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Revision 2

Native American Risk Assessment for the 200-PO-1 Groundwater Operable Unit

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

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Richland, Washington 99352

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I. M. Ross
Freestone Environmental Services, Inc.

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Assistant Secretary for Environmental Management

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Environmental Calculation Cover Page

Part 1: Completed by the Responsible Manager

Project: 200-PO-1 Groundwater OU RI **Date:** 9/6/2011

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Checker: RD Evans	**Basis of Qualification:** Education and experience
Senior Reviewer: RD Evans	**Basis of Qualification:** Education and experience

Part 2: Completed by Preparer

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Revision No.	Description	Date	Affected Pages
0	Initial issue.		All
1	Action levels updated as a result of EPA's December 4126/2010 update to toxicity values; aerosolization of nonvolatile constituents added to sweat lodge pathway assessment.	5/25/2010	All
2	Changed EPC values from 90th percentile to 95 UCL; calculated risk for all detected analytes; included information from the 10-year data set.	9/6/2011	All

Part 3: Document Review & Approval:

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1.0 PURPOSE

The purpose for this Environmental Calculation is to document the calculation of potential human health risk to Native Americans from exposure to contaminants in the 200-PO-1 Groundwater Operable Unit (OU). Exposure is evaluated for two currently available Native American exposure scenarios assuming a hypothetical failure of current administrative controls such that tribal use of 200-PO-1 OU groundwater becomes possible. Groundwater exposure pathway cancer risks and non-cancer hazards are calculated based on current groundwater conditions for both radioactive and nonradioactive contaminants of potential concern (COPCs). For purposes of this calculation, any analyte detected at least once in groundwater at the 200-PO-1 OU is included in the exposure and risk calculations as a COPC. Potential health risks are calculated for ingestion, inhalation, and dermal exposures to groundwater COPCs from use of groundwater as a domestic drinking water source and as a source of steam in a sweat lodge. Risks are calculated and presented separately for each of three 200-PO-1 OU groundwater exposure areas consisting of: 1) near-field, 2) far-field, and 3) river.

2.0 METHODOLOGY

Several local and regional tribes have ancestral ties to the Hanford Reach of the Columbia River and the U.S. Department of Energy (DOE) has requested that each tribe provide an exposure scenario that reflects their traditional activities. At this time, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) (Harris 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments*, Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*) and Yakama Nation (Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*) have provided scenarios.

For purposes of this Environmental Calculation, adult and child members of the CTUIR and Yakama Nation are assumed to use groundwater from the 200-PO-1 Groundwater OU as a drinking water source (i.e., domestic supply) and to make steam in a sweat lodge (adult tribal members only) as a part of their lifeways. Use of groundwater to irrigate crops and water livestock is not evaluated because those exposure pathways, although potentially complete, are considered insignificant and secondary to the drinking water and sweat lodge exposure pathways. Food chain pathways are generally evaluated quantitatively in the source area exposure assessments because the RESRAD model (ANL 2009, *RESRAD*, Version 6.5) used to estimate exposure considers these pathways. Contact with contaminated drill cuttings is not addressed because this assessment includes only groundwater pathway exposures.

Potentially complete exposure routes for adult and child tribal members associated with using groundwater as a domestic drinking water supply are as follows:

- Ingestion of drinking water
- Inhalation of volatiles when showering and using drinking water for other domestic purposes
- Dermal exposure from showering and using drinking water for other domestic purposes (e.g., washing dishes)

Potentially complete exposure routes for adult tribal members associated with using groundwater in a sweat lodge are as follows:

- Inhalation of volatiles and aerosolized nonvolatiles while spending time in a sweat lodge
- Dermal contact with vapors and condensed liquid while spending time in a sweat lodge.

2.1 CONTAMINANT INTAKE

For the drinking water pathway, contaminant intake is quantified using standard EPA equations and procedures as specified in EPA's Risk Assessment Guidance for Superfund (RAGS) documents (Parts A through F) (EPA/540/1-89/002, 1989, *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual, Part A, Interim Final*; EPA/540/R-92/003, 1991, *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals): Interim*; EPA/540/R/99/005, 2004, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)*; and EPA-540-R-070-002, 2009, Risk Assessment Guidance for Superfund: Volume 1—Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)). The equations and parameters used to quantify contaminant intake for the drinking water pathway are presented in Section 2.4.

For the sweat lodge pathway, contaminant intake is quantified based on standard EPA methods coupled with the sweat lodge steam model provided in Harris and Harper (2004). The equations and parameters used to quantify contaminant intake for the sweat lodge pathway are presented in Section 2.5.

The CTUIR and Yakama Nation have provided many of the exposure factors necessary to quantify contaminant intake in Harris (2008), Harris and Harper (2004), and Ridolfi (2007). Those values are used preferentially rather than EPA residential defaults. Where tribal-specific factors are not provided, EPA defaults are used (EPA/540/R-92/003).

2.2 CANCER EFFECTS

The potential for carcinogenic effects is evaluated by estimating the incremental increase in the probability of developing cancer over a lifetime (excess lifetime cancer risk [ELCR]) in addition to the background probability of developing cancer (that is, if no exposure to site contaminants occurs). Cancer slope factors developed by the EPA are considered to be a plausible upper bound estimate of the cancer potency of a contaminant. By using these upper bound estimates for the cancer slope factors, there is reasonable confidence that the actual cancer risk will not exceed the estimated risks calculated with these slope factors and may actually be lower (EPA/540/1-89/002). The following equation is used to estimate risk for non-radionuclides and radionuclides:

$$Risk = CDI \times SF \quad (1)$$

where:

Risk	=	Excess lifetime cancer risk (unitless probability)
CDI	=	Chronic daily intake averaged over a lifetime (mg/kg-day)
SF	=	Cancer slope factor $(mg/kg\text{-}day)^{-1}$

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For the sweat lodge pathway, contaminant intake is quantified based on standard EPA methods coupled with the sweat lodge steam model provided in Harris and Harper (2004). The equations and parameters used to quantify contaminant intake for the sweat lodge pathway are presented in Section 2.5.

The CTUIR and Yakama Nation have provided many of the exposure factors necessary to quantify contaminant intake in Harris (2008), Harris and Harper (2004), and Ridolfi (2007). Those values are used preferentially rather than EPA residential defaults. Where tribal-specific factors are not provided, EPA defaults are used (EPA/540/R-92/003).

2.2 CANCER EFFECTS

The potential for carcinogenic effects is evaluated by estimating the incremental increase in the probability of developing cancer over a lifetime (excess lifetime cancer risk [ELCR]) in addition to the background probability of developing cancer (that is, if no exposure to site contaminants occurs). Cancer slope factors developed by the EPA are considered to be a plausible upper bound estimate of the cancer potency of a contaminant. By using these upper bound estimates for the cancer slope factors, there is reasonable confidence that the actual cancer risk will not exceed the estimated risks calculated with these slope factors and may actually be lower (EPA/540/1-89/002). The following equation is used to estimate risk for non-radionuclides and radionuclides:

$$Risk = CDI \times SF \quad (1)$$

where:

Risk	=	Excess lifetime cancer risk (unitless probability)
CDI	=	Chronic daily intake averaged over a lifetime (mg/kg-day)
SF	=	Cancer slope factor $(mg/kg\text{-}day)^{-1}$

Or

$$Risk = Intake \times SF \quad (2)$$

where:

Risk = Excess lifetime cancer risk (unitless probability)
Intake = Activity (pCi)
SF = Cancer slope factor $(pCi)^{-1}$

For cases of high levels of ELCR, defined as an ELCR greater than 0.01, the following "one-hit" cancer risk equation from EPA RAGS A guidance (EPA/540/1-89/002) is used.

$$Risk = 1 - \exp(-CDI \times SF) \quad (3)$$

where:

Risk = Excess lifetime cancer risk (unitless probability)
CDI = Chronic daily intake averaged over a lifetime (mg/kg-day) or (pCi)
SF = Cancer slope factor $(mg/kg\text{-}day)^{-1}$ or $(pCi)^{-1}$

Although synergistic or antagonistic interactions might occur between cancer-causing contaminants and other contaminants, information is generally lacking in the toxicological literature to predict quantitatively the effects of these potential interactions. Therefore, cancer risks are treated as additive within an exposure route in this assessment. This is consistent with the EPA guidelines on chemical mixtures presented in EPA/630/P-03/001F, 2005, *Guidelines for Carcinogen Risk Assessment*. For estimating the cancer risks from exposure to multiple carcinogens from a single exposure route, the following equation is used:

$$Risk_T = \sum_1^N Risk_i \quad (4)$$

where:

$Risk_T$ = Total cancer risk from route of exposure
$Risk_i$ = Cancer risk for the ith chemical
N = Number of chemicals

It should be noted that EPA considers external radiation to be a significant exposure route only for radionuclides in soil (EPA/540/1-89/002); external radiation from radionuclides in water is considered insignificant due to its shielding effects. EPA does not publish radionuclide cancer slope factors to quantify cancer risk from external or dermal exposure to radioactive COPCs in groundwater. Radionuclide cancer risk is therefore calculated in this evaluation only for ingestion and inhalation exposures.

2.3 NONCANCER EFFECTS

For noncancer effects, the likelihood that a receptor will develop an adverse effect is estimated by comparing the predicted level of exposure for a particular contaminant with the highest level of exposure that is considered protective (that is, its reference dose [RfD]). The ratio of the chronic daily intake (CDI) divided by the RfD is termed the hazard quotient (HQ):

$$HQ = \frac{\text{Chemical Intake (mg/kg - day)}}{\text{RfD (mg/kg - day)}} \quad (5)$$

When the HQ for a contaminant exceeds 1 (that is, exposure exceeds RfD), there is a concern for potential noncancer health effects. To assess the potential for noncancer effects posed by exposure to multiple contaminants, a "hazard index" (HI) approach is used according to EPA guidance (EPA/540/1-89/002). This approach assumes that the noncancer hazard associated with exposure to more than one contaminant is additive; therefore, synergistic or antagonistic interactions between contaminants are not accounted for. The HI is calculated as follows:

$$HI = \sum_1^N CDI_i / RfD_i \quad (6)$$

where:

HI	=	hazard index
CDI_i	=	daily intake of the ith chemical (mg/kg-day)
RfD_i	=	reference dose of the ith chemical (mg/kg-day)
N	=	number of chemicals

2.4 DRINKING WATER PATHWAY EQUATIONS AND PARAMETERS

Drinking water-related intake for both the CTUIR and Yakama Nation scenarios is based on an exposure frequency of 365 days/yr over a 70-year exposure duration (apportioned as 6 years child, 64 years adult). Exposure factors used to quantify contaminant intake from drinking water exposure are provided in Tables 2-1 and 2-2. Contaminant specific factors are provided in the calculation attachments listed in Section 5.

Table 2-1. Summary of Exposure Assumptions Used to Calculate Drinking Water Intake for CTUIR Scenario.

Exposure Route/Exposure Factor	Symbol	Value	Units	Source
Averaging Time – Carcinogens and noncarcinogens	AT	70	yr	Harris and Harper 2004
Partitioning constant derived by Bunge Model	B	COPC-specific	unitless	See Table 3-2
Body Weight - adult	BWa	70	kg	Harris and Harper 2004
Body Weight - child	BWc	15	kg	Harris and Harper 2004
Conversion Factor	CF1	365	days/yr	1 year = 365 days/year
Conversion Factor	CF2	1/24	day/ hr	1 day = 24 hr
Conversion Factor	CF3	0.001	L/cm^3	1 L = 1,000 cm^3
Cancer Slope Factor - oral	CSFo	COPC-specific	$(mg/kg\text{-}day)^{-1}$	See Table 3-2
Chronic daily intake – nonradiological ingestion	CDI	Calculated value	mg/kg-day	Equation 7 and 10
Chronic daily intake – radiological ingestion	CDI	Calculated value	pCi	Equation 12
Chronic daily intake – carcinogen inhalation	CDI	Calculated value	$\mu g/m^3$	Equation 15
Chronic daily intake – noncarcinogen inhalation	CDI	Calculated value	mg/m^3	Equation 17
Chronic daily intake – radiological inhalation	CDI	Calculated value	pCi	Equation 19
Chronic daily intake – nonradiological dermal	CDI	Calculated value	mg/kg-day	Equation 23 and 26
Contaminant concentration in groundwater	Cw	COPC-specific	mg/L or pCi/L	ECF-200PO1-09-2027
Absorbed dose per event	DAevent	Calculated value	mg/cm^2-event	Equation 29, 30,and 31
Exposure Duration - adult	EDa	70	Yr	Harris and Harper 2004
Exposure Duration - child	EDc	6	yr	Harris and Harper 2004
Exposure Frequency	EF	365	days/yr	Harris and Harper 2004
Exposure time - adult	ETa	0.58	hours/day	EPA/540/R/99/005
Exposure time - child	ETc	1	hours/day	EPA/540/R/99/005
Age-Adjusted Exposure Time	ETadj	0.616	hours/day	Equation 21 and 28
Event frequency - adult	EVa	1	event/day	EPA/540/R/99/005

Table 2-1. Summary of Exposure Assumptions Used to Calculate Drinking Water Intake for CTUIR Scenario.

Exposure Route/Exposure Factor	Symbol	Value	Units	Source
Event frequency - child	EVc	1	event/day	EPA/540/R/99/005
Fraction of absorbed water	FA	COPC-specific	unitless	See Table 3-2
Gastrointestinal absorption factor	GIABS	COPC-specific	unitless	See Table 3-2
Age-Adjusted Inhalation Rate - radiological	INH_RADadj	1,690	m^3-yr/day	Equation 20
Inhalation rate - adult	INHa	25	m^3/day	Harris 2008
Inhalation rate - child	INHc	15	m^3/day	Harris 2008
Water Ingestion Rate - adult	IRWa	4	L/day	Harris and Harper 2004
Age-adjusted water ingestion rate – nonradiological	IRWadj	4.057	L-yr/kg-day	Equation 8
Water Ingestion Rate - child	IRWc	1	L/day	Harris and Harper 2004
Age-adjusted water ingestion rate – radiological	IRW_RADadj	262	L-yr/day	Equation 13
Inhalation Unit Risk	IUR	COPC-specific	$(ug/m^3)^{-1}$	See Table 3-2
Dermal permeability coefficient	Kp	COPC-specific	cm/hr	See Table 3-2
The constant pi	π	3.14159	unitless	EPA/540/R/99/005
Reference Concentration	RfC	COPC-specific	mg/m^3	See Table 3-2
Reference Dose - oral	RfDo	COPC-specific	mg/kg-day	See Table 3-2
Age-adjusted skin surface area	SAadj	19,097	cm^2-yr/kg-day	Equation 24
Skin Surface Area - adult	SAa	18,000	cm^2	EPA/540/R/99/005
Skin Surface Area - child	SAc	6,600	cm^2	EPA/540/R/99/005
Slope Factor - inhalation	SFi	COPC-specific	pCi^{-1}	See Table 3-2
Slope Factor - oral	SFo	COPC-specific	pCi^{-1}	See Table 3-2
Time to reach steady state conditions	t*	COPC-specific	hr	See Table 3-2
Lag time	τ	COPC-specific	hours/event	See Table 3-2
Volatilization Factor	VF	0.5	L/m^3	Andelman 1990

Table 2-1. Summary of Exposure Assumptions Used to Calculate Drinking Water Intake for CTUIR Scenario.

Exposure Route/Exposure Factor	Symbol	Value	Units	Source

Andelman, 1990, *Total Exposure to Volatile Organic Chemicals in Potable Water.*

ECF-200PO1-09-2027, *Calculation of Exposure Point Concentrations for the 200-PO-1 Groundwater Operable Unit.*

EPA/540/R/99/005, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Harris and Harper, 2004, *Exposure Scenario for the CTUIR Traditional Subsistence Lifeways.*

Table 2-2. Summary of Exposure Assumptions Used to Calculate Drinking Water Intake for Yakama Nation Scenario.

Exposure Route/Exposure Factor	Symbol	Value	Units	Source
Averaging Time – Carcinogens and noncarcinogens	AT	70	yr	Ridolfi 2007
Partitioning constant derived by Bunge Model	B	COPC-specific	unitless	See Table 3-2
Body Weight - adult	BWa	70	kg	Ridolfi 2007
Body Weight - child	BWc	16	kg	Ridolfi 2007
Conversion Factor	CF1	365	days/yr	1 year = 365 days/year
Conversion Factor	CF2	1/24	day/hr	1 day = 24 hr
Conversion Factor	CF3	0.001	L/cm^3	1 L = 1,000 cm^3
Cancer Slope Factor - oral	CSFo	COPC-specific	$(mg/kg\text{-}day)^{-1}$	See Table 3-2
Chronic daily intake – nonradiological ingestion	CDI	Calculated value	mg/kg-day	Equation 7 and 10
Chronic daily intake – radiological ingestion	CDI	Calculated value	pCi	Equation 12
Chronic daily intake – carcinogen inhalation	CDI	Calculated value	$\mu g/m^3$	Equation 15
Chronic daily intake – noncarcinogen inhalation	CDI	Calculated value	mg/m^3	Equation 17
Chronic daily intake – radiological inhalation	CDI	Calculated value	pCi	Equation 19
Chronic daily intake – nonradiological dermal	CDI	Calculated value	mg/kg-day	Equation 23 and 26
Contaminant concentration in groundwater	Cw	COPC-specific	mg/L or pCi/L	ECF-200PO1-09-2027
Absorbed dose per event	DAevent	Calculated value	mg/cm^2-event	Equation 29, 30, and 31
Exposure Duration - adult	EDa	70	yr	Ridolfi 2007
Exposure Duration - child	EDc	6	yr	Ridolfi 2007
Exposure Frequency	EF	365	days/yr	Ridolfi 2007
Exposure time - adult	ETa	0.58	hours/day	EPA/540/R/99/005
Exposure time - child	ETc	1	hours/day	EPA/540/R/99/005
Age-Adjusted Exposure Time	ETadj	0.616	hours/day	Equation 21 and 28
Event frequency - adult	EVa	1	event/day	EPA/540/R/99/005

Table 2-2. Summary of Exposure Assumptions Used to Calculate Drinking Water Intake for Yakama Nation Scenario.

Exposure Route/Exposure Factor	Symbol	Value	Units	Source
Event frequency - child	EVc	1	event/day	EPA/540/R/99/005
Fraction of absorbed water	FA	COPC-specific	unitless	See Table 3-2
Gastrointestinal absorption factor	GIABS	COPC-specific	unitless	See Table 3-2
Age-Adjusted Inhalation Rate - radiological	INH_RADadj	1,760	m^3-yr/day	Equation 20
Inhalation rate - adult	INHa	26	m^3/day	Ridolfi 2007
Inhalation rate - child	INHc	16	m^3/day	Ridolfi 2007
Water Ingestion Rate - adult	IRWa	4	L/day	Ridolfi 2007
Age-adjusted water ingestion rate – nonradiological	IRWadj	4.407	L-yr/kg-day	Equation 8
Water Ingestion Rate - child	IRWc	2	L/day	Ridolfi 2007
Age-adjusted water ingestion rate – radiological	IRW_RADadj	262	L-yr/day	Equation 13
Inhalation Unit Risk	IUR	COPC-specific	$(ug/m^3)^{-1}$	See Table 3-2
Dermal permeability coefficient	Kp	COPC-specific	cm/hr	See Table 3-2
The constant pi	π	3.14159	unitless	EPA/540/R/99/005
Reference Concentration	RfC	COPC-specific	mg/m^3	See Table 3-2
Reference Dose - oral	RfDo	COPC-specific	mg/kg-day	See Table 3-2
Age-adjusted skin surface area	SAadj	18,932	cm^2-yr/kg-day	Equation 24
Skin Surface Area - adult	SAa	18,000	cm^2	EPA/540/R/99/005
Skin Surface Area - child	SAc	6,600	cm^2	EPA/540/R/99/005
Slope Factor - inhalation	SFi	COPC-specific	pCi^{-1}	See Table 3-2
Slope Factor - oral	SFo	COPC-specific	pCi^{-1}	See Table 3-2
Time to reach steady state conditions	t*	COPC-specific	hr	See Table 3-2
Lag time	τ	COPC-specific	hours/event	See Table 3-2
Volatilization Factor	VF	0.5	L/m^3	Andelman 1990

Table 2-2. Summary of Exposure Assumptions Used to Calculate Drinking Water Intake for Yakama Nation Scenario.

Exposure Route/Exposure Factor	Symbol	Value	Units	Source

Andelman, 1990, *Total Exposure to Volatile Organic Chemicals in Potable Water.*

ECF-200PO1-09-2027, *Calculation of Exposure Point Concentrations for the 200-PO-1 Groundwater Operable Unit.*

EPA/540/R/99/005, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Ridolfi, 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment.*

2.4.1.1 Drinking Water Ingestion

The equations used to evaluate drinking water ingestion are as follows.

Carcinogens

For carcinogens, the CDI is calculated with the following equation:

$$CDI = \frac{C_w \times IRW_{adj} \times EF}{AT \times CF1} \quad (7)$$

where:

$$IRW_{adj} = \frac{ED_c \times IRW_c}{BW_c} + \frac{(ED_a - ED_c) \times IRW_a}{BW_a} \quad (8)$$

Cancer risk is calculated as:

$$RISK = CDI \times CSFo \quad (9)$$

Noncarcinogens

For noncarcinogens, the CDI is calculated with the following equation:

$$CDI = \frac{C_w \times IRW_a \times EF \times ED_a}{BW_a \times AT \times CF1} \quad (10)$$

Noncancer hazard is calculated as:

$$HQ = \frac{CDI}{RfDo} \quad (11)$$

Radionuclides

For radionuclides, the CDI is calculated with the following equation:

$$CDI = C_w \times IRW\_RAD_{adj} \times EF \quad (12)$$

where:

$$IRW\_RAD_{adj} = (ED_c \times IRW_c) + ([ED_a - ED_c] \times IRW_a) \quad (13)$$

Radiological cancer risk is calculated as:

$$RISK = CDI \times SFo \quad (14)$$

2.4.1.2 Drinking Water Inhalation of Volatiles

The equations used to evaluate inhalation of volatiles in drinking water are as follows.

Carcinogens

For carcinogens, the CDI is calculated with the following equation:

$$CDI = \frac{C_w \times ED_a \times EF \times ET_a \times CF2 \times VF \times \left(1000 \frac{\mu g}{mg}\right)}{AT \times CF1} \quad (15)$$

Cancer risk is calculated as:

$$RISK = CDI \times IUR \quad (16)$$

Noncarcinogens

For noncarcinogens, the CDI is calculated with the following equation:

$$CDI = \frac{C_w \times ED_a \times EF \times ET_a \times CF2 \times VF}{AT \times CF1} \quad (17)$$

Noncancer hazard is calculated as:

$$HQ = \frac{CDI}{RfC} \quad (18)$$

Radionuclides

For radionuclides, the CDI is calculated with the following equation:

$$CDI = C_w \times INH\_RAD_{adj} \times VF \times EF \times ET_{adj} \times CF2 \quad (19)$$

where:

$$INH\_RAD_{adj} = (ED_c \times INH_c) + ([ED_a - ED_c] \times INH_a) \quad (20)$$

and:

$$ET_{adj} = \frac{(ET_c \times ED_c) + ((ED_a - ED_c) \times ET_a)}{ED_a} \quad (21)$$

Radiological cancer risk is calculated as:

$$RISK = CDI \times SFi \quad (22)$$

2.4.1.3 Drinking Water Dermal Absorption

The equations used to evaluate dermal exposure to contaminants in drinking water are as follows.

Carcinogens

For carcinogens, the CDI is calculated with the following equation:

$$CDI = \frac{DA_{event} \times SA_{adj} \times EF}{AT \times CF1} \quad (23)$$

where:

$$SA_{adj} = \frac{ED_c \times SA_c \times EV_c}{BW_c} + \frac{(ED_a - ED_c) \times SA_a \times EV_a}{BW_a} \quad (24)$$

Cancer risk is calculated as:

$$RISK = CDI \times \frac{CSFo}{GIABS} \quad (25)$$

Noncarcinogens

For noncarcinogens, the CDI is calculated with the following equation:

$$CDI = \frac{DA_{event} \times SA_a \times EF \times ED_a \times EV_a}{BW_a \times AT \times CF1} \quad (26)$$

Noncancer hazard is calculated as:

$$HQ = \frac{CDI}{RfDo \times GIABS} \quad (27)$$

The exposure time of each event, ET, is calculated for carcinogens and noncarcinogens using the appropriate age-adjustment factors. For noncarcinogens, the event time is not age-adjusted. For carcinogens, the age-adjusted exposure event times are calculated as follows:

$$ET_{adj} = \frac{(ET_c \times ED_c) + ((ED_a - ED_c) \times ET_a)}{ED_a} \quad (28)$$

For organics, the following equations are used to calculate the dermally absorbed dose per event (DA_{event}), using the appropriate exposure time as calculated above:

If $ET^1 < t^*$, then

$$DA_{event} = 2 \times FA \times Kp \times Cw \times CF3 \times \sqrt{\frac{6 \times \tau \times ET}{\pi}} \quad (29)$$

If $ET^1 > t^*$, then

$$DA_{event} = FA \times Kp \times Cw \times CF3 \times \left[\frac{ET}{1+B} + 2 \times \tau \times \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right] \quad (30)$$

For inorganics, the following steady-state equation is used to estimate DA_{event}, using the appropriate exposure time as calculated above:

$$DA_{event} = Kp \times Cw \times ET \times CF3 \quad (31)$$

Values for the chemical-specific parameters (t*, FA, K_p, τ, and B) are obtained from EPA's dermal risk assessment guidance (EPA/540/R/99/005) and are provided in the attachments listed in Section 5.

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[1] ETadj is used in place of ET for the calculation of CDI for carcinogenic COPCs.

Radionuclides

Dermal exposure to radionuclides in drinking water is not evaluated. As noted in Section 2.2, EPA does not publish radionuclide cancer slope factors to quantify cancer risk from external or dermal exposure to radioactive contaminants in water due to the shielding effects of water.

2.5 SWEAT LODGE PATHWAY EQUATIONS AND PARAMETERS

Sweat lodge exposure is evaluated for both the CTUIR and Yakama Nation scenarios for adults based on an exposure frequency of 365 days/yr over a 68-year exposure duration (first 2 years of life excluded)[2]. Although the exposure scenarios provided indicate that childhood sweats occur, exposure assumptions are only for adults. Exposure factors used to quantify contaminant intake from sweat lodge exposure are provided in Tables 2-3 and 2-4. Contaminant specific factors are provided in the calculation attachments listed in Section 5.

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[2] Child exposure assumptions were not provided for the purpose of evaluating exposure through sweatlodge use, therefore an adult exposure frequency was assumed to be 68 years.

Table 2-3. Summary of Exposure Assumptions Used to Calculate Sweat Lodge Intake for CTUIR Scenario.

Exposure Route/Exposure Factor	Symbol	Value	Units	Source
Averaging Time – Carcinogens/Noncarcinogens[a]	AT	70/68	yr	Harris and Harper 2004
Average Body Weight – adult	BW	70	kg	Harris and Harper 2004
Conversion Factor	CF1	365	days/yr	1 year = 365 days/year
Conversion Factor	CF2	0.01	m/cm	1 meter = 100 cm
Conversion Factor	CF3	10	L/m^2-cm	Harris and Harper 2004
Dissolved groundwater concentration	Cdw	COPC-specific	mg/L or pCi/L	ECF-200PO1-09-2027
Cancer Slope Factor - oral	CSFo	COPC-specific	$(mg/kg\text{-}day)^{-1}$	See Table 3-2
Cancer Slope Factor - inhalation	CSFi	COPC-specific	$(mg/kg\text{-}day)^{-1}$	See Table 3-2
Exposure duration or number of years a person sweats in a lifetime - adult	ED	68	yr	Harris and Harper 2004
Exposure frequency or number of sweats per year	EF	365	events/yr	Harper and Harris 2004
Length of sweat event – adult[b]	ET	1	hr	Harper and Harris 2004
Gastrointestinal absorption factor	GIABS	COPC-specific	unitless	See Table 3-2
Inhalation exposure to COPCs in sweat lodge	Iinh	Calculated value	mg/kg-day or pCi	Equation 32, 35, 37 and 40
Total dermal exposure rate for volatile and semi-volatile compounds	Id,total	Calculated value	mg/kg-day	Equation 42 and 47
Intake of COPCs from dermal absorption to liquid within the sweat lodge	Id,I	Calculated value	mg/kg-day	Equation 45
Intake of COPCs from dermal absorption to vapor within sweat lodge	Id,v	Calculated value	mg/kg-day	Equation 46
Inhalation rate - adult	IR	25	m^3/day	Harris 2008
Inhalation Unit Risk	IUR	COPC-specific	$(ug/m^3)^{-1}$	See Table 3-2
COPC-specific permeability coefficient	Kp	COPC-specific	cm/hr	See Table 3-2

Table 2-3. Summary of Exposure Assumptions Used to Calculate Sweat Lodge Intake for CTUIR Scenario.

Exposure Route/Exposure Factor	Symbol	Value	Units	Source
Molecular weight of water	MWw	18	g/gmole	Harris and Harper 2004
Density of liquid water	ρw	1,000	g/L	Harris and Harper 2004
The constant pi	π	3.14159	unitless	Harris and Harper 2004
Radius of sweat lodge	r	1	m	Harris and Harper 2004
Ideal Gas Law Constant	R	0.06237	mmHg-m^3/mole-K	Equations 37 and 40, Harris and Harper 2004
Ideal Gas Law Constant	R	62.37	mmHg-L/mole-K	Equation 46, Harris and Harper 2004
Reference Concentration	RfC	COPC-specific	mg/m^3	See Table 3-2
Reference Dose - inhalation	RfDi	COPC-specific	mg/kg-day	See Table 3-2
Reference Dose - oral	RfDo	COPC-specific	mg/kg-day	See Table 3-2
Skin Surface Area - adult	SA	18,000	cm^2	Harris and Harper 2004
Slope Factor - inhalation	SFi	COPC-specific	pCi^{-1}	See Table 3-2
Temperature inside the sweat lodge[c]	T	338.7	K	Harris and Harper 2004
Cumulative Volume of water used in sweat	Vw,total	4	Liters	Harris and Harper 2004

[a] Averaging time of 1 year provided in Harris and Harper (2004) was replaced with 70 years for carcinogens and 68 years for noncarcinogens to account for lifetime intake rather than annual intake.

[b] For sweat lodge inhalation exposure, exposure time of 1 hr provided in Harris and Harper (2004) was replaced with 1/24 days/event so that intake values have appropriate units (mg/kg-day or pCi) when calculated using the inhalation equations provided in Harris and Harper (2004, Equations 7 and 15).

[c] Temperature of 389 °K provided in Harris and Harper (2004) (equates to 240 °F) was replaced with 338.7 °K (equates to 150 °F) for consistency with stated assumption in Harris and Harper (2004) that sweat lodge internal temperature is maintained at 150 °F.

[d] Ideal gas law of 0.06237 mmHg-m^3/gmole-K provided in Harris and Harper (2004) was replaced with 62.37 mmHg-L/gmole-K so that intake values have appropriate units (mg/kg-day) when calculated using the equations provided in Harris and Harper (2004, Equations 15 and 20).

CTUIR = Confederated Tribes of the Umatilla Indian Reservation

Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Table 2-3. Summary of Exposure Assumptions Used to Calculate Sweat Lodge Intake for CTUIR Scenario.

Exposure Route/Exposure Factor	Symbol	Value	Units	Source

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways.*

ECF-200PO1-09-2027, *Calculation of Exposure Point Concentrations for the 200-PO-1 Groundwater Operable Unit.*

Table 2-4. Summary of Exposure Assumptions Used to Calculate Sweat Lodge Intake for Yakama Nation Scenario.

Exposure Route/Exposure Factor	Symbol	Value	Units	Source
Averaging Time – Carcinogens/Noncarcinogens[a]	AT	70/68	yr	Harris and Harper 2004
Average Body Weight - adult	BW	70	kg	Harris and Harper 2004
Conversion Factor	CF1	365	days/yr	1 year = 365 days/year
Conversion Factor	CF2	0.01	m/cm	1 meter = 100 cm
Conversion Factor	CF3	10	L/m^2-cm	Harris and Harper 2004
Dissolved groundwater concentration	Cdw	COPC-specific	mg/L or pCi/L	ECF-200PO1-09-2027
Cancer Slope Factor - oral	CSFo	COPC-specific	$(mg/kg\text{-}day)^{-1}$	See Table 3-2
Cancer Slope Factor - inhalation	CSFi	COPC-specific	$(mg/kg\text{-}day)^{-1}$	See Table 3-2
Exposure duration or number of years a person sweats in a lifetime - adult	ED	68	yr	Harris and Harper 2004
Exposure frequency or number of sweats per year	EF	365	events/yr	Harris and Harper 2004
Length of sweat event - adult[b]	ET	2	hour	Ridolfi 2007
Gastrointestinal absorption factor	GIABS	COPC-specific	unitless	See Table 3-2

Table 2-4. Summary of Exposure Assumptions Used to Calculate Sweat Lodge Intake for Yakama Nation Scenario.

Exposure Route/Exposure Factor	Symbol	Value	Units	Source
Inhalation exposure to COPCs in sweat lodge	Iinh	Calculated value	mg/kg-day or pCi	Equation 32, 35, 37 and 40
Total dermal exposure rate for volatile and semi-volatile compounds	Id,total	Calculated value	mg/kg-day	Equation 42 and 47
Intake of COPCs from dermal absorption to liquid within the sweat lodge	Id,I	Calculated value	mg/kg-day	Equation 45
Intake of COPCs from dermal absorption to vapor within sweat lodge	Id,v	Calculated value	mg/kg-day	Equation 46
Inhalation rate - adult	IR	26	m^3/day	Ridolfi 2007
Inhalation Unit Risk	IUR	COPC-specific	$(ug/m^3)^{-1}$	See Table 3-2
COPC-specific permeability coefficient	Kp	COPC-specific	cm/hr	See Table 3-2
Molecular weight of water	MWw	18	g/gmole	Harris and Harper 2004
Density of liquid water	ρw	1,000	g/L	Harris and Harper 2004
The constant pi	π	3.14159	unitless	Harris and Harper 2004
Radius of sweat lodge	r	1	m	Harris and Harper 2004
Ideal Gas Law Constant	R	0.06237	mmHg-m^3/mole-K	Equations 37 and 40, Harris and Harper 2004
Ideal Gas Law Constant[d]	R	62.37	mmHg-m^3/mole-K	Equation 46, Harris and Harper 2004
Reference Concentration	RfC	COPC-specific	mg/m^3	See Table 3-2
Reference Dose - inhalation	RfDi	COPC-specific	mg/kg-day	See Table 3-2
Reference Dose - oral	RfDo	COPC-specific	mg/kg-day	See Table 3-2
Skin Surface Area - adult	SA	18,000	cm^2	Harris and Harper 2004

Table 2-4. Summary of Exposure Assumptions Used to Calculate Sweat Lodge Intake for Yakama Nation Scenario.

Exposure Route/Exposure Factor	Symbol	Value	Units	Source
Slope Factor - inhalation	SFi	COPC-specific	pCi^{-1}	See Table 3-2
Temperature inside the sweat lodge[c]	T	338.7	K	Harris and Harper 2004
Cumulative Volume of water used in sweat	Vw,total	4	Liters	Harris and Harper 2004

[a] Averaging time of 1 year provided in Harris and Harper (2004) was replaced with 70 years for carcinogens and 68 years for noncarcinogens to account for lifetime intake rather than annual intake.

[b] For sweat lodge inhalation exposure, exposure time of 2 hr provided in Ridolfi (2007) was replaced with 2/24 days/event so that intake values have appropriate units (mg/kg-day or pCi) when calculated using the inhalation equations provided in Harris and Harper (2004, Equations 7 and 15).

[c] Temperature of 389 °K provided in Harris and Harper (2004) (equates to 240 °F) was replaced with 338.7 °K (equates to 150 °F) for consistency with stated assumption in Harris and Harper (2004) that sweat lodge internal temperature is maintained at 150 °F.

[d] Ideal gas law of 0.06237 mmHg-m^3/gmole-K provided in Harris and Harper (2004) was replaced with 62.37 mmHg-L/gmole-K so that intake values have appropriate units (mg/kg-day) when calculated using the equations provided in Harris and Harper (2004, Equations 15 and 20).

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways.*

ECF-200PO1-09-2027, *Calculation of Exposure Point Concentrations for the 200-PO-1 Groundwater Operable Unit.*

Ridolfi, 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment.*

2.5.1 Inhalation in Sweat Lodge

The equations used to calculate contaminant intake from inhalation of water vapor and aerosols during sweat lodge use are based on the sweat lodge exposure model presented in Appendix 4 of Harris and Harper (2004).

2.5.1.1 Volatile and Semi-Volatile Compounds

Inhalation intake of volatile and semivolatile contaminants in sweat lodge vapor is calculated with the following equation (Harris and Harper 2004, Appendix 4, Equation 7) [3]:

$$I_{inh} = \frac{C_{dw} \times \left(\frac{V_{w,total}}{2}\right) \times \left(\frac{1}{\frac{2}{3} \cdot \pi \cdot r^3}\right) \times IR \times ET \times EF \times ED}{BW \times AT \times CF1} \quad (32)$$

Carcinogens

For carcinogens, the cancer risk is calculated as:

$$RISK = CSF_i \times I_{inh} \quad (33)$$

Noncarcinogens

For noncarcinogens, the noncancer hazard is calculated as:

$$HQ = \frac{1}{RfD_i} \times I_{inh} \quad (34)$$

Radionuclides

Inhalation intake of volatile radionuclides in sweat lodge vapor is calculated with the following equation (modified for pCi/L groundwater concentration units and inhalation slope factors from Harris and Harper 2004, Appendix 4, Equation 7):

$$I_{inh} = C_{dw} \times \left(\frac{V_{w,total}}{2}\right) \times \left(\frac{1}{\frac{2}{3} \cdot \pi \cdot r^3}\right) \times IR \times ET \times EF \times ED \quad (35)$$

Radiological cancer risk is calculated as:

$$RISK_{rad} = SF_i \times I_{inh} \quad (36)$$

2.5.1.2 Nonvolatile Compounds

Inhalation intake of aerosolized nonvolatile contaminants in a sweat lodge is calculated with the following equation (Harris and Harper 2004, Appendix 4, Equation 15):

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[3] Harris and Harper (2004, Appendix 4) indicates water concentration (C_{dw}) is "dissolved surface water concentration of the COPC (mg/L); calculated according to EPA 1998a, Appendix B." However, for this evaluation COPC exposure point concentrations reflect total concentrations in groundwater.

$$I_{inh} = \left(\frac{IR \cdot ET \cdot EF \cdot ED}{BW \cdot AT \cdot CF1}\right) \times C_{dw} \times \left(\frac{MW_w}{R \cdot T \cdot \rho_w}\right) \times EXP\left(18.3036 - \frac{3816.44}{T - 46.13}\right) \quad (37)$$

Carcinogens

For carcinogens the cancer risk is calculated as:

$$RISK = CSF_i \times I_{inh} \quad (38)$$

Noncarcinogens

For noncarcinogens, the noncancer hazard is calculated as:

$$HQ = \frac{1}{RfD_i} \times I_{inh} \quad (39)$$

Radionuclides

Inhalation intake of aerosolized nonvolatile radionuclides in a sweat lodge is calculated with the following equation (modified for pCi/L groundwater concentration units and inhalation slope factors from Harris and Harper 2004, Appendix 4, Equation 15):

$$I_{inh} = (IR \times ET \times EF \times ED) \times C_{dw} \times \left(\frac{MW_w}{R \cdot T \cdot \rho_w}\right) \times EXP\left(18.3036 - \frac{3816.44}{T - 46.13}\right) \quad (40)$$

Radiological cancer risk is calculated as:

$$RISK_{rad} = SF_i \times I_{inh} \quad (41)$$

2.5.1.3 Dermal Exposure in Sweat Lodge

The equations used to calculate contaminant intake from dermal contact with water vapor and aqueous condensate during sweat lodge use are based on the sweat lodge exposure model presented in Appendix 4 of Harris and Harper (2004).

2.5.1.4 Volatile and Semi-Volatile Compounds

For volatile and semivolatile compounds, the Harris and Harper (2004) model assumes 100% volatilization within the sweat lodge. Hence, vapor exposure is the primary exposure pathway and exposure from condensed water is considered incomplete.

Exposure from dermal contact with volatile and semivolatile contaminants in sweat lodge vapor is calculated with the following equation (Harris and Harper 2004, Appendix 4, Equation 18):

$$I_{d,total} = I_{d,v} = \frac{C_{dw} \times \left(\frac{V_{w,total}}{2}\right) \times \left(\frac{1}{\frac{2}{3} \cdot \pi \cdot r^3}\right) \times SA \times Kp \times ET \times EF \times ED \times CF2}{BW \times AT \times CF1} \quad (42)$$

Carcinogens

For carcinogens, the cancer risk is calculated as:

$$RISK = \frac{CSF_O}{GIABS} \times I_{d,total} \quad (43)$$

Noncarcinogens

For noncarcinogens, the noncancer hazard is calculated as:

$$HQ = \frac{1}{RfD_O \times GIABS} \times I_{d,total} \quad (44)$$

Radionuclides

Dermal exposure to radionuclides in a sweat lodge is not evaluated because radionuclide cancer slope factors are not published to quantify cancer risk from external or dermal exposure to radioactive contaminants in water.

2.5.1.5 Nonvolatile Compounds

In the Harris and Harper (2004) model, total dermal intake of nonvolatile contaminants is calculated as the sum of intakes from dermal exposure to vapors and aqueous condensate. For condensed liquid, the model assumes nonvolatile contaminant concentrations in the condensed water are equal to that of the water added to the heated rocks. Intake from dermal contact with non-volatile compounds in sweat lodge condensed liquid is calculated with the following equation (Harris and Harper 2004, Appendix 4, Equation 19):

$$I_{d,l} = \frac{C_{dw} \times SA \times Kp \times ET \times EF \times ED \times CF3}{BW \times AT \times CF1} \quad (45)$$

Intake from dermal contact with non-volatile compounds in sweat lodge vapor is calculated with the following equation (Harris and Harper 2004, Appendix 4, Equation 20):

$$I_{d,v} = \left(\frac{SA \times Kp \times ET \times EF \times ED \times CF_3}{BW \times AT \times CF1}\right) \times C_{dw} \times \left(\frac{MW_w}{R \times T \times \rho_w}\right) \times \ldots \quad (46)$$
$$\ldots EXP\left(18.3036 - \frac{3816.44}{T - 46.13}\right)$$

The total dermal exposure for nonvolatile compounds in a sweat lodge is calculated with the following equation (Harris and Harper 2004, Appendix 4, Equation 21):

$$I_{d,total} = I_{d,v} + I_{d,l} \quad (47)$$

Carcinogens

For carcinogens, the cancer risk is calculated as:

$$RISK = \frac{CSF_O}{GIABS} \times I_{d,total} \quad (48)$$

Noncarcinogens

For noncarcinogens, the noncancer hazard is calculated as:

$$HQ = \frac{1}{RfD_O \times GIABS} \times I_{d,total} \quad (49)$$

Radionuclides

Dermal exposure to radionuclides in a sweat lodge is not evaluated because radionuclide cancer slope factors are not published to quantify cancer risk from external or dermal exposure to radioactive contaminants in water.

3.0 ASSUMPTIONS AND INPUTS

Assumptions and inputs associated with the exposure scenarios, groundwater COPCs and associated exposure point concentrations (EPCs), and human health toxicity values used in the CTUIR and Yakama Nation human health risk calculations are described below.

3.1 EXPOSURE SCENARIOS

For domestic use of groundwater as a drinking water supply, EPA considers the inhalation pathway potentially complete only for volatile contaminants because there is no mechanism for release of nonvolatile chemicals into the air in significant concentrations (EPA/540/R-92/003). For tap water exposures, inhalation intake is quantified only for volatile contaminants. A contaminant is considered volatile if it meets EPA's working definition of a volatile, which is a chemical having a Henry's Law constant greater than 1 x 10^{-5} atm-m^3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003). The COPCs in the 200-PO-1 Groundwater OU that meet the EPA working definition of volatile are 1,1-dichloroethane, 1,1,1-trichloroethane, 1,1-dichloroethene, 1,2-dichlorobennzene, 1,4-dichlorobenzene, 2-butanone, 4-methyl-2-pentanone, acetone, carbon disulfide, carbon tetrachloride, chloroform, methylene chloride, tetrachloroethene, toluene, trichloroethene, trichloromonofluoromethane, and tritium. An upper-bound volatilization factor (VF) of 0.5 L/m^3 (Andelman 1990) is used to represent the volatilization of contaminants from household water uses (EPA/540/R-92/003).

Dermal exposure to contaminants in drinking water is evaluated using the methods presented in EPA's dermal risk assessment guidance (EPA/540/R/99/005). For dermal exposure during bathing and showering, the nonsteady-state (i.e., when the chemical is only in the outermost layer of the epidermis) model or pseudo-steady-state model is used to estimate the dermally absorbed dose per event for organic contaminants (EPA/540/R/99/005). If the exposure time (or event time, ET) is shorter than the time to reach steady state (i.e., when the chemical has been absorbed into the viable epidermis [t*]), the nonsteady-state model is used. If ET is greater than t*, the pseudo-steady-state model is used. For inorganics, the absorbed dose is calculated using a steady-state approach.

Dermal exposure to radionuclides in drinking water is not evaluated. As noted in Section 2.2, EPA does not publish radionuclide cancer slope factors to quantify cancer risk from external or dermal exposure to radioactive contaminants in water due to the shielding effects of water.

For the sweat lodge scenario, an exposure time of 1 hr/event is used for the CTUIR based on Harris and Harper (2004). For the Yakama Nation, an exposure time of 2 hr/event is used. In the Yakama Nation exposure document (Ridolfi 2007), 7 hr/day is the recommended sweat lodge exposure time based on the maximum value reported in a tribal survey. The average reported

Yakama Nation value is 5 hr/week. The maximum exposure time of seven hours for sweat lodge use has the potential to overestimate the time budgeted for this activity and has the potential to underestimate the time budgeted to conduct the remaining lifeway activities described in the Yakama Nation document (Ridolfi 2007). For purposes of this calculation, a value of 14 hr/week (2 hr/event) is assumed. The Yakama Nation document (Ridolfi 2007) did not provide intake equations for exposures related to sweat lodge use, therefore equations provided by Harris and Harper (2004) were used for this purpose.

The sweat lodge scenario assumes 4 liters of groundwater is poured over hot rocks to make steam in a hemispherical sweat lodge with a radius of 1 m (Harris and Harper 2004). The internal temperature of the sweat lodge is assumed to be maintained at a constant 150 degrees Fahrenheit (Harris and Harper 2004). This scenario creates a unique environment where volatile, semivolatile, and nonvolatile COPCs could potentially be present in the air and available for inhalation and dermal exposure. Harris and Harper (2004) describe a method for calculating a vaporization factor for the sweat lodge scenario. The vaporization factor is applied to the groundwater concentration to estimate COPC concentrations in sweat lodge steam. Ridolfi (2007) does not specify a method for estimating COPC concentrations in sweat lodge steam; therefore, the Harris and Harper (2004) steam model is used for both the CTUIR and Yakama Nation intake calculations.

Harris and Harper (2004) recommend different methods for calculating vaporization factors for volatile and semivolatile COPCs versus nonvolatile COPCs. For volatile and semivolatile COPCs, the model assumes 100 percent volatilization throughout the sweat; hence, dermal exposure to condensed water is considered incomplete and volatile and semivolatile COPCs (including tritium) are evaluated only for intake via inhalation and dermal absorption from the vapor phase. For nonvolatile COPCs, the model assumes the COPCs become airborne as an aerosol, and that once airborne, the COPCs can deposit onto the skin surface as aqueous condensate. Nonvolatile COPC intake is assumed to occur via inhalation from the vapor phase and dermal absorption from both the vapor and liquid phases. The Harris and Harper (2004) model assumes the concentration of nonvolatiles in condensed water is equal to the concentration in the water used to create steam.

Dermal exposure to radionuclides in a sweat lodge is not evaluated because radionuclide cancer slope factors are not published to quantify cancer risk from external or dermal exposure to radioactive contaminants in water.

3.2 GROUNDWATER CONTAMINANTS OF POTENTIAL CONCERN AND EXPOSURE POINT CONCENTRATIONS

The COPCs used for this environmental calculation were selected by applying an initial screening step to the 200-PO-1 Groundwater OU analytical data set as described in *Contaminant of Potential Concern Selection for the 200-PO-1 Groundwater Operable Unit* (ECF-200PO1-09-2018). For this evaluation, comparisons to action levels were not made; any analyte in the (processed) combined 200-PO-1 Groundwater Area data set with at least one reported detection in either the 5-year or the 10-year data set was identified as a COPC and assessed in the risk calculations. The EPCs associated with each COPC are the 95UCL groundwater concentration values calculated from the 200-PO-1 Groundwater OU analytical data set as described in *Calculation of Exposure Point Concentrations for the 200-PO-1 Groundwater Operable Unit* (ECF-200PO1-09-2027). The COPCs and associated EPCs for the 5-year data set are presented

in Table 3-1. The COPCs and associated EPCs for the 10-year data set are presented in Table 3-1 for comparison purposes only.

Table 3-1. 200-PO-1 Groundwater Operable Unit Contaminants of Potential Concern and Exposure Point Concentrations

Detected Analyte/COPC[a]	5-Year Data Set			10-Year Data Set		
	Near-Field EPC[b] (µg/L) or (pCi/L)	Far-Field EPC[b] (µg/L) or pCi/L)	River EPC[b] (µg/L) or pCi/L)	Near-Field EPC[b] (µg/L) or (pCi/L)	Far-Field EPC[b] (µg/L) or (pCi/L)	River EPC[b] (µg/L) or pCi/L)
(m+p)-Xylene	--	--	--	--	0.50	--
1,1,1-Trichloroethane	--	0.69	--	--	1.2	--
1,1-Dichloroethane	--	0.26	--	--	0.39	--
1,1-Dichloroethene	--	0.17	--	--	0.16	--
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.73E-06	--	--	3.73E-06	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.66E-06	--	--	5.60E-06	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran	2.90E-06	--	--	2.90E-06	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran	2.10E-06	--	--	2.10E-06	--	--
1,2-Dichlorobenzene	--	3.0	--	--	3.0	--
1,2-Dichloroethane	0.64	--	--	0.64	0.31	--
1,4-Dichlorobenzene	--	0.13	--	--	0.13	--
1,4-Dioxane	--	8.1	--	--	8.1	--
2,3,4,6-Tetrachlorophenol	7.7	--	--	7.7	--	--
2-Butanone	--	0.55	--	--	2.9	--
2-Methylphenol (cresol, o-)	--	--	--	7.5	--	--
2-Pentanone, 4-Methyl	--	0.64	--	--	0.64	--
4-Nitrophenol	--	--	--	7.2	--	--
Acetone	--	1.5	1.1	--	1.3	1.1
Aluminum	47	--	--	112	42	--
Arsenic	5.8	3.1	5.8	5.8	3.1	5.8
Barium	53	73	49	53	68	49
Benzene	--	--	--	--	1.9	--

Table 3-1. 200-PO-1 Groundwater Operable Unit Contaminants of Potential Concern and Exposure Point Concentrations

Detected Analyte/COPC[a]	5-Year Data Set			10-Year Data Set		
	Near-Field EPC[b] (µg/L) or (pCi/L)	Far-Field EPC[b] (µg/L) or pCi/L)	River EPC[b] (µg/L) or pCi/L)	Near-Field EPC[b] (µg/L) or (pCi/L)	Far-Field EPC[b] (µg/L) or (pCi/L)	River EPC[b] (µg/L) or pCi/L)
Benzyl alcohol	--	--	--	--	2.7	--
Beryllium	0.34	--	--	0.34	0.36	--
Bis(2-ethylhexyl) phthalate	11	1.0	--	11	1.3	--
Cadmium	2.7	4.5	--	18	4.5	--
Carbon disulfide	--	0.21	--	--	0.39	--
Carbon tetrachloride	0.28	0.17	0.27	1.8	0.16	0.28
Carbon-14	--	--	--	--	15	--
Chloride	12,623	9,970	11,373	11,440	9,821	12,545
Chlorobenzene	--	--	--	--	0.41	--
Chloroform	0.38	0.21	0.81	0.38	0.22	2.3
Chromium	15	9.5	10.0	16	7.5	14
cis-1,2-Dichloroethylene	--	--	--	--	0.20	--
Cobalt	4.5	--	--	4.4	--	--
Copper	4.4	4.9	6.0	4.5	3.0	6.0
Dinoseb(2-secButyl-4,6-dinitrophenol)	--	--	--	5.5	--	--
Fluoride	294	301	287	317	329	306
Gross alpha	5.3	6.4	2.4	4.9	6.0	2.8
Gross beta	--	32	31	--	27	22
Hexavalent Chromium	191	--	--	191	--	--
Iodine-129	2.7	2.0	--	3.2	1.8	--
Iron	90	121	611	144	473	611
Lead	1.5	0.58	0.68	1.4	0.71	0.66
Lithium	--	--	--	--	8.3	--
Manganese	6.2	16	42	9.6	11	41
Methanol	--	--	--	--	1,100	--
Methylene chloride	--	2.1	--	--	0.85	--

Table 3-1. 200-PO-1 Groundwater Operable Unit Contaminants of Potential Concern and Exposure Point Concentrations

Detected Analyte/COPC[a]	5-Year Data Set			10-Year Data Set		
	Near-Field EPC[b] (µg/L) or (pCi/L)	Far-Field EPC[b] (µg/L) or pCi/L)	River EPC[b] (µg/L) or pCi/L)	Near-Field EPC[b] (µg/L) or (pCi/L)	Far-Field EPC[b] (µg/L) or (pCi/L)	River EPC[b] (µg/L) or pCi/L)
Molybdenum	--	--	--	--	1.5	--
Nickel	12	6.0	5.6	11	3.6	5.6
Nickel-63	--	4.1	--	--	7.7	--
Nitrate	34,098	23,864	28,582	31,205	23,757	28,952
Nitrite	57	82	460	34	79	460
Nitrogen in Nitrite and Nitrate	14,700	--	--	14,700	--	--
Octachlorodibenzofuran	9.96E-06	--	--	9.96E-06	--	--
Octachlorodibenzo-p-dioxin	5.81E-06	--	--	5.69E-06	--	--
o-Xylene	--	--	--	--	0.21	--
Plutonium-239/240	0.029	--	--	0.029	--	--
Protactinium-231	0.28	0.31	--	0.28	0.31	--
Silver	5.7	5.8	--	5.7	5.3	--
Strontium	269	384	390	265	364	390
Strontium-90	4.3	0.61	2.6	4.6	0.61	2.6
Sulfate	64,094	45,031	42,560	56,164	45,070	41,899
Technetium-99	1,667	94	121	1,568	76	115
Tetrachloroethene	--	0.87	--	--	0.99	--
Thallium	--	--	0.37	--	--	0.37
Toluene	0.036	--	--	0.065	0.27	--
Total petroleum hydrocarbons - gasoline range	50	--	--	50	--	--
Tributyl phosphate	--	12	--	--	41	--
Trichloroethene	0.56	0.43	--	0.57	0.49	--
Trichloromonofluoromethane	--	0.58	--	--	0.58	--
Tritium	156,901	264,107	70,724	192,558	497,900	59,534

Table 3-1. 200-PO-1 Groundwater Operable Unit Contaminants of Potential Concern and Exposure Point Concentrations

Detected Analyte/COPC[a]	5-Year Data Set			10-Year Data Set		
	Near-Field EPC[b] (µg/L) or (pCi/L)	Far-Field EPC[b] (µg/L) or pCi/L)	River EPC[b] (µg/L) or pCi/L)	Near-Field EPC[b] (µg/L) or (pCi/L)	Far-Field EPC[b] (µg/L) or (pCi/L)	River EPC[b] (µg/L) or pCi/L)
Uranium	20	17	5.6	15	16	5.5
Vanadium	22	13	17	22	13	17
Vinyl chloride	--	--	--	--	1.8	--
Zinc	96	69	6.7	92	109	6.7

[a] Source = ECF-200PO1-09-2018, *Contaminant of Potential Concern Selection for the 200-PO-1 Groundwater Operable Unit.*

[b] Source = ECF-200PO1-09-2027, *Calculation of Exposure Point Concentrations for the 200-PO-1 Groundwater Operable Unit.*

COPC = contaminant of potential concern.

EPC = exposure point concentration.

3.3 TOXICITY VALUES

The toxicity criteria used for the Native American human health risk calculations are provided in Table 3-2. The sources for these criteria are discussed below.

3.3.1 Toxicity Values for Nonradionuclides

For nonradionuclides, the COPC-specific toxicity values shown in Table 3-2 are determined using the recommended reference hierarchy as described in Cook, 2003, *Human Health Toxicity Values in Superfund Risk Assessments*. The hierarchy is summarized below.

- Tier 1 – The EPA Integrated Risk Information System (IRIS)
- Tier 2 – The EPA Provisional Peer Reviewed Toxicity Values (PPRTVs)
- Tier 3 – Other Toxicity Values

Tier 1 – IRIS

The preferred source of toxicity data is EPA's IRIS database (http://www.epa.gov/iris/index.html). Expert toxicologists at EPA have derived the values in this database and most values have undergone a thorough review and validation both within and outside EPA. If a toxicity value is available in IRIS, that value is used in preference to any other value.

Tier 2 – PPRTVs

If a toxicity value is not available in IRIS, the next source is EPA's PPRTVs. This source

includes toxicity values that have been developed by the Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center (STSC). This database is not available to the general public, but is accessible to EPA risk assessors via EPA's intranet. These values are also published at the EPA's "Regional Screening Levels for Chemical Contaminants at Superfund Sites" website at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm.

Tier 3 – Other Toxicity Values

Tier 3 includes additional EPA and non-EPA sources of toxicity information, including:

- The California EPA (CalEPA)'s Toxicity Criteria Database contains toxicity values that are peer reviewed and address both cancer and non-cancer effects.
- The Agency for Toxic Substances and Disease Registry (ATSDR)'s Minimal Risk Levels (RMLs) for Hazard Substances are peer-reviewed estimates of the daily human exposure to hazardous substances that is likely to be without appreciable risk of adverse non-cancer health effects over a specified duration of exposure.
- Toxicity values in EPA's Health Effects Assessment summary Tables (HEAST) (EPA/540/R-97/036, July 1997). The HEAST values for chemical contaminants are not currently available on an EPA internet site.

When Tier 1, Tier 2, or Tier 3 toxicity values are not available for a COPC, the toxicity values from the National Center for Environmental Assessment (NCEA) are used. NCEA values can be found in the Oak Ridge National Laboratory Risk Assessment Information System (RAIS) available at http://rais.ornl.gov/.

A derived RfD for nitrate was calculated from the RfD reported in IRIS (1.6 mg/kg-day) for nitrate as nitrogen (NO_3^--N) using the mass fraction of nitrogen in nitrate. The mass fraction of nitrogen in nitrate = mol wt N/mol wt NO_3^- = (14 g/mol)/(62 g/mol) = 0.226. The derived RfD for nitrate = (1.6 mg NO_3^--N/kg-day) x (1 mg NO_3^-/0.226 mg NO_3^--N) = 7.1 mg NO_3^-/kg-day.

A derived RfD for nitrite was calculated from the RfD reported in IRIS (0.1 mg/kg-day) for nitrite as nitrogen (NO_2^--N) using the mass fraction of nitrogen in nitrite. The mass fraction of nitrogen in nitrite = mol wt N/mol wt NO_2^- = (14 g/mol)/(46 g/mol) = 0.304. The derived RfD for nitrite = (0.1 mg NO_2^--N /kg-day) x (1 mg NO_2^-/0.304 mg NO_2^--N) = 0.3 mg NO_2^-/kg-day.

For several nonradionuclide COPCs, the toxicity value used was obtained from a different source than recommended by the EPA Superfund hierarchy (Cook 2003). The differences in toxicity values are summarized below.

- For trichloroethene, the oral cancer slope factor of 0.089 $(mg/kg\text{-}day)^{-1}$ published in HEAST is used for this assessment. HEAST has not been updated since 1997 and does not reflect the most current source of information. The oral cancer slope factor currently implemented by EPA in the Regional Screening Levels is established by the CalEPA OEHHA. The oral slope factor derived by OEHHA is 0.0059 $(mg/kg\text{-}day)^{-1}$ as presented in OEHHA, 2009, *Public Health Goal for Chemicals In Drinking Water Trichloroethylene*. Use of the HEAST value in this assessment has the potential to over-estimate cancer risk.
- For fluoride, the oral reference dose of 0.06 mg/kg-day published on IRIS is used for this assessment. The value reported on IRIS has not been updated since 1989 and does not

reflect the most current source of information. The oral reference dose currently implemented by EPA in the Regional Screening Levels is established by the CalEPA OEHHA. The oral reference dose derived by OEHHA is 0.04 mg/kg-day as documented in OEHHA, 2003, *Chronic Toxicity Summary: Fluorides including Hydrogen Fluoride.* Use of the IRIS value in this assessment has the potential to under-estimate noncancer hazards.

- For hexavalent chromium, the current assessment considers cancer effects only for inhalation exposures. An oral cancer slope factor has recently been published by the New Jersey Department of Environmental Protection (NJDEP). The oral cancer slope factor derived by NJDEP is 0.5 $(mg/kg\text{-}day)^{-1}$, as presented in NJDEP, 2009, *Derivation of an Ingestion-Based Soil Remediation Criterion for Cr+6 Based on the NTP Chronic Bioassay Data for Sodium Dichromate Dihydrate.* Assessing only inhalation cancer effects from hexavalent chromium has the potential to under-estimate cancer risk.

- For consistency with previous Hanford analyses of carbon tetrachloride, the toxicity assessment uses an oral cancer slope factor of 0.13 $(mg/kg\text{-}day)^{-1}$, an oral reference dose of 0.0007 (mg/kg-day), and an inhalation unit risk factor of 1.5E-05 $(\mu g/m^3)^{-1}$ previously published in IRIS, as well as the inhalation reference concentration of 0.19 (mg/m^3) published by ATSDR. These values do not reflect the most current toxicity values published for carbon tetrachloride. The oral cancer slope factor of 0.07 $(mg/kg\text{-}day)^{-1}$, oral reference dose of 0.004 (mg/kg-day), inhalation unit risk of 6E-06 $(\mu g/m^3)^{-1}$, and inhalation reference concentration of 0.1 (mg/m^3) for carbon tetrachloride is currently implemented by EPA in the Regional Screening Levels (EPA, 2009) and are established by IRIS. Use of the previous IRIS values in this assessment has the potential to over-estimate both cancer risks and noncancer hazards.

- For 1,1-dichloroethane, the oral reference dose of 0.2 mg/kg-day published by the PPRTV and inhalation reference concentration of 0.7 mg/m^3 published by HEAST (EPA 540-R-97-036) are used for this assessment. Both an oral carcinogenic potency factor and inhalation unit risk have recently been published by the CalEPA OEHHA. The oral carcinogenic potency factor derived by OEHHA is 0.0057 $(mg/kg\text{-}day)^{-1}$, and the inhalation unit risk derived by OEHHA is 1.6E-06 $(\mu g/m^3)^{-1}$, as presented in OEHHA, 2003, *Public Health Goals for Chemicals in Drinking Water: 1,1-Dichloroethane in Drinking Water.* Use of the PPRTV and HEAST values in this assessment has the potential to under-estimate cancer risk.

3.3.2 Toxicity Values for Radionuclides

The cancer slope factors shown in Table 3-2 were obtained online from EPA's Health Effects Summary Tables (HEAST) - Radionuclide Table (formerly Table 4) (http://www.epa.gov/radiation/heast/). The HEAST values were developed by EPA's Office of Radiation and Indoor Air (ORIA) based on Federal Guidance Report No. 13, EPA 402-R-99-001, 1999, *Cancer Risk Coefficients for Environmental Exposure to Radionuclides.* The HEAST values are referenced in EPA/540-R-00-006, 2000, *Soil Screening Guidance for Radionuclides: Technical Background Document* and EPA/540-R-00-007, 2000, *Soil Screening Guidance for Radionuclides: User's Guide*, and have been adopted by EPA in its "Preliminary Remediation Goals for Radionuclides" online calculator tool (http://rais.ornl.gov/rad_start.shtml).

3.3.3 Toxicity Values for Sweat Lodge Equations

EPA has recently published guidance to address chemical inhalation exposures in EPA-540-R-070-002, 2009, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). RAGS Part F provides a methodology to use the toxicity values which are currently derived by the EPA IRIS as concentrations, reference concentrations [RfC] for non-cancer effects and inhalation unit risk values [IUR] for cancer endpoints. These values now supersede the intake-based approach used by the inhalation component of RAGS Part A. The method described in Harris and Harper (2004) for inhalation of nonradionuclide COPCs in sweat lodge vapor follows EPA's former approach of quantifying intake. Therefore, in the sweat lodge pathway calculations, current IUR and RfC values from EPA's toxicity tables are converted to SF_i and RfD_i values following EPA RAGS Part A protocol (EPA/540/1-89/002) using the following equations based on an assumed breathing rate of 20 m^3/day and body weight of 70 kg.

$$SF_i \text{ (kg-day/mg)} = IUR \text{ } (m^3/\mu g) \times 1/20 \text{ } (m^3/day) \times 70 \text{ (kg)} \times 1000 \text{ } (\mu g/mg) \quad (50)$$

$$RfD_i \text{ (mg/kg-day)} = RfC \text{ } (mg/m^3) \times 20 \text{ } (m^3/day) \times 1/70 \text{ (kg)} \quad (51)$$

The SF_i and RfD_i values are used to calculate inhalation cancer risks and non-cancer hazards, respectively. For inhalation of radionuclides in sweat lodge vapor, no toxicity factor conversions are necessary. Sweat lodge radiological risk is calculated by quantifying inhalation intake (pCi) and then multiplying by the EPA inhalation slope factor (risk/pCi).

Table 3-2. Toxicity Criteria for 200-PO-1 Groundwater Operable Unit Contaminants of Potential Concern[a]

COPC[a]	Oral Reference Dose (RfD_o)[b] (mg/kg-day)	Key	Oral Cancer Slope Factor (CSF_o)[b] $(mg/kg\text{-}day)^{-1}$ or Oral Slope Factor (SF_o)[c] (Risk/pCi)	Key	Inhalation Unit Risk (IUR)[b] $(\mu g/m^3)^{-1}$	Key	Inhalation Cancer Slope Factor (CSF_i)[d] (kg-day/mg) or Inhalation Slope Factor (SF_i)[c] (Risk/pCi)	Inhalation Reference Concentration (RfC)[b] (mg/m^3)	Key	Inhalation Reference Dose (RfD_i)[e] (mg/kg-day)	Volatile Nonradionuclides[b] Radionuclides[c]	GIABS Nonradionuclides[b] Radionuclides[c]	K_p[f] (cm/hour)	B[f]	τ[f] (hours/event)	t^*[f] (hours)	FA[f]
(m+p)-Xylene	2.00E-01	I	--	--	--	--	--	7.00E-01	C	2.00E-01	V	1	0.053	0.2	0.42	1.01	1
1,1,1-Trichloroethane	2.00E+00	I	--	--	--	--	--	5.00E+00	I	1.43E+00	V	1	0.013	0.1	0.6	1.43	1
1,1-Dichloroethane	2.00E-01	P	--	--	--	--	--	7.00E-01	H	2.00E-01	V	1	0.0067	0	0.38	0.92	1
1,1-Dichloroethene	5.00E-02	I	--	--	--	--	--	2.00E-01	I	5.71E-02	V	1	0.012	0	0.37	0.89	1
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	--	--	1.30E+03	WHO	3.80E-01	WHO	1.33E+03	--	--	--	--	1	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran[i]	--	--	1.30E+03	WHO	3.80E-01	WHO	1.33E+03	--	--	--	--	1	1.45	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran[i]	--	--	1.30E+04	WHO	3.80E+00	WHO	1.33E+04	--	--	--	--	1	2.25	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran[i]	--	--	1.30E+04	WHO	3.80E+00	WHO	1.33E+04	--	--	--	--	1	2.25	--	--	--	--
1,2-Dichlorobenzene	9.00E-02	I	--	--	--	--	--	2.00E-01	H	5.71E-02	V	1	0.041	0.2	0.71	1.71	1
1,2-Dichloroethane	2.00E-02	P	9.10E-02	I	2.60E-05	I	9.10E-02	2.40E+00	A	6.86E-01	V	1	0.0042	0	0.38	0.92	1
1,4-Dichlorobenzene	7.00E-02	A	5.40E-03	C	1.10E-05	C	3.85E-02	8.00E-01	I	2.29E-01	V	1	0.042	0.2	0.71	1.71	1
1,4-Dioxane	1.00E-01	A	1.10E-02	I	7.70E-06	C	2.70E-02	3.60E+00	A	1.03E+00	SV[h]	1	0.00033	0	0.33	0.8	1
2,3,4,6-Tetrachlorophenole	3.00E-02	I	--	--	--	--	--	--	--	--	SV[h]	1	0.071	--	--	--	--
2-Butanone	6.00E-01	I	--	--	--	--	--	5.00E+00	I	1.43E+00	V	1	0.00096	0	0.27	0.65	1
2-Methylphenol (cresol, o-)	5.00E-02	I	--	--	--	--	--	6.00E-01	C	1.71E-01	SV[h]	1	0.0077	0	0.43	1.03	1
2-Pentanone, 4-Methyl	8.00E-02	H	--	--	--	--	--	3.00E+00	I	8.57E-01	V	1	0.0027	0	0.39	0.93	1
4-Nitrophenol	8.00E-03	N	--	--	--	--	--	--	--	--	SV[h]	1	0.0048	0	0.64	1.54	1
Acetone[i]	9.00E-01	I	--	--	--	--	--	3.10E+01	A	8.86E+00	V	1	0.000512	--	--	--	--
Aluminum	1.00E+00	P	--	--	--	--	--	5.00E-03	P	1.43E-03	--	1	0.001	--	--	--	--

Table 3-2. Toxicity Criteria for 200-PO-1 Groundwater Operable Unit Contaminants of Potential Concern[a]

COPC[a]	Oral Reference Dose (RfD_o)[b] (mg/kg-day)	Key	Oral Cancer Slope Factor (CSF_o)[b] $(mg/kg\text{-}day)^{-1}$ or Oral Slope Factor (SF_o)[c] (Risk/pCi)	Key	Inhalation Unit Risk (IUR)[b] $(\mu g/m^3)^{-1}$	Key	Inhalation Cancer Slope Factor (CSF_i)[d] (kg-day/mg) or Inhalation Slope Factor (SF_i)[c] (Risk/pCi)	Inhalation Reference Concentration (RfC)[b] (mg/m^3)	Key	Inhalation Reference Dose (RfD_i)[e] (mg/kg-day)	Volatile Nonradionuclides[b] Radionuclides[c]	GIABS Nonradionuclides[b] Radionuclides[c]	K_p[f] (cm/hour)	B[f]	τ[f] (hours/event)	t^*[f] (hours)	FA[f]
Arsenic	3.00E-04	I	1.50E+00	I	4.30E-03	I	1.51E+01	1.50E-05	C	4.29E-06	--	1	0.001	--	--	--	--
Barium	2.00E-01	I	--	--	--	--	--	5.00E-04	H	1.43E-04	--	0.07	0.001	--	--	--	--
Benzene	4.00E-03	I	5.50E-02	I	7.80E-06	I	2.73E-02	3.00E-02	I	8.57E-03	V	1	0.015	0.1	0.29	0.7	1
Benzyl alcohol[i]	1.00E-01	P	--	--	--	--	--	--	--	--	SV[h]	1	0.00209	--	--	--	--
Beryllium	2.00E-03	I	--	--	2.40E-03	I	8.40E+00	2.00E-05	I	5.71E-06	--	0.007	0.001	--	--	--	--
Bis(2-ethylhexyl) phthalate	2.00E-02	I	1.40E-02	I	2.40E-06	C	8.40E-03	--	--	--	SV[h]	1	0.025	0.2	16.64	39.93	0.8
Cadmium	5.00E-04	I	--	--	1.80E-03	I	6.30E+00	1.00E-05	A	2.86E-06	--	0.05	0.001	--	--	--	--
Carbon disulfide	1.00E-01	I	--	--	--	--	--	7.00E-01	I	2.00E-01	V	1	0.017	0.1	0.3	0.72	1
Carbon tetrachloride	7.00E-04	I	1.30E-01	I	1.50E-05	I	5.25E-02	1.90E-01	A	5.43E-02	V	1	0.016	0.1	0.78	1.86	1
Carbon-14	--	--	1.55E-12	H	--	--	7.07E-12	--	--	--	--	--	--	--	--	--	--
Chloride	--	--	--	--	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Chlorobenzene	2.00E-02	I	--	--	--	--	--	5.00E-02	P	1.43E-02	V	1	0.028	0.1	0.46	1.09	1
Chloroform	1.00E-02	I	3.10E-02	C	2.30E-05	H	8.05E-02	9.80E-02	A	2.80E-02	V	1	0.0068	0	0.5	1.19	1
Chromium	1.50E+00	I	--	--	--	--	--	--	--	--	--	0.013	0.001	--	--	--	--
cis-1,2-Dichloroethylene	1.00E-02	P	--	--	--	--	--	--	--	--	V	1	0.0077	0	0.37	0.89	1
Cobalt	3.00E-04	P	--	--	9.00E-03	P	3.15E+01	6.00E-06	P	1.71E-06	--	1	0.0004	--	--	--	--
Copper	4.00E-02	H	--	--	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Dinoseb(2-secButyl-4,6-dinitrophenol)[i]	1.00E-03	I	--	--	--	--	--	--	--	--	SV[h]	1	0.0163	--	--	--	--
Fluoride	6.00E-02	I	--	--	--	--	--	1.30E-02	C	3.71E-03	--	1	0.001	--	--	--	--
Gross alpha	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Gross beta	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 3-2. Toxicity Criteria for 200-PO-1 Groundwater Operable Unit Contaminants of Potential Concern[a]

COPC[a]	Oral Reference Dose (RfD_o)[b] (mg/kg-day)	Key	Oral Cancer Slope Factor (CSF_o)[b] $(mg/kg\text{-}day)^{-1}$ or Oral Slope Factor (SF_o)[c] (Risk/pCi)	Key	Inhalation Unit Risk (IUR)[b] $(\mu g/m^3)^{-1}$	Key	Inhalation Cancer Slope Factor (CSF_i)[d] (kg-day/mg) or Inhalation Slope Factor (SF_i)[c] (Risk/pCi)	Inhalation Reference Concentration (RfC)[b] (mg/m^3)	Key	Inhalation Reference Dose (RfD_i)[e] (mg/kg-day)	Volatile Nonradionuclides[b] Radionuclides[c]	GIABS Nonradionuclides[b] Radionuclides[c]	K_p[f] (cm/hour)	B[f]	τ[f] (hours/event)	t^*[f] (hours)	FA[f]
Hexavalent Chromium	3.00E-03	I	--	--	8.40E-02	I	2.94E+02	1.00E-04	I	2.86E-05	--	0.025	0.002	--	--	--	--
Iodine-129	--	--	1.48E-10	H	--	--	6.07E-11	--	--	--	--	1	--	--	--	--	--
Iron	7.00E-01	P	--	--	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Lead	--	--	--	--	--	--	--	--	--	--	--	1	0.0001	--	--	--	--
Lithium	2.00E-03	P	--	--	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Manganese	2.40E-02	I	--	--	--	--	--	5.00E-05	I	1.43E-05	--	0.04	0.001	--	--	--	--
Methanol	5.00E-01	I	--	--	--	--	--	4.00E+00	C	1.14E+00	SV[h]	1	0.00032	0	0.16	0.39	1
Methylene chloride	6.00E-02	I	7.50E-03	I	4.70E-07	I	1.65E-03	1.00E+00	A	2.86E-01	V	1	0.0035	0	0.32	0.76	1
Molybdenum	5.00E-03	I	--	--	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Nickel	2.00E-02	I	--	--	2.60E-04	C	9.10E-01	9.00E-05	A	2.57E-05	--	0.04	0.0002	--	--	--	--
Nickel-63	--	--	6.70E-13	H	--	--	1.64E-12	--	--	--	--	--	--	--	--	--	--
Nitrate	7.10E+00	I	--	--	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Nitrite	3.00E-01	I	--	--	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Nitrogen in Nitrite and Nitrate	1.60E+00	I	--	--	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Octachlorodibenzofuran[i]	--	--	3.90E+01	WHO	1.14E-02	WHO	3.99E+01	--	--	--	--	1	2.63	--	--	--	--
Octachlorodibenzo-p-dioxin[i]	--	--	3.90E+01	WHO	1.14E-02	WHO	3.99E+01	--	--	--	--	1	1.16	--	--	--	--
o-Xylene	2.00E-01	I	--	--	--	--	--	7.00E-01	C	2.00E-01	V	1	0.054	0.2	0.42	1.01	1
Plutonium-239/240	--	--	1.35E-10	H	--	--	3.33E-08	--	--	--	--	--	--	--	--	--	--
Protactinium-231	--	--	1.73E-10	H	--	--	4.55E-08	--	--	--	--	--	--	--	--	--	--
Silver	5.00E-03	I	--	--	--	--	--	--	--	--	--	0.04	0.0006	--	--	--	--
Strontium	6.00E-01	I	--	--	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Strontium-90	--	--	5.59E-11	H	--	--	1.05E-10	--	--	--	--	0.3	--	--	--	--	--

Table 3-2. Toxicity Criteria for 200-PO-1 Groundwater Operable Unit Contaminants of Potential Concern[a]

COPC[a]	Oral Reference Dose (RfD_o)[b] (mg/kg-day)	Key	Oral Cancer Slope Factor (CSF_o)[b] $(mg/kg\text{-}day)^{-1}$ or Oral Slope Factor (SF_o)[c] (Risk/pCi)	Key	Inhalation Unit Risk (IUR)[b] $(\mu g/m^3)^{-1}$	Key	Inhalation Cancer Slope Factor (CSF_i)[d] (kg-day/mg) or Inhalation Slope Factor (SF_i)[c] (Risk/pCi)	Inhalation Reference Concentration (RfC)[b] (mg/m^3)	Key	Inhalation Reference Dose (RfD_i)[e] (mg/kg-day)	Volatile Nonradionuclides[b] Radionuclides[c]	GIABS Nonradionuclides[b] Radionuclides[c]	K_p[f] (cm/hour)	B[f]	τ[f] (hours/event)	t^*[f] (hours)	FA[f]
Sulfate	--	--	--	--	--	--		--	--		--	--	0.001	--	--	--	--
Technetium-99	--	--	2.75E-12	H	--	--		--	--		--	0.5	--	--	--	--	--
Tetrachloroethene	1.00E-02	I	5.40E-01	C	5.90E-06	C	2.07E-02	2.70E-01	A	7.71E-02	V	1	0.033	0.2	0.91	2.18	1
Thallium	--	--	--	--	--	--		--	--		--	1	0.001	--	--	--	--
Toluene	8.00E-02	I	--	--	--	--		5.00E+00	I		V	1	0.031	0.1	0.35	0.84	1
Total petroleum hydrocarbons - gasoline range	--	--	--	--	--	--		--	--		--	--	--	--	--	--	--
Tributyl phosphate[i]	2.00E-01	P	9.20E-03	P	--	--		--	--		SV[h]	1	0.0228	--	--	--	--
Trichloroethene	--	--	8.90E-02	H	2.50E-05	H	8.75E-02	3.50E-02	H	1.00E-02	V	1	0.012	0.1	0.58	1.39	1
Trichloromonofluoromethane	3.00E-01	I	--	--	--	--	--	7.00E-01	H	2.00E-01	V	1	0.013	0.1	0.63	1.51	1
Tritium	--	--	5.07E-14	H	--	--	5.62E-14	--	--	--	V	1	--	--	--	--	--
Uranium	3.00E-03	I	--	--	--	--	--	3.00E-04	A	8.57E-05	--	1	0.001	--	--	--	--
Vanadium	5.00E-03	S	--	--	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Vinyl chloride	3.00E-03	I	7.20E-01	I	4.40E-06	I	1.54E-02	1.00E-01	I	2.86E-02	V	1	0.0056	0	0.24	0.57	1
Zinc	3.00E-01	I	--	--	--	--	--	--	--	--	--	1	0.0006	--	--	--	--

Table 3-2. Toxicity Criteria for 200-PO-1 Groundwater Operable Unit Contaminants of Potential Concern[a]

COPC[a]	Oral Reference Dose (RfD_o)[b] (mg/kg-day)	Key	Oral Cancer Slope Factor (CSF_o)[b] $(mg/kg\text{-}day)^{-1}$ or Oral Slope Factor (SF_o)[c] (Risk/pCi)	Key	Inhalation Unit Risk (IUR)[b] $(\mu g/m^3)^{-1}$	Key	Inhalation Cancer Slope Factor (CSF_i)[d] (kg-day/mg) or Inhalation Slope Factor (SF_i)[c] (Risk/pCi)	Inhalation Reference Concentration (RfC)[b] (mg/m^3)	Key	Inhalation Reference Dose (RfD_i)[e] (mg/kg-day)	Volatile Nonradionuclides[b] Radionuclides[c]	GIABS Nonradionuclides[b] Radionuclides[c]	K_p[f] (cm/hour)	B[f]	τ[f] (hours/event)	t^*[f] (hours)	FA[f]
Notes:																	
a. Source = ECF-200PO1-09-2027.																	
b. Source = EPA, 2009.																	
c. Source = EPA, 2001.																	
d. CSF_i (kg-day/mg) = IUR ($m^3/\mu g$) x 1/20 (m^3/day) x 70 (kg) x 1000 (μg/mg)																	
e. RfD_i (mg/kg-day) = RfC (mg/m^3) x 20 (m^3/day) x 1/70 (kg)																	
f. Source = EPA/540/R/99/005, Exhibits 3-1 (inorganic COPCs) and B-3 (organic COPCs).																	
g. Source = ORNL, 2010.																	
h. Defined as a semi-volatile per EPA SW-846 Method 8270 for semi-volatiles																	
i. Kp for this analytes is taken from ORNL, 2010																	

-- = indicates toxicity value not available for this contaminant and exposure route.
A = ATSDR
B = partitioning constant.
C = Cal EPA
COPC = contaminant of potential concern.
FA = fraction absorbed.
GIABS = gastrointestinal absorption factor.
H = HEAST
I = IRIS
K_p = dermal permeability constant.
P = PPRTV
t^* = time to reach steady-state.
τ = lag time
V = volatile
SV= Semivolatile

ECF-200PO1-09-2027, *Calculation of Exposure Point Concentrations for the 200-PO-1 Groundwater Operable Unit.*
EPA/540/R/99/005, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment): Final.*
EPA, 2001, *Health Effects Assessment Summary Tables* database, "April 16, 2001 Update: Radionuclide Toxicity," "Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors."
EPA, 2009, "Regional Screening Levels for Chemical Contaminants at Superfund Sites."
ORNL, 2010, The Risk Assessment Information System (RAIS).

4.0 SOFTWARE APPLICATIONS

All supporting calculations for this Environmental Calculation are performed on electronic spreadsheets using Microsoft Excel[4]. These spreadsheets are provided as electronic attachments to this Environmental Calculation as discussed in Section 5.

5.0 CALCULATION

Potential human health risk to members of the CTUIR and Yakama Nation is calculated using the methodology presented in Section 2 and the COPCs, EPCs, and toxicity factors presented in Section 3. The calculation spreadsheets (formatted for on-screen viewing) are provided as electronic attachments to this Environmental Calculation. The individual Excel workbooks and their associated worksheets are listed in the tables below.

5.1 DRINKING WATER PATHWAY WORKSHEETS

The drinking water pathway calculations for the CTUIR exposure scenario 5-Year data set are contained in the Excel workbook "200-PO-1 Native Am Risk Env Calc - Attach A - Drinking Water CTUIR.xlsx". The worksheets in this workbook are listed in Table 5-1.

The drinking water pathway calculations for the Yakama Nation exposure scenario 5-Year Data Set are contained in the Excel workbook "200-PO-1 Native Am Risk Env Calc - Attach B - Drinking Water YN.xlsx". The worksheets in this workbook are listed in Table 5-2.

The drinking water pathway calculations for the CTUIR exposure scenario 10-Year Data Set are contained in the Excel workbook "200-PO-1 Native Am Risk Env Calc - Attach C - Drinking Water CTUIR.xlsx". The worksheets in this workbook are listed in Table 5-1.

The drinking water pathway calculations for the Yakama Nation exposure scenario 10-Year Data Set are contained in the Excel workbook "200-PO-1 Native Am Risk Env Calc - Attach D - Drinking Water YN.xlsx". The worksheets in this workbook are listed in Table 5-2.

Table 5-1. Worksheets for the CTUIR Drinking Water Pathway Calculations (5-Year Data Set)

Far-Field Exposure Area	Near-Field Exposure Area	River Exposure Area
A-1: Results summary	A-7: Results summary	A-13: Results summary
A-2: Ingestion of COPCs in drinking water	A-8: Ingestion of COPCs in drinking water	A-14: Ingestion of COPCs in drinking water

[4] Excel is a trademark of Microsoft Corporation, Redmond, Washington.

Table 5-1. Worksheets for the CTUIR Drinking Water Pathway Calculations (5-Year Data Set)

Far-Field Exposure Area	Near-Field Exposure Area	River Exposure Area
A-3: Inhalation of volatile COPCs in drinking water	A-9: Inhalation of volatile COPCs in drinking water	A-15: Inhalation of volatile COPCs in drinking water
A-4: Dermal absorption of COPCs in drinking water	A-10: Dermal absorption of COPCs in drinking water	A-16: Dermal absorption of COPCs in drinking water
A-5: Inhalation of volatile radioactive COPCs in drinking water	A-11: Inhalation of volatile radioactive COPCs in drinking water	A-17: Inhalation of volatile radioactive COPCs in drinking water
A-6: Ingestion of radioactive COPCs in drinking water	A-12: Ingestion of radioactive COPCs in drinking water	A-18: Ingestion of radioactive COPCs in drinking water

Table 5-2. Worksheets for the Yakama Nation Drinking Water Pathway Calculations (5-Year Data Set)

Far-Field Exposure Area	Near-Field Exposure Area	River Exposure Area
B-1: Results summary	B-7: Results summary	B-13: Results summary
B-2: Ingestion of COPCs in drinking water	B-8: Ingestion of COPCs in drinking water	B-14: Ingestion of COPCs in drinking water
B-3: Inhalation of volatile COPCs in drinking water	B-9: Inhalation of volatile COPCs in drinking water	B-15: Inhalation of volatile COPCs in drinking water
B-4: Dermal absorption of COPCs in drinking water	B-10: Dermal absorption of COPCs in drinking water	B-16: Dermal absorption of COPCs in drinking water
B-5: Inhalation of volatile radioactive COPCs in drinking	B-11: Inhalation of volatile radioactive COPCs in drinking	B-17: Inhalation of volatile radioactive COPCs in drinking

Table 5-2. Worksheets for the Yakama Nation Drinking Water Pathway Calculations (5-Year Data Set)

Far-Field Exposure Area	Near-Field Exposure Area	River Exposure Area
water	water	water
B-6: Ingestion of radioactive COPCs in drinking water	B-12: Ingestion of radioactive COPCs in drinking water	B-18: Ingestion of radioactive COPCs in drinking water

Table 5-3. Worksheets for the CTUIR Drinking Water Pathway Calculations (10-Year Data Set)

Far-Field Exposure Area	Near-Field Exposure Area	River Exposure Area
C-1: Results summary	C-7: Results summary	C-13: Results summary
C-2: Ingestion of COPCs in drinking water	C-8: Ingestion of COPCs in drinking water	C-14: Ingestion of COPCs in drinking water
C-3: Inhalation of volatile COPCs in drinking water	C-9: Inhalation of volatile COPCs in drinking water	C-15: Inhalation of volatile COPCs in drinking water
C-4: Dermal absorption of COPCs in drinking water	C-10: Dermal absorption of COPCs in drinking water	C-16: Dermal absorption of COPCs in drinking water
C-5: Inhalation of volatile radioactive COPCs in drinking water	C-11: Inhalation of volatile radioactive COPCs in drinking water	C-17: Inhalation of volatile radioactive COPCs in drinking water
C-6: Ingestion of radioactive COPCs in drinking water	C-12: Ingestion of radioactive COPCs in drinking water	C-18: Ingestion of radioactive COPCs in drinking water

Table 5-4. Worksheets for the Yakama Nation Drinking Water Pathway Calculations (10-Year Data Set)

Far-Field Exposure Area	Near-Field Exposure Area	River Exposure Area
D-1: Results summary	D-7: Results summary	D-13: Results summary
D-2: Ingestion of COPCs in drinking water	D-8: Ingestion of COPCs in drinking water	D-14: Ingestion of COPCs in drinking water
D-3: Inhalation of volatile COPCs in drinking water	D-9: Inhalation of volatile COPCs in drinking water	D-15: Inhalation of volatile COPCs in drinking water
D-4: Dermal absorption of COPCs in drinking water	D-10: Dermal absorption of COPCs in drinking water	D-16: Dermal absorption of COPCs in drinking water
D-5: Inhalation of volatile radioactive COPCs in drinking water	D-11: Inhalation of volatile radioactive COPCs in drinking water	D-17: Inhalation of volatile radioactive COPCs in drinking water
D-6: Ingestion of radioactive COPCs in drinking water	D-12: Ingestion of radioactive COPCs in drinking water	D-18: Ingestion of radioactive COPCs in drinking water

5.2 SWEAT LODGE PATHWAY WORKSHEETS

The sweat lodge pathway calculations for the CTUIR exposure scenario 5-Year Data Set are contained in the Excel workbook "200-PO-1 Native Am Risk Env Calc - Attach E - Sweatlodge CTUIR.xlsx". The worksheets in this workbook are listed in Table 5-5.

The sweat lodge pathway calculations for the Yakama Nation exposure scenario 5-Year Data Set are contained in the Excel workbook "200-PO-1 Native Am Risk Env Calc - Attach F - Sweatlodge YN.xlsx". The worksheets in this workbook are listed in Table 5-6.

The sweat lodge pathway calculations for the CTUIR exposure scenario 10-Year Data Set are contained in the Excel workbook "200-PO-1 Native Am Risk Env Calc - Attach G - Sweatlodge CTUIR.xlsx". The worksheets in this workbook are listed in Table 5-7.

The sweat lodge pathway calculations for the Yakama Nation exposure 10-Year Data Set scenario are contained in the Excel workbook "200-PO-1 Native Am Risk Env Calc - Attach H - Sweatlodge YN.xlsx". The worksheets in this workbook are listed in Table 5-8.

Table 5-5. Worksheets for the CTUIR Sweat Lodge Pathway Calculations (5-Year Data Set)

Far-Field Exposure Area	Near-Field Exposure Area	River Exposure Area
E-1: Results Summary	E-9: Results Summary	E-17: Results Summary
E-2: Inhalation of volatile COPCs in vapor	E-10: Inhalation of volatile COPCs in vapor	E-18: Inhalation of volatile COPCs in vapor
E-3: Inhalation of nonvolatile COPCs in vapor	E-11: Inhalation of nonvolatile COPCs in vapor	E-19: Inhalation of nonvolatile COPCs in vapor
E-4: Dermal exposure to volatile COPCs in vapor	E-12: Dermal exposure to volatile COPCs in vapor	E-20: Dermal exposure to volatile COPCs in vapor
E-5: Dermal exposure to nonvolatile COPCs in condensed water	E-13: Dermal exposure to nonvolatile COPCs in condensed water	E-21: Dermal exposure to nonvolatile COPCs in condensed water
E-6: Dermal exposure to nonvolatile COPCs in vapor	E-14: Dermal exposure to nonvolatile COPCs in vapor	E-22: Dermal exposure to nonvolatile COPCs in vapor
E-7: Inhalation of volatile radioactive COPCs in vapor	E-15: Inhalation of volatile radioactive COPCs in vapor	E-23: Inhalation of volatile radioactive COPCs in vapor
E-8: Inhalation of nonvolatile radioactive COPCs in vapor	E-16: Inhalation of nonvolatile radioactive COPCs in vapor	E-24: Inhalation of nonvolatile radioactive COPCs in vapor
COPC = contaminant of potential concern CTUIR = Confederated Tribes of the Umatilla Indian Reservation		

Table 5-6. Worksheets for the Yakama Nation Sweat Lodge Pathway Calculations (5-Year Data Set)

Far-Field Exposure Area	Near-Field Exposure Area	River Exposure Area
F-1: Results Summary	F-9: Results Summary	F-17: Results Summary
F-2: Inhalation of volatile COPCs in vapor	F-10: Inhalation of volatile COPCs in vapor	F-18: Inhalation of volatile COPCs in vapor

Table 5-6. Worksheets for the Yakama Nation Sweat Lodge Pathway Calculations (5-Year Data Set)

Far-Field Exposure Area	Near-Field Exposure Area	River Exposure Area
F-3: Inhalation of nonvolatile COPCs in vapor	F-11: Inhalation of nonvolatile COPCs in vapor	F-19: Inhalation of nonvolatile COPCs in vapor
F-4: Dermal exposure to volatile COPCs in vapor	F-12: Dermal exposure to volatile COPCs in vapor	F-20: Dermal exposure to volatile COPCs in vapor
F-5: Dermal exposure to nonvolatile COPCs in condensed water	F-13: Dermal exposure to nonvolatile COPCs in condensed water	F-21: Dermal exposure to nonvolatile COPCs in condensed water
F-6: Dermal exposure to nonvolatile COPCs in vapor	F-14: Dermal exposure to nonvolatile COPCs in vapor	F-22: Dermal exposure to nonvolatile COPCs in vapor
F-7: Inhalation of volatile radioactive COPCs in vapor	F-15: Inhalation of volatile radioactive COPCs in vapor	F-23: Inhalation of volatile radioactive COPCs in vapor
F-8: Inhalation of nonvolatile radioactive COPCs in vapor	F-16: Inhalation of nonvolatile radioactive COPCs in vapor	F-24: Inhalation of nonvolatile radioactive COPCs in vapor
COPC = contaminant of potential concern		

Table 5-7. Worksheets for the CTUIR Sweat Lodge Pathway Calculations (10-Year Data Set)

Far-Field Exposure Area	Near-Field Exposure Area	River Exposure Area
G-1: Results Summary	G-9: Results Summary	G-17: Results Summary
G-2: Inhalation of volatile COPCs in vapor	G-10: Inhalation of volatile COPCs in vapor	G-18: Inhalation of volatile COPCs in vapor
G-3: Inhalation of nonvolatile COPCs in vapor	G-11: Inhalation of nonvolatile COPCs in vapor	G-19: Inhalation of nonvolatile COPCs in vapor

Table 5-7. Worksheets for the CTUIR Sweat Lodge Pathway Calculations (10-Year Data Set)

Far-Field Exposure Area	Near-Field Exposure Area	River Exposure Area
G-4: Dermal exposure to volatile COPCs in vapor	G-12: Dermal exposure to volatile COPCs in vapor	G-20: Dermal exposure to volatile COPCs in vapor
G-5: Dermal exposure to nonvolatile COPCs in condensed water	G-13: Dermal exposure to nonvolatile COPCs in condensed water	G-21: Dermal exposure to nonvolatile COPCs in condensed water
G-6: Dermal exposure to nonvolatile COPCs in vapor	G-14: Dermal exposure to nonvolatile COPCs in vapor	G-22: Dermal exposure to nonvolatile COPCs in vapor
G-7: Inhalation of volatile radioactive COPCs in vapor	G-15: Inhalation of volatile radioactive COPCs in vapor	G-23: Inhalation of volatile radioactive COPCs in vapor
G-8: Inhalation of nonvolatile radioactive COPCs in vapor	G-16: Inhalation of nonvolatile radioactive COPCs in vapor	G-24: Inhalation of nonvolatile radioactive COPCs in vapor
COPC = contaminant of potential concern CTUIR = Confederated Tribes of the Umatilla Indian Reservation		

Table 5-8. Worksheets for the Yakama Nation Sweat Lodge Pathway Calculations (10-Year Data Set)

Far-Field Exposure Area	Near-Field Exposure Area	River Exposure Area
H-1: Results Summary	H-9: Results Summary	H-17: Results Summary
H-2: Inhalation of volatile COPCs in vapor	H-10: Inhalation of volatile COPCs in vapor	H-18: Inhalation of volatile COPCs in vapor
H-3: Inhalation of nonvolatile COPCs in vapor	H-11: Inhalation of nonvolatile COPCs in vapor	H-19: Inhalation of nonvolatile COPCs in vapor
H-4: Dermal exposure to volatile COPCs in vapor	H-12: Dermal exposure to volatile COPCs in	H-20: Dermal exposure to volatile COPCs in

Table 5-8. Worksheets for the Yakama Nation Sweat Lodge Pathway Calculations (10-Year Data Set)

Far-Field Exposure Area	Near-Field Exposure Area	River Exposure Area
	vapor	vapor
H-5: Dermal exposure to nonvolatile COPCs in condensed water	H-13: Dermal exposure to nonvolatile COPCs in condensed water	H-21: Dermal exposure to nonvolatile COPCs in condensed water
H-6: Dermal exposure to nonvolatile COPCs in vapor	H-14: Dermal exposure to nonvolatile COPCs in vapor	H-22: Dermal exposure to nonvolatile COPCs in vapor
H-7: Inhalation of volatile radioactive COPCs in vapor	H-15: Inhalation of volatile radioactive COPCs in vapor	H-23: Inhalation of volatile radioactive COPCs in vapor
H-8: Inhalation of nonvolatile radioactive COPCs in vapor	H-16: Inhalation of nonvolatile radioactive COPCs in vapor	H-24: Inhalation of nonvolatile radioactive COPCs in vapor
COPC = contaminant of potential concern		

5.3 HAND CALCULATIONS

The electronic spreadsheet calculations are validated by comparison with hand calculations. The hand calculations are presented in Figure 5-1 to this Environmental Calculation. The hand calculations are intended to provide validation for all equations used for both the drinking water and sweat lodge pathways.

6.0 RESULTS/CONCLUSIONS

Results of the CTUIR and Yakama Nation human health risk calculations are summarized and discussed in the sections below.

6.1 SUMMARY OF THE CTUIR RISK ASSESSMENT

This section summarizes the results for each of the three exposure areas associated with use of groundwater as a drinking water source and use of groundwater to make steam in a sweat lodge.

6.1.1 Use of Groundwater as a Potential Drinking Water Source

Exposure to groundwater as a drinking water source is evaluated using the following potential routes of exposure: ingestion, inhalation, and dermal contact (nonradionuclides only) of volatiles during household activities. Table 6-1 provides a summary of the risk estimates by exposure route for the 5-Year data set. Table 6-2 provides a summary of the risk estimates by exposure route for the 10-Year data set. The results of 10-Year data set are provided for comparison

purposes only. Additional detail including COPC-specific risk contributions is provided in the electronic spreadsheet attachments.

Table 6-1. CTUIR Exposure Scenario - Summary of Risk Estimates from Use of Groundwater as a Potential Drinking Water Source (5-Year Groundwater Data Set)

	Far-Field Exposure Area		Near-Field Exposure Area		River Exposure Area	
Exposure Route	**ELCR**	**HI**	**ELCR**	**HI**	**ELCR**	**HI**
Nonradionuclide COPCs						
Ingestion	3.2E-04	2.3	5.3E-04	7.9	5.0E-04	2.2
Inhalation	3.1E-07	<0.01	5.3E-07	<0.01	2.8E-07	<0.01
Dermal	1.1E-05	0.04	9.6E-06	0.8	1.8E-06	0.02
Total	3.3E-04	2.4	5.4E-04	8.7	5.1E-04	2.3
Radionuclide COPCs						
Ingestion	1.3E-03	--	1.2E-03	--	3.9E-04	--
Inhalation	1.2E-04	--	7.0E-05	--	3.1E-05	--
Total	1.5E-03	--	1.3E-03	--	4.2E-04	--
Total ELCR[a]	1.8E-03	--	1.8E-03	--	9.3E-04	--

Notes:
a. Sum of total ELCR values for nonradionuclides and radionuclides.
-- = Indicates HI not applicable.
COPC = contaminant of potential concern.
HI = hazard index.
ELCR = excess lifetime cancer risk.

Table 6-2. CTUIR Exposure Scenario - Summary of Risk Estimates from Use of Groundwater as a Potential Drinking Water Source (10-Year Groundwater Data Set)

	Far-Field Exposure Area		Near-Field Exposure Area		River Exposure Area	
Exposure Route	**ELCR**	**HI**	**ELCR**	**HI**	**ELCR**	**HI**
Nonradionuclide COPCs						
Ingestion	4.1E-04	2.8	5.4E-04	10	5.1E-04	2.3
Inhalation	7.0E-07	<0.01	8.1E-07	<0.01	6.9E-07	<0.01
Dermal	1.5E-05	0.051	1.1E-05	0.93	2.0E-06	0.016

Table 6-2. CTUIR Exposure Scenario - Summary of Risk Estimates from Use of Groundwater as a Potential Drinking Water Source (10-Year Groundwater Data Set)

	Far-Field Exposure Area		Near-Field Exposure Area		River Exposure Area	
Exposure Route	**ELCR**	**HI**	**ELCR**	**HI**	**ELCR**	**HI**
Total	4.3E-04	2.9	5.5E-04	11	5.1E-04	2.3
Radionuclide COPCs						
Ingestion	2.5E-03	--	1.4E-03	--	3.3E-04	--
Inhalation	2.2E-04	--	8.6E-05	--	2.7E-05	--
Total	2.7E-03	--	1.5E-03	--	3.6E-04	--
Total ELCR[a]	3.1E-03	--	2.0E-03	--	8.7E-04	--

Notes:
a. Sum of total ELCR values for nonradionuclides and radionuclides.
-- = Indicates HI not applicable.
COPC = contaminant of potential concern.
HI = hazard index.
ELCR = excess lifetime cancer risk.

6.1.1.1 Far-Field Exposure Area

The cumulative ELCRs for the far-field exposure area 5-year data set are 3.3×10^{-4} for nonradiological COPCs and 1.5×10^{-3} for radiological COPCs. Both ELCRs are greater than the EPA upper target risk threshold of 1×10^{-4}. The individual ELCR value for tritium is greater than the EPA upper target risk threshold of 1×10^{-4}.The individual ELCR values for carbon tetrachloride, iodine-129, technetium-99, tetrachloroethene, and trichloroethene are within the EPA range of 1×10^{-4} to 1×10^{-6}. The HI for the far-field exposure area 5-year data set is 2.4, which is greater than the EPA target HI of 1.0. No individual COPC in the 200-PO-1 far-field exposure area 5-year data set had a HQ greater than the EPA target HI of 1.0.

Although the individual ELCR value for 1,4-dioxane is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,4-dioxane is not considered to be a contributor to the ELCR. 1,4-Dioxane was detected in one of 307 water samples at well 699-24-33 at a concentration of 8.1 µg/L with a "B" data qualifier, indicating that the detection was a result of laboratory contamination.

Although the individual ELCR value for arsenic is greater than EPA's regulatory target risk threshold of 1×10^{-4}, the 95 UCL value of 3.1 µg/L is considered to be within the range of naturally occurring concentrations of arsenic. Therefore, arsenic is not considered a contributor to risk.

Although the individual ELCR value for bis(2-ethylhexyl) phthalate is within the EPA range of 1×10^{-4} to 1×10^{-6}, bis(2-ethylhexyl) phthalate is not considered to be a contributor to the ELCR. Bis(2-ethylhexyl) phthalate was detected in one of 31 water samples at well 699-32-22B at a concentration of 1 µg/L and is not considered to be associated with a trend or local exposure point.

Although the individual ELCR value for protactinium-231 is within the EPA range of 1×10^{-4} to 1×10^{-6}, protactinium-231 is not considered to be a contributor to the ELCR. Protactinium-231 was detected in two of 11 water samples at wells 699-33-56 and 699-46-21B at concentrations of 0.19 µg/L and 0.31 µg/L respectively, and is not considered to be associated with a trend or local exposure point.

Although the individual ELCR value for strontium-90 is within the EPA range of 1×10^{-4} to 1×10^{-6}, strontium-90 is not considered to be a contributor to the ELCR. Strontium-90 was detected in one of 68 water samples at well 699-26-33 at a concentration of 0.61 µg/L and is not considered to be associated with a trend or local exposure point.

The individual ELCR value associated with tributyl phosphate is within the EPA range of 1×10^{-4} to 1×10^{-6}. Tributyl phosphate does not originate from a 200-PO-1 OU source instead it originates from the 618-10 burial ground therefore it is not considered to be a contributor to risk or HI.

6.1.1.2 Near-Field Exposure Area

The cumulative ELCRs for the near-field exposure area 5-year data set are 5.4×10^{-4} for nonradiological COPCs and 1.3×10^{-3} for radiological COPCs. Both ELCRs are greater than the EPA upper target risk threshold of 1×10^{-4}. The individual ELCR values for tritium and technetium-99 are greater than the EPA upper target risk threshold of 1×10^{-4}. The individual ELCR values for iodine-129, strontium-90, and trichloroethene are within the EPA range of 1×10^{-4} to 1×10^{-6}. The HI for the near-field exposure area 5-year data set is 8.7, which is greater than the EPA target HI of 1.0. No individual COPC in the 200-PO-1 near-field exposure area 5-year data set had a HQ greater than the EPA target HI of 1.0.

Although the individual ELCR value for 1,2,3,4,7,8-hexachlorodibenzofuran is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,2,3,4,7,8-hexachlorodibenzofuran is not considered to be a contributor to the ELCR. 1,2,3,4,7,8-Hexachlorodibenzofuran was detected in one of 7 water samples at well 299-E17-25 at a concentration of 0.0000029 µg/L and was flagged with a "QBJ" indicating the result is an estimated value and the analyte was detected in both the QC blank and the sample. Results of this evaluation suggest the presence of 1,2,3,4,7,8-hexachlorodibenzofuran is the result of laboratory contamination.

Although the individual ELCR value for 1,2,3,6,7,8-hexachlorodibenzofuran is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,2,3,6,7,8-hexachlorodibenzofuran is not considered to be a contributor to the ELCR. 1,2,3,6,7,8-Hexachlorodibenzofuran was detected in one of 7 water samples at well 299-E17-25 at a concentration of 0.0000021 µg/L and is not considered to be associated with a trend or local exposure point.

Although the individual ELCR value for 1,2-dichloroethane is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,2-dichloroethane is not considered to be a contributor to the ELCR. 1,2-Dichloroethane was detected in one of 34 water samples at well 299-E17-25 at a concentration of 0.64 µg/L and is not considered to be associated with a trend or local exposure point.

Although the individual ELCR value for arsenic is greater than EPA's regulatory target risk threshold of 1×10^{-4} and the HQ is greater than 1.0, the 95 UCL value of 5.8 µg/L is considered to be within the range of naturally occurring concentrations of arsenic. Therefore, arsenic is not considered a contributor to risk or hazard.

Although the individual ELCR value for bis(2-ethylhexyl) phthalate is within the EPA range of 1×10^{-4} to 1×10^{-6}, bis(2-ethylhexyl) phthalate is not considered to be a contributor to the ELCR. Bis(2-ethylhexyl) phthalate was detected in one of 31 water samples at well 299-E25-39 at a concentration of 11 μg/L with a "B" data qualifier, indicating that the detection was a result of laboratory contamination.

Although the individual ELCR value for carbon tetrachloride is within the EPA range of 1×10^{-4} to 1×10^{-6}, carbon tetrachloride is not considered to be a contributor to the ELCR. Carbon tetrachloride was detected in three of 34 water samples with concentrations ranging between 0.13 μg/L and 1.8 μg/L and is not considered to be associated with a trend or local exposure point.

Although hexavalent chromium is reported with an HI greater than 1.0 it is not considered contributors to the HI. Hexavalent chromium was only analyzed in three groundwater samples and was not identified as a preliminary COPC in DOE/RL-2007-31, 2008, *Remedial Investigation/Feasibility Study Work Plan for the 200-PO-1 Groundwater Operable Unit.*

Although the individual ELCR value for protactinium-231 is within the EPA range of 1×10^{-4} to 1×10^{-6}, protactinium-231 is not considered to be a contributor to the ELCR. Protactinium-231 was detected in one of 16 water samples at well 299-E13-17 at a concentration of 0.28 μg/L and is not considered to be associated with a trend or local exposure point.

6.1.1.3 River Exposure Area

The cumulative ELCRs for the rive exposure area 5-year data set are 5.1×10^{-4} for nonradiological COPCs and 4.2×10^{-4} for radiological COPCs. Both ELCRs are greater than the EPA upper target risk threshold of 1×10^{-4}. The individual ELCR value for tritium is greater than the EPA upper target risk threshold of 1×10^{-4}. The individual ELCR values for strontium-90 and technetium-99 are within the EPA range of 1×10^{-4} to 1×10^{-6}.The HI for the river exposure area 5-year data set is 2.3, which is greater than the EPA target HI of 1.0. No individual COPCs in the 200-PO-1 river exposure area 5-year data set had a HQ greater than the EPA target HI of 1.0.

Although the individual ELCR value for arsenic is greater than EPA's regulatory target risk threshold of 1×10^{-4} and the HQ is greater than 1.0, the 95 UCL value of 5.8 μg/L is considered to be within the range of naturally occurring concentrations of arsenic. Therefore, arsenic is not considered a contributor to risk or hazard.

Although the individual ELCR value for carbon tetrachloride is within the EPA range of 1×10^{-4} to 1×10^{-6}, carbon tetrachloride is not considered to be a contributor to the ELCR. Carbon tetrachloride was detected in two of 29 water samples at well 699-20-E12O at concentrations of 0.27 μg/L and 0.28 μg/L respectively, that is associated with the subject field blank and is not considered to be associated with a trend or local exposure point.

6.1.2 Use of Groundwater as a Source of Steam for Sweat Lodge Use

Potential exposure to groundwater as a source of steam in a sweat lodge is evaluated under this scenario. Potential routes of exposure to steam generated from groundwater include inhalation of vaporized volatiles and semivolatiles and aerosolized nonvolatiles and dermal contact with vaporized volatiles, semivolatiles, and nonvolatiles and condensed liquid while spending time in a sweat lodge. Table 6-3 provides a summary of the risk estimates by exposure route for the 5-Year data set. Table 6-4 provides a summary of the risk estimates by exposure route for the 10-Year data set. The results of 10-Year data set are provided for comparison purposes only.

Additional detail including COPC-specific risk contributions are provided in the electronic spreadsheet attachments.

Table 6-3. CTUIR Exposure Scenario—Summary of Risk Estimates from Use of Groundwater in a Sweat Lodge (5-Year Groundwater Data Set)

Exposure Route	200-PO-1 Groundwater Operable Unit (Far-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (Near-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (River Exposure Area)	
	ELCR	HI	ELCR	HI	ELCR	HI
Nonradionuclide COPCs						
Inhalation in Sweat Lodge						
Volatile and Semi-Volatiles (vapor)	4.4E-06	<0.01	2.7E-06	<0.01	1.1E-06	<0.01
Nonvolatile (aerosol)	1.9E-04	11	1.3E-01	32	2.2E-04	12
Total	2.0E-04	11	1.3E-01	32	2.2E-04	12
Dermal Exposure in Sweat Lodge						
Volatile and Semi-Volatiles (vapor only)	4.7E-09	<0.01	1.3E-09	<0.01	1.8E-10	<0.01
Nonvolatile (vapor and aqueous condensate)	1.2E-06	0.06	4.2E-05	1.4	2.2E-06	0.02
Total	1.2E-06	0.06	4.2E-05	1.4	2.2E-06	0.02
Total Nonradionuclide	2.0E-04	11	1.3E-01	34	2.2E-04	12
Radionuclide COPCs						
Inhalation in Sweat Lodge						
Volatile and Semi-Volatiles (vapor)	3.7E-04	--	2.2E-04	--	9.8E-05	--
Nonvolatile (aerosol)	6.6E-05	--	1.6E-04	--	8.4E-06	--
Total Radionuclide	4.3E-04	--	3.8E-04	--	1.1E-04	--
Total ELCR[a]	6.3E-04	--	1.3E-01	--	3.3E-04	--

Table 6-3. CTUIR Exposure Scenario—Summary of Risk Estimates from Use of Groundwater in a Sweat Lodge (5-Year Groundwater Data Set)

Exposure Route	200-PO-1 Groundwater Operable Unit (Far-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (Near-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (River Exposure Area)	
	ELCR	**HI**	**ELCR**	**HI**	**ELCR**	**HI**

Notes:

a. Total ELCR represents the sum of the total nonradionuclide ELCR and the total radionuclide ELCR.

-- = Indicates HI not applicable.
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
HI = hazard index.
ELCR = excess lifetime cancer risk.

Table 6-4. CTUIR Exposure Scenario—Summary of Risk Estimates from Use of Groundwater in a Sweat Lodge (10-Year Groundwater Data Set)

Exposure Route	200-PO-1 Groundwater Operable Unit (Far-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (Near-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (River Exposure Area)	
	ELCR	HI	ELCR	HI	ELCR	HI
Nonradionuclide COPCs						
Inhalation in Sweat Lodge						
Volatile and Semi-Volatiles (vapor)	6.0E-06	<0.01	4.50E-06	<0.01	2.8E-06	<0.01
Nonvolatile (aerosol)	1.9E-04	10	1.3E-01	46	2.2E-04	12
Total	2.0E-04	10	1.3E-01	46	2.2E-04	12
Dermal Exposure in Sweat Lodge						
Volatile and Semi-Volatiles (vapor only)	8.7E-09	<0.01	2.0E-09	<0.01	2.6E-10	<0.01
Nonvolatile (vapor and aqueous condensate)	1.2E-06	0.070	4.2E-05	0.42	2.2E-06	0.022
Total	1.2E-06	0.070	4.2E-05	0.42	2.2E-06	0.022
Total Nonradionuclide	2.0E-04	10	1.3E-01	46	2.2E-04	12
Radionuclide COPCs						
Inhalation in Sweat Lodge						
Volatile and Semi-Volatiles (vapor)	6.9E-04	--	2.7E-04	--	8.3E-05	--
Nonvolatile (aerosol)	6.5E-05	--	1.6E-04	--	8.0E-06	--
Total Radionuclide	7.6E-04	--	4.2E-04	--	9.1E-05	--

Table 6-4. CTUIR Exposure Scenario—Summary of Risk Estimates from Use of Groundwater in a Sweat Lodge (10-Year Groundwater Data Set)

Exposure Route	200-PO-1 Groundwater Operable Unit (Far-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (Near-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (River Exposure Area)	
	ELCR	HI	ELCR	HI	ELCR	HI
Total ELCR[a]	9.5E-04	--	1.3E-01	--	3.1E-04	--

Notes:

b. Total ELCR represents the sum of the total nonradionuclide ELCR and the total radionuclide ELCR.

-- = Indicates HI not applicable.
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
HI = hazard index.
ELCR = excess lifetime cancer risk.

6.1.2.1 Far-Field Exposure Area

The cumulative ELCR for the far-field exposure area 5-year data set is 2.0×10^{-4} for nonradiological COPCs and 4.3×10^{-4} for radiological COPCs, which is greater than the EPA upper target risk threshold of 1×10^{-4}. The individual ELCR value for tritium is greater than the EPA upper target risk threshold of 1×10^{-4}. Individual ELCRs associated with nickel and technetium-99 are within the EPA range of 1×10^{-4} to 1×10^{-6}. The HI for the far-field exposure area is 11, which is greater than the EPA target HI of 1.0. No individual COPCs in the far-field exposure area had a HQ greater than the EPA target HI of 1.0.

Although the individual ELCR value for 1,4-dioxane is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,4-dioxane is not considered to be a contributor to the ELCR. 1,4-Dioxane was detected in one of 307 water samples at well 699-24-33 at a concentration of 8.1 µg/L with a "B" data qualifier, indicating that the detection was a result of laboratory contamination.

Although the individual ELCR value associated with arsenic is greater than the EPA's regulatory target risk threshold of 1×10^{-4} and the HQ is greater than 1.0, the 95 UCL value of 3.1 µg/L is considered to be within the range of naturally occurring concentrations. Therefore, arsenic is not considered to be a contributor to risk or HI.

Although the individual HQ associated with barium is greater than 1.0, the 95 UCL value of 73 µg/L is considered to be within the range of naturally occurring concentrations of barium. Therefore, barium is not considered a contributor the HI.

The individual ELCR value associated with cadmium is within the EPA range of 1×10^{-4} to 1×10^{-6} and the HQ is greater than 1.0. Cadmium is not considered a contributor to risk or HI because the analytical method used to measure cadmium is not considered reliable.

Although the individual HQ associated with manganese is greater than 1.0, manganese is not considered to be a contributor to the HI because the 95 UCL value of 10 µg/L is below the secondary MCL of 50 µg/L and the secondary MCL is based on aesthetic qualities and is not federally enforceable.

Although the individual ELCR value for protactinium-231 is within the EPA range of 1×10^{-4} to 1×10^{-6}, protactinium-231 is not considered to be a contributor to the ELCR. Protactinium-231 was detected in two of 11 water samples at wells 699-33-56 and 699-46-21B at concentrations of 0.19 µg/L and 0.31 µg/L respectively, and is not considered to be associated with a trend or local exposure point.

6.1.2.2 Near-Field Exposure Area

The cumulative ELCR for the near-field exposure area 5-year data set is 1.3×10^{-1} for nonradiological COPCs and 3.8×10^{-4} for radiological COPCs, which is greater than the EPA upper target risk threshold of 1×10^{-4}. The individual ELCR values for cobalt and tritium are greater than the EPA upper target risk threshold of 1×10^{-4}. Individual ELCRs associated with nickel, iodine-129, strontium-90, and technetium-99 are within the EPA range of 1×10^{-4} to 1×10^{-6}. The HI for the near-field exposure area is 34, which is greater than the EPA target HI of 1.0. The primary contributors to the noncancer HI are cobalt and nickel, which have HQs equal to or greater than 1.0.

Although the individual ELCR value for 1,2,3,4,7,8-hexachlorodibenzofuran is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,2,3,4,7,8-hexachlorodibenzofuran is not considered to be a contributor to the ELCR. 1,2,3,4,7,8-Hexachlorodibenzofuran was detected in one of 7 water samples at well 299-E17-25 at a concentration of 0.0000029 µg/L and was flagged with a "QBJ" indicating the result is an estimated value and the analyte was detected in both the QC blank and the sample. Results of this evaluation suggest the presence of 1,2,3,4,7,8-hexachlorodibenzofuran is the result of laboratory contamination.

Although the individual ELCR value for 1,2,3,6,7,8-hexachlorodibenzofuran is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,2,3,6,7,8-hexachlorodibenzofuran is not considered to be a contributor to the ELCR. 1,2,3,6,7,8-Hexachlorodibenzofuran was detected in one of 7 water samples at well 299-E17-25 at a concentration of 0.0000021 µg/L and is not considered to be associated with a trend or local exposure point.

Although the individual ELCR value for 1,2,3,4,6,7,8-heptachlorodibenzofuran is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,2,3,4,6,7,8-Heptachlorodibenzofuran is not considered to be a contributor to the ELCR. 1,2,3,4,6,7,8-Heptachlorodibenzofuran concentrations ranged between 1.3E-06 µg/L and 1.2E-05 µg/L. 1,2,3,4,6,7,8-Heptachlorodibenzofuran was detected in 8 of 10 samples . Two results were flagged with a "J" indicating the results are estimated values, two results were flagged with a "BJ" indicating the results are estimated values and the analyte was detected in both the QC blank and the sample, one result was flagged with a "QJ" indicating the result is an estimated value because one of the qualitative estimation criteria is not met, and 3 results were qualified with a "QBJ". Results of this evaluation suggest the presence of 1,2,3,4,6,7,8-heptachlorodibenzofuran concentrations are considered estimates or are the result of laboratory contamination.

Although the individual ELCR value for arsenic is greater than EPA's regulatory target risk threshold of 1×10^{-4} and the HQ is greater than 1.0, the 95 UCL value of 5.8 µg/L is considered to be within the range of naturally occurring concentrations of arsenic. Therefore, arsenic is not considered a contributor to risk or hazard.

Although the individual ELCR associated with beryllium is within the EPA range of 1×10^{-4} to 1×10^{-6}, the 95UCL value of 0.34 µg/L is considered to be within the range of naturally occurring concentrations of beryllium. Therefore, beryllium is not considered a contributor to the ELCR.

Although the individual ELCR value for bis(2-ethylhexyl) phthalate is within the EPA range of 1×10^{-4} to 1×10^{-6}, bis(2-ethylhexyl) phthalate is not considered to be a contributor to the ELCR. Bis(2-ethylhexyl) phthalate was detected in one of 31 water samples at well 299-E25-39 at a concentration of 11 µg/L with a "B" data qualifier, indicating that the detection was a result of laboratory contamination.

Although the individual ELCR value for cadmium is within the EPA range of 1×10^{-4} to 1×10^{-6}, cadmium is not considered to be a contributor to the ELCR. Cadmium was detected three out of 373 samples at concentration ranging from 2.6 to 18 µg/L. All of the results were qualified with a laboratory qualifier of "B" indicating the presence of cadmium is likely attributed to laboratory or field contamination.

Although the individual ELCR value associated with hexavalent chromium is greater than the EPA's regulatory target risk threshold of 1×10^{-4} and the HQ is greater than 1.0, it is not considered a contributor to risk or HI. Hexavalent chromium was only analyzed in three

groundwater samples and was not identified as a preliminary COPC in the 200-PO-1 OU work plan (DOE/RL-2007-31).

Although the individual HQ associated with manganese is greater than 1.0, manganese is not considered to be a contributor to the HI because the 95UCL value of 6.2 μg/L is below the secondary MCL of 50 μg/L and the secondary MCL is based on aesthetic qualities and is not federally enforceable.

Although the individual ELCR value for protactinium-231 is within the EPA range of 1×10^{-4} to 1×10^{-6}, protactinium-231 is not considered to be a contributor to the ELCR. Protactinium-231 was detected in one of 16 water samples at well 299-E13-17 at a concentration of 0.28 μg/L and is not considered to be associated with a trend or local exposure point.

Although the individual ELCR value for plutonium-239/240 is within the EPA range of 1×10^{-4} to 1×10^{-6}, plutonium-239/240 is not considered to be a contributor to the ELCR. Plutonium-239/240 was detected and analyzed for in one sampling event at well 299-E24-23 at a concentration of 0.029 μg/L, therefore plutonium-239/240 is not considered to be associated with a trend or local exposure point.

6.1.2.3 River Exposure Area

The cumulative ELCR for the river exposure area 5-year data set is 2.2×10^{-4} for nonradiological COPCs and 1.1×10^{-4} for radiological COPCs, which is greater than the EPA upper target risk threshold of 1×10^{-4}. Individual ELCRs associated with nickel, strontium-90, technetium-99, and tritium are within the EPA range of 1×10^{-4} to 1×10^{-6}. The HI for the river exposure area is 12, which is greater than the EPA target HI of 1.0.No individual COPCs in the river exposure area had a HQ greater than the EPA target HI of 1.0.

Although the individual ELCR value associated with arsenic is greater than the EPA's regulatory target risk threshold of 1×10^{-4} and the HQ is greater than 1.0, the 95 UCL value of 5.8 μg/L is considered to be within the range of naturally occurring concentrations. Therefore, arsenic is not considered to be a contributor to risk or HI.

Although the individual HQ associated with manganese is greater than 1.0 and the 95 UCL value of 65 μg/L is above the secondary MCL of 50 μg/L, manganese is not considered to be a contributor to the HI because the secondary MCL is based on aesthetic qualities and is not federally enforceable.

6.2 SUMMARY OF THE YAKAMA NATION RISK ASSESSMENT

This section summarizes the results for each of the three exposure areas associated with use of groundwater as a drinking water source and use of groundwater to make steam in a sweat lodge.

6.2.1 Use of Groundwater as a Potential Drinking Water Source

Exposure to groundwater as a drinking water source is evaluated using the following potential routes of exposure: ingestion, inhalation, and dermal contact (nonradionuclides only) of volatiles during household activities. Table 6-5 provides a summary of the risk estimates by exposure route for the 5-Year data set. Table 6-6 provides a summary of the risk estimates by exposure route for the 5-Year data set. The results of 10-Year data set are provided for comparison purposes only. Additional detail including COPC-specific risk contributions are provided in the electronic spreadsheet attachments.

Table 6-5. Yakama Nation Exposure Scenario - Summary of Risk Estimates from Use of Groundwater as a Potential Drinking Water Source (5-Year Groundwater Data Set)

Exposure Route	Far-Field Exposure Area		Near-Field Exposure Area		River Exposure Area	
	ELCR	HI	ELCR	HI	ELCR	HI
Nonradionuclide COPCs						
Ingestion	3.5E-04	2.3	5.7E-04	7.9	5.5E-04	2.2
Inhalation	3.1E-07	<0.01	5.3E-07	<0.01	2.8E-07	<0.01
Dermal	1.1E-05	0.043	9.5E-06	0.82	1.8E-06	0.016
Total	3.6E-04	2.4	5.8E-04	8.7	5.5E-04	2.3
Radionuclide COPCs						
Ingestion	1.4E-03	--	1.3E-03	--	4.0E-04	--
Inhalation	1.2E-04	--	7.3E-05	--	3.3E-05	--
Total	1.5E-03	--	1.4E-03	--	4.3E-04	--
Total ELCR[a]	1.9E-03	--	2.0E-03	--	9.8E-04	--

Notes:
a. Sum of total ELCR values for nonradionuclides and radionuclides.
-- = Indicates HI not applicable.
COPC = contaminant of potential concern.
HI = hazard index.
ELCR = excess lifetime cancer risk.

Table 6-6. Yakama Nation Exposure Scenario - Summary of Risk Estimates from Use of Groundwater as a Potential Drinking Water Source (10-Year Groundwater Data Set)

Exposure Route	Far-Field Exposure Area		Near-Field Exposure Area		River Exposure Area	
	ELCR	HI	ELCR	HI	ELCR	HI
Nonradionuclide COPCs						
Ingestion	4.5E-04	2.8	5.8E-04	10	5.5E-04	2.3
Inhalation	7.0E-07	<0.01	8.2E-07	<0.01	6.9E-07	<0.01
Dermal	1.5E-05	0.051	1.1E-05	0.93	1.9E-06	0.016
Total	4.6E-04	2.9	5.9E-04	11	5.5E-04	2.3
Radionuclide COPCs						
Ingestion	2.5E-03	--	1.5E-03	--	3.4E-04	--

Table 6-6. Yakama Nation Exposure Scenario - Summary of Risk Estimates from Use of Groundwater as a Potential Drinking Water Source (10-Year Groundwater Data Set)

	Far-Field Exposure Area		Near-Field Exposure Area		River Exposure Area	
Exposure Route	ELCR	HI	ELCR	HI	ELCR	HI
Inhalation	2.3E-04	--	8.9E-05	--	2.8E-05	--
Total	2.8E-03	--	1.5E-03	--	3.7E-04	--
Total ELCR[a]	3.2E-03	--	2.1E-03	--	9.2E-04	--

Notes:
a. Sum of total ELCR values for nonradionuclides and radionuclides.
-- = Indicates HI not applicable.
COPC = contaminant of potential concern.
HI = hazard index.
ELCR = excess lifetime cancer risk.

6.2.1.1 Far-Field Exposure Area

The cumulative ELCRs for the far-field exposure area 5-year data set are 3.6×10^{-4} for nonradiological COPCs and 1.5×10^{-3} for radiological COPCs. Both ELCRs are greater than the EPA upper target risk threshold of 1×10^{-4}. The individual ELCR value for tritium is greater than the EPA upper target risk threshold of 1×10^{-4}.The individual ELCR values for carbon tetrachloride, iodine-129, technetium-99, tetrachloroethene, and trichloroethene are within the EPA range of 1×10^{-4} to 1×10^{-6}. The HI for the far-field exposure area 5-year data set is 2.4, which is greater than the EPA target HI of 1.0. No individual COPCs in the 200-PO-1 far-field exposure area 5-year data set had a HQ greater than the EPA target HI of 1.0.

Although the individual ELCR value for 1,4-dioxane is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,4-dioxane is not considered to be a contributor to the ELCR. 1,4-Dioxane was detected in one of 307 water samples at well 699-24-33 at a concentration of 8.1 µg/L with a "B" data qualifier, indicating that the detection was a result of laboratory contamination.

Although the individual ELCR value for arsenic is greater than EPA's regulatory target risk threshold of 1×10^{-4}, the 95 UCL value of 3.1 µg/L is considered to be within the range of naturally occurring concentrations of arsenic. Therefore, arsenic is not considered a contributor to risk.

Although the individual ELCR value for bis(2-ethylhexyl) phthalate is within the EPA range of 1×10^{-4} to 1×10^{-6}, bis(2-ethylhexyl) phthalate is not considered to be a contributor to the ELCR. Bis(2-ethylhexyl) phthalate was detected in one of 31 water samples at well 699-32-22B at a concentration of 1 µg/L and is not considered to be associated with a trend or local exposure point.

Although the individual ELCR value for methylene chloride is within the EPA range of 1×10^{-4} to 1×10^{-6}, methylene chloride is not considered to be a contributor to the ELCR. Methylene chloride was detected in 11 of 365 water samples with concentrations ranging from 1.0 to 88µg/L. All detected results were associated with a "B" data qualifier, indicating that the detections were a result of laboratory contamination.

Although the individual ELCR value for protactinium-231 is within the EPA range of 1×10^{-4} to 1×10^{-6}, protactinium-231 is not considered to be a contributor to the ELCR. Protactinium-231 was detected in two of 11 water samples at wells 699-33-56 and 699-46-21B at concentrations of 0.19 µg/L and 0.31 µg/L respectively, and is not considered to be associated with a trend or local exposure point.

Although the individual ELCR value for strontium-90 is within the EPA range of 1×10^{-4} to 1×10^{-6}, strontium-90 is not considered to be a contributor to the ELCR. Strontium-90 was detected in one of 68 water samples at well 699-26-33 at a concentration of 0.6 µg/L and is not considered to be associated with a trend or local exposure point.

The individual ELCR value associated with tributyl phosphate is within the EPA range of 1×10^{-4} to 1×10^{-6}. Tributyl phosphate does not originate from a 200-PO-1 OU source instead it originates from the 618-10 burial ground therefore it is not considered to be a contributor to risk or HI.

6.2.1.2 Near-Field Exposure Area

The cumulative ELCRs for the near-field exposure area 5-year data set are 5.8×10^{-4} for nonradiological COPCs and 1.4×10^{-3} for radiological COPCs. Both ELCRs are greater than the EPA upper target risk threshold of 1×10^{-4}. The individual ELCR values for tritium and technetium-99 are greater than the EPA upper target risk threshold of 1×10^{-4}. The individual ELCR values for iodine-129, strontium-90, and trichloroethene are within the EPA range of 1×10^{-4} to 1×10^{-6}. The HI for the near-field exposure area 5-year data set is 8.7, which is greater than the EPA target HI of 1.0. No individual COPCs in the 200-PO-1 near-field exposure area 5-year data set had a HQ greater than the EPA target HI of 1.0.

Although the individual ELCR value for 1,2,3,4,7,8-hexachlorodibenzofuran is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,2,3,4,7,8-hexachlorodibenzofuran is not considered to be a contributor to the ELCR. 1,2,3,4,7,8-Hexachlorodibenzofuran was detected in one of 7 water samples at well 299-E17-25 at a concentration of 0.0000029 µg/L and was flagged with a "QBJ" indicating the result is an estimated value and the analyte was detected in both the QC blank and the sample. Results of this evaluation suggest the presence of 1,2,3,4,7,8-hexachlorodibenzofuran is the result of laboratory contamination.

Although the individual ELCR value for 1,2,3,6,7,8-hexachlorodibenzofuran is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,2,3,6,7,8-hexachlorodibenzofuran is not considered to be a contributor to the ELCR. 1,2,3,6,7,8-Hexachlorodibenzofuran was detected in one of 7 water samples at well 299-E17-25 at a concentration of 0.0000021 µg/L and is not considered to be associated with a trend or local exposure point.

Although the individual ELCR value for 1,2-dichloroethane is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,2-dichloroethane is not considered to be a contributor to the ELCR. 1,2-Dichloroethane phthalate was detected in one of 34 water samples at well 299-E17-25 at a concentration of 0.64 µg/L and is not considered to be associated with a trend or local exposure point.

Although the individual ELCR value for arsenic is greater than EPA's regulatory target risk threshold of 1×10^{-4} and the HQ is greater than 1.0, the 95 UCL value of 5.8 µg/L is considered to be within the range of naturally occurring concentrations of arsenic. Therefore, arsenic is not considered a contributor to risk or hazard.

Although the individual ELCR value for bis(2-ethylhexyl) phthalate is within the EPA range of 1×10^{-4} to 1×10^{-6}, bis(2-ethylhexyl) phthalate is not considered to be a contributor to the ELCR. Bis(2-ethylhexyl) phthalate was detected in one of 31 water samples at well 299-E25-39 at a concentration of 11 μg/L with a "B" data qualifier, indicating that the detection was a result of laboratory contamination.

Although the individual ELCR value for carbon tetrachloride is within the EPA range of 1×10^{-4} to 1×10^{-6}, carbon tetrachloride is not considered to be a contributor to the ELCR. Carbon tetrachloride was detected in three of 34 water samples with concentrations ranging between 0.13 μg/L and 1.8 μg/L and is not considered to be associated with a trend or local exposure point.

Although hexavalent chromium is reported with an HI greater than 1.0 it is not considered contributors to the HI. Hexavalent chromium was only analyzed in three groundwater samples and was not identified as a preliminary COPC in DOE/RL-2007-31, 2008, *Remedial Investigation/Feasibility Study Work Plan for the 200-PO-1 Groundwater Operable Unit.*

Although the individual ELCR value for protactinium-231 is within the EPA range of 1×10^{-4} to 1×10^{-6}, protactinium-231 is not considered to be a contributor to the ELCR. Protactinium-231 was detected in one of 16 water samples at well 299-E13-17 at a concentration of 0.28 μg/L and is not considered to be associated with a trend or local exposure point.

6.2.1.3 River Exposure Area

The cumulative ELCRs for the rive exposure area 5-year data set are 5.5×10^{-4} for nonradiological COPCs and 4.3×10^{-4} for radiological COPCs. Both ELCRs are greater than the EPA upper target risk threshold of 1×10^{-4}. The individual ELCR value for tritium is greater to the EPA upper target risk threshold of 1×10^{-4}. The individual ELCR values for strontium-90 and technetium-99 are within the EPA range of 1×10^{-4} to 1×10^{-6}.The HI for the river exposure area 5-year data set is 2.3, which is greater than the EPA target HI of 1.0. No individual COPCs in the 200-PO-1 river exposure area 5-year data set had a HQ greater than the EPA target HI of 1.0.

Although the individual ELCR value for arsenic is greater than EPA's regulatory target risk threshold of 1×10^{-4} and the HQ is greater than 1.0, the 95 UCL value of 5.8 μg/L is considered to be within the range of naturally occurring concentrations of arsenic. Therefore, arsenic is not considered a contributor to risk or hazard.

Although the individual ELCR value for carbon tetrachloride is within the EPA range of 1×10^{-4} to 1×10^{-6}, carbon tetrachloride is not considered to be a contributor to the ELCR. Carbon tetrachloride was detected in two of 29 water samples at well 699-20-E12O at concentrations of 0.27 μg/L and 0.28 μg/L respectively, that is associated with the subject field blank and is not considered to be associated with a trend or local exposure point.

Although the individual ELCR value for chloroform is within the EPA range of 1×10^{-4} to 1×10^{-6}, chloroform is not considered to be a contributor to the ELCR. Chloroform was detected in two of 29 water samples at well 699-20-E12O at concentrations of 0.62 μg/L and 2.3 μg/L respectively, that is associated with the subject field blank and is not considered to be associated with a trend or local exposure point.

6.2.2 Use of Groundwater as a Source of Steam for Sweat Lodge Use

Potential exposure to groundwater as a source of steam in a sweat lodge is evaluated under this scenario. Potential routes of exposure to steam generated from groundwater include inhalation of

vaporized volatiles and semivolatiles and aerosolized nonvolatiles and dermal contact with vaporized volatiles, semivolatiles, and nonvolatiles and condensed liquid while spending time in a sweat lodge. Table 6-7 provides a summary of the risk estimates by exposure route for the 5-Year data set. Table 6-8 provides a summary of the risk estimates by exposure route for the 5-Year data set. The results of 10-Year data set are provided for comparison purposes only. Additional detail including COPC-specific risk contributions is provided in the electronic spreadsheet attachments.

Table 6-7. Yakama Nation Exposure Scenario—Summary of Risk Estimates from Use of Groundwater in a Sweat Lodge (5-Year Groundwater Data Set)

Exposure Route	200-PO-1 Groundwater Operable Unit (Far-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (Near-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (River Exposure Area)	
	ELCR	HI	ELCR	HI	ELCR	HI
Nonradionuclide COPCs						
Inhalation in Sweat Lodge						
Volatile and Semi-Volatiles (vapor)	9.0E-06	<0.01	7.1E-06	<0.01	2.3E-06	<0.01
Nonvolatile (aerosol)	4.0E-04	22	2.4E-01	67	4.5E-04	25
Total	4.1E-04	22	2.4E-01	67	4.6E-04	25
Dermal Exposure in Sweat Lodge						
Volatile and Semi-Volatiles (vapor only)	9.3E-09	<0.01	2.6E-09	<0.01	3.5E-10	<0.01
Nonvolatile (vapor and aqueous condensate)	2.4E-06	0.13	8.3E-05	2.7	4.3E-06	0.044
Total	2.4E-06	0.13	8.3E-05	2.7	4.3E-06	0.044
Total Nonradionuclide	4.1E-04	23	2.4E-01	70	4.6E-04	25
Radionuclide COPCs						
Inhalation in Sweat Lodge						
Volatile and Semi-Volatiles (vapor)	7.6E-04	--	4.5E-04	--	2.0E-04	--
Nonvolatile (aerosol)	1.4E-04	--	3.3E-04	--	1.7E-05	--
Total Radionuclide	9.0E-04	--	7.9E-04	--	2.2E-04	--
Total ELCR[a]	1.3E-03	--	2.4E-01	--	6.8E-04	--

Table 6-7. Yakama Nation Exposure Scenario—Summary of Risk Estimates from Use of Groundwater in a Sweat Lodge (5-Year Groundwater Data Set)

Exposure Route	200-PO-1 Groundwater Operable Unit (Far-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (Near-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (River Exposure Area)	
	ELCR	HI	ELCR	HI	ELCR	HI

Notes:

c. Total ELCR represents the sum of the total nonradionuclide ELCR and the total radionuclide ELCR.

-- = Indicates HI not applicable.
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
HI = hazard index.
ELCR = excess lifetime cancer risk.

