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Revision 0

Tap Water Risk Assessment for Remedial Investigation/Feasibility Studies of the 200-BP-5 and 200-PO-1 Groundwater Operable Units

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

P.O. Box 1600
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

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Terms

ATSDR	Agency for Toxic Substances and Disease Registry
CalEPA	California Environmental Protection Agency
CDI	chronic daily intake
COPC	contaminant of potential concern
DA_{event}	dermally absorbed dose per event
ECF	environmental calculation file
ELCR	excess lifetime cancer risk
EPA	Environmental Protection Agency
EPC	exposure point concentration
ERMA	Environmental Risk Management Archive
ET	event time
GIABS	gastrointestinal absorption factor
HEAST	Health Effects Assessment Summary Tables
HEIS	Hanford Environmental Information System
HI	hazard index
HQ	hazard quotient
IRIS	Integrated Risk Information System
IUR	inhalation unit risk
MRL	minimal risk level
NCEA	National Center for Environmental Assessment
NJDEP	New Jersey Department of Environmental Protection
NRDWL/SWL	Nonradioactive Dangerous Waste Landfill/Solid Waste Landfill
OEHHA	Office of Environmental Health Hazard Assessment
ORNL	Oak Ridge National Laboratory
OSWER	Office of Solid Waste and Emergency Response (EPA)
OU	operable unit
pCi	picocurie
PPRTVs	Provisional Peer Reviewed Toxicity Values
RAIS	Risk Assessment Information System
RfC	Reference concentration
RfD	reference dose
RME	reasonable maximum exposure
VF	volatilization factor
WMA	Waste Management Area

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1 Purpose

The purpose of this environmental calculation is to document the assumptions, equations, and methods used to calculate the potential human health risks and hazards associated with exposure to radionuclides and nonradionuclides in groundwater under a residential tap water exposure scenario. It is assumed that the source of tap water is groundwater obtained from the 200-BP-5 and 200-PO-1 Groundwater Operable Units (OU). Potential cancer risks and noncancer hazards are calculated for the ingestion, dermal contact, and inhalation exposure routes associated with the tap water exposure scenario. The results of all exposure routes are summed to provide total excess lifetime cancer risk (ELCR) or hazard index (HI) from direct contact with tap water by a residential receptor. This methodology is used to calculate intake, ELCR both radiological and nonradiological analytes and HI for nonradiological analytes. For this calculation, any analyte detected at least once in groundwater at the 200-BP-5 and 200-PO-1 Groundwater OUs is included in the calculations. Cancer risks and noncancer hazards are calculated and presented separately for each of the 12 200-BP-5 Groundwater OU exposure areas. All but one of the exposure areas include wells screened in the unconfined aquifer. The 12 200-BP-5 Groundwater OU exposure areas are as follows:

- Low-Level Waste Management Area-1 (LLWMA1) (218-E-10 Landfill)
- Low-Level Waste Management Area-2 (LLWMA2) and the 216-B-63 Trench
- Waste Management Area (WMA) B-BX-BY Tank Farms
- WMA C Tank Farm
- B Plant
- Semiworks
- Liquid Effluent Retention Basin (LERF)
- Gable Mountain Pond
- 200-BP-5 West
- 200-BP-5 Far Field (North of Gable Gap)
- 200-BP-5 Near River
- 200- BP-5 Confined – the only exposure area screened in the confined aquifer.

Risks and hazards are calculated and presented separately for each of the seven 200-PO-1 Groundwater OU exposure areas. All of the exposure areas include wells that are screened in the unconfined aquifer. The seven 200-PO-1 Groundwater OU exposure areas are as follows:

- PUREX Cribs
- WMA A-AX Tank Farms and the 216-A-29 Ditch
- BC Cribs and Trenches
- 216-B-3 Pond Facility (Three lobes)
- Nonradioactive Dangerous Waste Landfill/Solid Waste Landfill (NRDWL/SWL)
- 200-PO-1 Far Field
- 200-PO-1 Near River

In addition to the exposure areas, well-specific cancer risks and noncancer hazards are calculated for 60 wells within the 200-BP-5 Groundwater OU and for 58 wells within the 200-PO-1 Groundwater OU.

This risk assessment supports DOE/RL-2009-127, *Remedial Investigation Report for the 200-BP-5 Groundwater Operable Unit* and DOE/RL-2009-85, *Remedial Investigation Report for the 200-PO-1 Groundwater Operable Unit Addendum*.

2 Background

The following subsections provide brief descriptions of cancer risks and noncancer health hazards, the exposure routes included with the tap water exposure scenario, and the references used in this environmental calculation.

2.1 Carcinogenic Effects

The potential for carcinogenic effects is evaluated by estimating incremental increases in the probability of developing cancer over a lifetime (excess lifetime cancer risk [ELCR]), above the background probability of developing cancer (that is, if no exposure to site contaminants occurs). Cancer slope factors developed by EPA are considered to be plausible upper bound estimates of the cancer potencies of contaminants. Using these cancer slope factors in calculating risks results in plausible, upper-bound estimates of risk; there is reasonable confidence that the actual cancer risks will not exceed the estimated risks and may actually be lower (EPA/540/1 89/002, *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A): Interim Final*).

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, in this assessment, cancer risks are treated as independent and additive within an exposure route. This is consistent with the EPA guidelines on chemical mixtures presented in EPA/630/P-03/001F, *Guidelines for Carcinogen Risk Assessment*.

2.2 Noncarcinogenic Effects

For noncarcinogenic 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).

When the HQ for a contaminant exceeds 1 (that is, exposure exceeds the RfD), there is a concern for potential noncarcinogenic health effects. To assess the potential for noncarcinogenic effects posed by exposure to multiple contaminants, a hazard index (HI) approach is used, in accordance with EPA guidance (EPA/540/1-89/002). This approach assumes that the noncancer hazards associated with exposure to multiple contaminants are simply additive; synergistic or antagonistic interactions between contaminants, which are largely unknown, are not accounted for.

2.3 Exposure Routes

Potentially complete exposure routes associated with the tap water exposure pathway for the residential exposure scenario are:

- Ingestion of water,
- Inhalation of volatiles when showering or bathing and household use of tap water,
- Dermal contact with water while showering or bathing and household use of tap water.

EPA considers external radiation to be a significant exposure route for radionuclides only in soil (EPA/540/1-89/002). External radiation from radionuclides in water is considered insignificant due to the radiation shielding effects of the water. Therefore, EPA does not publish radionuclide cancer slope factors to quantify cancer risk from external or dermal exposure to radionuclides in groundwater. Because this evaluation assesses risks associated with radionuclides only in water, radionuclide cancer risk is calculated only for the ingestion and inhalation exposure routes.

2.4 References

For the tap water exposure scenario, contaminant intake is quantified using standard equations and procedures as specified in the following references:

- EPA/540/1-89/002, *Risk Assessment Guidance for Superfund: Volume 1—Human Health Evaluation Manual, Part A, Interim Final*;
- EPA/540/R-92/003, *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, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment): Final*; and
- EPA-540-R-070-002, *Risk Assessment Guidance for Superfund: Volume 1—Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)*;
- ORNL, 2014, The Risk Assessment Information System (RAIS) (http://rais.ornl.gov/)
    - RAIS Risk Exposure Models for Chemicals User's Guide (http://rais.ornl.gov/tools/rais_chemical_risk_guide.html)
    - RAIS Risk Exposure Models for Radionuclides User's Guide (http://rais.ornl.gov/tools/rais_rad_risk_guide.html)

3 Methodology

This section provides the equations (and their applicable bases) used to calculate intake, cancer risks and noncancer hazards associated with exposure to analytes in groundwater via the exposure routes associated with the tap water exposure scenario. Definitions of variables and input values for the equations are provided in Table 3-1.

3.1 Intake and Risk Equations for Water Ingestion

The bases for the equations used to calculate intake, risk, and hazard associated with the water ingestion route are summarized in Table 3-2. Equations are provided in the following subsections.

Table 3-2. Calculated Values and Reference Bases Used for the Water Ingestion Exposure Route

Effect	Symbol for Calculated Value	Reference
Carcinogenic	CDI IRW_{adj}	RAIS Risk Exposure Models for Chemicals User's Guide (ORNL, 2014)
	Risk	EPA/540/R-92/003
Noncarcinogenic	CDI	RAIS Risk Exposure Models for Chemicals User's Guide (ORNL, 2014)
	HQ	EPA/540/R-92/003
Radionuclide	CDI IRW_RAD_{adj}	RAIS Risk Exposure Models for Radionuclides User's Guide (ORNL, 2014)
	Risk	EPA/540/R-92/003

Notes:

CDI= chronic daily intake

HQ= hazard quotient

IRW_{adj} = age-adjusted water ingestion rate.

IRW_RAD_{adj} = age-adjusted water ingestion rate for radionuclides.

EPA/540/R-92/003, *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals): Interim*.

ORNL, 2014, The Risk Assessment Information System (RAIS).

3.1.1 Ingestion of Water—Carcinogenic Effects

For ingestion of carcinogens, the chronic daily intake (CDI) is calculated using the following equations:

$$CDI = \frac{C_w \times IRW_{adj} \times EF}{AT_c \times CF1} \tag{1}$$

where:

$$IRW_{adj} = \frac{ED_c \times IRW_c}{BW_c} + \frac{(ED_a - ED_c) \times IRW_a}{BW_a} \tag{2}$$

Cancer risk is calculated using the following equation:

$$RISK = CDI \times CSF_o \tag{3}$$

Table 3-1. Summary of Exposure Assumptions Used for the Tap Water Exposure Scenario for the 200-BP-5 and 200-PO-1 Groundwater Operable Units. (3 Pages)

Exposure Factor	Symbol	Value	Units	Source
Averaging Time – carcinogen	AT_c	70	years	EPA/540/R-92/003
Averaging Time – noncarcinogen	AT_{nc}	26	years	EPA/600/R-090/052F
Partitioning constant derived by Bunge Model	B	Analyte-specific	unitless	See Table 4-8 and Table 4-9
Adult Body Weight	BW_a	80	kg	EPA/600/R-090/052F
Body Weight - child	BW_c	15	kg	EPA/600/R-090/052F
Conversion Factor	CF1	365	days/year	1 year = 365 days
Conversion Factor	CF2	1/24	days/ hour	1 day = 24 hours
Conversion Factor	CF3	0.001	L/cm^3	1 L = 1,000 cm^3
Cancer Slope Factor - oral	CSF_o	Analyte-specific	$(mg/kg\text{-}day)^{-1}$	See Table 4-8 and Table 4-9
Chronic Daily Intake – carcinogen water ingestion	CDI	Calculated value	mg/kg-day	Equation 1
Chronic Daily Intake – noncarcinogen water ingestion	CDI	Calculated value	mg/kg-day	Equation 4
Chronic Daily Intake – radiological water ingestion	CDI	Calculated value	pCi	Equation 6
Chronic Daily Intake – carcinogen inhalation	CDI	Calculated value	$\mu g/m^3$	Equation 9
Chronic Daily Intake – noncarcinogen inhalation	CDI	Calculated value	mg/m^3	Equation 11
Chronic Daily Intake – radiological inhalation	CDI	Calculated value	pCi	Equation 13
Chronic Daily Intake – carcinogen dermal	CDI	Calculated value	mg/kg-day	Equation 16
Chronic Daily Intake – noncarcinogen dermal	CDI	Calculated value	mg/kg-day	Equation 19
Contaminant concentration in groundwater	C_w	Analyte-specific	mg/L or pCi/L	ECF-HANFORD-13-0033
Absorbed dose per event	DA_{event}	Calculated value	mg/cm^2-event	Equation 22, 23,and 24
Exposure Duration - resident[a]	ED_a	26	years	EPA/600/R-090/052F
Exposure Duration - child	ED_c	6	year	EPA/540/R-92/003
Exposure Frequency	EF	350	days/year	EPA/540/R-92/003
Exposure Time	ET	24	hours/day	OSWER Directive 9200.1-120
Event Time - adult	ET_a	0.71	hours/event	EPA/600/R-090/052F
Event Time - child	ET_c	0.54	hours/event	EPA/600/R-090/052F
Age-Adjusted Event Time	ET_{adj}	0.671	hours/event	Equation 21

Table 3-1. Summary of Exposure Assumptions Used for the Tap Water Exposure Scenario for the 200-BP-5 and 200-PO-1 Groundwater Operable Units. (3 Pages)

Exposure Factor	Symbol	Value	Units	Source
Event frequency	EV	1	event/day	EPA/540/R/99/005
Fraction of absorbed water	FA	Analyte-specific	unitless	See Table 4-8 and Table 4-9
Gastrointestinal absorption factor	GIABS	Analyte-specific	unitless	See Table 4-8 and Table 4-9
Age-Adjusted Inhalation Rate - radiological	INH_RAD_{adj}	460	m^3-year/day	Equation 14
Inhalation Rate - adult	INH_a	20	m^3/day	OSWER Directive 9285.6-03
Inhalation Rate - child	INH_c	10	m^3/day	EPA/600/P-95/002Fa
Water Ingestion Rate - adult	IRW_a	2.5	L/day	EPA/600/R-090/052F
Water Ingestion Rate - child	IRW_c	0.78	L/day	EPA/600/R-090/052F
Age-adjusted Water Ingestion Rate – nonradiological	IRW_{adj}	0.937	L-year/kg-day	Equation 2
Age-adjusted Water Ingestion Rate – radiological	IRW_RAD_{adj}	54.68	L-year/day	Equation 7
Inhalation Unit Risk	IUR	Analyte-specific	$(\mu g/m^3)^{-1}$	See Table 4-8 and Table 4-9
Dermal permeability coefficient	K_p	Analyte-specific	cm/hour	See Table 4-8 and Table 4-9
The constant pi	π	3.14159	unitless	--
Reference Concentration	RfC	Analyte-specific	mg/m^3	See Table 4-8 and Table 4-9
Oral Chronic Reference Dose	RfD_o	Analyte-specific	mg/kg-day	See Table 4-8 and Table 4-9
Age-adjusted Skin Surface Area	SA_{adj}	7,776	cm^2-year-event/kg-day	Equation 17
Skin Surface Area - adult	SA_a	20,900	cm^2	EPA/600/R-090/052F
Skin Surface Area - child	SA_c	6,378	cm^2	EPA/600/R-090/052F
Slope Factor - inhalation	SF_i	Analyte-specific	risk/pCi	See Table 4-8 and Table 4-9
Slope Factor - oral	SF_o	Analyte-specific	risk/pCi	See Table 4-8 and Table 4-9
Time to reach steady state conditions	t*	Analyte-specific	hour	See Table 4-8 and Table 4-9
Lag time	τ	Analyte-specific	hours/event	See Table 4-8 and Table 4-9
Volatilization Factor	VF	0.5	L/m^3	EPA/540/R-92/003

Table 3-1. Summary of Exposure Assumptions Used for the Tap Water Exposure Scenario for the 200-BP-5 and 200-PO-1 Groundwater Operable Units. (3 Pages)

Exposure Factor	Symbol	Value	Units	Source

Note:

a. It is noted that the symbol ED_a is assigned the corresponding value for the resident exposure duration (26 years) in the equations and formulas documented in this ECF. The adult exposure duration is subsequently calculated in the equations and formulas as follows: ED_a - ED_c (26 years - 6 years = 20 years).

ECF-HANFORD-13-0033, *Exposure Point Concentrations for Baseline Conditions for Remedial Investigation/Feasibility Studies of the 200-BP-5 and 200-PO-1 Groundwater Operable Units.*

EPA/540/R-92/003, *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, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment): Final*.

OSWER Directive 9285.6-03, *Risk Assessment Guidance For Superfund Volume I: Human Health Evaluation Manual Supplemental Guidance, "Standard Default Exposure Factors," Interim Final*.

OSWER Directive 9200.1-120, *Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors*.

EPA/600/P-95/002Fa, *Exposure Factors Handbook Volume 1: General Factors*.

EPA/600/R-090/052F, *Exposure Factors Handbook 2011 Edition (Final)*.

3.1.2 Ingestion of Water—Noncarcinogenic Effects

For ingestion of noncarcinogens, the CDI is calculated using the following equation:

$$CDI = \frac{C_w \times IRW_a \times EF \times ED_a}{BW_a \times AT_{nc} \times CF1} \tag{4}$$

Noncancer hazard is calculated using the following equation:

$$HQ = \frac{CDI}{RfDo} \tag{5}$$

3.1.3 Ingestion of Water—Radionuclides

For ingestion of radionuclides, the CDI is calculated using the following equations:

$$CDI = C_w \times IRW_RAD_{adj} \times EF \tag{6}$$

where:

$$IRW_RAD_{adj} = (ED_c \times IRW_c) + ([ED_a - ED_c] \times IRW_a) \tag{7}$$

Radiological cancer risk is calculated using the following equation:

$$RISK = CDI \times SFo \tag{8}$$

3.2 Intake and Risk Equations for Inhalation of Volatiles

The bases for the equations used to calculate intake, risk, and hazard associated with inhalation of volatiles are summarized in Table 3-3. Equations are provided in the following subsections.

Table 3-3. Calculated Values and Reference Bases Used for the Tap Water Scenario Inhalation of Volatiles Exposure Route

Effect	Symbol for Calculated Value	Reference
Carcinogenic	CDI	RAIS Risk Exposure Models for Chemicals User's Guide (ORNL, 2014)
	Risk	EPA-540-R-070-002
Noncarcinogenic	CDI	RAIS Risk Exposure Models for Chemicals User's Guide (ORNL, 2014)
	HQ	EPA-540-R-070-002
Radionuclide	CDI INH_RAD_{adj}	RAIS Risk Exposure Models for Radionuclides User's Guide (ORNL, 2014)
	ET_{adj}	EPA-540-R-070-002 and EPA/540/R/99/005
	Risk	EPA/540/R-92/003

Table 3-3. Calculated Values and Reference Bases Used for the Tap Water Scenario Inhalation of Volatiles Exposure Route

Effect	Symbol for Calculated Value	Reference

Notes:
CDI= chronic daily intake.
ET_{adj} = age-adjusted exposure time.
HQ = hazard quotient.
INH_RAD_{adj} = age-adjusted radionuclide inhalation rate.

EPA-540-R-070-002, *Risk Assessment Guidance for Superfund: Volume 1—Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment).*

EPA/540/R-92/003, *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, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment): Final.*

ORNL, 2014, The Risk Assessment Information System (RAIS).

3.2.1 Inhalation of Volatiles—Carcinogenic Effects

For inhalation of carcinogens, the CDI is calculated using the following equation:

$$CDI = \frac{C_w \times ED_a \times EF \times ET \times CF2 \times VF \times \left(1000 \frac{\mu g}{mg}\right)}{AT_c \times CF1} \tag{9}$$

Cancer risk is calculated using the following equation:

$$RISK = CDI \times IUR \tag{10}$$

3.2.2 Inhalation of Volatiles— Noncarcinogenic Effects

For inhalation of noncarcinogens, the CDI is calculated using the following equation:

$$CDI = \frac{C_w \times ED_a \times EF \times ET \times CF2 \times VF}{AT_{nc} \times CF1} \tag{11}$$

Noncancer hazard is calculated using the following equation:

$$HQ = \frac{CDI}{RfC}$$

(12)

3.2.3 Inhalation of Volatiles— Radionuclides

For inhalation of radionuclides, the CDI is calculated using the following equations:

$$CDI = C_w \times INH_RAD_{adj} \times VF \times EF \times ET \times CF2 \quad (13)$$

where:

$$INH_RAD_{adj} = (ED_c \times INH_c) + ([ED_a - ED_c] \times INH_a) \quad (14)$$

Radiological cancer risk is calculated using the following equation:

$$RISK = CDI \times SFi \quad (15)$$

3.3 Intake and Risk Equations for Dermal Contact with Water

The bases for the equations used to calculate intake, risk, and hazard associated with the dermal contact exposure route are provided in Table 3-4. The equations are presented in the following subsections.

Table 3-4. Calculated Values and Reference Bases Used for the Tap Water Scenario Dermal Contact Exposure Route

Effect	Calculated Value	Reference
Carcinogenic	CDI	EPA/540/R/99/005
	SA_{adj}	EPA/540/R/99/005
	DA_{event}	EPA/540/R/99/005
	Risk	EPA/540/R/99/005
Noncarcinogenic	CDI	EPA/540/R/99/005
	DA_{event}	EPA/540/R/99/005
	HQ	EPA/540/R/99/005
Radionuclide	Not applicable	

Notes:
CDI= chronic daily intake.
DA_{event} = absorbed dose per event.
ET_{adj} = age-adjusted exposure time.
HQ = hazard quotient.
SA_{adj} = age-adjusted skin surface area.
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*.

3.3.1 Dermal Contact with Water — Carcinogenic Effects

For dermal exposure to carcinogens, the CDI is calculated using the following equations:

$$CDI = \frac{DA_{event} \times SA_{adj} \times EF}{AT_c \times CF1} \quad (16)$$

where:

$$SA_{adj} = \frac{ED_c \times SA_c \times EV_c}{BW_c} + \frac{(ED_a - ED_c) \times SA_a \times EV_a}{BW_a} \tag{17}$$

Cancer risk is calculated using the following equation:

$$RISK = CDI \times \frac{CSFo}{GIABS} \tag{18}$$

3.3.2 Dermal Contact with Water— Noncarcinogenic Effects

For dermal exposure to noncarcinogens, the CDI is calculated using the following equation:

$$CDI = \frac{DA_{event} \times SA_a \times EF \times ED_a \times EV}{BW_a \times AT_{nc} \times CF1} \tag{19}$$

Noncancer hazard is calculated using the following equation:

$$HQ = \frac{CDI}{RfDo \times GIABS} \tag{20}$$

3.3.3 Dermal Contact—Event Time (Carcinogenic Effects and Noncarcinogenic Effects)

The event time used in the intake equations is health effect-dependent. For noncarcinogens, the event time is not age-adjusted (ET = ETa). For carcinogens, an age-adjusted event time is calculated using the following equation:

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

3.3.4 Tap Water Dermal Absorption—Dermally Absorbed Dose (Carcinogenic Effects and Noncarcinogenic Effects)

For organics, the following equations are used to calculate the dermally absorbed dose per event (DA_{event}), using the adult event time for noncarcinogenic effects and the age-adjusted event time (as calculated above) for carcinogenic effects:

If ET ≤ t*, the following nonsteady-state equation is used:

$$DA_{event} = 2 \times FA \times Kp \times Cw \times CF3 \times \sqrt{\frac{6 \times \tau \times ET}{\pi}} \tag{22}$$

If ET > t*, the following pseudosteady-state equation is used:

$$DA_{event} = FA \times Kp \times Cw \times CF3 \times \left[\frac{ET}{1+B} + 2 \times \tau \times \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right] \tag{23}$$

where $ET = ET_a$ *or* ET_{adj}, for noncarcinogenic and carcinogenic effects, respectively.

For inorganics, the following steady-state equation is used to estimate DA_{event} ,:

$$DA_{event} = Kp \times Cw \times ET \times CF3 \tag{24}$$

where $ET = ET_a$ *or* ET_{adj}, for noncarcinogenic and carcinogenic effects, respectively.

3.3.5 Dermal Contact with Water—Radionuclides

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

3.4 Cumulative Risk—Cancer

For estimating the cancer risks from exposure to multiple carcinogens from a single exposure route, the following equation is used. The basis for the equation is provided in EPA/540/1-89/002.

$$Risk_T = \sum_1^N Risk_i \tag{25}$$

where:

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

3.5 Hazard Index—Noncancer

The HI is calculated using the following equation. The basis for the equation is provided in EPA/540/1-89/002.

$$HI = \sum_1^N CDI_i \Big/ RfD_i \tag{26}$$

where:

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

4 Assumptions and Inputs

Assumptions and inputs associated with the tap water exposure scenario, groundwater analytes and associated exposure point concentrations (EPCs), and human health toxicity values used to characterize risk are described below.

4.1 Exposure Inputs and Assumptions

- Exposure routes evaluated for the tap water exposure scenario are ingestion of water, inhalation of volatiles, and dermal contact with water (dermal exposure is evaluated for nonradionuclides only).
- Exposure assumptions for the tap water exposure scenario are consistent with EPA guidance and provide a reasonable maximum exposure (RME) estimate as defined in OSWER Directive 9285.6-03, *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual Supplemental Guidance, "Standard Default Exposure Factors"* and in OSWER Directive 9200.1-120*, Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Factors.*
- RME assumptions used to quantify chronic daily intake (CDI) from tap water exposure are provided in Table 3-1.
- 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 the tap water scenario, inhalation intake is quantified only for volatile contaminants, as defined by EPA, 2014, *Regional Screening Levels for Chemical Contaminants at Superfund Sites.*
- For the tap water scenario, the EPA-recommended RME values for showering/bathing event times for dermal contact with tap water are 0.71 hours for an adult and 0.54 hours for a child (EPA/600/R-090/052F). Exposure times for inhalation of volatiles in water is assumed to be 24 hours per day.

4.2 Groundwater Analytes and Exposure Point Concentrations

The analytes evaluated in this environmental calculation were obtained from the 200-BP-5 and 200-PO-1 Groundwater OU analytical data set in the Hanford Environmental Information System (HEIS) database. The data set was first processed and reduced as described in ECF-Hanford-13-0033, *Exposure Point Concentrations for Baseline Conditions for Remedial Investigation/Feasibility Studies of the 200-BP-5 and 200-PO-1 Groundwater Operable Units*.

Following the data processing and reduction step of analysis, any analyte with at least one reported detection and available toxicity values was included in the risk calculations.

The EPCs used for the risk calculations are the analyte-specific 95 percent upper confidence limit (UCL) or ProUCL value calculated from the analytical data set, as described in ECF-Hanford-13-0033, *Exposure Point Concentrations for Baseline Conditions for Remedial Investigation/Feasibility Studies of the 200-BP-5 and 200-PO-1 Groundwater Operable Units*. The identified analytes and their EPCs are presented in Table 4-1 and Table 4-2 for each exposure area identified for the 200-BP-5 Groundwater OU and the 200-PO-1 Groundwater OU, respectively. Table 4-3 through Table 4-8 list the EPCs for each of the individual wells that are evaluated within the 200-BP-5 Groundwater OU. Similarly, Table 4-9

through Table 4-14 list the EPCs for each of the individual wells that are evaluated within the 200-PO-1 Groundwater OU.

Table 4-1. Summary of Analytes and Exposure Point Concentrations for Exposure Areas in the 200-BP-5 Groundwater Operable Unit

Analyte Name	CAS #	Units	LLWMA 1	LLWMA 2/ 216-B-63 Trench	WMA B-BX-BY Tank Farms	WMA C Tank Farm	B Plant	Semiworks	LERF	Gable Mountain Pond	200-BP-5 West	200-BP-5 Far Field (North of Gable Gap)	200-BP-5 Near River	200-BP-5 Confined
2-Hexanone	591-78-6	µg/L	--	--	--	2.0	--	--	--	--	--	--	--	--
Acetone	67-64-1	µg/L	1.0	--	--	1.1	--	--	--	--	--	--	--	--
Acetophenone	98-86-2	µg/L	--	--	1.7	--	--	--	--	--	--	--	--	--
Aluminum	7429-90-5	µg/L	47	--	14	26	--	--	--	--	5,536	--	24	24
Antimony	7440-36-0	µg/L	47	65	44	46	75	--	0.32	72	59	--	--	42
Arsenic	7440-38-2	µg/L	4.8	8.5	8.9	6.5	4.5	4.0	4.4	4.7	6.1	13	3.2	3.0
Barium	7440-39-3	µg/L	72	55	120	56	70	83	66	52	68	26	29	91
Benzene	71-43-2	µg/L	--	--	--	--	--	--	--	--	--	--	--	2.5
Beryllium	7440-41-7	µg/L	--	--	--	--	--	--	--	--	0.12	--	--	--
Bis(2-ethylhexyl) phthalate	117-81-7	µg/L	--	--	1.7	--	--	--	--	--	2.5	--	--	3.8
Boron	7440-42-8	µg/L	--	--	--	23	53	53	--	--	--	29	21	18
Butylbenzylphthalate	85-68-7	µg/L	--	--	2.8	--	--	--	--	--	--	--	--	--
Cadmium	7440-43-9	µg/L	0.40	--	4.7	4.0	5.1	--	--	--	2.8	--	0.10	--
Carbon disulfide	75-15-0	µg/L	--	--	--	0.12	--	--	--	--	1.6	--	--	--
Carbon tetrachloride	56-23-5	µg/L	--	--	3.5	1.3	--	--	2.3	--	2.5	--	--	2.3
Chloroform	67-66-3	µg/L	0.13	--	1.4	0.14	--	--	--	--	0.66	--	0.19	1.3
Chromium	7440-47-3	µg/L	14	16	36	11	8.5	5.2	14	34	16	8.7	6.1	7.3
Chromium (Dissolved)	7440-47-3-D	µg/L	7.7	8.9	27	5.2	5.4	5.4	6.6	5.3	5.5	11	6.1	6.2
Cobalt	7440-48-4	µg/L	0.37	--	4.7	4.0	--	--	--	--	3.4	--	0.14	0.86
Copper	7440-50-8	µg/L	0.88	5.0	6.4	36	3.2	1.9	4.0	6.0	5.0	118	0.94	1.9
Cyanide	57-12-5	µg/L	139	57	320	6.7	6.9	--	--	--	72	--	--	9.6
Di-n-octylphthalate	117-84-0	µg/L	--	--	5.5	3.3	--	--	--	--	--	--	--	--
Fluoride	16984-48-8	µg/L	334	228	248	135	892	214	250	102	422	599	238	211
Hexavalent Chromium	18540-29-9	µg/L	8.2	3.2	33	5.5	3.1	3.1	--	--	4.0	11	4.7	3.9
Iron	7439-89-6	µg/L	82	90	351	65	136	--	230	3,103	4,414	1,316	190	2,496
Lead	7439-92-1	µg/L	0.24	0.23	0.55	0.30	--	--	--	--	5.1	0.42	2.3	--
Lithium	7439-93-2	µg/L	--	--	--	--	--	--	--	--	13	9.4	10	--
Manganese	7439-96-5	µg/L	1.6	5.1	18	5.2	9.3	--	9.7	91	147	40	14	64
Mercury	7439-97-6	µg/L	0.18	0.063	0.32	0.20	--	--	--	--	0.18	--	--	--
Methyl methacrylate	80-62-6	µg/L	--	--	--	1.4	--	--	--	--	--	--	--	--
Methyl methanesulfonate	66-27-3	µg/L	--	--	340	--	--	--	--	--	--	--	--	--
Methylene chloride	75-09-2	µg/L	--	--	1.8	--	--	--	--	--	--	--	--	--
Molybdenum	7439-98-7	µg/L	6.6	--	4.5	2.9	7.1	3.6	--	--	7.8	5.3	4.5	5.5
Nickel	7440-02-0	µg/L	5.6	17	51	11	8.5	1.2	11	22	13	5.3	0.63	7.8
Nitrate	14797-55-8	µg/L	180,551	53,893	598,495	44,448	86,183	41,300	41,898	94,233	86,692	21,027	23,767	9,270
Nitrite	14797-65-0	µg/L	156	159	191	149	207	200	323	209	191	224	222	187
n-Nitrosodi-n-dipropylamine	621-64-7	µg/L	--	--	3.5	--	--	--	--	--	--	--	--	--

Table 4-1. Summary of Analytes and Exposure Point Concentrations for Exposure Areas in the 200-BP-5 Groundwater Operable Unit

Analyte Name	CAS #	Units	LLWMA 1	LLWMA 2/ 216-B-63 Trench	WMA B-BX-BY Tank Farms	WMA C Tank Farm	B Plant	Semiworks	LERF	Gable Mountain Pond	200-BP-5 West	200-BP-5 Far Field (North of Gable Gap)	200-BP-5 Near River	200-BP-5 Confined
Octachlorodibenzofuran	39001-02-0	µg/L	1.43E-06	--	--	--	--	--	--	--	--	--	--	--
Phenol	108-95-2	µg/L	--	--	1.1	--	--	--	--	--	--	--	--	0.91
Selenium	7782-49-2	µg/L	6.7	--	11	11	8.2	5.9	--	--	3.1	1.2	1.7	--
Silver	7440-22-4	µg/L	6.8	4.6	5.1	5.5	8.0	--	7.5	--	--	--	--	17
Strontium	7440-24-6	µg/L	393	340	853	424	338	377	568	1,103	311	194	205	255
Thallium	7440-28-0	µg/L	0.24	--	0.13	0.32	--	--	--	--	--	--	1.8	0.065
Tin	7440-31-5	µg/L	0.23	--	0.44	0.39	0.28	--	--	--	--	--	0.079	--
Toluene	108-88-3	µg/L	--	--	--	--	--	--	--	--	--	--	--	2.3
Tributyl phosphate	126-73-8	µg/L	--	--	1.1	1.0	--	--	--	--	1.7	--	--	8.4
Trichloroethene	79-01-6	µg/L	--	--	--	--	--	--	--	--	--	--	1.8	--
Uranium	7440-61-1	µg/L	22	3.8	422	4.3	23	6.1	--	--	8.9	4.2	2.3	3.3
Vanadium	7440-62-2	µg/L	17	21	14	17	18	13	18	8.1	17	19	14	11
Zinc	7440-66-6	µg/L	5.5	5.7	40	5.6	369	6.6	8.3	23	1,168	368	164	79
Americium-241	14596-10-2	pCi/L	--	--	0.10	0.14	0.19	--	--	--	0.31	0.086	0.13	0.10
Carbon-14	14762-75-5	pCi/L	--	--	57	--	12	--	--	--	--	--	293	35
Cesium-137	10045-97-3	pCi/L	--	--	--	--	1,390	--	--	--	--	--	--	--
Cobalt-60	10198-40-0	pCi/L	26	--	40	--	--	--	--	--	6.4	--	--	--
Europium-154	15585-10-1	pCi/L	--	--	--	--	45	--	--	--	--	--	--	--
Iodine-129	15046-84-1	pCi/L	2.4	1.4	3.7	4.6	1.5	1.8	0.32	--	1.1	0.68	0.25	0.89
Neptunium-237	13994-20-2	pCi/L	--	--	0.56	--	0.71	--	--	--	0.57	--	--	--
Plutonium-238	13981-16-3	pCi/L	--	--	--	--	0.19	--	--	--	--	--	--	--
Plutonium-239/240	PU-239/240	pCi/L	--	--	0.098	0.11	30	0.11	--	--	0.052	--	--	0.074
Strontium-90	10098-97-2	pCi/L	--	--	2.7	--	1,127	2.8	--	214	83	--	--	2.3
Technetium-99	14133-76-7	pCi/L	3,168	801	11,391	5,981	1,415	62	--	--	1,711	150	61	353
Tritium	10028-17-8	pCi/L	7,417	572	11,424	1,074	5,272	7,500	632	3,200	6,693	12,770	12,568	1,756
Uranium-233/234	U-233/234	pCi/L	--	--	--	--	11	--	--	--	--	--	0.67	--
Uranium-234	13966-29-5	pCi/L	--	--	598	--	8.3	--	--	--	--	--	--	1.3
Uranium-235	15117-96-1	pCi/L	--	--	27	--	0.46	--	--	--	--	--	0.048	--
Uranium-238	U-238	pCi/L	--	--	585	--	8.4	--	--	--	--	--	0.53	1.1

Table 4-2. Summary of Analytes and Exposure Point Concentrations for Exposure Areas in the 200-PO-1 Groundwater Operable Unit

Analyte Name	CAS #	Units	PUREX Cribs	WMA A-AX and 216-A-29 Ditch	BC Cribs and Trenches	216-B-3 Pond Facility (All Lobes)	NRDWL/SWL	200-PO-1 Far Field	200-PO-1 Near River
1,1,1-Trichloroethane	71-55-6	µg/L	--	--	--	--	0.62	0.15	--
1,1-Dichloroethane	75-34-3	µg/L	--	--	--	--	0.16	0.25	--
1,1-Dichloroethene	75-35-4	µg/L	--	--	--	--	0.19	0.14	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	µg/L	--	1.70E-06	--	--	--	--	--
2,6-Dinitrotoluene	606-20-2	µg/L	17	--	--	--	--	--	--
Acetone	67-64-1	µg/L	--	--	--	--	6.6	1.2	2.5
Aluminum	7429-90-5	µg/L	--	--	--	--	--	47	54
Antimony	7440-36-0	µg/L	55	43	52	--	4.9	47	5.8
Arsenic	7440-38-2	µg/L	6.3	7.9	2.3	7.8	2.5	6.2	4.3
Barium	7440-39-3	µg/L	58	41	48	36	94	53	63
Benzyl alcohol	100-51-6	µg/L	--	--	--	--	--	1.1	--
Beryllium	7440-41-7	µg/L	9.4	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	117-81-7	µg/L	6.7	4.1	--	--	14	1.5	--
Boron	7440-42-8	µg/L	--	--	--	--	--	30	21
Bromodichloromethane	75-27-4	µg/L	--	--	--	--	--	0.58	--
Bromoform	75-25-2	µg/L	--	--	--	--	--	2.3	--
Bromomethane	74-83-9	µg/L	--	--	--	--	--	4.5	--
Butylbenzylphthalate	85-68-7	µg/L	--	--	--	--	--	1.3	--
Cadmium	7440-43-9	µg/L	18	5.2	--	--	--	4.5	0.12
Carbon disulfide	75-15-0	µg/L	--	--	--	--	--	0.12	--
Carbon tetrachloride	56-23-5	µg/L	0.13	--	--	--	1.0	4.0	--
Chloroform	67-66-3	µg/L	0.71	--	--	--	0.17	0.33	--
Chromium	7440-47-3	µg/L	13	13	17	10	11	5.3	5.1
Chromium (Dissolved)	7440-47-3-D	µg/L	9.5	5.8	28	8.4	6.1	4.6	5.0
Cobalt	7440-48-4	µg/L	4.8	4.0	8.1	--	--	0.23	0.31
Copper	7440-50-8	µg/L	5.2	4.8	4.0	12	9.0	1.3	2.5
Dibromochloromethane	124-48-1	µg/L	--	--	--	--	--	2.2	--
Diethylphthalate	84-66-2	µg/L	--	--	--	--	--	1.7	--
Ethyl methacrylate	97-63-2	µg/L	--	--	--	--	--	0.82	--
Ethylbenzene	100-41-4	µg/L	--	--	--	--	2.1	--	--
Fluoride	16984-48-8	µg/L	251	179	314	309	223	278	252
Hexavalent Chromium	18540-29-9	µg/L	--	191	--	--	--	2.9	4.6
Iron	7439-89-6	µg/L	205	129	16,816	3,901	225	381	2,530
Lead	7439-92-1	µg/L	0.12	0.16	35	--	0.15	0.98	0.68
Lithium	7439-93-2	µg/L	--	--	--	--	--	10	21
Manganese	7439-96-5	µg/L	12	7.3	201	65	5.3	19	69
Methylene chloride	75-09-2	µg/L	--	--	--	--	1.5	1.9	--
Molybdenum	7439-98-7	µg/L	--	--	--	--	--	6.9	12
Nickel	7440-02-0	µg/L	5.5	12	9.0	7.3	7.8	8.3	0.99

Table 4-2. Summary of Analytes and Exposure Point Concentrations for Exposure Areas in the 200-PO-1 Groundwater Operable Unit

Analyte Name	CAS #	Units	PUREX Cribs	WMA A-AX and 216-A-29 Ditch	BC Cribs and Trenches	216-B-3 Pond Facility (All Lobes)	NRDWL/SWL	200-PO-1 Far Field	200-PO-1 Near River
Nitrate	14797-55-8	µg/L	57,651	26,216	9,777	23,125	16,979	33,541	25,288
Nitrite	14797-65-0	µg/L	152	148	308	192	278	166	176
n-Nitrosodi-n-dipropylamine	621-64-7	µg/L	2.9	--	--	--	--	--	--
Selenium	7782-49-2	µg/L	--	4.5	--	--	--	2.1	2.2
Silver	7440-22-4	µg/L	5.2	6.0	8.0	--	5.4	18	--
Strontium	7440-24-6	µg/L	287	271	224	284	411	270	384
Tetrachloroethene	127-18-4	µg/L	--	--	--	--	0.90	4.0	--
Thallium	7440-28-0	µg/L	--	--	--	--	--	--	0.37
Tin	7440-31-5	µg/L	--	--	--	--	--	0.41	0.12
Toluene	108-88-3	µg/L	--	0.029	0.065	--	1.4	--	--
Tributyl phosphate	126-73-8	µg/L	--	--	--	--	--	5.6	--
Trichloroethene	79-01-6	µg/L	1.8	--	--	--	0.39	1.8	--
Trichloromonofluoromethane	75-69-4	µg/L	--	--	--	--	0.56	--	--
Uranium	7440-61-1	µg/L	26	4.1	3.8	4.0	8.0	22	6.9
Vanadium	7440-62-2	µg/L	22	25	22	25	11	13	14
Xylenes (total)	1330-20-7	µg/L	--	--	--	--	4.1	--	--
Zinc	7440-66-6	µg/L	7.9	9.0	3,813	21	8.9	284	17
Americium-241	14596-10-2	pCi/L	--	--	--	--	--	0.11	--
Carbon-14	14762-75-5	pCi/L	--	--	--	--	--	9.9	--
Iodine-129	15046-84-1	pCi/L	2.5	5.0	--	2.9	1.4	1.3	0.32
Protactinium-231	14331-85-2	pCi/L	--	--	0.28	--	--	0.31	--
Selenium-79	15758-45-9	pCi/L	--	33	6.0	--	--	--	39
Strontium-90	10098-97-2	pCi/L	5.1	4.5	2.5	--	--	2.2	2.8
Technetium-99	14133-76-7	pCi/L	82	1,291	--	--	24	80	68
Tritium	10028-17-8	pCi/L	199,057	6,649	190	15,005	23,462	179,470	50,867
Uranium-233/234	U-233/234	pCi/L	--	--	--	--	--	34	2.4
Uranium-234	13966-29-5	pCi/L	31	2.7	1.7	--	3.9	2.9	2.5
Uranium-235	15117-96-1	pCi/L	2.1	--	--	--	--	1.1	0.15
Uranium-238	U-238	pCi/L	34	2.0	0.96	--	2.9	20	1.8