Table 6-8. Yakama Nation Exposure Scenario—Summary of Risk Estimates from Use of Groundwater in a Sweat Lodge (10-Year Groundwater Data Set)

Exposure Route	200-PO-1 Groundwater Operable Unit (Far-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (Near-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (River Exposure Area)	
	ELCR	HI	ELCR	HI	ELCR	HI
Nonradionuclide COPCs						
Inhalation in Sweat Lodge						
Volatile and Semi-Volatiles (vapor)	1.2E-05	0.014	9.4E-06	<0.01	5.7E-06	<0.01
Nonvolatile (aerosol)	4.0E-04	21	2.8E-01	95	4.5E-04	25
Total	4.1E-04	21	2.8E-01	95	4.6E-04	25
Dermal Exposure in Sweat Lodge						
Volatile and Semi-Volatiles (vapor only)	1.8E-08	<0.01	4.1E-09	<0.01	5.1E-10	<0.01
Nonvolatile (vapor and aqueous condensate)	2.3E-06	0.14	8.3E-05	3.0	4.3E-06	0.044
Total	2.3E-06	0.14	8.3E-05	3.0	4.3E-06	0.044
Total Nonradionuclide	4.1E-04	21	2.8E-01	98	4.6E-04	25
Radionuclide COPCs						
Inhalation in Sweat Lodge						
Volatile and Semi-Volatiles (vapor)	1.4E-03	--	5.6E-04	--	1.7E-04	--
Nonvolatile (aerosol)	1.4E-04	--	3.2E-04	--	1.7E-05	--
Total Radionuclide	1.6E-03	--	8.8E-04	--	1.9E-04	--

Table 6-8. Yakama Nation Exposure Scenario—Summary of Risk Estimates from Use of Groundwater in a Sweat Lodge (10-Year Groundwater Data Set)

Exposure Route	200-PO-1 Groundwater Operable Unit (Far-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (Near-Field Exposure Area)		200-PO-1 Groundwater Operable Unit (River Exposure Area)	
	ELCR	**HI**	**ELCR**	**HI**	**ELCR**	**HI**
Total ELCR[a]	2.0E-03	--	2.8E-01	--	6.5E-04	--

Notes:

d. Total ELCR represents the sum of the total nonradionuclide ELCR and the total radionuclide ELCR.

-- = Indicates HI not applicable.
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
HI = hazard index.
ELCR = excess lifetime cancer risk.

6.2.2.1 Far-Field Exposure Area

The cumulative ELCR for the far-field exposure area 5-year data set is 4.1×10^{-4} for nonradiological COPCs and 9.0×10^{-4} for radiological COPCs, which is greater than the EPA upper target risk threshold of 1×10^{-4}. The individual ELCR value for tritium is greater than the EPA upper target risk threshold of 1×10^{-4}. Individual ELCRs associated with iodine-129, nickel, technetium-99, and trichloroethene are within the EPA range of 1×10^{-4} to 1×10^{-6}. The HI for the far-field exposure area is 23, which is greater than the EPA target HI of 1.0. The primary contributor to the noncancer HI is nickel, with a HQ of 1.2.

Although the individual ELCR value for 1,4-dioxane is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,4-dioxane is not considered to be a contributor to the ELCR. 1,4-Dioxane was detected in one of 307 water samples at well 699-24-33 at a concentration of 8.1 µg/L with a "B" data qualifier, indicating that the detection was a result of laboratory contamination.

Although the individual ELCR value associated with arsenic is greater than the EPA's regulatory target risk threshold of 1×10^{-4} and the HQ is greater than 1.0, the 95 UCL value of 3.1 µg/L is considered to be within the range of naturally occurring concentrations. Therefore, arsenic is not considered to be a contributor to risk or HI.

Although the individual HQ associated with barium is greater than 1.0, the 95 UCL value of 73 µg/L is considered to be within the range of naturally occurring concentrations of barium. Therefore, barium is not considered a contributor the HI.

The individual ELCR value associated with cadmium is within the EPA range of 1×10^{-4} to 1×10^{-6} and the HQ is greater than 1.0. Cadmium is not considered a contributor to risk or HI because the analytical method used to measure cadmium is not considered reliable.

Although the individual HQ associated with manganese is greater than 1.0, manganese is not considered to be a contributor to the HI because the 95 UCL value of 10 µg/L is below the secondary MCL of 50 µg/L and the secondary MCL is based on aesthetic qualities and is not federally enforceable.

Although the individual ELCR value for protactinium-231 is greater than the EPA's regulatory target risk threshold of 1×10^{-4}, protactinium-231 is not considered to be a contributor to the ELCR. Protactinium-231 was detected in two of 11 water samples at wells 699-33-56 and 699-46-21B at concentrations of 0.19 µg/L and 0.31 µg/L respectively, and is not considered to be associated with a trend or local exposure point.

6.2.2.2 Near-Field Exposure Area

The cumulative ELCR for the near-field exposure area 5-year data set is 2.4×10^{-1} for nonradiological COPCs and 7.9×10^{-4} for radiological COPCs, which is greater than the EPA upper target risk threshold of 1×10^{-4}. The individual ELCR values for cobalt, technetium-99, and tritium are greater than the EPA upper target risk threshold of 1×10^{-4}. Individual ELCRs associated with nickel, iodine-129, strontium-90, and trichloroethene are within the EPA range of 1×10^{-4} to 1×10^{-6}. The HI for the near-field exposure area is 70, which is greater than the EPA target HI of 1.0. The primary contributors to the noncancer HI are cobalt, nickel, and uranium, which have HQs equal to or greater than 1.0.

Although the individual ELCR value for 1,2,3,4,7,8-hexachlorodibenzofuran is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,2,3,4,7,8-hexachlorodibenzofuran is not considered to be a contributor to the ELCR. 1,2,3,4,7,8-Hexachlorodibenzofuran was detected in one of 7 water

samples at well 299-E17-25 at a concentration of 0.0000029 µg/L and was flagged with a "QBJ" indicating the result is an estimated value and the analyte was detected in both the QC blank and the sample. Results of this evaluation suggest the presence of 1,2,3,4,7,8-hexachlorodibenzofuran is the result of laboratory contamination.

Although the individual ELCR value for 1,2,3,6,7,8-hexachlorodibenzofuran is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,2,3,6,7,8-hexachlorodibenzofuran is not considered to be a contributor to the ELCR. 1,2,3,6,7,8-Hexachlorodibenzofuran was detected in one of 7 water samples at well 299-E17-25 at a concentration of 0.0000021 µg/L and is not considered to be associated with a trend or local exposure point.

Although the individual ELCR value for 1,2,3,4,6,7,8-heptachlorodibenzofuran is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,2,3,4,6,7,8-Heptachlorodibenzofuran is not considered to be a contributor to the ELCR. 1,2,3,4,6,7,8-Heptachlorodibenzofuran concentrations ranged between 1.3E-06 µg/L and 1.2E-05 µg/L. 1,2,3,4,6,7,8-Heptachlorodibenzofuran was detected in 8 of 10 samples . Two results were flagged with a "J" indicating the results are estimated values, two results were flagged with a "BJ" indicating the results are estimated values and the analyte was detected in both the QC blank and the sample, one result was flagged with a "QJ" indicating the result is an estimated value because one of the qualitative estimation criteria is not met, and 3 results were qualified with a "QBJ". Results of this evaluation suggest the presence of 1,2,3,4,6,7,8-heptachlorodibenzofuran concentrations are considered estimates or are the result of laboratory contamination

Although the individual ELCR value for 1,2-dichloroethane is within the EPA range of 1×10^{-4} to 1×10^{-6}, 1,2-dichloroethane is not considered to be a contributor to the ELCR. 1,2-Dichloroethane phthalate was detected in one of 34 water samples at well 299-E17-25 at a concentration of 0.64 µg/L and is not considered to be associated with a trend or local exposure point.

Although the individual ELCR value for arsenic is greater than EPA's regulatory target risk threshold of 1×10^{-4} and the HQ is greater than 1.0, the 95 UCL value of 5.8 µg/L is considered to be within the range of naturally occurring concentrations of arsenic. Therefore, arsenic is not considered a contributor to risk or hazard.

Although the individual HQ associated with barium is greater than 1.0, the 95 UCL value of 53 µg/L is considered to be within the range of naturally occurring concentrations of barium. Therefore, barium is not considered a contributor the HI.

Although the individual ELCR associated with beryllium is within the EPA range of 1×10^{-4} to 1×10^{-6}, the 95UCL value of 0.34 µg/L is considered to be within the range of naturally occurring concentrations of beryllium. Therefore, beryllium is not considered a contributor to the ELCR.

Although the individual ELCR value for bis(2-ethylhexyl) phthalate is within the EPA range of 1×10^{-4} to 1×10^{-6}, bis(2-ethylhexyl) phthalate is not considered to be a contributor to the ELCR. Bis(2-ethylhexyl) phthalate was detected in one of 31 water samples at well 299-E25-39 at a concentration of 11 µg/L with a "B" data qualifier, indicating that the detection was a result of laboratory contamination.

Although the individual ELCR value for cadmium is within the EPA range of 1×10^{-4} to 1×10^{-6}, cadmium is not considered to be a contributor to the ELCR. Cadmium was detected three out of 373 samples at concentration ranging from 2.6 to 18 µg/L. All of the results were qualified with a

laboratory qualifier of "B" indicating the presence of cadmium is likely attributed to laboratory or field contamination.

Although the individual ELCR value associated with hexavalent chromium is greater than the EPA's regulatory target risk threshold of 1×10^{-4} and the HQ is greater than 1.0, it is not considered a contributor to risk or HI. Hexavalent chromium was only analyzed in three groundwater samples and was not identified as a preliminary COPC in the 200-PO-1 OU work plan (DOE/RL-2007-31).

Although the individual HQ associated with manganese is greater than 1.0, manganese is not considered to be a contributor to the HI because the 95UCL value of 6.2 µg/L is below the secondary MCL of 50 µg/L and the secondary MCL is based on aesthetic qualities and is not federally enforceable.

Although the individual ELCR value for plutonium-239/240 is within the EPA range of 1×10^{-4} to 1×10^{-6}, plutonium-239/240 is not considered to be a contributor to the ELCR. Plutonium-239/240 was detected and analyzed for in one sampling event at well 299-E24-23 at a concentration of 0.029 µg/L, therefore plutonium-239/240 is not considered to be associated with a trend or local exposure point.

Although the individual ELCR value for protactinium-231 is greater than the EPA's regulatory target risk threshold of 1×10^{-4}, protactinium-231 is not considered to be a contributor to the ELCR. Protactinium-231 was detected in one of 16 water samples at well 299-E13-17 at a concentration of 0.28 µg/L and is not considered to be associated with a trend or local exposure point.

6.2.2.3 River Exposure Area

The cumulative ELCR for the river exposure area 5-year data set is 4.6×10^{-4} for nonradiological COPCs and 2.2×10^{-4} for radiological COPCs, which is greater than the EPA upper target risk threshold of 1×10^{-4}. The individual ELCR value for tritium is greater than the EPA upper target risk threshold of 1×10^{-4}. Individual ELCRs associated with nickel, strontium-90, and technetium-99 are within the EPA range of 1×10^{-4} to 1×10^{-6}. The HI for the river exposure area is 25, which is greater than the EPA target HI of 1.0. The primary contributor to the noncancer HI is nickel, which has an HQ of 1.1.

Although the individual ELCR value associated with arsenic is greater than the EPA's regulatory target risk threshold of 1×10^{-4} and the HQ is greater than 1.0, the 95 UCL value of 5.8 µg/L is considered to be within the range of naturally occurring concentrations. Therefore, arsenic is not considered to be a contributor to risk or HI.

Although the individual HQ associated with barium is greater than 1.0, the 95 UCL value of 49 µg/L is considered to be within the range of naturally occurring concentrations of barium. Therefore, barium is not considered a contributor the HI.

Although the individual ELCR value for chloroform is within the EPA range of 1×10^{-4} to 1×10^{-6}, chloroform is not considered to be a contributor to the ELCR. Chloroform was detected in two of 29 water samples at well 699-20-E12O at concentrations of 0.62 µg/L and 2.3 µg/L respectively, that is associated with the subject field blank and is not considered to be associated with a trend or local exposure point.

Although the individual HQ associated with manganese is greater than 1.0 and the 95 UCL value of 65 µg/L is above the secondary MCL of 50 µg/L, manganese is not considered to be a

contributor to the HI because the secondary MCL is based on aesthetic qualities and is not federally enforceable.

7.0 REFERENCES

Andelman, J.B. 1990, *Total Exposure to Volatile Organic Chemicals in Potable Water*, N.M. Ram, R.F. Christman, K.P. Cantor (eds.), Lewis Publishers.

ANL, 2009, *RESRAD*, Version 6.5, Argonne National Laboratory, Environmental Assessment Division, Argonne, Illinois. Updated October 30, 2009. http://web.ead.anl.gov/resrad/register2/

Cook, Michael B., 2003, "Human Health Toxicity Values in Superfund Risk Assessments" (memorandum to Superfund National Policy Managers, Regions 1 – 10), OSWER Directive 9285.7-53, Office of Superfund Remediation and Technology Innovation, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C., December 5. Available at: http://www.epa.gov/oswer/riskassessment/pdf/hhmemo.pdf.

DOE/RL-2007-31, 2008, *Remedial Investigation/Feasibility Study Work Plan for the 200-PO-1 Groundwater Operable Unit*, Rev.0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=DA07159571.

ECF-200PO1-09-2018, 2010, *Contaminant of Potential Concern Selection for the 200-PO-1 Groundwater Operable Unit*, Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington.

ECF-200PO1-09-2027, 2010, *Calculation of Exposure Point Concentrations for the 200-PO-1 Groundwater Operable Unit*, Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington.

EPA 402-R-99-001, 1999, *Cancer Risk Coefficients for Environmental Exposure to Radionuclides, Federal Guidance Report No. 13*, U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, DC.

EPA/540/1-89/002, 1989, Risk Assessment Guidance for Superfund: Volume 1—Human Health Evaluation Manual, Part A, Interim Final, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C.

EPA/540-R-00-006, 2000, *Soil Screening Guidance for Radionuclides: Technical Background Document*, U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, DC.

EPA/540-R-00-007, 2000, *Soil Screening Guidance for Radionuclides: User's Guide*, U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, DC.

EPA-540-R-070-002, 2009, Risk Assessment Guidance for Superfund: Volume 1—Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation, Washington, D.C.

EPA/540/R-92/003, 1991, Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals): Interim, Publication 9285.7-01B, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://epa.gov/swerrims/riskassessment/ragsb/index.htm

EPA/540/R-97/036, 1997, Health Effects Assessment Summary Tables, FY 1997 Update, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C.

EPA/540/R/99/005, 2004, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), OSWER Directive 9285.7-02EP, U.S. Environmental Protection Agency, Washington, D.C.

EPA/630/P-03/001F, 2005, Guidelines for Carcinogen Risk Assessment, Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=116283

EPA, 2001, Health Effects Assessment Summary Tables database, "April 16, 2001 Update: Radionuclide Toxicity," "Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors," Office of Radiation and Indoor Air, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/radiation/heast/index.html.

EPA, 2004, Provisional Peer Reviewed Toxicity Values for Superfund (PPRTV), database, October 2004. Available on the Internet through the Risk Assessment Information System database at: http://risk.lsd.ornl.gov/.

EPA, 2009, "Regional Screening Levels for Chemical Contaminants at Superfund Sites," U.S. Environmental Protection Agency, Mid-Atlantic Risk Assessment. Available at: http://www.epa.gov/reg3hscd/risk/human/rb-concentration_table/.

EPA, 2010, Integrated Risk Information System (IRIS) Online Database, accessed, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/iris/index.html.

Harris, S., 2008, Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments, Department of Science and Engineering, Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon.

Harris, S., and B. Harper, 2004, Exposure Scenario for CTUIR Traditional Subsistence Lifeways, Confederated Tribes of the Umatilla Indian Reservation, Department of Science and Engineering, Pendleton, Oregon.

NJDEP, 2009, *Derivation of an Ingestion-Based Soil Remediation Criterion for Cr+6 Based on the NTP Chronic Bioassay Data for Sodium Dichromate Dihydrate*, Division of Science, Research, and Technology, New Jersey Department of Environmental Protection, Trenton, New Jersey. Available at: http://www.state.nj.us/dep/dsr/publications/pub.htm

OEHHA, 2003, The California Environmental Protection Agency/Office of Environmental Health Hazard Assessment's toxicity values- Available at http://www.oehha.ca.gov/risk/ChemicalDB/index.aspOEHHA, 2009, The California Environmental Protection Agency/Office of Environmental Health Hazard Assessment's toxicity values- Available at http://www.oehha.ca.gov/risk/ChemicalDB/index.asp

Ridolfi, 2007, Yakama Nation Exposure Scenario for Hanford Site Risk Assessment, prepared for the Yakama Nation, Ridolfi Inc., Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=DA06587583.

Figure 5-1

HAND CALCULATIONS

(16 Sheets)

200-PO-1 OU	Natural Attenuation Risk Assmt.	D. Evans 7/29/2009	1

Drinking Water Ingestion - Carcinogens (Eq. 78.4)
Carbon tetrachloride
CTUIR
Near-Field (5-yr data set)

$$CDI = \frac{C_w \times IRW_{adj} \times EF}{AT \times CF}$$ (Eq. 1)

where:

$$IRW_{adj} = \frac{ED_c \times IRW_c}{BW_c} + \frac{(ED_a - ED_c) \times IRW_a}{BW_a}$$ (Eq 9)

$$Risk = CDI \times CSF_o$$ (Eq. 4)

Calculating IRW_{adj}

$$IRW_{adj} = \frac{6\,yr \times 1\ L/day}{15\ kg} + \frac{(70\,yr - 6\,yr) \times 1\ L/day}{70\ kg}$$

$$= 0.4 + 3.657\ \frac{L\text{-}yr}{kg\text{-}day}$$

$$= 4.057\ \frac{L\text{-}yr}{kg\text{-}day}$$ ✓

Calculating CDI

$$CDI = \frac{2.9267E\text{-}04\ \frac{mg}{L} \times 4.057\ \frac{L\text{-}yr}{kg\text{-}day} \times 365\ \frac{day}{yr}}{70\,yr \times 365\ day/yr}$$

$$= \frac{0.418}{25,550}\ \frac{mg}{kg\text{-}day}$$

$$= 1.64E\text{-}05\ mg/kg\text{-}day$$ ✓

Calculating Risk

$$Risk = 1.64E\text{-}05\ mg/kg\text{-}day \times 0.13\ (mg/kg\text{-}day)^{-1}$$

$$= 2.13E\text{-}06\ (unitless)$$ ✓ (agrees with sheet A-8)

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Drinking Water Ingestion - Noncarcinogens (Eq 10.11)
Carbon Tetrachloride
CT Unit Scenario
Near Field (5-yr data set)

$$CDI = \frac{C_w \times IRW_a \times EF \times ED_a}{BW_a \times AT \times CF1} \qquad (Eq\ 10)$$

$$HQ = CDI / RfD_o \qquad (Eq\ 11)$$

Calculating CDI

$$CDI = \frac{2.3167E-04\ mg/L \times 4\ L/day \times 365\ days/yr \times 70\ yr}{70\ kg \times 70\ yr \times 365\ days/yr}$$

$$= \frac{28.89\ mg}{1.709E+06\ kg \cdot day}$$

$$= 1.62E-05\ mg/kg \cdot day \checkmark$$

Calculating HQ

$$HQ = \frac{1.62E-05\ mg/kg\ day}{7.00E-04\ mg/kg \cdot day}$$

$$= 2.31E-02\ (unitless)/(agrees\ with\ sheet\ A-8)$$

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Drinking Water Ingestion - Radionuclides (Eq. 12, 13, 14)
Iodine 129
CTUIR Scenario
Near-Field (5yr data set)

$CDI = C_w \times IRW\_RADadj \times EF$ (Eq. 12)

Where:

$IRW\_RADadj = (ED_c \times IRW_c) + ([ED_a - ED_c] \times IRW_a)$ (Eq. 13)

$Risk = CDI \times SFO$ (Eq. 14)

Calculating IRW RADadj

$IRW\_RADadj = (6_{yr} \times 1\ ^L/_{day}) + ([70_{yr} - 6_{yr}] \times 4\ ^L/_{day})$

$= 6 + 256\ \frac{L\text{-}yr}{day}$

$= 262\ \frac{L\text{-}yr}{day}$ ✓

Calculating CDI

$CDI = 2.7080E{-}8\ ^{pCi}/_{L} \times 162\ \frac{L\text{-}yr}{day} \times 365\ ^{day}/_{yr}$

$= 258,970\ pCi$ ✓

Calculating Risk

$Risk = 258,970\ pCi \times 1.48E{-}10\ \frac{Risk}{pCi}$

$= 3.83E{-}05$ unitless ✓ (agrees with sheet A 12)

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Drinking Water Intake of Volatiles - Carcinogens (Eq. 15, 16)
Carbon Tetrachloride (VOC)
CTUIR Scenario
Near-Field (5yr data set)

$$CDI = \frac{C_w \times ED_a \times EF \times ET \times CF_2 \times VF \times 1000 \frac{mg}{mg}}{AT \times CF_1} \quad (Eq. 15)$$

$$Risk = CDI \times IUR \quad (Eq. 16)$$

Calculating CDI

$$CDI = \frac{2.0267E-04 \frac{mg}{L} \times 70_{yr} \times 365 \frac{day}{yr} \times 0.58 \frac{L}{day} \times \frac{1 day}{24 hr} \times 0.5 \frac{L}{m^3} \times 1000 \frac{mg}{mg}}{70_{yr} \times 365 \frac{day}{yr}}$$

$$= \frac{87.27}{25550} \frac{mg}{m^3}$$

$$= 3.42 E-03 \ mg/m^3 \ \checkmark$$

Calculating Risk

$$Risk = 3.42 E-03 \frac{mg}{m^3} \times 1.5 DE-05 \left(\frac{mg}{m^3}\right)^{-1}$$

$$= 5.12 E-08 \ unitless \ \checkmark \ (agrees \ with \ sheet \ A \ 9)$$

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Drinking Water Inhalation of Volatiles - Noncarcinogens (Eq 17, 18)
Carbon Tetrachloride (VOC)
CTUR Scenario
Near-Field (5-yr data set)

$$CDI = \frac{C_w \times EF \times ED_a \times ET_a \times CF_a \times VF}{AT \times CF1} \quad \text{(Eq. 17)}$$

$$HQ = \frac{CDI}{RFc} \quad \text{(Eq 18)}$$

Calculating CDI

$$CDI = \frac{2.8267E\text{-}04 \frac{mg}{L} \times 365 \frac{day}{yr} \times 70\,yr \times 0.58 \frac{hr}{day} \times \frac{1\,day}{24\,hr} \times 0.5 \frac{L}{m^3}}{10\,yr \times 365\,day/yr}$$

$$= \frac{0.08727}{25,550} \; mg/m^3$$

$$= 3.42E\text{-}06 \; mg/m^3$$

Calculating HQ

$$HQ = \frac{3.42E\text{-}06 \; mg/m^3}{1.90E\text{-}01 \; mg/m^3}$$

$$= 1.80E\text{-}05 \text{ unitless} \checkmark \text{ (agrees with sheet A-9)}$$

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Drinking Water Inhalation of Volatiles – Radionuclides (Eq. 19, 20, 21, 22)
Tritium (H-3) (Volatile)
CTUIR Scenario
Near-Field (5-yr data set)

$$CDI = C_w \times INH\_RAD_{adj} \times VF \times EF \times LT_{adj} \times CF_2 \quad (Eq\ 19)$$

where: $$INH\_RAD_{adj} = (ED_c \times INH_c) + ([ED_a - ED_c] \times INH_a) \quad (Eq.\ 20)$$

and where: $$ET_{adj} = \left(\frac{ET_c \times ED_c}{ED_a}\right) + \left(\frac{[ED_a - ED_c]}{ED_a} \times ET_a\right) \quad (Eq.\ 21)$$

Calculating INH_RAD_adj

$$INH\_RAD_{adj} = (6\ yr \times 15\ \tfrac{m^3}{day}) + ([70\ yr - 6\ yr] \times 25\ \tfrac{m^3}{day})$$
$$= 90\ \tfrac{m^3 \cdot yr}{day} + 1{,}600\ \tfrac{m^3 \cdot yr}{day} = 1{,}690\ \tfrac{m^3 \cdot day}{yr}$$ ✓

Calculating ET_adj

$$ET_{adj} = \left(\frac{1\ \frac{hr}{day} \times 6\ yr}{70\ yr}\right) + \left(\frac{[70\ yr - 6\ yr] \times 0.58\ \frac{hr}{day}}{70\ yr}\right)$$
$$= 0.08571\ \tfrac{hr}{day} + 0.5300\ \tfrac{hr}{day} = 0.616\ \tfrac{hr}{day}$$ ✓

Calculating CDI

$$CDI = 156{,}941.45\ \tfrac{pCi}{L} \times 1{,}690\ \tfrac{m^3 \cdot day}{yr} \times 0.5\ \tfrac{L}{m^3} \times 365\ \tfrac{day}{yr} \times 0.616\ \tfrac{hr}{day} \times \tfrac{1\ day}{24\ hr}$$
$$= 1.24E+09\ pCi$$

Calculating Risk

$$Risk = CDI \times SF_i \quad (Eq\ 22)$$
$$= 1.24E+09\ pCi \times 5.62E-14\ \tfrac{Risk}{pCi}$$
$$= 6.98E-05\ \text{unitless}$$ ✓ (agrees with Sheet A-11)

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Drinking Water Dermal Absorption - Carcinogens (Eq. 23, 24, 25, 28, 29)
Carbon Tetrachloride (Organic)
Cyclic Scenario
Near Field (5-yr data set)

$$CDI = \frac{DA_{event} \times SA_{adj} \times EF}{AT \times CF1} \quad (Eq\ 23)$$

where:

$$SA_{adj} = \frac{ED_c \times SA_c \times EV_c}{BW_c} + \frac{[ED_a - ED_c] \times SA_a \times EV_a}{BW_a} \quad (Eq.\ 24)$$

$$RISK = CDI \times CSF_o/GIABS \quad (Eq.\ 25)$$

Calculating Event Time (ET) - carcinogens (needed for DA_{event})

$$ET_{adj} = \frac{ED_c \times ET_c}{ED_a} + \frac{[ED_a - ED_c] \times ET_a}{ED_a} \quad (Eq.\ 28)$$

$$= \frac{6\,yr \times \frac{1\,hr}{day}}{70\,yr} + \frac{[70\,yr - 6\,yr] \times 0.58\,\frac{hr}{day}}{70\,yr}$$

$$= 0.616\ hr/day \checkmark$$

Calculating DA_{event}

CCl_4 organic is compare ET_{adj} to t^* (time to steady state)
$t^* = 1.86$ hr
$ET_{adj} < t^*$: calculate DA_{event} with Eq. 29

$$DA_{event} = 2 \times FA \times k_p \times C_w \times CF_3 \times \sqrt{6 \times \tau \times ET_{adj}/\pi} \quad (Eq.\ 29)$$

$$2 \times 1 \times 0.016\,\frac{cm}{hr} \times 2.8267E\text{-}04\,\frac{mg}{L} \times 0.001\,\frac{L}{cm^3} \times \sqrt{\frac{6 \times 0.78\,hr \times 0.616\,\frac{hr}{event}}{3.1415}}$$

$$= 9.05E\text{-}09 \times \sqrt{0.9177} = 8.67E\text{-}09\,\frac{mg}{cm^2 \cdot event} \checkmark \text{ (rounding)}$$

Calculating SA_{adj}

$$SA_{adj} = \frac{6\,yr \times 6{,}600\,cm^2 \times 1\,\frac{event}{day}}{15\,kg} + \frac{[70\,yr - 6\,yr] \times 18{,}000\,cm^2 \times 1\,\frac{event}{day}}{70\,kg}$$

$$= 2640 + 16{,}457 = 19{,}097\,\frac{yr \cdot cm^2 \cdot event}{kg \cdot day}$$

Calculating CDI

$$CDI = \left(8.66E\text{-}09\,\frac{mg}{cm^2 \cdot event} \times 19{,}097\,\frac{yr \cdot cm^2 \cdot event}{kg \cdot day} \times 365\,\frac{day}{yr}\right) / \left(70\,yr \times 365\,\frac{day}{yr}\right) = 2.36E\text{-}06 \checkmark\ mg/kg\text{-}day$$

Calculating Risk

$$Risk = 2.36E\text{-}06\,\frac{mg}{kg \cdot day} \times \frac{0.13\left(\frac{mg}{kg \cdot day}\right)^{-1}}{1} = 3.07E\text{-}07 \text{ unitless} \checkmark \text{ (agrees with sheet A-10)}$$

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Drinking Water, Dermal Absorption – Noncarcinogens (Eq. 26, 27, 29)
Carbon Tetrachloride (organic)
CTUIR Scenario
Near-Field (5 yr dek set)

$$CDI = \frac{DA_{event} \times SA_a \times EF \times ED_a \times EV_a}{BW_a \times AT \times CF1} \qquad (Eq.\ 26)$$

$$HQ = CDI/RfD_o \times GIABS \qquad (Eq.\ 27)$$

Calculating DA_{event}

CCl_4 organic ∴ compare ET to t^*
$t^* = 1.96$ hr
ET (adult) = 0.58 hr/event
$ET < t^*$ ∴ Calculate DA_{event} with Eq. 29

$$DA_{event} = 2 \times FA \times k_p \times C_w \times CF_3 \times \sqrt{6 \times \tau \times ET/\pi} \qquad (Eq.\ 29)$$

$$= 2 \times 1 \times 0.016 \tfrac{cm}{hr} \times 2.8267E\text{-}04 \tfrac{mg}{L} \times 0.001 \tfrac{L}{cm^3} \times \sqrt{\frac{6 \times 0.79 hr \times 0.58}{3.1415}} \tfrac{hr}{event}$$

$$= 9.05E\text{-}09 \times \sqrt{1.96}$$

$$= 8.41E\text{-}09 \ mg/cm^2\text{-event} \ \checkmark$$

Calculating CDI

$$CDI = \frac{8.41E\text{-}09 \tfrac{mg}{cm^2\text{-event}} \times 18{,}000 \ cm^2 \times 365 \tfrac{day}{yr} \times 70 \ yr \times 1 \tfrac{event}{day}}{70 \ kg \times 70 \ yr \times 365 \ day/yr}$$

$$= \frac{3.87}{1.79E+06}$$

$$= 2.16E\text{-}06 \ mg/kg\text{-day}$$

Calculating HQ

$$HQ = \frac{2.16E\text{-}06 \ mg/kg\text{-day}}{7.10E\text{-}04 \ mg/kg\text{-day} \times 1}$$

$$= 3.09E\text{-}03 \ \text{unitless} \ \checkmark \ (\text{agrees with Sheet A-10})$$

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Drinking Water Dermal Absorption - Noncarcinogens (Inorganic) (Eq. 26, 27, 31)
Chromium (inorganic)
CTUIR Scenario
Near Field (5-yr data set)

$$CDI = \frac{DA_{event} \times SA_a \times EF \times FD_a \times EV_a}{BW_a \times AT \times CF1} \quad \text{(Eq. 26)}$$

$$HQ = CDI / RfD_o \times GIABS \quad \text{(Eq 27)}$$

Calculating DA_{event}
Cr inorganic ∴ calculate DA_{event} with Eq. 31

$$DA_{event} = K_p \times C_w \times ET \times CF3 \quad \text{(Eq. 31)}$$

$$= 0.001 \frac{cm}{hr} \times 1.5259E-02 \frac{mg}{L} \times 0.58 \frac{hr}{event} \times 0.001 \frac{L}{cm^3}$$

$$= 8.85E-09 \ mg/cm^2\text{-event} \ \checkmark$$

Calculating CDI

$$CDI = \frac{8.85E-09 \frac{mg}{cm^2\text{-event}} \times 18,000 cm^2 \times 365 \frac{day}{yr} \times 70 yr \times 1 \frac{event}{day}}{70 kg \times 70 yr \times 365 day/yr}$$

$$= 2.28E-06 \ mg/kg\text{-day}$$

Calculating HQ

$$HQ = \frac{2.28E-06 \frac{mg}{kg\text{-day}}}{1.5 \frac{mg}{kg\text{-day}}} \times 0.013$$

$$= 1.17E-04 \ unitless \ \checkmark \ (agrees \ with \ Sheet \ A-10)$$

Sweatlodge Inhalation - Volatile & Semivolatile Compounds, Carcinogens & Noncarcinogens
Chloroform (VOC)
Yakama Nation Scenario
Near-field (5-yr data set)

$$Inh = \frac{C_{DW} \times \left(\frac{V_{sl,total}}{2}\right) \times \left(\frac{1}{\frac{2}{3} \times \pi \times r^3}\right) \times IR \times ET \times EF \times ED}{BW \times AT \times CF1} \quad (Eq.\ 32)$$

Calculating Iinh (VOC carcinogen)

$$I_{inh} = \frac{3.4906E\text{-}04 \frac{mg}{L} \times \frac{1L}{2} \times \left[\frac{1}{\frac{2}{3} \times \pi \times (1m)^3}\right] \times 26 \frac{m^3}{day} \times \frac{2}{24} \frac{day}{event} \times 365 \frac{events}{yr} \times 69\,yr}{70\,kg \times 70\,yr \times 365\,day/yr}$$

$$= 1.09E\text{-}05\ mg/kg\text{-}day \quad \checkmark$$

Calculating Iinh (VOC noncarcinogen)

$$I_{inh} = \frac{3.8136E\text{-}04 \frac{mg}{L} \times \frac{1L}{2} \times \left[\frac{1}{\frac{2}{3} \times \pi \times (1m)^3}\right] \times 26 \frac{m^3}{day} \times \frac{2}{24} \frac{day}{event} \times 365 \frac{events}{yr} \times 69\,yr}{70\,kg \times 69\,yr \times 365\,day/yr}$$

$$= 1.19E\text{-}05\ mg/kg\text{-}day \quad \checkmark$$

Calculating Risk (VOC carcinogen)

$$Risk = CSF_i \times I_{inh} \quad (Eq.\ 33)$$

$$= IUR\left(\frac{m^3}{\mu g}\right) \times \frac{1}{20}\left(\frac{m^3}{day}\right) \times 70\,kg \times 1000\,\mu g/mg \times I_{inh}$$

$$= 2.3E\text{-}05 \frac{m^3}{\mu g} \times \frac{1}{20} \frac{m^3}{day} \times 70kg \times 1000 \frac{\mu g}{mg} \times 1.09\,41E\text{-}05 \frac{mg}{kg\text{-}day}$$

$$= 8.81E\text{-}07\ \text{unitless} \quad \checkmark \text{ (agrees with sheet F-10)}$$

Calculating HQ (VOC noncarcinogen)

$$HQ = \frac{1}{RfD_i} \times I_{inh} \quad (Eq.\ 34)$$

$$= \left[RfC_i\left(\frac{mg}{m^3}\right) \times 20\left(\frac{m^3}{day}\right) \times \frac{1}{70kg}\right]^{-1} \times I_{inh}$$

$$= \left(9.0E\text{-}02 \frac{mg}{m^3} \times 20 \frac{m^3}{day} \times \frac{1}{70kg}\right)^{-1} \times 1.1243E\text{-}05 \frac{mg}{kg\text{-}day}$$

$$= 4.02E\text{-}04\ \text{unitless} \quad \checkmark \text{ (agrees with sheet F-10)}$$

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Sweetlodge Inhalation – Volatile Radionuclides
Tritium (volatile)
Yakama Nation Scenario
Near-Field (5-yr data set)

$$I_{inh} = CD_{air} \times \left(\frac{V_{br} \cdot t_{total}}{2}\right) \times \left(\frac{1}{2/3 \cdot \pi \cdot r^3}\right) \times IR \times ET \times EF \times ED \quad (Eq.\ 35)$$

Calculating I_{inh} (volatile radionuclides)

$$I_{inh} = 15690.45 \frac{pCi}{L} \times \left(\frac{1}{2}\right) \times \left(\frac{1}{2/3 \cdot \pi \cdot (1m)^3}\right) \times 26 \frac{m^3}{day} \times \frac{2}{24} \frac{day}{event} \times 365 \frac{events}{yr} \times 68\ yr$$

$$= 8.06\ E-09\ pCi \checkmark$$

Calculating Risk (volatile radionuclides)

$$Risk_{rad} = SF_i \times I_{inh} \quad (Eq.\ 36)$$

$$= 5.62\ E-14\ Risk/pCi \times 8.06\ E-09\ pCi$$

$$= 4.53\ E-04\ unitless \checkmark\ (approx.\ w.A.\ sheet\ F-15)$$

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Sweatlodge Inhalation – Nonvolatile Compounds, carcinogens & noncarcinogens
Arsenic
Yakama Nation Scenario
Near-Field (5-yr data set)

$$I_{inh} = \left[\frac{IR \times ET \times EF \times ED}{BW \times AT \times CF1}\right] \times CD_w \times \left[\frac{MW_w}{R \times T \times \rho_w}\right] \times Exp\left[18.3036 - \frac{3816.44}{T - 46.13}\right] \quad (Eq\ 37)$$

Calculating Iinh (nonvolatile carcinogen)

$$I_{inh} = \left[\frac{26\frac{m^3}{day} \times \frac{2}{24}\frac{day}{event} \times 365\frac{events}{yr} \times 68yr}{70kg \times 70yr \times 365\ day/yr}\right] \times 5.7921E\text{-}03\ \frac{mg}{L} \times \left[\frac{18\frac{g}{mole}}{0.06237\frac{mmHg\text{-}m^3}{mole\text{-}day\,K} \times 338.7K \times 1000\ g/L}\right] \times$$

$$\cdots Exp\left[18.3036 - \frac{3816.44}{338.7 - 46.13}\right]$$

$$= 1.484E\text{-}07 \times 192.30 = 2.85E\text{-}05\ mg/kg\text{-}day\ \checkmark$$

Calculating Iinh (nonvolatile noncarcinogen)

$$I_{inh} = \left[\frac{26\frac{m^3}{day} \times \frac{2}{24}\frac{day}{event} \times 365\frac{event}{yr} \times 68yr}{70kg \times 68yr \times 365\ day/yr}\right] \times 5.7921E\text{-}03\ \frac{mg}{L} \times \left[\frac{18\frac{g}{mole}}{0.06237\frac{mmHg\text{-}m^3}{mole\text{-}day\,K} \times 338.7K \times 1000\ g/L}\right] \times$$

$$\cdots Exp\left[18.3036 - \frac{3816.44}{338.7 - 46.13}\right]$$

$$= 1.521E\text{-}07 \times 192.30 = 2.93E\text{-}05\ mg/kg\text{-}day\ \checkmark\ (rounding)$$

Calculating Risk (nonvolatile carcinogen)

$$Risk = CSF_t \times I_{inh} \quad (Eq\ 38)$$

$$= IUR\left(\frac{m^3}{\mu g}\right) \times \frac{1}{20}\left(\frac{m^3}{day}\right) \times 70kg \times 1000\ \mu g/mg \times I_{inh}$$

$$= 0.0043\frac{m^3}{\mu g} \times \frac{1}{20}\frac{m^3}{day} \times 70kg \times 1000\frac{\mu g}{mg} \times 2.85E\text{-}05\ mg/kg\text{-}day$$

$$= 4.29E\text{-}04\ \checkmark\ (agrees\ with\ sheet\ F\text{-}11)$$

Calculating HQ (nonvolatile noncarcinogen)

$$HQ = \frac{1}{RfD_i} \times I_{inh} \quad (Eq.\ 39)$$

$$= \left[RfC_i\left(\frac{mg}{m^3}\right) \times 20\left(\frac{m^3}{day}\right) \times \frac{1}{70kg}\right]^{-1} \times I_{inh}$$

$$= \left(1.5E\text{-}05\frac{mg}{m^3} \times 20\frac{m^3}{day} \times \frac{1}{70kg}\right)^{-1} \times 2.94E\text{-}05\ mg/kg\text{-}day$$

$$= 6.86\ \checkmark\ (rounding)\ (agrees\ with\ sheet\ F\text{-}11)$$

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Sweatlodge Inhalation - Nonvolatile Radionuclides
Iodine-129
Yakama Nation Scenario
Near-Field (5-gr data set)

$$I_{inh} = (IR \times ET \times EF \times ED) \times CD_w \times \left[\frac{M_w}{R \times T \cdot \rho_w}\right] \times Exp\left(18.3036 - \frac{3816.44}{T - 46.13}\right) \quad \text{(Eq. 40)}$$

Calculating I_{inh} (nonvolatile radionuclide)

$$I_{inh} = \left(26 \frac{m^3}{day} \times \frac{2}{24} \frac{day}{event} \times 365 \frac{event}{yr} \times 68\,yr\right) \times 2.709 \frac{pCi}{L} \times \left(\frac{18\ g/mole}{0.08237 \frac{m^3 \cdot atm}{mole \cdot K} \times 338.7\,K \times 1000\,L/m^3}\right) \times$$

$$\cdots Exp\left(18.3036 - \frac{3816.44}{338.7 - 46.13}\right)$$

$$= 123.59 \times 192.30$$

$$= 2.38E+04\ pCi \checkmark \text{ (rounding)}$$

Calculating Risk (nonvolatile radionuclide)

$$Risk = SF_i \times I_{inh} \quad \text{(Eq. 41)}$$

$$= 6.07E-11\ risk/pCi \times 2.39E+04\ pCi$$

$$= 1.45E-06\ \text{(unitless)} \checkmark \text{ (agrees with Sheet F-16)}$$

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Sweatlodge Dermal Absorption – VOCs / SVOCs, carcinogens & noncarcinogens
Chloroform (VOC)
Yakama Nation Scenario
Near-Field (5yr data set)

$$I_{d,total} = I_{d,v} = \frac{CD_w \times \left(\frac{V_{w\,total}}{2}\right) \times \left(\frac{1}{2/3 \times \pi \times r^3}\right) \times SA \times k_p \times ET \times EF \times ED \times CF1}{BW \times AT \times CF2} \quad \text{(Eq. 42)}$$

Calculating $I_{d,total}$ (VOC carcinogen)

$$I_{d,total} = \frac{3.8106E\text{-}04\,\frac{mg}{L} \times \left(\frac{4}{2}L\right) \times \left(\frac{1}{2/3 \times \pi \times (1m)^3}\right) \times 1.8m^2 \times 0.0068\,\frac{cm}{hr} \times 2\,\frac{hr}{event} \times 365\,\frac{event}{yr} \times 68yr \times 0.01\,\frac{m}{cm}}{70kg \times 70yr \times 365\,day/yr}$$

$$= 1.24E\text{-}09\ mg/kg\text{-}day \checkmark$$

Calculating $I_{d,total}$ (VOC noncarcinogen)

$$I_{d,total} = \frac{3.8106E\text{-}04\,\frac{mg}{L} \times \left(\frac{4}{2}L\right) \times \left(\frac{1}{2/3 \times \pi \times (1m)^3}\right) \times 1.8m^2 \times 0.0068\,\frac{cm}{hr} \times 2\,\frac{hr}{event} \times 365\,\frac{event}{yr} \times 68yr \times 0.01\,\frac{m}{cm}}{70kg \times 68yr \times 365\,day/yr}$$

$$= 1.27E\text{-}09\ mg/kg\text{-}day \checkmark$$

Calculating Risk (VOC carcinogen)

$$Risk = \frac{CSF_o}{GIABS} \times I_{d,total} \quad \text{(Eq. 43)}$$

$$= \frac{3.1E\text{-}02\,(mg/kg\text{-}day)^{-1}}{1} \times 1.24E\text{-}09\ mg/kg\text{-}day$$

$$= 3.83E\text{-}11\ \text{unitless} \checkmark \text{ (agrees with sheet F-12)}$$

Calculating HQ (VOC noncarcinogen)

$$HQ = \frac{1}{RfD_o \times GIABS} \times I_{d,total} \quad \text{(Eq. 44)}$$

$$= \frac{1}{1.0E\text{-}02\,\frac{mg}{kg\text{-}day} \times 1} \times 1.27E\text{-}09\,\frac{mg}{kg\text{-}day}$$

$$= 1.27E\text{-}07\ \text{unitless} \checkmark \text{ (agrees with sheet F-12)}$$

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Sweetlodge Dermal Absorption - Nonvolatile Compounds, Carcinogens & noncarcinogens, Arsenic — Condensed Liquids & Vapors
Yakama Nation Scenario
Near-Field (5-yr data set)

$$Id,l = \frac{CDw \times SA \times kp \times ET \times EF \times ED \times CF3}{BW \times AT \times CF1}$$ (Eq 45) condensed liquid

Calculating Id,l (Nonvolatile carcinogen - liquid)

$$Id,l = \frac{5.7921E\text{-}03\ \frac{mg}{L} \times 1.8\ m^2 \times 0.001\ \frac{cm}{hr} \times 2\ \frac{hr}{event} \times 365\ \frac{event}{yr} \times 68_{yr} \times 10\ \frac{L}{m^2\text{-}cm}}{70\ kg \times 70\ yr \times 365\ day/yr}$$

$= 2.87E\text{-}06$ mg/kg-day ✓ (agrees with sheet F-13)

Calculating Id,l (nonvolatile noncarcinogen - liquid)

$$Id,l = \frac{5.7921E\text{-}03\ \frac{mg}{L} \times 1.8\ m^2 \times 0.001\ \frac{cm}{hr} \times 2\ \frac{hr}{event} \times 365\ \frac{event}{yr} \times 68_{yr} \times 10\ \frac{L}{m^2\text{-}cm}}{70\ kg \times 68\ yr \times 365\ day/yr}$$

$= 2.98E\text{-}06$ mg/kg-day ✓ (agrees with sheet F-13)

$$Id,v = \left[\frac{SA \times kp \times ET \times EF \times ED \times CF3}{BW \times AT \times CF1}\right] \times CDw \times \left[\frac{MW_w}{R \times T \times \rho_w}\right] \times Exp\left[18.3036 - \frac{3816.44}{T - 46.13}\right]$$ (Eq. 46) Vapor

Calculating Id,v (nonvolatile carcinogen - vapor)

$$Id,v = \left[\frac{1.8\ m^2 \times 0.001\ \frac{cm}{hr} \times 2\ \frac{hr}{event} \times 365\ \frac{event}{yr} \times 68_{yr} \times 10\ \frac{L}{m^2\text{-}cm}}{70\ kg \times 70\ yr \times 365\ day/yr}\right] \times 5.7921E\text{-}03\ \frac{kg}{L} \times$$

$$\cdots \left[\frac{18\ \frac{g}{mole}}{62.37\ \frac{mm\ Hg\text{-}L}{g mole\text{-}K} \times 338.7K \times 1000\ \frac{g}{L}}\right] \times Exp\left[18.3036 - \frac{3816.44}{338.7 - 46.13}\right]$$

$= 2.47E\text{-}12 \times 192.3$

$= 4.74E\text{-}10$ mg/kg-day ✓ (agrees with sheet F-14)

Calculating Id,v (nonvolatile noncarcinogen - vapor)

$$Id,v = \left[\frac{1.8\ m^2 \times 0.001\ \frac{cm}{hr} \times 2\ \frac{hr}{event} \times 365\ \frac{event}{yr} \times 68_{yr} \times 10\ \frac{L}{m^2\text{-}cm}}{70\ kg \times 68\ yr \times 365\ day/yr}\right] \times 5.7921E\text{-}03\ \frac{mg}{L} \times$$

$$\cdots \left[\frac{18\ \frac{g}{mole}}{62.37\ \frac{mm\ Hg\text{-}L}{g mole\text{-}K} \times 338.7K \times 1000\ \frac{g}{L}}\right] \times Exp\left[18.3036 - \frac{3816.44}{338.7 - 46.13}\right]$$

$= 2.54E\text{-}12 \times 192.3$

$= 4.88E\text{-}10$ mg/kg-day ✓ (agrees with sheet F-14)

Sweatlodge Dermal Absorption – Nonvolatile Compounds (Arsenic - continued)

Calculating Risk (nonvolatile carcinogen liquids)

$$Risk = \frac{CSF_o}{GIABS} \times I_{d,l} \qquad (Eq.\ 48)$$

$$= \frac{1.5E+00\ (mg/kg\text{-}day)^{-1}}{1} \times 2.98E-06\ mg/kg\text{-}day$$

$$= 4.34E-06\ unitless\ /\ (agrees\ with\ sheet\ F\text{-}13)$$

Calculating HQ (nonvolatile noncarcinogen liquids)

$$HQ = \frac{1}{RfD_o \times GIABS} \times I_{d,l} \qquad (Eq.\ 49)$$

$$= \frac{1}{3.0E-04\ mg/kg\text{-}day \times 1} \times 2.98E-06\ mg/kg\text{-}day$$

$$= 9.93E-03\ unitless\ \checkmark\ (agrees\ with\ sheet\ F\text{-}13)$$

Calculating Risk (nonvolatile carcinogen vapor)

$$Risk = \frac{CSF_o}{GIABS} \times I_{d,v} \qquad (Eq.\ 48)$$

$$= \frac{1.5E+00\ (mg/kg\text{-}day)^{-1}}{1} \times 4.74E-10\ mg/kg\text{-}day$$

$$= 7.11E-10\ unitless\ \checkmark\ (agrees\ with\ sheet\ F\text{-}14)$$

Calculating HQ (nonvolatile noncarcinogen vapor)

$$HQ = \frac{1}{RfD_o \times GIABS} \times I_{d,l} \qquad (Eq.\ 49)$$

$$= \frac{1}{3.0E-04\ mg/kg\text{-}day \times 1} \times 4.88E-10\ mg/kg\text{-}day$$

$$= 1.63E-06\ unitless\ \checkmark\ (agrees\ with\ sheet\ F\text{-}14)$$

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Drinking Water Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	ontaminant Concentration in Groundwate C_w (mg/L)	VOC?	HQ (Inhalation) (unitless)	HQ (Ingestion) (unitless)	HQ (Dermal) (unitless)	Total HI (unitless)	% Contribution
1,1,1-Trichloroethane	0.000691076	Yes	1.67E-06	1.97E-05	6.70E-07	2.21E-05	9.36E-04
1,1-Dichloroethane	0.000255649	Yes	4.41E-06	7.30E-05	1.28E-06	7.87E-05	0.0033
1,1-Dichloroethene	0.00016874	Yes	1.02E-05	1.93E-04	6.04E-06	2.09E-04	0.0089
1,2-Dichlorobenzene	0.003	Yes	1.81E-04	1.90E-03	6.23E-04	2.71E-03	0.11
1,4-Dichlorobenzene	0.000130957	Yes	1.98E-06	1.07E-04	3.58E-05	1.45E-04	0.0061
1,4-Dioxane	0.0081	--	--(b)	4.63E-03	8.31E-06	4.64E-03	0.20
2-Butanone	0.00055	Yes	1.33E-06	5.24E-05	2.48E-07	5.40E-05	0.0023
2-Pentanone, 4-Methyl	0.00064	Yes	2.58E-06	4.57E-04	7.30E-06	4.67E-04	0.020
Acetone	0.001511507	Yes	5.89E-07	9.60E-05	--	9.66E-05	0.0041
Arsenic	0.003140238	--	--(b)	5.98E-01	1.56E-03	6.00E-01	25
Barium	0.072881156	--	--(b)	2.08E-02	7.76E-04	2.16E-02	0.92
Bis(2-ethylhexyl) phthalate	0.001	--	--(b)	2.86E-03	2.21E-03	5.07E-03	0.21
Cadmium	0.0045	--	--(b)	5.14E-01	2.68E-02	5.41E-01	23
Carbon disulfide	0.00021	Yes	3.63E-06	1.20E-04	1.06E-05	1.34E-04	0.0057
Carbon tetrachloride	0.000170123	Yes	1.08E-05	1.39E-02	1.86E-03	1.58E-02	0.67
Chloride	9.9702351	--	--(b)	--	--	--	
Chloroform	0.000214204	Yes	2.64E-05	1.22E-03	5.57E-05	1.31E-03	0.055
Chromium	0.009493374	--	--(b)	3.62E-04	7.26E-05	4.34E-04	0.018
Copper	0.004884201	--	--(b)	6.98E-03	1.82E-05	7.00E-03	0.30
Fluoride	0.30080145	--	--(b)	2.86E-01	7.48E-04	2.87E-01	12
Iron	0.12126178	--	--(b)	9.90E-03	2.58E-05	9.92E-03	0.42
Lead	0.000581898	--	--(b)	--	--	--	
Manganese	0.015530827	--	--(b)	3.70E-02	2.41E-03	3.94E-02	1.7
Methylene chloride	0.002069589	Yes	2.50E-05	1.97E-03	3.70E-05	2.03E-03	0.086
Nickel	0.006014142	--	--(b)	1.72E-02	2.24E-04	1.74E-02	0.74
Nitrate	23.863649	--	--(b)	1.92E-01	5.01E-04	1.93E-01	8.2
Nitrite	0.081906164	--	--(b)	1.56E-02	4.07E-05	1.56E-02	0.66
Silver	0.005776818	--	--(b)	6.60E-02	2.58E-03	6.86E-02	2.9
Strontium	0.38364144	--	--(b)	3.65E-02	9.54E-05	3.66E-02	1.6
Sulfate	45.030868	--	--(b)	--	--	--	
Tetrachloroethene	0.000872033	Yes	3.90E-05	4.98E-03	1.49E-03	6.51E-03	0.28
Tributyl phosphate	0.012498806	--	--(b)	3.57E-03	--	3.57E-03	0.15
Trichloroethene	0.000433871	Yes	1.50E-04	--	--	1.50E-04	0.0063
Trichloromonofluoromethane	0.00058	Yes	1.00E-05	1.10E-04	1.08E-05	1.31E-04	0.0056
Uranium	0.016629145	--	--(b)	3.17E-01	8.27E-04	3.18E-01	13
Vanadium	0.012904693	--	--(b)	1.47E-01	3.85E-04	1.48E-01	6.3
Zinc	0.068859746	--	--(b)	1.31E-02	2.05E-05	1.31E-02	0.56
Total			4.69E-04	2.31	0.04	2.36	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

HQ = hazard quotient.

HI = hazard index.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Drinking Water Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	ontaminant Concentration in Groundwate C_w (mg/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
1,1,1-Trichloroethane	0.000691076	Yes	--	--	--	--	
1,1-Dichloroethane	0.000255649	Yes	--	--	--	--	
1,1-Dichloroethene	0.00016874	Yes	--	--	--	--	
1,2-Dichlorobenzene	0.003	Yes	--	--	--	--	
1,4-Dichlorobenzene	0.000130957	Yes	1.74E-08	4.10E-08	1.48E-08	7.32E-08	0.022
1,4-Dioxane	0.0081	--	--(b)	5.16E-06	1.00E-08	5.17E-06	1.6
2-Butanone	0.00055	Yes	--	--	--	--	
2-Pentanone, 4-Methyl	0.00064	Yes	--	--	--	--	
Acetone	0.001511507	Yes	--	--	--	--	
Arsenic	0.003140238	--	--(b)	2.73E-04	7.92E-07	2.74E-04	83
Barium	0.072881156	--	--(b)	--	--	--	
Bis(2-ethylhexyl) phthalate	0.001	--	--(b)	8.11E-07	6.76E-07	1.49E-06	0.45
Cadmium	0.0045	--	--(b)	--	--	--	
Carbon disulfide	0.00021	Yes	--	--	--	--	
Carbon tetrachloride	0.000170123	Yes	3.08E-08	1.28E-06	1.85E-07	1.50E-06	0.46
Chloride	9.9702351	--	--(b)	--	--	--	
Chloroform	0.000214204	Yes	5.95E-08	3.85E-07	1.89E-08	4.63E-07	0.14
Chromium	0.009493374	--	--(b)	--	--	--	
Copper	0.004884201	--	--(b)	--	--	--	
Fluoride	0.30080145	--	--(b)	--	--	--	
Iron	0.12126178	--	--(b)	--	--	--	
Lead	0.000581898	--	--(b)	--	--	--	
Manganese	0.015530827	--	--(b)	--	--	--	
Methylene chloride	0.002069589	Yes	1.18E-08	9.00E-07	1.82E-08	9.30E-07	0.28
Nickel	0.006014142	--	--(b)	--	--	--	
Nitrate	23.863649	--	--(b)	--	--	--	
Nitrite	0.081906164	--	--(b)	--	--	--	
Silver	0.005776818	--	--(b)	--	--	--	
Strontium	0.38364144	--	--(b)	--	--	--	
Sulfate	45.030868	--	--(b)	--	--	--	
Tetrachloroethene	0.000872033	Yes	6.22E-08	2.73E-05	8.77E-06	3.61E-05	11
Tributyl phosphate	0.012498806	--	--(b)	6.66E-06	--	6.66E-06	2.0
Trichloroethene	0.000433871	Yes	1.31E-07	2.24E-06	2.09E-07	2.58E-06	0.78
Trichloromonofluoromethane	0.00058	Yes	--	--	--	--	
Uranium	0.016629145	--	--(b)	--	--	--	
Vanadium	0.012904693	--	--(b)	--	--	--	
Zinc	0.068859746	--	--(b)	--	--	--	
Total ELCR			3.13E-07	3.18E-04	1.07E-05	3.29E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

SVOC = semivolatile organic compound.
VOC = volatile organic compound.
ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Drinking Water Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	ontaminant Concentration in Groundwat C_w (pCi/L)	Volatile?[a]	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	6.4100896	--	--(b)	--	--	
Gross beta	32.397036	--	--(b)	--	--	
Iodine-129	1.9883847	--	--(b)	2.81E-05	2.81E-05	1.9
Nickel-63	4.07	--	--(b)	2.61E-07	2.61E-07	0.018
Protactinium-231	0.308	--	--(b)	5.10E-06	5.10E-06	0.35
Strontium-90	0.611	--	--(b)	3.27E-06	3.27E-06	0.22
Technetium-99	93.996334	--	--(b)	2.47E-05	2.47E-05	1.7
Tritium	264106.86	Yes	1.17E-04	1.28E-03	1.40E-03	96
Total ELCR			1.17E-04	1.34E-03	1.46E-03	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
ELCR = excess lifetime cancer risk.
VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area - CTUIR

Ingestion of Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Ingestion Chronic Daily Intake	CDI	calculated		mg/kg-day	EPA 1989
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	15	kg	Harris et al, 2004
Drinking Water Ingestion Rate	IRW	4	1	Liters/day	Harris et al, 2004
Age-Adjusted Drinking Water Ingestion Rate	IRWadj	4.057		L-yr/kg-day	Calculated using the age adjusted intake factors equation
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	6	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Harris et al, 2004
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFo	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 1989

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	0.000691076	3.95E-05	2.00E+00	1.97E-05	8.53E-04
1,1-Dichloroethane	75-34-3	0.000255649	1.46E-05	2.00E-01	7.30E-05	0.0032
1,1-Dichloroethene	75-35-4	0.00016874	9.64E-06	5.00E-02	1.93E-04	0.0083
1,2-Dichlorobenzene	95-50-1	0.003	1.71E-04	9.00E-02	1.90E-03	0.082
1,4-Dichlorobenzene	106-46-7	0.000130957	7.48E-06	7.00E-02	1.07E-04	0.0046
1,4-Dioxane	123-91-1	0.0081	4.63E-04	1.00E-01	4.63E-03	0.20
2-Butanone	78-93-3	0.00055	3.14E-05	6.00E-01	5.24E-05	0.0023
2-Pentanone, 4-Methyl	108-10-1	0.00064	3.66E-05	8.00E-02	4.57E-04	0.020
Acetone	67-64-1	0.001511507	8.64E-05	9.00E-01	9.60E-05	0.0041
Arsenic	7440-38-2	0.003140238	1.79E-04	3.00E-04	5.98E-01	26
Barium	7440-39-3	0.072881156	4.16E-03	2.00E-01	2.08E-02	0.90
Bis(2-ethylhexyl) phthalate	117-81-7	0.001	5.71E-05	2.00E-02	2.86E-03	0.12
Cadmium	7440-43-9	0.0045	2.57E-04	5.00E-04	5.14E-01	22
Carbon disulfide	75-15-0	0.00021	1.20E-05	1.00E-01	1.20E-04	0.0052
Carbon tetrachloride	56-23-5	0.000170123	9.72E-06	7.00E-04	1.39E-02	0.60
Chloride	16887-00-6	9.9702351	5.70E-01	--	--	
Chloroform	67-66-3	0.000214204	1.22E-05	1.00E-02	1.22E-03	0.053
Chromium	7440-47-3	0.009493374	5.42E-04	1.50E+00	3.62E-04	0.016
Copper	7440-50-8	0.004884201	2.79E-04	4.00E-02	6.98E-03	0.30
Fluoride	16984-48-8	0.30080145	1.72E-02	6.00E-02	2.86E-01	12
Iron	7439-89-6	0.12126178	6.93E-03	7.00E-01	9.90E-03	0.43
Lead	7439-92-1	0.000581898	3.33E-05	--	--	
Manganese	7439-96-5	0.015530827	8.87E-04	2.40E-02	3.70E-02	1.6
Methylene chloride	75-09-2	0.002069589	1.18E-04	6.00E-02	1.97E-03	0.085
Nickel	7440-02-0	0.006014142	3.44E-04	2.00E-02	1.72E-02	0.74
Nitrate	14797-55-8	23.863649	1.36E+00	7.10E+00	1.92E-01	8.3
Nitrite	14797-65-0	0.081906164	4.68E-03	3.00E-01	1.56E-02	0.67
Silver	7440-22-4	0.005776818	3.30E-04	5.00E-03	6.60E-02	2.9
Strontium	7440-24-6	0.38364144	2.19E-02	6.00E-01	3.65E-02	1.6
Sulfate	14808-79-8	45.030868	2.57E+00	--	--	
Tetrachloroethene	127-18-4	0.000872033	4.98E-05	1.00E-02	4.98E-03	0.22
Tributyl phosphate	126-73-8	0.012498806	7.14E-04	2.00E-01	3.57E-03	0.15
Trichloroethene	79-01-6	0.000433871	2.48E-05	--	--	
Trichloromonofluoromethane	75-69-4	0.00058	3.31E-05	3.00E-01	1.10E-04	0.0048
Uranium	7440-61-1	0.016629145	9.50E-04	3.00E-03	3.17E-01	14
Vanadium	7440-62-2	0.012904693	7.37E-04	5.00E-03	1.47E-01	6.4
Zinc	7440-66-6	0.068859746	3.93E-03	3.00E-01	1.31E-02	0.57
Total					2.31E+00	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	0.000691076	4.01E-05	--	--	
1,1-Dichloroethane	75-34-3	0.000255649	1.48E-05	--	--	
1,1-Dichloroethene	75-35-4	0.00016874	9.78E-06	--	--	
1,2-Dichlorobenzene	95-50-1	0.003	1.74E-04	--	--	
1,4-Dichlorobenzene	106-46-7	0.000130957	7.59E-06	5.40E-03	4.10E-08	0.013
1,4-Dioxane	123-91-1	0.0081	4.69E-04	1.10E-02	5.16E-06	1.6
2-Butanone	78-93-3	0.00055	3.19E-05	--	--	
2-Pentanone, 4-Methyl	108-10-1	0.00064	3.71E-05	--	--	
Acetone	67-64-1	0.001511507	8.76E-05	--	--	
Arsenic	7440-38-2	0.003140238	1.82E-04	1.50E+00	2.73E-04	86
Barium	7440-39-3	0.072881156	4.22E-03	--	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.001	5.80E-05	1.40E-02	8.11E-07	0.26
Cadmium	7440-43-9	0.0045	2.61E-04	--	--	
Carbon disulfide	75-15-0	0.00021	1.22E-05	--	--	
Carbon tetrachloride	56-23-5	0.000170123	9.86E-06	1.30E-01	1.28E-06	0.40
Chloride	16887-00-6	9.9702351	5.78E-01	--	--	
Chloroform	67-66-3	0.000214204	1.24E-05	3.10E-02	3.85E-07	0.12
Chromium	7440-47-3	0.009493374	5.50E-04	--	--	
Copper	7440-50-8	0.004884201	2.83E-04	--	--	
Fluoride	16984-48-8	0.30080145	1.74E-02	--	--	
Iron	7439-89-6	0.12126178	7.03E-03	--	--	
Lead	7439-92-1	0.000581898	3.37E-05	--	--	
Manganese	7439-96-5	0.015530827	9.00E-04	--	--	
Methylene chloride	75-09-2	0.002069589	1.20E-04	7.50E-03	9.00E-07	0.28
Nickel	7440-02-0	0.006014142	3.49E-04	--	--	
Nitrate	14797-55-8	23.863649	1.38E+00	--	--	
Nitrite	14797-65-0	0.081906164	4.75E-03	--	--	

Silver	7440-22-4	0.005776818	3.35E-04	--	--	
Strontium	7440-24-6	0.38364144	2.22E-02	--	--	
Sulfate	14808-79-8	45.030868	2.61E+00	--	--	
Tetrachloroethene	127-18-4	0.000872033	5.05E-05	5.40E-01	2.73E-05	8.6
Tributyl phosphate	126-73-8	0.012498806	7.24E-04	9.20E-03	6.66E-06	2.1
Trichloroethene	79-01-6	0.000433871	2.51E-05	8.90E-02	2.24E-06	0.70
Trichloromonofluoromethane	75-69-4	0.00058	3.36E-05	--	--	
Uranium	7440-61-1	0.016629145	9.64E-04	--	--	
Vanadium	7440-62-2	0.012904693	7.48E-04	--	--	
Zinc	7440-66-6	0.068859746	3.99E-03	--	--	
Total ELCR					3.18E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area - CTUIR

inhalation of Volatile Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Inhalation Chronic Daily Intake	CDI	calculated		mg/m^3 for noncarcinogens, $\mu g/m^3$ for carcinogens	EPA 2009b
Contaminant concentration in drinking water	C_w	contaminant-specific		mg/L	ECF-200PO1-09-2027
Exposure Time	ET	0.580	--	hours/day	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	--	yr	Harris et al, 2004
Averaging Time	AT	70	--	yr	Harris et al, 2004
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Inhalation Reference Concentration	RfC_i	Chemical Specific		mg/m^3	EPA 2009a
Inhalation Unit Risk	IUR	Chemical Specific		$(\mu g/m^3)^{-1}$	EPA 2009a
Conversion Factor	CF1	365		days/year	EPA 2009b
Conversion Factor	CF2	0.042		1day/24 hours	EPA 2009b

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009a EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

U.S. EPA 2009b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (noncarcinogen) (mg/m^3)	RfC[a] (mg/m^3)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	Yes	0.000691076	8.35E-06	5.00E+00	1.67E-06	0.36
1,1-Dichloroethane	75-34-3	Yes	0.000255649	3.09E-06	7.00E-01	4.41E-06	0.94
1,1-Dichloroethene	75-35-4	Yes	0.00016874	2.04E-06	2.00E-01	1.02E-05	2.2
1,2-Dichlorobenzene	95-50-1	Yes	0.003	3.63E-05	2.00E-01	1.81E-04	39
1,4-Dichlorobenzene	106-46-7	Yes	0.000130957	1.58E-06	8.00E-01	1.98E-06	0.42
1,4-Dioxane	123-91-1	--	0.0081	--(b)	3.60E+00	--(b)	
2-Butanone	78-93-3	Yes	0.00055	6.65E-06	5.00E+00	1.33E-06	0.28
2-Pentanone, 4-Methyl	108-10-1	Yes	0.00064	7.73E-06	3.00E+00	2.58E-06	0.55
Acetone	67-64-1	Yes	0.001511507	1.83E-05	3.10E+01	5.89E-07	0.13
Arsenic	7440-38-2	--	0.003140238	--(b)	1.50E-05	--(b)	
Barium	7440-39-3	--	0.072881156	--(b)	5.00E-04	--(b)	
Bis(2-ethylhexyl) phthalate	117-81-7	--	0.001	--(b)	--	--(b)	
Cadmium	7440-43-9	--	0.0045	--(b)	1.00E-05	--(b)	
Carbon disulfide	75-15-0	Yes	0.00021	2.54E-06	7.00E-01	3.63E-06	0.77
Carbon tetrachloride	56-23-5	Yes	0.000170123	2.06E-06	1.90E-01	1.08E-05	2.3
Chloride	16887-00-6	--	9.9702351	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.000214204	2.59E-06	9.80E-02	2.64E-05	5.6
Chromium	7440-47-3	--	0.009493374	--(b)	--	--(b)	
Copper	7440-50-8	--	0.004884201	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.30080145	--(b)	1.30E-02	--(b)	
Iron	7439-89-6	--	0.12126178	--(b)	--	--(b)	
Lead	7439-92-1	--	0.000581898	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.015530827	--(b)	5.00E-05	--(b)	
Methylene chloride	75-09-2	Yes	0.002069589	2.50E-05	1.00E+00	2.50E-05	5.3
Nickel	7440-02-0	--	0.006014142	--(b)	9.00E-05	--(b)	
Nitrate	14797-55-8	--	23.863649	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.081906164	--(b)	--	--(b)	
Silver	7440-22-4	--	0.005776818	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.38364144	--(b)	--	--(b)	
Sulfate	14808-79-8	--	45.030868	--(b)	--	--(b)	
Tetrachloroethene	127-18-4	Yes	0.000872033	1.05E-05	2.70E-01	3.90E-05	8.3
Tributyl phosphate	126-73-8	--	0.012498806	--(b)	--	--(b)	
Trichloroethene	79-01-6	Yes	0.000433871	5.24E-06	3.50E-02	1.50E-04	32
Trichloromonofluoromethane	75-69-4	Yes	0.00058	7.01E-06	7.00E-01	1.00E-05	2.1
Uranium	7440-61-1	--	0.016629145	--(b)	3.00E-04	--(b)	
Vanadium	7440-62-2	--	0.012904693	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.068859746	--(b)	--	--(b)	
Total						4.69E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (carcinogen) ($\mu g/m^3$)	IUR[a] $(\mu g/m^3)^{-1}$	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	Yes	0.000691076	8.35E-03	--	--	
1,1-Dichloroethane	75-34-3	Yes	0.000255649	3.09E-03	--	--	
1,1-Dichloroethene	75-35-4	Yes	0.00016874	2.04E-03	--	--	
1,2-Dichlorobenzene	95-50-1	Yes	0.003	3.63E-02	--	--	
1,4-Dichlorobenzene	106-46-7	Yes	0.000130957	1.58E-03	1.10E-05	1.74E-08	5.6
1,4-Dioxane	123-91-1	--	0.0081	--(b)	7.70E-06	--(b)	
2-Butanone	78-93-3	Yes	0.00055	6.65E-03	--	--	
2-Pentanone, 4-Methyl	108-10-1	Yes	0.00064	7.73E-03	--	--	
Acetone	67-64-1	Yes	0.001511507	1.83E-02	--	--	
Arsenic	7440-38-2	--	0.003140238	--(b)	4.30E-03	--(b)	
Barium	7440-39-3	--	0.072881156	--(b)	--	--(b)	
Bis(2-ethylhexyl) phthalate	117-81-7	--	0.001	--(b)	2.40E-06	--(b)	
Cadmium	7440-43-9	--	0.0045	--(b)	1.80E-03	--(b)	
Carbon disulfide	75-15-0	Yes	0.00021	2.54E-03	--	--	
Carbon tetrachloride	56-23-5	Yes	0.000170123	2.06E-03	1.50E-05	3.08E-08	9.9
Chloride	16887-00-6	--	9.9702351	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.000214204	2.59E-03	2.30E-05	5.95E-08	19
Chromium	7440-47-3	--	0.009493374	--(b)	--	--(b)	
Copper	7440-50-8	--	0.004884201	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.30080145	--(b)	--	--(b)	
Iron	7439-89-6	--	0.12126178	--(b)	--	--(b)	
Lead	7439-92-1	--	0.000581898	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.015530827	--(b)	--	--(b)	
Methylene chloride	75-09-2	Yes	0.002069589	2.50E-02	4.70E-07	1.18E-08	3.8
Nickel	7440-02-0	--	0.006014142	--(b)	2.60E-04	--(b)	
Nitrate	14797-55-8	--	23.863649	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.081906164	--(b)	--	--(b)	
Silver	7440-22-4	--	0.005776818	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.38364144	--(b)	--	--(b)	
Sulfate	14808-79-8	--	45.030868	--(b)	--	--(b)	
Tetrachloroethene	127-18-4	Yes	0.000872033	1.05E-02	5.90E-06	6.22E-08	20
Tributyl phosphate	126-73-8	--	0.012498806	--(b)	--	--(b)	
Trichloroethene	79-01-6	Yes	0.000433871	5.24E-03	2.50E-05	1.31E-07	42

Trichloromonofluoromethane	75-69-4	Yes	0.00058	7.01E-03	--	--	
Uranium	7440-61-1	--	0.016629145	--(b)	--	--(b)	
Vanadium	7440-62-2	--	0.012904693	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.068859746	--(b)	--	--(b)	
Total ELCR						3.13E-07	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b]Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area - CTUIR

Dermal Absorption of Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	35	kg	Harris et al, 2004
Exposure Time	ET	0.58	1.0	hours/day	U.S. EPA, 2004
Exposure Time (Age-Adjusted)	ETadj	0.616		hours/day	Calculated using the age adjusted intake factors equation
Surface Area	SA	18,000	6,600	cm^2	Harris et al, 2004
Age-Adjusted Surface Area	SAadj	19,097		(cm^2-yr-event)/(kg-day)	Calculated using the age adjusted intake factors equation
Event Frequency	EV	1.0	1.0	event/days	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	6.0	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Harris et al, 2004
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFo	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
Conversion Factor	CF2	365		days/year	365 days = 1 year
Conversion Factor	CF3	0.001		L/cm^3	$1 L = 1000 cm^3$
t*	Time to reach steady state	Chemical Specific		hours	EPA, 2004
B	Dermal Partitioning Constant	Chemical Specific		unitless	EPA, 2004
DA	Absorbed Dose per Event	Chemical Specific		(mg/cm^2-event)	Calculated using dermal exposure to groundwater equations as provided by U.S. EPA, 2004
Kp	Dermal Permeability Constant	Chemical Specific		cm/hour	EPA, 2004
FA	Fraction Absorbed	Chemical Specific		unitless	EPA, 2004
t	Lag Time	Chemical Specific		hours	EPA, 2004

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*.

ECF-200PO1-09-2027; Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Absorbed Dermal Dose Calculation

Contaminant of Potential Concern	CAS #	Cw (mg/L)	inorganic/organic[a]	FA[b] (unitless)	K_p[c] (cm/hour)	B[c] (unitless)	t*[c] (hours/event)	t**[c] (hours)	DA (noncancer) (mg/cm^2-event)	DA (cancer) (mg/cm^2-event)
1,1,1-Trichloroethane	71-55-6	0.000691076	INORGANIC	1.00E+00	0.013	0.1	0.6	1.43	5.21E-09	5.53E-09
1,1-Dichloroethane	75-34-3	0.000255649	INORGANIC	1.00E+00	0.0067	0	0.38	0.92	9.93E-10	1.06E-09
1,1-Dichloroethene	75-35-4	0.00016874	INORGANIC	1.00E+00	0.012	0	0.37	0.89	1.17E-09	1.25E-09
1,2-Dichlorobenzene	95-50-1	0.003	--	1.00E+00	0.041	0.2	0.71	1.71	2.18E-07	2.25E-07
1,4-Dichlorobenzene	106-46-7	0.000130957	--	1.00E+00	0.042	0.2	0.71	1.71	9.76E-09	1.01E-08
1,4-Dioxane	123-91-1	0.0081	--	1.00E+00	0.00033	0	0.33	0.8	3.23E-09	3.33E-09
2-Butanone	78-93-3	0.00055	--	1.00E+00	0.00096	0	0.27	0.65	5.78E-10	5.95E-10
2-Pentanone, 4-Methyl	108-10-1	0.00064	--	1.00E+00	0.0027	0	0.39	0.93	2.27E-09	2.34E-09
Acetone[d]	67-64-1	0.001511507	--	--	0.000512	--	--	--	--	--
Arsenic	7440-38-2	0.003140238	INORGANIC	--	0.001	--	--	--	1.82E-09	1.93E-09
Barium	7440-39-3	0.072881156	INORGANIC	--	0.001	--	--	--	4.23E-08	4.49E-08
Bis(2-ethylhexyl) phthalate	117-81-7	0.001	--	8.00E-01	0.025	0.2	16.64	39.93	1.72E-07	1.77E-07
Cadmium	7440-43-9	0.0045	INORGANIC	--	0.001	--	--	--	2.61E-09	2.77E-09
Carbon disulfide	75-15-0	0.00021	--	1.00E+00	0.017	0.1	0.3	0.72	4.12E-09	4.24E-09
Carbon tetrachloride	56-23-5	0.000170123	--	1.00E+00	0.016	0.1	0.78	1.86	5.06E-09	5.21E-09
Chloride	16887-00-6	9.9702351	INORGANIC	--	0.001	--	--	--	5.78E-06	6.14E-06
Chloroform	67-66-3	0.000214204	--	1.00E+00	0.0068	0	0.5	1.19	2.17E-09	2.23E-09
Chromium	7440-47-3	0.009493174	INORGANIC	--	0.001	--	--	--	5.51E-09	5.85E-09
Copper	7440-50-8	0.004884201	INORGANIC	--	0.001	--	--	--	2.83E-09	3.01E-09
Fluoride	16984-48-8	0.30080145	INORGANIC	--	0.001	--	--	--	1.74E-07	1.85E-07
Iron	7439-89-6	0.12126178	INORGANIC	--	0.001	--	--	--	7.03E-08	7.47E-08
Lead	7439-92-1	0.000581898	INORGANIC	--	0.0001	--	--	--	3.38E-11	3.58E-11
Manganese	7439-96-5	0.015530827	INORGANIC	--	0.001	--	--	--	9.01E-09	9.57E-09
Methylene chloride	75-09-2	0.002069589	--	1.00E+00	0.0035	0	0.32	0.76	8.63E-09	8.89E-09
Nickel	7440-02-0	0.006014142	INORGANIC	--	0.0002	--	--	--	6.98E-10	7.41E-10
Nitrate	14797-55-8	23.863649	INORGANIC	--	0.001	--	--	--	1.38E-05	1.47E-05
Nitrite	14797-65-0	0.081906164	INORGANIC	--	0.001	--	--	--	4.75E-08	5.05E-08
Silver	7440-22-4	0.005776818	INORGANIC	--	0.0006	--	--	--	2.01E-09	2.14E-09
Strontium	7440-24-6	0.18364144	INORGANIC	--	0.001	--	--	--	2.23E-07	2.36E-07
Sulfate	14808-79-8	45.030868	INORGANIC	--	0.001	--	--	--	2.61E-05	2.77E-05
Tetrachloroethene	127-18-4	0.000872033	--	1.00E+00	0.033	0.2	0.91	2.18	5.78E-08	5.96E-08
Tributyl phosphate[e]	126-73-8	0.012498806	--	--	0.0228	--	--	--	--	--
Trichloroethene	79-01-6	0.000433871	--	1.00E+00	0.012	0.1	0.58	1.39	8.35E-09	8.60E-09
Trichloromonofluoromethane	75-69-4	0.00058	--	1.00E+00	0.013	0.1	0.63	1.51	3.26E-08	3.30E-08
Uranium	7440-61-1	0.016629145	INORGANIC	--	0.001	--	--	--	9.64E-09	1.02E-08
Vanadium	7440-62-2	0.012904693	INORGANIC	--	0.001	--	--	--	7.48E-09	7.95E-09
Zinc	7440-66-6	0.068859746	INORGANIC	--	0.0006	--	--	--	2.40E-08	2.55E-08

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

[a] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-3

[b] EPA/540/R/99/005 Exhibit B-3

[c] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	0.000691076	1.34E-06	2.00E+00	1	6.70E-07	0.0015
1,1-Dichloroethane	75-34-3	0.000255649	2.55E-07	2.00E-01	1	1.28E-06	0.0029
1,1-Dichloroethene	75-35-4	0.00016874	3.02E-07	5.00E-02	1	6.04E-06	0.014
1,2-Dichlorobenzene	95-50-1	0.003	5.61E-05	9.00E-02	1	6.23E-04	1.4
1,4-Dichlorobenzene	106-46-7	0.000130957	2.51E-06	7.00E-02	1	3.58E-05	0.082
1,4-Dioxane	123-91-1	0.0081	8.31E-07	1.00E-01	1	8.31E-06	0.019
2-Butanone	78-93-3	0.00055	1.49E-07	6.00E-01	1	2.48E-07	5.69E-04
2-Pentanone, 4-Methyl	108-10-1	0.00064	5.84E-07	8.00E-02	1	7.30E-06	0.017
Acetone	67-64-1	0.001511507	--	9.00E-01	1	--	--
Arsenic	7440-38-2	0.003140238	4.68E-07	3.00E-04	1	1.56E-03	3.6
Barium	7440-39-3	0.072881156	1.09E-05	2.00E-01	0.07	7.76E-04	1.8
Bis(2-ethylhexyl) phthalate	117-81-7	0.001	4.42E-05	2.00E-02	1	2.21E-03	5.1
Cadmium	7440-43-9	0.0045	6.71E-07	5.00E-04	0.05	2.68E-02	62
Carbon disulfide	75-15-0	0.00021	1.06E-06	1.00E-01	1	1.06E-05	0.024
Carbon tetrachloride	56-23-5	0.000170123	1.30E-06	7.00E-04	1	1.86E-03	4.3
Chloride	16887-00-6	9.9702351	1.49E-03	--	1	--	--
Chloroform	67-66-3	0.000214204	5.57E-07	1.00E-02	1	5.57E-05	0.13
Chromium	7440-47-3	0.009493174	1.42E-06	1.50E+00	0.013	7.26E-05	0.17
Copper	7440-50-8	0.004884201	7.28E-07	4.00E-02	1	1.82E-05	0.042
Fluoride	16984-48-8	0.30080145	4.49E-05	6.00E-02	1	7.48E-04	1.7
Iron	7439-89-6	0.12126178	1.81E-05	7.00E-01	1	2.58E-05	0.059
Lead	7439-92-1	0.000581898	8.68E-09	--	1	--	--
Manganese	7439-96-5	0.015530827	2.32E-06	2.40E-02	0.04	2.41E-03	5.5
Methylene chloride	75-09-2	0.002069589	2.22E-06	6.00E-02	1	3.70E-05	0.085
Nickel	7440-02-0	0.006014142	1.79E-07	2.00E-02	0.04	2.24E-04	0.52
Nitrate	14797-55-8	23.863649	3.56E-03	7.10E+00	1	5.01E-04	1.2
Nitrite	14797-65-0	0.081906164	1.22E-05	3.00E-01	1	4.07E-05	0.094
Silver	7440-22-4	0.005776818	5.17E-07	5.00E-03	0.04	2.58E-03	5.9
Strontium	7440-24-6	0.18364144	5.72E-05	6.00E-01	1	9.54E-05	0.22
Sulfate	14808-79-8	45.030868	6.72E-03	--	--	--	--
Tetrachloroethene	127-18-4	0.000872033	1.49E-05	1.00E-02	1	1.49E-03	3.4
Tributyl phosphate	126-73-8	0.012498806	--	2.00E-01	1	--	--
Trichloroethene	79-01-6	0.000433871	2.15E-06	--	1	--	--
Trichloromonofluoromethane	75-69-4	0.00058	3.24E-06	3.00E-01	1	1.08E-05	0.025
Uranium	7440-61-1	0.016629145	2.48E-06	3.00E-03	1	8.27E-04	1.9
Vanadium	7440-62-2	0.012904693	1.92E-06	5.00E-03	1	3.85E-04	0.89
Zinc	7440-66-6	0.068859746	6.16E-06	3.00E-01	1	2.05E-05	0.047
Total						0.04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	0.000691076	1.31E-06	--	1	--	
1,1-Dichloroethane	75-34-3	0.000255649	2.88E-07	--	1	--	
1,1-Dichloroethene	75-35-4	0.00016874	3.40E-07	--	1	--	
1,2-Dichlorobenzene	95-50-1	0.003	6.31E-05	--	1	--	
1,4-Dichlorobenzene	106-46-7	0.000130957	2.74E-06	5.40E-03	1	1.48E-08	0.14
1,4-Dioxane	123-91-1	0.0081	9.09E-07	1.10E-02	1	1.00E-08	0.093
2-Butanone	78-93-3	0.00055	1.62E-07	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	0.00064	6.39E-07	--	1	--	
Acetone	67-64-1	0.001511507	--	--	1	--	
Arsenic	7440-38-2	0.003140238	5.28E-07	1.50E+00	1	7.92E-07	7.4
Barium	7440-39-3	0.072881156	1.22E-05	--	0.07	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.001	4.83E-05	1.40E-02	1	6.76E-07	6.3
Cadmium	7440-43-9	0.0045	7.56E-07	--	0.05	--	
Carbon disulfide	75-15-0	0.00021	1.16E-06	--	1	--	
Carbon tetrachloride	56-23-5	0.000170123	1.42E-06	1.30E-01	1	1.85E-07	1.7
Chloride	16887-00-6	9.9702351	1.68E-03	--	1	--	
Chloroform	67-66-3	0.000214204	6.10E-07	3.10E-02	1	1.89E-08	0.18
Chromium	7440-47-3	0.009493174	1.56E-06	--	0.013	--	
Copper	7440-50-8	0.004884201	8.21E-07	--	1	--	
Fluoride	16984-48-8	0.30080145	5.06E-05	--	1	--	
Iron	7439-89-6	0.12126178	2.04E-05	--	1	--	
Lead	7439-92-1	0.000581898	9.78E-09	--	1	--	
Manganese	7439-96-5	0.015530827	2.61E-06	--	0.04	--	
Methylene chloride	75-09-2	0.002069589	2.43E-06	7.50E-03	1	1.82E-08	0.17
Nickel	7440-02-0	0.006014142	2.02E-07	--	0.04	--	

Nitrate	14797-55-8	23.863649	4.01E-03	--	1	--	
Nitrite	14797-65-0	0.081906164	1.38E-05	--	1	--	
Silver	7440-22-4	0.005776818	5.82E-07	--	0.04	--	
Strontium	7440-24-6	0.38364144	6.45E-05	--	1	--	
Sulfate	14808-79-8	45.030868	7.57E-03	--	--	--	
Tetrachloroethene	127-18-4	0.000872033	1.62E-05	5.40E-01	1	8.77E-06	82
Tributyl phosphate	126-73-8	0.012498806	--	9.20E-03	1	--	
Trichloroethene	79-01-6	0.000433871	2.35E-06	8.90E-02	1	2.09E-07	2.0
Trichloromonofluoromethane	75-69-4	0.00058	3.54E-06	--	1	--	
Uranium	7440-61-1	0.016629145	2.79E-06	--	1	--	
Vanadium	7440-62-2	0.012904693	2.17E-06	--	1	--	
Zinc	7440-66-6	0.068859746	6.10E-07	--	1	--	
Total ELCR						1.07E-05	100

* EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area - CTUIR

Inhalation of Volatile Radioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Factor	Symbol	Adult	Child	Unit	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Harris et al, 2004
Exposure duration	ED	70	6	years	Harris et al, 2004
Inhalation Rate	INH_a	25	15	m^3/day	Harris, 2008
Exposure time	ET	0.58	1	hr/day	U.S. EPA, 2004
Age Adjusted Exposure Time	ET_{adj}	0.616		hrs	Calculated using the age adjusted intake factors equation
Radiation Age-adjusted inhalation rate	INH_RAD_{adj}	1690		m^3-yr/day	Calculated using the age adjusted intake factors equation
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Radiation Inhalation of Volatiles Slope Factor	Sfi	Chemical Specific		risk/pCi	U.S. EPA, 1997

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*.

Harris, S., 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments*.

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

Inhalation of Volatile Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Radioactive COPC	CAS #	VOC[a]	Cw (pCi/L)	CDI (radiological inhalation) (pCi)	SF_i (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	6.4100896	--(b)	--	--(b)	
Gross beta	12587-47-2	--	32.397036	--(b)	--	--(b)	
Iodine-129	15046-84-1	--	1.9883847	--(b)	6.07E-11	--(b)	
Nickel-63	13981-37-8	--	4.07	--(b)	1.64E-12	--(b)	
Protactinium-231	14331-85-2	--	0.308	--(b)	4.55E-08	--(b)	
Strontium-90	10098-97-2	--	0.611	--(b)	1.05E-10	--(b)	
Technetium-99	14133-76-7	--	93.996334	--(b)	1.41E-11	--(b)	
Tritium	10028-17-8	Yes	264106.86	2.09E+09	5.62E-14	1.17E-04	100
Total ELCR						1.17E-04	100

[a] Radiological contaminants considered volatile for the groundwater inhalation pathway are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area - CTUIR

Ingestion of Radioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Factor	Symbol	Unit		Value	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Harris et al, 2004
Exposure duration	ED	70	6	years	Harris et al, 2004
Drinking Water Ingestion Rate	IRW	4	1	L/day	Harris, 2008
Radiation Age-adjusted drinking water ingestion rate	IRW_RAD_{adj}	262		L-yr/day	Calculated using the age adjusted intake factors equation
Radiation Ingestion of Water Slope Factor	Sfo	Chemical Specific		risk/pCi	U.S. EPA, 1997

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

Harris, S., 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

Ingestion of Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Radioactive COPC	CAS #	Cw (pCi/L)	I (radiological ingestic (pCi)	SF_o (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	6.4100896	612,997	--	--	
Gross beta	12587-47-2	32.397036	3,098,129	--	--	
Iodine-129	15046-84-1	1.9883847	190,149	1.48E-10	2.81E-05	2.1
Nickel-63	13981-37-8	4.07	389,214	6.70E-13	2.61E-07	0.020
Protactinium-231	14331-85-2	0.308	29,454	1.73E-10	5.10E-06	0.39
Strontium-90	10098-97-2	0.611	58,430	5.59E-11	3.27E-06	0.25
Technetium-99	14133-76-7	93.996334	8.99E+06	2.75E-12	2.47E-05	1.9
Tritium	10028-17-8	264106.86	2.53E+10	5.07E-14	1.28E-03	97
Total ELCR					1.31E-03	100

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Drinking Water Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwate C_w (mg/L)	VOC?	HQ (Inhalation) (unitless)	HQ (Ingestion) (unitless)	HQ (Dermal) (unitless)	Total HI (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--(b)	--	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.66E-09	--	--(b)	--	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--(b)	--	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--(b)	--	--	--	
1,2-Dichloroethane	0.00064	Yes	3.22E-06	1.83E-03	4.48E-05	1.88E-03	2.15E-02
2,3,4,6-Tetrachlorophenol	0.0077	--	--(b)	1.47E-02	--	1.47E-02	1.68E-01
Aluminum	0.046776593	--	--(b)	2.67E-03	6.98E-06	2.68E-03	3.07E-02
Arsenic	0.00579213	--	--(b)	1.10E+00	2.88E-03	1.11E+00	12.67
Barium	0.053448218	--	--(b)	1.53E-02	5.69E-04	1.58E-02	0.182
Beryllium	0.000342265	--	--(b)	9.78E-03	3.65E-03	1.34E-02	0.15
Bis(2-ethylhexyl) phthalate	0.011	--	--(b)	3.14E-02	2.43E-02	5.57E-02	0.638
Cadmium	0.002729138	--	--(b)	3.12E-01	1.63E-02	3.28E-01	3.8
Carbon tetrachloride	0.000282669	Yes	1.80E-05	2.31E-02	3.09E-03	2.62E-02	0.3000
Chloride	12.62269	--	--(b)	--	--	--	
Chloroform	0.00038106	Yes	4.70E-05	2.18E-03	9.92E-05	2.32E-03	2.66E-02
Chromium	0.015259293	--	--(b)	5.81E-04	1.17E-04	6.98E-04	0.008
Cobalt	0.004495239	--	--(b)	8.56E-01	8.94E-04	8.57E-01	9.82
Copper	0.004447607	--	--(b)	6.35E-03	1.66E-05	6.37E-03	0.0730
Fluoride	0.2940596	--	--(b)	2.80E-01	7.31E-04	2.81E-01	3.217
Hexavalent Chromium	0.191	--	--(b)	3.64E+00	7.60E-01	4.40E+00	50
Iron	0.090209963	--	--(b)	7.36E-03	1.92E-05	7.38E-03	0.0846
Lead	0.001548018	--	--(b)	--	--	--	
Manganese	0.006198141	--	--(b)	1.48E-02	9.63E-04	1.57E-02	0.18
Nickel	0.011729633	--	--(b)	3.35E-02	4.37E-04	3.40E-02	0.389
Nitrate	34.098186	--	--(b)	2.74E-01	7.16E-04	2.75E-01	3.153
Nitrite	0.057119962	--	--(b)	1.09E-02	2.84E-05	1.09E-02	0.1250
Nitrogen in Nitrite and Nitrate	14.7	--	--(b)	5.25E-01	1.37E-03	5.26E-01	6.03
Octachlorodibenzofuran	9.9649E-09	--	--(b)	--	--	--	
Octachlorodibenzo-p-dioxin	5.8071E-09	--	--(b)	--	--	--	
Silver	0.005686587	--	--(b)	6.50E-02	2.54E-03	6.75E-02	0.77
Strontium	0.2694514	--	--(b)	2.57E-02	6.70E-05	2.57E-02	0.2948
Sulfate	64.094058	--	--(b)	--	--	--	
Toluene	3.56519E-05	Yes	8.62E-08	2.55E-05	4.42E-06	3.00E-05	3.43E-04
Total petroleum hydrocarbons - gasoline range	0.05	--	--(b)	--	--	--	
Trichloroethene	0.000563286	Yes	1.94E-04	--	--	1.94E-04	2.23E-03
Uranium	0.020191069	--	--(b)	3.85E-01	1.00E-03	3.86E-01	
Vanadium	0.02186531	--	--(b)	2.50E-01	6.52E-04	2.51E-01	
Zinc	0.095789222	--	--(b)	1.82E-02	2.86E-05	1.83E-02	0.2094
Total			2.63E-04	7.91	0.82	8.73	93

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

HQ = hazard quotient.

HI = hazard index.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Drinking Water Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwate C_w (mg/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--(b)	2.81E-07	--	2.81E-07	0.052
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.66E-09	--	--(b)	4.26E-07	--	4.26E-07	0.080
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--(b)	2.19E-06	--	2.19E-06	0.41
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--(b)	1.58E-06	--	1.58E-06	0.30
1,2-Dichloroethane	0.00064	Yes	2.01E-07	3.38E-06	8.92E-08	3.67E-06	0.68
2,3,4,6-Tetrachlorophenol	0.0077	--	--(b)	--	--	--	
Aluminum	0.046776593	--	--(b)	--	--	--	
Arsenic	0.00579213	--	--(b)	5.04E-04	1.46E-06	5.05E-04	94
Barium	0.053448218	--	--(b)	--	--	--	
Beryllium	0.000342265	--	--(b)	--	--	--	
Bis(2-ethylhexyl) phthalate	0.011	--	--(b)	8.93E-06	7.44E-06	1.64E-05	3.1
Cadmium	0.002729138	--	--(b)	--	--	--	
Carbon tetrachloride	0.000282669	Yes	5.12E-08	2.13E-06	3.07E-07	2.49E-06	0.46
Chloride	12.62269	--	--(b)	--	--	--	
Chloroform	0.00038106	Yes	1.06E-07	6.85E-07	3.36E-08	8.24E-07	0.15
Chromium	0.015259293	--	--(b)	--	--	--	
Cobalt	0.004495239	--	--(b)	--	--	--	
Copper	0.004447607	--	--(b)	--	--	--	
Fluoride	0.2940596	--	--(b)	--	--	--	
Hexavalent Chromium	0.191	--	--(b)	--	--	--	

Iron	0.090209963	--	--(b)	--	--	--	
Lead	0.001548018	--	--(b)	--	--	--	
Manganese	0.006198141	--	--(b)	--	--	--	
Nickel	0.011729633	--	--(b)	--	--	--	
Nitrate	34.098186	--	--(b)	--	--	--	
Nitrite	0.057119962	--	--(b)	--	--	--	
Nitrogen in Nitrite and Nitrate	14.7	--	--(b)	--	--	--	
Octachlorodibenzofuran	9.9649E-09	--	--(b)	2.25E-08	--	2.25E-08	0.0042
Octachlorodibenzo-p-dioxin	5.8071E-09	--	--(b)	1.31E-08	--	1.31E-08	0.0024
Silver	0.005686587	--	--(b)	--	--	--	
Strontium	0.2694514	--	--(b)	--	--	--	
Sulfate	64.094058	--	--(b)	--	--	--	
Toluene	3.56519E-05	Yes	--	--	--	--	
Total petroleum hydrocarbons - gasoline range	0.05	--	--(b)	--	--	--	
Trichloroethene	0.000563286	Yes	1.70E-07	2.91E-06	2.71E-07	3.35E-06	0.62
Uranium	0.020191069	--	--(b)	--	--	--	
Vanadium	0.02186531	--	--(b)	--	--	--	
Zinc	0.095789222	--	--(b)	--	--	--	
Total ELCR			5.28E-07	5.26E-04	9.60E-06	5.36E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Drinking Water Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwate C_w (pCi/L)	Volatile?[a]	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	5.3264311	--	--(b)	--	--	
Iodine-129	2.708038	--	--(b)	3.83E-05	3.83E-05	2.9
Plutonium-239/240	0.029	--	--(b)	3.74E-07	3.74E-07	0.028
Protactinium-231	0.28	--	--(b)	4.63E-06	4.63E-06	0.35
Strontium-90	4.3004432	--	--(b)	2.30E-05	2.30E-05	1.7
Technetium-99	1667.3497	--	--(b)	4.38E-04	4.38E-04	33
Tritium	156901.45	Yes	6.98E-05	7.61E-04	8.31E-04	62
Total ELCR			6.98E-05	1.22E-03	1.34E-03	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-Field exposure area - CTUIR

Ingestion of Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Ingestion Chronic Daily Intake	CDI	calculated		mg/kg-day	EPA 1989
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70.0	15.0	kg	Harris et al, 2004
Drinking Water Ingestion Rate	IRW	4.0	1.0	Liters/day	Harris et al, 2004
Age-Adjusted Drinking Water Ingestion Rate	IRWadj	4.057		L-yr/kg-day	Calculated using the age adjusted intake factors equation
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	6	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Harris et al, 2004
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFo	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 1989

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.734E-09	2.13E-10	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.66E-09	3.23E-10	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	1.66E-10	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	1.20E-10	--	--	
1,2-Dichloroethane	107-06-2	0.00064	3.66E-05	2.00E-02	1.83E-03	0.02
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	4.40E-04	3.00E-02	1.47E-02	0.19
Aluminum	7429-90-5	0.046776593	2.67E-03	1.00E+00	2.67E-03	0.03
Arsenic	7440-38-2	0.00579213	3.31E-04	3.00E-04	1.10E+00	13.95
Barium	7440-39-3	0.053448218	3.05E-03	2.00E-01	1.53E-02	0.19
Beryllium	7440-41-7	0.000342265	1.96E-05	2.00E-03	9.78E-03	0.12
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	6.29E-04	2.00E-02	3.14E-02	0.40
Cadmium	7440-43-9	0.002729138	1.56E-04	5.00E-04	3.12E-01	3.94
Carbon tetrachloride	56-23-5	0.000282669	1.62E-05	7.00E-04	2.31E-02	0.29
Chloride	16887-00-6	12.62269	7.21E-01	--	--	
Chloroform	67-66-3	0.00038106	2.18E-05	1.00E-02	2.18E-03	0.03
Chromium	7440-47-3	0.015259293	8.72E-04	1.50E+00	5.81E-04	0.01
Cobalt	7440-48-4	0.004495239	2.57E-04	3.00E-04	8.56E-01	10.83
Copper	7440-50-8	0.004447607	2.54E-04	4.00E-02	6.35E-03	0.08
Fluoride	16984-48-8	0.2940596	1.68E-02	6.00E-02	2.80E-01	3.54
Hexavalent Chromium	18540-29-9	0.191	1.09E-02	3.00E-03	3.64E+00	46.01
Iron	7439-89-6	0.090209963	5.15E-03	7.00E-01	7.36E-03	0.09
Lead	7439-92-1	0.001548018	8.85E-05	--	--	
Manganese	7439-96-5	0.006198141	3.54E-04	2.40E-02	1.48E-02	0.19
Nickel	7440-02-0	0.011729633	6.70E-04	2.00E-02	3.35E-02	0.42
Nitrate	14797-55-8	34.098186	1.95E+00	7.10E+00	2.74E-01	3.47
Nitrite	14797-65-0	0.057119962	3.26E-03	3.00E-01	1.09E-02	0.14
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	8.40E-01	1.60E+00	5.25E-01	6.64
Octachlorodibenzofuran	39001-02-0	9.9649E-09	5.69E-10	--	--	
Octachlorodibenzo-p-dioxin	3268-87-9	5.8071E-09	3.32E-10	--	--	
Silver	7440-22-4	0.005686587	3.25E-04	5.00E-03	6.50E-02	0.82
Strontium	7440-24-6	0.2694514	1.54E-02	6.00E-01	2.57E-02	0.32
Sulfate	14808-79-8	64.094058	3.66E+00	--	--	
Toluene	108-88-3	3.56519E-05	2.04E-06	8.00E-02	2.55E-05	0.00
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	2.86E-03	--	--	
Trichloroethene	79-01-6	0.000563286	3.22E-05	--	--	
Uranium	7440-61-1	0.020191069	1.15E-03	3.00E-03	3.85E-01	4.86
Vanadium	7440-62-2	0.02186531	1.25E-03	5.00E-03	2.50E-01	3.16
Zinc	7440-66-6	0.095789222	5.47E-03	3.00E-01	1.82E-02	0.23
Total					7.91E+00	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.734E-09	2.16E-10	1.30E+03	2.81E-07	0.053
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.66E-09	3.28E-10	1.30E+03	4.26E-07	0.081
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	1.68E-10	1.30E+04	2.19E-06	0.42
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	1.22E-10	1.30E+04	1.58E-06	0.30
1,2-Dichloroethane	107-06-2	0.00064	3.71E-05	9.10E-02	3.38E-06	0.64
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	4.46E-04	--	--	
Aluminum	7429-90-5	0.046776593	2.71E-03	--	--	
Arsenic	7440-38-2	0.00579213	3.36E-04	1.50E+00	5.04E-04	96
Barium	7440-39-3	0.053448218	3.10E-03	--	--	
Beryllium	7440-41-7	0.000342265	1.98E-05	--	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	6.38E-04	1.40E-02	8.93E-06	1.7
Cadmium	7440-43-9	0.002729138	1.58E-04	--	--	
Carbon tetrachloride	56-23-5	0.000282669	1.64E-05	1.30E-01	2.13E-06	0.40
Chloride	16887-00-6	12.62269	7.32E-01	--	--	
Chloroform	67-66-3	0.00038106	2.21E-05	3.10E-02	6.85E-07	0.13
Chromium	7440-47-3	0.015259293	8.84E-04	--	--	
Cobalt	7440-48-4	0.004495239	2.61E-04	--	--	
Copper	7440-50-8	0.004447607	2.58E-04	--	--	
Fluoride	16984-48-8	0.2940596	1.70E-02	--	--	
Hexavalent Chromium	18540-29-9	0.191	1.11E-02	--	--	
Iron	7439-89-6	0.090209963	5.23E-03	--	--	
Lead	7439-92-1	0.001548018	8.97E-05	--	--	
Manganese	7439-96-5	0.006198141	3.59E-04	--	--	
Nickel	7440-02-0	0.011729633	6.80E-04	--	--	
Nitrate	14797-55-8	34.098186	1.98E+00	--	--	
Nitrite	14797-65-0	0.057119962	3.31E-03	--	--	

Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	8.52E-01	--	--	
Octachlorodibenzofuran	39001-02-0	9.9649E-09	5.78E-10	3.90E+01	2.25E-08	0.0043
Octachlorodibenzo-p-dioxin	3268-87-9	5.8071E-09	3.37E-10	3.90E+01	1.31E-08	0.0025
Silver	7440-22-4	0.005686587	3.30E-04	--	--	
Strontium	7440-24-6	0.2694514	1.56E-02	--	--	
Sulfate	14808-79-8	64.094058	3.71E+00	--	--	
Toluene	108-88-3	3.56519E-05	2.07E-06	--	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	2.90E-03	--	--	
Trichloroethene	79-01-6	0.000563286	3.26E-05	8.90E-02	2.91E-06	0.55
Uranium	7440-61-1	0.020191069	1.17E-03	--	--	
Vanadium	7440-62-2	0.02186531	1.27E-03	--	--	
Zinc	7440-66-6	0.095789222	5.55E-03	--	--	
Total ELCR					5.26E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-Field exposure area - CTUIR

Inhalation of Volatile Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Inhalation Chronic Daily Intake	CDI	calculated		mg/m^3 for noncarcinogens, $\mu g/m^3$ for carcinogens	EPA 2009b
Contaminant concentration in drinking water	C_w	contaminant-specific		mg/L	ECF-200PO1-09-2027
Exposure Time	ET	0.580	--	hours/day	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	--	yr	Harris et al, 2004
Averaging Time	AT	70	--	yr	Harris et al, 2004
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Inhalation Reference Concentration	RfC_i	Chemical Specific		mg/m^3	EPA 2009a
Inhalation Unit Risk	IUR	Chemical Specific		$(\mu g/m^3)^{-1}$	EPA 2009a
Conversion Factor	CF1	365		days/year	EPA 2009b
Conversion Factor	CF2	0.042		1day/24 hours	EPA 2009b

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009a EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

U.S. EPA 2009b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (noncarcinogen) (mg/m^3)	RfC^a (mg/m^3)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(b)	--	--(b)	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.66E-09	--(b)	--	--(b)	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(b)	--	--(b)	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(b)	--	--(b)	
1,2-Dichloroethane	107-06-2	Yes	0.00064	7.73E-06	2.40E+00	3.22E-06	1.23
2,3,4,6-Tetrachlorophenol	58-90-2	--	0.0077	--(b)	--	--(b)	
Aluminum	7429-90-5	--	0.046776593	--(b)	5.00E-03	--(b)	
Arsenic	7440-38-2	--	0.00579213	--(b)	1.50E-05	--(b)	
Barium	7440-39-3	--	0.053448218	--(b)	5.00E-04	--(b)	
Beryllium	7440-41-7	--	0.000342265	--(b)	2.00E-05	--(b)	
Bis(2-ethylhexyl) phthalate	117-81-7	--	0.011	--(b)	--	--(b)	
Cadmium	7440-43-9	--	0.002729138	--(b)	1.00E-05	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.000282669	3.42E-06	1.90E-01	1.80E-05	6.8
Chloride	16887-00-6	--	12.62269	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.00038106	4.60E-06	9.80E-02	4.70E-05	18
Chromium	7440-47-3	--	0.015259293	--(b)	--	--(b)	
Cobalt	7440-48-4	--	0.004495239	--(b)	6.00E-06	--(b)	
Copper	7440-50-8	--	0.004447607	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.2940596	--(b)	1.30E-02	--(b)	
Hexavalent Chromium	18540-29-9	--	0.191	--(b)	1.00E-04	--(b)	
Iron	7439-89-6	--	0.090209963	--(b)	--	--(b)	
Lead	7439-92-1	--	0.001548018	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.006198141	--(b)	5.00E-05	--(b)	
Nickel	7440-02-0	--	0.011729633	--(b)	9.00E-05	--(b)	
Nitrate	14797-55-8	--	34.098186	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.057119962	--(b)	--	--(b)	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(b)	--	--(b)	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(b)	--	--(b)	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.8071E-09	--(b)	--	--(b)	
Silver	7440-22-4	--	0.005686587	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.2694514	--(b)	--	--(b)	
Sulfate	14808-79-8	--	64.094058	--(b)	--	--(b)	
Toluene	108-88-3	Yes	3.56519E-05	4.31E-07	5.00E+00	8.62E-08	0.03
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(b)	--	--(b)	
Trichloroethene	79-01-6	Yes	0.000563286	6.81E-06	3.50E-02	1.94E-04	74
Uranium	7440-61-1	--	0.020191069	--(b)	3.00E-04	--(b)	
Vanadium	7440-62-2	--	0.02186531	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.095789222	--(b)	--	--(b)	
Total						2.63E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (carcinogen) ($\mu g/m^3$)	IUR^a $(\mu g/m^3)^{-1}$	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(b)	3.80E-01	--(b)	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.66E-09	--(b)	3.80E-01	--(b)	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(b)	3.80E+00	--(b)	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(b)	3.80E+00	--(b)	
1,2-Dichloroethane	107-06-2	Yes	0.00064	7.73E-03	2.60E-05	2.01E-07	38
2,3,4,6-Tetrachlorophenol	58-90-2	--	0.0077	--(b)	--	--(b)	
Aluminum	7429-90-5	--	0.046776593	--(b)	--	--(b)	
Arsenic	7440-38-2	--	0.00579213	--(b)	4.30E-03	--(b)	
Barium	7440-39-3	--	0.053448218	--(b)	--	--(b)	
Beryllium	7440-41-7	--	0.000342265	--(b)	2.40E-03	--(b)	
Bis(2-ethylhexyl) phthalate	117-81-7	--	0.011	--(b)	2.40E-06	--(b)	
Cadmium	7440-43-9	--	0.002729138	--(b)	1.80E-03	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.000282669	3.42E-03	1.50E-05	5.12E-08	10
Chloride	16887-00-6	--	12.62269	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.00038106	4.60E-03	2.30E-05	1.06E-07	20
Chromium	7440-47-3	--	0.015259293	--(b)	--	--(b)	
Cobalt	7440-48-4	--	0.004495239	--(b)	9.00E-03	--(b)	
Copper	7440-50-8	--	0.004447607	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.2940596	--(b)	--	--(b)	
Hexavalent Chromium	18540-29-9	--	0.191	--(b)	8.40E-02	--(b)	
Iron	7439-89-6	--	0.090209963	--(b)	--	--(b)	
Lead	7439-92-1	--	0.001548018	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.006198141	--(b)	--	--(b)	
Nickel	7440-02-0	--	0.011729633	--(b)	2.60E-04	--(b)	
Nitrate	14797-55-8	--	34.098186	--(b)	--	--(b)	

Nitrite	14797-65-0	--	0.057119962	--(b)	--	--(b)	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(b)	--	--(b)	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(b)	1.14E-02	--(b)	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.8071E-09	--(b)	1.14E-02	--(b)	
Silver	7440-22-4	--	0.005686587	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.2694514	--(b)	--	--(b)	
Sulfate	14808-79-8	--	64.094058	--(b)	--	--(b)	
Toluene	108-88-3	Yes	3.56519E-05	4.31E-04	--	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(b)	--	--(b)	
Trichloroethene	79-01-6	Yes	0.000563286	6.81E-03	2.50E-05	1.70E-07	32
Uranium	7440-61-1	--	0.020191069	--(b)	--	--(b)	
Vanadium	7440-62-2	--	0.02186531	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.095789222	--(b)	--	--(b)	
Total ELCR						5.28E-07	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-Field exposure area - CTUIR

Dermal Absorption of Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	15	kg	Harris et al, 2004
Exposure Time	ET	0.58	1.0	hours/day	U.S. EPA, 2004
Exposure Time (Age-Adjusted)	ETadj	0.616		hours/day	Calculated using the age adjusted intake factors equation
Surface Area	SA	18,000	6,600	cm^2	Harris et al, 2004
Age-Adjusted Surface Area	SAadj	19,097		(cm^2-yr event)/(kg-day)	Calculated using the age adjusted intake factors equation
Event Frequency	EV	1.0	1.0	Event/days	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	6.0	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Harris et al, 2004
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFO	Oral Cancer Slope Factor	Chemical Specific		(mg/kg-day)$^{-1}$	EPA 2009
Conversion Factor	CF2	365		days/year	365 days = 1 year
Conversion Factor	CF3	0.001		L/cm^3	1 L = 1000 cm^3
t*	Time to reach steady state	Chemical Specific		hours	EPA, 2004
B	Dermal Partitioning Constant	Chemical Specific		unitless	EPA, 2004
DA	Absorbed Dose per Event	Chemical Specific		(mg/cm^2-event)	Calculated using dermal exposure to groundwater equations as provided by U.S. EPA, 2004
Kp	Dermal Permeability Constant	Chemical Specific		cm/hour	EPA, 2004
FA	Fraction Absorbed	Chemical Specific		unitless	EPA, 2004
t	Lag Time	Chemical Specific		hours	EPA, 2004

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Absorbed Dermal Dose Calculation

Contaminant of Potential Concern	CAS #	Cw (mg/L)	Inorganic/organic[a]	FA[b] (unitless)	K_p[c] (cm/hour)	B[b] (unitless)	t*[b] (hours/event)	t**[b] (hours)	DA (noncancer) (mg/cm^2-event)	DA (cancer) (mg/cm^2-event)
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.73E-09	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran[c]	67562-39-4	5.66E-09	--	--	1.45	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran[c]	70648-26-9	2.9E-09	--	--	2.25	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuranc	57117-44-9	2.1E-09	--	--	2.25	--	--	--	--	--
1,2 Dichloroethane	107-06-2	0.00064	--	1.0	0.0042	0	0.38	0.92	3.49E-09	3.59E-09
2,3,4,6-Tetrachlorophenol[c]	58-90-2	0.0077	--	--	0.071	--	--	--	--	--
Aluminum	7429-90-5	0.046776593	INORGANIC	--	0.001	--	--	--	2.71E-08	2.88E-08
Arsenic	7440-38-2	0.00579213	INORGANIC	--	0.001	--	--	--	3.36E-09	3.57E-09
Barium	7440-39-3	0.053448218	INORGANIC	--	0.001	--	--	--	3.10E-08	3.29E-08
Beryllium	7440-41-7	0.000342265	INORGANIC	--	0.001	--	--	--	1.99E-10	2.11E-10
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	--	0.8	0.025	0.2	16.64	39.93	1.89E-06	1.95E-06
Cadmium	7440-43-9	0.002729138	INORGANIC	--	0.001	--	--	--	1.58E-09	1.68E-09
Carbon tetrachloride	56-23-5	0.000282669	--	1.0	0.016	0.1	0.78	1.86	8.41E-09	8.66E-09
Chloride	16887-00-6	12.62269	INORGANIC	--	0.001	--	--	--	7.32E-06	7.78E-06
Chloroform	67-66-3	0.00038106	--	1.0	0.0068	0	0.50	1.19	3.86E-09	3.97E-09
Chromium	7440-47-3	0.015259293	INORGANIC	--	0.001	--	--	--	8.85E-09	9.40E-09
Cobalt	7440-48-4	0.004495239	INORGANIC	--	0.0004	--	--	--	1.04E-09	1.11E-09
Copper	7440-50-8	0.004447607	INORGANIC	--	0.001	--	--	--	2.58E-09	2.74E-09
Fluoride	16984-48-8	0.2940596	INORGANIC	--	0.001	--	--	--	1.71E-07	1.81E-07
Hexavalent Chromium	18540-29-9	0.191	INORGANIC	--	0.002	--	--	--	2.22E-07	2.35E-07
Iron	7439-89-6	0.090209963	INORGANIC	--	0.001	--	--	--	5.23E-08	5.56E-08
Lead	7439-92-1	0.001548018	INORGANIC	--	0.0001	--	--	--	8.98E-11	9.54E-11
Manganese	7439-96-5	0.006158141	INORGANIC	--	0.001	--	--	--	3.59E-09	3.82E-09
Nickel	7440-02-0	0.011729633	INORGANIC	--	0.0002	--	--	--	1.36E-09	1.45E-09
Nitrate	14797-55-8	34.098186	INORGANIC	--	0.001	--	--	--	1.98E-05	2.10E-05
Nitrite	14797-65-0	0.057119962	INORGANIC	--	0.001	--	--	--	3.31E-08	3.52E-08
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	INORGANIC	--	0.001	--	--	--	8.53E-06	9.06E-06
Octachlorodibenzofuran[c]	39001-02-0	9.9649E-09	--	--	2.63	--	--	--	--	--
Octachlorodibenzo-p-dioxin[c]	3268-87-9	5.8071E-09	--	--	1.16	--	--	--	--	--
Silver	7440-22-4	0.005686587	INORGANIC	--	0.0006	--	--	--	1.98E-09	2.10E-09
Strontium	7440-24-6	0.2694514	INORGANIC	--	0.001	--	--	--	1.56E-07	1.66E-07
Sulfate	14808-79-8	64.094058	INORGANIC	--	0.001	--	--	--	3.72E-05	3.95E-05
Toluene	108-88-3	3.56519E-05	--	1.0	0.031	0.1	0.35	0.84	1.38E-09	1.42E-09
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	--	--	--	--	--	--	--	--
Trichloroethene	79-01-6	0.000563286	--	1.0	0.012	0.1	0.58	1.39	1.08E-08	1.12E-08
Uranium	7440-61-1	0.020191069	INORGANIC	--	0.001	--	--	--	1.17E-08	1.24E-08
Vanadium	7440-62-2	0.02186531	INORGANIC	--	0.001	--	--	--	1.27E-08	1.35E-08
Zinc	7440-66-6	0.095789222	INORGANIC	--	0.0006	--	--	--	3.33E-08	3.54E-08

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

[a] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2

[b] EPA/540/R/99/005 Exhibit B-3

[c] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.73E-09	--	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.66E-09	--	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	--	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	--	--	1	--	
1,2 Dichloroethane	107-06-2	0.00064	8.97E-07	2.00E-02	1	4.48E-05	5.47E-03
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	--	3.00E-02	1	--	
Aluminum	7429-90-5	0.046776593	6.98E-06	1.00E+00	1	6.98E-06	8.51E-04
Arsenic	7440-38-2	0.00579213	8.64E-07	3.00E-04	1	2.88E-03	0.35
Barium	7440-39-3	0.053448218	7.97E-06	2.00E-01	0.07	5.69E-04	0.069
Beryllium	7440-41-7	0.000342265	5.10E-08	2.00E-03	0.007	3.65E-03	0.44
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	4.86E-04	2.00E-02	1	2.43E-02	2.961
Cadmium	7440-43-9	0.002729138	4.07E-07	5.00E-04	0.05	1.63E-02	2.0
Carbon tetrachloride	56-23-5	0.000282669	2.16E-06	7.00E-04	1	3.09E-03	0.3766
Chloride	16887-00-6	12.62269	1.88E-03	--	1	--	
Chloroform	67-66-3	0.00038106	9.92E-07	1.00E-02	1	9.92E-05	1.21E-02
Chromium	7440-47-3	0.015259293	2.28E-06	1.50E+00	0.013	1.17E-04	0.014
Cobalt	7440-48-4	0.004495239	2.68E-07	3.00E-04	1	8.94E-04	0.11
Copper	7440-50-8	0.004447607	6.63E-07	4.00E-02	1	1.66E-05	0.0020
Fluoride	16984-48-8	0.2940596	4.39E-05	6.00E-02	1	7.31E-04	0.089
Hexavalent Chromium	18540-29-9	0.191	5.70E-05	3.00E-03	0.025	7.60E-01	93
Iron	7439-89-6	0.090209963	1.35E-05	7.00E-01	1	1.92E-05	0.0023
Lead	7439-92-1	0.001548018	2.31E-08	--	1	--	
Manganese	7439-96-5	0.006158141	9.24E-07	2.40E-02	0.04	9.63E-04	0.12
Nickel	7440-02-0	0.011729633	3.50E-07	2.00E-02	0.04	4.37E-04	0.053
Nitrate	14797-55-8	34.098186	5.09E-03	7.10E+00	1	7.16E-04	0.087
Nitrite	14797-65-0	0.057119962	8.52E-06	1.00E-01	1	2.84E-05	0.0035
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	2.19E-03	1.60E+00	1	1.37E-03	0.17
Octachlorodibenzofuran	39001-02-0	9.9649E-09	--	--	1	--	
Octachlorodibenzo-p-dioxin	3268-87-9	5.8071E-09	--	--	1	--	
Silver	7440-22-4	0.005686587	5.09E-07	5.00E-03	0.04	2.54E-03	0.31
Strontium	7440-24-6	0.2694514	4.02E-05	6.00E-01	1	6.70E-05	0.0082
Sulfate	14808-79-8	64.094058	9.56E-03	--	--	--	
Toluene	108-88-3	3.56519E-05	3.54E-07	8.00E-02	1	4.42E-06	5.39E-04
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	--	--	--	--	
Trichloroethene	79-01-6	0.000563286	2.79E-06	--	1	--	
Uranium	7440-61-1	0.020191069	3.01E-06	3.00E-03	1	1.00E-03	0.12
Vanadium	7440-62-2	0.02186531	3.26E-06	5.00E-03	1	0.0007	0.080
Zinc	7440-66-6	0.095789222	8.57E-06	3.00E-01	1	2.86E-05	0.0035
Total						0.82	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.73E-09	--	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.66E-09	--	1.30E+03	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	--	1.30E+04	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	--	1.30E+04	1	--	
1,2-Dichloroethane	107-06-2	0.00064	9.81E-07	9.10E-02	1	8.92E-08	0.93
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	--	--	1	--	
Aluminum	7429-90-5	0.046776593	7.86E-06	--	1	--	
Arsenic	7440-38-2	0.00579213	9.73E-07	1.50E+00	1	1.46E-06	15.21
Barium	7440-39-3	0.053448218	8.98E-06	--	0.07	--	
Beryllium	7440-41-7	0.000342265	5.75E-08	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	5.31E-04	1.40E-02	1	7.44E-06	77.48
Cadmium	7440-43-9	0.002729138	4.59E-07	--	0.05	--	
Carbon tetrachloride	56-23-5	0.000282669	2.36E-06	1.30E-01	1	3.07E-07	3.20
Chloride	16887-00-6	12.62269	2.12E-03	--	1	--	
Chloroform	67-66-3	0.00038106	1.08E-06	3.10E-02	1	3.36E-08	0.35
Chromium	7440-47-3	0.015259293	2.56E-06	--	0.013	--	
Cobalt	7440-48-4	0.004495239	3.02E-07	--	1	--	
Copper	7440-50-8	0.004447607	7.47E-07	--	1	--	

Fluoride	16984-48-8	0.2940596	4.94E-05	--	1	--	
Hexavalent Chromium	18540-29-9	0.191	6.42E-05	--	0.025	--	
Iron	7439-89-6	0.090209963	1.52E-05	--	1	--	
Lead	7439-92-1	0.001548018	2.60E-08	--	1	--	
Manganese	7439-96-5	0.006198141	1.04E-06	--	0.04	--	
Nickel	7440-02-0	0.011729633	3.94E-07	--	0.04	--	
Nitrate	14797-55-8	34.098186	5.73E-03	--	1	--	
Nitrite	14797-65-0	0.057119962	9.60E-06	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	2.47E-03	--	1	--	
Octachlorodibenzofuran	39001-02-0	9.9648E-09	--	3.90E+01	1	--	
Octachlorodibenzo-p-dioxin	3268-87-9	5.8071E-09	--	3.90E+01	1	--	
Silver	7440-22-4	0.005685587	5.73E-07	--	0.04	--	
Strontium	7440-24-6	0.2694514	4.53E-05	--	1	--	
Sulfate	14808-79-8	64.094058	1.08E-02	--	--	--	
Toluene	108-88-3	3.56519E-05	3.87E-07	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASO_NE	0.05	--	--	--	--	
Trichloroethene	79-01-6	0.000563286	3.05E-06	8.90E-02	1	2.71E-07	2.83
Uranium	7440-61-1	0.020191069	3.39E-06	--	1	--	
Vanadium	7440-62-2	0.02186531	3.67E-06	--	1	--	
Zinc	7440-66-6	0.095789222	9.66E-06	--	1	--	
Total ELCR						9.60E-06	100

* EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-Field exposure area - CTUIR

Inhalation of Volatile Radioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Factor	Symbol	Adult	Child	Unit	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Harris et al, 2004
Exposure duration	ED	70	6	years	Harris et al, 2004
Inhalation Rate	INH	25	15	m^3/day	Harris, 2008
Exposure time	ET	0.58	1	hr/day	U.S. EPA, 2004
Age Adjusted Exposure Time	ET_{adj}	0.616		hrs	Calculated using the age adjusted intake factors equation
Radiation Age-adjusted inhalation rate	INH_RAD_{adj}	1690		m^3-yr/day	Calculated using the age adjusted intake factors equation
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991b
Radiation Inhalation of Volatiles Slope Factor	Sfi	Chemical Specific		risk/pCi	U.S. EPA, 1997

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

Harris, S., 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Inhalation of Volatile Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	VOC[a]	Cw (pCi/L)	CDI (radiological inhalation) (pCi)	SF_i (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	5.3264311	--(b)	--	--(b)	
Iodine-129	15046-84-1	--	2.708038	--(b)	6.07E-11	--(b)	
Plutonium-239/240	PU-239/240	--	0.029	--(b)	3.33E-08	--(b)	
Protactinium-231	14331-85-2	--	0.28	--(b)	4.55E-08	--(b)	
Strontium-90	10098-97-2	--	4.3004432	--(b)	1.05E-10	--(b)	
Technetium-99	14133-76-7	--	1667.3497	--(b)	1.41E-11	--(b)	
Tritium	10028-17-8	Yes	156901.45	1.24E+09	5.62E-14	6.98E-05	100
Total ELCR						6.98E-05	100

[a] Radiological contaminants considered volatile for the groundwater inhalation pathway are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-Field exposure area - CTUIR

Ingestion of Radioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Factor	Symbol	Unit		Value	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Harris et al, 2004
Exposure duration	ED	70	6	years	Harris et al, 2004
Drinking Water Ingestion Rate	IRW	4	1	L/day	Harris, 2008
Radiation Age-adjusted drinking water ingestion rate	IRW_RAD_{adj}	262		L-yr/day	Calculated using the age adjusted intake factors equation
Radiation Ingestion of Water Slope Factor	Sfo	Chemical Specific		risk/pCi	U.S. EPA, 1997

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

Harris, S., 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Ingestion of Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	Cw (pCi/L)	)I (radiological ingestic (pCi)	SF_o (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	5.3264311	509,367	--	--	
Iodine-129	15046-84-1	2.708038	258,970	1.48E-10	3.83E-05	3.0
Plutonium-239/240	PU-239/240	0.029	2,773	1.35E-10	3.74E-07	0.030
Protactinium-231	14331-85-2	0.28	26,776	1.73E-10	4.63E-06	0.37
Strontium-90	10098-97-2	4.3004432	411,251	5.59E-11	2.30E-05	1.8
Technetium-99	14133-76-7	1667.3497	1.59E+08	2.75E-12	4.38E-04	35
Tritium	10028-17-8	156901.45	1.50E+10	5.07E-14	7.61E-04	60
Total ELCR					1.27E-03	100

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit River Unconfined Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Drinking Water Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwater C_w (mg/L)	VOC?	HQ (Inhalation) (unitless)	HQ (Ingestion) (unitless)	HQ (Dermal) (unitless)	Total HI (unitless)	% Contribution
Acetone	0.0011	Yes	4.29E-07	6.98E-05	--	7.03E-05	0.0031
Arsenic	0.005767892	--	--(b)	1.10E+00	2.87E-03	1.10E+00	49
Barium	0.049451657	--	--(b)	1.41E-02	5.27E-04	1.47E-02	0.65
Carbon tetrachloride	0.000271961	Yes	1.73E-05	2.22E-02	2.97E-03	2.52E-02	1.1
Chloride	11.3727	--	--(b)	--	--	--	
Chloroform	0.000814875	Yes	1.00E-04	4.66E-03	2.12E-04	4.97E-03	0.22
Chromium	0.009951236	--	--(b)	3.79E-04	7.61E-05	4.55E-04	0.020
Copper	0.00597989	--	--(b)	8.54E-03	2.23E-05	8.56E-03	0.38
Fluoride	0.28680392	--	--(b)	2.73E-01	7.13E-04	2.74E-01	12
Iron	0.61057915	--	--(b)	4.98E-02	1.30E-04	5.00E-02	2.2
Lead	0.0006805	--	--(b)	--	--	--	
Manganese	0.041694118	--	--(b)	9.93E-02	6.48E-03	1.06E-01	4.7
Nickel	0.0056	--	--(b)	1.60E-02	2.09E-04	1.62E-02	0.72
Nitrate	28.582087	--	--(b)	2.30E-01	6.00E-04	2.31E-01	10
Nitrite	0.46	--	--(b)	8.76E-02	2.29E-04	8.78E-02	3.9
Strontium	0.38963943	--	--(b)	3.71E-02	9.69E-05	3.72E-02	1.6
Sulfate	42.560202	--	--(b)	--	--	--	
Thallium	0.00037	--	--(b)	--	--	--	
Uranium	0.005589723	--	--(b)	1.06E-01	2.78E-04	1.07E-01	4.7
Vanadium	0.016788235	--	--(b)	1.92E-01	5.01E-04	1.92E-01	8.5
Zinc	0.006671161	--	--(b)	1.27E-03	1.99E-06	1.27E-03	0.056
Total			1.18E-04	2.24	0.02	2.26	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

HQ = hazard quotient.

HI = hazard index.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit River Unconfined Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Drinking Water Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwater C_w (mg/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Acetone	0.0011	Yes	--	--	--	--	
Arsenic	0.005767892	--	--(b)	5.01E-04	1.45E-06	5.03E-04	99
Barium	0.049451657	--	--(b)	--	--	--	
Carbon tetrachloride	0.000271961	Yes	4.93E-08	2.05E-06	2.96E-07	2.39E-06	0.47
Chloride	11.3727	--	--(b)	--	--	--	
Chloroform	0.000814875	Yes	2.26E-07	1.46E-06	7.19E-08	1.76E-06	0.35
Chromium	0.009951236	--	--(b)	--	--	--	
Copper	0.00597989	--	--(b)	--	--	--	
Fluoride	0.28680392	--	--(b)	--	--	--	
Iron	0.61057915	--	--(b)	--	--	--	
Lead	0.0006805	--	--(b)	--	--	--	
Manganese	0.041694118	--	--(b)	--	--	--	
Nickel	0.0056	--	--(b)	--	--	--	
Nitrate	28.582087	--	--(b)	--	--	--	
Nitrite	0.46	--	--(b)	--	--	--	
Strontium	0.38963943	--	--(b)	--	--	--	
Sulfate	42.560202	--	--(b)	--	--	--	
Thallium	0.00037	--	--(b)	--	--	--	
Uranium	0.005589723	--	--(b)	--	--	--	
Vanadium	0.016788235	--	--(b)	--	--	--	
Zinc	0.006671161	--	--(b)	--	--	--	
Total ELCR			2.76E-07	5.05E-04	1.82E-06	5.07E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit River Unconfined Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Drinking Water Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwater C_w (pCi/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	2.4	--	--(b)	--	--	
Gross beta	31.1	--	--(b)	--	--	
Strontium-90	2.60	--	--(b)	1.39E-05	1.39E-05	3.31
Technetium-99	121	--	--(b)	3.18E-05	3.18E-05	7.6
Tritium	70,724	Yes	3.15E-05	3.43E-04	3.74E-04	89
Total ELCR			3.15E-05	3.89E-04	4.20E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--River exposure area - CTUIR

Ingestion of Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Ingestion Chronic Daily Intake	CDI	calculated		mg/kg-day	EPA 1989
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	15	kg	Harris et al, 2004
Drinking Water Ingestion Rate	IRW	4.0	1.0	Liters/day	Harris et al, 2004
Age-Adjusted Drinking Water Ingestion Rate	IRWadj	4.057		L-yr/kg-day	Calculated using the age adjusted intake factors equation
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	6.0	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Harris et al, 2004
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFo	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 1989

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	HQ (unitless)	% Contribution
Acetone	67-64-1	0.0011	6.29E-05	9.00E-01	6.98E-05	0.0031
Arsenic	7440-38-2	0.005767892	3.30E-04	3.00E-04	1.10E+00	49
Barium	7440-39-3	0.049451657	2.83E-03	2.00E-01	1.41E-02	0.63
Carbon tetrachloride	56-23-5	0.000271961	1.55E-05	7.00E-04	2.22E-02	0.99
Chloride	16887-00-6	11.3727	6.50E-01	--	--	
Chloroform	67-66-3	0.000814875	4.66E-05	1.00E-02	4.66E-03	0.21
Chromium	7440-47-3	0.009951236	5.69E-04	1.50E+00	3.79E-04	0.017
Copper	7440-50-8	0.00597989	3.42E-04	4.00E-02	8.54E-03	0.38
Fluoride	16984-48-8	0.28680392	1.64E-02	6.00E-02	2.73E-01	12
Iron	7439-89-6	0.61057915	3.49E-02	7.00E-01	4.98E-02	2.2
Lead	7439-92-1	0.0006805	3.89E-05	--	--	
Manganese	7439-96-5	0.041694118	2.38E-03	2.40E-02	9.93E-02	4.4
Nickel	7440-02-0	0.0056	3.20E-04	2.00E-02	1.60E-02	0.71
Nitrate	14797-55-8	28.582087	1.63E+00	7.10E+00	2.30E-01	10
Nitrite	14797-65-0	0.46	2.63E-02	3.00E-01	8.76E-02	3.9
Strontium	7440-24-6	0.38963943	2.23E-02	6.00E-01	3.71E-02	1.7
Sulfate	14808-79-8	42.560202	2.43E+00	--	--	
Thallium	7440-28-0	0.00037	2.11E-05	--	--	
Uranium	7440-61-1	0.005589723	3.19E-04	3.00E-03	1.06E-01	4.8
Vanadium	7440-62-2	0.016788235	9.59E-04	5.00E-03	1.92E-01	8.6
Zinc	7440-66-6	0.006671161	3.81E-04	3.00E-01	1.27E-03	0.057
Total					2.2	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	Risk (unitless)	% Contribution
Acetone	67-64-1	0.0011	6.38E-05	--	--	
Arsenic	7440-38-2	0.005767892	3.34E-04	1.50E+00	5.01E-04	99
Barium	7440-39-3	0.049451657	2.87E-03	--	--	
Carbon tetrachloride	56-23-5	0.000271961	1.58E-05	1.30E-01	2.05E-06	0.41
Chloride	16887-00-6	11.3727	6.59E-01	--	--	
Chloroform	67-66-3	0.000814875	4.72E-05	3.10E-02	1.46E-06	0.29
Chromium	7440-47-3	0.009951236	5.77E-04	--	--	
Copper	7440-50-8	0.00597989	3.47E-04	--	--	
Fluoride	16984-48-8	0.28680392	1.66E-02	--	--	
Iron	7439-89-6	0.61057915	3.54E-02	--	--	
Lead	7439-92-1	0.0006805	3.94E-05	--	--	
Manganese	7439-96-5	0.041694118	2.42E-03	--	--	
Nickel	7440-02-0	0.0056	3.25E-04	--	--	
Nitrate	14797-55-8	28.582087	1.66E+00	--	--	
Nitrite	14797-65-0	0.46	2.67E-02	--	--	
Strontium	7440-24-6	0.38963943	2.26E-02	--	--	
Sulfate	14808-79-8	42.560202	2.47E+00	--	--	
Thallium	7440-28-0	0.00037	2.14E-05	--	--	
Uranium	7440-61-1	0.005589723	3.24E-04	--	--	
Vanadium	7440-62-2	0.016788235	9.73E-04	--	--	
Zinc	7440-66-6	0.006671161	3.87E-04	--	--	
Total ELCR					5.05E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--River exposure area - CTUIR

Inhalation of Volatile Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Inhalation Chronic Daily Intake	CDI	calculated		mg/m^3 for noncarcinogens, $\mu g/m^3$ for carcinogens	EPA 2009b
Contaminant concentration in drinking water	C_w	contaminant-specific		mg/L	ECF-200PO1-09-2027
Exposure Time	ET	0.580	--	hours/day	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	--	yr	Harris et al, 2004
Averaging Time	AT	70	--	yr	Harris et al, 2004
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Inhalation Reference Concentration	RfC_i	Chemical Specific		mg/m^3	EPA 2009a
Inhalation Unit Risk	IUR	Chemical Specific		$(\mu g/m^3)^{-1}$	EPA 2009a
Conversion Factor	CF1	365		days/year	EPA 2009b
Conversion Factor	CF2	0.042		1day/24 hours	EPA 2009b

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009a EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

U.S. EPA 2009b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	C_w (mg/L)	CDI (noncarcinogen) (mg/m^3)	RfC^a (mg/m^3)	HQ (unitless)	% Contribution
Acetone	67-64-1	Yes	0.0011	1.33E-05	3.10E+01	4.29E-07	0.36
Arsenic	7440-38-2	--	0.005767892	--(b)	1.50E-05	--(b)	
Barium	7440-39-3	--	0.049451657	--(b)	5.00E-04	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.000271961	3.29E-06	1.90E-01	1.73E-05	15
Chloride	16887-00-6	--	11.3727	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.000814875	9.85E-06	9.80E-02	1.00E-04	85
Chromium	7440-47-3	--	0.009951236	--(b)	--	--(b)	
Copper	7440-50-8	--	0.00597989	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.28680392	--(b)	1.30E-02	--(b)	
Iron	7439-89-6	--	0.61057915	--(b)	--	--(b)	
Lead	7439-92-1	--	0.0006805	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.041694118	--(b)	5.00E-05	--(b)	
Nickel	7440-02-0	--	0.0056	--(b)	9.00E-05	--(b)	
Nitrate	14797-55-8	--	28.582087	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.46	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.38963943	--(b)	--	--(b)	
Sulfate	14808-79-8	--	42.560202	--(b)	--	--(b)	
Thallium	7440-28-0	--	0.00037	--(b)	--	--(b)	
Uranium	7440-61-1	--	0.005589723	--(b)	3.00E-04	--(b)	
Vanadium	7440-62-2	--	0.016788235	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.006671161	--(b)	--	--(b)	
Total						1.18E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC[a]	C_w (mg/L)	CDI (cancer) $\mu g/m^3$	IUR^a $(\mu g/m^3)^{-1}$	Risk (unitless)	% Contribution
Acetone	67-64-1	Yes	0.0011	1.33E-02	--	--	
Arsenic	7440-38-2	--	0.005767892	--(b)	4.30E-03	--(b)	
Barium	7440-39-3	--	0.049451657	--(b)	--	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.000271961	3.29E-03	1.50E-05	4.93E-08	18
Chloride	16887-00-6	--	11.3727	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.000814875	9.85E-03	2.30E-05	2.26E-07	82
Chromium	7440-47-3	--	0.009951236	--(b)	--	--(b)	
Copper	7440-50-8	--	0.00597989	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.28680392	--(b)	--	--(b)	
Iron	7439-89-6	--	0.61057915	--(b)	--	--(b)	
Lead	7439-92-1	--	0.0006805	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.041694118	--(b)	--	--(b)	
Nickel	7440-02-0	--	0.0056	--(b)	2.60E-04	--(b)	
Nitrate	14797-55-8	--	28.582087	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.46	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.38963943	--(b)	--	--(b)	
Sulfate	14808-79-8	--	42.560202	--(b)	--	--(b)	
Thallium	7440-28-0	--	0.00037	--(b)	--	--(b)	
Uranium	7440-61-1	--	0.005589723	--(b)	--	--(b)	
Vanadium	7440-62-2	--	0.016788235	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.006671161	--(b)	--	--(b)	
Total ELCR						2.76E-07	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--River exposure area - CTUIR

Dermal Absorption of Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	15	kg	Harris et al, 2004
Exposure Time	ET	0.58	1.0	hours/day	U.S. EPA, 2004
Exposure Time (Age-Adjusted)	ETadj	0.616		hours/day	Calculated using the age adjusted intake factors equation
Surface Area	SA	18,000	6,600	cm^2	Harris et al, 2004
Age-Adjusted Surface Area	SAadj	19,097		$(cm^2$-yr-event)/(kg-day)	Calculated using the age adjusted intake factors equation
Event Frequency	EV	1.0	1.0	Event/days	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	6.0	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Harris et al, 2004
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFO	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
Conversion Factor	CF2	365		days/year	365 days = 1 year
Conversion Factor	CF3	0.001		L/cm^3	1 L = 1000 cm^3
t*	Time to reach steady state	Chemical Specific		hours	EPA, 2004
B	Dermal Partitioning Constant	Chemical Specific		unitless	EPA, 2004
DA	Absorbed Dose per Event	Chemical Specific		$(mg/cm^2$-event)	Calculated using dermal exposure to groundwater equations as provided by U.S. EPA, 2004
Kp	Dermal Permeability Constant	Chemical Specific		cm/hour	EPA, 2004
FA	Fraction Absorbed	Chemical Specific		unitless	EPA, 2004
τ	Lag Time	Chemical Specific		hours	EPA, 2004

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Absorbed Dermal Dose Calculation

Contaminant of Potential Concern	CAS #	Cw (mg/L)	Inorganic/organic[a]	FA[b] (unitless)	K_p[a] (cm/hour)	B[b] (unitless)	t*[b] (hours/event)	t*[b] (hours)	DA (noncancer) (mg/cm^2-event)	DA (cancer) (mg/cm^2-event)
Acetone[c]	67-64-1	0.0011	--	--	0.000512	--	--	--	--	--
Arsenic	7440-38-2	0.005767892	INORGANIC	--	0.001	--	--	--	3.35E-09	3.55E-09
Barium	7440-39-3	0.049451657	INORGANIC	--	0.001	--	--	--	2.87E-08	3.05E-08
Carbon tetrachloride	56-23-5	0.000271961	--	1	0.016	0.1	0.78	1.86	8.09E-09	8.34E-09
Chloride	16887-00-6	11.3727	INORGANIC	--	0.001	--	--	--	6.60E-06	7.01E-06
Chloroform	67-66-3	0.000814875	--	1	0.0068	0	0.5	1.19	8.25E-09	8.50E-09
Chromium	7440-47-3	0.009951236	INORGANIC	--	0.001	--	--	--	5.77E-09	6.13E-09
Copper	7440-50-8	0.00597989	INORGANIC	--	0.001	--	--	--	3.47E-09	3.68E-09
Fluoride	16984-48-8	0.28680392	INORGANIC	--	0.001	--	--	--	1.66E-07	1.77E-07
Iron	7439-89-6	0.61057915	INORGANIC	--	0.001	--	--	--	3.54E-07	3.76E-07
Lead	7439-92-1	0.0006805	INORGANIC	--	0.0001	--	--	--	3.95E-11	4.19E-11
Manganese	7439-96-5	0.041694118	INORGANIC	--	0.001	--	--	--	2.42E-08	2.57E-08
Nickel	7440-02-0	0.0056	INORGANIC	--	0.0002	--	--	--	6.50E-10	6.90E-10
Nitrate	14797-55-8	28.582087	INORGANIC	--	0.001	--	--	--	1.66E-05	1.76E-05
Nitrite	14797-65-0	0.46	INORGANIC	--	0.001	--	--	--	2.67E-07	2.83E-07
Strontium	7440-24-6	0.38963943	INORGANIC	--	0.001	--	--	--	2.26E-07	2.40E-07
Sulfate	14808-79-8	42.560202	INORGANIC	--	0.001	--	--	--	2.47E-05	2.62E-05
Thallium	7440-28-0	0.00037	INORGANIC	--	0.001	--	--	--	2.15E-10	2.28E-10
Uranium	7440-61-1	0.005589723	INORGANIC	--	0.001	--	--	--	3.24E-09	3.44E-09
Vanadium	7440-62-2	0.016788235	INORGANIC	--	0.001	--	--	--	9.74E-09	1.03E-08
Zinc	7440-66-6	0.006671161	INORGANIC	--	0.0006	--	--	--	2.32E-09	2.47E-09

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

[a] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2

[b] EPA/540/R/99/005 Exhibit B-3

[c] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	C_w (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone	67-64-1	0.0011	--	9.00E-01	1	--	
Arsenic	7440-38-2	0.005767892	8.60E-07	3.00E-04	1	0.0029	18
Barium	7440-39-3	0.049451657	7.38E-06	2.00E-01	0.07	5.27E-04	3.3
Carbon tetrachloride	56-23-5	0.000271961	2.08E-06	7.00E-04	1	0.0030	18.68
Chloride	16887-00-6	11.3727	1.70E-03	--	1	--	
Chloroform	67-66-3	0.000814875	2.12E-06	1.00E-02	1	2.12E-04	1.3328
Chromium	7440-47-3	0.009951236	1.48E-06	1.50E+00	0.013	7.61E-05	0.48
Copper	7440-50-8	0.00597989	8.92E-07	4.00E-02	1	2.23E-05	0.14
Fluoride	16984-48-8	0.28680392	4.28E-05	6.00E-02	1	7.13E-04	4.5
Iron	7439-89-6	0.61057915	9.11E-05	7.00E-01	1	1.30E-04	0.8
Lead	7439-92-1	0.0006805	1.01E-08	--	1	--	
Manganese	7439-96-5	0.041694118	6.22E-06	2.40E-02	0.04	0.0065	41
Nickel	7440-02-0	0.0056	1.67E-07	2.00E-02	0.04	2.09E-04	1.3
Nitrate	14797-55-8	28.582087	4.26E-03	7.10E+00	1	6.00E-04	3.8
Nitrite	14797-65-0	0.46	6.86E-05	3.00E-01	1	2.29E-04	1.4
Strontium	7440-24-6	0.38963943	5.81E-05	6.00E-01	1	9.69E-05	0.61
Sulfate	14808-79-8	42.560202	6.35E-03	--	--	--	
Thallium	7440-28-0	0.00037	5.52E-08	--	1	--	
Uranium	7440-61-1	0.005589723	8.34E-07	3.00E-03	1	2.78E-04	1.7
Vanadium	7440-62-2	0.016788235	2.50E-06	5.00E-03	1	5.01E-04	3.1
Zinc	7440-66-6	0.006671161	5.97E-07	3.00E-01	1	1.99E-06	0.013
Total						0.016	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	C_w (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
Acetone	67-64-1	0.0011	--	--	1	--	
Arsenic	7440-38-2	0.005767892	9.69E-07	1.50E+00	1	1.45E-06	80
Barium	7440-39-3	0.049451657	8.31E-06	--	0.07	--	
Carbon tetrachloride	56-23-5	0.000271961	2.27E-06	1.30E-01	1	2.96E-07	16
Chloride	16887-00-6	11.3727	1.91E-03	--	1	--	
Chloroform	67-66-3	0.000814875	2.32E-06	3.10E-02	1	7.19E-08	3.9
Chromium	7440-47-3	0.009951236	1.67E-06	--	0.013	--	
Copper	7440-50-8	0.00597989	1.00E-06	--	1	--	
Fluoride	16984-48-8	0.28680392	4.82E-05	--	1	--	
Iron	7439-89-6	0.61057915	1.03E-04	--	1	--	
Lead	7439-92-1	0.0006805	1.14E-08	--	1	--	
Manganese	7439-96-5	0.041694118	7.01E-06	--	0.04	--	
Nickel	7440-02-0	0.0056	1.88E-07	--	0.04	--	
Nitrate	14797-55-8	28.582087	4.80E-03	--	1	--	
Nitrite	14797-65-0	0.46	7.73E-05	--	1	--	
Strontium	7440-24-6	0.38963943	6.55E-05	--	1	--	
Sulfate	14808-79-8	42.560202	7.15E-03	--	--	--	
Thallium	7440-28-0	0.00037	6.22E-08	--	1	--	
Uranium	7440-61-1	0.005589723	9.39E-07	--	1	--	
Vanadium	7440-62-2	0.016788235	2.82E-06	--	1	--	
Zinc	7440-66-6	0.006671161	6.73E-07	--	1	--	
Total ELCR						1.82E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--River exposure area - CTUIR

inhalation of Volatile Radioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Factor	Symbol	Adult	Child	Unit	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Harris et al, 2004
Exposure duration	ED	70	6	years	Harris et al, 2004
Inhalation Rate	INH_a	25	15	m^3/day	Harris, 2008
Exposure time	ET	0.58	1	hr/day	U.S. EPA, 2004
Age Adjusted Exposure Time	ET_{adj}	0.616		hrs	Calculated using the age adjusted intake factors equation
Radiation Age-adjusted inhalation rate	INH_RAD_{adj}	1690		m^3-yr/day	Calculated using the age adjusted intake factors equation
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991b
Radiation Inhalation of Volatiles Slope Factor	Sfi	Chemical Specific		risk/pCi	U.S. EPA, 1997

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

Harris, S., 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

Inhalation of Volatile Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	VOC[a]	Cw (pCi/L)	CDi (radiological inhalation) (pCi)	SF_i (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	2.4	--(b)	--	--(b)	
Gross beta	12587-47-2	--	31.1	--(b)	--	--(b)	
Strontium-90	10098-97-2	--	2.60	--(b)	1.05E-10	--(b)	
Technetium-99	14133-76-7	--	121	--(b)	1.41E-11	--(b)	
Tritium	10028-17-8	Yes	70,724	5.60E+08	5.62E-14	3.15E-05	100
Total ELCR						3.15E-05	100

[a] Radiological contaminants considered volatile for the groundwater inhalation pathway are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--River exposure area - CTUIR

Ingestion of Radioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Factor	Symbol	Unit		Value	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Harris et al, 2004
Exposure duration	ED	70	6	years	Harris et al, 2004
Drinking Water Ingestion Rate	IRW	4	1	L/day	Harris, 2008
Radiation Age-adjusted drinking water ingestion rate	IRW_RAD_{adj}	262		L-yr/day	Calculated using the age adjusted intake factors equation
Radiation Ingestion of Water Slope Factor	Sfo	Chemical Specific		risk/pCi	U.S. EPA, 1997

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

Harris, S., 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

Ingestion of Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	Cw (pCi/L)	DI (radiological ingestic (pCi)	SF_o (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	2.4	228,365	--	--	
Gross beta	12587-47-2	31.1	2.97E+06	--	--	
Strontium-90	10098-97-2	2.60	2.49E+05	5.59E-11	1.39E-05	4
Technetium-99	14133-76-7	121	1.16E+07	2.75E-12	3.18E-05	8
Tritium	10028-17-8	70,724	6.76E+09	5.07E-14	3.43E-04	88.2
Total ELCR					3.89E-04	100

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakima Nation Drinking Water Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	ontaminant Concentration in Groundwat C_w (mg/L)	VOC?	HQ (Inhalation) (unitless)	HQ (Ingestion) (unitless)	HQ (Dermal) (unitless)	Total HI (unitless)	% Contribution
1,1,1-Trichloroethane	0.000691076	Yes	1.67E-06	1.97E-05	1.88E-06	2.33E-05	9.88E-04
1,1-Dichloroethane	0.000255649	Yes	4.41E-06	7.30E-05	2.86E-06	8.03E-05	0.0034
1,1-Dichloroethene	0.00016874	Yes	1.02E-05	1.93E-04	1.33E-05	2.16E-04	0.0092
1,2-Dichlorobenzene	0.003	Yes	1.81E-04	1.90E-03	6.23E-04	2.71E-03	0.11
1,4-Dichlorobenzene	0.000130957	Yes	1.98E-06	1.07E-04	3.58E-05	1.45E-04	0.0061
1,4-Dioxane	0.0081	--	--(b)	4.63E-03	8.31E-06	4.64E-03	0.20
2-Butanone	0.00055	Yes	1.33E-06	5.24E-05	2.48E-07	5.40E-05	0.0023
2-Pentanone, 4-Methyl	0.00064	Yes	2.58E-06	4.57E-04	7.30E-06	4.67E-04	0.020
Acetone	0.001511507	Yes	5.89E-07	9.60E-05	--	9.66E-05	0.0041
Arsenic	0.003140238	--	--(b)	5.98E-01	1.56E-03	6.00E-01	25
Barium	0.072881156	--	--(b)	2.08E-02	7.76E-04	2.16E-02	0.92
Bis(2-ethylhexyl) phthalate	0.001	--	--(b)	2.86E-03	2.21E-03	5.07E-03	0.21
Cadmium	0.0045	--	--(b)	5.14E-01	2.68E-02	5.41E-01	23
Carbon disulfide	0.00021	Yes	3.63E-06	1.20E-04	1.06E-05	1.34E-04	0.0057
Carbon tetrachloride	0.000170123	Yes	1.08E-05	1.39E-02	1.86E-03	1.58E-02	0.67
Chloride	9.9702351	--	--(b)	--	--	--	
Chloroform	0.000214204	Yes	2.64E-05	1.22E-03	5.57E-05	1.31E-03	0.055
Chromium	0.009493374	--	--(b)	3.62E-04	7.26E-05	4.34E-04	0.018
Copper	0.004884201	--	--(b)	6.98E-03	1.82E-05	7.00E-03	0.30
Fluoride	0.30080145	--	--(b)	2.86E-01	7.48E-04	2.87E-01	12
Iron	0.12126178	--	--(b)	9.90E-03	2.58E-05	9.92E-03	0.42
Lead	0.000581898	--	--(b)	--	--	--	
Manganese	0.015530827	--	--(b)	3.70E-02	2.41E-03	3.94E-02	1.7
Methylene chloride	0.002069589	Yes	2.50E-05	1.97E-03	3.70E-05	2.03E-03	0.086
Nickel	0.006014142	--	--(b)	1.72E-02	2.24E-04	1.74E-02	0.74
Nitrate	23.863649	--	--(b)	1.92E-01	5.01E-04	1.93E-01	8.2
Nitrite	0.081906164	--	--(b)	1.56E-02	4.07E-05	1.56E-02	0.66
Silver	0.005776818	--	--(b)	6.60E-02	2.58E-03	6.86E-02	2.9
Strontium	0.38364144	--	--(b)	3.65E-02	9.54E-05	3.66E-02	1.6
Sulfate	45.030868	--	--(b)	--	--	--	
Tetrachloroethene	0.000872033	Yes	3.90E-05	4.98E-03	1.49E-03	6.51E-03	0.28
Tributyl phosphate	0.012498806	--	--(b)	3.57E-03	--	3.57E-03	0.15
Trichloroethene	0.000433871	Yes	1.50E-04	--	--	1.50E-04	0.0063
Trichloromonofluoromethane	0.00058	Yes	1.00E-05	1.10E-04	1.08E-05	1.31E-04	0.0056
Uranium	0.016629145	--	--(b)	3.17E-01	8.27E-04	3.18E-01	13
Vanadium	0.012904693	--	--(b)	1.47E-01	3.85E-04	1.48E-01	6.3
Zinc	0.068859746	--	--(b)	1.31E-02	2.05E-05	1.31E-02	0.56
Total			4.69E-04	2.31	0.04	2.36	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

HQ = hazard quotient.

HI = hazard index.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakima Nation Drinking Water Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	ontaminant Concentration in Groundwat C_w (mg/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
1,1,1-Trichloroethane	0.000691076	Yes	--	--	--	--	
1,1-Dichloroethane	0.000255649	Yes	--	--	--	--	
1,1-Dichloroethene	0.00016874	Yes	--	--	--	--	
1,2-Dichlorobenzene	0.003	Yes	--	--	--	--	
1,4-Dichlorobenzene	0.000130957	Yes	1.74E-08	4.45E-08	1.47E-08	7.66E-08	0.022
1,4-Dioxane	0.0081	--	--(b)	5.61E-06	9.91E-09	5.62E-06	1.6
2-Butanone	0.00055	Yes	--	--	--	--	
2-Pentanone, 4-Methyl	0.00064	Yes	--	--	--	--	
Acetone	0.001511507	Yes	--	--	--	--	
Arsenic	0.003140238	--	--(b)	2.97E-04	7.85E-07	2.97E-04	83
Barium	0.072881156	--	--(b)	--	--	--	
Bis(2-ethylhexyl) phthalate	0.001	--	--(b)	8.81E-07	6.70E-07	1.55E-06	0.44
Cadmium	0.0045	--	--(b)	--	--	--	
Carbon disulfide	0.00021	Yes	--	--	--	--	
Carbon tetrachloride	0.000170123	Yes	3.08E-08	1.39E-06	1.83E-07	1.61E-06	0.45
Chloride	9.9702351	--	--(b)	--	--	--	
Chloroform	0.000214204	Yes	5.95E-08	4.18E-07	1.87E-08	4.96E-07	0.14
Chromium	0.009493374	--	--(b)	--	--	--	
Copper	0.004884201	--	--(b)	--	--	--	
Fluoride	0.30080145	--	--(b)	--	--	--	
Iron	0.12126178	--	--(b)	--	--	--	
Lead	0.000581898	--	--(b)	--	--	--	
Manganese	0.015530827	--	--(b)	--	--	--	
Methylene chloride	0.002069589	Yes	1.18E-08	9.77E-07	1.80E-08	1.01E-06	0.28
Nickel	0.006014142	--	--(b)	--	--	--	
Nitrate	23.863649	--	--(b)	--	--	--	
Nitrite	0.081906164	--	--(b)	--	--	--	
Silver	0.005776818	--	--(b)	--	--	--	
Strontium	0.38364144	--	--(b)	--	--	--	
Sulfate	45.030868	--	--(b)	--	--	--	
Tetrachloroethene	0.000872033	Yes	6.22E-08	2.96E-05	8.70E-06	3.84E-05	11
Tributyl phosphate	0.012498806	--	--(b)	7.24E-06	--	7.24E-06	2.0
Trichloroethene	0.000433871	Yes	1.31E-07	2.43E-06	2.07E-07	2.77E-06	0.78
Trichloromonofluoromethane	0.00058	Yes	--	--	--	--	
Uranium	0.016629145	--	--(b)	--	--	--	
Vanadium	0.012904693	--	--(b)	--	--	--	

Zinc	0.068859746	--	--(b)	--	--	--	
Total ELCR			3.13E-07	3.45E-04	1.06E-05	3.56E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakima Nation Drinking Water Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	ontaminant Concentration in Groundwat C_w (pCi/L)	Volatile?[a]	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	6.4100896	--	--(b)	--	--	
Gross beta	32.397036	--	--(b)	--	--	
Iodine-129	1.9883847	--	--(b)	2.88E-05	2.88E-05	1.9
Nickel-63	4.07	--	--(b)	2.67E-07	2.67E-07	0.018
Protactinium-231	0.308	--	--(b)	5.21E-06	5.21E-06	0.35
Strontium-90	0.611	--	--(b)	3.34E-06	3.34E-06	0.22
Technetium-99	93.996334	--	--(b)	2.53E-05	2.53E-05	1.7
Tritium	264106.86	Yes	1.22E-04	1.31E-03	1.43E-03	96
Total ELCR			1.22E-04	1.37E-03	1.50E-03	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area - Yakima Nation

Ingestion of Nonradioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Ingestion Chronic Daily Intake	CDI	calculated		mg/kg-day	EPA 1989
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	16	kg	Ridolfi, 2007
Drinking Water Ingestion Rate	IRW	4	2	Liters/day	Ridolfi, 2007
Age-Adjusted Drinking Water Ingestion Rate	IRWadj	4.407		L-yr/kg-day	Calculated using the age adjusted intake factors equation
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	6	yr	Ridolfi, 2007
Averaging time	AT	70	--	yr	Ridolfi, 2007
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFO	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 1989

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	0.000691076	3.95E-05	2.00E+00	0.0000	8.53E-04
1,1-Dichloroethane	75-34-3	0.000255649	1.46E-05	2.00E-01	0.0001	0.0032
1,1-Dichloroethene	75-35-4	0.00016874	9.64E-06	5.00E-02	0.0002	0.0083
1,2-Dichlorobenzene	95-50-1	0.003	1.71E-04	9.00E-02	0.0019	0.082
1,4-Dichlorobenzene	106-46-7	0.000130957	7.48E-06	7.00E-02	0.0001	0.0046
1,4-Dioxane	123-91-1	0.0081	4.63E-04	1.00E-01	0.0046	0.20
2-Butanone	78-93-3	0.00055	3.14E-05	6.00E-01	0.0001	0.0023
2-Pentanone, 4-Methyl	108-10-1	0.00064	3.66E-05	8.00E-02	0.0005	0.020
Acetone	67-64-1	0.001511507	8.64E-05	9.00E-01	0.0001	0.0041
Arsenic	7440-38-2	0.003140238	1.79E-04	3.00E-04	0.5981	26
Barium	7440-39-3	0.072881156	4.16E-03	2.00E-01	0.0208	0.90
Bis(2-ethylhexyl) phthalate	117-81-7	0.001	5.71E-05	2.00E-02	0.0029	0.12
Cadmium	7440-43-9	0.0045	2.57E-04	5.00E-04	0.5143	22
Carbon disulfide	75-15-0	0.00021	1.20E-05	1.00E-01	0.0001	0.0052
Carbon tetrachioride	56-23-5	0.000170123	9.72E-06	7.00E-04	0.0139	0.60
Chloride	16887-00-6	9.9702351	5.70E-01	--	--	
Chloroform	67-66-3	0.000214204	1.22E-05	1.00E-02	0.0012	0.053
Chromium	7440-47-3	0.009493374	5.42E-04	1.50E+00	0.0004	0.016
Copper	7440-50-8	0.004884201	2.79E-04	4.00E-02	0.0070	0.30
Fluoride	16984-48-8	0.30080145	1.72E-02	6.00E-02	0.2865	12
Iron	7439-89-6	0.12126178	6.93E-03	7.00E-01	0.0099	0.43
Lead	7439-92-1	0.000581898	3.33E-05	--	--	
Manganese	7439-96-5	0.015530827	8.87E-04	2.40E-02	0.0370	1.6
Methylene chloride	75-09-2	0.002069589	1.18E-04	6.00E-02	0.0020	0.085
Nickel	7440-02-0	0.006014142	3.44E-04	2.00E-02	0.0172	0.74
Nitrate	14797-55-8	23.863649	1.36E+00	7.10E+00	0.1921	8.3
Nitrite	14797-65-0	0.081906164	4.68E-03	3.00E-01	0.0156	0.67
Silver	7440-22-4	0.005776818	3.30E-04	5.00E-03	0.0660	2.9
Strontium	7440-24-6	0.38364144	2.19E-02	6.00E-01	0.0365	1.6
Sulfate	14808-79-8	45.030868	2.57E+00	--	--	
Tetrachloroethene	127-18-4	0.000872033	4.98E-05	1.00E-02	0.0050	0.22
Tributyl phosphate	126-73-8	0.012498806	7.14E-04	2.00E-01	0.0036	0.15
Trichloroethene	79-01-6	0.000433871	2.48E-05	--	--	
Trichloromonofluoromethane	75-69-4	0.00058	3.31E-05	3.00E-01	0.0001	0.0048
Uranium	7440-61-1	0.016629145	9.50E-04	3.00E-03	0.3167	14
Vanadium	7440-62-2	0.012904693	7.37E-04	5.00E-03	0.1475	6.4
Zinc	7440-66-6	0.068859746	3.93E-03	3.00E-01	0.0131	0.57
Total					2	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	0.000691076	4.35E-05	--	--	
1,1-Dichloroethane	75-34-3	0.000255649	1.61E-05	--	--	
1,1-Dichloroethene	75-35-4	0.00016874	1.06E-05	--	--	
1,2-Dichlorobenzene	95-50-1	0.003	1.89E-04	--	--	
1,4-Dichlorobenzene	106-46-7	0.000130957	8.24E-06	5.40E-03	4.45E-08	0.013
1,4-Dioxane	123-91-1	0.0081	5.10E-04	1.10E-02	5.61E-06	1.6
2-Butanone	78-93-3	0.00055	3.46E-05	--	--	
2-Pentanone, 4-Methyl	108-10-1	0.00064	4.03E-05	--	--	
Acetone	67-64-1	0.001511507	9.52E-05	--	--	
Arsenic	7440-38-2	0.003140238	1.98E-04	1.50E+00	2.97E-04	86
Barium	7440-39-3	0.072881156	4.59E-03	--	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.001	6.30E-05	1.40E-02	8.81E-07	0.26
Cadmium	7440-43-9	0.0045	2.83E-04	--	--	
Carbon disulfide	75-15-0	0.00021	1.32E-05	--	--	
Carbon tetrachloride	56-23-5	0.000170123	1.07E-05	1.30E-01	1.39E-06	0.40
Chloride	16887-00-6	9.9702351	6.28E-01	--	--	
Chloroform	67-66-3	0.000214204	1.35E-05	3.10E-02	4.18E-07	0.12
Chromium	7440-47-3	0.009493374	5.98E-04	--	--	
Copper	7440-50-8	0.004884201	3.08E-04	--	--	
Fluoride	16984-48-8	0.30080145	1.89E-02	--	--	
Iron	7439-89-6	0.12126178	7.63E-03	--	--	
Lead	7439-92-1	0.000581898	3.66E-05	--	--	

Manganese	7439-96-5	0.015530827	9.78E-04	--	--	
Methylene chloride	75-09-2	0.002069589	1.30E-04	7.50E-03	9.77E-07	0.28
Nickel	7440-02-0	0.006014142	3.79E-04	--	--	
Nitrate	14797-55-8	23.863649	1.50E+00	--	--	
Nitrite	14797-65-0	0.081906164	5.16E-03	--	--	
Silver	7440-22-4	0.005776818	3.64E-04	--	--	
Strontium	7440-24-6	0.38364144	2.42E-02	--	--	
Sulfate	14808-79-8	45.030868	2.84E+00	--	--	
Tetrachloroethene	127-18-4	0.000872033	5.49E-05	5.40E-01	2.96E-05	8.6
Tributyl phosphate	126-73-8	0.012498806	7.87E-04	9.20E-03	7.24E-06	2.1
Trichloroethene	79-01-6	0.000433871	2.73E-05	8.90E-02	2.43E-06	0.70
Trichloromonofluoromethane	75-69-4	0.00058	3.65E-05	--	--	
Uranium	7440-61-1	0.016629145	1.05E-03	--	--	
Vanadium	7440-62-2	0.012904693	8.12E-04	--	--	
Zinc	7440-66-6	0.068859746	4.34E-03	--	--	
Total ELCR					3.45E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area - Yakima Nation

Inhalation of Volatile Nonradioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Inhalation Chronic Daily Intake	CDI	calculated		mg/m^3 for noncarcinogens, $\mu g/m^3$ for carcinogens	EPA 2009b
Contaminant concentration in drinking water	C_w	contaminant-specific		mg/L	ECF-200PO1-09-2027
Exposure Time	ET	0.580	--	hours/day	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	--	yr	Ridolfi, 2007
Averaging Time	AT	70	--	yr	Ridolfi, 2007
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Inhalation Reference Concentration	RfC_i	Chemical Specific		mg/m^3	EPA 2009a
Inhalation Unit Risk	IUR	Chemical Specific		$(\mu g/m^3)^{-1}$	EPA 2009a
Conversion Factor	CF1	365		days/year	EPA 2009b
Conversion Factor	CF2	0.042		1day/24 hours	EPA 2009b

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009a EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

U.S. EPA 2009b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (noncarcinogen) (mg/m^3)	RfC[a] (mg/m^3)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	Yes	0.000691076	8.35E-06	5.00E+00	1.67E-06	0.36
1,1-Dichloroethane	75-34-3	Yes	0.000255649	3.09E-06	7.00E-01	4.41E-06	0.94
1,1-Dichloroethene	75-35-4	Yes	0.00016874	2.04E-06	2.00E-01	1.02E-05	2.2
1,2-Dichlorobenzene	95-50-1	Yes	0.003	3.63E-05	2.00E-01	1.81E-04	39
1,4-Dichlorobenzene	106-46-7	Yes	0.000130957	1.58E-06	8.00E-01	1.98E-06	0.42
1,4-Dioxane	123-91-1	--	0.0081	--(b)	3.60E+00	--(b)	
2-Butanone	78-93-3	Yes	0.00055	6.65E-06	5.00E+00	1.33E-06	0.28
2-Pentanone, 4-Methyl	108-10-1	Yes	0.00064	7.73E-06	3.00E+00	2.58E-06	0.55
Acetone	67-64-1	Yes	0.001511507	1.83E-05	3.10E+01	5.89E-07	0.13
Arsenic	7440-38-2	--	0.003140238	--(b)	1.50E-05	--(b)	
Barium	7440-39-3	--	0.072881156	--(b)	5.00E-04	--(b)	
Bis(2-ethylhexyl) phthalate	117-81-7	--	0.001	--(b)	--	--(b)	
Cadmium	7440-43-9	--	0.0045	--(b)	1.00E-05	--(b)	
Carbon disulfide	75-15-0	Yes	0.00021	2.54E-06	7.00E-01	3.63E-06	0.77
Carbon tetrachloride	56-23-5	Yes	0.000170123	2.06E-06	1.90E-01	1.08E-05	2.3
Chloride	16887-00-6	--	9.9702351	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.000214204	2.59E-06	9.80E-02	2.64E-05	5.6
Chromium	7440-47-3	--	0.009493374	--(b)	--	--(b)	
Copper	7440-50-8	--	0.004884201	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.30080145	--(b)	1.30E-02	--(b)	
Iron	7439-89-6	--	0.12126178	--(b)	--	--(b)	
Lead	7439-92-1	--	0.000581898	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.015530827	--(b)	5.00E-05	--(b)	
Methylene chloride	75-09-2	Yes	0.002069589	2.50E-05	1.00E+00	2.50E-05	5.3
Nickel	7440-02-0	--	0.006014142	--(b)	9.00E-05	--(b)	
Nitrate	14797-55-8	--	23.863649	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.081906164	--(b)	--	--(b)	
Silver	7440-22-4	--	0.005776818	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.38364144	--(b)	--	--(b)	
Sulfate	14808-79-8	--	45.030868	--(b)	--	--(b)	
Tetrachloroethene	127-18-4	Yes	0.000872033	1.05E-05	2.70E-01	3.90E-05	8.3
Tributyl phosphate	126-73-8	--	0.012498806	--(b)	--	--(b)	
Trichloroethene	79-01-6	Yes	0.000433871	5.24E-06	3.50E-02	1.50E-04	32
Trichloromonofluoromethane	75-69-4	Yes	0.00058	7.01E-06	7.00E-01	1.00E-05	2.1
Uranium	7440-61-1	--	0.016629145	--(b)	3.00E-04	--(b)	
Vanadium	7440-62-2	--	0.012904693	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.068859746	--(b)	--	--(b)	
Total						4.69E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (carcinogen) ($\mu g/m^3$)	IUR[a] $(\mu g/m^3)^{-1}$	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	Yes	0.000691076	8.35E-03	--	--	
1,1-Dichloroethane	75-34-3	Yes	0.000255649	3.09E-03	--	--	
1,1-Dichloroethene	75-35-4	Yes	0.00016874	2.04E-03	--	--	
1,2-Dichlorobenzene	95-50-1	Yes	0.003	3.63E-02	--	--	
1,4-Dichlorobenzene	106-46-7	Yes	0.000130957	1.58E-03	1.10E-05	1.74E-08	5.6
1,4-Dioxane	123-91-1	--	0.0081	--(b)	7.70E-06	--(b)	
2-Butanone	78-93-3	Yes	0.00055	6.65E-03	--	--	
2-Pentanone, 4-Methyl	108-10-1	Yes	0.00064	7.73E-03	--	--	
Acetone	67-64-1	Yes	0.001511507	1.83E-02	--	--	
Arsenic	7440-38-2	--	0.003140238	--(b)	4.30E-03	--(b)	
Barium	7440-39-3	--	0.072881156	--(b)	--	--(b)	
Bis(2-ethylhexyl) phthalate	117-81-7	--	0.001	--(b)	2.40E-06	--(b)	
Cadmium	7440-43-9	--	0.0045	--(b)	1.80E-03	--(b)	
Carbon disulfide	75-15-0	Yes	0.00021	2.54E-03	--	--	
Carbon tetrachloride	56-23-5	Yes	0.000170123	2.06E-03	1.50E-05	3.08E-08	9.9
Chloride	16887-00-6	--	9.9702351	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.000214204	2.59E-03	2.30E-05	5.95E-08	19
Chromium	7440-47-3	--	0.009493374	--(b)	--	--(b)	
Copper	7440-50-8	--	0.004884201	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.30080145	--(b)	--	--(b)	
Iron	7439-89-6	--	0.12126178	--(b)	--	--(b)	
Lead	7439-92-1	--	0.000581898	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.015530827	--(b)	--	--(b)	
Methylene chloride	75-09-2	Yes	0.002069589	2.50E-02	4.70E-07	1.18E-08	3.8
Nickel	7440-02-0	--	0.006014142	--(b)	2.60E-04	--(b)	
Nitrate	14797-55-8	--	23.863649	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.081906164	--(b)	--	--(b)	
Silver	7440-22-4	--	0.005776818	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.38364144	--(b)	--	--(b)	
Sulfate	14808-79-8	--	45.030868	--(b)	--	--(b)	
Tetrachloroethene	127-18-4	Yes	0.000872033	1.05E-02	5.90E-06	6.22E-08	20
Tributyl phosphate	126-73-8	--	0.012498806	--(b)	--	--(b)	
Trichloroethene	79-01-6	Yes	0.000433871	5.24E-03	2.50E-05	1.31E-07	42

Trichloromonofluoromethane	75-69-4	Yes	0.00058	7.01E-03	--	--	
Uranium	7440-61-1	--	0.016629145	--(b)	--	--(b)	
Vanadium	7440-62-2	--	0.012904693	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.068859746	--(b)	--	--(b)	
Total ELCR						3.13E-07	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b]Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year) - Far-field exposure area - Yakima Nation

Dermal Absorption of Nonradioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	16	kg	Ridolfi, 2007
Exposure Time	ET	0.58	1.0	hours/day	U.S. EPA, 2004
Exposure Time (Age-Adjusted)	ETadj	0.616		hours/day	Calculated using the age adjusted intake factors equation
Surface Area	SA	18,000	6,600	cm^2	Ridolfi, 2007
Age-Adjusted Surface Area	SAadj	18,912		(cm^2-yr event)/(kg-day)	Calculated using the age adjusted intake factors equation
Event Frequency	EV	1.0	1.0	Event/days	U.S. EPA, 2004
Exposure Frequency	Ef	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	6.0	yr	Ridolfi, 2007
Averaging time	AT	70		yr	Ridolfi, 2007
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFO	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA, 2004
CF3	Conversion Factor	0.001		L/cm^3	1 L = 1000 cm^3
t*	Time to reach steady state	Chemical Specific		hours	EPA, 2004
B	Dermal Partitioning Constant	Chemical Specific		unitless	EPA, 2004
DA	Absorbed Dose per Event	Chemical Specific		(mg/cm^2-event)	Calculated using dermal exposure to groundwater equations as provided by U.S. EPA, 2004
Kp	Dermal Permeability Constant	Chemical Specific		cm/hour	EPA, 2004
FA	Fraction Absorbed	Chemical Specific		unitless	EPA, 2004
τ	Lag Time	Chemical Specific		hours	EPA, 2004

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*

ECF-200PO1-09-2027. Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

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U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009 http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Absorbed Dermal Dose Calculation

Contaminant of Potential Concern	CAS #	Cw (mg/L)	Inorganic/organic[a]	FA[a] (unitless)	K_p[b] (cm/hour)	B[b] (unitless)	τ[b] (hours/event)	t*[b] (hours)	DA (noncancer) (mg/cm^2-event)	DA (cancer) (mg/cm^2-event)
1,1,1-Trichloroethane	71-55-6	0.000691076	--	1.00E+00	0.013	0.1	0.6	1.43	1.44E-08	1.51E-08
1,1-Dichloroethane	75-34-3	0.000255649	--	1.00E+00	0.0067	0	0.38	0.92	2.22E-09	2.29E-09
1,1-Dichloroethene	75-35-4	0.00016874	--	1.00E+00	0.012	0	0.37	0.89	2.59E-09	2.67E-09
1,2-Dichlorobenzene	95-50-1	0.003	--	1.00E+00	0.041	0.2	0.71	1.71	2.18E-07	2.25E-07
1,4-Dichlorobenzene	106-46-7	0.000130957	--	1.00E+00	0.042	0.2	0.71	1.71	9.76E-09	1.01E-08
1,4-Dioxane	123-91-1	0.0081	--	1.00E+00	0.00033	0	0.33	0.8	3.23E-09	3.33E-09
2-Butanone	78-93-3	0.00055	--	1.00E+00	0.00096	0	0.27	0.65	5.78E-10	5.95E-10
2-Pentanone, 4-Methyl	108-10-1	0.00064	--	1.00E+00	0.0027	0	0.39	0.93	2.27E-09	2.34E-09
Acetone[c]	67-64-1	0.001511507	--	--	0.000512	--	--	--	--	--
Arsenic	7440-38-2	0.003140238	INORGANIC	--	0.001	--	--	--	1.82E-09	1.91E-09
Barium	7440-39-3	0.072881156	INORGANIC	--	0.001	--	--	--	4.23E-08	4.49E-08
Bis(2-ethylhexyl) phthalate	117-81-7	0.001	--	8.00E-01	0.025	0.2	16.64	39.93	1.72E-07	1.77E-07
Cadmium	7440-43-9	0.0045	INORGANIC	--	0.001	--	--	--	2.61E-09	2.77E-09
Carbon disulfide	75-15-0	0.00021	--	1.00E+00	0.017	0.1	0.3	0.72	4.12E-06	4.24E-09
Carbon tetrachloride	56-23-5	0.000170123	--	1.00E+00	0.016	0.1	0.78	1.86	5.08E-09	5.21E-09
Chloride	16887-00-6	9.9702351	INORGANIC	--	0.001	--	--	--	5.78E-06	6.14E-06
Chloroform	67-66-3	0.000214204	--	1.00E+00	0.0068	0	0.5	1.19	2.17E-09	2.23E-09
Chromium	7440-47-3	0.009493174	INORGANIC	--	0.001	--	--	--	5.53E-09	5.85E-09
Copper	7440-50-8	0.004884201	INORGANIC	--	0.001	--	--	--	2.83E-09	3.01E-09
Fluoride	16984-48-8	0.30080145	INORGANIC	--	0.001	--	--	--	1.74E-07	1.85E-07
Iron	7439-89-6	0.12126178	INORGANIC	--	0.001	--	--	--	7.03E-08	7.47E-08
Lead	7439-92-1	0.000581898	INORGANIC	--	0.0001	--	--	--	3.38E-11	3.58E-11
Manganese	7439-96-5	0.015530827	INORGANIC	--	0.001	--	--	--	9.01E-09	9.57E-09
Methylene chloride	75-09-2	0.002065589	--	1.00E+00	0.0035	0	0.32	0.76	8.63E-09	8.88E-09
Nickel	7440-02-0	0.006014142	INORGANIC	--	0.0002	--	--	--	6.98E-10	7.41E-10
Nitrate	14797-55-8	23.863649	INORGANIC	--	0.001	--	--	--	1.38E-05	1.47E-05
Nitrite	14797-65-0	0.081906164	INORGANIC	--	0.001	--	--	--	4.75E-08	5.05E-08
Silver	7440-22-4	0.005776818	INORGANIC	--	0.0006	--	--	--	2.01E-09	2.14E-09
Strontium	7440-24-6	0.38364144	INORGANIC	--	0.001	--	--	--	2.23E-07	2.36E-07
Sulfate	14808-79-8	45.030868	INORGANIC	--	0.001	--	--	--	2.61E-05	2.77E-05
Tetrachloroethene	127-18-4	0.000872033	--	1.00E+00	0.033	0.2	0.91	2.18	5.78E-08	5.96E-08
Tributyl phosphate[c]	126-73-8	0.012498806	--	--	0.0228	--	--	--	--	--
Trichloroethene	79-01-6	0.000433871	--	1.00E+00	0.012	0.1	0.58	1.39	8.35E-09	8.60E-09
Trichloromonofluoromethane	75-69-4	0.00058	--	1.00E+00	0.013	0.1	0.63	1.51	1.26E-08	1.30E-08
Uranium	7440-61-1	0.016629145	INORGANIC	--	0.001	--	--	--	9.64E-09	1.02E-08
Vanadium	7440-62-2	0.012904693	INORGANIC	--	0.001	--	--	--	7.48E-09	7.95E-09
Zinc	7440-66-6	0.068859746	INORGANIC	--	0.0006	--	--	--	2.40E-08	2.55E-08

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

[a] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2

[b] EPA/540/R/99/005 Exhibit B-3

[c] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	0.000691076	3.77E-06	2.00E+00	1	1.88E-06	0.0043
1,1-Dichloroethane	75-34-3	0.000255649	5.72E-07	2.00E-01	1	2.86E-06	0.0066
1,1-Dichloroethene	75-35-4	0.00016874	6.63E-07	5.00E-02	1	1.33E-05	0.031
1,2-Dichlorobenzene	95-50-1	0.003	5.61E-05	9.00E-02	1	6.23E-04	1.4
1,4-Dichlorobenzene	106-46-7	0.000130957	2.53E-06	7.00E-02	1	3.58E-05	0.082
1,4-Dioxane	123-91-1	0.0081	8.31E-07	1.00E-01	1	8.31E-06	0.019
2-Butanone	78-93-3	0.00055	1.49E-07	6.00E-01	1	2.48E-07	5.69E-04
2-Pentanone, 4-Methyl	108-10-1	0.00064	5.84E-07	8.00E-02	1	7.30E-06	0.017
Acetone	67-64-1	0.001511507	--	9.00E-01	1	--	--
Arsenic	7440-38-2	0.003140238	4.68E-07	3.00E-04	1	1.56E-03	3.6
Barium	7440-39-3	0.072881156	1.09E-05	2.00E-01	0.07	7.76E-04	1.8
Bis(2-ethylhexyl) phthalate	117-81-7	0.001	4.42E-05	2.00E-02	1	2.21E-03	5.1
Cadmium	7440-43-9	0.0045	6.71E-07	5.00E-04	0.05	2.68E-02	62
Carbon disulfide	75-15-0	0.00021	1.06E-06	1.00E-01	1	1.06E-05	0.024
Carbon tetrachloride	56-23-5	0.000170123	1.30E-06	7.00E-04	1	1.86E-03	4.3
Chloride	16887-00-6	9.9702351	1.49E-03	--	1	--	--
Chloroform	67-66-3	0.000214204	5.57E-07	1.00E-02	1	5.57E-05	0.13
Chromium	7440-47-3	0.009493174	1.42E-06	1.50E+00	0.013	7.26E-05	0.17
Copper	7440-50-8	0.004884201	7.28E-07	4.00E-02	1	1.82E-05	0.042
Fluoride	16984-48-8	0.30080145	4.49E-05	6.00E-02	1	7.48E-04	1.7
Iron	7439-89-6	0.12126178	1.81E-05	7.00E-01	1	2.58E-05	0.059
Lead	7439-92-1	0.000581898	8.68E-09	--	1	--	--
Manganese	7439-96-5	0.015530827	2.32E-06	2.40E-02	0.04	2.41E-03	5.5
Methylene chloride	75-09-2	0.002065589	2.22E-06	6.00E-02	1	3.70E-05	0.085
Nickel	7440-02-0	0.006014142	1.79E-07	2.00E-02	0.04	2.24E-04	0.52
Nitrate	14797-55-8	23.863649	3.56E-03	7.10E+00	1	5.01E-04	1.2
Nitrite	14797-65-0	0.081906164	1.22E-05	3.00E-03	1	4.07E-05	0.094
Silver	7440-22-4	0.005776818	5.17E-07	5.00E-03	0.04	2.58E-03	5.9
Strontium	7440-24-6	0.38364144	5.72E-05	6.00E-01	1	9.54E-05	0.22
Sulfate	14808-79-8	45.030868	6.72E-03	--	--	--	--
Tetrachloroethene	127-18-4	0.000872033	1.49E-05	1.00E-02	1	1.49E-03	3.4
Tributyl phosphate	126-73-8	0.012498806	--	2.00E-01	1	--	--
Trichloroethene	79-01-6	0.000433871	2.15E-06	--	1	--	--
Trichloromonofluoromethane	75-69-4	0.00058	3.24E-06	3.00E-01	1	1.08E-05	0.025
Uranium	7440-61-1	0.016629145	2.48E-06	3.00E-03	1	8.27E-04	1.9
Vanadium	7440-62-2	0.012904693	1.92E-06	5.00E-03	1	3.85E-04	0.88
Zinc	7440-66-6	0.068859746	6.16E-06	3.00E-01	1	2.05E-05	0.047
Total						0.04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

COPC = contaminant of potential concern

HQ = hazard quotient

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	0.000691076	4.08E-06	--	1	--	
1,1-Dichloroethane	75-34-3	0.000255649	6.19E-07	--	1	--	
1,1-Dichloroethene	75-35-4	0.00016874	7.23E-07	--	1	--	
1,2-Dichlorobenzene	95-50-1	0.003	6.08E-05	--	1	--	
1,4-Dichlorobenzene	106-46-7	0.000130957	2.72E-06	5.40E-03	1	1.47E-08	0.14
1,4-Dioxane	123-91-1	0.0081	9.01E-07	1.10E-02	1	9.91E-09	0.093
2-Butanone	78-93-3	0.00055	1.61E-07	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	0.00064	6.33E-07	--	1	--	
Acetone	67-64-1	0.001511507	--	--	1	--	
Arsenic	7440-38-2	0.003140238	5.23E-07	1.50E+00	1	7.85E-07	7.4
Barium	7440-39-3	0.072881156	1.21E-05	--	0.07	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.001	4.79E-05	1.40E-02	1	6.70E-07	6.3
Cadmium	7440-43-9	0.0045	7.50E-07	--	0.05	--	
Carbon disulfide	75-15-0	0.00021	1.15E-06	--	1	--	
Carbon tetrachloride	56-23-5	0.000170123	1.41E-06	1.30E-01	1	1.83E-07	1.7
Chloride	16887-00-6	9.9702351	1.66E-03	--	1	--	
Chloroform	67-66-3	0.000214204	6.04E-07	3.10E-02	1	1.87E-08	0.18
Chromium	7440-47-3	0.009493174	1.58E-06	--	0.013	--	
Copper	7440-50-8	0.004884201	8.14E-07	--	1	--	
Fluoride	16984-48-8	0.30080145	5.01E-05	--	1	--	
Iron	7439-89-6	0.12126178	2.02E-05	--	1	--	
Lead	7439-92-1	0.000581898	9.69E-09	--	1	--	
Manganese	7439-96-5	0.015530827	2.59E-06	--	0.04	--	
Methylene chloride	75-09-2	0.002065589	2.40E-06	7.50E-03	1	1.80E-08	0.17
Nickel	7440-02-0	0.006014142	2.00E-07	--	0.04	--	
Nitrate	14797-55-8	23.863649	3.98E-03	--	1	--	

Nitrite	14797-65-0	0.081906164	1.36E-05	--	1	-	
Silver	7440-22-4	0.005776818	5.77E-07	--	0.04	-	
Strontium	7440-24-6	0.38364144	6.39E-05	--	1	-	
Sulfate	14808-79-8	45.030868	7.50E-03	--	--	-	
Tetrachloroethene	127-18-4	0.009872033	1.61E-05	5.40E-01	1	8.70E-06	82
Tributyl phosphate	126-73-8	0.012498806	--	9.20E-03	1	-	
Trichloroethene	79-01-6	0.000433871	2.33E-06	8.90E-02	1	2.07E-07	2.0
Trichloromonofluoromethane	75-69-4	0.00058	3.51E-06	--	1	-	
Uranium	7440-61-1	0.016629145	2.77E-06	--	1	-	
Vanadium	7440-62-2	0.012904693	2.15E-06	--	1	-	
Zinc	7440-66-6	0.068859746	6.88E-06	--	1	-	
Total ELCR						1.06E-05	100

* EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area - Yakima Nation

Inhalation of Volatile Radioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Factor	Symbol	Adult	Child	Unit	Reference
Chronic Daily Intake	CDi	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Ridolfi, 2007
Exposure duration	ED	70	6	years	Ridolfi, 2007
Inhalation Rate	INH_a	26	16	m^3/day	Ridolfi, 2007
Exposure time	ET	0.58	1	hr/day	U.S. EPA, 2004
Age Adjusted Exposure Time	ET_{adj}	0.616		hrs	Calculated using the age adjusted intake factors equation
Radiation Age-adjusted inhalation rate	INH_RAD_{adj}	1760		m^3-yr/day	Calculated using the age adjusted intake factors equation
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Radiation Inhalation of Volatiles Slope Factor	Sfi	Chemical Specific		risk/pCi	U.S. EPA, 1997

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027. Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Inhalation of Volatile Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Radioactive COPC	CAS #	VOC[a]	C_w (pCi/L)	CDI (radiological inhalation) (pCi)	SF_i (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	6.4100896	--(b)	--	--(b)	
Gross beta	12587-47-2	--	32.397036	--(b)	--	--(b)	
Iodine-129	15046-84-1	--	1.9883847	--(b)	6.07E-11	--(b)	
Nickel-63	13981-37-8	--	4.07	--(b)	1.64E-12	--(b)	
Protactinium-231	14331-85-2	--	0.308	--(b)	4.55E-08	--(b)	
Strontium-90	10098-97-2	--	0.611	--(b)	1.05E-10	--(b)	
Technetium-99	14133-76-7	--	93.996334	--(b)	1.41E-11	--(b)	
Tritium	10028-17-8	Yes	264106.86	2.18E+09	5.62E-14	1.22E-04	100
Total ELCR						1.22E-04	100

[a] Radiological contaminants considered volatile for the groundwater inhalation pathway are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area - Yakima Nation

Ingestion of Radioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Factor	Symbol	Unit		Value	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Ridolfi, 2007
Exposure duration	ED	70	6	years	Ridolfi, 2007
Drinking Water Ingestion Rate	IRW	4	2	L/day	Ridolfi, 2007
Radiation Age-adjusted drinking water ingestion rate	IRW_RAD_{adj}	268		L-yr/day	Calculated using the age adjusted intake factors equation
Radiation Ingestion of Water Slope Factor	Sfo	Chemical Specific		risk/pCi	U.S. EPA, 1997

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Ingestion of Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Radioactive COPC	CAS #	Cw (pCi/L)	CDI (radiological ingestion) (pCi)	SF_o (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	6.4100896	627,035	--	--	
Gross beta	12587-47-2	32.397036	3,169,078	--	--	
Iodine-129	15046-84-1	1.9883847	194,504	1.48E-10	2.88E-05	2.1
Nickel-63	13981-37-8	4.07	398,127	6.70E-13	2.67E-07	0.020
Protactinium-231	14331-85-2	0.308	30,129	1.73E-10	5.21E-06	0.39
Strontium-90	10098-97-2	0.611	59,768	5.59E-11	3.34E-06	0.25
Technetium-99	14133-76-7	93.996334	9.19E+06	2.75E-12	2.53E-05	1.9
Tritium	10028-17-8	264106.86	2.58E+10	5.07E-14	1.31E-03	97
Total ELCR					1.34E-03	100

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakima Nation Drinking Water Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwate C_w (mg/L)	VOC?	HQ (Inhalation) (unitless)	HQ (Ingestion) (unitless)	HQ (Dermal) (unitless)	Total HI (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--(b)	--	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.66E-09	--	--(b)	--	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--(b)	--	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--(b)	--	--	--	
1,2-Dichloroethane	0.00064	Yes	3.22E-06	1.83E-03	4.48E-05	1.88E-03	0.022
2,3,4,6-Tetrachlorophenol	0.0077	--	--(b)	1.47E-02	--	1.47E-02	0.17
Aluminum	0.046776593	--	--(b)	2.67E-03	6.98E-06	2.68E-03	0.031
Arsenic	0.00579213	--	--(b)	1.10E+00	2.88E-03	1.11E+00	13
Barium	0.053448218	--	--(b)	1.53E-02	5.69E-04	1.58E-02	0.18
Beryllium	0.000342265	--	--(b)	9.78E-03	3.65E-03	1.34E-02	0.15
Bis(2-ethylhexyl) phthalate	0.011	--	--(b)	3.14E-02	2.43E-02	5.57E-02	0.64
Cadmium	0.002729138	--	--(b)	3.12E-01	1.63E-02	3.28E-01	3.8
Carbon tetrachloride	0.000282669	Yes	1.80E-05	2.31E-02	3.09E-03	2.62E-02	0.30
Chloride	12.62269	--	--(b)	--	--	--	
Chloroform	0.00038106	Yes	4.70E-05	2.18E-03	9.92E-05	2.32E-03	0.027
Chromium	0.015259293	--	--(b)	5.81E-04	1.17E-04	6.98E-04	0.0080
Cobalt	0.004495239	--	--(b)	8.56E-01	8.94E-04	8.57E-01	9.8
Copper	0.004447607	--	--(b)	6.35E-03	1.66E-05	6.37E-03	0.073
Fluoride	0.2940596	--	--(b)	2.80E-01	7.31E-04	2.81E-01	3.2
Hexavalent Chromium	0.191	--	--(b)	3.64E+00	7.60E-01	4.40E+00	50
Iron	0.090209963	--	--(b)	7.36E-03	1.92E-05	7.38E-03	0.085
Lead	0.001548018	--	--(b)	--	--	--	
Manganese	0.006198141	--	--(b)	1.48E-02	9.63E-04	1.57E-02	0.18
Nickel	0.011729633	--	--(b)	3.35E-02	4.37E-04	3.40E-02	0.39
Nitrate	34.098186	--	--(b)	2.74E-01	7.16E-04	2.75E-01	3.2
Nitrite	0.057119962	--	--(b)	1.09E-02	2.84E-05	1.09E-02	0.12
Nitrogen in Nitrite and Nitrate	14.7	--	--(b)	5.25E-01	1.37E-03	5.26E-01	6.0
Octachlorodibenzofuran	9.9649E-09	--	--(b)	--	--	--	
Octachlorodibenzo-p-dioxin	5.8071E-09	--	--(b)	--	--	--	
Silver	0.005686587	--	--(b)	6.50E-02	2.54E-03	6.75E-02	0.77
Strontium	0.2694514	--	--(b)	2.57E-02	6.70E-05	2.57E-02	
Sulfate	64.094058	--	--(b)	--	--	--	
Toluene	3.56519E-05	Yes	8.62E-08	2.55E-05	4.42E-06	3.00E-05	3.43E-04
Total petroleum hydrocarbons - gasoline range	0.05	--	--(b)	--	--	--	
Trichloroethene	0.000563286	Yes	1.94E-04	--	--	1.94E-04	0.0022
Uranium	0.020191069	--	--(b)	3.85E-01	1.00E-03	3.86E-01	4.4
Vanadium	0.02186531	--	--(b)	2.50E-01	6.52E-04	2.51E-01	2.9
Zinc	0.095789222	--	--(b)	1.82E-02	2.86E-05	1.83E-02	0.21
Total			2.63E-04	7.91	0.82	8.73	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

HQ = hazard quotient.

HI = hazard index.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakima Nation Drinking Water Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwate C_w (mg/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--(b)	3.06E-07	--	3.06E-07	0.053
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.66E-09	--	--(b)	4.63E-07	--	4.63E-07	0.080
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--(b)	2.37E-06	--	2.37E-06	0.41
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--(b)	1.72E-06	--	1.72E-06	0.30
1,2-Dichloroethane	0.00064	Yes	2.01E-07	3.67E-06	8.85E-08	3.96E-06	0.68
2,3,4,6-Tetrachlorophenol	0.0077	--	--(b)	--	--	--	
Aluminum	0.046776593	--	--(b)	--	--	--	
Arsenic	0.00579213	--	--(b)	5.47E-04	1.45E-06	5.48E-04	94
Barium	0.053448218	--	--(b)	--	--	--	
Beryllium	0.000342265	--	--(b)	--	--	--	
Bis(2-ethylhexyl) phthalate	0.011	--	--(b)	9.70E-06	7.37E-06	1.71E-05	2.9
Cadmium	0.002729138	--	--(b)	--	--	--	
Carbon tetrachloride	0.000282669	Yes	5.12E-08	2.31E-06	3.05E-07	2.67E-06	0.46
Chloride	12.62269	--	--(b)	--	--	--	
Chloroform	0.00038106	Yes	1.06E-07	7.44E-07	3.33E-08	8.83E-07	0.15
Chromium	0.015259293	--	--(b)	--	--	--	
Cobalt	0.004495239	--	--(b)	--	--	--	
Copper	0.004447607	--	--(b)	--	--	--	
Fluoride	0.2940596	--	--(b)	--	--	--	

Hexavalent Chromium	0.191	--	--(b)	--	--	--	
Iron	0.090209963	--	--(b)	--	--	--	
Lead	0.001548018	--	--(b)	--	--	--	
Manganese	0.006198141	--	--(b)	--	--	--	
Nickel	0.011729633	--	--(b)	--	--	--	
Nitrate	34.098186	--	--(b)	--	--	--	
Nitrite	0.057119962	--	--(b)	--	--	--	
Nitrogen in Nitrite and Nitrate	14.7	--	--(b)	--	--	--	
Octachlorodibenzofuran	9.9649E-09	--	--(b)	2.45E-08	--	2.45E-08	0.0042
Octachlorodibenzo-p-dioxin	5.8071E-09	--	--(b)	1.43E-08	--	1.43E-08	0.0025
Silver	0.005686587	--	--(b)	--	--	--	
Strontium	0.2694514	--	--(b)	--	--	--	
Sulfate	64.094058	--	--(b)	--	--	--	
Toluene	3.56519E-05	Yes	--	--	--	--	
Total petroleum hydrocarbons - gasoline range	0.05	--	--(b)	--	--	--	
Trichloroethene	0.000563286	Yes	1.70E-07	3.16E-06	2.69E-07	3.60E-06	0.62
Uranium	0.020191069	--	--(b)	--	--	--	
Vanadium	0.02186531	--	--(b)	--	--	--	
Zinc	0.095789222	--	--(b)	--	--	--	
Total ELCR			5.28E-07	5.71E-04	9.51E-06	5.82E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakima Nation Drinking Water Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwate C_w (pCi/L)	Volatile?[a]	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	5.3264311	--	--(b)	--	--	
Iodine-129	2.708038	--	--(b)	3.92E-05	3.92E-05	2.9
Plutonium-239/240	0.029	--	--(b)	3.83E-07	3.83E-07	0.028
Protactinium-231	0.28	--	--(b)	4.74E-06	4.74E-06	0.35
Strontium-90	4.3004432	--	--(b)	2.35E-05	2.35E-05	1.7
Technetium-99	1667.3497	--	--(b)	4.49E-04	4.49E-04	33
Tritium	156901.45	Yes	7.27E-05	7.78E-04	8.51E-04	62
Total ELCR			7.27E-05	1.29E-03	1.37E-03	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-Field exposure area - Yakima Nation

Ingestion of Nonradioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Ingestion Chronic Daily Intake	CDI	calculated		mg/kg-day	EPA 1989
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	16	kg	Ridolfi, 2007
Drinking Water Ingestion Rate	IRW	4	2	Liters/day	Ridolfi, 2007
Age-Adjusted Drinking Water Ingestion Rate	IRWadj	4.407		L-yr/kg-day	Calculated using the age adjusted intake factors equation
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	6	yr	Ridolfi, 2007
Averaging time	AT	70	--	yr	Ridolfi, 2007
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFo	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 1989

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.734E-09	2.13E-10	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.66E-09	3.23E-10	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	1.66E-10	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	1.20E-10	--	--	
1,2-Dichloroethane	107-06-2	0.00064	3.66E-05	2.00E-02	1.83E-03	0.023
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	4.40E-04	3.00E-02	1.47E-02	0.19
Aluminum	7429-90-5	0.046776593	2.67E-03	1.00E+00	2.67E-03	0.034
Arsenic	7440-38-2	0.00579213	3.31E-04	3.00E-04	1.10E+00	14
Barium	7440-39-3	0.053448218	3.05E-03	2.00E-01	1.53E-02	0.19
Beryllium	7440-41-7	0.000342265	1.96E-05	2.00E-03	9.78E-03	0.12
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	6.29E-04	2.00E-02	3.14E-02	0.40
Cadmium	7440-43-9	0.002729138	1.56E-04	5.00E-04	3.12E-01	3.9
Carbon tetrachloride	56-23-5	0.000282669	1.62E-05	7.00E-04	2.31E-02	0.29
Chloride	16887-00-6	12.62269	7.21E-01	--	--	
Chloroform	67-66-3	0.00038106	2.18E-05	1.00E-02	2.18E-03	0.028
Chromium	7440-47-3	0.015259293	8.72E-04	1.50E+00	5.81E-04	0.0074
Cobalt	7440-48-4	0.004495239	2.57E-04	3.00E-04	8.56E-01	11
Copper	7440-50-8	0.004447607	2.54E-04	4.00E-02	6.35E-03	0.080
Fluoride	16984-48-8	0.2940596	1.68E-02	6.00E-02	2.80E-01	3.5
Hexavalent Chromium	18540-29-9	0.191	1.09E-02	3.00E-03	3.64E+00	46
Iron	7439-89-6	0.090209963	5.15E-03	7.00E-01	7.36E-03	0.093
Lead	7439-92-1	0.001548018	8.85E-05	--	--	
Manganese	7439-96-5	0.006198141	3.54E-04	2.40E-02	1.48E-02	0.19
Nickel	7440-02-0	0.011729633	6.70E-04	2.00E-02	3.35E-02	0.42
Nitrate	14797-55-8	34.098186	1.95E+00	7.10E+00	2.74E-01	3.5
Nitrite	14797-65-0	0.057119962	3.26E-03	3.00E-01	1.09E-02	0.14
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	8.40E-01	1.60E+00	5.25E-01	6.6
Octachlorodibenzofuran	39001-02-0	9.9649E-09	5.69E-10	--	--	
Octachlorodibenzo-p-dioxin	3268-87-9	5.8071E-09	3.32E-10	--	--	
Silver	7440-22-4	0.005686587	3.25E-04	5.00E-03	6.50E-02	0.82
Strontium	7440-24-6	0.2694514	1.54E-02	6.00E-01	2.57E-02	0.32
Sulfate	14808-79-8	64.094058	3.66E+00	--	--	
Toluene	108-88-3	3.56519E-05	2.04E-06	8.00E-02	2.55E-05	3.22E-04
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	2.86E-03	--	--	
Trichloroethene	79-01-6	0.000563286	3.22E-05	--	--	
Uranium	7440-61-1	0.020191069	1.15E-03	3.00E-03	3.85E-01	4.9
Vanadium	7440-62-2	0.02186531	1.25E-03	5.00E-03	2.50E-01	3.2
Zinc	7440-66-6	0.095789222	5.47E-03	3.00E-01	1.82E-02	0.23
Total					7.9	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.734E-09	2.35E-10	1.30E+03	3.06E-07	0.053
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.66E-09	3.56E-10	1.30E+03	4.63E-07	0.081
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	1.83E-10	1.30E+04	2.37E-06	0.42
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	1.32E-10	1.30E+04	1.72E-06	0.30
1,2-Dichloroethane	107-06-2	0.00064	4.03E-05	9.10E-02	3.67E-06	0.64
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	4.85E-04	--	--	
Aluminum	7429-90-5	0.046776593	2.95E-03	--	--	
Arsenic	7440-38-2	0.00579213	3.65E-04	1.50E+00	5.47E-04	96
Barium	7440-39-3	0.053448218	3.37E-03	--	--	
Beryllium	7440-41-7	0.000342265	2.15E-05	--	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	6.93E-04	1.40E-02	9.70E-06	1.7
Cadmium	7440-43-9	0.002729138	1.72E-04	--	--	
Carbon tetrachloride	56-23-5	0.000282669	1.78E-05	1.30E-01	2.31E-06	0.40
Chloride	16887-00-6	12.62269	7.95E-01	--	--	
Chloroform	67-66-3	0.00038106	2.40E-05	3.10E-02	7.44E-07	0.13
Chromium	7440-47-3	0.015259293	9.61E-04	--	--	
Cobalt	7440-48-4	0.004495239	2.83E-04	--	--	
Copper	7440-50-8	0.004447607	2.80E-04	--	--	
Fluoride	16984-48-8	0.2940596	1.85E-02	--	--	
Hexavalent Chromium	18540-29-9	0.191	1.20E-02	--	--	
Iron	7439-89-6	0.090209963	5.68E-03	--	--	
Lead	7439-92-1	0.001548018	9.75E-05	--	--	
Manganese	7439-96-5	0.006198141	3.90E-04	--	--	
Nickel	7440-02-0	0.011729633	7.38E-04	--	--	
Nitrate	14797-55-8	34.098186	2.15E+00	--	--	
Nitrite	14797-65-0	0.057119962	3.60E-03	--	--	

Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	9.26E-01	--	--	
Octachlorodibenzofuran	39001-02-0	9.9649E-09	6.27E-10	3.90E+01	2.45E-08	0.0043
Octachlorodibenzo-p-dioxin	3268-87-9	5.8071E-09	3.66E-10	3.90E+01	1.43E-08	0.0025
Silver	7440-22-4	0.005686587	3.58E-04	--	--	
Strontium	7440-24-6	0.2694514	1.70E-02	--	--	
Sulfate	14808-79-8	64.094058	4.04E+00	--	--	
Toluene	108-88-3	3.56519E-05	2.24E-06	--	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	3.15E-03	--	--	
Trichloroethene	79-01-6	0.000563286	3.55E-05	8.90E-02	3.16E-06	0.55
Uranium	7440-61-1	0.020191069	1.27E-03	--	--	
Vanadium	7440-62-2	0.02186531	1.38E-03	--	--	
Zinc	7440-66-6	0.095789222	6.03E-03	--	--	
Total ELCR					5.71E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-Field exposure area - Yakima Nation

Inhalation of Volatile Nonradioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Inhalation Chronic Daily Intake	CDI	calculated		mg/m^3 for noncarcinogens, $\mu g/m^3$ for carcinogens	EPA 2009b
Contaminant concentration in drinking water	C_w	contaminant-specific		mg/L	ECF-200PO1-09-2027
Exposure Time	ET	0.580	--	hours/day	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	--	yr	Ridolfi, 2007
Averaging Time	AT	70	--	yr	Ridolfi, 2007
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Inhalation Reference Concentration	RfC_i	Chemical Specific		mg/m^3	EPA 2009a
Inhalation Unit Risk	IUR	Chemical Specific		$(\mu g/m^3)^{-1}$	EPA 2009a
Conversion Factor	CF1	365		days/year	EPA 2009b
Conversion Factor	CF2	0.042		1day/24 hours	EPA 2009b

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009a EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

U.S. EPA 2009b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (noncarcinogen) (mg/m^3)	RfC[a] (mg/m^3)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(b)	--	--(b)	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.66E-09	--(b)	--	--(b)	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(b)	--	--(b)	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(b)	--	--(b)	
1,2-Dichloroethane	107-06-2	Yes	0.00064	7.73E-06	2.40E+00	3.22E-06	1.2
2,3,4,6-Tetrachlorophenol	58-90-2	--	0.0077	--(b)	--	--(b)	
Aluminum	7429-90-5	--	0.046776593	--(b)	5.00E-03	--(b)	
Arsenic	7440-38-2	--	0.00579213	--(b)	1.50E-05	--(b)	
Barium	7440-39-3	--	0.053448218	--(b)	5.00E-04	--(b)	
Beryllium	7440-41-7	--	0.000342265	--(b)	2.00E-05	--(b)	
Bis(2-ethylhexyl) phthalate	117-81-7	--	0.011	--(b)	--	--(b)	
Cadmium	7440-43-9	--	0.002729138	--(b)	1.00E-05	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.000282669	3.42E-06	1.90E-01	1.80E-05	6.8
Chloride	16887-00-6	--	12.62269	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.00038106	4.60E-06	9.80E-02	4.70E-05	18
Chromium	7440-47-3	--	0.015259293	--(b)	--	--(b)	
Cobalt	7440-48-4	--	0.004495239	--(b)	6.00E-06	--(b)	
Copper	7440-50-8	--	0.004447607	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.2940596	--(b)	1.30E-02	--(b)	
Hexavalent Chromium	18540-29-9	--	0.191	--(b)	1.00E-04	--(b)	
Iron	7439-89-6	--	0.090209963	--(b)	--	--(b)	
Lead	7439-92-1	--	0.001548018	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.006198141	--(b)	5.00E-05	--(b)	
Nickel	7440-02-0	--	0.011729633	--(b)	9.00E-05	--(b)	
Nitrate	14797-55-8	--	34.098186	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.057119962	--(b)	--	--(b)	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(b)	--	--(b)	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(b)	--	--(b)	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.8071E-09	--(b)	--	--(b)	
Silver	7440-22-4	--	0.005686587	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.2694514	--(b)	--	--(b)	
Sulfate	14808-79-8	--	64.094058	--(b)	--	--(b)	
Toluene	108-88-3	Yes	3.56519E-05	4.31E-07	5.00E+00	8.62E-08	0.033
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(b)	--	--(b)	
Trichloroethene	79-01-6	Yes	0.000563286	6.81E-06	3.50E-02	1.94E-04	74
Uranium	7440-61-1	--	0.020191069	--(b)	3.00E-04	--(b)	
Vanadium	7440-62-2	--	0.02186531	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.095789222	--(b)	--	--(b)	
Total						2.63E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (carcinogen) ($\mu g/m^3$)	IUR[a] $(\mu g/m^3)^{-1}$	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(b)	3.80E-01	--(b)	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.66E-09	--(b)	3.80E-01	--(b)	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(b)	3.80E+00	--(b)	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(b)	3.80E+00	--(b)	
1,2-Dichloroethane	107-06-2	Yes	0.00064	7.73E-03	2.60E-05	2.01E-07	38
2,3,4,6-Tetrachlorophenol	58-90-2	--	0.0077	--(b)	--	--(b)	
Aluminum	7429-90-5	--	0.046776593	--(b)	--	--(b)	
Arsenic	7440-38-2	--	0.00579213	--(b)	4.30E-03	--(b)	
Barium	7440-39-3	--	0.053448218	--(b)	--	--(b)	
Beryllium	7440-41-7	--	0.000342265	--(b)	2.40E-03	--(b)	
Bis(2-ethylhexyl) phthalate	117-81-7	--	0.011	--(b)	2.40E-06	--(b)	
Cadmium	7440-43-9	--	0.002729138	--(b)	1.80E-03	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.000282669	3.42E-03	1.50E-05	5.12E-08	9.7
Chloride	16887-00-6	--	12.62269	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.00038106	4.60E-03	2.30E-05	1.06E-07	20
Chromium	7440-47-3	--	0.015259293	--(b)	--	--(b)	
Cobalt	7440-48-4	--	0.004495239	--(b)	9.00E-03	--(b)	
Copper	7440-50-8	--	0.004447607	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.2940596	--(b)	--	--(b)	
Hexavalent Chromium	18540-29-9	--	0.191	--(b)	8.40E-02	--(b)	
Iron	7439-89-6	--	0.090209963	--(b)	--	--(b)	
Lead	7439-92-1	--	0.001548018	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.006198141	--(b)	--	--(b)	
Nickel	7440-02-0	--	0.011729633	--(b)	2.60E-04	--(b)	
Nitrate	14797-55-8	--	34.098186	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.057119962	--(b)	--	--(b)	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(b)	--	--(b)	

Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(b)	1.14E-02	--(b)	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.8071E-09	--(b)	1.14E-02	--(b)	
Silver	7440-22-4	--	0.005686587	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.2694514	--(b)	--	--(b)	
Sulfate	14808-79-8	--	64.094058	--(b)	--	--(b)	
Toluene	108-88-3	Yes	3.56519E-05	4.31E-04	--	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(b)	--	--(b)	
Trichloroethene	79-01-6	Yes	0.000563286	6.81E-03	2.50E-05	1.70E-07	32
Uranium	7440-61-1	--	0.020191069	--(b)	--	--(b)	
Vanadium	7440-62-2	--	0.02186531	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.095789222	--(b)	--	--(b)	
Total ELCR						5.28E-07	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year) -Near-Field exposure area - Yakima Nation

Dermal Absorption of Nonradioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	16	kg	Harris et al, 2004
Exposure Time	ET	0.58	1.0	hours/day	U.S. EPA, 2004
Exposure Time (Age-Adjusted)	ETadj	0.616		hours/day	Calculated using the age adjusted intake factors equation
Surface Area	SA	18,000	6,600	cm^2	Ridolfi, 2007
Age-Adjusted Surface Area	SAadj	18,932		(cm^2-yr-event)/(kg-day)	Calculated using the age adjusted intake factors equation
Event Frequency	EV	1.0	1.0	Event/days	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	6.0	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Ridolfi, 2007
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFO	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 2009
Conversion Factor	CF3	0.001		L/cm^3	1 L = 1000 cm^3
t*	Time to reach steady state	Chemical Specific		hours	EPA, 2004
B	Dermal Partitioning Constant	Chemical Specific		unitless	EPA, 2004
DA	Absorbed Dose per Event	Chemical Specific		(mg/cm^2-event)	Calculated using dermal exposure to groundwater equations as provided by U.S. EPA, 2004
Kp	Dermal Permeability Constant	Chemical Specific		cm/hour	EPA, 2004
FA	Fraction Absorbed	Chemical Specific		unitless	EPA, 2004
t	Lag Time	Chemical Specific		hours	EPA, 2004

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Absorbed Dermal Dose Calculation

Contaminant of Potential Concern	CAS #	Cw (mg/L)	Inorganic/organic[a]	FA[c] (unitless)	K_p[b] (cm/hour)	B[a] (unitless)	t^*[b] (hours/event)	t*[a] (hours)	DA (noncancer) (mg/cm^2-event)	DA (cancer) (mg/cm^2-event)
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.734E-09	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran[c]	67562-39-4	5.66E-09	--	--	1.45	--	--	-	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran[c]	70648-26-9	2.9E-09	--	--	2.25	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuranc	57117-44-9	2.1E-09	--	--	2.25	--	--	--	--	--
1,2-Dichloroethane	107-06-2	0.00064	--	1.0	0.0042	0	0.38	0.92	3.49E-09	3.59E-09
2,3,4,6-Tetrachlorophenol[c]	58-90-2	0.0077	--	--	0.071	--	--	--	--	--
Aluminum	7429-90-5	0.046776593	INORGANIC	--	0.001	--	--	--	2.71E-08	2.88E-08
Arsenic	7440-38-2	0.00579213	INORGANIC	--	0.001	--	--	--	3.36E-09	3.57E-09
Barium	7440-39-3	0.053448218	INORGANIC	--	0.001	--	--	--	3.10E-08	3.29E-08
Beryllium	7440-41-7	0.000342265	INORGANIC	--	0.001	--	--	-	1.99E-10	2.11E-10
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	--	0.8	0.025	0.2	16.64	39.93	1.89E-06	1.95E-06
Cadmium	7440-43-9	0.002729138	INORGANIC	--	0.001	--	--	--	1.58E-09	1.68E-09
Carbon tetrachloride	56-23-5	0.000282669	--	1.0	0.016	0.1	0.78	1.86	8.41E-09	8.66E-09
Chloride	16887-00-6	12.62269	INORGANIC	--	0.001	--	--	--	7.32E-06	7.78E-06
Chloroform	67-66-3	0.00038106	--	1.0	0.0068	0	0.50	1.19	3.86E-09	3.97E-09
Chromium	7440-47-3	0.015259293	INORGANIC	--	0.001	--	--	-	8.85E-09	9.40E-09
Cobalt	7440-48-4	0.004495239	INORGANIC	--	0.0004	--	--	--	1.04E-09	1.11E-09
Copper	7440-50-8	0.004447607	INORGANIC	--	0.001	--	--	--	2.58E-09	2.74E-09
Fluoride	16984-48-8	0.2940596	INORGANIC	--	0.001	--	--	--	1.71E-07	1.81E-07
Hexavalent Chromium	18540-29-9	0.191	INORGANIC	--	0.002	--	--	--	2.22E-07	2.35E-07
Iron	7439-89-6	0.090209963	INORGANIC	--	0.001	--	--	--	5.23E-08	5.56E-08
Lead	7439-92-1	0.001548018	INORGANIC	--	0.0001	--	--	-	8.98E-11	9.54E-11
Manganese	7439-96-5	0.006198141	INORGANIC	--	0.001	--	--	--	3.59E-09	3.82E-09
Nickel	7440-02-0	0.011729633	INORGANIC	--	0.0002	--	--	--	1.36E-09	1.45E-09
Nitrate	14797-55-8	34.098186	INORGANIC	--	0.001	--	--	-	1.98E-05	2.10E-05
Nitrite	14797-65-0	0.057119962	INORGANIC	--	0.001	--	--	--	3.31E-08	3.52E-08
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	INORGANIC	--	0.001	--	--	--	8.53E-06	9.06E-06
Octachlorodibenzofuran[c]	39001-02-0	9.9649E-09	--	--	2.63	--	--	--	--	--
Octachlorodibenzo-p-dioxin[c]	3268-87-9	5.8071E-09	--	--	1.16	--	--	--	--	--
Silver	7440-22-4	0.005686587	INORGANIC	--	0.0006	--	--	--	1.98E-09	2.10E-09
Strontium	7440-24-6	0.2694514	INORGANIC	--	0.001	--	--	--	1.56E-07	1.66E-07
Sulfate	14808-79-8	64.094058	INORGANIC	--	0.001	--	--	--	3.72E-05	3.95E-05
Toluene	108-88-3	3.56519E-05	--	1.0	0.031	0.1	0.35	0.84	1.38E-09	1.42E-09
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	--	--	--	--	--	-	--	--
Trichloroethene	79-01-6	0.000563286	--	1.0	0.012	0.1	0.58	1.39	1.08E-08	1.12E-08
Uranium	7440-61-1	0.020191069	INORGANIC	--	0.001	--	--	--	1.17E-08	1.24E-08
Vanadium	7440-62-2	0.02186531	INORGANIC	--	0.001	--	--	--	1.27E-08	1.35E-08
Zinc	7440-66-6	0.095789222	INORGANIC	--	0.0006	--	--	-	3.33E-08	3.54E-08

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

[a] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2

[b] EPA/540/R/99/005 Exhibit B-3

[c] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.734E-09	--	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.66E-09	--	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	--	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	--	--	1	--	
1,2-Dichloroethane	107-06-2	0.00064	8.97E-07	2.00E-02	1	4.48E-05	0.0055
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	--	3.00E-02	1	--	
Aluminum	7429-90-5	0.046776593	6.98E-06	1.00E+00	1	6.98E-06	8.51E-04
Arsenic	7440-38-2	0.00579213	8.64E-07	3.00E-04	1	2.88E-03	0.35
Barium	7440-39-3	0.053448218	7.97E-06	2.00E-01	0.07	5.69E-04	0.069
Beryllium	7440-41-7	0.000342265	5.10E-08	2.00E-03	0.007	3.65E-03	0.44
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	4.86E-04	2.00E-02	1	2.43E-02	3.0
Cadmium	7440-43-9	0.002729138	4.07E-07	5.00E-04	0.05	1.63E-02	2.0
Carbon tetrachloride	56-23-5	0.000282669	2.16E-06	7.00E-04	1	3.09E-03	0.38
Chloride	16887-00-6	12.62269	1.88E-03	--	1	--	
Chloroform	67-66-3	0.00038106	9.92E-07	1.00E-02	1	9.92E-05	0.012
Chromium	7440-47-3	0.015259293	2.28E-06	1.50E+00	0.013	1.17E-04	0.014
Cobalt	7440-48-4	0.004495239	2.68E-07	3.00E-04	1	8.94E-04	0.11
Copper	7440-50-8	0.004447607	6.63E-07	4.00E-02	1	1.66E-05	0.0020
Fluoride	16984-48-8	0.2940596	4.39E-05	6.00E-02	1	7.31E-04	0.089
Hexavalent Chromium	18540-29-9	0.191	5.70E-05	3.00E-03	0.025	7.60E-01	93
Iron	7439-89-6	0.090209963	1.35E-05	7.00E-01	1	1.92E-05	0.0023
Lead	7439-92-1	0.001548018	2.31E-08	--	1	--	
Manganese	7439-96-5	0.006198141	9.24E-07	2.40E-02	0.04	9.63E-04	0.12
Nickel	7440-02-0	0.011729633	3.50E-07	2.00E-02	0.04	4.37E-04	0.053
Nitrate	14797-55-8	34.098186	5.09E-03	7.10E+00	1	7.16E-04	0.087
Nitrite	14797-65-0	0.057119962	8.52E-06	3.00E-01	1	2.84E-05	0.0035
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	2.19E-03	1.60E+00	1	1.37E-03	0.17
Octachlorodibenzofuran	39001-02-0	9.9649E-09	--	--	1	--	
Octachlorodibenzo-p-dioxin	3268-87-9	5.8071E-09	--	--	1	--	
Silver	7440-22-4	0.005686587	5.09E-07	5.00E-03	0.04	2.54E-03	0.31
Strontium	7440-24-6	0.2694514	4.02E-05	6.00E-01	1	6.70E-05	0.0082
Sulfate	14808-79-8	64.094058	9.56E-03	--	--	--	
Toluene	108-88-3	3.56519E-05	3.54E-07	8.00E-02	1	4.42E-06	5.39E-04
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	--	--	--	--	
Trichloroethene	79-01-6	0.000563286	2.79E-06	--	1	--	
Uranium	7440-61-1	0.020191069	3.01E-06	3.00E-03	1	1.00E-03	0.12
Vanadium	7440-62-2	0.02186531	3.26E-06	5.00E-03	1	0.0007	0.080
Zinc	7440-66-6	0.095789222	8.57E-06	3.00E-01	1	2.86E-05	0.0035
Total						0.82	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.734E-09	--	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.66E-09	--	1.30E+03	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	--	1.30E+04	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	--	1.30E+04	1	--	
1,2-Dichloroethane	107-06-2	0.00064	9.72E-07	9.10E-02	1	8.85E-08	0.93
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	--	--	1	--	
Aluminum	7429-90-5	0.046776593	7.79E-06	--	1	--	
Arsenic	7440-38-2	0.00579213	9.65E-07	1.50E+00	1	1.45E-06	15
Barium	7440-39-3	0.053448218	8.90E-06	--	0.07	--	
Beryllium	7440-41-7	0.000342265	5.70E-08	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	5.27E-04	1.40E-02	1	7.37E-06	77
Cadmium	7440-43-9	0.002729138	4.55E-07	--	0.05	--	
Carbon tetrachloride	56-23-5	0.000282669	2.34E-06	1.30E-01	1	3.05E-07	3.2
Chloride	16887-00-6	12.62269	2.10E-03	--	1	--	
Chloroform	67-66-3	0.00038106	1.08E-06	3.10E-02	1	3.33E-08	0.35
Chromium	7440-47-3	0.015259293	2.54E-06	--	0.013	--	
Cobalt	7440-48-4	0.004495239	3.00E-07	--	1	--	
Copper	7440-50-8	0.004447607	7.41E-07	--	1	--	
Fluoride	16984-48-8	0.2940596	4.90E-05	--	1	--	

Hexavalent Chromium	18540-29-9	0.191	6.36E-05	--	0.025	--	
Iron	7439-89-6	0.090209963	1.50E-05	--	1	--	
Lead	7439-92-1	0.001548018	2.58E-08	--	1	--	
Manganese	7439-96-5	0.006198141	1.03E-06	--	0.04	--	
Nickel	7440-02-0	0.011729633	3.91E-07	--	0.04	--	
Nitrate	14797-55-8	34.098186	5.68E-03	--	1	--	
Nitrite	14797-65-0	0.057119962	9.52E-06	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	24.7	2.45E-03	--	1	--	
Octachlorodibenzofuran	39001-02-0	9.9849E-09	--	3.90E+01	1	--	
Octachlorodibenzo-p-dioxin	3268-87-9	5.8071E-09	--	3.90E+01	1	--	
Silver	7440-22-4	0.005686567	5.68E-07	--	0.04	--	
Strontium	7440-24-6	0.2684514	4.49E-05	--	1	--	
Sulfate	14808-79-8	64.094058	1.07E-02	--	--	--	
Toluene	108-88-3	3.56519E-05	3.84E-07	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	--	--	--	--	
Trichloroethene	79-01-6	0.000563286	3.02E-06	8.90E-02	1	2.69E-07	2.8
Uranium	7440-61-1	0.020191069	3.36E-06	--	1	--	
Vanadium	7440-62-2	0.02186631	3.64E-06	--	1	--	
Zinc	7440-66-6	0.095789222	6.36E-05	--	1	--	
Total ELCR						9.51E-06	100

* EPA Region 3 Regional Screening Level tables downloaded January 2010: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-Field exposure area - Yakima Nation

Inhalation of Volatile Radioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Factor	Symbol	Adult	Child	Unit	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Ridolfi, 2007
Exposure duration	ED	70	6	years	Ridolfi, 2007
Inhalation Rate	INH	26	16	m^3/day	Ridolfi, 2007
Exposure time	ET	0.58	1	hr/day	U.S. EPA, 2004
Age Adjusted Exposure Time	ET_{adj}	0.616		hrs	Calculated using the age adjusted intake factors equation
Radiation Age-adjusted inhalation rate	INH_RAD_{adj}	1760		m^3-yr/day	Calculated using the age adjusted intake factors equation
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991b
Radiation Inhalation of Volatiles Slope Factor	Sfi	Chemical Specific		risk/pCi	U.S. EPA, 1997

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Inhalation of Volatile Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	VOC[a]	Cw (pCi/L)	CDI (radiological inhalation) (pCi)	SF_i (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	5.3264311	--(b)	--	--(b)	
Iodine-129	15046-84-1	--	2.708038	--(b)	6.07E-11	--(b)	
Plutonium-239/240	PU-239/240	--	0.029	--(b)	3.33E-08	--(b)	
Protactinium-231	14331-85-2	--	0.28	--(b)	4.55E-08	--(b)	
Strontium-90	10098-97-2	--	4.3004432	--(b)	1.05E-10	--(b)	
Technetium-99	14133-76-7	--	1667.3497	--(b)	1.41E-11	--(b)	
Tritium	10028-17-8	Yes	156901.45	1.29E+09	5.62E-14	7.27E-05	100
Total ELCR						7.27E-05	100

[a] Radiological contaminants considered volatile for the groundwater inhalation pathway are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-Field exposure area - Yakima Nation

Ingestion of Radioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Factor	Symbol	Unit		Value	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Ridolfi, 2007
Exposure duration	ED	70	6	years	Ridolfi, 2007
Drinking Water Ingestion Rate	IRW	4	2	L/day	Ridolfi, 2007
Radiation Age-adjusted drinking water ingestion rate	IRW_RAD_{adj}	268		L-yr/day	Calculated using the age adjusted intake factors equation
Radiation Ingestion of Water Slope Factor	Sfo	Chemical Specific		risk/pCi	U.S. EPA, 1997

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Ingestion of Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	Cw (pCi/L)	CDI (radiological ingestion) (pCi)	SF_o (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	5.3264311	5.21E+05	--	--	
Iodine-129	15046-84-1	2.708038	264,900	1.48E-10	3.92E-05	3.0
Plutonium-239/240	PU-239/240	0.029	2,837	1.35E-10	3.83E-07	0.030
Protactinium-231	14331-85-2	0.28	27,390	1.73E-10	4.74E-06	0.37
Strontium-90	10098-97-2	4.3004432	420,669	5.59E-11	2.35E-05	1.8
Technetium-99	14133-76-7	1667.3497	1.63E+08	2.75E-12	4.49E-04	35
Tritium	10028-17-8	156901.45	1.53E+10	5.07E-14	7.78E-04	60
Total ELCR					1.29E-03	100

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit River Unconfined Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakima Nation Drinking Water Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwater C_w (mg/L)	VOC?	HQ (Inhalation) (unitless)	HQ (Ingestion) (unitless)	HQ (Dermal) (unitless)	Total HI (unitless)	% Contribution
Acetone	0.0011	Yes	4.29E-07	6.98E-05	--	7.03E-05	0.0031
Arsenic	0.005767892	--	--(b)	1.10E+00	2.87E-03	1.10E+00	49
Barium	0.049451657	--	--(b)	1.41E-02	5.27E-04	1.47E-02	0.65
Carbon tetrachloride	0.000271961	Yes	1.73E-05	2.22E-02	2.97E-03	2.52E-02	1.1
Chloride	11.3727	--	--(b)	--	--	--	
Chloroform	0.000814875	Yes	1.00E-04	4.66E-03	2.12E-04	4.97E-03	0.22
Chromium	0.009951236	--	--(b)	3.79E-04	7.61E-05	4.55E-04	0.020
Copper	0.00597989	--	--(b)	8.54E-03	2.23E-05	8.56E-03	0.38
Fluoride	0.28680392	--	--(b)	2.73E-01	7.13E-04	2.74E-01	12
Iron	0.61057915	--	--(b)	4.98E-02	1.30E-04	5.00E-02	2.2
Lead	0.0006805	--	--(b)	--	--	--	
Manganese	0.041694118	--	--(b)	9.93E-02	6.48E-03	1.06E-01	4.7
Nickel	0.0056	--	--(b)	1.60E-02	2.09E-04	1.62E-02	0.72
Nitrate	28.582087	--	--(b)	2.30E-01	6.00E-04	2.31E-01	10
Nitrite	0.46	--	--(b)	8.76E-02	2.29E-04	8.78E-02	3.9
Strontium	0.38963943	--	--(b)	3.71E-02	9.69E-05	3.72E-02	1.6
Sulfate	42.560202	--	--(b)	--	--	--	
Thallium	0.00037	--	--(b)	--	--	--	
Uranium	0.005589723	--	--(b)	1.06E-01	2.78E-04	1.07E-01	4.7
Vanadium	0.016788235	--	--(b)	1.92E-01	5.01E-04	1.92E-01	8.5
Zinc	0.006671161	--	--(b)	1.27E-03	1.99E-06	1.27E-03	0.056
Total			1.18E-04	2.24	0.02	2.26	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

HQ = hazard quotient.

HI = hazard index.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit River Unconfined Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakama Nation Drinking Water Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwater C_w (mg/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Acetone	0.0011	Yes	--	--	--	--	
Arsenic	0.005767892	--	--(b)	5.45E-04	1.44E-06	5.46E-04	99
Barium	0.049451657	--	--(b)	--	--	--	
Carbon tetrachloride	0.000271961	Yes	0.0000	2.23E-06	2.93E-07	2.57E-06	0.47
Chloride	11.3727	--	--(b)	--	--	--	
Chloroform	0.000814875	Yes	0.0000	1.59E-06	7.13E-08	1.89E-06	0.34
Chromium	0.009951236	--	--(b)	--	--	--	
Copper	0.00597989	--	--(b)	--	--	--	
Fluoride	0.28680392	--	--(b)	--	--	--	
Iron	0.61057915	--	--(b)	--	--	--	
Lead	0.0006805	--	--(b)	--	--	--	
Manganese	0.041694118	--	--(b)	--	--	--	
Nickel	0.0056	--	--(b)	--	--	--	
Nitrate	28.582087	--	--(b)	--	--	--	
Nitrite	0.46	--	--(b)	--	--	--	
Strontium	0.38963943	--	--(b)	--	--	--	
Sulfate	42.560202	--	--(b)	--	--	--	
Thallium	0.00037	--	--(b)	--	--	--	
Uranium	0.005589723	--	--(b)	--	--	--	
Vanadium	0.016788235	--	--(b)	--	--	--	
Zinc	0.006671161	--	--(b)	--	--	--	
Total ELCR			2.76E-07	5.49E-04	1.81E-06	5.51E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit River Unconfined Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakama Nation Drinking Water Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwater C_w (pCi/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	2.4	--	--(b)	--	--	
Gross beta	31.1	--	--(b)	--	--	
Strontium-90	2.60	--	--(b)	1.42E-05	1.42E-05	3.30
Technetium-99	121	--	--(b)	3.25E-05	3.25E-05	7.6
Tritium	70,724	Yes	3.28E-05	3.51E-04	3.84E-04	89
Total ELCR			3.28E-05	3.98E-04	4.30E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--River exposure area - Yakima Nation

Ingestion of Nonradioactive Compounds in Drinking Water

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Ingestion Chronic Daily Intake	CDI	calculated		mg/kg-day	EPA 1989
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	16	kg	Ridolfi, 2007
Drinking Water Ingestion Rate	IRW	4	2	Liters/day	Ridolfi, 2007
Age-Adjusted Drinking Water Ingestion Rate	IRWadj	4.407		L-yr/kg-day	Calculated using the age adjusted intake factors equation
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	6	yr	Ridolfi, 2007
Averaging time	AT	70	--	yr	Ridolfi, 2007
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFo	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 1989

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	HQ (unitless)	% Contribution
Acetone	67-64-1	0.0011	6.29E-05	0.90	6.98E-05	0.0031
Arsenic	7440-38-2	0.005767892	3.30E-04	3.00E-04	1.1	49
Barium	7440-39-3	0.049451657	2.83E-03	0.20	0.014	0.63
Carbon tetrachloride	56-23-5	0.000271961	1.55E-05	7.00E-04	0.022	0.99
Chloride	16887-00-6	11.3727	6.50E-01	--	--	
Chloroform	67-66-3	0.000814875	4.66E-05	0.010	0.0047	0.21
Chromium	7440-47-3	0.009951236	5.69E-04	1.5	3.79E-04	0.017
Copper	7440-50-8	0.00597989	3.42E-04	0.040	0.0085	0.38
Fluoride	16984-48-8	0.28680392	1.64E-02	0.060	0.27	12
Iron	7439-89-6	0.61057915	3.49E-02	0.70	0.050	2.2
Lead	7439-92-1	0.0006805	3.89E-05	--	--	
Manganese	7439-96-5	0.041694118	2.38E-03	0.024	0.099	4.4
Nickel	7440-02-0	0.0056	3.20E-04	0.020	0.016	0.71
Nitrate	14797-55-8	28.582087	1.63E+00	7.1	0.23	10
Nitrite	14797-65-0	0.46	2.63E-02	0.30	0.088	3.9
Strontium	7440-24-6	0.38963943	2.23E-02	0.60	0.037	1.7
Sulfate	14808-79-8	42.560202	2.43E+00	--	--	
Thallium	7440-28-0	0.00037	2.11E-05	--	--	
Uranium	7440-61-1	0.005589723	3.19E-04	0.0030	0.11	4.8
Vanadium	7440-62-2	0.016788235	9.59E-04	0.0050	0.19	8.6
Zinc	7440-66-6	0.006671161	3.81E-04	0.30	0.0013	0.057
Total					2.2	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	Risk (unitless)	% Contribution
Acetone	67-64-1	0.0011	6.93E-05	--	--	
Arsenic	7440-38-2	0.005767892	3.63E-04	1.50E+00	5.45E-04	99
Barium	7440-39-3	0.049451657	3.11E-03	--	--	
Carbon tetrachloride	56-23-5	0.000271961	1.71E-05	1.30E-01	2.23E-06	0.41
Chloride	16887-00-6	11.3727	7.16E-01	--	--	
Chloroform	67-66-3	0.000814875	5.13E-05	3.10E-02	1.59E-06	0.29
Chromium	7440-47-3	0.009951236	6.27E-04	--	--	
Copper	7440-50-8	0.00597989	3.76E-04	--	--	
Fluoride	16984-48-8	0.28680392	1.81E-02	--	--	
Iron	7439-89-6	0.61057915	3.84E-02	--	--	
Lead	7439-92-1	0.0006805	4.28E-05	--	--	
Manganese	7439-96-5	0.041694118	2.63E-03	--	--	
Nickel	7440-02-0	0.0056	3.53E-04	--	--	
Nitrate	14797-55-8	28.582087	1.80E+00	--	--	
Nitrite	14797-65-0	0.46	2.90E-02	--	--	
Strontium	7440-24-6	0.38963943	2.45E-02	--	--	
Sulfate	14808-79-8	42.560202	2.68E+00	--	--	
Thallium	7440-28-0	0.00037	2.33E-05	--	--	
Uranium	7440-61-1	0.005589723	3.52E-04	--	--	
Vanadium	7440-62-2	0.016788235	1.06E-03	--	--	
Zinc	7440-66-6	0.006671161	4.20E-04	--	--	
Total ELCR					5.49E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--River exposure area - Yakima Nation

Inhalation of Volatile Nonradioactive Compounds in Drinking Water

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Inhalation Chronic Daily Intake	CDI	calculated		mg/m^3 for noncarcinogens, $\mu g/m^3$ for carcinogens	EPA 2009b
Contaminant concentration in drinking water	C_w	contaminant-specific		mg/L	ECF-200PO1-09-2027
Exposure Time	ET	0.580	--	hours/day	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	--	yr	Ridolfi, 2007
Averaging Time	AT	70	--	yr	Ridolfi, 2007
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Inhalation Reference Concentration	RfC_i	Chemical Specific		mg/m^3	EPA 2009a
Inhalation Unit Risk	IUR	Chemical Specific		$(\mu g/m^3)^{-1}$	EPA 2009a
Conversion Factor	CF1	365		days/year	EPA 2009b
Conversion Factor	CF2	0.042		1day/24 hours	EPA 2009b

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009a EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

U.S. EPA 2009b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (noncarcinogen) (mg/m^3)	RfC[a] (mg/m^3)	HQ (unitless)	% Contribution
Acetone	67-64-1	Yes	0.0011	1.33E-05	3.10E+01	4.29E-07	0.36
Arsenic	7440-38-2	--	0.005767892	--(b)	1.50E-05	--(b)	
Barium	7440-39-3	--	0.049451657	--(b)	5.00E-04	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.000271961	3.29E-06	1.90E-01	1.73E-05	15
Chloride	16887-00-6	--	11.3727	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.000814875	9.85E-06	9.80E-02	1.00E-04	85
Chromium	7440-47-3	--	0.009951236	--(b)	--	--(b)	
Copper	7440-50-8	--	0.00597989	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.28680392	--(b)	1.30E-02	--(b)	
Iron	7439-89-6	--	0.61057915	--(b)	--	--(b)	
Lead	7439-92-1	--	0.0006805	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.041694118	--(b)	5.00E-05	--(b)	
Nickel	7440-02-0	--	0.0056	--(b)	9.00E-05	--(b)	
Nitrate	14797-55-8	--	28.582087	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.46	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.38963943	--(b)	--	--(b)	
Sulfate	14808-79-8	--	42.560202	--(b)	--	--(b)	
Thallium	7440-28-0	--	0.00037	--(b)	--	--(b)	
Uranium	7440-61-1	--	0.005589723	--(b)	3.00E-04	--(b)	
Vanadium	7440-62-2	--	0.016788235	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.006671161	--(b)	--	--(b)	
Total						1.18E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (carcinogen) ($\mu g/m^3$)	IUR[a] $(\mu g/m^3)^{-1}$	Risk (unitless)	% Contribution
Acetone	67-64-1	Yes	0.0011	1.33E-02	--	--	
Arsenic	7440-38-2	--	0.005767892	--(b)	4.30E-03	--(b)	
Barium	7440-39-3	--	0.049451657	--(b)	--	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.000271961	3.29E-03	1.50E-05	4.93E-08	18
Chloride	16887-00-6	--	11.3727	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.000814875	9.85E-03	2.30E-05	2.26E-07	82
Chromium	7440-47-3	--	0.009951236	--(b)	--	--(b)	
Copper	7440-50-8	--	0.00597989	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.28680392	--(b)	--	--(b)	
Iron	7439-89-6	--	0.61057915	--(b)	--	--(b)	
Lead	7439-92-1	--	0.0006805	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.041694118	--(b)	--	--(b)	
Nickel	7440-02-0	--	0.0056	--(b)	2.60E-04	--(b)	
Nitrate	14797-55-8	--	28.582087	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.46	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.38963943	--(b)	--	--(b)	
Sulfate	14808-79-8	--	42.560202	--(b)	--	--(b)	
Thallium	7440-28-0	--	0.00037	--(b)	--	--(b)	
Uranium	7440-61-1	--	0.005589723	--(b)	--	--(b)	
Vanadium	7440-62-2	--	0.016788235	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.006671161	--(b)	--	--(b)	
Total ELCR						2.76E-07	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b]Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--River exposure area - Yakima Nation

Dermal Absorption of Nonradioactive Compounds in Drinking Water

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	16	kg	Harris et al, 2004
Exposure Time	ET	0.58	1.0	hours/day	U.S. EPA, 2004
Exposure Time (Age-Adjusted)	ETadj	0.616		hours/day	Calculated using the age adjusted intake factors equation
Surface Area	SA	18,000	6,600	cm^2	Ridolfi, 2007
Age-Adjusted Surface Area	SAadj	18,932		$(cm^2$-yr-event)/(kg-day)	Calculated using the age adjusted intake factors equation
Event Frequency	EV	1.0	1.0	Event/days	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	6.0	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Ridolfi, 2007
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFO	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 2009
Conversion Factor	CF3	0.001		L/cm^3	1 L = 1000 cm^3
t*	Time to reach steady state	Chemical Specific		hours	EPA, 2004
B	Dermal Partitioning Constant	Chemical Specific		unitless	EPA, 2004
DA	Absorbed Dose per Event	Chemical Specific		$(mg/cm^2$-event)	Calculated using dermal exposure to groundwater equations as provided by U.S. EPA, 2004
Kp	Dermal Permeability Constant	Chemical Specific		cm/hour	EPA, 2004
FA	Fraction Absorbed	Chemical Specific		unitless	EPA, 2004
τ	Lag Time	Chemical Specific		hours	EPA, 2004

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Absorbed Dermal Dose Calculation

Contaminant of Potential Concern	CAS #	Cw (mg/L)	Inorganic/organic[a]	FA[b] (unitless)	K_p*[c] (cm/hour)	B[b] (unitless)	τ[b] (hours/event)	t*[b] (hours)	DA (noncancer) (mg/cm^2-event)	DA (cancer) (mg/cm^2-event)
Acetone[c]	67-64-1	0.0011	--	--	0.000512	--	--	--	--	--
Arsenic	7440-38-2	0.005767892	INORGANIC	--	0.001	--	--	--	3.35E-09	3.55E-09
Barium	7440-39-3	0.049451657	INORGANIC	--	0.001	--	--	--	2.87E-08	3.05E-08
Carbon tetrachloride	56-23-5	0.000271961	--	1	0.016	0.1	0.78	1.86	8.09E-09	8.34E-09
Chloride	16887-00-6	11.3727	INORGANIC	--	0.001	--	--	--	6.60E-06	7.01E-06
Chloroform	67-66-3	0.000814875	--	1	0.0068	0	0.5	1.19	8.25E-09	8.50E-09
Chromium	7440-47-3	0.009951236	INORGANIC	--	0.001	--	--	--	5.77E-09	6.13E-09
Copper	7440-50-8	0.00597989	INORGANIC	--	0.001	--	--	--	3.47E-09	3.68E-09
Fluoride	16984-48-8	0.28680392	INORGANIC	--	0.001	--	--	--	1.66E-07	1.77E-07
Iron	7439-89-6	0.61057915	INORGANIC	--	0.001	--	--	--	3.54E-07	3.76E-07
Lead	7439-92-1	0.0006805	INORGANIC	--	0.0001	--	--	--	3.95E-11	4.19E-11
Manganese	7439-96-5	0.041694118	INORGANIC	--	0.001	--	--	--	2.42E-08	2.57E-08
Nickel	7440-02-0	0.0056	INORGANIC	--	0.0002	--	--	--	6.50E-10	6.90E-10
Nitrate	14797-55-8	28.582087	INORGANIC	--	0.001	--	--	--	1.66E-05	1.76E-05
Nitrite	14797-65-0	0.46	INORGANIC	--	0.001	--	--	--	2.67E-07	2.83E-07
Strontium	7440-24-6	0.38963943	INORGANIC	--	0.001	--	--	--	2.26E-07	2.40E-07
Sulfate	14808-79-8	42.560202	INORGANIC	--	0.001	--	--	--	2.47E-05	2.62E-05
Thallium	7440-28-0	0.00037	INORGANIC	--	0.001	--	--	--	2.15E-10	2.28E-10
Uranium	7440-61-1	0.005589723	INORGANIC	--	0.001	--	--	--	3.24E-09	3.44E-09
Vanadium	7440-62-2	0.016788235	INORGANIC	--	0.001	--	--	--	9.74E-09	1.03E-08
Zinc	7440-66-6	0.006671161	INORGANIC	--	0.0006	--	--	--	2.32E-09	2.47E-09

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

[a] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2

[b] EPA/540/R/99/005 Exhibit B-3

[c] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone	67-64-1	0.0011	--	9.00E-01	1	--	
Arsenic	7440-38-2	0.005767892	8.60E-07	3.00E-04	1	0.0029	18
Barium	7440-39-3	0.049451657	7.38E-06	2.00E-01	0.07	5.27E-04	3.3
Carbon tetrachloride	56-23-5	0.000271961	2.08E-06	7.00E-04	1	0.0030	19
Chloride	16887-00-6	11.3727	1.70E-03	--	1	--	
Chloroform	67-66-3	0.000814875	2.12E-06	1.00E-02	1	2.12E-04	1.3
Chromium	7440-47-3	0.009951236	1.48E-06	1.50E+00	0.013	7.61E-05	0.48
Copper	7440-50-8	0.00597989	8.92E-07	4.00E-02	1	2.23E-05	0.14
Fluoride	16984-48-8	0.28680392	4.28E-05	6.00E-02	1	7.13E-04	4.5
Iron	7439-89-6	0.61057915	9.11E-05	7.00E-01	1	1.30E-04	0.82
Lead	7439-92-1	0.0006805	1.01E-08	--	1	--	
Manganese	7439-96-5	0.041694118	6.22E-06	2.40E-02	0.04	0.0065	41
Nickel	7440-02-0	0.0056	1.67E-07	2.00E-02	0.04	2.09E-04	1.3
Nitrate	14797-55-8	28.582087	4.26E-03	7.10E+00	1	6.00E-04	3.8
Nitrite	14797-65-0	0.46	6.86E-05	3.00E-01	1	2.29E-04	1.4
Strontium	7440-24-6	0.38963943	5.81E-05	6.00E-01	1	9.69E-05	0.61
Sulfate	14808-79-8	42.560202	6.35E-03	--	--	--	
Thallium	7440-28-0	0.00037	5.52E-08	--	1	--	
Uranium	7440-61-1	0.005589723	8.34E-07	3.00E-03	1	2.78E-04	1.7
Vanadium	7440-62-2	0.016788235	2.50E-06	5.00E-03	1	5.01E-04	3.1
Zinc	7440-66-6	0.006671161	5.97E-07	3.00E-01	1	1.99E-06	0.013
Total						0.016	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	GIABS[a] (unitless)	Risk (unitless)	Risk (unitless)
Acetone	67-64-1	0.0011	--	--	1	--	
Arsenic	7440-38-2	0.005767892	9.61E-07	1.50E+00	1	1.44E-06	80
Barium	7440-39-3	0.049451657	8.24E-06	--	0.07	--	
Carbon tetrachloride	56-23-5	0.000271961	2.25E-06	1.30E-01	1	2.93E-07	16
Chloride	16887-00-6	11.3727	1.89E-03	--	1	--	
Chloroform	67-66-3	0.000814875	2.30E-06	3.10E-02	1	7.13E-08	3.9
Chromium	7440-47-3	0.009951236	1.66E-06	--	0.013	--	
Copper	7440-50-8	0.00597989	9.96E-07	--	1	--	
Fluoride	16984-48-8	0.28680392	4.78E-05	--	1	--	
Iron	7439-89-6	0.61057915	1.02E-04	--	1	--	
Lead	7439-92-1	0.0006805	1.13E-08	--	1	--	
Manganese	7439-96-5	0.041694118	6.95E-06	--	0.04	--	
Nickel	7440-02-0	0.0056	1.87E-07	--	0.04	--	
Nitrate	14797-55-8	28.582087	4.76E-03	--	1	--	
Nitrite	14797-65-0	0.46	7.66E-05	--	1	--	
Strontium	7440-24-6	0.38963943	6.49E-05	--	1	--	
Sulfate	14808-79-8	42.560202	7.09E-03	--	--	--	
Thallium	7440-28-0	0.00037	6.16E-08	--	1	--	
Uranium	7440-61-1	0.005589723	9.31E-07	--	1	--	
Vanadium	7440-62-2	0.016788235	2.80E-06	--	1	--	
Zinc	7440-66-6	0.006671161	6.67E-07	--	1	--	
Total ELCR						1.81E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--River exposure area - Yakima Nation

Inhalation of Volatile Radioactive Compounds in Drinking Water

Intake Parameter Values		Value			
Factor	Symbol	Adult	Child	Unit	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Ridolfi, 2007
Exposure duration	ED	70	6	years	Ridolfi, 2007
Inhalation Rate	INH	26	16	m^3/day	Ridolfi, 2007
Exposure time	ET	0.58	1	hr/day	U.S. EPA, 2004
Age Adjusted Exposure Time	ET_{adj}	0.616		hrs	Calculated using the age adjusted intake factors equation
Radiation Age-adjusted inhalation rate	INH_RAD_{adj}	1760		m^3-yr/day	Calculated using the age adjusted intake factors equation
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991b
Radiation Inhalation of Volatiles Slope Factor	Sfi	Chemical Specific		risk/pCi	U.S. EPA, 1997

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Inhalation of Volatile Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	VOC[a]	Cw (pCi/L)	CDI (radiological inhalation) (pCi)	SF_i (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	2.4	--(b)	--	--(b)	
Gross beta	12587-47-2	--	31.1	--(b)	--	--(b)	
Strontium-90	10098-97-2	--	2.60	--(b)	1.05E-10	--(b)	
Technetium-99	14133-76-7	--	121	--(b)	1.41E-11	--(b)	
Tritium	10028-17-8	Yes	70,724	5.83E+08	5.62E-14	3.28E-05	100
Total ELCR						3.28E-05	100

[a] Radiological contaminants considered volatile for the groundwater inhalation pathway are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--River exposure area - Yakima Nation

Ingestion of Radioactive Compounds in Drinking Water

Intake Parameter Values		Value			
Factor	Symbol	Unit		Value	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Ridolfi, 2007
Exposure duration	ED	70	6	years	Ridolfi, 2007
Drinking Water Ingestion Rate	IRW	4	2	L/day	Ridolfi, 2007
Radiation Age-adjusted drinking water ingestion rate	IRW_RAD_{adj}	268		L-yr/day	Calculated using the age adjusted intake factors equation
Radiation Ingestion of Water Slope Factor	Sfo	Chemical Specific		risk/pCi	U.S. EPA, 1997

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Ingestion of Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	Cw (pCi/L)	CDI (radiological ingestion) (pCi)	SF_o (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	2.4	233,594	--	--	
Gross beta	12587-47-2	31.1	3,041,733	--	--	
Strontium-90	10098-97-2	2.60	254,332	5.59E-11	1.42E-05	3.6
Technetium-99	14133-76-7	121	1.18E+07	2.75E-12	3.25E-05	8.2
Tritium	10028-17-8	70,724	6.92E+09	5.07E-14	3.51E-04	88
Total ELCR					3.98E-04	100

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area - CTUIR

COPC	ontaminant Concentration in Groundwate C_w (mg/L)	VOC?	HQ (Inhalation) (unitless)	HQ (Ingestion) (unitless)	HQ (Dermal) (unitless)	Total HI (unitless)	% Contribution
(m+p)-Xylene	0.0005	Yes	8.63E-06	1.43E-04	4.65E-05	1.98E-04	0.0069
1,1,1-Trichloroethane	0.001204711	Yes	2.91E-06	3.44E-05	3.28E-06	4.06E-05	0.0014
1,1-Dichloroethane	0.000389235	Yes	6.72E-06	1.11E-04	4.35E-06	1.22E-04	0.0043
1,1-Dichloroethene	0.000164225	Yes	9.92E-06	1.88E-04	1.30E-05	2.11E-04	0.0074
1,2-Dichlorobenzene	0.003	Yes	1.81E-04	1.90E-03	6.23E-04	2.71E-03	0.095
1,2-Dichloroethane	0.000305426	Yes	1.54E-06	8.73E-04	2.14E-05	8.96E-04	0.031
1,4-Dichlorobenzene	0.000130994	Yes	1.98E-06	1.07E-04	3.58E-05	1.45E-04	0.0051
1,4-Dioxane	0.0081	--	--(b)	4.63E-03	8.31E-06	4.64E-03	0.16
2-Butanone	0.0029	Yes	7.01E-06	2.76E-04	1.31E-06	2.85E-04	0.0100
2-Pentanone, 4-Methyl	0.00064	Yes	2.58E-06	4.57E-04	7.30E-06	4.67E-04	0.016
Acetone	0.00128316	Yes	5.00E-07	8.15E-05	--	8.20E-05	0.0029
Aluminum	0.041755539	--	--(b)	2.39E-03	6.23E-06	2.39E-03	0.084
Arsenic	0.003060574	--	--(b)	5.83E-01	1.52E-03	5.84E-01	20
Barium	0.068082679	--	--(b)	1.95E-02	7.25E-04	2.02E-02	0.71
Benzene	0.0019	Yes	7.65E-04	2.71E-02	2.08E-03	3.00E-02	1.1
Benzyl alcohol	0.0027	--	--(b)	1.54E-03	--	1.54E-03	0.054
Beryllium	0.000360659	--	--(b)	1.03E-02	3.84E-03	1.41E-02	0.50
Bis(2-ethylhexyl) phthalate	0.001271216	--	--(b)	3.63E-03	2.81E-03	6.44E-03	0.23
Cadmium	0.0045	--	--(b)	5.14E-01	2.68E-02	5.41E-01	19
Carbon disulfide	0.00039	Yes	6.73E-06	2.23E-04	1.97E-05	2.49E-04	0.0087
Carbon tetrachloride	0.000164414	Yes	1.05E-05	1.34E-02	1.80E-03	1.52E-02	0.53
Chloride	9.821328	--	--(b)	--	--	--	
Chlorobenzene	0.00041	Yes	9.91E-05	1.17E-03	2.11E-04	1.48E-03	0.052
Chloroform	0.00022061	Yes	2.72E-05	1.26E-03	5.74E-05	1.35E-03	0.047
Chromium	0.007505402	--	--(b)	2.86E-04	5.74E-05	3.43E-04	0.012
cis-1,2-Dichloroethylene	0.0002	Yes	--	1.14E-03	5.07E-05	1.19E-03	0.042
Copper	0.002993571	--	--(b)	4.28E-03	1.12E-05	4.29E-03	0.15
Fluoride	0.32861624	--	--(b)	3.13E-01	8.17E-04	3.14E-01	11
Iron	0.47301923	--	--(b)	3.86E-02	1.01E-04	3.87E-02	1.4
Lead	0.000710361	--	--(b)	--	--	--	
Lithium	0.0083	--	--(b)	2.37E-01	6.19E-04	2.38E-01	8.3
Manganese	0.011254937	--	--(b)	2.68E-02	1.75E-03	2.85E-02	1.00
Methanol	1.1	--	--(b)	1.26E-01	1.63E-04	1.26E-01	4.4
Methylene chloride	0.000852962	Yes	1.03E-05	8.12E-04	1.52E-05	8.38E-04	0.029
Molybdenum	0.0015	--	--(b)	1.71E-02	4.47E-05	1.72E-02	0.60
Nickel	0.003603478	--	--(b)	1.03E-02	1.34E-04	1.04E-02	0.37
Nitrate	23.756902	--	--(b)	1.91E-01	4.99E-04	1.92E-01	6.7
Nitrite	0.079227256	--	--(b)	1.51E-02	3.94E-05	1.51E-02	0.53
o-Xylene	0.000210551	Yes	3.63E-06	6.02E-05	1.99E-05	8.37E-05	0.0029
Silver	0.005341496	--	--(b)	6.10E-02	2.39E-03	6.34E-02	2.2
Strontium	0.36357229	--	--(b)	3.46E-02	9.04E-05	3.47E-02	1.2
Sulfate	45.069738	--	--(b)	--	--	--	
Tetrachloroethene	0.000993146	Yes	4.44E-05	5.68E-03	1.69E-03	7.41E-03	0.26
Toluene	0.000274725	Yes	6.64E-07	1.96E-04	3.41E-05	2.31E-04	0.0081
Tributyl phosphate	0.040836371	--	--(b)	1.17E-02	--	1.17E-02	0.41
Trichloroethene	0.000492361	Yes	1.70E-04	--	--	1.70E-04	0.0060
Trichloromonofluoromethane	0.00058	Yes	1.00E-05	1.10E-04	1.08E-05	1.31E-04	0.0046
Uranium	0.016251153	--	--(b)	3.10E-01	8.08E-04	3.10E-01	11
Vanadium	0.013487657	--	--(b)	1.54E-01	4.02E-04	1.55E-01	5.4
Vinyl chloride	0.0018	Yes	2.18E-04	3.43E-02	9.16E-04	3.54E-02	1.2
Zinc	0.10896358	--	--(b)	2.08E-02	3.25E-05	2.08E-02	0.73
Total			1.59E-03	2.80	0.05	2.85	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

HQ = hazard quotient.

HI = hazard index.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Drinking Water Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	ontaminant Concentration in Groundwate C_w (mg/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
(m+p)-Xylene	0.0005	Yes	--	--	--	--	
1,1,1-Trichloroethane	0.001204711	Yes	--	--	--	--	
1,1-Dichloroethane	0.000389235	Yes	--	--	--	--	
1,1-Dichloroethene	0.000164225	Yes	--	--	--	--	
1,2-Dichlorobenzene	0.003	Yes	--	--	--	--	
1,2-Dichloroethane	0.000305426	Yes	9.60E-08	1.61E-06	4.26E-08	1.75E-06	0.41
1,4-Dichlorobenzene	0.000130994	Yes	1.74E-08	4.10E-08	1.48E-08	7.32E-08	0.017
1,4-Dioxane	0.0081	--	--(b)	5.16E-06	1.00E-08	5.17E-06	1.2
2-Butanone	0.0029	Yes	--	--	--	--	
2-Pentanone, 4-Methyl	0.00064	Yes	--	--	--	--	
Acetone	0.00128316	Yes	--	--	--	--	
Aluminum	0.041755539	--	--(b)	--	--	--	
Arsenic	0.003060574	--	--(b)	2.66E-04	7.72E-07	2.67E-04	62
Barium	0.068082679	--	--(b)	--	--	--	
Benzene	0.0019	Yes	1.79E-07	6.06E-06	5.00E-07	6.74E-06	1.6
Benzyl alcohol	0.0027	--	--(b)	--	--	--	
Beryllium	0.000360659	--	--(b)	--	--	--	
Bis(2-ethylhexyl) phthalate	0.001271216	--	--(b)	1.03E-06	8.59E-07	1.89E-06	0.44
Cadmium	0.0045	--	--(b)	--	--	--	
Carbon disulfide	0.00039	Yes	--	--	--	--	
Carbon tetrachloride	0.000164414	Yes	2.98E-08	1.24E-06	1.79E-07	1.45E-06	0.34
Chloride	9.821328	--	--(b)	--	--	--	
Chlorobenzene	0.00041	Yes	--	--	--	--	
Chloroform	0.00022061	Yes	6.13E-08	3.96E-07	1.95E-08	4.77E-07	0.11
Chromium	0.007505402	--	--(b)	--	--	--	
cis-1,2-Dichloroethylene	0.0002	Yes	--	--	--	--	
Copper	0.002993571	--	--(b)	--	--	--	
Fluoride	0.32861624	--	--(b)	--	--	--	

Iron	0.47301923	--	--(b)	--	--	--	
Lead	0.000710361	--	--(b)	--	--	--	
Lithium	0.0083	--	--(b)	--	--	--	
Manganese	0.011254937	--	--(b)	--	--	--	
Methanol	1.1	--	--(b)	--	--	--	
Methylene chloride	0.000852962	Yes	4.84E-09	3.71E-07	7.50E-09	3.83E-07	0.090
Molybdenum	0.0015	--	--(b)	--	--	--	
Nickel	0.003603478	--	--(b)	--	--	--	
Nitrate	23.756902	--	--(b)	--	--	--	
Nitrite	0.079227256	--	--(b)	--	--	--	
o-Xylene	0.000210551	Yes	--	--	--	--	
Silver	0.005341496	--	--(b)	--	--	--	
Strontium	0.36357229	--	--(b)	--	--	--	
Sulfate	45.069738	--	--(b)	--	--	--	
Tetrachloroethene	0.000993146	Yes	7.08E-08	3.11E-05	9.99E-06	4.11E-05	9.6
Toluene	0.000274725	Yes	--	--	--	--	
Tributyl phosphate	0.040836371	--	--(b)	2.18E-05	2.37E-07	2.20E-05	5.1
Trichloroethene	0.000492361	Yes	1.49E-07	2.54E-06	--	2.69E-06	0.63
Trichloromonofluoromethane	0.00058	Yes	--	--	--	--	
Uranium	0.016251153	--	--(b)	--	--	--	
Vanadium	0.013487657	--	--(b)	--	--	--	
Vinyl chloride	0.0018	Yes	9.57E-08	7.51E-05	2.17E-06	7.74E-05	18
Zinc	0.10896358	--	--(b)	--	--	--	
Total ELCR			7.04E-07	4.13E-04	1.48E-05	4.28E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Drinking Water Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	ontaminant Concentration in Groundwat C_w (pCi/L)	Volatile?[a]	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Total Risk (unitless)	% Contribution
Carbon-14	15.2	--	--(b)	2.25E-06	2.25E-06	0.084
Gross alpha	5.9880167	--	--(b)	--	--	
Gross beta	26.717649	--	--(b)	--	--	
Iodine-129	1.7529182	--	--(b)	2.48E-05	2.48E-05	0.92
Nickel-63	7.66125	--	--(b)	4.91E-07	4.91E-07	0.018
Protactinium-231	0.308	--	--(b)	5.10E-06	5.10E-06	0.19
Strontium-90	0.611	--	--(b)	3.27E-06	3.27E-06	0.12
Technetium-99	75.671084	--	--(b)	1.99E-05	1.99E-05	0.74
Tritium	497899.63	Yes	2.22E-04	2.41E-03	2.64E-03	98
Total ELCR			2.22E-04	2.47E-03	2.69E-03	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area - CTUIR

Ingestion of Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Ingestion Chronic Daily Intake	CDI	calculated		mg/kg-day	EPA 1989
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	15	kg	Harris et al, 2004
Drinking Water Ingestion Rate	IRW	4	1	Liters/day	Harris et al, 2004
Age-Adjusted Drinking Water Ingestion Rate	IRWadj	4.057		L-yr/kg-day	Calculated using the age adjusted intake factors equation
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	6	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Harris et al, 2004
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFo	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 1989

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	HQ (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	0.0005	2.86E-05	2.00E-01	1.43E-04	0.0051
1,1,1-Trichloroethane	71-55-6	0.001204711	6.88E-05	2.00E+00	3.44E-05	0.0012
1,1-Dichloroethane	75-34-3	0.000389235	2.22E-05	2.00E-01	1.11E-04	0.0040
1,1-Dichloroethene	75-35-4	0.000164225	9.38E-06	5.00E-02	1.88E-04	0.0067
1,2-Dichlorobenzene	95-50-1	0.003	1.71E-04	9.00E-02	1.90E-03	0.068
1,2-Dichloroethane	107-06-2	0.000305426	1.75E-05	2.00E-02	8.73E-04	0.031
1,4-Dichlorobenzene	106-46-7	0.000130994	7.49E-06	7.00E-02	1.07E-04	0.0038
1,4-Dioxane	123-91-1	0.0081	4.63E-04	1.00E-01	4.63E-03	0.17
2-Butanone	78-93-3	0.0029	1.66E-04	6.00E-01	2.76E-04	0.0099
2-Pentanone, 4-Methyl	108-10-1	0.00064	3.66E-05	8.00E-02	4.57E-04	0.016
Acetone	67-64-1	0.00128316	7.33E-05	9.00E-01	8.15E-05	0.0029
Aluminum	7429-90-5	0.041755539	2.39E-03	1.00E+00	2.39E-03	0.085
Arsenic	7440-38-2	0.003060574	1.75E-04	3.00E-04	5.83E-01	21
Barium	7440-39-3	0.068082679	3.89E-03	2.00E-01	1.95E-02	0.69
Benzene	71-43-2	0.0019	1.09E-04	4.00E-03	2.71E-02	0.97
Benzyl alcohol	100-51-6	0.0027	1.54E-04	1.00E-01	1.54E-03	0.055
Beryllium	7440-41-7	0.000360659	2.06E-05	2.00E-03	1.03E-02	0.37
Bis(2-ethylhexyi) phthalate	117-81-7	0.001271216	7.26E-05	2.00E-02	3.63E-03	0.13
Cadmium	7440-43-9	0.0045	2.57E-04	5.00E-04	5.14E-01	18
Carbon disulfide	75-15-0	0.00039	2.23E-05	1.00E-01	2.23E-04	0.0080
Carbon tetrachloride	56-23-5	0.000164414	9.40E-06	7.00E-04	1.34E-02	0.48
Chloride	16887-00-6	9.821328	5.61E-01	--	--	
Chlorobenzene	108-90-7	0.00041	2.34E-05	2.00E-02	1.17E-03	0.042
Chloroform	67-66-3	0.00022061	1.26E-05	1.00E-02	1.26E-03	0.045
Chromium	7440-47-3	0.007505402	4.29E-04	1.50E+00	2.86E-04	0.010
cis-1,2-Dichloroethylene	156-59-2	0.0002	1.14E-05	1.00E-02	1.14E-03	0.041
Copper	7440-50-8	0.002993571	1.71E-04	4.00E-02	4.28E-03	0.15
Fluoride	16984-48-8	0.32861624	1.88E-02	6.00E-02	3.13E-01	11
Iron	7439-89-6	0.47301923	2.70E-02	7.00E-01	3.86E-02	1.4
Lead	7439-92-1	0.000710361	4.06E-05	--	--	
Lithium	7439-93-2	0.0083	4.74E-04	2.00E-03	2.37E-01	8.5
Manganese	7439-96-5	0.011254937	6.43E-04	2.40E-02	2.68E-02	0.96
Methanol	67-56-1	1.1	6.29E-02	5.00E-01	1.26E-01	4.5
Methylene chloride	75-09-2	0.000852962	4.87E-05	6.00E-02	8.12E-04	0.029
Molybdenum	7439-98-7	0.0015	8.57E-05	5.00E-03	1.71E-02	0.61
Nickel	7440-02-0	0.003603478	2.06E-04	2.00E-02	1.03E-02	0.37
Nitrate	14797-55-8	23.756902	1.36E+00	7.10E+00	1.91E-01	6.8
Nitrite	14797-65-0	0.079227256	4.53E-03	3.00E-01	1.51E-02	0.54
o-Xylene	95-47-6	0.000210551	1.20E-05	2.00E-01	6.02E-05	0.0021
Silver	7440-22-4	0.005341496	3.05E-04	5.00E-03	6.10E-02	2.2
Strontium	7440-24-6	0.36357229	2.08E-02	6.00E-01	3.46E-02	1.2
Sulfate	14808-79-8	45.069738	2.58E+00	--	--	
Tetrachloroethene	127-18-4	0.000993146	5.68E-05	1.00E-02	5.68E-03	0.20
Toluene	108-88-3	0.000274725	1.57E-05	8.00E-02	1.96E-04	0.0070
Tributyl phosphate	126-73-8	0.040836371	2.33E-03	2.00E-01	1.17E-02	0.42
Trichloroethene	79-01-6	0.000492361	2.81E-05	--	--	
Trichloromonofluoromethane	75-69-4	0.00058	3.31E-05	3.00E-01	1.10E-04	0.0039
Uranium	7440-61-1	0.016251153	9.29E-04	3.00E-03	3.10E-01	11
Vanadium	7440-62-2	0.013487657	7.71E-04	5.00E-03	1.54E-01	5.5
Vinyl chloride[b]	75-01-4	0.0018	1.03E-04	3.00E-03	3.43E-02	1.2
Zinc	7440-66-6	0.10896358	6.23E-03	3.00E-01	2.08E-02	0.74
Total					2.80E+00	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b]For the purposes of this exercise, the mutagenic exposure equations where not used for vinyl chloride

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	Risk (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	0.0005	2.90E-05	--	--	
1,1,1-Trichloroethane	71-55-6	0.001204711	6.98E-05	--	--	
1,1-Dichloroethane	75-34-3	0.000389235	2.26E-05	--	--	
1,1-Dichloroethene	75-35-4	0.000164225	9.52E-06	--	--	
1,2-Dichlorobenzene	95-50-1	0.003	1.74E-04	--	--	
1,2-Dichloroethane	107-06-2	0.000305426	1.77E-05	9.10E-02	1.61E-06	0.39
1,4-Dichlorobenzene	106-46-7	0.000130994	7.59E-06	5.40E-03	4.10E-08	0.0099
1,4-Dioxane	123-91-1	0.0081	4.69E-04	1.10E-02	5.16E-06	1.3
2-Butanone	78-93-3	0.0029	1.68E-04	--	--	
2-Pentanone, 4-Methyl	108-10-1	0.00064	3.71E-05	--	--	
Acetone	67-64-1	0.00128316	7.44E-05	--	--	

Aluminum	7429-90-5	0.041755539	2.42E-03	--	--	
Arsenic	7440-38-2	0.003060574	1.77E-04	1.50E+00	2.66E-04	65
Barium	7440-39-3	0.068082679	3.95E-03	--	--	
Benzene	71-43-2	0.0019	1.10E-04	5.50E-02	6.06E-06	1.5
Benzyl alcohol	100-51-6	0.0027	1.56E-04	--	--	
Beryllium	7440-41-7	0.000360659	2.09E-05	--	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.001271216	7.37E-05	1.40E-02	1.03E-06	0.25
Cadmium	7440-43-9	0.0045	2.61E-04	--	--	
Carbon disulfide	75-15-0	0.00039	2.26E-05	--	--	
Carbon tetrachloride	56-23-5	0.000164414	9.53E-06	1.30E-01	1.24E-06	0.30
Chloride	16887-00-6	9.821328	5.69E-01	--	--	
Chlorobenzene	108-90-7	0.00041	2.38E-05	--	--	
Chloroform	67-66-3	0.00022061	1.28E-05	3.10E-02	3.96E-07	0.096
Chromium	7440-47-3	0.007505402	4.35E-04	--	--	
cis-1,2-Dichloroethylene	156-59-2	0.0002	1.16E-05	--	--	
Copper	7440-50-8	0.002993571	1.74E-04	--	--	
Fluoride	16984-48-8	0.32861624	1.90E-02	--	--	
Iron	7439-89-6	0.47301923	2.74E-02	--	--	
Lead	7439-92-1	0.000710361	4.12E-05	--	--	
Lithium	7439-93-2	0.0083	4.81E-04	--	--	
Manganese	7439-96-5	0.011254937	6.52E-04	--	--	
Methanol	67-56-1	1.1	6.38E-02	--	--	
Methylene chloride	75-09-2	0.000852962	4.94E-05	7.50E-03	3.71E-07	0.090
Molybdenum	7439-98-7	0.0015	8.69E-05	--	--	
Nickel	7440-02-0	0.003603478	2.09E-04	--	--	
Nitrate	14797-55-8	23.756902	1.38E+00	--	--	
Nitrite	14797-65-0	0.079227256	4.59E-03	--	--	
o-Xylene	95-47-6	0.000210551	1.22E-05	--	--	
Silver	7440-22-4	0.005341496	3.10E-04	--	--	
Strontium	7440-24-6	0.36357229	2.11E-02	--	--	
Sulfate	14808-79-8	45.069738	2.61E+00	--	--	
Tetrachloroethene	127-18-4	0.000993146	5.76E-05	5.40E-01	3.11E-05	7.5
Toluene	108-88-3	0.000274725	1.59E-05	--	--	
Tributyl phosphate	126-73-8	0.040836371	2.37E-03	9.20E-03	2.18E-05	5.3
Trichloroethene	79-01-6	0.000492361	2.85E-05	8.90E-02	2.54E-06	0.62
Trichloromonofluoromethane	75-69-4	0.00058	3.36E-05	--	--	
Uranium	7440-61-1	0.016251153	9.42E-04	--	--	
Vanadium	7440-62-2	0.013487657	7.82E-04	--	--	
Vinyl chloride[b]	75-01-4	0.0018	1.04E-04	7.20E-01	7.51E-05	18
Zinc	7440-66-6	0.10896358	6.32E-03	--	--	
Total ELCR					4.13E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b]For the purposes of this exercise, the mutagenic exposure equations where not used for vinyl chloride

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area - CTUIR

Inhalation of Volatile Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Inhalation Chronic Daily intake	CDI	calculated		mg/m^3 for noncarcinogens, $\mu g/m^3$ for carcinogens	EPA 2009b
Contaminant concentration in drinking water	C_w	contaminant-specific		mg/L	ECF-200PO1-09-2027
Exposure Time	ET	0.580	--	hours/day	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	--	yr	Harris et al, 2004
Averaging Time	AT	70	--	yr	Harris et al, 2004
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Inhalation Reference Concentration	RfC_i	Chemical Specific		mg/m^3	EPA 2009a
Inhalation Unit Risk	IUR	Chemical Specific		$(\mu g/m^3)^{-1}$	EPA 2009a
Conversion Factor	CF1	365		days/year	EPA 2009b
Conversion Factor	CF2	0.042		1day/24 hours	EPA 2009b

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009a EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

U.S. EPA 2009b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (noncarcinogen) (mg/m^3)	RfC[a] (mg/m^3)	HQ (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	Yes	0.0005	6.04E-06	7.00E-01	8.63E-06	0.54
1,1,1-Trichloroethane	71-55-6	Yes	0.001204711	1.46E-05	5.00E+00	2.91E-06	0.18
1,1-Dichloroethane	75-34-3	Yes	0.000389235	4.70E-06	7.00E-01	6.72E-06	0.42
1,1-Dichloroethene	75-35-4	Yes	0.000164225	1.98E-06	2.00E-01	9.92E-06	0.62
1,2-Dichlorobenzene	95-50-1	Yes	0.003	3.63E-05	2.00E-01	1.81E-04	11
1,2-Dichloroethane	107-06-2	Yes	0.000305426	3.69E-06	2.40E+00	1.54E-06	0.097
1,4-Dichlorobenzene	106-46-7	Yes	0.000130994	1.58E-06	8.00E-01	1.98E-06	0.12
1,4-Dioxane	123-91-1	--	0.0081	--(b)	3.60E+00	--(b)	
2-Butanone	78-93-3	Yes	0.0029	3.50E-05	5.00E+00	7.01E-06	0.44
2-Pentanone, 4-Methyl	108-10-1	Yes	0.00064	7.73E-06	3.00E+00	2.58E-06	0.16
Acetone	67-64-1	Yes	0.00128316	1.55E-05	3.10E+01	5.00E-07	0.031
Aluminum	7429-90-5	--	0.041755539	--(b)	5.00E-03	--(b)	
Arsenic	7440-38-2	--	0.003060574	--(b)	1.50E-05	--(b)	
Barium	7440-39-3	--	0.068082679	--(b)	5.00E-04	--(b)	
Benzene	71-43-2	Yes	0.0019	2.30E-05	3.00E-02	7.65E-04	48
Benzyl alcohol	100-51-6	--	0.0027	--(b)	--	--(b)	
Beryllium	7440-41-7	--	0.000360659	--(b)	2.00E-05	--(b)	
Bis(2-ethylhexyl) phthalate	117-81-7	--	0.001271216	--(b)	--	--(b)	
Cadmium	7440-43-9	--	0.0045	--(b)	1.00E-05	--(b)	
Carbon disulfide	75-15-0	Yes	0.00039	4.71E-06	7.00E-01	6.73E-06	0.42
Carbon tetrachloride	56-23-5	Yes	0.000164414	1.99E-06	1.90E-01	1.05E-05	0.66
Chloride	16887-00-6	--	9.821328	--(b)	--	--(b)	
Chlorobenzene	108-90-7	Yes	0.00041	4.95E-06	5.00E-02	9.91E-05	6.2
Chloroform	67-66-3	Yes	0.00022061	2.67E-06	9.80E-02	2.72E-05	1.7
Chromium	7440-47-3	--	0.007505402	--(b)	--	--(b)	
cis-1,2-Dichloroethylene	156-59-2	Yes	0.0002	2.42E-06	--	--	
Copper	7440-50-8	--	0.002993571	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.32861624	--(b)	1.30E-02	--(b)	
Iron	7439-89-6	--	0.47301923	--(b)	--	--(b)	
Lead	7439-92-1	--	0.000710361	--(b)	--	--(b)	
Lithium	7439-93-2	--	0.0083	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.011254937	--(b)	5.00E-05	--(b)	
Methanol	67-56-1	--	1.1	--(b)	4.00E+00	--(b)	
Methylene chloride	75-09-2	Yes	0.000852962	1.03E-05	1.00E+00	1.03E-05	0.65
Molybdenum	7439-98-7	--	0.0015	--(b)	--	--(b)	
Nickel	7440-02-0	--	0.003603478	--(b)	9.00E-05	--(b)	
Nitrate	14797-55-8	--	23.756902	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.079227256	--(b)	--	--(b)	
o-Xylene	95-47-6	Yes	0.000210551	2.54E-06	7.00E-01	3.63E-06	0.23
Silver	7440-22-4	--	0.005341496	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.36357229	--(b)	--	--(b)	
Sulfate	14808-79-8	--	45.069738	--(b)	--	--(b)	
Tetrachloroethene	127-18-4	Yes	0.000993146	1.20E-05	2.70E-01	4.44E-05	2.8
Toluene	108-88-3	Yes	0.000274725	3.32E-06	5.00E+00	6.64E-07	0.042
Tributyl phosphate	126-73-8	--	0.040836371	--(b)	--	--(b)	
Trichloroethene	79-01-6	Yes	0.000492361	5.95E-06	3.50E-02	1.70E-04	11
Trichloromonofluoromethane	75-69-4	Yes	0.00058	7.01E-06	7.00E-01	1.00E-05	0.63
Uranium	7440-61-1	--	0.016251153	--(b)	3.00E-04	--(b)	
Vanadium	7440-62-2	--	0.013487657	--(b)	--	--(b)	
Vinyl chloride[c]	75-01-4	Yes	0.0018	2.18E-05	1.00E-01	2.18E-04	14
Zinc	7440-66-6	--	0.10896358	--(b)	--	--(b)	
Total						1.59E-03	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

[c] For the purposes of this exercise, the mutagenic exposure equations where not used for vinyl chloride

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

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COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (carcinogen) ($\mu g/m^3$)	IUR[a] $(\mu g/m^3)^{-1}$	Risk (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	Yes	0.0005	6.04E-03	--	--	
1,1,1-Trichloroethane	71-55-6	Yes	0.001204711	1.46E-02	--	--	
1,1-Dichloroethane	75-34-3	Yes	0.000389235	4.70E-03	--	--	
1,1-Dichloroethene	75-35-4	Yes	0.000164225	1.98E-03	--	--	
1,2-Dichlorobenzene	95-50-1	Yes	0.003	3.63E-02	--	--	
1,2-Dichloroethane	107-06-2	Yes	0.000305426	3.69E-03	2.60E-05	9.60E-08	14
1,4-Dichlorobenzene	106-46-7	Yes	0.000130994	1.58E-03	1.10E-05	1.74E-08	2.5
1,4-Dioxane	123-91-1	--	0.0081	--(b)	7.70E-06	--(b)	
2-Butanone	78-93-3	Yes	0.0029	3.50E-02	--	--	
2-Pentanone, 4-Methyl	108-10-1	Yes	0.00064	7.73E-03	--	--	
Acetone	67-64-1	Yes	0.00128316	1.55E-02	--	--	
Aluminum	7429-90-5	--	0.041755539	--(b)	--	--(b)	
Arsenic	7440-38-2	--	0.003060574	--(b)	4.30E-03	--(b)	
Barium	7440-39-3	--	0.068082679	--(b)	--	--(b)	
Benzene	71-43-2	Yes	0.0019	2.30E-02	7.80E-06	1.79E-07	25
Benzyl alcohol	100-51-6	--	0.0027	--(b)	--	--(b)	
Beryllium	7440-41-7	--	0.000360659	--(b)	2.40E-03	--(b)	

Bis(2-ethylhexyl) phthalate	117-81-7	--	0.001271216	--(b)	2.40E-06	--(b)	
Cadmium	7440-43-9	--	0.0045	--(b)	1.80E-03	--(b)	
Carbon disulfide	75-15-0	Yes	0.00039	4.71E-03	--	--	
Carbon tetrachloride	56-23-5	Yes	0.000164414	1.99E-03	1.50E-05	2.98E-08	4.2
Chloride	16887-00-6	--	9.821328	--(b)	--	--(b)	
Chlorobenzene	108-90-7	Yes	0.00041	4.95E-03	--	--	
Chloroform	67-66-3	Yes	0.00022061	2.67E-03	2.30E-05	6.13E-08	8.7
Chromium	7440-47-3	--	0.007505402	--(b)	--	--(b)	
cis-1,2-Dichloroethylene	156-59-2	Yes	0.0002	2.42E-03	--	--	
Copper	7440-50-8	--	0.002993571	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.32861624	--(b)	--	--(b)	
Iron	7439-89-6	--	0.47301923	--(b)	--	--(b)	
Lead	7439-92-1	--	0.000710361	--(b)	--	--(b)	
Lithium	7439-93-2	--	0.0083	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.011254937	--(b)	--	--(b)	
Methanol	67-56-1	--	1.1	--(b)	--	--(b)	
Methylene chloride	75-09-2	Yes	0.000852962	1.03E-02	4.70E-07	4.84E-09	0.69
Molybdenum	7439-98-7	--	0.0015	--(b)	--	--(b)	
Nickel	7440-02-0	--	0.003603478	--(b)	2.60E-04	--(b)	
Nitrate	14797-55-8	--	23.756902	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.079227256	--(b)	--	--(b)	
o-Xylene	95-47-6	Yes	0.000210551	2.54E-03	--	--	
Silver	7440-22-4	--	0.005341496	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.36357229	--(b)	--	--(b)	
Sulfate	14808-79-8	--	45.069738	--(b)	--	--(b)	
Tetrachloroethene	127-18-4	Yes	0.000993146	1.20E-02	5.90E-06	7.08E-08	10
Toluene	108-88-3	Yes	0.000274725	3.32E-03	--	--	
Tributyl phosphate	126-73-8	--	0.040836371	--(b)	--	--(b)	
Trichloroethene	79-01-6	Yes	0.000492361	5.95E-03	2.50E-05	1.49E-07	21
Trichloromonofluoromethane	75-69-4	Yes	0.00058	7.01E-03	--	--	
Uranium	7440-61-1	--	0.016251153	--(b)	--	--(b)	
Vanadium	7440-62-2	--	0.013487657	--(b)	--	--(b)	
Vinyl chloride[c]	75-01-4	Yes	0.0018	2.18E-02	4.40E-06	9.57E-08	14
Zinc	7440-66-6	--	0.10896358	--(b)	--	--(b)	
Total ELCR						7.04E-07	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b]Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

[c] For the purposes of this exercise, the mutagenic exposure equations where not used for vinyl chloride

-- = indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

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COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10 Year) - Far-field exposure area - CTUIR

Dermal Absorption of Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	15	kg	Harris et al, 2004
Exposure Time	ET	0.58	1.0	hours/day	U.S. EPA, 2004
Exposure Time (Age-Adjusted)	ETadj	0.616		hours/day	Calculated using the age adjusted intake factors equation
Surface Area	SA	18,000	6,600	cm^2	Harris et al, 2004
Age-Adjusted Surface Area	SAadj	19,097		(cm^2-yr event)/(kg-day)	Calculated using the age adjusted intake factors equation
Event Frequency	EV	1.0	1.0	event/days	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	6.0	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Harris et al, 2004
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFo	Oral Cancer Slope Factor	Chemical Specific		(mg/kg-day) $^{-1}$	EPA 2009
Conversion Factor	CF2	365		days/year	365 days = 1 year
Conversion Factor	CF3	0.001		L/cm^3	1 L = 1000 cm^3
t*	Time to reach steady state	Chemical Specific		hours	EPA, 2004
B	Dermal Partitioning Constant	Chemical Specific		unitless	EPA, 2004
DA	Absorbed Dose per Event	Chemical Specific		(mg/cm^2-event)	Calculated using dermal exposure to groundwater equations as provided by U.S. EPA, 2004
Kp	Dermal Permeability Constant	Chemical Specific		cm/hour	EPA, 2004
FA	Fraction Absorbed	Chemical Specific		unitless	EPA, 2004
τ	Lag Time	Chemical Specific		hours	EPA, 2004

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*.