Table 4-3. Summary of Analytes and Exposure Point Concentrations for Wells Associated with LLWMA 1 and LLWMA 2 Exposure Areas in the 200-BP-5 Groundwater Operable Unit

Analyte Name	CAS #	Units	LLWMA 1				LLWMA 2		
			299-E28-28	299-E33-34	299-E33-265	299-E33-266	299-E27-10	299-E33-33	299-E34-9
2-Hexanone	591-78-6	µg/L	--	--	--	--	--	--	--
Acetone	67-64-1	µg/L	--	--	--	1.0	--	--	--
Acetophenone	98-86-2	µg/L	--	--	--	--	--	--	--
Aluminum	7429-90-5	µg/L	--	--	--	--	--	--	--
Antimony	7440-36-0	µg/L	46	--	--	--	79	--	--
Arsenic	7440-38-2	µg/L	4.0	6.3	4.9	4.7	4.4	9.0	7.3
Barium	7440-39-3	µg/L	63	167	56	60	101	58	156
Benzene	71-43-2	µg/L	--	--	--	--	--	--	--
Beryllium	7440-41-7	µg/L	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	117-81-7	µg/L	--	--	--	--	--	--	--
Boron	7440-42-8	µg/L	--	--	--	--	--	--	--
Butylbenzylphthalate	85-68-7	µg/L	--	--	--	--	--	--	--
Cadmium	7440-43-9	µg/L	--	--	--	--	--	--	--
Carbon disulfide	75-15-0	µg/L	--	--	--	--	--	--	--
Carbon tetrachloride	56-23-5	µg/L	--	--	--	--	--	--	--
Chloroform	67-66-3	µg/L	--	--	0.13	--	--	--	--
Chromium	7440-47-3	µg/L	10	28	5.2	5.1	26	26	25
Chromium (Dissolved)	7440-47-3-D	µg/L	3.7	26	5.8	3.1	9.9	18	17
Cobalt	7440-48-4	µg/L	--	0.57	--	--	--	--	--
Copper	7440-50-8	µg/L	0.62	4.9	2.3	--	5.4	--	5.0
Cyanide	57-12-5	µg/L	6.7	450	42	26	--	20	411
Di-n-octylphthalate	117-84-0	µg/L	--	--	--	--	--	--	--
Fluoride	16984-48-8	µg/L	430	327	348	376	164	289	301
Hexavalent Chromium	18540-29-9	µg/L	--	14	--	--	8.5	4.3	2.8
Iron	7439-89-6	µg/L	41	282	22	39	317	81	266
Lead	7439-92-1	µg/L	--	--	0.41	0.56	0.22	--	--
Lithium	7439-93-2	µg/L	--	--	--	--	--	--	--
Manganese	7439-96-5	µg/L	1.2	0.65	0.36	0.21	14	--	5.9
Mercury	7439-97-6	µg/L	--	0.18	--	--	--	--	--
Methyl methacrylate	80-62-6	µg/L	--	--	--	--	--	--	--
Methyl methanesulfonate	66-27-3	µg/L	--	--	--	--	--	--	--
Methylene chloride	75-09-2	µg/L	--	--	--	--	--	--	--
Molybdenum	7439-98-7	µg/L	6.5	4.5	6.3	6.5	--	--	--
Nickel	7440-02-0	µg/L	5.1	3.7	2.5	0.59	113	13	9.5
Nitrate	14797-55-8	µg/L	47,893	813,045	99,478	83,394	55,646	86,069	321,818
Nitrite	14797-65-0	µg/L	230	--	189	219	--	223	281
n-Nitrosodi-n-dipropylamine	621-64-7	µg/L	--	--	--	--	--	--	--
Octachlorodibenzofuran	39001-02-0	µg/L	--	--	--	1.70E-06	--	--	--
Phenol	108-95-2	µg/L	--	--	--	--	--	--	--

Table 4-3. Summary of Analytes and Exposure Point Concentrations for Wells Associated with LLWMA 1 and LLWMA 2 Exposure Areas in the 200-BP-5 Groundwater Operable Unit

Analyte Name	CAS #	Units	LLWMA 1				LLWMA 2		
			299-E28-28	299-E33-34	299-E33-265	299-E33-266	299-E27-10	299-E33-33	299-E34-9
Selenium	7782-49-2	µg/L	4.9	8.4	6.5	6.0	--	--	--
Silver	7440-22-4	µg/L	--	0.14	6.7	--	15	--	--
Strontium	7440-24-6	µg/L	246	1,091	359	355	753	309	564
Thallium	7440-28-0	µg/L	--	--	--	--	--	--	--
Tin	7440-31-5	µg/L	--	--	--	--	--	--	--
Toluene	108-88-3	µg/L	--	--	--	--	--	--	--
Tributyl phosphate	126-73-8	µg/L	--	--	--	--	--	--	--
Trichloroethene	79-01-6	µg/L	--	--	--	--	--	--	--
Uranium	7440-61-1	µg/L	5.6	120	18	20	4.0	4.0	5.2
Vanadium	7440-62-2	µg/L	21	15	16	17	17	25	19
Zinc	7440-66-6	µg/L	--	--	6.0	8.0	60	--	27
Americium-241	14596-10-2	pCi/L	--	--	--	--	--	--	--
Carbon-14	14762-75-5	pCi/L	--	--	--	--	--	--	--
Cesium-137	10045-97-3	pCi/L	--	--	--	--	--	--	--
Cobalt-60	10198-40-0	pCi/L	--	36	--	--	--	--	--
Europium-154	15585-10-1	pCi/L	--	--	--	--	--	--	--
Iodine-129	15046-84-1	pCi/L	--	4.0	2.4	1.5	1.5	2.5	0.61
Neptunium-237	13994-20-2	pCi/L	--	--	--	--	--	--	--
Plutonium-238	13981-16-3	pCi/L	--	--	--	--	--	--	--
Plutonium-239/240	PU-239/240	pCi/L	--	--	--	--	--	--	--
Strontium-90	10098-97-2	pCi/L	--	--	--	--	--	--	--
Technetium-99	14133-76-7	pCi/L	42	16,966	970	333	83	497	9,800
Tritium	10028-17-8	pCi/L	711	20,191	6,600	5,267	310	511	1,090
Uranium-233/234	U-233/234	pCi/L	--	--	--	--	--	--	--
Uranium-234	13966-29-5	pCi/L	--	--	--	--	--	--	--
Uranium-235	15117-96-1	pCi/L	--	--	--	--	--	--	--
Uranium-238	U-238	pCi/L	--	--	--	--	--	--	--

Table 4-4. Summary of Analytes and Exposure Point Concentrations for Wells Associated with the WMA B-BX-BY and 216-B-63 Trench Exposure Area in the 200-BP-5 Groundwater Operable Unit (Table 1 of 2)

Analyte Name	CAS #	Units	WMA B-BX-BY and 216-B-63 Trench									
			299-E33-15	299-E33-16	299-E33-17	299-E33-18	299-E33-1A	299-E33-20	299-E33-205	299-E33-334	299-E33-337	299-E33-338
2-Hexanone	591-78-6	µg/L	--	--	--	--	--	--	--	--	--	--
Acetone	67-64-1	µg/L	--	--	--	--	--	--	--	--	--	--
Acetophenone	98-86-2	µg/L	--	--	--	--	--	--	--	--	--	--
Aluminum	7429-90-5	µg/L	--	--	--	--	--	--	--	--	--	--
Antimony	7440-36-0	µg/L	--	211	--	109	--	--	--	43	78	62
Arsenic	7440-38-2	µg/L	7.1	82	6.1	5.2	--	4.7	4.6	6.1	5.7	6.7
Barium	7440-39-3	µg/L	200	176	166	138	225	244	117	78	90	76
Benzene	71-43-2	µg/L	--	--	--	--	--	--	--	--	--	--
Beryllium	7440-41-7	µg/L	--	--	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	117-81-7	µg/L	--	--	--	--	--	--	--	--	--	--
Boron	7440-42-8	µg/L	--	--	--	--	--	--	--	--	--	--
Butylbenzylphthalate	85-68-7	µg/L	--	--	--	--	--	--	--	--	--	--
Cadmium	7440-43-9	µg/L	--	--	--	--	--	--	--	--	--	--
Carbon disulfide	75-15-0	µg/L	--	--	--	--	--	--	--	--	--	--
Carbon tetrachloride	56-23-5	µg/L	--	--	--	--	--	--	--	--	--	--
Chloroform	67-66-3	µg/L	--	--	--	--	--	--	--	--	--	--
Chromium	7440-47-3	µg/L	65	100	61	63	69	53	25	13	187	24
Chromium (Dissolved)	7440-47-3-D	µg/L	61	81	58	63	49	52	26	7.8	31	13
Cobalt	7440-48-4	µg/L	5.3	--	--	--	4.8	--	--	--	22	4.0
Copper	7440-50-8	µg/L	--	--	4.4	4.8	--	--	--	--	65	6.2
Cyanide	57-12-5	µg/L	835	874	1,020	53	791	143	51	43	163	87
Di-n-octylphthalate	117-84-0	µg/L	--	--	--	--	--	--	--	--	--	--
Fluoride	16984-48-8	µg/L	572	85	293	174	522	353	150	237	211	213
Hexavalent Chromium	18540-29-9	µg/L	69	80	77	67	--	34	24	2.6	12	8.0
Iron	7439-89-6	µg/L	464	706	325	110	640	220	--	64	652	88
Lead	7439-92-1	µg/L	--	--	--	0.33	--	2.4	--	0.43	0.73	--
Lithium	7439-93-2	µg/L	--	--	--	--	--	--	--	--	--	--
Manganese	7439-96-5	µg/L	42	16	15	8.6	29	82	8.9	5.4	147	4.3
Mercury	7439-97-6	µg/L	--	--	--	--	--	--	--	--	0.14	--
Methyl methacrylate	80-62-6	µg/L	--	--	--	--	--	--	--	--	--	--
Methyl methanesulfonate	66-27-3	µg/L	--	--	--	--	--	--	--	--	--	--
Methylene chloride	75-09-2	µg/L	--	--	--	--	--	--	--	--	--	--
Molybdenum	7439-98-7	µg/L	--	--	--	--	--	--	--	--	--	--
Nickel	7440-02-0	µg/L	--	16	--	15	17	--	--	6.4	1,728	9.2
Nitrate	14797-55-8	µg/L	1.09E+06	1.09E+06	1.16E+06	588,586	1.28E+06	891,124	401,000	114,057	319,054	210,101
Nitrite	14797-65-0	µg/L	154	407	--	--	--	125	165	232	182	213
n-Nitrosodi-n-dipropylamine	621-64-7	µg/L	--	--	--	--	--	--	--	3.5	--	--

Table 4-4. Summary of Analytes and Exposure Point Concentrations for Wells Associated with the WMA B-BX-BY and 216-B-63 Trench Exposure Area in the 200-BP-5 Groundwater Operable Unit (Table 1 of 2)

Analyte Name	CAS #	Units	WMA B-BX-BY and 216-B-63 Trench									
			299-E33-15	299-E33-16	299-E33-17	299-E33-18	299-E33-1A	299-E33-20	299-E33-205	299-E33-334	299-E33-337	299-E33-338
Octachlorodibenzofuran	39001-02-0	µg/L	--	--	--	--	--	--	--	--	--	--
Phenol	108-95-2	µg/L	--	--	--	--	--	--	--	--	--	--
Selenium	7782-49-2	µg/L	--	--	--	18	--	12	--	7.4	11	7.5
Silver	7440-22-4	µg/L	--	4.5	--	7.0	--	4.0	--	--	--	7.3
Strontium	7440-24-6	µg/L	1,251	1,035	1,035	889	1,534	1,091	844	362	557	392
Thallium	7440-28-0	µg/L	--	--	--	--	--	--	--	--	0.11	--
Tin	7440-31-5	µg/L	--	--	--	0.51	--	0.92	--	1.1	--	--
Toluene	108-88-3	µg/L	--	--	--	--	--	--	--	--	--	--
Tributyl phosphate	126-73-8	µg/L	--	--	--	--	--	--	--	--	--	--
Trichloroethene	79-01-6	µg/L	--	--	--	--	--	--	--	--	--	--
Uranium	7440-61-1	µg/L	59	500	5.8	2,648	164	19	794	32	64	46
Vanadium	7440-62-2	µg/L	19	25	14	13	15	9.9	14	16	17	16
Zinc	7440-66-6	µg/L	351	58	253	8.1	--	632	136	6.7	7.4	6.0
Americium-241	14596-10-2	pCi/L	--	--	--	--	--	--	0.12	--	--	--
Carbon-14	14762-75-5	pCi/L	--	--	--	--	--	--	14	--	--	--
Cesium-137	10045-97-3	pCi/L	--	--	--	--	--	--	--	--	--	--
Cobalt-60	10198-40-0	pCi/L	19	43	30	16	43	--	3.9	--	--	--
Europium-154	15585-10-1	pCi/L	--	--	--	--	--	--	--	--	--	--
Iodine-129	15046-84-1	pCi/L	2.3	4.7	4.0	4.5	3.9	3.6	4.4	3.8	2.7	4.7
Neptunium-237	13994-20-2	pCi/L	--	--	--	--	--	--	0.48	--	--	--
Plutonium-238	13981-16-3	pCi/L	--	--	--	--	--	--	--	--	--	--
Plutonium-239/240	PU-239/240	pCi/L	--	--	--	--	--	--	--	--	--	--
Strontium-90	10098-97-2	pCi/L	--	--	--	--	--	--	--	--	--	4.6
Technetium-99	14133-76-7	pCi/L	15,364	21,243	16,987	23,389	23,167	5,881	8,300	1,103	3,614	2,832
Tritium	10028-17-8	pCi/L	14,139	14,136	11,401	17,498	19,068	3,457	4,900	9,314	9,128	4,477
Uranium-233/234	U-233/234	pCi/L	--	--	--	--	--	--	--	--	--	--
Uranium-234	13966-29-5	pCi/L	--	--	--	--	--	--	--	--	--	--
Uranium-235	15117-96-1	pCi/L	--	--	--	--	--	--	--	--	--	--
Uranium-238	U-238	pCi/L	--	--	--	--	--	--	--	--	--	--

Table 4-5. Summary of Analytes and Exposure Point Concentrations for Wells Associated with the WMA B-BX-BY and 216-B-63 Trench Exposure Area in the 200-BP-5 Groundwater Operable Unit (Table 2 of 2)

Analyte Name	CAS #	Units	WMA B-BX-BY and 216-B-63 Trench										
			299-E33-339	299-E33-341	299-E33-342	299-E33-343	299-E33-345	299-E33-38	299-E33-4	299-E33-42	299-E33-44	299-E33-47	299-E33-48
2-Hexanone	591-78-6	µg/L	--	--	--	--	--	--	--	--	--	--	--
Acetone	67-64-1	µg/L	--	--	--	--	--	--	--	--	--	--	--
Acetophenone	98-86-2	µg/L	--	--	--	--	--	--	--	--	--	--	--
Aluminum	7429-90-5	µg/L	--	10	--	6.2	23	--	--	--	--	--	--
Antimony	7440-36-0	µg/L	92	147	213	--	--	175	--	101	150	118	48
Arsenic	7440-38-2	µg/L	5.9	6.2	6.4	6.0	4.3	6.9	--	5.0	7.8	6.4	6.6
Barium	7440-39-3	µg/L	98	180	154	112	89	190	--	153	96	225	74
Benzene	71-43-2	µg/L	--	--	--	--	--	--	--	--	--	--	--
Beryllium	7440-41-7	µg/L	--	--	--	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	117-81-7	µg/L	--	2.1	1.5	2.6	1.7	--	--	--	8.0	--	--
Boron	7440-42-8	µg/L	--	--	--	--	--	--	--	--	--	--	--
Butylbenzylphthalate	85-68-7	µg/L	--	--	--	--	--	--	--	--	2.8	--	--
Cadmium	7440-43-9	µg/L	--	--	--	--	--	1.7	--	--	--	--	--
Carbon disulfide	75-15-0	µg/L	--	--	--	--	--	--	--	--	--	--	--
Carbon tetrachloride	56-23-5	µg/L	--	3.4	5.9	2.0	--	--	--	--	--	--	--
Chloroform	67-66-3	µg/L	--	--	1.4	1.5	--	--	--	--	--	--	--
Chromium	7440-47-3	µg/L	79	45	37	33	66	39	--	21	53	46	16
Chromium (Dissolved)	7440-47-3-D	µg/L	15	46	38	31	73	37	--	17	51	47	8.6
Cobalt	7440-48-4	µg/L	13	--	--	--	--	4.4	--	--	8.2	4.5	--
Copper	7440-50-8	µg/L	10	--	5.0	9.2	--	--	--	--	4.2	--	7.4
Cyanide	57-12-5	µg/L	69	1,093	849	7.5	2.2	952	--	85	553	505	45
Di-n-octylphthalate	117-84-0	µg/L	--	--	--	--	--	--	--	2.3	5.5	1.6	--
Fluoride	16984-48-8	µg/L	209	458	247	206	256	267	--	178	168	209	231
Hexavalent Chromium	18540-29-9	µg/L	11	49	36	26	64	25	--	17	67	69	--
Iron	7439-89-6	µg/L	477	476	373	35	53	467	--	107	393	424	63
Lead	7439-92-1	µg/L	0.36	--	--	--	0.20	0.67	--	0.49	0.44	0.34	0.60
Lithium	7439-93-2	µg/L	--	--	--	--	--	--	--	--	--	--	--
Manganese	7439-96-5	µg/L	21	22	14	5.6	94	1.2	--	--	--	--	35
Mercury	7439-97-6	µg/L	0.22	1.3	0.26	--	--	0.51	--	0.099	0.33	1.7	--
Methyl methacrylate	80-62-6	µg/L	--	--	--	--	--	--	--	--	--	--	--
Methyl methanesulfonate	66-27-3	µg/L	--	--	--	--	--	--	--	--	--	340	--
Methylene chloride	75-09-2	µg/L	--	--	--	1.8	--	--	--	--	--	--	--
Molybdenum	7439-98-7	µg/L	--	--	--	--	--	--	--	--	0.58	--	--
Nickel	7440-02-0	µg/L	148	--	--	--	4.9	6.2	--	6.6	6.6	6.7	28
Nitrate	14797-55-8	µg/L	204,707	1.38E+06	1.22E+06	303,021	345,056	1.21E+06	--	506,111	954,455	1.17E+06	216,068
Nitrite	14797-65-0	µg/L	223	884	3,639	162	4,481	247	--	195	339	299	205
n-Nitrosodi-n-dipropylamine	621-64-7	µg/L	--	--	--	--	--	--	--	2.6	--	--	--

Table 4-5. Summary of Analytes and Exposure Point Concentrations for Wells Associated with the WMA B-BX-BY and 216-B-63 Trench Exposure Area in the 200-BP-5 Groundwater Operable Unit (Table 2 of 2)

Analyte Name	CAS #	Units	WMA B-BX-BY and 216-B-63 Trench										
			299-E33-339	299-E33-341	299-E33-342	299-E33-343	299-E33-345	299-E33-38	299-E33-4	299-E33-42	299-E33-44	299-E33-47	299-E33-48
Octachlorodibenzofuran	39001-02-0	µg/L	--	--	--	--	--	--	--	--	--	--	--
Phenol	108-95-2	µg/L	--	1.1	--	--	1.1	--	--	--	--	--	--
Selenium	7782-49-2	µg/L	9.7	--	--	--	--	12	--	11	16	16	7.9
Silver	7440-22-4	µg/L	--	8.0	5.4	12	51	20	--	99	4.0	5.0	31
Strontium	7440-24-6	µg/L	503	1,562	1,391	684	694	1,504	--	837	1,298	1,369	376
Thallium	7440-28-0	µg/L	--	--	--	--	0.13	--	--	--	--	--	--
Tin	7440-31-5	µg/L	0.41	--	--	--	--	0.95	--	0.36	0.35	0.61	1.5
Toluene	108-88-3	µg/L	--	--	--	--	--	--	--	--	--	--	--
Tributyl phosphate	126-73-8	µg/L	--	--	--	--	1.1	--	--	--	--	--	--
Trichloroethene	79-01-6	µg/L	--	--	--	--	--	--	--	--	--	--	--
Uranium	7440-61-1	µg/L	194	115	608	3,730	360	541	--	262	370	24	41
Vanadium	7440-62-2	µg/L	16	15	18	14	12	13	--	13	8.8	16	17
Zinc	7440-66-6	µg/L	12	--	7.6	20	5.0	9.2	--	4.9	4.1	9.9	7.6
Americium-241	14596-10-2	pCi/L	--	0.19	0.16	0.097	0.10	--	--	--	--	--	--
Carbon-14	14762-75-5	pCi/L	--	126	54	49	15	--	--	--	--	--	--
Cesium-137	10045-97-3	pCi/L	--	--	--	--	--	--	--	--	--	--	--
Cobalt-60	10198-40-0	pCi/L	--	54	45	--	--	55	1,040	--	35	56	--
Europium-154	15585-10-1	pCi/L	--	--	--	--	--	--	--	--	--	--	--
Iodine-129	15046-84-1	pCi/L	4.0	3.4	4.9	4.9	5.4	4.9	--	4.3	3.9	4.5	3.7
Neptunium-237	13994-20-2	pCi/L	--	--	--	1.3	--	--	--	--	--	--	--
Plutonium-238	13981-16-3	pCi/L	--	--	--	--	--	--	--	--	--	--	--
Plutonium-239/240	PU-239/240	pCi/L	--	0.073	0.090	--	0.098	--	--	--	--	--	--
Strontium-90	10098-97-2	pCi/L	--	2.6	3.5	2.7	2.3	--	--	--	--	--	--
Technetium-99	14133-76-7	pCi/L	2,975	26,849	24,473	15,471	18,739	30,677	--	6,027	17,420	26,061	1,492
Tritium	10028-17-8	pCi/L	8,744	13,716	22,110	10,549	11,274	16,047	--	5,797	13,587	7,942	9,410
Uranium-233/234	U-233/234	pCi/L	--	--	--	--	--	--	--	--	--	--	--
Uranium-234	13966-29-5	pCi/L	--	--	--	598	--	--	--	--	--	--	--
Uranium-235	15117-96-1	pCi/L	--	--	--	27	--	--	--	--	--	--	--
Uranium-238	U-238	pCi/L	--	--	--	585	--	--	--	--	--	--	--

Table 4-6. Summary of Analytes and Exposure Point Concentrations for Wells Associated with WMA C, B Plant, Semiworks, LERF, and Gable Mountain Pond Exposure Areas in the 200-BP-5 Groundwater Operable Unit

			WMA C						B Plant					Semiworks	LERF	Gable Mountain Pond	
Analyte Name	CAS #	Units	299-E27-14	299-E27-15	299-E27-155	299-E27-23	299-E27-24	299-E27-7	299-E28-23	299-E28-24	299-E28-25	299-E28-30	299-E29-54	299-E24-25	299-E26-10	699-53-47A	699-53-47B
2-Hexanone	591-78-6	µg/L	--	--	2.0	--	--	--	--	--	--	--	--	--	--	--	--
Acetone	67-64-1	µg/L	--	--	5.6	1.9	--	--	--	--	--	--	--	--	--	--	--
Acetophenone	98-86-2	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aluminum	7429-90-5	µg/L	--	--	26	--	--	--	--	--	--	--	--	--	--	--	--
Antimony	7440-36-0	µg/L	--	62	--	39	--	--	--	--	44	63	--	--	0.32	--	72
Arsenic	7440-38-2	µg/L	16	12	4.9	7.7	4.7	4.9	2.8	1.2	3.9	3.5	3.5	4.0	4.4	--	--
Barium	7440-39-3	µg/L	88	45	61	49	81	59	--	--	63	69	72	83	76	66	68
Benzene	71-43-2	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium	7440-41-7	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	117-81-7	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Boron	7440-42-8	µg/L	--	--	23	--	--	--	--	--	--	20	23	53	--	--	--
Butylbenzylphthalate	85-68-7	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cadmium	7440-43-9	µg/L	--	--	--	4.0	--	--	--	--	--	--	--	--	--	--	--
Carbon disulfide	75-15-0	µg/L	--	--	0.12	0.089	--	--	--	--	--	--	--	--	--	--	--
Carbon tetrachloride	56-23-5	µg/L	--	--	1.3	--	--	--	--	--	--	--	--	--	--	--	--
Chloroform	67-66-3	µg/L	--	0.11	0.20	0.15	0.13	--	--	--	--	--	--	--	--	--	--
Chromium	7440-47-3	µg/L	12	18	7.8	17	14	9.9	--	--	--	36	0.83	5.2	16	--	--
Chromium (Dissolved)	7440-47-3-D	µg/L	7.2	15	7.2	7.5	8.1	6.4	--	--	--	--	--	5.4	--	--	5.3
Cobalt	7440-48-4	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Copper	7440-50-8	µg/L	981	5.9	0.62	6.0	4.0	5.0	--	--	--	8.3	5.0	1.9	--	6.0	5.9
Cyanide	57-12-5	µg/L	15	--	6.9	5.1	13	21	--	--	--	9.0	5.0	--	--	--	--
Di-n-octylphthalate	117-84-0	µg/L	--	3.3	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoride	16984-48-8	µg/L	136	153	136	165	161	110	399	3,270	402	415	321	214	187	93	115
Hexavalent Chromium	18540-29-9	µg/L	--	--	5.5	--	--	--	--	--	--	2.9	2.6	3.1	--	--	--
Iron	7439-89-6	µg/L	113	67	43	149	106	192	--	--	201	126	--	--	108	362	432
Lead	7439-92-1	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lithium	7439-93-2	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	7439-96-5	µg/L	1.3	5.2	25	5.1	0.80	5.8	--	--	--	2.3	0.24	--	5.9	14	16
Mercury	7439-97-6	µg/L	--	--	0.060	--	--	--	--	--	--	--	--	--	--	--	--
Methyl methacrylate	80-62-6	µg/L	--	--	1.4	--	--	--	--	--	--	--	--	--	--	--	--
Methyl methanesulfonate	66-27-3	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	75-09-2	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Molybdenum	7439-98-7	µg/L	--	--	1.2	--	2.9	--	--	--	--	7.1	5.2	3.6	--	--	--
Nickel	7440-02-0	µg/L	9.5	29	0.23	19	5.4	6.6	--	--	--	20	--	1.2	14	--	6.6

Table 4-6. Summary of Analytes and Exposure Point Concentrations for Wells Associated with WMA C, B Plant, Semiworks, LERF, and Gable Mountain Pond Exposure Areas in the 200-BP-5 Groundwater Operable Unit

Analyte Name	CAS #	Units	WMA C						B Plant					Semiworks	LERF	Gable Mountain Pond	
			299-E27-14	299-E27-15	299-E27-155	299-E27-23	299-E27-24	299-E27-7	299-E28-23	299-E28-24	299-E28-25	299-E28-30	299-E29-54	299-E24-25	299-E26-10	699-53-47A	699-53-47B
Nitrate	14797-55-8	µg/L	92,014	19,572	50,829	39,671	70,372	37,882	56,200	420,000	71,931	60,200	126,000	41,300	52,600	88,500	82,300
Nitrite	14797-65-0	µg/L	--	195	290	207	269	150	--	155	203	279	--	200	--	--	220
n-Nitrosodi-n-dipropylamine	621-64-7	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Octachlorodibenzofuran	39001-02-0	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenol	108-95-2	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	7782-49-2	µg/L	17	17	13	11	14	13	--	--	--	4.4	8.2	5.9	--	--	--
Silver	7440-22-4	µg/L	--	--	6.1	5.5	--	4.7	--	--	--	--	--	--	7.5	--	--
Strontium	7440-24-6	µg/L	621	318	470	368	624	533	--	--	332	315	345	377	668	601	431
Thallium	7440-28-0	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tin	7440-31-5	µg/L	--	0.21	--	--	--	--	--	--	--	--	0.28	--	--	--	--
Toluene	108-88-3	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tributyl phosphate	126-73-8	µg/L	1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene	79-01-6	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Uranium	7440-61-1	µg/L	7.2	12	6.1	3.2	7.0	3.9	29	26	28	4.4	47	6.1	--	--	--
Vanadium	7440-62-2	µg/L	18	18	18	20	15	16	--	--	9.8	13	13	13	13	--	5.7
Zinc	7440-66-6	µg/L	6.9	10	6.5	6.2	10	6.6	--	--	394	--	6.0	6.6	11	12	12
Americium-241	14596-10-2	pCi/L	--	--	0.14	--	--	--	0.25	--	0.094	--	--	--	--	--	--
Carbon-14	14762-75-5	pCi/L	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--
Cesium-137	10045-97-3	pCi/L	--	--	--	--	--	--	2,430	89	41	--	--	--	--	--	--
Cobalt-60	10198-40-0	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Europium-154	15585-10-1	pCi/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iodine-129	15046-84-1	pCi/L	4.5	5.7	4.4	5.1	5.0	6.1	1.8	1.5	1.9	--	0.39	1.8	0.25	--	--
Neptunium-237	13994-20-2	pCi/L	--	--	--	--	--	--	--	--	--	--	0.71	--	--	--	--
Plutonium-238	13981-16-3	pCi/L	--	--	--	--	--	--	0.19	--	--	--	--	--	--	--	--
Plutonium-239/240	PU-239/240	pCi/L	--	--	0.11	--	--	--	52	1.1	1.3	0.047	--	0.11	--	--	--
Strontium-90	10098-97-2	pCi/L	--	--	--	--	--	--	4,900	685	2,199	--	--	2.8	--	522	320
Technetium-99	14133-76-7	pCi/L	5,396	80	8,100	17,311	4,400	81	--	5,700	--	76	55	62	--	--	--
Tritium	10028-17-8	pCi/L	946	1,200	1,581	1,368	1,300	829	6,600	7,611	6,398	3,200	4,400	5,000	--	--	3,200
Uranium-233/234	U-233/234	pCi/L	--	--	--	--	--	--	--	9.0	11	--	--	--	--	--	--
Uranium-234	13966-29-5	pCi/L	--	--	--	--	--	--	10	7.2	6.0	--	--	--	--	--	--
Uranium-235	15117-96-1	pCi/L	--	--	--	--	--	--	0.39	0.52	0.72	--	--	--	--	--	--
Uranium-238	U-238	pCi/L	--	--	--	--	--	--	9.6	8.9	10	--	--	--	--	--	--

Table 4-7. Summary of Analytes and Exposure Point Concentrations for Wells Associated with 200-BP-5 West Exposure Area in the 200-BP-5 Groundwater Operable Unit

Analyte Name	CAS #	Units	200-BP-5 West							
			699-49-57A	699-50-56	699-50-59	699-52-55	699-53-55B	699-53-55C	699-54-45A	699-55-57
2-Hexanone	591-78-6	µg/L	--	--	--	--	--	--	--	--
Acetone	67-64-1	µg/L	--	--	--	--	--	--	--	--
Acetophenone	98-86-2	µg/L	--	--	--	--	--	--	--	--
Aluminum	7429-90-5	µg/L	--	7.2	--	7,180	--	--	274	--
Antimony	7440-36-0	µg/L	59	--	--	--	--	52	--	--
Arsenic	7440-38-2	µg/L	5.4	7.9	--	5.1	--	--	--	5.9
Barium	7440-39-3	µg/L	76	34	70	330	44	44	29	29
Benzene	71-43-2	µg/L	--	--	--	--	--	--	--	--
Beryllium	7440-41-7	µg/L	--	--	--	--	--	--	0.12	--
Bis(2-ethylhexyl) phthalate	117-81-7	µg/L	--	2.9	--	2.3	--	--	--	--
Boron	7440-42-8	µg/L	--	--	--	--	--	--	--	--
Butylbenzylphthalate	85-68-7	µg/L	--	--	--	--	--	--	--	--
Cadmium	7440-43-9	µg/L	--	--	--	35	--	--	0.55	--
Carbon disulfide	75-15-0	µg/L	--	--	--	--	--	--	2.4	--
Carbon tetrachloride	56-23-5	µg/L	--	--	--	2.0	--	--	5.4	--
Chloroform	67-66-3	µg/L	--	--	--	--	--	--	0.66	--
Chromium	7440-47-3	µg/L	8.2	7.1	--	69	33	--	43	140
Chromium (Dissolved)	7440-47-3-D	µg/L	10	7.8	--	--	--	5.2	--	4.7
Cobalt	7440-48-4	µg/L	--	15	--	34	--	--	9.1	--
Copper	7440-50-8	µg/L	--	--	--	68	--	--	11	5.9
Cyanide	57-12-5	µg/L	152	55	52	18	170	172	--	64
Di-n-octylphthalate	117-84-0	µg/L	--	--	--	--	--	--	--	--
Fluoride	16984-48-8	µg/L	434	500	322	684	320	293	175	336
Hexavalent Chromium	18540-29-9	µg/L	2.9	3.8	--	--	--	--	--	--
Iron	7439-89-6	µg/L	151	55	36	15,800	1,660	197	18,900	2,690
Lead	7439-92-1	µg/L	--	--	--	--	--	--	8.5	--
Lithium	7439-93-2	µg/L	--	--	--	--	--	--	13	--
Manganese	7439-96-5	µg/L	9.0	--	--	1,190	52	5.7	213	146
Mercury	7439-97-6	µg/L	--	--	--	0.64	--	--	--	--
Methyl methacrylate	80-62-6	µg/L	--	--	--	--	--	--	--	--
Methyl methanesulfonate	66-27-3	µg/L	--	--	--	--	--	--	--	--
Methylene chloride	75-09-2	µg/L	--	--	--	--	--	--	--	--
Molybdenum	7439-98-7	µg/L	--	--	--	--	--	--	0.50	--
Nickel	7440-02-0	µg/L	--	11	--	63	15	--	21	78
Nitrate	14797-55-8	µg/L	285,966	55,116	112,209	6,570	153,000	149,068	1,560	84,177
Nitrite	14797-65-0	µg/L	196	193	256	255	181	224	160	246
n-Nitrosodi-n-dipropylamine	621-64-7	µg/L	--	--	--	--	--	--	--	--
Octachlorodibenzofuran	39001-02-0	µg/L	--	--	--	--	--	--	--	--

Table 4-7. Summary of Analytes and Exposure Point Concentrations for Wells Associated with 200-BP-5 West Exposure Area in the 200-BP-5 Groundwater Operable Unit

Analyte Name	CAS #	Units	200-BP-5 West							
			699-49-57A	699-50-56	699-50-59	699-52-55	699-53-55B	699-53-55C	699-54-45A	699-55-57
Phenol	108-95-2	µg/L	--	--	--	--	--	--	--	--
Selenium	7782-49-2	µg/L	--	--	--	--	--	--	4.2	--
Silver	7440-22-4	µg/L	--	--	--	--	--	--	--	--
Strontium	7440-24-6	µg/L	545	329	443	363	465	516	146	354
Thallium	7440-28-0	µg/L	--	--	--	--	--	--	--	--
Tin	7440-31-5	µg/L	--	--	--	--	--	--	--	--
Toluene	108-88-3	µg/L	--	--	--	--	--	--	--	--
Tributyl phosphate	126-73-8	µg/L	--	0.63	--	1.7	--	--	--	--
Trichloroethene	79-01-6	µg/L	--	--	--	--	--	--	--	--
Uranium	7440-61-1	µg/L	21	5.0	13	5.3	4.6	4.9	--	6.8
Vanadium	7440-62-2	µg/L	22	19	15	29	15	18	--	12
Zinc	7440-66-6	µg/L	22	14	--	2,680	--	9.0	5,450	--
Americium-241	14596-10-2	pCi/L	--	0.27	--	0.092	--	--	--	--
Carbon-14	14762-75-5	pCi/L	--	--	--	--	--	--	--	--
Cesium-137	10045-97-3	pCi/L	--	--	--	--	--	--	--	--
Cobalt-60	10198-40-0	pCi/L	8.0	--	--	--	6.7	9.9	--	--
Europium-154	15585-10-1	pCi/L	--	--	--	--	--	--	--	--
Iodine-129	15046-84-1	pCi/L	3.3	--	4.0	--	--	--	--	--
Neptunium-237	13994-20-2	pCi/L	--	--	--	0.57	--	--	--	--
Plutonium-238	13981-16-3	pCi/L	--	--	--	--	--	--	--	--
Plutonium-239/240	PU-239/240	pCi/L	--	0.052	--	--	--	--	--	--
Strontium-90	10098-97-2	pCi/L	2.9	180	--	--	--	--	--	--
Technetium-99	14133-76-7	pCi/L	5,308	1,088	1,560	129	2,641	3,075	--	1,616
Tritium	10028-17-8	pCi/L	11,906	866	7,909	300	755	619	--	1,894
Uranium-233/234	U-233/234	pCi/L	--	--	--	--	--	--	--	--
Uranium-234	13966-29-5	pCi/L	--	--	--	--	--	--	--	--
Uranium-235	15117-96-1	pCi/L	--	--	--	--	--	--	--	--
Uranium-238	U-238	pCi/L	--	--	--	--	--	--	--	--

Table 4-8. Summary of Analytes and Exposure Point Concentrations for Wells Associated with Far Field, Near River, and 200-BP-5 Confined Exposure Areas in the 200-BP-5 Groundwater Operable Unit

			200-BP-5 Far Field				200-BP-5 Near River		200-BP-5 Confined		
Analyte Name	**CAS #**	**Units**	**699-62-43F**	**699-64-62**	699-65-50	**699-66-58**	**699-66-64**	699-70-68	**299-E33-12**	**299-E33-50**	**699-52-55B**
2-Hexanone	591-78-6	µg/L	--	--	--	--	--	--	--	--	--
Acetone	67-64-1	µg/L	--	--	--	--	--	--	--	--	--
Acetophenone	98-86-2	µg/L	--	--	--	--	--	--	--	--	--
Aluminum	7429-90-5	µg/L	--	--	--	--	--	34	--	43	48
Antimony	7440-36-0	µg/L	--	--	--	--	--	--	--	--41	--
Arsenic	7440-38-2	µg/L	15	--	11	6.8	4.8	3.8	1.6	4.0	2.1
Barium	7440-39-3	µg/L	18	26	14	15	21	22	101	88	119
Benzene	71-43-2	µg/L	--	--	--	--	--	--	--	--	2.5
Beryllium	7440-41-7	µg/L	--	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	117-81-7	µg/L	--	--	--	--	--	--	--	2.6	11
Boron	7440-42-8	µg/L	29	--	--	--	23	27	--	18	--
Butylbenzylphthalate	85-68-7	µg/L	--	--	--	--	--	--	--	--	--
Cadmium	7440-43-9	µg/L	--	--	--	--	--	--	--	--	--
Carbon disulfide	75-15-0	µg/L	--	--	--	--	--	--	--	--	--
Carbon tetrachloride	56-23-5	µg/L	--	--	--	--	--	--	--	--	2.3
Chloroform	67-66-3	µg/L	--	--	--	--	--	--	--	--	1.3
Chromium	7440-47-3	µg/L	16	5.0	12	2.1	2.8	4.9	--	4.8	--
Chromium (Dissolved)	7440-47-3-D	µg/L	16	7.6	12	9.9	2.9	5.0	--	5.5	--
Cobalt	7440-48-4	µg/L	--	--	--	--	--	--	--	0.12	--
Copper	7440-50-8	µg/L	--	--	--	--	0.36	4.1	--	0.26	--
Cyanide	57-12-5	µg/L	--	--	--	--	--	--	31	--	--
Di-n-octylphthalate	117-84-0	µg/L	--	--	--	--	--	--	--	--	--
Fluoride	16984-48-8	µg/L	759	542	763	642	462	293	76	203	110
Hexavalent Chromium	18540-29-9	µg/L	13	--	9.7	--	2.4	4.7	--	3.9	--
Iron	7439-89-6	µg/L	94	117	--	95	85	224	295	298	198
Lead	7439-92-1	µg/L	--	--	--	0.82	--	--	--	--	--
Lithium	7439-93-2	µg/L	12	--	12	13	--	6.8	--	--	--
Manganese	7439-96-5	µg/L	14	--	--	--	0.62	1.4	4.1	102	246
Mercury	7439-97-6	µg/L	--	--	--	--	--	--	--	--	--
Methyl methacrylate	80-62-6	µg/L	--	--	--	--	--	--	--	--	--
Methyl methanesulfonate	66-27-3	µg/L	--	--	--	--	--	--	--	--	--
Methylene chloride	75-09-2	µg/L	--	--	--	--	--	--	--	--	--
Molybdenum	7439-98-7	µg/L	5.6	--	5.8	5.2	7.3	7.2	--	5.1	--
Nickel	7440-02-0	µg/L	--	--	--	8.0	0.97	0.44	--	0.54	7.0
Nitrate	14797-55-8	µg/L	15,145	30,314	14,623	19,567	25,600	26,161	40,616	2,135	2,267
Nitrite	14797-65-0	µg/L	--	305	235	204	217	240	161	186	328
n-Nitrosodi-n-dipropylamine	621-64-7	µg/L	--	--	--	--	--	--	--	--	--
Octachlorodibenzofuran	39001-02-0	µg/L	--	--	--	--	--	--	--	--	--

Table 4-8. Summary of Analytes and Exposure Point Concentrations for Wells Associated with Far Field, Near River, and 200-BP-5 Confined Exposure Areas in the 200-BP-5 Groundwater Operable Unit