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Absorbed Dermal Dose Calculation

Contaminant of Potential Concern	CAS #	Cw (mg/L)	Inorganic/organic[a]	FA[b] (unitless)	K_p[c] (cm/hour)	B[c] (unitless)	τ[c] (hours/event)	t*[c] (hours)	DA (noncancer) (mg/cm^2-event)	DA (cancer) (mg/cm^2-event)
(m+p)-Xylene[d]	179601-23-1	0.0005	--	1.00E+00	0.053	0.2	0.42	1.01	3.62E-08	3.73E-08
1,1,1-Trichloroethane	71-55-6	0.001204711	--	1.00E+00	0.013	0.1	0.6	1.43	2.55E-08	2.63E-08
1,1-Dichloroethane	75-34-3	0.000389235	--	1.00E+00	0.0067	0	0.38	0.92	3.38E-09	3.49E-09
1,1-Dichloroethene	75-35-4	0.000164225	--	1.00E+00	0.012	0	0.37	0.89	2.52E-09	2.60E-09
1,2-Dichlorobenzene	95-50-1	0.003	--	1.00E+00	0.041	0.2	0.71	1.71	2.18E-07	2.25E-07
1,2-Dichloroethane	107-06-2	0.000305426	--	1.00E+00	0.0042	0	0.38	0.92	1.66E-09	1.72E-09
1,4-Dichlorobenzene	106-46-7	0.000130994	--	1.00E+00	0.042	0.2	0.71	1.71	9.76E-09	1.01E-08
1,4-Dioxane	123-91-1	0.0081	--	1.00E+00	0.00033	0	0.33	0.8	3.23E-09	3.33E-09
2-Butanone	78-93-3	0.0029	--	1.00E+00	0.00096	0	0.27	0.65	3.05E-09	3.14E-09
2-Pentanone, 4-Methyl	108-10-1	0.00054	--	1.00E+00	0.0027	0	0.39	0.93	2.27E-09	2.34E-09
Acetone[e]	67-64-1	0.00128316	--	--	0.000512	--	--	--	--	--
Aluminum	7429-90-5	0.041755539	INORGANIC	--	0.001	--	--	--	2.42E-08	2.57E-08
Arsenic	7440-38-2	0.003060574	INORGANIC	--	0.001	--	--	--	1.78E-09	1.89E-09
Barium	7440-39-3	0.068082679	INORGANIC	--	0.001	--	--	--	3.95E-08	4.19E-08
Benzene	71-43-2	0.0019	--	1.00E+00	0.015	0.1	0.29	0.7	3.23E-08	3.33E-08
Benzyl alcohol[f]	100-51-6	0.0027	--	--	0.00209	--	--	--	--	--
Beryllium	7440-41-7	0.000360659	INORGANIC	--	0.001	--	--	--	2.09E-10	2.22E-10
Bis(2-ethylhexyl) phthalate	117-81-7	0.001271316	--	8.00E-01	0.025	0.2	16.64	39.93	2.18E-07	2.25E-07
Cadmium	7440-43-9	0.0045	INORGANIC	--	0.001	--	--	--	2.63E-09	2.77E-09
Carbon disulfide	75-15-0	0.00039	--	1.00E+00	0.017	0.1	0.3	0.72	7.64E-09	7.88E-09
Carbon tetrachloride	56-23-5	0.000164414	--	1.00E+00	0.016	0.1	0.78	1.86	4.89E-09	5.04E-09
Chloride	16887-00-6	9.821328	INORGANIC	--	0.001	--	--	--	5.70E-06	6.05E-06
Chlorobenzene	108-90-7	0.00041	--	1.00E+00	0.028	0.1	0.46	1.09	1.64E-08	1.69E-08
Chloroform	67-66-3	0.00022061	--	1.00E+00	0.0068	0	0.5	1.19	2.23E-09	2.30E-09
Chromium	7440-47-3	0.007505402	INORGANIC	--	0.001	--	--	--	4.35E-09	4.62E-09
cis-1,2-Dichloroethylene[g]	156-59-2	0.0002	--	1.00E+00	0.0027	0	0.37	0.89	1.97E-09	2.03E-09
Copper	7440-50-8	0.002993571	INORGANIC	--	0.001	--	--	--	1.74E-09	1.84E-09
Fluoride	16984-48-8	0.32861624	INORGANIC	--	0.001	--	--	--	1.91E-07	2.02E-07
Iron	7439-89-6	0.47301923	INORGANIC	--	0.001	--	--	--	2.74E-07	2.91E-07
Lead	7439-92-1	0.000710361	INORGANIC	--	0.0001	--	--	--	4.12E-11	4.38E-11
Lithium	7439-93-2	0.0083	INORGANIC	--	0.001	--	--	--	4.81E-09	5.11E-09
Manganese	7439-96-5	0.011254937	INORGANIC	--	0.001	--	--	--	6.53E-09	6.93E-09
Methanol	67-56-1	1.1	--	1.00E+00	0.00032	0	0.16	0.39	3.17E-07	3.29E-07
Methylene chloride	75-09-2	0.000852962	--	1.00E+00	0.0035	0	0.32	0.76	3.55E-09	3.66E-09
Molybdenum	7439-98-7	0.0015	INORGANIC	--	0.001	--	--	--	8.70E-10	9.24E-10
Nickel	7440-02-0	0.003603478	INORGANIC	--	0.0002	--	--	--	4.18E-10	4.44E-10
Nitrate	14797-55-8	23.756902	INORGANIC	--	0.001	--	--	--	1.38E-05	1.46E-05
Nitrite	14797-65-0	0.079227256	INORGANIC	--	0.001	--	--	--	4.60E-08	4.88E-08
o-Xylene[d]	95-47-6	0.000210551	--	1.00E+00	0.054	0.2	0.42	1.01	1.55E-08	1.60E-08
Silver	7440-22-4	0.005341496	INORGANIC	--	0.0006	--	--	--	1.86E-09	1.97E-09
Strontium	7440-24-6	0.36357229	INORGANIC	--	0.001	--	--	--	2.11E-07	2.24E-07
Sulfate	14808-79-8	45.069738	INORGANIC	--	0.001	--	--	--	2.61E-05	2.78E-05
Tetrachloroethene	127-18-4	0.000993146	--	1.00E+00	0.033	0.2	0.91	2.18	6.58E-08	6.78E-08
Toluene	108-88-3	0.000274725	--	1.00E+00	0.031	0.1	0.35	0.84	1.06E-08	1.09E-08
Tributyl phosphate[e]	126-73-8	0.040836371	--	--	0.0228	--	--	--	--	--
Trichloroethene	79-01-6	0.000492361	--	1.00E+00	0.012	0.1	0.58	1.39	9.47E-09	9.76E-09
Trichloromonofluoromethane	75-69-4	0.00058	--	1.00E+00	0.013	0.1	0.63	1.51	1.26E-08	1.30E-08
Uranium	7440-61-1	0.016251153	INORGANIC	--	0.001	--	--	--	9.43E-09	1.00E-08
Vanadium	7440-62-2	0.013487657	INORGANIC	--	0.001	--	--	--	7.82E-09	8.31E-09
Vinyl chloride[h]	75-01-4	0.0018	--	1.00E+00	0.0056	0	0.24	0.57	1.07E-08	1.10E-08
Zinc	7440-66-6	0.10896358	INORGANIC	--	0.0006	--	--	--	3.79E-08	4.03E-08

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

[a] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-3

[b] EPA/540/R/99/005 Exhibit B-3

[c] the τ,b value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

[d] For the purposes of this exercise, the mutagenic exposure equations where not used for vinyl chloride

[e] for cis-1,2-dichloroethylene the chemical-specific inputs are assummed to be the same as trans-1,2-dichloroethylene

[f] for (m+p) xylenes and o-xylene the chemical-specific inputs are assummed to be the same as m-xylene

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit far-field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	0.0005	9.30E-06	2.00E-01	1	4.65E-05	0.090
1,1,1-Trichloroethane	71-55-6	0.001204711	6.57E-06	2.00E+00	1	3.28E-06	0.0064
1,1-Dichloroethane	75-34-3	0.000389235	8.70E-07	2.00E-01	1	4.35E-06	0.0085
1,1-Dichloroethene	75-35-4	0.000164225	6.49E-07	5.00E-02	1	1.30E-05	0.025
1,2-Dichlorobenzene	95-50-1	0.003	5.61E-05	9.00E-02	1	6.23E-04	1.2
1,2-Dichloroethane	107-06-2	0.000305426	4.28E-07	2.00E-02	1	2.14E-05	0.042
1,4-Dichlorobenzene	106-46-7	0.000130994	2.51E-06	7.00E-02	1	3.58E-05	0.070
1,4-Dioxane	123-91-1	0.0081	8.31E-07	3.00E-01	1	8.31E-06	0.016
2-Butanone	78-93-3	0.0029	7.83E-07	6.00E-01	1	1.31E-06	0.0025
2-Pentanone, 4-Methyl	108-10-1	0.00054	5.84E-07	8.00E-02	1	7.30E-06	0.014
Acetone	67-64-1	0.00128316	--	9.00E-01	1	--	--
Aluminum	7429-90-5	0.041755539	6.23E-06	1.00E+00	1	6.23E-06	0.012
Arsenic	7440-38-2	0.003060574	4.56E-07	3.00E-04	1	1.52E-03	3.0
Barium	7440-39-3	0.068082679	1.02E-05	2.00E-01	0.07	7.25E-04	1.4
Benzene	71-43-2	0.0019	8.31E-06	4.00E-03	1	2.08E-03	4.0
Benzyl alcohol	100-51-6	0.0027	--	1.00E-01	1	--	--
Beryllium	7440-41-7	0.000360659	5.38E-08	2.00E-03	0.007	3.84E-03	7.5
Bis(2-ethylhexyl) phthalate	117-81-7	0.001271316	5.61E-05	2.00E-02	1	2.81E-03	5.5
Cadmium	7440-43-9	0.0045	6.71E-07	5.00E-04	0.05	2.68E-02	52
Carbon disulfide	75-15-0	0.00039	1.97E-06	1.00E-01	1	1.97E-05	0.038
Carbon tetrachloride	56-23-5	0.000164414	1.26E-06	7.00E-04	1	1.80E-03	3.5
Chloride	16887-00-6	9.821328	1.46E-03	--	1	--	--
Chlorobenzene	108-90-7	0.00041	4.21E-06	2.00E-02	1	2.11E-04	0.41
Chloroform	67-66-3	0.00022061	5.74E-07	1.00E-02	1	5.74E-05	0.11
Chromium	7440-47-3	0.007505402	1.12E-06	1.50E+00	0.013	5.74E-05	0.11
cis-1,2-Dichloroethylene	156-59-2	0.0002	5.07E-07	1.00E-02	1	5.07E-05	0.099
Copper	7440-50-8	0.002993571	4.46E-07	4.00E-02	1	1.12E-05	0.022
Fluoride	16984-48-8	0.32861624	4.90E-05	6.00E-02	1	8.17E-04	1.6
Iron	7439-89-6	0.47301923	7.05E-05	7.00E-01	1	1.01E-04	0.20
Lead	7439-92-1	0.000710361	1.06E-08	--	1	--	--
Lithium	7439-93-2	0.0083	1.24E-06	2.00E-03	1	6.19E-04	1.2
Manganese	7439-96-5	0.011254937	1.68E-06	2.40E-02	0.04	1.75E-03	3.4
Methanol	67-56-1	1.1	8.15E-05	5.00E-01	1	1.63E-04	0.32
Methylene chloride	75-09-2	0.000852962	9.14E-07	6.00E-02	1	1.52E-05	0.030
Molybdenum	7439-98-7	0.0015	2.24E-07	5.00E-03	1	4.47E-05	0.087
Nickel	7440-02-0	0.003603478	1.07E-07	2.00E-02	0.04	1.34E-04	0.26
Nitrate	14797-55-8	23.756902	3.54E-03	7.10E+00	1	4.99E-04	0.97
Nitrite	14797-65-0	0.079227256	1.18E-05	3.00E-01	1	3.94E-05	0.077
o-Xylene	95-47-6	0.000210551	3.59E-06	2.00E-01	1	1.79E-05	0.039
Silver	7440-22-4	0.005341496	4.78E-07	5.00E-03	0.04	2.39E-03	4.7
Strontium	7440-24-6	0.36357229	5.42E-05	6.00E-01	1	9.04E-05	0.18
Sulfate	14808-79-8	45.069738	6.72E-03	--	--	--	--
Tetrachloroethene	127-18-4	0.000993146	1.69E-05	1.00E-02	1	1.69E-03	3.3
Toluene	108-88-3	0.000274725	2.73E-06	8.00E-02	1	3.41E-05	0.066
Tributyl phosphate	126-73-8	0.040836371	--	2.00E-01	1	--	--
Trichloroethene	79-01-6	0.000492361	2.44E-06	--	1	--	--
Trichloromonofluoromethane	75-69-4	0.00058	3.24E-06	3.00E-01	1	1.08E-05	0.021
Uranium	7440-61-1	0.016251153	2.42E-06	3.00E-03	1	8.08E-04	1.6
Vanadium	7440-62-2	0.013487657	2.01E-06	5.00E-03	1	4.02E-04	0.78
Vinyl chloride[b]	75-01-4	0.0018	2.75E-06	3.00E-03	1	9.16E-04	1.8
Zinc	7440-66-6	0.10896358	9.75E-06	3.00E-01	1	3.25E-05	0.063
Total						0.05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] For the purposes of this exercise, the mutagenic exposure equations where not used for vinyl chloride

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

COPC = contaminant of potential concern.

HQ = hazard quotient

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF$_o$* (mg/kg-day)$^{-1}$	GIABS* (unitless)	Risk (unitless)	% Contribution
(m-o-p)-Xylene	179601-23-1	0.0005	1.02E-05	--	1	--	
1,1,1-Trichloroethane	71-55-6	0.001204711	7.18E-06	--	1	--	
1,1-Dichloroethane	75-34-3	0.000389235	9.51E-07	--	1	--	
1,1-Dichloroethene	75-35-4	0.000164225	7.09E-07	--	1	--	
1,2-Dichlorobenzene	95-50-1	0.003	6.13E-05	--	1	--	
1,2-Dichloroethane	107-06-2	0.000305426	4.68E-07	9.10E-02	1	4.26E-08	0.29
1,4-Dichlorobenzene	106-46-7	0.000130994	2.74E-06	5.40E-03	1	1.48E-08	0.10
1,4-Dioxane	123-91-1	0.0081	9.09E-07	1.10E-02	1	1.00E-08	0.068
2-Butanone	78-93-3	0.0029	8.54E-07	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	0.00064	6.39E-07	--	1	--	
Acetone	67-64-1	0.00128316		--	1	--	
Aluminum	7429-90-5	0.041755539	7.02E-06	--	1	--	
Arsenic	7440-38-2	0.003065174	5.14E-07	1.50E+00	1	7.72E-07	5.2
Barium	7440-39-3	0.068082679	1.14E-05	--	0.07	--	
Benzene	71-43-2	0.0019	9.08E-06	5.50E-02	1	5.00E-07	3.4
Benzyl alcohol	100-51-6	0.0027	--	--	1	--	
Beryllium	7440-41-7	0.000360659	6.06E-08	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.001271716	6.14E-05	1.40E-02	1	8.59E-07	5.8
Cadmium	7440-43-9	0.0045	7.56E-07	--	0.05	--	
Carbon disulfide	75-15-0	0.00039	2.15E-06	--	1	--	
Carbon tetrachloride	56-23-5	0.000164414	1.37E-06	1.30E-01	1	1.79E-07	1.2
Chloride	16887-00-6	9.821328	1.65E-03	--	1	--	
Chlorobenzene	108-90-7	0.00041	4.61E-06	--	1	--	
Chloroform	67-66-3	0.00022061	6.28E-07	3.10E-02	1	1.95E-08	0.13
Chromium	7440-47-3	0.007505402	1.26E-06	--	0.013	--	
cis-1,2-Dichloroethylene	156-59-2	0.0002	5.54E-07	--	1	--	
Copper	7440-50-8	0.002953571	5.01E-07	--	1	--	
Fluoride	16984-48-8	0.32861624	5.52E-05	--	1	--	
Iron	7439-89-6	0.47301923	7.95E-05	--	1	--	
Lead	7439-92-1	0.000710361	1.19E-08	--	1	--	
Lithium	7439-93-2	0.0083	1.39E-06	--	1	--	
Manganese	7439-96-5	0.011254937	1.89E-06	--	0.04	--	
Methanol	67-56-1	1.1	8.99E-05	--	1	--	
Methylene chloride	75-09-2	0.000852962	9.99E-07	7.50E-03	1	7.50E-09	0.051
Molybdenum	7439-98-7	0.0015	2.52E-07	--	1	--	
Nickel	7440-02-0	0.003603478	1.21E-07	--	0.04	--	
Nitrate	14797-55-8	23.756902	3.99E-03	--	1	--	
Nitrite	14797-65-0	0.079227156	1.33E-05	--	1	--	
o-Xylene	95-47-6	0.000210551	4.36E-06	--	1	--	
Silver	7440-22-4	0.005341496	5.39E-07	--	0.04	--	
Strontium	7440-24-6	0.36357229	6.11E-05	--	1	--	
Sulfate	14808-79-8	45.069738	7.57E-03	--	-	--	
Tetrachloroethene	127-18-4	0.000953146	1.85E-05	5.40E-01	1	9.99E-06	68
Toluene	108-88-3	0.000274725	2.98E-06	--	1	--	
Tributyl phosphate	126-73-8	0.040836371		9.20E-03	1	--	
Trichloroethene	75-01-6	0.000492361	2.66E-06	8.90E-02	1	2.37E-07	1.6
Trichloromonofluoromethane	75-69-4	0.00058	3.54E-06	--	1	--	
Uranium	7440-61-1	0.016251153	2.73E-06	--	1	--	
Vanadium	7440-62-2	0.013487657	2.27E-06	--	1	--	
Vinyl chloride*	75-01-4	0.0018	3.01E-06	7.20E-01	1	2.17E-06	15
Zinc	7440-66-6	0.10896358	1.10E-05	--	1	--	
Total ELCR						1.48E-05	100

* EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

COPC = contaminant of potential concern

ELCR = excess lifetime cancer risk

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area - CTUIR

Inhalation of Volatile Radioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Factor	Symbol	Adult	Child	Unit	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Harris et al, 2004
Exposure duration	ED	70	6	years	Harris et al, 2004
Inhalation Rate	INH_a	25	15	m^3/day	Harris, 2008
Exposure time	ET	0.58	1	hr/day	U.S. EPA, 2004
Age Adjusted Exposure Time	ET_{adj}	0.616		hrs	Calculated using the age adjusted intake factors equation
Radiation Age-adjusted inhalation rate	INH_RAD_{adj}	1690		m^3-yr/day	Calculated using the age adjusted intake factors equation
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Radiation Inhalation of Volatiles Slope Factor	SfI	Chemical Specific		risk/pCi	U.S. EPA, 1997

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

Harris, S., 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

Inhalation of Volatile Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Radioactive COPC	CAS #	VOC[a]	Cw (pCi/L)	CDI (radiological inhalation) (pCi)	SF_i (risk/pCi)	Risk (unitless)	% Contribution
Carbon-14	14762-75-5	--	15.2	--(b)	7.07E-12	--(b)	
Gross alpha	12587-46-1	--	5.9880167	--(b)	--	--(b)	
Gross beta	12587-47-2	--	26.717649	--(b)	--	--(b)	
Iodine-129	15046-84-1	--	1.7529182	--(b)	6.07E-11	--(b)	
Nickel-63	13981-37-8	--	7.66125	--(b)	1.64E-12	--(b)	
Protactinium-231	14331-85-2	--	0.308	--(b)	4.55E-08	--(b)	
Strontium-90	10098-97-2	--	0.611	--(b)	1.05E-10	--(b)	
Technetium-99	14133-76-7	--	75.671084	--(b)	1.41E-11	--(b)	
Tritium	10028-17-8	Yes	497899.63	3.94E+09	5.62E-14	2.22E-04	100
Total ELCR						2.22E-04	100

[a] Radiological contaminants considered volatile for the groundwater inhalation pathway are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume i: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area - CTUIR

Ingestion of Radioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Factor	Symbol	Unit		Value	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Harris et al, 2004
Exposure duration	ED	70	6	years	Harris et al, 2004
Drinking Water Ingestion Rate	IRW	4	1	L/day	Harris, 2008
Radiation Age-adjusted drinking water ingestion rate	IRW_RAD_{adj}	262		L-yr/day	Calculated using the age adjusted intake factors equation
Radiation Ingestion of Water Slope Factor	Sfo	Chemical Specific		risk/pCi	U.S. EPA, 1997

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

Harris, S., 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

Ingestion of Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Radioactive COPC	CAS #	Cw (pCi/L)	CDI (radiological ingestion) (pCi)	SF_o (risk/pCi)	Risk (unitless)	% Contribution
Carbon-14	14762-75-5	15.2	1,453,576	1.55E-12	2.25E-06	0.092
Gross alpha	12587-46-1	5.9880167	572,634	--	--	
Gross beta	12587-47-2	26.717649	2,555,009	--	--	
Iodine-129	15046-84-1	1.7529182	167,632	1.48E-10	2.48E-05	1.0
Nickel-63	13981-37-8	7.66125	732,645	6.70E-13	4.91E-07	0.020
Protactinium-231	14331-85-2	0.308	29,454	1.73E-10	5.10E-06	0.21
Strontium-90	10098-97-2	0.611	58,430	5.59E-11	3.27E-06	0.13
Technetium-99	14133-76-7	75.671084	7.24E+06	2.75E-12	1.99E-05	0.81
Tritium	10028-17-8	497899.63	4.76E+10	5.07E-14	2.41E-03	99
Total ELCR					2.44E-03	100

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Drinking Water Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwate C_w (mg/L)	VOC?	HQ (Inhalation) (unitless)	HQ (Ingestion) (unitless)	HQ (Dermal) (unitless)	Total HI (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--(b)	--	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.6E-09	--	--(b)	--	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--(b)	--	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--(b)	--	--	--	
1,2-Dichloroethane	0.00064	Yes	3.22E-06	1.83E-03	4.48E-05	1.88E-03	0.017
2,3,4,6-Tetrachlorophenol	0.0077	--	--(b)	1.47E-02	--	1.47E-02	0.13
2-Methylphenol (cresol, o-)	0.0075	--	--(b)	8.57E-03	4.10E-04	8.98E-03	0.082
4-Nitrophenol	0.0072	--	--(b)	5.14E-02	1.87E-03	5.33E-02	0.49
Aluminum	0.11217909	--	--(b)	6.41E-03	1.67E-05	6.43E-03	0.059
Arsenic	0.005765062	--	--(b)	1.10E+00	2.87E-03	1.10E+00	10
Barium	0.052626075	--	--(b)	1.50E-02	5.61E-04	1.56E-02	0.14
Beryllium	0.00034431	--	--(b)	9.84E-03	3.67E-03	1.35E-02	0.12
Bis(2-ethylhexyl) phthalate	0.011	--	--(b)	3.14E-02	2.43E-02	5.57E-02	0.51
Cadmium	0.018	--	--(b)	2.06E+00	1.07E-01	2.16E+00	20
Carbon tetrachloride	0.0018	Yes	1.14E-04	1.47E-01	1.97E-02	1.67E-01	1.5
Chloride	11.439962	--	--(b)	--	--	--	
Chloroform	0.00038106	Yes	4.70E-05	2.18E-03	9.92E-05	2.32E-03	0.021
Chromium	0.015609389	--	--(b)	5.95E-04	1.19E-04	7.14E-04	0.0065
Cobalt	0.004378857	--	--(b)	8.34E-01	8.71E-04	8.35E-01	7.6
Copper	0.004482187	--	--(b)	6.40E-03	1.67E-05	6.42E-03	0.059
Dinoseb(2-secButyl-4,6-dinitrophenol)	0.005506461	--	--(b)	3.15E-01	--	3.15E-01	2.9
Fluoride	0.31715504	--	--(b)	3.02E-01	7.88E-04	3.03E-01	2.8
Hexavalent Chromium	0.191	--	--(b)	3.64E+00	7.60E-01	4.40E+00	40
Iron	0.14355212	--	--(b)	1.17E-02	3.06E-05	1.17E-02	0.11
Lead	0.00142074	--	--(b)	--	--	--	
Manganese	0.009635007	--	--(b)	2.29E-02	1.50E-03	2.44E-02	0.22
Nickel	0.010760715	--	--(b)	3.07E-02	4.01E-04	3.11E-02	0.28
Nitrate	31.205071	--	--(b)	2.51E-01	6.55E-04	2.52E-01	2.3
Nitrite	0.034429846	--	--(b)	6.56E-03	1.71E-05	6.58E-03	0.060
Nitrogen in Nitrite and Nitrate	14.7	--	--(b)	5.25E-01	1.37E-03	5.26E-01	4.8
Octachlorodibenzofuran	9.9649E-09	--	--(b)	--	--	--	
Octachlorodibenzo-p-dioxin	5.6857E-09	--	--(b)	--	--	--	
Silver	0.005650889	--	--(b)	6.46E-02	2.53E-03	6.71E-02	0.61
Strontium	0.26495344	--	--(b)	2.52E-02	6.59E-05	2.53E-02	0.23
Sulfate	56.164035	--	--(b)	--	--	--	
Toluene	0.000065	Yes	1.57E-07	4.64E-05	8.07E-06	5.47E-05	4.99E-04
Total petroleum hydrocarbons - gasoline range	0.05	--	--(b)	--	--	--	
Trichloroethene	0.000570461	Yes	1.97E-04	--	--	1.97E-04	0.0018
Uranium	0.014879201	--	--(b)	2.83E-01	7.40E-04	2.84E-01	2.6
Vanadium	0.021937779	--	--(b)	2.51E-01	6.54E-04	2.51E-01	2.3
Zinc	0.092316084	--	--(b)	1.76E-02	2.75E-05	1.76E-02	0.16
Total			3.62E-04	10.03	0.93	10.96	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

HQ = hazard quotient.

HI = hazard index.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Drinking Water Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwate C_w (mg/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--(b)	2.81E-07	--	2.81E-07	0.051
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.6E-09	--	--(b)	4.22E-07	--	4.22E-07	0.077
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--(b)	2.19E-06	--	2.19E-06	0.40
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--(b)	1.58E-06	--	1.58E-06	0.29
1,2-Dichloroethane	0.00064	Yes	2.01E-07	3.38E-06	8.92E-08	3.67E-06	0.67
2,3,4,6-Tetrachlorophenol	0.0077	--	--(b)	--	--	--	
2-Methylphenol (cresol, o-)	0.0075	--	--(b)	--	--	--	
4-Nitrophenol	0.0072	--	--(b)	--	--	--	
Aluminum	0.11217909	--	--(b)	--	--	--	
Arsenic	0.005765062	--	--(b)	5.01E-04	1.45E-06	5.03E-04	92
Barium	0.052626075	--	--(b)	--	--	--	
Beryllium	0.00034431	--	--(b)	--	--	--	
Bis(2-ethylhexyl) phthalate	0.011	--	--(b)	8.93E-06	7.44E-06	1.64E-05	3.0
Cadmium	0.018	--	--(b)	--	--	--	
Carbon tetrachloride	0.0018	Yes	3.26E-07	1.36E-05	1.96E-06	1.58E-05	2.9

Chloride	11.439962	--	--(b)	--	--	--	
Chloroform	0.00038106	Yes	1.06E-07	6.85E-07	3.36E-08	8.24E-07	0.15
Chromium	0.015609389	--	--(b)	--	--	--	
Cobalt	0.004378857	--	--(b)	--	--	--	
Copper	0.004482187	--	--(b)	--	--	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)	0.005506461	--	--(b)	--	--	--	
Fluoride	0.31715504	--	--(b)	--	--	--	
Hexavalent Chromium	0.191	--	--(b)	--	--	--	
Iron	0.14355212	--	--(b)	--	--	--	
Lead	0.00142074	--	--(b)	--	--	--	
Manganese	0.009635007	--	--(b)	--	--	--	
Nickel	0.010760715	--	--(b)	--	--	--	
Nitrate	31.205071	--	--(b)	--	--	--	
Nitrite	0.034429846	--	--(b)	--	--	--	
Nitrogen in Nitrite and Nitrate	14.7	--	--(b)	--	--	--	
Octachlorodibenzofuran	9.9649E-09	--	--(b)	2.25E-08	--	--	
Octachlorodibenzo-p-dioxin	5.6857E-09	--	--(b)	1.29E-08	--	--	
Silver	0.005650889	--	--(b)	--	--	--	
Strontium	0.26495344	--	--(b)	--	--	--	
Sulfate	56.164035	--	--(b)	--	--	--	
Toluene	0.000065	Yes	--	--	--	--	
Total petroleum hydrocarbons - gasoline range	0.05	--	--(b)	--	--	--	
Trichloroethene	0.000570461	Yes	1.72E-07	2.94E-06	2.75E-07	3.39E-06	0.62
Uranium	0.014879201	--	--(b)	--	--	--	
Vanadium	0.021937779	--	--(b)	--	--	--	
Zinc	0.092316084	--	--(b)	--	--	--	
Total ELCR			8.06E-07	5.35E-04	1.12E-05	5.47E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Drinking Water Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwate C_w (pCi/L)	Volatile?[a]	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	4.8703439	--	--(b)	--	--	
Iodine-129	3.1689247	--	--(b)	4.49E-05	4.49E-05	3.0
Plutonium-239/240	0.029	--	--(b)	3.74E-07	3.74E-07	0.025
Protactinium-231	0.28	--	--(b)	4.63E-06	4.63E-06	0.31
Strontium-90	4.5802399	--	--(b)	2.45E-05	2.45E-05	1.6
Technetium-99	1567.7398	--	--(b)	4.12E-04	4.12E-04	27
Tritium	192557.5	Yes	8.57E-05	9.34E-04	1.02E-03	68
Total ELCR			8.57E-05	1.37E-03	1.51E-03	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-Field exposure area - CTUIR

Ingestion of Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Ingestion Chronic Daily Intake	CDI	calculated		mg/kg-day	EPA 1989
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70.0	15.0	kg	Harris et al, 2004
Drinking Water Ingestion Rate	IRW	4.0	1.0	Liters/day	Harris et al, 2004
Age-Adjusted Drinking Water Ingestion Rate	IRWadj	4.057		L-yr/kg-day	Calculated using the age adjusted intake factors equation
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	6	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Harris et al, 2004
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFo	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 1989

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.734E-09	2.13E-10	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.6E-09	3.20E-10	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	1.66E-10	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	1.20E-10	--	--	
1,2-Dichloroethane	107-06-2	0.00064	3.66E-05	2.00E-02	1.83E-03	0.018
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	4.40E-04	3.00E-02	1.47E-02	0.15
2-Methylphenol (cresol, o-)	95-48-7	0.0075	4.29E-04	5.00E-02	8.57E-03	0.085
4-Nitrophenol	100-02-7	0.0072	4.11E-04	8.00E-03	5.14E-02	0.51
Aluminum	7429-90-5	0.11217909	6.41E-03	1.00E+00	6.41E-03	0.064
Arsenic	7440-38-2	0.005765062	3.29E-04	3.00E-04	1.10E+00	11
Barium	7440-39-3	0.052626075	3.01E-03	2.00E-01	1.50E-02	0.15
Beryllium	7440-41-7	0.00034431	1.97E-05	2.00E-03	9.84E-03	0.098
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	6.29E-04	2.00E-02	3.14E-02	0.31
Cadmium	7440-43-9	0.018	1.03E-03	5.00E-04	2.06E+00	21
Carbon tetrachloride	56-23-5	0.0018	1.03E-04	7.00E-04	1.47E-01	1.5
Chloride	16887-00-6	11.439962	6.54E-01	--	--	
Chloroform	67-66-3	0.00038106	2.18E-05	1.00E-02	2.18E-03	0.022
Chromium	7440-47-3	0.015609389	8.92E-04	1.50E+00	5.95E-04	0.0059
Cobalt	7440-48-4	0.004378857	2.50E-04	3.00E-04	8.34E-01	8.3
Copper	7440-50-8	0.004482187	2.56E-04	4.00E-02	6.40E-03	0.064
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	0.005506461	3.15E-04	1.00E-03	3.15E-01	3.1
Fluoride	16984-48-8	0.31715504	1.81E-02	6.00E-02	3.02E-01	3.0
Hexavalent Chromium	18540-29-9	0.191	1.09E-02	3.00E-03	3.64E+00	36
Iron	7439-89-6	0.14355212	8.20E-03	7.00E-01	1.17E-02	0.12
Lead	7439-92-1	0.00142074	8.12E-05	--	--	
Manganese	7439-96-5	0.009635007	5.51E-04	2.40E-02	2.29E-02	0.23
Nickel	7440-02-0	0.010760715	6.15E-04	2.00E-02	3.07E-02	0.31
Nitrate	14797-55-8	31.205071	1.78E+00	7.10E+00	2.51E-01	2.5
Nitrite	14797-65-0	0.034429846	1.97E-03	3.00E-01	6.56E-03	0.065
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	8.40E-01	1.60E+00	5.25E-01	5.2
Octachlorodibenzofuran	39001-02-0	9.9649E-09	5.69E-10	--	--	
Octachlorodibenzo-p-dioxin	3268-87-9	5.6857E-09	3.25E-10	--	--	
Silver	7440-22-4	0.005650889	3.23E-04	5.00E-03	6.46E-02	0.64
Strontium	7440-24-6	0.26495344	1.51E-02	6.00E-01	2.52E-02	0.25
Sulfate	14808-79-8	56.164035	3.21E+00	--	--	
Toluene	108-88-3	0.000065	3.71E-06	8.00E-02	4.64E-05	4.63E-04
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	2.86E-03	--	--	
Trichloroethene	79-01-6	0.000570461	3.26E-05	--	--	
Uranium	7440-61-1	0.014879201	8.50E-04	3.00E-03	2.83E-01	2.8
Vanadium	7440-62-2	0.021937779	1.25E-03	5.00E-03	2.51E-01	2.5
Zinc	7440-66-6	0.092316084	5.28E-03	3.00E-01	1.76E-02	0.18
Total					1.00E+01	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.734E-09	2.16E-10	1.30E+03	2.81E-07	0.053
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.6E-09	3.25E-10	1.30E+03	4.22E-07	0.079
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	1.68E-10	1.30E+04	2.19E-06	0.41
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	1.22E-10	1.30E+04	1.58E-06	0.30
1,2-Dichloroethane	107-06-2	0.00064	3.71E-05	9.10E-02	3.38E-06	0.63
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	4.46E-04	--	--	
2-Methylphenol (cresol, o-)	95-48-7	0.0075	4.35E-04	--	--	
4-Nitrophenol	100-02-7	0.0072	4.17E-04	--	--	
Aluminum	7429-90-5	0.11217909	6.50E-03	--	--	
Arsenic	7440-38-2	0.005765062	3.34E-04	1.50E+00	5.01E-04	94
Barium	7440-39-3	0.052626075	3.05E-03	--	--	
Beryllium	7440-41-7	0.00034431	2.00E-05	--	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	6.38E-04	1.40E-02	8.93E-06	1.7
Cadmium	7440-43-9	0.018	1.04E-03	--	--	
Carbon tetrachloride	56-23-5	0.0018	1.04E-04	1.30E-01	1.36E-05	2.5
Chloride	16887-00-6	11.439962	6.63E-01	--	--	
Chloroform	67-66-3	0.00038106	2.21E-05	3.10E-02	6.85E-07	0.13
Chromium	7440-47-3	0.015609389	9.05E-04	--	--	
Cobalt	7440-48-4	0.004378857	2.54E-04	--	--	
Copper	7440-50-8	0.004482187	2.60E-04	--	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	0.005506461	3.19E-04	--	--	
Fluoride	16984-48-8	0.31715504	1.84E-02	--	--	
Hexavalent Chromium	18540-29-9	0.191	1.11E-02	--	--	

Iron	7439-89-6	0.14355212	8.32E-03	--	--	
Lead	7439-92-1	0.00142074	8.23E-05	--	--	
Manganese	7439-96-5	0.009635007	5.58E-04	--	--	
Nickel	7440-02-0	0.010760715	6.24E-04	--	--	
Nitrate	14797-55-8	31.205071	1.81E+00	--	--	
Nitrite	14797-65-0	0.034429846	2.00E-03	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	8.52E-01	--	--	
Octachlorodibenzofuran	39001-02-0	9.9649E-09	5.78E-10	3.90E+01	2.25E-08	0.0042
Octachlorodibenzo-p-dioxin	3268-87-9	5.6857E-09	3.30E-10	3.90E+01	1.29E-08	0.0024
Silver	7440-22-4	0.005650889	3.28E-04	--	--	
Strontium	7440-24-6	0.26495344	1.54E-02	--	--	
Sulfate	14808-79-8	56.164035	3.26E+00	--	--	
Toluene	108-88-3	0.000065	3.77E-06	--	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	2.90E-03	--	--	
Trichloroethene	79-01-6	0.000570461	3.31E-05	8.90E-02	2.94E-06	0.55
Uranium	7440-61-1	0.014879201	8.62E-04	--	--	
Vanadium	7440-62-2	0.021937779	1.27E-03	--	--	
Zinc	7440-66-6	0.092316084	5.35E-03	--	--	
Total ELCR					5.35E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-Field exposure area - CTUIR

Inhalation of Volatile Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Inhalation Chronic Daily Intake	CDI	calculated		mg/m^3 for noncarcinogens, $\mu g/m^3$ for carcinogens	EPA 2009b
Contaminant concentration in drinking water	C_w	contaminant-specific		mg/L	ECF-200PO1-09-2027
Exposure Time	ET	0.580	--	hours/day	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	--	yr	Harris et al, 2004
Averaging Time	AT	70	--	yr	Harris et al, 2004
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Inhalation Reference Concentration	RfC_i	Chemical Specific		mg/m^3	EPA 2009a
Inhalation Unit Risk	IUR	Chemical Specific		$(\mu g/m^3)^{-1}$	EPA 2009a
Conversion Factor	CF1	365		days/year	EPA 2009b
Conversion Factor	CF2	0.042		1day/24 hours	EPA 2009b

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009a EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

U.S. EPA 2009b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (noncarcinogen) (mg/m^3)	RfC^a (mg/m^3)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(b)	--	--(b)	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.6E-09	--(b)	--	--(b)	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(b)	--	--(b)	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(b)	--	--(b)	
1,2-Dichloroethane	107-06-2	Yes	0.00064	7.73E-06	2.40E+00	3.22E-06	0.89
2,3,4,6-Tetrachlorophenol	58-90-2	--	0.0077	--(b)	--	--(b)	
2-Methylphenol (cresol, o-)	95-48-7	--	0.0075	--(b)	6.00E-01	--(b)	
4-Nitrophenol	100-02-7	--	0.0072	--(b)	--	--(b)	
Aluminum	7429-90-5	--	0.11217909	--(b)	5.00E-03	--(b)	
Arsenic	7440-38-2	--	0.005765062	--(b)	1.50E-05	--(b)	
Barium	7440-39-3	--	0.052626075	--(b)	5.00E-04	--(b)	
Beryllium	7440-41-7	--	0.00034431	--(b)	2.00E-05	--(b)	
Bis(2-ethylhexyl) phthalate	117-81-7	--	0.011	--(b)	--	--(b)	
Cadmium	7440-43-9	--	0.018	--(b)	1.00E-05	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.0018	2.18E-05	1.90E-01	1.14E-04	32
Chloride	16887-00-6	--	11.439962	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.00038106	4.60E-06	9.80E-02	4.70E-05	13
Chromium	7440-47-3	--	0.015609389	--(b)	--	--(b)	
Cobalt	7440-48-4	--	0.004378857	--(b)	6.00E-06	--(b)	
Copper	7440-50-8	--	0.004482187	--(b)	--	--(b)	
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	--	0.005506461	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.31715504	--(b)	1.30E-02	--(b)	
Hexavalent Chromium	18540-29-9	--	0.191	--(b)	1.00E-04	--(b)	
Iron	7439-89-6	--	0.14355212	--(b)	--	--(b)	
Lead	7439-92-1	--	0.00142074	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.009635007	--(b)	5.00E-05	--(b)	
Nickel	7440-02-0	--	0.010760715	--(b)	9.00E-05	--(b)	
Nitrate	14797-55-8	--	31.205071	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.034429846	--(b)	--	--(b)	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(b)	--	--(b)	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(b)	--	--(b)	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.6857E-09	--(b)	--	--(b)	
Silver	7440-22-4	--	0.005650889	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.26495344	--(b)	--	--(b)	
Sulfate	14808-79-8	--	56.164035	--(b)	--	--(b)	
Toluene	108-88-3	Yes	0.000065	7.85E-07	5.00E+00	1.57E-07	0.043
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(b)	--	--(b)	
Trichloroethene	79-01-6	Yes	0.000570461	6.89E-06	3.50E-02	1.97E-04	54
Uranium	7440-61-1	--	0.014879201	--(b)	3.00E-04	--(b)	
Vanadium	7440-62-2	--	0.021937779	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.092316084	--(b)	--	--(b)	
Total						3.62E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (carcinogen) ($\mu g/m^3$)	IUR^a $(\mu g/m^3)^{-1}$	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(b)	3.80E-01	--(b)	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.6E-09	--(b)	3.80E-01	--(b)	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(b)	3.80E+00	--(b)	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(b)	3.80E+00	--(b)	
1,2-Dichloroethane	107-06-2	Yes	0.00064	7.73E-03	2.60E-05	2.01E-07	25
2,3,4,6-Tetrachlorophenol	58-90-2	--	0.0077	--(b)	--	--(b)	
2-Methylphenol (cresol, o-)	95-48-7	--	0.0075	--(b)	--	--(b)	
4-Nitrophenol	100-02-7	--	0.0072	--(b)	--	--(b)	
Aluminum	7429-90-5	--	0.11217909	--(b)	--	--(b)	
Arsenic	7440-38-2	--	0.005765062	--(b)	4.30E-03	--(b)	
Barium	7440-39-3	--	0.052626075	--(b)	--	--(b)	
Beryllium	7440-41-7	--	0.00034431	--(b)	2.40E-03	--(b)	
Bis(2-ethylhexyl) phthalate	117-81-7	--	0.011	--(b)	2.40E-06	--(b)	
Cadmium	7440-43-9	--	0.018	--(b)	1.80E-03	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.0018	2.18E-02	1.50E-05	3.26E-07	41
Chloride	16887-00-6	--	11.439962	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.00038106	4.60E-03	2.30E-05	1.06E-07	13
Chromium	7440-47-3	--	0.015609389	--(b)	--	--(b)	
Cobalt	7440-48-4	--	0.004378857	--(b)	9.00E-03	--(b)	
Copper	7440-50-8	--	0.004482187	--(b)	--	--(b)	
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	--	0.005506461	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.31715504	--(b)	--	--(b)	

Hexavalent Chromium	18540-29-9	--	0.191	--(b)	8.40E-02	--(b)	
Iron	7439-89-6	--	0.14355212	--(b)	--	--(b)	
Lead	7439-92-1	--	0.00142074	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.009635007	--(b)	--	--(b)	
Nickel	7440-02-0	--	0.010760715	--(b)	2.60E-04	--(b)	
Nitrate	14797-55-8	--	31.205071	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.034429846	--(b)	--	--(b)	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(b)	--	--(b)	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(b)	1.14E-02	--(b)	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.6857E-09	--(b)	1.14E-02	--(b)	
Silver	7440-22-4	--	0.005650889	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.26495344	--(b)	--	--(b)	
Sulfate	14808-79-8	--	56.164035	--(b)	--	--(b)	
Toluene	108-88-3	Yes	0.000065	7.85E-04	--	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(b)	--	--(b)	
Trichloroethene	79-01-6	Yes	0.000570461	6.89E-03	2.50E-05	1.72E-07	21
Uranium	7440-61-1	--	0.014879201	--(b)	--	--(b)	
Vanadium	7440-62-2	--	0.021937779	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.092316084	--(b)	--	--(b)	
Total ELCR						8.06E-07	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b]Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-Field exposure area - CTUIR

Dermal Absorption of Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Contaminant concentration in Drinking Water	Cw	contaminant specific		mg/L	ECF-200PO1-09 2027
Average Body Weight	BW	70	15	kg	Harris et al, 2004
Exposure Time	ET	0.58	1.0	hours/day	U.S. EPA, 2004
Exposure Time (Age-Adjusted)	ETadj	0.616		hours/day	Calculated using the age adjusted intake factors equation
Surface Area	SA	18,000	6,600	cm^2	Harris et al, 2004
Age-Adjusted Surface Area	SAadj	19,097		(cm^2-yr event)/(1 kg-day)	Calculated using the age adjusted intake factors equation
Event Frequency	EV	1.0	1.0	Event/days	U.S. EPA, 2004
Exposure Frequency	Ef	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	6.0	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Harris et al, 2004
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFO	Oral Cancer Slope Factor	Chemical Specific		(mg/kg-day)$^{-1}$	EPA 2009
Conversion Factor	CF2	365		days/year	365 days = 1 year
Conversion Factor	CF3	0.001		L/cm^3	1 L = 1000 cm^3
t*	Time to reach steady state	Chemical Specific		hours	EPA, 2004
B	Dermal Partitioning Constant	Chemical Specific		unitless	EPA, 2004
DA	Absorbed Dose per Event	Chemical Specific		(mg/cm^2-event)	Calculated using dermal exposure to groundwater equations as provided by U.S. EPA, 2004
Kp	Dermal Permeability Constant	Chemical Specific		cm/hour	EPA, 2004
FA	Fraction Absorbed	Chemical Specific		unitless	EPA, 2004
t	Lag Time	Chemical Specific		hours	EPA, 2004

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027 Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I : Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for inhalation Risk Assessment) Final

Absorbed Dermal Dose Calculation

Contaminant of Potential Concern	CAS #	Cw (mg/L)	Inorganic/organic[a]	FA[a] (unitless)	K_p[a] (cm/hour)	B[a] (unitless)	t*[a] (hours/event)	t*[a] (hours)	DA (noncancer) (mg/cm^2-event)	DA (cancer) (mg/cm^2-event)
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.734E-09	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.6E-09	--	--	1.45	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	--	--	2.25	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	--	--	2.25	--	--	--	--	--
1,2-Dichloroethane	107-06-2	0.00064	--	1.0	0.0042	0	0.38	0.92	3.49E-09	3.59E-09
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	--	--	0.071	--	--	--	--	--
2-Methylphenol (cresol, o-)	95-48-7	0.0075	--	1.0	0.0077	0	0.43	1.03	7.97E-08	8.21E-08
4-Nitrophenol	100-02-7	0.0072	--	1.0	0.0048	0	0.64	1.54	5.82E-08	6.00E-08
Aluminum	7429-90-5	0.11217909	INORGANIC	--	0.001	--	--	--	6.51E-08	6.91E-08
Arsenic	7440-38-2	0.005765062	INORGANIC	--	0.001	--	--	--	3.34E-09	3.55E-09
Barium	7440-39-3	0.052626075	INORGANIC	--	0.001	--	--	--	3.05E-08	3.24E-08
Beryllium	7440-41-7	0.00034431	INORGANIC	--	0.001	--	--	--	2.00E-10	2.12E-10
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	--	0.8	0.025	0.2	16.64	39.93	1.89E-06	1.95E-06
Cadmium	7440-43-9	0.018	INORGANIC	--	0.001	--	--	--	1.04E-08	1.11E-08
Carbon tetrachloride	56-23-5	0.0018	--	1.0	0.016	0.1	0.78	1.86	5.35E-08	5.52E-08
Chloride	16887-00-6	11.439962	INORGANIC	--	0.001	--	--	--	6.64E-06	7.05E-06
Chloroform	67-66-3	0.00038106	--	1.0	0.0068	0	0.50	1.19	3.86E-09	3.97E-09
Chromium	7440-47-3	0.015609389	INORGANIC	--	0.001	--	--	--	9.05E-09	9.62E-09
Cobalt	7440-48-4	0.004378857	INORGANIC	--	0.0004	--	--	--	1.02E-09	1.08E-09
Copper	7440-50-8	0.004482187	INORGANIC	--	0.001	--	--	--	2.60E-09	2.76E-09
Dinoseb(2-secButyl-4,6-dinitrophenol)[c]	88-85-7	0.005506461	--	--	0.0163	--	--	--	--	--
Fluoride	16984-48-8	0.31715504	INORGANIC	--	0.001	--	--	--	1.84E-07	1.95E-07
Hexavalent Chromium	18540-29-9	0.191	INORGANIC	--	0.002	--	--	--	2.22E-07	2.35E-07
Iron	7439-89-6	0.14355212	INORGANIC	--	0.001	--	--	--	8.33E-08	8.84E-08
Lead	7439-92-1	0.00142074	INORGANIC	--	0.0001	--	--	--	8.24E-11	8.75E-11
Manganese	7439-96-5	0.009635007	INORGANIC	--	0.001	--	--	--	5.59E-09	5.94E-09
Nickel	7440-02-0	0.010760715	INORGANIC	--	0.0002	--	--	--	1.25E-09	1.33E-09
Nitrate	14797-55-8	31.205071	INORGANIC	--	0.001	--	--	--	1.81E-05	1.92E-05
Nitrite	14797-65-0	0.034429846	INORGANIC	--	0.001	--	--	--	2.00E-08	2.12E-08
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	INORGANIC	--	0.001	--	--	--	8.53E-06	9.06E-06
Octachlorodibenzofuran	39001-02-0	9.9649E-09	--	--	2.63	--	--	--	--	--
Octachlorodibenzo-p-dioxin	3268-87-9	5.6857E-09	--	--	1.16	--	--	--	--	--
Silver	7440-22-4	0.005650889	INORGANIC	--	0.0006	--	--	--	1.97E-09	2.09E-09
Strontium	7440-24-6	0.26495344	INORGANIC	--	0.001	--	--	--	1.54E-07	1.63E-07
Sulfate	14808-79-8	56.164035	INORGANIC	--	0.001	--	--	--	3.26E-05	3.46E-05
Toluene	108-88-3	0.000065	--	1.0	0.031	0.1	0.35	0.84	2.51E-09	2.59E-09
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	--	--	--	--	--	--	--	--
Trichloroethene	79-01-6	0.000570461	--	1.0	0.012	0.1	0.58	1.39	1.10E-08	1.13E-08
Uranium	7440-61-1	0.014879201	INORGANIC	--	0.001	--	--	--	8.63E-09	9.17E-09
Vanadium	7440-62-2	0.021937779	INORGANIC	--	0.001	--	--	--	1.27E-08	1.35E-08
Zinc	7440-66-6	0.092316084	INORGANIC	--	0.0006	--	--	--	3.21E-08	3.41E-08

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

[a] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2

[b] EPA/540/R/99/005 Exhibit B-3

[c] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin[c]	35822-46-9	3.734E-09	--	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[c]	67562-39-4	5.6E-09	--	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[c]	70648-26-9	2.9E-09	--	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran[c]	57117-44-9	2.1E-09	--	--	1	--	
1,2-Dichloroethane	107-06-2	0.00064	8.97E-07	2.00E-02	1	4.48E-05	0.0048
2,3,4,6-Tetrachlorophenol[c]	58-90-2	0.0077	--	3.00E-02	1	--	
2-Methylphenol (cresol, o-)	95-48-7	0.0075	2.05E-05	5.00E-02	1	4.10E-04	0.044
4-Nitrophenol	100-02-7	0.0072	1.50E-05	8.00E-03	1	1.87E-03	0.20
Aluminum	7429-90-5	0.11217909	1.67E-05	1.00E+00	1	1.67E-05	0.0018
Arsenic	7440-38-2	0.005765062	8.60E-07	3.00E-04	1	2.87E-03	0.31
Barium	7440-39-3	0.052626075	7.85E-06	2.00E-01	0.07	5.61E-04	0.060
Beryllium	7440-41-7	0.00034431	5.14E-08	2.00E-03	0.007	3.67E-03	0.39
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	4.86E-04	2.00E-02	1	2.43E-02	2.6
Cadmium	7440-43-9	0.018	2.68E-06	5.00E-04	0.05	1.07E-01	12
Carbon tetrachloride	56-23-5	0.0018	1.38E-05	7.00E-04	1	1.97E-02	2.1
Chloride	16887-00-6	11.439962	1.71E-03	--	1	--	
Chloroform	67-66-3	0.00038106	9.92E-07	1.00E-02	1	9.92E-05	0.011
Chromium	7440-47-3	0.015609389	2.33E-06	1.50E+00	0.013	1.19E-04	0.013
Cobalt	7440-48-4	0.004378857	2.61E-07	3.00E-04	1	8.71E-04	0.094
Copper	7440-50-8	0.004482187	6.68E-07	4.00E-02	1	1.67E-05	0.0018
Dinoseb(2-secButyl-4,6-dinitrophenol)[c]	88-85-7	0.005506461	--	1.00E-03	1	--	
Fluoride	16984-48-8	0.31715504	4.73E-05	6.00E-02	1	7.88E-04	0.085
Hexavalent Chromium	18540-29-9	0.191	5.70E-05	3.00E-03	0.025	7.60E-01	82
Iron	7439-89-6	0.14355212	2.14E-05	7.00E-01	1	3.06E-05	0.0033
Lead	7439-92-1	0.00142074	2.12E-08	--	1	--	
Manganese	7439-96-5	0.009635007	1.44E-06	2.40E-02	0.04	1.50E-03	0.16
Nickel	7440-02-0	0.010760715	3.21E-07	2.00E-02	0.04	4.01E-04	0.043
Nitrate	14797-55-8	31.205071	4.65E-03	7.00E+00	1	6.55E-04	0.070
Nitrite	14797-65-0	0.034429846	5.13E-06	9.00E-01	1	1.71E-05	0.0018
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	2.19E-03	1.60E+00	1	1.37E-03	0.15
Octachlorodibenzofuran[c]	39001-02-0	9.9649E-09	--	--	1	--	
Octachlorodibenzo-p-dioxin[c]	3268-87-9	5.6857E-09	--	--	1	--	
Silver	7440-22-4	0.005650889	5.06E-07	5.00E-03	0.04	2.53E-03	0.27
Strontium	7440-24-6	0.26495344	3.95E-05	6.00E-01	1	6.59E-05	0.0071
Sulfate	14808-79-8	56.164035	8.38E-03	--	--	--	
Toluene	108-88-3	0.000065	6.45E-07	8.00E-02	1	8.07E-06	8.67E-04
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	--	--	--	--	
Trichloroethene	79-01-6	0.000570461	2.82E-06	--	1	--	
Uranium	7440-61-1	0.014879201	2.22E-06	3.00E-03	1	7.40E-04	0.080
Vanadium	7440-62-2	0.021937779	3.27E-06	5.00E-03	1	0.0007	0.070
Zinc	7440-66-6	0.092316084	8.26E-06	3.00E-01	1	2.75E-05	0.0030
Total						0.93	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.734E-09	--	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.6E-09	--	1.30E+03	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	--	1.30E+04	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	--	1.30E+04	1	--	
1,2-Dichloroethane	107-06-2	0.00064	9.81E-07	9.10E-02	1	8.92E-08	0.79
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	--	--	1	--	
2-Methylphenol (cresol, o-)	95-48-7	0.0075	2.24E-05	--	1	--	
4-Nitrophenol	100-02-7	0.0072	1.64E-05	--	1	--	
Aluminum	7429-90-5	0.11217909	1.83E-05	--	1	--	
Arsenic	7440-38-2	0.005765062	9.69E-07	1.50E+00	1	1.45E-06	13
Barium	7440-39-3	0.052626075	8.84E-06	--	0.07	--	

Beryllium	7440-41-7	0.00034431	5.79E-08	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	5.91E-04	1.40E-02	1	7.44E-06	66
Cadmium	7440-43-9	0.018	3.02E-06	--	0.05	--	
Carbon tetrachloride	56-23-5	0.0018	1.51E-05	1.30E-01	1	1.96E-06	17
Chloride	16887-00-6	11.439962	1.92E-03	--	1	--	
Chloroform	67-66-3	0.00038106	1.08E-06	3.10E-02	1	3.36E-08	0.3C
Chromium	7440-47-3	0.015609389	2.62E-06	--	0.013	--	
Cobalt	7440-48-4	0.004378857	2.94E-07	--	1	--	
Copper	7440-50-8	0.004482187	7.53E-07	--	1	--	
Dinoseb(2-secbutyl-4,6-dinitrophenol)	88-85-7	0.005506461	--	--	1	--	
Fluoride	16984-48-8	0.31715504	5.33E-05	--	1	--	
Hexavalent Chromium	18540-29-9	0.191	6.42E-05	--	0.025	--	
Iron	7439-89-6	0.14355212	2.41E-05	--	1	--	
Lead	7439-92-1	0.00142074	2.39E-08	--	1	--	
Manganese	7439-96-5	0.009635007	1.62E-06	--	0.04	--	
Nickel	7440-02-0	0.010760715	3.62E-07	--	0.04	--	
Nitrate	14797-55-8	31.205071	5.24E-03	--	1	--	
Nitrite	14797-65-0	0.034429846	5.79E-06	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	2.47E-03	--	1	--	
Octachlorodibenzofuran	39001-02-0	9.9649E-09	--	3.90E+01	1	--	
Octachlorodibenzo-p-dioxin	3268-87-9	5.6857E-09	--	3.90E+01	1	--	
Silver	7440-22-4	0.005650889	5.70E-07	--	0.04	--	
Strontium	7440-24-6	0.26895344	4.45E-05	--	1	--	
Sulfate	14808-79-8	56.164035	9.44E-03	--	--	--	
Toluene	108-88-3	0.000065	7.06E-07	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	--	--	--	--	
Trichloroethene	79-01-6	0.000570461	3.09E-06	8.90E-02	1	2.75E-07	2.4
Uranium	7440-61-1	0.014879201	2.50E-06	--	1	--	
Vanadium	7440-62-2	0.021937779	3.69E-06	--	1	--	
Zinc	7440-66-6	0.092316084	9.31E-06	--	1	--	
Total ELCR						1.12E-05	100

* EPA Region 3 Regional Screening Level tables downloaded January 2010: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-Field exposure area - CTUIR

Inhalation of Volatile Radioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Factor	Symbol	Adult	Child	Unit	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Harris et al, 2004
Exposure duration	ED	70	6	years	Harris et al, 2004
Inhalation Rate	INH	25	15	m^3/day	Harris, 2008
Exposure time	ET	0.58	1	hr/day	U.S. EPA, 2004
Age Adjusted Exposure Time	ET_{adj}	0.616		hrs	Calculated using the age adjusted intake factors equation
Radiation Age-adjusted inhalation rate	INH_RAD_{adj}	1690		m^3-yr/day	Calculated using the age adjusted intake factors equation
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991b
Radiation Inhalation of Volatiles Slope Factor	Sfi	Chemical Specific		risk/pCi	U.S. EPA, 1997

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

Harris, S., 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Inhalation of Volatile Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	VOC[a]	Cw (pCi/L)	CDI (radiological inhalation) (pCi)	SF_i (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	4.8703439	--(b)	--	--(b)	
Iodine-129	15046-84-1	--	3.1689247	--(b)	6.07E-11	--(b)	
Plutonium-239/240	PU-239/240	--	0.029	--(b)	3.33E-08	--(b)	
Protactinium-231	14331-85-2	--	0.28	--(b)	4.55E-08	--(b)	
Strontium-90	10098-97-2	--	4.5802399	--(b)	1.05E-10	--(b)	
Technetium-99	14133-76-7	--	1567.7398	--(b)	1.41E-11	--(b)	
Tritium	10028-17-8	Yes	192557.5	1.52E+09	5.62E-14	8.57E-05	100
Total ELCR						8.57E-05	100

[a] Radiological contaminants considered volatile for the groundwater inhalation pathway are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-Field exposure area - CTUIR

Ingestion of Radioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Factor	Symbol	Unit		Value	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Harris et al, 2004
Exposure duration	ED	70	6	years	Harris et al, 2004
Drinking Water Ingestion Rate	IRW	4	1	L/day	Harris, 2008
Radiation Age-adjusted drinking water ingestion rate	IRW_RAD_{adj}	262		L-yr/day	Calculated using the age adjusted intake factors equation
Radiation Ingestion of Water Slope Factor	Sfo	Chemical Specific		risk/pCi	U.S. EPA, 1997

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

Harris, S., 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Ingestion of Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	Cw (pCi/L)	I (radiological ingestic (pCi)	SF_o (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	4.8703439	465,751	--	--	
Iodine-129	15046-84-1	3.1689247	303,044	1.48E-10	4.49E-05	3.2
Plutonium-239/240	PU-239/240	0.029	2,773	1.35E-10	3.74E-07	0.026
Protactinium-231	14331-85-2	0.28	26,776	1.73E-10	4.63E-06	0.33
Strontium-90	10098-97-2	4.5802399	438,008	5.59E-11	2.45E-05	1.7
Technetium-99	14133-76-7	1567.7398	1.50E+08	2.75E-12	4.12E-04	29
Tritium	10028-17-8	192557.5	1.84E+10	5.07E-14	9.34E-04	66
Total ELCR					1.42E-03	100

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit River Unconfined Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Drinking Water Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	ontaminant Concentration in Groundwat C_w (mg/L)	VOC?	HQ (Inhalation) (unitless)	HQ (Ingestion) (unitless)	HQ (Dermal) (unitless)	Total HI (unitless)	% Contribution
Acetone	0.0011	Yes	4.29E-07	6.98E-05	--	7.03E-05	0.0031
Arsenic	0.005767892	--	--(b)	1.10E+00	2.87E-03	1.10E+00	48
Barium	0.049451657	--	--(b)	1.41E-02	5.27E-04	1.47E-02	0.64
Carbon tetrachloride	0.00028	Yes	1.78E-05	2.29E-02	3.06E-03	2.59E-02	1.1
Chloride	12.545114	--	--(b)	--	--	--	
Chloroform	0.0023	Yes	2.84E-04	1.31E-02	5.99E-04	1.40E-02	0.61
Chromium	0.0141	--	--(b)	5.37E-04	1.08E-04	6.45E-04	0.028
Copper	0.00597989	--	--(b)	8.54E-03	2.23E-05	8.56E-03	0.37
Fluoride	0.30621978	--	--(b)	2.92E-01	7.61E-04	2.92E-01	13
Iron	0.61057915	--	--(b)	4.98E-02	1.30E-04	5.00E-02	2.2
Lead	0.000663667	--	--(b)	--	--	--	
Manganese	0.040717647	--	--(b)	9.69E-02	6.33E-03	1.03E-01	4.5
Nickel	0.0056	--	--(b)	1.60E-02	2.09E-04	1.62E-02	0.71
Nitrate	28.952	--	--(b)	2.33E-01	6.08E-04	2.34E-01	10
Nitrite	0.46	--	--(b)	8.76E-02	2.29E-04	8.78E-02	3.8
Strontium	0.38963943	--	--(b)	3.71E-02	9.69E-05	3.72E-02	1.6
Sulfate	41.899078	--	--(b)	--	--	--	
Thallium	0.00037	--	--(b)	--	--	--	
Uranium	0.005491757	--	--(b)	1.05E-01	2.73E-04	1.05E-01	4.6
Vanadium	0.0168	--	--(b)	1.92E-01	5.01E-04	1.93E-01	8.4
Zinc	0.006671161	--	--(b)	1.27E-03	1.99E-06	1.27E-03	0.056
Total			3.02E-04	2.27	0.02	2.28	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

HQ = hazard quotient.

HI = hazard index.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit River Unconfined Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Drinking Water Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	ontaminant Concentration in Groundwat C_w (mg/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Acetone	0.0011	Yes	--	--	--	--	
Arsenic	0.005767892	--	--(b)	5.01E-04	1.45E-06	5.03E-04	99
Barium	0.049451657	--	--(b)	--	--	--	
Carbon tetrachloride	0.00028	Yes	5.08E-08	2.11E-06	3.04E-07	2.46E-06	0.48
Chloride	12.545114	--	--(b)	--	--	--	
Chloroform	0.0023	Yes	6.39E-07	4.13E-06	2.03E-07	4.97E-06	0.97
Chromium	0.0141	--	--(b)	--	--	--	
Copper	0.00597989	--	--(b)	--	--	--	
Fluoride	0.30621978	--	--(b)	--	--	--	
Iron	0.61057915	--	--(b)	--	--	--	
Lead	0.000663667	--	--(b)	--	--	--	
Manganese	0.040717647	--	--(b)	--	--	--	
Nickel	0.0056	--	--(b)	--	--	--	
Nitrate	28.952	--	--(b)	--	--	--	
Nitrite	0.46	--	--(b)	--	--	--	
Strontium	0.38963943	--	--(b)	--	--	--	
Sulfate	41.899078	--	--(b)	--	--	--	
Thallium	0.00037	--	--(b)	--	--	--	
Uranium	0.005491757	--	--(b)	--	--	--	
Vanadium	0.0168	--	--(b)	--	--	--	
Zinc	0.006671161	--	--(b)	--	--	--	
Total ELCR			6.90E-07	5.08E-04	1.96E-06	5.10E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit River Unconfined Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Drinking Water Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	ontaminant Concentration in Groundwat C_w (pCi/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	2.8	--	--(b)	--	--	
Gross beta	22.2	--	--(b)	--	--	
Strontium-90	2.60	--	--(b)	1.39E-05	1.39E-05	4.18
Technetium-99	115	--	--(b)	3.02E-05	3.02E-05	9.1
Tritium	59,534	Yes	2.65E-05	2.89E-04	2.89E-04	87
Total ELCR			2.65E-05	3.33E-04	3.33E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
ELCR = excess lifetime cancer risk.
VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--River exposure area - CTUIR

Ingestion of Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Ingestion Chronic Daily Intake	CDI	calculated		mg/kg-day	EPA 1989
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	15	kg	Harris et al, 2004
Drinking Water Ingestion Rate	IRW	4.0	1.0	Liters/day	Harris et al, 2004
Age-Adjusted Drinking Water Ingestion Rate	IRWadj	4.057		L-yr/kg-day	Calculated using the age adjusted intake factors equation
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	6.0	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Harris et al, 2004
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFo	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 1989

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	HQ (unitless)	% Contribution
Acetone	67-64-1	0.0011	6.29E-05	9.00E-01	6.98E-05	0.0031
Arsenic	7440-38-2	0.005767892	3.30E-04	3.00E-04	1.10E+00	48
Barium	7440-39-3	0.049451657	2.83E-03	2.00E-01	1.41E-02	0.62
Carbon tetrachloride	56-23-5	0.00028	1.60E-05	7.00E-04	2.29E-02	1.01
Chloride	16887-00-6	12.545114	7.17E-01	--	--	
Chloroform	67-66-3	0.0023	1.31E-04	1.00E-02	1.31E-02	0.58
Chromium	7440-47-3	0.0141	8.06E-04	1.50E+00	5.37E-04	0.024
Copper	7440-50-8	0.00597989	3.42E-04	4.00E-02	8.54E-03	0.38
Fluoride	16984-48-8	0.30621978	1.75E-02	6.00E-02	2.92E-01	13
Iron	7439-89-6	0.61057915	3.49E-02	7.00E-01	4.98E-02	2.2
Lead	7439-92-1	0.000663667	3.79E-05	--	--	
Manganese	7439-96-5	0.040717647	2.33E-03	2.40E-02	9.69E-02	4.3
Nickel	7440-02-0	0.0056	3.20E-04	2.00E-02	1.60E-02	0.71
Nitrate	14797-55-8	28.952	1.65E+00	7.10E+00	2.33E-01	10
Nitrite	14797-65-0	0.46	2.63E-02	3.00E-01	8.76E-02	3.9
Strontium	7440-24-6	0.38963943	2.23E-02	6.00E-01	3.71E-02	1.6
Sulfate	14808-79-8	41.899078	2.39E+00	--	--	
Thallium	7440-28-0	0.00037	2.11E-05	--	--	
Uranium	7440-61-1	0.005491757	3.14E-04	3.00E-03	1.05E-01	4.6
Vanadium	7440-62-2	0.0168	9.60E-04	5.00E-03	1.92E-01	8.5
Zinc	7440-66-6	0.006671161	3.81E-04	3.00E-01	1.27E-03	0.056
Total					2.3	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	Risk (unitless)	% Contribution
Acetone	67-64-1	0.0011	6.38E-05	--	--	
Arsenic	7440-38-2	0.005767892	3.34E-04	1.50E+00	5.01E-04	99
Barium	7440-39-3	0.049451657	2.87E-03	--	--	
Carbon tetrachloride	56-23-5	0.00028	1.62E-05	1.30E-01	2.11E-06	0.42
Chloride	16887-00-6	12.545114	7.27E-01	--	--	
Chloroform	67-66-3	0.0023	1.33E-04	3.10E-02	4.13E-06	0.81
Chromium	7440-47-3	0.0141	8.17E-04	--	--	
Copper	7440-50-8	0.00597989	3.47E-04	--	--	
Fluoride	16984-48-8	0.30621978	1.77E-02	--	--	
Iron	7439-89-6	0.61057915	3.54E-02	--	--	
Lead	7439-92-1	0.000663667	3.85E-05	--	--	
Manganese	7439-96-5	0.040717647	2.36E-03	--	--	
Nickel	7440-02-0	0.0056	3.25E-04	--	--	
Nitrate	14797-55-8	28.952	1.68E+00	--	--	
Nitrite	14797-65-0	0.46	2.67E-02	--	--	
Strontium	7440-24-6	0.38963943	2.26E-02	--	--	
Sulfate	14808-79-8	41.899078	2.43E+00	--	--	
Thallium	7440-28-0	0.00037	2.14E-05	--	--	
Uranium	7440-61-1	0.005491757	3.18E-04	--	--	
Vanadium	7440-62-2	0.0168	9.74E-04	--	--	
Zinc	7440-66-6	0.006671161	3.87E-04	--	--	
Total ELCR					5.08E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--River exposure area - CTUIR

Inhalation of Volatile Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Inhalation Chronic Daily Intake	CDI	calculated		mg/m^3 for noncarcinogens, $\mu g/m^3$ for carcinogens	EPA 2009b
Contaminant concentration in drinking water	C_w	contaminant-specific		mg/L	ECF-200PO1-09-2027
Exposure Time	ET	0.580	--	hours/day	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	--	yr	Harris et al, 2004
Averaging Time	AT	70	--	yr	Harris et al, 2004
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Inhalation Reference Concentration	RfC_i	Chemical Specific		mg/m^3	EPA 2009a
Inhalation Unit Risk	IUR	Chemical Specific		$(\mu g/m^3)^{-1}$	EPA 2009a
Conversion Factor	CF1	365		days/year	EPA 2009b
Conversion Factor	CF2	0.042		1day/24 hours	EPA 2009b

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009a EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

U.S. EPA 2009b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (noncarcinogen) (mg/m^3)	RfC[a] (mg/m^3)	HQ (unitless)	% Contribution
Acetone	67-64-1	Yes	0.0011	1.33E-05	3.10E+01	4.29E-07	0.14
Arsenic	7440-38-2	--	0.005767892	--(b)	1.50E-05	--(b)	
Barium	7440-39-3	--	0.049451657	--(b)	5.00E-04	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.00028	3.38E-06	1.90E-01	1.78E-05	6
Chloride	16887-00-6	--	12.545114	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.0023	2.78E-05	9.80E-02	2.84E-04	94
Chromium	7440-47-3	--	0.0141	--(b)	--	--(b)	
Copper	7440-50-8	--	0.00597989	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.30621978	--(b)	1.30E-02	--(b)	
Iron	7439-89-6	--	0.61057915	--(b)	--	--(b)	
Lead	7439-92-1	--	0.000663667	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.040717647	--(b)	5.00E-05	--(b)	
Nickel	7440-02-0	--	0.0056	--(b)	9.00E-05	--(b)	
Nitrate	14797-55-8	--	28.952	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.46	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.38963943	--(b)	--	--(b)	
Sulfate	14808-79-8	--	41.899078	--(b)	--	--(b)	
Thallium	7440-28-0	--	0.00037	--(b)	--	--(b)	
Uranium	7440-61-1	--	0.005491757	--(b)	3.00E-04	--(b)	
Vanadium	7440-62-2	--	0.0168	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.006671161	--(b)	--	--(b)	
Total						3.02E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC[a]	C_w 90th Percentile (mg/L)	CDI (cancer) $\mu g/m^3$	IUR[a] $(\mu g/m^3)^{-1}$	Risk (unitless)	% Contribution
Acetone	67-64-1	Yes	0.0011	1.33E-02	--	--	
Arsenic	7440-38-2	--	0.005767892	--(b)	4.30E-03	--(b)	
Barium	7440-39-3	--	0.049451657	--(b)	--	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.00028	3.38E-03	1.50E-05	5.08E-08	7
Chloride	16887-00-6	--	12.545114	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.0023	2.78E-02	2.30E-05	6.39E-07	93
Chromium	7440-47-3	--	0.0141	--(b)	--	--(b)	
Copper	7440-50-8	--	0.00597989	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.30621978	--(b)	--	--(b)	
Iron	7439-89-6	--	0.61057915	--(b)	--	--(b)	
Lead	7439-92-1	--	0.000663667	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.040717647	--(b)	--	--(b)	
Nickel	7440-02-0	--	0.0056	--(b)	2.60E-04	--(b)	
Nitrate	14797-55-8	--	28.952	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.46	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.38963943	--(b)	--	--(b)	
Sulfate	14808-79-8	--	41.899078	--(b)	--	--(b)	
Thallium	7440-28-0	--	0.00037	--(b)	--	--(b)	
Uranium	7440-61-1	--	0.005491757	--(b)	--	--(b)	
Vanadium	7440-62-2	--	0.0168	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.006671161	--(b)	--	--(b)	
Total ELCR						6.90E-07	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--River exposure area - CTUIR

Dermal Absorption of Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	15	kg	Harris et al, 2004
Exposure Time	ET	0.58	1.0	hours/day	U.S. EPA, 2004
Exposure Time (Age-Adjusted)	ETadj	0.616		hours/day	Calculated using the age adjusted intake factors equation
Surface Area	SA	18,000	6,600	cm^2	Harris et al, 2004
Age-Adjusted Surface Area	SAadj	19,097		(cm^2-yr-event)/(kg-day)	Calculated using the age adjusted intake factors equation
Event Frequency	EV	1.0	1.0	Event/days	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Harris et al, 2004
Exposure Duration	ED	70	6.0	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Harris et al, 2004
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFO	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
Conversion Factor	CF2	365		days/year	365 days = 1 year
Conversion Factor	CF3	0.001		L/cm^3	1 L = 1000 cm^3
t*	Time to reach steady state	Chemical Specific		hours	EPA, 2004
B	Dermal Partitioning Constant	Chemical Specific		unitless	EPA, 2004
DA	Absorbed Dose per Event	Chemical Specific		(mg/cm^2-event)	Calculated using dermal exposure to groundwater equations as provided by U.S. EPA, 2004
Kp	Dermal Permeability Constant	Chemical Specific		cm/hour	EPA, 2004
FA	Fraction Absorbed	Chemical Specific		unitless	EPA, 2004
τ	Lag Time	Chemical Specific		hours	EPA, 2004

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Absorbed Dermal Dose Calculation

Contaminant of Potential Concern	CAS #	Cw (mg/L)	inorganic/organic[a]	FA[b] (unitless)	K_p[a] (cm/hour)	B[b] (unitless)	τ[b] (hours/event)	t*[b] (hours)	DA (noncancer) (mg/cm^2-event)	DA (cancer) (mg/cm^2-event)
Acetone[c]	67-64-1	0.0011	--	--	0.000512	--	--	--	--	--
Arsenic	7440-38-2	0.005767892	INORGANIC	--	0.001	--	--	--	3.35E-09	3.55E-09
Barium	7440-39-3	0.049451657	INORGANIC	--	0.001	--	--	--	2.87E-08	3.05E-08
Carbon tetrachloride	56-23-5	0.00028	--	1	0.016	0.1	0.78	1.86	8.33E-09	8.58E-09
Chlonde	16887-00-6	12.545114	INORGANIC	--	0.001	--	--	--	7.28E-06	7.73E-06
Chloroform	67-66-3	0.0023	--	1	0.0068	0	0.5	1.19	2.33E-08	2.40E-08
Chromium	7440-47-3	0.0141	INORGANIC	--	0.001	--	--	--	8.18E-09	8.69E-09
Copper	7440-50-8	0.00597989	INORGANIC	--	0.001	--	--	--	3.47E-09	3.68E-09
Fluoride	16984-48-8	0.30621978	INORGANIC	--	0.001	--	--	--	1.78E-07	1.89E-07
Iron	7439-89-6	0.61057915	INORGANIC	--	0.001	--	--	--	3.54E-07	3.76E-07
Lead	7439-92-1	0.000663667	INORGANIC	--	0.0001	--	--	--	3.85E-11	4.09E-11
Manganese	7439-96-5	0.040717647	INORGANIC	--	0.001	--	--	--	2.36E-08	2.51E-08
Nickel	7440-02-0	0.0056	INORGANIC	--	0.0002	--	--	--	6.50E-10	6.90E-10
Nitrate	14797-55-8	28.952	INORGANIC	--	0.001	--	--	--	1.68E-05	1.78E-05
Nitrite	14797-65-0	0.46	INORGANIC	--	0.001	--	--	--	2.67E-07	2.83E-07
Strontium	7440-24-6	0.38963943	INORGANIC	--	0.001	--	--	--	2.26E-07	2.40E-07
Sulfate	14808-79-8	41.899078	INORGANIC	--	0.001	--	--	--	2.43E-05	2.58E-05
Thallium	7440-28-0	0.00037	INORGANIC	--	0.001	--	--	--	2.15E-10	2.28E-10
Uranium	7440-61-1	0.005491757	INORGANIC	--	0.001	--	--	--	3.19E-09	3.38E-09
Vanadium	7440-62-2	0.0168	INORGANIC	--	0.001	--	--	--	9.74E-09	1.03E-08
Zinc	7440-66-6	0.006671161	INORGANIC	--	0.0006	--	--	--	2.32E-09	2.47E-09

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

[a] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2

[b] EPA/540/R/99/005 Exhibit B-3

[c] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDi (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone	67-64-1	0.0011	--	9.00E-01	1	--	
Arsenic	7440-38-2	0.005767892	8.60E-07	3.00E-04	1	0.0029	18
Barium	7440-39-3	0.049451657	7.38E-06	2.00E-01	0.07	5.27E-04	3.2
Carbon tetrachloride	56-23-5	0.00028	2.14E-06	7.00E-04	1	0.0031	18.75
Chloride	16887-00-6	12.545114	1.87E-03	--	1	--	
Chloroform	67-66-3	0.0023	5.99E-06	1.00E-02	1	5.99E-04	3.6683
Chromium	7440-47-3	0.0141	2.10E-06	1.50E+00	0.013	1.08E-04	0.66
Copper	7440-50-8	0.00597989	8.92E-07	4.00E-02	1	2.23E-05	0.14
Fluoride	16984-48-8	0.30621978	4.57E-05	6.00E-02	1	7.61E-04	4.7
Iron	7439-89-6	0.61057915	9.11E-05	7.00E-01	1	1.30E-04	0.8
Lead	7439-92-1	0.000663667	9.90E-09	--	1	--	
Manganese	7439-96-5	0.040717647	6.07E-06	2.40E-02	0.04	0.0063	39
Nickel	7440-02-0	0.0056	1.67E-07	2.00E-02	0.04	2.09E-04	1.3
Nitrate	14797-55-8	28.952	4.32E-03	7.10E+00	1	6.08E-04	3.7
Nitrite	14797-65-0	0.46	6.86E-05	3.00E-01	1	2.29E-04	1.4
Strontium	7440-24-6	0.38963943	5.81E-05	6.00E-01	1	9.69E-05	0.59
Sulfate	14808-79-8	41.899078	6.25E-03	--	--	--	
Thallium	7440-28-0	0.00037	5.52E-08	--	1	--	
Uranium	7440-61-1	0.005491757	8.19E-07	3.00E-03	1	2.73E-04	1.7
Vanadium	7440-62-2	0.0168	2.51E-06	5.00E-03	1	5.01E-04	3.1
Zinc	7440-66-6	0.006671161	5.97E-07	3.00E-01	1	1.99E-06	0.012
Total						0.016	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
Acetone	67-64-1	0.0011	--	--	1	--	
Arsenic	7440-38-2	0.005767892	9.69E-07	1.50E+00	1	1.45E-06	74
Barium	7440-39-3	0.049451657	8.31E-06	--	0.07	--	
Carbon tetrachloride	56-23-5	0.00028	2.34E-06	1.30E-01	1	3.04E-07	16
Chloride	16887-00-6	12.545114	2.11E-03	--	1	--	
Chloroform	67-66-3	0.0023	6.55E-06	3.10E-02	1	2.03E-07	10.3
Chromium	7440-47-3	0.0141	2.37E-06	--	0.013	--	
Copper	7440-50-8	0.00597989	1.00E-06	--	1	--	
Fluoride	16984-48-8	0.30621978	5.15E-05	--	1	--	
Iron	7439-89-6	0.61057915	1.03E-04	--	1	--	
Lead	7439-92-1	0.000663667	1.12E-08	--	1	--	
Manganese	7439-96-5	0.040717647	6.84E-06	--	0.04	--	
Nickel	7440-02-0	0.0056	1.88E-07	--	0.04	--	
Nitrate	14797-55-8	28.952	4.87E-03	--	1	--	
Nitrite	14797-65-0	0.46	7.73E-05	--	1	--	
Strontium	7440-24-6	0.38963943	6.55E-05	--	1	--	
Sulfate	14808-79-8	41.899078	7.04E-03	--	--	--	
Thallium	7440-28-0	0.00037	6.22E-08	--	1	--	
Uranium	7440-61-1	0.005491757	9.23E-07	--	1	--	
Vanadium	7440-62-2	0.0168	2.82E-06	--	1	--	
Zinc	7440-66-6	0.006671161	6.73E-07	--	1	--	
Total ELCR						1.96E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--River exposure area - CTUIR

Inhalation of Volatile Radioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Factor	Symbol	Adult	Child	Unit	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Harris et al, 2004
Exposure duration	ED	70	6	years	Harris et al, 2004
Inhalation Rate	INH_a	25	15	m^3/day	Harris, 2008
Exposure time	ET	0.58	1	hr/day	U.S. EPA, 2004
Age Adjusted Exposure Time	ET_{adj}	0.616		hrs	Calculated using the age adjusted intake factors equation
Radiation Age-adjusted inhalation rate	INH_RAD_{adj}	1690		m^3-yr/day	Calculated using the age adjusted intake factors equation
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991b
Radiation Inhalation of Volatiles Slope Factor	Sfi	Chemical Specific		risk/pCi	U.S. EPA, 1997

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways .*

Harris, S., 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments .*

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

Inhalation of Volatile Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	VOC[a]	Cw (pCi/L)	CDI (radiological inhalation) (pCi)	SF_i (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	2.8	--(b)	--	--(b)	
Gross beta	12587-47-2	--	22.2	--(b)	--	--(b)	
Strontium-90	10098-97-2	--	2.60	--(b)	1.05E-10	--(b)	
Technetium-99	14133-76-7	--	115	--(b)	1.41E-11	--(b)	
Tritium	10028-17-8	Yes	59,534	4.71E+08	5.62E-14	2.65E-05	100
Total ELCR						2.65E-05	100

[a] Radiological contaminants considered volatile for the groundwater inhalation pathway are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--River exposure area - CTUIR

Ingestion of Radioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Factor	Symbol	Unit		Value	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Harris et al, 2004
Exposure duration	ED	70	6	years	Harris et al, 2004
Drinking Water Ingestion Rate	IRW	4	1	L/day	Harris, 2008
Radiation Age-adjusted drinking water ingestion rate	IRW_RAD_{adj}	262		L-yr/day	Calculated using the age adjusted intake factors equation
Radiation Ingestion of Water Slope Factor	Sfo	Chemical Specific		risk/pCi	U.S. EPA, 1997

Harris, S, and B. Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

Harris, S., 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

Ingestion of Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	Cw (pCi/L)	)I (radiological ingestio (pCi)	SF_o (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	2.8	265,156	--	--	
Gross beta	12587-47-2	22.2	2.12E+06	--	--	
Strontium-90	10098-97-2	2.60	2.49E+05	5.59E-11	1.39E-05	4
Technetium-99	14133-76-7	115	1.10E+07	2.75E-12	3.02E-05	9
Tritium	10028-17-8	59,534	5.69E+09	5.07E-14	2.89E-04	86.8
Total ELCR					3.33E-04	100

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Native American Risk Assessment (10-Year)--Summary of Yakima Nation Drinking Water Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	ontaminant Concentration in Groundwat C_w (mg/L)	VOC?	HQ (Inhalation) (unitless)	HQ (Ingestion) (unitless)	HQ (Dermal) (unitless)	Total HI (unitless)	% Contribution
(m+p)-Xylene	0.0005	Yes	8.63E-06	1.43E-04	4.65E-05	1.98E-04	0.0069
1,1,1-Trichloroethane	0.001204711	Yes	2.91E-06	3.44E-05	3.28E-06	4.06E-05	0.0014
1,1-Dichloroethane	0.000389235	Yes	6.72E-06	1.11E-04	4.35E-06	1.22E-04	0.0043
1,1-Dichloroethene	0.000164225	Yes	9.92E-06	1.88E-04	1.30E-05	2.11E-04	0.0074
1,2-Dichlorobenzene	0.003	Yes	1.81E-04	1.90E-03	6.23E-04	2.71E-03	0.095
1,2-Dichloroethane	0.000305426	Yes	1.54E-06	8.73E-04	2.14E-05	8.96E-04	0.031
1,4-Dichlorobenzene	0.000130994	Yes	1.98E-06	1.07E-04	3.58E-05	1.45E-04	0.0051
1,4-Dioxane	0.0081	--	--(b)	4.63E-03	8.31E-06	4.64E-03	0.16
2-Butanone	0.0029	Yes	7.01E-06	2.76E-04	1.31E-06	2.85E-04	0.0100
2-Pentanone, 4-Methyl	0.00064	Yes	2.58E-06	4.57E-04	7.30E-06	4.67E-04	0.016
Acetone	0.00128316	Yes	5.00E-07	8.15E-05	--	8.20E-05	0.0029
Aluminum	0.041755539	--	--(b)	2.39E-03	6.23E-06	2.39E-03	0.084
Arsenic	0.003060574	--	--(b)	5.83E-01	1.52E-03	5.84E-01	20
Barium	0.068082679	--	--(b)	1.95E-02	7.25E-04	2.02E-02	0.71
Benzene	0.0019	Yes	7.65E-04	2.71E-02	2.08E-03	3.00E-02	1.05
Benzyl alcohol	0.0027	--	--(b)	1.54E-03	--	1.54E-03	0.054
Beryllium	0.000360659	--	--(b)	1.03E-02	3.84E-03	1.41E-02	0.50
Bis(2-ethylhexyl) phthalate	0.001271216	--	--(b)	3.63E-03	2.81E-03	6.44E-03	0.23
Cadmium	0.0045	--	--(b)	5.14E-01	2.68E-02	5.41E-01	19
Carbon disulfide	0.00039	Yes	6.73E-06	2.23E-04	1.97E-05	2.49E-04	0.0087
Carbon tetrachloride	0.000164414	Yes	1.05E-05	1.34E-02	1.80E-03	1.52E-02	0.53
Chloride	9.821328	--	--(b)	--	--	--	
Chlorobenzene	0.00041	Yes	9.91E-05	1.17E-03	2.11E-04	1.48E-03	0.052
Chloroform	0.00022061	Yes	2.72E-05	1.26E-03	5.74E-05	1.35E-03	0.047
Chromium	0.007505402	--	--(b)	2.86E-04	5.74E-05	3.43E-04	0.012
cis-1,2-Dichloroethylene	0.0002	Yes	--	1.14E-03	5.07E-05	1.19E-03	0.042
Copper	0.002993571	--	--(b)	4.28E-03	1.12E-05	4.29E-03	0.15
Fluoride	0.32861624	--	--(b)	3.13E-01	8.17E-04	3.14E-01	11.0
Iron	0.47301923	--	--(b)	3.86E-02	1.01E-04	3.87E-02	1.4
Lead	0.000710361	--	--(b)	--	--	--	
Lithium	0.0083	--	--(b)	2.37E-01	6.19E-04	2.38E-01	8.3
Manganese	0.011254937	--	--(b)	2.68E-02	1.75E-03	2.85E-02	1.00
Methanol	1.1	--	--(b)	1.26E-01	1.63E-04	1.26E-01	4.4
Methylene chloride	0.000852962	Yes	1.03E-05	8.12E-04	1.52E-05	8.38E-04	0.029
Molybdenum	0.0015	--	--(b)	1.71E-02	4.47E-05	1.72E-02	0.60
Nickel	0.003603478	--	--(b)	1.03E-02	1.34E-04	1.04E-02	0.37
Nitrate	23.756902	--	--(b)	1.91E-01	4.99E-04	1.92E-01	6.7
Nitrite	0.079227256	--	--(b)	1.51E-02	3.94E-05	1.51E-02	0.53
o-Xylene	0.000210551	Yes	3.63E-06	6.02E-05	1.99E-05	8.37E-05	0.0029
Silver	0.005341496	--	--(b)	6.10E-02	2.39E-03	6.34E-02	2.2
Strontium	0.36357229	--	--(b)	3.46E-02	9.04E-05	3.47E-02	1.2
Sulfate	45.069738	--	--(b)	--	--	--	
Tetrachloroethene	0.000993146	Yes	4.44E-05	5.68E-03	1.69E-03	7.41E-03	0.26
Toluene	0.000274725	Yes	6.64E-07	1.96E-04	3.41E-05	2.31E-04	0.0081
Tributyl phosphate	0.040836371	--	--(b)	1.17E-02	--	1.17E-02	0.41
Trichloroethene	0.000492361	Yes	1.70E-04	--	--	1.70E-04	0.0060
Trichloromonofluoromethane	0.00058	Yes	1.00E-05	1.10E-04	1.08E-05	1.31E-04	0.0046
Uranium	0.01625113	--	--(b)	3.10E-01	8.08E-04	3.10E-01	11
Vanadium	0.013487657	--	--(b)	1.54E-01	4.02E-04	1.55E-01	5.4
Vinyl chloride	0.0018	Yes	2.18E-04	3.43E-02	9.16E-04	3.54E-02	1.2
Zinc	0.10896358	--	--(b)	2.08E-02	3.25E-05	2.08E-02	0.73
Total			1.59E-03	2.80	0.05	2.85	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

HQ = hazard quotient.

HI = hazard index.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Native American Risk Assessment (10-Year)--Summary of Yakima Nation Drinking Water Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	ontaminant Concentration in Groundwat C_w (mg/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
(m+p)-Xylene	0.0005	Yes	--	--	--	--	
1,1,1-Trichloroethane	0.001204711	Yes	--	--	--	--	
1,1-Dichloroethane	0.000389235	Yes	--	--	--	--	
1,1-Dichloroethene	0.000164225	Yes	--	--	--	--	
1,2-Dichlorobenzene	0.003	Yes	--	--	--	--	
1,2-Dichloroethane	0.000305426	Yes	9.60E-08	1.75E-06	4.22E-08	1.89E-06	0.41
1,4-Dichlorobenzene	0.000130994	Yes	1.74E-08	4.45E-08	1.47E-08	7.66E-08	0.017
1,4-Dioxane	0.0081	--	--	5.61E-06	9.91E-09	5.62E-06	1.2
2-Butanone	0.0029	Yes	--	--	--	--	
2-Pentanone, 4-Methyl	0.00064	Yes	--	--	--	--	
Acetone	0.00128316	Yes	--	--	--	--	
Aluminum	0.041755539	--	--	--	--	--	
Arsenic	0.003060574	--	--	2.89E-04	7.65E-07	2.90E-04	63
Barium	0.068082679	--	--	--	--	--	
Benzene	0.0019	Yes	1.79E-07	6.58E-06	4.95E-07	7.25E-06	1.6
Benzyl alcohol	0.0027	--	--	--	--	--	
Beryllium	0.000360659	--	--	--	--	--	
Bis(2-ethylhexyl) phthalate	0.001271216	--	--	1.12E-06	8.52E-07	1.97E-06	0.43
Cadmium	0.0045	--	--	--	--	--	
Carbon disulfide	0.00039	Yes	--	--	--	--	
Carbon tetrachloride	0.000164414	Yes	2.98E-08	1.35E-06	1.77E-07	1.55E-06	0.34
Chloride	9.821328	--	--	--	--	--	
Chlorobenzene	0.00041	Yes	--	--	--	--	
Chloroform	0.00022061	Yes	6.13E-08	4.31E-07	1.93E-08	5.11E-07	0.11

Chromium	0.007505402	--	--	--	--	--	
cis-1,2-Dichloroethylene	0.0002	Yes	--	--	--	--	
Copper	0.002993571	--	--	--	--	--	
Fluoride	0.32861624	--	--	--	--	--	
Iron	0.47301923	--	--	--	--	--	
Lead	0.000710361	--	--	--	--	--	
Lithium	0.0083	--	--	--	--	--	
Manganese	0.011254937	--	--	--	--	--	
Methanol	1.1	--	--	--	--	--	
Methylene chloride	0.000852962	Yes	4.84E-09	4.03E-07	7.43E-09	4.15E-07	0.090
Molybdenum	0.0015	--	--	--	--	--	
Nickel	0.003603478	--	--	--	--	--	
Nitrate	23.756902	--	--	--	--	--	
Nitrite	0.079227256	--	--	--	--	--	
o-Xylene	0.000210551	Yes	--	--	--	--	
Silver	0.005341496	--	--	--	--	--	
Strontium	0.36357229	--	--	--	--	--	
Sulfate	45.069738	--	--	--	--	--	
Tetrachloroethene	0.000993146	Yes	7.08E-08	3.38E-05	9.91E-06	4.37E-05	9.4
Toluene	0.000274725	Yes	--	--	--	--	
Tributyl phosphate	0.040836371	--	--	2.37E-05	--	2.37E-05	5.1
Trichloroethene	0.000492361	Yes	1.49E-07	2.76E-06	2.35E-07	3.14E-06	0.68
Trichloromonofluoromethane	0.00058	Yes	--	--	--	--	
Uranium	0.01625113	--	--	--	--	--	
Vanadium	0.013487657	--	--	--	--	--	
Vinyl chloride	0.0018	Yes	9.57E-08	8.16E-05	2.15E-06	8.38E-05	18
Zinc	0.10896358	--	--	--	--	--	
Total ELCR			7.04E-07	4.48E-04	1.47E-05	4.63E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Native American Risk Assessment (10-Year)--Summary of Yakima Nation Drinking Water Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	ontaminant Concentration in Groundwat C_w (pCi/L)	Volatile?[a]	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Total Risk (unitless)	% Contribution
Carbon-14	15.2	--	--(b)	2.30E-06	2.30E-06	0.084
Gross alpha	5.9880167	--	--(b)	--	--	
Gross beta	26.717649	--	--(b)	--	--	
Iodine-129	1.7529182	--	--(b)	2.54E-05	2.54E-05	0.92
Nickel-63	7.66125	--	--(b)	5.02E-07	5.02E-07	0.018
Protactinium-231	0.308	--	--(b)	5.21E-06	5.21E-06	0.19
Strontium-90	0.611	--	--(b)	3.34E-06	3.34E-06	0.12
Technetium-99	75.671084	--	--(b)	2.04E-05	2.04E-05	0.74
Tritium	497899.63	Yes	2.31E-04	2.47E-03	2.70E-03	98
Total ELCR			2.31E-04	2.53E-03	2.76E-03	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area - Yakima Nation

Ingestion of Nonradioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Ingestion Chronic Daily Intake	CDI	calculated		mg/kg-day	EPA 1989
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	16	kg	Ridolfi, 2007
Drinking Water Ingestion Rate	IRW	4	2	Liters/day	Ridolfi, 2007
Age-Adjusted Drinking Water Ingestion Rate	IRWadj	4.407		L-yr/kg-day	Calculated using the age adjusted intake factors equation
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	6	yr	Ridolfi, 2007
Averaging time	AT	70	--	yr	Ridolfi, 2007
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFO	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 1989

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	HQ (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	0.0005	2.86E-05	2.00E-01	1.43E-04	0.0051
1,1,1-Trichloroethane	71-55-6	0.001204711	6.88E-05	2.00E+00	3.44E-05	0.0012
1,1-Dichloroethane	75-34-3	0.000389235	2.22E-05	2.00E-01	1.11E-04	0.0040
1,1-Dichloroethene	75-35-4	0.000164225	9.38E-06	5.00E-02	1.88E-04	0.0067
1,2-Dichlorobenzene	95-50-1	0.003	1.71E-04	9.00E-02	1.90E-03	0.068
1,2-Dichloroethane	107-06-2	0.000305426	1.75E-05	2.00E-02	8.73E-04	0.031
1,4-Dichlorobenzene	106-46-7	0.000130994	7.49E-06	7.00E-02	1.07E-04	0.0038
1,4-Dioxane	123-91-1	0.0081	4.63E-04	1.00E-01	4.63E-03	0.17
2-Butanone	78-93-3	0.0029	1.66E-04	6.00E-01	2.76E-04	0.0099
2-Pentanone, 4-Methyl	108-10-1	0.00064	3.66E-05	8.00E-02	4.57E-04	0.016
Acetone	67-64-1	0.00128316	7.33E-05	9.00E-01	8.15E-05	0.0029
Aluminum	7429-90-5	0.041755539	2.39E-03	1.00E+00	2.39E-03	0.085
Arsenic	7440-38-2	0.003060574	1.75E-04	3.00E-04	5.83E-01	21
Barium	7440-39-3	0.068082679	3.89E-03	2.00E-01	1.95E-02	0.69
Benzene	71-43-2	0.0019	1.09E-04	4.00E-03	2.71E-02	0.97
Benzyl alcohol	100-51-6	0.0027	1.54E-04	1.00E-01	1.54E-03	0.055
Beryllium	7440-41-7	0.000360659	2.06E-05	2.00E-03	1.03E-02	0.37
Bis(2-ethylhexyl) phthalate	117-81-7	0.001271216	7.26E-05	2.00E-02	3.63E-03	0.13
Cadmium	7440-43-9	0.0045	2.57E-04	5.00E-04	5.14E-01	18
Carbon disulfide	75-15-0	0.00039	2.23E-05	1.00E-01	2.23E-04	0.0080
Carbon tetrachloride	56-23-5	0.000164414	9.40E-06	7.00E-04	1.34E-02	0.48
Chloride	16887-00-6	9.821328	5.61E-01	--	--	
Chlorobenzene	108-90-7	0.00041	2.34E-05	2.00E-02	1.17E-03	0.042
Chloroform	67-66-3	0.00022061	1.26E-05	1.00E-02	1.26E-03	0.045
Chromium	7440-47-3	0.007505402	4.29E-04	1.50E+00	2.86E-04	0.010
cis-1,2-Dichloroethylene	156-59-2	0.0002	1.14E-05	1.00E-02	1.14E-03	0.041
Copper	7440-50-8	0.002993571	1.71E-04	4.00E-02	4.28E-03	0.15
Fluoride	16984-48-8	0.32861624	1.88E-02	6.00E-02	3.13E-01	11
Iron	7439-89-6	0.47301923	2.70E-02	7.00E-01	3.86E-02	1.4
Lead	7439-92-1	0.000710361	4.06E-05	--	--	
Lithium	7439-93-2	0.0083	4.74E-04	2.00E-03	2.37E-01	8.5
Manganese	7439-96-5	0.011254937	6.43E-04	2.40E-02	2.68E-02	0.96
Methanol	67-56-1	1.1	6.29E-02	5.00E-01	1.26E-01	4.5
Methylene chloride	75-09-2	0.000852962	4.87E-05	6.00E-02	8.12E-04	0.029
Molybdenum	7439-98-7	0.0015	8.57E-05	5.00E-03	1.71E-02	0.61
Nickel	7440-02-0	0.003603478	2.06E-04	2.00E-02	1.03E-02	0.37
Nitrate	14797-55-8	23.756902	1.36E+00	7.10E+00	1.91E-01	6.8
Nitrite	14797-65-0	0.079227256	4.53E-03	3.00E-01	1.51E-02	0.54
o-Xylene	95-47-6	0.000210551	1.20E-05	2.00E-01	6.02E-05	0.0021
Silver	7440-22-4	0.005341496	3.05E-04	5.00E-03	6.10E-02	2.2
Strontium	7440-24-6	0.36357229	2.08E-02	6.00E-01	3.46E-02	1.2
Sulfate	14808-79-8	45.069738	2.58E+00	--	--	
Tetrachloroethene	127-18-4	0.000993146	5.68E-05	1.00E-02	5.68E-03	0.20
Toluene	108-88-3	0.000274725	1.57E-05	8.00E-02	1.96E-04	0.0070
Tributyl phosphate	126-73-8	0.040836371	2.33E-03	2.00E-01	1.17E-02	0.42
Trichloroethene	79-01-6	0.000492361	2.81E-05	--	--	
Trichloromonofluoromethane	75-69-4	0.00058	3.31E-05	3.00E-01	1.10E-04	0.0039
Uranium	7440-61-1	0.01625113	9.29E-04	3.00E-03	3.10E-01	11
Vanadium	7440-62-2	0.013487657	7.71E-04	5.00E-03	1.54E-01	5.5
Vinyl chloride[b]	75-01-4	0.0018	1.03E-04	3.00E-03	3.43E-02	1.2
Zinc	7440-66-6	0.10896358	6.23E-03	3.00E-01	2.08E-02	0.74
Total					3	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b]For the purposed of this exercise, the mutagenic exposure equations where not used for vinyl chloride

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	Risk (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	0.0005	3.15E-05	--	--	
1,1,1-Trichloroethane	71-55-6	0.001204711	7.58E-05	--	--	
1,1-Dichloroethane	75-34-3	0.000389235	2.45E-05	--	--	
1,1-Dichloroethene	75-35-4	0.000164225	1.03E-05	--	--	
1,2-Dichlorobenzene	95-50-1	0.003	1.89E-04	--	--	
1,2-Dichloroethane	107-06-2	0.000305426	1.92E-05	9.10E-02	1.75E-06	0.39
1,4-Dichlorobenzene	106-46-7	0.000130994	8.25E-06	5.40E-03	4.45E-08	0.0099

1,4-Dioxane	123-91-1	0.0081	5.10E-04	1.10E-02	5.61E-06	1.3
2-Butanone	78-93-3	0.0029	1.83E-04	--	--	
2-Pentanone, 4-Methyl	108-10-1	0.00064	4.03E-05	--	--	
Acetone	67-64-1	0.00128316	8.08E-05	--	--	
Aluminum	7429-90-5	0.041755539	2.63E-03	--	--	
Arsenic	7440-38-2	0.003060574	1.93E-04	1.50E+00	2.89E-04	65
Barium	7440-39-3	0.068082679	4.29E-03	--	--	
Benzene	71-43-2	0.0019	1.20E-04	5.50E-02	6.58E-06	1.5
Benzyl alcohol	100-51-6	0.0027	1.70E-04	--	--	
Beryllium	7440-41-7	0.000360659	2.27E-05	--	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.001271216	8.00E-05	1.40E-02	1.12E-06	0.25
Cadmium	7440-43-9	0.0045	2.83E-04	--	--	
Carbon disulfide	75-15-0	0.00039	2.46E-05	--	--	
Carbon tetrachloride	56-23-5	0.000164414	1.04E-05	1.30E-01	1.35E-06	0.30
Chloride	16887-00-6	9.821328	6.18E-01	--	--	
Chlorobenzene	108-90-7	0.00041	2.58E-05	--	--	
Chloroform	67-66-3	0.00022061	1.39E-05	3.10E-02	4.31E-07	0.096
Chromium	7440-47-3	0.007505402	4.73E-04	--	--	
cis-1,2-Dichloroethylene	156-59-2	0.0002	1.26E-05	--	--	
Copper	7440-50-8	0.002993571	1.88E-04	--	--	
Fluoride	16984-48-8	0.32861624	2.07E-02	--	--	
Iron	7439-89-6	0.47301923	2.98E-02	--	--	
Lead	7439-92-1	0.000710361	4.47E-05	--	--	
Lithium	7439-93-2	0.0083	5.23E-04	--	--	
Manganese	7439-96-5	0.011254937	7.09E-04	--	--	
Methanol	67-56-1	1.1	6.93E-02	--	--	
Methylene chloride	75-09-2	0.000852962	5.37E-05	7.50E-03	4.03E-07	0.090
Molybdenum	7439-98-7	0.0015	9.44E-05	--	--	
Nickel	7440-02-0	0.003603478	2.27E-04	--	--	
Nitrate	14797-55-8	23.756902	1.50E+00	--	--	
Nitrite	14797-65-0	0.079227256	4.99E-03	--	--	
o-Xylene	95-47-6	0.000210551	1.33E-05	--	--	
Silver	7440-22-4	0.005341496	3.36E-04	--	--	
Strontium	7440-24-6	0.36357229	2.29E-02	--	--	
Sulfate	14808-79-8	45.069738	2.84E+00	--	--	
Tetrachloroethene	127-18-4	0.000993146	6.25E-05	5.40E-01	3.38E-05	7.5
Toluene	108-88-3	0.000274725	1.73E-05	--	--	
Tributyl phosphate	126-73-8	0.040836371	2.57E-03	9.20E-03	2.37E-05	5.3
Trichloroethene	79-01-6	0.000492361	3.10E-05	8.90E-02	2.76E-06	0.62
Trichloromonofluoromethane	75-69-4	0.00058	3.65E-05	--	--	
Uranium	7440-61-1	0.01625113	1.02E-03	--	--	
Vanadium	7440-62-2	0.013487657	8.49E-04	--	--	
Vinyl chloride[b]	75-01-4	0.0018	1.13E-04	7.20E-01	8.16E-05	18
Zinc	7440-66-6	0.10896358	6.86E-03	--	--	
Total ELCR					4.48E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b]For the purposed of this exercise, the mutagenic exposure equations where not used for vinyl chloride

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area - Yakima Nation

Inhalation of Volatile Nonradioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Inhalation Chronic Daily Intake	CDI	calculated		mg/m^3 for noncarcinogens, $\mu g/m^3$ for carcinogens	EPA 2009b
Contaminant concentration in drinking water	C_w	contaminant-specific		mg/L	ECF-200PO1-09-2027
Exposure Time	ET	0.580	--	hours/day	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	--	yr	Ridolfi, 2007
Averaging Time	AT	70	--	yr	Ridolfi, 2007
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Inhalation Reference Concentration	RfC_i	Chemical Specific		mg/m^3	EPA 2009a
Inhalation Unit Risk	IUR	Chemical Specific		$(\mu g/m^3)^{-1}$	EPA 2009a
Conversion Factor	CF1	365		days/year	EPA 2009b
Conversion Factor	CF2	0.042		1day/24 hours	EPA 2009b

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009a EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

U.S. EPA 2009b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (noncarcinogen) (mg/m^3)	RfC[a] (mg/m^3)	HQ (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	Yes	0.0005	6.04E-06	7.00E-01	8.63E-06	0.54
1,1,1-Trichloroethane	71-55-6	Yes	0.001204711	1.46E-05	5.00E+00	2.91E-06	0.18
1,1-Dichloroethane	75-34-3	Yes	0.000389235	4.70E-06	7.00E-01	6.72E-06	0.42
1,1-Dichloroethene	75-35-4	Yes	0.000164225	1.98E-06	2.00E-01	9.92E-06	0.62
1,2-Dichlorobenzene	95-50-1	Yes	0.003	3.63E-05	2.00E-01	1.81E-04	11
1,2-Dichloroethane	107-06-2	Yes	0.000305426	3.69E-06	2.40E+00	1.54E-06	0.097
1,4-Dichlorobenzene	106-46-7	Yes	0.000130994	1.58E-06	8.00E-01	1.98E-06	0.12
1,4-Dioxane	123-91-1	--	0.0081	--(b)	3.60E+00	--(b)	
2-Butanone	78-93-3	Yes	0.0029	3.50E-05	5.00E+00	7.01E-06	0.44
2-Pentanone, 4-Methyl	108-10-1	Yes	0.00064	7.73E-06	3.00E+00	2.58E-06	0.16
Acetone	67-64-1	Yes	0.00128316	1.55E-05	3.10E+01	5.00E-07	0.031
Aluminum	7429-90-5	--	0.041755539	--(b)	5.00E-03	--(b)	
Arsenic	7440-38-2	--	0.003060574	--(b)	1.50E-05	--(b)	
Barium	7440-39-3	--	0.068082679	--(b)	5.00E-04	--(b)	
Benzene	71-43-2	Yes	0.0019	2.30E-05	3.00E-02	7.65E-04	48
Benzyl alcohol	100-51-6	--	0.0027	--(b)	--	--(b)	
Beryllium	7440-41-7	--	0.000360659	--(b)	2.00E-05	--(b)	
Bis(2-ethylhexyl) phthalate	117-81-7	--	0.001271216	--(b)	--	--(b)	
Cadmium	7440-43-9	--	0.0045	--(b)	1.00E-05	--(b)	
Carbon disulfide	75-15-0	Yes	0.00039	4.71E-06	7.00E-01	6.73E-06	0.42
Carbon tetrachloride	56-23-5	Yes	0.000164414	1.99E-06	1.90E-01	1.05E-05	0.66
Chloride	16887-00-6	--	9.821328	--(b)	--	--(b)	
Chlorobenzene	108-90-7	Yes	0.00041	4.95E-06	5.00E-02	9.91E-05	6.2
Chloroform	67-66-3	Yes	0.00022061	2.67E-06	9.80E-02	2.72E-05	1.7
Chromium	7440-47-3	--	0.007505402	--(b)	--	--(b)	
cis-1,2-Dichloroethylene	156-59-2	Yes	0.0002	2.42E-06	--	--	
Copper	7440-50-8	--	0.002993571	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.32861624	--(b)	1.30E-02	--(b)	
Iron	7439-89-6	--	0.47301923	--(b)	--	--(b)	
Lead	7439-92-1	--	0.000710361	--(b)	--	--(b)	
Lithium	7439-93-2	--	0.0083	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.011254937	--(b)	5.00E-05	--(b)	
Methanol	67-56-1	--	1.1	--(b)	4.00E+00	--(b)	
Methylene chloride	75-09-2	Yes	0.000852962	1.03E-05	1.00E+00	1.03E-05	0.65
Molybdenum	7439-98-7	--	0.0015	--(b)	--	--(b)	
Nickel	7440-02-0	--	0.003603478	--(b)	9.00E-05	--(b)	
Nitrate	14797-55-8	--	23.756902	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.079227256	--(b)	--	--(b)	
o-Xylene	95-47-6	Yes	0.000210551	2.54E-06	7.00E-01	3.63E-06	0.23
Silver	7440-22-4	--	0.005341496	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.36357229	--(b)	--	--(b)	
Sulfate	14808-79-8	--	45.069738	--(b)	--	--(b)	
Tetrachloroethene	127-18-4	Yes	0.000993146	1.20E-05	2.70E-01	4.44E-05	2.8
Toluene	108-88-3	Yes	0.000274725	3.32E-06	5.00E+00	6.64E-07	0.042
Tributyl phosphate	126-73-8	--	0.040836371	--(b)	--	--(b)	
Trichloroethene	79-01-6	Yes	0.000492361	5.95E-06	3.50E-02	1.70E-04	11
Trichloromonofluoromethane	75-69-4	Yes	0.00058	7.01E-06	7.00E-01	1.00E-05	0.63
Uranium	7440-61-1	--	0.01625113	--(b)	3.00E-04	--(b)	
Vanadium	7440-62-2	--	0.013487657	--(b)	--	--(b)	
Vinyl chloride[c]	75-01-4	Yes	0.0018	2.18E-05	1.00E-01	2.18E-04	14
Zinc	7440-66-6	--	0.10896358	--(b)	--	--(b)	
Total						1.59E-03	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

[c] For the purposed of this exercise, the mutagenic exposure equations where not used for vinyl chloride

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (carcinogen) ($\mu g/m^3$)	IUR[a] $(\mu g/m^3)^{-1}$	Risk (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	Yes	0.0005	6.04E-03	--	--	--
1,1,1-Trichloroethane	71-55-6	Yes	0.001204711	1.46E-02	--	--	--
1,1-Dichloroethane	75-34-3	Yes	0.000389235	4.70E-03	--	--	--
1,1-Dichloroethene	75-35-4	Yes	0.000164225	1.98E-03	--	--	--
1,2-Dichlorobenzene	95-50-1	Yes	0.003	3.63E-02	--	--	--
1,2-Dichloroethane	107-06-2	Yes	0.000305426	3.69E-03	2.60E-05	9.60E-08	3.54E-10
1,4-Dichlorobenzene	106-46-7	Yes	0.000130994	1.58E-03	1.10E-05	1.74E-08	2.76E-11
1,4-Dioxane	123-91-1	--	0.0081	--(b)	7.70E-06	--	--
2-Butanone	78-93-3	Yes	0.0029	3.50E-02	--	--	--
2-Pentanone, 4-Methyl	108-10-1	Yes	0.00064	7.73E-03	--	--	--
Acetone	67-64-1	Yes	0.00128316	1.55E-02	--	--	--
Aluminum	7429-90-5	--	0.041755539	--(b)	--	--	--
Arsenic	7440-38-2	--	0.003060574	--(b)	4.30E-03	--	--
Barium	7440-39-3	--	0.068082679	--(b)	--	--	--
Benzene	71-43-2	Yes	0.0019	2.30E-02	7.80E-06	1.79E-07	4.11E-09
Benzyl alcohol	100-51-6	--	0.0027	--(b)	--	--	--
Beryllium	7440-41-7	--	0.000360659	--(b)	2.40E-03	--	--

Bis(2-ethylhexyl) phthalate	117-81-7	--	0.001271216	--(b)	2.40E-06	--	--
Cadmium	7440-43-9	--	0.0045	--(b)	1.80E-03	--	--
Carbon disulfide	75-15-0	Yes	0.00039	4.71E-03	--	--	--
Carbon tetrachloride	56-23-5	Yes	0.000164414	1.99E-03	1.50E-05	2.98E-08	5.92E-11
Chloride	16887-00-6	--	9.821328	--(b)	--	--	--
Chlorobenzene	108-90-7	Yes	0.00041	4.95E-03	--	--	--
Chloroform	67-66-3	Yes	0.00022061	2.67E-03	2.30E-05	6.13E-08	1.63E-10
Chromium	7440-47-3	--	0.007505402	--(b)	--	--	--
cis-1,2-Dichloroethylene	156-59-2	Yes	0.0002	2.42E-03	--	--	--
Copper	7440-50-8	--	0.002993571	--(b)	--	--	--
Fluoride	16984-48-8	--	0.32861624	--(b)	--	--	--
Iron	7439-89-6	--	0.47301923	--(b)	--	--	--
Lead	7439-92-1	--	0.000710361	--(b)	--	--	--
Lithium	7439-93-2	--	0.0083	--(b)	--	--	--
Manganese	7439-96-5	--	0.011254937	--(b)	--	--	--
Methanol	67-56-1	--	1.1	--(b)	--	--	--
Methylene chloride	75-09-2	Yes	0.000852962	1.03E-02	4.70E-07	4.84E-09	4.99E-11
Molybdenum	7439-98-7	--	0.0015	--(b)	--	--	--
Nickel	7440-02-0	--	0.003603478	--(b)	2.60E-04	--	--
Nitrate	14797-55-8	--	23.756902	--(b)	--	--	--
Nitrite	14797-65-0	--	0.079227256	--(b)	--	--	--
o-Xylene	95-47-6	Yes	0.000210551	2.54E-03	--	--	--
Silver	7440-22-4	--	0.005341496	--(b)	--	--	--
Strontium	7440-24-6	--	0.36357229	--(b)	--	--	--
Sulfate	14808-79-8	--	45.069738	--(b)	--	--	--
Tetrachloroethene	127-18-4	Yes	0.000993146	1.20E-02	5.90E-06	7.08E-08	8.50E-10
Toluene	108-88-3	Yes	0.000274725	3.32E-03	--	--	--
Tributyl phosphate	126-73-8	--	0.040836371	--(b)	--	--	--
Trichloroethene	79-01-6	Yes	0.000492361	5.95E-03	2.50E-05	1.49E-07	8.85E-10
Trichloromonofluoromethane	75-69-4	Yes	0.00058	7.01E-03	--	--	--
Uranium	7440-61-1	--	0.01625113	--(b)	--	--	--
Vanadium	7440-62-2	--	0.013487657	--(b)	--	--	--
Vinyl chloride[c]	75-01-4	Yes	0.0018	2.18E-02	4.40E-06	9.57E-08	2.08E-09
Zinc	7440-66-6	--	0.10896358	--(b)	--	--	--
Total ELCR						7.04E-07	0

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b]Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

[c] For the purposed of this exercise, the mutagenic exposure equations where not used for vinyl chloride

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area - Yakima Nation

Dermal Absorption of Nonradioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	16	kg	Ridolfi, 2007
Exposure Time	ET	0.58	1.0	hours/day	U.S. EPA, 2004
Exposure Time (Age-Adjusted)	ETadj	0.616		hours/day	Calculated using the age adjusted intake factors equation
Surface Area	SA	18,000	6,600	cm^2	Ridolfi, 2007
Age-Adjusted Surface Area	SAadj	18,932		(cm^2-yr-event)/(kg day)	Calculated using the age adjusted intake factors equation
Event Frequency	EV	1.0	1.0	Event/days	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	6.0	yr	Ridolfi, 2007
Averaging time	AT	70	--	yr	Ridolfi, 2007
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFO	Oral Cancer Slope Factor	Chemical Specific		(mg/kg-day)$^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA, 2004
CF3	Conversion Factor	0.001		L/cm^3	1 L = 1000 cm^3
t*	Time to reach steady state	Chemical Specific		hours	EPA, 2004
B	Dermal Partitioning Constant	Chemical Specific		unitless	EPA, 2004
DA	Absorbed Dose per Event	Chemical Specific		(mg/cm^2-event)	Calculated using dermal exposure to groundwater equations as provided by U.S. EPA, 2004
Kp	Dermal Permeability Constant	Chemical Specific		cm/hour	EPA, 2004
FA	Fraction Absorbed	Chemical Specific		unitless	EPA, 2004
t	Lag Time	Chemical Specific		hours	EPA, 2004

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals)

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Absorbed Dermal Dose Calculation

Contaminant of Potential Concern	CAS #	Cw (mg/L)	Inorganic/organic[a]	FA[b] (unitless)	K_p[a] (cm/hour)	B[a] (unitless)	t^*[a] (hours/event)	t^{*b} (hours)	DA (noncancer) (mg/cm^2-event)	DA (cancer) (mg/cm^2-event)
(m+p)-Xylene[f]	179601-23-1	0.0005	--	1.00E+00	0.053	0.2	0.42	1.01	3.62E-08	3.73E-08
1,1,1-Trichloroethane	71-55-6	0.001204711	--	1.00E+00	0.013	0.1	0.6	1.43	2.55E-08	2.63E-08
1,1-Dichloroethane	75-34-3	0.000389235	--	1.00E+00	0.0067	0	0.38	0.92	3.38E-09	3.49E-09
1,1-Dichloroethene	75-35-4	0.000164225	--	1.00E+00	0.012	0	0.37	0.89	2.52E-09	2.60E-09
1,2-Dichlorobenzene	95-50-1	0.003	--	1.00E+00	0.041	0.2	0.71	1.71	2.18E-07	2.25E-07
1,2-Dichloroethane	107-06-2	0.000305426	--	1.00E+00	0.0042	0	0.38	0.92	1.66E-09	1.72E-09
1,4-Dichlorobenzene	106-46-7	0.000130994	--	1.00E+00	0.042	0.2	0.71	1.71	9.76E-09	1.01E-08
1,4-Dioxane	123-91-1	0.0081	--	1.00E+00	0.00033	0	0.33	0.8	3.23E-09	3.33E-09
2-Butanone	78-93-3	0.0029	--	1.00E+00	0.00096	0	0.27	0.65	3.05E-09	3.14E-09
2-Pentanone, 4-Methyl	108-10-1	0.00064	--	1.00E+00	0.0027	0	0.39	0.93	2.27E-09	2.34E-09
Acetone[c]	67-64-1	0.00128316	--	--	0.000512	--	--	--	--	--
Aluminum	7429-90-5	0.041755539	INORGANIC	--	0.001	--	--	--	2.42E-08	2.57E-08
Arsenic	7440-38-2	0.003060574	INORGANIC	--	0.001	--	--	--	1.78E-09	1.89E-09
Barium	7440-39-3	0.068082679	INORGANIC	--	0.001	--	--	--	3.95E-08	4.19E-08
Benzene	71-43-2	0.0019	--	1.00E+00	0.015	0.1	0.29	0.7	3.23E-08	3.38E-08
Benzyl alcohol[c]	100-51-6	0.0027	--	--	0.00209	--	--	--	--	--
Beryllium	7440-41-7	0.000360659	INORGANIC	--	0.001	--	--	--	2.09E-10	2.22E-10
Bis(2-ethylhexyl) phthalate	117-81-7	0.001271216	--	8.00E-01	0.025	0.2	16.64	39.93	2.18E-07	2.25E-07
Cadmium	7440-43-9	0.0045	INORGANIC	--	0.001	--	--	--	2.61E-09	2.72E-09
Carbon disulfide	75-15-0	0.00039	--	1.00E+00	0.017	0.1	0.3	0.72	7.64E-09	7.88E-09
Carbon tetrachloride	56-23-5	0.000164414	--	1.00E+00	0.016	0.1	0.78	1.86	4.89E-09	5.04E-09
Chloride	16887-00-6	9.821328	INORGANIC	--	0.001	--	--	--	5.70E-06	6.05E-06
Chlorobenzene	108-90-7	0.00041	--	1.00E+00	0.028	0.1	0.46	1.09	1.64E-08	1.69E-08
Chloroform	67-66-3	0.00022061	--	1.00E+00	0.0068	0	0.5	1.19	2.23E-09	2.30E-09
Chromium	7440-47-3	0.007505402	INORGANIC	--	0.001	--	--	--	4.35E-09	4.62E-09
cis-1,2-Dichloroethylene[e]	156-59-2	0.0002	--	1.00E+00	0.0077	0	0.37	0.89	1.97E-09	2.03E-09
Copper	7440-50-8	0.002993571	INORGANIC	--	0.001	--	--	--	1.74E-09	1.84E-09
Fluoride	16984-48-8	0.32861624	INORGANIC	--	0.001	--	--	--	1.91E-07	2.02E-07
Iron	7439-89-6	0.47301923	INORGANIC	--	0.001	--	--	--	2.74E-07	2.91E-07
Lead	7439-92-1	0.000710361	INORGANIC	--	0.0001	--	--	--	4.12E-11	4.38E-11
Lithium	7439-93-2	0.0083	INORGANIC	--	0.001	--	--	--	4.81E-09	5.11E-09
Manganese	7439-96-5	0.011254937	INORGANIC	--	0.001	--	--	--	6.53E-09	6.93E-09
Methanol	67-56-1	1.1	--	1.00E+00	0.00032	0	0.16	0.39	3.17E-07	3.29E-07
Methylene chloride	75-09-2	0.000852962	--	1.00E+00	0.0035	0	0.32	0.76	3.55E-09	3.66E-09
Molybdenum	7439-98-7	0.0015	INORGANIC	--	0.001	--	--	--	8.70E-10	9.24E-10
Nickel	7440-02-0	0.003603478	INORGANIC	--	0.0002	--	--	--	4.18E-10	4.44E-10
Nitrate	14797-55-8	23.756902	INORGANIC	--	0.001	--	--	--	1.38E-05	1.46E-05
Nitrite	14797-65-0	0.079222756	INORGANIC	--	0.001	--	--	--	4.60E-08	4.88E-08
o-Xylene[f]	95-47-6	0.000210551	--	1.00E+00	0.024	0.2	0.42	1.01	1.55E-08	1.60E-08
Silver	7440-22-4	0.005341496	INORGANIC	--	0.0006	--	--	--	1.86E-09	1.97E-09
Strontium	7440-24-6	0.36357229	INORGANIC	--	0.001	--	--	--	2.11E-07	2.24E-07
Sulfate	14808-79-8	45.069738	INORGANIC	--	0.001	--	--	--	2.61E-05	2.78E-05
Tetrachloroethene	127-18-4	0.000993146	--	1.00E+00	0.033	0.2	0.91	2.18	6.58E-08	6.78E-08
Toluene	108-88-3	0.000274725	--	1.00E+00	0.031	0.1	0.35	0.84	1.06E-08	1.09E-08
Tributyl phosphate[c]	126-73-8	0.040836371	--	--	0.0228	--	--	--	--	--
Trichloroethene	79-01-6	0.000492361	--	1.00E+00	0.012	0.1	0.58	1.39	9.47E-09	9.76E-09
Trichloromonofluoromethane	75-69-4	0.00058	--	1.00E+00	0.013	0.1	0.63	1.51	1.26E-08	1.30E-08
Uranium	7440-61-1	0.016251113	INORGANIC	--	0.001	--	--	--	9.43E-09	1.00E-08
Vanadium	7440-62-2	0.013487657	INORGANIC	--	0.001	--	--	--	7.82E-09	8.31E-09
Vinyl chloride[d]	75-01-4	0.0018	--	1.00E+00	0.0056	0	0.24	0.57	1.07E-08	1.10E-08
Zinc	7440-66-6	0.10896358	INORGANIC	--	0.0006	--	--	--	3.79E-08	4.03E-08

[a] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2

[b] EPA/540/R/99/005 Exhibit B-3

[c] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

[d] for the purposed of this exercise, the mutagenic exposure equations where not used for vinyl chloride

[e] for cis-1,2- dichloroethylene the chemical-specific inputs are assumed to be the same as trans-1,2-dichloroethylene

[f] for (m+p) xylenes and o-xylene the chemical-specific inputs are assumed to be the same as m-xylene

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	GIABS[b] (unitless)	HQ (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	0.0005	9.30E-06	2.00E-01	1	4.65E-05	0.090
1,1,1-Trichloroethane	71-55-6	0.001204711	6.57E-06	2.00E+00	1	3.28E-06	0.0064
1,1-Dichloroethane	75-34-3	0.000389235	8.70E-07	2.00E-01	1	4.35E-06	0.0085
1,1-Dichloroethene	75-35-4	0.000164225	6.49E-07	5.00E-02	1	1.30E-05	0.025
1,2-Dichlorobenzene	95-50-1	0.003	5.61E-05	9.00E-02	1	6.23E-04	1.2
1,2-Dichloroethane	107-06-2	0.000305426	4.28E-07	2.00E-02	1	2.14E-05	0.042
1,4-Dichlorobenzene	106-46-7	0.000130994	2.51E-06	7.00E-02	1	3.58E-05	0.070
1,4-Dioxane	123-91-1	0.0081	8.31E-07	1.00E-01	1	8.31E-06	0.016
2-Butanone	78-93-3	0.0029	7.83E-07	6.00E-01	1	1.31E-06	0.0025
2-Pentanone, 4-Methyl	108-10-1	0.00064	5.84E-07	8.00E-02	1	7.30E-06	0.014
Acetone	67-64-1	0.00128316	--	9.00E-01	1	--	--
Aluminum	7429-90-5	0.041755539	6.23E-06	1.00E+00	1	6.23E-06	0.012
Arsenic	7440-38-2	0.003060574	4.56E-07	3.00E-04	1	1.52E-03	3.0
Barium	7440-39-3	0.068082679	1.02E-05	2.00E-01	0.07	7.25E-04	1.4
Benzene	71-43-2	0.0019	8.31E-06	4.00E-03	1	2.08E-03	4.0
Benzyl alcohol	100-51-6	0.0027	--	1.00E-01	1	--	--
Beryllium	7440-41-7	0.000360659	5.38E-08	2.00E-03	0.007	3.84E-03	7.5
Bis(2-ethylhexyl) phthalate	117-81-7	0.001271216	5.61E-05	2.00E-02	1	2.81E-03	5.5
Cadmium	7440-43-9	0.0045	6.71E-07	1.00E-04	0.05	2.68E-02	52
Carbon disulfide	75-15-0	0.00039	1.97E-06	1.00E-01	1	1.97E-05	0.038
Carbon tetrachloride	56-23-5	0.000164414	1.26E-06	7.00E-04	1	1.80E-03	3.5
Chloride	16887-00-6	9.821328	1.46E-03	--	1	--	--
Chlorobenzene	108-90-7	0.00041	4.21E-06	2.00E-02	1	2.11E-04	0.41
Chloroform	67-66-3	0.00022061	5.74E-07	1.00E-02	1	5.74E-05	0.11
Chromium	7440-47-3	0.007505402	1.12E-06	1.50E+00	0.013	5.74E-05	0.11
cis-1,2-Dichloroethylene	156-59-2	0.0002	5.07E-07	1.00E-02	1	5.07E-05	0.099
Copper	7440-50-8	0.002993571	4.46E-07	4.00E-02	1	1.12E-05	0.022
Fluoride	16984-48-8	0.32861624	4.90E-05	6.00E-02	1	8.17E-04	1.6
Iron	7439-89-6	0.47301923	7.05E-05	7.00E-01	1	1.01E-04	0.20
Lead	7439-92-1	0.000710361	1.06E-08	--	1	--	--
Lithium	7439-93-2	0.0083	1.24E-06	2.00E-03	1	6.19E-04	1.2
Manganese	7439-96-5	0.011254937	1.68E-06	2.40E-02	0.04	1.75E-03	3.4
Methanol	67-56-1	1.1	8.15E-05	5.00E-01	1	1.63E-04	0.32
Methylene chloride	75-09-2	0.000852962	9.14E-07	6.00E-02	1	1.52E-05	0.030
Molybdenum	7439-98-7	0.0015	2.24E-07	5.00E-03	1	4.47E-05	0.087
Nickel	7440-02-0	0.003603478	1.07E-07	2.00E-02	0.04	1.34E-04	0.26
Nitrate	14797-55-8	23.756902	3.54E-03	7.10E+00	1	4.99E-04	0.97
Nitrite	14797-65-0	0.079222756	1.18E-05	3.00E-01	1	3.94E-05	0.077
o-Xylene	95-47-6	0.000210551	3.99E-06	2.00E-01	1	1.99E-05	0.039
Silver	7440-22-4	0.005341496	4.78E-07	5.00E-03	0.04	2.39E-03	4.7
Strontium	7440-24-6	0.36357229	5.42E-05	6.00E-01	1	9.04E-05	0.18
Sulfate	14808-79-8	45.069738	6.72E-03	--	--	--	--
Tetrachloroethene	127-18-4	0.000993146	1.69E-05	1.00E-02	1	1.69E-03	3.3
Toluene	108-88-3	0.000274725	2.73E-06	8.00E-02	1	3.41E-05	0.066
Tributyl phosphate	126-73-8	0.040836371	--	2.00E-01	1	--	--
Trichloroethene	79-01-6	0.000492361	2.44E-06	--	1	--	--
Trichloromonofluoromethane	75-69-4	0.00058	3.24E-06	3.00E-01	1	1.08E-05	0.021
Uranium	7440-61-1	0.016251113	2.42E-06	3.00E-03	1	8.08E-04	1.6
Vanadium	7440-62-2	0.013487657	2.01E-06	5.00E-03	1	4.02E-04	0.78
Vinyl chloride[b]	75-01-4	0.0018	2.75E-06	3.00E-03	1	9.16E-04	1.8
Zinc	7440-66-6	0.10896358	9.75E-06	3.00E-01	1	3.25E-05	0.063
Total						0.05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] For the purposed of this exercise, the mutagenic exposure equations where not used for vinyl chloride

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

COPC = contaminant of potential concern.

HQ = hazard quotient

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Norvadioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o* (mg/kg-day)$^{-1}$	GIABS* (unitless)	Risk (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	0.0005	1.01E-05	--	1	--	
1,1,1-Trichloroethane	71-55-6	0.001204711	7.12E-06	--	1	--	
1,1-Dichloroethane	75-34-3	0.000389235	9.43E-07	--	1	--	
1,1-Dichloroethene	75-35-4	0.000164225	7.03E-07	--	1	--	
1,2-Dichlorobenzene	95-50-1	0.003	6.08E-05	--	1	--	
1,2-Dichloroethane	107-06-2	0.000305426	4.64E-07	9.10E-02	1	4.22E-08	0.29
1,4-Dichlorobenzene	106-46-7	0.000130994	2.72E-06	5.40E-03	1	1.47E-08	0.10
1,4-Dioxane	123-91-1	0.0081	9.01E-07	1.10E-02	1	9.91E-09	0.068
2-Butanone	78-93-3	0.0029	8.49E-07	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	0.00064	6.33E-07	--	1	--	
Acetone	67-64-1	0.001283316	--	--	1	--	
Aluminum	7429-90-5	0.041755539	6.96E-06	--	1	--	
Arsenic	7440-38-2	0.003060574	5.10E-07	1.50E+00	1	7.65E-07	5.2
Barium	7440-39-3	0.068082679	1.13E-05	--	0.07	--	
Benzene	71-43-2	0.0019	9.00E-06	5.50E-02	1	4.95E-07	3.4
Benzyl alcohol	100-51-6	0.0027	--	--	1	--	
Beryllium	7440-41-7	0.000360659	6.01E-08	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.001271216	6.08E-05	1.40E-02	1	8.52E-07	5.8
Cadmium	7440-43-9	0.0045	7.50E-07	--	0.05	--	
Carbon disulfide	75-15-0	0.00039	2.13E-06	--	1	--	
Carbon tetrachloride	56-23-5	0.000164414	1.36E-06	1.30E-01	1	1.77E-07	1.2
Chloride	16887-00-6	9.821328	1.64E-03	--	1	--	
Chlorobenzene	108-90-7	0.00041	4.57E-06	--	1	--	
Chloroform	67-66-3	0.00022061	6.22E-07	3.10E-02	1	1.93E-08	0.13
Chromium	7440-47-3	0.007505402	1.25E-06	--	0.013	--	
cis-1,2-Dichloroethylene	156-59-2	0.0002	3.50E-07	--	1	--	
Copper	7440-50-8	0.002993571	4.99E-07	--	1	--	
Fluoride	16984-48-8	0.32861624	5.47E-05	--	1	--	
Iron	7439-89-6	0.47301923	7.88E-05	--	1	--	
Lead	7439-92-1	0.000710161	1.18E-08	--	1	--	
Lithium	7439-93-2	0.0083	1.38E-06	--	1	--	
Manganese	7439-96-5	0.011254937	1.88E-06	--	0.04	--	
Methanol	67-56-1	1.1	8.91E-05	--	1	--	
Methylene chloride	75-09-2	0.000852962	9.91E-07	7.50E-03	1	7.43E-09	0.051
Molybdenum	7439-98-7	0.0015	2.50E-07	--	1	--	
Nickel	7440-02-0	0.003603478	1.20E-07	--	0.04	--	
Nitrate	14797-55-8	23.756902	3.96E-03	--	1	--	
Nitrite	14797-65-0	0.079227256	1.32E-05	--	1	--	
o-Xylene	95-47-6	0.000210551	4.32E-06	--	1	--	
Silver	7440-22-4	0.005341496	5.34E-07	--	0.04	--	
Strontium	7440-24-6	0.36357229	6.06E-05	--	1	--	
Sulfate	14808-79-8	45.069738	7.51E-03	--	--	--	
Tetrachloroethene	127-18-4	0.000993146	1.83E-05	5.40E-01	1	9.91E-06	68
Toluene	108-88-3	0.000274725	2.96E-06	--	1	--	
Tributyl phosphate	126-73-8	0.040836371	--	9.20E-03	1	--	
Trichloroethene	79-01-6	0.000492361	2.64E-06	8.90E-02	1	2.35E-07	1.6
Trichloromonofluoromethane	75-69-4	0.00058	3.51E-06	--	1	--	
Uranium	7440-61-1	0.01625213	2.71E-06	--	1	--	
Vanadium	7440-62-2	0.013487657	2.25E-06	--	1	--	
Vinyl chloride[1]	75-01-4	0.0018	2.99E-06	7.20E-01	1	2.15E-06	15
Zinc	7440-66-6	0.10896358	1.09E-05	--	1	--	
Total ELCR						1.47E-05	100

* EPA Region 9 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg9hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[1]For the purposed of this exercise, the mutagenic exposure equations where not used for vinyl chloride

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area - Yakima Nation

Inhalation of Volatile Radioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Factor	Symbol	Adult	Child	Unit	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Ridolfi, 2007
Exposure duration	ED	70	6	years	Ridolfi, 2007
Inhalation Rate	INH_a	26	16	m^3/day	Ridolfi, 2007
Exposure time	ET	0.58	1	hr/day	U.S. EPA, 2004
Age Adjusted Exposure Time	ET_{adj}	0.616		hrs	Calculated using the age adjusted intake factors equation
Radiation Age-adjusted inhalation rate	INH_RAD_{adj}	1760		m^3-yr/day	Calculated using the age adjusted intake factors equation
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Radiation Inhalation of Volatiles Slope Factor	SfI	Chemical Specific		risk/pCi	U.S. EPA, 1997

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Inhalation of Volatile Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Radioactive COPC	CAS #	VOC[a]	C_w (pCi/L)	CDI (radiological inhalation) (pCi)	SF_i (risk/pCi)	Risk (unitless)	% Contribution
Carbon-14	14762-75-5	--	15.2	--(b)	7.07E-12	--(b)	
Gross alpha	12587-46-1	--	5.9880167	--(b)	--	--(b)	
Gross beta	12587-47-2	--	26.717649	--(b)	--	--(b)	
Iodine-129	15046-84-1	--	1.7529182	--(b)	6.07E-11	--(b)	
Nickel-63	13981-37-8	--	7.66125	--(b)	1.64E-12	--(b)	
Protactinium-231	14331-85-2	--	0.308	--(b)	4.55E-08	--(b)	
Strontium-90	10098-97-2	--	0.611	--(b)	1.05E-10	--(b)	
Technetium-99	14133-76-7	--	75.671084	--(b)	1.41E-11	--(b)	
Tritium	10028-17-8	Yes	497899.63	4.10E+09	5.62E-14	2.31E-04	100
Total ELCR						2.31E-04	100

[a] Radiological contaminants considered volatile for the groundwater inhalation pathway are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area - Yakima Nation

Ingestion of Radioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Factor	Symbol	Unit		Value	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Ridolfi, 2007
Exposure duration	ED	70	6	years	Ridolfi, 2007
Drinking Water Ingestion Rate	IRW	4	2	L/day	Ridolfi, 2007
Radiation Age-adjusted drinking water ingestion rate	IRW_RAD_{adj}	268		L-yr/day	Calculated using the age adjusted intake factors equation
Radiation Ingestion of Water Slope Factor	Sfo	Chemical Specific		risk/pCi	U.S. EPA, 1997

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Ingestion of Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Far Field Exposure Area Radioactive COPC	CAS #	Cw (pCi/L)	CDI (radiological ingestion) (pCi)	SF_o (risk/pCi)	Risk (unitless)	% Contribution
Carbon-14	14762-75-5	15.2	1,486,864	1.55E-12	2.30E-06	0.092
Gross alpha	12587-46-1	5.9880167	585,748	--	--	
Gross beta	12587-47-2	26.717649	2,613,520	--	--	
Iodine-129	15046-84-1	1.7529182	171,470	1.48E-10	2.54E-05	1.0
Nickel-63	13981-37-8	7.66125	749,423	6.70E-13	5.02E-07	0.020
Protactinium-231	14331-85-2	0.308	30,129	1.73E-10	5.21E-06	0.21
Strontium-90	10098-97-2	0.611	59,768	5.59E-11	3.34E-06	0.13
Technetium-99	14133-76-7	75.671084	7.40E+06	2.75E-12	2.04E-05	0.81
Tritium	10028-17-8	497899.63	4.87E+10	5.07E-14	2.47E-03	99
Total ELCR					2.50E-03	100

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of Yakima Nation Drinking Water Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwater C_w (mg/L)	VOC?	HQ (Inhalation) (unitless)	HQ (Ingestion) (unitless)	HQ (Dermal) (unitless)	Total HI (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--(b)	--	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.6E-09	--	--(b)	--	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--(b)	--	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--(b)	--	--	--	
1,2-Dichloroethane	0.00064	Yes	3.22E-06	1.83E-03	4.48E-05	1.88E-03	0.017
2,3,4,6-Tetrachlorophenol	0.0077	--	--(b)	1.47E-02	--	1.47E-02	0.13
2-Methylphenol (cresol, o-)	0.0075	--	--(b)	8.57E-03	4.10E-04	8.98E-03	0.082
4-Nitrophenol	0.0072	--	--(b)	5.14E-02	1.87E-03	5.33E-02	0.49
Aluminum	0.11217909	--	--(b)	6.41E-03	1.67E-05	6.43E-03	0.059
Arsenic	0.005765062	--	--(b)	1.10E+00	2.87E-03	1.10E+00	10
Barium	0.052626075	--	--(b)	1.50E-02	5.61E-04	1.56E-02	0.14
Beryllium	0.00034431	--	--(b)	9.84E-03	3.67E-03	1.35E-02	0.12
Bis(2-ethylhexyl) phthalate	0.011	--	--(b)	3.14E-02	2.43E-02	5.57E-02	0.51
Cadmium	0.018	--	--(b)	2.06E+00	1.07E-01	2.16E+00	20
Carbon tetrachloride	0.0018	Yes	1.14E-04	1.47E-01	1.97E-02	1.67E-01	1.5
Chloride	11.439962	--	--(b)	--	--	--	
Chloroform	0.00038106	Yes	4.70E-05	2.18E-03	9.92E-05	2.32E-03	0.021
Chromium	0.015609389	--	--(b)	5.95E-04	1.19E-04	7.14E-04	0.0065
Cobalt	0.004378857	--	--(b)	8.34E-01	8.71E-04	8.35E-01	7.6
Copper	0.004482187	--	--(b)	6.40E-03	1.67E-05	6.42E-03	0.059
Dinoseb(2-secButyl-4,6-dinitrophenol)	0.005506461	--	--(b)	3.15E-01	--	3.15E-01	2.9
Fluoride	0.31715504	--	--(b)	3.02E-01	7.88E-04	3.03E-01	2.8
Hexavalent Chromium	0.191	--	--(b)	3.64E+00	7.60E-01	4.40E+00	40
Iron	0.14355212	--	--(b)	1.17E-02	3.06E-05	1.17E-02	0.11
Lead	0.00142074	--	--(b)	--	--	--	
Manganese	0.009635007	--	--(b)	2.29E-02	1.50E-03	2.44E-02	0.22
Nickel	0.010760715	--	--(b)	3.07E-02	4.01E-04	3.11E-02	0.28
Nitrate	31.205071	--	--(b)	2.51E-01	6.55E-04	2.52E-01	2.3
Nitrite	0.034429846	--	--(b)	6.56E-03	1.71E-05	6.58E-03	0.060
Nitrogen in Nitrite and Nitrate	14.7	--	--(b)	5.25E-01	1.37E-03	5.26E-01	4.8
Octachlorodibenzofuran	9.9649E-09	--	--(b)	--	--	--	
Octachlorodibenzo-p-dioxin	5.6857E-09	--	--(b)	--	--	--	
Silver	0.005650889	--	--(b)	6.46E-02	2.53E-03	6.71E-02	0.61
Strontium	0.26495344	--	--(b)	2.52E-02	6.59E-05	2.53E-02	0.23
Sulfate	56.164035	--	--(b)	--	--	--	
Toluene	0.000065	Yes	1.57E-07	4.64E-05	8.07E-06	5.47E-05	4.99E-04
Total petroleum hydrocarbons - gasoline range	0.05	--	--(b)	--	--	--	
Trichloroethene	0.000570461	Yes	1.97E-04	--	--	1.97E-04	0.0018
Uranium	0.014879201	--	--(b)	2.83E-01	7.40E-04	2.84E-01	2.6
Vanadium	0.021937779	--	--(b)	2.51E-01	6.54E-04	2.51E-01	2.3
Zinc	0.092316084	--	--(b)	1.76E-02	2.75E-05	1.76E-02	0.16
Total			3.62E-04	10.03	0.93	10.96	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

HQ = hazard quotient.

HI = hazard index.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of Yakima Nation Drinking Water Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwater C_w (mg/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--(b)	3.06E-07	--	3.06E-07	0.052
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.6E-09	--	--(b)	4.58E-07	--	4.58E-07	0.077
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--(b)	2.37E-06	--	2.37E-06	0.40
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--(b)	1.72E-06	--	1.72E-06	0.29
1,2-Dichloroethane	0.00064	Yes	2.01E-07	3.67E-06	8.85E-08	3.96E-06	0.67
2,3,4,6-Tetrachlorophenol	0.0077	--	--(b)	--	--	--	
2-Methylphenol (cresol, o-)	0.0075	--	--(b)	--	--	--	
4-Nitrophenol	0.0072	--	--(b)	--	--	--	
Aluminum	0.11217909	--	--(b)	--	--	--	
Arsenic	0.005765062	--	--(b)	5.44E-04	1.44E-06	5.46E-04	92
Barium	0.052626075	--	--(b)	--	--	--	
Beryllium	0.00034431	--	--(b)	--	--	--	
Bis(2-ethylhexyl) phthalate	0.011	--	--(b)	9.70E-06	7.37E-06	1.71E-05	2.9
Cadmium	0.018	--	--(b)	--	--	--	

Carbon tetrachloride	0.0018	Yes	3.26E-07	1.47E-05	1.94E-06	1.70E-05	2.9
Chloride	11.439962	--	--(b)	--	--	--	
Chloroform	0.00038106	Yes	1.06E-07	7.44E-07	3.33E-08	8.83E-07	0.15
Chromium	0.015609389	--	--(b)	--	--	--	
Cobalt	0.004378857	--	--(b)	--	--	--	
Copper	0.004482187	--	--(b)	--	--	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)	0.005506461	--	--(b)	--	--	--	
Fluoride	0.31715504	--	--(b)	--	--	--	
Hexavalent Chromium	0.191	--	--(b)	--	--	--	
Iron	0.14355212	--	--(b)	--	--	--	
Lead	0.00142074	--	--(b)	--	--	--	
Manganese	0.009635007	--	--(b)	--	--	--	
Nickel	0.010760715	--	--(b)	--	--	--	
Nitrate	31.205071	--	--(b)	--	--	--	
Nitrite	0.034429846	--	--(b)	--	--	--	
Nitrogen in Nitrite and Nitrate	14.7	--	--(b)	--	--	--	
Octachlorodibenzofuran	9.9649E-09	--	--(b)	2.45E-08	--	2.45E-08	0.0041
Octachlorodibenzo-p-dioxin	5.6857E-09	--	--(b)	1.40E-08	--	1.40E-08	0.0024
Silver	0.005650889	--	--(b)	--	--	--	
Strontium	0.26495344	--	--(b)	--	--	--	
Sulfate	56.164035	--	--(b)	--	--	--	
Toluene	0.000065	Yes	--	--	--	--	
Total petroleum hydrocarbons - gasoline range	0.05	--	--(b)	--	--	--	
Trichloroethene	0.000570461	Yes	1.72E-07	3.20E-06	2.72E-07	3.64E-06	0.61
Uranium	0.014879201	--	--(b)	--	--	--	
Vanadium	0.021937779	--	--(b)	--	--	--	
Zinc	0.092316084	--	--(b)	--	--	--	
Total ELCR			8.06E-07	5.81E-04	1.11E-05	5.93E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of Yakima Nation Drinking Water Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwater C_w (pCi/L)	Volatile?[a]	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	4.8703439	--	--(b)	--	--	
Iodine-129	3.1689247	--	--(b)	4.59E-05	4.59E-05	3.0
Plutonium-239/240	0.029	--	--(b)	3.83E-07	3.83E-07	0.025
Protactinium-231	0.28	--	--(b)	4.74E-06	4.74E-06	0.31
Strontium-90	4.5802399	--	--(b)	2.50E-05	2.50E-05	1.6
Technetium-99	1567.7398	--	--(b)	4.22E-04	4.22E-04	27
Tritium	192557.5	Yes	8.92E-05	9.55E-04	1.04E-03	68
Total ELCR			8.92E-05	1.45E-03	1.54E-03	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

COPC = contaminant of potential concern.

Yakima Nation = Confederated Tribes of the Umatilla Indian Reservation.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-Field exposure area - Yakima Nation

Ingestion of Nonradioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Ingestion Chronic Daily Intake	CDI	calculated		mg/kg-day	EPA 1989
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	16	kg	Ridolfi, 2007
Drinking Water Ingestion Rate	IRW	4	2	Liters/day	Ridolfi, 2007
Age-Adjusted Drinking Water Ingestion Rate	IRWadj	4.407		L-yr/kg-day	Calculated using the age adjusted intake factors equation
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	6	yr	Ridolfi, 2007
Averaging time	AT	70	--	yr	Ridolfi, 2007
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFo	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 1989

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.734E-09	2.13E-10	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.6E-09	3.20E-10	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	1.66E-10	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	1.20E-10	--	--	
1,2-Dichloroethane	107-06-2	0.00064	3.66E-05	2.00E-02	1.83E-03	0.018
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	4.40E-04	3.00E-02	1.47E-02	0.15
2-Methylphenol (cresol, o-)	95-48-7	0.0075	4.29E-04	5.00E-02	8.57E-03	0.085
4-Nitrophenol	100-02-7	0.0072	4.11E-04	8.00E-03	5.14E-02	0.51
Aluminum	7429-90-5	0.11217909	6.41E-03	1.00E+00	6.41E-03	0.064
Arsenic	7440-38-2	0.005765062	3.29E-04	3.00E-04	1.10E+00	11
Barium	7440-39-3	0.052626075	3.01E-03	2.00E-01	1.50E-02	0.15
Beryllium	7440-41-7	0.00034431	1.97E-05	2.00E-03	9.84E-03	0.098
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	6.29E-04	2.00E-02	3.14E-02	0.31
Cadmium	7440-43-9	0.018	1.03E-03	5.00E-04	2.06E+00	21
Carbon tetrachloride	56-23-5	0.0018	1.03E-04	7.00E-04	1.47E-01	1.5
Chloride	16887-00-6	11.439962	6.54E-01	--	--	
Chloroform	67-66-3	0.00038106	2.18E-05	1.00E-02	2.18E-03	0.022
Chromium	7440-47-3	0.015609389	8.92E-04	1.50E+00	5.95E-04	0.0059
Cobalt	7440-48-4	0.004378857	2.50E-04	3.00E-04	8.34E-01	8.3
Copper	7440-50-8	0.004482187	2.56E-04	4.00E-02	6.40E-03	0.064
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	0.005506461	3.15E-04	1.00E-03	3.15E-01	3.1
Fluoride	16984-48-8	0.31715504	1.81E-02	6.00E-02	3.02E-01	3.0
Hexavalent Chromium	18540-29-9	0.191	1.09E-02	3.00E-03	3.64E+00	36
Iron	7439-89-6	0.14355212	8.20E-03	7.00E-01	1.17E-02	0.12
Lead	7439-92-1	0.00142074	8.12E-05	--	--	
Manganese	7439-96-5	0.009635007	5.51E-04	2.40E-02	2.29E-02	0.23
Nickel	7440-02-0	0.010760715	6.15E-04	2.00E-02	3.07E-02	0.31
Nitrate	14797-55-8	31.205071	1.78E+00	7.10E+00	2.51E-01	2.5
Nitrite	14797-65-0	0.034429846	1.97E-03	3.00E-01	6.56E-03	0.065
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	8.40E-01	1.60E+00	5.25E-01	5.2
Octachlorodibenzofuran	39001-02-0	9.9649E-09	5.69E-10	--	--	
Octachlorodibenzo-p-dioxin	3268-87-9	5.6857E-09	3.25E-10	--	--	
Silver	7440-22-4	0.005650889	3.23E-04	5.00E-03	6.46E-02	0.64
Strontium	7440-24-6	0.26495344	1.51E-02	6.00E-01	2.52E-02	0.25
Sulfate	14808-79-8	56.164035	3.21E+00	--	--	
Toluene	108-88-3	0.000065	3.71E-06	8.00E-02	4.64E-05	4.63E-04
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	2.86E-03	--	--	
Trichloroethene	79-01-6	0.000570461	3.26E-05	--	--	
Uranium	7440-61-1	0.014879201	8.50E-04	3.00E-03	2.83E-01	2.8
Vanadium	7440-62-2	0.021937779	1.25E-03	5.00E-03	2.51E-01	2.5
Zinc	7440-66-6	0.092316084	5.28E-03	3.00E-01	1.76E-02	0.18
Total					10.0	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.734E-09	2.35E-10	1.30E+03	3.06E-07	0.053
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.6E-09	3.53E-10	1.30E+03	4.58E-07	0.079
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	1.83E-10	1.30E+04	2.37E-06	0.41
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	1.32E-10	1.30E+04	1.72E-06	0.30
1,2-Dichloroethane	107-06-2	0.00064	4.03E-05	9.10E-02	3.67E-06	0.63
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	4.85E-04	--	--	
2-Methylphenol (cresol, o-)	95-48-7	0.0075	4.72E-04	--	--	
4-Nitrophenol	100-02-7	0.0072	4.53E-04	--	--	
Aluminum	7429-90-5	0.11217909	7.06E-03	--	--	
Arsenic	7440-38-2	0.005765062	3.63E-04	1.50E+00	5.44E-04	94
Barium	7440-39-3	0.052626075	3.31E-03	--	--	
Beryllium	7440-41-7	0.00034431	2.17E-05	--	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	6.93E-04	1.40E-02	9.70E-06	1.7
Cadmium	7440-43-9	0.018	1.13E-03	--	--	
Carbon tetrachloride	56-23-5	0.0018	1.13E-04	1.30E-01	1.47E-05	2.5
Chloride	16887-00-6	11.439962	7.20E-01	--	--	
Chloroform	67-66-3	0.00038106	2.40E-05	3.10E-02	7.44E-07	0.13
Chromium	7440-47-3	0.015609389	9.83E-04	--	--	
Cobalt	7440-48-4	0.004378857	2.76E-04	--	--	
Copper	7440-50-8	0.004482187	2.82E-04	--	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	0.005506461	3.47E-04	--	--	
Fluoride	16984-48-8	0.31715504	2.00E-02	--	--	
Hexavalent Chromium	18540-29-9	0.191	1.20E-02	--	--	

Iron	7439-89-6	0.14355212	9.04E-03	--	--	
Lead	7439-92-1	0.00142074	8.94E-05	--	--	
Manganese	7439-96-5	0.009635007	6.07E-04	--	--	
Nickel	7440-02-0	0.010760715	6.77E-04	--	--	
Nitrate	14797-55-8	31.205071	1.96E+00	--	--	
Nitrite	14797-65-0	0.034429846	2.17E-03	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	9.26E-01	--	--	
Octachlorodibenzofuran	39001-02-0	9.9649E-09	6.27E-10	3.90E+01	2.45E-08	0.0042
Octachlorodibenzo-p-dioxin	3268-87-9	5.6857E-09	3.58E-10	3.90E+01	1.40E-08	0.0024
Silver	7440-22-4	0.005650889	3.56E-04	--	--	
Strontium	7440-24-6	0.26495344	1.67E-02	--	--	
Sulfate	14808-79-8	56.164035	3.54E+00	--	--	
Toluene	108-88-3	0.000065	4.09E-06	--	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	3.15E-03	--	--	
Trichloroethene	79-01-6	0.000570461	3.59E-05	8.90E-02	3.20E-06	0.55
Uranium	7440-61-1	0.014879201	9.37E-04	--	--	
Vanadium	7440-62-2	0.021937779	1.38E-03	--	--	
Zinc	7440-66-6	0.092316084	5.81E-03	--	--	
Total ELCR					5.81E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-Field exposure area - Yakima Nation

Inhalation of Volatile Nonradioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Inhalation Chronic Daily Intake	CDI	calculated		mg/m^3 for noncarcinogens, $\mu g/m^3$ for carcinogens	EPA 2009b
Contaminant concentration in drinking water	C_w	contaminant-specific		mg/L	ECF-200PO1-09-2027
Exposure Time	ET	0.580	--	hours/day	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	--	yr	Ridolfi, 2007
Averaging Time	AT	70	--	yr	Ridolfi, 2007
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Inhalation Reference Concentration	RfC_i	Chemical Specific		mg/m^3	EPA 2009a
Inhalation Unit Risk	IUR	Chemical Specific		$(\mu g/m^3)^{-1}$	EPA 2009a
Conversion Factor	CF1	365		days/year	EPA 2009b
Conversion Factor	CF2	0.042		1day/24 hours	EPA 2009b

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009a EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

U.S. EPA 2009b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (noncarcinogen) (mg/m^3)	RfC[a] (mg/m^3)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(b)	--	--(b)	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.6E-09	--(b)	--	--(b)	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(b)	--	--(b)	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(b)	--	--(b)	
1,2-Dichloroethane	107-06-2	Yes	0.00064	7.73E-06	2.40E+00	3.22E-06	0.89
2,3,4,6-Tetrachlorophenol	58-90-2	--	0.0077	--(b)	--	--(b)	
2-Methylphenol (cresol, o-)	95-48-7	--	0.0075	--(b)	6.00E-01	--(b)	
4-Nitrophenol	100-02-7	--	0.0072	--(b)	--	--(b)	
Aluminum	7429-90-5	--	0.11217909	--(b)	5.00E-03	--(b)	
Arsenic	7440-38-2	--	0.005765062	--(b)	1.50E-05	--(b)	
Barium	7440-39-3	--	0.052626075	--(b)	5.00E-04	--(b)	
Beryllium	7440-41-7	--	0.00034431	--(b)	2.00E-05	--(b)	
Bis(2-ethylhexyl) phthalate	117-81-7	--	0.011	--(b)	--	--(b)	
Cadmium	7440-43-9	--	0.018	--(b)	1.00E-05	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.0018	2.18E-05	1.90E-01	1.14E-04	32
Chloride	16887-00-6	--	11.439962	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.00038106	4.60E-06	9.80E-02	4.70E-05	13
Chromium	7440-47-3	--	0.015609389	--(b)	--	--(b)	
Cobalt	7440-48-4	--	0.004378857	--(b)	6.00E-06	--(b)	
Copper	7440-50-8	--	0.004482187	--(b)	--	--(b)	
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	--	0.005506461	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.31715504	--(b)	1.30E-02	--(b)	
Hexavalent Chromium	18540-29-9	--	0.191	--(b)	1.00E-04	--(b)	
Iron	7439-89-6	--	0.14355212	--(b)	--	--(b)	
Lead	7439-92-1	--	0.00142074	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.009635007	--(b)	5.00E-05	--(b)	
Nickel	7440-02-0	--	0.010760715	--(b)	9.00E-05	--(b)	
Nitrate	14797-55-8	--	31.205071	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.034429846	--(b)	--	--(b)	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(b)	--	--(b)	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(b)	--	--(b)	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.6857E-09	--(b)	--	--(b)	
Silver	7440-22-4	--	0.005650889	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.26495344	--(b)	--	--(b)	
Sulfate	14808-79-8	--	56.164035	--(b)	--	--(b)	
Toluene	108-88-3	Yes	0.000065	7.85E-07	5.00E+00	1.57E-07	0.043
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(b)	--	--(b)	
Trichloroethene	79-01-6	Yes	0.000570461	6.89E-06	3.50E-02	1.97E-04	54
Uranium	7440-61-1	--	0.014879201	--(b)	3.00E-04	--(b)	
Vanadium	7440-62-2	--	0.021937779	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.092316084	--(b)	--	--(b)	
Total						3.62E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (carcinogen) ($\mu g/m^3$)	IUR[a] $(\mu g/m^3)^{-1}$	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(b)	3.80E-01	--(b)	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.6E-09	--(b)	3.80E-01	--(b)	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(b)	3.80E+00	--(b)	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(b)	3.80E+00	--(b)	
1,2-Dichloroethane	107-06-2	Yes	0.00064	7.73E-03	2.60E-05	2.01E-07	25
2,3,4,6-Tetrachlorophenol	58-90-2	--	0.0077	--(b)	--	--(b)	
2-Methylphenol (cresol, o-)	95-48-7	--	0.0075	--(b)	--	--(b)	
4-Nitrophenol	100-02-7	--	0.0072	--(b)	--	--(b)	
Aluminum	7429-90-5	--	0.11217909	--(b)	--	--(b)	
Arsenic	7440-38-2	--	0.005765062	--(b)	4.30E-03	--(b)	
Barium	7440-39-3	--	0.052626075	--(b)	--	--(b)	
Beryllium	7440-41-7	--	0.00034431	--(b)	2.40E-03	--(b)	
Bis(2-ethylhexyl) phthalate	117-81-7	--	0.011	--(b)	2.40E-06	--(b)	
Cadmium	7440-43-9	--	0.018	--(b)	1.80E-03	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.0018	2.18E-02	1.50E-05	3.26E-07	41
Chloride	16887-00-6	--	11.439962	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.00038106	4.60E-03	2.30E-05	1.06E-07	13
Chromium	7440-47-3	--	0.015609389	--(b)	--	--(b)	
Cobalt	7440-48-4	--	0.004378857	--(b)	9.00E-03	--(b)	
Copper	7440-50-8	--	0.004482187	--(b)	--	--(b)	
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	--	0.005506461	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.31715504	--(b)	--	--(b)	
Hexavalent Chromium	18540-29-9	--	0.191	--(b)	8.40E-02	--(b)	
Iron	7439-89-6	--	0.14355212	--(b)	--	--(b)	

Lead	7439-92-1	--	0.00142074	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.009635007	--(b)	--	--(b)	
Nickel	7440-02-0	--	0.010760715	--(b)	2.60E-04	--(b)	
Nitrate	14797-55-8	--	31.205071	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.034429846	--(b)	--	--(b)	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(b)	--	--(b)	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(b)	1.14E-02	--(b)	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.6857E-09	--(b)	1.14E-02	--(b)	
Silver	7440-22-4	--	0.005650889	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.26495344	--(b)	--	--(b)	
Sulfate	14808-79-8	--	56.164035	--(b)	--	--(b)	
Toluene	108-88-3	Yes	0.000065	7.85E-04	--	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(b)	--	--(b)	
Trichloroethene	79-01-6	Yes	0.000570461	6.89E-03	2.50E-05	1.72E-07	21
Uranium	7440-61-1	--	0.014879201	--(b)	--	--(b)	
Vanadium	7440-62-2	--	0.021937779	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.092316084	--(b)	--	--(b)	
Total ELCR						8.06E-07	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-Field exposure area - Yakima Nation

Dermal Absorption of Nonradioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	16	kg	Harris et al, 2004
Exposure Time	ET	0.58	1.0	hours/day	U.S. EPA, 2004
Exposure Time (Age-Adjusted)	ETadj	0.616		hours/day	Calculated using the age adjusted intake factors equation
Surface Area	SA	18,000	6,600	cm^2	Ridolfi, 2007
Age-Adjusted Surface Area	SAadj	18,932		$(cm^2$-yr-event)/(kg-day)	Calculated using the age adjusted intake factors equation
Event Frequency	EV	1.0	1.0	Event/days	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	6.0	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Ridolfi, 2007
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFO	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 2009
Conversion Factor	CF3	0.001		L/cm^3	$1 L = 1000 cm^3$
t*	Time to reach steady state	Chemical Specific		hours	EPA, 2004
B	Dermal Partitioning Constant	Chemical Specific		unitless	EPA, 2004
DA	Absorbed Dose per Event	Chemical Specific		$(mg/cm^2$-event)	Calculated using dermal exposure to groundwater equations as provided by U.S. EPA, 2004
Kp	Dermal Permeability Constant	Chemical Specific		cm/hour	EPA, 2004
FA	Fraction Absorbed	Chemical Specific		unitless	EPA, 2004
τ	Lag Time	Chemical Specific		hours	EPA, 2004

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Absorbed Dermal Dose Calculation

Contaminant of Potential Concern	CAS #	Cw (mg/L)	Inorganic/organic[a]	FA[b] (unitless)	K_p[a] (cm/hour)	B[b] (unitless)	τ[b] (hours/event)	t*[b] (hours)	DA (noncancer) (mg/cm^2-event)	DA (cancer) (mg/cm^2-event)
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.73E-09								
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.6E-09	--	--	1.45	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	--	--	2.25	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	--	--	2.25	--	--	--	--	--
1,2 Dichloroethane	107-06-2	0.00064	--	1.0	0.0042	0	0.38	0.92	3.49E-09	3.59E-09
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	--	--	0.071	--	--	--	--	--
2-Methylphenol (cresol, o-)	95-48-7	0.0075	--	1.0	0.0077	0	0.43	1.03	7.97E-08	8.21E-08
4-Nitrophenol	100-02-7	0.0072	--	1.0	0.0048	0	0.64	1.54	5.82E-08	6.00E-08
Aluminum	7429-90-5	0.11217909	INORGANIC	--	0.001	--	--	--	6.51E-08	6.91E-08
Arsenic	7440-38-2	0.005765062	INORGANIC	--	0.001	--	--	--	3.34E-09	3.55E-09
Barium	7440-39-3	0.052626075	INORGANIC	--	0.001	--	--	--	3.05E-08	3.24E-08
Beryllium	7440-41-7	0.00034431	INORGANIC	--	0.001	--	--	--	2.00E-10	2.12E-10
Bis(2-ethylhexyl) phthalate	117-81-7	0.011		0.8	0.025	0.2	16.64	39.93	1.89E-06	1.95E-06
Cadmium	7440-43-9	0.018	INORGANIC	--	0.001	--	--	--	1.04E-08	1.11E-08
Carbon tetrachloride	56-23-5	0.0018	--	1.0	0.016	0.1	0.78	1.86	5.35E-08	5.52E-08
Chloride	16887-00-6	11.439862	INORGANIC	--	0.001	--	--	--	6.64E-06	7.05E-06
Chloroform	67-66-3	0.00038106	--	1.0	0.0068	0	0.50	1.19	3.86E-09	3.97E-09
Chromium	7440-47-3	0.015609389	INORGANIC	--	0.001	--	--	--	9.05E-09	9.62E-09
Cobalt	7440-48-4	0.004378857	INORGANIC	--	0.0004	--	--	--	1.02E-09	1.08E-09
Copper	7440-50-8	0.004482187	INORGANIC	--	0.001	--	--	--	2.60E-09	2.76E-09
Dinoseb(2-secbutyl-4,6-dinitrophenol)[c]	88-85-7	0.005506461	--	--	0.0163	--	--	--	--	--
Fluoride	16984-48-8	0.31715504	INORGANIC	--	0.001	--	--	--	1.84E-07	1.95E-07
Hexavalent Chromium	18540-29-9	0.193	INORGANIC	--	0.002	--	--	--	2.22E-07	2.35E-07
Iron	7439-89-6	0.14355212	INORGANIC	--	0.001	--	--	--	8.33E-08	8.84E-08
Lead	7439-92-1	0.00142074	INORGANIC	--	0.0001	--	--	--	8.24E-11	8.75E-11
Manganese	7439-96-5	0.009635007	INORGANIC	--	0.001	--	--	--	5.59E-09	5.94E-09
Nickel	7440-02-0	0.010760715	INORGANIC	--	0.0002	--	--	--	1.25E-09	1.33E-09
Nitrate	14797-55-8	31.205071	INORGANIC	--	0.001	--	--	--	1.81E-05	1.92E-05
Nitrite	14797-65-0	0.034429846	INORGANIC	--	0.001	--	--	--	2.00E-08	2.12E-08
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	INORGANIC	--	0.001	--	--	--	8.53E-06	9.06E-06
Octachlorodibenzofuran	39001-02-0	9.9649E-09	--	--	2.63	--	--	--	--	--
Octachlorodibenzo-p-dioxin	3268-87-9	5.6857E-09	--	--	1.16	--	--	--	--	--
Silver	7440-22-4	0.005650889	INORGANIC	--	0.0006	--	--	--	1.97E-09	2.09E-09
Strontium	7440-24-6	0.26495344	INORGANIC	--	0.001	--	--	--	1.54E-07	1.63E-07
Sulfate	14808-79-8	58.164035	INORGANIC	--	0.001	--	--	--	3.26E-05	3.46E-05
Toluene	108-88-3	0.000065	--	1.0	0.031	0.1	0.35	0.84	2.51E-09	2.59E-09
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	--	--	--	--	--	--	--	--
Trichloroethene	79-01-6	0.000570461	--	1.0	0.012	0.1	0.58	1.39	1.10E-08	1.13E-08
Uranium	7440-61-1	0.014879201	INORGANIC	--	0.001	--	--	--	8.63E-09	9.17E-09
Vanadium	7440-62-2	0.021937779	INORGANIC	--	0.001	--	--	--	1.27E-08	1.35E-08
Zinc	7440-66-6	0.092316084	INORGANIC	--	0.0006	--	--	--	3.21E-08	3.41E-08

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

[a] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2

[b] EPA/540/R/99/005 Exhibit B-3

[c] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.73E-09	--	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.6E-09	--	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	--	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	--	--	1	--	
1,2 Dichloroethane	107-06-2	0.00064	8.97E-07	2.00E-02	1	4.48E-05	0.0048
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	--	3.00E-02	1	--	
2-Methylphenol (cresol, o-)	95-48-7	0.0075	2.05E-05	5.00E-02	1	4.10E-04	0.044
4-Nitrophenol	100-02-7	0.0072	1.50E-05	8.00E-03	1	1.87E-03	0.20
Aluminum	7429-90-5	0.11217909	1.67E-05	1.00E+00	1	1.67E-05	0.0018
Arsenic	7440-38-2	0.005765062	8.60E-07	3.00E-04	1	2.87E-03	0.31
Barium	7440-39-3	0.052626075	7.85E-06	2.00E-01	0.07	5.61E-04	0.060
Beryllium	7440-41-7	0.00034431	5.14E-08	2.00E-03	0.007	3.67E-03	0.39
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	4.86E-04	2.00E-02	1	2.43E-02	2.6
Cadmium	7440-43-9	0.018	2.68E-06	5.00E-04	0.05	1.07E-01	12
Carbon tetrachloride	56-23-5	0.0018	1.38E-05	7.00E-04	1	1.97E-02	2.1
Chloride	16887-00-6	11.439962	1.71E-03	--	1	--	
Chloroform	67-66-3	0.00038106	9.92E-07	1.00E-02	1	9.92E-05	0.011
Chromium	7440-47-3	0.015609389	2.33E-06	1.50E+00	0.013	1.19E-04	0.013
Cobalt	7440-48-4	0.004378857	2.61E-07	3.00E-04	1	8.71E-04	0.094
Copper	7440-50-8	0.004482187	6.68E-07	4.00E-02	1	1.67E-05	0.0018
Dinoseb(2-secbutyl-4,6-dinitrophenol)	88-85-7	0.005506461	--	1.00E-03	1	--	
Fluoride	16984-48-8	0.31715504	4.73E-05	6.00E-02	1	7.88E-04	0.085
Hexavalent Chromium	18540-29-9	0.193	5.70E-05	3.00E-03	0.025	7.60E-01	82
Iron	7439-89-6	0.14355212	2.14E-05	7.00E-01	1	3.06E-05	0.0033
Lead	7439-92-1	0.00142074	2.12E-08	--	1	--	
Manganese	7439-96-5	0.009635007	1.44E-06	2.40E-02	0.04	1.50E-03	0.16
Nickel	7440-02-0	0.010760715	3.21E-07	2.00E-02	0.04	4.01E-04	0.043
Nitrate	14797-55-8	31.205071	4.65E-03	7.10E+00	1	6.55E-04	0.070
Nitrite	14797-65-0	0.034429846	5.13E-06	3.00E-03	1	1.71E-05	0.0018
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	2.19E-03	1.60E+00	1	1.37E-03	0.15
Octachlorodibenzofuran	39001-02-0	9.9649E-09	--	--	1	--	
Octachlorodibenzo-p-dioxin	3268-87-9	5.6857E-09	--	--	1	--	
Silver	7440-22-4	0.005650889	5.06E-07	5.00E-03	0.04	2.53E-03	0.27
Strontium	7440-24-6	0.26495344	3.95E-05	6.00E-01	1	6.59E-05	0.0071
Sulfate	14808-79-8	58.164035	8.38E-03	--	--	--	
Toluene	108-88-3	0.000065	6.45E-07	8.00E-02	1	8.07E-06	8.67E-04
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	--	--	--	--	
Trichloroethene	79-01-6	0.000570461	2.82E-06		1	--	
Uranium	7440-61-1	0.014879201	2.22E-06	3.00E-03	1	7.40E-04	0.080
Vanadium	7440-62-2	0.021937779	3.27E-06	5.00E-03	1	0.0007	0.070
Zinc	7440-66-6	0.092316084	8.26E-06	3.00E-01	1	2.75E-05	0.0030
Total						0.93	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	3.73E-09	--	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	5.6E-09	--	1.30E+03	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	2.9E-09	--	1.30E+04	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	2.1E-09	--	1.30E+04	1	--	
1,2 Dichloroethane	107-06-2	0.00064	9.72E-07	9.10E-02	1	8.85E-08	0.79
2,3,4,6-Tetrachlorophenol	58-90-2	0.0077	--	--	1	--	
2-Methylphenol (cresol, o-)	95-48-7	0.0075	2.22E-05	--	1	--	
4-Nitrophenol	100-02-7	0.0072	1.62E-05	--	1	--	
Aluminum	7429-90-5	0.11217909	1.87E-05	--	1	--	
Arsenic	7440-38-2	0.005765062	9.60E-07	1.50E+00	1	1.44E-06	13
Barium	7440-39-3	0.052626075	8.77E-06	--	0.07	--	
Beryllium	7440-41-7	0.00034431	5.74E-08	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	0.011	5.27E-04	1.40E-02	1	7.37E-06	66
Cadmium	7440-43-9	0.018	3.00E-06	--	0.05	--	

Carbon tetrachloride	56-23-5	0.0018	1.49E-05	1.30E-01	1	1.94E-06	17
Chloride	16887-00-6	11.439962	1.91E-03	--	1	--	
Chloroform	67-66-3	0.00038106	1.08E-06	3.10E-02	1	3.33E-08	0.30
Chromium	7440-47-3	0.015609389	2.60E-06	--	0.013	--	
Cobalt	7440-48-4	0.004378857	2.92E-07	--	1	--	
Copper	7440-50-8	0.004482187	7.47E-07	--	1	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	0.005506461	--	--	1	--	
Fluoride	16984-48-8	0.31715504	5.28E-05	--	1	--	
Hexavalent Chromium	18540-29-9	0.193	6.36E-05	--	0.015	--	
Iron	7439-89-6	0.14355212	2.39E-05	--	1	--	
Lead	7439-92-1	0.00142074	2.37E-08	--	1	--	
Manganese	7439-96-5	0.009635907	1.61E-06	--	0.04	--	
Nickel	7440-02-0	0.010760715	3.59E-07	--	0.04	--	
Nitrate	14797-55-8	31.205071	5.20E-03	--	1	--	
Nitrite	14797-65-0	0.034429846	5.74E-06	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	14.7	2.45E-03	--	1	--	
Octachlorodibenzofuran	39001-02-0	9.9649E-09	--	3.90E+01	1	--	
Octachlorodibenzo-p-dioxin	3268-87-9	5.6857E-09	--	3.90E+01	1	--	
Silver	7440-22-4	0.005650889	5.65E-07	--	0.04	--	
Strontium	7440-24-6	0.26495344	4.41E-05	--	1	--	
Sulfate	14808-79-8	56.164035	9.36E-03	--	--	--	
Toluene	108-88-3	0.000065	6.99E-07	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	0.05	--	--	--	--	
Trichloroethene	79-01-6	0.000570461	3.06E-06	8.90E-02	1	2.72E-07	2.4
Uranium	7440-61-1	0.014879701	2.48E-06	--	1	--	
Vanadium	7440-62-2	0.021937779	3.65E-06	--	1	--	
Zinc	7440-66-6	0.092316084	9.23E-06	--	1	--	
Total ELCR						1.11E-05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-Field exposure area - Yakima Nation

Inhalation of Volatile Radioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Factor	Symbol	Adult	Child	Unit	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Ridolfi, 2007
Exposure duration	ED	70	6	years	Ridolfi, 2007
Inhalation Rate	INH	26	16	m^3/day	Ridolfi, 2007
Exposure time	ET	0.58	1	hr/day	U.S. EPA, 2004
Age Adjusted Exposure Time	ET_{adj}	0.616		hrs	Calculated using the age adjusted intake factors equation
Radiation Age-adjusted inhalation rate	INH_RAD_{adj}	1760		m^3-yr/day	Calculated using the age adjusted intake factors equation
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991b
Radiation Inhalation of Volatiles Slope Factor	Sfi	Chemical Specific		risk/pCi	U.S. EPA, 1997

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Inhalation of Volatile Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	VOC[a]	Cw (pCi/L)	CDI (radiological inhalation) (pCi)	SF_i (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	4.8703439	--(b)	--	--(b)	
Iodine-129	15046-84-1	--	3.1689247	--(b)	6.07E-11	--(b)	
Plutonium-239/240	PU-239/240	--	0.029	--(b)	3.33E-08	--(b)	
Protactinium-231	14331-85-2	--	0.28	--(b)	4.55E-08	--(b)	
Strontium-90	10098-97-2	--	4.5802399	--(b)	1.05E-10	--(b)	
Technetium-99	14133-76-7	--	1567.7398	--(b)	1.41E-11	--(b)	
Tritium	10028-17-8	Yes	192557.5	1.59E+09	5.62E-14	8.92E-05	100
Total ELCR						8.92E-05	100

[a] Radiological contaminants considered volatile for the groundwater inhalation pathway are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-Field exposure area - Yakima Nation

Ingestion of Radioactive Compounds in Drinking Water - Yakima Nation

Intake Parameter Values		Value			
Factor	Symbol	Unit		Value	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Ridolfi, 2007
Exposure duration	ED	70	6	years	Ridolfi, 2007
Drinking Water Ingestion Rate	IRW	4	2	L/day	Ridolfi, 2007
Radiation Age-adjusted drinking water ingestion rate	IRW_RAD_{adj}	268		L-yr/day	Calculated using the age adjusted intake factors equation
Radiation Ingestion of Water Slope Factor	Sfo	Chemical Specific		risk/pCi	U.S. EPA, 1997

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Ingestion of Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	Cw (pCi/L)	CDI (radiological ingestion) (pCi)	SF_o (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	4.8703439	4.76E+05	--	--	
Iodine-129	15046-84-1	3.1689247	309,984	1.48E-10	4.59E-05	3.2
Plutonium-239/240	PU-239/240	0.029	2,837	1.35E-10	3.83E-07	0.026
Protactinium-231	14331-85-2	0.28	27,390	1.73E-10	4.74E-06	0.33
Strontium-90	10098-97-2	4.5802399	448,039	5.59E-11	2.50E-05	1.7
Technetium-99	14133-76-7	1567.7398	1.53E+08	2.75E-12	4.22E-04	29
Tritium	10028-17-8	192557.5	1.88E+10	5.07E-14	9.55E-04	66
Total ELCR					1.45E-03	100

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit River Unconfined Exposure Area Native American Risk Assessment (10-Year)--Summary of Yakima Drinking Water Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwater C_w (mg/L)	VOC?	HQ (Inhalation) (unitless)	HQ (Ingestion) (unitless)	HQ (Dermal) (unitless)	Total HI (unitless)	% Contribution
Acetone	0.0011	Yes	4.29E-07	6.98E-05	--	7.03E-05	0.0031
Arsenic	0.005767892	--	--(b)	1.10E+00	2.87E-03	1.10E+00	48
Barium	0.049451657	--	--(b)	1.41E-02	5.27E-04	1.47E-02	0.64
Carbon tetrachloride	0.00028	Yes	1.78E-05	2.29E-02	3.06E-03	2.59E-02	1.1
Chloride	12.545114	--	--(b)	--	--	--	
Chloroform	0.0023	Yes	2.84E-04	1.31E-02	5.99E-04	1.40E-02	0.61
Chromium	0.0141	--	--(b)	5.37E-04	1.08E-04	6.45E-04	0.028
Copper	0.00597989	--	--(b)	8.54E-03	2.23E-05	8.56E-03	0.37
Fluoride	0.30621978	--	--(b)	2.92E-01	7.61E-04	2.92E-01	13
Iron	0.61057915	--	--(b)	4.98E-02	1.30E-04	5.00E-02	2.2
Lead	0.000663667	--	--(b)	--	--	--	
Manganese	0.040717647	--	--(b)	9.69E-02	6.33E-03	1.03E-01	4.5
Nickel	0.0056	--	--(b)	1.60E-02	2.09E-04	1.62E-02	0.71
Nitrate	28.952	--	--(b)	2.33E-01	6.08E-04	2.34E-01	10.2
Nitrite	0.46	--	--(b)	8.76E-02	2.29E-04	8.78E-02	3.8
Strontium	0.38963943	--	--(b)	3.71E-02	9.69E-05	3.72E-02	1.6
Sulfate	41.899078	--	--(b)	--	--	--	
Thallium	0.00037	--	--(b)	--	--	--	
Uranium	0.005491757	--	--(b)	1.05E-01	2.73E-04	1.05E-01	4.6
Vanadium	0.0168	--	--(b)	1.92E-01	5.01E-04	1.93E-01	8.4
Zinc	0.006671161	--	--(b)	1.27E-03	1.99E-06	1.27E-03	0.056
Total			3.02E-04	2.27	0.02	2.28	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

HQ = hazard quotient.

HI = hazard index.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit River Unconfined Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Drinking Water Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwater C_w (mg/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Acetone	0.0011	Yes	--	--	--	--	
Arsenic	0.005767892	--	--(b)	5.45E-04	1.44E-06	5.46E-04	99
Barium	0.049451657	--	--(b)	--	--	--	
Carbon tetrachloride	0.00028	Yes	0.0000	2.29E-06	3.02E-07	2.64E-06	0.48
Chloride	12.545114	--	--(b)	--	--	--	
Chloroform	0.0023	Yes	0.0000	4.49E-06	2.01E-07	5.33E-06	0.96
Chromium	0.0141	--	--(b)	--	--	--	
Copper	0.00597989	--	--(b)	--	--	--	
Fluoride	0.30621978	--	--(b)	--	--	--	
Iron	0.61057915	--	--(b)	--	--	--	
Lead	0.000663667	--	--(b)	--	--	--	
Manganese	0.040717647	--	--(b)	--	--	--	
Nickel	0.0056	--	--(b)	--	--	--	
Nitrate	28.952	--	--(b)	--	--	--	
Nitrite	0.46	--	--(b)	--	--	--	
Strontium	0.38963943	--	--(b)	--	--	--	
Sulfate	41.899078	--	--(b)	--	--	--	
Thallium	0.00037	--	--(b)	--	--	--	
Uranium	0.005491757	--	--(b)	--	--	--	
Vanadium	0.0168	--	--(b)	--	--	--	
Zinc	0.006671161	--	--(b)	--	--	--	
Total ELCR			6.90E-07	5.51E-04	1.94E-06	5.54E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit River Unconfined Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Drinking Water Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	Contaminant Concentration in Groundwater C_w (pCi/L)	VOC?	Risk (Inhalation) (unitless)	Risk (Ingestion) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	2.8	--	--(b)	--	--	
Gross beta	22.2	--	--(b)	--	--	
Strontium-90	2.60	--	--(b)	1.42E-05	1.42E-05	3.86
Technetium-99	115	--	--(b)	3.09E-05	3.09E-05	8.4
Tritium	59,534	Yes	2.76E-05	2.95E-04	3.23E-04	88
Total ELCR			2.76E-05	3.40E-04	3.68E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--River exposure area - Yakima

Ingestion of Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Ingestion Chronic Daily Intake	CDI	calculated		mg/kg-day	EPA 1989
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	16	kg	Ridolfi, 2007
Drinking Water Ingestion Rate	IRW	4	2	Liters/day	Ridolfi, 2007
Age-Adjusted Drinking Water Ingestion Rate	IRWadj	4.407		L-yr/kg-day	Calculated using the age adjusted intake factors equation
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	6	yr	Ridolfi, 2007
Averaging time	AT	70	--	yr	Ridolfi, 2007
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFo	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 1989

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA, 2009 EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	RfD_o[a] (mg/kg-day)	HQ (unitless)	% Contribution
Acetone	67-64-1	0.0011	6.29E-05	0.90	6.98E-05	0.0031
Arsenic	7440-38-2	0.005767892	3.30E-04	3.00E-04	1.1	48
Barium	7440-39-3	0.049451657	2.83E-03	0.20	0.014	0.62
Carbon tetrachloride	56-23-5	0.00028	1.60E-05	7.00E-04	0.023	1.01
Chloride	16887-00-6	12.545114	7.17E-01	--	--	
Chloroform	67-66-3	0.0023	1.31E-04	0.010	0.0131	0.58
Chromium	7440-47-3	0.0141	8.06E-04	1.5	5.37E-04	0.024
Copper	7440-50-8	0.00597989	3.42E-04	0.040	0.0085	0.38
Fluoride	16984-48-8	0.30621978	1.75E-02	0.060	0.29	13
Iron	7439-89-6	0.61057915	3.49E-02	0.70	0.050	2.2
Lead	7439-92-1	0.000663667	3.79E-05	--	--	
Manganese	7439-96-5	0.040717647	2.33E-03	0.024	0.097	4.3
Nickel	7440-02-0	0.0056	3.20E-04	0.020	0.016	0.71
Nitrate	14797-55-8	28.952	1.65E+00	7.1	0.23	10.3
Nitrite	14797-65-0	0.46	2.63E-02	0.30	0.088	3.9
Strontium	7440-24-6	0.38963943	2.23E-02	0.60	0.037	1.6
Sulfate	14808-79-8	41.899078	2.39E+00	--	--	
Thallium	7440-28-0	0.00037	2.11E-05	--	--	
Uranium	7440-61-1	0.005491757	3.14E-04	0.0030	0.10	4.6
Vanadium	7440-62-2	0.0168	9.60E-04	0.0050	0.19	8.5
Zinc	7440-66-6	0.006671161	3.81E-04	0.30	0.0013	0.056
Total					2.3	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	CSF_o[a] $(mg/kg\text{-}day)^{-1}$	Risk (unitless)	% Contribution
Acetone	67-64-1	0.0011	6.93E-05	--	--	
Arsenic	7440-38-2	0.005767892	3.63E-04	1.50E+00	5.45E-04	99
Barium	7440-39-3	0.049451657	3.11E-03	--	--	
Carbon tetrachloride	56-23-5	0.00028	1.76E-05	1.30E-01	2.29E-06	0.42
Chloride	16887-00-6	12.545114	7.90E-01	--	--	
Chloroform	67-66-3	0.0023	1.45E-04	3.10E-02	4.49E-06	0.81
Chromium	7440-47-3	0.0141	8.88E-04	--	--	
Copper	7440-50-8	0.00597989	3.76E-04	--	--	
Fluoride	16984-48-8	0.30621978	1.93E-02	--	--	
Iron	7439-89-6	0.61057915	3.84E-02	--	--	
Lead	7439-92-1	0.000663667	4.18E-05	--	--	
Manganese	7439-96-5	0.040717647	2.56E-03	--	--	
Nickel	7440-02-0	0.0056	3.53E-04	--	--	
Nitrate	14797-55-8	28.952	1.82E+00	--	--	
Nitrite	14797-65-0	0.46	2.90E-02	--	--	
Strontium	7440-24-6	0.38963943	2.45E-02	--	--	
Sulfate	14808-79-8	41.899078	2.64E+00	--	--	
Thallium	7440-28-0	0.00037	2.33E-05	--	--	
Uranium	7440-61-1	0.005491757	3.46E-04	--	--	
Vanadium	7440-62-2	0.0168	1.06E-03	--	--	
Zinc	7440-66-6	0.006671161	4.20E-04	--	--	
Total ELCR					5.51E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--River exposure area - Yakima

Inhalation of Volatile Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Inhalation Chronic Daily Intake	CDI	calculated		mg/m^3 for noncarcinogens, $\mu g/m^3$ for carcinogens	EPA 2009b
Contaminant concentration in drinking water	C_w	contaminant-specific		mg/L	ECF-200PO1-09-2027
Exposure Time	ET	0.580	--	hours/day	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	--	yr	Ridolfi, 2007
Averaging Time	AT	70	--	yr	Ridolfi, 2007
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991
Inhalation Reference Concentration	RfC_i	Chemical Specific		mg/m^3	EPA 2009a
Inhalation Unit Risk	IUR	Chemical Specific		$(\mu g/m^3)^{-1}$	EPA 2009a
Conversion Factor	CF1	365		days/year	EPA 2009b
Conversion Factor	CF2	0.042		1day/24 hours	EPA 2009b

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA, 2009a EPA Region III Regional Screening Level downloaded December 2009. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

U.S. EPA 2009b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (noncarcinogen) (mg/m^3)	RfC[a] (mg/m^3)	HQ (unitless)	% Contribution
Acetone	67-64-1	Yes	0.0011	1.33E-05	3.10E+01	4.29E-07	0.14
Arsenic	7440-38-2	--	0.005767892	--(b)	1.50E-05	--(b)	
Barium	7440-39-3	--	0.049451657	--(b)	5.00E-04	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.00028	3.38E-06	1.90E-01	1.78E-05	6
Chloride	16887-00-6	--	12.545114	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.0023	2.78E-05	9.80E-02	2.84E-04	94
Chromium	7440-47-3	--	0.0141	--(b)	--	--(b)	
Copper	7440-50-8	--	0.00597989	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.30621978	--(b)	1.30E-02	--(b)	
Iron	7439-89-6	--	0.61057915	--(b)	--	--(b)	
Lead	7439-92-1	--	0.000663667	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.040717647	--(b)	5.00E-05	--(b)	
Nickel	7440-02-0	--	0.0056	--(b)	9.00E-05	--(b)	
Nitrate	14797-55-8	--	28.952	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.46	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.38963943	--(b)	--	--(b)	
Sulfate	14808-79-8	--	41.899078	--(b)	--	--(b)	
Thallium	7440-28-0	--	0.00037	--(b)	--	--(b)	
Uranium	7440-61-1	--	0.005491757	--(b)	3.00E-04	--(b)	
Vanadium	7440-62-2	--	0.0168	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.006671161	--(b)	--	--(b)	
Total						3.02E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Volatile[a]	Cw (mg/L)	CDI (carcinogen) ($\mu g/m^3$)	IUR[a] $(\mu g/m^3)^{-1}$	Risk (unitless)	% Contribution
Acetone	67-64-1	Yes	0.0011	1.33E-02	--	--	
Arsenic	7440-38-2	--	0.005767892	--(b)	4.30E-03	--(b)	
Barium	7440-39-3	--	0.049451657	--(b)	--	--(b)	
Carbon tetrachloride	56-23-5	Yes	0.00028	3.38E-03	1.50E-05	5.08E-08	7
Chloride	16887-00-6	--	12.545114	--(b)	--	--(b)	
Chloroform	67-66-3	Yes	0.0023	2.78E-02	2.30E-05	6.39E-07	93
Chromium	7440-47-3	--	0.0141	--(b)	--	--(b)	
Copper	7440-50-8	--	0.00597989	--(b)	--	--(b)	
Fluoride	16984-48-8	--	0.30621978	--(b)	--	--(b)	
Iron	7439-89-6	--	0.61057915	--(b)	--	--(b)	
Lead	7439-92-1	--	0.000663667	--(b)	--	--(b)	
Manganese	7439-96-5	--	0.040717647	--(b)	--	--(b)	
Nickel	7440-02-0	--	0.0056	--(b)	2.60E-04	--(b)	
Nitrate	14797-55-8	--	28.952	--(b)	--	--(b)	
Nitrite	14797-65-0	--	0.46	--(b)	--	--(b)	
Strontium	7440-24-6	--	0.38963943	--(b)	--	--(b)	
Sulfate	14808-79-8	--	41.899078	--(b)	--	--(b)	
Thallium	7440-28-0	--	0.00037	--(b)	--	--(b)	
Uranium	7440-61-1	--	0.005491757	--(b)	--	--(b)	
Vanadium	7440-62-2	--	0.0168	--(b)	--	--(b)	
Zinc	7440-66-6	--	0.006671161	--(b)	--	--(b)	
Total ELCR						6.90E-07	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--River exposure area - Yakima

Dermal Absorption of Nonradioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Parameter	Symbol	Adult	Child	Unit	Source
Contaminant concentration in Drinking Water	Cw	contaminant-specific		mg/L	ECF-200PO1-09-2027
Average Body Weight	BW	70	16	kg	Harris et al, 2004
Exposure Time	ET	0.58	1.0	hours/day	U.S. EPA, 2004
Exposure Time (Age-Adjusted)	ETadj	0.616		hours/day	Calculated using the age adjusted intake factors equation
Surface Area	SA	18,000	6,600	cm^2	Ridolfi, 2007
Age-Adjusted Surface Area	SAadj	18,932		(cm^2-yr-event)/(kg-day)	Calculated using the age adjusted intake factors equation
Event Frequency	EV	1.0	1.0	Event/days	U.S. EPA, 2004
Exposure Frequency	EF	365		days/yr	Ridolfi, 2007
Exposure Duration	ED	70	6.0	yr	Harris et al, 2004
Averaging time	AT	70	--	yr	Ridolfi, 2007
RfDo	Oral Reference Dose	Chemical Specific		mg/kg-day	EPA 2009
CSFO	Oral Cancer Slope Factor	Chemical Specific		$(mg/kg\text{-}day)^{-1}$	EPA 2009
CF2	Conversion Factor	365		days/year	EPA 2009
Conversion Factor	CF3	0.001		L/cm^3	1 L = 1000 cm^3
t*	Time to reach steady state	Chemical Specific		hours	EPA, 2004
B	Dermal Partitioning Constant	Chemical Specific		unitless	EPA, 2004
DA	Absorbed Dose per Event	Chemical Specific		(mg/cm^2-event)	Calculated using dermal exposure to groundwater equations as provided by U.S. EPA, 2004
Kp	Dermal Permeability Constant	Chemical Specific		cm/hour	EPA, 2004
FA	Fraction Absorbed	Chemical Specific		unitless	EPA, 2004
τ	Lag Time	Chemical Specific		hours	EPA, 2004

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

U.S. EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) Final

Absorbed Dermal Dose Calculation

Contaminant of Potential Concern	CAS #	Cw (mg/L)	Inorganic/organic[a]	FA^b (unitless)	$K_p{}^a$ (cm/hour)	B^b (unitless)	τ^b (hours/event)	t^{*b} (hours)	DA (noncancer) (mg/cm^2-event)	DA (cancer) (mg/cm^2-event)
Acetone[c]	67-64-1	0.0011	--	--	0.000512	--	--	--	--	--
Arsenic	7440-38-2	0.005767892	INORGANIC	--	0.001	--	--	--	3.35E-09	3.55E-09
Barium	7440-39-3	0.049451657	INORGANIC	--	0.001	--	--	--	2.87E-08	3.05E-08
Carbon tetrachloride	56-23-5	0.00028	--	1	0.016	0.1	0.78	1.86	8.33E-09	8.58E-09
Chloride	16887-00-6	12.545114	INORGANIC	--	0.001	--	--	--	7.28E-06	7.73E-06
Chloroform	67-66-3	0.0023	--	1	0.0068	0	0.5	1.19	2.33E-08	2.40E-08
Chromium	7440-47-3	0.0141	INORGANIC	--	0.001	--	--	--	8.18E-09	8.69E-09
Copper	7440-50-8	0.00597989	INORGANIC	--	0.001	--	--	--	3.47E-09	3.68E-09
Fluoride	16984-48-8	0.30621978	INORGANIC	--	0.001	--	--	--	1.78E-07	1.89E-07
Iron	7439-89-6	0.61057915	INORGANIC	--	0.001	--	--	--	3.54E-07	3.76E-07
Lead	7439-92-1	0.000663667	INORGANIC	--	0.0001	--	--	--	3.85E-11	4.09E-11
Manganese	7439-96-5	0.040717647	INORGANIC	--	0.001	--	--	--	2.36E-08	2.51E-08
Nickel	7440-02-0	0.0056	INORGANIC	--	0.0002	--	--	--	6.50E-10	6.90E-10
Nitrate	14797-55-8	28.952	INORGANIC	--	0.001	--	--	--	1.68E-05	1.78E-05
Nitrite	14797-65-0	0.46	INORGANIC	--	0.001	--	--	--	2.67E-07	2.83E-07
Strontium	7440-24-6	0.38963943	INORGANIC	--	0.001	--	--	--	2.26E-07	2.40E-07
Sulfate	14808-79-8	41.899078	INORGANIC	--	0.001	--	--	--	2.43E-05	2.58E-05
Thallium	7440-28-0	0.00037	INORGANIC	--	0.001	--	--	--	2.15E-10	2.28E-10
Uranium	7440-61-1	0.005491757	INORGANIC	--	0.001	--	--	--	3.19E-09	3.38E-09
Vanadium	7440-62-2	0.0168	INORGANIC	--	0.001	--	--	--	9.74E-09	1.03E-08
Zinc	7440-66-6	0.006671161	INORGANIC	--	0.0006	--	--	--	2.32E-09	2.47E-09

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

[a] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2

[b] EPA/540/R/99/005 Exhibit B-3

[c] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (noncarcinogen) (mg/kg-day)	$RfD_o{}^a$ (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone	67-64-1	0.0011	--	9.00E-01	1	--	
Arsenic	7440-38-2	0.005767892	8.60E-07	3.00E-04	1	0.0029	18
Barium	7440-39-3	0.049451657	7.38E-06	2.00E-01	0.07	5.27E-04	3.2
Carbon tetrachloride	56-23-5	0.00028	2.14E-06	7.00E-04	1	0.0031	18.75
Chloride	16887-00-6	12.545114	1.87E-03	--	1	--	
Chloroform	67-66-3	0.0023	5.99E-06	1.00E-02	1	5.99E-04	3.6683
Chromium	7440-47-3	0.0141	2.10E-06	1.50E+00	0.013	1.08E-04	0.66
Copper	7440-50-8	0.00597989	8.92E-07	4.00E-02	1	2.23E-05	0.14
Fluoride	16984-48-8	0.30621978	4.57E-05	6.00E-02	1	7.61E-04	4.7
Iron	7439-89-6	0.61057915	9.11E-05	7.00E-01	1	1.30E-04	0.8
Lead	7439-92-1	0.000663667	9.90E-09	--	1	--	
Manganese	7439-96-5	0.040717647	6.07E-06	2.40E-02	0.04	0.0063	39
Nickel	7440-02-0	0.0056	1.67E-07	2.00E-02	0.04	2.09E-04	1.3
Nitrate	14797-55-8	28.952	4.32E-03	7.10E+00	1	6.08E-04	3.7
Nitrite	14797-65-0	0.46	6.86E-05	3.00E-01	1	2.29E-04	1.4
Strontium	7440-24-6	0.38963943	5.81E-05	6.00E-01	1	9.69E-05	0.59
Sulfate	14808-79-8	41.899078	6.25E-03	--	--	--	
Thallium	7440-28-0	0.00037	5.52E-08	--	1	--	
Uranium	7440-61-1	0.005491757	8.19E-07	3.00E-03	1	2.73E-04	1.7
Vanadium	7440-62-2	0.0168	2.51E-06	5.00E-03	1	5.01E-04	3.1
Zinc	7440-66-6	0.006671161	5.97E-07	3.00E-01	1	1.99E-06	0.012
Total						0.016	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

HQ = hazard quotient.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	Cw (mg/L)	CDI (carcinogen) (mg/kg-day)	$CSF_o{}^a$ $(mg/kg\text{-}day)^{-1}$	GIABS[a] (unitless)	Risk (unitless)	Risk (unitless)
Acetone	67-64-1	0.0011	--	--	1	--	
Arsenic	7440-38-2	0.005767892	9.61E-07	1.50E+00	1	1.44E-06	74
Barium	7440-39-3	0.049451657	8.24E-06	--	0.07	--	
Carbon tetrachloride	56-23-5	0.00028	2.32E-06	1.30E-01	1	3.02E-07	16
Chloride	16887-00-6	12.545114	2.09E-03	--	1	--	
Chloroform	67-66-3	0.0023	6.49E-06	3.10E-02	1	2.01E-07	10.3
Chromium	7440-47-3	0.0141	2.35E-06	--	0.013	--	
Copper	7440-50-8	0.00597989	9.96E-07	--	1	--	
Fluoride	16984-48-8	0.30621978	5.10E-05	--	1	--	
Iron	7439-89-6	0.61057915	1.02E-04	--	1	--	
Lead	7439-92-1	0.000663667	1.11E-08	--	1	--	
Manganese	7439-96-5	0.040717647	6.78E-06	--	0.04	--	
Nickel	7440-02-0	0.0056	1.87E-07	--	0.04	--	
Nitrate	14797-55-8	28.952	4.82E-03	--	1	--	
Nitrite	14797-65-0	0.46	7.66E-05	--	1	--	
Strontium	7440-24-6	0.38963943	6.49E-05	--	1	--	
Sulfate	14808-79-8	41.899078	6.98E-03	--	--	--	
Thallium	7440-28-0	0.00037	6.16E-08	--	1	--	
Uranium	7440-61-1	0.005491757	9.15E-07	--	1	--	
Vanadium	7440-62-2	0.0168	2.80E-06	--	1	--	
Zinc	7440-66-6	0.006671161	6.67E-07	--	1	--	
Total ELCR						1.94E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--River exposure area - Yakima

Inhalation of Volatile Radioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Factor	Symbol	Adult	Child	Unit	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Ridolfi, 2007
Exposure duration	ED	70	6	years	Ridolfi, 2007
Inhalation Rate	INH	26	16	m^3/day	Ridolfi, 2007
Exposure time	ET	0.58	1	hr/day	U.S. EPA, 2004
Age Adjusted Exposure Time	ET_{adj}	0.616		hrs	Calculated using the age adjusted intake factors equation
Radiation Age-adjusted inhalation rate	INH_RAD_{adj}	1760		m^3-yr/day	Calculated using the age adjusted intake factors equation
Andelman Volatilization Factor	VF	0.5		m^3/kg	U.S. EPA, 1991b
Radiation Inhalation of Volatiles Slope Factor	SfI	Chemical Specific		risk/pCi	U.S. EPA, 1997

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Inhalation of Volatile Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	VOC[a]	Cw (pCi/L)	CDI (radiological inhalation) (pCi)	SF_I (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	2.8	--(b)	--	--(b)	
Gross beta	12587-47-2	--	22.2	--(b)	--	--(b)	
Strontium-90	10098-97-2	--	2.60	--(b)	1.05E-10	--(b)	
Technetium-99	14133-76-7	--	115	--(b)	1.41E-11	--(b)	
Tritium	10028-17-8	Yes	59,534	4.91E+08	5.62E-14	2.76E-05	100
Total ELCR						2.76E-05	100

[a] Radiological contaminants considered volatile for the groundwater inhalation pathway are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

[b] Nonvolatile constituents are not considered in the inhalation of groundwater in the drinking water pathway

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--River exposure area - Yakima

Ingestion of Radioactive Compounds in Drinking Water - CTUIR

Intake Parameter Values		Value			
Factor	Symbol	Unit		Value	Reference
Chronic Daily Intake	CDI	calculated		pCi	EPA 1989
Contaminant concentration in drinking water	C_w	contaminant-specific		pCi/l	ECF-200PO1-09-2027
Exposure frequency	EF	365	365	days/year	Ridolfi, 2007
Exposure duration	ED	70	6	years	Ridolfi, 2007
Drinking Water Ingestion Rate	IRW	4	2	L/day	Ridolfi, 2007
Radiation Age-adjusted drinking water ingestion rate	IRW_RAD_{adj}	268		L-yr/day	Calculated using the age adjusted intake factors equation
Radiation Ingestion of Water Slope Factor	Sfo	Chemical Specific		risk/pCi	U.S. EPA, 1997

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

ECF-200PO1-09-2027: Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

U.S. EPA 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals).

U.S. EPA, 1997 US EPA Health Effects Assessment Summary Tables (HEAST) fy 1997 Update. EPA-540-R-97-036. July 1997.

U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)

Ingestion of Radioactive Constituents in Groundwater

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	Cw (pCi/L)	CDI (radiological ingestion) (pCi)	SF_o (risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	2.8	271,228	--	--	
Gross beta	12587-47-2	22.2	2,171,821	--	--	
Strontium-90	10098-97-2	2.60	254,332	5.59E-11	1.42E-05	4
Technetium-99	14133-76-7	115	1.12E+07	2.75E-12	3.09E-05	9
Tritium	10028-17-8	59,534	5.82E+09	5.07E-14	2.95E-04	86.8
Total ELCR					3.40E-04	100

U.S. EPA 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response.

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
Acetone	67-64-1	VOC	0.0011	--(c)	--	--	--	
Arsenic	7440-38-2	--	0.005767892	1.37E-05	4.30E-03	1.51E+01	2.06E-04	94
Barium	7440-39-3	--	0.049451657	1.17E-04	--	--	--	
Carbon tetrachloride	56-23-5	VOC	0.000271961	--(c)	1.50E-05	5.25E-02	--	
Chloride	16887-00-6	--	11.3727	2.69E-02	--	--	--	
Chloroform	67-66-3	VOC	0.000814875	--(c)	2.30E-05	8.05E-02	--	
Chromium	7440-47-3	--	0.009951236	2.36E-05	--	--	--	
Copper	7440-50-8	--	0.00597989	1.42E-05	--	--	--	
Fluoride	16984-48-8	--	0.28680392	6.79E-04	--	--	--	
Iron	7439-89-6	--	0.61057915	1.45E-03	--	--	--	
Lead	7439-92-1	--	0.0006805	1.61E-06	--	--	--	
Manganese	7439-96-5	--	0.041694118	9.88E-05	--	--	--	
Nickel	7440-02-0	--	0.0056	1.33E-05	2.60E-04	9.10E-01	1.21E-05	5.5
Nitrate	14797-55-8	--	28.582087	6.77E-02	--	--	--	
Nitrite	14797-65-0	--	0.46	1.09E-03	--	--	--	
Strontium	7440-24-6	--	0.38963943	9.23E-04	--	--	--	
Sulfate	14808-79-8	--	42.560202	1.01E-01	--	--	--	
Thallium	7440-28-0	--	0.00037	8.76E-07	--	--	--	
Uranium	7440-61-1	--	0.005589723	1.32E-05	--	--	--	
Vanadium	7440-62-2	--	0.016788235	3.98E-05	--	--	--	
Zinc	7440-66-6	--	0.006671161	1.58E-05	--	--	--	
Total ELCR							2.18E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of volatile compounds in vapor is presented in Table C-18

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--river exposure area-- CTUIR

Hazard quotient and cancer risk from dermal exposure to VOCs/SVOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water (*Id,l*)
can be neglected and total dermal intake (*Id,total*) is equal to dermal intake from VOCs/SVOCs in sweat lodge vapor (*Id,v*)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 3)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF1	0.01	m/cm
Conversion factor	CF2	365	day/yr

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone[c]	67-64-1	VOC	0.0011	0.000512	1.38E-10	9.00E-01	1	1.54E-10	0.0092
Arsenic	7440-38-2	--	0.005767892	0.001	--(c)	3.00E-04	1	--	
Barium	7440-39-3	--	0.049451657	0.001	--(c)	2.00E-01	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.000271961	0.016	1.07E-09	7.00E-04	1	1.53E-06	92
Chloride	16887-00-6	--	11.3727	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.000814875	0.0068	1.36E-09	1.00E-02	1	1.36E-07	8.2
Chromium	7440-47-3	--	0.009951236	0.001	--(c)	1.50E+00	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	--(c)	4.00E-02	1	--	
Fluoride	16984-48-8	--	0.28680392	0.001	--(c)	6.00E-02	1	--	
Iron	7439-89-6	--	0.61057915	0.001	--(c)	7.00E-01	1	--	
Lead	7439-92-1	--	0.0006805	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.041694118	0.001	--(c)	2.40E-02	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	--(c)	2.00E-02	0.04	--	
Nitrate	14797-55-8	--	28.582087	0.001	--(c)	7.10E+00	1	--	
Nitrite	14797-65-0	--	0.46	0.001	--(c)	3.00E-01	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	--(c)	6.00E-01	1	--	
Sulfate	14808-79-8	--	42.560202	0.001	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	--(c)	--	1	--	
Uranium	7440-61-1	--	0.005589723	0.001	--(c)	3.00E-03	1	--	
Vanadium	7440-62-2	--	0.016788235	0.001	--(c)	5.00E-03	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	--(c)	3.00E-01	1	--	
Total								1.66E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit 8-2 (organics).

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table C-22

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.
VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] $(mg/kg\text{-}day)^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
Acetone[c]	67-64-1	VOC	0.0011	0.000512	1.34E-10	--	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	--(c)	1.50E+00	1	--	
Barium	7440-39-3	--	0.049451657	0.001	--(c)	--	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.000271961	0.016	1.04E-09	1.30E-01	1	1.35E-10	77
Chloride	16887-00-6	--	11.3727	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.000814875	0.0068	1.32E-09	3.10E-02	1	4.10E-11	23
Chromium	7440-47-3	--	0.009951236	0.001	--(c)	--	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	--(c)	--	1	--	
Fluoride	16984-48-8	--	0.28680392	0.001	--(c)	--	1	--	
Iron	7439-89-6	--	0.61057915	0.001	--(c)	--	1	--	
Lead	7439-92-1	--	0.0006805	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.041694118	0.001	--(c)	--	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	--(c)	--	0.04	--	
Nitrate	14797-55-8	--	28.582087	0.001	--(c)	--	1	--	
Nitrite	14797-65-0	--	0.46	0.001	--(c)	--	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	--(c)	--	1	--	
Sulfate	14808-79-8	--	42.560202	0.001	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	--(c)	--	1	--	
Uranium	7440-61-1	--	0.005589723	0.001	--(c)	--	1	--	
Vanadium	7440-62-2	--	0.016788235	0.001	--(c)	--	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	--(c)	--	1	--	
Total ELCR								1.76E-10	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table C-22

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--river exposure area-- CTUIR

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge condensed water
Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4)
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
Model assumes concentration of nonvolatiles in condensed water is equal to concentration in water used to create steam

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from liquid	$I_{d,l}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,l}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	9.00E-01	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	1.48E-06	3.00E-04	1	4.94E-03	23
Barium	7440-39-3	--	0.049451657	0.001	1.27E-05	2.00E-01	0.07	9.08E-04	4.1
Carbon tetrachloride	56-23-5	VOC	0.000271961	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	11.3727	0.001	2.92E-03	--	1	--	
Chloroform	67-66-3	VOC	0.000814875	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.009951236	0.001	2.56E-06	1.50E+00	0.013	1.31E-04	0.60
Copper	7440-50-8	--	0.00597989	0.001	1.54E-06	4.00E-02	1	3.84E-05	0.18
Fluoride	16984-48-8	--	0.28680392	0.001	7.37E-05	6.00E-02	1	1.23E-03	5.6
Iron	7439-89-6	--	0.61057915	0.001	1.57E-04	7.00E-01	1	2.24E-04	1.0
Lead	7439-92-1	--	0.0006805	0.0001	1.75E-08	--	1	--	
Manganese	7439-96-5	--	0.041694118	0.001	1.07E-05	2.40E-02	0.04	1.12E-02	51
Nickel	7440-02-0	--	0.0056	0.0002	2.88E-07	2.00E-02	0.04	3.60E-04	1.6
Nitrate	14797-55-8	--	28.582087	0.001	7.35E-03	7.10E+00	1	1.04E-03	4.7
Nitrite	14797-65-0	--	0.46	0.001	1.18E-04	3.00E-01	1	3.94E-04	1.8
Strontium	7440-24-6	--	0.38963943	0.001	1.00E-04	6.00E-01	1	1.67E-04	0.76
Sulfate	14808-79-8	--	42.560202	0.001	1.09E-02	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	9.51E-08	--	1	--	
Uranium	7440-61-1	--	0.005589723	0.001	1.44E-06	3.00E-03	1	4.79E-04	2.2
Vanadium	7440-62-2	--	0.016788235	0.001	4.32E-06	5.00E-03	1	8.63E-04	3.9
Zinc	7440-66-6	--	0.006671161	0.0006	1.03E-06	3.00E-01	1	3.43E-06	0.016
Total								0.022	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	HQ (Inhalation) (Volatiles) (unitless)	HQ (Inhalation) (Nonvolatiles) (unitless)	HQ (Dermal, Vapor, volatiles) (unitless)	HQ (Dermal, Liquid, Nonvolatiles) (unitless)	HQ (Dermal, Vapor, Nonvolatiles) (unitless)	Total HI (unitless)	% Contribution
1,1,1-Trichloroethane	0.000691076	VOC	6.87E-06	--	1.10E-09	--	--	6.88E-06	6.35E-05
1,1-Dichloroethane	0.000255649	VOC	1.82E-05	--	2.10E-09	--	--	1.82E-05	1.68E-04
1,1-Dichloroethene	0.00016874	VOC	4.20E-05	--	9.94E-09	--	--	4.20E-05	3.88E-04
1,2-Dichlorobenzene	0.003	VOC	7.46E-04	--	3.36E-07	--	--	7.46E-04	0.0069
1,4-Dichlorobenzene	0.000130957	VOC	8.14E-06	--	1.93E-08	--	--	8.16E-06	7.54E-05
1,4-Dioxane	0.0081	SVOC	1.12E-04	--	6.56E-09	--	--	1.12E-04	0.0010
2-Butanone	0.00055	VOC	5.47E-06	--	2.16E-10	--	--	5.47E-06	5.05E-05
2-Pentanone, 4-Methyl	0.00064	VOC	1.06E-05	--	5.30E-09	--	--	1.06E-05	9.80E-05
Acetone	0.001511507	VOC	2.43E-06	--	2.11E-10	--	--	2.43E-06	2.24E-05
Arsenic	0.003140238	--	--	1.79	--	2.69E-03	4.41E-07	1.79E+00	17
Barium	0.072881156	--	--	1.24	--	1.34E-03	2.19E-07	1.25E+00	11
Bis(2-ethylhexyl) phthalate	0.001	SVOC	--	--	3.07E-07	--	--	3.07E-07	2.83E-06
Cadmium	0.0045	--	--	3.84	--	4.63E-02	7.58E-06	3.89E+00	36
Carbon disulfide	0.00021	VOC	1.49E-05	--	8.77E-09	--	--	1.49E-05	1.38E-04
Carbon tetrachloride	0.000170123	VOC	4.45E-05	--	9.55E-07	--	--	4.55E-05	4.20E-04
Chloride	9.9702351	--	--	--	--	--	--	--	
Chloroform	0.000214204	VOC	1.09E-04	--	3.58E-08	--	--	1.09E-04	0.0010
Chromium	0.009493374	--	--	--	--	1.25E-04	2.05E-08	1.25E-04	0.0012
Copper	0.004884201	--	--	--	--	3.14E-05	5.14E-09	3.14E-05	2.90E-04
Fluoride	0.30080145	--	--	0.20	--	1.29E-03	2.11E-07	1.99E-01	1.8
Iron	0.12126178	--	--	--	--	4.45E-05	7.30E-09	4.46E-05	4.11E-04
Lead	0.000581898	--	--	--	--	--	--	--	
Manganese	0.015530827	--	--	2.65	--	4.16E-03	6.82E-07	2.66E+00	25
Methylene chloride	0.002069589	VOC	1.03E-04	--	2.96E-08	--	--	1.03E-04	9.51E-04
Nickel	0.006014142	--	--	0.57	--	3.87E-04	6.34E-08	5.71E-01	5.3
Nitrate	23.863649	--	--	--	--	8.64E-04	1.42E-07	8.64E-04	0.0080
Nitrite	0.081906164	--	--	--	--	7.02E-05	1.15E-08	7.02E-05	6.48E-04
Silver	0.005776818	--	--	--	--	4.46E-03	7.30E-07	4.46E-03	0.041
Strontium	0.38364144	--	--	--	--	1.64E-04	2.69E-08	1.64E-04	0.0015
Sulfate	45.030868	--	--	--	--	--	--	--	
Tetrachloroethene	0.000872033	VOC	1.61E-04	--	7.07E-07	--	--	1.61E-04	0.0015
Tributyl phosphate	0.012498806	SVOC	--	--	3.50E-07	--	--	3.50E-07	3.23E-06
Trichloroethene	0.000433871	VOC	6.17E-04	--	--	--	--	6.17E-04	0.0057
Trichloromonofluoromethane	0.00058	VOC	4.12E-05	--	6.17E-09	--	--	4.12E-05	3.81E-04
Uranium	0.016629145	--	--	0.47	--	1.43E-03	2.34E-07	4.74E-01	4.4
Vanadium	0.012904693	--	--	--	--	6.64E-04	1.09E-07	6.64E-04	0.0061
Zinc	0.068859746	--	--	--	--	3.54E-05	5.80E-09	3.54E-05	3.27E-04
Total			2.04E-03	1.08E+01	2.78E-06	6.40E-02	1.05E-05	10.83	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.
Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
HQ = hazard quotient.
HI = hazard index.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal, Vapor, volatiles) (unitless)	Risk (Dermal, Liquid, Nonvolatiles) (unitless)	Risk (Dermal, Vapor, Nonvolatiles) (unitless)	Total Risk (unitless)	% Contribution
1,1,1-Trichloroethane	0.000691076	VOC	--	--	--	--	--	--	
1,1-Dichloroethane	0.000255649	VOC	--	--	--	--	--	--	
1,1-Dichloroethene	0.00016874	VOC	--	--	--	--	--	--	
1,2-Dichlorobenzene	0.003	VOC	--	--	--	--	--	--	
1,4-Dichlorobenzene	0.000130957	VOC	6.96E-08	--	7.08E-12	--	--	6.96E-08	0.035
1,4-Dioxane	0.0081	SVOC	3.01E-06	--	7.01E-12	--	--	3.01E-06	1.5
2-Butanone	0.00055	VOC	--	--	--	--	--	--	
2-Pentanone, 4-Methyl	0.00064	VOC	--	--	--	--	--	--	
Acetone	0.001511507	VOC	--	--	--	--	--	--	
Arsenic	0.003140238	--	--	1.12E-04	--	1.18E-06	1.93E-10	1.13E-04	57
Barium	0.072881156	--	--	--	--	--	--	--	
Bis(2-ethylhexyl) phthalate	0.001	SVOC	1.16E-07	--	8.35E-11	--	--	1.16E-07	0.059
Cadmium	0.0045	--	--	6.72E-05	--	--	--	6.72E-05	34
Carbon disulfide	0.00021	VOC	--	--	--	--	--	--	
Carbon tetrachloride	0.000170123	VOC	1.23E-07	--	8.44E-11	--	--	1.23E-07	0.062
Chloride	9.9702351	--	--	--	--	--	--	--	
Chloroform	0.000214204	VOC	2.38E-07	--	1.08E-11	--	--	2.38E-07	0.12
Chromium	0.009493374	--	--	--	--	--	--	--	
Copper	0.004884201	--	--	--	--	--	--	--	
Fluoride	0.30080145	--	--	--	--	--	--	--	
Iron	0.12126178	--	--	--	--	--	--	--	
Lead	0.000581898	--	--	--	--	--	--	--	
Manganese	0.015530827	--	--	--	--	--	--	--	
Methylene chloride	0.002069589	VOC	4.70E-08	--	1.30E-11	--	--	4.70E-08	0.024
Nickel	0.006014142	--	--	1.30E-05	--	--	--	1.30E-05	6.6
Nitrate	23.863649	--	--	--	--	--	--	--	
Nitrite	0.081906164	--	--	--	--	--	--	--	
Silver	0.005776818	--	--	--	--	--	--	--	
Strontium	0.38364144	--	--	--	--	--	--	--	
Sulfate	45.030868	--	--	--	--	--	--	--	
Tetrachloroethene	0.000872033	VOC	2.49E-07	--	3.71E-09	--	--	2.52E-07	0.13
Tributyl phosphate	0.012498806	SVOC	--	--	6.25E-10	--	--	6.25E-10	3.16E-04
Trichloroethene	0.000433871	VOC	5.24E-07	--	1.11E-10	--	--	5.24E-07	0.27
Trichloromonofluoromethane	0.00058	VOC	--	--	--	--	--	--	
Uranium	0.016629145	--	--	--	--	--	--	--	
Vanadium	0.012904693	--	--	--	--	--	--	--	
Zinc	0.068859746	--	--	--	--	--	--	--	
Total ELCR			4.38E-06	1.92E-04	4.65E-09	1.18E-06	1.93E-10	1.98E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.
ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (pCi/L)	Volatile?[a]	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	6.4100896	--	--	--	--	--	
Gross beta	32.397036	--	--	--	--	--	
Iodine-129	1.9883847	--	--	5.11E-07	--	5.11E-07	0.12
Nickel-63	4.07	--	--	2.83E-08	--	2.83E-08	0.0065
Protactinium-231	0.308	--	--	5.94E-05	--	5.94E-05	14
Strontium-90	0.611	--	--	2.72E-07	--	2.72E-07	0.063
Technetium-99	93.996334	--	--	5.61E-06	--	5.61E-06	1.3
Tritium	264106.86	Yes	3.66E-04	--	--	3.66E-04	85
Total ELCR			3.66E-04	6.58E-05	--	4.32E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area -- CTUIR

Hazard quotient and cancer risk from inhalation of VOCs/SVOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Contaminant concentration in water	C_{dw}	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF	365	day/yr

[a] Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	9.82E-06	5.00E+00	1.43E+00	6.87E-06	0.34
1,1-Dichloroethane	75-34-3	VOC	0.000255649	3.63E-06	7.00E-01	2.00E-01	1.82E-05	0.89
1,1-Dichloroethene	75-35-4	VOC	0.00016874	2.40E-06	2.00E-01	5.71E-02	4.20E-05	2.1
1,2-Dichlorobenzene	95-50-1	VOC	0.003	4.26E-05	2.00E-01	5.71E-02	7.46E-04	37
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	1.86E-06	8.00E-01	2.29E-01	8.14E-06	0.40
1,4-Dioxane	123-91-1	SVOC	0.0081	1.15E-04	3.60E+00	1.03E+00	1.12E-04	5.5
2-Butanone	78-93-3	VOC	0.00055	7.82E-06	5.00E+00	1.43E+00	5.47E-06	0.27
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	9.09E-06	3.00E+00	8.57E-01	1.06E-05	0.52
Acetone	67-64-1	VOC	0.001511507	2.15E-05	3.10E+01	8.86E+00	2.43E-06	0.12
Arsenic	7440-38-2	--	0.003140238	--(c)	1.50E-05	4.29E-06	--	
Barium	7440-39-3	--	0.072881156	--(c)	5.00E-04	1.43E-04	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	1.42E-05	--	--	--	
Cadmium	7440-43-9	--	0.0045	--(c)	1.00E-05	2.86E-06	--	
Carbon disulfide	75-15-0	VOC	0.00021	2.98E-06	7.00E-01	2.00E-01	1.49E-05	0.73
Carbon tetrachloride	56-23-5	VOC	0.000170123	2.42E-06	1.90E-01	5.43E-02	4.45E-05	2.2
Chloride	16887-00-6	--	9.9702351	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.000214204	3.04E-06	9.80E-02	2.80E-02	1.09E-04	5.3
Chromium	7440-47-3	--	0.009493374	--(c)	--	--	--	
Copper	7440-50-8	--	0.004884201	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.30080145	--(c)	1.30E-02	3.71E-03	--	
Iron	7439-89-6	--	0.12126178	--(c)	--	--	--	
Lead	7439-92-1	--	0.000581898	--(c)	--	--	--	
Manganese	7439-96-5	--	0.015530827	--(c)	5.00E-05	1.43E-05	--	
Methylene chloride	75-09-2	VOC	0.002069589	2.94E-05	1.00E+00	2.86E-01	1.03E-04	5.0
Nickel	7440-02-0	--	0.006014142	--(c)	9.00E-05	2.57E-05	--	
Nitrate	14797-55-8	--	23.863649	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.081906164	--(c)	--	--	--	
Silver	7440-22-4	--	0.005776818	--(c)	--	--	--	
Strontium	7440-24-6	--	0.38364144	--(c)	--	--	--	
Sulfate	14808-79-8	--	45.030868	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	1.24E-05	2.70E-01	7.71E-02	1.61E-04	7.9
Tributyl phosphate	126-73-8	SVOC	0.012498806	1.78E-04	--	--	--	
Trichloroethene	79-01-6	VOC	0.000433871	6.17E-06	3.50E-02	1.00E-02	6.17E-04	30
Trichloromonofluoromethane	75-69-4	VOC	0.00058	8.24E-06	7.00E-01	2.00E-01	4.12E-05	2.0

Uranium	7440-61-1	--	0.016629145	--(c)	3.00E-04	8.57E-05	--	
Vanadium	7440-62-2	--	0.012904693	--(c)	--	--	--	
Zinc	7440-66-6	--	0.068859746	--(c)	--	--	--	
Total							2.04E-03	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of nonvolatile chemicals is presented in table C-3

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	9.54E-06	--	--	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	3.53E-06	--	--	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	2.33E-06	--	--	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	4.14E-05	--	--	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	1.81E-06	1.10E-05	3.85E-02	6.96E-08	1.6
1,4-Dioxane	123-91-1	SVOC	0.0081	1.12E-04	7.70E-06	2.70E-02	3.01E-06	69
2-Butanone	78-93-3	VOC	0.00055	7.59E-06	--	--	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	8.83E-06	--	--	--	
Acetone	67-64-1	VOC	0.001511507	2.09E-05	--	--	--	
Arsenic	7440-38-2	--	0.003140238	--(c)	4.30E-03	1.51E+01	--	
Barium	7440-39-3	--	0.072881156	--(c)	--	--	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	1.38E-05	2.40E-06	8.40E-03	1.16E-07	2.6
Cadmium	7440-43-9	--	0.0045	--(c)	1.80E-03	6.30E+00	--	
Carbon disulfide	75-15-0	VOC	0.00021	2.90E-06	--	--	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	2.35E-06	1.50E-05	5.25E-02	1.23E-07	2.8
Chloride	16887-00-6	--	9.9702351	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.000214204	2.96E-06	2.30E-05	8.05E-02	2.38E-07	5.4
Chromium	7440-47-3	--	0.009493374	--(c)	--	--	--	
Copper	7440-50-8	--	0.004884201	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.30080145	--(c)	--	--	--	
Iron	7439-89-6	--	0.12126178	--(c)	--	--	--	
Lead	7439-92-1	--	0.000581898	--(c)	--	--	--	
Manganese	7439-96-5	--	0.015530827	--(c)	--	--	--	
Methylene chloride	75-09-2	VOC	0.002069589	2.86E-05	4.70E-07	1.65E-03	4.70E-08	1.1
Nickel	7440-02-0	--	0.006014142	--(c)	2.60E-04	9.10E-01	--	
Nitrate	14797-55-8	--	23.863649	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.081906164	--(c)	--	--	--	
Silver	7440-22-4	--	0.005776818	--(c)	--	--	--	
Strontium	7440-24-6	--	0.38364144	--(c)	--	--	--	
Sulfate	14808-79-8	--	45.030868	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	1.20E-05	5.90E-06	2.07E-02	2.49E-07	5.7
Tributyl phosphate	126-73-8	SVOC	0.012498806	1.73E-04	--	--	--	
Trichloroethene	79-01-6	VOC	0.000433871	5.99E-06	2.50E-05	8.75E-02	5.24E-07	12
Trichloromonofluoromethane	75-69-4	VOC	0.00058	8.01E-06	--	--	--	
Uranium	7440-61-1	--	0.016629145	--(c)	--	--	--	
Vanadium	7440-62-2	--	0.012904693	--(c)	--	--	--	
Zinc	7440-66-6	--	0.068859746	--(c)	--	--	--	
Total ELCR							4.38E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of nonvolatile chemicals is presented in table C-3

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area -- CTUIR

Hazard quotient and cancer risk from inhalation of non-VOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 2)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion Factor	CF	365	day/yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L

[a] Harris (2008)

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	--(c)	5.00E+00	1.43E+00	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	--(c)	7.00E-01	2.00E-01	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	--(c)	2.00E-01	5.71E-02	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	--(c)	2.00E-01	5.71E-02	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	--(c)	8.00E-01	2.29E-01	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	--(c)	3.60E+00	1.03E+00	--	
2-Butanone	78-93-3	VOC	0.00055	--(c)	5.00E+00	1.43E+00	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	--(c)	3.00E+00	8.57E-01	--	
Acetone	67-64-1	VOC	0.001511507	--(c)	3.10E+01	8.86E+00	--	
Arsenic	7440-38-2	--	0.003140238	7.66E-06	1.50E-05	4.29E-06	1.79	17
Barium	7440-39-3	--	0.072881156	1.78E-04	5.00E-04	1.43E-04	1.24	12
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	--(c)	--	--	--	
Cadmium	7440-43-9	--	0.0045	1.10E-05	1.00E-05	2.86E-06	3.84	36
Carbon disulfide	75-15-0	VOC	0.00021	--(c)	7.00E-01	2.00E-01	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	--(c)	1.90E-01	5.43E-02	--	
Chloride	16887-00-6	--	9.9702351	2.43E-02	--	--	--	
Chloroform	67-66-3	VOC	0.000214204	--(c)	9.80E-02	2.80E-02	--	
Chromium	7440-47-3	--	0.009493374	2.31E-05	--	--	--	
Copper	7440-50-8	--	0.004884201	1.19E-05	--	--	--	
Fluoride	16984-48-8	--	0.30080145	7.33E-04	1.30E-02	3.71E-03	0.20	1.8
Iron	7439-89-6	--	0.12126178	2.96E-04	--	--	--	
Lead	7439-92-1	--	0.000581898	1.42E-06	--	--	--	
Manganese	7439-96-5	--	0.015530827	3.79E-05	5.00E-05	1.43E-05	2.65	25
Methylene chloride	75-09-2	VOC	0.002069589	--(c)	1.00E+00	2.86E-01	--	
Nickel	7440-02-0	--	0.006014142	1.47E-05	9.00E-05	2.57E-05	0.57	5.3
Nitrate	14797-55-8	--	23.863649	5.82E-02	--	--	--	
Nitrite	14797-65-0	--	0.081906164	2.00E-04	--	--	--	
Silver	7440-22-4	--	0.005776818	1.41E-05	--	--	--	
Strontium	7440-24-6	--	0.38364144	9.35E-04	--	--	--	
Sulfate	14808-79-8	--	45.030868	1.10E-01	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	--(c)	2.70E-01	7.71E-02	--	
Tributyl phosphate	126-73-8	SVOC	0.012498806	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000433871	--(c)	3.50E-02	1.00E-02	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	--(c)	7.00E-01	2.00E-01	--	
Uranium	7440-61-1	--	0.016629145	4.05E-05	3.00E-04	8.57E-05	0.47	4.4
Vanadium	7440-62-2	--	0.012904693	3.15E-05	--	--	--	
Zinc	7440-66-6	--	0.068859746	1.68E-04	--	--	--	
Total							11	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of volatile compounds in vapor is presented in Table C-2

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
HQ = hazard quotient.
SVOC = semivolatile organic compound.
VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	--(c)	--	--	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	--(c)	--	--	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	--(c)	--	--	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	--(c)	--	--	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	--(c)	1.10E-05	3.85E-02	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	--(c)	7.70E-06	2.70E-02	--	
2-Butanone	78-93-3	VOC	0.00055	--(c)	--	--	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	--(c)	--	--	--	
Acetone	67-64-1	VOC	0.001511507	--(c)	--	--	--	
Arsenic	7440-38-2	--	0.003140238	7.44E-06	4.30E-03	1.51E+01	1.12E-04	58
Barium	7440-39-3	--	0.072881156	1.73E-04	--	--	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	--(c)	2.40E-06	8.40E-03	--	
Cadmium	7440-43-9	--	0.0045	1.07E-05	1.80E-03	6.30E+00	6.72E-05	35
Carbon disulfide	75-15-0	VOC	0.00021	--(c)	--	--	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	--(c)	1.50E-05	5.25E-02	--	
Chloride	16887-00-6	--	9.9702351	2.36E-02	--	--	--	
Chloroform	67-66-3	VOC	0.000214204	--(c)	2.30E-05	8.05E-02	--	
Chromium	7440-47-3	--	0.009493374	2.25E-05	--	--	--	
Copper	7440-50-8	--	0.004884201	1.16E-05	--	--	--	
Fluoride	16984-48-8	--	0.30080145	7.13E-04	--	--	--	
Iron	7439-89-6	--	0.12126178	2.87E-04	--	--	--	
Lead	7439-92-1	--	0.000581898	1.38E-06	--	--	--	
Manganese	7439-96-5	--	0.015530827	3.68E-05	--	--	--	
Methylene chloride	75-09-2	VOC	0.002069589	--(c)	4.70E-07	1.65E-03	--	
Nickel	7440-02-0	--	0.006014142	1.42E-05	2.60E-04	9.10E-01	1.30E-05	6.7
Nitrate	14797-55-8	--	23.863649	5.65E-02	--	--	--	
Nitrite	14797-65-0	--	0.081906164	1.94E-04	--	--	--	
Silver	7440-22-4	--	0.005776818	1.37E-05	--	--	--	
Strontium	7440-24-6	--	0.38364144	9.09E-04	--	--	--	
Sulfate	14808-79-8	--	45.030868	1.07E-01	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	--(c)	5.90E-06	2.07E-02	--	
Tributyl phosphate	126-73-8	SVOC	0.012498806	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000433871	--(c)	2.50E-05	8.75E-02	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	--(c)	--	--	--	
Uranium	7440-61-1	--	0.016629145	3.94E-05	--	--	--	
Vanadium	7440-62-2	--	0.012904693	3.06E-05	--	--	--	
Zinc	7440-66-6	--	0.068859746	1.63E-04	--	--	--	
Total ELCR							1.92E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of volatile compounds in vapor is presented in Table C-2

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area -- CTUIR

Hazard quotient and cancer risk from dermal exposure to VOCs/SVOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water (*Id,l*)
can be neglected and total dermal intake (*Id,total*) is equal to dermal intake from VOCs/SVOCs in sweat lodge vapor (*Id,v*)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 3)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF1	0.01	m/cm
Conversion factor	CF2	365	day/yr

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{ow} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	0.013	2.21E-09	2.00E+00	1	1.10E-09	0.040
1,1-Dichloroethane	75-34-3	VOC	0.000255649	0.0067	4.21E-10	2.00E-01	1	2.10E-09	0.076
1,1-Dichloroethene	75-35-4	VOC	0.00016874	0.012	4.97E-10	5.00E-02	1	9.94E-09	0.36
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	3.02E-08	9.00E-02	1	3.36E-07	12
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	0.042	1.35E-09	7.00E-02	1	1.93E-08	0.69
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	6.56E-10	1.00E-01	1	6.56E-09	0.24
2-Butanone	78-93-3	VOC	0.00055	0.00096	1.30E-10	6.00E-01	1	2.16E-10	0.0078
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	4.24E-10	8.00E-02	1	5.30E-09	0.19
Acetone[d]	67-64-1	VOC	0.001511507	0.000512	1.90E-10	9.00E-01	1	2.11E-10	0.0076
Arsenic	7440-38-2	--	0.003140238	0.001	--(c)	3.00E-04	1	--	
Barium	7440-39-3	--	0.072881156	0.001	--(c)	2.00E-01	0.07	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	0.025	6.14E-09	2.00E-02	1	3.07E-07	11
Cadmium	7440-43-9	--	0.0045	0.001	--(c)	5.00E-04	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00021	0.017	8.77E-10	1.00E-01	1	8.77E-09	0.32
Carbon tetrachloride	56-23-5	VOC	0.000170123	0.016	6.68E-10	7.00E-04	1	9.55E-07	34
Chloride	16887-00-6	--	9.9702351	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.000214204	0.0068	3.58E-10	1.00E-02	1	3.58E-08	1.3
Chromium	7440-47-3	--	0.009493374	0.001	--(c)	1.50E+00	0.013	--	
Copper	7440-50-8	--	0.004884201	0.001	--(c)	4.00E-02	1	--	
Fluoride	16984-48-8	--	0.30080145	0.001	--(c)	6.00E-02	1	--	
Iron	7439-89-6	--	0.12126178	0.001	--(c)	7.00E-01	1	--	
Lead	7439-92-1	--	0.000581898	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.015530827	0.001	--(c)	2.40E-02	0.04	--	
Methylene chloride	75-09-2	VOC	0.002069589	0.0035	1.78E-09	6.00E-02	1	2.96E-08	1.1
Nickel	7440-02-0	--	0.006014142	0.0002	--(c)	2.00E-02	0.04	--	
Nitrate	14797-55-8	--	23.863649	0.001	--(c)	7.10E+00	1	--	
Nitrite	14797-65-0	--	0.081906164	0.001	--(c)	3.00E-01	1	--	
Silver	7440-22-4	--	0.005776818	0.0006	--(c)	5.00E-03	0.04	--	
Strontium	7440-24-6	--	0.38364144	0.001	--(c)	6.00E-01	1	--	
Sulfate	14808-79-8	--	45.030868	0.001	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	0.033	7.07E-09	1.00E-02	1	7.07E-07	25
Tributyl phosphate[d]	126-73-8	SVOC	0.012498806	0.0228	7.00E-08	2.00E-01	1	3.50E-07	13
Trichloroethene	79-01-6	VOC	0.000433871	0.012	1.28E-09	--	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	1.85E-09	3.00E-01	1	6.17E-09	0.22

Uranium	7440-61-1	--	0.016629145	0.001	--(c)	3.00E-03	1	--	
Vanadium	7440-62-2	--	0.012904693	0.001	--(c)	5.00E-03	1	--	
Zinc	7440-66-6	--	0.068859746	0.0006	--(c)	3.00E-01	1	--	
Total								2.78E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal absorption of nonvolatile chemicals is presented in tables C-5 and C-6

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	0.013	2.14E-09	--	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	0.0067	4.09E-10	--	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	0.012	4.83E-10	--	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	2.93E-08	--	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	0.042	1.31E-09	5.40E-03	1	7.08E-12	0.15
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	6.38E-10	1.10E-02	1	7.01E-12	0.15
2-Butanone	78-93-3	VOC	0.00055	0.00096	1.26E-10	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	4.12E-10	--	1	--	
Acetone[d]	67-64-1	VOC	0.001511507	0.000512	1.85E-10	--	1	--	
Arsenic	7440-38-2	--	0.003140238	0.001	--(c)	1.50E+00	1	--	
Barium	7440-39-3	--	0.072881156	0.001	--(c)	--	0.07	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	0.025	5.96E-09	1.40E-02	1	8.35E-11	1.8
Cadmium	7440-43-9	--	0.0045	0.001	--(c)	--	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00021	0.017	8.52E-10	--	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	0.016	6.49E-10	1.30E-01	1	8.44E-11	
Chloride	16887-00-6	--	9.9702351	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.000214204	0.0068	3.47E-10	3.10E-02	1	1.08E-11	
Chromium	7440-47-3	--	0.009493374	0.001	--(c)	--	0.013	--	
Copper	7440-50-8	--	0.004884201	0.001	--(c)	--	1	--	
Fluoride	16984-48-8	--	0.30080145	0.001	--(c)	--	1	--	
Iron	7439-89-6	--	0.12126178	0.001	--(c)	--	1	--	
Lead	7439-92-1	--	0.000581898	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.015530827	0.001	--(c)	--	0.04	--	
Methylene chloride	75-09-2	VOC	0.002069589	0.0035	1.73E-09	7.50E-03	1	1.30E-11	
Nickel	7440-02-0	--	0.006014142	0.0002	--(c)	--	0.04	--	
Nitrate	14797-55-8	--	23.863649	0.001	--(c)	--	1	--	
Nitrite	14797-65-0	--	0.081906164	0.001	--(c)	--	1	--	
Silver	7440-22-4	--	0.005776818	0.0006	--(c)	--	0.04	--	
Strontium	7440-24-6	--	0.38364144	0.001	--(c)	--	1	--	
Sulfate	14808-79-8	--	45.030868	0.001	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	0.033	6.86E-09	5.40E-01	1	3.71E-09	80
Tributyl phosphate[d]	126-73-8	SVOC	0.012498806	0.0228	6.80E-08	9.20E-03	1	6.25E-10	13
Trichloroethene	79-01-6	VOC	0.000433871	0.012	1.24E-09	8.90E-02	1	1.11E-10	2.4
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	1.80E-09	--	1	--	
Uranium	7440-61-1	--	0.016629145	0.001	--(c)	--	1	--	
Vanadium	7440-62-2	--	0.012904693	0.001	--(c)	--	1	--	
Zinc	7440-66-6	--	0.068859746	0.0006	--(c)	--	1	--	
Total ELCR								4.65E-09	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Dermal absorption of nonvolatile chemicals is presented in tables C-5 and C-6

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area -- CTUIR

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge condensed water
Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4)
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
Model assumes concentration of nonvolatiles in condensed water is equal to concentration in water used to create steam

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from liquid	$I_{d,l}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{o,l}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	0.013	--(c)	2.00E+00	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	0.0067	--(c)	2.00E-01	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	0.012	--(c)	5.00E-02	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	9.00E-02	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	0.042	--(c)	7.00E-02	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.00E-01	1	--	
2-Butanone	78-93-3	VOC	0.00055	0.00096	--(c)	6.00E-01	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	8.00E-02	1	--	
Acetone[d]	67-64-1	VOC	0.001511507	0.000512	--(c)	9.00E-01	1	--	
Arsenic	7440-38-2	--	0.003140238	0.001	8.07E-07	3.00E-04	1	2.69E-03	4.2
Barium	7440-39-3	--	0.072881156	0.001	1.87E-05	2.00E-01	0.07	1.34E-03	2.1
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	0.025	--(c)	2.00E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	1.16E-06	5.00E-04	0.05	4.63E-02	72
Carbon disulfide	75-15-0	VOC	0.00021	0.017	--(c)	1.00E-01	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	9.9702351	0.001	2.56E-03	--	1	--	
Chloroform	67-66-3	VOC	0.000214204	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.009493374	0.001	2.44E-06	1.50E+00	0.013	1.25E-04	0.20
Copper	7440-50-8	--	0.004884201	0.001	1.26E-06	4.00E-02	1	3.14E-05	0.049
Fluoride	16984-48-8	--	0.30080145	0.001	7.73E-05	6.00E-02	1	1.29E-03	2.0
Iron	7439-89-6	--	0.12126178	0.001	3.12E-05	7.00E-01	1	4.45E-05	0.070
Lead	7439-92-1	--	0.000581898	0.0001	1.50E-08	--	1	--	
Manganese	7439-96-5	--	0.015530827	0.001	3.99E-06	2.40E-02	0.04	4.16E-03	6.5
Methylene chloride	75-09-2	VOC	0.002069589	0.0035	--(c)	6.00E-02	1	--	
Nickel	7440-02-0	--	0.006014142	0.0002	3.09E-07	2.00E-02	0.04	3.87E-04	0.60
Nitrate	14797-55-8	--	23.863649	0.001	6.14E-03	7.10E+00	1	8.64E-04	1.3
Nitrite	14797-65-0	--	0.081906164	0.001	2.11E-05	3.00E-01	1	7.02E-05	0.11
Silver	7440-22-4	--	0.005776818	0.0006	8.91E-07	5.00E-03	0.04	4.46E-03	7.0
Strontium	7440-24-6	--	0.38364144	0.001	9.87E-05	6.00E-01	1	1.64E-04	0.26
Sulfate	14808-79-8	--	45.030868	0.001	1.16E-02	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	0.033	--(c)	1.00E-02	1	--	
Tributyl phosphate[d]	126-73-8	SVOC	0.012498806	0.0228	--(c)	2.00E-01	1	--	
Trichloroethene	79-01-6	VOC	0.000433871	0.012	--(c)	--	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	3.00E-01	1	--	

Uranium	7440-61-1	--	0.016629145	0.001	4.28E-06	3.00E-03	1	1.43E-03	2.2
Vanadium	7440-62-2	--	0.012904693	0.001	3.32E-06	5.00E-03	1	6.64E-04	1.0
Zinc	7440-66-6	--	0.068859746	0.0006	1.06E-05	3.00E-01	1	3.54E-05	0.055
Total								0.1	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,i}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	0.013	--(c)	--	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	0.0067	--(c)	--	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	0.012	--(c)	--	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	--	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	0.042	--(c)	5.40E-03	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.10E-02	1	--	
2-Butanone	78-93-3	VOC	0.00055	0.00096	--(c)	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	--	1	--	
Acetone[d]	67-64-1	VOC	0.001511507	0.000512	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.003140238	0.001	7.84E-07	1.50E+00	1	1.18E-06	100
Barium	7440-39-3	--	0.072881156	0.001	1.82E-05	--	0.07	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	1.12E-06	--	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00021	0.017	--(c)	--	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	9.9702351	0.001	2.49E-03	--	1	--	
Chloroform	67-66-3	VOC	0.000214204	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.009493374	0.001	2.37E-06	--	0.013	--	
Copper	7440-50-8	--	0.004884201	0.001	1.22E-06	--	1	--	
Fluoride	16984-48-8	--	0.30080145	0.001	7.51E-05	--	1	--	
Iron	7439-89-6	--	0.12126178	0.001	3.03E-05	--	1	--	
Lead	7439-92-1	--	0.000581898	0.0001	1.45E-08	--	1	--	
Manganese	7439-96-5	--	0.015530827	0.001	3.88E-06	--	0.04	--	
Methylene chloride	75-09-2	VOC	0.002069589	0.0035	--(c)	7.50E-03	1	--	
Nickel	7440-02-0	--	0.006014142	0.0002	3.00E-07	--	0.04	--	
Nitrate	14797-55-8	--	23.863649	0.001	5.96E-03	--	1	--	
Nitrite	14797-65-0	--	0.081906164	0.001	2.05E-05	--	1	--	
Silver	7440-22-4	--	0.005776818	0.0006	8.66E-07	--	0.04	--	
Strontium	7440-24-6	--	0.38364144	0.001	9.58E-05	--	1	--	
Sulfate	14808-79-8	--	45.030868	0.001	1.12E-02	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	0.033	--(c)	5.40E-01	1	--	
Tributyl phosphate[d]	126-73-8	SVOC	0.012498806	0.0228	--(c)	9.20E-03	1	--	
Trichloroethene	79-01-6	VOC	0.000433871	0.012	--(c)	8.90E-02	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	--	1	--	
Uranium	7440-61-1	--	0.016629145	0.001	4.15E-06	--	1	--	
Vanadium	7440-62-2	--	0.012904693	0.001	3.22E-06	--	1	--	
Zinc	7440-66-6	--	0.068859746	0.0006	1.03E-05	--	1	--	
Total ELCR								1.18E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area -- CTUIR

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/day
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Ideal gas law constant	R	62.37	(mmHg-L)/(gmole-K)
Temperature of the sweat lodge	T	338.7	K
Density of liquid water	rhow	1000	g/L
Conversion factor	CF_2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	0.013	--(c)	2.00E+00	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	0.0067	--(c)	2.00E-01	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	0.012	--(c)	5.00E-02	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	9.00E-02	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	0.042	--(c)	7.00E-02	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.00E-01	1	--	
2-Butanone	78-93-3	VOC	0.00055	0.00096	--(c)	6.00E-01	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	8.00E-02	1	--	
Acetone[d]	67-64-1	VOC	0.001511507	0.000512	--(c)	9.00E-01	1	--	
Arsenic	7440-38-2	--	0.003140238	0.001	1.32E-10	3.00E-04	1	4.41E-07	4.2
Barium	7440-39-3	--	0.072881156	0.001	3.07E-09	2.00E-01	0.07	2.19E-07	2.1
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	0.025	--(c)	2.00E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	1.90E-10	5.00E-04	0.05	7.58E-06	72
Carbon disulfide	75-15-0	VOC	0.00021	0.017	--(c)	1.00E-01	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	9.9702351	0.001	4.20E-07	--	1	--	
Chloroform	67-66-3	VOC	0.000214204	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.009493374	0.001	4.00E-10	1.50E+00	0.013	2.05E-08	0.20
Copper	7440-50-8	--	0.004884201	0.001	2.06E-10	4.00E-02	1	5.14E-09	0.049
Fluoride	16984-48-8	--	0.30080145	0.001	1.27E-08	6.00E-02	1	2.11E-07	2.0
Iron	7439-89-6	--	0.12126178	0.001	5.11E-09	7.00E-01	1	7.30E-09	0.070
Lead	7439-92-1	--	0.000581898	0.0001	2.45E-12	--	1	--	
Manganese	7439-96-5	--	0.015530827	0.001	6.54E-10	2.40E-02	0.04	6.82E-07	6.5
Methylene chloride	75-09-2	VOC	0.002069589	0.0035	--(c)	6.00E-02	1	--	
Nickel	7440-02-0	--	0.006014142	0.0002	5.07E-11	2.00E-02	0.04	6.34E-08	0.60
Nitrate	14797-55-8	--	23.863649	0.001	1.01E-06	7.10E+00	1	1.42E-07	1.3
Nitrite	14797-65-0	--	0.081906164	0.001	3.45E-09	3.00E-01	1	1.15E-08	0.11
Silver	7440-22-4	--	0.005776818	0.0006	1.46E-10	5.00E-03	0.04	7.30E-07	7.0
Strontium	7440-24-6	--	0.38364144	0.001	1.62E-08	6.00E-01	1	2.69E-08	0.26
Sulfate	14808-79-8	--	45.030868	0.001	1.90E-06	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	0.033	--(c)	1.00E-02	1	--	
Tributyl phosphate[d]	126-73-8	SVOC	0.012498806	0.0228	--(c)	2.00E-01	1	--	
Trichloroethene	79-01-6	VOC	0.000433871	0.012	--(c)	--	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	3.00E-01	1	--	
Uranium	7440-61-1	--	0.016629145	0.001	7.01E-10	3.00E-03	1	2.34E-07	2.2
Vanadium	7440-62-2	--	0.012904693	0.001	5.44E-10	5.00E-03	1	1.09E-07	1.0
Zinc	7440-66-6	--	0.068859746	0.0006	1.74E-09	3.00E-01	1	5.80E-09	0.055
Total								0.00	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal Absorption of volatiles is presented in table C-4

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	0.013	--(c)	--	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	0.0067	--(c)	--	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	0.012	--(c)	--	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	--	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	0.042	--(c)	5.40E-03	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.10E-02	1	--	
2-Butanone	78-93-3	VOC	0.00055	0.00096	--(c)	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	--	1	--	
Acetone[d]	67-64-1	VOC	0.001511507	0.000512	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.003140238	0.001	1.29E-10	1.50E+00	1	1.93E-10	100
Barium	7440-39-3	--	0.072881156	0.001	2.98E-09	--	0.07	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	1.84E-10	--	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00021	0.017	--(c)	--	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	9.9702351	0.001	4.08E-07	--	1	--	
Chloroform	67-66-3	VOC	0.000214204	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.009493374	0.001	3.89E-10	--	0.013	--	
Copper	7440-50-8	--	0.004884201	0.001	2.00E-10	--	1	--	
Fluoride	16984-48-8	--	0.30080145	0.001	1.23E-08	--	1	--	
Iron	7439-89-6	--	0.12126178	0.001	4.96E-09	--	1	--	
Lead	7439-92-1	--	0.000581898	0.0001	2.38E-12	--	1	--	
Manganese	7439-96-5	--	0.015530827	0.001	6.36E-10	--	0.04	--	
Methylene chloride	75-09-2	VOC	0.002069589	0.0035	--(c)	7.50E-03	1	--	
Nickel	7440-02-0	--	0.006014142	0.0002	4.92E-11	--	0.04	--	
Nitrate	14797-55-8	--	23.863649	0.001	9.77E-07	--	1	--	
Nitrite	14797-65-0	--	0.081906164	0.001	3.35E-09	--	1	--	
Silver	7440-22-4	--	0.005776818	0.0006	1.42E-10	--	0.04	--	
Strontium	7440-24-6	--	0.38364144	0.001	1.57E-08	--	1	--	
Sulfate	14808-79-8	--	45.030868	0.001	1.84E-06	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	0.033	--(c)	5.40E-01	1	--	
Tributyl phosphate[d]	126-73-8	SVOC	0.012498806	0.0228	--(c)	9.20E-03	1	--	
Trichloroethene	79-01-6	VOC	0.000433871	0.012	--(c)	8.90E-02	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	--	1	--	
Uranium	7440-61-1	--	0.016629145	0.001	6.81E-10	--	1	--	
Vanadium	7440-62-2	--	0.012904693	0.001	5.28E-10	--	1	--	
Zinc	7440-66-6	--	0.068859746	0.0006	1.69E-09	--	1	--	
Total ELCR								1.93E-10	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Dermal Absorption of volatiles is presented in table C-4

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area -- CTUIR

Cancer risk from inhalation of volatile radioactive contaminants in sweat lodge vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr

[a] Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	6.4100896	--(c)	--	--	
Gross beta	12587-47-2	--	32.397036	--(c)	--	--	
Iodine-129	15046-84-1	--	1.9883847	--(c)	6.07E-11	--	
Nickel-63	13981-37-8	--	4.07	--(c)	1.64E-12	--	
Protactinium-231	14331-85-2	--	0.308	--(c)	4.55E-08	--	
Strontium-90	10098-97-2	--	0.611	--(c)	1.05E-10	--	
Technetium-99	14133-76-7	--	93.996334	--(c)	1.41E-11	--	
Tritium	10028-17-8	Yes	264106.86	6.52E+09	5.62E-14	3.66E-04	100
Total ELCR						3.66E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of nonvolatile contaminants is presented in Table C-8

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area -- CTUIR

Cancer risk from inhalation of nonvolatile radioactive contaminants in sweathouse vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event[b]	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	6.4100896	2.72E+04	--	--	
Gross beta	12587-47-2	--	32.397036	1.37E+05	--	--	
Iodine-129	15046-84-1	--	1.9883847	8.42E+03	6.07E-11	5.11E-07	0.78
Nickel-63	13981-37-8	--	4.07	1.72E+04	1.64E-12	2.83E-08	0.043
Protactinium-231	14331-85-2	--	0.308	1.30E+03	4.55E-08	5.94E-05	90
Strontium-90	10098-97-2	--	0.611	2.59E+03	1.05E-10	2.72E-07	0.41
Technetium-99	14133-76-7	--	93.996334	3.98E+05	1.41E-11	5.61E-06	8.5
Tritium	10028-17-8	Yes	264106.86	--(c)	5.62E-14	--	
Total ELCR						6.58E-05	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of volatile contaminants in presented in table C-7

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	HQ (Inhalation) (Volatiles) (unitless)	HQ (Inhalation) (Nonvolatiles) (unitless)	HQ (Dermal, Vapor, volatiles) (unitless)	HQ (Dermal, Liquid, Nonvolatiles) (unitless)	HQ (Dermal, Vapor, Nonvolatiles) (unitless)	Total HI (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--	--	--	--	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.66E-09	--	--	--	--	--	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--	--	--	--	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--	--	--	--	--	--	
1,2-Dichloroethane	0.00064	VOC	1.33E-05	--	3.30E-08	--	--	1.33E-05	3.94E-05
2,3,4,6-Tetrachlorophenol	0.0077	SVOC	--	--	4.47E-06	--	--	4.47E-06	1.33E-05
Aluminum	0.046776593	--	--	7.98E-02	--	1.20E-05	1.97E-09	7.99E-02	0.24
Arsenic	0.00579213	--	--	3.30E+00	--	4.96E-03	8.13E-07	3.30E+00	9.8
Barium	0.053448218	--	--	9.12E-01	--	9.82E-04	1.61E-07	9.13E-01	2.7
Beryllium	0.000342265	--	--	1.46E-01	--	6.29E-03	1.03E-06	1.52E-01	0.45
Bis(2-ethylhexyl) phthalate	0.011	SVOC	--	--	3.38E-06	--	--	3.38E-06	1.00E-05
Cadmium	0.002729138	--	--	2.33E+00	--	2.81E-02	4.60E-06	2.36E+00	7.0
Carbon tetrachloride	0.000282669	VOC	7.40E-05	--	1.59E-06	--	--	7.56E-05	2.24E-04
Chloride	12.62269	--	--	--	--	--	--	--	
Chloroform	0.00038106	VOC	1.93E-04	--	6.36E-08	--	--	1.93E-04	5.73E-04
Chromium	0.015259293	--	--	--	--	2.01E-04	3.30E-08	2.01E-04	5.96E-04
Cobalt	0.004495239	--	--	6.39E+00	--	1.54E-03	2.53E-07	6.40E+00	19
Copper	0.004447607	--	--	--	--	2.86E-05	4.68E-09	2.86E-05	8.47E-05
Fluoride	0.2940596	--	--	1.93E-01	--	1.26E-03	2.07E-07	1.94E-01	0.58
Hexavalent Chromium	0.191	--	--	1.63E+01	--	1.31E+00	2.15E-04	1.76E+01	52
Iron	0.090209963	--	--	--	--	3.31E-05	5.43E-09	3.31E-05	9.82E-05
Lead	0.001548018	--	--	--	--	--	--	--	
Manganese	0.006198141	--	--	1.06E+00	--	1.66E-03	2.72E-07	1.06E+00	3.1
Nickel	0.011729633	--	--	1.11E+00	--	7.54E-04	1.24E-07	1.11E+00	3.3
Nitrate	34.098186	--	--	--	--	1.23E-03	2.02E-07	1.24E-03	0.0037
Nitrite	0.057119962	--	--	--	--	4.90E-05	8.02E-09	4.90E-05	1.45E-04
Nitrogen in Nitrite and Nitrate	14.7	--	--	--	--	2.36E-03	3.87E-07	2.36E-03	0.0070
Octachlorodibenzofuran	9.9649E-09	--	--	--	--	--	--	--	
Octachlorodibenzo-p-dioxin	5.8071E-09	--	--	--	--	--	--	--	
Silver	0.005686587	--	--	--	--	4.39E-03	7.19E-07	4.39E-03	0.013
Strontium	0.2694514	--	--	--	--	1.15E-04	1.89E-08	1.15E-04	3.42E-04
Sulfate	64.094058	--	--	--	--	--	--	--	
Toluene	3.56519E-05	VOC	3.55E-07	--	3.39E-09	--	--	3.58E-07	1.06E-06
Total petroleum hydrocarbons - gasoline range	0.05	--	--	--	--	--	--	--	
Trichloroethene	0.000563286	VOC	8.00E-04	--	--	--	--	8.00E-04	0.0024
Uranium	0.020191069	--	--	5.74E-01	--	1.73E-03	2.84E-07	5.76E-01	1.7
Vanadium	0.02186531	--	--	--	--	1.12E-03	1.84E-07	1.12E-03	0.0033
Zinc	0.095789222	--	--	--	--	4.93E-05	8.07E-09	4.93E-05	1.46E-04
Total			1.08E-03	3.24E+01	9.54E-06	1.37E+00	2.24E-04	33.76	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.
Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
HQ = hazard quotient.
HI = hazard index.