			200-BP-5 Far Field				200-BP-5 Near River		200-BP-5 Confined		
Analyte Name	**CAS #**	**Units**	**699-62-43F**	**699-64-62**	699-65-50	**699-66-58**	**699-66-64**	699-70-68	**299-E33-12**	**299-E33-50**	**699-52-55B**
Phenol	108-95-2	µg/L	--	--	--	--	--	--	--	--	--
Selenium	7782-49-2	µg/L	1.3	--	1.0	1.8	3.1	3.1	--	--	--
Silver	7440-22-4	µg/L	--	--	--	--	--	--	--	--	--
Strontium	7440-24-6	µg/L	236	221	171	165	190	191	283	241	296
Thallium	7440-28-0	µg/L	--	--	--	--	--	--	--	--	0.065
Tin	7440-31-5	µg/L	--	--	--	--	--	--	--	--	--
Toluene	108-88-3	µg/L	--	--	--	--	--	--	--	--	2.3
Tributyl phosphate	126-73-8	µg/L	--	--	--	--	--	--	--	--	8.4
Trichloroethene	79-01-6	µg/L	--	--	--	--	--	1.7	--	--	--
Uranium	7440-61-1	µg/L	--	3.0	--	--	2.9	2.4	3.3	2.4	3.3
Vanadium	7440-62-2	µg/L	28	24	27	21	16	22	10	11	11
Zinc	7440-66-6	µg/L	8.4	314	7.2	590	64	--	9.0	13	48
Americium-241	14596-10-2	pCi/L	--	--	0.086	--	--	0.13	--	0.11	0.10
Carbon-14	14762-75-5	pCi/L	--	--	--	--	--	--	--	35	--
Cesium-137	10045-97-3	pCi/L	--	--	--	--	--	--	--	--	--
Cobalt-60	10198-40-0	pCi/L	--	--	--	--	--	--	--	--	--
Europium-154	15585-10-1	pCi/L	--	--	--	--	--	--	--	--	--
Iodine-129	15046-84-1	pCi/L	0.28	0.30	0.31	0.30	--	0.25	--	0.18	--
Neptunium-237	13994-20-2	pCi/L	--	--	--	--	--	--	--	--	--
Plutonium-238	13981-16-3	pCi/L	--	--	--	--	--	--	--	--	--
Plutonium-239/240	PU-239/240	pCi/L	--	--	--	--	--	--	--	0.065	--
Strontium-90	10098-97-2	pCi/L	--	--	--	--	--	--	--	1.2	--
Technetium-99	14133-76-7	pCi/L	120	137	117	150	91	103	1,221	182	26
Tritium	10028-17-8	pCi/L	3,177	12,976	3,297	6,706	13,000	10,925	189	--	--
Uranium-233/234	U-233/234	pCi/L	--	--	--	--	--	--	--	--	--
Uranium-234	13966-29-5	pCi/L	--	--	--	--	--	--	--	--	--
Uranium-235	15117-96-1	pCi/L	--	--	--	--	--	--	--	--	--
Uranium-238	U-238	pCi/L	--	--	--	--	--	--	--	--	--

Table 4-9. Summary of Analytes and Exposure Point Concentrations for Wells Associated with the PUREX CribsExposure Area in the 200-PO-1 Groundwater OU

Analyte Name	CAS #	Units	PUREX Cribs									
			299-E16-2	299-E17-1	299-E17-14	299-E17-19	299-E24-16	299-E24-23	299-E25-19	299-E25-20	299-E25-22	299-E25-3
1,1,1-Trichloroethane	71-55-6	µg/L	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethane	75-34-3	µg/L	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethene	75-35-4	µg/L	--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	µg/L	--	--	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	606-20-2	µg/L	--	--	--	--	--	17	--	--	--	--
Acetone	67-64-1	µg/L	--	--	--	--	--	--	--	--	--	--
Aluminum	7429-90-5	µg/L	--	--	--	--	--	--	--	--	--	--
Antimony	7440-36-0	µg/L	--	--	72	101	--	--	--	--	--	54
Arsenic	7440-38-2	µg/L	9.7	5.5	7.4	7.6	7.5	6.1	8.1	9.6	11	5.7
Barium	7440-39-3	µg/L	16	88	79	79	75	82	27	25	20	40
Benzyl alcohol	100-51-6	µg/L	--	--	--	--	--	--	--	--	--	--
Beryllium	7440-41-7	µg/L	--	9.4	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	117-81-7	µg/L	--	--	--	--	--	--	--	6.7	--	--
Boron	7440-42-8	µg/L	--	--	--	--	--	--	--	--	--	--
Bromodichloromethane	75-27-4	µg/L	--	--	--	--	--	--	--	--	--	--
Bromoform	75-25-2	µg/L	--	--	--	--	--	--	--	--	--	--
Bromomethane	74-83-9	µg/L	--	--	--	--	--	--	--	--	--	--
Butylbenzylphthalate	85-68-7	µg/L	--	--	--	--	--	--	--	--	--	--
Cadmium	7440-43-9	µg/L	--	18	--	--	--	--	--	--	--	--
Carbon disulfide	75-15-0	µg/L	--	--	--	--	--	--	--	--	--	--
Carbon tetrachloride	56-23-5	µg/L	--	--	--	--	--	--	--	--	--	--
Chloroform	67-66-3	µg/L	--	--	0.22	--	--	0.57	--	--	--	--
Chromium	7440-47-3	µg/L	23	17	13	20	18	--	7.5	--	--	--
Chromium (Dissolved)	7440-47-3-D	µg/L	6.0	--	17	8.0	15	--	9.1	16	--	--
Cobalt	7440-48-4	µg/L	--	19	--	--	--	--	--	--	--	--
Copper	7440-50-8	µg/L	--	38	4.1	--	23	--	--	5.0	--	--
Dibromochloromethane	124-48-1	µg/L	--	--	--	--	--	--	--	--	--	--
Diethylphthalate	84-66-2	µg/L	--	--	--	--	--	--	--	--	--	--
Ethyl methacrylate	97-63-2	µg/L	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	100-41-4	µg/L	--	--	--	--	--	--	--	--	--	--
Fluoride	16984-48-8	µg/L	312	306	202	208	211	221	224	215	260	167
Hexavalent Chromium	18540-29-9	µg/L	--	--	--	--	--	--	--	--	--	--
Iron	7439-89-6	µg/L	1,027	5,287	63	160	87	49	412	350	129	95
Lead	7439-92-1	µg/L	--	--	0.12	--	--	0.10	--	--	--	--
Lithium	7439-93-2	µg/L	--	--	--	--	--	--	--	--	--	--
Manganese	7439-96-5	µg/L	40	225	9.0	7.6	--	--	62	57	--	4.3
Methylene chloride	75-09-2	µg/L	--	--	--	--	--	--	--	--	--	--
Molybdenum	7439-98-7	µg/L	--	--	--	--	--	--	--	--	--	--
Nickel	7440-02-0	µg/L	11	18	5.6	9.5	8.6	--	--	4.0	4.9	--

Table 4-9. Summary of Analytes and Exposure Point Concentrations for Wells Associated with the PUREX CribsExposure Area in the 200-PO-1 Groundwater OU

Analyte Name	CAS #	Units	PUREX Cribs									
			299-E16-2	299-E17-1	299-E17-14	299-E17-19	299-E24-16	299-E24-23	299-E25-19	299-E25-20	299-E25-22	299-E25-3
Nitrate	14797-55-8	µg/L	7,204	82,935	124,763	148,193	73,672	84,391	41,106	60,220	17,857	38,918
Nitrite	14797-65-0	µg/L	191	263	289	246	284	147	--	174	126	198
n-Nitrosodi-n-dipropylamine	621-64-7	µg/L	--	--	--	--	--	2.9	--	--	--	--
Selenium	7782-49-2	µg/L	--	--	--	--	--	--	--	--	--	--
Silver	7440-22-4	µg/L	--	5.5	--	--	--	--	--	--	--	4.0
Strontium	7440-24-6	µg/L	147	345	480	449	375	453	203	195	184	335
Tetrachloroethene	127-18-4	µg/L	--	--	--	--	--	--	--	--	--	--
Thallium	7440-28-0	µg/L	--	--	--	--	--	--	--	--	--	--
Tin	7440-31-5	µg/L	--	--	--	--	--	--	--	--	--	--
Toluene	108-88-3	µg/L	--	--	--	--	--	--	--	--	--	--
Tributyl phosphate	126-73-8	µg/L	--	--	--	--	--	--	--	--	--	--
Trichloroethene	79-01-6	µg/L	--	--	1.7	1.1	2.8	3.1	--	--	--	--
Trichloromonofluoromethane	75-69-4	µg/L	--	--	--	--	--	--	--	--	--	--
Uranium	7440-61-1	µg/L	--	13	30	12	27	106	--	--	--	3.3
Vanadium	7440-62-2	µg/L	40	24	23	21	26	24	28	34	41	24
Xylenes (total)	1330-20-7	µg/L	--	--	--	--	--	--	--	--	--	--
Zinc	7440-66-6	µg/L	--	79	4.1	--	--	7.0	9.7	16	6.9	7.9
Americium-241	14596-10-2	pCi/L	--	--	--	--	--	--	--	--	--	--
Carbon-14	14762-75-5	pCi/L	--	--	--	--	--	--	--	--	--	--
Iodine-129	15046-84-1	pCi/L	1.5	7.1	9.5	9.8	7.9	6.8	2.4	2.4	2.4	5.1
Protactinium-231	14331-85-2	pCi/L	--	--	--	--	--	--	--	--	--	--
Selenium-79	15758-45-9	pCi/L	--	--	--	--	--	--	--	--	--	--
Strontium-90	10098-97-2	pCi/L	2.1	1.7	21	2.3	6.3	2.8	1.8	1.7	3.2	--
Technetium-99	14133-76-7	pCi/L	--	107	135	90	47	250	84	--	--	--
Tritium	10028-17-8	pCi/L	4,652	530,289	585,757	546,667	272,115	499,634	175,648	185,787	25,359	4,898
Uranium-233/234	U-233/234	pCi/L	--	--	--	--	--	--	--	--	--	--
Uranium-234	13966-29-5	pCi/L	--	--	8.4	--	--	31	--	--	--	--
Uranium-235	15117-96-1	pCi/L	--	--	0.45	--	--	2.1	--	--	--	--
Uranium-238	U-238	pCi/L	--	--	8.2	--	--	34	--	--	--	--

Table 4-10. Summary of Analytes and Exposure Point Concentrations for Wells Associated with the WMA A-AX Exposure Area in the 200-PO-1 Groundwater OU

Analyte Name	CAS #	Units	WMA A-AX Tank Farms and 216-A-29 Ditch -									
			299-E24-20	299-E24-22	299-E25-236	299-E25-28	299-E25-29P	299-E25-34	299-E25-42	299-E25-93	299-E25-94	699-43-45 [a]
1,1,1-Trichloroethane	71-55-6	µg/L	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethane	75-34-3	µg/L	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethene	75-35-4	µg/L	--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	µg/L	--	--	1.70E-06	--	--	--	--	--	--	--
2,6-Dinitrotoluene	606-20-2	µg/L	--	--	--	--	--	--	--	--	--	--
Acetone	67-64-1	µg/L	--	--	--	--	--	--	--	--	--	--
Aluminum	7429-90-5	µg/L	--	--	--	--	--	--	--	--	--	--
Antimony	7440-36-0	µg/L	46	--	--	--	--	--	45	--	--	--
Arsenic	7440-38-2	µg/L	8.8	9.1	6.9	10	9.9	11	11	8.0	8.4	10.0
Barium	7440-39-3	µg/L	48	33	41	57	43	21	35	60	58	33
Benzyl alcohol	100-51-6	µg/L	--	--	--	--	--	--	--	--	--	--
Beryllium	7440-41-7	µg/L	--	--	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	117-81-7	µg/L	--	--	--	--	--	--	--	--	--	--
Boron	7440-42-8	µg/L	--	--	--	--	--	--	--	--	--	--
Bromodichloromethane	75-27-4	µg/L	--	--	--	--	--	--	--	--	--	--
Bromoform	75-25-2	µg/L	--	--	--	--	--	--	--	--	--	--
Bromomethane	74-83-9	µg/L	--	--	--	--	--	--	--	--	--	--
Butylbenzylphthalate	85-68-7	µg/L	--	--	--	--	--	--	--	--	--	--
Cadmium	7440-43-9	µg/L	4.4	--	--	--	--	--	--	5.2	--	--
Carbon disulfide	75-15-0	µg/L	--	--	--	--	--	--	--	--	--	--
Carbon tetrachloride	56-23-5	µg/L	--	--	--	--	--	--	--	--	--	--
Chloroform	67-66-3	µg/L	--	--	--	--	--	--	--	--	--	--
Chromium	7440-47-3	µg/L	15	7.3	51	--	10	15	118	37	16	7.5
Chromium (Dissolved)	7440-47-3-D	µg/L	8.3	6.6	9.0	18	6.0	8.1	13	20	--	--
Cobalt	7440-48-4	µg/L	4.0	--	--	--	--	--	--	--	--	--
Copper	7440-50-8	µg/L	5.6	--	6.2	--	--	--	6.6	--	12	--
Dibromochloromethane	124-48-1	µg/L	--	--	--	--	--	--	--	--	--	--
Diethylphthalate	84-66-2	µg/L	--	--	--	--	--	--	--	--	--	--
Ethyl methacrylate	97-63-2	µg/L	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	100-41-4	µg/L	--	--	--	--	--	--	--	--	--	--
Fluoride	16984-48-8	µg/L	197	219	164	193	318	187	507	144	155	186
Hexavalent Chromium	18540-29-9	µg/L	--	--	191	--	--	--	--	--	--	--
Iron	7439-89-6	µg/L	40	35	302	76	59	97	317	55	229	68
Lead	7439-92-1	µg/L	0.19	0.11	0.14	--	--	--	--	0.48	0.36	--
Lithium	7439-93-2	µg/L	--	--	--	--	--	--	--	--	--	--
Manganese	7439-96-5	µg/L	5.2	--	12	--	--	--	15	48	37	--
Methylene chloride	75-09-2	µg/L	--	--	--	--	--	--	--	--	--	--
Molybdenum	7439-98-7	µg/L	--	--	--	--	--	--	--	--	--	--
Nickel	7440-02-0	µg/L	6.3	4.2	72	--	9.0	27	79	53	6.2	6.3

Table 4-10. Summary of Analytes and Exposure Point Concentrations for Wells Associated with the WMA A-AX Exposure Area in the 200-PO-1 Groundwater OU

Analyte Name	CAS #	Units	WMA A-AX Tank Farms and 216-A-29 Ditch -									
			299-E24-20	299-E24-22	299-E25-236	299-E25-28	299-E25-29P	299-E25-34	299-E25-42	299-E25-93	299-E25-94	699-43-45 [a]
Nitrate	14797-55-8	µg/L	41,217	18,147	24,926	3,754	104,194	1,645	17,157	55,900	30,074	5,851
Nitrite	14797-65-0	µg/L	203	173	182	157	175	162	150	241	194	233
n-Nitrosodi-n-dipropylamine	621-64-7	µg/L	--	--	--	--	--	--	--	--	--	--
Selenium	7782-49-2	µg/L	--	--	4.5	--	--	--	--	--	--	--
Silver	7440-22-4	µg/L	8.7	--	--	--	--	5.8	--	9.1	--	--
Strontium	7440-24-6	µg/L	263	240	302	254	253	132	201	396	330	158
Tetrachloroethene	127-18-4	µg/L	--	--	--	--	--	--	--	--	--	--
Thallium	7440-28-0	µg/L	--	--	--	--	--	--	--	--	--	--
Tin	7440-31-5	µg/L	--	--	--	--	--	--	--	--	--	--
Toluene	108-88-3	µg/L	--	--	--	--	--	--	--	--	--	--
Tributyl phosphate	126-73-8	µg/L	--	--	--	--	--	--	--	--	--	--
Trichloroethene	79-01-6	µg/L	--	--	--	--	--	--	--	--	--	--
Trichloromonofluoromethane	75-69-4	µg/L	--	--	--	--	--	--	--	--	--	--
Uranium	7440-61-1	µg/L	2.4	2.5	--	2.5	--	2.1	--	2.4	1.9	2.8
Vanadium	7440-62-2	µg/L	30	25	23	31	27	35	32	25	24	35
Xylenes (total)	1330-20-7	µg/L	--	--	--	--	--	--	--	--	--	--
Zinc	7440-66-6	µg/L	18	22	6.7	5.1	9.0	--	6.0	399	18	27
Americium-241	14596-10-2	pCi/L	--	--	--	--	--	--	--	--	--	--
Carbon-14	14762-75-5	pCi/L	--	--	--	--	--	--	--	--	--	--
Iodine-129	15046-84-1	pCi/L	5.5	6.3	5.8	4.3	3.0	4.9	8.2	6.1	7.6	9.2
Protactinium-231	14331-85-2	pCi/L	--	--	--	--	--	--	--	--	--	--
Selenium-79	15758-45-9	pCi/L	--	--	--	--	--	--	--	33	--	--
Strontium-90	10098-97-2	pCi/L	--	--	--	--	--	--	--	5.8	4.5	--
Technetium-99	14133-76-7	pCi/L	186	707	550	--	--	--	108	4,516	730	--
Tritium	10028-17-8	pCi/L	7,408	2,134	7,550	4,837	5,645	559	14,039	4,579	4,138	1,123
Uranium-233/234	U-233/234	pCi/L	--	--	--	--	--	--	--	--	--	--
Uranium-234	13966-29-5	pCi/L	--	--	--	--	--	--	--	1.1	--	--
Uranium-235	15117-96-1	pCi/L	--	--	--	--	--	--	--	--	--	--
Uranium-238	U-238	pCi/L	--	--	--	--	--	--	--	0.72	--	--

a. Well 699-43-45 is also assigned to the 216-B-3 Pond Facility exposure area.

Table 4-11. Summary of Analytes and Exposure Point Concentrations for Wells Associated with BC Cribs and Trenches, 216-B-3 Pond, and 200-PO-1 Near River Exposure Area in the 200-PO-1 Groundwater OU

Analyte Name	CAS #	Units	BC Cribs and Trenches		216-B-3 Pond facility				200-PO-1 Near River	
			299-E13-11	299-E13-5	699-42-40A	699-42-42B	699-43-41F	699-43-44	699-40-1	699-41-1A
1,1,1-Trichloroethane	71-55-6	µg/L	--	--	--	--	--	--	--	--
1,1-Dichloroethane	75-34-3	µg/L	--	--	--	--	--	--	--	--
1,1-Dichloroethene	75-35-4	µg/L	--	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	µg/L	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	606-20-2	µg/L	--	--	--	--	--	--	--	--
Acetone	67-64-1	µg/L	--	--	--	--	--	--	--	--
Aluminum	7429-90-5	µg/L	--	--	--	--	--	--	--	--
Antimony	7440-36-0	µg/L	--	52	--	--	--	--	--	--
Arsenic	7440-38-2	µg/L	3.0	2.1	2.3	6.8	5.5	8.3	--	5.6
Barium	7440-39-3	µg/L	72	50	48	24	--	28	--	55
Benzyl alcohol	100-51-6	µg/L	--	--	--	--	--	--	--	--
Beryllium	7440-41-7	µg/L	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	117-81-7	µg/L	--	--	--	--	--	--	--	--
Boron	7440-42-8	µg/L	--	--	--	--	--	--	--	7.2
Bromodichloromethane	75-27-4	µg/L	--	--	--	--	--	--	--	--
Bromoform	75-25-2	µg/L	--	--	--	--	--	--	--	--
Bromomethane	74-83-9	µg/L	--	--	--	--	--	--	--	--
Butylbenzylphthalate	85-68-7	µg/L	--	--	--	--	--	--	--	--
Cadmium	7440-43-9	µg/L	--	--	--	--	--	--	--	--
Carbon disulfide	75-15-0	µg/L	--	--	--	--	--	--	--	--
Carbon tetrachloride	56-23-5	µg/L	--	--	--	--	--	--	--	--
Chloroform	67-66-3	µg/L	--	--	--	--	--	--	--	--
Chromium	7440-47-3	µg/L	6.3	3.6	25	7.0	--	47	--	7.1
Chromium (Dissolved)	7440-47-3-D	µg/L	--	3.7	--	16	--	--	--	3.6
Cobalt	7440-48-4	µg/L	7.3	--	--	--	--	--	--	--
Copper	7440-50-8	µg/L	--	--	12	--	--	--	--	--
Dibromochloromethane	124-48-1	µg/L	--	--	--	--	--	--	--	--
Diethylphthalate	84-66-2	µg/L	--	--	--	--	--	--	--	--
Ethyl methacrylate	97-63-2	µg/L	--	--	--	--	--	--	--	--
Ethylbenzene	100-41-4	µg/L	--	--	--	--	--	--	--	--
Fluoride	16984-48-8	µg/L	299	347	200	356	--	325	259	250
Hexavalent Chromium	18540-29-9	µg/L	--	--	--	--	--	--	--	--
Iron	7439-89-6	µg/L	19,500	224	36,000	76	--	370	--	72
Lead	7439-92-1	µg/L	--	--	--	--	--	--	--	--
Lithium	7439-93-2	µg/L	--	--	--	--	--	--	--	--
Manganese	7439-96-5	µg/L	587	7.3	930	--	--	--	--	4.7
Methylene chloride	75-09-2	µg/L	--	--	--	--	--	--	--	--
Molybdenum	7439-98-7	µg/L	--	--	--	--	--	--	--	2.4

Table 4-11. Summary of Analytes and Exposure Point Concentrations for Wells Associated with BC Cribs and Trenches, 216-B-3 Pond, and 200-PO-1 Near River Exposure Area in the 200-PO-1 Groundwater OU

Analyte Name	CAS #	Units	BC Cribs and Trenches		216-B-3 Pond facility				200-PO-1 Near River	
			299-E13-11	299-E13-5	699-42-40A	699-42-42B	699-43-41F	699-43-44	699-40-1	699-41-1A
Nickel	7440-02-0	µg/L	--	9.0	25	5.7	--	14	--	0.44
Nitrate	14797-55-8	µg/L	8,167	10,225	9,250	7,968	--	3,329	30,600	30,902
Nitrite	14797-65-0	µg/L	401	294	874	227	--	267	152	157
n-Nitrosodi-n-dipropylamine	621-64-7	µg/L	--	--	--	--	--	--	--	--
Selenium	7782-49-2	µg/L	--	--	--	--	--	--	--	--
Silver	7440-22-4	µg/L	--	--	--	--	--	--	--	--
Strontium	7440-24-6	µg/L	258	220	231	192	--	197	--	330
Tetrachloroethene	127-18-4	µg/L	--	--	--	--	--	--	--	--
Thallium	7440-28-0	µg/L	--	--	--	--	--	--	--	--
Tin	7440-31-5	µg/L	--	--	--	--	--	--	--	--
Toluene	108-88-3	µg/L	--	--	--	--	--	--	--	--
Tributyl phosphate	126-73-8	µg/L	--	--	--	--	--	--	--	--
Trichloroethene	79-01-6	µg/L	--	--	--	--	--	--	--	--
Trichloromonofluoromethane	75-69-4	µg/L	--	--	--	--	--	--	--	--
Uranium	7440-61-1	µg/L	3.6	3.6	--	3.8	--	5.2	--	4.4
Vanadium	7440-62-2	µg/L	29	26	17	30	--	26	--	19
Xylenes (total)	1330-20-7	µg/L	--	--	--	--	--	--	--	--
Zinc	7440-66-6	µg/L	16	7.3	66	9.4	--	196	--	8.0
Americium-241	14596-10-2	pCi/L	--	--	--	--	--	--	--	--
Carbon-14	14762-75-5	pCi/L	--	--	--	--	--	--	--	--
Iodine-129	15046-84-1	pCi/L	--	--	0.93	3.0	1.9	5.1	0.55	0.43
Protactinium-231	14331-85-2	pCi/L	--	--	--	--	--	--	--	--
Selenium-79	15758-45-9	pCi/L	--	--	--	--	--	--	--	39
Strontium-90	10098-97-2	pCi/L	2.4	0.64	--	--	--	--	--	2.5
Technetium-99	14133-76-7	pCi/L	--	--	--	--	--	--	--	110
Tritium	10028-17-8	pCi/L	--	--	43,853	14,848	18,000	16,400	50,000	58,465
Uranium-233/234	U-233/234	pCi/L	--	--	--	--	--	--	--	1.8
Uranium-234	13966-29-5	pCi/L	2.0	--	--	--	--	--	--	1.7
Uranium-235	15117-96-1	pCi/L	--	--	--	--	--	--	--	0.15
Uranium-238	U-238	pCi/L	1.4	--	--	--	--	--	--	1.5

Table 4-12. Summary of Analytes and Exposure Point Concentrations for Wells Associated with NRDWL/SWL Exposure Area in the 200-PO-1 Groundwater OU

Analyte Name	CAS #	Units	NRDWL/SWL										
			699-22-35	699-23-34A	699-23-34B	699-24-33	699-24-34A	699-24-34B	699-24-34C	699-25-34A	699-25-34B	699-25-34D	699-26-33
1,1,1-Trichloroethane	71-55-6	µg/L	1.5	0.95	0.95	0.70	1.4	1.4	0.64	0.30	0.40	0.40	0.25
1,1-Dichloroethane	75-34-3	µg/L	0.18	0.16	0.18	0.17	0.17	0.16	--	--	--	0.094	0.090
1,1-Dichloroethene	75-35-4	µg/L	--	--	--	--	--	--	--	--	--	--	0.19
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	µg/L	--	--	--	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	606-20-2	µg/L	--	--	--	--	--	--	--	--	--	--	--
Acetone	67-64-1	µg/L	6.6	--	--	--	1.4	--	--	--	--	--	--
Aluminum	7429-90-5	µg/L	--	--	--	--	--	--	--	--	--	--	--
Antimony	7440-36-0	µg/L	0.14	0.20	0.16	2.7	0.16	0.15	0.11	--	--	62	--
Arsenic	7440-38-2	µg/L	2.7	2.5	2.3	2.4	3.1	2.3	2.0	--	--	--	3.0
Barium	7440-39-3	µg/L	149	116	128	99	94	97	82	107	70	74	63
Benzyl alcohol	100-51-6	µg/L	--	--	--	--	--	--	--	--	--	--	--
Beryllium	7440-41-7	µg/L	--	--	--	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	117-81-7	µg/L	--	--	1.9	--	--	--	--	14	3.2	--	--
Boron	7440-42-8	µg/L	--	--	--	--	--	--	--	--	--	--	--
Bromodichloromethane	75-27-4	µg/L	--	--	--	--	--	--	--	--	--	--	--
Bromoform	75-25-2	µg/L	--	--	--	--	--	--	--	--	--	--	--
Bromomethane	74-83-9	µg/L	--	--	--	--	--	--	--	--	--	--	--
Butylbenzylphthalate	85-68-7	µg/L	--	--	--	--	--	--	--	--	--	--	--
Cadmium	7440-43-9	µg/L	--	--	--	--	--	--	--	--	--	--	--
Carbon disulfide	75-15-0	µg/L	--	--	--	--	--	--	--	--	--	--	--
Carbon tetrachloride	56-23-5	µg/L	1.0	2.1	--	--	--	--	--	1.0	--	0.098	--
Chloroform	67-66-3	µg/L	0.26	0.11	0.30	0.10	0.10	--	--	0.23	0.23	0.18	0.24
Chromium	7440-47-3	µg/L	8.9	7.6	8.1	6.0	8.2	32	27	10	14	11	17
Chromium (Dissolved)	7440-47-3-D	µg/L	14	6.9	5.2	3.2	4.1	7.6	35	--	--	17	17
Cobalt	7440-48-4	µg/L	--	--	--	--	--	--	--	--	--	--	--
Copper	7440-50-8	µg/L	4.0	--	--	5.0	--	4.0	--	--	--	--	--
Dibromochloromethane	124-48-1	µg/L	--	--	--	--	--	--	--	--	--	--	--
Diethylphthalate	84-66-2	µg/L	--	--	--	--	--	--	--	--	--	--	--
Ethyl methacrylate	97-63-2	µg/L	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	100-41-4	µg/L	--	--	--	--	--	2.1	--	--	--	--	--
Fluoride	16984-48-8	µg/L	116	187	165	221	223	229	227	237	282	249	265
Hexavalent Chromium	18540-29-9	µg/L	--	--	--	--	--	--	--	--	--	--	--
Iron	7439-89-6	µg/L	51	70	34	146	51	1,558	143	73	--	52	366
Lead	7439-92-1	µg/L	--	--	--	--	--	--	--	--	--	--	--
Lithium	7439-93-2	µg/L	--	--	--	--	--	--	--	--	--	--	--
Manganese	7439-96-5	µg/L	4.2	--	--	--	4.1	6.0	--	--	--	--	9.1
Methylene chloride	75-09-2	µg/L	--	--	--	--	--	--	--	--	--	--	1.5
Molybdenum	7439-98-7	µg/L	--	--	--	--	--	--	--	--	--	--	--

Table 4-12. Summary of Analytes and Exposure Point Concentrations for Wells Associated with NRDWL/SWL Exposure Area in the 200-PO-1 Groundwater OU

Analyte Name	CAS #	Units	NRDWL/SWL										
			699-22-35	699-23-34A	699-23-34B	699-24-33	699-24-34A	699-24-34B	699-24-34C	699-25-34A	699-25-34B	699-25-34D	699-26-33
Nickel	7440-02-0	µg/L	7.1	5.7	5.2	8.0	19	9.6	11	--	--	--	6.0
Nitrate	14797-55-8	µg/L	18,126	19,482	17,420	14,885	14,226	16,285	14,972	22,475	19,585	18,624	20,026
Nitrite	14797-65-0	µg/L	907	733	799	756	601	655	--	585	446	867	478
n-Nitrosodi-n-dipropylamine	621-64-7	µg/L	--	--	--	--	--	--	--	--	--	--	--
Selenium	7782-49-2	µg/L	--	--	--	--	--	--	--	--	--	--	--
Silver	7440-22-4	µg/L	--	--	5.4	5.6	7.0	--	--	--	--	--	--
Strontium	7440-24-6	µg/L	613	495	500	469	413	429	484	386	337	355	363
Tetrachloroethene	127-18-4	µg/L	1.1	2.4	2.7	1.7	2.0	1.7	2.9	3.5	3.5	2.8	3.5
Thallium	7440-28-0	µg/L	--	--	--	--	--	--	--	--	--	--	--
Tin	7440-31-5	µg/L	--	--	--	--	--	--	--	--	--	--	--
Toluene	108-88-3	µg/L	--	--	--	--	1.4	--	--	--	--	--	--
Tributyl phosphate	126-73-8	µg/L	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene	79-01-6	µg/L	0.32	0.35	0.42	0.53	0.46	0.48	0.52	0.40	0.48	0.41	0.41
Trichloromonofluoromethane	75-69-4	µg/L	--	--	--	--	--	--	--	0.29	0.51	0.50	0.58
Uranium	7440-61-1	µg/L	--	--	--	--	--	--	--	--	--	--	8.0
Vanadium	7440-62-2	µg/L	9.6	11	9.0	11	11	13	16	9.7	15	14	16
Xylenes (total)	1330-20-7	µg/L	--	--	--	--	1.4	4.1	--	--	--	--	--
Zinc	7440-66-6	µg/L	16	132	--	9.2	4.0	6.7	11	12	11	11	8.4
Americium-241	14596-10-2	pCi/L	--	--	--	--	--	--	--	--	--	--	--
Carbon-14	14762-75-5	pCi/L	--	--	--	--	--	--	--	--	--	--	--
Iodine-129	15046-84-1	pCi/L	--	--	--	--	--	--	0.54	--	--	--	1.6
Protactinium-231	14331-85-2	pCi/L	--	--	--	--	--	--	--	--	--	--	--
Selenium-79	15758-45-9	pCi/L	--	--	--	--	--	--	--	--	--	--	--
Strontium-90	10098-97-2	pCi/L	--	--	--	--	--	--	--	--	--	--	--
Technetium-99	14133-76-7	pCi/L	--	--	--	--	--	--	--	--	--	--	21
Tritium	10028-17-8	pCi/L	--	--	--	--	--	--	6,800	--	--	--	28,072
Uranium-233/234	U-233/234	pCi/L	--	--	--	--	--	--	--	--	--	--	--
Uranium-234	13966-29-5	pCi/L	--	--	--	--	--	--	--	--	--	--	3.9
Uranium-235	15117-96-1	pCi/L	--	--	--	--	--	--	--	--	--	--	--
Uranium-238	U-238	pCi/L	--	--	--	--	--	--	--	--	--	--	2.9

Table 4-13. Summary of Analytes and Exposure Point Concentrations for Wells Associated with the Far Field Exposure Area in the 200-PO-1 Groundwater OU (Table 1 of 2)

Analyte Name	CAS #	Units	200-PO-1 Far Field							
			499-S0-7	499-S0-8	499-S1-8J	699-10-54A	699-12-2C	699-13-1A	699-13-3A	699-20-20
1,1,1-Trichloroethane	71-55-6	µg/L	--	--	--	--	--	--	--	--
1,1-Dichloroethane	75-34-3	µg/L	--	--	--	--	--	--	--	--
1,1-Dichloroethene	75-35-4	µg/L	--	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	µg/L	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	606-20-2	µg/L	--	--	--	--	--	--	--	--
Acetone	67-64-1	µg/L	--	--	--	--	--	--	--	--
Aluminum	7429-90-5	µg/L	--	--	--	--	--	--	128	--
Antimony	7440-36-0	µg/L	--	--	--	--	--	--	34	--
Arsenic	7440-38-2	µg/L	2.6	2.8	2.3	4.9	--	15	4.8	13
Barium	7440-39-3	µg/L	40	21	18	24	60	28	81	58
Benzyl alcohol	100-51-6	µg/L	--	--	--	--	--	1.1	--	--
Beryllium	7440-41-7	µg/L	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	117-81-7	µg/L	--	--	--	--	--	--	--	--
Boron	7440-42-8	µg/L	--	--	--	--	--	--	--	29
Bromodichloromethane	75-27-4	µg/L	2.1	1.6	1.0	--	--	0.56	--	--
Bromoform	75-25-2	µg/L	2.9	2.5	2.3	--	--	--	--	--
Bromomethane	74-83-9	µg/L	0.33	0.41	0.33	--	--	--	--	--
Butylbenzylphthalate	85-68-7	µg/L	--	--	--	--	--	--	--	--
Cadmium	7440-43-9	µg/L	--	--	--	--	--	--	--	--
Carbon disulfide	75-15-0	µg/L	--	--	--	--	--	--	--	--
Carbon tetrachloride	56-23-5	µg/L	--	--	--	--	--	--	0.16	--
Chloroform	67-66-3	µg/L	1.1	0.76	0.47	--	--	7.1	--	--
Chromium	7440-47-3	µg/L	--	--	8.1	4.3	6.8	--	7.5	6.6
Chromium (Dissolved)	7440-47-3-D	µg/L	--	--	--	3.6	7.4	--	6.2	6.9
Cobalt	7440-48-4	µg/L	--	--	--	--	--	--	0.90	--
Copper	7440-50-8	µg/L	4.3	15	18	0.29	--	3.2	0.63	--
Dibromochloromethane	124-48-1	µg/L	3.3	2.8	2.2	--	--	--	--	--
Diethylphthalate	84-66-2	µg/L	--	--	1.7	--	--	--	--	--
Ethyl methacrylate	97-63-2	µg/L	--	--	--	--	--	--	--	--
Ethylbenzene	100-41-4	µg/L	--	--	--	--	--	--	--	--
Fluoride	16984-48-8	µg/L	246	230	236	256	179	279	159	306
Hexavalent Chromium	18540-29-9	µg/L	--	--	--	--	--	--	--	2.5
Iron	7439-89-6	µg/L	147	130	112	147	49	394	149	202
Lead	7439-92-1	µg/L	0.36	--	1.8	--	--	--	0.42	0.39
Lithium	7439-93-2	µg/L	25	24	25	6.0	--	9.0	31	15

Table 4-13. Summary of Analytes and Exposure Point Concentrations for Wells Associated with the Far Field Exposure Area in the 200-PO-1 Groundwater OU (Table 1 of 2)

Analyte Name	CAS #	Units	200-PO-1 Far Field							
			499-S0-7	499-S0-8	499-S1-8J	699-10-54A	699-12-2C	699-13-1A	699-13-3A	699-20-20
Manganese	7439-96-5	µg/L	269	16	16	4.6	--	46	5.2	--
Methylene chloride	75-09-2	µg/L	--	--	--	0.39	--	--	--	--
Molybdenum	7439-98-7	µg/L	8.5	8.8	8.9	2.8	--	6.0	2.0	5.8
Nickel	7440-02-0	µg/L	--	--	4.0	--	17	--	17	--
Nitrate	14797-55-8	µg/L	3,709	16,600	695	21,010	58,851	14,300	110,272	36,100
Nitrite	14797-65-0	µg/L	394	306	281	270	181	--	272	--
n-Nitrosodi-n-dipropylamine	621-64-7	µg/L	--	--	--	--	--	--	--	--
Selenium	7782-49-2	µg/L	--	--	--	2.3	--	--	2.6	2.4
Silver	7440-22-4	µg/L	--	--	--	--	--	--	18	--
Strontium	7440-24-6	µg/L	198	201	170	205	367	232	406	214
Tetrachloroethene	127-18-4	µg/L	--	--	--	--	--	--	--	--
Thallium	7440-28-0	µg/L	--	--	--	--	--	--	--	--
Tin	7440-31-5	µg/L	0.18	0.12	0.26	--	--	--	--	--
Toluene	108-88-3	µg/L	--	--	--	--	--	--	--	--
Tributyl phosphate	126-73-8	µg/L	--	--	--	--	--	--	--	--
Trichloroethene	79-01-6	µg/L	--	--	--	--	--	--	--	--
Trichloromonofluoromethane	75-69-4	µg/L	--	--	--	--	--	--	--	--
Uranium	7440-61-1	µg/L	3.6	4.7	0.26	1.8	10	6.1	10	--
Vanadium	7440-62-2	µg/L	--	--	--	24	10	20	11	23
Xylenes (total)	1330-20-7	µg/L	--	--	--	--	--	--	--	--
Zinc	7440-66-6	µg/L	76	12	14	14	--	--	5.0	8.3
Americium-241	14596-10-2	pCi/L	--	--	--	0.11	--	--	--	--
Carbon-14	14762-75-5	pCi/L	--	--	--	--	--	--	--	9.8
Iodine-129	15046-84-1	pCi/L	--	--	--	--	--	--	--	3.2
Protactinium-231	14331-85-2	pCi/L	--	--	--	--	--	--	--	--
Selenium-79	15758-45-9	pCi/L	--	--	--	--	--	--	--	--
Strontium-90	10098-97-2	pCi/L	--	--	--	--	--	--	--	--
Technetium-99	14133-76-7	pCi/L	--	24	--	50	204	--	191	45
Tritium	10028-17-8	pCi/L	8,472	8,131	2,529	--	130,978	--	934,736	47,000
Uranium-233/234	U-233/234	pCi/L	--	--	--	--	--	--	--	--
Uranium-234	13966-29-5	pCi/L	--	--	--	0.86	--	--	--	--
Uranium-235	15117-96-1	pCi/L	--	--	--	--	--	--	--	--
Uranium-238	U-238	pCi/L	--	--	--	0.59	--	--	--	--

Table 4-14. Summary of Analytes and Exposure Point Concentrations for Wells Associated with the Far Field Exposure Area in the 200-PO-1 Groundwater OU (Table 2 of 2)

Analyte Name	CAS #	Units	Far Field										
			699-29-4	699-31-11	699-32-22A	699-32-22B	699-32-43	699-41-23	699-S6-E4A	699-S6-E4E	699-S6-E4K	699-S6-E4L	699-S8-19
1,1,1-Trichloroethane	71-55-6	µg/L	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethane	75-34-3	µg/L	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethene	75-35-4	µg/L	--	--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	µg/L	--	--	--	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	606-20-2	µg/L	--	--	--	--	--	--	--	--	--	--	--
Acetone	67-64-1	µg/L	--	--	--	--	--	--	--	--	1.2	--	1.6
Aluminum	7429-90-5	µg/L	19	--	--	--	--	--	--	--	--	--	13
Antimony	7440-36-0	µg/L	--	--	--	--	--	--	66	56	--	--	--
Arsenic	7440-38-2	µg/L	9.0	4.2	5.7	--	4.4	5.4	6.3	--	--	--	13
Barium	7440-39-3	µg/L	72	50	29	259	48	17	55	59	49	107	61
Benzyl alcohol	100-51-6	µg/L	--	--	--	--	--	--	--	--	--	--	--
Beryllium	7440-41-7	µg/L	--	--	--	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	117-81-7	µg/L	--	--	--	1.0	--	--	--	--	12	--	3.0
Boron	7440-42-8	µg/L	22	--	42	--	--	28	52	--	--	--	107
Bromodichloromethane	75-27-4	µg/L	--	--	--	--	--	--	--	--	--	--	--
Bromoform	75-25-2	µg/L	--	--	--	--	--	--	--	--	--	--	--
Bromomethane	74-83-9	µg/L	--	--	--	--	--	--	--	--	--	--	--
Butylbenzylphthalate	85-68-7	µg/L	--	--	--	--	--	--	--	--	--	--	--
Cadmium	7440-43-9	µg/L	--	--	--	--	--	--	--	4.5	--	--	--
Carbon disulfide	75-15-0	µg/L	--	0.12	--	--	--	--	--	--	--	--	--
Carbon tetrachloride	56-23-5	µg/L	--	--	--	--	--	--	4.6	--	7.4	4.0	--
Chloroform	67-66-3	µg/L	--	0.14	--	--	0.31	0.10	0.11	--	--	--	--
Chromium	7440-47-3	µg/L	4.7	4.1	9.6	--	18	5.0	6.1	11	6.4	11	1.1
Chromium (Dissolved)	7440-47-3-D	µg/L	4.1	2.8	6.8	--	24	--	5.3	11	5.7	7.8	1.1
Cobalt	7440-48-4	µg/L	--	--	--	--	4.2	--	1.0	--	--	--	--
Copper	7440-50-8	µg/L	--	--	0.40	--	9.4	--	--	--	--	--	--
Dibromochloromethane	124-48-1	µg/L	--	--	--	--	--	--	--	--	--	--	--
Diethylphthalate	84-66-2	µg/L	--	--	--	--	--	--	--	--	--	--	--
Ethyl methacrylate	97-63-2	µg/L	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	100-41-4	µg/L	--	--	--	--	--	--	--	--	--	--	--
Fluoride	16984-48-8	µg/L	166	275	401	1,176	385	487	287	267	251	205	894
Hexavalent Chromium	18540-29-9	µg/L	--	--	3.3	--	--	--	--	--	--	--	--
Iron	7439-89-6	µg/L	41	2,600	114	5,897	40	626	414	237	130	122	57
Lead	7439-92-1	µg/L	1.3	0.20	0.64	0.81	--	--	0.42	--	--	--	--
Lithium	7439-93-2	µg/L	8.5	7.3	11	--	--	10	22	--	--	--	23
Manganese	7439-96-5	µg/L	--	39	6.8	462	--	29	23	5.9	31	28	--

Table 4-14. Summary of Analytes and Exposure Point Concentrations for Wells Associated with the Far Field Exposure Area in the 200-PO-1 Groundwater OU (Table 2 of 2)

Analyte Name	CAS #	Units	Far Field										
			699-29-4	699-31-11	699-32-22A	699-32-22B	699-32-43	699-41-23	699-S6-E4A	699-S6-E4E	699-S6-E4K	699-S6-E4L	699-S8-19
Methylene chloride	75-09-2	µg/L	--	--	--	--	--	--	--	--	1.9	--	--
Molybdenum	7439-98-7	µg/L	0.88	3.2	8.1	--	--	11	5.6	--	--	--	3.7
Nickel	7440-02-0	µg/L	--	--	6.0	--	--	--	--	--	6.1	79	--
Nitrate	14797-55-8	µg/L	34,100	29,300	20,904	--	21,008	7,029	29,487	27,507	28,133	45,100	27,600
Nitrite	14797-65-0	µg/L	--	--	201	325	260	229	208	238	281	214	--
n-Nitrosodi-n-dipropylamine	621-64-7	µg/L	--	--	--	--	--	--	--	--	--	--	--
Selenium	7782-49-2	µg/L	2.0	2.0	2.0	--	--	0.94	6.1	--	--	--	1.3
Silver	7440-22-4	µg/L	--	--	--	--	--	--	--	--	--	--	--
Strontium	7440-24-6	µg/L	281	265	194	126	238	163	315	328	294	505	233
Tetrachloroethene	127-18-4	µg/L	--	--	--	--	--	--	--	--	--	4.0	--
Thallium	7440-28-0	µg/L	--	--	--	--	--	--	--	--	--	--	--
Tin	7440-31-5	µg/L	--	--	--	--	--	--	--	--	--	--	--
Toluene	108-88-3	µg/L	--	--	--	--	--	--	--	--	--	--	--
Tributyl phosphate	126-73-8	µg/L	--	--	--	--	--	--	5.8	--	--	--	--
Trichloroethene	79-01-6	µg/L	--	--	--	--	--	--	--	--	--	2.3	--
Trichloromonofluoromethane	75-69-4	µg/L	--	--	--	--	--	--	--	--	--	--	--
Uranium	7440-61-1	µg/L	--	--	2.7	0.17	6.8	1.2	12	15	9.8	98	4.6
Vanadium	7440-62-2	µg/L	23	--	19	--	29	16	14	14	13	10	21
Xylenes (total)	1330-20-7	µg/L	--	--	--	--	--	--	--	--	--	--	--
Zinc	7440-66-6	µg/L	17	4.0	13	7,046	107	8.4	66	--	8.7	6.1	7.0
Americium-241	14596-10-2	pCi/L	--	--	--	--	--	--	--	--	--	--	--
Carbon-14	14762-75-5	pCi/L	8.2	14	13	--	--	--	--	--	--	--	--
Iodine-129	15046-84-1	pCi/L	0.77	1.7	6.2	--	1.3	5.6	--	--	--	--	--
Protactinium-231	14331-85-2	pCi/L	--	--	--	--	--	--	--	--	--	--	--
Selenium-79	15758-45-9	pCi/L	--	--	--	--	--	--	--	--	--	--	--
Strontium-90	10098-97-2	pCi/L	--	--	--	--	--	--	--	--	--	--	--
Technetium-99	14133-76-7	pCi/L	120	97	43	--	22	6.7	25	--	20	24	--
Tritium	10028-17-8	pCi/L	63,000	59,000	38,401	--	22,848	8,555	9,878	10,849	9,035	8,451	--
Uranium-233/234	U-233/234	pCi/L	--	--	--	--	--	--	3.8	--	4.5	48	--
Uranium-234	13966-29-5	pCi/L	--	--	1.2	--	3.2	0.76	3.8	--	3.9	5.7	--
Uranium-235	15117-96-1	pCi/L	--	--	--	--	--	--	0.21	--	0.21	2.4	--
Uranium-238	U-238	pCi/L	--	--	0.84	0.21	2.2	0.34	4.4	--	3.2	46	--

4.3 Toxicity Values

The toxicity values used for the human health risk calculations are provided in Table 4-15 and Table 4-16, for the 200-BP-5 Groundwater OU and the 200-PO-1 Groundwater OU, respectively. The sources for these values are discussed below.

4.3.1 Toxicity Values for Nonradionuclides

For nonradionuclides, the analyte-specific toxicity values shown in Table 4-15 and Table 4-16 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 the EPA IRIS database (http://www.epa.gov/iris/index.html). Expert toxicologists at EPA have derived the values in this database and the 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 the EPA 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. This database is not available to the general public, but is accessible to EPA risk assessors via the EPA intranet. These values are also published at the EPA Regional Screening Levels website (EPA, 2013).

Tier 3 – Other Toxicity Values

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

- The California EPA (CalEPA) Toxicity Criteria Database contains toxicity values that are peer reviewed and address both carcinogenic and noncarcinogenic effects.
- The Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs) 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 noncarcinogenic health effects over a specified duration of exposure.
- Toxicity values in EPA 540-R-97-036, *Health Effects Assessment Summary Tables (HEAST)*.

When Tier 1, Tier 2, or Tier 3 toxicity values are not available for an analyte, the toxicity values from the National Center for Environmental Assessment (NCEA) are used. The NCEA values can be found in RAIS (ORNL, 2014).

For this environmental calculation, two toxicity values required conversion to a different concentration basis: nitrate and nitrite.

- **Nitrate**. A derived RfD for nitrate (NO_3^-) was calculated from the RfD reported in IRIS, which is given as 1.6 mg/kg-day for *nitrate as nitrogen* (NO_3^- as N). Conversion from *nitrate as nitrogen*

to *nitrate* was made 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^- as N/kg-day) × (1 mg NO_3^-/0.226 mg NO_3^- as N) = 7.1 mg NO_3^-/kg-day.

- **Nitrite**. A derived RfD for nitrate (NO_2^-) was calculated from the RfD reported in IRIS, which is given as 0.1 mg/kg-day for *nitrite as nitrogen* (NO_2^- as N). Conversion from *nitrite as nitrogen* to *nitrite* was made 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^- as N/kg-day) × (1 mg NO_2^-/0.304 mg NO_2^- as N) = 0.3 mg NO_2^-/kg-day.

For hexavalent chromium, the toxicity value used was obtained from a different source than recommended by the EPA Superfund hierarchy (Cook, 2003). The difference in toxicity values is summarized below.

- For hexavalent chromium, this assessment considers carcinogenic 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 carcinogenic effects from hexavalent chromium has the potential to under-estimate cancer risk.

4.3.2 Toxicity Values for Radionuclides

The cancer slope factors for radionuclides in Table 4-15 and Table 4-16 were obtained from EPA, 2001, "*Health Effects Assessment Summary Tables* database" / "April 16, 2001 Update: Radionuclide Toxicity," / "Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors."

Table 4-15. Toxicity Values for 200-BP-5 Groundwater Operable Unit

Analyte Name	Oral Reference Dose[a] (mg/kg-day)	Source	Oral Cancer Slope Factor[a] $(mg/kg\text{-}day)^{-1}$ or Slope Factor Water Ingestion[b] (Risk/pCi)	Source	Inhalation Reference Concentration[a] (mg/m^3)	Source	Inhalation Unit Risk (IUR)[a] $(\mu g/m^3)^{-1}$ Or Slope Factor Inhalation[b] (Risk/pCi)	Source	Volatile[a,b]	GIABS[a,b] (unitless)	Kp[c] (cm/hr)	B[c] (unitless)	τ [c] (hours/event)	t*[c] (hours)	FA[c] (unitless)
2-Hexanone	0.005	I	--	--	0.03	I	--	--	Yes	1	0.00355[d]	--	--	--	--
Acetone	0.9	I	--	--	31	A	--	--	Yes	1	0.000512[d]	--	--	--	--
Acetophenone	0.1	I	--	--	--	--	--	--	Yes	1	0.00372[d]	--	--	--	--
Aluminum	1	P	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Antimony	0.0004	I	--	--	--	--	--	--	--	0.15	0.001	--	--	--	--
Arsenic	0.0003	I	1.5	I	--	--	--	--	--	1	0.001	--	--	--	--
Barium	0.2	I	--	--	--	--	--	--	--	0.07	0.001	--	--	--	--
Benzene	0.004	I	0.055	I	0.03	I	7.8E-06	I	Yes	1	0.015	0.10	0.29	0.70	1.00
Beryllium	0.002	I	--	--	--	--	--	--	--	0.007	0.001	--	--	--	--
Bis(2-ethylhexyl) phthalate	0.02	I	0.014	I	--	--	--	--	--	1	0.025	0.2	16.64	39.93	0.80
Boron	0.2	I	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Butylbenzylphthalate	0.2	I	0.0019	P	--	--	--	--	--	1	0.0385[d]	--	--	--	--
Cadmium	0.0005	I	--	--	--	--	--	--	--	0.05	0.001	0.1	--	--	--
Carbon disulfide	0.1	I	--	--	0.7	I	--	--	Yes	1	0.017	0.1	0.3	0.72	1.00
Carbon tetrachloride	0.004	I	0.07	I	0.1	I	0.000006	I	Yes	1	0.016	0	0.78	1.86	1.00
Chloroform	0.01	I	0.031	C	0.098	A	0.000023	I	Yes	1	0.0068	--	0.5	1.19	1.00
Chromium	1.5	I			--	--	--	--	--	0.013	0.001	--	--	--	--
Cobalt	0.0003	P	--	--	--	--	--	--	--	1	0.0004	--	--	--	--
Copper	0.04	H	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Cyanide	0.0006	I	--	--	0.0008	S	--	--	Yes	1	0.001	--	--	--	--
Di-n-octylphthalate	0.01	P	--	--	--	--	--	--	--	1	2.43[d]	--	--	--	--
Fluoride	0.06	I	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Hexavalent Chromium	0.003	I	--	--	--	--	--	--	--	0.025	0.002	--	--	--	--
Iron	0.7	P	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Lead	--	--	--	--	--	--	--	--	--	1	0.0001	--	--	--	--
Lithium	0.002	P	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Manganese	0.024	S	--	--	--	--	--	--	--	0.04	0.001	--	--	--	--
Mercury	0.0003	I	--	--	--	--	--	--	--	0.07	0.001	--	--	--	--
Methyl methacrylate	1.4	I	--	--	0.7	I	--	--	Yes	1	0.00355[d]	--	--	--	--

Table 4-15. Toxicity Values for 200-BP-5 Groundwater Operable Unit

Analyte Name	Oral Reference Dose[a] (mg/kg-day)	Source	Oral Cancer Slope Factor[a] $(mg/kg\text{-}day)^{-1}$ or Slope Factor Water Ingestion[b] (Risk/pCi)	Source	Inhalation Reference Concentration[a] (mg/m^3)	Source	Inhalation Unit Risk (IUR)[a] $(\mu g/m^3)^{-1}$ Or Slope Factor Inhalation[b] (Risk/pCi)	Source	Volatile[a,b]	GIABS[a,b] (unitless)	Kp[c] (cm/hr)	B[c] (unitless)	τ [c] (hours/event)	t*[c] (hours)	FA[c] (unitless)
Methyl methanesulfonate	--	--	0.099	C	--	--	--	--	--	1	0.000138[d]	--	--	--	--
Methylene chloride	0.006	I	0.002	I	0.6	I	1E-08	I	Yes	1	0.0035	0	0.32	0.76	1.00
Molybdenum	0.005	I	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Nickel	0.02	I	--	--	--	--	--	--	--	0.04	0.0002	--	--	--	--
Nitrate	7.1	I	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Nitrite	0.3	I	--	--	--	--	--	--	--	1	0.001	--	--	--	--
n-Nitrosodi-n-dipropylamine	--	--	7	I	--	--	--	--	--	1	0.0023	0	0.57	1.37	1
Octachlorodibenzofuran	2.33E-06	WAC	39	WAC	--	--	--	--	--	0.03	0.81	5.6	6.82	30.09	0.5
Phenol	0.3	I	--	--	--	--	--	--	--	1	0.0043	0	0.36	0.86	1
Selenium	0.005	I	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Silver	0.005	I	--	--	--	--	--	--	--	0.04	0.0006	--	--	--	--
Strontium	0.6	I	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Thallium	0.00001	X	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Tin	0.6	H	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Toluene	0.08	I	--	--	5	I	--	--	Yes	1	0.031	0.1	0.35	0.84	1.00
Tributyl phosphate	0.01	P	0.009	P	--	--	--	--	--	1	0.0228[d]	--	--	--	--
Trichloroethene	0.0005	I	0.046	I	0.002	I	4.1E-06	I	Yes	1	0.012	0.1	0.58	1.39	1.00
Uranium	0.003	I	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Vanadium	0.005	S	--	--	--	--	--	--	--	0.026	0.001	--	--	--	--
Zinc	0.3	I	--	--	--	--	--	--	--	1	0.0006	--	--	--	--
Americium-241	--	--	1.04E-10	H	--	--	--	--	--	0.0005	--	--	--	--	--
Carbon-14	--	--	1.55E-12	H	--	--	--	--	--	1	--	--	--	--	--
Cesium-137	--	--	3.04E-11	H	--	--	--	--	--	1	--	--	--	--	--
Cobalt-60	--	--	1.57E-11	H	--	--	--	--	--	0.1	--	--	--	--	--
Europium-154	--	--	1.03E-11	H	--	--	--	--	--	0.0005	--	--	--	--	--
Iodine-129	--	--	1.48E-10	H	--	--	--	--	--	1	--	--	--	--	--
Neptunium-237	--	--	6.18E-11	H	--	--	--	--	--	0.0005	--	--	--	--	--
Plutonium-238	--	--	1.31E-10	H	--	--	--	--	--	0.0005	--	--	--	--	--
Plutonium-239/240	--	--	1.35E-10	H	--	--	--	--	--	0.0005	--	--	--	--	--

Table 4-15. Toxicity Values for 200-BP-5 Groundwater Operable Unit

Analyte Name	Oral Reference Dose[a] (mg/kg-day)	Source	Oral Cancer Slope Factor[a] $(mg/kg\text{-}day)^{-1}$ or Slope Factor Water Ingestion[b] (Risk/pCi)	Source	Inhalation Reference Concentration[a] (mg/m^3)	Source	Inhalation Unit Risk (IUR)[a] $(\mu g/m^3)^{-1}$ Or Slope Factor Inhalation[b] (Risk/pCi)	Source	Volatile[a,b]	GIABS[a,b] (unitless)	Kp[c] (cm/hr)	B[c] (unitless)	τ [c] (hours/event)	t*[c] (hours)	FA[c] (unitless)
Strontium-90	--	--	5.59E-11	H	--	--	--	--	--	0.3	--	--	--	--	--
Technetium-99	--	--	2.75E-12	H	--	--	--	--	--	0.5	--	--	--	--	--
Tritium	--	--	5.07E-14	H	--	--	5.62E-14	H	Yes	1	--	--	--	--	--
Uranium-233/234	--	--	7.18E-11	H	--	--	--	--	--	0.02	--	--	--	--	--
Uranium-234	--	--	7.07E-11	H	--	--	--	--	--	0.02	--	--	--	--	--
Uranium-235	--	--	6.96E-11	H	--	--	--	--	--	0.02	--	--	--	--	--
Uranium-238	--	--	6.40E-11	H	--	--	--	--	--	0.02	--	--	--	--	--

Notes:

a. U.S. Environmental Protection Agency web site "Regional Screening Levels for Chemical Contaminants at Superfund Sites" (EPA, May 2013).
Reference key:
A=The Agency for Toxic Substances and Disease Registry
C = The California Environmental Protection Agency (CalEPA)
E = Environmental Criteria and Assessment Office
H = Health Effects Assessment Summary Tables (HEAST)
I = EPA's Integrated Risk Information System (IRIS)
P = Provisional Peer Reviewed Toxicity Values (PPRTV)
S = Special Case chemical; basis for value discussed on EPA Regional Screening Levels website (EPA, May 2013)

b. EPA, 2001, *Health Effects Assessment Summary Tables* database, "April 16, 2001 Update: Radionuclide Toxicity," "Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors."

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

d. The Kp value was taken from ORNL, 2014, The Risk Assessment Information System (RAIS).

GIABS = gastrointestinal absorption factor.

H = HEAST

I = IRIS

K_p = dermal permeability constant.

t* = time to reach steady-state.

τ = lag time

Table 4-16. Toxicity Values for 200-PO-1 Groundwater Operable Unit

Analyte Name	Oral Reference Dose[a] (mg/kg-day)	Source	Oral Cancer Slope Factor[a] $(mg/kg\text{-}day)^{-1}$ or Slope Factor Water Ingestion[b] (Risk/pCi)	Source	Inhalation Reference Concentration[a] (mg/m^3)	Source	Inhalation Unit Risk (IUR)[a] $(\mu g/m^3)^{-1}$ or Slope Factor Inhalation[b] (Risk/pCi)	Source	Volatile[a,b]	GIABS[a,b] (unitless)	Kp[c] (cm/hr)	B[c] (unitless)	τ[c] (hours/event)	t*[c] (hours)	FA[c] (unitless)
1,1,1-Trichloroethane	2	I	--	--	5	I	--	--	Yes	1	0.013	0.1	0.6	1.43	1.00
1,1-Dichloroethane	0.2	P	0.0057	C	--	--	0.0000016	C	Yes	1	0.0067	0	0.38	0.92	1.00
1,1-Dichloroethene	0.05	I	--	--	0.2	I	--	--	Yes	1	0.012	0	0.37	0.89	1.00
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.000000007	WAC	13000	WAC	--	--	--	--	--	1	0.81	5.6	6.82	30.09	0.50
2,6-Dinitrotoluene	0.0003	X	1.5	P	--	--	--	--	--	1	0.0021	0	1.12	2.69	1.00
Acetone	0.9	I	--	--	31	A	--	--	Yes	1	0.000512[d]	--	--	--	--
Aluminum	1	P	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Antimony	0.0004	I	--	--	--	--	--	--	--	0.15	0.001	--	--	--	--
Arsenic	0.0003	I	1.5	I	--	--	--	--	--	1	0.001	--	--	--	--
Barium	0.2	I	--	--	--	--	--	--	--	0.07	0.001	--	--	--	--
Benzyl alcohol	0.1	P	--	--	--	--	--	--	--	1	0.00209[d]	--	--	--	--
Beryllium	0.002	I	--	--	--	--	--	--	--	0.007	0.001	--	--	--	--
Bis(2-ethylhexyl) phthalate	0.02	I	0.014	I	--	--	--	--	--	1	0.025	0.2	16.64	39.93	0.80
Boron	0.2	I	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Bromodichloromethane	0.02	I	0.062	I	--	--	0.000037	C	Yes	1	0.0046	0	0.88	2.12	1.00
Bromoform	0.02	I	0.0079	I	--	--	--	--	--	1	0.0022	0	2.79	6.7	1.00
Bromomethane	0.0014	I	--	--	0.005	I	--	--	Yes	1	0.0028	0	0.36	0.87	1.00
Butylbenzylphthalate	0.2	I	0.0019	P	--	--	--	--	--	1	0.0385[d]	--	--	--	--
Cadmium	0.0005	I	--	--	--	--	--	--	--	0.05	0.001	--	--	--	--
Carbon disulfide	0.1	I	--	--	0.7	I	--	--	Yes	1	0.017	0.1	0.3	0.72	1.00
Carbon tetrachloride	0.004	I	0.07	I	0.1	I	0.000006	I	Yes	1	0.016	0.1	0.78	1.86	1.00
Chloroform	0.01	I	0.031	C	0.098	A	0.000023	I	Yes	1	0.0068	0	0.5	1.19	1.00
Chromium	1.5	I	--	--	--	--	--	--	--	0.013	0.001	--	--	--	--
Cobalt	0.0003	P	--	--	--	--	--	--	--	1	0.0004	--	--	--	--
Copper	0.04	H	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Dibromochloromethane	0.02	I	0.084	I	--	--	0.000027	C	Yes	1	0.0032	0	1.57	3.77	1.00
Diethylphthalate	0.8	I	--	--	--	--	--	--	--	1	0.0039	0	1.87	4.5	1.00
Ethyl methacrylate	0.09	H	--	--	0.3	P	--	--	Yes	1	0.00698[d]	--	--	--	--
Ethylbenzene	0.1	I	0.011	C	1	I	0.0000025	C	Yes	1	0.049	0.2	0.42	1.01	1.00
Fluoride	0.06	C	--	--	--	--	--	--	--	1	0.001	--	--	--	--

Table 4-16. Toxicity Values for 200-PO-1 Groundwater Operable Unit

Analyte Name	Oral Reference Dose[a] (mg/kg-day)	Source	Oral Cancer Slope Factor[a] $(mg/kg\text{-}day)^{-1}$ or Slope Factor Water Ingestion[b] (Risk/pCi)	Source	Inhalation Reference Concentration[a] (mg/m^3)	Source	Inhalation Unit Risk (IUR)[a] $(\mu g/m^3)^{-1}$ or Slope Factor Inhalation[b] (Risk/pCi)	Source	Volatile[a,b]	GIABS[a,b] (unitless)	Kp[c] (cm/hr)	B[c] (unitless)	τ [c] (hours/event)	t*[c] (hours)	FA[c] (unitless)
Hexavalent Chromium	0.003	I	--	--	--	--	--	--	--	0.025	0.002	--	--	--	--
Iron	0.7	P	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Lead	--	--	--	--	--	--	--	--	--	1	0.0001	--	--	--	--
Lithium	0.002	P	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Manganese	0.024	I	--	--	--	--	--	--	--	0.04	0.001	--	--	--	--
Methylene chloride	0.006	I	0.002	I	0.6	I	0.00000001	I	Yes	1	0.0035	0	0.32	0.76	1.00
Molybdenum	0.005	I	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Nickel	0.02	I	--	--	--	--	--	--	--	0.04	0.0002	--	--	--	--
Nitrate	7.1	I	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Nitrite	0.3	I	--	--	--	--	--	--	--	1	0.001	--	--	--	--
n-Nitrosodi-n-dipropylamine	--	--	7	I	--	--	--	--	--	1	0.0023	0	0.57	1.37	1.00
Selenium	0.005	I	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Silver	0.005	I	--	--	--	--	--	--	--	0.04	0.0006	--	--	--	--
Strontium	0.6	I	--	--	--	--	--	--	--	1	1.00E-03	--	--	--	--
Tetrachloroethene	0.006	I	0.0021	I	0.04	I	0.00000026	I	Yes	1	0.033	0.2	0.91	2.18	1.00
Thallium	0.00001	X	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Tin	0.6	H	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Toluene	0.08	I	--	--	--	--	--	--	Yes	1	0.031	0.1	0.35	0.84	1
Tributyl phosphate	0.01	P	0.009	P	--	--	--	--	--	1	0.0228[d]	--	--	--	--
Trichloroethene	0.0005	I	0.046	I	0.002	I	0.0000041	I	Yes	1	0.012	0.1	0.58	1.39	1.00
Trichloromonofluoromethane	0.3	I	--	--	0.7	H	--	--	Yes	1	0.013	0.1	0.63	1.51	1.00
Uranium	0.003	I	--	--	--	--	--	--	--	1	0.001	--	--	--	--
Vanadium	0.005	S	--	--	--	--	--	--	--	0.026	0.001	--	--	--	--
Xylenes (total)	0.2	I	--	--	0.1	I	--	--	Yes	1	0.053	0.2	0.42	1.01	1.00
Zinc	0.3	I	--	--	--	--	--	--	--	1	0.0006	--	--	--	--
Americium-241	--	--	1.04E-10	H	--	--	--	--	--	0.0005	--	--	--	--	--
Carbon-14	--	--	1.55E-12	H	--	--	--	--	--	1	--	--	--	--	--
Iodine-129	--	--	1.48E-10	H	--	--	--	--	--	1	--	--	--	--	--
Neptunium-237	--	--	6.18E-11	H	--	--	--	--	--	0.0005	--	--	--	--	--
Plutonium-238	--	--	1.31E-10	H	--	--	--	--	--	0.0005	--	--	--	--	--

Table 4-16. Toxicity Values for 200-PO-1 Groundwater Operable Unit

Analyte Name	Oral Reference Dose[a] (mg/kg-day)	Source	Oral Cancer Slope Factor[a] $(mg/kg\text{-}day)^{-1}$ or Slope Factor Water Ingestion[b] (Risk/pCi)	Source	Inhalation Reference Concentration[a] (mg/m^3)	Source	Inhalation Unit Risk (IUR)[a] $(\mu g/m^3)^{-1}$ or Slope Factor Inhalation[b] (Risk/pCi)	Source	Volatile[a,b]	GIABS[a,b] (unitless)	Kp[c] (cm/hr)	B[c] (unitless)	τ [c] (hours/event)	t*[c] (hours)	FA[c] (unitless)
Protactinium-231	--	--	1.73E-10	H	--	--	--	--	--	0.0005	--	--	--	--	--
Selenium-79	--	--	7.29E-12	H	--	--	--	--	--	0.8	--	--	--	--	--
Strontium-90	--	--	5.59E-11	H	--	--	--	--	--	0.3	--	--	--	--	--
Technetium-99	--	--	2.75E-12	H	--	--	--	--	--	0.5	--	--	--	--	--
Tritium	--	--	5.07E-14	H	--	--	5.62E-14	H	Yes	1	--	--	--	--	--
Uranium-233/234	--	--	7.18E-11	H	--	--	--	--	--	0.02	--	--	--	--	--
Uranium-234	--	--	7.07E-11	H	--	--	--	--	--	0.02	--	--	--	--	--
Uranium-235	--	--	6.96E-11	H	--	--	--	--	--	0.02	--	--	--	--	--
Uranium-238	--	--	6.40E-11	H	--	--	--	--	--	0.02	--	--	--	--	--

Notes:

a. U.S. Environmental Protection Agency web site "Regional Screening Levels for Chemical Contaminants at Superfund Sites" (EPA, May 2013).
Reference key:
A=The Agency for Toxic Substances and Disease Registry
C = The California Environmental Protection Agency (CalEPA)
E = Environmental Criteria and Assessment Office
H = Health Effects Assessment Summary Tables (HEAST)
I = EPA's Integrated Risk Information System (IRIS)
P = Provisional Peer Reviewed Toxicity Values (PPRTV)
S = Special Case chemical; basis for value discussed on EPA Regional Screening Levels website (EPA, May 2013)

b. EPA, 2001, *Health Effects Assessment Summary Tables* database, "April 16, 2001 Update: Radionuclide Toxicity," "Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors."

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

d. The Kp value was taken from ORNL, 2014, The Risk Assessment Information System (RAIS).

GIABS = gastrointestinal absorption factor.
H = HEAST
I = IRIS
K_p = dermal permeability constant.
t* = time to reach steady-state.
τ = lag time

5 Software Applications

All calculations for this environmental calculation were performed on electronic spreadsheets using Microsoft Excel®. These spreadsheets are provided as attachments to this environmental calculation.

6 Calculation

Human health cancer risks and noncancer hazards are calculated using the methodology, analytes, EPCs, and toxicity factors described in Sections 3 and 4 of this environmental calculation. The calculation spreadsheets were validated by comparison with hand calculations, which are presented in Figure 6-1.

6.1 Tap Water Exposure Scenario Calculation Files

Excel files are generated for each exposure area and each individual well for the purpose of calculating cancer risks and noncancer hazards. The excel file names for the tap water exposure scenario are listed in Table 6-1 for 200-BP-5 Groundwater OU and Table 6-2 for 200-PO-1 Groundwater OU, respectively. The Excel files have been archived under this ECF number in the Environmental Risk Management Archive (ERMA). Each excel file contains six worksheets which contain the following information:

- Worksheet A-1: Summary of Tap Water Exposure Pathway Noncancer Hazard Results for Nonradioactive Analytes; Summary of Tap Water Exposure Pathway Cancer Risk Results for Nonradioactive Analytes in Groundwater; Summary of Tap Water Exposure Pathway Cancer Risk Results for Radioactive Analytes in Groundwater; and Summary of Tap Water Exposure Pathway Cancer Risk Results for Radioactive and Nonradioactive Analytes in Groundwater
- Worksheet A-2: Ingestion of Nonradioactive Analytes in Tap Water; Noncancer Hazard Quotient Calculations and Cancer Risk Calculations
- Worksheet A-3: Dermal Absorption of Nonradioactive Analytes in Tap Water; Noncancer Hazard Quotient Calculations and Cancer Risk Calculations
- Worksheet A-4: Inhalation of Volatile Nonradioactive Analytes in Tap Water; Noncancer Hazard Quotient Calculations and Cancer Risk Calculations
- Worksheet A-5: Ingestion of Radioactive Analytes in Tap Water; Cancer Risk Calculations
- Worksheet A-6: Inhalation of Radioactive Analytes in Tap Water; Cancer Risk Calculations

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Table 6-1. Excel Spreadsheet File Names for the 200-BP-5 Groundwater OU Tap Water Scenario Calculations

LLWMA 1	
200-BP-5 LLWMA1 Unconfined TapWater Risk.xlsx	200-BP-5 299-E28-28 TapWater Risk.xlsx
200-BP-5 299-E33-265 TapWater Risk.xlsx	200-BP-5 299-E33-266 TapWater Risk.xlsx
200-BP-5 299-E33-34 TapWater Risk.xlsx	--
LLWMA 2/ 216-B-63 Trench	
200-BP-5 LLWMA2_B63 Unconfined TapWater Risk.xlsx	200-BP-5 299-E27-10 TapWater Risk.xlsx
200-BP-5 299-E33-33 TapWater Risk.xlsx	200-BP-5 299-E34-9 TapWater Risk.xlsx
WMA B-BX-BY Tank Farms	
200-BP-5 B_BX_BY Unconfined TapWater Risk.xlsx	200-BP-5 299-E33-4 TapWater Risk.xlsx
200-BP-5 299-E33-15 TapWater Risk.xlsx	200-BP-5 299-E33-16 TapWater Risk.xlsx
200-BP-5 299-E33-17 TapWater Risk.xlsx	200-BP-5 299-E33-1A TapWater Risk.xlsx
200-BP-5 299-E33-18 TapWater Risk.xlsx	200-BP-5 299-E33-20 TapWater Risk.xlsx
200-BP-5 299-E33-205 TapWater Risk.xlsx	200-BP-5 299-E33-334 TapWater Risk.xlsx
200-BP-5 299-E33-337 TapWater Risk.xlsx	200-BP-5 299-E33-338 TapWater Risk.xlsx
200-BP-5 299-E33-339 TapWater Risk.xlsx	200-BP-5 299-E33-341 TapWater Risk.xlsx
200-BP-5 299-E33-342 TapWater Risk.xlsx	200-BP-5 299-E33-343 TapWater Risk.xlsx
200-BP-5 299-E33-345 TapWater Risk.xlsx	200-BP-5 299-E33-38 TapWater Risk.xlsx
200-BP-5 299-E33-42 TapWater Risk.xlsx	200-BP-5 299-E33-44 TapWater Risk.xlsx
200-BP-5 299-E33-47 TapWater Risk.xlsx	200-BP-5 299-E33-48 TapWater Risk.xlsx
WMA C Tank Farm	
200-BP-5 WMA C Unconfined TapWater Risk.xlsx	200-BP-5 299-E27-14 TapWater Risk.xlsx
200-BP-5 299-E27-15 TapWater Risk.xlsx	200-BP-5 299-E27-155 TapWater Risk.xlsx
200-BP-5 299-E27-23 TapWater Risk.xlsx	200-BP-5 299-E27-24 TapWater Risk.xlsx
200-BP-5 299-E27-7 TapWater Risk.xlsx	--
B Plant	
200-BP-5 B Plant Unconfined TapWater Risk.xlsx	200-BP-5 299-E28-23 TapWater Risk.xlsx
200-BP-5 299-E28-24 TapWater Risk.xlsx	200-BP-5 299-E28-25 TapWater Risk.xlsx
200-BP-5 299-E28-30 TapWater Risk.xlsx	200-BP-5 299-E29-54 TapWater Risk.xlsx
Semiworks	
200-BP-5 Semiworks Unconfined TapWater Risk.xlsx	200-BP-5 299-E24-25 TapWater Risk.xlsx
LERF	
200-BP-5 LERF Unconfined TapWater Risk.xlsx	200-BP-5 299-E26-10 TapWater Risk.xlsx
Gable Mountain Pond	
200-BP-5 GMP Unconfined TapWater Risk.xlsx	200-BP-5 699-53-47A TapWater Risk.xlsx
200-BP-5 699-53-47B TapWater Risk.xlsx	--

Table 6-1. Excel Spreadsheet File Names for the 200-BP-5 Groundwater OU Tap Water Scenario Calculations

200-BP-5 West	
200-BP-5 BP-5 West Unconfined TapWater Risk.xlsx	200-BP-5 699-49-57A TapWater Risk.xlsx
200-BP-5 699-50-56 TapWater Risk.xlsx	200-BP-5 699-50-59 TapWater Risk.xlsx
200-BP-5 699-52-55 TapWater Risk.xlsx	200-BP-5 699-53-55B TapWater Risk.xlsx
200-BP-5 699-53-55C TapWater Risk.xlsx	200-BP-5 699-54-45A TapWater Risk.xlsx
200-BP-5 699-55-57 TapWater Risk.xlsx	--
200-BP-5 Far Field (North of Gable Gap)	
200-BP-5 Farfield (North of Gable Gap) TapWater Risk.xlsx	200-BP-5 699-62-43F TapWater Risk.xlsx
200-BP-5 699-64-62 TapWater Risk.xlsx	200-BP-5 699-65-50 TapWater Risk.xlsx
200-BP-5 699-66-58 TapWater Risk.xlsx	--
200-BP-5 Near-River	
200-BP-5 Near River TapWater Risk.xlsx	200-BP-5 699-66-64 TapWater Risk.xlsx
200-BP-5 699-70-68 TapWater Risk.xlsx	--
200-BP-5 Confined	
200-BP-5 Confined TapWater Risk.xlsx	200-BP-5 299-E33-12 TapWater Risk.xlsx
200-BP-5 299-E33-50 TapWater Risk.xlsx	200-BP-5 699-52-55B TapWater Risk.xlsx

Table 6-2. Excel Spreadsheet File Names for the 200-PO-1 Groundwater OU Tap Water Scenario Calculations

PUREX Cribs	
200-PO-1 Purex Cribs TapWater Risk.xlsx	200-PO-1 299-E16-2 TapWater Risk.xlsx
200-PO-1 299-E17-1 TapWater Risk.xlsx	200-PO-1 299-E17-14 TapWater Risk.xlsx
200-PO-1 299-E17-19 TapWater Risk.xlsx	200-PO-1 299-E24-16 TapWater Risk.xlsx
200-PO-1 299-E24-23 TapWater Risk.xlsx	200-PO-1 299-E25-19 TapWater Risk.xlsx
200-PO-1 299-E25-20 TapWater Risk.xlsx	200-PO-1 299-E25-22 TapWater Risk.xlsx
200-PO-1 299-E25-3 TapWater Risk.xlsx	--
WMA A-AX and 216-A-29 Ditch	
200-PO-1 WMA A_AX TapWater Risk.xlsx	200-PO-1 299-E24-20 TapWater Risk.xlsx
200-PO-1 299-E24-22 TapWater Risk.xlsx	200-PO-1 299-E25-236 TapWater Risk.xlsx
200-PO-1 299-E25-28 TapWater Risk.xlsx	200-PO-1 299-E25-29P TapWater Risk.xlsx
200-PO-1 299-E25-34 TapWater Risk.xlsx	200-PO-1 299-E25-42 TapWater Risk.xlsx
200-PO-1 299-E25-93 TapWater Risk.xlsx	200-PO-1 299-E25-94 TapWater Risk.xlsx
200-PO-1 699-43-45 TapWater Risk.xlsx	--

Table 6-2. Excel Spreadsheet File Names for the 200-PO-1 Groundwater OU Tap Water Scenario Calculations

BC Cribs and Trenches	
200-PO-1 BC Cribs TapWater Risk.xlsx	200-PO-1 299-E13-5 TapWater Risk.xlsx
200-PO-1 299-E13-11 TapWater Risk.xlsx	--
216-B-3 Pond Facility (All Lobes)	
200-PO-1 B Pond (all lobes) TapWater Risk.xlsx	200-PO-1 699-42-40A TapWater Risk.xlsx
200-PO-1 699-42-42B TapWater Risk.xlsx	200-PO-1 699-43-41F TapWater Risk.xlsx
200-PO-1 699-43-44 TapWater Risk.xlsx	--
NRDWL/SWL	
200-PO-1 NRDWL_SWL TapWater Risk.xlsx	200-PO-1 699-22-35 TapWater Risk.xlsx
200-PO-1 699-23-34A TapWater Risk.xlsx	200-PO-1 699-23-34B TapWater Risk.xlsx
200-PO-1 699-24-33 TapWater Risk.xlsx	200-PO-1 699-24-34A TapWater Risk.xlsx
200-PO-1 699-24-34B TapWater Risk.xlsx	200-PO-1 699-24-34C TapWater Risk.xlsx
200-PO-1 699-25-34A TapWater Risk.xlsx	200-PO-1 699-25-34B TapWater Risk.xlsx
200-PO-1 699-25-34D TapWater Risk.xlsx	200-PO-1 699-26-33 TapWater Risk.xlsx-
200-PO-1 Far Field	
200-PO-1 Farfield TapWater Risk.xlsx	200-PO-1 499- S0-7 TapWater Risk.xlsx
200-PO-1 499- S0-8 TapWater Risk.xlsx	200-PO-1 499-S1-8J TapWater Risk.xlsx
200-PO-1 699-10-54A TapWater Risk.xlsx	200-PO-1 699-12-2C TapWater Risk.xlsx
200-PO-1 699-13-1A TapWater Risk.xlsx	200-PO-1 699-13-3A TapWater Risk.xlsx
200-PO-1 699-20-20 TapWater Risk.xlsx	200-PO-1 699-29-4 TapWater Risk.xlsx
200-PO-1 699-31-11 TapWater Risk.xlsx	200-PO-1 699-32-22A TapWater Risk.xlsx
200-PO-1 699-32-22B TapWater Risk.xlsx	200-PO-1 699-32-43 TapWater Risk.xlsx
200-PO-1 699-41-23 TapWater Risk.xlsx	200-PO-1 699-S6-E4A TapWater Risk.xlsx
200-PO-1 699-S6-E4E TapWater Risk.xlsx	200-PO-1 699-S6-E4K TapWater Risk.xlsx
200-PO-1 699-S6-E4L TapWater Risk.xlsx	200-PO-1 699-S8-19 TapWater Risk.xlsx
200-PO-1 Near River	
200-PO-1 Near River TapWater Risk.xlsx	200-PO-1 699-40-1 TapWater Risk.xlsx
200-PO-1 699-41-1A TapWater Risk.xlsx	--

6.1.1 Hand Calculations

The electronic spreadsheet calculations are validated by comparison with hand calculations, which are presented in Figure 6-1. The hand calculations were performed to validate the formulas used in the spreadsheets.

7 Results/Conclusions

This section summarizes the risk assessment results for the tap water exposure scenario for the 200-BP-5 Groundwater OU and 200-PO-1 Groundwater OU. Exposure to groundwater as a tap water source is evaluated using the following potential exposure routes: ingestion, inhalation of volatiles, and dermal contact (nonradionuclides only) under a residential exposure scenario. Table 7-1 through Table 7-137 provide a summary of the risk estimates by exposure route. Additional detail, including analyte-specific risk contributions, is provided in the spreadsheet attachments.

7.1.1 200-BP-5 Groundwater OU

Table 7-1 through Table 7-72 provide a summary of the risk estimates by exposure route. Additional detail, including analyte-specific risk contributions, is provided in the spreadsheet attachments.

7.1.1.1 LLWMA-1 Exposure Area

The total cumulative ELCR for the LLWMA 1 exposure area is 3.2×10^{-4}. The total ELCR for nonradiological analytes is 9.4×10^{-5} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 2.2×10^{-4} which is greater than the EPA upper risk threshold of 1×10^{-4}. Table 7-1 provides a summary of the cancer risks and noncancer hazards by exposure route for the LLWMA 1 exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are cobalt-60 (ELCR = 7.8×10^{-6}; 2.5 percent contribution), iodine-129 (ELCR = 6.7×10^{-6}; 2.1 percent contribution), technetium-99 (ELCR = 1.7×10^{-4}; 53 percent contribution), and tritium (ELCR = 4.1×10^{-5}; 13 percent contribution). Contribution to ELCR is elevated for arsenic (9.3×10^{-5}; 30 percent contribution) where measured concentrations (4.8 µg/L) are within natural background values.