SVOC = semivolatile organic compound.
VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal, Vapor, volatiles) (unitless)	Risk (Dermal, Liquid, Nonvolatiles) (unitless)	Risk (Dermal, Vapor, Nonvolatiles) (unitless)	Total Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--	1.18E-08	--	--	--	1.18E-08	9.40E-06
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.66E-09	--	--	1.78E-08	--	2.67E-06	4.37E-10	2.68E-06	0.0021
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--	9.14E-08	--	2.12E-05	3.47E-09	2.13E-05	0.017
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--	6.62E-08	--	1.53E-05	2.51E-09	1.54E-05	0.012
1,2-Dichloroethane	0.00064	VOC	8.04E-07	--	5.83E-11	--	--	8.04E-07	6.42E-04
2,3,4,6-Tetrachlorophenol	0.0077	SVOC	--	--	--	--	--	--	
Aluminum	0.046776593	--	--	--	--	--	--	--	
Arsenic	0.00579213	--	--	2.06E-04	--	2.17E-06	3.56E-10	2.09E-04	0.17
Barium	0.053448218	--	--	--	--	--	--	--	
Beryllium	0.000342265	--	--	6.81E-06	--	--	--	6.81E-06	0.0054
Bis(2-ethylhexyl) phthalate	0.011	SVOC	1.28E-06	--	9.18E-10	--	--	1.28E-06	0.0010
Cadmium	0.002729138	--	--	4.07E-05	--	--	--	4.07E-05	0.033
Carbon tetrachloride	0.000282669	VOC	2.05E-07	--	1.40E-10	--	--	2.05E-07	1.64E-04
Chloride	12.62269	--	--	--	--	--	--	--	
Chloroform	0.00038106	VOC	4.23E-07	--	1.92E-11	--	--	4.23E-07	3.38E-04
Chromium	0.015259293	--	--	--	--	--	--	--	
Cobalt	0.004495239	--	--	3.35E-04	--	--	--	3.35E-04	0.27
Copper	0.004447607	--	--	--	--	--	--	--	
Fluoride	0.2940596	--	--	--	--	--	--	--	
Hexavalent Chromium	0.191	--	--	1.25E-01	--	--	--	1.25E-01	99
Iron	0.090209963	--	--	--	--	--	--	--	
Lead	0.001548018	--	--	--	--	--	--	--	
Manganese	0.006198141	--	--	--	--	--	--	--	
Nickel	0.011729633	--	--	2.53E-05	--	--	--	2.53E-05	0.020
Nitrate	34.098186	--	--	--	--	--	--	--	
Nitrite	0.057119962	--	--	--	--	--	--	--	
Nitrogen in Nitrite and Nitrate	14.7	--	--	--	--	--	--	--	
Octachlorodibenzofuran	9.9649E-09	--	--	9.42E-10	--	2.55E-07	4.18E-11	2.56E-07	2.05E-04
Octachlorodibenzo-p-dioxin	5.8071E-09	--	--	5.49E-10	--	6.56E-08	1.08E-11	6.62E-08	5.29E-05
Silver	0.005686587	--	--	--	--	--	--	--	
Strontium	0.2694514	--	--	--	--	--	--	--	
Sulfate	64.094058	--	--	--	--	--	--	--	
Toluene	3.56519E-05	VOC	--	--	--	--	--	--	
Total petroleum hydrocarbons - gasoline range	0.05	--	--	--	--	--	--	--	
Trichloroethene	0.000563286	VOC	--	--	1.44E-10	--	--	1.44E-10	1.15E-07
Uranium	0.020191069	--	--	--	--	--	--	--	
Vanadium	0.02186531	--	--	--	--	--	--	--	
Zinc	0.095789222	--	--	--	--	--	--	--	
Total ELCR			2.71E-06	1.25E-01	1.28E-09	4.17E-05	6.83E-09	1.25E-01	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
ELCR = excess lifetime cancer risk.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (pCi/L)	Volatile?[a]	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	5.3264311	No	--	--	--	--	
Iodine-129	2.708038	No	--	6.96E-07	--	6.96E-07	0.18
Plutonium-239/240	0.029	No	--	4.09E-06	--	4.09E-06	1.1
Protactinium-231	0.28	No	--	5.40E-05	--	5.40E-05	14
Strontium-90	4.3004432	No	--	1.91E-06	--	1.91E-06	0.51
Technetium-99	1667.3497	No	--	9.96E-05	--	9.96E-05	26
Tritium	156901.45	Yes	2.18E-04	--	--	2.18E-04	58
Total ELCR			2.18E-04	1.60E-04	--	3.78E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-field exposure area -- CTUIR

Hazard quotient and cancer risk from inhalation of VOCs/SVOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Contaminant concentration in water	C_{dw}	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF	365	day/yr

[a] Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(c)	--	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.66E-09	--(c)	--	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(c)	--	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(c)	--	--	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	9.09E-06	2.40E+00	6.86E-01	1.33E-05	1.2
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	1.09E-04	--	--	--	
Aluminum	7429-90-5	--	0.046776593	--(c)	5.00E-03	1.43E-03	--	
Arsenic	7440-38-2	--	0.00579213	--(c)	1.50E-05	4.29E-06	--	
Barium	7440-39-3	--	0.053448218	--(c)	5.00E-04	1.43E-04	--	
Beryllium	7440-41-7	--	0.000342265	--(c)	2.00E-05	5.71E-06	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	1.56E-04	--	--	--	
Cadmium	7440-43-9	--	0.002729138	--(c)	1.00E-05	2.86E-06	--	
Carbon tetrachloride	56-23-5	VOC	0.000282669	4.02E-06	1.90E-01	5.43E-02	7.40E-05	6.8
Chloride	16887-00-6	--	12.62269	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.00038106	5.41E-06	9.80E-02	2.80E-02	1.93E-04	18
Chromium	7440-47-3	--	0.015259293	--(c)	--	--	--	
Cobalt	7440-48-4	--	0.004495239	--(c)	6.00E-06	1.71E-06	--	
Copper	7440-50-8	--	0.004447607	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.2940596	--(c)	1.30E-02	3.71E-03	--	
Hexavalent Chromium	18540-29-9	--	0.191	--(c)	1.00E-04	2.86E-05	--	
Iron	7439-89-6	--	0.090209963	--(c)	--	--	--	
Lead	7439-92-1	--	0.001548018	--(c)	--	--	--	
Manganese	7439-96-5	--	0.006198141	--(c)	5.00E-05	1.43E-05	--	
Nickel	7440-02-0	--	0.011729633	--(c)	9.00E-05	2.57E-05	--	
Nitrate	14797-55-8	--	34.098186	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.057119962	--(c)	--	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(c)	--	--	--	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(c)	--	--	--	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.8071E-09	--(c)	--	--	--	
Silver	7440-22-4	--	0.005686587	--(c)	--	--	--	
Strontium	7440-24-6	--	0.2694514	--(c)	--	--	--	
Sulfate	14808-79-8	--	64.094058	--(c)	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	5.07E-07	5.00E+00	1.43E+00	3.55E-07	0.033
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(c)	--	--	--	

Trichloroethene	79-01-6	VOC	0.000563286	8.00E-06	3.50E-02	1.00E-02	8.00E-04	74
Uranium	7440-61-1	--	0.020191069	--(c)	3.00E-04	8.57E-05	--	
Vanadium	7440-62-2	--	0.02186531	--(c)	--	--	--	
Zinc	7440-66-6	--	0.095789222	1.36E-03	--	--	--	
Total							1.08E-03	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of nonvolatile chemicals is presented in Table C-11

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(c)	3.80E-01	1.33E+03	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.66E-09	--(c)	3.80E-01	1.33E+03	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(c)	3.80E+00	1.33E+04	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(c)	3.80E+00	1.33E+04	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	8.83E-06	2.60E-05	9.10E-02	8.04E-07	30
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	1.06E-04	--	--	--	
Aluminum	7429-90-5	--	0.046776593	--(c)	--	--	--	
Arsenic	7440-38-2	--	0.00579213	--(c)	4.30E-03	1.51E+01	--	
Barium	7440-39-3	--	0.053448218	--(c)	--	--	--	
Beryllium	7440-41-7	--	0.000342265	--(c)	2.40E-03	8.40E+00	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	1.52E-04	2.40E-06	8.40E-03	1.28E-06	47
Cadmium	7440-43-9	--	0.002729138	--(c)	1.80E-03	6.30E+00	--	
Carbon tetrachloride	56-23-5	VOC	0.000282669	3.90E-06	1.50E-05	5.25E-02	2.05E-07	7.6
Chloride	16887-00-6	--	12.62269	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.00038106	5.26E-06	2.30E-05	8.05E-02	4.23E-07	16
Chromium	7440-47-3	--	0.015259293	--(c)	--	--	--	
Cobalt	7440-48-4	--	0.004495239	--(c)	9.00E-03	3.15E+01	--	
Copper	7440-50-8	--	0.004447607	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.2940596	--(c)	--	--	--	
Hexavalent Chromium	18540-29-9	--	0.191	--(c)	8.40E-02	2.94E+02	--	
Iron	7439-89-6	--	0.090209963	--(c)	--	--	--	
Lead	7439-92-1	--	0.001548018	--(c)	--	--	--	
Manganese	7439-96-5	--	0.006198141	--(c)	--	--	--	
Nickel	7440-02-0	--	0.011729633	--(c)	2.60E-04	9.10E-01	--	
Nitrate	14797-55-8	--	34.098186	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.057119962	--(c)	--	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(c)	--	--	--	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(c)	1.14E-02	3.99E+01	--	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.8071E-09	--(c)	1.14E-02	3.99E+01	--	
Silver	7440-22-4	--	0.005686587	--(c)	--	--	--	
Strontium	7440-24-6	--	0.2694514	--(c)	--	--	--	
Sulfate	14808-79-8	--	64.094058	--(c)	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	4.92E-07	--	--	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	--(c)	2.50E-05	8.75E-02	--	
Uranium	7440-61-1	--	0.020191069	2.79E-04	--	--	--	
Vanadium	7440-62-2	--	0.02186531	--(c)	--	--	--	
Zinc	7440-66-6	--	0.095789222	--(c)	--	--	--	
Total ELCR							2.71E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of nonvolatile chemicals is presented in Table C-11

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-field exposure area -- CTUIR

Hazard quotient and cancer risk from inhalation of non-VOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 2)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	$(mmHg*m^3)/gmole*K)$
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion Factor	CF	365	day/yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L

[a] Harris (2008)

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	9.10E-12	--	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.66E-09	1.38E-11	--	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	7.07E-12	--	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	5.12E-12	--	--	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	--(c)	2.40E+00	6.86E-01	--	
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	--(c)	--	--	--	
Aluminum	7429-90-5	--	0.046776593	1.14E-04	5.00E-03	1.43E-03	7.98E-02	0.25
Arsenic	7440-38-2	--	0.00579213	1.41E-05	1.50E-05	4.29E-06	3.30E+00	10
Barium	7440-39-3	--	0.053448218	1.30E-04	5.00E-04	1.43E-04	9.12E-01	2.8
Beryllium	7440-41-7	--	0.000342265	8.35E-07	2.00E-05	5.71E-06	1.46E-01	0.45
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	--(c)	--	--	--	
Cadmium	7440-43-9	--	0.002729138	6.65E-06	1.00E-05	2.86E-06	2.33E+00	7.2
Carbon tetrachloride	56-23-5	VOC	0.000282669	--(c)	1.90E-01	5.43E-02	--	
Chloride	16887-00-6	--	12.62269	3.08E-02	--	--	--	
Chloroform	67-66-3	VOC	0.00038106	--(c)	9.80E-02	2.80E-02	--	
Chromium	7440-47-3	--	0.015259293	3.72E-05	--	--	--	
Cobalt	7440-48-4	--	0.004495239	1.10E-05	6.00E-06	1.71E-06	6.39E+00	20
Copper	7440-50-8	--	0.004447607	1.08E-05	--	--	--	
Fluoride	16984-48-8	--	0.2940596	7.17E-04	1.30E-02	3.71E-03	1.93E-01	0.60
Hexavalent Chromium	18540-29-9	--	0.191	4.66E-04	1.00E-04	2.86E-05	1.63E+01	50
Iron	7439-89-6	--	0.090209963	2.20E-04	--	--	--	
Lead	7439-92-1	--	0.001548018	3.77E-06	--	--	--	
Manganese	7439-96-5	--	0.006198141	1.51E-05	5.00E-05	1.43E-05	1.06E+00	3.3
Nickel	7440-02-0	--	0.011729633	2.86E-05	9.00E-05	2.57E-05	1.11E+00	3.4
Nitrate	14797-55-8	--	34.098186	8.31E-02	--	--	--	
Nitrite	14797-65-0	--	0.057119962	1.39E-04	--	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	3.58E-02	--	--	--	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	2.43E-11	--	--	--	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.8071E-09	1.42E-11	--	--	--	
Silver	7440-22-4	--	0.005686587	1.39E-05	--	--	--	
Strontium	7440-24-6	--	0.2694514	6.57E-04	--	--	--	
Sulfate	14808-79-8	--	64.094058	1.56E-01	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	--(c)	5.00E+00	1.43E+00	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	1.22E-04	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	--(c)	3.50E-02	1.00E-02	--	
Uranium	7440-61-1	--	0.020191069	4.92E-05	3.00E-04	8.57E-05	5.74E-01	1.8
Vanadium	7440-62-2	--	0.02186531	5.33E-05	--	--	--	
Zinc	7440-66-6	--	0.095789222	2.34E-04	--	--	--	
Total							32.4	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of volatile compounds in vapor is presented in Table C-10

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
HQ = hazard quotient.
SVOC = semivolatile organic compound.
VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	8.84E-12	3.80E-01	1.33E+03	1.18E-08	9.40E-06
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.66E-09	1.34E-11	3.80E-01	1.33E+03	1.78E-08	1.42E-05
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	6.87E-12	3.80E+00	1.33E+04	9.14E-08	7.30E-05
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	4.97E-12	3.80E+00	1.33E+04	6.62E-08	5.29E-05
1,2-Dichloroethane	107-06-2	VOC	0.00064	--(c)	2.60E-05	9.10E-02	--	
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	--(c)	--	--	--	
Aluminum	7429-90-5	--	0.046776593	1.11E-04	--	--	--	
Arsenic	7440-38-2	--	0.00579213	1.37E-05	4.30E-03	1.51E+01	2.06E-04	0.16
Barium	7440-39-3	--	0.053448218	1.27E-04	--	--	--	
Beryllium	7440-41-7	--	0.000342265	8.11E-07	2.40E-03	8.40E+00	6.81E-06	0.0054
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	--(c)	2.40E-06	8.40E-03	--	
Cadmium	7440-43-9	--	0.002729138	6.46E-06	1.80E-03	6.30E+00	4.07E-05	0.033
Carbon tetrachloride	56-23-5	VOC	0.000282669	--(c)	1.50E-05	5.25E-02	--	
Chloride	16887-00-6	--	12.62269	2.99E-02	--	--	--	
Chloroform	67-66-3	VOC	0.00038106	--(c)	2.30E-05	8.05E-02	--	
Chromium	7440-47-3	--	0.015259293	3.61E-05	--	--	--	
Cobalt	7440-48-4	--	0.004495239	1.06E-05	9.00E-03	3.15E+01	3.35E-04	0.27
Copper	7440-50-8	--	0.004447607	1.05E-05	--	--	--	
Fluoride	16984-48-8	--	0.2940596	6.97E-04	--	--	--	
Hexavalent Chromium	18540-29-9	--	0.191	4.52E-04	8.40E-02	2.94E+02	1.25E-01	100
Iron	7439-89-6	--	0.090209963	2.14E-04	--	--	--	
Lead	7439-92-1	--	0.001548018	3.67E-06	--	--	--	
Manganese	7439-96-5	--	0.006198141	1.47E-05	--	--	--	
Nickel	7440-02-0	--	0.011729633	2.78E-05	2.60E-04	9.10E-01	2.53E-05	0.020
Nitrate	14797-55-8	--	34.098186	8.08E-02	--	--	--	
Nitrite	14797-65-0	--	0.057119962	1.35E-04	--	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	3.48E-02	--	--	--	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	2.36E-11	1.14E-02	3.99E+01	9.42E-10	7.52E-07
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.8071E-09	1.38E-11	1.14E-02	3.99E+01	5.49E-10	4.39E-07
Silver	7440-22-4	--	0.005686587	1.35E-05	--	--	--	
Strontium	7440-24-6	--	0.2694514	6.38E-04	--	--	--	
Sulfate	14808-79-8	--	64.094058	1.52E-01	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	--(c)	--	--	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	1.18E-04	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	--(c)	2.50E-05	8.75E-02	--	
Uranium	7440-61-1	--	0.020191069	4.78E-05	--	--	--	
Vanadium	7440-62-2	--	0.02186531	5.18E-05	--	--	--	
Zinc	7440-66-6	--	0.095789222	2.27E-04	--	--	--	
Total ELCR							1.25E-01	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of volatile compounds in vapor is presented in Table C-10

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-field exposure area -- CTUIR

Hazard quotient and cancer risk from dermal exposure to VOCs/SVOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water (*Id,l*)
can be neglected and total dermal intake (*Id,total*) is equal to dermal intake from VOCs/SVOCs in sweat lodge vapor (*Id,v*)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 3)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF1	0.01	m/cm
Conversion factor	CF2	365	day/yr

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--	--(c)	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.66E-09	1.45	--(c)	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	--(c)	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuranc	57117-44-9	--	2.1E-09	2.25	--(c)	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	6.60E-10	2.00E-02	1	3.30E-08	0.35
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	1.34E-07	3.00E-02	1	4.47E-06	47
Aluminum	7429-90-5	--	0.046776593	0.001	--(c)	1.00E+00	1	--	
Arsenic	7440-38-2	--	0.00579213	0.001	--(c)	3.00E-04	1	--	
Barium	7440-39-3	--	0.053448218	0.001	--(c)	2.00E-01	0.07	--	
Beryllium	7440-41-7	--	0.000342265	0.001	--(c)	2.00E-03	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	6.75E-08	2.00E-02	1	3.38E-06	35
Cadmium	7440-43-9	--	0.002729138	0.001	--(c)	5.00E-04	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.000282669	0.016	1.11E-09	7.00E-04	1	1.59E-06	17
Chloride	16887-00-6	--	12.62269	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	6.36E-10	1.00E-02	1	6.36E-08	0.67
Chromium	7440-47-3	--	0.015259293	0.001	--(c)	1.50E+00	0.013	--	
Cobalt	7440-48-4	--	0.004495239	0.0004	--(c)	3.00E-04	1	--	
Copper	7440-50-8	--	0.004447607	0.001	--(c)	4.00E-02	1	--	
Fluoride	16984-48-8	--	0.2940596	0.001	--(c)	6.00E-02	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	--(c)	3.00E-03	0.025	--	
Iron	7439-89-6	--	0.090209963	0.001	--(c)	7.00E-01	1	--	
Lead	7439-92-1	--	0.001548018	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.006198141	0.001	--(c)	2.40E-02	0.04	--	
Nickel	7440-02-0	--	0.011729633	0.0002	--(c)	2.00E-02	0.04	--	
Nitrate	14797-55-8	--	34.098186	0.001	--(c)	7.10E+00	1	--	
Nitrite	14797-65-0	--	0.057119962	0.001	--(c)	3.00E-01	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	--(c)	1.60E+00	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	--(c)	--	1	--	
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.8071E-09	1.16	--(c)	--	1	--	
Silver	7440-22-4	--	0.005686587	0.0006	--(c)	5.00E-03	0.04	--	
Strontium	7440-24-6	--	0.2694514	0.001	--(c)	6.00E-01	1	--	
Sulfate	14808-79-8	--	64.094058	0.001	--(c)	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	0.031	2.71E-10	8.00E-02	1	3.39E-09	0.036
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--(c)	--	--	--	

Trichloroethene	79-01-6	VOC	0.000563286	0.012	1.66E-09	--	1	--	
Uranium	7440-61-1	--	0.020191069	0.001	--(c)	3.00E-03	1	--	
Vanadium	7440-62-2	--	0.02186531	0.001	--(c)	5.00E-03	1	--	
Zinc	7440-66-6	--	0.095789222	0.0006	--(c)	3.00E-01	1	--	
Total								9.54E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table C-14

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--	--(c)	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.66E-09	1.45	--(c)	1.30E+03	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	--(c)	1.30E+04	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuranc	57117-44-9	--	2.1E-09	2.25	--(c)	1.30E+04	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	6.41E-10	9.10E-02	1	5.83E-11	4.6
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	1.30E-07	--	1	--	
Aluminum	7429-90-5	--	0.046776593	0.001	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.00579213	0.001	--(c)	1.50E+00	1	--	
Barium	7440-39-3	--	0.053448218	0.001	--(c)	--	0.07	--	
Beryllium	7440-41-7	--	0.000342265	0.001	--(c)	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	6.56E-08	1.40E-02	1	9.18E-10	72
Cadmium	7440-43-9	--	0.002729138	0.001	--(c)	--	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.000282669	0.016	1.08E-09	1.30E-01	1	1.40E-10	11
Chloride	16887-00-6	--	12.62269	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	6.18E-10	3.10E-02	1	1.92E-11	1.5
Chromium	7440-47-3	--	0.015259293	0.001	--(c)	--	0.013	--	
Cobalt	7440-48-4	--	0.004495239	0.0004	--(c)	--	1	--	
Copper	7440-50-8	--	0.004447607	0.001	--(c)	--	1	--	
Fluoride	16984-48-8	--	0.2940596	0.001	--(c)	--	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	--(c)	--	0.025	--	
Iron	7439-89-6	--	0.090209963	0.001	--(c)	--	1	--	
Lead	7439-92-1	--	0.001548018	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.006198141	0.001	--(c)	--	0.04	--	
Nickel	7440-02-0	--	0.011729633	0.0002	--(c)	--	0.04	--	
Nitrate	14797-55-8	--	34.098186	0.001	--(c)	--	1	--	
Nitrite	14797-65-0	--	0.057119962	0.001	--(c)	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	--(c)	--	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	--(c)	3.90E+01	1	--	
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.8071E-09	1.16	--(c)	3.90E+01	1	--	
Silver	7440-22-4	--	0.005686587	0.0006	--(c)	--	0.04	--	
Strontium	7440-24-6	--	0.2694514	0.001	--(c)	--	1	--	
Sulfate	14808-79-8	--	64.094058	0.001	--(c)	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	0.031	2.64E-10	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	0.012	1.61E-09	8.90E-02	1	1.44E-10	11
Uranium	7440-61-1	--	0.020191069	0.001	--(c)	--	1	--	
Vanadium	7440-62-2	--	0.02186531	0.001	--(c)	--	1	--	
Zinc	7440-66-6	--	0.095789222	0.0006	--(c)	--	1	--	
Total ELCR								1.28E-09	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table C-14

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-field exposure area -- CTUIR

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge condensed water

Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4)
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
Model assumes concentration of nonvolatiles in condensed water is equal to concentration in water used to create steam

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from liquid	$I_{d,l}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,l}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--	--	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.66E-09	1.45	2.11E-09	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	1.68E-09	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	1.22E-09	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	2.00E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	3.00E-02	1	--	
Aluminum	7429-90-5	--	0.046776593	0.001	1.20E-05	1.00E+00	1	1.20E-05	8.80E-04
Arsenic	7440-38-2	--	0.00579213	0.001	1.49E-06	3.00E-04	1	4.96E-03	0.36
Barium	7440-39-3	--	0.053448218	0.001	1.37E-05	2.00E-01	0.07	9.82E-04	0.072
Beryllium	7440-41-7	--	0.000342265	0.001	8.80E-08	2.00E-03	0.007	6.29E-03	0.46
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	2.00E-02	1	--	
Cadmium	7440-43-9	--	0.002729138	0.001	7.02E-07	5.00E-04	0.05	2.81E-02	2.1
Carbon tetrachloride	56-23-5	VOC	0.000282669	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	12.62269	0.001	3.25E-03	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.015259293	0.001	3.92E-06	1.50E+00	0.013	2.01E-04	0.015
Cobalt	7440-48-4	--	0.004495239	0.0004	4.62E-07	3.00E-04	1	1.54E-03	0.11
Copper	7440-50-8	--	0.004447607	0.001	1.14E-06	4.00E-02	1	2.86E-05	0.0021
Fluoride	16984-48-8	--	0.2940596	0.001	7.56E-05	6.00E-02	1	1.26E-03	0.092
Hexavalent Chromium	18540-29-9	--	0.191	0.002	9.82E-05	3.00E-03	0.025	1.31E+00	96
Iron	7439-89-6	--	0.090209963	0.001	2.32E-05	7.00E-01	1	3.31E-05	0.0024
Lead	7439-92-1	--	0.001548018	0.0001	3.98E-08	--	1	--	
Manganese	7439-96-5	--	0.006198141	0.001	1.59E-06	2.40E-02	0.04	1.66E-03	0.12
Nickel	7440-02-0	--	0.011729633	0.0002	6.03E-07	2.00E-02	0.04	7.54E-04	0.055
Nitrate	14797-55-8	--	34.098186	0.001	8.77E-03	7.10E+00	1	1.23E-03	0.090
Nitrite	14797-65-0	--	0.057119962	0.001	1.47E-05	3.00E-01	1	4.90E-05	0.0036
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	3.78E-03	1.60E+00	1	2.36E-03	0.17
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	6.74E-09	--	1	--	
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.8071E-09	1.16	1.73E-09	--	1	--	
Silver	7440-22-4	--	0.005686587	0.0006	8.77E-07	5.00E-03	0.04	4.39E-03	0.32
Strontium	7440-24-6	--	0.2694514	0.001	6.93E-05	6.00E-01	1	1.15E-04	0.0085
Sulfate	14808-79-8	--	64.094058	0.001	1.65E-02	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	0.031	--(c)	8.00E-02	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	

Trichloroethene	79-01-6	VOC	0.000563286	0.012	--(c)	--	1	--	
Uranium	7440-61-1	--	0.020191069	0.001	5.19E-06	3.00E-03	1	1.73E-03	0.13
Vanadium	7440-62-2	--	0.02186531	0.001	5.62E-06	5.00E-03	1	1.12E-03	0.082
Zinc	7440-66-6	--	0.095789222	0.0006	1.48E-05	3.00E-01	1	4.93E-05	0.0036
Total								1.37	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,i}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--	--	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.66E-09	1.45	2.05E-09	1.30E+03	1	2.67E-06	6.4
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	1.63E-09	1.30E+04	1	2.12E-05	51
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	1.18E-09	1.30E+04	1	1.53E-05	37
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	9.10E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	--	1	--	
Aluminum	7429-90-5	--	0.046776593	0.001	1.17E-05	--	1	--	
Arsenic	7440-38-2	--	0.00579213	0.001	1.45E-06	1.50E+00	1	2.17E-06	5.2
Barium	7440-39-3	--	0.053448218	0.001	1.34E-05	--	0.07	--	
Beryllium	7440-41-7	--	0.000342265	0.001	8.55E-08	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.002729138	0.001	6.82E-07	--	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.000282669	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	12.62269	0.001	3.15E-03	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.015259293	0.001	3.81E-06	--	0.013	--	
Cobalt	7440-48-4	--	0.004495239	0.0004	4.49E-07	--	1	--	
Copper	7440-50-8	--	0.004447607	0.001	1.11E-06	--	1	--	
Fluoride	16984-48-8	--	0.2940596	0.001	7.35E-05	--	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	9.54E-05	--	0.025	--	
Iron	7439-89-6	--	0.090209963	0.001	2.25E-05	--	1	--	
Lead	7439-92-1	--	0.001548018	0.0001	3.87E-08	--	1	--	
Manganese	7439-96-5	--	0.006198141	0.001	1.55E-06	--	0.04	--	
Nickel	7440-02-0	--	0.011729633	0.0002	5.86E-07	--	0.04	--	
Nitrate	14797-55-8	--	34.098186	0.001	8.52E-03	--	1	--	
Nitrite	14797-65-0	--	0.057119962	0.001	1.43E-05	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	3.67E-03	--	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	6.55E-09	3.90E+01	1	2.55E-07	0.61
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.8071E-09	1.16	1.68E-09	3.90E+01	1	6.56E-08	0.16
Silver	7440-22-4	--	0.005686587	0.0006	8.52E-07	--	0.04	--	
Strontium	7440-24-6	--	0.2694514	0.001	6.73E-05	--	1	--	
Sulfate	14808-79-8	--	64.094058	0.001	1.60E-02	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	0.031	--(c)	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	0.012	--(c)	8.90E-02	1	--	
Uranium	7440-61-1	--	0.020191069	0.001	5.04E-06	--	1	--	
Vanadium	7440-62-2	--	0.02186531	0.001	5.46E-06	--	1	--	
Zinc	7440-66-6	--	0.095789222	0.0006	1.44E-05	--	1	--	
Total ELCR								4.17E-05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-field exposure area -- CTUIR

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/day
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Ideal gas law constant	R	62.37	(mmHg-L)/(gmole-K)
Temperature of the sweat lodge	T	338.7	K
Density of liquid water	rhow	1000	g/L
Conversion factor	CF_2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--	--	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.66E-09	1.45	3.46E-13	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	2.75E-13	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	1.99E-13	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	2.00E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	3.00E-02	1	--	
Aluminum	7429-90-5	--	0.046776593	0.001	1.97E-09	1.00E+00	1	1.97E-09	8.80E-04
Arsenic	7440-38-2	--	0.00579213	0.001	2.44E-10	3.00E-04	1	8.13E-07	0.36
Barium	7440-39-3	--	0.053448218	0.001	2.25E-09	2.00E-01	0.07	1.61E-07	0.072
Beryllium	7440-41-7	--	0.000342265	0.001	1.44E-11	2.00E-03	0.007	1.03E-06	0.46
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	2.00E-02	1	--	
Cadmium	7440-43-9	--	0.002729138	0.001	1.15E-10	5.00E-04	0.05	4.60E-06	2.1
Carbon tetrachloride	56-23-5	VOC	0.000282669	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	12.62269	0.001	5.32E-07	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.015259293	0.001	6.43E-10	1.50E+00	0.013	3.30E-08	0.015
Cobalt	7440-48-4	--	0.004495239	0.0004	7.58E-11	3.00E-04	1	2.53E-07	0.11
Copper	7440-50-8	--	0.004447607	0.001	1.87E-10	4.00E-02	1	4.68E-09	0.0021
Fluoride	16984-48-8	--	0.2940596	0.001	1.24E-08	6.00E-02	1	2.07E-07	0.092
Hexavalent Chromium	18540-29-9	--	0.191	0.002	1.61E-08	3.00E-03	0.025	2.15E-04	96
Iron	7439-89-6	--	0.090209963	0.001	3.80E-09	7.00E-01	1	5.43E-09	0.0024
Lead	7439-92-1	--	0.001548018	0.0001	6.52E-12	--	1	--	
Manganese	7439-96-5	--	0.006198141	0.001	2.61E-10	2.40E-02	0.04	2.72E-07	0.12
Nickel	7440-02-0	--	0.011729633	0.0002	9.88E-11	2.00E-02	0.04	1.24E-07	0.055
Nitrate	14797-55-8	--	34.098186	0.001	1.44E-06	7.10E+00	1	2.02E-07	0.090
Nitrite	14797-65-0	--	0.057119962	0.001	2.41E-09	3.00E-01	1	8.02E-09	0.0036
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	6.19E-07	1.60E+00	1	3.87E-07	0.17
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	1.10E-12	--	1	--	
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.8071E-09	1.16	2.84E-13	--	1	--	
Silver	7440-22-4	--	0.005686587	0.0006	1.44E-10	5.00E-03	0.04	7.19E-07	0.32
Strontium	7440-24-6	--	0.2694514	0.001	1.14E-08	6.00E-01	1	1.89E-08	0.0085
Sulfate	14808-79-8	--	64.094058	0.001	2.70E-06	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	0.031	--(c)	8.00E-02	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	0.012	--(c)	--	1	--	
Uranium	7440-61-1	--	0.020191069	0.001	8.51E-10	3.00E-03	1	2.84E-07	0.13
Vanadium	7440-62-2	--	0.02186531	0.001	9.21E-10	5.00E-03	1	1.84E-07	0.082
Zinc	7440-66-6	--	0.095789222	0.0006	2.42E-09	3.00E-01	1	8.07E-09	0.0036
Total								2.239E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
HQ = hazard quotient.
SVOC = semivolatile organic compound.
VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--	--	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.66E-09	1.45	3.36E-13	1.30E+03	1	4.37E-10	6.4
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	2.67E-13	1.30E+04	1	3.47E-09	51
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	1.93E-13	1.30E+04	1	2.51E-09	37
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	9.10E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	--	1	--	
Aluminum	7429-90-5	--	0.046776593	0.001	1.91E-09	--	1	--	
Arsenic	7440-38-2	--	0.00579213	0.001	2.37E-10	1.50E+00	1	3.56E-10	5.2
Barium	7440-39-3	--	0.053448218	0.001	2.19E-09	--	0.07	--	
Beryllium	7440-41-7	--	0.000342265	0.001	1.40E-11	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.002729138	0.001	1.12E-10	--	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.000282669	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	12.62269	0.001	5.17E-07	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.015259293	0.001	6.25E-10	--	0.013	--	
Cobalt	7440-48-4	--	0.004495239	0.0004	7.36E-11	--	1	--	
Copper	7440-50-8	--	0.004447607	0.001	1.82E-10	--	1	--	
Fluoride	16984-48-8	--	0.2940596	0.001	1.20E-08	--	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	1.56E-08	--	0.025	--	
Iron	7439-89-6	--	0.090209963	0.001	3.69E-09	--	1	--	
Lead	7439-92-1	--	0.001548018	0.0001	6.34E-12	--	1	--	
Manganese	7439-96-5	--	0.006198141	0.001	2.54E-10	--	0.04	--	
Nickel	7440-02-0	--	0.011729633	0.0002	9.60E-11	--	0.04	--	
Nitrate	14797-55-8	--	34.098186	0.001	1.40E-06	--	1	--	
Nitrite	14797-65-0	--	0.057119962	0.001	2.34E-09	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	6.02E-07	--	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	1.07E-12	3.90E+01	1	4.18E-11	0.61
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.8071E-09	1.16	2.76E-13	3.90E+01	1	1.08E-11	0.16
Silver	7440-22-4	--	0.005686587	0.0006	1.40E-10	--	0.04	--	
Strontium	7440-24-6	--	0.2694514	0.001	1.10E-08	--	1	--	
Sulfate	14808-79-8	--	64.094058	0.001	2.62E-06	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	0.031	--(c)	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	0.012	--(c)	8.90E-02	1	--	
Uranium	7440-61-1	--	0.020191069	0.001	8.26E-10	--	1	--	
Vanadium	7440-62-2	--	0.02186531	0.001	8.95E-10	--	1	--	
Zinc	7440-66-6	--	0.095789222	0.0006	2.35E-09	--	1	--	
Total ELCR								6.83E-09	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-field exposure area -- CTUIR

Cancer risk from inhalation of volatile radioactive contaminants in sweat lodge vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr

[a] Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	5.3264311	--(c)	--	--	
Iodine-129	15046-84-1	--	2.708038	--(c)	6.07E-11	--	
Plutonium-239/240	PU-239/240	--	0.029	--(c)	3.33E-08	--	
Protactinium-231	14331-85-2	--	0.28	--(c)	4.55E-08	--	
Strontium-90	10098-97-2	--	4.3004432	--(c)	1.05E-10	--	
Technetium-99	14133-76-7	--	1667.3497	--(c)	1.41E-11	--	
Tritium	10028-17-8	Yes	156901.45	3.87E+09	5.62E-14	2.18E-04	100
Total ELCR						2.18E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of nonvolatile contaminants is presented in Table C-16

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-field exposure area -- CTUIR

Cancer risk from inhalation of nonvolatile radioactive contaminants in sweathouse vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event[b]	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	5.3264311	2.26E+04	--	--	
Iodine-129	15046-84-1	--	2.708038	1.15E+04	6.07E-11	6.96E-07	0.43
Plutonium-239/240	PU-239/240	--	0.029	1.23E+02	3.33E-08	4.09E-06	2.6
Protactinium-231	14331-85-2	--	0.28	1.19E+03	4.55E-08	5.40E-05	34
Strontium-90	10098-97-2	--	4.3004432	1.82E+04	1.05E-10	1.91E-06	1.2
Technetium-99	14133-76-7	--	1667.3497	7.06E+06	1.41E-11	9.96E-05	62
Tritium	10028-17-8	Yes	156901.45	--(c)	5.62E-14	--	
Total ELCR						1.60E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of volatile contaminants is presented in Table C-15

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit River Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	HQ (Inhalation) (Volatiles) (unitless)	HQ (Inhalation) (Nonvolatiles) (unitless)	HQ (Dermal, Vapor, volatiles) (unitless)	HQ (Dermal, Liquid, Nonvolatiles) (unitless)	HQ (Dermal, Vapor, Nonvolatiles) (unitless)	Total HI (unitless)	% Contribution
Acetone	0.0011	VOC	1.76E-06	--	1.54E-10	--	--	1.76E-06	1.45E-05
Arsenic	0.005767892	--	--	3.3	--	0.0049	8.10E-07	3.29E+00	27
Barium	0.049451657	--	--	0.8	--	0.0009	1.49E-07	8.45E-01	7.0
Carbon tetrachloride	0.000271961	VOC	7.12E-05	--	1.53E-06	--	--	7.27E-05	5.99E-04
Chloride	11.3727	--	--	--	--	--	--	--	
Chloroform	0.000814875	VOC	4.14E-04	--	1.36E-07	--	--	4.14E-04	0.0034
Chromium	0.009951236	--	--	--	--	0.0001	2.15E-08	1.31E-04	0.0011
Copper	0.00597989	--	--	--	--	0.0000	6.30E-09	3.84E-05	3.17E-04
Fluoride	0.28680392	--	--	0.2	--	0.0012	2.01E-07	1.90E-01	1.6
Iron	0.61057915	--	--	--	--	0.0002	3.68E-08	2.24E-04	0.0018
Lead	0.0006805	--	--	--	--	--	--	--	
Manganese	0.041694118	--	--	7.1	--	0.0112	1.83E-06	7.13E+00	59
Nickel	0.0056	--	--	0.5	--	0.0004	5.90E-08	5.31E-01	4.4
Nitrate	28.582087	--	--	--	--	0.0010	1.70E-07	1.04E-03	0.0085
Nitrite	0.46	--	--	--	--	0.0004	6.46E-08	3.94E-04	0.0032
Strontium	0.38963943	--	--	--	--	0.0002	2.74E-08	1.67E-04	0.0014
Sulfate	42.560202	--	--	--	--	--	--	--	
Thallium	0.00037	--	--	--	--	--	--	--	
Uranium	0.005589723	--	--	0.2	--	0.0005	7.85E-08	1.59E-01	1.3
Vanadium	0.016788235	--	--	--	--	0.0009	1.41E-07	8.64E-04	0.0071
Zinc	0.006671161	--	--	--	--	0.0000	5.62E-10	3.43E-06	2.83E-05
Total			4.87E-04	1.21E+01	1.66E-06	2.19E-02	3.60E-06	12.14	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.
Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
HQ = hazard quotient.
HI = hazard index.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit River Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal, Vapor, volatiles) (unitless)	Risk (Dermal, Liquid, Nonvolatiles) (unitless)	Risk (Dermal, Vapor, Nonvolatiles) (unitless)	Total Risk (unitless)	% Contribution
Acetone	0.0011	VOC	--	--	--	--	--	--	
Arsenic	0.005767892	--	--	2.06E-04	--	2.16E-06	3.54E-10	2.08E-04	94
Barium	0.049451657	--	--	--	--	--	--	--	
Carbon tetrachloride	0.000271961	VOC	1.97E-07	--	1.35E-10	--	--	1.97E-07	0.089
Chloride	11.3727	--	--	--	--	--	--	--	
Chloroform	0.000814875	VOC	9.06E-07	--	4.10E-11	--	--	9.06E-07	0.41
Chromium	0.009951236	--	--	--	--	--	--	--	
Copper	0.00597989	--	--	--	--	--	--	--	
Fluoride	0.28680392	--	--	--	--	--	--	--	
Iron	0.61057915	--	--	--	--	--	--	--	
Lead	0.0006805	--	--	--	--	--	--	--	
Manganese	0.041694118	--	--	--	--	--	--	--	
Nickel	0.0056	--	--	1.21E-05	--	--	--	1.21E-05	5.5
Nitrate	28.582087	--	--	--	--	--	--	--	
Nitrite	0.46	--	--	--	--	--	--	--	
Strontium	0.38963943	--	--	--	--	--	--	--	
Sulfate	42.560202	--	--	--	--	--	--	--	
Thallium	0.00037	--	--	--	--	--	--	--	
Uranium	0.005589723	--	--	--	--	--	--	--	
Vanadium	0.016788235	--	--	--	--	--	--	--	
Zinc	0.006671161	--	--	--	--	--	--	--	
Total ELCR			1.10E-06	2.18E-04	1.76E-10	2.16E-06	3.54E-10	2.21E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
ELCR = excess lifetime cancer risk.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit River Exposure Area Native American Risk Assessment (5-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (pCi/L)	Volatile?[a]	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	2.4	No	--	--	--	--	
Gross beta	31.1	No	--	--	--	--	
Strontium-90	2.60	No	--	1.16E-06		1.16E-06	1.1
Technetium-99	121	No	--	7.23E-06	--	7.23E-06	6.8
Tritium	70,724	Yes	9.81E-05	--	--	9.81E-05	92
Total ELCR			9.81E-05	8.38E-06	--	1.07E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--river exposure area-- CTUIR

Hazard quotient and cancer risk from inhalation of VOCs/SVOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Contaminant concentration in water	C_{dw}	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF	365	day/yr

[a] Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
Acetone	67-64-1	VOC	0.0011	1.56E-05	3.10E+01	8.86E+00	1.76E-06	0.36
Arsenic	7440-38-2	--	0.005767892	--(c)	1.50E-05	4.29E-06	--	
Barium	7440-39-3	--	0.049451657	--(c)	5.00E-04	1.43E-04	--	
Carbon tetrachloride	56-23-5	VOC	0.000271961	3.86E-06	1.90E-01	5.43E-02	7.12E-05	15
Chloride	16887-00-6	--	11.3727	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.000814875	1.16E-05	9.80E-02	2.80E-02	4.14E-04	85
Chromium	7440-47-3	--	0.009951236	--(c)	--	--	--	
Copper	7440-50-8	--	0.00597989	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.28680392	--(c)	1.30E-02	3.71E-03	--	
Iron	7439-89-6	--	0.61057915	--(c)	--	--	--	
Lead	7439-92-1	--	0.0006805	--(c)	--	--	--	
Manganese	7439-96-5	--	0.041694118	--(c)	5.00E-05	1.43E-05	--	
Nickel	7440-02-0	--	0.0056	--(c)	9.00E-05	2.57E-05	--	
Nitrate	14797-55-8	--	28.582087	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.46	--(c)	--	--	--	
Strontium	7440-24-6	--	0.38963943	--(c)	--	--	--	
Sulfate	14808-79-8	--	42.560202	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	--(c)	--	--	--	
Uranium	7440-61-1	--	0.005589723	--(c)	3.00E-04	8.57E-05	--	
Vanadium	7440-62-2	--	0.016788235	--(c)	--	--	--	
Zinc	7440-66-6	--	0.006671161	--(c)	--	--	--	
Total							4.87E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of nonvolatile chemicals is presented in Table C-19

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
HQ = hazard quotient.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
Acetone	67-64-1	VOC	0.0011	1.52E-05	--	--	--	
Arsenic	7440-38-2	--	0.005767892	--(c)	4.30E-03	1.51E+01	--	
Barium	7440-39-3	--	0.049451657	--(c)	--	--	--	
Carbon tetrachloride	56-23-5	VOC	0.000271961	3.75E-06	1.50E-05	5.25E-02	1.97E-07	18
Chloride	16887-00-6	--	11.3727	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.000814875	1.12E-05	2.30E-05	8.05E-02	9.06E-07	82
Chromium	7440-47-3	--	0.009951236	--(c)	--	--	--	
Copper	7440-50-8	--	0.00597989	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.28680392	--(c)	--	--	--	
Iron	7439-89-6	--	0.61057915	--(c)	--	--	--	
Lead	7439-92-1	--	0.0006805	--(c)	--	--	--	
Manganese	7439-96-5	--	0.041694118	--(c)	--	--	--	
Nickel	7440-02-0	--	0.0056	--(c)	2.60E-04	9.10E-01	--	
Nitrate	14797-55-8	--	28.582087	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.46	--(c)	--	--	--	
Strontium	7440-24-6	--	0.38963943	--(c)	--	--	--	
Sulfate	14808-79-8	--	42.560202	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	--(c)	--	--	--	
Uranium	7440-61-1	--	0.005589723	--(c)	--	--	--	
Vanadium	7440-62-2	--	0.016788235	--(c)	--	--	--	
Zinc	7440-66-6	--	0.006671161	--(c)	--	--	--	
Total ELCR							1.10E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of nonvolatile chemicals is presented in Table C-19

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--river exposure area-- CTUIR

Hazard quotient and cancer risk from inhalation of non-VOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 2)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion Factor	CF	365	day/yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L

[a] Harris (2008)

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
Acetone	67-64-1	VOC	0.0011	--(c)	3.10E+01	8.86E+00	--	
Arsenic	7440-38-2	--	0.005767892	1.41E-05	1.50E-05	4.29E-06	3.28E+00	27
Barium	7440-39-3	--	0.049451657	1.21E-04	5.00E-04	1.43E-04	8.44E-01	7.0
Carbon tetrachloride	56-23-5	VOC	0.000271961	--(c)	1.90E-01	5.43E-02	--	
Chloride	16887-00-6	--	11.3727	2.77E-02	--	--	--	
Chloroform	67-66-3	VOC	0.000814875	--(c)	9.80E-02	2.80E-02	--	
Chromium	7440-47-3	--	0.009951236	2.43E-05	--	--	--	
Copper	7440-50-8	--	0.00597989	1.46E-05	--	--	--	
Fluoride	16984-48-8	--	0.28680392	6.99E-04	1.30E-02	3.71E-03	1.88E-01	1.6
Iron	7439-89-6	--	0.61057915	1.49E-03	--	--	--	
Lead	7439-92-1	--	0.0006805	1.66E-06	--	--	--	
Manganese	7439-96-5	--	0.041694118	1.02E-04	5.00E-05	1.43E-05	7.12E+00	59
Nickel	7440-02-0	--	0.0056	1.37E-05	9.00E-05	2.57E-05	5.31E-01	4.4
Nitrate	14797-55-8	--	28.582087	6.97E-02	--	--	--	
Nitrite	14797-65-0	--	0.46	1.12E-03	--	--	--	
Strontium	7440-24-6	--	0.38963943	9.50E-04	--	--	--	
Sulfate	14808-79-8	--	42.560202	1.04E-01	--	--	--	
Thallium	7440-28-0	--	0.00037	9.02E-07	--	--	--	
Uranium	7440-61-1	--	0.005589723	1.36E-05	3.00E-04	8.57E-05	1.59E-01	1.3
Vanadium	7440-62-2	--	0.016788235	4.09E-05	--	--	--	
Zinc	7440-66-6	--	0.006671161	1.63E-05	--	--	--	
Total							1.21E+01	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of volatile compounds in vapor is presented in Table C-18

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,i}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	1.44E-06	1.50E+00	1	2.16E-06	100
Barium	7440-39-3	--	0.049451657	0.001	1.24E-05	--	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.000271961	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	11.3727	0.001	2.84E-03	--	1	--	
Chloroform	67-66-3	VOC	0.000814875	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.009951236	0.001	2.49E-06	--	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	1.49E-06	--	1	--	
Fluoride	16984-48-8	--	0.28680392	0.001	7.16E-05	--	1	--	
Iron	7439-89-6	--	0.61057915	0.001	1.53E-04	--	1	--	
Lead	7439-92-1	--	0.0006805	0.0001	1.70E-08	--	1	--	
Manganese	7439-96-5	--	0.041694118	0.001	1.04E-05	--	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	2.80E-07	--	0.04	--	
Nitrate	14797-55-8	--	28.582087	0.001	7.14E-03	--	1	--	
Nitrite	14797-65-0	--	0.46	0.001	1.15E-04	--	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	9.73E-05	--	1	--	
Sulfate	14808-79-8	--	42.560202	0.001	1.06E-02	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	9.24E-08	--	1	--	
Uranium	7440-61-1	--	0.005589723	0.001	1.40E-06	--	1	--	
Vanadium	7440-62-2	--	0.016788235	0.001	4.19E-06	--	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	1.00E-06	--	1	--	
Total ELCR								2.16E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--river exposure area-- CTUIR

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/day
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Ideal gas law constant	R	62.37	(mmHg-L)/(gmole-K)
Temperature of the sweat lodge	T	338.7	K
Density of liquid water	rhow	1000	g/L
Conversion factor	CF_2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	9.00E-01	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	2.43E-10	3.00E-04	1	8.10E-07	23
Barium	7440-39-3	--	0.049451657	0.001	2.08E-09	2.00E-01	0.07	1.49E-07	4.1
Carbon tetrachloride	56-23-5	VOC	0.000271961	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	11.3727	0.001	4.79E-07	--	1	--	
Chloroform	67-66-3	VOC	0.000814875	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.009951236	0.001	4.19E-10	1.50E+00	0.013	2.15E-08	0.60
Copper	7440-50-8	--	0.00597989	0.001	2.52E-10	4.00E-02	1	6.30E-09	0.18
Fluoride	16984-48-8	--	0.28680392	0.001	1.21E-08	6.00E-02	1	2.01E-07	5.6
Iron	7439-89-6	--	0.61057915	0.001	2.57E-08	7.00E-01	1	3.68E-08	1.0
Lead	7439-92-1	--	0.0006805	0.0001	2.87E-12	--	1	--	
Manganese	7439-96-5	--	0.041694118	0.001	1.76E-09	2.40E-02	0.04	1.83E-06	51
Nickel	7440-02-0	--	0.0056	0.0002	4.72E-11	2.00E-02	0.04	5.90E-08	1.6
Nitrate	14797-55-8	--	28.582087	0.001	1.20E-06	7.10E+00	1	1.70E-07	4.7
Nitrite	14797-65-0	--	0.46	0.001	1.94E-08	3.00E-01	1	6.46E-08	1.8
Strontium	7440-24-6	--	0.38963943	0.001	1.64E-08	6.00E-01	1	2.74E-08	0.76
Sulfate	14808-79-8	--	42.560202	0.001	1.79E-06	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	1.56E-11	--	1	--	
Uranium	7440-61-1	--	0.005589723	0.001	2.36E-10	3.00E-03	1	7.85E-08	2.2
Vanadium	7440-62-2	--	0.016788235	0.001	7.07E-10	5.00E-03	1	1.41E-07	3.9
Zinc	7440-66-6	--	0.006671161	0.0006	1.69E-10	3.00E-01	1	5.62E-10	0.016
Total								0.0000	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal Intake of Volatiles in Sweatlodge vapor is presented in Table C-20

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	2.36E-10	1.50E+00	1	3.54E-10	100
Barium	7440-39-3	--	0.049451657	0.001	2.02E-09	--	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.000271961	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	11.3727	0.001	4.65E-07	--	1	--	
Chloroform	67-66-3	VOC	0.000814875	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.009951236	0.001	4.07E-10	--	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	2.45E-10	--	1	--	
Fluoride	16984-48-8	--	0.28680392	0.001	1.17E-08	--	1	--	
Iron	7439-89-6	--	0.61057915	0.001	2.50E-08	--	1	--	
Lead	7439-92-1	--	0.0006805	0.0001	2.79E-12	--	1	--	
Manganese	7439-96-5	--	0.041694118	0.001	1.71E-09	--	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	4.58E-11	--	0.04	--	
Nitrate	14797-55-8	--	28.582087	0.001	1.17E-06	--	1	--	
Nitrite	14797-65-0	--	0.46	0.001	1.88E-08	--	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	1.59E-08	--	1	--	
Sulfate	14808-79-8	--	42.560202	0.001	1.74E-06	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	1.51E-11	--	1	--	
Uranium	7440-61-1	--	0.005589723	0.001	2.29E-10	--	1	--	
Vanadium	7440-62-2	--	0.016788235	0.001	6.87E-10	--	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	1.64E-10	--	1	--	
Total ELCR								3.54E-10	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Dermal Intake of Volatiles in Sweatlodge vapor is presented in Table C-20

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--river exposure area-- CTUIR

Cancer risk from inhalation of volatile radioactive contaminants in sweat lodge vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr

[a] Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	2.4	--(c)	--	--	
Gross beta	12587-47-2	--	31.1	--(c)	--	--	
Strontium-90	10098-97-2	--	2.60	--(c)	1.05E-10	--	
Technetium-99	14133-76-7	--	121	--(c)	1.41E-11	--	
Tritium	10028-17-8	Yes	70,724	1.75E+09	5.62E-14	9.81E-05	100
Total ELCR						9.81E-05	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of nonvolatile contaminants is Presented in Table C-24

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--river exposure area-- CTUIR

Cancer risk from inhalation of nonvolatile radioactive contaminants in sweathouse vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)

[a] Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	2.4	1.01E+04	--	--	
Gross beta	12587-47-2	--	31.1	1.32E+05	--	--	
Strontium-90	10098-97-2	--	2.60	1.10E+04	1.05E-10	1.16E-06	14
Technetium-99	14133-76-7	--	121	5.13E+05	1.41E-11	7.23E-06	86
Tritium	10028-17-8	Yes	70,724	--(c)	5.62E-14	--	
Total ELCR						8.38E-06	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of volatile contaminants is presented in Table C-23

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakima Nationa Sweat Lodge Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	HQ (Inhalation) (Volatiles) (unitless)	HQ (Inhalation) (Nonvolatiles) (unitless)	HQ (Dermal, Vapor, volatiles) (unitless)	HQ (Dermal, Liquid, Nonvolatiles) (unitless)	HQ (Dermal, Vapor, Nonvolatiles) (unitless)	Total HI (unitless)	% Contribution
1,1,1-Trichloroethane	0.000691076	VOC	1.43E-05	--	2.21E-09	--	--	1.43E-05	6.35E-05
1,1-Dichloroethane	0.000255649	VOC	3.78E-05	--	4.21E-09	--	--	3.78E-05	1.68E-04
1,1-Dichloroethene	0.00016874	VOC	8.73E-05	--	1.99E-08	--	--	8.73E-05	3.88E-04
1,2-Dichlorobenzene	0.003	VOC	1.55E-03	--	6.71E-07	--	--	1.55E-03	0.0069
1,4-Dichlorobenzene	0.000130957	VOC	1.69E-05	--	3.86E-08	--	--	1.70E-05	7.54E-05
1,4-Dioxane	0.0081	SVOC	2.33E-04	--	1.31E-08	--	--	2.33E-04	0.0010
2-Butanone	0.00055	VOC	1.14E-05	--	4.32E-10	--	--	1.14E-05	5.05E-05
2-Pentanone, 4-Methyl	0.00064	VOC	2.21E-05	--	1.06E-08	--	--	2.21E-05	9.81E-05
Acetone	0.001511507	VOC	5.04E-06	--	4.22E-10	--	--	5.04E-06	2.24E-05
Arsenic	0.003140238	--	--	3.72E+00	--	5.38E-03	8.82E-07	3.72E+00	17
Barium	0.072881156	--	--	2.59E+00	--	2.68E-03	4.39E-07	2.59E+00	12
Bis(2-ethylhexyl) phthalate	0.001	SVOC	--	--	6.14E-07	--	--	6.14E-07	2.73E-06
Cadmium	0.0045	--	--	7.99E+00	--	9.26E-02	1.52E-05	8.08E+00	36
Carbon disulfide	0.00021	VOC	3.10E-05	--	1.75E-08	--	--	3.11E-05	1.38E-04
Carbon tetrachloride	0.000170123	VOC	9.26E-05	--	1.91E-06	--	--	9.45E-05	4.20E-04
Chloride	9.9702351	--	--	--	--	--	--	--	
Chloroform	0.000214204	VOC	2.26E-04	--	7.15E-08	--	--	2.26E-04	0.0010
Chromium	0.009493374	--	--	--	--	2.50E-04	4.10E-08	2.50E-04	0.0011
Copper	0.004884201	--	--	--	--	6.28E-05	1.03E-08	6.28E-05	2.79E-04
Fluoride	0.30080145	--	--	4.11E-01	--	2.58E-03	4.22E-07	4.13E-01	1.8
Iron	0.12126178	--	--	--	--	8.91E-05	1.46E-08	8.91E-05	3.96E-04
Lead	0.000581898	--	--	--	--	--	--	--	
Manganese	0.015530827	--	--	5.51E+00	--	8.32E-03	1.36E-06	5.52E+00	25
Methylene chloride	0.002069589	VOC	2.14E-04	--	5.93E-08	--	--	2.14E-04	9.51E-04
Nickel	0.006014142	--	--	1.19E+00	--	7.73E-04	1.27E-07	1.19E+00	5.3
Nitrate	23.863649	--	--	--	--	1.73E-03	2.83E-07	1.73E-03	0.0077
Nitrite	0.081906164	--	--	--	--	1.40E-04	2.30E-08	1.40E-04	6.24E-04
Silver	0.005776818	--	--	--	--	8.91E-03	1.46E-06	8.91E-03	0.040
Strontium	0.38364144	--	--	--	--	3.29E-04	5.39E-08	3.29E-04	0.0015
Sulfate	45.030868	--	--	--	--	--	--	--	
Tetrachloroethene	0.000872033	VOC	3.34E-04	--	1.41E-06	--	--	3.36E-04	0.0015
Tributyl phosphate	0.012498806	SVOC	--	--	7.00E-07	--	--	7.00E-07	3.11E-06
Trichloroethene	0.000433871	VOC	1.28E-03	--	--	--	--	1.28E-03	0.0057
Trichloromonofluoromethane	0.00058	VOC	8.57E-05	--	1.23E-08	--	--	8.57E-05	3.81E-04
Uranium	0.016629145	--	--	9.84E-01	--	2.85E-03	4.67E-07	9.87E-01	4.4
Vanadium	0.012904693	--	--	--	--	1.33E-03	2.17E-07	1.33E-03	0.0059
Zinc	0.068859746	--	--	--	--	7.08E-05	1.16E-08	7.08E-05	3.15E-04
Total			4.25E-03	2.24E+01	5.56E-06	1.28E-01	2.10E-05	2.25E+01	100

[a] Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment.*

COPC = contaminant of potential concern.

HI = hazard index.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Native American Risk Assessment (5-Year)–Summary of Yakima Nationa Sweat Lodge Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal, Vapor, volatiles) (unitless)	Risk (Dermal, Liquid, Nonvolatiles) (unitless)	Risk (Dermal, Vapor, Nonvolatiles) (unitless)	Total Risk (unitless)	% Contribution
1,1,1-Trichloroethane	0.000691076	VOC	--	--	--	--	--	--	
1,1-Dichloroethane	0.000255649	VOC	--	--	--	--	--	--	
1,1-Dichloroethene	0.00016874	VOC	--	--	--	--	--	--	
1,2-Dichlorobenzene	0.003	VOC	--	--	--	--	--	--	
1,4-Dichlorobenzene	0.000130957	VOC	1.45E-07	--	1.42E-11	--	--	1.45E-07	0.035
1,4-Dioxane	0.0081	SVOC	6.27E-06	--	1.40E-11	--	--	6.27E-06	1.5
2-Butanone	0.00055	VOC	--	--	--	--	--	--	
2-Pentanone, 4-Methyl	0.00064	VOC	--	--	--	--	--	--	
Acetone	0.001511507	VOC	--	--	--	--	--	--	
Arsenic	0.003140238	--	--	2.33E-04	--	2.35E-06	3.86E-10	2.35E-04	57
Barium	0.072881156	--	--	--	--	--	--	--	
Bis(2-ethylhexyl) phthalate	0.001	SVOC	2.41E-07	--	1.67E-10	--	--	2.41E-07	0.059
Cadmium	0.0045	--	--	1.40E-04	--	--	--	1.40E-04	34
Carbon disulfide	0.00021	VOC	--	--	--	--	--	--	
Carbon tetrachloride	0.000170123	VOC	2.56E-07	--	1.69E-10	--	--	2.57E-07	0.062
Chloride	9.9702351	--	--	--	--	--	--	--	
Chloroform	0.000214204	VOC	4.95E-07	--	2.15E-11	--	--	4.95E-07	0.12
Chromium	0.009493374	--	--	--	--	--	--	--	
Copper	0.004884201	--	--	--	--	--	--	--	
Fluoride	0.30080145	--	--	--	--	--	--	--	
Iron	0.12126178	--	--	--	--	--	--	--	
Lead	0.000581898	--	--	--	--	--	--	--	
Manganese	0.015530827	--	--	--	--	--	--	--	
Methylene chloride	0.002069589	VOC	--	--	2.59E-11	--	--	2.59E-11	6.31E-06
Nickel	0.006014142	--	--	2.70E-05	--	--	--	2.70E-05	6.6
Nitrate	23.863649	--	--	--	--	--	--	--	
Nitrite	0.081906164	--	--	--	--	--	--	--	
Silver	0.005776818	--	--	--	--	--	--	--	
Strontium	0.38364144	--	--	--	--	--	--	--	
Sulfate	45.030868	--	--	--	--	--	--	--	
Tetrachloroethene	0.000872033	VOC	5.17E-07	--	7.41E-09	--	--	5.24E-07	0.13
Tributyl phosphate	0.012498806	SVOC	--	--	1.25E-09	--	--	1.25E-09	3.04E-04
Trichloroethene	0.000433871	VOC	1.09E-06	--	2.21E-10	--	--	1.09E-06	0.27
Trichloromonofluoromethane	0.00058	VOC	--	--	--	--	--	--	
Uranium	0.016629145	--	--	--	--	--	--	--	
Vanadium	0.012904693	--	--	--	--	--	--	--	
Zinc	0.068859746	--	--	--	--	--	--	--	
Total ELCR			9.01E-06	3.99E-04	9.30E-09	2.35E-06	3.86E-10	4.11E-04	100

[a] Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment.*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakima Nationa Sweat Lodge Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.							
COPC	95 UCL Groundwater Concentration (pCi/L)	Volatile?[a]	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	6.4100896	--	--	--	--	--	
Gross beta	32.397036	--	--	--		--	
Iodine-129	1.9883847	--	--	1.06E-06		1.06E-06	0.12
Nickel-63	4.07	--	--	5.88E-08		5.88E-08	0.0065
Protactinium-231	0.308	--	--	1.23E-04	--	1.23E-04	14
Strontium-90	0.611	--	--	5.65E-07	--	5.65E-07	0.063
Technetium-99	93.996334	--	--	1.17E-05	--	1.17E-05	1.3
Tritium	264106.86	Yes	7.62E-04	--	--	7.62E-04	85
Total ELCR			7.62E-04	1.37E-04	--	8.99E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from inhalation of VOCs/SVOCs in sweat lodge vapor
Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Contaminant concentration in water	C_{dw}	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF	365	day/yr

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	2.04E-05	5.00E+00	1.43E+00	1.43E-05	0.34
1,1-Dichloroethane	75-34-3	VOC	0.000255649	7.56E-06	7.00E-01	2.00E-01	3.78E-05	0.89
1,1-Dichloroethene	75-35-4	VOC	0.00016874	4.99E-06	2.00E-01	5.71E-02	8.73E-05	2.1
1,2-Dichlorobenzene	95-50-1	VOC	0.003	8.87E-05	2.00E-01	5.71E-02	1.55E-03	37
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	3.87E-06	8.00E-01	2.29E-01	1.69E-05	0.40
1,4-Dioxane	123-91-1	SVOC	0.0081	2.39E-04	3.60E+00	1.03E+00	2.33E-04	5.5
2-Butanone	78-93-3	VOC	0.00055	1.63E-05	5.00E+00	1.43E+00	1.14E-05	0.27
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	1.89E-05	3.00E+00	8.57E-01	2.21E-05	0.52
Acetone	67-64-1	VOC	0.001511507	4.47E-05	3.10E+01	8.86E+00	5.04E-06	0.12
Arsenic	7440-38-2	--	0.003140238	--(c)	1.50E-05	4.29E-06	--	
Barium	7440-39-3	--	0.072881156	--(c)	5.00E-04	1.43E-04	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	2.96E-05	--	--	--	
Cadmium	7440-43-9	--	0.0045	--(c)	1.00E-05	2.86E-06	--	
Carbon disulfide	75-15-0	VOC	0.00021	6.21E-06	7.00E-01	2.00E-01	3.10E-05	0.73
Carbon tetrachloride	56-23-5	VOC	0.000170123	5.03E-06	1.90E-01	5.43E-02	9.26E-05	2.2
Chloride	16887-00-6	--	9.9702351	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.000214204	6.33E-06	9.80E-02	2.80E-02	2.26E-04	5.3
Chromium	7440-47-3	--	0.009493374	--(c)	--	--	--	
Copper	7440-50-8	--	0.004884201	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.30080145	--(c)	1.30E-02	3.71E-03	--	
Iron	7439-89-6	--	0.12126178	--(c)	--	--	--	
Lead	7439-92-1	--	0.000581898	--(c)	--	--	--	
Manganese	7439-96-5	--	0.015530827	--(c)	5.00E-05	1.43E-05	--	
Methylene chloride	75-09-2	VOC	0.002069589	6.12E-05	1.00E+00	2.86E-01	2.14E-04	5.0
Nickel	7440-02-0	--	0.006014142	--(c)	9.00E-05	2.57E-05	--	
Nitrate	14797-55-8	--	23.863649	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.081906164	--(c)	--	--	--	
Silver	7440-22-4	--	0.005776818	--(c)	--	--	--	
Strontium	7440-24-6	--	0.38364144	--(c)	--	--	--	
Sulfate	14808-79-8	--	45.030868	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	2.58E-05	2.70E-01	7.71E-02	3.34E-04	7.9
Tributyl phosphate	126-73-8	SVOC	0.012498806	3.69E-04	--	--	--	
Trichloroethene	79-01-6	VOC	0.000433871	1.28E-05	3.50E-02	1.00E-02	1.28E-03	30
Trichloromonofluoromethane	75-69-4	VOC	0.00058	1.71E-05	7.00E-01	2.00E-01	8.57E-05	2.0
Uranium	7440-61-1	--	0.016629145	--(c)	3.00E-04	8.57E-05	--	
Vanadium	7440-62-2	--	0.012904693	--(c)	--	--	--	

Zinc	7440-66-6	--	0.068859746	--(c)	--	--	--	
Total							4.25E-03	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of nonvolatile chemicals is presented in table D-3

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	1.98E-05	--	--	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	7.34E-06	--	--	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	4.85E-06	--	--	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	8.61E-05	--	--	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	3.76E-06	1.10E-05	3.85E-02	1.45E-07	1.6
1,4-Dioxane	123-91-1	SVOC	0.0081	2.33E-04	7.70E-06	2.70E-02	6.27E-06	70
2-Butanone	78-93-3	VOC	0.00055	1.58E-05	--	--	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	1.84E-05	--	--	--	
Acetone	67-64-1	VOC	0.001511507	4.34E-05	--	--	--	
Arsenic	7440-38-2	--	0.003140238	--(c)	4.30E-03	1.51E+01	--	
Barium	7440-39-3	--	0.072881156	--(c)	--	--	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	2.87E-05	2.40E-06	8.40E-03	2.41E-07	2.7
Cadmium	7440-43-9	--	0.0045	--(c)	1.80E-03	6.30E+00	--	
Carbon disulfide	75-15-0	VOC	0.00021	6.03E-06	--	--	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	4.88E-06	1.50E-05	5.25E-02	2.56E-07	2.8
Chloride	16887-00-6	--	9.9702351	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.000214204	6.15E-06	2.30E-05	8.05E-02	4.95E-07	5.5
Chromium	7440-47-3	--	0.009493374	--(c)	--	--	--	
Copper	7440-50-8	--	0.004884201	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.30080145	--(c)	--	--	--	
Iron	7439-89-6	--	0.12126178	--(c)	--	--	--	
Lead	7439-92-1	--	0.000581898	--(c)	--	--	--	
Manganese	7439-96-5	--	0.015530827	--(c)	--	--	--	
Methylene chloride	75-09-2	VOC	0.002069589	--(c)	4.70E-07	1.65E-03	--	
Nickel	7440-02-0	--	0.006014142	--(c)	2.60E-04	9.10E-01	--	
Nitrate	14797-55-8	--	23.863649	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.081906164	--(c)	--	--	--	
Silver	7440-22-4	--	0.005776818	--(c)	--	--	--	
Strontium	7440-24-6	--	0.38364144	--(c)	--	--	--	
Sulfate	14808-79-8	--	45.030868	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	2.50E-05	5.90E-06	2.07E-02	5.17E-07	5.7
Tributyl phosphate	126-73-8	SVOC	0.012498806	3.59E-04	--	--	--	
Trichloroethene	79-01-6	VOC	0.000433871	1.25E-05	2.50E-05	8.75E-02	1.09E-06	12
Trichloromonofluoromethane	75-69-4	VOC	0.00058	1.67E-05	--	--	--	
Uranium	7440-61-1	--	0.016629145	--(c)	--	--	--	
Vanadium	7440-62-2	--	0.012904693	--(c)	--	--	--	
Zinc	7440-66-6	--	0.068859746	--(c)	--	--	--	
Total ELCR							9.01E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of nonvolatile chemicals is presented in table D-3

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from inhalation of nonvolatiles in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 2, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion Factor	CF	365	day/yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	--(c)	5.00E+00	1.43E+00	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	--(c)	7.00E-01	2.00E-01	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	--(c)	2.00E-01	5.71E-02	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	--(c)	2.00E-01	5.71E-02	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	--(c)	8.00E-01	2.29E-01	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	--(c)	3.60E+00	1.03E+00	--	
2-Butanone	78-93-3	VOC	0.00055	--(c)	5.00E+00	1.43E+00	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	--(c)	3.00E+00	8.57E-01	--	
Acetone	67-64-1	VOC	0.001511507	--(c)	3.10E+01	8.86E+00	--	
Arsenic	7440-38-2	--	0.003140238	1.59E-05	1.50E-05	4.29E-06	3.72	17
Barium	7440-39-3	--	0.072881156	3.70E-04	5.00E-04	1.43E-04	2.59	12
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	--(c)	--	--	--	
Cadmium	7440-43-9	--	0.0045	2.28E-05	1.00E-05	2.86E-06	7.99	36
Carbon disulfide	75-15-0	VOC	0.00021	--(c)	7.00E-01	2.00E-01	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	--(c)	1.90E-01	5.43E-02	--	
Chloride	16887-00-6	--	9.9702351	5.06E-02	--	--	--	
Chloroform	67-66-3	VOC	0.000214204	--(c)	9.80E-02	2.80E-02	--	
Chromium	7440-47-3	--	0.009493374	4.81E-05	--	--	--	
Copper	7440-50-8	--	0.004884201	2.48E-05	--	--	--	
Fluoride	16984-48-8	--	0.30080145	1.53E-03	1.30E-02	3.71E-03	0.41	1.8
Iron	7439-89-6	--	0.12126178	6.15E-04	--	--	--	
Lead	7439-92-1	--	0.000581898	2.95E-06	--	--	--	
Manganese	7439-96-5	--	0.015530827	7.88E-05	5.00E-05	1.43E-05	5.51	25
Methylene chloride	75-09-2	VOC	0.002069589	--(c)	1.00E+00	2.86E-01	--	
Nickel	7440-02-0	--	0.006014142	3.05E-05	9.00E-05	2.57E-05	1.19	5.3
Nitrate	14797-55-8	--	23.863649	1.21E-01	--	--	--	
Nitrite	14797-65-0	--	0.081906164	4.15E-04	--	--	--	
Silver	7440-22-4	--	0.005776818	2.93E-05	--	--	--	
Strontium	7440-24-6	--	0.38364144	1.95E-03	--	--	--	
Sulfate	14808-79-8	--	45.030868	2.28E-01	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	--(c)	2.70E-01	7.71E-02	--	
Tributyl phosphate	126-73-8	SVOC	0.012498806	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000433871	--(c)	3.50E-02	1.00E-02	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	--(c)	7.00E-01	2.00E-01	--	
Uranium	7440-61-1	--	0.016629145	8.43E-05	3.00E-04	8.57E-05	0.98	4.4
Vanadium	7440-62-2	--	0.012904693	6.54E-05	--	--	--	
Zinc	7440-66-6	--	0.068859746	3.49E-04	--	--	--	
Total							22	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of volatile compounds in vapor is presented in Table D-2

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
HQ = hazard quotient.
SVOC = semivolatile organic compound.
VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	--(c)	--	--	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	--(c)	--	--	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	--(c)	--	--	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	--(c)	--	--	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	--(c)	1.10E-05	3.85E-02	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	--(c)	7.70E-06	2.70E-02	--	
2-Butanone	78-93-3	VOC	0.00055	--(c)	--	--	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	--(c)	--	--	--	
Acetone	67-64-1	VOC	0.001511507	--(c)	--	--	--	
Arsenic	7440-38-2	--	0.003140238	1.55E-05	4.30E-03	1.51E+01	2.33E-04	58
Barium	7440-39-3	--	0.072881156	3.59E-04	--	--	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	--(c)	2.40E-06	8.40E-03	--	
Cadmium	7440-43-9	--	0.0045	2.22E-05	1.80E-03	6.30E+00	1.40E-04	35
Carbon disulfide	75-15-0	VOC	0.00021	--(c)	--	--	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	--(c)	1.50E-05	5.25E-02	--	
Chloride	16887-00-6	--	9.9702351	4.91E-02	--	--	--	
Chloroform	67-66-3	VOC	0.000214204	--(c)	2.30E-05	8.05E-02	--	
Chromium	7440-47-3	--	0.009493374	4.68E-05	--	--	--	
Copper	7440-50-8	--	0.004884201	2.41E-05	--	--	--	
Fluoride	16984-48-8	--	0.30080145	1.48E-03	--	--	--	
Iron	7439-89-6	--	0.12126178	5.97E-04	--	--	--	
Lead	7439-92-1	--	0.000581898	2.87E-06	--	--	--	
Manganese	7439-96-5	--	0.015530827	7.65E-05	--	--	--	
Methylene chloride	75-09-2	VOC	0.002069589	--(c)	4.70E-07	1.65E-03	--	
Nickel	7440-02-0	--	0.006014142	2.96E-05	2.60E-04	9.10E-01	2.70E-05	6.7
Nitrate	14797-55-8	--	23.863649	1.18E-01	--	--	--	
Nitrite	14797-65-0	--	0.081906164	4.04E-04	--	--	--	
Silver	7440-22-4	--	0.005776818	2.85E-05	--	--	--	
Strontium	7440-24-6	--	0.38364144	1.89E-03	--	--	--	
Sulfate	14808-79-8	--	45.030868	2.22E-01	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	--(c)	5.90E-06	2.07E-02	--	
Tributyl phosphate	126-73-8	SVOC	0.012498806	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000433871	--(c)	2.50E-05	8.75E-02	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	--(c)	--	--	--	
Uranium	7440-61-1	--	0.016629145	8.19E-05	--	--	--	
Vanadium	7440-62-2	--	0.012904693	6.36E-05	--	--	--	
Zinc	7440-66-6	--	0.068859746	3.39E-04	--	--	--	
Total ELCR							3.99E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of volatile compounds in vapor is presented in Table D-2

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to VOCs/SVOCs in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water (*Id,l*)
can be neglected and total dermal intake (*Id,total*) is equal to dermal intake from VOCs/SVOCs in sweat lodge vapor (*Id,v*)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 3, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight[b]	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF1	0.01	m/cm
Conversion factor	CF2	365	day/yr

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	0.013	4.41E-09	2.00E+00	1	2.21E-09	0.040
1,1-Dichloroethane	75-34-3	VOC	0.000255649	0.0067	8.41E-10	2.00E-01	1	4.21E-09	0.076
1,1-Dichloroethene	75-35-4	VOC	0.00016874	0.012	9.94E-10	5.00E-02	1	1.99E-08	0.36
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	6.04E-08	9.00E-02	1	6.71E-07	12
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	0.042	2.70E-09	7.00E-02	1	3.86E-08	0.69
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	1.31E-09	1.00E-01	1	1.31E-08	0.24
2-Butanone	78-93-3	VOC	0.00055	0.00096	2.59E-10	6.00E-01	1	4.32E-10	0.0078
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	8.49E-10	8.00E-02	1	1.06E-08	0.19
Acetone[d]	67-64-1	VOC	0.001511507	0.000512	3.80E-10	9.00E-01	1	4.22E-10	0.0076
Arsenic	7440-38-2	--	0.003140238	0.001	--(c)	3.00E-04	1	--	
Barium	7440-39-3	--	0.072881156	0.001	--(c)	2.00E-01	0.07	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	0.025	1.23E-08	2.00E-02	1	6.14E-07	11
Cadmium	7440-43-9	--	0.0045	0.001	--(c)	5.00E-04	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00021	0.017	1.75E-09	1.00E-01	1	1.75E-08	0.32
Carbon tetrachloride	56-23-5	VOC	0.000170123	0.016	1.34E-09	7.00E-04	1	1.91E-06	34
Chloride	16887-00-6	--	9.9702351	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.000214204	0.0068	7.15E-10	1.00E-02	1	7.15E-08	1.3
Chromium	7440-47-3	--	0.009493374	0.001	--(c)	1.50E+00	0.013	--	
Copper	7440-50-8	--	0.004884201	0.001	--(c)	4.00E-02	1	--	
Fluoride	16984-48-8	--	0.30080145	0.001	--(c)	6.00E-02	1	--	
Iron	7439-89-6	--	0.12126178	0.001	--(c)	7.00E-01	1	--	
Lead	7439-92-1	--	0.000581898	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.015530827	0.001	--(c)	2.40E-02	0.04	--	
Methylene chloride	75-09-2	VOC	0.002069589	0.0035	3.56E-09	6.00E-02	1	5.93E-08	1.1
Nickel	7440-02-0	--	0.006014142	0.0002	--(c)	2.00E-02	0.04	--	
Nitrate	14797-55-8	--	23.863649	0.001	--(c)	7.10E+00	1	--	
Nitrite	14797-65-0	--	0.081906164	0.001	--(c)	3.00E-01	1	--	
Silver	7440-22-4	--	0.005776818	0.0006	--(c)	5.00E-03	0.04	--	
Strontium	7440-24-6	--	0.38364144	0.001	--(c)	6.00E-01	1	--	
Sulfate	14808-79-8	--	45.030868	0.001	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	0.033	1.41E-08	1.00E-02	1	1.41E-06	25
Tributyl phosphate[d]	126-73-8	SVOC	0.012498806	0.0228	1.40E-07	2.00E-01	1	7.00E-07	13
Trichloroethene	79-01-6	VOC	0.000433871	0.012	2.56E-09	--	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	3.70E-09	3.00E-01	1	1.23E-08	0.22
Uranium	7440-61-1	--	0.016629145	0.001	--(c)	3.00E-03	1	--	
Vanadium	7440-62-2	--	0.012904693	0.001	--(c)	5.00E-03	1	--	

Zinc	7440-66-6	--	0.068859746	0.0006	--(c)	3.00E-01	1	--	
Total								5.56E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal absorption of nonvolatile chemicals is presented in tables D-5 and D-6

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways .*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] $(mg/kg\text{-}day)^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	0.013	4.29E-09	--	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	0.0067	8.17E-10	--	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	0.012	9.66E-10	--	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	5.87E-08	--	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	0.042	2.62E-09	5.40E-03	1	1.42E-11	0.15
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	1.28E-09	1.10E-02	1	1.40E-11	0.15
2-Butanone	78-93-3	VOC	0.00055	0.00096	2.52E-10	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	8.24E-10	--	1	--	
Acetone[d]	67-64-1	VOC	0.001511507	0.000512	3.69E-10	--	1	--	
Arsenic	7440-38-2	--	0.003140238	0.001	--(c)	1.50E+00	1	--	
Barium	7440-39-3	--	0.072881156	0.001	--(c)	--	0.07	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	0.025	1.19E-08	1.40E-02	1	1.67E-10	1.8
Cadmium	7440-43-9	--	0.0045	0.001	--(c)	--	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00021	0.017	1.70E-09	--	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	0.016	1.30E-09	1.30E-01	1	1.69E-10	1.8
Chloride	16887-00-6	--	9.9702351	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.000214204	0.0068	6.95E-10	3.10E-02	1	2.15E-11	0.23
Chromium	7440-47-3	--	0.009493374	0.001	--(c)	--	0.013	--	
Copper	7440-50-8	--	0.004884201	0.001	--(c)	--	1	--	
Fluoride	16984-48-8	--	0.30080145	0.001	--(c)	--	1	--	
Iron	7439-89-6	--	0.12126178	0.001	--(c)	--	1	--	
Lead	7439-92-1	--	0.000581898	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.015530827	0.001	--(c)	--	0.04	--	
Methylene chloride	75-09-2	VOC	0.002069589	0.0035	3.46E-09	7.50E-03	1	2.59E-11	0.28
Nickel	7440-02-0	--	0.006014142	0.0002	--(c)	--	0.04	--	
Nitrate	14797-55-8	--	23.863649	0.001	--(c)	--	1	--	
Nitrite	14797-65-0	--	0.081906164	0.001	--(c)	--	1	--	
Silver	7440-22-4	--	0.005776818	0.0006	--(c)	--	0.04	--	
Strontium	7440-24-6	--	0.38364144	0.001	--(c)	--	1	--	
Sulfate	14808-79-8	--	45.030868	0.001	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	0.033	1.37E-08	5.40E-01	1	7.41E-09	80
Tributyl phosphate[d]	126-73-8	SVOC	0.012498806	0.0228	1.36E-07	9.20E-03	1	1.25E-09	13
Trichloroethene	79-01-6	VOC	0.000433871	0.012	2.48E-09	8.90E-02	1	2.21E-10	2.4
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	3.60E-09	--	1	--	
Uranium	7440-61-1	--	0.016629145	0.001	--(c)	--	1	--	
Vanadium	7440-62-2	--	0.012904693	0.001	--(c)	--	1	--	
Zinc	7440-66-6	--	0.068859746	0.0006	--(c)	--	1	--	
Total ELCR								9.30E-09	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Dermal absorption of nonvolatile chemicals is presented in tables D-5 and D-6

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge condensed water

Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4)

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Model assumes concentration of nonvolatiles in condensed water is equal to concentration in water used to create steam

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from liquid	$I_{d,l}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight[b]	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,l}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	0.013	--(c)	2.00E+00	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	0.0067	--(c)	2.00E-01	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	0.012	--(c)	5.00E-02	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	9.00E-02	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	0.042	--(c)	7.00E-02	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.00E-01	1	--	
2-Butanone	78-93-3	VOC	0.00055	0.00096	--(c)	6.00E-01	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	8.00E-02	1	--	
Acetone[d]	67-64-1	VOC	0.001511507	0.000512	--(c)	9.00E-01	1	--	
Arsenic	7440-38-2	--	0.003140238	0.001	1.61E-06	3.00E-04	1	5.38E-03	4.2
Barium	7440-39-3	--	0.072881156	0.001	3.75E-05	2.00E-01	0.07	2.68E-03	2.1
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	0.025	--(c)	2.00E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	2.31E-06	5.00E-04	0.05	9.26E-02	72
Carbon disulfide	75-15-0	VOC	0.00021	0.017	--(c)	1.00E-01	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	9.9702351	0.001	5.13E-03	--	1	--	
Chloroform	67-66-3	VOC	0.000214204	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.009493374	0.001	4.88E-06	1.50E+00	0.013	2.50E-04	0.20
Copper	7440-50-8	--	0.004884201	0.001	2.51E-06	4.00E-02	1	6.28E-05	0.049
Fluoride	16984-48-8	--	0.30080145	0.001	1.55E-04	6.00E-02	1	2.58E-03	2.0
Iron	7439-89-6	--	0.12126178	0.001	6.24E-05	7.00E-01	1	8.91E-05	0.070
Lead	7439-92-1	--	0.000581898	0.0001	2.99E-08	--	1	--	
Manganese	7439-96-5	--	0.015530827	0.001	7.99E-06	2.40E-02	0.04	8.32E-03	6.5
Methylene chloride	75-09-2	VOC	0.002069589	0.0035	--(c)	6.00E-02	1	--	
Nickel	7440-02-0	--	0.006014142	0.0002	6.19E-07	2.00E-02	0.04	7.73E-04	0.60
Nitrate	14797-55-8	--	23.863649	0.001	1.23E-02	7.10E+00	1	1.73E-03	1.3
Nitrite	14797-65-0	--	0.081906164	0.001	4.21E-05	3.00E-01	1	1.40E-04	0.11
Silver	7440-22-4	--	0.005776818	0.0006	1.78E-06	5.00E-03	0.04	8.91E-03	7.0
Strontium	7440-24-6	--	0.38364144	0.001	1.97E-04	6.00E-01	1	3.29E-04	0.26
Sulfate	14808-79-8	--	45.030868	0.001	2.32E-02	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	0.033	--(c)	1.00E-02	1	--	
Tributyl phosphate[d]	126-73-8	SVOC	0.012498806	0.0228	--(c)	2.00E-01	1	--	
Trichloroethene	79-01-6	VOC	0.000433871	0.012	--(c)	--	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	3.00E-01	1	--	

Uranium	7440-61-1	--	0.016629145	0.001	8.55E-06	3.00E-03	1	2.85E-03	2.2
Vanadium	7440-62-2	--	0.012904693	0.001	6.64E-06	5.00E-03	1	1.33E-03	1.0
Zinc	7440-66-6	--	0.068859746	0.0006	2.12E-05	3.00E-01	1	7.08E-05	0.055
Total								1.28E-01	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,i}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	0.013	--(c)	--	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	0.0067	--(c)	--	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	0.012	--(c)	--	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	--	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	0.042	--(c)	5.40E-03	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.10E-02	1	--	
2-Butanone	78-93-3	VOC	0.00055	0.00096	--(c)	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	--	1	--	
Acetone[d]	67-64-1	VOC	0.001511507	0.000512	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.003140238	0.001	1.57E-06	1.50E+00	1	2.35E-06	100
Barium	7440-39-3	--	0.072881156	0.001	3.64E-05	--	0.07	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	2.25E-06	--	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00021	0.017	--(c)	--	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	9.9702351	0.001	4.98E-03	--	1	--	
Chloroform	67-66-3	VOC	0.000214204	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.009493374	0.001	4.74E-06	--	0.013	--	
Copper	7440-50-8	--	0.004884201	0.001	2.44E-06	--	1	--	
Fluoride	16984-48-8	--	0.30080145	0.001	1.50E-04	--	1	--	
Iron	7439-89-6	--	0.12126178	0.001	6.06E-05	--	1	--	
Lead	7439-92-1	--	0.000581898	0.0001	2.91E-08	--	1	--	
Manganese	7439-96-5	--	0.015530827	0.001	7.76E-06	--	0.04	--	
Methylene chloride	75-09-2	VOC	0.002069589	0.0035	--(c)	7.50E-03	1	--	
Nickel	7440-02-0	--	0.006014142	0.0002	6.01E-07	--	0.04	--	
Nitrate	14797-55-8	--	23.863649	0.001	1.19E-02	--	1	--	
Nitrite	14797-65-0	--	0.081906164	0.001	4.09E-05	--	1	--	
Silver	7440-22-4	--	0.005776818	0.0006	1.73E-06	--	0.04	--	
Strontium	7440-24-6	--	0.38364144	0.001	1.92E-04	--	1	--	
Sulfate	14808-79-8	--	45.030868	0.001	2.25E-02	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	0.033	--(c)	5.40E-01	1	--	
Tributyl phosphate[d]	126-73-8	SVOC	0.012498806	0.0228	--(c)	9.20E-03	1	--	
Trichloroethene	79-01-6	VOC	0.000433871	0.012	--(c)	8.90E-02	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	--	1	--	
Uranium	7440-61-1	--	0.016629145	0.001	8.31E-06	--	1	--	
Vanadium	7440-62-2	--	0.012904693	0.001	6.45E-06	--	1	--	
Zinc	7440-66-6	--	0.068859746	0.0006	2.06E-05	--	1	--	
Total ELCR								2.35E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--near-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/day
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Ideal gas law constant	R	62.37	(mmHg-L)/(gmole-K)
Temperature of the sweat lodge	T	338.7	K
Density of liquid water	rhow	1000	g/L
Conversion factor	CF_2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	0.013	--(c)	2.00E+00	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	0.0067	--(c)	2.00E-01	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	0.012	--(c)	5.00E-02	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	9.00E-02	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	0.042	--(c)	7.00E-02	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.00E-01	1	--	
2-Butanone	78-93-3	VOC	0.00055	0.00096	--(c)	6.00E-01	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	8.00E-02	1	--	
Acetone[d]	67-64-1	VOC	0.001511507	0.000512	--(c)	9.00E-01	1	--	
Arsenic	7440-38-2	--	0.003140238	0.001	2.65E-10	3.00E-04	1	8.82E-07	4.2
Barium	7440-39-3	--	0.072881156	0.001	6.14E-09	2.00E-01	0.07	4.39E-07	2.1
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	0.025	--(c)	2.00E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	3.79E-10	5.00E-04	0.05	1.52E-05	72
Carbon disulfide	75-15-0	VOC	0.00021	0.017	--(c)	1.00E-01	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	9.9702351	0.001	8.40E-07	--	1	--	
Chloroform	67-66-3	VOC	0.000214204	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.009493374	0.001	8.00E-10	1.50E+00	0.013	4.10E-08	0.20
Copper	7440-50-8	--	0.004884201	0.001	4.12E-10	4.00E-02	1	1.03E-08	0.049
Fluoride	16984-48-8	--	0.30080145	0.001	2.53E-08	6.00E-02	1	4.22E-07	2.0
Iron	7439-89-6	--	0.12126178	0.001	1.02E-08	7.00E-01	1	1.46E-08	0.070
Lead	7439-92-1	--	0.000581898	0.0001	4.90E-12	--	1	--	
Manganese	7439-96-5	--	0.015530827	0.001	1.31E-09	2.40E-02	0.04	1.36E-06	6.5
Methylene chloride	75-09-2	VOC	0.002069589	0.0035	--(c)	6.00E-02	1	--	
Nickel	7440-02-0	--	0.006014142	0.0002	1.01E-10	2.00E-02	0.04	1.27E-07	0.60
Nitrate	14797-55-8	--	23.863649	0.001	2.01E-06	7.10E+00	1	2.83E-07	1.3
Nitrite	14797-65-0	--	0.081906164	0.001	6.90E-09	3.00E-01	1	2.30E-08	0.11
Silver	7440-22-4	--	0.005776818	0.0006	2.92E-10	5.00E-03	0.04	1.46E-06	7.0
Strontium	7440-24-6	--	0.38364144	0.001	3.23E-08	6.00E-01	1	5.39E-08	0.26
Sulfate	14808-79-8	--	45.030868	0.001	3.79E-06	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	0.033	--(c)	1.00E-02	1	--	
Tributyl phosphate[d]	126-73-8	SVOC	0.012498806	0.0228	--(c)	2.00E-01	1	--	
Trichloroethene	79-01-6	VOC	0.000433871	0.012	--(c)	--	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	3.00E-01	1	--	
Uranium	7440-61-1	--	0.016629145	0.001	1.40E-09	3.00E-03	1	4.67E-07	2.2
Vanadium	7440-62-2	--	0.012904693	0.001	1.09E-09	5.00E-03	1	2.17E-07	1.0
Zinc	7440-66-6	--	0.068859746	0.0006	3.48E-09	3.00E-01	1	1.16E-08	0.055
Total								2.10E-05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c]Dermal Absorption of volatiles is presented in table D-4

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
HQ = hazard quotient.
SVOC = semivolatile organic compound.
VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,1,1-Trichloroethane	71-55-6	VOC	0.000691076	0.013	--(c)	--	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000255649	0.0067	--(c)	--	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.00016874	0.012	--(c)	--	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	--	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130957	0.042	--(c)	5.40E-03	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.10E-02	1	--	
2-Butanone	78-93-3	VOC	0.00055	0.00096	--(c)	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	--	1	--	
Acetone[d]	67-64-1	VOC	0.001511507	0.000512	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.003140238	0.001	2.57E-10	1.50E+00	1	3.86E-10	100
Barium	7440-39-3	--	0.072881156	0.001	5.97E-09	--	0.07	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	3.68E-10	--	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00021	0.017	--(c)	--	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000170123	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	9.9702351	0.001	8.16E-07	--	1	--	
Chloroform	67-66-3	VOC	0.000214204	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.009493374	0.001	7.77E-10	--	0.013	--	
Copper	7440-50-8	--	0.004884201	0.001	4.00E-10	--	1	--	
Fluoride	16984-48-8	--	0.30080145	0.001	2.46E-08	--	1	--	
Iron	7439-89-6	--	0.12126178	0.001	9.93E-09	--	1	--	
Lead	7439-92-1	--	0.000581898	0.0001	4.76E-12	--	1	--	
Manganese	7439-96-5	--	0.015530827	0.001	1.27E-09	--	0.04	--	
Methylene chloride	75-09-2	VOC	0.002069589	0.0035	--(c)	7.50E-03	1	--	
Nickel	7440-02-0	--	0.006014142	0.0002	9.85E-11	--	0.04	--	
Nitrate	14797-55-8	--	23.863649	0.001	1.95E-06	--	1	--	
Nitrite	14797-65-0	--	0.081906164	0.001	6.70E-09	--	1	--	
Silver	7440-22-4	--	0.005776818	0.0006	2.84E-10	--	0.04	--	
Strontium	7440-24-6	--	0.38364144	0.001	3.14E-08	--	1	--	
Sulfate	14808-79-8	--	45.030868	0.001	3.69E-06	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000872033	0.033	--(c)	5.40E-01	1	--	
Tributyl phosphate[d]	126-73-8	SVOC	0.012498806	0.0228	--(c)	9.20E-03	1	--	
Trichloroethene	79-01-6	VOC	0.000433871	0.012	--(c)	8.90E-02	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	--	1	--	
Uranium	7440-61-1	--	0.016629145	0.001	1.36E-09	--	1	--	
Vanadium	7440-62-2	--	0.012904693	0.001	1.06E-09	--	1	--	
Zinc	7440-66-6	--	0.068859746	0.0006	3.38E-09	--	1	--	
Total ELCR								3.86E-10	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Dermal Absorption of volatiles is presented in table D-4

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area -- Yakima Nation

Cancer risk from inhalation of volatile radioactive contaminants in sweat lodge vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	6.4100896	--(c)	--	--	
Gross beta	12587-47-2	--	32.397036	--(c)	--	--	
Iodine-129	15046-84-1	--	1.9883847	--(c)	6.07E-11	--	
Nickel-63	13981-37-8	--	4.07	--(c)	1.64E-12	--	
Protactinium-231	14331-85-2	--	0.308	--(c)	4.55E-08	--	
Strontium-90	10098-97-2	--	0.611	--(c)	1.05E-10	--	
Technetium-99	14133-76-7	--	93.996334	--(c)	1.41E-11	--	
Tritium	10028-17-8	Yes	264106.86	1.36E+10	5.62E-14	7.62E-04	100
Total ELCR						7.62E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of nonvolatile contaminants is presented in Table D-8

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)*.
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Far-field exposure area -- Yakima Nation

Cancer risk from inhalation of nonvolatile radioactive contaminants in sweathouse vapor
Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	6.4100896	5.65E+04	--	--	
Gross beta	12587-47-2	--	32.397036	2.85E+05	--	--	
Iodine-129	15046-84-1	--	1.9883847	1.75E+04	6.07E-11	1.06E-06	0.78
Nickel-63	13981-37-8	--	4.07	3.59E+04	1.64E-12	5.88E-08	0.043
Protactinium-231	14331-85-2	--	0.308	2.71E+03	4.55E-08	1.23E-04	90
Strontium-90	10098-97-2	--	0.611	5.38E+03	1.05E-10	5.65E-07	0.41
Technetium-99	14133-76-7	--	93.996334	8.28E+05	1.41E-11	1.17E-05	8.5
Tritium	10028-17-8	Yes	264106.86	--(c)	5.62E-14	--	
Total ELCR						1.37E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of volatile contaminants in presented in table D-7

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakima Nationa Sweat Lodge Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	HQ (Inhalation) (Volatiles) (unitless)	HQ (Inhalation) (Nonvolatiles) (unitless)	HQ (Dermal, Vapor, volatiles) (unitless)	HQ (Dermal, Liquid, Nonvolatiles) (unitless)	HQ (Dermal, Vapor, Nonvolatiles) (unitless)	Total HI (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--	--	--	--	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.66E-09	--	--	--	--	--	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--	--	--	--	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--	--	--	--	--	--	
1,2-Dichloroethane	0.00064	VOC	2.76E-05	--	6.60E-08	--	--	2.77E-05	3.94E-05
2,3,4,6-Tetrachlorophenol	0.0077	SVOC	--	--	8.95E-06	--	--	8.95E-06	1.28E-05
Aluminum	0.046776593	--	--	1.66E-01	--	2.41E-05	3.94E-09	1.66E-01	0.24
Arsenic	0.00579213	--	--	6.85E+00	--	9.93E-03	1.63E-06	6.86E+00	9.8
Barium	0.053448218	--	--	1.90E+00	--	1.96E-03	3.22E-07	1.90E+00	2.7
Beryllium	0.000342265	--	--	3.04E-01	--	1.26E-02	2.06E-06	3.16E-01	0.45
Bis(2-ethylhexyl) phthalate	0.011	SVOC	--	--	6.75E-06	--	--	6.75E-06	9.63E-06
Cadmium	0.002729138	--	--	4.84E+00	--	5.61E-02	9.20E-06	4.90E+00	7.0
Carbon tetrachloride	0.000282669	VOC	1.54E-04	--	3.17E-06	--	--	1.57E-04	2.24E-04
Chloride	12.62269	--	--	--	--	--	--	--	
Chloroform	0.00038106	VOC	4.02E-04	--	1.27E-07	--	--	4.02E-04	5.74E-04
Chromium	0.015259293	--	--	--	--	4.02E-04	6.59E-08	4.03E-04	5.74E-04
Cobalt	0.004495239	--	--	1.33E+01	--	3.08E-03	5.05E-07	1.33E+01	19
Copper	0.004447607	--	--	--	--	5.72E-05	9.37E-09	5.72E-05	8.16E-05
Fluoride	0.2940596	--	--	4.02E-01	--	2.52E-03	4.13E-07	4.04E-01	0.58
Hexavalent Chromium	0.191	--	--	3.39E+01	--	2.62E+00	4.29E-04	3.65E+01	52
Iron	0.090209963	--	--	--	--	6.63E-05	1.09E-08	6.63E-05	9.45E-05
Lead	0.001548018	--	--	--	--	--	--	--	
Manganese	0.006198141	--	--	2.20E+00	--	3.32E-03	5.44E-07	2.20E+00	3.1
Nickel	0.011729633	--	--	2.31E+00	--	1.51E-03	2.47E-07	2.31E+00	3.3
Nitrate	34.098186	--	--	--	--	2.47E-03	4.05E-07	2.47E-03	0.0035
Nitrite	0.057119962	--	--	--	--	9.79E-05	1.60E-08	9.79E-05	1.40E-04
Nitrogen in Nitrite and Nitrate	14.7	--	--	--	--	4.73E-03	7.74E-07	4.73E-03	0.0067
Octachlorodibenzofuran	9.9649E-09	--	--	--	--	--	--	--	
Octachlorodibenzo-p-dioxin	5.8071E-09	--	--	--	--	--	--	--	
Silver	0.005686587	--	--	--	--	8.77E-03	1.44E-06	8.78E-03	0.013
Strontium	0.2694514	--	--	--	--	2.31E-04	3.78E-08	2.31E-04	3.29E-04
Sulfate	64.094058	--	--	--	--	--	--	--	
Toluene	3.56519E-05	VOC	7.38E-07	--	6.78E-09	--	--	7.44E-07	1.06E-06
Total petroleum hydrocarbons - gasoline range	0.05	--	--	--	--	--	--	--	
Trichloroethene	0.000563286	VOC	1.66E-03	--	--	--	--	1.66E-03	0.0024
Uranium	0.020191069	--	--	1.19E+00	--	3.46E-03	5.67E-07	1.20E+00	1.7
Vanadium	0.02186531	--	--	--	--	2.25E-03	3.69E-07	2.25E-03	0.0032
Zinc	0.095789222	--	--	--	--	9.85E-05	1.61E-08	9.85E-05	1.41E-04
Total			2.25E-03	67.38	1.91E-05	2.73	0.00	70.12	100

[a] Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

HI = hazard index.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakima Nationa Sweat Lodge Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal, Vapor, volatiles) (unitless)	Risk (Dermal, Liquid, Nonvolatiles) (unitless)	Risk (Dermal, Vapor, Nonvolatiles) (unitless)	Total Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--	2.45E-08	--	--	--	2.45E-08	1.01E-05
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.66E-09	--	--	3.71E-08	--	5.33E-06	8.73E-10	5.37E-06	0.0022
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--	1.90E-07	--	4.24E-05	6.94E-09	4.26E-05	0.018
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--	1.38E-07	--	3.07E-05	5.03E-09	3.08E-05	0.013
1,2-Dichloroethane	0.00064	VOC	1.67E-06	--	1.17E-10	--	--	1.67E-06	6.88E-04
2,3,4,6-Tetrachlorophenol	0.0077	SVOC	--	--	--	--	--	--	
Aluminum	0.046776593	--	--	--	--	--	--	--	
Arsenic	0.00579213	--	--	4.29E-04	--	4.34E-06	7.11E-10	4.34E-04	0.18
Barium	0.053448218	--	--	--	--	--	--	--	
Beryllium	0.000342265	--	--	1.42E-05	--	--	--	1.42E-05	0.0058
Bis(2-ethylhexyl) phthalate	0.011	SVOC	2.65E-06	--	1.84E-09	--	--	2.65E-06	0.0011
Cadmium	0.002729138	--	--	8.47E-05	--	--	--	8.47E-05	0.035
Carbon tetrachloride	0.000282669	VOC	4.26E-07	--	2.80E-10	--	--	4.26E-07	1.75E-04
Chloride	12.62269	--	--	--	--	--	--	--	
Chloroform	0.00038106	VOC	8.81E-07	--	3.83E-11	--	--	8.81E-07	3.62E-04
Chromium	0.015259293	--	--	--	--	--	--	--	
Cobalt	0.004495239	--	--	6.98E-04	--	--	--	6.98E-04	0.29
Copper	0.004447607	--	--	--	--	--	--	--	
Fluoride	0.2940596	--	--	--	--	--	--	--	
Hexavalent Chromium	0.191	--	--	2.42E-01	--	--	--	2.42E-01	99
Iron	0.090209963	--	--	--	--	--	--	--	
Lead	0.001548018	--	--	--	--	--	--	--	
Manganese	0.006198141	--	--	--	--	--	--	--	
Nickel	0.011729633	--	--	5.26E-05	--	--	--	5.26E-05	0.022
Nitrate	34.098186	--	--	--	--	--	--	--	
Nitrite	0.057119962	--	--	--	--	--	--	--	
Nitrogen in Nitrite and Nitrate	14.7	--	--	--	--	--	--	--	
Octachlorodibenzofuran	9.9649E-09	--	--	1.96E-09	--	5.11E-07	8.37E-11	5.13E-07	2.11E-04
Octachlorodibenzo-p-dioxin	5.8071E-09	--	--	1.14E-09	--	1.31E-07	2.15E-11	1.32E-07	5.45E-05
Silver	0.005686587	--	--	--	--	--	--	--	
Strontium	0.2694514	--	--	--	--	--	--	--	
Sulfate	64.094058	--	--	--	--	--	--	--	
Toluene	3.56519E-05	VOC	--	--	--	--	--	--	
Total petroleum hydrocarbons - gasoline range	0.05	--	--	--	--	--	--	--	
Trichloroethene	0.000563286	VOC	1.42E-06	--	2.87E-10	--	--	1.42E-06	5.82E-04
Uranium	0.020191069	--	--	--	--	--	--	--	
Vanadium	0.02186531	--	--	--	--	--	--	--	
Zinc	0.095789222	--	--	--	--	--	--	--	
Total ELCR			7.05E-06	2.43E-01	2.56E-09	8.34E-05	1.37E-08	2.43E-01	100

[a] Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.
VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakima Nation Sweat Lodge Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.							
COPC	95 UCL Groundwater Concentration (pCi/L)	Volatile?[a]	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	5.3264311	No	--	--	--	--	
Iodine-129	2.708038	No	--	1.45E-06	--	1.45E-06	0.18
Plutonium-239/240	0.029	No	--	8.51E-06	--	8.51E-06	1.1
Protactinium-231	0.28	No	--	1.12E-04	--	1.12E-04	14
Strontium-90	4.3004432	No	--	3.98E-06	--	3.98E-06	0.51
Technetium-99	1667.3497	No	--	2.07E-04	--	2.07E-04	26
Tritium	156901.45	Yes	4.53E-04	--	--	4.53E-04	58
Total ELCR			4.53E-04	3.33E-04	--	7.86E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from inhalation of VOCs/SVOCs in sweat lodge vapor
Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Contaminant concentration in water	C_{dw}	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF	365	day/yr

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(c)	--	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.66E-09	--(c)	--	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(c)	--	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(c)	--	--	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	1.89E-05	2.40E+00	6.86E-01	2.76E-05	1.2
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	2.28E-04	--	--	--	
Aluminum	7429-90-5	--	0.046776593	--(c)	5.00E-03	1.43E-03	--	
Arsenic	7440-38-2	--	0.00579213	--(c)	1.50E-05	4.29E-06	--	
Barium	7440-39-3	--	0.053448218	--(c)	5.00E-04	1.43E-04	--	
Beryllium	7440-41-7	--	0.000342265	--(c)	2.00E-05	5.71E-06	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	3.25E-04	--	--	--	
Cadmium	7440-43-9	--	0.002729138	--(c)	1.00E-05	2.86E-06	--	
Carbon tetrachloride	56-23-5	VOC	0.000282669	8.35E-06	1.90E-01	5.43E-02	1.54E-04	6.8
Chloride	16887-00-6	--	12.62269	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.00038106	1.13E-05	9.80E-02	2.80E-02	4.02E-04	18
Chromium	7440-47-3	--	0.015259293	--(c)	--	--	--	
Cobalt	7440-48-4	--	0.004495239	--(c)	6.00E-06	1.71E-06	--	
Copper	7440-50-8	--	0.004447607	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.2940596	--(c)	1.30E-02	3.71E-03	--	
Hexavalent Chromium	18540-29-9	--	0.191	--(c)	1.00E-04	2.86E-05	--	
Iron	7439-89-6	--	0.090209963	--(c)	--	--	--	
Lead	7439-92-1	--	0.001548018	--(c)	--	--	--	
Manganese	7439-96-5	--	0.006198141	--(c)	5.00E-05	1.43E-05	--	
Nickel	7440-02-0	--	0.011729633	--(c)	9.00E-05	2.57E-05	--	
Nitrate	14797-55-8	--	34.098186	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.057119962	--(c)	--	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(c)	--	--	--	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(c)	--	--	--	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.8071E-09	--(c)	--	--	--	
Silver	7440-22-4	--	0.005686587	--(c)	--	--	--	
Strontium	7440-24-6	--	0.2694514	--(c)	--	--	--	
Sulfate	14808-79-8	--	64.094058	--(c)	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	1.05E-06	5.00E+00	1.43E+00	7.38E-07	0.033
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	1.66E-05	3.50E-02	1.00E-02	1.66E-03	74

Uranium	7440-61-1	--	0.020191069	--(c)	3.00E-04	8.57E-05	--	
Vanadium	7440-62-2	--	0.02186531	--(c)	--	--	--	
Zinc	7440-66-6	--	0.095789222	--(c)	--	--	--	
Total							2.25E-03	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of nonvolatile chemicals is presented in Table D-11

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(c)	3.80E-01	1.33E+03	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.66E-09	--(c)	3.80E-01	1.33E+03	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(c)	3.80E+00	1.33E+04	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(c)	3.80E+00	1.33E+04	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	1.84E-05	2.60E-05	9.10E-02	1.67E-06	24
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	2.21E-04	--	--	--	
Aluminum	7429-90-5	--	0.046776593	--(c)	--	--	--	
Arsenic	7440-38-2	--	0.00579213	--(c)	4.30E-03	1.51E+01	--	
Barium	7440-39-3	--	0.053448218	--(c)	--	--	--	
Beryllium	7440-41-7	--	0.000342265	--(c)	2.40E-03	8.40E+00	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	3.16E-04	2.40E-06	8.40E-03	2.65E-06	38
Cadmium	7440-43-9	--	0.002729138	--(c)	1.80E-03	6.30E+00	--	
Carbon tetrachloride	56-23-5	VOC	0.000282669	8.12E-06	1.50E-05	5.25E-02	4.26E-07	6.0
Chloride	16887-00-6	--	12.62269	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.00038106	1.09E-05	2.30E-05	8.05E-02	8.81E-07	12
Chromium	7440-47-3	--	0.015259293	--(c)	--	--	--	
Cobalt	7440-48-4	--	0.004495239	--(c)	9.00E-03	3.15E+01	--	
Copper	7440-50-8	--	0.004447607	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.2940596	--(c)	--	--	--	
Hexavalent Chromium	18540-29-9	--	0.191	--(c)	8.40E-02	2.94E+02	--	
Iron	7439-89-6	--	0.090209963	--(c)	--	--	--	
Lead	7439-92-1	--	0.001548018	--(c)	--	--	--	
Manganese	7439-96-5	--	0.006198141	--(c)	--	--	--	
Nickel	7440-02-0	--	0.011729633	--(c)	2.60E-04	9.10E-01	--	
Nitrate	14797-55-8	--	34.098186	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.057119962	--(c)	--	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(c)	--	--	--	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(c)	1.14E-02	3.99E+01	--	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.8071E-09	--(c)	1.14E-02	3.99E+01	--	
Silver	7440-22-4	--	0.005686587	--(c)	--	--	--	
Strontium	7440-24-6	--	0.2694514	--(c)	--	--	--	
Sulfate	14808-79-8	--	64.094058	--(c)	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	1.02E-06	--	--	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	1.62E-05	2.50E-05	8.75E-02	1.42E-06	20
Uranium	7440-61-1	--	0.020191069	--(c)	--	--	--	
Vanadium	7440-62-2	--	0.02186531	--(c)	--	--	--	
Zinc	7440-66-6	--	0.095789222	--(c)	--	--	--	
Total ELCR							7.05E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of nonvolatile chemicals is presented in Table D-11

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from inhalation of nonvolatiles in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 2, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion Factor	CF	365	day/yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,I}$(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	1.89E-11	--	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.66E-09	2.87E-11	--	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	1.47E-11	--	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	1.07E-11	--	--	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	--(c)	2.40E+00	6.86E-01	--	
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	--(c)	--	--	--	
Aluminum	7429-90-5	--	0.046776593	2.37E-04	5.00E-03	1.43E-03	1.66E-01	0.25
Arsenic	7440-38-2	--	0.00579213	2.94E-05	1.50E-05	4.29E-06	6.85E+00	10
Barium	7440-39-3	--	0.053448218	2.71E-04	5.00E-04	1.43E-04	1.90E+00	2.8
Beryllium	7440-41-7	--	0.000342265	1.74E-06	2.00E-05	5.71E-06	3.04E-01	0.45
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	--(c)	--	--	--	
Cadmium	7440-43-9	--	0.002729138	1.38E-05	1.00E-05	2.86E-06	4.84E+00	7.2
Carbon tetrachloride	56-23-5	VOC	0.000282669	--(c)	1.90E-01	5.43E-02	--	
Chloride	16887-00-6	--	12.62269	6.40E-02	--	--	--	
Chloroform	67-66-3	VOC	0.00038106	--(c)	9.80E-02	2.80E-02	--	
Chromium	7440-47-3	--	0.015259293	7.74E-05	--	--	--	
Cobalt	7440-48-4	--	0.004495239	2.28E-05	6.00E-06	1.71E-06	1.33E+01	20
Copper	7440-50-8	--	0.004447607	2.26E-05	--	--	--	
Fluoride	16984-48-8	--	0.2940596	1.49E-03	1.30E-02	3.71E-03	4.02E-01	0.60
Hexavalent Chromium	18540-29-9	--	0.191	9.69E-04	1.00E-04	2.86E-05	3.39E+01	50
Iron	7439-89-6	--	0.090209963	4.58E-04	--	--	--	
Lead	7439-92-1	--	0.001548018	7.85E-06	--	--	--	
Manganese	7439-96-5	--	0.006198141	3.14E-05	5.00E-05	1.43E-05	2.20E+00	3.3
Nickel	7440-02-0	--	0.011729633	5.95E-05	9.00E-05	2.57E-05	2.31E+00	3.4
Nitrate	14797-55-8	--	34.098186	1.73E-01	--	--	--	
Nitrite	14797-65-0	--	0.057119962	2.90E-04	--	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	7.46E-02	--	--	--	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	5.05E-11	--	--	--	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.8071E-09	2.95E-11	--	--	--	
Silver	7440-22-4	--	0.005686587	2.88E-05	--	--	--	
Strontium	7440-24-6	--	0.2694514	1.37E-03	--	--	--	
Sulfate	14808-79-8	--	64.094058	3.25E-01	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	--(c)	5.00E+00	1.43E+00	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	2.54E-04	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	--(c)	3.50E-02	1.00E-02	--	
Uranium	7440-61-1	--	0.020191069	1.02E-04	3.00E-04	8.57E-05	1.19E+00	1.8
Vanadium	7440-62-2	--	0.02186531	1.11E-04	--	--	--	
Zinc	7440-66-6	--	0.095789222	4.86E-04	--	--	--	
Total							67.4	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of volatile compounds in vapor is presented in Table D-10

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
HQ = hazard quotient.
SVOC = semivolatile organic compound.
VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	1.84E-11	3.80E-01	1.33E+03	2.45E-08	1.01E-05
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.66E-09	2.79E-11	3.80E-01	1.33E+03	3.71E-08	1.53E-05
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	1.43E-11	3.80E+00	1.33E+04	1.90E-07	7.82E-05
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	1.03E-11	3.80E+00	1.33E+04	1.38E-07	5.66E-05
1,2-Dichloroethane	107-06-2	VOC	0.00064	--(c)	2.60E-05	9.10E-02	--	
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	--(c)	--	--	--	
Aluminum	7429-90-5	--	0.046776593	2.30E-04	--	--	--	
Arsenic	7440-38-2	--	0.00579213	2.85E-05	4.30E-03	1.51E+01	4.29E-04	0.18
Barium	7440-39-3	--	0.053448218	2.63E-04	--	--	--	
Beryllium	7440-41-7	--	0.000342265	1.69E-06	2.40E-03	8.40E+00	1.42E-05	0.0058
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	--(c)	2.40E-06	8.40E-03	--	
Cadmium	7440-43-9	--	0.002729138	1.34E-05	1.80E-03	6.30E+00	8.47E-05	0.035
Carbon tetrachloride	56-23-5	VOC	0.000282669	--(c)	1.50E-05	5.25E-02	--	
Chloride	16887-00-6	--	12.62269	6.22E-02	--	--	--	
Chloroform	67-66-3	VOC	0.00038106	--(c)	2.30E-05	8.05E-02	--	
Chromium	7440-47-3	--	0.015259293	7.52E-05	--	--	--	
Cobalt	7440-48-4	--	0.004495239	2.21E-05	9.00E-03	3.15E+01	6.98E-04	0.29
Copper	7440-50-8	--	0.004447607	2.19E-05	--	--	--	
Fluoride	16984-48-8	--	0.2940596	1.45E-03	--	--	--	
Hexavalent Chromium	18540-29-9	--	0.191	9.41E-04	8.40E-02	2.94E+02	2.42E-01	99
Iron	7439-89-6	--	0.090209963	4.44E-04	--	--	--	
Lead	7439-92-1	--	0.001548018	7.63E-06	--	--	--	
Manganese	7439-96-5	--	0.006198141	3.05E-05	--	--	--	
Nickel	7440-02-0	--	0.011729633	5.78E-05	2.60E-04	9.10E-01	5.26E-05	0.022
Nitrate	14797-55-8	--	34.098186	1.68E-01	--	--	--	
Nitrite	14797-65-0	--	0.057119962	2.81E-04	--	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	7.24E-02	--	--	--	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	4.91E-11	1.14E-02	3.99E+01	1.96E-09	8.06E-07
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.8071E-09	2.86E-11	1.14E-02	3.99E+01	1.14E-09	4.70E-07
Silver	7440-22-4	--	0.005686587	2.80E-05	--	--	--	
Strontium	7440-24-6	--	0.2694514	1.33E-03	--	--	--	
Sulfate	14808-79-8	--	64.094058	3.16E-01	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	--(c)	--	--	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	2.46E-04	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	--(c)	2.50E-05	8.75E-02	--	
Uranium	7440-61-1	--	0.020191069	9.95E-05	--	--	--	
Vanadium	7440-62-2	--	0.02186531	1.08E-04	--	--	--	
Zinc	7440-66-6	--	0.095789222	4.72E-04	--	--	--	
Total ELCR							2.43E-01	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of volatile compounds in vapor is presented in Table D-10

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to VOCs/SVOCs in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water (Id,l) can be neglected and total dermal intake ($Id,total$) is equal to dermal intake from VOCs/SVOCs in sweat lodge vapor (Id,v)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 3, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF1	0.01	m/cm
Conversion factor	CF2	365	day/yr

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--	--(c)	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.66E-09	1.45	--(c)	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	--(c)	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuranc	57117-44-9	--	2.1E-09	2.25	--(c)	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	1.32E-09	2.00E-02	1	6.60E-08	0.35
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	2.68E-07	3.00E-02	1	8.95E-06	47
Aluminum	7429-90-5	--	0.046776593	0.001	--(c)	1.00E+00	1	--	
Arsenic	7440-38-2	--	0.00579213	0.001	--(c)	3.00E-04	1	--	
Barium	7440-39-3	--	0.053448218	0.001	--(c)	2.00E-01	0.07	--	
Beryllium	7440-41-7	--	0.000342265	0.001	--(c)	2.00E-03	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	1.35E-07	2.00E-02	1	6.75E-06	35
Cadmium	7440-43-9	--	0.002729138	0.001	--(c)	5.00E-04	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.000282669	0.016	2.22E-09	7.00E-04	1	3.17E-06	17
Chloride	16887-00-6	--	12.62269	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	1.27E-09	1.00E-02	1	1.27E-07	0.67
Chromium	7440-47-3	--	0.015259293	0.001	--(c)	1.50E+00	0.013	--	
Cobalt	7440-48-4	--	0.004495239	0.0004	--(c)	3.00E-04	1	--	
Copper	7440-50-8	--	0.004447607	0.001	--(c)	4.00E-02	1	--	
Fluoride	16984-48-8	--	0.2940596	0.001	--(c)	6.00E-02	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	--(c)	3.00E-03	0.025	--	
Iron	7439-89-6	--	0.090209963	0.001	--(c)	7.00E-01	1	--	
Lead	7439-92-1	--	0.001548018	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.006198141	0.001	--(c)	2.40E-02	0.04	--	
Nickel	7440-02-0	--	0.011729633	0.0002	--(c)	2.00E-02	0.04	--	
Nitrate	14797-55-8	--	34.098186	0.001	--(c)	7.10E+00	1	--	
Nitrite	14797-65-0	--	0.057119962	0.001	--(c)	3.00E-01	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	--(c)	1.60E+00	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	--(c)	--	1	--	
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.8071E-09	1.16	--(c)	--	1	--	
Silver	7440-22-4	--	0.005686587	0.0006	--(c)	5.00E-03	0.04	--	
Strontium	7440-24-6	--	0.2694514	0.001	--(c)	6.00E-01	1	--	
Sulfate	14808-79-8	--	64.094058	0.001	--(c)	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	0.031	5.43E-10	8.00E-02	1	6.78E-09	0.036

Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	0.012	3.32E-09	--	1	--	
Uranium	7440-61-1	--	0.020191069	0.001	--(c)	3.00E-03	1	--	
Vanadium	7440-62-2	--	0.02186531	0.001	--(c)	5.00E-03	1	--	
Zinc	7440-66-6	--	0.095789222	0.0006	--(c)	3.00E-01	1	--	
Total								1.91E-05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics except tributyl phosphate). Tributyl phosphate value taken from Risk Assessment Information System http://rais.ornl.gov

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table D-14

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--	--(c)	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.66E-09	1.45	--(c)	1.30E+03	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	--(c)	1.30E+04	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuranc	57117-44-9	--	2.1E-09	2.25	--(c)	1.30E+04	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	1.28E-09	9.10E-02	1	1.17E-10	4.6
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	2.61E-07	--	1	--	
Aluminum	7429-90-5	--	0.046776593	0.001	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.00579213	0.001	--(c)	1.50E+00	1	--	
Barium	7440-39-3	--	0.053448218	0.001	--(c)	--	0.07	--	
Beryllium	7440-41-7	--	0.000342265	0.001	--(c)	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	1.31E-07	1.40E-02	1	1.84E-09	72
Cadmium	7440-43-9	--	0.002729138	0.001	--(c)	--	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.000282669	0.016	2.16E-09	1.30E-01	1	2.80E-10	11
Chloride	16887-00-6	--	12.62269	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	1.24E-09	3.10E-02	1	3.83E-11	1.5
Chromium	7440-47-3	--	0.015259293	0.001	--(c)	--	0.013	--	
Cobalt	7440-48-4	--	0.004495239	0.0004	--(c)	--	1	--	
Copper	7440-50-8	--	0.004447607	0.001	--(c)	--	1	--	
Fluoride	16984-48-8	--	0.2940596	0.001	--(c)	--	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	--(c)	--	0.025	--	
Iron	7439-89-6	--	0.090209963	0.001	--(c)	--	1	--	
Lead	7439-92-1	--	0.001548018	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.006198141	0.001	--(c)	--	0.04	--	
Nickel	7440-02-0	--	0.011729633	0.0002	--(c)	--	0.04	--	
Nitrate	14797-55-8	--	34.098186	0.001	--(c)	--	1	--	
Nitrite	14797-65-0	--	0.057119962	0.001	--(c)	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	--(c)	--	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	--(c)	3.90E+01	1	--	
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.8071E-09	1.16	--(c)	3.90E+01	1	--	
Silver	7440-22-4	--	0.005686587	0.0006	--(c)	--	0.04	--	
Strontium	7440-24-6	--	0.2694514	0.001	--(c)	--	1	--	
Sulfate	14808-79-8	--	64.094058	0.001	--(c)	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	0.031	5.27E-10	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	0.012	3.22E-09	8.90E-02	1	2.87E-10	11
Uranium	7440-61-1	--	0.020191069	0.001	--(c)	--	1	--	
Vanadium	7440-62-2	--	0.02186531	0.001	--(c)	--	1	--	
Zinc	7440-66-6	--	0.095789222	0.0006	--(c)	--	1	--	
Total ELCR								2.56E-09	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics except tributyl phosphate). Tributyl phosphate value taken from Risk Assessment Information System http://rais.ornl.gov

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table D-14

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge condensed water

Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4)

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Model assumes concentration of nonvolatiles in condensed water is equal to concentration in water used to create steam

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from liquid	$I_{d,l}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,l}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--	--	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.66E-09	1.45	4.22E-09	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[c]	70648-26-9	--	2.9E-09	2.25	3.36E-09	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	2.43E-09	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	2.00E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	3.00E-02	1	--	
Aluminum	7429-90-5	--	0.046776593	0.001	2.41E-05	1.00E+00	1	2.41E-05	8.80E-04
Arsenic	7440-38-2	--	0.00579213	0.001	2.98E-06	3.00E-04	1	9.93E-03	0.36
Barium	7440-39-3	--	0.053448218	0.001	2.75E-05	2.00E-01	0.07	1.96E-03	0.072
Beryllium	7440-41-7	--	0.000342265	0.001	1.76E-07	2.00E-03	0.007	1.26E-02	0.46
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	2.00E-02	1	--	
Cadmium	7440-43-9	--	0.002729138	0.001	1.40E-06	5.00E-04	0.05	5.61E-02	2.1
Carbon tetrachloride	56-23-5	VOC	0.000282669	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	12.62269	0.001	6.49E-03	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.015259293	0.001	7.85E-06	1.50E+00	0.013	4.02E-04	0.015
Cobalt	7440-48-4	--	0.004495239	0.0004	9.25E-07	3.00E-04	1	3.08E-03	0.11
Copper	7440-50-8	--	0.004447607	0.001	2.29E-06	4.00E-02	1	5.72E-05	0.0021
Fluoride	16984-48-8	--	0.2940596	0.001	1.51E-04	6.00E-02	1	2.52E-03	0.092
Hexavalent Chromium	18540-29-9	--	0.191	0.002	1.96E-04	3.00E-03	0.025	2.62E+00	96
Iron	7439-89-6	--	0.090209963	0.001	4.64E-05	7.00E-01	1	6.63E-05	0.0024
Lead	7439-92-1	--	0.001548018	0.0001	7.96E-08	--	1	--	
Manganese	7439-96-5	--	0.006198141	0.001	3.19E-06	2.40E-02	0.04	3.32E-03	0.12
Nickel	7440-02-0	--	0.011729633	0.0002	1.21E-06	2.00E-02	0.04	1.51E-03	0.055
Nitrate	14797-55-8	--	34.098186	0.001	1.75E-02	7.10E+00	1	2.47E-03	0.090
Nitrite	14797-65-0	--	0.057119962	0.001	2.94E-05	3.00E-01	1	9.79E-05	0.0036
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	7.56E-03	1.60E+00	1	4.73E-03	0.17
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	1.35E-08	--	1	--	
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.8071E-09	1.16	3.46E-09	--	1	--	
Silver	7440-22-4	--	0.005686587	0.0006	1.75E-06	5.00E-03	0.04	8.77E-03	0.32
Strontium	7440-24-6	--	0.2694514	0.001	1.39E-04	6.00E-01	1	2.31E-04	0.0085
Sulfate	14808-79-8	--	64.094058	0.001	3.30E-02	--	--	--	

Toluene	108-88-3	VOC	3.56519E-05	0.031	--(c)	8.00E-02	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	0.012	--(c)	--	1	--	
Uranium	7440-61-1	--	0.020191069	0.001	1.04E-05	3.00E-03	1	3.46E-03	0.13
Vanadium	7440-62-2	--	0.02186531	0.001	1.12E-05	5.00E-03	1	2.25E-03	0.082
Zinc	7440-66-6	--	0.095789222	0.0006	2.96E-05	3.00E-01	1	9.85E-05	0.0036
Total								2.73	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics except tributyl phosphate). Tributyl phosphate value taken from Risk Assessment Information System http://rais.ornl.gov/cgi-bin/tox/TOX_select?select=chem

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,i}$(cancer) (mg/kg-day)	CSFo[a] $(mg/kg\text{-}day)^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--	--	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.66E-09	1.45	4.10E-09	1.30E+03	1	5.33E-06	6.4
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	3.26E-09	1.30E+04	1	4.24E-05	51
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	2.36E-09	1.30E+04	1	3.07E-05	37
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	9.10E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	--	1	--	
Aluminum	7429-90-5	--	0.046776593	0.001	2.34E-05	--	1	--	
Arsenic	7440-38-2	--	0.00579213	0.001	2.89E-06	1.50E+00	1	4.34E-06	5.2
Barium	7440-39-3	--	0.053448218	0.001	2.67E-05	--	0.07	--	
Beryllium	7440-41-7	--	0.000342265	0.001	1.71E-07	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.002729138	0.001	1.36E-06	--	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.000282669	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	12.62269	0.001	6.31E-03	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.015259293	0.001	7.62E-06	--	0.013	--	
Cobalt	7440-48-4	--	0.004495239	0.0004	8.98E-07	--	1	--	
Copper	7440-50-8	--	0.004447607	0.001	2.22E-06	--	1	--	
Fluoride	16984-48-8	--	0.2940596	0.001	1.47E-04	--	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	1.91E-04	--	0.025	--	
Iron	7439-89-6	--	0.090209963	0.001	4.51E-05	--	1	--	
Lead	7439-92-1	--	0.001548018	0.0001	7.73E-08	--	1	--	
Manganese	7439-96-5	--	0.006198141	0.001	3.10E-06	--	0.04	--	
Nickel	7440-02-0	--	0.011729633	0.0002	1.17E-06	--	0.04	--	
Nitrate	14797-55-8	--	34.098186	0.001	1.70E-02	--	1	--	
Nitrite	14797-65-0	--	0.057119962	0.001	2.85E-05	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	7.34E-03	--	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	1.31E-08	3.90E+01	1	5.11E-07	0.61
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.8071E-09	1.16	3.37E-09	3.90E+01	1	1.31E-07	0.16
Silver	7440-22-4	--	0.005686587	0.0006	1.70E-06	--	0.04	--	
Strontium	7440-24-6	--	0.2694514	0.001	1.35E-04	--	1	--	
Sulfate	14808-79-8	--	64.094058	0.001	3.20E-02	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	0.031	--(c)	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	0.012	--(c)	8.90E-02	1	--	
Uranium	7440-61-1	--	0.020191069	0.001	1.01E-05	--	1	--	
Vanadium	7440-62-2	--	0.02186531	0.001	1.09E-05	--	1	--	
Zinc	7440-66-6	--	0.095789222	0.0006	2.87E-05	--	1	--	
Total ELCR								8.34E-05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics except tributyl phosphate). Tributyl phosphate value taken from Risk Assessment Information System http://rais.ornl.gov/cgi-bin/tox/TOX_select?select=chem

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/day
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Ideal gas law constant	R	62.37	(mmHg-L)/(gmole-K)
Temperature of the sweat lodge	T	338.7	K
Density of liquid water	rhow	1000	g/L
Conversion factor	CF_2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--	--	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.66E-09	1.45	6.92E-13	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	5.50E-13	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	3.98E-13	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	2.00E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	3.00E-02	1	--	
Aluminum	7429-90-5	--	0.046776593	0.001	3.94E-09	1.00E+00	1	3.94E-09	8.80E-04
Arsenic	7440-38-2	--	0.00579213	0.001	4.88E-10	3.00E-04	1	1.63E-06	0.36
Barium	7440-39-3	--	0.053448218	0.001	4.50E-09	2.00E-01	0.07	3.22E-07	0.072
Beryllium	7440-41-7	--	0.000342265	0.001	2.88E-11	2.00E-03	0.007	2.06E-06	0.46
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	2.00E-02	1	--	
Cadmium	7440-43-9	--	0.002729138	0.001	2.30E-10	5.00E-04	0.05	9.20E-06	2.1
Carbon tetrachloride	56-23-5	VOC	0.000282669	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	12.62269	0.001	1.06E-06	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.015259293	0.001	1.29E-09	1.50E+00	0.013	6.59E-08	0.015
Cobalt	7440-48-4	--	0.004495239	0.0004	1.52E-10	3.00E-04	1	5.05E-07	0.11
Copper	7440-50-8	--	0.004447607	0.001	3.75E-10	4.00E-02	1	9.37E-09	0.0021
Fluoride	16984-48-8	--	0.2940596	0.001	2.48E-08	6.00E-02	1	4.13E-07	0.092
Hexavalent Chromium	18540-29-9	--	0.191	0.002	3.22E-08	3.00E-03	0.025	4.29E-04	96
Iron	7439-89-6	--	0.090209963	0.001	7.60E-09	7.00E-01	1	1.09E-08	0.0024
Lead	7439-92-1	--	0.001548018	0.0001	1.30E-11	--	1	--	
Manganese	7439-96-5	--	0.006198141	0.001	5.22E-10	2.40E-02	0.04	5.44E-07	0.12
Nickel	7440-02-0	--	0.011729633	0.0002	1.98E-10	2.00E-02	0.04	2.47E-07	0.055
Nitrate	14797-55-8	--	34.098186	0.001	2.87E-06	7.10E+00	1	4.05E-07	0.090
Nitrite	14797-65-0	--	0.057119962	0.001	4.81E-09	3.00E-01	1	1.60E-08	0.0036
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	1.24E-06	1.60E+00	1	7.74E-07	0.17
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	2.21E-12	--	1	--	
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.8071E-09	1.16	5.68E-13	--	1	--	
Silver	7440-22-4	--	0.005686587	0.0006	2.88E-10	5.00E-03	0.04	1.44E-06	0.32
Strontium	7440-24-6	--	0.2694514	0.001	2.27E-08	6.00E-01	1	3.78E-08	0.0085
Sulfate	14808-79-8	--	64.094058	0.001	5.40E-06	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	0.031	--(c)	8.00E-02	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	0.012	--(c)	--	1	--	
Uranium	7440-61-1	--	0.020191069	0.001	1.70E-09	3.00E-03	1	5.67E-07	0.13
Vanadium	7440-62-2	--	0.02186531	0.001	1.84E-09	5.00E-03	1	3.69E-07	0.082
Zinc	7440-66-6	--	0.095789222	0.0006	4.84E-09	3.00E-01	1	1.61E-08	0.0036
Total								4.478E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics except tributyl phosphate). Tributyl phosphate value taken from Risk Assessment Information System http://rais.ornl.gov/cgi-bin/tox/TOX_select?select=chem

[c] dermal intake of VOCs is presented in Table D-12

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

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Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--	--	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.66E-09	1.45	6.72E-13	1.30E+03	1	8.73E-10	6.4
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	5.34E-13	1.30E+04	1	6.94E-09	51
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	3.87E-13	1.30E+04	1	5.03E-09	37
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	9.10E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	--	1	--	
Aluminum	7429-90-5	--	0.046776593	0.001	3.83E-09	--	1	--	
Arsenic	7440-38-2	--	0.00579213	0.001	4.74E-10	1.50E+00	1	7.11E-10	5.2
Barium	7440-39-3	--	0.053448218	0.001	4.38E-09	--	0.07	--	
Beryllium	7440-41-7	--	0.000342265	0.001	2.80E-11	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.002729138	0.001	2.23E-10	--	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.000282669	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	12.62269	0.001	1.03E-06	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.015259293	0.001	1.25E-09	--	0.013	--	
Cobalt	7440-48-4	--	0.004495239	0.0004	1.47E-10	--	1	--	
Copper	7440-50-8	--	0.004447607	0.001	3.64E-10	--	1	--	
Fluoride	16984-48-8	--	0.2940596	0.001	2.41E-08	--	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	3.13E-08	--	0.025	--	
Iron	7439-89-6	--	0.090209963	0.001	7.38E-09	--	1	--	
Lead	7439-92-1	--	0.001548018	0.0001	1.27E-11	--	1	--	
Manganese	7439-96-5	--	0.006198141	0.001	5.07E-10	--	0.04	--	
Nickel	7440-02-0	--	0.011729633	0.0002	1.92E-10	--	0.04	--	
Nitrate	14797-55-8	--	34.098186	0.001	2.79E-06	--	1	--	
Nitrite	14797-65-0	--	0.057119962	0.001	4.68E-09	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	1.20E-06	--	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	2.15E-12	3.90E+01	1	8.37E-11	0.61
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.8071E-09	1.16	5.51E-13	3.90E+01	1	2.15E-11	0.16
Silver	7440-22-4	--	0.005686587	0.0006	2.79E-10	--	0.04	--	
Strontium	7440-24-6	--	0.2694514	0.001	2.21E-08	--	1	--	
Sulfate	14808-79-8	--	64.094058	0.001	5.25E-06	--	--	--	
Toluene	108-88-3	VOC	3.56519E-05	0.031	--(c)	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	
Trichloroethene	79-01-6	VOC	0.000563286	0.012	--(c)	8.90E-02	1	--	
Uranium	7440-61-1	--	0.020191069	0.001	1.65E-09	--	1	--	
Vanadium	7440-62-2	--	0.02186531	0.001	1.79E-09	--	1	--	
Zinc	7440-66-6	--	0.095789222	0.0006	4.70E-09	--	1	--	
Total ELCR								1.37E-08	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics except tributyl phosphate). Tributyl phosphate value taken from Risk Assessment Information System http://rais.ornl.gov/cgi-bin/tox/TOX_select?select=chem

[c] dermal intake of VOCs is presented in Table D-12

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-field exposure area -- Yakima Nation

Cancer risk from inhalation of volatile radioactive contaminants in sweat lodge vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	5.3264311	--(c)	--	--	
Iodine-129	15046-84-1	--	2.708038	--(c)	6.07E-11	--	
Plutonium-239/240	PU-239/240	--	0.029	--(c)	3.33E-08	--	
Protactinium-231	14331-85-2	--	0.28	--(c)	4.55E-08	--	
Strontium-90	10098-97-2	--	4.3004432	--(c)	1.05E-10	--	
Technetium-99	14133-76-7	--	1667.3497	--(c)	1.41E-11	--	
Tritium	10028-17-8	Yes	156901.45	8.06E+09	5.62E-14	4.53E-04	100
Total ELCR						4.53E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of nonvolatile contaminants is presented in Table D-16

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--Near-field exposure area -- Yakima Nation

Cancer risk from inhalation of nonvolatile radioactive contaminants in sweathouse vapor
Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	5.3264311	4.69E+04	--	--	
Iodine-129	15046-84-1	--	2.708038	2.39E+04	6.07E-11	1.45E-06	0.43
Plutonium-239/240	PU-239/240	--	0.029	2.56E+02	3.33E-08	8.51E-06	2.6
Protactinium-231	14331-85-2	--	0.28	2.47E+03	4.55E-08	1.12E-04	34
Strontium-90	10098-97-2	--	4.3004432	3.79E+04	1.05E-10	3.98E-06	1.2
Technetium-99	14133-76-7	--	1667.3497	1.47E+07	1.41E-11	2.07E-04	62
Tritium	10028-17-8	Yes	156901.45	--(c)	5.62E-14	--	
Total ELCR						3.33E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of volatile contaminants is presented in Table D-15

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit River Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakima Nationa Sweat Lodge Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	HQ (Inhalation) (Volatiles) (unitless)	HQ (Inhalation) (Nonvolatiles) (unitless)	HQ (Dermal, Vapor, volatiles) (unitless)	HQ (Dermal, Liquid, Nonvolatiles) (unitless)	HQ (Dermal, Vapor, Nonvolatiles) (unitless)	Total HI (unitless)	% Contribution
Acetone	0.0011	VOC	3.67E-06	--	3.07E-10	--	--	3.67E-06	1.45E-05
Arsenic	0.005767892	--	--	6.8	--	0.0099	1.62E-06	6.84E+00	27
Barium	0.049451657	--	--	1.8	--	0.0018	2.98E-07	1.76E+00	7.0
Carbon tetrachloride	0.000271961	VOC	1.48E-04	--	3.05E-06	--	--	1.51E-04	5.98E-04
Chloride	11.3727	--	--	--	--	--	--	--	
Chloroform	0.000814875	VOC	8.60E-04	--	2.72E-07	--	--	8.60E-04	0.0034
Chromium	0.009951236	--	--	--	--	0.0003	4.30E-08	2.62E-04	0.0010
Copper	0.00597989	--	--	--	--	0.0001	1.26E-08	7.69E-05	3.04E-04
Fluoride	0.28680392	--	--	0.4	--	0.0025	4.03E-07	3.94E-01	1.6
Iron	0.61057915	--	--	--	--	0.0004	7.35E-08	4.49E-04	0.0018
Lead	0.0006805	--	--	--	--	--	--	--	
Manganese	0.041694118	--	--	14.8	--	0.0223	3.66E-06	1.48E+01	59
Nickel	0.0056	--	--	1.1	--	0.0007	1.18E-07	1.11E+00	4.4
Nitrate	28.582087	--	--	--	--	0.0021	3.39E-07	2.07E-03	0.0082
Nitrite	0.46	--	--	--	--	0.0008	1.29E-07	7.89E-04	0.0031
Strontium	0.38963943	--	--	--	--	0.0003	5.47E-08	3.34E-04	0.0013
Sulfate	42.560202	--	--	--	--	--	--	--	
Thallium	0.00037	--	--	--	--	--	--	--	
Uranium	0.005589723	--	--	0.3	--	0.0010	1.57E-07	3.32E-01	1.3
Vanadium	0.016788235	--	--	--	--	0.0017	2.83E-07	1.73E-03	0.0068
Zinc	0.006671161	--	--	--	--	0.0000	1.12E-09	6.86E-06	2.72E-05
Total			1.01E-03	25.21	3.33E-06	0.044	7.19E-06	25.26	100

[a] Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

HI = hazard index.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit River Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakima Nationa Sweat Lodge Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal, Vapor, volatiles) (unitless)	Risk (Dermal, Liquid, Nonvolatiles) (unitless)	Risk (Dermal, Vapor, Nonvolatiles) (unitless)	Total Risk (unitless)	% Contribution
Acetone	0.0011	VOC	--	--	--	--	--	--	
Arsenic	0.005767892	--	--	4.28E-04	--	4.32E-06	7.08E-10	4.32E-04	94
Barium	0.049451657	--	--	--	--	--	--	--	
Carbon tetrachloride	0.000271961	VOC	4.10E-07	--	2.70E-10	--	--	4.10E-07	0.089
Chloride	11.3727	--	--	--	--	--	--	--	
Chloroform	0.000814875	VOC	1.88E-06	--	8.19E-11	--	--	1.88E-06	0.41
Chromium	0.009951236	--	--	--	--	--	--	--	
Copper	0.00597989	--	--	--	--	--	--	--	
Fluoride	0.28680392	--	--	--	--	--	--	--	
Iron	0.61057915	--	--	--	--	--	--	--	
Lead	0.0006805	--	--	--	--	--	--	--	
Manganese	0.041694118	--	--	--	--	--	--	--	
Nickel	0.0056	--	--	2.51E-05	--	--	--	2.51E-05	5.5
Nitrate	28.582087	--	--	--	--	--	--	--	
Nitrite	0.46	--	--	--	--	--	--	--	
Strontium	0.38963943	--	--	--	--	--	--	--	
Sulfate	42.560202	--	--	--	--	--	--	--	
Thallium	0.00037	--	--	--	--	--	--	--	
Uranium	0.005589723	--	--	--	--	--	--	--	
Vanadium	0.016788235	--	--	--	--	--	--	--	
Zinc	0.006671161	--	--	--	--	--	--	--	
Total ELCR			2.29E-06	4.53E-04	3.52E-10	4.32E-06	7.08E-10	4.59E-04	100

[a] Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit River Exposure Area Native American Risk Assessment (5-Year)--Summary of Yakima Nation Sweat Lodge Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (pCi/L)	Volatile?[a]	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	2.4	No	--	--	--	--	
Gross beta	31.1	No	--	--	--	--	
Strontium-90	2.60	No	--	2.41E-06	--	2.41E-06	1.1
Technetium-99	121	No	--	1.50E-05	--	1.50E-05	6.8
Tritium	70,724	Yes	2.04E-04	--	--	2.04E-04	92
Total ELCR			2.04E-04	1.74E-05	--	2.22E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--river exposure area-- Yakima Nation

Hazard quotient and cancer risk from inhalation of VOCs/SVOCs in sweat lodge vapor
Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Contaminant concentration in water	C_{dw}	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF	365	day/yr

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{aw} 95 UCL (mg/L)	I_{inh}(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
Acetone	67-64-1	VOC	0.0011	3.25E-05	3.10E+01	8.86E+00	3.67E-06	0.36
Arsenic	7440-38-2	--	0.005767892	--(c)	1.50E-05	4.29E-06	--	
Barium	7440-39-3	--	0.049451657	--(c)	5.00E-04	1.43E-04	--	
Carbon tetrachloride	56-23-5	VOC	0.000271961	8.04E-06	1.90E-01	5.43E-02	1.48E-04	15
Chloride	16887-00-6	--	11.3727	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.000814875	2.41E-05	9.80E-02	2.80E-02	8.60E-04	85
Chromium	7440-47-3	--	0.009951236	--(c)	--	--	--	
Copper	7440-50-8	--	0.00597989	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.28680392	--(c)	1.30E-02	3.71E-03	--	
Iron	7439-89-6	--	0.61057915	--(c)	--	--	--	
Lead	7439-92-1	--	0.0006805	--(c)	--	--	--	
Manganese	7439-96-5	--	0.041694118	--(c)	5.00E-05	1.43E-05	--	
Nickel	7440-02-0	--	0.0056	--(c)	9.00E-05	2.57E-05	--	
Nitrate	14797-55-8	--	28.582087	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.46	--(c)	--	--	--	
Strontium	7440-24-6	--	0.38963943	--(c)	--	--	--	
Sulfate	14808-79-8	--	42.560202	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	--(c)	--	--	--	
Uranium	7440-61-1	--	0.005589723	--(c)	3.00E-04	8.57E-05	--	
Vanadium	7440-62-2	--	0.016788235	--(c)	--	--	--	
Zinc	7440-66-6	--	0.006671161	--(c)	--	--	--	
Total							1.01E-03	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of nonvolatile chemicals is presented in Table D-19

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*
Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
HQ = hazard quotient.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(cancer) (mg/kg-day)	IUR[d] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
Acetone	67-64-1	VOC	0.0011	3.16E-05	--	--	--	
Arsenic	7440-38-2	--	0.005767892	--(c)	4.30E-03	1.51E+01	--	
Barium	7440-39-3	--	0.049451657	--(c)	--	--	--	
Carbon tetrachloride	56-23-5	VOC	0.000271961	7.81E-06	1.50E-05	5.25E-02	4.10E-07	18
Chloride	16887-00-6	--	11.3727	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.000814875	2.34E-05	2.30E-05	8.05E-02	1.88E-06	82
Chromium	7440-47-3	--	0.009951236	--(c)	--	--	--	
Copper	7440-50-8	--	0.00597989	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.28680392	--(c)	--	--	--	
Iron	7439-89-6	--	0.61057915	--(c)	--	--	--	
Lead	7439-92-1	--	0.0006805	--(c)	--	--	--	
Manganese	7439-96-5	--	0.041694118	--(c)	--	--	--	
Nickel	7440-02-0	--	0.0056	--(c)	2.60E-04	9.10E-01	--	
Nitrate	14797-55-8	--	28.582087	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.46	--(c)	--	--	--	
Strontium	7440-24-6	--	0.38963943	--(c)	--	--	--	
Sulfate	14808-79-8	--	42.560202	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	--(c)	--	--	--	
Uranium	7440-61-1	--	0.005589723	--(c)	--	--	--	
Vanadium	7440-62-2	--	0.016788235	--(c)	--	--	--	
Zinc	7440-66-6	--	0.006671161	--(c)	--	--	--	
Total ELCR							2.29E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of nonvolatile chemicals is presented in Table D-19

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--river exposure area-- Yakima Nation

Hazard quotient and cancer risk from inhalation of nonvolatiles in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 2, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion Factor	CF	365	day/yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
Acetone	67-64-1	VOC	0.0011	--(c)	3.10E+01	8.86E+00	--	
Arsenic	7440-38-2	--	0.005767892	2.93E-05	1.50E-05	4.29E-06	6.83E+00	27
Barium	7440-39-3	--	0.049451657	2.51E-04	5.00E-04	1.43E-04	1.76E+00	7.0
Carbon tetrachloride	56-23-5	VOC	0.000271961	--(c)	1.90E-01	5.43E-02	--	
Chloride	16887-00-6	--	11.3727	5.77E-02	--	--	--	
Chloroform	67-66-3	VOC	0.000814875	--(c)	9.80E-02	2.80E-02	--	
Chromium	7440-47-3	--	0.009951236	5.05E-05	--	--	--	
Copper	7440-50-8	--	0.00597989	3.03E-05	--	--	--	
Fluoride	16984-48-8	--	0.28680392	1.45E-03	1.30E-02	3.71E-03	3.92E-01	1.6
Iron	7439-89-6	--	0.61057915	3.10E-03	--	--	--	
Lead	7439-92-1	--	0.0006805	3.45E-06	--	--	--	
Manganese	7439-96-5	--	0.041694118	2.11E-04	5.00E-05	1.43E-05	1.48E+01	59
Nickel	7440-02-0	--	0.0056	2.84E-05	9.00E-05	2.57E-05	1.10E+00	4.4
Nitrate	14797-55-8	--	28.582087	1.45E-01	--	--	--	
Nitrite	14797-65-0	--	0.46	2.33E-03	--	--	--	
Strontium	7440-24-6	--	0.38963943	1.98E-03	--	--	--	
Sulfate	14808-79-8	--	42.560202	2.16E-01	--	--	--	
Thallium	7440-28-0	--	0.00037	1.88E-06	--	--	--	
Uranium	7440-61-1	--	0.005589723	2.83E-05	3.00E-04	8.57E-05	3.31E-01	1.3
Vanadium	7440-62-2	--	0.016788235	8.51E-05	--	--	--	
Zinc	7440-66-6	--	0.006671161	3.38E-05	--	--	--	
Total							25	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of volatile compounds in vapor is presented in Table D-18

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
HQ = hazard quotient.
SVOC = semivolatile organic compound.
VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
Acetone	67-64-1	VOC	0.0011	--(c)	--	--	--	
Arsenic	7440-38-2	--	0.005767892	2.84E-05	4.30E-03	1.51E+01	4.28E-04	94
Barium	7440-39-3	--	0.049451657	2.44E-04	--	--	--	
Carbon tetrachloride	56-23-5	VOC	0.000271961	--(c)	1.50E-05	5.25E-02	--	
Chloride	16887-00-6	--	11.3727	5.60E-02	--	--	--	
Chloroform	67-66-3	VOC	0.000814875	--(c)	2.30E-05	8.05E-02	--	
Chromium	7440-47-3	--	0.009951236	4.90E-05	--	--	--	
Copper	7440-50-8	--	0.00597989	2.95E-05	--	--	--	
Fluoride	16984-48-8	--	0.28680392	1.41E-03	--	--	--	
Iron	7439-89-6	--	0.61057915	3.01E-03	--	--	--	
Lead	7439-92-1	--	0.0006805	3.35E-06	--	--	--	
Manganese	7439-96-5	--	0.041694118	2.05E-04	--	--	--	
Nickel	7440-02-0	--	0.0056	2.76E-05	2.60E-04	9.10E-01	2.51E-05	5.5
Nitrate	14797-55-8	--	28.582087	1.41E-01	--	--	--	
Nitrite	14797-65-0	--	0.46	2.27E-03	--	--	--	
Strontium	7440-24-6	--	0.38963943	1.92E-03	--	--	--	
Sulfate	14808-79-8	--	42.560202	2.10E-01	--	--	--	
Thallium	7440-28-0	--	0.00037	1.82E-06	--	--	--	
Uranium	7440-61-1	--	0.005589723	2.75E-05	--	--	--	
Vanadium	7440-62-2	--	0.016788235	8.27E-05	--	--	--	
Zinc	7440-66-6	--	0.006671161	3.29E-05	--	--	--	
Total ELCR							4.53E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of volatile compounds in vapor is presented in Table D-18

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--river exposure area-- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to VOCs/SVOCs in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water (*Id,l*)
can be neglected and total dermal intake (*Id,total*) is equal to dermal intake from VOCs/SVOCs in sweat lodge vapor (*Id,v*)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 3, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF1	0.01	m/cm
Conversion factor	CF2	365	day/yr

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	2.77E-10	9.00E-01	1	3.07E-10	0.0092
Arsenic	7440-38-2	--	0.005767892	0.001	--(c)	3.00E-04	1	--	
Barium	7440-39-3	--	0.049451657	0.001	--(c)	2.00E-01	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.000271961	0.016	2.14E-09	7.00E-04	1	3.05E-06	92
Chloride	16887-00-6	--	11.3727	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.000814875	0.0068	2.72E-09	1.00E-02	1	2.72E-07	8.2
Chromium	7440-47-3	--	0.009951236	0.001	--(c)	1.50E+00	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	--(c)	4.00E-02	1	--	
Fluoride	16984-48-8	--	0.28680392	0.001	--(c)	6.00E-02	1	--	
Iron	7439-89-6	--	0.61057915	0.001	--(c)	7.00E-01	1	--	
Lead	7439-92-1	--	0.0006805	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.041694118	0.001	--(c)	2.40E-02	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	--(c)	2.00E-02	0.04	--	
Nitrate	14797-55-8	--	28.582087	0.001	--(c)	7.10E+00	1	--	
Nitrite	14797-65-0	--	0.46	0.001	--(c)	3.00E-01	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	--(c)	6.00E-01	1	--	
Sulfate	14808-79-8	--	42.560202	0.001	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	--(c)	--	1	--	
Uranium	7440-61-1	--	0.005589723	0.001	--(c)	3.00E-03	1	--	
Vanadium	7440-62-2	--	0.016788235	0.001	--(c)	5.00E-03	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	--(c)	3.00E-01	1	--	
Total								3.33E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table D-22

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] $(mg/kg\text{-}day)^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	2.69E-10	--	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	--(c)	1.50E+00	1	--	
Barium	7440-39-3	--	0.049451657	0.001	--(c)	--	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.000271961	0.016	2.08E-09	1.30E-01	1	2.70E-10	77
Chloride	16887-00-6	--	11.3727	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.000814875	0.0068	2.64E-09	3.10E-02	1	8.19E-11	23
Chromium	7440-47-3	--	0.009951236	0.001	--(c)	--	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	--(c)	--	1	--	
Fluoride	16984-48-8	--	0.28680392	0.001	--(c)	--	1	--	
Iron	7439-89-6	--	0.61057915	0.001	--(c)	--	1	--	
Lead	7439-92-1	--	0.0006805	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.041694118	0.001	--(c)	--	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	--(c)	--	0.04	--	
Nitrate	14797-55-8	--	28.582087	0.001	--(c)	--	1	--	
Nitrite	14797-65-0	--	0.46	0.001	--(c)	--	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	--(c)	--	1	--	
Sulfate	14808-79-8	--	42.560202	0.001	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	--(c)	--	1	--	
Uranium	7440-61-1	--	0.005589723	0.001	--(c)	--	1	--	
Vanadium	7440-62-2	--	0.016788235	0.001	--(c)	--	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	--(c)	--	1	--	
Total ELCR								3.52E-10	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table D-22

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--river exposure area-- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge condensed water

Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4)

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

Model assumes concentration of nonvolatiles in condensed water is equal to concentration in water used to create steam

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4)

Parameter	Symbol	Value	Unit
Dermal absorption intake from liquid	$I_{d,l}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,l}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	9.00E-01	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	2.97E-06	3.00E-04	1	9.89E-03	23
Barium	7440-39-3	--	0.049451657	0.001	2.54E-05	2.00E-01	0.07	1.82E-03	4.1
Carbon tetrachloride	56-23-5	VOC	0.000271961	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	11.3727	0.001	5.85E-03	--	1	--	
Chloroform	67-66-3	VOC	0.000814875	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.009951236	0.001	5.12E-06	1.50E+00	0.013	2.62E-04	0.60
Copper	7440-50-8	--	0.00597989	0.001	3.08E-06	4.00E-02	1	7.69E-05	0.18
Fluoride	16984-48-8	--	0.28680392	0.001	1.47E-04	6.00E-02	1	2.46E-03	5.6
Iron	7439-89-6	--	0.61057915	0.001	3.14E-04	7.00E-01	1	4.49E-04	1.0
Lead	7439-92-1	--	0.0006805	0.0001	3.50E-08	--	1	--	
Manganese	7439-96-5	--	0.041694118	0.001	2.14E-05	2.40E-02	0.04	2.23E-02	51
Nickel	7440-02-0	--	0.0056	0.0002	5.76E-07	2.00E-02	0.04	7.20E-04	1.6
Nitrate	14797-55-8	--	28.582087	0.001	1.47E-02	7.10E+00	1	2.07E-03	4.7
Nitrite	14797-65-0	--	0.46	0.001	2.37E-04	3.00E-01	1	7.89E-04	1.8
Strontium	7440-24-6	--	0.38963943	0.001	2.00E-04	6.00E-01	1	3.34E-04	0.76
Sulfate	14808-79-8	--	42.560202	0.001	2.19E-02	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	1.90E-07	--	1	--	
Uranium	7440-61-1	--	0.005589723	0.001	2.87E-06	3.00E-03	1	9.58E-04	2.2
Vanadium	7440-62-2	--	0.016788235	0.001	8.63E-06	5.00E-03	1	1.73E-03	3.9
Zinc	7440-66-6	--	0.006671161	0.0006	2.06E-06	3.00E-01	1	6.86E-06	0.016
Total								0.044	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,i}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	2.88E-06	1.50E+00	1	4.32E-06	100
Barium	7440-39-3	--	0.049451657	0.001	2.47E-05	--	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.000271961	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	11.3727	0.001	5.68E-03	--	1	--	
Chloroform	67-66-3	VOC	0.000814875	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.009951236	0.001	4.97E-06	--	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	2.99E-06	--	1	--	
Fluoride	16984-48-8	--	0.28680392	0.001	1.43E-04	--	1	--	
Iron	7439-89-6	--	0.61057915	0.001	3.05E-04	--	1	--	
Lead	7439-92-1	--	0.0006805	0.0001	3.40E-08	--	1	--	
Manganese	7439-96-5	--	0.041694118	0.001	2.08E-05	--	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	5.60E-07	--	0.04	--	
Nitrate	14797-55-8	--	28.582087	0.001	1.43E-02	--	1	--	
Nitrite	14797-65-0	--	0.46	0.001	2.30E-04	--	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	1.95E-04	--	1	--	
Sulfate	14808-79-8	--	42.560202	0.001	2.13E-02	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	1.85E-07	--	1	--	
Uranium	7440-61-1	--	0.005589723	0.001	2.79E-06	--	1	--	
Vanadium	7440-62-2	--	0.016788235	0.001	8.39E-06	--	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	2.00E-06	--	1	--	
Total ELCR								4.32E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--river exposure area-- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/day
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Ideal gas law constant	R	62.37	(mmHg-L)/(gmole-K)
Temperature of the sweat lodge	T	338.7	K
Density of liquid water	rhow	1000	g/L
Conversion factor	CF_2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	9.00E-01	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	4.86E-10	3.00E-04	1	1.62E-06	23
Barium	7440-39-3	--	0.049451657	0.001	4.17E-09	2.00E-01	0.07	2.98E-07	4.1
Carbon tetrachloride	56-23-5	VOC	0.000271961	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	11.3727	0.001	9.58E-07	--	1	--	
Chloroform	67-66-3	VOC	0.000814875	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.009951236	0.001	8.39E-10	1.50E+00	0.013	4.30E-08	0.60
Copper	7440-50-8	--	0.00597989	0.001	5.04E-10	4.00E-02	1	1.26E-08	0.18
Fluoride	16984-48-8	--	0.28680392	0.001	2.42E-08	6.00E-02	1	4.03E-07	5.6
Iron	7439-89-6	--	0.61057915	0.001	5.15E-08	7.00E-01	1	7.35E-08	1.0
Lead	7439-92-1	--	0.0006805	0.0001	5.73E-12	--	1	--	
Manganese	7439-96-5	--	0.041694118	0.001	3.51E-09	2.40E-02	0.04	3.66E-06	51
Nickel	7440-02-0	--	0.0056	0.0002	9.44E-11	2.00E-02	0.04	1.18E-07	1.6
Nitrate	14797-55-8	--	28.582087	0.001	2.41E-06	7.10E+00	1	3.39E-07	4.7
Nitrite	14797-65-0	--	0.46	0.001	3.88E-08	3.00E-01	1	1.29E-07	1.8
Strontium	7440-24-6	--	0.38963943	0.001	3.28E-08	6.00E-01	1	5.47E-08	0.76
Sulfate	14808-79-8	--	42.560202	0.001	3.59E-06	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	3.12E-11	--	1	--	
Uranium	7440-61-1	--	0.005589723	0.001	4.71E-10	3.00E-03	1	1.57E-07	2.2
Vanadium	7440-62-2	--	0.016788235	0.001	1.41E-09	5.00E-03	1	2.83E-07	3.9
Zinc	7440-66-6	--	0.006671161	0.0006	3.37E-10	3.00E-01	1	1.12E-09	0.016
Total								0.0000	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal Intake of Volatiles in Sweatlodge vapor is presented in Table D-20

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
HQ = hazard quotient.
SVOC = semivolatile organic compound.
VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	4.72E-10	1.50E+00	1	7.08E-10	100
Barium	7440-39-3	--	0.049451657	0.001	4.05E-09	--	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.000271961	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	11.3727	0.001	9.31E-07	--	1	--	
Chloroform	67-66-3	VOC	0.000814875	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.009951236	0.001	8.15E-10	--	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	4.90E-10	--	1	--	
Fluoride	16984-48-8	--	0.28680392	0.001	2.35E-08	--	1	--	
Iron	7439-89-6	--	0.61057915	0.001	5.00E-08	--	1	--	
Lead	7439-92-1	--	0.0006805	0.0001	5.57E-12	--	1	--	
Manganese	7439-96-5	--	0.041694118	0.001	3.41E-09	--	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	9.17E-11	--	0.04	--	
Nitrate	14797-55-8	--	28.582087	0.001	2.34E-06	--	1	--	
Nitrite	14797-65-0	--	0.46	0.001	3.77E-08	--	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	3.19E-08	--	1	--	
Sulfate	14808-79-8	--	42.560202	0.001	3.48E-06	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	3.03E-11	--	1	--	
Uranium	7440-61-1	--	0.005589723	0.001	4.58E-10	--	1	--	
Vanadium	7440-62-2	--	0.016788235	0.001	1.37E-09	--	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	3.28E-10	--	1	--	
Total ELCR								7.08E-10	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Dermal Intake of Volatiles in Sweatlodge vapor is presented in Table D-20

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--river exposure area-- Yakama Nation

Cancer risk from inhalation of volatile radioactive contaminants in sweat lodge vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw}, 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	2.4	--(c)	--	--	
Gross beta	12587-47-2	--	31.1	--(c)	--	--	
Strontium-90	10098-97-2	--	2.60	--(c)	1.05E-10	--	
Technetium-99	14133-76-7	--	121	--(c)	1.41E-11	--	
Tritium	10028-17-8	Yes	70,724	3.63E+09	5.62E-14	2.04E-04	100
Total ELCR						2.04E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of nonvolatile contaminants is Presented in Table D-24

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (5-Year)--river exposure area-- Yakama Nation

Cancer risk from inhalation of nonvolatile radioactive contaminants in sweathouse vapor
Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	2.4	2.10E+04	--	--	
Gross beta	12587-47-2	--	31.1	2.74E+05	--	--	
Strontium-90	10098-97-2	--	2.60	2.29E+04	1.05E-10	2.41E-06	14
Technetium-99	14133-76-7	--	121	1.07E+06	1.41E-11	1.50E-05	86
Tritium	10028-17-8	Yes	70,724	--(c)	5.62E-14	--	
Total ELCR						1.74E-05	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of volatile contaminants is presented in Table D-23

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	HQ (Inhalation) (Volatiles) (unitless)	HQ (Inhalation) (Nonvolatiles) (unitless)	HQ (Dermal, Vapor, volatiles) (unitless)	HQ (Dermal, Liquid, Nonvolatiles) (unitless)	HQ (Dermal, Vapor, Nonvolatiles) (unitless)	Total HI (unitless)	% Contribution
(m+p)-Xylene	0.0005	VOC	3.55E-05	--	3.25E-08	--	--	3.56E-05	3.56E-04
1,1,1-Trichloroethane	0.001204711	VOC	1.20E-05	--	1.92E-09	--	--	1.20E-05	1.20E-04
1,1-Dichloroethane	0.000389235	VOC	2.77E-05	--	3.20E-09	--	--	2.77E-05	2.77E-04
1,1-Dichloroethene	0.000164225	VOC	4.08E-05	--	9.68E-09	--	--	4.08E-05	4.09E-04
1,2-Dichlorobenzene	0.003	VOC	7.46E-04	--	3.36E-07	--	--	7.46E-04	0.0075
1,2-Dichloroethane	0.000305426	VOC	6.33E-06	--	1.57E-08	--	--	6.35E-06	6.35E-05
1,4-Dichlorobenzene	0.000130994	VOC	8.14E-06	--	1.93E-08	--	--	8.16E-06	8.17E-05
1,4-Dioxane	0.0081	SVOC	1.12E-04	--	6.56E-09	--	--	1.12E-04	0.0011
2-Butanone	0.0029	VOC	2.88E-05	--	1.14E-09	--	--	2.88E-05	2.89E-04
2-Pentanone, 4-Methyl	0.00064	VOC	1.06E-05	--	5.30E-09	--	--	1.06E-05	1.06E-04
Acetone	0.00128316	VOC	2.06E-06	--	1.79E-10	--	--	2.06E-06	2.06E-05
Aluminum	0.041755539	--	--	0.07	--	1.07E-05	1.76E-09	7.13E-02	0.71
Arsenic	0.003060574	--	--	1.74	--	2.62E-03	4.30E-07	1.74E+00	17
Barium	0.068082679	--	--	1.16	--	1.25E-03	2.05E-07	1.16E+00	12
Benzene	0.0019	VOC	3.15E-03	--	1.75E-06	--	--	3.15E-03	0.032
Benzyl alcohol	0.0027	SVOC	--	--	1.39E-08	--	--	1.39E-08	1.39E-07
Beryllium	0.000360659	--	--	0.15	--	6.62E-03	1.09E-06	1.61E-01	1.6
Bis(2-ethylhexyl) phthalate	0.001271216	SVOC	--	--	3.90E-07	--	--	3.90E-07	3.91E-06
Cadmium	0.0045	--	--	3.84	--	4.63E-02	7.58E-06	3.89E+00	39
Carbon disulfide	0.00039	VOC	2.77E-05	--	1.63E-08	--	--	2.77E-05	2.78E-04
Carbon tetrachloride	0.000164414	VOC	4.30E-05	--	9.23E-07	--	--	4.40E-05	4.40E-04
Chloride	9.821328	--	--	--	--	--	--	--	
Chlorobenzene	0.00041	VOC	4.08E-04	--	1.41E-07	--	--	4.08E-04	0.0041
Chloroform	0.00022061	VOC	1.12E-04	--	3.68E-08	--	--	1.12E-04	0.0011
Chromium	0.007505402	--	--	--	--	9.90E-05	1.62E-08	9.90E-05	9.91E-04
cis-1,2-Dichloroethylene	0.0002	VOC	--	--	3.78E-08	--	--	3.78E-08	3.79E-07
Copper	0.002993571	--	--	--	--	1.92E-05	3.15E-09	1.92E-05	1.93E-04
Fluoride	0.32861624	--	--	0.22	--	1.41E-03	2.31E-07	2.17E-01	2.2
Iron	0.47301923	--	--	--	--	1.74E-04	2.85E-08	1.74E-04	0.0017
Lead	0.000710361	--	--	--	--	--	--	--	
Lithium	0.0083	--	--	--	--	1.07E-03	1.75E-07	1.07E-03	0.011
Manganese	0.011254937	--	--	1.92	--	3.01E-03	4.94E-07	1.92E+00	19
Methanol	1.1	--	--	0.00	--	1.81E-04	2.97E-08	2.53E-03	0.025
Methylene chloride	0.000852962	VOC	4.24E-05	--	1.22E-08	--	--	4.24E-05	4.25E-04
Molybdenum	0.0015	--	--	--	--	7.71E-05	1.26E-08	7.72E-05	7.72E-04
Nickel	0.003603478	--	--	0.34	--	2.32E-04	3.80E-08	3.42E-01	3.4
Nitrate	23.756902	--	--	--	--	8.60E-04	1.41E-07	8.61E-04	0.0086
Nitrite	0.079227256	--	--	--	--	6.79E-05	1.11E-08	6.79E-05	6.80E-04
o-Xylene	0.000210551	VOC	1.50E-05	--	1.40E-08	--	--	1.50E-05	1.50E-04
Silver	0.005341496	--	--	--	--	4.12E-03	6.75E-07	4.12E-03	0.041
Strontium	0.36357229	--	--	--	--	1.56E-04	2.55E-08	1.56E-04	0.0016
Sulfate	45.069738	--	--	--	--	--	--	--	
Tetrachloroethene	0.000993146	VOC	1.83E-04	--	8.05E-07	--	--	1.84E-04	0.0018
Toluene	0.000274725	VOC	2.73E-06	--	2.61E-08	--	--	2.76E-06	2.76E-05
Tributyl phosphate	0.040836371	SVOC	--	--	1.14E-06	--	--	1.14E-06	1.14E-05
Trichloroethene	0.000492361	VOC	7.00E-04	--	--	--	--	7.00E-04	0.0070
Trichloromonofluoromethane	0.00058	VOC	4.12E-05	--	6.17E-09	--	--	4.12E-05	4.13E-04
Uranium	0.01625113	--	--	0.46	--	1.39E-03	2.28E-07	4.64E-01	4.6
Vanadium	0.013487657	--	--	--	--	6.94E-04	1.14E-07	6.94E-04	0.0069
Vinyl chloride	0.0018	VOC	8.95E-04	--	8.25E-07	--	--	8.96E-04	0.0090
Zinc	0.10896358	--	--	--	--	5.60E-05	9.18E-09	5.60E-05	5.61E-04
Total			6.65E-03	9.91E+00	6.57E-06	7.04E-02	1.15E-05	9.99E+00	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.
Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
HQ = hazard quotient.