The HI for the LLWMA 1 exposure area is 96, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributor to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) is cyanide (HQ of 90; 94 percent contribution). Contribution to HI is elevated for antimony (HQ of 3.6; 3.8 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-1. Summary of Cancer Risks and Noncancer Hazards for the LLWMA-1 Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	9.3×10^{-5}	Arsenic (ELCR = 9.3×10^{-5}; 30%) Co-60 (ELCR = 7.8×10^{-6}; 2.5%) I-129 (ELCR = 6.7×10^{-6}; 2.1%) Tc-99 (ELCR = 1.7×10^{-4}; 53%) Tritium (ELCR = 4.1×10^{-5}; 13%)	13	Antimony (HQ = 3.6; 3.8%) Cyanide (HQ = 90; 94%)
	Dermal Contact	5.4×10^{-7}		0.26	
	Inhalation of Volatiles	5.3×10^{-7}		83	
	Total	9.4×10^{-5}		96	

Table 7-1. Summary of Cancer Risks and Noncancer Hazards for the LLWMA-1 Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Radionuclides	Ingestion	1.9×10^{-4}		--	
	Inhalation of Volatiles	3.4×10^{-5}			
	Total	2.2×10^{-4}			
Total Cumulative		3.2×10^{-4}			

7.1.1.2 LLWMA 1 - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for four wells within the LLWMA 1 exposure area (299-E28-28, 299-E33-265, 299-E33-266, and 299-E33-34), the calculated risks and noncancer hazards are presented in Table 7-2 through Table 7-5.

The total cumulative ELCR for the wells within the LLWMA 1 exposure area ranged between 8.4×10^{-5} to 1.1×10^{-3}. The total ELCR for nonradiological analytes ranged between 7.8×10^{-5} to 1.2×10^{-4}, which are greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5} at all four wells. The total ELCR for radiological analytes ranged between 6.1×10^{-6} to 1.0×10^{-3}. The radiological ELCR is greater than the EPA upper risk threshold of 1×10^{-4} at well 299-E33-34. The radiological ELCR is less than the EPA upper risk threshold of 1×10^{-4} at wells 299-E28-28, 299-E33-265, and 299-E33-266.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are iodine-129 (wells 299-E33-265 and 299-E33-266), technetium-99, and tritium. Contribution to ELCR is elevated for arsenic (7.8×10^{-5} to 1.2×10^{-4}) where measured concentrations (4.0 to 6.3 µg/L) are within natural background values.

The HI for the individual wells within the LLWMA 1 exposure area ranged from 9.2 to 298, which are greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributors to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) are cyanide (HQ of 4.4 to 292) and nitrate (HQ of 3.4; 1.2 percent contribution at well 299-E33-34 only). All remaining individual analytes (arsenic, fluoride, nitrate, uranium, and vanadium) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for antimony (HQ of 3.6; 36 percent contribution) at well 299-E28-28, where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-2. Summary of Cancer Risks and Noncancer Hazards for Well 299-E28-28 (Within the LLWMA 1 Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	7.8×10^{-5}	Arsenic (ELCR = 7.8×10^{-5}, 93%) Tc-99 (ELCR = 2.2×10^{-6}, 2.6%) Tritium (ELCR = 3.9×10^{-6}, 4.6%)	5.0	Antimony (HQ = 3.6, 39%) Arsenic (HQ = 0.41, 4.4%) Cyanide (HQ = 4.4, 48%) Fluoride (HQ = 0.22, 2.4%) Nitrate (HQ = 0.20, 2.2%) Vanadium (HQ = 0.16, 1.7%)
	Dermal Contact	4.3×10^{-7}		0.19	
	Inhalation of Volatiles	0.0E+00		4.0	
	Total	7.8×10^{-5}		9.2	
Radionuclides	Ingestion	2.9×10^{-6}		--	
	Inhalation of Volatiles	3.2×10^{-6}			
	Total	6.1×10^{-6}			
Total Cumulative		8.4×10^{-5}			

Table 7-3. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-265 (Within the LLWMA 1 Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	9.5×10^{-5}	Arsenic (ELCR = 9.5×10^{-5}, 50%) I-129 (ELCR = 6.8×10^{-6}, 3.6%) Tc-99 (ELCR = 5.1×10^{-5}, 27%) Tritium (ELCR = 3.6×10^{-5}, 19%)	3.7	Arsenic (HQ = 0.49, 1.7%) Cyanide (HQ = 27, 94%) Nitrate (HQ = 0.42, 1.5%)
	Dermal Contact	5.3×10^{-7}		0.07	
	Inhalation of Volatiles	5.3×10^{-7}		25	
	Total	9.6×10^{-5}		29	
Radionuclides	Ingestion	6.4×10^{-5}		--	
	Inhalation of Volatiles	3.0×10^{-5}			
	Total	9.4×10^{-5}			
Total Cumulative		1.9×10^{-4}			

Table 7-4. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-266 (Within the LLWMA 1 Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	9.0×10^{-5}	Arsenic (ELCR = 9.1×10^{-5}, 64%) I-129 (ELCR = 4.3×10^{-6}, 3.1%) Tc-99 (ELCR = 1.8×10^{-5}, 12%) Tritium (ELCR = 2.9×10^{-5}, 20%)	2.8	Arsenic (HQ = 0.47, 2.5%) Cyanide (HQ = 17, 92%) Nitrate (HQ = 0.35, 1.9%) Uranium (HQ = 0.20, 1.1%)
	Dermal Contact	5.2×10^{-7}		0.06	
	Inhalation of Volatiles	--		16	
	Total	9.1×10^{-5}		19	
Radionuclides	Ingestion	2.7×10^{-5}		--	
	Inhalation of Volatiles	2.4×10^{-5}			
	Total	5.1×10^{-5}			
Total Cumulative		1.4×10^{-4}			

Table 7-5. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-34 (Within the LLWMA 1 Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.2×10^{-4}	Arsenic (ELCR = 1.2×10^{-4}; 11%) Tc-99 (ELCR = 8.9×10^{-4}; 78%) Tritium (ELCR = 1.1×10^{-4}; 9.7%)	28	Cyanide (HQ = 292; 98%) Nitrate (HQ = 3.5; 1.2%)
	Dermal Contact	6.8×10^{-7}		0.31	
	Inhalation of Volatiles	--		270	
	Total	1.2×10^{-4}		298	
Radionuclides	Ingestion	9.3×10^{-4}		--	
	Inhalation of Volatiles	9.1×10^{-5}			
	Total	1.0×10^{-3}			
Total Cumulative		1.1×10^{-3}			

7.1.1.3 LLWMA 2 Exposure Area

The total cumulative ELCR for the LLWMA 2 exposure area is 2.1×10^{-4}. The total ELCR for nonradiological analytes is 1.6×10^{-4} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 4.9×10^{-5} which is greater than the EPA upper risk threshold of 1×10^{-4}. Table 7-6 provides a summary of the cancer risks and noncancer hazards by exposure route for the LLWMA 2 exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are iodine-129 (ELCR = 3.9×10^{-6}; 1.8 percent contribution), technetium-99 (ELCR = 4.2×10^{-5}; 20 percent contribution), and tritium (ELCR = 3.1×10^{-6}; 1.5 percent contribution). Contribution to ELCR is elevated for arsenic (1.6×10^{-4}; 77 percent contribution) where measured concentrations (4.8 µg/L) are within natural background values.

The HI for the LLWMA 2 exposure area is 44, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributor to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) is cyanide (HQ of 37; 85 percent contribution). Contribution to HI is elevated for antimony (HQ of 5.1; 12 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010. Contribution to HI is elevated for arsenic (HQ of 0.85; 1.9 percent contribution) where measured concentrations (4.8 µg/L) are within natural background values.

Table 7-6. Summary of Cancer Risks and Noncancer Hazards for the LLWMA 2 Exposure Area

<table>
<tr><th>Analyte Group</th><th>Exposure Route</th><th>ELCR</th><th>% Risk Contribution</th><th>HI</th><th>% HI Contribution</th></tr>
<tr><td rowspan="4">Nonradionuclides</td><td>Ingestion</td><td>1.6×10^{-4}</td><td rowspan="7">Arsenic (ELCR = 1.6×10^{-4}; 77%)
I-129 (ELCR = 3.9×10^{-6}; 1.8%)
Tc-99 (ELCR = 4.2×10^{-5}; 20%)
Tritium (ELCR = 3.1×10^{-6}; 1.5%)</td><td>9.3</td><td rowspan="3">Antimony (HQ = 5.1; 12%)
Arsenic (HQ = 0.85; 1.9%)
Cyanide (HQ = 37; 85%)</td></tr>
<tr><td>Dermal Contact</td><td>9.1×10^{-7}</td><td>0.29</td></tr>
<tr><td>Inhalation of Volatiles</td><td>--</td><td>34</td></tr>
<tr><td>Total</td><td>1.6×10^{-4}</td><td colspan="2">44</td></tr>
<tr><td rowspan="3">Radionuclides</td><td>Ingestion</td><td>4.7×10^{-5}</td><td colspan="2" rowspan="4">--</td></tr>
<tr><td>Inhalation of Volatiles</td><td>2.6×10^{-6}</td></tr>
<tr><td>Total</td><td>4.9×10^{-5}</td></tr>
<tr><td colspan="2">Total Cumulative</td><td colspan="2">2.1×10^{-4}</td></tr>
</table>

7.1.1.4 LLWMA 2 - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for three wells within the LLWMA 2 exposure area (299-E27-10, 299-E33-33, and 299-E34-9), the calculated risks and noncancer hazards are presented in Table 7-7 through Table 7-9.

The total cumulative ELCR for the individual wells within the LLWMA 2 exposure area ranged between 6.6×10^{-4} and 9.6×10^{-5}. The total ELCR for nonradiological analytes ranged between 1.7×10^{-4} and 8.5×10^{-5} which are greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes ranged between 5.2×10^{-4} and 1.0×10^{-5}. The total ELCR at well 299-E34-9 is greater than the upper risk threshold of 1×10^{-4} and is within the EPA acceptable risk range of 1×10^{-4} to 1×10^{-6} at wells 299-E27-10 and 299-E33-33.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are iodine-129 (wells 299-E27-10 and 299-E33-33 only), technetium-99, and tritium (wells 299-E27-10 and 299-E33-33 only). Contribution to ELCR is elevated for arsenic (1.7×10^{-4} to 8.5×10^{-5}) where measured concentrations (4.4 µg/L to 9.0 µg/L) are within natural background values.

The HI for the individual wells within the LLWMA 2 exposure area ranged from 7.6 to 270, which are greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. At wells 299-E33-33 and 299-E34-9, the primary contributor to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) is cyanide (HQ of 13 and 267, respectively). At well 299-E33-33, additional individual analytes that contribute greater than one percent of the HI but report a HQ less than 1 include arsenic, Cr(VI), nitrate, and vanadium. At well 299-E27-10, all individual analytes (arsenic, fluoride, Cr(VI), nickel, nitrate, silver, and vanadium) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for antimony at well 299-E27-10, (HQ of 6.2; 81 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-7. Summary of Cancer Risks and Noncancer Hazards for Well 299-E27-10 (Within the LLWMA 2 Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	8.5×10^{-5}	Arsenic (ELCR = 8.5×10^{-5}; 89%) I-129 (ELCR = 4.3×10^{-6}; 4.5%) Tc-99 (ELCR = 4.4×10^{-6}; 4.6%) Tritium (ELCR = 1.7×10^{-6}; 1.8%)	7.3	Antimony (HQ = 6.2; 81%) Arsenic (HQ = 0.44; 5.8%) Fluoride (HQ = 0.082; 1.1%) Cr(VI) (HQ = 0.15; 1.9%) Nickel (HQ = 0.18; 2.3%) Nitrate (HQ = 0.24; 3.1%) Silver (HQ = 0.099; 1.3%) Vanadium (HQ 0.13; 1.7%)
	Dermal Contact	4.7×10^{-7}		0.33	
	Inhalation of Volatiles	--		--	
	Total	8.5×10^{-5}		7.6	
Radionuclides	Ingestion	8.9×10^{-6}		--	
	Inhalation of Volatiles	1.4×10^{-6}			

Table 7-7. Summary of Cancer Risks and Noncancer Hazards for Well 299-E27-10 (Within the LLWMA 2 Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Total	1.0×10^{-5}			
Total Cumulative		9.6×10^{-5}			

Table 7-8. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-33 (Within the LLWMA 2 Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.7×10^{-4}	Arsenic (ELCR = 1.7×10^{-4}, 83%) I-129 (ELCR = 7.2×10^{-6}, 3.4%) Tc-99 (ELCR = 2.6×10^{-5}, 12%) Tritium (ELCR = 2.8×10^{-6}, 1.3%)	2.9	Arsenic (HQ = 0.90, 5.9%) Cyanide (HQ = 13, 87%) Cr(VI) (HQ = 0.26, 1.7%) Nitrate (HQ = 0.37, 2.4%) Vanadium (HQ = 0.18, 1.2%)
	Dermal Contact	9.6×10^{-7}		0.13	
	Inhalation of Volatiles	--		12	
	Total	1.7×10^{-4}		15	
Radionuclides	Ingestion	3.4×10^{-5}		--	
	Inhalation of Volatiles	2.3×10^{-6}			
	Total	3.6×10^{-5}			
Total Cumulative		2.1×10^{-4}			

Table 7-9. Summary of Cancer Risks and Noncancer Hazards for Well 299-E34-9 (Within the LLWMA 2 Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.4×10^{-4}	Arsenic (ELCR = 1.4×10^{-4}; 21%) Tc-99 (ELCR = 5.2×10^{-4}; 78%)	23	Cyanide (HQ = 267; 99%)
	Dermal Contact	7.8×10^{-7}		0.25	

Table 7-9. Summary of Cancer Risks and Noncancer Hazards for Well 299-E34-9 (Within the LLWMA 2 Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Inhalation of Volatiles	--		246	
	Total	1.4×10^{-4}		270	
Radionuclides	Ingestion	5.2×10^{-4}		--	
	Inhalation of Volatiles	4.9×10^{-6}			
	Total	5.2×10^{-4}			
Total Cumulative		6.6×10^{-4}			

7.1.1.5 WMA B-BY-BX Tank Farms and 216-B-63 Trench Exposure Area

The total cumulative ELCR for the WMA B-BY-BX tank farms and 216-B-63 trench exposure area is 3.2×10^{-3}. The total ELCR for nonradiological analytes is 9.4×10^{-4} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 2.3×10^{-3} which is greater than the EPA upper risk threshold of 1×10^{-4}. Table 7-10 provides a summary of the cancer risks and noncancer hazards by exposure route for the WMA B-BY-BX tank farms and 216-B-63 trench exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are methyl methanesulfonate (ELCR = 4.3×10^{-4}; 14 percent contribution), n-nitrosodi-n-dipropylamine (ELCR = 3.2×10^{-4}; 10 percent contribution), technetium-99 (ELCR = 6.0×10^{-4}; 19 percent contribution), tritium (ELCR = 6.3×10^{-5}; 2.0 percent contribution), uranium-234 (ELCR = 8.1×10^{-4}; 25 percent contribution), uranium-235 (ELCR = 3.6×10^{-5}; 1.1 percent contribution), and uranium-238 (ELCR = 7.2×10^{-4}; 22 percent contribution). Contribution to ELCR is elevated for arsenic (1.7×10^{-4}; 5.4 percent contribution) where measured concentrations (8.9 µg/L) are within natural background values.

The HI for the WMA B-BY-BX tank farms and 216-B-63 trench exposure area is 221, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributors to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) are cyanide (HQ of 208; 94 percent contribution), uranium, (HQ of 4.2; 1.9 percent contribution), and nitrate (HQ of 2.5; 1.2 percent contribution). Contribution to HI is elevated for antimony (HQ of 3.5; 1.6 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-10. Summary of Cancer Risks and Noncancer Hazards for the WMA B-BY-BX and 216-B-63 Trench Exposure Area

<table>
<tr><th>Analyte Group</th><th>Exposure Route</th><th>ELCR</th><th>% Risk Contribution</th><th>HI</th><th>% HI Contribution</th></tr>
<tr><td rowspan="4">Nonradionuclides</td><td>Ingestion</td><td>9.2×10^{-4}</td><td rowspan="7">Arsenic (ELCR = 1.7×10^{-4}; 5.4%)
Methyl methanesulfonate (ELCR = 4.3×10^{-4}; 14%)
n-Nitrosodi-n-dipropylamine (ELCR = 3.2×10^{-4}; 10%)
Tc-99 (ELCR = 6.0×10^{-4}; 19%)
Tritium (ELCR = 6.3×10^{-5}; 2.0%)
U-234 (ELCR = 8.1×10^{-4}; 25%)
U-235 (ELCR = 3.6×10^{-5}; 1.1%)
U-238 (ELCR = 7.2×10^{-4}; 22%)</td><td>29</td><td rowspan="3">Antimony (HQ = 3.5; 1.6%)
Cyanide (HQ = 208; 94%)
Nitrate (HQ = 2.5; 1.2%)
Uranium (HQ = 4.2; 1.9%)</td></tr>
<tr><td>Dermal Contact</td><td>1.3×10^{-5}</td><td>0.48</td></tr>
<tr><td>Inhalation of Volatiles</td><td>9.5×10^{-6}</td><td>192</td></tr>
<tr><td>Total</td><td>9.4×10^{-4}</td><td colspan="2">221</td></tr>
<tr><td rowspan="3">Radionuclides</td><td>Ingestion</td><td>2.2×10^{-3}</td><td rowspan="4">--</td></tr>
<tr><td>Inhalation of Volatiles</td><td>5.2×10^{-5}</td></tr>
<tr><td>Total</td><td>2.3×10^{-3}</td></tr>
<tr><td colspan="2">Total Cumulative</td><td colspan="2">3.2×10^{-3}</td></tr>
</table>

7.1.1.6 WMA B-BY-BX Tank Farms and 216-B-63 Trench - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for 21 wells within the WMA B-BY-BX tank farms and 216-B-63 trench exposure area (299-E33-1A, 299-E33-4, 299-E33-15, 299-E33-16, 299-E33-17, 299-E33-18, 299-E33-20, 299-E33-38, 299-E33-42, 299-E33-44, 299-E33-47, 299-E33-48, 299-E33-205, 299-E33-334, 299-E33-337, 299-E33-338, 299-E33-339, 299-E33-341, 299-E33-342, 299-E33-343, and 299-E33-345), the calculated risks and noncancer hazards are presented in Table 7-11 through Table 7-31, respectively.

The total cumulative ELCR for the individual wells within the WMA B-BY-BX tank farms and 216-B-63 trench exposure area ranged between 2.8×10^{-3} and 2.7×10^{-4}. The total ELCR for nonradiological analytes ranged between 1.6×10^{-3} and 8.4×10^{-5} which are greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes ranged between 2.4×10^{-3} and 1.2×10^{-4} which are greater than the upper risk threshold of 1×10^{-4}.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) include the following:

- Technetium-99 and tritium at wells 299-E33-1A, 299-E33-15, 299-E33-18, 299-E33-341, 299-E33-342, 299-E33-38, 299-E33-44
- Arsenic, technetium-99 and tritium at well 299-E33-16

- Iodine-129, technetium-99 and tritium at wells 299-E33-17, 299-E33-20, 299-E33-205, 299-E33-337, 299-E33-48
- N-nitrosodi-n-dipropylamine, iodine-129, technetium-99 and tritium at wells 299-E33-334 and 299-E33-42
- Iodine-129, technetium-99 and tritium at wells 299-E33-337, 299-E33-339, 299-E33-345
- Iodine-129, strontium-90, technetium-99 and tritium at well 299-E33-338
- Technetium-99, tritium, uranium-234, uranium-235, and uranium-238 at well 299-E33-343
- Cobalt-60 at well 299-E33-4
- Methyl methanesulfonate, technetium-99, and tritium at well 299-E33-47

Except for 299-E33-16, contribution to ELCR is elevated for arsenic (1.5×10^{-4} to 8.3×10^{-5}) where measured concentrations (4.3 µg/L to 7.8 µg/L) are within natural background values.

The HI for the individual wells within the WMA B-BY-BX tank farms and 216-B-63 trench exposure area ranged from 9.2 to 731, which are greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributors to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) are as follows:

- Cyanide at well 299-E33-15, 299-E33-17, 299-E33-334, 299-E33-338, 299-E33-341, 299-E33-38, 299-E33-48
- Cyanide and arsenic at well 299-E33-16
- Cyanide, nitrate, and uranium at wells 299-E33-18, 299-E33-205, and 299-E33-343
- Cobalt, cyanide, nickel, and nitrate at 299-E33-337
- Cobalt, cyanide, and uranium at well 299-E33-339
- Cyanide and nitrate at well 299-E33-1A, 299-E33-20, 299-E33-44, 299-E33-47
- Cyanide and uranium at well 299-E33-342
- Cyanide, nitrate, and uranium at 299-E33-205, 299-E33-343, 299-E33-42
- Cyanide, Cr(VI), nitrate, and uranium at 299-E33-345

Contribution to HI is elevated for antimony at wells 299-E33-16, 299-E33-18, 299-E33-38, 299-E33-42, 299-E33-44, 299-E33-47, 299-E33-48, 299-E33-334, 299-E33-337, 299-E33-338, 299-E33-339, 299-E33-341, 299-E33-342 where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-11. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-1A (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	--	Tc-99 (ELCR = 1.2×10^{-3}, 90%) Tritium (ELCR = 1.0×10^{-4}, 7.8%)	48	Cyanide (HQ = 514, 98%) Nitrate (HQ = 5.4, 1.0%)
	Dermal Contact	--		0.54	
	Inhalation of Volatiles	--		474	
	Total	--		523	
Radionuclides	Ingestion	1.3×10^{-3}		--	
	Inhalation of Volatiles	8.6×10^{-5}			
	Total	1.3×10^{-3}			
Total Cumulative		1.3×10^{-3}			

Table 7-12. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-4 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	--	Co-60 (ELCR = 3.1×10^{-4}; 100%)	--	--
	Dermal Contact	--		--	
	Inhalation of Volatiles	--		--	
	Total	--		--	
Radionuclides	Ingestion	3.1×10^{-4}		--	
	Inhalation of Volatiles	--			
	Total	3.1×10^{-4}			

Table 7-12. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-4
(Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Total Cumulative		3.1×10^{-4}			

Table 7-13. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-15
(Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.4×10^{-4}	Arsenic (ELCR = 1.4×10^{-4}, 13%) Tc-99 (ELCR = 8.1×10^{-4}, 78%) Tritium (ELCR = 7.8×10^{-5}, 7.5%)	49	Cyanide (HQ = 542, 99%)
	Dermal Contact	7.6×10^{-7}		0.61	
	Inhalation of Volatiles	--		501	
	Total	1.4×10^{-4}		550	
Radionuclides	Ingestion	8.3×10^{-4}		--	
	Inhalation of Volatiles	6.4×10^{-5}			
	Total	9.0×10^{-4}			
Total Cumulative		1.0×10^{-3}			

Table 7-14. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-16
(Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.6×10^{-3}	Arsenic (ELCR = 1.6×10^{-3}; 57%) Tc-99 (ELCR = 1.1×10^{-3}; 40%) Tritium (ELCR = 7.8×10^{-5}; 2.8%)	79	Antimony (HQ = 16; 2.7%) Arsenic (HQ = 8.3; 1.4%) Cyanide (HQ = 568; 94%)
	Dermal Contact	8.8×10^{-6}		1.4	
	Inhalation of Volatiles	--		524	
	Total	1.6×10^{-3}		604	

Table 7-14. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-16
(Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Radionuclides	Ingestion	1.2×10^{-3}		--	
	Inhalation of Volatiles	6.4×10^{-5}			
	Total	1.2×10^{-3}			
Total Cumulative		2.8×10^{-3}			

Table 7-15. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-17
(Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.2×10^{-4}	Arsenic (ELCR = 1.2×10^{-4}, 11%) I-129 (ELCR = 1.1×10^{-5}, 1.0%) Tc-99 (ELCR = 8.9×10^{-4}, 82%) Tritium (ELCR = 6.3×10^{-5}, 5.7%)	57	Cyanide (HQ = 663, 99%)
	Dermal Contact	6.5×10^{-7}		0.64	
	Inhalation of Volatiles	--		611	
	Total	1.2×10^{-4}		669	
Radionuclides	Ingestion	9.3×10^{-4}		--	
	Inhalation of Volatiles	5.2×10^{-5}			
	Total	9.8×10^{-4}			
Total Cumulative		1.1×10^{-3}			

Table 7-16. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-18
(Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclid	Ingestion	1.0×10^{-4}	Arsenic (ELCR = 1.0×10^{-4}; 7.0%)	41	Antimony (HQ = 8.5; 11%) Cyanide (HQ = 35; 47%)

Table 7-16. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-18 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Dermal Contact	5.6×10^{-7}	Tc-99 (ELCR = 1.2×10^{-3}; 85%) Tritium (ELCR = 9.6×10^{-5}; 6.7%)	0.84	Cr(VI) (HQ = 0.93; 1.3%) Nitrate (HQ = 2.5; 3.4%) Uranium (HQ = 27; 36%)
	Inhalation of Volatiles	--		32	
	Total	1.0×10^{-4}		74	
Radionuclides	Ingestion	1.3×10^{-3}		--	
	Inhalation of Volatiles	7.9×10^{-5}			
	Total	1.3×10^{-3}			
Total Cumulative		1.4×10^{-3}			

Table 7-17. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-20 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	9.1×10^{-5}	Arsenic (ELCR = 9.1×10^{-5}, 21%) I-129 (ELCR = 1.0×10^{-5}, 2.4%) Tc-99 (ELCR = 3.1×10^{-4}, 72%) Tritium (ELCR = 1.9×10^{-5}, 4.4%)	13	Cyanide (HQ = 93, 94%) Nitrate (HQ = 3.8, 3.8%)
	Dermal Contact	5.0×10^{-7}		0.35	
	Inhalation of Volatiles	--		86	
	Total	9.1×10^{-5}		99	
Radionuclides	Ingestion	3.2×10^{-4}		--	
	Inhalation of Volatiles	1.6×10^{-5}			
	Total	3.4×10^{-4}			
Total Cumulative		4.3×10^{-4}			

Table 7-18. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-205 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	8.9×10^{-5}	Arsenic (ELCR = 8.9×10^{-5}, 16%) I-129 (ELCR = 1.2×10^{-5}, 2.2%) Tc-99 (ELCR = 4.4×10^{-4}, 77%) Tritium (ELCR = 2.7×10^{-5}, 4.7%)	13	Arsenic (HQ = 0.46, 1.1%) Cyanide (HQ = 33, 75%) Nitrate (HQ = 1.7, 3.9%) Uranium (HQ = 8.0, 18%)
	Dermal Contact	5.0×10^{-7}		0.22	
	Inhalation of Volatiles	--		30	
	Total	8.9×10^{-5}		44	
Radionuclides	Ingestion	4.6×10^{-4}		--	
	Inhalation of Volatiles	2.2×10^{-5}			
	Total	4.8×10^{-4}			
Total Cumulative		5.7×10^{-4}			

Table 7-19. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-334 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	4.3×10^{-4}	Arsenic (ELCR = 1.2×10^{-4}, 21%) n-Nitrosodi-n-dipropylamine (ELCR = 3.2×10^{-4}, 58%) I-129 (ELCR = 1.1 × 10-5, 1.9%) Tc-99 (ELCR = 5.8×10^{-5}, 10%) Tritium (ELCR = 5.1×10^{-5}, 9.1%)	7.3	Antimony (HQ = 3.4, 10%) Arsenic (HQ = 0.62, 1.8%) Cyanide (HQ = 28, 84%) Nitrate (HQ = 0.48, 1.4%)
	Dermal Contact	1.1×10^{-5}		0.21	
	Inhalation of Volatiles	--		26	
	Total	4.4×10^{-4}		34	
Radionuclides	Ingestion	7.8×10^{-5}		--	
	Inhalation of Volatiles	4.2×10^{-5}			
	Total	1.2×10^{-4}			
Total Cumulative		5.6×10^{-4}			

Table 7-20. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-337 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.1×10^{-4}	Arsenic (ELCR = 1.1×10^{-4}; 31%) I-129 (ELCR = 7.5×10^{-6}; 2.1%) Tc-99 (ELCR = 1.9×10^{-4}; 53%) Tritium (ELCR = 5.0×10^{-5}; 14%)	22	Antimony (HQ = 6.1; 5.0%) Cobalt (HQ = 2.2; 1.8%) Cyanide (HQ = 106; 88%) Nickel (HQ = 2.7; 2.2%) Nitrate (HQ = 1.4; 1.1%)
	Dermal Contact	6.2×10^{-7}		0.58	
	Inhalation of Volatiles	--		97	
	Total	1.1×10^{-4}		120	
Radionuclides	Ingestion	2.1×10^{-4}		--	
	Inhalation of Volatiles	4.1×10^{-5}			
	Total	2.5×10^{-4}			
Total Cumulative		3.6×10^{-4}			

Table 7-21. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-338 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.3×10^{-4}	Arsenic (ELCR = 1.3×10^{-4}, 40%) I-129 (ELCR = 1.3×10^{-5}, 4.2%) Strontium-90 (ELCR = 4.9×10^{-6}, 1.5%) Tc-99 (ELCR = 1.5×10^{-4}, 46%) Tritium (ELCR = 2.5×10^{-5}, 7.7%)	12	Antimony (HQ = 4.9, 7.5%) Cyanide (HQ = 57, 88%) Nitrate (HQ = 0.89, 1.4%)
	Dermal Contact	7.1×10^{-7}		0.31	
	Inhalation of Volatiles	--		52	
	Total	1.3×10^{-4}		64	
Radionuclides	Ingestion	1.7×10^{-4}		--	
	Inhalation of Volatiles	2.0×10^{-5}			
	Total	1.9×10^{-4}			

Table 7-21. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-338 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Total Cumulative		3.2×10^{-4}			

Table 7-22. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-339 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.1×10^{-4}	Arsenic (ELCR = 1.1×10^{-4}; 35%) I-129 (ELCR = 1.1×10^{-5}; 3.4%) Tc-99 (ELCR = 1.6×10^{-4}; 47%) Tritium (ELCR = 4.8×10^{-5}; 15%)	16	Antimony (HQ = 7.2; 12%) Cobalt (HQ = 1.3; 2.2%) Cyanide (HQ = 45; 78%) Nitrate (HQ = 0.87; 1.5%) Uranium (HQ = 2.0; 3.4%)
	Dermal Contact	6.3×10^{-7}		0.43	
	Inhalation of Volatiles	--		42	
	Total	1.1×10^{-4}		58	
Radionuclides	Ingestion	1.8×10^{-4}		--	
	Inhalation of Volatiles	4.0×10^{-5}			
	Total	2.2×10^{-4}			
Total Cumulative		3.3×10^{-4}			

Table 7-23. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-341 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.2×10^{-4}	Arsenic (ELCR = 1.2×10^{-4}, 7.3%) Tc-99 (ELCR = 1.4×10^{-3}, 86%) Tritium (ELCR = 7.5×10^{-5}, 4.6%)	74	Antimony (HQ = 11, 1.6%) Cyanide (HQ = 710, 97%)
	Dermal Contact	2.1×10^{-6}		1.1	
	Inhalation of Volatiles	3.6×10^{-6}		655	

Table 7-23. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-341 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Total	1.3×10^{-4}		731	
Radionuclides	Ingestion	1.5×10^{-3}		--	
	Inhalation of Volatiles	6.2×10^{-5}			
	Total	1.5×10^{-3}			
Total Cumulative		1.6×10^{-3}			

Table 7-24. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-342 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.3×10^{-4}	Arsenic (ELCR = 1.2×10^{-4}, 7.9%) Tc-99 (ELCR = 1.3×10^{-3}, 81%) Tritium (ELCR = 1.2×10^{-4}, 7.7%)	71	Antimony (HQ = 17, 2.9%) Cyanide (HQ = 551, 95%) Uranium (HQ = 6.1, 1.1%)
	Dermal Contact	2.6×10^{-6}		1.2	
	Inhalation of Volatiles	1.2×10^{-5}		509	
	Total	1.4×10^{-4}		581	
Radionuclides	Ingestion	1.3×10^{-3}		--	
	Inhalation of Volatiles	1.0×10^{-4}			
	Total	1.4×10^{-3}			
Total Cumulative		1.6×10^{-3}			

Table 7-25. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-343 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.2×10^{-4}	Arsenic (ELCR = 1.2×10^{-4}; 4.5%) Tc-99 (ELCR = 8.1×10^{-4}; 32%) Tritium (ELCR = 5.8×10^{-5}; 2.2%) U-234 (ELCR = 8.1×10^{-4}; 31%) U-235 (ELCR = 3.6×10^{-5}; 1.4%) U-238 (ELCR = 7.2×10^{-4}; 28%)	40	Arsenic (HQ = 0.60; 1.3%) Cyanide (HQ = 4.9; 11%) Nitrate (HQ = 1.3; 2.9%) Uranium (HQ = 37; 83%)
	Dermal Contact	1.9×10^{-6}		0.42	
	Inhalation of Volatiles	8.3×10^{-6}		4.5	
	Total	1.3×10^{-4}		45	
Radionuclides	Ingestion	2.4×10^{-3}		--	
	Inhalation of Volatiles	4.8×10^{-5}			
	Total	2.4×10^{-3}			
Total Cumulative		2.6×10^{-3}			

Table 7-26. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-345 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	8.3×10^{-5}	Arsenic (ELCR = 8.3×10^{-5}, 7.2%) I-129 (ELCR = 1.5×10^{-5}, 1.3%) Tc-99 (ELCR = 9.9×10^{-4}, 86%) Tritium (ELCR = 6.2×10^{-5}, 5.4%)	7.5	Arsenic (HQ = 0.43, 4.7%) Cyanide (HQ = 1.4, 16%) Fluoride (HQ = 0.13, 1.4%) Cr(VI) (HQ = 1.1, 12%) Manganese (HQ = 0.13, 1.5%) Nitrate (HQ = 1.5, 16%) Nitrite (HQ = 0.45, 4.9%) Silver (HQ = 0.33, 3.6%) Uranium (HQ = 3.6, 39%)
	Dermal Contact	9.3×10^{-7}		0.45	
	Inhalation of Volatiles	--		1.3	
	Total	8.4×10^{-5}		9.2	
Radionuclides	Ingestion	1.0×10^{-3}		--	
	Inhalation of Volatiles	5.1×10^{-5}			
	Total	1.1×10^{-3}			

Table 7-26. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-345
(Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Total Cumulative		1.2×10^{-3}			

Table 7-27. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-38
(Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.3×10^{-4}	Arsenic (ELCR = 1.3×10^{-4}, 7.2%) Tc-99 (ELCR = 1.6×10^{-3}, 86%) Tritium (ELCR = 8.8×10^{-5}, 4.7%)	73	Antimony (HQ = 14, 2.1%) Cyanide (HQ = 619, 96%)
	Dermal Contact	7.4×10^{-7}		1.1	
	Inhalation of Volatiles	--		571	
	Total	1.3×10^{-4}		645	
Radionuclides	Ingestion	1.7×10^{-3}		--	
	Inhalation of Volatiles	7.3×10^{-5}			
	Total	1.7×10^{-3}			
Total Cumulative		1.9×10^{-3}			

Table 7-28. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-42
(Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	3.3×10^{-4}	Arsenic (ELCR = 9.6×10^{-5}, 14%) n-Nitrosodi-n-dipropylamine (ELCR = 2.4×10^{-4}, 35%) I-129 (ELCR = 1.2×10^{-5}, 1.8%) Tc-99 (ELCR = 3.2×10^{-4}, 45%) Tritium (ELCR = 3.2×10^{-5}, 4.6%)	18	Antimony (HQ = 7.9, 11%) Cyanide (HQ = 55, 79%) Nitrate (HQ = 2.1, 3.1%) Uranium (HQ = 2.6, 3.8%)
	Dermal Contact	8.2×10^{-6}		0.51	
	Inhalation of Volatiles	--		51	
	Total	3.4×10^{-4}		69	

Table 7-28. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-42
(Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Radionuclides	Ingestion	3.4×10^{-4}		--	
	Inhalation of Volatiles	2.6×10^{-5}			
	Total	3.6×10^{-4}			
Total Cumulative		7.0×10^{-4}			

Table 7-29. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-44
(Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.5×10^{-4}	Arsenic (ELCR = 1.5×10^{-4}, 13%) Tc-99 (ELCR = 9.2×10^{-4}, 79%) Tritium (ELCR = 7.5×10^{-5}, 6.4%)	49	Antimony (HQ = 12, 3.1%) Cyanide (HQ = 359, 94%) Nitrate (HQ = 4.1, 1.1%)
	Dermal Contact	3.0×10^{-6}		0.94	
	Inhalation of Volatiles	--		331	
	Total	1.5×10^{-4}		381	
Radionuclides	Ingestion	9.5×10^{-4}		--	
	Inhalation of Volatiles	6.1×10^{-5}			
	Total	1.0×10^{-3}			
Total Cumulative		1.2×10^{-3}			

Table 7-30. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-47
(Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	5.6×10^{-4}	Arsenic (ELCR = 1.2×10^{-4}; 6.2%) Methyl methanesulfonate	41	

Table 7-30. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-47 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Dermal Contact	6.9×10^{-7}	(ELCR = 4.3×10^{-4}; 22%) Tc-99 (ELCR = 1.4×10^{-3}; 69%) Tritium (ELCR = 4.4×10^{-5}; 2.2%)	0.80	Antimony (HQ = 9.2; 2.7%) Cyanide (HQ = 328; 95%) Nitrate (HQ = 5.0; 1.4%)
	Inhalation of Volatiles	--		303	
	Total	5.6×10^{-4}		345	
Radionuclides	Ingestion	1.4×10^{-3}		--	
	Inhalation of Volatiles	3.6×10^{-5}			
	Total	1.4×10^{-3}			
Total Cumulative		2.0×10^{-3}			

Table 7-31. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-48 (Within the WMA B-BY-BX and 216-B-63 Trench Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.3×10^{-4}	Arsenic (ELCR = 1.3×10^{-4}, 47%) I-129 (ELCR = 1.0×10^{-5}, 3.9%) Tc-99 (ELCR = 7.9×10^{-5}, 29%) Tritium (ELCR = 5.2×10^{-5}, 19%)	8.5	Antimony (HQ = 3.7, 10%) Arsenic (HQ = 0.66, 1.8%) Cyanide (HQ = 29, 82%) Nitrate (HQ = 0.92, 2.6%) Uranium (HQ = 0.41, 1.1%)
	Dermal Contact	7.0×10^{-7}		0.26	
	Inhalation of Volatiles	--		27	
	Total	1.3×10^{-4}		36	
Radionuclides	Ingestion	9.8×10^{-5}		--	
	Inhalation of Volatiles	4.3×10^{-5}			
	Total	1.4×10^{-4}			
Total Cumulative		2.7×10^{-4}			

7.1.1.7 WMA C Tank Farm Exposure Area

The total cumulative ELCR for the WMA C exposure area is 4.6×10^{-4}. The total ELCR for nonradiological analytes is 1.3×10^{-4} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 3.3×10^{-4} which is greater than the EPA upper risk threshold of 1×10^{-4}. Table 7-32 provides a summary of the cancer risks and noncancer hazards by exposure route for the WMA C Tank Farm Exposure Area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are iodine-129 (ELCR = 1.3×10^{-5}; 2.8 percent contribution), technetium-99 (ELCR = 3.1×10^{-4}; 68 percent contribution), and tritium (ELCR = 5.9×10^{-6}; 1.3 percent contribution. Contribution to ELCR is elevated for arsenic (1.3×10^{-4}; 27 percent contribution) where measured concentrations (6.3 µg/L) are within natural background values.

The HI for the WMA C Tank Farm Exposure Area is 10, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributor to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) is cyanide (HQ of 4.4; 43 percent contribution). All remaining individual analytes (arsenic, cadmium, cobalt, nitrate, and vanadium) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for antimony (HQ of 3.6; 36 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-32. Summary of Cancer Risks and Noncancer Hazards for the WMA C Tank Farm Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.3×10^{-4}	Arsenic (ELCR = 1.3×10^{-4}; 27%) I-129 (ELCR = 1.3×10^{-5}; 2.8%) Tc-99 (ELCR = 3.1×10^{-4}; 68%) Tritium (ELCR = 5.9×10^{-6}; 1.3%)	5.8	Antimony (HQ = 3.6; 36%) Arsenic (HQ = 0.66; 6.5%) Cadmium (HQ = 0.27; 2.6%) Cobalt (HQ = 0.40; 3.9%) Cyanide (HQ = 4.4; 43%) Nitrate (HQ = 0.19; 1.9%) Vanadium (HQ = 0.13; 1.2%)
	Dermal Contact	1.0×10^{-6}		0.23	
	Inhalation of Volatiles	2.0×10^{-6}		4.1	
	Total	1.3×10^{-4}		10	
Radionuclides	Ingestion	3.3×10^{-4}		--	
	Inhalation of Volatiles	4.9×10^{-6}			
	Total	3.3×10^{-4}			
Total Cumulative		4.6×10^{-4}			

7.1.1.8 WMA C Tank Farm - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for six wells within the WMA C tank farm exposure area (299-E27-7, 299-E27-14, 299-E27-15, 299-E27-23, 299-E27-24, and 299-E27-155), the calculated risks and noncancer hazards are presented in Table 7-33 through Table 7-38, respectively.

The total cumulative ELCR for the individual wells within the WMA C Tank Farm Exposure Area ranged between 1.1×10^{-3} and 1.2×10^{-4}. The total ELCR for nonradiological analytes ranged between 3.2×10^{-4} and 9.1×10^{-5} which are greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes ranged between 9.3×10^{-4} and 2.6×10^{-5} which are greater than the upper risk threshold of 1×10^{-4} for wells 299-E27-14, 299-E27-23, 299-E27-24, and 299-E27-155 and is within the EPA acceptable risk range of 1×10^{-4} to 1×10^{-6} for wells 299-E27-7 and 299-E27-15.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are iodine-129, technetium-99 at all six wells , and tritium at wells 299-E27-7, 299-E27-15, 299-E27-24, and 299-E27-155. Contribution to ELCR is elevated for arsenic (3.2×10^{-4} to 9.1×10^{-5}) where measured concentrations (4.7 µg/L to 16 µg/L) are within natural background values.

The HI for the individual wells within the WMA C Tank Farm Exposure Area ranged from 5.9 to 15, which are greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributor to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) is cyanide (HQ ranges between 3.3 and 14). The remaining individual analytes (arsenic, cadmium, copper, Cr(VI), fluoride, nitrate, selenium, uranium, and vanadium) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for arsenic at wells 299-E27-14 and 299-E27-15 (1.6 and 1.2, respectively) where measured concentrations (16 µg/L and 12 µg/L, respectively) are within natural background values. Contribution to HI is elevated for antimony at wells 299-E27-15 and 299-E27-23, (HQ of 4.8 and 3.0, respectively) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-33. Summary of Cancer Risks and Noncancer Hazards for Well 299-E27-7 (Within the WMA C Tank Farm Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	9.4×10^{-5}	Arsenic (ELCR = 9.5×10^{-5}, 78%) I-129 (ELCR = 1.7×10^{-5}, 14%) Tc-99 (ELCR = 4.3×10^{-6}, 3.5%) Tritium (ELCR = 4.6×10^{-6}, 3.8%)	2.1	Arsenic (HQ = 0.49, 3.3%) Cyanide (HQ = 14, 92%) Nitrate (HQ = 0.16, 1.1%)
	Dermal Contact	5.3×10^{-7}		0.07	
	Inhalation of Volatiles	--		13	
	Total	9.5×10^{-5}		15	
Radionuclides	Ingestion	2.2×10^{-5}		--	
	Inhalation of Volatiles	3.8×10^{-6}			

Table 7-33. Summary of Cancer Risks and Noncancer Hazards for Well 299-E27-7
(Within the WMA C Tank Farm Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Total	2.6×10^{-5}			
Total Cumulative		1.2×10^{-4}			

Table 7-34. Summary of Cancer Risks and Noncancer Hazards for Well 299-E27-14
(Within the WMA C Tank Farm Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	3.1×10^{-4}	Arsenic (ELCR = 3.2×10^{-4}; 51%) I-129 (ELCR = 1.3×10^{-5}; 2.1%) Tc-99 (ELCR = 2.8×10^{-4}; 46%)	4.0	Arsenic (HQ = 1.6; 13%) Copper (HQ = 0.74; 5.7%) Cyanide (HQ = 9.6; 74%) Nitrate (HQ = 0.39; 3.0%)
	Dermal Contact	1.8×10^{-6}		0.083	
	Inhalation of Volatiles	--		8.9	
	Total	3.2×10^{-4}		13	
Radionuclides	Ingestion	3.0×10^{-4}		--	
	Inhalation of Volatiles	4.3×10^{-6}			
	Total	3.0×10^{-4}			
Total Cumulative		6.2×10^{-4}			

Table 7-35. Summary of Cancer Risks and Noncancer Hazards for Well 299-E27-15
(Within the WMA C Tank Farm Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	2.3×10^{-4}	Arsenic (ELCR = 2.3×10^{-4}, 89%) I-129 (ELCR = 1.6×10^{-5}, 6.3%) Tc-99 (ELCR = 4.2×10^{-6}, 1.7%) Tritium (ELCR = 6.6×10^{-6}, 2.6%)	6.5	Antimony (HQ = 4.8, 71%) Arsenic (HQ = 1.2, 17%) Fluoride (HQ = 0.08, 1.1%) Cr(VI) (HQ = 0.21, 3.1%) Nitrate (HQ = 0.08, 1.2%) Selenium (HQ = 0.10, 1.5%)
	Dermal Contact	1.3×10^{-6}		0.29	
	Inhalation of Volatiles	4.7×10^{-7}		<0.01	

Table 7-35. Summary of Cancer Risks and Noncancer Hazards for Well 299-E27-15 (Within the WMA C Tank Farm Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
					Uranium (HQ = 0.12, 1.7%) Vanadium (HQ = 0.13, 1.9%)
	Total	2.3×10^{-4}		6.8	
Radionuclides	Ingestion	2.1×10^{-5}		--	
	Inhalation of Volatiles	5.4×10^{-6}			
	Total	2.7×10^{-5}			
Total Cumulative		2.5×10^{-4}			

Table 7-36. Summary of Cancer Risks and Noncancer Hazards for Well 299-E27-23 (Within the WMA C Tank Farm Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.5×10^{-4}	Arsenic (ELCR = 1.5×10^{-4}; 14%) I-129 (ELCR = 1.5×10^{-5}; 1.3%) Tc-99 (ELCR = 9.1×10^{-4}; 84%)	4.8	Antimony (HQ = 3.0; 37%) Arsenic (HQ = 0.77; 9.5%) Cadmium (HQ = 0.27; 3.3%) Cyanide (HQ = 3.3; 41%) Cr(VI) (HQ = 0.11; 1.4%) Nitrate (HQ = 0.17; 2.1%) Vanadium (HQ = 0.15; 1.8%)
	Dermal Contact	8.3×10^{-7}		0.22	
	Inhalation of Volatiles	6.1×10^{-7}		3.1	
	Total	1.5×10^{-4}		8.1	
Radionuclides	Ingestion	9.3×10^{-4}		--	
	Inhalation of Volatiles	6.2×10^{-6}			
	Total	9.3×10^{-4}			
Total Cumulative		1.1×10^{-3}			

Table 7-37. Summary of Cancer Risks and Noncancer Hazards for Well 299-E27-24 (Within the WMA C Tank Farm Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	9.0×10^{-5}	Arsenic (ELCR = 9.1×10^{-5}; 26%) I-129 (ELCR = 1.4×10^{-5}; 4.1%) Tc-99 (ELCR = 2.3×10^{-4}; 67%) Tritium (ELCR = 7.1×10^{-6}; 2.1%)	1.9	Arsenic (HQ = 0.47; 4.8%) Cyanide (HQ = 8.4; 86%) Cr(VI) (HQ = 0.12; 1.2%) Nitrate (HQ = 0.30; 3.1%) Vanadium (HQ = 0.11; 1.1%)
	Dermal Contact	5.1×10^{-7}		0.071	
	Inhalation of Volatiles	5.3×10^{-7}		7.7	
	Total	9.1×10^{-5}		9.7	
Radionuclides	Ingestion	2.5×10^{-4}		--	
	Inhalation of Volatiles	5.9×10^{-6}			
	Total	2.5×10^{-4}			
Total Cumulative		3.4×10^{-4}			

Table 7-38. Summary of Cancer Risks and Noncancer Hazards for Well 299-E27-155 (Within the WMA C Tank Farm Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	9.5×10^{-5}	Arsenic (ELCR = 9.5×10^{-5}, 17%) I-129 (ELCR = 1.2×10^{-5}, 2.3%) Tc-99 (ELCR = 4.3×10^{-4}, 78%) Tritium (ELCR = 8.7×10^{-6}, 1.6%)	1.6	Arsenic (HQ = 0.49, 8.4%) Cyanide (HQ = 4.5, 76%) Fluoride (HQ = 0.07, 1.2%) Cr(VI) (HQ = 0.11, 1.8%) Nitrate (HQ = 0.22, 3.7%) Selenium (HQ = 0.08, 1.4%) Vanadium (HQ = 0.13, 2.2%)
	Dermal Contact	8.4×10^{-7}		0.08	
	Inhalation of Volatiles	2.2×10^{-6}		4.2	
	Total	9.8×10^{-5}		5.9	
Radionuclides	Ingestion	4.4×10^{-4}		--	
	Inhalation of Volatiles	7.2×10^{-6}			
	Total	4.5×10^{-4}			

Table 7-38. Summary of Cancer Risks and Noncancer Hazards for Well 299-E27-155 (Within the WMA C Tank Farm Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Total Cumulative		5.5×10^{-4}			

7.1.1.9 B Plant Exposure Area

The total cumulative ELCR for the B Plant exposure area is 2.3×10^{-3}. The total ELCR for nonradiological analytes is 8.8×10^{-5} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 2.2×10^{-3} which is greater than the EPA upper risk threshold of 1×10^{-4}. Table 7-39 provides a summary of the cancer risks and noncancer hazards by exposure route for the B Plant exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are cesium-137 (ELCR = 8.1×10^{-4}; 35 percent contribution), plutonium-239/240 (ELCR = 7.8×10^{-5}; 3.4 percent contribution), strontium-90 (ELCR = 1.2×10^{-3}; 52 percent contribution), technetium-99 (ELCR = 7.4×10^{-5}; 3.2 percent contribution),and tritium (ELCR = 2.9×10^{-5}; 1.2 percent contribution). Contribution to ELCR is elevated for arsenic (8.8×10^{-5}; 3.8 percent contribution) where measured concentrations (4.5 µg/L) are within natural background values.

The HI for the B Plant exposure area is 13, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributor to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) is cyanide (HQ of 4.5; 35 percent contribution). All remaining individual analytes (arsenic, cadmium, fluoride, nitrate, and uranium) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for antimony (HQ of 5.9; 46 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-39. Summary of Cancer Risks and Noncancer Hazards for the B Plant Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	8.7×10^{-5}	Arsenic (ELCR = 8.8×10^{-5}; 3.8%) Cs-137 (ELCR = 8.1×10^{-4}; 35%) Pu-239/240 (ELCR = 7.8×10^{-5}; 3.4%) Sr-90 (ELCR = 1.2×10^{-3}; 52%) Tc-99 (ELCR = 7.4×10^{-5}; 3.2%) Tritium (ELCR = 2.9×10^{-5}; 1.2%)	8.2	Antimony (HQ = 5.9; 46%) Arsenic (HQ = 0.46; 3.6%) Cadmium (HQ = 0.34; 2.7%) Cyanide (HQ = 4.5; 35%) Fluoride (HQ = 0.45; 3.5%) Nitrate (HQ = 0.37; 2.9%) Uranium (HQ = 0.23; 1.8%)
	Dermal Contact	4.9×10^{-7}		0.33	
	Inhalation of Volatiles	--		4.1	
	Total	8.8×10^{-5}		13	
Radionuclides	Ingestion	2.2×10^{-3}		--	
	Inhalation of Volatiles	2.4×10^{-5}			

Table 7-39. Summary of Cancer Risks and Noncancer Hazards for the B Plant Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Total	2.2×10^{-3}			
Total Cumulative		2.3×10^{-3}			

7.1.1.10 B Plant - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for five wells within the B Plant exposure area (299-E28-23, 299-E28-24, 299-E28-25, 299-E28-30, and 299-E29-54), the calculated risks and noncancer hazards are presented in Table 7-40 through Table 7-44. Well-specific results for well 299-E24-25 are presented under the Semiworks exposure area.

The total cumulative ELCR for the individual wells within the B Plant exposure area ranged between 6.9×10^{-3} and 8.9×10^{-5}. The total ELCR for nonradiological analytes ranged between 7.5×10^{-5} and 2.3×10^{-5} which are greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes ranged between 6.9×10^{-3} and 2.2×10^{-5}. The total ELCR at wells 299-E28-23, 299-E28-24, and 299-E28-25 is greater than the upper risk threshold of 1×10^{-4} and is within the EPA acceptable risk range of 1×10^{-4} to 1×10^{-6} at wells 299-E28-30 and 299-E29-54.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) include:

- Cesium-137, plutonium-239/240, and strontium-90 at well 299-E28-23
- Cesium-137, strontium-90, technetium-99, tritium, and uranium-233/234 at well 299-E28-24
- Strontium-90 and tritium at well 299-E28-25
- Technetium-99 and tritium at well 299-E28-30
- Iodine-129, technetium-99, and tritium at well 299-E29-54.

Contribution to ELCR is elevated for arsenic (2.3×10^{-5} to 6.7×10^{-5}) at wells 299-E28-24, 299-E28-25, 299-E28-30, and 299-E29-54 where measured concentrations (1.2 µg/L to 3.9 µg/L) are within natural background values.

The HI for the individual wells within the B Plant exposure area ranged from 1.0 to 12, which are equal to or greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributor to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) is cyanide (HQ ranges between 3.2 and 5.9) at wells 299-E28-30 and 299-E29-54 and fluoride (HQ = 1.6) and nitrate (HQ = 1.8) at well 299-E28-24. The remaining individual analytes (arsenic, fluoride, nitrate, uranium, and vanadium) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for antimony at wells 299-E28-25 and 299-E28-30, (HQ of 3.4 and 4.9, respectively) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-40. Summary of Cancer Risks and Noncancer Hazards for Well 299-E28-23 (Within the B Plant Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	5.5×10^{-5}	Cs-137 (ELCR = 1.4×10^{-3}; 20%) Pu-239/240 (ELCR = 1.3×10^{-4}; 1.9%) Sr-90 (ELCR = 5.2×10^{-3}; 76%)	1.0	--
	Dermal Contact	3.0×10^{-7}		0.006	
	Inhalation of Volatiles	--		--	
	Total	5.5×10^{-5}		1.0	
Radionuclides	Ingestion	6.8×10^{-3}		--	
	Inhalation of Volatiles	3.0×10^{-5}			
	Total	6.9×10^{-3}			
Total Cumulative		6.9×10^{-3}			

Table 7-41. Summary of Cancer Risks and Noncancer Hazards for Well 299-E28-24 (Within the B Plant Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	2.3×10^{-5}	Arsenic (ELCR = 2.3×10^{-5}, 2.0%) Cs-137 (ELCR = 5.2×10^{-5}, 4.4%) Sr-90 (ELCR = 7.3×10^{-4}, 62%) Tc-99 (ELCR = 3.0×10^{-4}, 25%) Tritium (ELCR = 4.2×10^{-5}, 3.5%))	3.8	Arsenic (HQ = 0.12, 3.2%) Fluoride (HQ = 1.6, 43%) Nitrate (HQ = 1.8, 47%) Uranium (HQ = 0.26, 6.7%)
	Dermal Contact	1.3×10^{-7}		0.02	
	Inhalation of Volatiles	--		0.00	
	Total	2.3×10^{-5}		3.8	
Radionuclides	Ingestion	1.1×10^{-3}		--	
	Inhalation of Volatiles	3.4×10^{-5}			
	Total	1.2×10^{-3}			
Total Cumulative		1.2×10^{-3}			

Table 7-42. Summary of Cancer Risks and Noncancer Hazards for Well 299-E28-25 (Within the B Plant Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	7.4×10^{-5}	Arsenic (ELCR = 7.5×10^{-5}, 2.9%) Sr-90 (ELCR = 2.4×10^{-3}, 93%) Tritium (ELCR = 3.5×10^{-5}, 1.4%)	4.6	Antimony (HQ = 3.4, 72%) Arsenic (HQ = 0.39, 8.1%) Fluoride (HQ = 0.20, 4.3%) Nitrate (HQ = 0.31, 6.4%) Uranium (HQ = 0.29, 6.0%) Vanadium (HQ = 0.07, 1.5%)
	Dermal Contact	4.1×10^{-7}		0.15	
	Inhalation of Volatiles	--		0.00	
	Total	7.5×10^{-5}		4.8	
Radionuclides	Ingestion	2.4×10^{-3}		--	
	Inhalation of Volatiles	2.9×10^{-5}			
	Total	2.5×10^{-3}			
Total Cumulative		2.5×10^{-3}			

Table 7-43. Summary of Cancer Risks and Noncancer Hazards for Well 299-E28-30 (Within the B Plant Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	6.7×10^{-5}	Arsenic (ELCR = 6.7×10^{-5}; 76%) Tc-99 (ELCR = 4.0×10^{-6}; 4.5%) Tritium (ELCR = 1.8×10^{-5}; 20%)	6.3	Antimony (HQ = 4.9; 41%) Arsenic (HQ = 0.35; 2.9%) Cyanide (HQ = 5.9; 49%) Fluoride (HQ = 0.21; 1.8%) Nitrate (HQ = 0.26; 2.2%)
	Dermal Contact	3.7×10^{-7}		0.21	
	Inhalation of Volatiles	--		5.4	
	Total	6.7×10^{-5}		12	
Radionuclides	Ingestion	7.2×10^{-6}		--	
	Inhalation of Volatiles	1.4×10^{-5}			

Table 7-43. Summary of Cancer Risks and Noncancer Hazards for Well 299-E28-30 (Within the B Plant Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Total	2.2×10^{-5}			
Total Cumulative		8.9×10^{-5}			

Table 7-44. Summary of Cancer Risks and Noncancer Hazards for Well 299-E29-54 (Within the B Plant Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	6.7×10^{-5}	Arsenic (ELCR = 6.7×10^{-5}; 70%) I-129 (ELCR = 1.1×10^{-6}; 1.1%) Tc-99 (ELCR = 2.9×10^{-6}; 3.0%) Tritium (ELCR = 2.4×10^{-5}; 25%)	2.0	Arsenic (HQ = 0.35; 7.0%) Cyanide (HQ = 3.2; 65%) Fluoride (HQ = 0.16; 3.3%) Nitrate (HQ = 0.54; 11%) Uranium (HQ = 0.48; 9.6%) Vanadium (HQ = 0.096; 1.9%)
	Dermal Contact	3.7×10^{-7}		0.030	
	Inhalation of Volatiles	--		3.0	
	Total	6.7×10^{-5}		5.0	
Radionuclides	Ingestion	9.5×10^{-6}		--	
	Inhalation of Volatiles	2.0×10^{-5}			
	Total	2.9×10^{-5}			
Total Cumulative		9.7×10^{-5}			

7.1.1.11 Semiworks Exposure Area

The total cumulative ELCR for the Semiworks exposure area is 1.3×10^{-4}. The total ELCR for nonradiological analytes is 7.7×10^{-5} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 5.3×10^{-5} which is within the EPA acceptable risk range of 1×10^{-4} to 1×10^{-6}. Table 7-45 provides a summary of the cancer risks and noncancer hazards by exposure route for the Semiworks exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are iodine-129 (ELCR = 5.2×10^{-6}; 4.0 percent contribution), strontium-90 (ELCR = 3.0×10^{-6}; 2.3 percent contribution), technetium-99 (ELCR = 3.3×10^{-6}; 2.5 percent contribution), and tritium (ELCR = 4.1×10^{-5}; 32 percent contribution). Contribution to ELCR is

elevated for arsenic (7.7×10^{-5}; 59 percent contribution) where measured concentrations (4.0 µg/L) are within natural background values.

The HI for the Semiworks exposure area is 1.0, which is equal to the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes report a HQ less than 1.

Table 7-45. Summary of Cancer Risks and Noncancer Hazards for the Semiworks Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	7.7×10^{-5}	Arsenic (ELCR = 7.7×10^{-5}; 59%) I-129 (ELCR = 5.2×10^{-6}; 4.0%) Sr-90 (ELCR = 3.0×10^{-6}; 2.3%) Tc-99 (ELCR = 3.3×10^{-6}; 2.5%) Tritium (ELCR = 4.1×10^{-5}; 32%)	0.99	--
	Dermal Contact	4.3×10^{-7}		0.049	
	Inhalation of Volatiles	--		--	
	Total	7.7×10^{-5}		1.0	
Radionuclides	Ingestion	1.9×10^{-5}		--	
	Inhalation of Volatiles	3.4×10^{-5}			
	Total	5.3×10^{-5}			
Total Cumulative		1.3×10^{-4}			

7.1.1.12 Semiworks - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for one well within the Semiworks exposure area (299-E24-25), the calculated risks and noncancer hazards are presented in Table 7-46.

The total cumulative ELCR for the individual well within the Semiworks exposure area is 1.2×10^{-4}. The total ELCR for nonradiological analytes is 7.7×10^{-5} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 3.9×10^{-5} which is within the EPA acceptable risk range of 1×10^{-4} to 1×10^{-6}.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are iodine-129 (ELCR = 5.2×10^{-6}; 4.4 percent contribution), strontium-90 (ELCR = 3.0×10^{-6}; 2.6 percent contribution), technetium-99 (ELCR = 3.3×10^{-6}; 2.8 percent contribution), tritium (ELCR = 2.8×10^{-5}; 24 percent contribution). Contribution to ELCR is elevated for arsenic (7.7×10^{-5}; 66 percent contribution) where measured concentrations (4.0 µg/L) are within natural background values.

The HI for the individual well within the Semiworks exposure area is 1.0, which is equal to the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes report a HQ less than 1.

Table 7-46. Summary of Cancer Risks and Noncancer Hazards for Well 299-E24-25 (Within the Semiworks Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	7.7×10^{-5}	Arsenic (ELCR = 7.7×10^{-5}; 66%) I-129 (ELCR = 5.2×10^{-6}; 4.4%) Sr-90 (ELCR = 3.0×10^{-6}; 2.6%) Tc-99 (ELCR = 3.3×10^{-6}; 2.8%) Tritium (ELCR = 2.8×10^{-5}; 24%)	0.99	--
	Dermal Contact	4.3×10^{-7}		0.049	
	Inhalation of Volatiles	--		--	
	Total	7.7×10^{-5}		1.0	
Radionuclides	Ingestion	1.7×10^{-5}		--	
	Inhalation of Volatiles	2.3×10^{-5}			
	Total	3.9×10^{-5}			
Total Cumulative		1.2×10^{-4}			

7.1.1.13 LERF Exposure Area

The total cumulative ELCR for the LERF exposure area is 9.5×10^{-5}. The total ELCR for nonradiological analytes is 9.1×10^{-5} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 4.4×10^{-6} which is within the EPA acceptable risk range of 1×10^{-4} to 1×10^{-6}. Table 7-47 provides a summary of the cancer risks and noncancer hazards by exposure route for the LERF exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are carbon tetrachloride (ELCR = 5.1×10^{-6}; 5.3 percent contribution) and tritium (ELCR = 3.5×10^{-6}; 3.6 percent contribution). Contribution to ELCR is elevated for arsenic (8.6×10^{-5}; 90 percent contribution) where measured concentrations (4.4 µg/L) are within natural background values.

The HI for the LERF exposure area is 1.2, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes (antimony, arsenic, carbon tetrachloride, fluoride, Cr(VI), manganese, nickel, nitrate, nitrite, silver, strontium, and vanadium) that contribute greater than one percent of the HI also report a HQ less than 1.

Table 7-47. Summary of Cancer Risks and Noncancer Hazards for the LERF Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	8.8×10^{-5}	Arsenic (ELCR = 8.6×10^{-5}; 90%) CTET (ELCR = 5.1×10^{-6}; 5.3%) Tritium (ELCR = 3.5×10^{-6}; 3.6%)	1.1	Antimony (HQ = 0.025; 2.1%) Arsenic (HQ = 0.45; 37%) CTET (HQ = 0.033; 2.8%) Fluoride (HQ = 0.13; 10%) Cr(VI) (HQ = 0.097; 8.1%) Manganese (HQ = 0.014; 1.2%) Nickel (HQ = 0.017; 1.4%) Nitrate (HQ = 0.18; 15%) Nitrite (HQ = 0.032; 2.7%) Silver (HQ = 0.049; 4.1%) Strontium (HQ = 0.029; 2.4%) Vanadium (HQ = 0.13; 11%)
	Dermal Contact	1.0×10^{-6}		0.074	
	Inhalation of Volatiles	2.5×10^{-6}		0.011	
	Total	9.1×10^{-5}		1.2	
Radionuclides	Ingestion	1.5×10^{-6}		--	
	Inhalation of Volatiles	2.9×10^{-6}			
	Total	4.4×10^{-6}			
Total Cumulative		9.5×10^{-5}			

7.1.1.14 LERF - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for one well within the LERF exposure area (299-E26-10), the calculated risks and noncancer hazards are presented in Table 7-48.

The total cumulative ELCR for the individual well within the LERF exposure area is 8.5×10^{-5}. The total ELCR for nonradiological analytes is 8.4×10^{-5} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 7.0×10^{-7} which is less than the lower EPA acceptable risk threshold of 1×10^{-6}.

Contribution to ELCR is elevated for arsenic (8.4×10^{-5}; 99 percent contribution) where measured concentrations (4.4 µg/L) are within natural background values.

The HI for the individual well within the LERF exposure area is 1.0, which is equal to the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes report a HQ less than 1.

Table 7-48. Summary of Cancer Risks and Noncancer Hazards for Well 299-E26-10 (Within the LERF Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	8.4×10^{-5}	Arsenic (ELCR = 8.4×10^{-5}; 99%)	0.98	--
	Dermal Contact	4.7×10^{-7}		0.031	
	Inhalation of Volatiles	--		--	
	Total	8.4×10^{-5}		1.0	
Radionuclides	Ingestion	7.0×10^{-7}			
	Inhalation of Volatiles	--			
	Total	7.0×10^{-7}			
Total Cumulative		8.5×10^{-5}			

7.1.1.15 Gable Mountain Pond Exposure Area

The total cumulative ELCR for the Gable Mountain Pond exposure area is 3.4×10^{-4}. The total ELCR for nonradiological analytes is 9.0×10^{-5} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 2.5×10^{-4} which is greater than the upper risk threshold of 1×10^{-4}. Table 7-49 provides a summary of the cancer risks and noncancer hazards by exposure route for the Gable Mountain Pond exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are strontium-90 (ELCR = 2.3×10^{-4}; 68 percent contribution) and tritium (ELCR = 1.8×10^{-5}; 5.2 percent contribution). Contribution to ELCR is elevated for arsenic (9.0×10^{-5}; 27 percent contribution) where measured concentrations (4.7 µg/L) are within natural background values.

The HI for the Gable Mountain Pond exposure area is 7.0, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes (arsenic, Cr(VI), iron, manganese, and nitrate) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for antimony (HQ of 5.6; 79 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-49. Summary of Cancer Risks and Noncancer Hazards for the Gable Mountain Pond Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	9.0×10^{-5}	Arsenic (ELCR = 9.0×10^{-5}; 27%) Sr-90 (ELCR = 2.3×10^{-4}; 68%) Tritium (ELCR = 1.8×10^{-5}; 5.2%)	6.8	Antimony (HQ = 5.6; 79%) Arsenic (HQ = 0.47; 6.7%) Cr(VI) (HQ = 0.078; 1.1%); Iron (HQ = 0.13; 1.9%) Manganese (HQ = 0.13; 1.9%) Nitrate (HQ =0.40; 5.7%)
	Dermal Contact	5.0×10^{-7}		0.27	
	Inhalation of Volatiles	--		--	
	Total	9.0×10^{-5}		7.0	
Radionuclides	Ingestion	2.3×10^{-4}			
	Inhalation of Volatiles	1.4×10^{-5}			
	Total	2.5×10^{-4}			
Total Cumulative		3.4×10^{-4}			

7.1.1.16 Gable Mountain Pond - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for two wells within the Gable Mountain Pond exposure area (699-53-47A and 699-53-47B), the calculated risks and noncancer hazards are presented in Table 7-50 and Table 7-51, respectively.

The total cumulative ELCR for the individual wells within the Gable Mountain Pond exposure area ranged between 5.6×10^{-4} and 3.6×10^{-4}. An ELCR for nonradiological analytes was not reported for either well because nonradiological carcinogenic analytes were not detected. The total ELCR for radiological analytes ranged between 5.6×10^{-4} and 3.6×10^{-4} which is greater than the upper risk threshold of 1×10^{-4}.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are strontium-90 and tritium.

The HI for well 699-53-47B within the Gable Mountain Pond exposure area is 6.2, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The HI for well 699-53-47A is 0.50 which is less than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. Contribution to HI is elevated for antimony at well 699-53-47B, (HQ of 5.6; 90 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010. The remaining individual analytes (Cr(VI) and nitrate) that contribute greater than one percent of the HI also report a HQ less than 1.

Table 7-50. Summary of Cancer Risks and Noncancer Hazards for Well 699-53-47A (Within the Gable Mountain Pond Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	--	Sr-90 (ELCR = 5.6x 10^{-4}; 100%)	0.50	--
	Dermal Contact	--		0.0062	
	Inhalation of Volatiles	--		--	
	Total	--		0.50	
Radionuclides	Ingestion	5.6×10^{-4}		--	
	Inhalation of Volatiles	--			
	Total	5.6×10^{-4}			
Total Cumulative		5.6×10^{-4}			

Table 7-51. Summary of Cancer Risks and Noncancer Hazards for Well 699-53-47B (Within the Gable Mountain Pond Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	--	Sr-90 (ELCR = 3.4×10^{-4}; 95%) Tritium (ELCR = 1.8×10^{-5}; 4.9%)	6.0	Antimony (HQ = 5.6; 90%) Cr(VI) (HQ = 0.078; 1.3%) Nitrate (HQ = 0.35; 5.6%)
	Dermal Contact	--		0.25	
	Inhalation of Volatiles	--		--	
	Total	--		6.2	
Radionuclides	Ingestion	3.5×10^{-4}		--	
	Inhalation of Volatiles	1.4×10^{-5}			
	Total	3.6×10^{-4}			
Total Cumulative		3.6×10^{-4}			

7.1.1.17 200-BP-5 West Exposure Area

The total cumulative ELCR for the 200-BP-5 West exposure area is 3.5×10^{-4}. The total ELCR for nonradiological analytes is 1.3×10^{-4} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 2.2×10^{-4} which is greater than the upper risk threshold of 1×10^{-4}. Table 7-52 provides a summary of the cancer risks and noncancer hazards by exposure route for the 200-BP-5 West exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are carbon tetrachloride (ELCR = 5.6×10^{-6}; 1.6 percent contribution), strontium-90 (ELCR = 8.8×10^{-5}; 25 percent contribution), technetium-99 (ELCR = 9.0×10^{-5}; 26 percent contribution), and tritium (ELCR = 3.7×10^{-5}; 11 percent contribution). Contribution to ELCR is elevated for arsenic (1.2×10^{-4}; 34 percent contribution) where measured concentrations (6.1 µg/L) are within natural background values.

The HI for the 200-BP-5 West exposure area is 54, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributor to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) is cyanide (HQ of 46; 86 percent contribution). The remaining individual analyte (arsenic) that contributes greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for antimony (HQ of 4.6; 8.5 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-52. Summary of Cancer Risks and Noncancer Hazards for the 200-BP-5 West Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.2×10^{-4}	Arsenic (ELCR = 1.2×10^{-4}; 34%) CTET (ELCR = 5.6×10^{-6}; 1.6%) Sr-90 (ELCR = 8.8×10^{-5}; 25%) Tc-99 (ELCR = 9.0×10^{-5}; 26%) Tritium (ELCR = 3.7×10^{-5}; 11%)	11	Antimony (HQ = 4.6; 8.5%) Arsenic (HQ = 0.61; 1.1%) Cyanide (HQ =46; 86%)
	Dermal Contact	2.0×10^{-6}		0.32	
	Inhalation of Volatiles	5.4×10^{-6}		43	
	Total	1.3×10^{-4}		54	
Radionuclides	Ingestion	1.9×10^{-4}		--	
	Inhalation of Volatiles	3.0×10^{-5}			
	Total	2.2×10^{-4}			
Total Cumulative		3.5×10^{-4}			

7.1.1.18 200-BP-5 West - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for eight wells within the 200-BP-5 West exposure area (699-49-57A, 699-50-56, 699-50-59, 699-52-55, 699-53-55B, 699-53-55C, 699-54-45A, and 699-55-57), the calculated risks and noncancer hazards are presented in Table 7-53 through Table 7-60.

The total cumulative ELCR for the individual wells within the 200-BP-5 West exposure area ranged between 4.7×10^{-4} and 1.5×10^{-5}. The total ELCR for nonradiological analytes ranged from 1.1×10^{-4} to 1.5×10^{-5} at wells 699-49-57A, 699-50-56, 699-52-55, 699-54-45A, and 699-55-57, which are greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. An ELCR for nonradiological analytes was not reported for wells 699-50-59, 699-53-55B, and 699-53-55C because nonradiological carcinogenic analytes were not detected. The total ELCR for radiological analytes ranged between 3.6×10^{-4} and 9.3×10^{-6}. Radiological ELCRs are greater than the upper risk threshold of 1×10^{-4} at wells 699-49-57A, 699-50-56, 699-50-59, 699-53-55B, and 699-53-55C. Radiological ELCRs are within the EPA acceptable risk range of 1×10^{-4} to 1×10^{-6} at wells 699-52-55 and 699-55-57. An ELCR for radiological analytes was not reported for well 699-54-45A because radiological carcinogenic analytes were not detected.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) include:

- Iodine-139, technetium-99, and tritium at wells 699-49-57A and 699-50-59
- Strontium-90, technetium-99, and tritium at well 699-50-56
- Carbon tetrachloride, technetium-99, and tritium at well 699-52-55
- Cobalt-60, technetium-99 and tritium at well 699-53-55B and 699-53-55C
- Carbon tetrachloride and chloroform at well 699-54-45A
- Technetium-99 and tritium at well 699-55-57

Contribution to ELCR is elevated for arsenic at wells 699-49-57A, 699-50-56, 699-52-55, and 699-55-57 (1.0×10^{-4} to 1.5×10^{-4}, respectively) where measured concentrations (5.1 µg/L to 7.9 µg/L) are within natural background values.

The HI for the individual wells within the BP-5 West exposure area ranged from 3.1 to 117, which are greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributors to the noncancer HI (those analytes that contribute greater than 1 percent of total HI)) include:

- Cyanide and nitrate at well 699-49-57A
- Cobalt and cyanide at well 699-50-56
- Cyanide at wells 699-50-59, 699-53-55B, and 699-53-55C and 699-55-57
- Cadmium, cobalt, cyanide, manganese at well 699-52-55

The remaining individual analytes that contribute greater than one percent of the HI but report a HQ less than 1 (for at least one well) include arsenic, cadmium, carbon tetrachloride, fluoride, iron, lithium, manganese, nickel, nitrate, and zinc. Contribution to HI is elevated for antimony at wells 699-49-57A and

699-53-55C (HQ of 4.0 and 4.6) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-53. Summary of Cancer Risks and Noncancer Hazards for Well 699-49-57A (Within the 200-BP-5 West Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.0×10^{-4}	Arsenic (ELCR = 1.1×10^{-4}; 23%) I-129 (ELCR = 9.5×10^{-6}; 2.0%) Tc-99 (ELCR = 2.8×10^{-4}; 60%) Tritium (ELCR = 6.5×10^{-5}; 14%)	14	Antimony (HQ = 4.6; 4.3%) Cyanide (HQ = 99; 93%) Nitrate (HQ = 1.2; 1.1%)
	Dermal Contact	5.8×10^{-7}		0.31	
	Inhalation of Volatiles	--		91	
	Total	1.1×10^{-4}		106	
Radionuclides	Ingestion	3.1×10^{-4}		--	
	Inhalation of Volatiles	5.4×10^{-5}			
	Total	3.6×10^{-4}			
Total Cumulative		4.7×10^{-4}			

Table 7-54. Summary of Cancer Risks and Noncancer Hazards for Well 699-50-56 (Within the 200-BP-5 West Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.5×10^{-4}	Arsenic (ELCR = 1.5×10^{-4}, 37%) Strontium-90 (ELCR = 1.9×10^{-4}, 47%) Tc-99 (ELCR = 5.7×10^{-5}, 14%) Tritium (ELCR = 4.8×10^{-6}, 1.2%)	5.8	Arsenic (HQ = 0.79, 2.0%) Cobalt (HQ = 1.5, 3.9%) Cyanide (HQ = 35, 92%)
	Dermal Contact	1.6×10^{-6}		0.10	
	Inhalation of Volatiles	--		33	
	Total	1.5×10^{-4}		39	
Radionuclides	Ingestion	2.5×10^{-4}		--	
	Inhalation of Volatiles	3.9×10^{-6}			
	Total	2.6×10^{-4}			

Table 7-54. Summary of Cancer Risks and Noncancer Hazards for Well 699-50-56 (Within the 200-BP-5 West Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Total Cumulative		4.1×10^{-4}			

Table 7-55. Summary of Cancer Risks and Noncancer Hazards for Well 699-50-59 (Within the 200-BP-5 West Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	--	I-129 (ELCR = 1.1×10^{-5}, 8.3%) Tc-99 (ELCR = 8.2×10^{-5}, 60%) Tritium (ELCR = 4.3×10^{-5}, 32%)	3.5	Cyanide (HQ = 34, 97%) Nitrate (HQ = 0.48, 1.4%)
	Dermal Contact	--		0.04	
	Inhalation of Volatiles	--		31	
	Total	--		35	
Radionuclides	Ingestion	1.0×10^{-4}		--	
	Inhalation of Volatiles	3.6×10^{-5}			
	Total	1.4×10^{-4}			
Total Cumulative		1.4×10^{-4}			

Table 7-56. Summary of Cancer Risks and Noncancer Hazards for Well 699-52-55 (Within the 200-BP-5 West Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.0×10^{-4}	Arsenic (ELCR = 1.0×10^{-4}, 87%) CTET (ELCR = 4.4×10^{-6}, 3.9%) Tc-99 (ELCR = 6.8×10^{-6}, 5.9%) Tritium (ELCR = 1.6×10^{-6}, 1.4%)	10	Arsenic (HQ = 0.52, 2.4%) Cadmium (HQ = 2.3, 11%) Cobalt (HQ = 3.4, 16%) Cyanide (HQ = 11, 53%) Fluoride (HQ = 0.34, 1.6%) Iron (HQ = 0.68, 3.2%) Manganese (HQ = 1.7, 7.9%) Zinc (HQ = 0.27, 1.2%)
	Dermal Contact	1.7×10^{-6}		0.56	
	Inhalation of Volatiles	2.1×10^{-6}		11	
	Total	1.1×10^{-4}		22	

Table 7-56. Summary of Cancer Risks and Noncancer Hazards for Well 699-52-55
(Within the 200-BP-5 West Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Radionuclides	Ingestion	7.9×10^{-6}		--	
	Inhalation of Volatiles	1.4×10^{-6}			
	Total	9.3×10^{-6}			
Total Cumulative		1.1×10^{-4}			

Table 7-57. Summary of Cancer Risks and Noncancer Hazards for Well 699-53-55B
(Within the 200-BP-5 West Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	--	Cobalt-60 (ELCR = 2.0×10^{-6}, 1.4%) Tc-99 (ELCR = 1.4×10^{-4}, 96%) Tritium (ELCR = 4.1×10^{-6}, 2.9%)	9.6	Cyanide (HQ = 110, 99%)
	Dermal Contact	--		0.09	
	Inhalation of Volatiles	--		102	
	Total	--		111	
Radionuclides	Ingestion	1.4×10^{-4}		--	
	Inhalation of Volatiles	3.4×10^{-6}			
	Total	1.5×10^{-4}			
Total Cumulative		1.5×10^{-4}			

Table 7-58. Summary of Cancer Risks and Noncancer Hazards for Well 699-53-55C
(Within the 200-BP-5 West Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonr adio nucli des	Ingestion	--	Co-60 (ELCR = 3.0×10^{-6}; 1.8%) Tc-99 (ELCR = 1.6×10^{-4}; 96%)	14	Antimony (HQ = 4.0; 3.5%) Cyanide (HQ = 112; 96%)

Table 7-58. Summary of Cancer Risks and Noncancer Hazards for Well 699-53-55C (Within the 200-BP-5 West Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Dermal Contact	--	Tritium (ELCR = 3.4×10^{-6}; 2.0%)	0.26	
	Inhalation of Volatiles	--		103	
	Total	--		117	
Radionuclides	Ingestion	1.7×10^{-4}		--	
	Inhalation of Volatiles	2.8×10^{-6}			
	Total	1.7×10^{-4}			
Total Cumulative		1.7×10^{-4}			

Table 7-59. Summary of Cancer Risks and Noncancer Hazards for Well 699-54-45A (Within the 200-BP-5 West Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	5.1×10^{-6}	CTET (ELCR = 1.2×10^{-5}, 80%) Chloroform (ELCR = 3.0×10^{-6}, 20%)	3.0	Cadmium (HQ = 0.04, 1.2%) CTET (HQ = 0.08, 2.5%) Cobalt (HQ = 0.92, 29%) Fluoride (HQ = 0.09, 2.8%) Iron (HQ = 0.81, 26%) Lithium (HQ = 0.20, 6.3%) Manganese (HQ = 0.31, 9.8%) Zinc (HQ = 0.55, 18%)
	Dermal Contact	1.3×10^{-6}		0.07	
	Inhalation of Volatiles	8.5×10^{-6}		0.03	
	Total	1.5×10^{-5}		3.1	
Radionuclides	Ingestion	--		--	
	Inhalation of Volatiles	--			
	Total	--			

Table 7-59. Summary of Cancer Risks and Noncancer Hazards for Well 699-54-45A (Within the 200-BP-5 West Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Total Cumulative		1.5×10^{-5}			

Table 7-60. Summary of Cancer Risks and Noncancer Hazards for Well 699-55-57 (Within the 200-BP-5 West Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.1×10^{-4}	Arsenic (ELCR = 1.1×10^{-4}, 54%) Tc-99 (ELCR = 8.5×10^{-5}, 41%) Tritium (ELCR = 1.0×10^{-5}, 5.0%)	5.0	Arsenic (HQ = 0.59, 1.4%) Cyanide (HQ = 42, 96%)
	Dermal Contact	6.3×10^{-7}		0.10	
	Inhalation of Volatiles	--		39	
	Total	1.1×10^{-4}		44	
Radionuclides	Ingestion	8.7×10^{-5}		--	
	Inhalation of Volatiles	8.6×10^{-6}			
	Total	9.5×10^{-5}			
Total Cumulative		2.1×10^{-4}			

7.1.1.19 200-BP-5 Far Field (North of Gable Gap) Exposure Area

The total cumulative ELCR for the 200-BP-5 Far Field exposure area is 3.3×10^{-4}. The total ELCR for nonradiological analytes is 2.5×10^{-4} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 8.0×10^{-5} which is within the EPA risk range of 1×10^{-4} to 1×10^{-6}. Table 7-61 provides a summary of the cancer risks and noncancer hazards by exposure route for the 200-BP-5 Far Field exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are technetium-99 (ELCR = 7.9×10^{-6}; 2.4 percent contribution) and tritium (ELCR = 7.0×10^{-5}; 22 percent contribution). Contribution to ELCR is elevated for arsenic (2.5×10^{-4}; 75 percent contribution) where measured concentrations (13 µg/L) are within natural background values.

The HI for the 200-BP-5 Far Field exposure area is 2.5, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1.

All individual analytes (fluoride, Cr(VI), lithium, molybdenum, nitrate, and vanadium) that contributes greater than one percent of the HI also report an HQ less than 1. Contribution to HI is elevated for arsenic (HQ of 1.3; 51 percent contribution) where measured concentrations (13 µg/L) are within natural background values.