HI = hazard index.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Native American Risk Assessment (10-Year)–Summary of CTUIR Sweat Lodge Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal, Vapor, volatiles) (unitless)	Risk (Dermal, Liquid, Nonvolatiles) (unitless)	Risk (Dermal, Vapor, Nonvolatiles) (unitless)	Total Risk (unitless)	% Contribution
(m+p)-Xylene	0.0005	VOC	--	--	--	--	--	--	
1,1,1-Trichloroethane	0.001204711	VOC	--	--	--	--	--	--	
1,1-Dichloroethane	0.000389235	VOC	--	--	--	--	--	--	
1,1-Dichloroethene	0.000164225	VOC	--	--	--	--	--	--	
1,2-Dichlorobenzene	0.003	VOC	--	--	--	--	--	--	
1,2-Dichloroethane	0.000305426	VOC	3.84E-07	--	2.78E-11	--	--	3.84E-07	0.19
1,4-Dichlorobenzene	0.000130994	VOC	6.96E-08	--	7.09E-12	--	--	6.96E-08	0.035
1,4-Dioxane	0.0081	SVOC	3.01E-06	--	7.01E-12	--	--	3.01E-06	1.5
2-Butanone	0.0029	VOC	--	--	--	--	--	--	
2-Pentanone, 4-Methyl	0.00064	VOC	--	--	--	--	--	--	
Acetone	0.00128316	VOC	--	--	--	--	--	--	
Aluminum	0.041755539	--	--	--	--	--	--	--	
Arsenic	0.003060574	--	--	1.09E-04	--	1.15E-06	1.88E-10	1.10E-04	56
Barium	0.068082679	--	--	--	--	--	--	--	
Benzene	0.0019	VOC	7.16E-07	--	3.74E-10	--	--	7.16E-07	0.36
Benzyl alcohol	0.0027	SVOC	--	--	--	--	--	--	
Beryllium	0.000360659	--	--	7.18E-06	--	--	--	7.18E-06	3.6
Bis(2-ethylhexyl) phthalate	0.001271216	SVOC	1.47E-07	--	1.06E-10	--	--	1.48E-07	0.074
Cadmium	0.0045	--	--	6.72E-05	--	--	--	6.72E-05	34
Carbon disulfide	0.00039	VOC	--	--	--	--	--	--	
Carbon tetrachloride	0.000164414	VOC	1.19E-07	--	8.16E-11	--	--	1.19E-07	0.060
Chloride	9.821328	--	--	--	--	--	--	--	
Chlorobenzene	0.00041	VOC	--	--	--	--	--	--	
Chloroform	0.00022061	VOC	2.45E-07	--	1.11E-11	--	--	2.45E-07	0.12
Chromium	0.007505402	--	--	--	--	--	--	--	
cis-1,2-Dichloroethylene	0.0002	VOC	--	--	--	--	--	--	
Copper	0.002993571	--	--	--	--	--	--	--	
Fluoride	0.32861624	--	--	--	--	--	--	--	
Iron	0.47301923	--	--	--	--	--	--	--	
Lead	0.000710361	--	--	--	--	--	--	--	
Lithium	0.0083	--	--	--	--	--	--	--	
Manganese	0.011254937	--	--	--	--	--	--	--	
Methanol	1.1	--	--	--	--	--	--	--	
Methylene chloride	0.000852962	VOC	1.94E-08	--	5.34E-12	--	--	1.94E-08	0.0098
Molybdenum	0.0015	--	--	--	--	--	--	--	
Nickel	0.003603478	--	--	7.77E-06	--	--	--	7.77E-06	3.9
Nitrate	23.756902	--	--	--	--	--	--	--	
Nitrite	0.079227256	--	--	--	--	--	--	--	
o-Xylene	0.000210551	VOC	--	--	--	--	--	--	
Silver	0.005341496	--	--	--	--	--	--	--	
Strontium	0.36357229	--	--	--	--	--	--	--	
Sulfate	45.069738	--	--	--	--	--	--	--	
Tetrachloroethene	0.000993146	VOC	2.83E-07	--	4.22E-09	--	--	2.87E-07	0.14
Toluene	0.000274725	VOC	--	--	--	--	--	--	
Tributyl phosphate	0.040836371	SVOC	--	--	2.04E-09	--	--	2.04E-09	0.0010
Trichloroethene	0.000492361	VOC	5.95E-07	--	1.25E-10	--	--	5.95E-07	0.30
Trichloromonofluoromethane	0.00058	VOC	--	--	--	--	--	--	
Uranium	0.01625113	--	--	--	--	--	--	--	
Vanadium	0.013487657	--	--	--	--	--	--	--	
Vinyl chloride	0.0018	VOC	3.83E-07	--	1.73E-09	--	--	3.84E-07	0.19
Zinc	0.10896358	--	--	--	--	--	--	--	
Total ELCR			5.97E-06	1.91E-04	8.74E-09	1.15E-06	1.88E-10	1.98E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
SVOC = semivolatile organic compound.

VOC = volatile organic compound.
ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (pCi/L)	Volatile?[a]	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Carbon-14	15.2	--	--	4.55E-07	--	4.55E-07	0.060
Gross alpha	5.9880167	--	--	--	--	--	
Gross beta	26.717649	--	--	--	--	--	
Iodine-129	1.7529182	--	--	4.51E-07	--	4.51E-07	0.060
Nickel-63	7.66125	--	--	5.32E-08	--	5.32E-08	0.0070
Protactinium-231	0.308	--	--	5.94E-05	--	5.94E-05	7.9
Strontium-90	0.611	--	--	2.72E-07	--	2.72E-07	0.036
Technetium-99	75.671084	--	--	4.52E-06	--	4.52E-06	0.60
Tritium	497899.63	VOC	6.91E-04	--	--	6.91E-04	91
Total ELCR			6.91E-04	6.51E-05	--	7.56E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area -- CTUIR

Hazard quotient and cancer risk from inhalation of VOCs/SVOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Contaminant concentration in water	C_{dw}	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF	365	day/yr

[a] Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	VOC	0.0005	7.11E-06	7.00E-01	2.00E-01	3.55E-05	0.53
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	1.71E-05	5.00E+00	1.43E+00	1.20E-05	0.18
1,1-Dichloroethane	75-34-3	VOC	0.000389235	5.53E-06	7.00E-01	2.00E-01	2.77E-05	0.42
1,1-Dichloroethene	75-35-4	VOC	0.000164225	2.33E-06	2.00E-01	5.71E-02	4.08E-05	0.61
1,2-Dichlorobenzene	95-50-1	VOC	0.003	4.26E-05	2.00E-01	5.71E-02	7.46E-04	11
1,2-Dichloroethane	107-06-2	VOC	0.000305426	4.34E-06	2.40E+00	6.86E-01	6.33E-06	0.095
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	1.86E-06	8.00E-01	2.29E-01	8.14E-06	0.12
1,4-Dioxane	123-91-1	SVOC	0.0081	1.15E-04	3.60E+00	1.03E+00	1.12E-04	1.7
2-Butanone	78-93-3	VOC	0.0029	4.12E-05	5.00E+00	1.43E+00	2.88E-05	0.43
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	9.09E-06	3.00E+00	8.57E-01	1.06E-05	0.16
Acetone	67-64-1	VOC	0.00128316	1.82E-05	3.10E+01	8.86E+00	2.06E-06	0.031
Aluminum	7429-90-5	--	0.041755539	--(c)	5.00E-03	1.43E-03	--	
Arsenic	7440-38-2	--	0.003060574	--(c)	1.50E-05	4.29E-06	--	
Barium	7440-39-3	--	0.068082679	--(c)	5.00E-04	1.43E-04	--	
Benzene	71-43-2	VOC	0.0019	2.70E-05	3.00E-02	8.57E-03	3.15E-03	47
Benzyl alcohol	100-51-6	SVOC	0.0027	3.84E-05	--	--	--	
Beryllium	7440-41-7	--	0.000360659	--(c)	2.00E-05	5.71E-06	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	1.81E-05	--	--	--	
Cadmium	7440-43-9	--	0.0045	--(c)	1.00E-05	2.86E-06	--	
Carbon disulfide	75-15-0	VOC	0.00039	5.54E-06	7.00E-01	2.00E-01	2.77E-05	0.42
Carbon tetrachloride	56-23-5	VOC	0.000164414	2.34E-06	1.90E-01	5.43E-02	4.30E-05	0.65
Chloride	16887-00-6	--	9.821328	--(c)	--	--	--	
Chlorobenzene	108-90-7	VOC	0.00041	5.83E-06	5.00E-02	1.43E-02	4.08E-04	6.1
Chloroform	67-66-3	VOC	0.00022061	3.13E-06	9.80E-02	2.80E-02	1.12E-04	1.7
Chromium	7440-47-3	--	0.007505402	--(c)	--	--	--	
cis-1,2-Dichloroethylene	156-59-2	VOC	0.0002	2.84E-06	--	--	--	
Copper	7440-50-8	--	0.002993571	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.32861624	--(c)	1.30E-02	3.71E-03	--	
Iron	7439-89-6	--	0.47301923	--(c)	--	--	--	
Lead	7439-92-1	--	0.000710361	--(c)	--	--	--	
Lithium	7439-93-2	--	0.0083	--(c)	--	--	--	
Manganese	7439-96-5	--	0.011254937	--(c)	5.00E-05	1.43E-05	--	
Methanol	67-56-1	--	1.1	--(c)	4.00E+00	1.14E+00	--	
Methylene chloride	75-09-2	VOC	0.000852962	1.21E-05	1.00E+00	2.86E-01	4.24E-05	0.64

Molybdenum	7439-98-7	--	0.0015	--(c)	--	--	--	
Nickel	7440-02-0	--	0.003603478	--(c)	9.00E-05	2.57E-05	--	
Nitrate	14797-55-8	--	23.756902	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.079227256	--(c)	--	--	--	
o-Xylene	95-47-6	VOC	0.000210551	2.99E-06	7.00E-01	2.00E-01	1.50E-05	0.22
Silver	7440-22-4	--	0.005341496	--(c)	--	--	--	
Strontium	7440-24-6	--	0.36357229	--(c)	--	--	--	
Sulfate	14808-79-8	--	45.069738	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	1.41E-05	2.70E-01	7.71E-02	1.83E-04	2.8
Toluene	108-88-3	VOC	0.000274725	3.90E-06	5.00E+00	1.43E+00	2.73E-06	0.041
Tributyl phosphate	126-73-8	SVOC	0.040836371	5.80E-04	--	--	--	
Trichloroethene	79-01-6	VOC	0.000492361	7.00E-06	3.50E-02	1.00E-02	7.00E-04	11
Trichloromonofluoromethane	75-69-4	VOC	0.00058	8.24E-06	7.00E-01	2.00E-01	4.12E-05	0.62
Uranium	7440-61-1	--	0.01625113	--(c)	3.00E-04	8.57E-05	--	
Vanadium	7440-62-2	--	0.013487657	--(c)	--	--	--	
Vinyl chloride	75-01-4	VOC	0.0018	2.56E-05	1.00E-01	2.86E-02	8.95E-04	13
Zinc	7440-66-6	--	0.10896358	--(c)	--	--	--	
Total							6.65E-03	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of nonvolatile chemicals is presented in table C-3

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways .*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{gw} 95 UCL (mg/L)	I_{inh}(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	VOC	0.0005	6.90E-06	--	--	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	1.66E-05	--	--	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	5.37E-06	--	--	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	2.27E-06	--	--	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	4.14E-05	--	--	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	4.22E-06	2.60E-05	9.10E-02	3.84E-07	6.4
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	1.81E-06	1.10E-05	3.85E-02	6.96E-08	1.2
1,4-Dioxane	123-91-1	SVOC	0.0081	1.12E-04	7.70E-06	2.70E-02	3.01E-06	50.4
2-Butanone	78-93-3	VOC	0.0029	4.00E-05	--	--	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	8.83E-06	--	--	--	
Acetone	67-64-1	VOC	0.00128316	1.77E-05	--	--	--	
Aluminum	7429-90-5	--	0.041755539	--(c)	--	--	--	
Arsenic	7440-38-2	--	0.003060574	--(c)	4.30E-03	1.51E+01	--	
Barium	7440-39-3	--	0.068082679	--(c)	--	--	--	
Benzene	71-43-2	VOC	0.0019	2.62E-05	7.80E-06	2.73E-02	7.16E-07	12.0
Benzyl alcohol	100-51-6	SVOC	0.0027	3.73E-05	--	--	--	
Beryllium	7440-41-7	--	0.000360659	--(c)	2.40E-03	8.40E+00	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	1.75E-05	2.40E-06	8.40E-03	1.47E-07	2.5
Cadmium	7440-43-9	--	0.0045	--(c)	1.80E-03	6.30E+00	--	
Carbon disulfide	75-15-0	VOC	0.00039	5.38E-06	--	--	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	2.27E-06	1.50E-05	5.25E-02	1.19E-07	2.0
Chloride	16887-00-6	--	9.821328	--(c)	--	--	--	
Chlorobenzene	108-90-7	VOC	0.00041	5.66E-06	--	--	--	
Chloroform	67-66-3	VOC	0.00022061	3.05E-06	2.30E-05	8.05E-02	2.45E-07	4.1
Chromium	7440-47-3	--	0.007505402	--(c)	--	--	--	
cis-1,2-Dichloroethylene	156-59-2	VOC	0.0002	2.76E-06	--	--	--	
Copper	7440-50-8	--	0.002993571	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.32861624	--(c)	--	--	--	
Iron	7439-89-6	--	0.47301923	--(c)	--	--	--	
Lead	7439-92-1	--	0.000710361	--(c)	--	--	--	
Lithium	7439-93-2	--	0.0083	--(c)	--	--	--	
Manganese	7439-96-5	--	0.011254937	--(c)	--	--	--	
Methanol	67-56-1	--	1.1	--(c)	--	--	--	
Methylene chloride	75-09-2	VOC	0.000852962	1.18E-05	4.70E-07	1.65E-03	1.94E-08	0.3
Molybdenum	7439-98-7	--	0.0015	--(c)	--	--	--	
Nickel	7440-02-0	--	0.003603478	--(c)	2.60E-04	9.10E-01	--	
Nitrate	14797-55-8	--	23.756902	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.079227256	--(c)	--	--	--	
o-Xylene	95-47-6	VOC	0.000210551	2.91E-06	--	--	--	
Silver	7440-22-4	--	0.005341496	--(c)	--	--	--	
Strontium	7440-24-6	--	0.36357229	--(c)	--	--	--	
Sulfate	14808-79-8	--	45.069738	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	1.37E-05	5.90E-06	2.07E-02	2.83E-07	4.7
Toluene	108-88-3	VOC	0.000274725	3.79E-06	--	--	--	
Tributyl phosphate	126-73-8	SVOC	0.040836371	5.64E-04	--	--	--	
Trichloroethene	79-01-6	VOC	0.000492361	6.80E-06	2.50E-05	8.75E-02	5.95E-07	10.0
Trichloromonofluoromethane	75-69-4	VOC	0.00058	8.01E-06	--	--	--	
Uranium	7440-61-1	--	0.01625113	--(c)	--	--	--	
Vanadium	7440-62-2	--	0.013487657	--(c)	--	--	--	
Vinyl chloride	75-01-4	VOC	0.0018	2.48E-05	4.40E-06	1.54E-02	3.83E-07	6.4
Zinc	7440-66-6	--	0.10896358	--(c)	--	--	--	
Total ELCR							5.97E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of nonvolatile chemicals is presented in table C-3

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area -- CTUIR

Hazard quotient and cancer risk from inhalation of non-VOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 2)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion Factor	CF	365	day/yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L

[a] Harris (2008)

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	VOC	0.0005	--(c)	7.00E-01	2.00E-01	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	--(c)	5.00E+00	1.43E+00	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	--(c)	7.00E-01	2.00E-01	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	--(c)	2.00E-01	5.71E-02	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	--(c)	2.00E-01	5.71E-02	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	--(c)	2.40E+00	6.86E-01	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	--(c)	8.00E-01	2.29E-01	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	--(c)	3.60E+00	1.03E+00	--	
2-Butanone	78-93-3	VOC	0.0029	--(c)	5.00E+00	1.43E+00	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	--(c)	3.00E+00	8.57E-01	--	
Acetone	67-64-1	VOC	0.00128316	--(c)	3.10E+01	8.86E+00	--	
Aluminum	7429-90-5	--	0.041755539	1.02E-04	5.00E-03	1.43E-03	7.13E-02	0.72
Arsenic	7440-38-2	--	0.003060574	7.46E-06	1.50E-05	4.29E-06	1.74E+00	18
Barium	7440-39-3	--	0.068082679	1.66E-04	5.00E-04	1.43E-04	1.16E+00	12
Benzene	71-43-2	VOC	0.0019	--(c)	3.00E-02	8.57E-03	--	
Benzyl alcohol	100-51-6	SVOC	0.0027	--(c)	--	--	--	
Beryllium	7440-41-7	--	0.000360659	8.79E-07	2.00E-05	5.71E-06	1.54E-01	1.6
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	--(c)	--	--	--	
Cadmium	7440-43-9	--	0.0045	1.10E-05	1.00E-05	2.86E-06	3.84E+00	39
Carbon disulfide	75-15-0	VOC	0.00039	--(c)	7.00E-01	2.00E-01	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	--(c)	1.90E-01	5.43E-02	--	
Chloride	16887-00-6	--	9.821328	2.39E-02	--	--	--	
Chlorobenzene	108-90-7	VOC	0.00041	--(c)	5.00E-02	1.43E-02	--	
Chloroform	67-66-3	VOC	0.00022061	--(c)	9.80E-02	2.80E-02	--	
Chromium	7440-47-3	--	0.007505402	1.83E-05	--	--	--	
cis-1,2-Dichloroethylene	156-59-2	VOC	0.0002	--(c)	--	--	--	
Copper	7440-50-8	--	0.002993571	7.30E-06	--	--	--	
Fluoride	16984-48-8	--	0.32861624	8.01E-04	1.30E-02	3.71E-03	2.16E-01	2.2
Iron	7439-89-6	--	0.47301923	1.15E-03	--	--	--	
Lead	7439-92-1	--	0.000710361	1.73E-06	--	--	--	
Lithium	7439-93-2	--	0.0083	2.02E-05	--	--	--	
Manganese	7439-96-5	--	0.011254937	2.74E-05	5.00E-05	1.43E-05	1.92E+00	19
Methanol	67-56-1	--	1.1	2.68E-03	4.00E+00	1.14E+00	2.35E-03	0.024
Methylene chloride	75-09-2	VOC	0.000852962	--(c)	1.00E+00	2.86E-01	--	
Molybdenum	7439-98-7	--	0.0015	3.66E-06	--	--	--	
Nickel	7440-02-0	--	0.003603478	8.79E-06	9.00E-05	2.57E-05	3.42E-01	3.4
Nitrate	14797-55-8	--	23.756902	5.79E-02	--	--	--	
Nitrite	14797-65-0	--	0.079227256	1.93E-04	--	--	--	
o-Xylene	95-47-6	VOC	0.000210551	--(c)	7.00E-01	2.00E-01	--	
Silver	7440-22-4	--	0.005341496	1.30E-05	--	--	--	
Strontium	7440-24-6	--	0.36357229	8.87E-04	--	--	--	
Sulfate	14808-79-8	--	45.069738	1.10E-01	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	--(c)	2.70E-01	7.71E-02	--	
Toluene	108-88-3	VOC	0.000274725	--(c)	5.00E+00	1.43E+00	--	
Tributyl phosphate	126-73-8	SVOC	0.040836371	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000492361	--(c)	3.50E-02	1.00E-02	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	--(c)	7.00E-01	2.00E-01	--	
Uranium	7440-61-1	--	0.01625113	3.96E-05	3.00E-04	8.57E-05	4.62E-01	4.7
Vanadium	7440-62-2	--	0.013487657	3.29E-05	--	--	--	
Vinyl chloride	75-01-4	VOC	0.0018	--(c)	1.00E-01	2.86E-02	--	
Zinc	7440-66-6	--	0.10896358	2.66E-04	--	--	--	
Total							10	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of volatile compounds in vapor is presented in Table C-2

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	VOC	0.0005	--(c)	--	--	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	--(c)	--	--	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	--(c)	--	--	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	--(c)	--	--	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	--(c)	--	--	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	--(c)	2.60E-05	9.10E-02	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	--(c)	1.10E-05	3.85E-02	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	--(c)	7.70E-06	2.70E-02	--	
2-Butanone	78-93-3	VOC	0.0029	--(c)	--	--	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	--(c)	--	--	--	
Acetone	67-64-1	VOC	0.00128316	--(c)	--	--	--	
Aluminum	7429-90-5	--	0.041755539	9.89E-05	--	--	--	
Arsenic	7440-38-2	--	0.003060574	7.25E-06	4.30E-03	1.51E+01	1.09E-04	57
Barium	7440-39-3	--	0.068082679	1.61E-04	--	--	--	
Benzene	71-43-2	VOC	0.0019	--(c)	7.80E-06	2.73E-02	--	
Benzyl alcohol	100-51-6	SVOC	0.0027	--(c)	--	--	--	
Beryllium	7440-41-7	--	0.000360659	8.54E-07	2.40E-03	8.40E+00	7.18E-06	3.8
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	--(c)	2.40E-06	8.40E-03	--	
Cadmium	7440-43-9	--	0.0045	1.07E-05	1.80E-03	6.30E+00	6.72E-05	35
Carbon disulfide	75-15-0	VOC	0.00039	--(c)	--	--	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	--(c)	1.50E-05	5.25E-02	--	
Chloride	16887-00-6	--	9.821328	2.33E-02	--	--	--	
Chlorobenzene	108-90-7	VOC	0.00041	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.00022061	--(c)	2.30E-05	8.05E-02	--	
Chromium	7440-47-3	--	0.007505402	1.78E-05	--	--	--	
cis-1,2-Dichloroethylene	156-59-2	VOC	0.0002	--(c)	--	--	--	
Copper	7440-50-8	--	0.002993571	7.09E-06	--	--	--	
Fluoride	16984-48-8	--	0.32861624	7.78E-04	--	--	--	
Iron	7439-89-6	--	0.47301923	1.12E-03	--	--	--	
Lead	7439-92-1	--	0.000710361	1.68E-06	--	--	--	
Lithium	7439-93-2	--	0.0083	1.97E-05	--	--	--	
Manganese	7439-96-5	--	0.011254937	2.67E-05	--	--	--	
Methanol	67-56-1	--	1.1	2.61E-03	--	--	--	
Methylene chloride	75-09-2	VOC	0.000852962	--(c)	4.70E-07	1.65E-03	--	
Molybdenum	7439-98-7	--	0.0015	3.55E-06	--	--	--	
Nickel	7440-02-0	--	0.003603478	8.54E-06	2.60E-04	9.10E-01	7.77E-06	4.1
Nitrate	14797-55-8	--	23.756902	5.63E-02	--	--	--	
Nitrite	14797-65-0	--	0.079227256	1.88E-04	--	--	--	
o-Xylene	95-47-6	VOC	0.000210551	--(c)	--	--	--	
Silver	7440-22-4	--	0.005341496	1.27E-05	--	--	--	
Strontium	7440-24-6	--	0.36357229	8.61E-04	--	--	--	
Sulfate	14808-79-8	--	45.069738	1.07E-01	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	--(c)	5.90E-06	2.07E-02	--	
Toluene	108-88-3	VOC	0.000274725	--(c)	--	--	--	
Tributyl phosphate	126-73-8	SVOC	0.040836371	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000492361	--(c)	2.50E-05	8.75E-02	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	--(c)	--	--	--	
Uranium	7440-61-1	--	0.01625113	3.85E-05	--	--	--	
Vanadium	7440-62-2	--	0.013487657	3.19E-05	--	--	--	
Vinyl chloride	75-01-4	VOC	0.0018	--(c)	4.40E-06	1.54E-02	--	
Zinc	7440-66-6	--	0.10896358	2.58E-04	--	--	--	
Total ELCR							1.91E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of volatile compounds in vapor is presented in Table C-2

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area -- CTUIR

Hazard quotient and cancer risk from dermal exposure to VOCs/SVOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water (*Id,l*)
can be neglected and total dermal intake (*Id,total*) is equal to dermal intake from VOCs/SVOCs in sweat lodge vapor (*Id,v*)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 3)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF1	0.01	m/cm
Conversion factor	CF2	365	day/yr

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
(m+p)-Xylene[f]	179601-23-1	VOC	0.0005	0.053	6.51E-09	2.00E-01	1	3.25E-08	0.50
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	0.013	3.85E-09	2.00E+00	1	1.92E-09	0.029
1,1-Dichloroethane	75-34-3	VOC	0.000389235	0.0067	6.40E-10	2.00E-01	1	3.20E-09	0.049
1,1-Dichloroethene	75-35-4	VOC	0.000164225	0.012	4.84E-10	5.00E-02	1	9.68E-09	0.15
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	3.02E-08	9.00E-02	1	3.36E-07	5.1
1,2-Dichloroethane	107-06-2	VOC	0.000305426	0.0042	3.15E-10	2.00E-02	1	1.57E-08	0.24
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	0.042	1.35E-09	7.00E-02	1	1.93E-08	0.29
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	6.56E-10	1.00E-01	1	6.56E-09	0.100
2-Butanone	78-93-3	VOC	0.0029	0.00096	6.84E-10	6.00E-01	1	1.14E-09	0.017
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	4.24E-10	8.00E-02	1	5.30E-09	0.081
Acetone[d]	67-64-1	VOC	0.00128316	0.000512	1.61E-10	9.00E-01	1	1.79E-10	0.0027
Aluminum	7429-90-5	--	0.041755539	0.001	--(c)	1.00E+00	1	--	
Arsenic	7440-38-2	--	0.003060574	0.001	--(c)	3.00E-04	1	--	
Barium	7440-39-3	--	0.068082679	0.001	--(c)	2.00E-01	0.07	--	
Benzene	71-43-2	VOC	0.0019	0.015	7.00E-09	4.00E-03	1	1.75E-06	27
Benzyl alcohol[d]	100-51-6	SVOC	0.0027	0.00209	1.39E-09	1.00E-01	1	1.39E-08	0.21
Beryllium	7440-41-7	--	0.000360659	0.001	--(c)	2.00E-03	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	0.025	7.80E-09	2.00E-02	1	3.90E-07	5.9
Cadmium	7440-43-9	--	0.0045	0.001	--(c)	5.00E-04	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00039	0.017	1.63E-09	1.00E-01	1	1.63E-08	0.25
Carbon tetrachloride	56-23-5	VOC	0.000164414	0.016	6.46E-10	7.00E-04	1	9.23E-07	14
Chloride	16887-00-6	--	9.821328	0.001	--(c)	--	1	--	
Chlorobenzene	108-90-7	VOC	0.00041	0.028	2.82E-09	2.00E-02	1	1.41E-07	2.1
Chloroform	67-66-3	VOC	0.00022061	0.0068	3.68E-10	1.00E-02	1	3.68E-08	0.56
Chromium	7440-47-3	--	0.007505402	0.001	--(c)	1.50E+00	0.013	--	
cis-1,2-Dichloroethylene[e]	156-59-2	VOC	0.0002	0.0077	3.78E-10	1.00E-02	1	3.78E-08	0.58
Copper	7440-50-8	--	0.002993571	0.001	--(c)	4.00E-02	1	--	
Fluoride	16984-48-8	--	0.32861624	0.001	--(c)	6.00E-02	1	--	
Iron	7439-89-6	--	0.47301923	0.001	--(c)	7.00E-01	1	--	
Lead	7439-92-1	--	0.000710361	0.0001	--(c)	--	1	--	
Lithium	7439-93-2	--	0.0083	0.001	--(c)	2.00E-03	1	--	
Manganese	7439-96-5	--	0.011254937	0.001	--(c)	2.40E-02	0.04	--	
Methanol	67-56-1	--	1.1	0.00032	--(c)	5.00E-01	1	--	
Methylene chloride	75-09-2	VOC	0.000852962	0.0035	7.33E-10	6.00E-02	1	1.22E-08	0.19

Molybdenum	7439-98-7	--	0.0015	0.001	--(c)	5.00E-03	1	--	
Nickel	7440-02-0	--	0.003603478	0.0002	--(c)	2.00E-02	0.04	--	
Nitrate	14797-55-8	--	23.756902	0.001	--(c)	7.10E+00	1	--	
Nitrite	14797-65-0	--	0.079227256	0.001	--(c)	3.00E-01	1	--	
o-Xylene[f]	95-47-6	VOC	0.000210551	0.054	2.79E-09	2.00E-01	1	1.40E-08	0.21
Silver	7440-22-4	--	0.005341496	0.0006	--(c)	5.00E-03	0.04	--	
Strontium	7440-24-6	--	0.36357229	0.001	--(c)	6.00E-01	1	--	
Sulfate	14808-79-8	--	45.069738	0.001	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	0.033	8.05E-09	1.00E-02	1	8.05E-07	12
Toluene	108-88-3	VOC	0.000274725	0.031	2.09E-09	8.00E-02	1	2.61E-08	0.40
Tributyl phosphate[d]	126-73-8	SVOC	0.040836371	0.0228	2.29E-07	2.00E-01	1	1.14E-06	17
Trichloroethene	79-01-6	VOC	0.000492361	0.012	1.45E-09	--	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	1.85E-09	3.00E-01	1	6.17E-09	0.094
Uranium	7440-61-1	--	0.01625113	0.001	--(c)	3.00E-03	1	--	
Vanadium	7440-62-2	--	0.013487657	0.001	--(c)	5.00E-03	1	--	
Vinyl chloride[d]	75-01-4	VOC	0.0018	0.0056	2.48E-09	3.00E-03	1	8.25E-07	13
Zinc	7440-66-6	--	0.10896358	0.0006	--(c)	3.00E-01	1	--	
Total								6.57E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal absorption of nonvolatile chemicals is presented in tables C-5 and C-6

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

[e] for cis-1,2-dichloroethyelene the chemical-specific inputs are assummed to be the same as trans-1,2-dichloroethylene

[f] for (m+p) xylenes and o-xylene the chemical-specific inputs are assummed to be the same as m-xylene

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways .*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
(m+p)-Xylene[f]	179601-23-1	VOC	0.0005	0.053	6.32E-09	--	1	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	0.013	3.74E-09	--	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	0.0067	6.22E-10	--	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	0.012	4.70E-10	--	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	2.93E-08	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	0.0042	3.06E-10	9.10E-02	1	2.78E-11	0.32
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	0.042	1.31E-09	5.40E-03	1	7.09E-12	0.081
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	6.38E-10	1.10E-02	1	7.01E-12	0.080
2-Butanone	78-93-3	VOC	0.0029	0.00096	6.64E-10	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	4.12E-10	--	1	--	
Acetone[d]	67-64-1	VOC	0.00128316	0.000512	1.57E-10	--	1	--	
Aluminum	7429-90-5	--	0.041755539	0.001	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.003060574	0.001	--(c)	1.50E+00	1	--	
Barium	7440-39-3	--	0.068082679	0.001	--(c)	--	0.07	--	
Benzene	71-43-2	VOC	0.0019	0.015	6.80E-09	5.50E-02	1	3.74E-10	4.3
Benzyl alcohol[d]	100-51-6	SVOC	0.0027	0.00209	1.35E-09	--	1	--	
Beryllium	7440-41-7	--	0.000360659	0.001	--(c)	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	0.025	7.58E-09	1.40E-02	1	1.06E-10	1.2
Cadmium	7440-43-9	--	0.0045	0.001	--(c)	--	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00039	0.017	1.58E-09	--	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	0.016	6.28E-10	1.30E-01	1	8.16E-11	0.93
Chloride	16887-00-6	--	9.821328	0.001	--(c)	--	1	--	
Chlorobenzene	108-90-7	VOC	0.00041	0.028	2.74E-09	--	1	--	
Chloroform	67-66-3	VOC	0.00022061	0.0068	3.58E-10	3.10E-02	1	1.11E-11	0.13
Chromium	7440-47-3	--	0.007505402	0.001	--(c)	--	0.013	--	
cis-1,2-Dichloroethylene[e]	156-59-2	VOC	0.0002	0.0077	3.67E-10	--	1	--	
Copper	7440-50-8	--	0.002993571	0.001	--(c)	--	1	--	
Fluoride	16984-48-8	--	0.32861624	0.001	--(c)	--	1	--	
Iron	7439-89-6	--	0.47301923	0.001	--(c)	--	1	--	
Lead	7439-92-1	--	0.000710361	0.0001	--(c)	--	1	--	
Lithium	7439-93-2	--	0.0083	0.001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.011254937	0.001	--(c)	--	0.04	--	
Methanol	67-56-1	--	1.1	0.00032	--(c)	--	1	--	
Methylene chloride	75-09-2	VOC	0.000852962	0.0035	7.12E-10	7.50E-03	1	5.34E-12	0.061
Molybdenum	7439-98-7	--	0.0015	0.001	--(c)	--	1	--	
Nickel	7440-02-0	--	0.003603478	0.0002	--(c)	--	0.04	--	
Nitrate	14797-55-8	--	23.756902	0.001	--(c)	--	1	--	
Nitrite	14797-65-0	--	0.079227256	0.001	--(c)	--	1	--	
o-Xylene[f]	95-47-6	VOC	0.000210551	0.054	2.71E-09	--	1	--	
Silver	7440-22-4	--	0.005341496	0.0006	--(c)	--	0.04	--	
Strontium	7440-24-6	--	0.36357229	0.001	--(c)	--	1	--	
Sulfate	14808-79-8	--	45.069738	0.001	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	0.033	7.82E-09	5.40E-01	1	4.22E-09	48
Toluene	108-88-3	VOC	0.000274725	0.031	2.03E-09	--	1	--	
Tributyl phosphate[d]	126-73-8	SVOC	0.040836371	0.0228	2.22E-07	9.20E-03	1	2.04E-09	23
Trichloroethene	79-01-6	VOC	0.000492361	0.012	1.41E-09	8.90E-02	1	1.25E-10	1.4
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	1.80E-09	--	1	--	
Uranium	7440-61-1	--	0.01625113	0.001	--(c)	--	1	--	
Vanadium	7440-62-2	--	0.013487657	0.001	--(c)	--	1	--	
Vinyl chloride[d]	75-01-4	VOC	0.0018	0.0056	2.40E-09	7.20E-01	1	1.73E-09	20
Zinc	7440-66-6	--	0.10896358	0.0006	--(c)	--	1	--	
Total ELCR								8.74E-09	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Dermal absorption of nonvolatile chemicals is presented in tables C-5 and C-6

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

[e] for cis-1,2-dichloroethylene the chemical-specific inputs are assummed to be the same as trans-1,2-dichloroethylene

[f] for (m+p) xylenes and o-xylene the chemical-specific inputs are assummed to be the same as m-xylene

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)–Far-field exposure area -- CTUIR

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge condensed water
Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4)
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
Model assumes concentration of nonvolatiles in condensed water is equal to concentration in water used to create steam

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from liquid	$I_{d,l}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,l}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	VOC	0.0005	0.053	--(c)	2.00E-01	1	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	0.013	--(c)	2.00E+00	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	0.0067	--(c)	2.00E-01	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	0.012	--(c)	5.00E-02	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	9.00E-02	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	0.0042	--(c)	2.00E-02	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	0.042	--(c)	7.00E-02	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.00E-01	1	--	
2-Butanone	78-93-3	VOC	0.0029	0.00096	--(c)	6.00E-01	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	8.00E-02	1	--	
Acetone	67-64-1	VOC	0.00128316	0.000512	--(c)	9.00E-01	1	--	
Aluminum	7429-90-5	--	0.041755539	0.001	1.07E-05	1.00E+00	1	1.07E-05	0.015
Arsenic	7440-38-2	--	0.003060574	0.001	7.87E-07	3.00E-04	1	2.62E-03	3.7
Barium	7440-39-3	--	0.068082679	0.001	1.75E-05	2.00E-01	0.07	1.25E-03	1.8
Benzene	71-43-2	VOC	0.0019	0.015	--(c)	4.00E-03	1	--	
Benzyl alcohol	100-51-6	SVOC	0.0027	0.00209	--(c)	1.00E-01	1	--	
Beryllium	7440-41-7	--	0.000360659	0.001	9.27E-08	2.00E-03	0.007	6.62E-03	9.4
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	0.025	--(c)	2.00E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	1.16E-06	5.00E-04	0.05	4.63E-02	66
Carbon disulfide	75-15-0	VOC	0.00039	0.017	--(c)	1.00E-01	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	9.821328	0.001	2.53E-03	--	1	--	
Chlorobenzene	108-90-7	VOC	0.00041	0.028	--(c)	2.00E-02	1	--	
Chloroform	67-66-3	VOC	0.00022061	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.007505402	0.001	1.93E-06	1.50E+00	0.013	9.90E-05	0.14
cis-1,2-Dichloroethylene	156-59-2	VOC	0.0002	0.0077	--(c)	1.00E-02	1	--	
Copper	7440-50-8	--	0.002993571	0.001	7.70E-07	4.00E-02	1	1.92E-05	0.027
Fluoride	16984-48-8	--	0.32861624	0.001	8.45E-05	6.00E-02	1	1.41E-03	2.0
Iron	7439-89-6	--	0.47301923	0.001	1.22E-04	7.00E-01	1	1.74E-04	0.25
Lead	7439-92-1	--	0.000710361	0.0001	1.83E-08	--	1	--	
Lithium	7439-93-2	--	0.0083	0.001	2.13E-06	2.00E-03	1	1.07E-03	1.5
Manganese	7439-96-5	--	0.011254937	0.001	2.89E-06	2.40E-02	0.04	3.01E-03	4.3
Methanol	67-56-1	--	1.1	0.00032	9.05E-05	5.00E-01	1	1.81E-04	0.26
Methylene chloride	75-09-2	VOC	0.000852962	0.0035	--(c)	6.00E-02	1	--	

Molybdenum	7439-98-7	--	0.0015	0.001	3.86E-07	5.00E-03	1	7.71E-05	0.11
Nickel	7440-02-0	--	0.003603478	0.0002	1.85E-07	2.00E-02	0.04	2.32E-04	0.33
Nitrate	14797-55-8	--	23.756902	0.001	6.11E-03	7.10E+00	1	8.60E-04	1.2
Nitrite	14797-65-0	--	0.079227256	0.001	2.04E-05	3.00E-01	1	6.79E-05	0.096
o-Xylene	95-47-6	VOC	0.000210551	0.054	--(c)	2.00E-01	1	--	
Silver	7440-22-4	--	0.005341496	0.0006	8.24E-07	5.00E-03	0.04	4.12E-03	5.9
Strontium	7440-24-6	--	0.36357229	0.001	9.35E-05	6.00E-01	1	1.56E-04	0.22
Sulfate	14808-79-8	--	45.069738	0.001	1.16E-02	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	0.033	--(c)	1.00E-02	1	--	
Toluene	108-88-3	VOC	0.000274725	0.031	--(c)	8.00E-02	1	--	
Tributyl phosphate	126-73-8	SVOC	0.040836371	0.0228	--(c)	2.00E-01	1	--	
Trichloroethene	79-01-6	VOC	0.000492361	0.012	--(c)	--	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	3.00E-01	1	--	
Uranium	7440-61-1	--	0.01625113	0.001	4.18E-06	3.00E-03	1	1.39E-03	2.0
Vanadium	7440-62-2	--	0.013487657	0.001	3.47E-06	5.00E-03	1	6.94E-04	0.99
Vinyl chloride	75-01-4	VOC	0.0018	0.0056	--(c)	3.00E-03	1	--	
Zinc	7440-66-6	--	0.10896358	0.0006	1.68E-05	3.00E-01	1	5.60E-05	0.080
Total								0.1	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

[e] for cis-1,2-dichloroethyelene the chemical-specific inputs are assummed to be the same as trans-1,2-dichloroethylene

[f] for (m+p) xylenes and o-xylene the chemical-specific inputs are assummed to be the same as m-xylene

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

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COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,i}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	VOC	0.0005	0.053	--(c)	--	1	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	0.013	--(c)	--	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	0.0067	--(c)	--	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	0.012	--(c)	--	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	0.0042	--(c)	9.10E-02	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	0.042	--(c)	5.40E-03	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.10E-02	1	--	
2-Butanone	78-93-3	VOC	0.0029	0.00096	--(c)	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	--	1	--	
Acetone	67-64-1	VOC	0.00128316	0.000512	--(c)	--	1	--	
Aluminum	7429-90-5	--	0.041755539	0.001	1.04E-05	--	1	--	
Arsenic	7440-38-2	--	0.003060574	0.001	7.65E-07	1.50E+00	1	1.15E-06	100
Barium	7440-39-3	--	0.068082679	0.001	1.70E-05	--	0.07	--	
Benzene	71-43-2	VOC	0.0019	0.015	--(c)	5.50E-02	1	--	
Benzyl alcohol	100-51-6	SVOC	0.0027	0.00209	--(c)	--	1	--	
Beryllium	7440-41-7	--	0.000360659	0.001	9.01E-08	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	1.12E-06	--	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00039	0.017	--(c)	--	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	9.821328	0.001	2.45E-03	--	1	--	
Chlorobenzene	108-90-7	VOC	0.00041	0.028	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.00022061	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.007505402	0.001	1.87E-06	--	0.013	--	
cis-1,2-Dichloroethylene	156-59-2	VOC	0.0002	0.0077	--(c)	--	1	--	
Copper	7440-50-8	--	0.002993571	0.001	7.48E-07	--	1	--	
Fluoride	16984-48-8	--	0.32861624	0.001	8.21E-05	--	1	--	
Iron	7439-89-6	--	0.47301923	0.001	1.18E-04	--	1	--	
Lead	7439-92-1	--	0.000710361	0.0001	1.77E-08	--	1	--	
Lithium	7439-93-2	--	0.0083	0.001	2.07E-06	--	1	--	
Manganese	7439-96-5	--	0.011254937	0.001	2.81E-06	--	0.04	--	
Methanol	67-56-1	--	1.1	0.00032	8.79E-05	--	1	--	
Methylene chloride	75-09-2	VOC	0.000852962	0.0035	--(c)	7.50E-03	1	--	
Molybdenum	7439-98-7	--	0.0015	0.001	3.75E-07	--	1	--	
Nickel	7440-02-0	--	0.003603478	0.0002	1.80E-07	--	0.04	--	
Nitrate	14797-55-8	--	23.756902	0.001	5.93E-03	--	1	--	
Nitrite	14797-65-0	--	0.079227256	0.001	1.98E-05	--	1	--	
o-Xylene	95-47-6	VOC	0.000210551	0.054	--(c)	--	1	--	
Silver	7440-22-4	--	0.005341496	0.0006	8.01E-07	--	0.04	--	
Strontium	7440-24-6	--	0.36357229	0.001	9.08E-05	--	1	--	
Sulfate	14808-79-8	--	45.069738	0.001	1.13E-02	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	0.033	--(c)	5.40E-01	1	--	
Toluene	108-88-3	VOC	0.000274725	0.031	--(c)	--	1	--	
Tributyl phosphate	126-73-8	SVOC	0.040836371	0.0228	--(c)	9.20E-03	1	--	
Trichloroethene	79-01-6	VOC	0.000492361	0.012	--(c)	8.90E-02	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	--	1	--	
Uranium	7440-61-1	--	0.01625113	0.001	4.06E-06	--	1	--	
Vanadium	7440-62-2	--	0.013487657	0.001	3.37E-06	--	1	--	
Vinyl chloride	75-01-4	VOC	0.0018	0.0056	--(c)	7.20E-01	1	--	
Zinc	7440-66-6	--	0.10896358	0.0006	1.63E-05	--	1	--	
Total ELCR								1.15E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

[e] for cis-1,2-dichloroethylene the chemical-specific inputs are assummed to be the same as trans-1,2-dichloroethylene

[f] for (m+p) xylenes and o-xylene the chemical-specific inputs are assummed to be the same as m-xylene

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.
SVOC = semivolatile organic compound.
VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area -- CTUIR

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/day
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Ideal gas law constant	R	62.37	(mmHg-L)/(gmole-K)
Temperature of the sweat lodge	T	338.7	K
Density of liquid water	rhow	1000	g/L
Conversion factor	CF_2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	VOC	0.0005	0.053	--(c)	2.00E-01	1	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	0.013	--(c)	2.00E+00	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	0.0067	--(c)	2.00E-01	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	0.012	--(c)	5.00E-02	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	9.00E-02	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	0.0042	--(c)	2.00E-02	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	0.042	--(c)	7.00E-02	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.00E-01	1	--	
2-Butanone	78-93-3	VOC	0.0029	0.00096	--(c)	6.00E-01	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	8.00E-02	1	--	
Acetone	67-64-1	VOC	0.00128316	0.000512	--(c)	9.00E-01	1	--	
Aluminum	7429-90-5	--	0.041755539	0.001	1.76E-09	1.00E+00	1	1.76E-09	0.015
Arsenic	7440-38-2	--	0.003060574	0.001	1.29E-10	3.00E-04	1	4.30E-07	3.7
Barium	7440-39-3	--	0.068082679	0.001	2.87E-09	2.00E-01	0.07	2.05E-07	1.8
Benzene	71-43-2	VOC	0.0019	0.015	--(c)	4.00E-03	1	--	
Benzyl alcohol	100-51-6	SVOC	0.0027	0.00209	--(c)	1.00E-01	1	--	
Beryllium	7440-41-7	--	0.000360659	0.001	1.52E-11	2.00E-03	0.007	1.09E-06	9.4
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	0.025	--(c)	2.00E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	1.90E-10	5.00E-04	0.05	7.58E-06	66
Carbon disulfide	75-15-0	VOC	0.00039	0.017	--(c)	1.00E-01	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	9.821328	0.001	4.14E-07	--	1	--	
Chlorobenzene	108-90-7	VOC	0.00041	0.028	--(c)	2.00E-02	1	--	
Chloroform	67-66-3	VOC	0.00022061	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.007505402	0.001	3.16E-10	1.50E+00	0.013	1.62E-08	0.14
cis-1,2-Dichloroethylene	156-59-2	VOC	0.0002	0.0077	--(c)	1.00E-02	1	--	
Copper	7440-50-8	--	0.002993571	0.001	1.26E-10	4.00E-02	1	3.15E-09	0.027
Fluoride	16984-48-8	--	0.32861624	0.001	1.38E-08	6.00E-02	1	2.31E-07	2.0
Iron	7439-89-6	--	0.47301923	0.001	1.99E-08	7.00E-01	1	2.85E-08	0.25
Lead	7439-92-1	--	0.000710361	0.0001	2.99E-12	--	1	--	
Lithium	7439-93-2	--	0.0083	0.001	3.50E-10	2.00E-03	1	1.75E-07	1.5
Manganese	7439-96-5	--	0.011254937	0.001	4.74E-10	2.40E-02	0.04	4.94E-07	4.3
Methanol	67-56-1	--	1.1	0.00032	1.48E-08	5.00E-01	1	2.97E-08	0.26
Methylene chloride	75-09-2	VOC	0.000852962	0.0035	--(c)	6.00E-02	1	--	
Molybdenum	7439-98-7	--	0.0015	0.001	6.32E-11	5.00E-03	1	1.26E-08	0.11
Nickel	7440-02-0	--	0.003603478	0.0002	3.04E-11	2.00E-02	0.04	3.80E-08	0.33
Nitrate	14797-55-8	--	23.756902	0.001	1.00E-06	7.10E+00	1	1.41E-07	1.2
Nitrite	14797-65-0	--	0.079227256	0.001	3.34E-09	3.00E-01	1	1.11E-08	0.096
o-Xylene	95-47-6	VOC	0.000210551	0.054	--(c)	2.00E-01	1	--	
Silver	7440-22-4	--	0.005341496	0.0006	1.35E-10	5.00E-03	0.04	6.75E-07	5.9
Strontium	7440-24-6	--	0.36357229	0.001	1.53E-08	6.00E-01	1	2.55E-08	0.22
Sulfate	14808-79-8	--	45.069738	0.001	1.90E-06	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	0.033	--(c)	1.00E-02	1	--	
Toluene	108-88-3	VOC	0.000274725	0.031	--(c)	8.00E-02	1	--	
Tributyl phosphate	126-73-8	SVOC	0.040836371	0.0228	--(c)	2.00E-01	1	--	
Trichloroethene	79-01-6	VOC	0.000492361	0.012	--(c)	--	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	3.00E-01	1	--	
Uranium	7440-61-1	--	0.01625113	0.001	6.85E-10	3.00E-03	1	2.28E-07	2.0
Vanadium	7440-62-2	--	0.013487657	0.001	5.68E-10	5.00E-03	1	1.14E-07	0.99
Vinyl chloride	75-01-4	VOC	0.0018	0.0056	--(c)	3.00E-03	1	--	
Zinc	7440-66-6	--	0.10896358	0.0006	2.75E-09	3.00E-01	1	9.18E-09	0.080
Total								0.00	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal Absorption of volatiles is presented in table C-4

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

[e] for cis-1,2-dichloroethyelene the chemical-specific inputs are assummed to be the same as trans-1,2-dichloroethylene

[f] for (m+p) xylenes and o-xylene the chemical-specific inputs are assummed to be the same as m-xylene

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] $(mg/kg\text{-}day)^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	VOC	0.0005	0.053	--(c)	--	1	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	0.013	--(c)	--	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	0.0067	--(c)	--	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	0.012	--(c)	--	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	0.0042	--(c)	9.10E-02	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	0.042	--(c)	5.40E-03	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.10E-02	1	--	
2-Butanone	78-93-3	VOC	0.0029	0.00096	--(c)	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	--	1	--	
Acetone	67-64-1	VOC	0.00128316	0.000512	--(c)	--	1	--	
Aluminum	7429-90-5	--	0.041755539	0.001	1.71E-09	--	1	--	
Arsenic	7440-38-2	--	0.003060574	0.001	1.25E-10	1.50E+00	1	1.88E-10	100
Barium	7440-39-3	--	0.068082679	0.001	2.79E-09	--	0.07	--	
Benzene	71-43-2	VOC	0.0019	0.015	--(c)	5.50E-02	1	--	
Benzyl alcohol	100-51-6	SVOC	0.0027	0.00209	--(c)	--	1	--	
Beryllium	7440-41-7	--	0.000360659	0.001	1.48E-11	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	1.84E-10	--	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00039	0.017	--(c)	--	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	9.821328	0.001	4.02E-07	--	1	--	
Chlorobenzene	108-90-7	VOC	0.00041	0.028	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.00022061	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.007505402	0.001	3.07E-10	--	0.013	--	
cis-1,2-Dichloroethylene	156-59-2	VOC	0.0002	0.0077	--(c)	--	1	--	
Copper	7440-50-8	--	0.002993571	0.001	1.23E-10	--	1	--	
Fluoride	16984-48-8	--	0.32861624	0.001	1.35E-08	--	1	--	
Iron	7439-89-6	--	0.47301923	0.001	1.94E-08	--	1	--	
Lead	7439-92-1	--	0.000710361	0.0001	2.91E-12	--	1	--	
Lithium	7439-93-2	--	0.0083	0.001	3.40E-10	--	1	--	
Manganese	7439-96-5	--	0.011254937	0.001	4.61E-10	--	0.04	--	
Methanol	67-56-1	--	1.1	0.00032	1.44E-08	--	1	--	
Methylene chloride	75-09-2	VOC	0.000852962	0.0035	--(c)	7.50E-03	1	--	
Molybdenum	7439-98-7	--	0.0015	0.001	6.14E-11	--	1	--	
Nickel	7440-02-0	--	0.003603478	0.0002	2.95E-11	--	0.04	--	
Nitrate	14797-55-8	--	23.756902	0.001	9.72E-07	--	1	--	
Nitrite	14797-65-0	--	0.079227256	0.001	3.24E-09	--	1	--	
o-Xylene	95-47-6	VOC	0.000210551	0.054	--(c)	--	1	--	
Silver	7440-22-4	--	0.005341496	0.0006	1.31E-10	--	0.04	--	
Strontium	7440-24-6	--	0.36357229	0.001	1.49E-08	--	1	--	
Sulfate	14808-79-8	--	45.069738	0.001	1.84E-06	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	0.033	--(c)	5.40E-01	1	--	
Toluene	108-88-3	VOC	0.000274725	0.031	--(c)	--	1	--	
Tributyl phosphate	126-73-8	SVOC	0.040836371	0.0228	--(c)	9.20E-03	1	--	
Trichloroethene	79-01-6	VOC	0.000492361	0.012	--(c)	8.90E-02	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	--	1	--	
Uranium	7440-61-1	--	0.01625113	0.001	6.65E-10	--	1	--	
Vanadium	7440-62-2	--	0.013487657	0.001	5.52E-10	--	1	--	
Vinyl chloride	75-01-4	VOC	0.0018	0.0056	--(c)	7.20E-01	1	--	
Zinc	7440-66-6	--	0.10896358	0.0006	2.68E-09	--	1	--	
Total ELCR								1.88E-10	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Dermal Absorption of volatiles is presented in table C-4

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

[e] for cis-1,2-dichloroethyelene the chemical-specific inputs are assummed to be the same as trans-1,2-dichloroethylene

[f] for (m+p) xylenes and o-xylene the chemical-specific inputs are assummed to be the same as m-xylene

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area -- CTUIR

Cancer risk from inhalation of volatile radioactive contaminants in sweat lodge vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr

[a] Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Carbon-14	14762-75-5	--	15.2	--(c)	7.07E-12	--	
Gross alpha	12587-46-1	--	5.9880167	--(c)	--	--	
Gross beta	12587-47-2	--	26.717649	--(c)	--	--	
Iodine-129	15046-84-1	--	1.7529182	--(c)	6.07E-11	--	
Nickel-63	13981-37-8	--	7.66125	--(c)	1.64E-12	--	
Protactinium-231	14331-85-2	--	0.308	--(c)	4.55E-08	--	
Strontium-90	10098-97-2	--	0.611	--(c)	1.05E-10	--	
Technetium-99	14133-76-7	--	75.671084	--(c)	1.41E-11	--	
Tritium	10028-17-8	Yes	497899.63	1.23E+10	5.62E-14	6.91E-04	100
Total ELCR						6.91E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of nonvolatile contaminants is presented in Table C-8

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area -- CTUIR

Cancer risk from inhalation of nonvolatile radioactive contaminants in sweathouse vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event[b]	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Carbon-14	14762-75-5	--	15.2	6.44E+04	7.07E-12	4.55E-07	0.70
Gross alpha	12587-46-1	--	5.9880167	2.54E+04	--	--	
Gross beta	12587-47-2	--	26.717649	1.13E+05	--	--	
Iodine-129	15046-84-1	--	1.7529182	7.43E+03	6.07E-11	4.51E-07	0.69
Nickel-63	13981-37-8	--	7.66125	3.25E+04	1.64E-12	5.32E-08	0.082
Protactinium-231	14331-85-2	--	0.308	1.30E+03	4.55E-08	5.94E-05	91
Strontium-90	10098-97-2	--	0.611	2.59E+03	1.05E-10	2.72E-07	0.42
Technetium-99	14133-76-7	--	75.671084	3.21E+05	1.41E-11	4.52E-06	6.9
Tritium	10028-17-8	Yes	497899.63	--(c)	5.62E-14	--	
Total ELCR						6.51E-05	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of volatile contaminants in presented in table C-7

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)*.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	HQ (Inhalation) (Volatiles) (unitless)	HQ (Inhalation) (Nonvolatiles) (unitless)	HQ (Dermal, Vapor, volatiles) (unitless)	HQ (Dermal, Liquid, Nonvolatiles) (unitless)	HQ (Dermal, Vapor, Nonvolatiles) (unitless)	Total HI (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--	--	--	--	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.6E-09	--	--	--	--	--	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--	--	--	--	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--	--	--	--	--	--	
1,2-Dichloroethane	0.00064	VOC	1.33E-05	--	3.30E-08	--	--	1.33E-05	2.88E-05
2,3,4,6-Tetrachlorophenol	0.0077	SVOC	--	--	4.47E-06	--	--	4.47E-06	9.70E-06
2-Methylphenol (cresol, o-)	0.0075	SVOC	6.22E-04	--	2.84E-07	1.49E-05	--	6.37E-04	0.0014
4-Nitrophenol	0.0072	SVOC	--	--	1.06E-06	2.96E-02	--	2.96E-02	0.064
Aluminum	0.11217909	--	--	1.91E-01	--	2.06E-03	3.38E-07	1.94E-01	0.42
Arsenic	0.005765062	--	--	3.28E+00	--	1.06E-01	1.74E-05	3.39E+00	7.3
Barium	0.052626075	--	--	8.98E-01	--	--	1.11E-07	8.98E-01	1.9
Beryllium	0.00034431	--	--	1.47E-01	--	3.54E-03	5.80E-07	1.50E-01	0.33
Bis(2-ethylhexyl) phthalate	0.011	SVOC	--	--	3.38E-06	--	--	3.38E-06	7.32E-06
Cadmium	0.018	--	--	1.54E+01	--	--	--	1.54E+01	33
Carbon tetrachloride	0.0018	VOC	4.71E-04	--	1.01E-05	--	--	4.81E-04	0.0010
Chloride	11.439962	--	--	--	--	1.51E-01	2.47E-05	1.51E-01	0.33
Chloroform	0.00038106	VOC	1.93E-04	--	6.36E-08	2.22E-03	--	2.41E-03	0.0052
Chromium	0.015609389	--	--	--	--	1.00E-04	1.64E-08	1.00E-04	2.18E-04
Cobalt	0.004378857	--	--	6.23E+00	--	7.51E-06	1.23E-09	6.23E+00	14
Copper	0.004482187	--	--	--	--	1.54E-02	2.52E-06	1.54E-02	0.033
Dinoseb(2-secButyl-4,6-dinitrophenol)	0.005506461	SVOC	--	--	2.20E-05	3.30E-05	--	5.50E-05	1.19E-04
Fluoride	0.31715504	--	--	2.08E-01	--	--	--	2.08E-01	0.45
Hexavalent Chromium	0.191	--	--	1.63E+01	--	1.02E-01	1.68E-05	1.64E+01	36
Iron	0.14355212	--	--	--	--	0.00E+00	--	--	
Lead	0.00142074	--	--	--	--	0.00E+00	--	--	
Manganese	0.009635007	--	--	1.64E+00	--	0.00E+00	--	1.64E+00	3.6
Nickel	0.010760715	--	--	1.02E+00	--	6.92E-04	1.13E-07	1.02E+00	2.2
Nitrate	31.205071	--	--	--	--	1.13E-03	1.85E-07	1.13E-03	0.0025
Nitrite	0.034429846	--	--	--	--	2.95E-05	4.84E-09	2.95E-05	6.40E-05
Nitrogen in Nitrite and Nitrate	14.7	--	--	--	--	2.36E-03	3.87E-07	2.36E-03	0.0051
Octachlorodibenzofuran	9.9649E-09	--	--	--	--	--	--	--	
Octachlorodibenzo-p-dioxin	5.6857E-09	--	--	--	--	--	--	--	
Silver	0.005650889	--	--	--	--	4.36E-03	7.14E-07	4.36E-03	0.0095
Strontium	0.26495344	--	--	--	--	1.14E-04	1.86E-08	1.14E-04	2.46E-04
Sulfate	56.164035	--	--	--	--	--	--	--	
Toluene	0.000065	VOC	6.47E-07	--	6.18E-09	--	--	6.53E-07	1.42E-06
Total petroleum hydrocarbons - gasoline range	0.05	--	--	--	--	--	--	--	
Trichloroethene	0.000570461	VOC	8.11E-04	--	--	--	--	8.11E-04	0.0018
Uranium	0.014879201	--	--	4.23E-01	--	1.28E-03	2.09E-07	4.25E-01	0.92
Vanadium	0.021937779	--	--	--	--	1.13E-03	1.85E-07	1.13E-03	0.0024
Zinc	0.092316084	--	--	--	--	4.75E-05	7.78E-09	4.75E-05	1.03E-04
Total			2.11E-03	45.70	4.14E-05	0.42	0.000	46.13	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.
Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
HQ = hazard quotient.
HI = hazard index.
SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal, Vapor, volatiles) (unitless)	Risk (Dermal, Liquid, Nonvolatiles) (unitless)	Risk (Dermal, Vapor, Nonvolatiles) (unitless)	Total Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--	1.18E-08	--	--	--	1.18E-08	9.40E-06
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.6E-09	--	--	1.76E-08	--	2.64E-06	4.32E-10	2.65E-06	0.0021
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--	9.14E-08	--	2.12E-05	3.47E-09	2.13E-05	0.017
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--	6.62E-08	--	1.53E-05	2.51E-09	1.54E-05	0.012
1,2-Dichloroethane	0.00064	VOC	8.04E-07	--	5.83E-11	--	--	8.04E-07	6.42E-04
2,3,4,6-Tetrachlorophenol	0.0077	SVOC	--	--	--	--	--	--	
2-Methylphenol (cresol, o-)	0.0075	SVOC	--	--	--	--	--	--	
4-Nitrophenol	0.0072	SVOC	--	--	--	--	--	--	
Aluminum	0.11217909	--	--	--	--	--	--	--	
Arsenic	0.005765062	--	--	2.06E-04	--	2.16E-06	3.54E-10	2.08E-04	0.17
Barium	0.052626075	--	--	--	--	--	--	--	
Beryllium	0.00034431	--	--	6.85E-06	--	--	--	6.85E-06	0.0055
Bis(2-ethylhexyl) phthalate	0.011	SVOC	1.28E-06	--	9.18E-10	--	--	1.28E-06	0.0010
Cadmium	0.018	--	--	0.00E+00	--	--	--	--	
Carbon tetrachloride	0.0018	VOC	1.30E-06	0.00E+00	8.93E-10	--	--	1.31E-06	0.0010
Chloride	11.439962	--	--	--	--	--	--	--	
Chloroform	0.00038106	VOC	4.23E-07	7.27E-08	1.92E-11	--	--	4.96E-07	3.96E-04
Chromium	0.015609389	--	--	--	--	--	--	--	
Cobalt	0.004378857	--	--	3.27E-04	--	--	--	3.27E-04	0.26
Copper	0.004482187	--	--	--	--	--	--	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)	0.005506461	SVOC	--	--	--	--	--	--	
Fluoride	0.31715504	--	--	--	--	--	--	--	
Hexavalent Chromium	0.191	--	--	1.25E-01	--	--	--	1.25E-01	100
Iron	0.14355212	--	--	--	--	--	--	--	
Lead	0.00142074	--	--	--	--	--	--	--	
Manganese	0.009635007	--	--	--	--	--	--	--	
Nickel	0.010760715	--	--	2.32E-05	--	--	--	2.32E-05	0.019
Nitrate	31.205071	--	--	--	--	--	--	--	
Nitrite	0.034429846	--	--	--	--	--	--	--	
Nitrogen in Nitrite and Nitrate	14.7	--	--	--	--	--	--	--	
Octachlorodibenzofuran	9.9649E-09	--	--	9.42E-10	--	2.55E-07	4.18E-11	2.56E-07	2.05E-04
Octachlorodibenzo-p-dioxin	5.6857E-09	--	--	5.37E-10	--	6.43E-08	1.05E-11	6.48E-08	5.18E-05
Silver	0.005650889	--	--	--	--	--	--	--	
Strontium	0.26495344	--	--	--	--	--	--	--	
Sulfate	56.164035	--	--	--	--	--	--	--	
Toluene	0.000065	VOC	--	--	--	--	--	--	
Total petroleum hydrocarbons - gasoline range	0.05	--	--	--	--	--	--	--	
Trichloroethene	0.000570461	VOC	6.89E-07	--	1.45E-10	--	--	6.89E-07	5.51E-04
Uranium	0.014879201	--	--	--	--	--	--	--	
Vanadium	0.021937779	--	--	--	--	--	--	--	
Zinc	0.092316084	--	--	--	--	--	--	--	
Total ELCR			4.50E-06	1.25E-01	2.03E-09	4.16E-05	6.82E-09	1.25E-01	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
ELCR = excess lifetime cancer risk.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (pCi/L)	Volatile?[a]	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	4.8703439	No	--	--	--	--	
Iodine-129	3.1689247	No	--	8.15E-07	--	8.15E-07	0.20
Plutonium-239/240	0.029	No	--	4.09E-06	--	4.09E-06	1.0
Protactinium-231	0.28	No	--	5.40E-05	--	5.40E-05	13
Strontium-90	4.5802399	No	--	2.04E-06	--	2.04E-06	0.49
Technetium-99	1567.7398	No	--	9.36E-05	--	9.36E-05	22
Tritium	192557.5	Yes	2.67E-04	--	--	2.67E-04	64
Total ELCR			2.67E-04	1.55E-04	--	4.17E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-field exposure area -- CTUIR

Hazard quotient and cancer risk from inhalation of VOCs/SVOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Contaminant concentration in water	C_{dw}	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF	365	day/yr

[a] Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(c)	--	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.6E-09	--(c)	--	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(c)	--	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(c)	--	--	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	9.09E-06	2.40E+00	6.86E-01	1.33E-05	0.63
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	1.09E-04	--	--	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	1.07E-04	6.00E-01	1.71E-01	6.22E-04	29
4-Nitrophenol	100-02-7	SVOC	0.0072	1.02E-04	--	--	--	
Aluminum	7429-90-5	--	0.11217909	--(c)	5.00E-03	1.43E-03	--	
Arsenic	7440-38-2	--	0.005765062	--(c)	1.50E-05	4.29E-06	--	
Barium	7440-39-3	--	0.052626075	--(c)	5.00E-04	1.43E-04	--	
Beryllium	7440-41-7	--	0.00034431	--(c)	2.00E-05	5.71E-06	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	1.56E-04	--	--	--	
Cadmium	7440-43-9	--	0.018	--(c)	1.00E-05	2.86E-06	--	
Carbon tetrachloride	56-23-5	VOC	0.0018	2.56E-05	1.90E-01	5.43E-02	4.71E-04	22
Chloride	16887-00-6	--	11.439962	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.00038106	5.41E-06	9.80E-02	2.80E-02	1.93E-04	9.2
Chromium	7440-47-3	--	0.015609389	--(c)	--	--	--	
Cobalt	7440-48-4	--	0.004378857	--(c)	6.00E-06	1.71E-06	--	
Copper	7440-50-8	--	0.004482187	--(c)	--	--	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	SVOC	0.005506461	7.82E-05	--	--	--	
Fluoride	16984-48-8	--	0.31715504	--(c)	1.30E-02	3.71E-03	--	
Hexavalent Chromium	18540-29-9	--	0.191	--(c)	1.00E-04	2.86E-05	--	
Iron	7439-89-6	--	0.14355212	--(c)	--	--	--	
Lead	7439-92-1	--	0.00142074	--(c)	--	--	--	
Manganese	7439-96-5	--	0.009635007	--(c)	5.00E-05	1.43E-05	--	
Nickel	7440-02-0	--	0.010760715	--(c)	9.00E-05	2.57E-05	--	
Nitrate	14797-55-8	--	31.205071	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.034429846	--(c)	--	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(c)	--	--	--	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(c)	--	--	--	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.6857E-09	--(c)	--	--	--	
Silver	7440-22-4	--	0.005650889	--(c)	--	--	--	
Strontium	7440-24-6	--	0.26495344	--(c)	--	--	--	

Sulfate	14808-79-8	--	56.164035	--(c)	--	--	--	
Toluene	108-88-3	VOC	0.000065	9.24E-07	5.00E+00	1.43E+00	6.47E-07	0.031
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	8.11E-06	3.50E-02	1.00E-02	8.11E-04	38
Uranium	7440-61-1	--	0.014879201	--(c)	3.00E-04	8.57E-05	--	
Vanadium	7440-62-2	--	0.021937779	--(c)	--	--	--	
Zinc	7440-66-6	--	0.092316084	--(c)	--	--	--	
Total							2.11E-03	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of nonvolatile chemicals is presented in Table C-11

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(c)	3.80E-01	1.33E+03	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.6E-09	--(c)	3.80E-01	1.33E+03	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(c)	3.80E+00	1.33E+04	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(c)	3.80E+00	1.33E+04	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	8.83E-06	2.60E-05	9.10E-02	8.04E-07	18
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	1.06E-04	--	--	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	1.04E-04	--	--	--	
4-Nitrophenol	100-02-7	SVOC	0.0072	9.94E-05	--	--	--	
Aluminum	7429-90-5	--	0.11217909	--(c)	--	--	--	
Arsenic	7440-38-2	--	0.005765062	--(c)	4.30E-03	1.51E+01	--	
Barium	7440-39-3	--	0.052626075	--(c)	--	--	--	
Beryllium	7440-41-7	--	0.00034431	--(c)	2.40E-03	8.40E+00	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	1.52E-04	2.40E-06	8.40E-03	1.28E-06	28
Cadmium	7440-43-9	--	0.018	--(c)	1.80E-03	6.30E+00	--	
Carbon tetrachloride	56-23-5	VOC	0.0018	2.48E-05	1.50E-05	5.25E-02	1.30E-06	29
Chloride	16887-00-6	--	11.439962	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.00038106	5.26E-06	2.30E-05	8.05E-02	4.23E-07	9.4
Chromium	7440-47-3	--	0.015609389	--(c)	--	--	--	
Cobalt	7440-48-4	--	0.004378857	--(c)	9.00E-03	3.15E+01	--	
Copper	7440-50-8	--	0.004482187	--(c)	--	--	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	SVOC	0.005506461	7.60E-05	--	--	--	
Fluoride	16984-48-8	--	0.31715504	--(c)	--	--	--	
Hexavalent Chromium	18540-29-9	--	0.191	--(c)	8.40E-02	2.94E+02	--	
Iron	7439-89-6	--	0.14355212	--(c)	--	--	--	
Lead	7439-92-1	--	0.00142074	--(c)	--	--	--	
Manganese	7439-96-5	--	0.009635007	--(c)	--	--	--	
Nickel	7440-02-0	--	0.010760715	--(c)	2.60E-04	9.10E-01	--	
Nitrate	14797-55-8	--	31.205071	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.034429846	--(c)	--	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(c)	--	--	--	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(c)	1.14E-02	3.99E+01	--	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.6857E-09	--(c)	1.14E-02	3.99E+01	--	
Silver	7440-22-4	--	0.005650889	--(c)	--	--	--	
Strontium	7440-24-6	--	0.26495344	--(c)	--	--	--	
Sulfate	14808-79-8	--	56.164035	--(c)	--	--	--	
Toluene	108-88-3	VOC	0.000065	8.97E-07	--	--	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	7.87E-06	2.50E-05	8.75E-02	6.89E-07	15
Uranium	7440-61-1	--	0.014879201	--(c)	--	--	--	
Vanadium	7440-62-2	--	0.021937779	--(c)	--	--	--	
Zinc	7440-66-6	--	0.092316084	--(c)	--	--	--	
Total ELCR							4.50E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of nonvolatile chemicals is presented in Table C-11

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-field exposure area -- CTUIR

Hazard quotient and cancer risk from inhalation of non-VOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 2)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion Factor	CF	365	day/yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L

[a] Harris (2008)

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,I}$(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	9.10E-12	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.6E-09	1.37E-11	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	7.07E-12	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	5.12E-12	--	--	--
1,2-Dichloroethane	107-06-2	VOC	0.00064	--(c)	2.40E+00	6.86E-01	--
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	--(c)	--	--	--
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	--(c)	6.00E-01	1.71E-01	--
4-Nitrophenol	100-02-7	SVOC	0.0072	--(c)	--	--	--
Aluminum	7429-90-5	--	0.11217909	2.74E-04	5.00E-03	1.43E-03	1.91E-01
Arsenic	7440-38-2	--	0.005765062	1.41E-05	1.50E-05	4.29E-06	3.28E+00
Barium	7440-39-3	--	0.052626075	1.28E-04	5.00E-04	1.43E-04	8.98E-01
Beryllium	7440-41-7	--	0.00034431	8.40E-07	2.00E-05	5.71E-06	1.47E-01
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	--(c)	--	--	--
Cadmium	7440-43-9	--	0.018	4.39E-05	1.00E-05	2.86E-06	1.54E+01
Carbon tetrachloride	56-23-5	VOC	0.0018	--(c)	1.90E-01	5.43E-02	--
Chloride	16887-00-6	--	11.439962	2.79E-02	--	--	--
Chloroform	67-66-3	VOC	0.00038106	--(c)	9.80E-02	2.80E-02	--
Chromium	7440-47-3	--	0.015609389	3.81E-05	--	--	--
Cobalt	7440-48-4	--	0.004378857	1.07E-05	6.00E-06	1.71E-06	6.23E+00
Copper	7440-50-8	--	0.004482187	1.09E-05	--	--	--
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	SVOC	0.005506461	--(c)	--	--	--
Fluoride	16984-48-8	--	0.31715504	7.73E-04	1.30E-02	3.71E-03	2.08E-01
Hexavalent Chromium	18540-29-9	--	0.191	4.66E-04	1.00E-04	2.86E-05	1.63E+01
Iron	7439-89-6	--	0.14355212	3.50E-04	--	--	--
Lead	7439-92-1	--	0.00142074	3.46E-06	--	--	--
Manganese	7439-96-5	--	0.009635007	2.35E-05	5.00E-05	1.43E-05	1.64E+00
Nickel	7440-02-0	--	0.010760715	2.62E-05	9.00E-05	2.57E-05	1.02E+00
Nitrate	14797-55-8	--	31.205071	7.61E-02	--	--	--
Nitrite	14797-65-0	--	0.034429846	8.40E-05	--	--	--
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	3.58E-02	--	--	--
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	2.43E-11	--	--	--
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.6857E-09	1.39E-11	--	--	--
Silver	7440-22-4	--	0.005650889	1.38E-05	--	--	--
Strontium	7440-24-6	--	0.26495344	6.46E-04	--	--	--
Sulfate	14808-79-8	--	56.164035	1.37E-01	--	--	--
Toluene	108-88-3	VOC	0.000065	--(c)	5.00E+00	1.43E+00	--
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	1.22E-04	--	--	--
Trichloroethene	79-01-6	VOC	0.000570461	--(c)	3.50E-02	1.00E-02	--
Uranium	7440-61-1	--	0.014879201	3.63E-05	3.00E-04	8.57E-05	4.23E-01
Vanadium	7440-62-2	--	0.021937779	5.35E-05	--	--	--
Zinc	7440-66-6	--	0.092316084	2.25E-04	--	--	--
Total							45.7

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1

[c] Inhalation of volatile compounds in vapor is presented in Table C-10

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	8.84E-12	3.80E-01	1.33E+03	1.18E-08
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.6E-09	1.33E-11	3.80E-01	1.33E+03	1.76E-08
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	6.87E-12	3.80E+00	1.33E+04	9.14E-08
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	4.97E-12	3.80E+00	1.33E+04	6.62E-08
1,2-Dichloroethane	107-06-2	VOC	0.00064	--(c)	2.60E-05	9.10E-02	--
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	--(c)	--	--	--
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	1.78E-05	--	--	--
4-Nitrophenol	100-02-7	SVOC	0.0072	1.71E-05	--	--	--
Aluminum	7429-90-5	--	0.11217909	2.66E-04	--	--	--
Arsenic	7440-38-2	--	0.005765062	1.37E-05	4.30E-03	1.51E+01	2.06E-04
Barium	7440-39-3	--	0.052626075	--(c)	--	--	--
Beryllium	7440-41-7	--	0.00034431	8.16E-07	2.40E-03	8.40E+00	6.85E-06
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	--(c)	2.40E-06	8.40E-03	--
Cadmium	7440-43-9	--	0.018		1.80E-03	6.30E+00	0.00E+00
Carbon tetrachloride	56-23-5	VOC	0.0018		1.50E-05	5.25E-02	0.00E+00
Chloride	16887-00-6	--	11.439962		--	--	--
Chloroform	67-66-3	VOC	0.00038106	9.03E-07	2.30E-05	8.05E-02	7.27E-08
Chromium	7440-47-3	--	0.015609389	--(c)	--	--	--
Cobalt	7440-48-4	--	0.004378857	1.04E-05	9.00E-03	3.15E+01	3.27E-04
Copper	7440-50-8	--	0.004482187	1.06E-05	--	--	--
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	SVOC	0.005506461	1.30E-05	--	--	--
Fluoride	16984-48-8	--	0.31715504	7.51E-04	--	--	--
Hexavalent Chromium	18540-29-9	--	0.191	4.52E-04	8.40E-02	2.94E+02	1.25E-01
Iron	7439-89-6	--	0.14355212	3.40E-04	--	--	--
Lead	7439-92-1	--	0.00142074	3.37E-06	--	--	--
Manganese	7439-96-5	--	0.009635007	2.28E-05	--	--	--
Nickel	7440-02-0	--	0.010760715	2.55E-05	2.60E-04	9.10E-01	2.32E-05
Nitrate	14797-55-8	--	31.205071	7.39E-02	--	--	--
Nitrite	14797-65-0	--	0.034429846	8.16E-05	--	--	--
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	3.48E-02	--	--	--
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	2.36E-11	1.14E-02	3.99E+01	9.42E-10
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.6857E-09	1.35E-11	1.14E-02	3.99E+01	5.37E-10
Silver	7440-22-4	--	0.005650889	1.34E-05	--	--	--
Strontium	7440-24-6	--	0.26495344	6.28E-04	--	--	--
Sulfate	14808-79-8	--	56.164035	1.33E-01	--	--	--
Toluene	108-88-3	VOC	0.000065	--(c)	--	--	--
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	1.18E-04	--	--	--
Trichloroethene	79-01-6	VOC	0.000570461	--(c)	2.50E-05	8.75E-02	--
Uranium	7440-61-1	--	0.014879201	3.52E-05	--	--	--
Vanadium	7440-62-2	--	0.021937779	5.20E-05	--	--	--
Zinc	7440-66-6	--	0.092316084	2.19E-04	--	--	--
Total ELCR							1.25E-01

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (u

[c] Inhalation of volatile compounds in vapor is presented in Table C-10

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

% Contribution
0.42
7.2
2.0
0.32
34
14
0.46
36
3.6
2.2
0.93
100

/70 (kg).

% Contribution
9.40E-06
1.41E-05
7.30E-05
5.29E-05
0.16
0.0055
0
0
5.81E-05
0.26
100
0.019
7.53E-07
4.30E-07
100

ug/mg).

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-field exposure area -- CTUIR

Hazard quotient and cancer risk from dermal exposure to VOCs/SVOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water (*Id,l*)
can be neglected and total dermal intake (*Id,total*) is equal to dermal intake from VOCs/SVOCs in sweat lodge vapor (*Id,v*)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 3)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF1	0.01	m/cm
Conversion factor	CF2	365	day/yr

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin[d]	35822-46-9	--	3.734E-09	--	--(c)	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.6E-09	1.45	--(c)	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	--(c)	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	--(c)	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	6.60E-10	2.00E-02	1	3.30E-08	0.080
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	1.34E-07	3.00E-02	1	4.47E-06	11
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	0.0077	1.42E-08	5.00E-02	1	2.84E-07	0.68
4-Nitrophenol	100-02-7	SVOC	0.0072	0.0048	8.49E-09	8.00E-03	1	1.06E-06	2.6
Aluminum	7429-90-5	--	0.11217909	0.001	--(c)	1.00E+00	1	--	
Arsenic	7440-38-2	--	0.005765062	0.001	--(c)	3.00E-04	1	--	
Barium	7440-39-3	--	0.052626075	0.001	--(c)	2.00E-01	0.07	--	
Beryllium	7440-41-7	--	0.00034431	0.001	--(c)	2.00E-03	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	6.75E-08	2.00E-02	1	3.38E-06	8.1
Cadmium	7440-43-9	--	0.018	0.001	--(c)	5.00E-04	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.0018	0.016	7.07E-09	7.00E-04	1	1.01E-05	24
Chloride	16887-00-6	--	11.439962	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	6.36E-10	1.00E-02	1	6.36E-08	0.15
Chromium	7440-47-3	--	0.015609389	0.001	--(c)	1.50E+00	0.013	--	
Cobalt	7440-48-4	--	0.004378857	0.0004	--(c)	3.00E-04	1	--	
Copper	7440-50-8	--	0.004482187	0.001	--(c)	4.00E-02	1	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)[d]	88-85-7	SVOC	0.005506461	0.0163	2.20E-08	1.00E-03	1	2.20E-05	53
Fluoride	16984-48-8	--	0.31715504	0.001	--(c)	6.00E-02	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	--(c)	3.00E-03	0.025	--	
Iron	7439-89-6	--	0.14355212	0.001	--(c)	7.00E-01	1	--	
Lead	7439-92-1	--	0.00142074	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.009635007	0.001	--(c)	2.40E-02	0.04	--	
Nickel	7440-02-0	--	0.010760715	0.0002	--(c)	2.00E-02	0.04	--	
Nitrate	14797-55-8	--	31.205071	0.001	--(c)	7.10E+00	1	--	
Nitrite	14797-65-0	--	0.034429846	0.001	--(c)	3.00E-01	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	--(c)	1.60E+00	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	--(c)	--	1	--	
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.6857E-09	1.16	--(c)	--	1	--	
Silver	7440-22-4	--	0.005650889	0.0006	--(c)	5.00E-03	0.04	--	

Strontium	7440-24-6	--	0.26495344	0.001	--(c)	6.00E-01	1	--	
Sulfate	14808-79-8	--	56.164035	0.001	--(c)	--	--	--	
Toluene	108-88-3	VOC	0.000065	0.031	4.95E-10	8.00E-02	1	6.18E-09	0.015
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	0.012	1.68E-09	--	1	--	
Uranium	7440-61-1	--	0.014879201	0.001	--(c)	3.00E-03	1	--	
Vanadium	7440-62-2	--	0.021937779	0.001	--(c)	5.00E-03	1	--	
Zinc	7440-66-6	--	0.092316084	0.0006	--(c)	3.00E-01	1	--	
Total								4.14E-05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table C-14

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{ow} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] $(mg/kg\text{-}day)^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin[d]	35822-46-9	--	3.734E-09	--	--(c)	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.6E-09	1.45	--(c)	1.30E+03	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	--(c)	1.30E+04	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	--(c)	1.30E+04	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	6.41E-10	9.10E-02	1	5.83E-11	2.9
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	1.30E-07	--	1	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	0.0077	1.38E-08	--	1	--	
4-Nitrophenol	100-02-7	SVOC	0.0072	0.0048	8.24E-09	--	1	--	
Aluminum	7429-90-5	--	0.11217909	0.001	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.005765062	0.001	--(c)	1.50E+00	1	--	
Barium	7440-39-3	--	0.052626075	0.001	--(c)	--	0.07	--	
Beryllium	7440-41-7	--	0.00034431	0.001	--(c)	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	6.56E-08	1.40E-02	1	9.18E-10	45
Cadmium	7440-43-9	--	0.018	0.001	--(c)	--	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.0018	0.016	6.87E-09	1.30E-01	1	8.93E-10	44
Chloride	16887-00-6	--	11.439962	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	6.18E-10	3.10E-02	1	1.92E-11	0.94
Chromium	7440-47-3	--	0.015609389	0.001	--(c)	--	0.013	--	
Cobalt	7440-48-4	--	0.004378857	0.0004	--(c)	--	1	--	
Copper	7440-50-8	--	0.004482187	0.001	--(c)	--	1	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)[a]	88-85-7	SVOC	0.005506461	0.0163	2.14E-08	--	1	--	
Fluoride	16984-48-8	--	0.31715504	0.001	--(c)	--	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	--(c)	--	0.025	--	
Iron	7439-89-6	--	0.14355212	0.001	--(c)	--	1	--	
Lead	7439-92-1	--	0.00142074	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.009635007	0.001	--(c)	--	0.04	--	
Nickel	7440-02-0	--	0.010760715	0.0002	--(c)	--	0.04	--	
Nitrate	14797-55-8	--	31.205071	0.001	--(c)	--	1	--	
Nitrite	14797-65-0	--	0.034429846	0.001	--(c)	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	--(c)	--	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	--(c)	3.90E+01	1	--	
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.6857E-09	1.16	--(c)	3.90E+01	1	--	
Silver	7440-22-4	--	0.005650889	0.0006	--(c)	--	0.04	--	
Strontium	7440-24-6	--	0.26495344	0.001	--(c)	--	1	--	
Sulfate	14808-79-8	--	56.164035	0.001	--(c)	--	--	--	
Toluene	108-88-3	VOC	0.000065	0.031	4.81E-10	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	0.012	1.63E-09	8.90E-02	1	1.45E-10	7.1
Uranium	7440-61-1	--	0.014879201	0.001	--(c)	--	1	--	
Vanadium	7440-62-2	--	0.021937779	0.001	--(c)	--	1	--	
Zinc	7440-66-6	--	0.092316084	0.0006	--(c)	--	1	--	
Total ELCR								2.03E-09	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table C-14

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways .*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-field exposure area -- CTUIR

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge condensed water

Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4)
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
Model assumes concentration of nonvolatiles in condensed water is equal to concentration in water used to create steam

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from liquid	$I_{d,l}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF2	365	day/yr
Conversion factor	CF3	10	L/m^2 cm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,l}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin[d]	35822-46-9	--	3.734E-09	--	--	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.6E-09	1.45	2.09E-09	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	1.68E-09	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	1.22E-09	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	2.00E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	3.00E-02	1	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	0.0077	1.49E-05	1.00E+00	1	1.49E-05	3.51E-03
4-Nitrophenol	100-02-7	SVOC	0.0072	0.0048	8.89E-06	3.00E-04	1	2.96E-02	7.00
Aluminum	7429-90-5	--	0.11217909	0.001	2.88E-05	2.00E-01	0.07	2.06E-03	0.487
Arsenic	7440-38-2	--	0.005765062	0.001	1.48E-06	2.00E-03	0.007	1.06E-01	25.02
Barium	7440-39-3	--	0.052626075	0.001	--(c)	2.00E-02	1	--	
Beryllium	7440-41-7	--	0.00034431	0.001	8.85E-08	5.00E-04	0.05	3.54E-03	0.8
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	7.00E-04	1	--	
Cadmium	7440-43-9	--	0.018	0.001	4.63E-06	--	1	--	
Carbon tetrachloride	56-23-5	VOC	0.0018	0.016	--(c)	1.00E-02	1	--	
Chloride	16887-00-6	--	11.439962	0.001	2.94E-03	1.50E+00	0.013	1.51E-01	35.649
Chloroform	67-66-3	VOC	0.00038106	0.0068	6.66E-07	3.00E-04	1	2.22E-03	0.52
Chromium	7440-47-3	--	0.015609389	0.001	4.01E-06	4.00E-02	1	1.00E-04	0.0237
Cobalt	7440-48-4	--	0.004378857	0.0004	4.50E-07	6.00E-02	1	7.51E-06	0.002
Copper	7440-50-8	--	0.004482187	0.001	1.15E-06	3.00E-03	0.025	1.54E-02	4
Dinoseb(2-secButyl-4,6-dinitrophenol)[d]	88-85-7	SVOC	0.005506461	0.0163	2.31E-05	7.00E-01	1	3.30E-05	0.0078
Fluoride	16984-48-8	--	0.31715504	0.001	8.16E-05	--	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	9.82E-05	2.40E-02	0.04	1.02E-01	24.18
Iron	7439-89-6	--	0.14355212	0.001	3.69E-05				
Lead	7439-92-1	--	0.00142074	0.0001	3.65E-08				
Manganese	7439-96-5	--	0.009635007	0.001	2.48E-06				
Nickel	7440-02-0	--	0.010760715	0.0002	5.53E-07	2.00E-02	0.04	6.92E-04	0.163
Nitrate	14797-55-8	--	31.205071	0.001	8.02E-03	7.10E+00	1	1.13E-03	0.267
Nitrite	14797-65-0	--	0.034429846	0.001	8.85E-06	3.00E-01	1	2.95E-05	0.0070
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	3.78E-03	1.60E+00	1	2.36E-03	0.56
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	6.74E-09	--	1	--	
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.6857E-09	1.16	1.70E-09	--	1	--	
Silver	7440-22-4	--	0.005650889	0.0006	8.72E-07	5.00E-03	0.04	4.36E-03	1.03
Strontium	7440-24-6	--	0.26495344	0.001	6.81E-05	6.00E-01	1	1.14E-04	0.0268

Sulfate	14808-79-8	--	56.164035	0.001	1.44E-02	--	--	--	
Toluene	108-88-3	VOC	0.000065	0.031	--(c)	8.00E-02	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	0.012	--(c)	--	1	--	
Uranium	7440-61-1	--	0.014879201	0.001	3.83E-06	3.00E-03	1	1.28E-03	0.30
Vanadium	7440-62-2	--	0.021937779	0.001	5.64E-06	5.00E-03	1	1.13E-03	0.267
Zinc	7440-66-6	--	0.092316084	0.0006	1.42E-05	3.00E-01	1	4.75E-05	0.0112
Total								0.42	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

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COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,i}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin[d]	35822-46-9	--	3.734E-09	--	--	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.6E-09	1.45	2.03E-09	1.30E+03	1	2.64E-06	6.3
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	1.63E-09	1.30E+04	1	2.12E-05	51
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	1.18E-09	1.30E+04	1	1.53E-05	37
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	9.10E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	--	1	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	0.0077	--(c)	--	1	--	
4-Nitrophenol	100-02-7	SVOC	0.0072	0.0048	--(c)	--	1	--	
Aluminum	7429-90-5	--	0.11217909	0.001	2.80E-05	--	1	--	
Arsenic	7440-38-2	--	0.005765062	0.001	1.44E-06	1.50E+00	1	2.16E-06	5.2
Barium	7440-39-3	--	0.052626075	0.001	1.31E-05	--	0.07	--	
Beryllium	7440-41-7	--	0.00034431	0.001	8.60E-08	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.018	0.001	4.50E-06	--	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.0018	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	11.439962	0.001	2.86E-03	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.015609389	0.001	3.90E-06	--	0.013	--	
Cobalt	7440-48-4	--	0.004378857	0.0004	4.38E-07	--	1	--	
Copper	7440-50-8	--	0.004482187	0.001	1.12E-06	--	1	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)[d]	88-85-7	SVOC	0.005506461	0.0163	--(c)	--	1	--	
Fluoride	16984-48-8	--	0.31715504	0.001	7.92E-05	--	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	9.54E-05	--	0.025	--	
Iron	7439-89-6	--	0.14355212	0.001	3.59E-05	--	1	--	
Lead	7439-92-1	--	0.00142074	0.0001	3.55E-08	--	1	--	
Manganese	7439-96-5	--	0.009635007	0.001	2.41E-06	--	0.04	--	
Nickel	7440-02-0	--	0.010760715	0.0002	5.38E-07	--	0.04	--	
Nitrate	14797-55-8	--	31.205071	0.001	7.79E-03	--	1	--	
Nitrite	14797-65-0	--	0.034429846	0.001	8.60E-06	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	3.67E-03	--	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	6.55E-09	3.90E+01	1	2.55E-07	0.61
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.6857E-09	1.16	1.65E-09	3.90E+01	1	6.43E-08	0.15
Silver	7440-22-4	--	0.005650889	0.0006	8.47E-07	--	0.04	--	
Strontium	7440-24-6	--	0.26495344	0.001	6.62E-05	--	1	--	
Sulfate	14808-79-8	--	56.164035	0.001	1.40E-02	--	--	--	
Toluene	108-88-3	VOC	0.000065	0.031	--(c)	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	0.012	--(c)	8.90E-02	1	--	
Uranium	7440-61-1	--	0.014879201	0.001	3.72E-06	--	1	--	
Vanadium	7440-62-2	--	0.021937779	0.001	5.48E-06	--	1	--	
Zinc	7440-66-6	--	0.092316084	0.0006	1.38E-05	--	1	--	
Total ELCR								4.16E-05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-field exposure area -- CTUIR

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/day
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Ideal gas law constant	R	62.37	(mmHg-L)/(gmole-K)
Temperature of the sweat lodge	T	338.7	K
Density of liquid water	rhow	1000	g/L
Conversion factor	CF_2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin[d]	35822-46-9	--	3.734E-09	--	--	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.6E-09	1.45	3.42E-13	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	2.75E-13	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	1.99E-13	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	2.00E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	3.00E-02	1	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	0.0077	--(c)	1.00E+00	1	--	
4-Nitrophenol	100-02-7	SVOC	0.0072	0.0048	--(c)	3.00E-04	1	--	
Aluminum	7429-90-5	--	0.11217909	0.001	4.73E-09	2.00E-01	0.07	3.38E-07	0.53
Arsenic	7440-38-2	--	0.005765062	0.001	2.43E-10	2.00E-03	0.007	1.74E-05	27
Barium	7440-39-3	--	0.052626075	0.001	2.22E-09	2.00E-02	1	1.11E-07	0.17
Beryllium	7440-41-7	--	0.00034431	0.001	1.45E-11	5.00E-04	0.05	5.80E-07	0.90
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	7.00E-04	1	--	
Cadmium	7440-43-9	--	0.018	0.001	7.58E-10	--	1	--	
Carbon tetrachloride	56-23-5	VOC	0.0018	0.016	--(c)	1.00E-02	1	--	
Chloride	16887-00-6	--	11.439962	0.001	4.82E-07	1.50E+00	0.013	2.47E-05	38
Chloroform	67-66-3	VOC	0.00038106	0.0068	--(c)	3.00E-04	1	--	
Chromium	7440-47-3	--	0.015609389	0.001	6.58E-10	4.00E-02	1	1.64E-08	0.026
Cobalt	7440-48-4	--	0.004378857	0.0004	7.38E-11	6.00E-02	1	1.23E-09	0.0019
Copper	7440-50-8	--	0.004482187	0.001	1.89E-10	3.00E-03	0.025	2.52E-06	3.9
Dinoseb(2-secButyl-4,6-dinitrophenol)[d]	88-85-7	SVOC	0.005506461	0.0163	--(c)	7.00E-01	1	--	
Fluoride	16984-48-8	--	0.31715504	0.001	1.34E-08	--	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	1.61E-08	2.40E-02	0.04	1.68E-05	26
Iron	7439-89-6	--	0.14355212	0.001	6.05E-09			--	
Lead	7439-92-1	--	0.00142074	0.0001	5.99E-12			--	
Manganese	7439-96-5	--	0.009635007	0.001	4.06E-10			--	
Nickel	7440-02-0	--	0.010760715	0.0002	9.07E-11	2.00E-02	0.04	1.13E-07	0.18
Nitrate	14797-55-8	--	31.205071	0.001	1.31E-06	7.10E+00	1	1.85E-07	0.29
Nitrite	14797-65-0	--	0.034429846	0.001	1.45E-09	3.00E-01	1	4.84E-09	0.0075
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	6.19E-07	1.60E+00	1	3.87E-07	0.60
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	1.10E-12	--	1	--	
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.6857E-09	1.16	2.78E-13	--	1	--	
Silver	7440-22-4	--	0.005650889	0.0006	1.43E-10	5.00E-03	0.04	7.14E-07	1.1
Strontium	7440-24-6	--	0.26495344	0.001	1.12E-08	6.00E-01	1	1.86E-08	0.029
Sulfate	14808-79-8	--	56.164035	0.001	2.37E-06	--	--	--	
Toluene	108-88-3	VOC	0.000065	0.031	--(c)	8.00E-02	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	0.012	--(c)	--	1	--	
Uranium	7440-61-1	--	0.014879201	0.001	6.27E-10	3.00E-03	1	2.09E-07	0.33
Vanadium	7440-62-2	--	0.021937779	0.001	9.24E-10	5.00E-03	1	1.85E-07	0.29
Zinc	7440-66-6	--	0.092316084	0.0006	2.33E-09	3.00E-01	1	7.78E-09	0.012
Total								6.423E-05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin[d]	35822-46-9	--	3.734E-09	--	--	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.6E-09	1.45	3.32E-13	1.30E+03	1	4.32E-10	6.3
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	2.67E-13	1.30E+04	1	3.47E-09	51
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	1.93E-13	1.30E+04	1	2.51E-09	37
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	9.10E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	--	1	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	0.0077	--(c)	--	1	--	
4-Nitrophenol	100-02-7	SVOC	0.0072	0.0048	--(c)	--	1	--	
Aluminum	7429-90-5	--	0.11217909	0.001	4.59E-09	--	1	--	
Arsenic	7440-38-2	--	0.005765062	0.001	2.36E-10	1.50E+00	1	3.54E-10	5.2
Barium	7440-39-3	--	0.052626075	0.001	2.15E-09	--	0.07	--	
Beryllium	7440-41-7	--	0.00034431	0.001	1.41E-11	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.018	0.001	7.37E-10	--	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.0018	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	11.439962	0.001	4.68E-07	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.015609389	0.001	6.39E-10	--	0.013	--	
Cobalt	7440-48-4	--	0.004378857	0.0004	7.17E-11	--	1	--	
Copper	7440-50-8	--	0.004482187	0.001	1.83E-10	--	1	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)[d]	88-85-7	SVOC	0.005506461	0.0163	--(c)	--	1	--	
Fluoride	16984-48-8	--	0.31715504	0.001	1.30E-08	--	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	1.56E-08	--	0.025	--	
Iron	7439-89-6	--	0.14355212	0.001	5.88E-09	--	1	--	
Lead	7439-92-1	--	0.00142074	0.0001	5.82E-12	--	1	--	
Manganese	7439-96-5	--	0.009635007	0.001	3.94E-10	--	0.04	--	
Nickel	7440-02-0	--	0.010760715	0.0002	8.81E-11	--	0.04	--	
Nitrate	14797-55-8	--	31.205071	0.001	1.28E-06	--	1	--	
Nitrite	14797-65-0	--	0.034429846	0.001	1.41E-09	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	6.02E-07	--	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	1.07E-12	3.90E+01	1	4.18E-11	0.61
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.6857E-09	1.16	2.70E-13	3.90E+01	1	1.05E-11	0.15
Silver	7440-22-4	--	0.005650889	0.0006	1.39E-10	--	0.04	--	
Strontium	7440-24-6	--	0.26495344	0.001	1.08E-08	--	1	--	
Sulfate	14808-79-8	--	56.164035	0.001	2.30E-06	--	--	--	
Toluene	108-88-3	VOC	0.000065	0.031	--(c)	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	0.012	--(c)	8.90E-02	1	--	
Uranium	7440-61-1	--	0.014879201	0.001	6.09E-10	--	1	--	
Vanadium	7440-62-2	--	0.021937779	0.001	8.98E-10	--	1	--	
Zinc	7440-66-6	--	0.092316084	0.0006	2.27E-09	--	1	--	
Total ELCR								6.82E-09	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-field exposure area -- CTUIR

Cancer risk from inhalation of volatile radioactive contaminants in sweat lodge vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr

[a] Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	4.8703439	--(c)	--	--	
Iodine-129	15046-84-1	--	3.1689247	--(c)	6.07E-11	--	
Plutonium-239/240	PU-239/240	--	0.029	--(c)	3.33E-08	--	
Protactinium-231	14331-85-2	--	0.28	--(c)	4.55E-08	--	
Strontium-90	10098-97-2	--	4.5802399	--(c)	1.05E-10	--	
Technetium-99	14133-76-7	--	1567.7398	--(c)	1.41E-11	--	
Tritium	10028-17-8	Yes	192557.5	4.75E+09	5.62E-14	2.67E-04	100
Total ELCR						2.67E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of nonvolatile contaminants is presented in Table C-16

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)*.
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-field exposure area -- CTUIR

Cancer risk from inhalation of nonvolatile radioactive contaminants in sweathouse vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event[b]	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)
Gross alpha	12587-46-1	--	4.8703439	2.06E+04	--	--
Iodine-129	15046-84-1	--	3.1689247	1.34E+04	6.07E-11	8.15E-07
Plutonium-239/240	PU-239/240	--	0.029	1.23E+02	3.33E-08	4.09E-06
Protactinium-231	14331-85-2	--	0.28	1.19E+03	4.55E-08	5.40E-05
Strontium-90	10098-97-2	--	4.5802399	1.94E+04	1.05E-10	2.04E-06
Technetium-99	14133-76-7	--	1567.7398	6.64E+06	1.41E-11	9.36E-05
Tritium	10028-17-8	Yes	192557.5	--(c)	5.62E-14	--
Total ELCR						1.55E-04

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.l

[c] Inhalation of volatile contaminants is presented in Table C-15

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

% Contribution
0.53
2.6
35
1.3
61
100

html

200-PO-1 Groundwater Operable Unit River Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	HQ (Inhalation) (Volatiles) (unitless)	HQ (Inhalation) (Nonvolatiles) (unitless)	HQ (Dermal, Vapor, volatiles) (unitless)	HQ (Dermal, Liquid, Nonvolatiles) (unitless)	HQ (Dermal, Vapor, Nonvolatiles) (unitless)	Total HI (unitless)	% Contribution
Acetone	0.0011	VOC	1.76E-06	--	1.54E-10	--	--	1.76E-06	1.47E-05
Arsenic	0.005767892	--	--	3.3	--	0.0049	8.10E-07	3.29E+00	27
Barium	0.049451657	--	--	0.8	--	0.0009	1.49E-07	8.45E-01	7.0
Carbon tetrachloride	0.00028	VOC	7.33E-05	--	1.57E-06	--	--	7.49E-05	6.25E-04
Chloride	12.545114	--	--	--	--	--	--	--	
Chloroform	0.0023	VOC	1.17E-03	--	3.84E-07	--	--	1.17E-03	0.0097
Chromium	0.0141	--	--	--	--	0.0002	3.05E-08	1.86E-04	0.0016
Copper	0.00597989	--	--	--	--	0.0000	6.30E-09	3.84E-05	3.21E-04
Fluoride	0.30621978	--	--	0.2	--	0.0013	2.15E-07	2.02E-01	1.7
Iron	0.61057915	--	--	--	--	0.0002	3.68E-08	2.24E-04	0.0019
Lead	0.000663667	--	--	--	--	--	--	--	
Manganese	0.040717647	--	--	6.9	--	0.0109	1.79E-06	6.96E+00	58
Nickel	0.0056	--	--	0.5	--	0.0004	5.90E-08	5.31E-01	4.4
Nitrate	28.952	--	--	--	--	0.0010	1.72E-07	1.05E-03	0.0087
Nitrite	0.46	--	--	--	--	0.0004	6.46E-08	3.94E-04	0.0033
Strontium	0.38963943	--	--	--	--	0.0002	2.74E-08	1.67E-04	0.0014
Sulfate	41.899078	--	--	--	--	--	--	--	
Thallium	0.00037	--	--	--	--	--	--	--	
Uranium	0.005491757	--	--	0.2	--	0.0005	7.71E-08	1.57E-01	1.3
Vanadium	0.0168	--	--	--	--	0.0009	1.42E-07	8.64E-04	0.0072
Zinc	0.006671161	--	--	--	--	0.0000	5.62E-10	3.43E-06	2.86E-05
Total			1.24E-03	11.96	1.96E-06	0.022	0.0000	11.99	100

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.
Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
HQ = hazard quotient.
HI = hazard index.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit River Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal, Vapor, volatiles) (unitless)	Risk (Dermal, Liquid, Nonvolatiles) (unitless)	Risk (Dermal, Vapor, Nonvolatiles) (unitless)	Total Risk (unitless)	% Contribution
Acetone	0.0011	VOC	--	--	--	--	--	--	
Arsenic	0.005767892	--	--	2.06E-04	--	2.16E-06	3.54E-10	2.08E-04	93
Barium	0.049451657	--	--	--	--	--	--	--	
Carbon tetrachloride	0.00028	VOC	2.03E-07	--	1.39E-10	--	--	2.03E-07	0.091
Chloride	12.545114	--	--	--	--	--	--	--	
Chloroform	0.0023	VOC	2.56E-06	--	1.16E-10	--	--	2.56E-06	1.15
Chromium	0.0141	--	--	--	--	--	--	--	
Copper	0.00597989	--	--	--	--	--	--	--	
Fluoride	0.30621978	--	--	--	--	--	--	--	
Iron	0.61057915	--	--	--	--	--	--	--	
Lead	0.000663667	--	--	--	--	--	--	--	
Manganese	0.040717647	--	--	--	--	--	--	--	
Nickel	0.0056	--	--	1.21E-05	--	--	--	1.21E-05	5.4
Nitrate	28.952	--	--	--	--	--	--	--	
Nitrite	0.46	--	--	--	--	--	--	--	
Strontium	0.38963943	--	--	--	--	--	--	--	
Sulfate	41.899078	--	--	--	--	--	--	--	
Thallium	0.00037	--	--	--	--	--	--	--	
Uranium	0.005491757	--	--	--	--	--	--	--	
Vanadium	0.0168	--	--	--	--	--	--	--	
Zinc	0.006671161	--	--	--	--	--	--	--	
Total ELCR			2.76E-06	2.18E-04	2.55E-10	2.16E-06	3.54E-10	2.23E-04	100

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
CTUIR = Confederated Tribes of the Umatilla Indian Reservation.
ELCR = excess lifetime cancer risk.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit River Exposure Area Native American Risk Assessment (10-Year)--Summary of CTUIR Sweat Lodge Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (pCi/L)	Volatile?[a]	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	2.8	No	--	--	--	--	
Gross beta	22.2	No	--	--	--	--	
Strontium-90	2.60	No	--	1.16E-06		1.16E-06	1.3
Technetium-99	115	No	--	6.85E-06	--	6.85E-06	7.6
Tritium	59,534	Yes	8.26E-05	--	--	8.26E-05	91
Total ELCR			8.26E-05	8.01E-06	--	9.06E-05	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

CTUIR = Confederated Tribes of the Umatilla Indian Reservation.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--river exposure area-- CTUIR

Hazard quotient and cancer risk from inhalation of VOCs/SVOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Contaminant concentration in water	C_{dw}	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF	365	day/yr

[a] Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
Acetone	67-64-1	VOC	0.0011	1.56E-05	3.10E+01	8.86E+00	1.76E-06	0.14
Arsenic	7440-38-2	--	0.005767892	--(c)	1.50E-05	4.29E-06	--	
Barium	7440-39-3	--	0.049451657	--(c)	5.00E-04	1.43E-04	--	
Carbon tetrachloride	56-23-5	VOC	0.00028	3.98E-06	1.90E-01	5.43E-02	7.33E-05	6
Chloride	16887-00-6	--	12.545114	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.0023	3.27E-05	9.80E-02	2.80E-02	1.17E-03	94
Chromium	7440-47-3	--	0.0141	--(c)	--	--	--	
Copper	7440-50-8	--	0.00597989	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.30621978	--(c)	1.30E-02	3.71E-03	--	
Iron	7439-89-6	--	0.61057915	--(c)	--	--	--	
Lead	7439-92-1	--	0.000663667	--(c)	--	--	--	
Manganese	7439-96-5	--	0.040717647	--(c)	5.00E-05	1.43E-05	--	
Nickel	7440-02-0	--	0.0056	--(c)	9.00E-05	2.57E-05	--	
Nitrate	14797-55-8	--	28.952	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.46	--(c)	--	--	--	
Strontium	7440-24-6	--	0.38963943	--(c)	--	--	--	
Sulfate	14808-79-8	--	41.899078	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	--(c)	--	--	--	
Uranium	7440-61-1	--	0.005491757	--(c)	3.00E-04	8.57E-05	--	
Vanadium	7440-62-2	--	0.0168	--(c)	--	--	--	
Zinc	7440-66-6	--	0.006671161	--(c)	--	--	--	
Total							1.24E-03	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of nonvolatile chemicals is presented in Table C-19

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
HQ = hazard quotient.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
Acetone	67-64-1	VOC	0.0011	1.52E-05	--	--	--	
Arsenic	7440-38-2	--	0.005767892	--(c)	4.30E-03	1.51E+01	--	
Barium	7440-39-3	--	0.049451657	--(c)	--	--	--	
Carbon tetrachloride	56-23-5	VOC	0.00028	3.87E-06	1.50E-05	5.25E-02	2.03E-07	7
Chloride	16887-00-6	--	12.545114	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.0023	3.17E-05	2.30E-05	8.05E-02	2.56E-06	93
Chromium	7440-47-3	--	0.0141	--(c)	--	--	--	
Copper	7440-50-8	--	0.00597989	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.30621978	--(c)	--	--	--	
Iron	7439-89-6	--	0.61057915	--(c)	--	--	--	
Lead	7439-92-1	--	0.000663667	--(c)	--	--	--	
Manganese	7439-96-5	--	0.040717647	--(c)	--	--	--	
Nickel	7440-02-0	--	0.0056	--(c)	2.60E-04	9.10E-01	--	
Nitrate	14797-55-8	--	28.952	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.46	--(c)	--	--	--	
Strontium	7440-24-6	--	0.38963943	--(c)	--	--	--	
Sulfate	14808-79-8	--	41.899078	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	--(c)	--	--	--	
Uranium	7440-61-1	--	0.005491757	--(c)	--	--	--	
Vanadium	7440-62-2	--	0.0168	--(c)	--	--	--	
Zinc	7440-66-6	--	0.006671161	--(c)	--	--	--	
Total ELCR							2.76E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of nonvolatile chemicals is presented in Table C-19

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--river exposure area-- CTUIR

Hazard quotient and cancer risk from inhalation of non-VOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 2)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion Factor	CF	365	day/yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L

[a] Harris (2008)

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,I}$(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)
Acetone	67-64-1	VOC	0.0011	--(c)	3.10E+01	8.86E+00	--
Arsenic	7440-38-2	--	0.005767892	1.41E-05	1.50E-05	4.29E-06	3.28E+00
Barium	7440-39-3	--	0.049451657	1.21E-04	5.00E-04	1.43E-04	8.44E-01
Carbon tetrachloride	56-23-5	VOC	0.00028	--(c)	1.90E-01	5.43E-02	--
Chloride	16887-00-6	--	12.545114	3.06E-02	--	--	--
Chloroform	67-66-3	VOC	0.0023	--(c)	9.80E-02	2.80E-02	--
Chromium	7440-47-3	--	0.0141	3.44E-05	--	--	--
Copper	7440-50-8	--	0.00597989	1.46E-05	--	--	--
Fluoride	16984-48-8	--	0.30621978	7.47E-04	1.30E-02	3.71E-03	2.01E-01
Iron	7439-89-6	--	0.61057915	1.49E-03	--	--	--
Lead	7439-92-1	--	0.000663667	1.62E-06	--	--	--
Manganese	7439-96-5	--	0.040717647	9.93E-05	5.00E-05	1.43E-05	6.95E+00
Nickel	7440-02-0	--	0.0056	1.37E-05	9.00E-05	2.57E-05	5.31E-01
Nitrate	14797-55-8	--	28.952	7.06E-02	--	--	--
Nitrite	14797-65-0	--	0.46	1.12E-03	--	--	--
Strontium	7440-24-6	--	0.38963943	9.50E-04	--	--	--
Sulfate	14808-79-8	--	41.899078	1.02E-01	--	--	--
Thallium	7440-28-0	--	0.00037	9.02E-07	--	--	--
Uranium	7440-61-1	--	0.005491757	1.34E-05	3.00E-04	8.57E-05	1.56E-01
Vanadium	7440-62-2	--	0.0168	4.10E-05	--	--	--
Zinc	7440-66-6	--	0.006671161	1.63E-05	--	--	--
Total							1.20E+01

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1

[c] Inhalation of volatile compounds in vapor is presented in Table C-18

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)
Acetone	67-64-1	VOC	0.0011	--(c)	--	--	--
Arsenic	7440-38-2	--	0.005767892	1.37E-05	4.30E-03	1.51E+01	2.06E-04
Barium	7440-39-3	--	0.049451657	1.17E-04	--	--	--
Carbon tetrachloride	56-23-5	VOC	0.00028	--(c)	1.50E-05	5.25E-02	--
Chloride	16887-00-6	--	12.545114	2.97E-02	--	--	--
Chloroform	67-66-3	VOC	0.0023	--(c)	2.30E-05	8.05E-02	--
Chromium	7440-47-3	--	0.0141	3.34E-05	--	--	--
Copper	7440-50-8	--	0.00597989	1.42E-05	--	--	--
Fluoride	16984-48-8	--	0.30621978	7.25E-04	--	--	--
Iron	7439-89-6	--	0.61057915	1.45E-03	--	--	--
Lead	7439-92-1	--	0.000663667	1.57E-06	--	--	--
Manganese	7439-96-5	--	0.040717647	9.64E-05	--	--	--
Nickel	7440-02-0	--	0.0056	1.33E-05	2.60E-04	9.10E-01	1.21E-05
Nitrate	14797-55-8	--	28.952	6.86E-02	--	--	--
Nitrite	14797-65-0	--	0.46	1.09E-03	--	--	--
Strontium	7440-24-6	--	0.38963943	9.23E-04	--	--	--
Sulfate	14808-79-8	--	41.899078	9.92E-02	--	--	--
Thallium	7440-28-0	--	0.00037	8.76E-07	--	--	--
Uranium	7440-61-1	--	0.005491757	1.30E-05	--	--	--
Vanadium	7440-62-2	--	0.0168	3.98E-05	--	--	--
Zinc	7440-66-6	--	0.006671161	1.58E-05	--	--	--
Total ELCR							2.18E-04

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (u

[c] Inhalation of volatile compounds in vapor is presented in Table C-18

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

% Contribution
27
7.1
1.7
58
4.4
1.3
100

/70 (kg).

% Contribution
94
5.5
100

ug/mg).

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--river exposure area-- CTUIR

Hazard quotient and cancer risk from dermal exposure to VOCs/SVOCs in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water (*Id,l*)
can be neglected and total dermal intake (*Id,total*) is equal to dermal intake from VOCs/SVOCs in sweat lodge vapor (*Id,v*)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 3)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF1	0.01	m/cm
Conversion factor	CF2	365	day/yr

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone[c]	67-64-1	VOC	0.0011	0.000512	1.38E-10	9.00E-01	1	1.54E-10	0.0079
Arsenic	7440-38-2	--	0.005767892	0.001	--(c)	3.00E-04	1	--	
Barium	7440-39-3	--	0.049451657	0.001	--(c)	2.00E-01	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.00028	0.016	1.10E-09	7.00E-04	1	1.57E-06	80
Chloride	16887-00-6	--	12.545114	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.0023	0.0068	3.84E-09	1.00E-02	1	3.84E-07	19.6
Chromium	7440-47-3	--	0.0141	0.001	--(c)	1.50E+00	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	--(c)	4.00E-02	1	--	
Fluoride	16984-48-8	--	0.30621978	0.001	--(c)	6.00E-02	1	--	
Iron	7439-89-6	--	0.61057915	0.001	--(c)	7.00E-01	1	--	
Lead	7439-92-1	--	0.000663667	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.040717647	0.001	--(c)	2.40E-02	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	--(c)	2.00E-02	0.04	--	
Nitrate	14797-55-8	--	28.952	0.001	--(c)	7.10E+00	1	--	
Nitrite	14797-65-0	--	0.46	0.001	--(c)	3.00E-01	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	--(c)	6.00E-01	1	--	
Sulfate	14808-79-8	--	41.899078	0.001	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	--(c)	--	1	--	
Uranium	7440-61-1	--	0.005491757	0.001	--(c)	3.00E-03	1	--	
Vanadium	7440-62-2	--	0.0168	0.001	--(c)	5.00E-03	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	--(c)	3.00E-01	1	--	
Total								1.96E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table C-22

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.
VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,vl}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
Acetone[c]	67-64-1	VOC	0.0011	0.000512	1.34E-10	--	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	--(c)	1.50E+00	1	--	
Barium	7440-39-3	--	0.049451657	0.001	--(c)	--	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.00028	0.016	1.07E-09	1.30E-01	1	1.39E-10	55
Chloride	16887-00-6	--	12.545114	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.0023	0.0068	3.73E-09	3.10E-02	1	1.16E-10	45
Chromium	7440-47-3	--	0.0141	0.001	--(c)	--	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	--(c)	--	1	--	
Fluoride	16984-48-8	--	0.30621978	0.001	--(c)	--	1	--	
Iron	7439-89-6	--	0.61057915	0.001	--(c)	--	1	--	
Lead	7439-92-1	--	0.000663667	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.040717647	0.001	--(c)	--	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	--(c)	--	0.04	--	
Nitrate	14797-55-8	--	28.952	0.001	--(c)	--	1	--	
Nitrite	14797-65-0	--	0.46	0.001	--(c)	--	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	--(c)	--	1	--	
Sulfate	14808-79-8	--	41.899078	0.001	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	--(c)	--	1	--	
Uranium	7440-61-1	--	0.005491757	0.001	--(c)	--	1	--	
Vanadium	7440-62-2	--	0.0168	0.001	--(c)	--	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	--(c)	--	1	--	
Total ELCR								2.55E-10	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table C-22

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--river exposure area-- CTUIR

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge condensed water
Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4)
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
Model assumes concentration of nonvolatiles in condensed water is equal to concentration in water used to create steam

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from liquid	$I_{d,l}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,l}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	9.00E-01	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	1.48E-06	3.00E-04	1	4.94E-03	23
Barium	7440-39-3	--	0.049451657	0.001	1.27E-05	2.00E-01	0.07	9.08E-04	4.2
Carbon tetrachloride	56-23-5	VOC	0.00028	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	12.545114	0.001	3.23E-03	--	1	--	
Chloroform	67-66-3	VOC	0.0023	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.0141	0.001	3.63E-06	1.50E+00	0.013	1.86E-04	0.85
Copper	7440-50-8	--	0.00597989	0.001	1.54E-06	4.00E-02	1	3.84E-05	0.18
Fluoride	16984-48-8	--	0.30621978	0.001	7.87E-05	6.00E-02	1	1.31E-03	6.0
Iron	7439-89-6	--	0.61057915	0.001	1.57E-04	7.00E-01	1	2.24E-04	1.0
Lead	7439-92-1	--	0.000663667	0.0001	1.71E-08	--	1	--	
Manganese	7439-96-5	--	0.040717647	0.001	1.05E-05	2.40E-02	0.04	1.09E-02	50
Nickel	7440-02-0	--	0.0056	0.0002	2.88E-07	2.00E-02	0.04	3.60E-04	1.6
Nitrate	14797-55-8	--	28.952	0.001	7.44E-03	7.10E+00	1	1.05E-03	4.8
Nitrite	14797-65-0	--	0.46	0.001	1.18E-04	3.00E-01	1	3.94E-04	1.8
Strontium	7440-24-6	--	0.38963943	0.001	1.00E-04	6.00E-01	1	1.67E-04	0.77
Sulfate	14808-79-8	--	41.899078	0.001	1.08E-02	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	9.51E-08	--	1	--	
Uranium	7440-61-1	--	0.005491757	0.001	1.41E-06	3.00E-03	1	4.71E-04	2.2
Vanadium	7440-62-2	--	0.0168	0.001	4.32E-06	5.00E-03	1	8.64E-04	4.0
Zinc	7440-66-6	--	0.006671161	0.0006	1.03E-06	3.00E-01	1	3.43E-06	0.016
Total								0.022	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.
EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
HQ = hazard quotient.
SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,i}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	1.44E-06	1.50E+00	1	2.16E-06	100
Barium	7440-39-3	--	0.049451657	0.001	1.24E-05	--	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.00028	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	12.545114	0.001	3.13E-03	--	1	--	
Chloroform	67-66-3	VOC	0.0023	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.0141	0.001	3.52E-06	--	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	1.49E-06	--	1	--	
Fluoride	16984-48-8	--	0.30621978	0.001	7.65E-05	--	1	--	
Iron	7439-89-6	--	0.61057915	0.001	1.53E-04	--	1	--	
Lead	7439-92-1	--	0.000663667	0.0001	1.66E-08	--	1	--	
Manganese	7439-96-5	--	0.040717647	0.001	1.02E-05	--	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	2.80E-07	--	0.04	--	
Nitrate	14797-55-8	--	28.952	0.001	7.23E-03	--	1	--	
Nitrite	14797-65-0	--	0.46	0.001	1.15E-04	--	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	9.73E-05	--	1	--	
Sulfate	14808-79-8	--	41.899078	0.001	1.05E-02	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	9.24E-08	--	1	--	
Uranium	7440-61-1	--	0.005491757	0.001	1.37E-06	--	1	--	
Vanadium	7440-62-2	--	0.0168	0.001	4.20E-06	--	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	1.00E-06	--	1	--	
Total ELCR								2.16E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--river exposure area-- CTUIR

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge vapor
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event	ET	1	hr/day
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Ideal gas law constant	R	62.37	(mmHg-L)/(gmole-K)
Temperature of the sweat lodge	T	338.7	K
Density of liquid water	rhow	1000	g/L
Conversion factor	CF_2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	9.00E-01	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	2.43E-10	3.00E-04	1	8.10E-07	23
Barium	7440-39-3	--	0.049451657	0.001	2.08E-09	2.00E-01	0.07	1.49E-07	4.2
Carbon tetrachloride	56-23-5	VOC	0.00028	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	12.545114	0.001	5.29E-07	--	1	--	
Chloroform	67-66-3	VOC	0.0023	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.0141	0.001	5.94E-10	1.50E+00	0.013	3.05E-08	0.85
Copper	7440-50-8	--	0.00597989	0.001	2.52E-10	4.00E-02	1	6.30E-09	0.18
Fluoride	16984-48-8	--	0.30621978	0.001	1.29E-08	6.00E-02	1	2.15E-07	6.0
Iron	7439-89-6	--	0.61057915	0.001	2.57E-08	7.00E-01	1	3.68E-08	1.0
Lead	7439-92-1	--	0.000663667	0.0001	2.80E-12	--	1	--	
Manganese	7439-96-5	--	0.040717647	0.001	1.72E-09	2.40E-02	0.04	1.79E-06	50
Nickel	7440-02-0	--	0.0056	0.0002	4.72E-11	2.00E-02	0.04	5.90E-08	1.6
Nitrate	14797-55-8	--	28.952	0.001	1.22E-06	7.10E+00	1	1.72E-07	4.8
Nitrite	14797-65-0	--	0.46	0.001	1.94E-08	3.00E-01	1	6.46E-08	1.8
Strontium	7440-24-6	--	0.38963943	0.001	1.64E-08	6.00E-01	1	2.74E-08	0.77
Sulfate	14808-79-8	--	41.899078	0.001	1.77E-06	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	1.56E-11	--	1	--	
Uranium	7440-61-1	--	0.005491757	0.001	2.31E-10	3.00E-03	1	7.71E-08	2.2
Vanadium	7440-62-2	--	0.0168	0.001	7.08E-10	5.00E-03	1	1.42E-07	4.0
Zinc	7440-66-6	--	0.006671161	0.0006	1.69E-10	3.00E-01	1	5.62E-10	0.016
Total								0.0000	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal Intake of Volatiles in Sweatlodge vapor is presented in Table C-20

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

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Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	2.36E-10	1.50E+00	1	3.54E-10	100
Barium	7440-39-3	--	0.049451657	0.001	2.02E-09	--	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.00028	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	12.545114	0.001	5.13E-07	--	1	--	
Chloroform	67-66-3	VOC	0.0023	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.0141	0.001	5.77E-10	--	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	2.45E-10	--	1	--	
Fluoride	16984-48-8	--	0.30621978	0.001	1.25E-08	--	1	--	
Iron	7439-89-6	--	0.61057915	0.001	2.50E-08	--	1	--	
Lead	7439-92-1	--	0.000663667	0.0001	2.72E-12	--	1	--	
Manganese	7439-96-5	--	0.040717647	0.001	1.67E-09	--	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	4.58E-11	--	0.04	--	
Nitrate	14797-55-8	--	28.952	0.001	1.19E-06	--	1	--	
Nitrite	14797-65-0	--	0.46	0.001	1.88E-08	--	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	1.59E-08	--	1	--	
Sulfate	14808-79-8	--	41.899078	0.001	1.71E-06	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	1.51E-11	--	1	--	
Uranium	7440-61-1	--	0.005491757	0.001	2.25E-10	--	1	--	
Vanadium	7440-62-2	--	0.0168	0.001	6.88E-10	--	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	1.64E-10	--	1	--	
Total ELCR								3.54E-10	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Dermal Intake of Volatiles in Sweatlodge vapor is presented in Table C-20

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--river exposure area-- CTUIR

Cancer risk from inhalation of volatile radioactive contaminants in sweat lodge vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr

[a] Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	2.8	--(c)	--	--	
Gross beta	12587-47-2	--	22.2	--(c)	--	--	
Strontium-90	10098-97-2	--	2.60	--(c)	1.05E-10	--	
Technetium-99	14133-76-7	--	115	--(c)	1.41E-11	--	
Tritium	10028-17-8	Yes	59,534	1.47E+09	5.62E-14	8.26E-05	100
Total ELCR						8.26E-05	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of nonvolatile contaminants is Presented in Table C-24

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--river exposure area-- CTUIR

Cancer risk from inhalation of nonvolatile radioactive contaminants in sweathouse vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	25	m^3/day
Length of sweat event	ET	0.042	day/event (1hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)

[a] Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments.*

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)
Gross alpha	12587-46-1	--	2.8	1.17E+04	--	--
Gross beta	12587-47-2	--	22.2	9.41E+04	--	--
Strontium-90	10098-97-2	--	2.60	1.10E+04	1.05E-10	1.16E-06
Technetium-99	14133-76-7	--	115	4.86E+05	1.41E-11	6.85E-06
Tritium	10028-17-8	Yes	59,534	--[c]	5.62E-14	--
Total ELCR						8.01E-06

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of volatile contaminants is presented in Table C-23

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)*.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

% Contribution
14
86
100

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Native American Risk Assessment (10-Year)–Summary of Yakima Nationa Sweat Lodge Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	HQ (Inhalation) (Volatiles) (unitless)	HQ (Inhalation) (Nonvolatiles) (unitless)	HQ (Dermal, Vapor, volatiles) (unitless)	HQ (Dermal, Liquid, Nonvolatiles) (unitless)	HQ (Dermal, Vapor, Nonvolatiles) (unitless)	Total HI (unitless)	% Contribution
(m+p)-Xylene	0.0005	VOC	7.39E-05	--	6.51E-08	--	--	7.40E-05	3.56E-04
1,1,1-Trichloroethane	0.001204711	VOC	2.49E-05	--	3.85E-09	--	--	2.49E-05	1.20E-04
1,1-Dichloroethane	0.000389235	VOC	5.75E-05	--	6.40E-09	--	--	5.75E-05	2.77E-04
1,1-Dichloroethene	0.000164225	VOC	8.49E-05	--	1.94E-08	--	--	8.50E-05	4.09E-04
1,2-Dichlorobenzene	0.003	VOC	1.55E-03	--	6.71E-07	--	--	1.55E-03	0.0075
1,2-Dichloroethane	0.000305426	VOC	1.32E-05	--	3.15E-08	--	--	1.32E-05	6.35E-05
1,4-Dichlorobenzene	0.000130994	VOC	1.69E-05	--	3.86E-08	--	--	1.70E-05	8.17E-05
1,4-Dioxane	0.0081	SVOC	2.33E-04	--	1.31E-08	--	--	2.33E-04	0.0011
2-Butanone	0.0029	VOC	6.00E-05	--	2.28E-09	--	--	6.00E-05	2.89E-04
2-Pentanone, 4-Methyl	0.00064	VOC	2.21E-05	--	1.06E-08	--	--	2.21E-05	1.06E-04
Acetone	0.00128316	VOC	4.28E-06	--	3.58E-10	--	--	4.28E-06	2.06E-05
Aluminum	0.041755539	--	--	1.48E-01	--	2.15E-05	3.52E-09	1.48E-01	0.71
Arsenic	0.003060574	--	--	3.62E+00	--	5.25E-03	8.60E-07	3.63E+00	17
Barium	0.068082679	--	--	2.42E+00	--	2.50E-03	4.10E-07	2.42E+00	12
Benzene	0.0019	VOC	6.55E-03	--	3.50E-06	--	--	6.56E-03	0.032
Benzyl alcohol	0.0027	SVOC	--	--	2.77E-08	--	--	2.77E-08	1.33E-07
Beryllium	0.000360659	--	--	3.20E-01	--	1.32E-02	2.17E-06	3.33E-01	1.6
Bis(2-ethylhexyl) phthalate	0.001271216	SVOC	--	--	7.80E-07	--	--	7.80E-07	3.76E-06
Cadmium	0.0045	--	--	7.99E+00	--	9.26E-02	1.52E-05	8.08E+00	39
Carbon disulfide	0.00039	VOC	5.76E-05	--	3.26E-08	--	--	5.77E-05	2.78E-04
Carbon tetrachloride	0.000164414	VOC	8.95E-05	--	1.85E-06	--	--	9.14E-05	4.40E-04
Chloride	9.821328	--	--	--	--	--	--	--	
Chlorobenzene	0.00041	VOC	8.48E-04	--	2.82E-07	--	--	8.49E-04	0.0041
Chloroform	0.00022061	VOC	2.33E-04	--	7.37E-08	--	--	2.33E-04	0.0011
Chromium	0.007505402	--	--	--	--	1.98E-04	3.24E-08	1.98E-04	9.53E-04
cis-1,2-Dichloroethylene	0.0002	VOC	--	--	7.56E-08	--	--	7.56E-08	3.64E-07
Copper	0.002993571	--	--	--	--	3.85E-05	6.31E-09	3.85E-05	1.85E-04
Fluoride	0.32861624	--	--	4.49E-01	--	2.82E-03	4.62E-07	4.52E-01	2.2
Iron	0.47301923	--	--	--	--	3.48E-04	5.69E-08	3.48E-04	0.0017
Lead	0.000710361	--	--	--	--	--	--	--	
Lithium	0.0083	--	--	--	--	2.13E-03	3.50E-07	2.13E-03	0.010
Manganese	0.011254937	--	--	4.00E+00	--	6.03E-03	9.88E-07	4.00E+00	19
Methanol	1.1	--	--	4.88E-03	--	3.62E-04	5.93E-08	5.24E-03	0.025
Methylene chloride	0.000852962	VOC	8.82E-05	--	2.44E-08	--	--	8.83E-05	4.25E-04
Molybdenum	0.0015	--	--	--	--	1.54E-04	2.53E-08	1.54E-04	7.43E-04
Nickel	0.003603478	--	--	7.11E-01	--	4.63E-04	7.59E-08	7.11E-01	3.4
Nitrate	23.756902	--	--	--	--	1.72E-03	2.82E-07	1.72E-03	0.0083
Nitrite	0.079227256	--	--	--	--	1.36E-04	2.23E-08	1.36E-04	6.54E-04
o-Xylene	0.000210551	VOC	3.11E-05	--	2.79E-08	--	--	3.11E-05	1.50E-04
Silver	0.005341496	--	--	--	--	8.24E-03	1.35E-06	8.24E-03	0.040
Strontium	0.36357229	--	--	--	--	3.12E-04	5.11E-08	3.12E-04	0.0015
Sulfate	45.069738	--	--	--	--	--	--	--	
Tetrachloroethene	0.000993146	VOC	3.81E-04	--	1.61E-06	--	--	3.82E-04	0.0018
Toluene	0.000274725	VOC	5.68E-06	--	5.23E-08	--	--	5.74E-06	2.76E-05
Tributyl phosphate	0.040836371	SVOC	--	--	2.29E-06	--	--	2.29E-06	1.10E-05
Trichloroethene	0.000492361	VOC	1.46E-03	--	--	--	--	1.46E-03	0.0070
Trichloromonofluoromethane	0.00058	VOC	8.57E-05	--	1.23E-08	--	--	8.57E-05	4.13E-04
Uranium	0.01625113	--	--	9.62E-01	--	2.79E-03	4.56E-07	9.64E-01	4.6
Vanadium	0.013487657	--	--	--	--	1.39E-03	2.27E-07	1.39E-03	0.0067
Vinyl chloride	0.0018	VOC	1.86E-03	--	1.65E-06	--	--	1.86E-03	0.0090
Zinc	0.10896358	--	--	--	--	1.12E-04	1.84E-08	1.12E-04	5.40E-04
Total			0.014	21	1.31E-05	0.14	2.31E-05	20.77	100

[a] Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment.*

COPC = contaminant of potential concern.