Table 7-61. Summary of Cancer Risks and Noncancer Hazards for the 200-BP-5 Far Field (North of Gable Gap) Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	2.4×10^{-4}	Arsenic (ELCR = 2.5×10^{-4}; 75%) Tc-99 (ELCR = 7.9×10^{-6}; 2.4%) Tritium (ELCR = 7.0×10^{-5}; 22%)	2.4	Arsenic (HQ = 1.3; 51%) Copper (HQ = 0.089; 3.6%) Fluoride (HQ = 0.30; 12%) Cr(VI) (HQ = 0.17; 6.8%) Iron (HQ = 0.057; 2.3%) Lithium (HQ = 0.14; 5.7%) Manganese (HQ = 0.058; 2.3%) Molybdenum (HQ = 0.032; 1.3%) Nitrate (HQ = 0.089; 3.6%) Uranium (HQ = 0.042; 1.7%) Vanadium (HQ = 0.14; 5.7%) Zinc (HQ = 0.037; 1.5%)
	Dermal Contact	1.4×10^{-6}		0.10	
	Inhalation of Volatiles	--		--	
	Total	2.5×10^{-4}		2.5	
Radionuclides	Ingestion	2.2×10^{-5}		--	
	Inhalation of Volatiles	5.8×10^{-5}			
	Total	8.0×10^{-5}			
Total Cumulative		3.3×10^{-4}			

7.1.1.20 200-BP-5 Far Field - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for four wells within the 200-BP-5 Far Field exposure area (699-62-43F, 699-64-62, 699-65-50, and 699-66-58), the calculated risks and noncancer hazards are presented in Table 7-62 through Table 7-65, respectively.

The total cumulative ELCR for the individual wells within the 200-BP-5 Far Field exposure area ranged between 3.1×10^{-4} and 7.9×10^{-5}. The total ELCR for nonradiological analytes ranges between 2.9×10^{-4} and 1.3×10^{-4} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. An ELCR for nonradiological analytes was not reported for well 699-64-62 because nonradiological carcinogenic analytes were not detected. The total ELCR for radiological analytes ranged between 7.9×10^{-5} and 2.5×10^{-5} which are within the EPA risk range of 1×10^{-4} to 1×10^{-6}.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are technetium-99 and tritium. Contribution to ELCR is elevated for arsenic at

wells 699-62-43F, 699-65-50, and 699-66-58 (2.9×10^{-4} to 1.3×10^{-4}) where measured concentrations (6.8 µg/L to 15 µg/L) are within natural background values.

The HIs for wells 699-62-43F, 699-65-50, and 699-68-58 within the 200-BP-5 Far Field exposure area range from 1.7 to 2.7, which are greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The HI for well 699-64-62 is 0.80 which is less than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. Individual analytes (fluoride, Cr(VI), lithium, molybdenum, nitrate, nitrite, vanadium, and zinc) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for arsenic at wells 699-62-43F and 699-65-50 (HQ = 1.5 and 1.1, respectively) where measured concentrations (15 µg/L and 11 µg/L, respectively) are within natural background values.

Table 7-62. Summary of Cancer Risks and Noncancer Hazards for Well 699-62-43F (Within the 200-BP-5 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	2.9×10^{-4}	Arsenic (ELCR = 2.9×10^{-4}; 92%) Tc-99 (ELCR = 6.3×10^{-6}; 2.0%) Tritium (ELCR = 1.7×10^{-5}; 5.6%)	2.5	Arsenic (HQ = 1.5; 56%) Fluoride (HQ = 0.38; 14%) Cr(VI) (HQ = 0.24; 9.0 %) Lithium (HQ = 0.18; 6.8%) Molybdenum (HQ = 0.034; 1.3%) Nitrate (HQ = 0.064; 2.4%) Vanadium (HQ = 0.20; 7.6%)
	Dermal Contact	1.6×10^{-6}		0.13	
	Inhalation of Volatiles	--		--	
	Total	2.9×10^{-4}		2.7	
Radionuclides	Ingestion	1.0×10^{-5}		--	
	Inhalation of Volatiles	1.4×10^{-5}			
	Total	2.5×10^{-5}			
Total Cumulative		3.1×10^{-4}			

Table 7-63. Summary of Cancer Risks and Noncancer Hazards for Well 699-64-62 (Within the 200-BP-5 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	--	Tc-99 (ELCR = 7.2×10^{-6}; 9.1%) Tritium (ELCR = 7.1×10^{-5};90%)	0.73	--
	Dermal Contact	--		0.072	
	Inhalation of Volatiles	--		--	

Table 7-63. Summary of Cancer Risks and Noncancer Hazards for Well 699-64-62 (Within the 200-BP-5 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Total	--		0.80	
Radionuclides	Ingestion	2.1×10^{-5}		--	
	Inhalation of Volatiles	5.9×10^{-5}			
	Total	7.9×10^{-5}			
Total Cumulative		7.9×10^{-5}			

Table 7-64. Summary of Cancer Risks and Noncancer Hazards for Well 699-65-50 (Within the 200-BP-5 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	2.0×10^{-4}	Arsenic (ELCR = 2.1×10^{-4}, 89%) Tc-99 (ELCR = 6.1×10^{-6}, 2.7%) Tritium (ELCR = 1.8×10^{-5}, 7.9%)	2.0	Arsenic (HQ = 1.1, 50%) Fluoride (HQ = 0.38, 18%) Cr(VI) (HQ = 0.18, 8.2%) Lithium (HQ = 0.18, 8.4%) Molybdenum (HQ = 0.03, 1.6%) Nitrate (HQ = 0.06, 2.9%) Nitrite (HQ = 0.02, 1.1%) Vanadium (HQ = 0.20, 9.3%)
	Dermal Contact	1.1×10^{-6}		0.10	
	Inhalation of Volatiles	--		0.00	
	Total	2.1×10^{-4}		2.1	
Radionuclides	Ingestion	1.0×10^{-5}		--	
	Inhalation of Volatiles	1.5×10^{-5}			
	Total	2.5×10^{-5}			
Total Cumulative		2.3×10^{-4}			

Table 7-65. Summary of Cancer Risks and Noncancer Hazards for Well 699-66-58 (Within the 200-BP-5 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.3×10^{-4}	Arsenic (ELCR = 1.3×10^{-4}; 74%) Tc-99 (ELCR = 7.9×10^{-6}; 4.4%) Tritium (ELCR = 3.7×10^{-5}; 21%)	1.7	Arsenic (HQ = 0.69; 40%) Fluoride (HQ = 0.32; 19%) Cr(VI) (HQ = 0.15; 8.4%) Lithium (HQ = 0.20; 11%) Molybdenum (HQ = 0.031; 1.8%) Nitrate (HQ = 0.083; 4.8%) Nitrite (HQ = 0.020; 1.2%) Vanadium (HQ = 0.15; 8.9%) Zinc (HQ = 0.059; 3.4%)
	Dermal Contact	7.3×10^{-7}		0.084	
	Inhalation of Volatiles	--		--	
	Total	1.3×10^{-4}		1.7	
Radionuclides	Ingestion	1.5×10^{-5}		--	
	Inhalation of Volatiles	3.0×10^{-5}			
	Total	4.6×10^{-5}			
Total Cumulative		1.8×10^{-4}			

7.1.1.21 200-BP-5 Near River Exposure Area

The total cumulative ELCR for the 200-BP-5 Near River exposure area is 1.5×10^{-4}. The total ELCR for nonradiological analytes is 6.4×10^{-5} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 8.4×10^{-5} which is within the EPA risk range of 1×10^{-4} to 1×10^{-6}. Table 7-66 provides a summary of the cancer risks and noncancer hazards by exposure route for the 200-BP-5 Near River exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are trichloroethene (ELCR = 2.6×10^{-6}; 1.8 percent contribution), carbon-14 (ELCR = 8.7×10^{-6}; 5.9 percent contribution), technetium-99 (ELCR = 3.2×10^{-6}; 2.2 percent contribution), and tritium (ELCR = 6.9×10^{-5}; 47 percent contribution). Contribution to ELCR is elevated for arsenic (6.1×10^{-5}; 41 percent contribution) where measured concentrations 3.2 µg/L) are within natural background values.

The HI for the 200-BP-5 Near River exposure area is 1.6, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes (arsenic, fluoride, Cr(VI), lithium, molybdenum, nitrate, nitrite, selenium, uranium, and vanadium) that contributes greater than one percent of the HI also report an HQ less than 1.

Table 7-66. Summary of Cancer Risks and Noncancer Hazards for the 200-BP-5 Near River Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	6.2×10^{-5}	Arsenic (ELCR 6.1×10^{-5}; 41%) TCE (ELCR = 2.6×10^{-6}; 1.8%) C-14 (ELCR = 8.7×10^{-6}; 5.9%) Tc-99 (ELCR = 3.2×10^{-6}; 2.2%) Tritium (ELCR = 6.9×10^{-5}; 47%)	1.1	Arsenic (HQ = 0.32; 20%) Fluoride (HQ = 0.12; 7.4%) Cr(VI) (HQ =0.090; 5.5%) Lithium (HQ =0.15; 9.4%) Manganese (HQ =0.021; 1.3%) Molybdenum (HQ =0.027; 1.7%) Nitrate (HQ =0.10; 6.2%) Nitrite (HQ =0.022; 1.4%) TCE (HQ =0.57; 35%) Uranium (HQ =0.024; 1.5%) Vanadium (HQ =0.11; 6.5%)
	Dermal Contact	5.3×10^{-7}		0.077	
	Inhalation of Volatiles	2.1×10^{-6}		0.44	
	Total	6.4×10^{-5}		1.6	
Radionuclides	Ingestion	2.7×10^{-5}		--	
	Inhalation of Volatiles	5.7×10^{-5}			
	Total	8.4×10^{-5}			
Total Cumulative		1.5×10^{-4}			

7.1.1.22 200-BP-5 Near River - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for two wells within the 200-BP-5 Near River exposure area (699-66-64 and 699-70-68), the calculated risks and noncancer hazards are presented in Table 7-67 and Table 7-68.

The total cumulative ELCRs for wells 699-66-64 and 699-70-68 within the 200-BP-5 Near River exposure area are 1.7×10^{-4} and 1.7×10^{-4}, respectively. The total ELCR for nonradiological analytes are 9.3×10^{-5} and 7.6×10^{-5} at wells 699-66-64 and 699-70-68, which are greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCRs for radiological analytes are 7.6×10^{-5} and 6.6×10^{-5} for wells 699-66-64 and 699-70-68, which are within the EPA acceptable risk range of 1×10^{-4} to 1×10^{-6}.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) include technetium-99 and tritium at both wells. Trichloroethene is also a major contributor at well 699-70-68 (ELCR = 2.4×10^{-6}; 1.7 percent contribution) . Contribution to ELCR is elevated for arsenic at both wells (9.3×10^{-5} and 9.3×10^{-5} at wells 699-66-64 and 699-70-68, respectively) where measured concentrations (4.8 µg/L and 3.8 µg/L) are within natural background values.

The HI s 699-66-64 and 699-70-68 for the individual well within the Near River exposure area are 1.1 and 1.7, respectively, which are greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes (arsenic,

fluoride, Cr(VI), lithium, molybdenum, nitrate, nitrite, selenium, trichloroethene, uranium, and vanadium) that contribute greater than one percent of the HI also report an HQ less than 1.

Table 7-67. Summary of Cancer Risks and Noncancer Hazards for Well 699-66-64 (Within the 200-BP-5 Near River Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	9.2×10^{-5}	Arsenic (ELCR = 9.3×10^{-5}; 55%) Tc-99 (ELCR = 4.8×10^{-6}; 2.8%) Tritium (ELCR = 7.1×10^{-5}; 42%)	1.1	Arsenic (HQ = 0.48; 43%) Fluoride (HQ = 0.23; 21%) Cr(VI) (HQ = 0.043; 3.8%) Molybdenum (HQ = 0.044; 3.9%) Nitrate (HQ = 0.11; 9.7%) Nitrite (HQ = 0.022; 1.9%) Selenium (HQ = 0.018; 1.6%) Uranium (HQ = 0.029; 2.5%) Vanadium (HQ = 0.12; 10%)
	Dermal Contact	5.1×10^{-7}		0.042	
	Inhalation of Volatiles	--		--	
	Total	9.3×10^{-5}		1.1	
Radionuclides	Ingestion	1.7×10^{-5}		--	
	Inhalation of Volatiles	5.9×10^{-5}			
	Total	7.6×10^{-5}			
Total Cumulative		1.7×10^{-4}			

Table 7-68. Summary of Cancer Risks and Noncancer Hazards for Well 699-70-68 (Within the 200-BP-5 Near River Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	7.4×10^{-5}	Arsenic (ELCR = 7.4×10^{-5}, 52%) Trichloroethene (ELCR = 2.4×10^{-6}, 1.7%) Tc-99 (ELCR = 5.4×10^{-6}, 3.8%) Tritium (ELCR = 6.0×10^{-5}, 42%)	1.2	Arsenic (HQ = 0.38, 23%) Fluoride (HQ = 0.15, 8.9%) Cr(VI) (HQ = 0.07, 4.4%) Lithium (HQ = 0.10, 6.2%) Molybdenum (HQ = 0.04, 2.6%) Nitrate (HQ = 0.11, 6.7%) Nitrite (HQ = 0.02, 1.5%) Selenium (HQ = 0.02, 1.1%) Trichloroethene (HQ = 0.53, 32%) Uranium (HQ = 0.02, 1.5%) Vanadium (HQ = 0.16, 9.8%)
	Dermal Contact	5.8×10^{-7}		0.08	
	Inhalation of Volatiles	1.2×10^{-6}		0.41	
	Total	7.6×10^{-5}		1.7	

Table 7-68. Summary of Cancer Risks and Noncancer Hazards for Well 699-70-68 (Within the 200-BP-5 Near River Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Radionuclides	Ingestion	1.7×10^{-5}		--	
	Inhalation of Volatiles	4.9×10^{-5}			
	Total	6.6×10^{-5}			
Total Cumulative		1.4×10^{-4}			

7.1.1.23 200-BP-5 Confined Exposure Area

The total cumulative ELCR for the 200-BP-5 Confined exposure area is 1.2×10^{-4}. The total ELCR for nonradiological analytes is 7.8×10^{-5} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 3.8×10^{-5} which is within the EPA risk range of 1×10^{-4} to 1×10^{-6}. Table 7-69 provides a summary of the cancer risks and noncancer hazards by exposure route for the 200-BP-5 Confined exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are benzene (ELCR 5.5×10^{-6}; 4.8 percent contribution), bis(2-ethylhexyl) phthalate (ELCR = 1.7×10^{-6}; 1.5 percent contribution), carbon tetrachloride (ELCR = 5.1×10^{-6}; 4.4 percent contribution), chloroform (ELCR = 5.9×10^{-6}; 5.1 percent contribution), iodine-129 (ELCR = 2.5×10^{-6}; 2.2 percent contribution), strontium-90 (ELCR = 2.5×10^{-6}; 2.1 percent contribution), technetium-99 (ELCR = 1.9×10^{-5}; 16 percent contribution), tritium (ELCR = 9.7×10^{-6}; 8.3 percent contribution), uranium-234 (ELCR = 1.8×10^{-6}; 1.6 percent contribution), and uranium-238 (ELCR = 1.3×10^{-6}; 1.1 percent contribution). Contribution to ELCR is elevated for arsenic (5.9×10^{-5}; 51 percent contribution) where measured concentrations (3.0 µg/L) are within natural background values.

The HI for the 200-BP-5 Near River exposure area is 11, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributor to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) is cyanide (HQ of 6.2; 58 percent contribution). The remaining analyte (arsenic) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for antimony (HQ of 3.3; 30 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-69. Summary of Cancer Risks and Noncancer Hazards for the 200-BP-5 Confined Aquifer Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	6.5×10^{-5}	Arsenic (ELCR 5.9×10^{-5}; 51%) Benzene (ELCR 5.5×10^{-6}; 4.8%) BEHP (ELCR = 1.7×10^{-6}; 1.5%) CTET (ELCR = 5.1×10^{-6}; 4.4%) Chloroform (ELCR = 5.9×10^{-6}; 5.1%) I-129 (ELCR = 2.5×10^{-6}; 2.2%) Sr-90 (ELCR = 2.5×10^{-6}; 2.1%) Tc-99 (ELCR = 1.9×10^{-5}; 16%) Tritium (ELCR = 9.7×10^{-6}; 8.3%) U-234 (ELCR = 1.8×10^{-6}; 1.6%) U-238 (ELCR = 1.3×10^{-6}; 1.1%)	4.8	Antimony (HQ = 3.3; 30%) Arsenic (HQ = 0.31; 2.8%) Cyanide (HQ = 6.2; 58%)
	Dermal Contact	2.2×10^{-6}		0.22	
	Inhalation of Volatiles	1.1×10^{-5}		5.8	
	Total	7.8×10^{-5}		11	
Radionuclides	Ingestion	3.0×10^{-5}		--	
	Inhalation of Volatiles	8.0×10^{-6}			
	Total	3.8×10^{-5}			
Total Cumulative		1.2×10^{-4}			

7.1.1.24 200-BP-5 Confined - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for three wells within the 200-BP-5 Confined exposure area (299-E33-12, 299-E33-50, and 699-52-55B), the calculated risks and noncancer hazards are presented in Table 7-70 through Table 7-72.

The total cumulative ELCR for the individual wells within the 200-BP-5 Confined exposure area ranged between 9.6×10^{-5} and 6.4×10^{-5}. The total ELCR for nonradiological analytes ranged between 7.9×10^{-5} and 3.0×10^{-5} which are greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes ranged between 6.5×10^{-5} and 1.6×10^{-6} which are within the EPA acceptable risk range of 1×10^{-4} to 1×10^{-6}.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) include the following:

- Technetium-99 and tritium at well 299-E33-12
- Bis(2-ethylhexyl) phthalate, carbon-14, strontium-90, and technetium-99 at well 299-E33-50
- Benzene, bis(2-ethylhexyl) phthalate, carbon tetrachloride, chloroform, and technetium-99 at well 699-52-55B

The HI for the individual wells within the 200-BP-5 Confined exposure area ranged from 1.0 to 21, which are equal to or greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributor to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) is cyanide (HQ of 20) at well 299-E33-

12. At well 299-E33-50 and 699-52-55B, all individual analytes (arsenic, fluoride, Cr(VI), manganese, and vanadium) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for antimony at well 299-E33-50, (HQ of 3.2; 77 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-70. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-12 (Within the 200-BP-5 Confined Aquifer Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	3.0×10^{-5}	Arsenic (ELCR = 3.0×10^{-5}; 32%) Tc-99 (ELCR = 6.4×10^{-5}; 67%) Tritium (ELCR = 1.0×10^{-6}; 1.1%)	2.1	Cyanide (HQ = 20; 97%)
	Dermal Contact	1.7×10^{-7}		0.028	
	Inhalation of Volatiles	--		19	
	Total	3.0×10^{-5}		21	
Radionuclides	Ingestion	6.4×10^{-5}		--	
	Inhalation of Volatiles	8.5×10^{-7}			
	Total	6.5×10^{-5}			
Total Cumulative		9.6×10^{-5}			

Table 7-71. Summary of Cancer Risks and Noncancer Hazards for Well 299-E33-50 (Within the 200-BP-5 Confined Aquifer Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	7.8×10^{-5}	Arsenic (ELCR = 7.8×10^{-5}; 85%) BEHP (ELCR = 1.2×10^{-6}; 1.3%) C-14 (ELCR = 1.0×10^{-6}; 1.1%) Sr-90 (ELCR = 1.3×10^{-6}; 1.4%) Tc-99 (ELCR = 9.6×10^{-6}; 10%)	3.9	Antimony (HQ = 3.2; 77%) Arsenic (HQ = 0.41; 9.8%) Fluoride (HQ = 0.10; 2.5%) Cr(VI) (HQ = 0.081; 2.0%) Manganese (HQ = 0.15; 3.6%) Vanadium (HQ = 0.078; 1.9%)
	Dermal Contact	1.1×10^{-6}		0.19	
	Inhalation of Volatiles	--		--	
	Total	7.9×10^{-5}		4.1	
Radionuclides	Ingestion	1.3×10^{-5}		--	
	Inhalation of Volatiles	--			
	Total	1.3×10^{-5}			
Total Cumulative		9.2×10^{-5}			

Table 7-72. Summary of Cancer Risks and Noncancer Hazards for Well 699-52-55B (Within the 200-BP-5 Confined Aquifer Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	4.7×10^{-5}	Arsenic (ELCR = 4.0×10^{-5}; 63%) Benzene (ELCR = 5.5×10^{-6}; 8.6%) BEHP (ELCR = 5.0×10^{-6}; 7.8%) CTET (ELCR = 5.1×10^{-6}; 7.9%) Chloroform (ELCR = 5.9×10^{-6}; 9.2%) Tc-99 (ELCR = 1.4×10^{-6}; 2.1%)	0.85	--
	Dermal Contact	4.1×10^{-6}		0.098	
	Inhalation of Volatiles	1.1×10^{-5}		0.058	
	Total	6.3×10^{-5}		1.0	
Radionuclides	Ingestion	1.6×10^{-6}		--	
	Inhalation of Volatiles	--			
	Total	1.6×10^{-6}			
Total Cumulative		6.4×10^{-5}			

7.1.2 200-PO-1 Groundwater OU

Table 7-73 through Table 7-137 provide a summary of the risk estimates by exposure route. Additional detail, including analyte-specific risk contributions, is provided in the spreadsheet attachments.

7.1.2.1 PUREX Cribs Exposure Area

The total cumulative ELCR for the PUREX Cribs exposure area is 1.9×10^{-3}. The total ELCR for nonradiological analytes is 7.4×10^{-4} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 1.2×10^{-3} which is greater than the upper risk threshold of 1×10^{-4}. Table 7-73 provides a summary of the cancer risks and noncancer hazards by exposure route for the PUREX Cribs exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are tritium (1.1×10^{-3}; 56 percent contribution), 2,6-dintrotoluene (3.4×10^{-4}; 18 percent contribution), n-nitrosodi-n-dipropylamine (2.7×10^{-4}; 14 percent contribution), U-234 (4.2×10^{-5}; 2.2 percent contribution) and U-238 (4.1×10^{-5}; 2.1 percent contribution). Contribution to ELCR is elevated for arsenic (1.2×10^{-4}; 6.3 percent contribution) where measured concentrations (6.3 µg/L) are within natural background values.

The HI for the PUREX cribs exposure area is 8.5, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributor to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) is cadmium (HQ of 1.2; 14 percent contribution). All remaining individual analytes (arsenic, beryllium, cobalt, fluoride, Cr(VI), nitrate, trichloroethene, uranium, and vanadium) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for antimony (HQ of 4.3; 50 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-73. Summary of Cancer Risks and Noncancer Hazards for the PUREX Cribs Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	7.1×10^{-4}	2,6-dinitrotoluene (ELCR = 3.4×10^{-4}; 18%) n-nitrosodi-n-dipropylamine (ELCR = 2.7×10^{-4}; 14%) Arsenic (ELCR = 1.2×10^{-4}; 6.3%) Tritium (ELCR = 1.1×10^{-3}; 56%) U-234 (ELCR = 4.2×10^{-5}; 2.2%) U-238 (ELCR = 4.1×10^{-5}; 2.1%)	7.5	Antimony (HQ = 4.3; 50%) Arsenic (HQ = 0.63; 7.4%) Beryllium (HQ = 0.26; 3.1%) Cadmium (HQ = 1.2; 14%) Cobalt (HQ = 0.48; 5.6%) Fluoride (HQ = 0.13; 1.5%) Cr(VI) (HQ = 0.14; 1.6%) Nitrate (HQ = 0.24; 2.9%) TCE (HQ = 0.57; 6.7%) Uranium (HQ = 0.26; 3.1%) Vanadium (HQ = 0.16; 1.9%)
	Dermal Contact	2.5×10^{-5}		0.53	
	Inhalation of Volatiles	4.4×10^{-6}		0.44	
	Total	7.4×10^{-4}		8.5	
Radionuclides	Ingestion	3.0×10^{-4}		--	
	Inhalation of Volatiles	9.0×10^{-4}			

Table 7-73. Summary of Cancer Risks and Noncancer Hazards for the PUREX Cribs Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Total	1.2×10^{-3}			
Total Cumulative		1.9×10^{-3}			

7.1.2.2 PUREX Cribs - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for ten wells within the PUREX Cribs exposure area (299-E16-2, 299-E17-1, 299-E17-14, 299-E17-19, 299-E24-16, 299-E24-23, 299-E25-19, 299-E25-20, 299-E25-22, and 299-E25-3.), the calculated risks and noncancer hazards are presented in Table 7-74 through Table 7-83, respectively.

The total cumulative ELCR for the individual wells within the PUREX Cribs exposure area ranged between 3.6×10^{-3} and 1.5×10^{-4}. The total ELCR for nonradiological analytes ranged between 7.4×10^{-4} and 1.1×10^{-4} which are greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes ranged between 3.3×10^{-3} and 3.2×10^{-5}. Wells 299-E17-1, 299-E17-14, 299-E17-19, 299-E24-16, 299-E24-23, 299-E25-19, 299-E25-20, and 299-E25-22 are greater than the upper risk threshold of 1×10^{-4}. Wells 299-E16-2 and 299-E25-3 are within the EPA acceptable risk range of 1×10^{-4} to 1×10^{-6}.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) include the following:

- Tritium at wells 299-E17-1, 299-E17-14, 299-E17-19, 299-E25-19, and 299-E25-20
- Iodine-129 and tritium at wells 299-E24-16, 299-E25-22, and 299-E25-3
- Iodine-129, strontium-90, and tritium at well 299-E19-2
- 2,6-Dinitrotoluene, n-nitrosodi-n-dipropylamine, tritium, uranium-234, and uranium-238 at well 299-E24-23

. Contribution to ELCR is elevated for arsenic (1.1×10^{-4} to 2.1×10^{-4}) where measured concentrations (5.5 µg/L to 11 µg/L) are within natural background values.

The HI for the individual wells within the PUREX cribs exposure area ranged from 1.6 to 10, which are greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributors to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) include:

- Cadmium and cobalt at well 299-E17-1
- Uranium at well 299-E24-23

The remaining individual analytes (beryllium, bis(2-ethylhexyl)phthalate, fluoride, Cr(VI), iron, manganese, nickel, nitrate, nitrite, trichloroethene, and vanadium) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for arsenic at well 299-E25-22 (HQ

= 1.1; 66%), where measured concentrations are within natural background values. Contribution to HI is elevated for antimony at wells 299-E17-14, 299-E17-19, 299-E25-3 (HQ ranged between 4.2 and 7.9) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-74. Summary of Cancer Risks and Noncancer Hazards for Well 299-E16-2 (Within the PUREX Cribs Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.9×10^{-4}	Arsenic (ELCR = 1.9×10^{-4}, 85%) I-129 (ELCR = 4.3×10^{-6}, 1.9%) Sr-90 (ELCR = 2.2×10^{-6}, 1.0%) Tritium (ELCR = 2.6×10^{-5}, 12%)	1.6	Arsenic (HQ = 0.97, 58%) Fluoride (HQ = 0.16, 9.2%) Cr(VI)(HQ = 0.09, 5.2%) Iron (HQ = 0.04, 2.6%) Manganese (HQ = 0.06, 3.4%) Nitrate (HQ = 0.03, 1.8%) Nitrite (HQ = 0.02, 1.1%) Vanadium (HQ = 0.29, 17%)
	Dermal Contact	1.0×10^{-6}		0.10	
	Inhalation of Volatiles	--		--	
	Total	1.9×10^{-4}		1.7	
Radionuclides	Ingestion	1.1×10^{-5}		--	
	Inhalation of Volatiles	2.1×10^{-5}			
	Total	3.2×10^{-5}			
Total Cumulative		2.20×10^{-4}			

Table 7-75. Summary of Cancer Risks and Noncancer Hazards for Well 299-E17-1 (Within the PUREX Cribs Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.1×10^{-4}	Arsenic (ELCR = 1.1×10^{-4}, 3.5%) Tritium (ELCR = 2.9×10^{-3}, 96%)	5.1	Arsenic (HQ = 0.56, 10%) Beryllium (HQ = 0.26, 4.8%) Cadmium (HQ = 1.2, 22%) Cobalt (HQ = 1.9, 35%) Fluoride (HQ = 0.15, 2.8%) Iron (HQ = 0.23, 4.2%) Manganese (HQ = 0.32, 5.9%) Nitrate (HQ = 0.35, 6.4%) Uranium (HQ = 0.13, 2.4%) Vanadium (HQ = 0.18, 3.3%)
	Dermal Contact	5.9×10^{-7}		0.34	
	Inhalation of Volatiles	--		--	
	Total	1.1×10^{-4}		5.5	
Radionuclides	Ingestion	5.4×10^{-4}		--	

Table 7-75. Summary of Cancer Risks and Noncancer Hazards for Well 299-E17-1 (Within the PUREX Cribs Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Inhalation of Volatiles	2.4×10^{-3}			
	Total	2.9×10^{-3}			
Total Cumulative		3.0×10^{-3}			

Table 7-76. Summary of Cancer Risks and Noncancer Hazards for Well 299-E17-14 (Within the PUREX Cribs Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.4×10^{-4}	Arsenic (ELCR = 1.4×10^{-4}; 4.2%) Tritium (ELCR = 3.2×10^{-3}; 93%)	7.5	Antimony (HQ = 5.6; 67%) Arsenic (HQ = 0.74; 9.0%) Fluoride (HQ = 0.10; 1.2%) Cr(VI) (HQ = 0.25; 3.0%) Nitrate (HQ = 0.53; 6.4%) TCE (HQ = 0.53; 6.4%) Uranium (HQ = 0.30; 3.7%) Vanadium (HQ = 0.17; 2.1%)
	Dermal Contact	9.7×10^{-7}		0.35	
	Inhalation of Volatiles	2.1×10^{-6}		0.41	
	Total	1.5×10^{-4}		8.3	
Radionuclides	Ingestion	6.5×10^{-4}		--	
	Inhalation of Volatiles	2.7×10^{-3}			
	Total	3.3×10^{-3}			
Total Cumulative		3.4×10^{-3}			

Table 7-77. Summary of Cancer Risks and Noncancer Hazards for Well 299-E17-19 (Within the PUREX Cribs Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.5×10^{-4}	Arsenic (ELCR = 1.5×10^{-4}; 4.6%) Tritium (ELCR = 3.0×10^{-3}; 94%)	9.5	Antimony (HQ = 7.9; 77%) Arsenic (HQ = 0.76; 7.5%) Cr(VI) (HQ = 0.12; 1.2%) Nitrate (HQ = 0.63; 6.1%) TCE (HQ = 0.34; 3.4%)
	Dermal Contact	9.3×10^{-7}		0.39	

Table 7-77. Summary of Cancer Risks and Noncancer Hazards for Well 299-E17-19 (Within the PUREX Cribs Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Inhalation of Volatiles	8.0×10^{-7}		0.26	Uranium (HQ = 0.12; 1.1%) Vanadium (HQ = 0.16; 1.6%)
	Total	1.5×10^{-4}		10	
Radionuclides	Ingestion	5.7×10^{-4}		--	
	Inhalation of Volatiles	2.5×10^{-3}			
	Total	3.0×10^{-3}			
Total Cumulative		3.2×10^{-3}			

Table 7-78. Summary of Cancer Risks and Noncancer Hazards for Well 299-E24-16 (Within the PUREX Cribs Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.5×10^{-4}	Arsenic (ELCR = 1.5×10^{-4}; 8.7%) I-129 (ELCR = 2.2×10^{-5}; 1.3%) Tritium (ELCR = 1.5×10^{-3}; 89%)	2.0	Arsenic (HQ = 0.76; 27%) Fluoride (HQ = 0.11; 3.8%) Cr(VI) (HQ = 0.22; 7.6%) Nitrate (HQ = 0.31; 11%) TCE (HQ = 0.87; 31%) Uranium (HQ = 0.27; 9.7%) Vanadium (HQ = 0.19; 6.8%)
	Dermal Contact	1.1×10^{-6}		0.14	
	Inhalation of Volatiles	2.0×10^{-6}		0.67	
	Total	1.5×10^{-4}		2.8	
Radionuclides	Ingestion	3.0×10^{-4}		--	
	Inhalation of Volatiles	1.2×10^{-3}			
	Total	1.5×10^{-3}			
Total Cumulative		1.7×10^{-3}			

Table 7-79. Summary of Cancer Risks and Noncancer Hazards for Well 299-E24-23 (Within the PUREX Cribs Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	7.1×10^{-4}	2,6-Dinitrotoluene (ELCR = 3.4×10^{-4}, 9.5%) Arsenic (ELCR = 1.2×10^{-4}, 3.3%) n-Nitrosodi-n-dipropylamine (ELCR = 2.7×10^{-4}, 7.5%) Tritium (ELCR = 2.7×10^{-3}, 76%) U-234 (ELCR = 4.2×10^{-5}, 1.2%) U-238 (ELCR = 4.1×10^{-5}, 1.1%)	2.5	Arsenic (HQ = 0.61, 18%) Fluoride (HQ = 0.11, 3.3%) Nitrate (HQ = 0.36, 11%) TCE (HQ = 0.96, 29%) Uranium (HQ = 1.1, 32%) Vanadium (HQ = 0.18, 5.3%)
	Dermal Contact	2.3×10^{-5}		0.08	
	Inhalation of Volatiles	4.6×10^{-6}		0.75	
	Total	7.4×10^{-4}		3.3	
Radionuclides	Ingestion	6.1×10^{-4}		--	
	Inhalation of Volatiles	2.3×10^{-3}			
	Total	2.9×10^{-3}			
Total Cumulative		3.6×10^{-3}			

Table 7-80. Summary of Cancer Risks and Noncancer Hazards for Well 299-E25-19 (Within the PUREX Cribs Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.6×10^{-4}	Arsenic (ELCR = 1.6×10^{-4}, 14%) Tritium (ELCR = 9.7×10^{-4}, 85%)	1.5	Arsenic (HQ = 0.81, 52%) Fluoride (HQ = 0.11, 7.2%) Cr(VI)(HQ = 0.13, 8.6%) Iron (HQ = 0.02, 1.1%) Manganese (HQ = 0.09, 5.7%) Nitrate (HQ = 0.17, 11%) Vanadium (HQ = 0.21, 13%)
	Dermal Contact	8.7×10^{-7}		0.10	
	Inhalation of Volatiles	--		--	
	Total	1.6×10^{-4}		1.6	
Radionuclides	Ingestion	1.8×10^{-4}		--	
	Inhalation of Volatiles	7.9×10^{-4}			
	Total	9.8×10^{-4}			

Table 7-80. Summary of Cancer Risks and Noncancer Hazards for Well 299-E25-19 (Within the PUREX Cribs Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Total Cumulative		1.1×10^{-3}			

Table 7-81. Summary of Cancer Risks and Noncancer Hazards for Well 299-E25-20 (Within the PUREX Cribs Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.9×10^{-4}	Arsenic (ELCR = 1.9×10^{-4}, 15%) Tritium (ELCR = 1.0×10^{-3}, 84%)	1.8	Arsenic (HQ = 0.97, 49%) Bis(2-ethylhexyl) phthalate (HQ = 0.03, 1.3%) Fluoride (HQ = 0.11, 5.4%) Cr(VI)(HQ = 0.24, 12%) Manganese (HQ = 0.08, 4.1%) Nitrate (HQ = 0.25, 13%) Vanadium (HQ = 0.25, 13%)
	Dermal Contact	2.9×10^{-6}		0.16	
	Inhalation of Volatiles	--		--	
	Total	1.9×10^{-4}		2.0	
Radionuclides	Ingestion	1.9×10^{-4}			
	Inhalation of Volatiles	8.4×10^{-4}			
	Total	1.0×10^{-3}			
Total Cumulative		1.2×10^{-3}			

Table 7-82. Summary of Cancer Risks and Noncancer Hazards for Well 299-E25-22 (Within the PUREX Cribs Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	2.1×10^{-4}	Arsenic (ELCR = 2.1×10^{-4}, 58%) I-129 (ELCR = 6.7×10^{-6}, 1.9%) Tritium (ELCR = 1.4×10^{-4}, 39%)	1.6	Arsenic (HQ = 1.1, 66%) Fluoride (HQ = 0.13, 8.0%) Nitrate (HQ = 0.08, 4.6%) Vanadium (HQ = 0.30, 19%)
	Dermal Contact	1.2×10^{-6}		0.06	
	Inhalation of Volatiles	--		--	

Table 7-82. Summary of Cancer Risks and Noncancer Hazards for Well 299-E25-22 (Within the PUREX Cribs Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Total	2.1×10^{-4}		1.6	
Radionuclides	Ingestion	3.5×10^{-5}		--	
	Inhalation of Volatiles	1.1×10^{-4}			
	Total	1.5×10^{-4}			
Total Cumulative		3.6×10^{-4}			

Table 7-83. Summary of Cancer Risks and Noncancer Hazards for Well 299-E25-3 (Within the PUREX Cribs Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.1×10^{-4}	Arsenic (ELCR = 1.1×10^{-4}; 73%) I-129 (ELCR = 1.4×10^{-5}; 9.5%) Tritium (ELCR = 2.7×10^{-5}; 18%)	5.1	Antimony (HQ = 4.2; 79%) Arsenic (HQ = 0.57; 11%) Fluoride (HQ = 0.084; 1.6%) Nitrate (HQ = 0.16; 3.1%) Vanadium (HQ = 0.18; 3.3%)
	Dermal Contact	6.1×10^{-7}		0.20	
	Inhalation of Volatiles	--		--	
	Total	1.1×10^{-4}		5.3	
Radionuclides	Ingestion	1.9×10^{-5}		--	
	Inhalation of Volatiles	2.2×10^{-5}			
	Total	4.1×10^{-5}			
Total Cumulative		1.5×10^{-4}			

7.1.2.3 WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area

The total cumulative ELCR for the WMA A-AX and the 216-A-29 Ditch exposure area is 3.0×10^{-4}. The total ELCR for nonradiological analytes is 1.6×10^{-4} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 1.3×10^{-4} which is greater than the upper risk threshold of

1×10^{-4}. Table 7-84 provides a summary of the cancer risks and noncancer hazards by exposure route for the WMA A-AX and the 216-A-29 Ditch exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are technetium-99 (6.8×10^{-5}; 23 percent contribution), tritium (3.7×10^{-5}; 12 percent contribution), iodine-129 (1.4×10^{-5}; 4.8 percent contribution), 1,2,3,4,7,8-hexachlorodibenzo-p-dioxin (5.9×10^{-6}; 2.0 percent contribution), strontium-90 (4.8×10^{-6}; 1.6 percent contribution), selenium-79 (4.6×10^{-6}; 1.5 percent contribution), and U-234 (3.6×10^{-6}; 1.2 percent contribution). Contribution to ELCR is elevated for arsenic (1.5×10^{-4}; 52 percent contribution) where measured concentrations (7.9 µg/L) are within natural background values.

The HI for the WMA A-AX and the 216-A-29 Ditch exposure area is 5.7, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes (1,2,3,4,7,8-hexachlorodibenzo-p-dioxin, cadmium, cobalt, fluoride, Cr(VI), nitrate, and vanadium) contribute greater than one percent of the HI but also report a HQ less than 1. Contribution to HI is elevated for arsenic (HQ of 0.80; 14 percent contribution) where measured concentrations are within natural background values. Contribution to HI is elevated for antimony (HQ of 3.3; 58 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-84. Summary of Cancer Risks and Noncancer Hazards for the WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.5×10^{-4}	HxCDD (ELCR = 5.9×10^{-6}; 2.0%) Arsenic (ELCR = 1.5×10^{-4}; 52%) I-129 (ELCR = 1.4×10^{-5}; 4.8%) Se-79 (ELCR = 4.6×10^{-6}; 1.5%) Sr-90 (ELCR = 4.8×10^{-6}; 1.6%) Tc-99 (ELCR = 6.8×10^{-5}; 23%) Tritium (ELCR = 3.7×10^{-5}; 12%) U-234 (ELCR = 3.6×10^{-6}; 1.2%	5.3	HxCDD (HQ = 0.16; 2.8%) Antimony (HQ = 3.3; 58%) Arsenic (HQ = 0.8; 14%) Cadmium (HQ = 0.35; 6.1%) Cobalt (HQ = 0.40; 7.0%) Fluoride (HQ = 0.090; 1.6%) Cr(VI) (HQ = 0.085; 1.5%) Nitrate (HQ = 0.11; 1.9%) Vanadium (HQ = 0.18; 3.2%)
	Dermal Contact	7.6×10^{-6}		0.40	
	Inhalation of Volatiles	--		<0.001	
	Total	1.6×10^{-4}		5.7	
Radionuclides	Ingestion	1.0×10^{-4}		--	
	Inhalation of Volatiles	3.0×10^{-5}			
	Total	1.3×10^{-4}			
Total Cumulative		3.0×10^{-4}			

7.1.2.4 WMA A-AX Tank Farms and the 216-A-29 Ditch - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for ten wells within the WMA A-AX and the 216-A-29 Ditch exposure area (299-E24-20, 299-E24-22, 299-E25-236, 299-E25-28, 299-E25-29P, 299-E25-34, 299-E25-42, 299-E25-93, 299-E25-94, and 699-43-45), the calculated risks and noncancer hazards are presented in Table 7-85 through Table 7-94, respectively.

The total cumulative ELCR for the individual wells within the WMA A-AX and the 216-A-29 Ditch exposure area ranged between 4.5×10^{-4} and 2.3×10^{-4}. The total ELCR for nonradiological analytes ranged between 2.2×10^{-4} and 1.4×10^{-4} which are greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes ranged between 2.9×10^{-4} and 1.7×10^{-5}. Wells 299-E25-42 and 299-E25-93 are greater than the upper risk threshold of 1×10^{-4} for radionuclides. Wells 299-E24-20, 299-E24-22, 299-E25-28, 299-E25-236, 299-E25-29P, 299-E25-34, 299-E25-94, and 699-43-45 are within the EPA range of 1×10^{-4} to 1×10^{-6} for radionuclides.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are iodine-129, technetium-99, and tritium. Strontium-90 is also measured at wells 299-E25-93 and 299-E25-94. 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin was also measured at well 299-E-25-236 Contribution to ELCR is elevated for arsenic (1.3×10^{-4} to 2.2×10^{-4}) where measured concentrations (6.9 µg/L to 11 µg/L) are within natural background values.