HI = hazard index.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of Yakima Nationa Sweat Lodge Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal, Vapor, volatiles) (unitless)	Risk (Dermal, Liquid, Nonvolatiles) (unitless)	Risk (Dermal, Vapor, Nonvolatiles) (unitless)	Total Risk (unitless)	% Contribution
(m+p)-Xylene	0.0005	VOC	--	--	--	--	--	--	
1,1,1-Trichloroethane	0.001204711	VOC	--	--	--	--	--	--	
1,1-Dichloroethane	0.000389235	VOC	--	--	--	--	--	--	
1,1-Dichloroethene	0.000164225	VOC	--	--	--	--	--	--	
1,2-Dichlorobenzene	0.003	VOC	--	--	--	--	--	--	
1,2-Dichloroethane	0.000305426	VOC	7.98E-07	--	5.57E-11	--	--	7.98E-07	0.194
1,4-Dichlorobenzene	0.000130994	VOC	1.45E-07	--	1.42E-11	--	--	1.45E-07	0.035
1,4-Dioxane	0.0081	SVOC	6.27E-06	--	1.40E-11	--	--	6.27E-06	1.520
2-Butanone	0.0029	VOC	--	--	--	--	--	--	
2-Pentanone, 4-Methyl	0.00064	VOC	--	--	--	--	--	--	
Acetone	0.00128316	VOC	--	--	--	--	--	--	
Aluminum	0.041755539	--	--	--	--	--	--	--	
Arsenic	0.003060574	--	--	2.27E-04	--	2.29E-06	3.76E-10	2.29E-04	55.580
Barium	0.068082679	--	--	--	--	--	--	--	
Benzene	0.0019	VOC	1.49E-06	--	7.48E-10	--	--	1.49E-06	0.361
Benzyl alcohol	0.0027	SVOC	--	--	--	--	--	--	
Beryllium	0.000360659	--	--	1.49E-05	--	--	--	1.49E-05	3.619
Bis(2-ethylhexyl) phthalate	0.001271216	SVOC	3.07E-07	--	2.12E-10	--	--	3.07E-07	0.074
Cadmium	0.0045	--	--	1.40E-04	--	--	--	1.40E-04	33.866
Carbon disulfide	0.00039	VOC	--	--	--	--	--	--	
Carbon tetrachloride	0.000164414	VOC	2.48E-07	--	1.63E-10	--	--	2.48E-07	0.060
Chloride	9.821328	--	--	--	--	--	--	--	
Chlorobenzene	0.00041	VOC	--	--	--	--	--	--	
Chloroform	0.00022061	VOC	5.10E-07	--	2.22E-11	--	--	5.10E-07	0.124
Chromium	0.007505402	--	--	--	--	--	--	--	
cis-1,2-Dichloroethylene	0.0002	VOC	--	--	--	--	--	--	
Copper	0.002993571	--	--	--	--	--	--	--	
Fluoride	0.32861624	--	--	--	--	--	--	--	
Iron	0.47301923	--	--	--	--	--	--	--	
Lead	0.000710361	--	--	--	--	--	--	--	
Lithium	0.0083	--	--	--	--	--	--	--	
Manganese	0.011254937	--	--	--	--	--	--	--	
Methanol	1.1	--	--	--	--	--	--	--	
Methylene chloride	0.000852962	VOC	4.03E-08	--	1.07E-11	--	--	4.03E-08	0.010
Molybdenum	0.0015	--	--	--	--	--	--	--	
Nickel	0.003603478	--	--	1.62E-05	--	--	--	1.62E-05	3.917
Nitrate	23.756902	--	--	--	--	--	--	--	
Nitrite	0.079227256	--	--	--	--	--	--	--	
o-Xylene	0.000210551	VOC	--	--	--	--	--	--	
Silver	0.005341496	--	--	--	--	--	--	--	
Strontium	0.36357229	--	--	--	--	--	--	--	
Sulfate	45.069738	--	--	--	--	--	--	--	
Tetrachloroethene	0.000993146	VOC	5.89E-07	--	8.44E-09	--	--	5.97E-07	0.145
Toluene	0.000274725	VOC	--	--	--	--	--	--	
Tributyl phosphate	0.040836371	SVOC	--	--	4.09E-09	--	--	4.09E-09	0.001
Trichloroethene	0.000492361	VOC	1.24E-06	--	2.51E-10	--	--	1.24E-06	0.300
Trichloromonofluoromethane	0.00058	VOC	--	--	--	--	--	--	
Uranium	0.01625113	--	--	--	--	--	--	--	
Vanadium	0.013487657	--	--	--	--	--	--	--	
Vinyl chloride	0.0018	VOC	7.96E-07	--	3.46E-09	--	--	7.99E-07	0.194
Zinc	0.10896358	--	--	--	--	--	--	--	
Total ELCR			1.24E-05	3.98E-04	1.75E-08	2.29E-06	3.76E-10	4.12E-04	100

[a] Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment.*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of Yakima Nationa Sweat Lodge Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.							
COPC	95 UCL Groundwater Concentration (pCi/L)	Volatile?[a]	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Carbon-14	15.2	--	--	9.47E-07	--	9.47E-07	0.060
Gross alpha	5.9880167	--	--	--	--	0.00E+00	0
Gross beta	26.717649	--	--	--	--	0.00E+00	0
Iodine-129	1.7529182	--	--	9.38E-07	--	9.38E-07	0.060
Nickel-63	7.66125	--	--	1.11E-07	--	1.11E-07	0.0070
Protactinium-231	0.308	--	--	1.23E-04	--	1.23E-04	7.9
Strontium-90	0.611	--	--	5.65E-07	--	5.65E-07	0.036
Technetium-99	75.671084	--	--	9.40E-06	--	9.40E-06	0.60
Tritium	497899.63	Yes	1.44E-03	--	--	1.44E-03	91
Total ELCR			1.44E-03	1.35E-04	--	1.57E-03	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from inhalation of VOCs/SVOCs in sweat lodge vapor
Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Contaminant concentration in water	C_{dw}	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF	365	day/yr

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	VOC	0.0005	1.48E-05	7.00E-01	2.00E-01	7.39E-05	0.53
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	3.56E-05	5.00E+00	1.43E+00	2.49E-05	0.18
1,1-Dichloroethane	75-34-3	VOC	0.000389235	1.15E-05	7.00E-01	2.00E-01	5.75E-05	0.42
1,1-Dichloroethene	75-35-4	VOC	0.000164225	4.85E-06	2.00E-01	5.71E-02	8.49E-05	0.61
1,2-Dichlorobenzene	95-50-1	VOC	0.003	8.87E-05	2.00E-01	5.71E-02	1.55E-03	11
1,2-Dichloroethane	107-06-2	VOC	0.000305426	9.03E-06	2.40E+00	6.86E-01	1.32E-05	0.095
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	3.87E-06	8.00E-01	2.29E-01	1.69E-05	0.12
1,4-Dioxane	123-91-1	SVOC	0.0081	2.39E-04	3.60E+00	1.03E+00	2.33E-04	1.7
2-Butanone	78-93-3	VOC	0.0029	8.57E-05	5.00E+00	1.43E+00	6.00E-05	0.43
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	1.89E-05	3.00E+00	8.57E-01	2.21E-05	0.16
Acetone	67-64-1	VOC	0.00128316	3.79E-05	3.10E+01	8.86E+00	4.28E-06	0.031
Aluminum	7429-90-5	--	0.041755539	--(c)	5.00E-03	1.43E-03	--	
Arsenic	7440-38-2	--	0.003060574	--(c)	1.50E-05	4.29E-06	--	
Barium	7440-39-3	--	0.068082679	--(c)	5.00E-04	1.43E-04	--	
Benzene	71-43-2	VOC	0.0019	5.62E-05	3.00E-02	8.57E-03	6.55E-03	47
Benzyl alcohol	100-51-6	SVOC	0.0027	7.98E-05	--	--	--	
Beryllium	7440-41-7	--	0.000360659	--(c)	2.00E-05	5.71E-06	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	3.76E-05	--	--	--	
Cadmium	7440-43-9	--	0.0045	--(c)	1.00E-05	2.86E-06	--	
Carbon disulfide	75-15-0	VOC	0.00039	1.15E-05	7.00E-01	2.00E-01	5.76E-05	0.42
Carbon tetrachloride	56-23-5	VOC	0.000164414	4.86E-06	1.90E-01	5.43E-02	8.95E-05	0.65
Chloride	16887-00-6	--	9.821328	--(c)	--	--	--	
Chlorobenzene	108-90-7	VOC	0.00041	1.21E-05	5.00E-02	1.43E-02	8.48E-04	6.1
Chloroform	67-66-3	VOC	0.00022061	6.52E-06	9.80E-02	2.80E-02	2.33E-04	1.7
Chromium	7440-47-3	--	0.007505402	--(c)	--	--	--	
cis-1,2-Dichloroethylene	156-59-2	VOC	0.0002	5.91E-06	--	--	--	
Copper	7440-50-8	--	0.002993571	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.32861624	--(c)	1.30E-02	3.71E-03	--	
Iron	7439-89-6	--	0.47301923	--(c)	--	--	--	
Lead	7439-92-1	--	0.000710361	--(c)	--	--	--	
Lithium	7439-93-2	--	0.0083	--(c)	--	--	--	
Manganese	7439-96-5	--	0.011254937	--(c)	5.00E-05	1.43E-05	--	
Methanol	67-56-1	--	1.1	--(c)	4.00E+00	1.14E+00	--	
Methylene chloride	75-09-2	VOC	0.000852962	2.52E-05	1.00E+00	2.86E-01	8.82E-05	0.6
Molybdenum	7439-98-7	--	0.0015	--(c)	--	--	--	
Nickel	7440-02-0	--	0.003603478	--(c)	9.00E-05	2.57E-05	--	

Nitrate	14797-55-8	--	23.756902	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.079227256	--(c)	--	--	--	
o-Xylene	95-47-6	VOC	0.000210551	6.22E-06	7.00E-01	2.00E-01	3.11E-05	0.2
Silver	7440-22-4	--	0.005341496	--(c)	--	--	--	
Strontium	7440-24-6	--	0.36357229	--(c)	--	--	--	
Sulfate	14808-79-8	--	45.069738	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	2.94E-05	2.70E-01	7.71E-02	3.81E-04	2.8
Toluene	108-88-3	VOC	0.000274725	8.12E-06	5.00E+00	1.43E+00	5.68E-06	0.041
Tributyl phosphate	126-73-8	SVOC	0.040836371	1.21E-03	--	--	--	
Trichloroethene	79-01-6	VOC	0.000492361	1.46E-05	3.50E-02	1.00E-02	1.46E-03	11
Trichloromonofluoromethane	75-69-4	VOC	0.00058	1.71E-05	7.00E-01	2.00E-01	8.57E-05	0.62
Uranium	7440-61-1	--	0.01625113	--(c)	3.00E-04	8.57E-05	--	
Vanadium	7440-62-2	--	0.013487657	--(c)	--	--	--	
Vinyl chloride	75-01-4	VOC	0.0018	5.32E-05	1.00E-01	2.86E-02	1.86E-03	13
Zinc	7440-66-6	--	0.10896358	--(c)	--	--	--	
Total							1.38E-02	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of nonvolatile chemicals is presented in table D-3

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*.

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{ow} 95 UCL (mg/L)	I_{inh}(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	VOC	0.0005	1.44E-05	--	--	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	3.46E-05	--	--	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	1.12E-05	--	--	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	4.72E-06	--	--	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	8.61E-05	--	--	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	8.77E-06	2.60E-05	9.10E-02	7.98E-07	6.4
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	3.76E-06	1.10E-05	3.85E-02	1.45E-07	1.2
1,4-Dioxane	123-91-1	SVOC	0.0081	2.33E-04	7.70E-06	2.70E-02	6.27E-06	50
2-Butanone	78-93-3	VOC	0.0029	8.33E-05	--	--	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	1.84E-05	--	--	--	
Acetone	67-64-1	VOC	0.00128316	3.68E-05	--	--	--	
Aluminum	7429-90-5	--	0.041755539	--(c)	--	--	--	
Arsenic	7440-38-2	--	0.003060574	--(c)	4.30E-03	1.51E+01	--	
Barium	7440-39-3	--	0.068082679	--(c)	--	--	--	
Benzene	71-43-2	VOC	0.0019	5.46E-05	7.80E-06	2.73E-02	1.49E-06	12
Benzyl alcohol	100-51-6	SVOC	0.0027	7.75E-05	--	--	--	
Beryllium	7440-41-7	--	0.000360659	--(c)	2.40E-03	8.40E+00	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	3.65E-05	2.40E-06	8.40E-03	3.07E-07	2.5
Cadmium	7440-43-9	--	0.0045	--(c)	1.80E-03	6.30E+00	--	
Carbon disulfide	75-15-0	VOC	0.00039	1.12E-05	--	--	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	4.72E-06	1.50E-05	5.25E-02	2.48E-07	2.0
Chloride	16887-00-6	--	9.821328	--(c)	--	--	--	
Chlorobenzene	108-90-7	VOC	0.00041	1.18E-05	--	--	--	
Chloroform	67-66-3	VOC	0.00022061	6.33E-06	2.30E-05	8.05E-02	5.10E-07	4.1
Chromium	7440-47-3	--	0.007505402	--(c)	--	--	--	
cis-1,2-Dichloroethylene	156-59-2	VOC	0.0002	5.74E-06	--	--	--	
Copper	7440-50-8	--	0.002993571	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.32861624	--(c)	--	--	--	
Iron	7439-89-6	--	0.47301923	--(c)	--	--	--	
Lead	7439-92-1	--	0.000710361	--(c)	--	--	--	
Lithium	7439-93-2	--	0.0083	--(c)	--	--	--	
Manganese	7439-96-5	--	0.011254937	--(c)	--	--	--	
Methanol	67-56-1	--	1.1	--(c)	--	--	--	
Methylene chloride	75-09-2	VOC	0.000852962	2.45E-05	4.70E-07	1.65E-03	4.03E-08	0.32
Molybdenum	7439-98-7	--	0.0015	--(c)	--	--	--	
Nickel	7440-02-0	--	0.003603478	--(c)	2.60E-04	9.10E-01	--	
Nitrate	14797-55-8	--	23.756902	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.079227256	--(c)	--	--	--	
o-Xylene	95-47-6	VOC	0.000210551	6.05E-06	--	--	--	
Silver	7440-22-4	--	0.005341496	--(c)	--	--	--	
Strontium	7440-24-6	--	0.36357229	--(c)	--	--	--	
Sulfate	14808-79-8	--	45.069738	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	2.85E-05	5.90E-06	2.07E-02	5.89E-07	4.7
Toluene	108-88-3	VOC	0.000274725	7.89E-06	--	--	--	
Tributyl phosphate	126-73-8	SVOC	0.040836371	1.17E-03	--	--	--	
Trichloroethene	79-01-6	VOC	0.000492361	1.41E-05	2.50E-05	8.75E-02	1.24E-06	10.0
Trichloromonofluoromethane	75-69-4	VOC	0.00058	1.67E-05	--	--	--	
Uranium	7440-61-1	--	0.01625113	--(c)	--	--	--	
Vanadium	7440-62-2	--	0.013487657	--(c)	--	--	--	
Vinyl chloride	75-01-4	VOC	0.0018	5.17E-05	4.40E-06	1.54E-02	7.96E-07	6.4
Zinc	7440-66-6	--	0.10896358	--(c)	--	--	--	
Total ELCR							1.24E-05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of nonvolatile chemicals is presented in table D-3

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from inhalation of nonvolatiles in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 2, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion Factor	CF	365	day/yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	VOC	0.0005	--(c)	7.00E-01	2.00E-01	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	--(c)	5.00E+00	1.43E+00	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	--(c)	7.00E-01	2.00E-01	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	--(c)	2.00E-01	5.71E-02	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	--(c)	2.00E-01	5.71E-02	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	--(c)	2.40E+00	6.86E-01	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	--(c)	8.00E-01	2.29E-01	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	--(c)	3.60E+00	1.03E+00	--	
2-Butanone	78-93-3	VOC	0.0029	--(c)	5.00E+00	1.43E+00	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	--(c)	3.00E+00	8.57E-01	--	
Acetone	67-64-1	VOC	0.00128316	--(c)	3.10E+01	8.86E+00	--	
Aluminum	7429-90-5	--	0.041755539	2.12E-04	5.00E-03	1.43E-03	1.48E-01	0.72
Arsenic	7440-38-2	--	0.003060574	1.55E-05	1.50E-05	4.29E-06	3.62E+00	18
Barium	7440-39-3	--	0.068082679	3.45E-04	5.00E-04	1.43E-04	2.42E+00	12
Benzene	71-43-2	VOC	0.0019	--(c)	3.00E-02	8.57E-03	--	
Benzyl alcohol	100-51-6	SVOC	0.0027	--(c)	--	--	--	
Beryllium	7440-41-7	--	0.000360659	1.83E-06	2.00E-05	5.71E-06	3.20E-01	1.6
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	--(c)	--	--	--	
Cadmium	7440-43-9	--	0.0045	2.28E-05	1.00E-05	2.86E-06	7.99E+00	39
Carbon disulfide	75-15-0	VOC	0.00039	--(c)	7.00E-01	2.00E-01	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	--(c)	1.90E-01	5.43E-02	--	
Chloride	16887-00-6	--	9.821328	4.98E-02	--	--	--	
Chlorobenzene	108-90-7	VOC	0.00041	--(c)	5.00E-02	1.43E-02	--	
Chloroform	67-66-3	VOC	0.00022061	--(c)	9.80E-02	2.80E-02	--	
Chromium	7440-47-3	--	0.007505402	3.81E-05	--	--	--	
cis-1,2-Dichloroethylene	156-59-2	VOC	0.0002	--(c)	--	--	--	
Copper	7440-50-8	--	0.002993571	1.52E-05	--	--	--	
Fluoride	16984-48-8	--	0.32861624	1.67E-03	1.30E-02	3.71E-03	4.49E-01	2.2
Iron	7439-89-6	--	0.47301923	2.40E-03	--	--	--	
Lead	7439-92-1	--	0.000710361	3.60E-06	--	--	--	
Lithium	7439-93-2	--	0.0083	4.21E-05	--	--	--	
Manganese	7439-96-5	--	0.011254937	5.71E-05	5.00E-05	1.43E-05	4.00E+00	19
Methanol	67-56-1	--	1.1	5.58E-03	4.00E+00	1.14E+00	4.88E-03	0.024
Methylene chloride	75-09-2	VOC	0.000852962	--(c)	1.00E+00	2.86E-01	--	
Molybdenum	7439-98-7	--	0.0015	7.61E-06	--	--	--	
Nickel	7440-02-0	--	0.003603478	1.83E-05	9.00E-05	2.57E-05	7.11E-01	3.4
Nitrate	14797-55-8	--	23.756902	1.20E-01	--	--	--	
Nitrite	14797-65-0	--	0.079227256	4.02E-04	--	--	--	
o-Xylene	95-47-6	VOC	0.000210551	--(c)	7.00E-01	2.00E-01	--	
Silver	7440-22-4	--	0.005341496	2.71E-05	--	--	--	
Strontium	7440-24-6	--	0.36357229	1.84E-03	--	--	--	
Sulfate	14808-79-8	--	45.069738	2.29E-01	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	--(c)	2.70E-01	7.71E-02	--	
Toluene	108-88-3	VOC	0.000274725	--(c)	5.00E+00	1.43E+00	--	
Tributyl phosphate	126-73-8	SVOC	0.040836371	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000492361	--(c)	3.50E-02	1.00E-02	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	--(c)	7.00E-01	2.00E-01	--	
Uranium	7440-61-1	--	0.01625113	8.24E-05	3.00E-04	8.57E-05	9.62E-01	4.7
Vanadium	7440-62-2	--	0.013487657	6.84E-05	--	--	--	
Vinyl chloride	75-01-4	VOC	0.0018	--(c)	1.00E-01	2.86E-02	--	
Zinc	7440-66-6	--	0.10896358	5.53E-04	--	--	--	
Total							21	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of volatile compounds in vapor is presented in Table D-2
-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
HQ = hazard quotient.
SVOC = semivolatile organic compound.
VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
(m+p)-Xylene	179601-23-1	VOC	0.0005	--(c)	--	--	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	--(c)	--	--	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	--(c)	--	--	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	--(c)	--	--	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	--(c)	--	--	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	--(c)	2.60E-05	9.10E-02	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	--(c)	1.10E-05	3.85E-02	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	--(c)	7.70E-06	2.70E-02	--	
2-Butanone	78-93-3	VOC	0.0029	--(c)	--	--	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	--(c)	--	--	--	
Acetone	67-64-1	VOC	0.00128316	--(c)	--	--	--	
Aluminum	7429-90-5	--	0.041755539	2.06E-04	--	--	--	
Arsenic	7440-38-2	--	0.003060574	1.51E-05	4.30E-03	1.51E+01	2.27E-04	57
Barium	7440-39-3	--	0.068082679	3.35E-04	--	--	--	
Benzene	71-43-2	VOC	0.0019	--(c)	7.80E-06	2.73E-02	--	
Benzyl alcohol	100-51-6	SVOC	0.0027	--(c)	--	--	--	
Beryllium	7440-41-7	--	0.000360659	1.78E-06	2.40E-03	8.40E+00	1.49E-05	3.8
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	--(c)	2.40E-06	8.40E-03	--	
Cadmium	7440-43-9	--	0.0045	2.22E-05	1.80E-03	6.30E+00	1.40E-04	35
Carbon disulfide	75-15-0	VOC	0.00039	--(c)	--	--	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	--(c)	1.50E-05	5.25E-02	--	
Chloride	16887-00-6	--	9.821328	4.84E-02	--	--	--	
Chlorobenzene	108-90-7	VOC	0.00041	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.00022061	--(c)	2.30E-05	8.05E-02	--	
Chromium	7440-47-3	--	0.007505402	3.70E-05	--	--	--	
cis-1,2-Dichloroethylene	156-59-2	VOC	0.0002	--(c)	--	--	--	
Copper	7440-50-8	--	0.002993571	1.47E-05	--	--	--	
Fluoride	16984-48-8	--	0.32861624	1.62E-03	--	--	--	
Iron	7439-89-6	--	0.47301923	2.33E-03	--	--	--	
Lead	7439-92-1	--	0.000710361	3.50E-06	--	--	--	
Lithium	7439-93-2	--	0.0083	4.09E-05	--	--	--	
Manganese	7439-96-5	--	0.011254937	5.55E-05	--	--	--	
Methanol	67-56-1	--	1.1	5.42E-03	--	--	--	
Methylene chloride	75-09-2	VOC	0.000852962	--(c)	4.70E-07	1.65E-03	--	
Molybdenum	7439-98-7	--	0.0015	7.39E-06	--	--	--	
Nickel	7440-02-0	--	0.003603478	1.78E-05	2.60E-04	9.10E-01	1.62E-05	4.1
Nitrate	14797-55-8	--	23.756902	1.17E-01	--	--	--	
Nitrite	14797-65-0	--	0.079227256	3.90E-04	--	--	--	
o-Xylene	95-47-6	VOC	0.000210551	--(c)	--	--	--	
Silver	7440-22-4	--	0.005341496	2.63E-05	--	--	--	
Strontium	7440-24-6	--	0.36357229	1.79E-03	--	--	--	
Sulfate	14808-79-8	--	45.069738	2.22E-01	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	--(c)	5.90E-06	2.07E-02	--	
Toluene	108-88-3	VOC	0.000274725	--(c)	--	--	--	
Tributyl phosphate	126-73-8	SVOC	0.040836371	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000492361	--(c)	2.50E-05	8.75E-02	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	--(c)	--	--	--	
Uranium	7440-61-1	--	0.01625113	8.01E-05	--	--	--	
Vanadium	7440-62-2	--	0.013487657	6.65E-05	--	--	--	
Vinyl chloride	75-01-4	VOC	0.0018	--(c)	4.40E-06	1.54E-02	--	
Zinc	7440-66-6	--	0.10896358	5.37E-04	--	--	--	
Total ELCR							3.98E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of volatile compounds in vapor is presented in Table D-2

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to VOCs/SVOCs in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water (*Id,l*)
can be neglected and total dermal intake (*Id,total*) is equal to dermal intake from VOCs/SVOCs in sweat lodge vapor (*Id,v*)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 3, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight[b]	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF1	0.01	m/cm
Conversion factor	CF2	365	day/yr

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
(m+p)-Xylene[f]	179601-23-1	VOC	0.0005	0.053	1.30E-08	2.00E-01	1	6.51E-08	0.50
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	0.013	7.69E-09	2.00E+00	1	3.85E-09	0.029
1,1-Dichloroethane	75-34-3	VOC	0.000389235	0.0067	1.28E-09	2.00E-01	1	6.40E-09	0.049
1,1-Dichloroethene	75-35-4	VOC	0.000164225	0.012	9.68E-10	5.00E-02	1	1.94E-08	0.15
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	6.04E-08	9.00E-02	1	6.71E-07	5.1
1,2-Dichloroethane	107-06-2	VOC	0.000305426	0.0042	6.30E-10	2.00E-02	1	3.15E-08	0.24
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	0.042	2.70E-09	7.00E-02	1	3.86E-08	0.29
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	1.31E-09	1.00E-01	1	1.31E-08	0.100
2-Butanone	78-93-3	VOC	0.0029	0.00096	1.37E-09	6.00E-01	1	2.28E-09	0.017
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	8.49E-10	8.00E-02	1	1.06E-08	0.081
Acetone[d]	67-64-1	VOC	0.00128316	0.000512	3.23E-10	9.00E-01	1	3.58E-10	0.0027
Aluminum	7429-90-5	--	0.041755539	0.001	--(c)	1.00E+00	1	--	
Arsenic	7440-38-2	--	0.003060574	0.001	--(c)	3.00E-04	1	--	
Barium	7440-39-3	--	0.068082679	0.001	--(c)	2.00E-01	0.07	--	
Benzene	71-43-2	VOC	0.0019	0.015	1.40E-08	4.00E-03	1	3.50E-06	27
Benzyl alcohol[d]	100-51-6	SVOC	0.0027	0.00209	2.77E-09	1.00E-01	1	2.77E-08	0.21
Beryllium	7440-41-7	--	0.000360659	0.001	--(c)	2.00E-03	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	0.025	1.56E-08	2.00E-02	1	7.80E-07	5.9
Cadmium	7440-43-9	--	0.0045	0.001	--(c)	5.00E-04	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00039	0.017	3.26E-09	1.00E-01	1	3.26E-08	0.25
Carbon tetrachloride	56-23-5	VOC	0.000164414	0.016	1.29E-09	7.00E-04	1	1.85E-06	14
Chloride	16887-00-6	--	9.821328	0.001	--(c)	--	1	--	
Chlorobenzene	108-90-7	VOC	0.00041	0.028	5.64E-09	2.00E-02	1	2.82E-07	2.1
Chloroform	67-66-3	VOC	0.00022061	0.0068	7.37E-10	1.00E-02	1	7.37E-08	0.56
Chromium	7440-47-3	--	0.007505402	0.001	--(c)	1.50E+00	0.013	--	
cis-1,2-Dichloroethylene[e]	156-59-2	VOC	0.0002	0.0077	7.56E-10	1.00E-02	1	7.56E-08	0.58
Copper	7440-50-8	--	0.002993571	0.001	--(c)	4.00E-02	1	--	
Fluoride	16984-48-8	--	0.32861624	0.001	--(c)	6.00E-02	1	--	
Iron	7439-89-6	--	0.47301923	0.001	--(c)	7.00E-01	1	--	
Lead	7439-92-1	--	0.000710361	0.0001	--(c)	--	1	--	
Lithium	7439-93-2	--	0.0083	0.001	--(c)	2.00E-03	1	--	
Manganese	7439-96-5	--	0.011254937	0.001	--(c)	2.40E-02	0.04	--	
Methanol	67-56-1	--	1.1	0.00032	--(c)	5.00E-01	1	--	
Methylene chloride	75-09-2	VOC	0.000852962	0.0035	1.47E-09	6.00E-02	1	2.44E-08	0.19
Molybdenum	7439-98-7	--	0.0015	0.001	--(c)	5.00E-03	1	--	
Nickel	7440-02-0	--	0.003603478	0.0002	--(c)	2.00E-02	0.04	--	

Nitrate	14797-55-8	--	23.756902	0.001	--(c)	7.10E+00	1	--	
Nitrite	14797-65-0	--	0.079227256	0.001	--(c)	3.00E-01	1	--	
o-Xylene[f]	95-47-6	VOC	0.000210551	0.054	5.58E-09	2.00E-01	1	2.79E-08	0.21
Silver	7440-22-4	--	0.005341496	0.0006	--(c)	5.00E-03	0.04	--	
Strontium	7440-24-6	--	0.36357229	0.001	--(c)	6.00E-01	1	--	
Sulfate	14808-79-8	--	45.069738	0.001	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	0.033	1.61E-08	1.00E-02	1	1.61E-06	12
Toluene	108-88-3	VOC	0.000274725	0.031	4.18E-09	8.00E-02	1	5.23E-08	0.40
Tributyl phosphate[d]	126-73-8	SVOC	0.040836371	0.0228	4.57E-07	2.00E-01	1	2.29E-06	17
Trichloroethene	79-01-6	VOC	0.000492361	0.012	2.90E-09	--	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	3.70E-09	3.00E-01	1	1.23E-08	0.094
Uranium	7440-61-1	--	0.01625113	0.001	--(c)	3.00E-03	1	--	
Vanadium	7440-62-2	--	0.013487657	0.001	--(c)	5.00E-03	1	--	
Vinyl chloride[d]	75-01-4	VOC	0.0018	0.0056	4.95E-09	3.00E-03	1	1.65E-06	13
Zinc	7440-66-6	--	0.10896358	0.0006	--(c)	3.00E-01	1	--	
Total								1.31E-05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal absorption of nonvolatile chemicals is presented in tables D-5 and D-6

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

[e] for cis-1,2-dichloroethyelene the chemical-specific inputs are assummed to be the same as trans-1,2-dichloroethylene

[f] for (m+p) xylenes and o-xylene the chemical-specific inputs are assummed to be the same as m-xylene

-- = indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
(m+p)-Xylene[f]	179601-23-1	VOC	0.0005	0.053	1.26E-08	--	1	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	0.013	7.47E-09	--	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	0.0067	1.24E-09	--	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	0.012	9.40E-10	--	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	5.87E-08	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	0.0042	6.12E-10	9.10E-02	1	5.57E-11	0.32
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	0.042	2.62E-09	5.40E-03	1	1.42E-11	0.081
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	1.28E-09	1.10E-02	1	1.40E-11	0.080
2-Butanone	78-93-3	VOC	0.0029	0.00096	1.33E-09	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	8.24E-10	--	1	--	
Acetone[d]	67-64-1	VOC	0.00128316	0.000512	3.13E-10	--	1	--	
Aluminum	7429-90-5	--	0.041755539	0.001	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.003060574	0.001	--(c)	1.50E+00	1	--	
Barium	7440-39-3	--	0.068082679	0.001	--(c)	--	0.07	--	
Benzene	71-43-2	VOC	0.0019	0.015	1.36E-08	5.50E-02	1	7.48E-10	4.3
Benzyl alcohol[d]	100-51-6	SVOC	0.0027	0.00209	2.69E-09	--	1	--	
Beryllium	7440-41-7	--	0.000360659	0.001	--(c)	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	0.025	1.52E-08	1.40E-02	1	2.12E-10	1.2
Cadmium	7440-43-9	--	0.0045	0.001	--(c)	--	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00039	0.017	3.16E-09	--	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	0.016	1.26E-09	1.30E-01	1	1.63E-10	0.93
Chloride	16887-00-6	--	9.821328	0.001	--(c)	--	1	--	
Chlorobenzene	108-90-7	VOC	0.00041	0.028	5.48E-09	--	1	--	
Chloroform	67-66-3	VOC	0.00022061	0.0068	7.16E-10	3.10E-02	1	2.22E-11	0.13
Chromium	7440-47-3	--	0.007505402	0.001	--(c)	--	0.013	--	
cis-1,2-Dichloroethylene[e]	156-59-2	VOC	0.0002	0.0077	7.35E-10	--	1	--	
Copper	7440-50-8	--	0.002993571	0.001	--(c)	--	1	--	
Fluoride	16984-48-8	--	0.32861624	0.001	--(c)	--	1	--	
Iron	7439-89-6	--	0.47301923	0.001	--(c)	--	1	--	
Lead	7439-92-1	--	0.000710361	0.0001	--(c)	--	1	--	
Lithium	7439-93-2	--	0.0083	0.001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.011254937	0.001	--(c)	--	0.04	--	
Methanol	67-56-1	--	1.1	0.00032	--(c)	--	1	--	
Methylene chloride	75-09-2	VOC	0.000852962	0.0035	1.42E-09	7.50E-03	1	1.07E-11	0.061
Molybdenum	7439-98-7	--	0.0015	0.001	--(c)	--	1	--	
Nickel	7440-02-0	--	0.003603478	0.0002	--(c)	--	0.04	--	
Nitrate	14797-55-8	--	23.756902	0.001	--(c)	--	1	--	
Nitrite	14797-65-0	--	0.079227256	0.001	--(c)	--	1	--	
o-Xylene[f]	95-47-6	VOC	0.000210551	0.054	5.42E-09	--	1	--	
Silver	7440-22-4	--	0.005341496	0.0006	--(c)	--	0.04	--	
Strontium	7440-24-6	--	0.36357229	0.001	--(c)	--	1	--	
Sulfate	14808-79-8	--	45.069738	0.001	--(c)	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	0.033	1.56E-08	5.40E-01	1	8.44E-09	48
Toluene	108-88-3	VOC	0.000274725	0.031	4.06E-09	--	1	--	
Tributyl phosphate[d]	126-73-8	SVOC	0.040836371	0.0228	4.44E-07	9.20E-03	1	4.09E-09	23
Trichloroethene	79-01-6	VOC	0.000492361	0.012	2.82E-09	8.90E-02	1	2.51E-10	1.4
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	3.60E-09	--	1	--	
Uranium	7440-61-1	--	0.01625113	0.001	--(c)	--	1	--	
Vanadium	7440-62-2	--	0.013487657	0.001	--(c)	--	1	--	
Vinyl chloride[d]	75-01-4	VOC	0.0018	0.0056	4.81E-09	7.20E-01	1	3.46E-09	20
Zinc	7440-66-6	--	0.10896358	0.0006	--(c)	--	1	--	
Total ELCR								1.75E-08	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Dermal absorption of nonvolatile chemicals is presented in tables D-5 and D-6

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

[e] for cis-1,2-dichloroethyelene the chemical-specific inputs are assummed to be the same as trans-1,2-dichloroethylene

[f] for (m+p) xylenes and o-xylene the chemical-specific inputs are assummed to be the same as m-xylene

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge condensed water

Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4)

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

Model assumes concentration of nonvolatiles in condensed water is equal to concentration in water used to create steam

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from liquid	$I_{d,l}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight[b]	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,l}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
(m+p)-Xylene[f]	179601-23-1	VOC	0.0005	0.053	--(c)	2.00E-01	1	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	0.013	--(c)	2.00E+00	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	0.0067	--(c)	2.00E-01	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	0.012	--(c)	5.00E-02	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	9.00E-02	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	0.0042	--(c)	2.00E-02	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	0.042	--(c)	7.00E-02	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.00E-01	1	--	
2-Butanone	78-93-3	VOC	0.0029	0.00096	--(c)	6.00E-01	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	8.00E-02	1	--	
Acetone[d]	67-64-1	VOC	0.00128316	0.000512	--(c)	9.00E-01	1	--	
Aluminum	7429-90-5	--	0.041755539	0.001	2.15E-05	1.00E+00	1	2.15E-05	0.015
Arsenic	7440-38-2	--	0.003060574	0.001	1.57E-06	3.00E-04	1	5.25E-03	3.7
Barium	7440-39-3	--	0.068082679	0.001	3.50E-05	2.00E-01	0.07	2.50E-03	1.8
Benzene	71-43-2	VOC	0.0019	0.015	--(c)	4.00E-03	1	--	
Benzyl alcohol[d]	100-51-6	SVOC	0.0027	0.00209	--(c)	1.00E-01	1	--	
Beryllium	7440-41-7	--	0.000360659	0.001	1.85E-07	2.00E-03	0.007	1.32E-02	9.4
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	0.025	--(c)	2.00E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	2.31E-06	5.00E-04	0.05	9.26E-02	66
Carbon disulfide	75-15-0	VOC	0.00039	0.017	--(c)	1.00E-01	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	9.821328	0.001	5.05E-03	--	1	--	
Chlorobenzene	108-90-7	VOC	0.00041	0.028	--(c)	2.00E-02	1	--	
Chloroform	67-66-3	VOC	0.00022061	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.007505402	0.001	3.86E-06	1.50E+00	0.013	1.98E-04	0.14
cis-1,2-Dichloroethylene[e]	156-59-2	VOC	0.0002	0.0077	--(c)	1.00E-02	1	--	
Copper	7440-50-8	--	0.002993571	0.001	1.54E-06	4.00E-02	1	3.85E-05	0.027
Fluoride	16984-48-8	--	0.32861624	0.001	1.69E-04	6.00E-02	1	2.82E-03	2.0
Iron	7439-89-6	--	0.47301923	0.001	2.43E-04	7.00E-01	1	3.48E-04	0.25
Lead	7439-92-1	--	0.000710361	0.0001	3.65E-08	--	1	--	
Lithium	7439-93-2	--	0.0083	0.001	4.27E-06	2.00E-03	1	2.13E-03	1.5
Manganese	7439-96-5	--	0.011254937	0.001	5.79E-06	2.40E-02	0.04	6.03E-03	4.3
Methanol	67-56-1	--	1.1	0.00032	1.81E-04	5.00E-01	1	3.62E-04	0.26
Methylene chloride	75-09-2	VOC	0.000852962	0.0035	--(c)	6.00E-02	1	--	

Molybdenum	7439-98-7	--	0.0015	0.001	7.71E-07	5.00E-03	1	1.54E-04	0.11
Nickel	7440-02-0	--	0.003603478	0.0002	3.71E-07	2.00E-02	0.04	4.63E-04	0.33
Nitrate	14797-55-8	--	23.756902	0.001	1.22E-02	7.10E+00	1	1.72E-03	1.2
Nitrite	14797-65-0	--	0.079227256	0.001	4.07E-05	3.00E-01	1	1.36E-04	0.096
o-Xylene[f]	95-47-6	VOC	0.000210551	0.054	--(c)	2.00E-01	1	--	
Silver	7440-22-4	--	0.005341496	0.0006	1.65E-06	5.00E-03	0.04	8.24E-03	5.9
Strontium	7440-24-6	--	0.36357229	0.001	1.87E-04	6.00E-01	1	3.12E-04	0.22
Sulfate	14808-79-8	--	45.069738	0.001	2.32E-02	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	0.033	--(c)	1.00E-02	1	--	
Toluene	108-88-3	VOC	0.000274725	0.031	--(c)	8.00E-02	1	--	
Tributyl phosphate[d]	126-73-8	SVOC	0.040836371	0.0228	--(c)	2.00E-01	1	--	
Trichloroethene	79-01-6	VOC	0.000492361	0.012	--(c)	--	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	3.00E-01	1	--	
Uranium	7440-61-1	--	0.01625113	0.001	8.36E-06	3.00E-03	1	2.79E-03	2.0
Vanadium	7440-62-2	--	0.013487657	0.001	6.94E-06	5.00E-03	1	1.39E-03	0.99
Vinyl chloride[d]	75-01-4	VOC	0.0018	0.0056	--(c)	3.00E-03	1	--	
Zinc	7440-66-6	--	0.10896358	0.0006	3.36E-05	3.00E-01	1	1.12E-04	0.080
Total								1.41E-01	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

[e] for cis-1,2-dichloroethyelene the chemical-specific inputs are assummed to be the same as trans-1,2-dichloroethylene

[f] for (m+p) xylenes and o-xylene the chemical-specific inputs are assummed to be the same as m-xylene

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{gw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,i}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
(m+p)-Xylene[f]	179601-23-1	VOC	0.0005	0.053	--(c)	--	1	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	0.013	--(c)	--	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	0.0067	--(c)	--	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	0.012	--(c)	--	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	0.0042	--(c)	9.10E-02	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	0.042	--(c)	5.40E-03	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.10E-02	1	--	
2-Butanone	78-93-3	VOC	0.0029	0.00096	--(c)	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	--	1	--	
Acetone[d]	67-64-1	VOC	0.00128316	0.000512	--(c)	--	1	--	
Aluminum	7429-90-5	--	0.041755539	0.001	2.09E-05	--	1	--	
Arsenic	7440-38-2	--	0.003060574	0.001	1.53E-06	1.50E+00	1	2.29E-06	100
Barium	7440-39-3	--	0.068082679	0.001	3.40E-05	--	0.07	--	
Benzene	71-43-2	VOC	0.0019	0.015	--(c)	5.50E-02	1	--	
Benzyl alcohol[d]	100-51-6	SVOC	0.0027	0.00209	--(c)	--	1	--	
Beryllium	7440-41-7	--	0.000360659	0.001	1.80E-07	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	2.25E-06	--	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00039	0.017	--(c)	--	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	9.821328	0.001	4.91E-03	--	1	--	
Chlorobenzene	108-90-7	VOC	0.00041	0.028	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.00022061	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.007505402	0.001	3.75E-06	--	0.013	--	
cis-1,2-Dichloroethylene[e]	156-59-2	VOC	0.0002	0.0077	--(c)	--	1	--	
Copper	7440-50-8	--	0.002993571	0.001	1.50E-06	--	1	--	
Fluoride	16984-48-8	--	0.32861624	0.001	1.64E-04	--	1	--	
Iron	7439-89-6	--	0.47301923	0.001	2.36E-04	--	1	--	
Lead	7439-92-1	--	0.000710361	0.0001	3.55E-08	--	1	--	
Lithium	7439-93-2	--	0.0083	0.001	4.15E-06	--	1	--	
Manganese	7439-96-5	--	0.011254937	0.001	5.62E-06	--	0.04	--	
Methanol	67-56-1	--	1.1	0.00032	1.76E-04	--	1	--	
Methylene chloride	75-09-2	VOC	0.000852962	0.0035	--(c)	7.50E-03	1	--	
Molybdenum	7439-98-7	--	0.0015	0.001	7.49E-07	--	1	--	
Nickel	7440-02-0	--	0.003603478	0.0002	3.60E-07	--	0.04	--	
Nitrate	14797-55-8	--	23.756902	0.001	1.19E-02	--	1	--	
Nitrite	14797-65-0	--	0.079227256	0.001	3.96E-05	--	1	--	
o-Xylene[f]	95-47-6	VOC	0.000210551	0.054	--(c)	--	1	--	
Silver	7440-22-4	--	0.005341496	0.0006	1.60E-06	--	0.04	--	
Strontium	7440-24-6	--	0.36357229	0.001	1.82E-04	--	1	--	
Sulfate	14808-79-8	--	45.069738	0.001	2.25E-02	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	0.033	--(c)	5.40E-01	1	--	
Toluene	108-88-3	VOC	0.000274725	0.031	--(c)	--	1	--	
Tributyl phosphate[d]	126-73-8	SVOC	0.040836371	0.0228	--(c)	9.20E-03	1	--	
Trichloroethene	79-01-6	VOC	0.000492361	0.012	--(c)	8.90E-02	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	--	1	--	
Uranium	7440-61-1	--	0.01625113	0.001	8.12E-06	--	1	--	
Vanadium	7440-62-2	--	0.013487657	0.001	6.74E-06	--	1	--	
Vinyl chloride[d]	75-01-4	VOC	0.0018	0.0056	--(c)	7.20E-01	1	--	
Zinc	7440-66-6	--	0.10896358	0.0006	3.27E-05	--	1	--	
Total ELCR								2.29E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

[e] for cis-1,2-dichloroethyelene the chemical-specific inputs are assummed to be the same as trans-1,2-dichloroethylene

[f] for (m+p) xylenes and o-xylene the chemical-specific inputs are assummed to be the same as m-xylene

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--near-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/day
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Ideal gas law constant	R	62.37	(mmHg-L)/(gmole-K)
Temperature of the sweat lodge	T	338.7	K
Density of liquid water	rhow	1000	g/L
Conversion factor	CF_2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
(m+p)-Xylene[f]	179601-23-1	VOC	0.0005	0.053	--(c)	2.00E-01	1	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	0.013	--(c)	2.00E+00	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	0.0067	--(c)	2.00E-01	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	0.012	--(c)	5.00E-02	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	9.00E-02	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	0.0042	--(c)	2.00E-02	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	0.042	--(c)	7.00E-02	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.00E-01	1	--	
2-Butanone	78-93-3	VOC	0.0029	0.00096	--(c)	6.00E-01	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	8.00E-02	1	--	
Acetone[d]	67-64-1	VOC	0.00128316	0.000512	--(c)	9.00E-01	1	--	
Aluminum	7429-90-5	--	0.041755539	0.001	3.52E-09	1.00E+00	1	3.52E-09	0.015
Arsenic	7440-38-2	--	0.003060574	0.001	2.58E-10	3.00E-04	1	8.60E-07	3.7
Barium	7440-39-3	--	0.068082679	0.001	5.74E-09	2.00E-01	0.07	4.10E-07	1.8
Benzene	71-43-2	VOC	0.0019	0.015	--(c)	4.00E-03	1	--	
Benzyl alcohol[d]	100-51-6	SVOC	0.0027	0.00209	--(c)	1.00E-01	1	--	
Beryllium	7440-41-7	--	0.000360659	0.001	3.04E-11	2.00E-03	0.007	2.17E-06	9.4
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	0.025	--(c)	2.00E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	3.79E-10	5.00E-04	0.05	1.52E-05	66
Carbon disulfide	75-15-0	VOC	0.00039	0.017	--(c)	1.00E-01	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	9.821328	0.001	8.28E-07	--	1	--	
Chlorobenzene	108-90-7	VOC	0.00041	0.028	--(c)	2.00E-02	1	--	
Chloroform	67-66-3	VOC	0.00022061	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.007505402	0.001	6.32E-10	1.50E+00	0.013	3.24E-08	0.14
cis-1,2-Dichloroethylene[e]	156-59-2	VOC	0.0002	0.0077	--(c)	1.00E-02	1	--	
Copper	7440-50-8	--	0.002993571	0.001	2.52E-10	4.00E-02	1	6.31E-09	0.027
Fluoride	16984-48-8	--	0.32861624	0.001	2.77E-08	6.00E-02	1	4.62E-07	2.0
Iron	7439-89-6	--	0.47301923	0.001	3.99E-08	7.00E-01	1	5.69E-08	0.25
Lead	7439-92-1	--	0.000710361	0.0001	5.99E-12	--	1	--	
Lithium	7439-93-2	--	0.0083	0.001	6.99E-10	2.00E-03	1	3.50E-07	1.5
Manganese	7439-96-5	--	0.011254937	0.001	9.48E-10	2.40E-02	0.04	9.88E-07	4.3
Methanol	67-56-1	--	1.1	0.00032	2.97E-08	5.00E-01	1	5.93E-08	0.26
Methylene chloride	75-09-2	VOC	0.000852962	0.0035	--(c)	6.00E-02	1	--	
Molybdenum	7439-98-7	--	0.0015	0.001	1.26E-10	5.00E-03	1	2.53E-08	0.11
Nickel	7440-02-0	--	0.003603478	0.0002	6.07E-11	2.00E-02	0.04	7.59E-08	0.33
Nitrate	14797-55-8	--	23.756902	0.001	2.00E-06	7.10E+00	1	2.82E-07	1.2
Nitrite	14797-65-0	--	0.079227256	0.001	6.68E-09	3.00E-01	1	2.23E-08	0.096
o-Xylene[f]	95-47-6	VOC	0.000210551	0.054	--(c)	2.00E-01	1	--	
Silver	7440-22-4	--	0.005341496	0.0006	2.70E-10	5.00E-03	0.04	1.35E-06	5.9
Strontium	7440-24-6	--	0.36357229	0.001	3.06E-08	6.00E-01	1	5.11E-08	0.22
Sulfate	14808-79-8	--	45.069738	0.001	3.80E-06	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	0.033	--(c)	1.00E-02	1	--	
Toluene	108-88-3	VOC	0.000274725	0.031	--(c)	8.00E-02	1	--	
Tributyl phosphate[d]	126-73-8	SVOC	0.040836371	0.0228	--(c)	2.00E-01	1	--	
Trichloroethene	79-01-6	VOC	0.000492361	0.012	--(c)	--	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	3.00E-01	1	--	
Uranium	7440-61-1	--	0.01625113	0.001	1.37E-09	3.00E-03	1	4.56E-07	2.0
Vanadium	7440-62-2	--	0.013487657	0.001	1.14E-09	5.00E-03	1	2.27E-07	0.99
Vinyl chloride[d]	75-01-4	VOC	0.0018	0.0056	--(c)	3.00E-03	1	--	
Zinc	7440-66-6	--	0.10896358	0.0006	5.51E-09	3.00E-01	1	1.84E-08	0.080
Total								2.31E-05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal Absorption of volatiles is presented in table D-4

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

[e] for cis-1,2-dichloroethyelene the chemical-specific inputs are assummed to be the same as trans-1,2-dichloroethylene

[f] for (m+p) xylenes and o-xylene the chemical-specific inputs are assummed to be the same as m-xylene

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
(m+p)-Xylene[f]	179601-23-1	VOC	0.0005	0.053	--(c)	--	1	--	
1,1,1-Trichloroethane	71-55-6	VOC	0.001204711	0.013	--(c)	--	1	--	
1,1-Dichloroethane	75-34-3	VOC	0.000389235	0.0067	--(c)	--	1	--	
1,1-Dichloroethene	75-35-4	VOC	0.000164225	0.012	--(c)	--	1	--	
1,2-Dichlorobenzene	95-50-1	VOC	0.003	0.041	--(c)	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.000305426	0.0042	--(c)	9.10E-02	1	--	
1,4-Dichlorobenzene	106-46-7	VOC	0.000130994	0.042	--(c)	5.40E-03	1	--	
1,4-Dioxane	123-91-1	SVOC	0.0081	0.00033	--(c)	1.10E-02	1	--	
2-Butanone	78-93-3	VOC	0.0029	0.00096	--(c)	--	1	--	
2-Pentanone, 4-Methyl	108-10-1	VOC	0.00064	0.0027	--(c)	--	1	--	
Acetone[d]	67-64-1	VOC	0.00128316	0.000512	--(c)	--	1	--	
Aluminum	7429-90-5	--	0.041755539	0.001	3.42E-09	--	1	--	
Arsenic	7440-38-2	--	0.003060574	0.001	2.51E-10	1.50E+00	1	3.76E-10	100
Barium	7440-39-3	--	0.068082679	0.001	5.57E-09	--	0.07	--	
Benzene	71-43-2	VOC	0.0019	0.015	--(c)	5.50E-02	1	--	
Benzyl alcohol[d]	100-51-6	SVOC	0.0027	0.00209	--(c)	--	1	--	
Beryllium	7440-41-7	--	0.000360659	0.001	2.95E-11	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.001271216	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.0045	0.001	3.68E-10	--	0.05	--	
Carbon disulfide	75-15-0	VOC	0.00039	0.017	--(c)	--	1	--	
Carbon tetrachloride	56-23-5	VOC	0.000164414	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	9.821328	0.001	8.04E-07	--	1	--	
Chlorobenzene	108-90-7	VOC	0.00041	0.028	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.00022061	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.007505402	0.001	6.14E-10	--	0.013	--	
cis-1,2-Dichloroethylene[e]	156-59-2	VOC	0.0002	0.0077	--(c)	--	1	--	
Copper	7440-50-8	--	0.002993571	0.001	2.45E-10	--	1	--	
Fluoride	16984-48-8	--	0.32861624	0.001	2.69E-08	--	1	--	
Iron	7439-89-6	--	0.47301923	0.001	3.87E-08	--	1	--	
Lead	7439-92-1	--	0.000710361	0.0001	5.82E-12	--	1	--	
Lithium	7439-93-2	--	0.0083	0.001	6.79E-10	--	1	--	
Manganese	7439-96-5	--	0.011254937	0.001	9.21E-10	--	0.04	--	
Methanol	67-56-1	--	1.1	0.00032	2.88E-08	--	1	--	
Methylene chloride	75-09-2	VOC	0.000852962	0.0035	--(c)	7.50E-03	1	--	
Molybdenum	7439-98-7	--	0.0015	0.001	1.23E-10	--	1	--	
Nickel	7440-02-0	--	0.003603478	0.0002	5.90E-11	--	0.04	--	
Nitrate	14797-55-8	--	23.756902	0.001	1.94E-06	--	1	--	
Nitrite	14797-65-0	--	0.079227256	0.001	6.49E-09	--	1	--	
o-Xylene[f]	95-47-6	VOC	0.000210551	0.054	--(c)	--	1	--	
Silver	7440-22-4	--	0.005341496	0.0006	2.62E-10	--	0.04	--	
Strontium	7440-24-6	--	0.36357229	0.001	2.98E-08	--	1	--	
Sulfate	14808-79-8	--	45.069738	0.001	3.69E-06	--	--	--	
Tetrachloroethene	127-18-4	VOC	0.000993146	0.033	--(c)	5.40E-01	1	--	
Toluene	108-88-3	VOC	0.000274725	0.031	--(c)	--	1	--	
Tributyl phosphate[d]	126-73-8	SVOC	0.040836371	0.0228	--(c)	9.20E-03	1	--	
Trichloroethene	79-01-6	VOC	0.000492361	0.012	--(c)	8.90E-02	1	--	
Trichloromonofluoromethane	75-69-4	VOC	0.00058	0.013	--(c)	--	1	--	
Uranium	7440-61-1	--	0.01625113	0.001	1.33E-09	--	1	--	
Vanadium	7440-62-2	--	0.013487657	0.001	1.10E-09	--	1	--	
Vinyl chloride[d]	75-01-4	VOC	0.0018	0.0056	--(c)	7.20E-01	1	--	
Zinc	7440-66-6	--	0.10896358	0.0006	5.35E-09	--	1	--	
Total ELCR								3.76E-10	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Dermal Absorption of volatiles is presented in table D-4

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

[e] for cis-1,2-dichloroethyelene the chemical-specific inputs are assummed to be the same as trans-1,2-dichloroethylene

[f] for (m+p) xylenes and o-xylene the chemical-specific inputs are assummed to be the same as m-xylene

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area -- Yakima Nation

Cancer risk from inhalation of volatile radioactive contaminants in sweat lodge vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Carbon-14	14762-75-5	--	15.2	--(c)	7.07E-12	--	
Gross alpha	12587-46-1	--	5.9880167	--(c)	--	--	
Gross beta	12587-47-2	--	26.717649	--(c)	--	--	
Iodine-129	15046-84-1	--	1.7529182	--(c)	6.07E-11	--	
Nickel-63	13981-37-8	--	7.66125	--(c)	1.64E-12	--	
Protactinium-231	14331-85-2	--	0.308	--(c)	4.55E-08	--	
Strontium-90	10098-97-2	--	0.611	--(c)	1.05E-10	--	
Technetium-99	14133-76-7	--	75.671084	--(c)	1.41E-11	--	
Tritium	10028-17-8	Yes	497899.63	2.56E+10	5.62E-14	1.44E-03	100
Total ELCR						1.44E-03	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of nonvolatile contaminants is presented in Table D-8

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Far-field exposure area -- Yakima Nation

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Far-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Carbon-14	14762-75-5	--	15.2	1.34E+05	7.07E-12	9.47E-07	0.70
Gross alpha	12587-46-1	--	5.9880167	5.28E+04	--	--	
Gross beta	12587-47-2	--	26.717649	2.35E+05	--	--	
Iodine-129	15046-84-1	--	1.7529182	1.54E+04	6.07E-11	9.38E-07	0.69
Nickel-63	13981-37-8	--	7.66125	6.75E+04	1.64E-12	1.11E-07	0.082
Protactinium-231	14331-85-2	--	0.308	2.71E+03	4.55E-08	1.23E-04	91
Strontium-90	10098-97-2	--	0.611	5.38E+03	1.05E-10	5.65E-07	0.42
Technetium-99	14133-76-7	--	75.671084	6.67E+05	1.41E-11	9.40E-06	6.9
Tritium	10028-17-8	Yes	497899.63	--(c)	5.62E-14	--	
Total ELCR						1.35E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of volatile contaminants in presented in table D-7

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of Yakima Nationa Sweat Lodge Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	HQ (Inhalation) (Volatiles) (unitless)	HQ (Inhalation) (Nonvolatiles) (unitless)	HQ (Dermal, Vapor, volatiles) (unitless)	HQ (Dermal, Liquid, Nonvolatiles) (unitless)	HQ (Dermal, Vapor, Nonvolatiles) (unitless)	Total HI (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--	--	--	--	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.6E-09	--	--	--	--	--	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--	--	--	--	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--	--	--	--	--	--	
1,2-Dichloroethane	0.00064	VOC	2.76E-05	--	6.60E-08	--	--	2.77E-05	2.82E-05
2,3,4,6-Tetrachlorophenol	0.0077	SVOC	--	--	8.95E-06	--	--	8.95E-06	9.12E-06
2-Methylphenol (cresol, o-)	0.0075	SVOC	1.29E-03	--	5.67E-07	--	--	1.29E-03	0.0013
4-Nitrophenol	0.0072	SVOC	--	--	2.12E-06	--	--	2.12E-06	2.16E-06
Aluminum	0.11217909	--	--	3.98E-01	--	5.77E-05	9.45E-09	3.98E-01	0.41
Arsenic	0.005765062	--	--	6.82E+00	--	9.88E-03	1.62E-06	6.83E+00	7.0
Barium	0.052626075	--	--	1.87E+00	--	1.93E-03	3.17E-07	1.87E+00	1.9
Beryllium	0.00034431	--	--	3.06E-01	--	1.26E-02	2.07E-06	3.18E-01	0.32
Bis(2-ethylhexyl) phthalate	0.011	SVOC	--	--	6.75E-06	--	--	6.75E-06	6.88E-06
Cadmium	0.018	--	--	3.20E+01	--	3.70E-01	6.07E-05	3.23E+01	33
Carbon tetrachloride	0.0018	VOC	9.80E-04	--	2.02E-05	--	--	1.00E-03	0.0010
Chloride	11.439962	--	--	--	--	--	--	--	
Chloroform	0.00038106	VOC	4.02E-04	--	1.27E-07	--	--	4.02E-04	4.10E-04
Chromium	0.015609389	--	--	--	--	4.12E-04	6.75E-08	4.12E-04	4.20E-04
Cobalt	0.004378857	--	--	1.30E+01	--	3.00E-03	4.92E-07	1.30E+01	13
Copper	0.004482187	--	--	--	--	5.76E-05	9.44E-09	5.76E-05	5.87E-05
Dinoseb(2-secButyl-4,6-dinitrophenol)	0.005506461	SVOC	--	--	4.41E-05	--	--	4.41E-05	4.49E-05
Fluoride	0.31715504	--	--	4.33E-01	--	2.72E-03	4.45E-07	4.36E-01	0.44
Hexavalent Chromium	0.191	--	--	3.39E+01	--	2.62E+00	4.29E-04	3.65E+01	37
Iron	0.14355212	--	--	--	--	1.05E-04	1.73E-08	1.05E-04	1.08E-04
Lead	0.00142074	--	--	--	--	--	--	--	
Manganese	0.009635007	--	--	3.42E+00	--	5.16E-03	8.46E-07	3.43E+00	3.5
Nickel	0.010760715	--	--	2.12E+00	--	1.38E-03	2.27E-07	2.12E+00	2.2
Nitrate	31.205071	--	--	--	--	2.26E-03	3.70E-07	2.26E-03	0.0023
Nitrite	0.034429846	--	--	--	--	5.90E-05	9.67E-09	5.90E-05	6.02E-05
Nitrogen in Nitrite and Nitrate	14.7	--	--	--	--	4.73E-03	7.74E-07	4.73E-03	0.0048
Octachlorodibenzofuran	9.9649E-09	--	--	--	--	--	--	--	
Octachlorodibenzo-p-dioxin	5.6857E-09	--	--	--	--	--	--	--	
Silver	0.005650889	--	--	--	--	8.72E-03	1.43E-06	8.72E-03	0.0089
Strontium	0.26495344	--	--	--	--	2.27E-04	3.72E-08	2.27E-04	2.32E-04
Sulfate	56.164035	--	--	--	--	--	--	--	
Toluene	0.000065	VOC	1.34E-06	--	1.24E-08	--	--	1.36E-06	1.38E-06
Total petroleum hydrocarbons - gasoline range	0.05	--	--	--	--	--	--	--	
Trichloroethene	0.000570461	VOC	1.69E-03	--	--	--	--	1.69E-03	0.0017
Uranium	0.014879201	--	--	8.80E-01	--	2.55E-03	4.18E-07	8.83E-01	0.90
Vanadium	0.021937779	--	--	--	--	2.26E-03	3.70E-07	2.26E-03	0.0023
Zinc	0.092316084	--	--	--	--	9.50E-05	1.56E-08	9.50E-05	9.68E-05
Total			4.39E-03	95.06	8.29E-05	3.05	0.00	98.12	100

[a] Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

HI = hazard index.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of Yakima Nationa Sweat Lodge Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal, Vapor, volatiles) (unitless)	Risk (Dermal, Liquid, Nonvolatiles) (unitless)	Risk (Dermal, Vapor, Nonvolatiles) (unitless)	Total Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	3.734E-09	--	--	2.45E-08	--	--	--	2.45E-08	8.79E-06
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.6E-09	--	--	3.67E-08	--	5.27E-06	8.64E-10	5.31E-06	0.0019
1,2,3,4,7,8-Hexachlorodibenzofuran	2.9E-09	--	--	1.90E-07	--	4.24E-05	6.94E-09	4.26E-05	0.015
1,2,3,6,7,8-Hexachlorodibenzofuran	2.1E-09	--	--	1.38E-07	--	3.07E-05	5.03E-09	3.08E-05	0.011
1,2-Dichloroethane	0.00064	VOC	1.67E-06	--	1.17E-10	--	--	1.67E-06	6.01E-04
2,3,4,6-Tetrachlorophenol	0.0077	SVOC	--	--	--	--	--	--	
2-Methylphenol (cresol, o-)	0.0075	SVOC	--	--	--	--	--	--	
4-Nitrophenol	0.0072	SVOC	--	--	--	--	--	--	
Aluminum	0.11217909	--	--	--	--	--	--	--	
Arsenic	0.005765062	--	--	4.27E-04	--	4.32E-06	7.08E-10	4.32E-04	0.16
Barium	0.052626075	--	--	--	--	--	--	--	
Beryllium	0.00034431	--	--	1.42E-05	--	--	--	1.42E-05	0.0051
Bis(2-ethylhexyl) phthalate	0.011	SVOC	2.65E-06	--	1.84E-09	--	--	2.65E-06	9.53E-04
Cadmium	0.018	--	--	5.59E-04	--	--	--	5.59E-04	0.20
Carbon tetrachloride	0.0018	VOC	2.71E-06	--	1.79E-09	--	--	2.72E-06	9.75E-04
Chloride	11.439962	--	--	--	--	--	--	--	
Chloroform	0.00038106	VOC	8.81E-07	--	3.83E-11	--	--	8.81E-07	3.16E-04
Chromium	0.015609389	--	--	--	--	--	--	--	
Cobalt	0.004378857	--	--	6.80E-04	--	--	--	6.80E-04	0.24
Copper	0.004482187	--	--	--	--	--	--	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)	0.005506461	SVOC	--	--	--	--	--	--	
Fluoride	0.31715504	--	--	--	--	--	--	--	
Hexavalent Chromium	0.191	--	--	2.77E-01	--	--	--	2.77E-01	99
Iron	0.14355212	--	--	--	--	--	--	--	
Lead	0.00142074	--	--	--	--	--	--	--	
Manganese	0.009635007	--	--	--	--	--	--	--	
Nickel	0.010760715	--	--	4.82E-05	--	--	--	4.82E-05	0.017
Nitrate	31.205071	--	--	--	--	--	--	--	
Nitrite	0.034429846	--	--	--	--	--	--	--	
Nitrogen in Nitrite and Nitrate	14.7	--	--	--	--	--	--	--	
Octachlorodibenzofuran	9.9649E-09	--	--	1.96E-09	--	5.11E-07	8.37E-11	5.13E-07	1.84E-04
Octachlorodibenzo-p-dioxin	5.6857E-09	--	--	1.12E-09	--	1.29E-07	2.11E-11	1.30E-07	4.66E-05
Silver	0.005650889	--	--	--	--	--	--	--	
Strontium	0.26495344	--	--	--	--	--	--	--	
Sulfate	56.164035	--	--	--	--	--	--	--	
Toluene	0.000065	VOC	--	--	--	--	--	--	
Total petroleum hydrocarbons - gasoline range	0.05	--	--	--	--	--	--	--	
Trichloroethene	0.000570461	VOC	1.43E-06	--	2.91E-10	--	--	1.43E-06	5.15E-04
Uranium	0.014879201	--	--	--	--	--	--	--	
Vanadium	0.021937779	--	--	--	--	--	--	--	
Zinc	0.092316084	--	--	--	--	--	--	--	
Total ELCR			9.35E-06	2.78E-01	4.07E-09	8.33E-05	1.36E-08	2.78E-01	100

[a] Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

– = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Native American Risk Assessment (10-Year)--Summary of Yakima Nation Sweat Lodge Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.							
COPC	95 UCL Groundwater Concentration (pCi/L)	Volatile?[a]	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	4.8703439	No	--	--	--	--	
Iodine-129	3.1689247	No	--	1.69E-06	--	1.69E-06	0.2
Plutonium-239/240	0.029	No	--	8.51E-06	--	8.51E-06	1.0
Protactinium-231	0.28	No	--	1.12E-04	--	1.12E-04	12.8
Strontium-90	4.5802399	No	--	4.24E-06	--	4.24E-06	0.5
Technetium-99	1567.7398	No	--	1.95E-04	--	1.95E-04	22
Tritium	192557.5	Yes	5.56E-04	--	--	5.56E-04	63
Total ELCR			5.56E-04	3.21E-04	--	8.77E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from inhalation of VOCs/SVOCs in sweat lodge vapor
Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Contaminant concentration in water	C_{dw}	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF	365	day/yr

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(c)	--	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.6E-09	--(c)	--	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(c)	--	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(c)	--	--	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	1.89E-05	2.40E+00	6.86E-01	2.76E-05	0.63
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	2.28E-04	--	--	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	2.22E-04	6.00E-01	1.71E-01	1.29E-03	29
4-Nitrophenol	100-02-7	SVOC	0.0072	2.13E-04	--	--	--	
Aluminum	7429-90-5	--	0.11217909	--(c)	5.00E-03	1.43E-03	--	
Arsenic	7440-38-2	--	0.005765062	--(c)	1.50E-05	4.29E-06	--	
Barium	7440-39-3	--	0.052626075	--(c)	5.00E-04	1.43E-04	--	
Beryllium	7440-41-7	--	0.00034431	--(c)	2.00E-05	5.71E-06	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	3.25E-04	--	--	--	
Cadmium	7440-43-9	--	0.018	--(c)	1.00E-05	2.86E-06	--	
Carbon tetrachloride	56-23-5	VOC	0.0018	5.32E-05	1.90E-01	5.43E-02	9.80E-04	22
Chloride	16887-00-6	--	11.439962	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.00038106	1.13E-05	9.80E-02	2.80E-02	4.02E-04	9.2
Chromium	7440-47-3	--	0.015609389	--(c)	--	--	--	
Cobalt	7440-48-4	--	0.004378857	--(c)	6.00E-06	1.71E-06	--	
Copper	7440-50-8	--	0.004482187	--(c)	--	--	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	SVOC	0.005506461	1.63E-04	--	--	--	
Fluoride	16984-48-8	--	0.31715504	--(c)	1.30E-02	3.71E-03	--	
Hexavalent Chromium	18540-29-9	--	0.191	--(c)	1.00E-04	2.86E-05	--	
Iron	7439-89-6	--	0.14355212	--(c)	--	--	--	
Lead	7439-92-1	--	0.00142074	--(c)	--	--	--	
Manganese	7439-96-5	--	0.009635007	--(c)	5.00E-05	1.43E-05	--	
Nickel	7440-02-0	--	0.010760715	--(c)	9.00E-05	2.57E-05	--	
Nitrate	14797-55-8	--	31.205071	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.034429846	--(c)	--	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(c)	--	--	--	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(c)	--	--	--	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.6857E-09	--(c)	--	--	--	
Silver	7440-22-4	--	0.005650889	--(c)	--	--	--	
Strontium	7440-24-6	--	0.26495344	--(c)	--	--	--	
Sulfate	14808-79-8	--	56.164035	--(c)	--	--	--	

Toluene	108-88-3	VOC	0.000065	1.92E-06	5.00E+00	1.43E+00	1.34E-06	0.031
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	1.69E-05	3.50E-02	1.00E-02	1.69E-03	38
Uranium	7440-61-1	--	0.014879201	--(c)	3.00E-04	8.57E-05	--	
Vanadium	7440-62-2	--	0.021937779	--(c)	--	--	--	
Zinc	7440-66-6	--	0.092316084	--(c)	--	--	--	
Total							4.39E-03	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of nonvolatile chemicals is presented in Table D-11

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	--(c)	3.80E-01	1.33E+03	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.6E-09	--(c)	3.80E-01	1.33E+03	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	--(c)	3.80E+00	1.33E+04	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	--(c)	3.80E+00	1.33E+04	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	1.84E-05	2.60E-05	9.10E-02	1.67E-06	18
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	2.21E-04	--	--	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	2.15E-04	--	--	--	
4-Nitrophenol	100-02-7	SVOC	0.0072	2.07E-04	--	--	--	
Aluminum	7429-90-5	--	0.11217909	--(c)	--	--	--	
Arsenic	7440-38-2	--	0.005765062	--(c)	4.30E-03	1.51E+01	--	
Barium	7440-39-3	--	0.052626075	--(c)	--	--	--	
Beryllium	7440-41-7	--	0.00034431	--(c)	2.40E-03	8.40E+00	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	3.16E-04	2.40E-06	8.40E-03	2.65E-06	28
Cadmium	7440-43-9	--	0.018	--(c)	1.80E-03	6.30E+00	--	
Carbon tetrachloride	56-23-5	VOC	0.0018	5.17E-05	1.50E-05	5.25E-02	2.71E-06	29
Chloride	16887-00-6	--	11.439962	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.00038106	1.09E-05	2.30E-05	8.05E-02	8.81E-07	9.4
Chromium	7440-47-3	--	0.015609389	--(c)	--	--	--	
Cobalt	7440-48-4	--	0.004378857	--(c)	9.00E-03	3.15E+01	--	
Copper	7440-50-8	--	0.004482187	--(c)	--	--	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	SVOC	0.005506461	1.58E-04	--	--	--	
Fluoride	16984-48-8	--	0.31715504	--(c)	--	--	--	
Hexavalent Chromium	18540-29-9	--	0.191	--(c)	8.40E-02	2.94E+02	--	
Iron	7439-89-6	--	0.14355212	--(c)	--	--	--	
Lead	7439-92-1	--	0.00142074	--(c)	--	--	--	
Manganese	7439-96-5	--	0.009635007	--(c)	--	--	--	
Nickel	7440-02-0	--	0.010760715	--(c)	2.60E-04	9.10E-01	--	
Nitrate	14797-55-8	--	31.205071	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.034429846	--(c)	--	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	--(c)	--	--	--	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	--(c)	1.14E-02	3.99E+01	--	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.6857E-09	--(c)	1.14E-02	3.99E+01	--	
Silver	7440-22-4	--	0.005650889	--(c)	--	--	--	
Strontium	7440-24-6	--	0.26495344	--(c)	--	--	--	
Sulfate	14808-79-8	--	56.164035	--(c)	--	--	--	
Toluene	108-88-3	VOC	0.000065	1.87E-06	--	--	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	1.64E-05	2.50E-05	8.75E-02	1.43E-06	15
Uranium	7440-61-1	--	0.014879201	--(c)	--	--	--	
Vanadium	7440-62-2	--	0.021937779	--(c)	--	--	--	
Zinc	7440-66-6	--	0.092316084	--(c)	--	--	--	
Total ELCR							9.35E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of nonvolatile chemicals is presented in Table D-11

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from inhalation of nonvolatiles in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 2, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion Factor	CF	365	day/yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	1.89E-11	--	--	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.6E-09	2.84E-11	--	--	--	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	1.47E-11	--	--	--	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	1.07E-11	--	--	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	--(c)	2.40E+00	6.86E-01	--	
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	--(c)	--	--	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	--(c)	6.00E-01	1.71E-01	--	
4-Nitrophenol	100-02-7	SVOC	0.0072	--(c)	--	--	--	
Aluminum	7429-90-5	--	0.11217909	5.69E-04	5.00E-03	1.43E-03	3.98E-01	0.42
Arsenic	7440-38-2	--	0.005765062	2.92E-05	1.50E-05	4.29E-06	6.82E+00	7.2
Barium	7440-39-3	--	0.052626075	2.67E-04	5.00E-04	1.43E-04	1.87E+00	2.0
Beryllium	7440-41-7	--	0.00034431	1.75E-06	2.00E-05	5.71E-06	3.06E-01	0.32
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	--(c)	--	--	--	
Cadmium	7440-43-9	--	0.018	9.13E-05	1.00E-05	2.86E-06	3.20E+01	34
Carbon tetrachloride	56-23-5	VOC	0.0018	--(c)	1.90E-01	5.43E-02	--	
Chloride	16887-00-6	--	11.439962	5.80E-02	--	--	--	
Chloroform	67-66-3	VOC	0.00038106	--(c)	9.80E-02	2.80E-02	--	
Chromium	7440-47-3	--	0.015609389	7.92E-05	--	--	--	
Cobalt	7440-48-4	--	0.004378857	2.22E-05	6.00E-06	1.71E-06	1.30E+01	14
Copper	7440-50-8	--	0.004482187	2.27E-05	--	--	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	SVOC	0.005506461	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.31715504	1.61E-03	1.30E-02	3.71E-03	4.33E-01	0.46
Hexavalent Chromium	18540-29-9	--	0.191	9.69E-04	1.00E-04	2.86E-05	3.39E+01	36
Iron	7439-89-6	--	0.14355212	7.28E-04	--	--	--	
Lead	7439-92-1	--	0.00142074	7.21E-06	--	--	--	
Manganese	7439-96-5	--	0.009635007	4.89E-05	5.00E-05	1.43E-05	3.42E+00	3.6
Nickel	7440-02-0	--	0.010760715	5.46E-05	9.00E-05	2.57E-05	2.12E+00	2.2
Nitrate	14797-55-8	--	31.205071	1.58E-01	--	--	--	
Nitrite	14797-65-0	--	0.034429846	1.75E-04	--	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	7.46E-02	--	--	--	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	5.05E-11	--	--	--	
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.6857E-09	2.88E-11	--	--	--	
Silver	7440-22-4	--	0.005650889	2.87E-05	--	--	--	
Strontium	7440-24-6	--	0.26495344	1.34E-03	--	--	--	
Sulfate	14808-79-8	--	56.164035	2.85E-01	--	--	--	
Toluene	108-88-3	VOC	0.000065	--(c)	5.00E+00	1.43E+00	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	2.54E-04	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	--(c)	3.50E-02	1.00E-02	--	
Uranium	7440-61-1	--	0.014879201	7.55E-05	3.00E-04	8.57E-05	8.80E-01	0.93
Vanadium	7440-62-2	--	0.021937779	1.11E-04	--	--	--	
Zinc	7440-66-6	--	0.092316084	4.68E-04	--	--	--	
Total							95.1	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of volatile compounds in vapor is presented in Table D-10

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.

HQ = hazard quotient.
SVOC = semivolatile organic compound.
VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	35822-46-9	--	3.734E-09	1.84E-11	3.80E-01	1.33E+03	2.45E-08	8.79E-06
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	--	5.6E-09	2.76E-11	3.80E-01	1.33E+03	3.67E-08	1.32E-05
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	--	2.9E-09	1.43E-11	3.80E+00	1.33E+04	1.90E-07	6.83E-05
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	--	2.1E-09	1.03E-11	3.80E+00	1.33E+04	1.38E-07	4.94E-05
1,2-Dichloroethane	107-06-2	VOC	0.00064	--(c)	2.60E-05	9.10E-02	--	
2,3,4,6-Tetrachlorophenol	58-90-2	SVOC	0.0077	--(c)	--	--	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	--(c)	--	--	--	
4-Nitrophenol	100-02-7	SVOC	0.0072	--(c)	--	--	--	
Aluminum	7429-90-5	--	0.11217909	5.53E-04	--	--	--	
Arsenic	7440-38-2	--	0.005765062	2.84E-05	4.30E-03	1.51E+01	4.27E-04	0.15
Barium	7440-39-3	--	0.052626075	2.59E-04	--	--	--	
Beryllium	7440-41-7	--	0.00034431	1.70E-06	2.40E-03	8.40E+00	1.42E-05	0.0051
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	--(c)	2.40E-06	8.40E-03	--	
Cadmium	7440-43-9	--	0.018	8.87E-05	1.80E-03	6.30E+00	5.59E-04	0.20
Carbon tetrachloride	56-23-5	VOC	0.0018	--(c)	1.50E-05	5.25E-02	--	
Chloride	16887-00-6	--	11.439962	5.64E-02	--	--	--	
Chloroform	67-66-3	VOC	0.00038106	--(c)	2.30E-05	8.05E-02	--	
Chromium	7440-47-3	--	0.015609389	7.69E-05	--	--	--	
Cobalt	7440-48-4	--	0.004378857	2.16E-05	9.00E-03	3.15E+01	6.80E-04	0.24
Copper	7440-50-8	--	0.004482187	2.21E-05	--	--	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)	88-85-7	SVOC	0.005506461	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.31715504	1.56E-03	--	--	--	
Hexavalent Chromium	18540-29-9	--	0.191	9.41E-04	8.40E-02	2.94E+02	2.77E-01	99
Iron	7439-89-6	--	0.14355212	7.07E-04	--	--	--	
Lead	7439-92-1	--	0.00142074	7.00E-06	--	--	--	
Manganese	7439-96-5	--	0.009635007	4.75E-05	--	--	--	
Nickel	7440-02-0	--	0.010760715	5.30E-05	2.60E-04	9.10E-01	4.82E-05	0.017
Nitrate	14797-55-8	--	31.205071	1.54E-01	--	--	--	
Nitrite	14797-65-0	--	0.034429846	1.70E-04	--	--	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	7.24E-02	--	--	--	
Octachlorodibenzofuran	39001-02-0	--	9.9649E-09	4.91E-11	1.14E-02	3.99E+01	1.96E-09	7.04E-07
Octachlorodibenzo-p-dioxin	3268-87-9	--	5.6857E-09	2.80E-11	1.14E-02	3.99E+01	1.12E-09	4.01E-07
Silver	7440-22-4	--	0.005650889	2.78E-05	--	--	--	
Strontium	7440-24-6	--	0.26495344	1.31E-03	--	--	--	
Sulfate	14808-79-8	--	56.164035	2.77E-01	--	--	--	
Toluene	108-88-3	VOC	0.000065	--(c)	--	--	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	2.46E-04	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	--(c)	2.50E-05	8.75E-02	--	
Uranium	7440-61-1	--	0.014879201	7.33E-05	--	--	--	
Vanadium	7440-62-2	--	0.021937779	1.08E-04	--	--	--	
Zinc	7440-66-6	--	0.092316084	4.55E-04	--	--	--	
Total ELCR							2.78E-01	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of volatile compounds in vapor is presented in Table D-10

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to VOCs/SVOCs in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water (Id,l)
can be neglected and total dermal intake ($Id,total$) is equal to dermal intake from VOCs/SVOCs in sweat lodge vapor (Id,v)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 3, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF1	0.01	m/cm
Conversion factor	CF2	365	day/yr

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin[d]	35822-46-9	--	3.734E-09	--	--(c)	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.6E-09	1.45	--(c)	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	--(c)	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	--(c)	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	1.32E-09	2.00E-02	1	6.60E-08	0.08
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	2.68E-07	3.00E-02	1	8.95E-06	11
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	0.0077	2.84E-08	5.00E-02	1	5.67E-07	0.68
4-Nitrophenol	100-02-7	SVOC	0.0072	0.0048	1.70E-08	8.00E-03	1	2.12E-06	2.6
Aluminum	7429-90-5	--	0.11217909	0.001	--(c)	1.00E+00	1	--	
Arsenic	7440-38-2	--	0.005765062	0.001	--(c)	3.00E-04	1	--	
Barium	7440-39-3	--	0.052626075	0.001	--(c)	2.00E-01	0.07	--	
Beryllium	7440-41-7	--	0.00034431	0.001	--(c)	2.00E-03	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	1.35E-07	2.00E-02	1	6.75E-06	8
Cadmium	7440-43-9	--	0.018	0.001	--(c)	5.00E-04	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.0018	0.016	1.41E-08	7.00E-04	1	2.02E-05	24
Chloride	16887-00-6	--	11.439962	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	1.27E-09	1.00E-02	1	1.27E-07	0.154
Chromium	7440-47-3	--	0.015609389	0.001	--(c)	1.50E+00	0.013	--	
Cobalt	7440-48-4	--	0.004378857	0.0004	--(c)	3.00E-04	1	--	
Copper	7440-50-8	--	0.004482187	0.001	--(c)	4.00E-02	1	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)[d]	88-85-7	SVOC	0.005506461	0.0163	4.41E-08	1.00E-03	1	4.41E-05	53
Fluoride	16984-48-8	--	0.31715504	0.001	--(c)	6.00E-02	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	--(c)	3.00E-03	0.025	--	
Iron	7439-89-6	--	0.14355212	0.001	--(c)	7.00E-01	1	--	
Lead	7439-92-1	--	0.00142074	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.009635007	0.001	--(c)	2.40E-02	0.04	--	
Nickel	7440-02-0	--	0.010760715	0.0002	--(c)	2.00E-02	0.04	--	
Nitrate	14797-55-8	--	31.205071	0.001	--(c)	7.10E+00	1	--	
Nitrite	14797-65-0	--	0.034429846	0.001	--(c)	3.00E-01	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	--(c)	1.60E+00	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	--(c)	--	1	--	
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.6857E-09	1.16	--(c)	--	1	--	
Silver	7440-22-4	--	0.005650889	0.0006	--(c)	5.00E-03	0.04	--	

Strontium	7440-24-6	--	0.26495344	0.001	--(c)	6.00E-01	1	--	
Sulfate	14808-79-8	--	56.164035	0.001	--(c)	--	--	--	
Toluene	108-88-3	VOC	0.000065	0.031	9.90E-10	8.00E-02	1	1.24E-08	0.015
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	0.012	3.36E-09	--	1	--	
Uranium	7440-61-1	--	0.014879201	0.001	--(c)	3.00E-03	1	--	
Vanadium	7440-62-2	--	0.021937779	0.001	--(c)	5.00E-03	1	--	
Zinc	7440-66-6	--	0.092316084	0.0006	--(c)	3.00E-01	1	--	
Total								8.29E-05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics except tributyl phosphate). Tributyl phosphate value taken from Risk Assessment Information System http://rais.ornl.gov

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table D-14

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] $(mg/kg\text{-}day)^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin[d]	35822-46-9	--	3.734E-09	--	--(c)	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.6E-09	1.45	--(c)	1.30E+03	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	--(c)	1.30E+04	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	--(c)	1.30E+04	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	1.28E-09	9.10E-02	1	1.17E-10	2.9
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	2.61E-07	--	1	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	0.0077	2.76E-08	--	1	--	
4-Nitrophenol	100-02-7	SVOC	0.0072	0.0048	1.65E-08	--	1	--	
Aluminum	7429-90-5	--	0.11217909	0.001	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.005765062	0.001	--(c)	1.50E+00	1	--	
Barium	7440-39-3	--	0.052626075	0.001	--(c)	--	0.07	--	
Beryllium	7440-41-7	--	0.00034431	0.001	--(c)	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	1.31E-07	1.40E-02	1	1.84E-09	45
Cadmium	7440-43-9	--	0.018	0.001	--(c)	--	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.0018	0.016	1.37E-08	1.30E-01	1	1.79E-09	44
Chloride	16887-00-6	--	11.439962	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	1.24E-09	3.10E-02	1	3.83E-11	0.94
Chromium	7440-47-3	--	0.015609389	0.001	--(c)	--	0.013	--	
Cobalt	7440-48-4	--	0.004378857	0.0004	--(c)	--	1	--	
Copper	7440-50-8	--	0.004482187	0.001	--(c)	--	1	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)[d]	88-85-7	SVOC	0.005506461	0.0163	4.28E-08	--	1	--	
Fluoride	16984-48-8	--	0.31715504	0.001	--(c)	--	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	--(c)	--	0.025	--	
Iron	7439-89-6	--	0.14355212	0.001	--(c)	--	1	--	
Lead	7439-92-1	--	0.00142074	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.009635007	0.001	--(c)	--	0.04	--	
Nickel	7440-02-0	--	0.010760715	0.0002	--(c)	--	0.04	--	
Nitrate	14797-55-8	--	31.205071	0.001	--(c)	--	1	--	
Nitrite	14797-65-0	--	0.034429846	0.001	--(c)	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	--(c)	--	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	--(c)	3.90E+01	1	--	
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.6857E-09	1.16	--(c)	3.90E+01	1	--	
Silver	7440-22-4	--	0.005650889	0.0006	--(c)	--	0.04	--	
Strontium	7440-24-6	--	0.26495344	0.001	--(c)	--	1	--	
Sulfate	14808-79-8	--	56.164035	0.001	--(c)	--	--	--	
Toluene	108-88-3	VOC	0.000065	0.031	9.61E-10	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--(c)	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	0.012	3.27E-09	8.90E-02	1	2.91E-10	7.1
Uranium	7440-61-1	--	0.014879201	0.001	--(c)	--	1	--	
Vanadium	7440-62-2	--	0.021937779	0.001	--(c)	--	1	--	
Zinc	7440-66-6	--	0.092316084	0.0006	--(c)	--	1	--	
Total ELCR								4.07E-09	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics except tributyl phosphate). Tributyl phosphate value taken from Risk Assessment Information System http://rais.ornl.gov

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table D-14

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge condensed water

Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4)

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Model assumes concentration of nonvolatiles in condensed water is equal to concentration in water used to create steam

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from liquid	$I_{d,l}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,l}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin[d]	35822-46-9	--	3.734E-09	--	--	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.6E-09	1.45	4.18E-09	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	3.36E-09	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	2.43E-09	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	2.00E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	3.00E-02	1	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	0.0077	--(c)	5.00E-02	1	--	
4-Nitrophenol	100-02-7	SVOC	0.0072	0.0048	--(c)	8.00E-03	1	--	
Aluminum	7429-90-5	--	0.11217909	0.001	5.77E-05	1.00E+00	1	5.77E-05	0.0019
Arsenic	7440-38-2	--	0.005765062	0.001	2.96E-06	3.00E-04	1	9.88E-03	0.32
Barium	7440-39-3	--	0.052626075	0.001	2.71E-05	2.00E-01	0.07	1.93E-03	0.1
Beryllium	7440-41-7	--	0.00034431	0.001	1.77E-07	2.00E-03	0.007	1.26E-02	0.41
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	2.00E-02	1	--	
Cadmium	7440-43-9	--	0.018	0.001	9.26E-06	5.00E-04	0.05	3.70E-01	12
Carbon tetrachloride	56-23-5	VOC	0.0018	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	11.439962	0.001	5.88E-03	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.015609389	0.001	8.03E-06	1.50E+00	0.013	4.12E-04	0.014
Cobalt	7440-48-4	--	0.004378857	0.0004	9.01E-07	3.00E-04	1	3.00E-03	0.10
Copper	7440-50-8	--	0.004482187	0.001	2.31E-06	4.00E-02	1	5.76E-05	0
Dinoseb(2-secButyl-4,6-dinitrophenol)[d]	88-85-7	SVOC	0.005506461	0.0163	--(c)	1.00E-03	1	--	
Fluoride	16984-48-8	--	0.31715504	0.001	1.63E-04	6.00E-02	1	2.72E-03	0
Hexavalent Chromium	18540-29-9	--	0.191	0.002	1.96E-04	3.00E-03	0.025	2.62E+00	86
Iron	7439-89-6	--	0.14355212	0.001	7.38E-05	7.00E-01	1	1.05E-04	0.0035
Lead	7439-92-1	--	0.00142074	0.0001	7.31E-08	--	1	--	
Manganese	7439-96-5	--	0.009635007	0.001	4.96E-06	2.40E-02	0.04	5.16E-03	0.17
Nickel	7440-02-0	--	0.010760715	0.0002	1.11E-06	2.00E-02	0.04	1.38E-03	0.045
Nitrate	14797-55-8	--	31.205071	0.001	1.60E-02	7.10E+00	1	2.26E-03	0.074
Nitrite	14797-65-0	--	0.034429846	0.001	1.77E-05	3.00E-01	1	5.90E-05	0.0019
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	7.56E-03	1.60E+00	1	4.73E-03	0.16
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	1.35E-08	--	1	--	

Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.6857E-09	1.16	3.39E-09	--	1	--	
Silver	7440-22-4	--	0.005650889	0.0006	1.74E-06	5.00E-03	0.04	8.72E-03	0.29
Strontium	7440-24-6	--	0.26495344	0.001	1.36E-04	6.00E-01	1	2.27E-04	0.0075
Sulfate	14808-79-8	--	56.164035	0.001	2.89E-02	--	--	--	
Toluene	108-88-3	VOC	0.000065	0.031	--(c)	8.00E-02	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	0.012	--(c)	--	1	--	
Uranium	7440-61-1	--	0.014879201	0.001	7.65E-06	3.00E-03	1	2.55E-03	0.084
Vanadium	7440-62-2	--	0.021937779	0.001	1.13E-05	5.00E-03	1	2.26E-03	0.074
Zinc	7440-66-6	--	0.092316084	0.0006	2.85E-05	3.00E-01	1	9.50E-05	0.0031
Total								3.05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics except tributyl phosphate). Tributyl phosphate value taken from Risk Assessment Information System http://rais.ornl.gov/cgi-bin/tox/TOX_select?select=chem

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,i}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin[d]	35822-46-9	--	3.734E-09	--	--	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.6E-09	1.45	4.06E-09	1.30E+03	1	5.27E-06	6.3
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	3.26E-09	1.30E+04	1	4.24E-05	51
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	2.36E-09	1.30E+04	1	3.07E-05	37
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	9.10E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	--	1	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	0.0077	--(c)	--	1	--	
4-Nitrophenol	100-02-7	SVOC	0.0072	0.0048	--(c)	--	1	--	
Aluminum	7429-90-5	--	0.11217909	0.001	5.60E-05	--	1	--	
Arsenic	7440-38-2	--	0.005765062	0.001	2.88E-06	1.50E+00	1	4.32E-06	5.2
Barium	7440-39-3	--	0.052626075	0.001	2.63E-05	--	0.07	--	
Beryllium	7440-41-7	--	0.00034431	0.001	1.72E-07	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.018	0.001	8.99E-06	--	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.0018	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	11.439962	0.001	5.72E-03	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.015609389	0.001	7.80E-06	--	0.013	--	
Cobalt	7440-48-4	--	0.004378857	0.0004	8.75E-07	--	1	--	
Copper	7440-50-8	--	0.004482187	0.001	2.24E-06	--	1	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)[d]	88-85-7	SVOC	0.005506461	0.0163	--(c)	--	1	--	
Fluoride	16984-48-8	--	0.31715504	0.001	1.58E-04	--	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	1.91E-04	--	0.025	--	
Iron	7439-89-6	--	0.14355212	0.001	7.17E-05	--	1	--	
Lead	7439-92-1	--	0.00142074	0.0001	7.10E-08	--	1	--	
Manganese	7439-96-5	--	0.009635007	0.001	4.81E-06	--	0.04	--	
Nickel	7440-02-0	--	0.010760715	0.0002	1.08E-06	--	0.04	--	
Nitrate	14797-55-8	--	31.205071	0.001	1.56E-02	--	1	--	
Nitrite	14797-65-0	--	0.034429846	0.001	1.72E-05	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	7.34E-03	--	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	1.31E-08	3.90E+01	1	5.11E-07	0.61
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.6857E-09	1.16	3.30E-09	3.90E+01	1	1.29E-07	0.15
Silver	7440-22-4	--	0.005650889	0.0006	1.69E-06	--	0.04	--	
Strontium	7440-24-6	--	0.26495344	0.001	1.32E-04	--	1	--	
Sulfate	14808-79-8	--	56.164035	0.001	2.81E-02	--	--	--	
Toluene	108-88-3	VOC	0.000065	0.031	--(c)	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	0.012	--(c)	8.90E-02	1	--	
Uranium	7440-61-1	--	0.014879201	0.001	7.43E-06	--	1	--	
Vanadium	7440-62-2	--	0.021937779	0.001	1.10E-05	--	1	--	
Zinc	7440-66-6	--	0.092316084	0.0006	2.77E-05	--	1	--	
Total ELCR								8.33E-05	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics except tributyl phosphate). Tributyl phosphate value taken from Risk Assessment Information System http://rais.ornl.gov/cgi-bin/tox/TOX_select?select=chem

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-field exposure area -- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/day
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Ideal gas law constant	R	62.37	(mmHg-L)/(gmole-K)
Temperature of the sweat lodge	T	338.7	K
Density of liquid water	rhow	1000	g/L
Conversion factor	CF_2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin[d]	35822-46-9	--	3.734E-09	--	--	--	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.6E-09	1.45	6.84E-13	--	1	--	
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	5.50E-13	--	1	--	
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	3.98E-13	--	1	--	
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	2.00E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	3.00E-02	1	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	0.0077	--(c)	5.00E-02	1	--	
4-Nitrophenol	100-02-7	SVOC	0.0072	0.0048	--(c)	8.00E-03	1	--	
Aluminum	7429-90-5	--	0.11217909	0.001	9.45E-09	1.00E+00	1	9.45E-09	0.0
Arsenic	7440-38-2	--	0.005765062	0.001	4.86E-10	3.00E-04	1	1.62E-06	0.3
Barium	7440-39-3	--	0.052626075	0.001	4.43E-09	2.00E-01	0.07	3.17E-07	0.1
Beryllium	7440-41-7	--	0.00034431	0.001	2.90E-11	2.00E-03	0.007	2.07E-06	0.4
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	2.00E-02	1	--	
Cadmium	7440-43-9	--	0.018	0.001	1.52E-09	5.00E-04	0.05	6.07E-05	12.1
Carbon tetrachloride	56-23-5	VOC	0.0018	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	11.439962	0.001	9.64E-07	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.015609389	0.001	1.32E-09	1.50E+00	0.013	6.75E-08	0.0
Cobalt	7440-48-4	--	0.004378857	0.0004	1.48E-10	3.00E-04	1	4.92E-07	0.1
Copper	7440-50-8	--	0.004482187	0.001	3.78E-10	4.00E-02	1	9.44E-09	0.0
Dinoseb(2-secButyl-4,6-dinitrophenol)[d]	88-85-7	SVOC	0.005506461	0.0163	--(c)	1.00E-03	1	--	
Fluoride	16984-48-8	--	0.31715504	0.001	2.67E-08	6.00E-02	1	4.45E-07	0.1
Hexavalent Chromium	18540-29-9	--	0.191	0.002	3.22E-08	3.00E-03	0.025	4.29E-04	85.9
Iron	7439-89-6	--	0.14355212	0.001	1.21E-08	7.00E-01	1	1.73E-08	0.0
Lead	7439-92-1	--	0.00142074	0.0001	1.20E-11	--	1	--	
Manganese	7439-96-5	--	0.009635007	0.001	8.12E-10	2.40E-02	0.04	8.46E-07	0.2
Nickel	7440-02-0	--	0.010760715	0.0002	1.81E-10	2.00E-02	0.04	2.27E-07	0.0
Nitrate	14797-55-8	--	31.205071	0.001	2.63E-06	7.10E+00	1	3.70E-07	0.1
Nitrite	14797-65-0	--	0.034429846	0.001	2.90E-09	3.00E-01	1	9.67E-09	0.0
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	1.24E-06	1.60E+00	1	7.74E-07	0.2
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	2.21E-12	--	1	--	
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.6857E-09	1.16	5.56E-13	--	1	--	
Silver	7440-22-4	--	0.005650889	0.0006	2.86E-10	5.00E-03	0.04	1.43E-06	0.3
Strontium	7440-24-6	--	0.26495344	0.001	2.23E-08	6.00E-01	1	3.72E-08	0.0
Sulfate	14808-79-8	--	56.164035	0.001	4.73E-06	--	--	--	
Toluene	108-88-3	VOC	0.000065	0.031	--(c)	8.00E-02	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	0.012	--(c)	--	1	--	
Uranium	7440-61-1	--	0.014879201	0.001	1.25E-09	3.00E-03	1	4.18E-07	0.1
Vanadium	7440-62-2	--	0.021937779	0.001	1.85E-09	5.00E-03	1	3.70E-07	0.1
Zinc	7440-66-6	--	0.092316084	0.0006	4.67E-09	3.00E-01	1	1.56E-08	0.0
Total								4.994E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics except tributyl phosphate). Tributyl phosphate value taken from Risk Assessment Information System http://rais.ornl.gov/cgi-bin/tox/TOX_select?select=chem

[c] dermal intake of VOCs is presented in Table D-12

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
1,2,3,4,6,7,8-Heptachlorodibenzodioxin[d]	35822-46-9	--	3.734E-09	--	--	1.30E+03	1	--	
1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	67562-39-4	--	5.6E-09	1.45	6.65E-13	1.30E+03	1	8.64E-10	6.3
1,2,3,4,7,8-Hexachlorodibenzofuran[d]	70648-26-9	--	2.9E-09	2.25	5.34E-13	1.30E+04	1	6.94E-09	51
1,2,3,6,7,8-Hexachlorodibenzofuran[d]	57117-44-9	--	2.1E-09	2.25	3.87E-13	1.30E+04	1	5.03E-09	37
1,2-Dichloroethane	107-06-2	VOC	0.00064	0.0042	--(c)	9.10E-02	1	--	
2,3,4,6-Tetrachlorophenol[d]	58-90-2	SVOC	0.0077	0.071	--(c)	--	1	--	
2-Methylphenol (cresol, o-)	95-48-7	SVOC	0.0075	0.0077	--(c)	--	1	--	
4-Nitrophenol	100-02-7	SVOC	0.0072	0.0048	--(c)	--	1	--	
Aluminum	7429-90-5	--	0.11217909	0.001	9.18E-09	--	1	--	
Arsenic	7440-38-2	--	0.005765062	0.001	4.72E-10	1.50E+00	1	7.08E-10	5.2
Barium	7440-39-3	--	0.052626075	0.001	4.31E-09	--	0.07	--	
Beryllium	7440-41-7	--	0.00034431	0.001	2.82E-11	--	0.007	--	
Bis(2-ethylhexyl) phthalate	117-81-7	SVOC	0.011	0.025	--(c)	1.40E-02	1	--	
Cadmium	7440-43-9	--	0.018	0.001	1.47E-09	--	0.05	--	
Carbon tetrachloride	56-23-5	VOC	0.0018	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	11.439962	0.001	9.36E-07	--	1	--	
Chloroform	67-66-3	VOC	0.00038106	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.015609389	0.001	1.28E-09	--	0.013	--	
Cobalt	7440-48-4	--	0.004378857	0.0004	1.43E-10	--	1	--	
Copper	7440-50-8	--	0.004482187	0.001	3.67E-10	--	1	--	
Dinoseb(2-secButyl-4,6-dinitrophenol)[d]	88-85-7	SVOC	0.005506461	0.0163	--(c)	--	1	--	
Fluoride	16984-48-8	--	0.31715504	0.001	2.60E-08	--	1	--	
Hexavalent Chromium	18540-29-9	--	0.191	0.002	3.13E-08	--	0.025	--	
Iron	7439-89-6	--	0.14355212	0.001	1.18E-08	--	1	--	
Lead	7439-92-1	--	0.00142074	0.0001	1.16E-11	--	1	--	
Manganese	7439-96-5	--	0.009635007	0.001	7.89E-10	--	0.04	--	
Nickel	7440-02-0	--	0.010760715	0.0002	1.76E-10	--	0.04	--	
Nitrate	14797-55-8	--	31.205071	0.001	2.55E-06	--	1	--	
Nitrite	14797-65-0	--	0.034429846	0.001	2.82E-09	--	1	--	
Nitrogen in Nitrite and Nitrate	NO2+NO3-N	--	14.7	0.001	1.20E-06	--	1	--	
Octachlorodibenzofuran[d]	39001-02-0	--	9.9649E-09	2.63	2.15E-12	3.90E+01	1	8.37E-11	0.61
Octachlorodibenzo-p-dioxin[d]	3268-87-9	--	5.6857E-09	1.16	5.40E-13	3.90E+01	1	2.11E-11	0.15
Silver	7440-22-4	--	0.005650889	0.0006	2.78E-10	--	0.04	--	
Strontium	7440-24-6	--	0.26495344	0.001	2.17E-08	--	1	--	
Sulfate	14808-79-8	--	56.164035	0.001	4.60E-06	--	--	--	
Toluene	108-88-3	VOC	0.000065	0.031	--(c)	--	1	--	
Total petroleum hydrocarbons - gasoline range	TPHGASOLINE	--	0.05	--	--	--	--	--	
Trichloroethene	79-01-6	VOC	0.000570461	0.012	--(c)	8.90E-02	1	--	
Uranium	7440-61-1	--	0.014879201	0.001	1.22E-09	--	1	--	
Vanadium	7440-62-2	--	0.021937779	0.001	1.80E-09	--	1	--	
Zinc	7440-66-6	--	0.092316084	0.0006	4.53E-09	--	1	--	
Total ELCR								1.36E-08	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics except tributyl phosphate). Tributyl phosphate value taken from Risk Assessment Information System http://rais.ornl.gov/cgi-bin/tox/TOX_select?select=chem

[c] dermal intake of VOCs is presented in Table D-12

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-field exposure area -- Yakima Nation

Cancer risk from inhalation of volatile radioactive contaminants in sweat lodge vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	4.8703439	--(c)	--	--	
Iodine-129	15046-84-1	--	3.1689247	--(c)	6.07E-11	--	
Plutonium-239/240	PU-239/240	--	0.029	--(c)	3.33E-08	--	
Protactinium-231	14331-85-2	--	0.28	--(c)	4.55E-08	--	
Strontium-90	10098-97-2	--	4.5802399	--(c)	1.05E-10	--	
Technetium-99	14133-76-7	--	1567.7398	--(c)	1.41E-11	--	
Tritium	10028-17-8	Yes	192557.5	9.89E+09	5.62E-14	5.56E-04	100
Total ELCR						5.56E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of nonvolatile contaminants is presented in Table D-16

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.
EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--Near-field exposure area -- Yakima Nation

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Cancer risk calculation

200-PO-1 Groundwater Operable Unit Near-Field Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)
Gross alpha	12587-46-1	--	4.8703439	4.29E+04	--	--
Iodine-129	15046-84-1	--	3.1689247	2.79E+04	6.07E-11	1.69E-06
Plutonium-239/240	PU-239/240	--	0.029	2.56E+02	3.33E-08	8.51E-06
Protactinium-231	14331-85-2	--	0.28	2.47E+03	4.55E-08	1.12E-04
Strontium-90	10098-97-2	--	4.5802399	4.04E+04	1.05E-10	4.24E-06
Technetium-99	14133-76-7	--	1567.7398	1.38E+07	1.41E-11	1.95E-04
Tritium	10028-17-8	Yes	192557.5	--(c)	5.62E-14	--
Total ELCR						3.21E-04

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003)

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.l

[c] Inhalation of volatile contaminants is presented in Table D-15

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

% Contribution
0.53
2.6
35
1.3
61
100

html

200-PO-1 Groundwater Operable Unit River Exposure Area Native American Risk Assessment (10-Year)--Summary of Yakima Nationa Sweat Lodge Exposure Scenario Noncancer Hazard Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	HQ (Inhalation) (Volatiles) (unitless)	HQ (Inhalation) (Nonvolatiles) (unitless)	HQ (Dermal, Vapor, volatiles) (unitless)	HQ (Dermal, Liquid, Nonvolatiles) (unitless)	HQ (Dermal, Vapor, Nonvolatiles) (unitless)	Total HI (unitless)	% Contribution
Acetone	0.0011	VOC	3.67E-06	--	3.07E-10	--	--	3.67E-06	1.47E-05
Arsenic	0.005767892	--	--	6.8	--	9.89E-03	1.62E-06	6.84E+00	27
Barium	0.049451657	--	--	1.8	--	1.82E-03	2.98E-07	1.76E+00	7.0
Carbon tetrachloride	0.00028	VOC	1.52E-04	--	3.14E-06	--	--	1.56E-04	6.24E-04
Chloride	12.545114	--	--	--	--	--	--	--	
Chloroform	0.0023	VOC	2.43E-03	--	7.68E-07	--	--	2.43E-03	0.0097
Chromium	0.0141	--	--	--	--	3.72E-04	6.09E-08	3.72E-04	0.0015
Copper	0.00597989	--	--	--	--	7.69E-05	1.26E-08	7.69E-05	3.08E-04
Fluoride	0.30621978	--	--	0.4	--	2.62E-03	4.30E-07	4.21E-01	1.7
Iron	0.61057915	--	--	--	--	4.49E-04	7.35E-08	4.49E-04	0.0018
Lead	0.000663667	--	--	--	--	--	--	--	
Manganese	0.040717647	--	--	14.5	--	2.18E-02	3.57E-06	1.45E+01	58
Nickel	0.0056	--	--	1.1	--	7.20E-04	1.18E-07	1.11E+00	4.4
Nitrate	28.952	--	--	--	--	2.10E-03	3.44E-07	2.10E-03	0.0084
Nitrite	0.46	--	--	--	--	7.89E-04	1.29E-07	7.89E-04	0.0032
Strontium	0.38963943	--	--	--	--	3.34E-04	5.47E-08	3.34E-04	0.0013
Sulfate	41.899078	--	--	--	--	--	--	--	
Thallium	0.00037	--	--	--	--	--	--	--	
Uranium	0.005491757	--	--	0.3	--	9.41E-04	1.54E-07	3.26E-01	1.3
Vanadium	0.0168	--	--	--	--	1.73E-03	2.83E-07	1.73E-03	0.0069
Zinc	0.006671161	--	--	--	--	6.86E-06	1.12E-09	6.86E-06	2.75E-05
Total			2.58E-03	24.88	3.91E-06	0.044	7.15E-06	24.93	100

[a] Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

HI = hazard index.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit River Exposure Area Native American Risk Assessment (10-Year)--Summary of Yakima Nationa Sweat Lodge Exposure Scenario Cancer Risk Results for Nonradioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (mg/L)	VOC/SVOC?	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal, Vapor, volatiles) (unitless)	Risk (Dermal, Liquid, Nonvolatiles) (unitless)	Risk (Dermal, Vapor, Nonvolatiles) (unitless)	Total Risk (unitless)	% Contribution
Acetone	0.0011	VOC	--	--	--	--	--	--	
Arsenic	0.005767892	--	--	4.28E-04	--	4.32E-06	7.08E-10	4.32E-04	93
Barium	0.049451657	--	--	--	--	--	--	--	
Carbon tetrachloride	0.00028	VOC	4.22E-07	--	2.78E-10	--	--	4.22E-07	0.1
Chloride	12.545114	--	--	--	--	--	--	--	
Chloroform	0.0023	VOC	5.32E-06	--	2.31E-10	--	--	5.32E-06	1
Chromium	0.0141	--	--	--	--	--	--	--	
Copper	0.00597989	--	--	--	--	--	--	--	
Fluoride	0.30621978	--	--	--	--	--	--	--	
Iron	0.61057915	--	--	--	--	--	--	--	
Lead	0.000663667	--	--	--	--	--	--	--	
Manganese	0.040717647	--	--	--	--	--	--	--	
Nickel	0.0056	--	--	2.51E-05	--	--	--	2.51E-05	5.4
Nitrate	28.952	--	--	--	--	--	--	--	
Nitrite	0.46	--	--	--	--	--	--	--	
Strontium	0.38963943	--	--	--	--	--	--	--	
Sulfate	41.899078	--	--	--	--	--	--	--	
Thallium	0.00037	--	--	--	--	--	--	--	
Uranium	0.005491757	--	--	--	--	--	--	--	
Vanadium	0.0168	--	--	--	--	--	--	--	
Zinc	0.006671161	--	--	--	--	--	--	--	
Total ELCR			5.74E-06	4.53E-04	5.09E-10	4.32E-06	7.08E-10	4.63E-04	100

[a] Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 Groundwater Operable Unit River Exposure Area Native American Risk Assessment (10-Year)--Summary of Yakima Nation Sweat Lodge Exposure Scenario Cancer Risk Results for Radioactive COPCs in Groundwater.

COPC	95 UCL Groundwater Concentration (pCi/L)	Volatile?[a]	Risk (Inhalation) (Volatiles) (unitless)	Risk (Inhalation) (Nonvolatiles) (unitless)	Risk (Dermal) (unitless)	Total Risk (unitless)	% Contribution
Gross alpha	2.8	No	--	--	--	--	
Gross beta	22.2	No	--	--	--	--	
Strontium-90	2.60	No	--	2.41E-06	--	2.41E-06	1.3
Technetium-99	115	No	--	1.42E-05	--	1.42E-05	7.6
Tritium	59,534	Yes	1.72E-04	--	--	1.72E-04	91
Total ELCR			1.72E-04	1.67E-05	--	1.88E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole.

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--river exposure area-- Yakima Nation

Hazard quotient and cancer risk from inhalation of VOCs/SVOCs in sweat lodge vapor
Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment*.

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Contaminant concentration in water	C_{dw}	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF	365	day/yr

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
Acetone	67-64-1	VOC	0.0011	3.25E-05	3.10E+01	8.86E+00	3.67E-06	0.14
Arsenic	7440-38-2	--	0.005767892	--(c)	1.50E-05	4.29E-06	--	
Barium	7440-39-3	--	0.049451657	--(c)	5.00E-04	1.43E-04	--	
Carbon tetrachloride	56-23-5	VOC	0.00028	8.28E-06	1.90E-01	5.43E-02	1.52E-04	6
Chloride	16887-00-6	--	12.545114	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.0023	6.80E-05	9.80E-02	2.80E-02	2.43E-03	94
Chromium	7440-47-3	--	0.0141	--(c)	--	--	--	
Copper	7440-50-8	--	0.00597989	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.30621978	--(c)	1.30E-02	3.71E-03	--	
Iron	7439-89-6	--	0.61057915	--(c)	--	--	--	
Lead	7439-92-1	--	0.000663667	--(c)	--	--	--	
Manganese	7439-96-5	--	0.040717647	--(c)	5.00E-05	1.43E-05	--	
Nickel	7440-02-0	--	0.0056	--(c)	9.00E-05	2.57E-05	--	
Nitrate	14797-55-8	--	28.952	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.46	--(c)	--	--	--	
Strontium	7440-24-6	--	0.38963943	--(c)	--	--	--	
Sulfate	14808-79-8	--	41.899078	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	--(c)	--	--	--	
Uranium	7440-61-1	--	0.005491757	--(c)	3.00E-04	8.57E-05	--	
Vanadium	7440-62-2	--	0.0168	--(c)	--	--	--	
Zinc	7440-66-6	--	0.006671161	--(c)	--	--	--	
Total							2.58E-03	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of nonvolatile chemicals is presented in Table D-19

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*
Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways .*
COPC = contaminant of potential concern.
HQ = hazard quotient.
SVOC = semivolatile organic compound.
VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	I_{inh}(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
Acetone	67-64-1	VOC	0.0011	3.16E-05	--	--	--	
Arsenic	7440-38-2	--	0.005767892	--(c)	4.30E-03	1.51E+01	--	
Barium	7440-39-3	--	0.049451657	--(c)	--	--	--	
Carbon tetrachloride	56-23-5	VOC	0.00028	8.04E-06	1.50E-05	5.25E-02	4.22E-07	7.4
Chloride	16887-00-6	--	12.545114	--(c)	--	--	--	
Chloroform	67-66-3	VOC	0.0023	6.60E-05	2.30E-05	8.05E-02	5.32E-06	93
Chromium	7440-47-3	--	0.0141	--(c)	--	--	--	
Copper	7440-50-8	--	0.00597989	--(c)	--	--	--	
Fluoride	16984-48-8	--	0.30621978	--(c)	--	--	--	
Iron	7439-89-6	--	0.61057915	--(c)	--	--	--	
Lead	7439-92-1	--	0.000663667	--(c)	--	--	--	
Manganese	7439-96-5	--	0.040717647	--(c)	--	--	--	
Nickel	7440-02-0	--	0.0056	--(c)	2.60E-04	9.10E-01	--	
Nitrate	14797-55-8	--	28.952	--(c)	--	--	--	
Nitrite	14797-65-0	--	0.46	--(c)	--	--	--	
Strontium	7440-24-6	--	0.38963943	--(c)	--	--	--	
Sulfate	14808-79-8	--	41.899078	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	--(c)	--	--	--	
Uranium	7440-61-1	--	0.005491757	--(c)	--	--	--	
Vanadium	7440-62-2	--	0.0168	--(c)	--	--	--	
Zinc	7440-66-6	--	0.006671161	--(c)	--	--	--	
Total ELCR							5.74E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of nonvolatile chemicals is presented in Table D-19

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA 540/1-89/002 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--river exposure area-- Yakima Nation

Hazard quotient and cancer risk from inhalation of nonvolatiles in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 2, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	mg/kg-day
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion Factor	CF	365	day/yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(non-cancer) (mg/kg-day)	RfCi[a] (mg/m^3)	RfDi[b] (mg/kg-day)	HQ (unitless)	% Contribution
Acetone	67-64-1	VOC	0.0011	--(c)	3.10E+01	8.86E+00	--	
Arsenic	7440-38-2	--	0.005767892	2.93E-05	1.50E-05	4.29E-06	6.83E+00	27
Barium	7440-39-3	--	0.049451657	2.51E-04	5.00E-04	1.43E-04	1.76E+00	7.1
Carbon tetrachloride	56-23-5	VOC	0.00028	--(c)	1.90E-01	5.43E-02	--	
Chloride	16887-00-6	--	12.545114	6.36E-02	--	--	--	
Chloroform	67-66-3	VOC	0.0023	--(c)	9.80E-02	2.80E-02	--	
Chromium	7440-47-3	--	0.0141	7.15E-05	--	--	--	
Copper	7440-50-8	--	0.00597989	3.03E-05	--	--	--	
Fluoride	16984-48-8	--	0.30621978	1.55E-03	1.30E-02	3.71E-03	4.18E-01	1.7
Iron	7439-89-6	--	0.61057915	3.10E-03	--	--	--	
Lead	7439-92-1	--	0.000663667	3.37E-06	--	--	--	
Manganese	7439-96-5	--	0.040717647	2.07E-04	5.00E-05	1.43E-05	1.45E+01	58
Nickel	7440-02-0	--	0.0056	2.84E-05	9.00E-05	2.57E-05	1.10E+00	4.4
Nitrate	14797-55-8	--	28.952	1.47E-01	--	--	--	
Nitrite	14797-65-0	--	0.46	2.33E-03	--	--	--	
Strontium	7440-24-6	--	0.38963943	1.98E-03	--	--	--	
Sulfate	14808-79-8	--	41.899078	2.13E-01	--	--	--	
Thallium	7440-28-0	--	0.00037	1.88E-06	--	--	--	
Uranium	7440-61-1	--	0.005491757	2.79E-05	3.00E-04	8.57E-05	3.25E-01	1.3
Vanadium	7440-62-2	--	0.0168	8.52E-05	--	--	--	
Zinc	7440-66-6	--	0.006671161	3.38E-05	--	--	--	
Total							25	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation reference concentration (RfCi) converted to inhalation reference dose (RfDi) following EPA protocol (EPA 540/1-89/002) using formula RfDi (mg/kg-day) = RfCi (mg/m3) x 20 (m3/day) x 1/70 (kg).

[c] Inhalation of volatile compounds in vapor is presented in Table D-18

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
COPC = contaminant of potential concern.
HQ = hazard quotient.
SVOC = semivolatile organic compound.
VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	$I_{d,i}$(cancer) (mg/kg-day)	IUR[a] $(\mu g/m^3)^{-1}$	SFi[b] (kg-day/mg)	Risk (unitless)	% Contribution
Acetone	67-64-1	VOC	0.0011	--(c)	--	--	--	
Arsenic	7440-38-2	--	0.005767892	2.84E-05	4.30E-03	1.51E+01	4.28E-04	94
Barium	7440-39-3	--	0.049451657	2.44E-04	--	--	--	
Carbon tetrachloride	56-23-5	VOC	0.00028	--(c)	1.50E-05	5.25E-02	--	
Chloride	16887-00-6	--	12.545114	6.18E-02	--	--	--	
Chloroform	67-66-3	VOC	0.0023	--(c)	2.30E-05	8.05E-02	--	
Chromium	7440-47-3	--	0.0141	6.95E-05	--	--	--	
Copper	7440-50-8	--	0.00597989	2.95E-05	--	--	--	
Fluoride	16984-48-8	--	0.30621978	1.51E-03	--	--	--	
Iron	7439-89-6	--	0.61057915	3.01E-03	--	--	--	
Lead	7439-92-1	--	0.000663667	3.27E-06	--	--	--	
Manganese	7439-96-5	--	0.040717647	2.01E-04	--	--	--	
Nickel	7440-02-0	--	0.0056	2.76E-05	2.60E-04	9.10E-01	2.51E-05	5.5
Nitrate	14797-55-8	--	28.952	1.43E-01	--	--	--	
Nitrite	14797-65-0	--	0.46	2.27E-03	--	--	--	
Strontium	7440-24-6	--	0.38963943	1.92E-03	--	--	--	
Sulfate	14808-79-8	--	41.899078	2.06E-01	--	--	--	
Thallium	7440-28-0	--	0.00037	1.82E-06	--	--	--	
Uranium	7440-61-1	--	0.005491757	2.71E-05	--	--	--	
Vanadium	7440-62-2	--	0.0168	8.28E-05	--	--	--	
Zinc	7440-66-6	--	0.006671161	3.29E-05	--	--	--	
Total ELCR							4.53E-04	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] Inhalation unit risk (IUR) converted to inhalation cancer slope factor (SFi) following EPA protocol (EPA 540/1-89/002) using formula SFi (kg-day/mg) = IUR (m3/ug) x 1/20 (m3/day) x 70 (kg) x 1000 (ug/mg).

[c] Inhalation of volatile compounds in vapor is presented in Table D-18

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--river exposure area-- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to VOCs/SVOCs in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).

Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water (*Id,l*)
can be neglected and total dermal intake (*Id,total*) is equal to dermal intake from VOCs/SVOCs in sweat lodge vapor (*Id,v*)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 3, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF1	0.01	m/cm
Conversion factor	CF2	365	day/yr

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	2.77E-10	9.00E-01	1	3.07E-10	0.0079
Arsenic	7440-38-2	--	0.005767892	0.001	--(c)	3.00E-04	1	--	
Barium	7440-39-3	--	0.049451657	0.001	--(c)	2.00E-01	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.00028	0.016	2.20E-09	7.00E-04	1	3.14E-06	80
Chloride	16887-00-6	--	12.545114	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.0023	0.0068	7.68E-09	1.00E-02	1	7.68E-07	19.6
Chromium	7440-47-3	--	0.0141	0.001	--(c)	1.50E+00	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	--(c)	4.00E-02	1	--	
Fluoride	16984-48-8	--	0.30621978	0.001	--(c)	6.00E-02	1	--	
Iron	7439-89-6	--	0.61057915	0.001	--(c)	7.00E-01	1	--	
Lead	7439-92-1	--	0.000663667	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.040717647	0.001	--(c)	2.40E-02	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	--(c)	2.00E-02	0.04	--	
Nitrate	14797-55-8	--	28.952	0.001	--(c)	7.10E+00	1	--	
Nitrite	14797-65-0	--	0.46	0.001	--(c)	3.00E-01	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	--(c)	6.00E-01	1	--	
Sulfate	14808-79-8	--	41.899078	0.001	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	--(c)	--	1	--	
Uranium	7440-61-1	--	0.005491757	0.001	--(c)	3.00E-03	1	--	
Vanadium	7440-62-2	--	0.0168	0.001	--(c)	5.00E-03	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	--(c)	3.00E-01	1	--	
Total								3.91E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table D-22

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	2.69E-10	--	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	--(c)	1.50E+00	1	--	
Barium	7440-39-3	--	0.049451657	0.001	--(c)	--	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.00028	0.016	2.14E-09	1.30E-01	1	2.78E-10	55
Chloride	16887-00-6	--	12.545114	0.001	--(c)	--	1	--	
Chloroform	67-66-3	VOC	0.0023	0.0068	7.46E-09	3.10E-02	1	2.31E-10	45
Chromium	7440-47-3	--	0.0141	0.001	--(c)	--	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	--(c)	--	1	--	
Fluoride	16984-48-8	--	0.30621978	0.001	--(c)	--	1	--	
Iron	7439-89-6	--	0.61057915	0.001	--(c)	--	1	--	
Lead	7439-92-1	--	0.000663667	0.0001	--(c)	--	1	--	
Manganese	7439-96-5	--	0.040717647	0.001	--(c)	--	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	--(c)	--	0.04	--	
Nitrate	14797-55-8	--	28.952	0.001	--(c)	--	1	--	
Nitrite	14797-65-0	--	0.46	0.001	--(c)	--	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	--(c)	--	1	--	
Sulfate	14808-79-8	--	41.899078	0.001	--(c)	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	--(c)	--	1	--	
Uranium	7440-61-1	--	0.005491757	0.001	--(c)	--	1	--	
Vanadium	7440-62-2	--	0.0168	0.001	--(c)	--	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	--(c)	--	1	--	
Total ELCR								5.09E-10	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal absorption of nonvolatile chemicals in sweat lodge vapor is presented in Table D-22

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways* .

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organic compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--river exposure area-- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge condensed water

Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4)

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Model assumes concentration of nonvolatiles in condensed water is equal to concentration in water used to create steam

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4)

Parameter	Symbol	Value	Unit
Dermal absorption intake from liquid	$I_{d,l}$	calculated	mg/kg-day
Contaminant concentration in water	Cdw	contaminant-specific	mg/L
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/event
Number of sweats per year	EF	365	events/yr
Number of years a person sweats in a lifetime	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Conversion factor	CF2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,l}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	9.00E-01	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	2.97E-06	3.00E-04	1	9.89E-03	23
Barium	7440-39-3	--	0.049451657	0.001	2.54E-05	2.00E-01	0.07	1.82E-03	4.2
Carbon tetrachloride	56-23-5	VOC	0.00028	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	12.545114	0.001	6.45E-03	--	1	--	
Chloroform	67-66-3	VOC	0.0023	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.0141	0.001	7.25E-06	1.50E+00	0.013	3.72E-04	0.85
Copper	7440-50-8	--	0.00597989	0.001	3.08E-06	4.00E-02	1	7.69E-05	0.18
Fluoride	16984-48-8	--	0.30621978	0.001	1.57E-04	6.00E-02	1	2.62E-03	6.0
Iron	7439-89-6	--	0.61057915	0.001	3.14E-04	7.00E-01	1	4.49E-04	1.0
Lead	7439-92-1	--	0.000663667	0.0001	3.41E-08	--	1	--	
Manganese	7439-96-5	--	0.040717647	0.001	2.09E-05	2.40E-02	0.04	2.18E-02	50
Nickel	7440-02-0	--	0.0056	0.0002	5.76E-07	2.00E-02	0.04	7.20E-04	1.6
Nitrate	14797-55-8	--	28.952	0.001	1.49E-02	7.10E+00	1	2.10E-03	4.8
Nitrite	14797-65-0	--	0.46	0.001	2.37E-04	3.00E-01	1	7.89E-04	1.8
Strontium	7440-24-6	--	0.38963943	0.001	2.00E-04	6.00E-01	1	3.34E-04	0.77
Sulfate	14808-79-8	--	41.899078	0.001	2.15E-02	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	1.90E-07	--	1	--	
Uranium	7440-61-1	--	0.005491757	0.001	2.82E-06	3.00E-03	1	9.41E-04	2.2
Vanadium	7440-62-2	--	0.0168	0.001	8.64E-06	5.00E-03	1	1.73E-03	4.0
Zinc	7440-66-6	--	0.006671161	0.0006	2.06E-06	3.00E-01	1	6.86E-06	0.016
Total								0.044	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,i}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	2.88E-06	1.50E+00	1	4.32E-06	100
Barium	7440-39-3	--	0.049451657	0.001	2.47E-05	--	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.00028	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	12.545114	0.001	6.27E-03	--	1	--	
Chloroform	67-66-3	VOC	0.0023	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.0141	0.001	7.04E-06	--	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	2.99E-06	--	1	--	
Fluoride	16984-48-8	--	0.30621978	0.001	1.53E-04	--	1	--	
Iron	7439-89-6	--	0.61057915	0.001	3.05E-04	--	1	--	
Lead	7439-92-1	--	0.000663667	0.0001	3.32E-08	--	1	--	
Manganese	7439-96-5	--	0.040717647	0.001	2.03E-05	--	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	5.60E-07	--	0.04	--	
Nitrate	14797-55-8	--	28.952	0.001	1.45E-02	--	1	--	
Nitrite	14797-65-0	--	0.46	0.001	2.30E-04	--	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	1.95E-04	--	1	--	
Sulfate	14808-79-8	--	41.899078	0.001	2.09E-02	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	1.85E-07	--	1	--	
Uranium	7440-61-1	--	0.005491757	0.001	2.74E-06	--	1	--	
Vanadium	7440-62-2	--	0.0168	0.001	8.39E-06	--	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	2.00E-06	--	1	--	
Total ELCR								4.32E-06	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Model assumes 100% volatilization of VOCs/SVOCs; hence, dermal intake from VOCs/SVOCs in condensed water can be neglected (Harris and Harper 2004, Appendix 4).

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--river exposure area-- Yakima Nation

Hazard quotient and cancer risk from dermal exposure to nonvolatile compounds in sweat lodge vapor

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*
CTUIR sweat lodge scenario (Harris and Harper 2004, Appendix 4)

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 4, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Dermal absorption intake from vapor	$I_{d,v}$	calculated	mg/kg-day
Body surface area available for contact	SA	1.8	m^2
Permeability constant	Kp	contaminant-specific	cm/hr
Length of sweat event[a]	ET	2	hr/day
Number of sweats per year	EF	365	days/yr
Exposure duration	ED	68	yr
Average body weight	BW	70	kg
Averaging time (non-cancer)	ATnc	68	yr
Averaging time (cancer)	ATc	70	yr
Contaminant concentration	Cdw	contaminant-specific	mg/L
Molecular weight of water	MWw	18	g/mole
Ideal gas law constant	R	62.37	(mmHg-L)/(gmole-K)
Temperature of the sweat lodge	T	338.7	K
Density of liquid water	rhow	1000	g/L
Conversion factor	CF_2	365	day/yr
Conversion factor	CF3	10	L/m^2-cm

[a] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Non-cancer HQ calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(non-cancer) (mg/kg-day)	RfDo[a] (mg/kg-day)	GIABS[a] (unitless)	HQ (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	9.00E-01	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	4.86E-10	3.00E-04	1	1.62E-06	23
Barium	7440-39-3	--	0.049451657	0.001	4.17E-09	2.00E-01	0.07	2.98E-07	4.2
Carbon tetrachloride	56-23-5	VOC	0.00028	0.016	--(c)	7.00E-04	1	--	
Chloride	16887-00-6	--	12.545114	0.001	1.06E-06	--	1	--	
Chloroform	67-66-3	VOC	0.0023	0.0068	--(c)	1.00E-02	1	--	
Chromium	7440-47-3	--	0.0141	0.001	1.19E-09	1.50E+00	0.013	6.09E-08	0.85
Copper	7440-50-8	--	0.00597989	0.001	5.04E-10	4.00E-02	1	1.26E-08	0.18
Fluoride	16984-48-8	--	0.30621978	0.001	2.58E-08	6.00E-02	1	4.30E-07	6.0
Iron	7439-89-6	--	0.61057915	0.001	5.15E-08	7.00E-01	1	7.35E-08	1.0
Lead	7439-92-1	--	0.000663667	0.0001	5.59E-12	--	1	--	
Manganese	7439-96-5	--	0.040717647	0.001	3.43E-09	2.40E-02	0.04	3.57E-06	50
Nickel	7440-02-0	--	0.0056	0.0002	9.44E-11	2.00E-02	0.04	1.18E-07	1.6
Nitrate	14797-55-8	--	28.952	0.001	2.44E-06	7.10E+00	1	3.44E-07	4.8
Nitrite	14797-65-0	--	0.46	0.001	3.88E-08	3.00E-01	1	1.29E-07	1.8
Strontium	7440-24-6	--	0.38963943	0.001	3.28E-08	6.00E-01	1	5.47E-08	0.77
Sulfate	14808-79-8	--	41.899078	0.001	3.53E-06	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	3.12E-11	--	1	--	
Uranium	7440-61-1	--	0.005491757	0.001	4.63E-10	3.00E-03	1	1.54E-07	2.2
Vanadium	7440-62-2	--	0.0168	0.001	1.42E-09	5.00E-03	1	2.83E-07	4.0
Zinc	7440-66-6	--	0.006671161	0.0006	3.37E-10	3.00E-01	1	1.12E-09	0.016
Total								0.0000	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics).

[c] Dermal Intake of Volatiles in Sweatlodge vapor is presented in Table D-20

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's noncancer hazard via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

HQ = hazard quotient.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Nonradioactive COPC	CAS #	VOC/SVOC?[a]	C_{dw} 95 UCL (mg/L)	Kp[b] (cm/hr)	$I_{d,v}$(cancer) (mg/kg-day)	CSFo[a] (mg/kg-day)$^{-1}$	GIABS[a] (unitless)	Risk (unitless)	% Contribution
Acetone[d]	67-64-1	VOC	0.0011	0.000512	--(c)	--	1	--	
Arsenic	7440-38-2	--	0.005767892	0.001	4.72E-10	1.50E+00	1	7.08E-10	100
Barium	7440-39-3	--	0.049451657	0.001	4.05E-09	--	0.07	--	
Carbon tetrachloride	56-23-5	VOC	0.00028	0.016	--(c)	1.30E-01	1	--	
Chloride	16887-00-6	--	12.545114	0.001	1.03E-06	--	1	--	
Chloroform	67-66-3	VOC	0.0023	0.0068	--(c)	3.10E-02	1	--	
Chromium	7440-47-3	--	0.0141	0.001	1.15E-09	--	0.013	--	
Copper	7440-50-8	--	0.00597989	0.001	4.90E-10	--	1	--	
Fluoride	16984-48-8	--	0.30621978	0.001	2.51E-08	--	1	--	
Iron	7439-89-6	--	0.61057915	0.001	5.00E-08	--	1	--	
Lead	7439-92-1	--	0.000663667	0.0001	5.43E-12	--	1	--	
Manganese	7439-96-5	--	0.040717647	0.001	3.33E-09	--	0.04	--	
Nickel	7440-02-0	--	0.0056	0.0002	9.17E-11	--	0.04	--	
Nitrate	14797-55-8	--	28.952	0.001	2.37E-06	--	1	--	
Nitrite	14797-65-0	--	0.46	0.001	3.77E-08	--	1	--	
Strontium	7440-24-6	--	0.38963943	0.001	3.19E-08	--	1	--	
Sulfate	14808-79-8	--	41.899078	0.001	3.43E-06	--	--	--	
Thallium	7440-28-0	--	0.00037	0.001	3.03E-11	--	1	--	
Uranium	7440-61-1	--	0.005491757	0.001	4.50E-10	--	1	--	
Vanadium	7440-62-2	--	0.0168	0.001	1.38E-09	--	1	--	
Zinc	7440-66-6	--	0.006671161	0.0006	3.28E-10	--	1	--	
Total ELCR								7.08E-10	100

[a] EPA Region 3 Regional Screening Level tables downloaded January 2010. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

[b] EPA/540/R/99/005 Exhibit 3-1 (inorganics) and Exhibit B-2 (organics.)

[c] Dermal Intake of Volatiles in Sweatlodge vapor is presented in Table D-20

[d] the Kp value was taken from the Oak Ridge National Laboratory Risk Assessment Information System database found at rais.ornl.gov

-- = Indicates toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R//99/005 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).*

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

SVOC = semivolatile organic compound.

VOC = volatile organice compound.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--river exposure area-- CTUIR

Cancer risk from inhalation of volatile radioactive contaminants in sweat lodge vapor
Cancer risk from dermal exposure to radioactive contamiants is not evaluated because radionuclide cancer slope factors are not available to quantify cancer risk via this exposure route

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1, except as noted)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi^b (Risk/pCi)	Risk (unitless)	% Contribution
Gross alpha	12587-46-1	--	2.8	--(c)	--	--	
Gross beta	12587-47-2	--	22.2	--(c)	--	--	
Strontium-90	10098-97-2	--	2.60	--(c)	1.05E-10	--	
Technetium-99	14133-76-7	--	115	--(c)	1.41E-11	--	
Tritium	10028-17-8	Yes	59,534	3.06E+09	5.62E-14	1.72E-04	100
Total ELCR						1.72E-04	100

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of nonvolatile contaminants is Presented in Table D-24

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

200-PO-1 groundwater operable unit Native American Risk Assessment (10-Year)--river exposure area-- CTUIR

Yakama Nation sweathouse scenario (Ridolfi 2007)
Ridolfi 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment* .

Yakama Nation exposure scenario (Ridolfi 2007) does not include a model for estimating contaminant concentrations in sweathouse air from contaminant concentrations in groundwater used to make steam. Evaluation performed using steam model from CTUIR sweat lodge scenario (Harris and Harper 2004).
Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

Intake parameter values (Harris and Harper 2004, Appendix 4, Table 1)
Cdw values taken from ECF-200PO1-09-2027 : Exposure Point Concentration for Groundwater Risk Assessment at the 200-PO-1 Operable Unit. CHPRC 2010

Parameter	Symbol	Value	Unit
Inhalation intake	I_{inh}	calculated	pCi
Contaminant concentration in water	C_{dw}	contaminant-specific	pCi/L
Volume of water used in a sweat	Vw,total	4	L
Radius of a hemispherical sweat lodge	r	1	m
Inhalation rate[a]	IR	26	m^3/day
Length of sweat event[b]	ET	0.083	day/event (2hr/24hr)
Number of sweats per year	EF	365	days/yr
Number of years a person sweats in a lifetime	ED	68	yr
Molecular weight of water	MWw	18	g/mole
Density of liquid water	rhow	1000	g/L
Temperature of the sweat lodge	T	338.7	K
Ideal gas law constant	R	0.06237	(mmHg*m^3)/gmole*K)

[a] Ridolfi (2007, Table 7).

[b] Average reported Yakama Nation time spent inside sweathouse is 5 hr per week (Ridolfi 2007); value used conservatively assumes 2 hr/event, 1 event/day (14 hr/week).

Cancer risk calculation

200-PO-1 Groundwater Operable Unit River Exposure Area Radioactive COPC	CAS #	Volatile?[a]	C_{dw} 95 UCL (pCi/L)	I_{inh} (pCi)	SFi[b] (Risk/pCi)	Risk (unitless)
Gross alpha	12587-46-1	--	2.8	2.44E+04	--	--
Gross beta	12587-47-2	--	22.2	1.96E+05	--	--
Strontium-90	10098-97-2	--	2.60	2.29E+04	1.05E-10	2.41E-06
Technetium-99	14133-76-7	--	115	1.01E+06	1.41E-11	1.42E-05
Tritium	10028-17-8	Yes	59,534	--(c)	5.62E-14	--
Total ELCR						1.67E-05

[a] Volatile radioactive contaminants are operationally defined as those with a Henry's Law constant greater than 10-5 atm-m3/mole and a molecular weight less than 200 g/mole (EPA/540/R-92/003).

[b] Inhalation cancer slope factors (SFi) taken from EPA Health Effects Assessment Summary Tables (HEAST), Update April 16, 2001: Radionuclide Toxicity. http://www.epa.gov/radiation/heast/index.html

[c] Inhalation of volatile contaminants is presented in Table D-23

-- = Indicates radionuclide toxicity criteria not available to quantify contaminant's cancer risk via this exposure route.

EPA/540/R-92/003 *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (Part B, Development of Preliminary Remediation Goals)* .

Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*

COPC = contaminant of potential concern.

ELCR = excess lifetime cancer risk.

% Contribution
14
86
100