The HI for the individual wells within the WMA A-AX and the 216-A-29 Ditch exposure area ranged from 1.4 to 5.9, which are greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes (cadmium, cobalt, fluoride, Cr(VI), manganese, nickel, nitrate, nitrite, selenium, silver, strontium, uranium, vanadium, and zinc) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for arsenic (0.70 to 1.1) where measured concentrations (6.9 µg/L to 11 µg/L) are within natural background values. Contribution to HI is elevated for antimony at well 299-E24-20 (HQ = 3.6, 60 percent contribution) and at well 299-E25-42 (HQ = 3.5, 63 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-85. Summary of Cancer Risks and Noncancer Hazards for Well 299-E24-20 (Within the WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.7×10^{-4}	Arsenic (ELCR = 1.7×10^{-4}; 72%) I-129 (ELCR = 1.6×10^{-5}; 6.6%) Tc-99 (ELCR = 9.8×10^{-6}; 4.2%) Tritium (ELCR = 4.1×10^{-5}; 17%)	5.7	Antimony (HQ = 3.6; 60%) Arsenic (HQ = 0.88; 15%) Cadmium (HQ = 0.30; 5.0%) Cobalt (HQ = 0.40; 6.8%) Fluoride (HQ = 0.099; 1.7%) Cr(VI) (HQ = 0.12; 2.1%) Nitrate (HQ = 0.17; 2.9%) Vanadium (HQ = 0.22; 3.8%)
	Dermal Contact	9.4×10^{-7}		0.26	
	Inhalation of Volatiles	--		--	
	Total	1.7×10^{-4}		5.9	
Radionuclides	Ingestion	3.2×10^{-5}		--	

Table 7-85. Summary of Cancer Risks and Noncancer Hazards for Well 299-E24-20 (Within the WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Inhalation of Volatiles	3.4×10^{-5}			
	Total	6.6×10^{-5}			
Total Cumulative		2.4×10^{-4}			

Table 7-86. Summary of Cancer Risks and Noncancer Hazards for Well 299-E24-22 (Within the WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.7×10^{-4}	Arsenic (ELCR = 1.8×10^{-4}; 72%) I-129 (ELCR = 1.8×10^{-5}; 7.4%) Tc-99 (ELCR = 3.7×10^{-5}; 15%) Tritium (ELCR = 1.2×10^{-5}; 4.8%)	1.4	Arsenic (HQ = 0.91; 63%) Fluoride (HQ = 0.11; 7.6%) Cr(VI) (HQ = 0.097; 6.7%) Nitrate (HQ = 0.077; 5.3%) Nitrite (HQ = 0.017; 1.2%) Uranium (HQ = 0.025; 1.7%) Vanadium (HQ = 0.18; 13%)
	Dermal Contact	9.7×10^{-7}		0.072	
	Inhalation of Volatiles	--		--	
	Total	1.8×10^{-4}		1.4	
Radionuclides	Ingestion	5.7×10^{-5}		--	
	Inhalation of Volatiles	9.7×10^{-6}			
	Total	6.7×10^{-5}			
Total Cumulative		2.4×10^{-4}			

Table 7-87. Summary of Cancer Risks and Noncancer Hazards for Well 299-E25-236 (Within the WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.3×10^{-4}	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (ELCR = 5.9×10^{-6}, 2.6%) Arsenic (ELCR = 1.3×10^{-4}, 59%)	1.3	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HQ = 0.16, 10%) Arsenic (HQ = 0.69, 45%) Fluoride (HQ = 0.08, 5.3%)
	Dermal Contact	6.4×10^{-6}		0.23	

Table 7-87. Summary of Cancer Risks and Noncancer Hazards for Well 299-E25-236 (Within the WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Inhalation of Volatiles	--	I-129 (ELCR = 1.6×10^{-5}, 7.3%) Tc-99 (ELCR = 2.9×10^{-5}, 13%) Tritium (ELCR = 4.1×10^{-5}, 18%)	--	Cr(VI) (HQ = 0.13, 8.5%) Manganese (HQ = 0.02, 1.1%) Nickel (HQ = 0.11, 7.1%) Nitrate (HQ = 0.11, 6.8%) Nitrite (HQ = 0.02, 1.2%) Selenium (HQ = 0.03, 1.8%) Vanadium (HQ = 0.17, 11%)
	Total	1.4×10^{-4}		1.5	
Radionuclides	Ingestion	5.3×10^{-5}		--	
	Inhalation of Volatiles	3.4×10^{-5}			
	Total	8.7×10^{-5}			
Total Cumulative		2.3×10^{-4}			

Table 7-88. Summary of Cancer Risks and Noncancer Hazards for Well 299-E25-28 (Within the WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	2.0×10^{-4}	Arsenic (ELCR = 2.0×10^{-4}, 84%) I-129 (ELCR = 1.2×10^{-5}, 5.1%) Tritium (ELCR = 2.7×10^{-5}, 11%)	1.6	Arsenic (HQ = 1.0, 61%) Fluoride (HQ = 0.10, 5.7%) Cr(VI)(HQ = 0.27, 16%) Uranium (HQ = 0.03, 1.5%) Vanadium (HQ = 0.23, 13%)
	Dermal Contact	1.1×10^{-6}		0.13	
	Inhalation of Volatiles	--		--	
	Total	2.0×10^{-4}		1.7	
Radionuclides	Ingestion	1.7×10^{-5}		--	
	Inhalation of Volatiles	2.2×10^{-5}			
	Total	3.9×10^{-5}			
Total Cumulative		2.4×10^{-4}			

Table 7-89. Summary of Cancer Risks and Noncancer Hazards for Well 299-E25-29P (Within the WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.9×10^{-4}	Arsenic (ELCR = 1.9×10^{-4}; 83%) I-129 (ELCR = 8.4×10^{-6}; 3.6%) Tritium (ELCR = 3.1×10^{-5}; 13%)	1.9	Arsenic (HQ = 1.0; 51%) Fluoride (HQ = 0.16; 8.2%) Cr(VI) (HQ = 0.088; 4.5%) Nitrate (HQ = 0.44; 23%) Vanadium (HQ = 0.20; 10%)
	Dermal Contact	1.1×10^{-6}		0.074	
	Inhalation of Volatiles	--		--	
	Total	1.9×10^{-4}		1.9	
Radionuclides	Ingestion	1.4×10^{-5}		--	
	Inhalation of Volatiles	2.6×10^{-5}			
	Total	4.0×10^{-5}			
Total Cumulative		2.3×10^{-4}			

Table 7-90. Summary of Cancer Risks and Noncancer Hazards for Well 299-E25-34 (Within the WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	2.2×10^{-4}	Arsenic (ELCR = 2.2×10^{-4}, 93%) I-129 (ELCR = 1.4×10^{-5}, 6.0%) Tritium (ELCR = 3.1×10^{-6}, 1.3%)	1.6	Arsenic (HQ = 1.1, 65%) Fluoride (HQ = 0.09, 5.4%) Cr(VI) (HQ = 0.12, 6.9%) Nickel (HQ = 0.04, 2.4%) Silver (HQ = 0.04, 2.2%) Uranium (HQ = 0.02, 1.2%) Vanadium (HQ = 0.26, 15%)
	Dermal Contact	1.2×10^{-6}		0.10	
	Inhalation of Volatiles	--		--	
	Total	2.2×10^{-4}		1.7	
Radionuclides	Ingestion	1.5×10^{-5}		--	
	Inhalation of Volatiles	2.5×10^{-6}			
	Total	1.7×10^{-5}			
Total Cumulative		2.3×10^{-4}			

Table 7-91. Summary of Cancer Risks and Noncancer Hazards for Well 299-E25-42 (Within the WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	2.0×10^{-4}	Arsenic (ELCR = 2.1×10^{-4}; 66%) I-129 (ELCR = 2.3×10^{-5}; 7.5%) Tc-99 (ELCR = 5.7×10^{-6}; 1.8%) Tritium (ELCR = 7.7×10^{-5}; 25%)	5.3	Antimony (HQ = 3.5; 63%) Arsenic (HQ = 1.1; 19%) Fluoride (HQ = 0.25; 4.6%) Cr(VI) (HQ = 0.19; 3.5%) Nickel (HQ = 0.12; 2.2%) Nitrate (HQ = 0.073; 1.3%) Vanadium (HQ = 0.24; 4.3%)
	Dermal Contact	1.1×10^{-6}		0.26	
	Inhalation of Volatiles	--		--	
	Total	2.1×10^{-4}		5.5	
Radionuclides	Ingestion	4.3×10^{-5}		--	
	Inhalation of Volatiles	6.4×10^{-5}			
	Total	1.1×10^{-4}			
Total Cumulative		3.1×10^{-4}			

Table 7-92. Summary of Cancer Risks and Noncancer Hazards for Well 299-E25-93 (Within the WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.5×10^{-4}	Arsenic (ELCR = 1.5×10^{-4}; 35%) I-129 (ELCR = 1.7×10^{-5}; 3.8%) Sr-90 (ELCR = 6.2×10^{-6}; 1.4%) Tc-99 (ELCR = 2.4×10^{-4}; 53%) Tritium (ELCR = 2.5×10^{-5}; 5.6%)	2.1	Arsenic (HQ = 0.80; 35%) Cadmium (HQ = 0.35; 15%) Fluoride (HQ = 0.072; 3.2%) Cr(VI) (HQ = 0.29; 13%) Manganese (HQ = 0.069; 3.0%) Nickel (HQ = 0.082; 3.6%) Nitrate (HQ = 0.24; 10%) Nitrite (HQ = 0.024; 1.1%) Silver (HQ = 0.059; 2.6%) Uranium (HQ = 0.024; 1.1%) Vanadium (HQ = 0.19; 8.2%) Zinc (HQ = 0.040; 1.8%)
	Dermal Contact	8.6×10^{-7}		0.19	
	Inhalation of Volatiles	--		--	
	Total	1.5×10^{-4}		2.3	
Radionuclides	Ingestion	2.7×10^{-4}		--	
	Inhalation of Volatiles	2.1×10^{-5}			
	Total	2.9×10^{-4}			

Table 7-92. Summary of Cancer Risks and Noncancer Hazards for Well 299-E25-93 (Within the WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Total Cumulative		4.5×10^{-4}			

Table 7-93. Summary of Cancer Risks and Noncancer Hazards for Well 299-E25-94 (Within the WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.6×10^{-4}	Arsenic (ELCR = 1.6×10^{-4}; 65%) I-129 (ELCR = 2.1×10^{-5}; 8.6%) Sr-90 (ELCR = 4.8×10^{-6}; 1.9%) Tc-99 (ELCR = 3.8×10^{-5}; 15%) Tritium (ELCR = 2.3×10^{-5}; 9.1%)	1.3	Arsenic (HQ = 0.84; 61%) Fluoride (HQ = 0.078; 5.7%) Manganese (HQ = 0.053; 3.8%) Nitrate (HQ = 0.13; 9.2%) Nitrite (HQ = 0.020; 1.4%) Strontium (HQ = 0.017; 1.2%) Uranium (HQ = 0.019; 1.4%) Vanadium (HQ = 0.18; 13%)
	Dermal Contact	9.0×10^{-7}		0.047	
	Inhalation of Volatiles	--		--	
	Total	1.6×10^{-4}		1.4	
Radionuclides	Ingestion	6.9×10^{-5}		--	
	Inhalation of Volatiles	1.9×10^{-5}			
	Total	8.7×10^{-5}			
Total Cumulative		2.5×10^{-4}			

Table 7-94. Summary of Cancer Risks and Noncancer Hazards for Well 699-43-45 (Within the WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.9×10^{-4}	Arsenic (ELCR = 1.9×10^{-4}; 86%) I-129 (ELCR = 2.6×10^{-5}; 12%) Tritium (ELCR = 6.2×10^{-6}; 2.7%)	1.4	Arsenic (HQ = 1.0; 69%) Fluoride (HQ = 0.094; 6.4%) Nitrate (HQ = 0.025; 1.7%) Nitrite (HQ = 0.023; 1.6%) Uranium (HQ = 0.028; 1.9%) Vanadium (HQ = 0.26; 18%)
	Dermal Contact	1.1×10^{-6}		0.055	
	Inhalation of Volatiles	--		--	
	Total	1.9×10^{-4}		1.5	

Table 7-94. Summary of Cancer Risks and Noncancer Hazards for Well 699-43-45 (Within the WMA A-AX Tank Farms and the 216-A-29 Ditch Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Radionuclides	Ingestion	2.7×10^{-5}		--	
	Inhalation of Volatiles	5.1×10^{-6}			
	Total	3.2×10^{-5}			
Total Cumulative		2.3×10^{-4}			

7.1.2.5 BC Cribs and Trenches Exposure Area

The total cumulative ELCR for the BC Cribs and Trenches exposure area is 5.4×10^{-5}. The total ELCR for nonradiological analytes is 4.5×10^{-5} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 9.0×10^{-6} which is within the EPA risk range of 1×10^{-4} to 1×10^{-6}. Table 7-95 provides a summary of the cancer risks and noncancer hazards by exposure route for the BC Cribs and Trenches exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are strontium-90 (2.7×10^{-6}; 5.0 percent contribution), uranium-234 (2.4×10^{-6}; 4.4 percent contribution), uranium-238 (1.2×10^{-6}; 2.2 percent contribution), and tritium (1.0×10^{-6}; 1.9 percent contribution). Contribution to ELCR is elevated for arsenic (4.5×10^{-5}; 83 percent contribution) where measured concentrations (2.3 µg/L) are within natural background values.

The HI for the BC Cribs and Trenches exposure area is 7.4, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes (cobalt, fluoride, Cr(VI), iron, manganese, vanadium, and zinc) contribute greater than one percent of the HI but also report a HQ less than 1. Contribution to HI is elevated for arsenic (HQ of 0.23; 3.2 percent contribution) where measured concentrations are within natural background values. Contribution to HI is elevated for antimony (HQ of 4.0; 55 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-95. Summary of Cancer Risks and Noncancer Hazards for the BC Cribs and Trenches Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	4.5×10^{-5}	Arsenic (ELCR = 4.5×10^{-5}; 83%) Sr-90 (ELCR = 2.7×10^{-6}; 5.0%) Tritium (ELCR = 1.0×10^{-6}; 1.9%) U-234 (ELCR = 2.4×10^{-6}; 4.4%)	7.0	Antimony (HQ = 4.0; 55%) Arsenic (HQ = 0.23; 3.2%) Cobalt (HQ = 0.81; 11%) Fluoride (HQ =0.16; 2.1%) Cr(VI) (HQ = 0.42; 5.6%) Iron (HQ = 0.72; 9.8%) Manganese (HQ = 0.29;
	Dermal Contact	2.5×10^{-7}		0.37	

Table 7-95. Summary of Cancer Risks and Noncancer Hazards for the BC Cribs and Trenches Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Inhalation of Volatiles	--	U-238 (ELCR = 1.2×10^{-6}; 2.2%)	<0.001	3.9%) Vanadium (HQ = 0.16; 2.1%) Zinc (HQ = 0.38; 5.2%)
	Total	4.5×10^{-5}		7.4	
Radionuclides	Ingestion	8.2×10^{-6}		--	
	Inhalation of Volatiles	8.6×10^{-7}			
	Total	9.0×10^{-6}			
Total Cumulative		5.4×10^{-5}			

7.1.2.6 BC Cribs and Trenches - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for two wells within the BC Cribs and Trenches exposure area (299-E13-5 and 299-E13-11), the calculated risks and noncancer hazards are presented in Table 7-96 and Table 7-97, respectively.

The total cumulative ELCR for the individual wells within the BC Cribs and Trenches exposure area ranged between 4.1×10^{-5} and 6.6×10^{-5}. The total ELCR for nonradiological analytes ranged between 4.1×10^{-5} and 5.9×10^{-5} which are greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes ranged between 7.0×10^{-6} and 6.9×10^{-7}. Well 299-E13-11 is within the EPA range of 1×10^{-4} to 1×10^{-6} and well 299-E13-5 is less than the lower risk threshold of 1×10^{-6} for radionuclides.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are uranium-234, strontium-90 and uranium-238 at well 299-E13-11. Contribution to ELCR is elevated for arsenic ($4.1x\ 10^{-5}$ and 5.9×10^{-5}) where measured concentrations (2.1 µg/L and 3 µg/L) are within natural background values.

The HI for the individual wells within the BC Cribs and Trenches exposure area ranged from 3.2 to 4.8, which are greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes (cobalt, fluoride, Cr(VI), iron, manganese, nitrate, nitrite, uranium, and vanadium) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI from arsenic (HQ = 0.21 and 0.31) reflects concentrations (2.1 µg/L and 3 µg/L) that are within natural background values. Contribution to HI is elevated for antimony at well 299-E13-5 (HQ = 4.1; 84 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-96. Summary of Cancer Risks and Noncancer Hazards for Well 299-E13-5 (Within the BC Cribs and Trenches Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	4.0×10^{-5}	Arsenic (ELCR = 4.1×10^{-5}; 98%)	4.6	Antimony (HQ = 4.0; 84%) Arsenic (HQ = 0.21; 4.4%) Fluoride (HQ =0.17; 3.6%) Cr(VI) (HQ = 0.055; 1.1%) Vanadium (HQ = 0.19; 3.9%)
	Dermal Contact	2.3×10^{-7}		0.21	
	Inhalation of Volatiles	--		--	
	Total	4.1×10^{-5}		4.8	
Radionuclides	Ingestion	6.9×10^{-7}		--	
	Inhalation of Volatiles	--			
	Total	6.9×10^{-7}			
Total Cumulative		4.1×10^{-5}			

Table 7-97. Summary of Cancer Risks and Noncancer Hazards for Well 299-E13-11 (Within the BC Cribs and Trenches Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	5.9×10^{-5}	Arsenic (ELCR = 5.9×10^{-5}; 89%) Sr-90 (ELCR = 2.6×10^{-6}; 3.9%) U-234 (ELCR = 2.7×10^{-6}; 4.2%) U-238 (ELCR = 1.7×10^{-6}; 2.5%)	3.1	Arsenic (HQ = 0.31; 9.5%) Cobalt (HQ = 0.73; 23%) Fluoride (HQ =0.15; 4.7%) Iron (HQ = 0.84; 26%) Manganese (HQ = 0.84; 26%) Nitrate (HQ = 0.034; 1.1%) Nitrite (HQ = 0.040; 1.3%) Uranium (HQ = 0.036; 1.1%) Vanadium (HQ = 0.22; 6.7%)
	Dermal Contact	3.3×10^{-7}		0.16	
	Inhalation of Volatiles	--		--	
	Total	5.9×10^{-5}		3.2	
Radionuclides	Ingestion	7.0×10^{-6}		--	
	Inhalation of Volatiles	--			
	Total	7.0×10^{-6}			

Table 7-97. Summary of Cancer Risks and Noncancer Hazards for Well 299-E13-11 (Within the BC Cribs and Trenches Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Total Cumulative		6.6×10^{-5}			

7.1.2.7 216-B-3 Pond Facility (Three Lobes) Exposure Area

The total cumulative ELCR for the 216-B-3 Pond exposure area is 2.4×10^{-4}. The total ELCR for nonradiological analytes is 1.5×10^{-4} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 9.1×10^{-5} which is within the EPA risk range of 1×10^{-4} to 1×10^{-6}. Table 7-98 provides a summary of the cancer risks and noncancer hazards by exposure route for the B Ponds exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are tritium (8.2×10^{-5}; 34 percent contribution) and iodine-129 (8.3×10^{-6}; 3.4 percent contribution). Contribution to ELCR is elevated for arsenic (1.5×10^{-4}; 62 percent contribution) where measured concentrations (7.8 µg/L) are within natural background values.

The HI for the 216-B-3 Pond exposure area is 1.7, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes (fluoride, Cr(VI), iron, manganese, nitrate, nitrite, uranium, and vanadium) contribute greater than one percent of the HI but also report a HQ less than 1. Contribution to HI is elevated for arsenic (HQ of 0.78; 46 percent contribution) where measured concentrations are within natural background values.

Table 7-98. Summary of Cancer Risks and Noncancer Hazards for the 216-B-3 Pond Facility (All Lobes) Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.5×10^{-4}	Arsenic (ELCR = 1.5×10^{-4}; 62%) I-129 (ELCR = 8.3×10^{-6}; 3.4%) Tritium (ELCR = 8.2×10^{-5}; 34%)	1.6	Arsenic (HQ = 0.78; 46%) Fluoride (HQ =0.16; 9.1%) Cr(VI) (HQ =0.12; 7.2%) Iron (HQ =0.17; 9.9%) Manganese (HQ = 0.093; 5.5%) Nitrate (HQ = 0.098; 5.7%) Nitrite (HQ = 0.019; 1.1%) Uranium (HQ = 0.040; 2.4%) Vanadium (HQ = 0.18; 11%)
	Dermal Contact	8.3×10^{-7}		0.093	
	Inhalation of Volatiles	--		--	
	Total	1.5×10^{-4}		1.7	
Radionuclides	Ingestion	2.3×10^{-5}		--	
	Inhalation of Volatiles	6.8×10^{-5}			

Table 7-98. Summary of Cancer Risks and Noncancer Hazards for the 216-B-3 Pond Facility (All Lobes) Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Total	9.1×10^{-5}			
Total Cumulative		2.4×10^{-4}			

7.1.2.8 216-B-3 Pond Facility (Three Lobes) Exposure Area- Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for four wells within the 216-B-3 Pond exposure area (699-42-40A, 699-42-42B, 699-43-41F and 699-43-44), the calculated risks and noncancer hazards are presented in Table 7-99 through Table 7-102, respectively. Well-specific results for well 699-43-45 are presented under the WMA A-AX and the 216-A-29 Ditch exposure area.

The total cumulative ELCR for the individual wells within the 216-B-3 Pond exposure area ranged between 2.1×10^{-4} and 2.9×10^{-4}. The total ELCR for nonradiological analytes ranged between 4.5×10^{-5} and 1.6×10^{-4} which are greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes ranged between 2.4×10^{-4} and 9.0×10^{-5}. The radiological ELCR is greater than the upper EPA risk range of 1×10^{-4} at well 699-42-40A and which are within the EPA risk range of 1×10^{-4} to 1×10^{-6} at wells 699-42-42B, 699-43-41F and 699-43-44.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are tritium and iodine-129. Contribution to ELCR is elevated for arsenic (4.5×10^{-5} to 1.6×10^{-4}) where the measured concentrations (2.3 µg/L to 8.3 µg/L) are within natural background values.

The HI for the individual wells within the 216-B-3 Pond exposure area ranged from 0.55 to 3.5; well 699-43-41F is less than the target HI of 1.0 and wells 699-42-40A, 699-42-42B and 699-43-44 are greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The primary contributors to the noncancer HI (those analytes that contribute greater than 1 percent of total HI) are iron (HQ of 1.6) and manganese (HQ of 1.3) at well 699-42-40A.All individual analytes at well 699-42-42B and 699-43-44 (fluoride, Cr(VI), iron, nickel, nitrate, nitrite, uranium, vanadium, and zinc) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for arsenic (HQ ranges between 0.23 and 0.84) where measured concentrations (2.3 µg/L to 8.3 µg/L) are within natural background values.

Table 7-99. Summary of Cancer Risks and Noncancer Hazards for Well 699-42-40A (Within the 216-B-3 Pond Facility (All Lobes) Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclid	Ingestion	4.4×10^{-5}	Arsenic (ELCR = 4.5×10^{-5}, 15%) Tritium (ELCR = 2.4×10^{-4}, 84%)	3.3	Arsenic (HQ = 0.23, 6.5%) Fluoride (HQ = 0.10, 2.8%)

Table 7-99. Summary of Cancer Risks and Noncancer Hazards for Well 699-42-40A (Within the 216-B-3 Pond Facility (All Lobes) Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Dermal Contact	2.5×10^{-7}		0.21	Iron (HQ = 1.6, 44%) Manganese (HQ = 1.3, 38%) Nickel (HQ = 0.04, 1.1%) Nitrate (HQ = 0.04, 1.1%) Nitrite (HQ = 0.09, 2.5%) Vanadium (HQ = 0.13, 3.6%)
	Inhalation of Volatiles	--		--	
	Total	4.5×10^{-5}		3.5	
Radionuclides	Ingestion	4.5×10^{-5}		--	
	Inhalation of Volatiles	2.0×10^{-4}			
	Total	2.4×10^{-4}			
Total Cumulative		2.9×10^{-4}			

Table 7-100. Summary of Cancer Risks and Noncancer Hazards for Well 699-42-42B (Within the 216-B-3 Pond Facility (All Lobes) Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.3×10^{-4}	Arsenic (ELCR = 1.3×10^{-4}; 59%) I-129 (ELCR = 8.5×10^{-6}; 3.9%) Tritium (ELCR = 8.2×10^{-5}; 37%)	1.3	Arsenic (HQ = 0.68; 48%) Fluoride (HQ =0.18; 12%) Cr(VI) (HQ =0.23; 16%) Nitrate (HQ = 0.034; 2.3%) Nitrite (HQ = 0.023; 1.6%) Uranium (HQ = 0.038; 2.7%) Vanadium (HQ =0.22; 15%)
	Dermal Contact	7.3×10^{-7}		0.12	
	Inhalation of Volatiles	--		--	
	Total	1.3×10^{-4}		1.4	
Radionuclides	Ingestion	2.3×10^{-5}		--	
	Inhalation of Volatiles	6.7×10^{-5}			
	Total	9.0×10^{-5}			
Total Cumulative		2.2×10^{-4}			

Table 7-101. Summary of Cancer Risks and Noncancer Hazards for Well 699-43-41F (Within the 216-B-3 Pond Facility (All Lobes) Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.1×10^{-4}	Arsenic (ELCR = 1.1×10^{-4}; 50%) I-129 (ELCR = 5.2×10^{-6}; 2.5%) Tritium (ELCR = 9.9×10^{-5}; 47%)	0.55	--
	Dermal Contact	5.9×10^{-7}		0.0032	
	Inhalation of Volatiles	--		--	
	Total	1.1×10^{-4}		0.55	
Radionuclides	Ingestion	2.3×10^{-5}		--	
	Inhalation of Volatiles	8.1×10^{-5}			
	Total	1.0×10^{-4}			
Total Cumulative		2.1×10^{-4}			

Table 7-102. Summary of Cancer Risks and Noncancer Hazards for Well 699-43-44 (Within the 216-B-3 Pond Facility (All Lobes) Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.6×10^{-4}	Arsenic (ELCR = 1.6×10^{-4}; 61%) I-129 (ELCR = 1.5×10^{-5}; 5.5%) Tritium (ELCR = 9.0×10^{-5}; 34%)	1.3	Arsenic (HQ = 0.84; 62%) Fluoride (HQ = 0.16; 12%) Iron (HQ = 0.016; 1.2%) Nickel (HQ = 0.021; 1.6%) Nitrite (HQ = 0.027; 2.0%) Uranium (HQ = 0.053; 3.9%) Vanadium (HQ = 0.19; 14%) Zinc (HQ =0.020; 1.5%)
	Dermal Contact	8.9×10^{-7}		0.043	
	Inhalation of Volatiles	--		--	
	Total	1.6×10^{-4}		1.4	
Radionuclides	Ingestion	3.0×10^{-5}		--	
	Inhalation of Volatiles	7.4×10^{-5}			
	Total	1.0×10^{-4}			
Total Cumulative		2.7×10^{-4}			

7.1.2.9 NRDWL/SWL Exposure Area

The total cumulative ELCR for the NRDWL/SWL exposure area is 2.0×10^{-4}. The total ELCR for nonradiological analytes is 6.1×10^{-5} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 1.4×10^{-4} which is greater than the upper risk threshold of 1×10^{-4}. Table 7-103 provides a summary of the cancer risks and noncancer hazards by exposure route for the NRDWL/SWL exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are tritium (1.3×10^{-4}; 63 percent contribution), bis(2-ethylhexyl) phthalate (6.4×10^{-6}; 3.1 percent contribution), uranium-234 (5.3×10^{-6}; 2.6 percent contribution), iodine-129 (4.0×10^{-6}; 1.9 percent contribution), uranium-238 (3.6×10^{-6}; 1.8 percent contribution), and carbon tetrachloride (2.2×10^{-6}; 1.1 percent contribution). Contribution to ELCR is elevated for arsenic (4.9×10^{-5}; 24 percent contribution) where measured concentrations (2.5 µg/L) are within natural background values.

The HI for the NRDWL/SWL exposure area is 1.5, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes (antimony, arsenic, barium, bis(2-ethylhexyl) phthalate, fluoride, Cr(VI), nitrate, nitrite, silver, strontium, tetrachloroethene, trichloroethene, uranium, vanadium, and xylenes) contribute greater than one percent of the HI but also report a HQ less than 1.

Table 7-103. Summary of Cancer Risks and Noncancer Hazards for the NRDWL/SWL Exposure Area

<table>
<tr><th>Analyte Group</th><th>Exposure Route</th><th>ELCR</th><th>% Risk Contribution</th><th>HI</th><th>% HI Contribution</th></tr>
<tr><td rowspan="4">Nonradionuclides</td><td>Ingestion</td><td>5.3×10^{-5}</td><td rowspan="8">Arsenic (ELCR = 4.9×10^{-5}; 24%)
BEHP (ELCR = 6.4×10^{-6}; 3.1%)
CTET (ELCR = 2.2×10^{-6}; 1.1%)
I-129 (ELCR = 4.0×10^{-6}; 1.9%)
Tritium (ELCR = 1.3×10^{-4}; 63%)
U-234 (ELCR = 5.3×10^{-6}; 2.6%)
U-238 (ELCR = 3.6×10^{-6}; 1.8%</td><td>1.2</td><td rowspan="4">Antimony (HQ = 0.38; 26%)
Arsenic (HQ = 0.26; 18%)
Barium (HQ = 0.015; 1.1%)
BEHP (HQ = 0.054; 3.7%)
Fluoride (HQ =0.11; 7.7%)
Cr(VI) (HQ = 0.090; 6.2%)
Nitrate (HQ = 0.072; 4.9%)
Nitrite (HQ = 0.028; 1.9%)
Silver (HQ = 0.035; 2.4%)
Strontium (HQ = 0.021; 1.4%)
PCE (HQ = 0.018; 1.2%)
TCE (HQ = 0.12; 8.4%)
Uranium (HQ = 0.081; 5.6%)
Vanadium (HQ = 0.082; 5.7 %)
Xylenes (HQ = 0.021; 1.4%)</td></tr>
<tr><td>Dermal Contact</td><td>4.6×10^{-6}</td><td>0.11</td></tr>
<tr><td>Inhalation of Volatiles</td><td>3.1×10^{-6}</td><td>0.13</td></tr>
<tr><td>Total</td><td>6.1×10^{-5}</td><td colspan="2">1.5</td></tr>
<tr><td rowspan="3">Radionuclides</td><td>Ingestion</td><td>3.7×10^{-5}</td><td colspan="2" rowspan="3">--</td></tr>
<tr><td>Inhalation of Volatiles</td><td>1.1×10^{-4}</td></tr>
<tr><td>Total</td><td>1.4×10^{-4}</td></tr>
</table>

Table 7-103. Summary of Cancer Risks and Noncancer Hazards for the NRDWL/SWL Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Total Cumulative		2.0×10^{-4}			

7.1.2.10 NRDWL/SWL Exposure Area- Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for 11 wells within the NRDWL/SWL exposure area (699-22-35, 699-23-34A, 699-23-34B, 699-24-33, 699-24-34A, 699-24-34B, 699-24-34C, 699-25-34A, 699-25-34B, 699-25-34D, and 699-26-33), the calculated risks and noncancer hazards are presented in Table 7-104 through Table 7-114.

The total cumulative ELCR for the individual wells within the NRDWL/SWL exposure area ranged between 2.3×10^{-4} and 1.9×10^{-6}. The total ELCR for nonradiological analytes ranged between 1.9×10^{-6} and 6.2×10^{-5}. Nonradiological ELCRs are less than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5} at wells 699-25-34B and 699-25-34D. The remaining nine wells report an ELCR for nonradiological analytes greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes was ranged between 3.9×10^{-5} and 1.7×10^{-4} at wells 699-24-34C and 699-26-33. The total ELCR for radiological analytes was greater than the upper risk threshold of 1×10^{-4} at well 699-26-33 and less than the upper risk threshold of 1×10^{-4} at well 699-24-34C. No radiological analytes were reported at the remaining nine wells.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) include the following:

- Carbon tetrachloride and chloroform at well 699-22-35
- Carbon tetrachloride at well 699-23-34B
- Chloroform at well 699-23-34B
- Ethylbenzene at well 699-24-34B
- Iodine-129 and tritium at well 699-24-34C
- Bis(2-ethylhexyl) phthalate and carbon tetrachloride at well 699-25-34A
- Bis(2-ethylhexyl) phthalate at well 699-25-34B
- Iodine-129, tritium , uranium-234 , and uranium-238 at well 699-26-33

Contribution to ELCR is elevated for arsenic (3.9×10^{-5} to 6.0×10^{-5}) at wells 699-22-35, 699-23-34A, 699-23-34B, 699-24-33, 699-24-34A, 699-24-34B, 699-24-34C, and 699-26-33 where the measured concentrations (2.0 to 3.1 µg/L) are within natural background values.

The HI for the individual wells within the NRDWL/SWL exposure area ranged from 0.64 to 5.7; Wells 699-24-33, 699-24-34C, 699-25-34D, and 699-26-33 are greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. The remaining seven wells (699-25-34B, 699-22-35, 699-23-34A, 699-23-34B, 699-24-34A, 699-24-34B, and 699-25-34A) are less than or equal to the the target HI of 1. All individual analytes (antimony, arsenic, barium, fluoride, Cr(VI), iron, nickel, nitrate, nitrite, silver, strontium, tetrachloroethene, trichloroethene,

uranium, and vanadium) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for antimony (HQ of 4.8; 85 percent contribution) at well 699-25-34D where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-104. Summary of Cancer Risks and Noncancer Hazards for Well 699-22-35 (Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	5.4×10^{-5}	Arsenic (ELCR = 5.3×10^{-5}, 93%) CTET (ELCR = 2.2×10^{-6}, 3.9%) Chloroform (ELCR = 1.2×10^{-6}, 2.1%)	0.81	--
	Dermal Contact	5.9×10^{-7}		0.09	
	Inhalation of Volatiles	2.5×10^{-6}		0.10	
	Total	5.7×10^{-5}		1.0	
Radionuclides	Ingestion	--		--	
	Inhalation of Volatiles	--			
	Total	--			
Total Cumulative		5.7×10^{-5}			

Table 7-105. Summary of Cancer Risks and Noncancer Hazards for Well 699-23-34A (Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	5.1×10^{-5}	Arsenic (ELCR = 4.9×10^{-5}, 89%) CTET (ELCR = 4.6×10^{-6}, 8.4%)	0.76	--
	Dermal Contact	8.5×10^{-7}		0.07	
	Inhalation of Volatiles	3.1×10^{-6}		0.12	
	Total	5.5×10^{-5}		1.0	
Radionuc lides	Ingestion	--		--	
	Inhalation of Volatiles	--			

Table 7-105. Summary of Cancer Risks and Noncancer Hazards for Well 699-23-34A
(Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Total	--			
Total Cumulative		5.5×10^{-5}			

Table 7-106. Summary of Cancer Risks and Noncancer Hazards for Well 699-23-34B
(Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	4.6×10^{-5}	Arsenic (ELCR = 4.5×10^{-5}, 94%) Chloroform (ELCR = 1.4×10^{-6}, 2.8%)	0.72	
	Dermal Contact	8.7×10^{-7}		0.06	
	Inhalation of Volatiles	1.7×10^{-6}		0.13	
	Total	4.8×10^{-5}		0.91	
Radionuclides	Ingestion	--		--	
	Inhalation of Volatiles	--			
	Total	--			
Total Cumulative		4.8×10^{-5}			

Table 7-107. Summary of Cancer Risks and Noncancer Hazards for Well 699-24-33
(Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	4.6×10^{-5}	Arsenic (ELCR = 4.6×10^{-5}, 97%)	0.92	Antimony (HQ = 0.21, 18%) Arsenic (HQ = 0.24, 21%) Barium (HQ = 0.02, 1.4%) Fluoride (HQ = 0.11, 9.9%) Cr(VI) (HQ = 0.05, 4.2%)
	Dermal Contact	3.4×10^{-7}		0.06	

Table 7-107. Summary of Cancer Risks and Noncancer Hazards for Well 699-24-33 (Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Inhalation of Volatiles	9.2×10^{-7}		0.15	Nickel (HQ = 0.01, 1.1%) Nitrate (HQ = 0.06, 5.6%) Nitrite (HQ = 0.08, 6.7%) Silver (HQ = 0.04, 3.2%) Strontium (HQ = 0.02, 2.1%) PCE (HQ = 0.03, 3.0%) TCE (HQ = 0.16, 15%) Vanadium (HQ = 0.08, 7.3%)
	Total	4.7×10^{-5}		1.1	
Radionuclides	Ingestion	--		--	
	Inhalation of Volatiles	--			
	Total	--			
Total Cumulative		4.7×10^{-5}			

Table 7-108. Summary of Cancer Risks and Noncancer Hazards for Well 699-24-34A (Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	6.0×10^{-5}	Arsenic (ELCR = 6.0×10^{-5}, 98%)	0.81	--
	Dermal Contact	4.2×10^{-7}		0.06	
	Inhalation of Volatiles	8.8×10^{-7}		0.14	
	Total	6.2×10^{-5}		1.0	
Radionuclides	Ingestion	--		--	
	Inhalation of Volatiles	--			
	Total	--			

Table 7-108. Summary of Cancer Risks and Noncancer Hazards for Well 699-24-34A (Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Total Cumulative		6.2×10^{-5}			

Table 7-109. Summary of Cancer Risks and Noncancer Hazards for Well 699-24-34B (Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	4.6×10^{-5}	Arsenic (ELCR = 4.5×10^{-5}, 95%) Ethylbenzene (ELCR = 1.4×10^{-6}, 3.0%)	0.82	--
	Dermal Contact	5.0×10^{-7}		0.07	
	Inhalation of Volatiles	1.4×10^{-6}		0.16	
	Total	4.8×10^{-5}		1.0	
Radionuclides	Ingestion	--		--	
	Inhalation of Volatiles	--			
	Total	--			
Total Cumulative		4.8×10^{-5}			

Table 7-110. Summary of Cancer Risks and Noncancer Hazards for Well 699-24-34C (Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	3.9×10^{-5}	Arsenic (ELCR = 3.9×10^{-5}, 49%) I-129 (ELCR = 1.5×10^{-6}, 2.0%) Tritium (ELCR = 3.7×10^{-5}, 47%)	0.94	Arsenic (HQ = 0.20, 15%) Fluoride (HQ = 0.11, 8.7%) Cr(VI) (HQ = 0.52, 40%) Nickel (HQ = 0.02, 1.3%) Nitrate (HQ = 0.06, 4.8%) Strontium (HQ = 0.02, 1.9%) PCE (HQ = 0.06, 4.4%) TCE (HQ = 0.16, 12%) Vanadium (HQ = 0.12, 9.1%)
	Dermal Contact	3.1×10^{-7}		0.21	
	Inhalation of Volatiles	5.1×10^{-7}		0.16	
	Total	4.0×10^{-5}		1.3	

Table 7-110. Summary of Cancer Risks and Noncancer Hazards for Well 699-24-34C (Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Radionuclides	Ingestion	8.1×10^{-6}		--	
	Inhalation of Volatiles	3.1×10^{-5}			
	Total	3.9×10^{-5}			
Total Cumulative		7.9×10^{-5}			

Table 7-111. Summary of Cancer Risks and Noncancer Hazards for Well 699-25-34A (Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	3.8×10^{-6}	BEHP (ELCR = 6.4×10^{-6}, 61%) CTET (ELCR = 2.2×10^{-6}, 21%)	0.44	--
	Dermal Contact	4.2×10^{-6}		0.07	
	Inhalation of Volatiles	2.5×10^{-6}		0.14	
	Total	1.1×10^{-5}		0.65	
Radionuclides	Ingestion	--		--	
	Inhalation of Volatiles	--			
	Total	--			
Total Cumulative		1.1×10^{-5}			

Table 7-112. Summary of Cancer Risks and Noncancer Hazards for Well 699-25-34B (Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclid	Ingestion	1.0×10^{-6}	BEHP (ELCR = 1.5×10^{-6}; 42%)	0.44	--

Table 7-112. Summary of Cancer Risks and Noncancer Hazards for Well 699-25-34B (Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Dermal Contact	9.9×10^{-7}		0.047	
	Inhalation of Volatiles	1.5×10^{-6}		0.16	
	Total	3.5×10^{-6}		0.64	
Radionuclides	Ingestion	--		--	
	Inhalation of Volatiles	--			
	Total	--			
Total Cumulative		3.5×10^{-6}			

Table 7-113. Summary of Cancer Risks and Noncancer Hazards for Well 699-25-34D (Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	4.8×10^{-7}		5.3	Antimony (HQ = 4.8, 85%) Fluoride (HQ = 0.12, 2.2%) Cr(VI) (HQ = 0.25, 4.4%) Nitrate (HQ = 0.08, 1.4%) Nitrite (HQ = 0.09, 1.5%) TCE (HQ = 0.13, 2.2%) Vanadium (HQ = 0.10, 1.8%)
	Dermal Contact	1.2×10^{-7}		0.30	
	Inhalation of Volatiles	1.3×10^{-6}		0.13	
	Total	1.9×10^{-6}	--	5.7	
Radionuclides	Ingestion	--		--	
	Inhalation of Volatiles	--			
	Total	--			
Total Cumulative		1.9×10^{-6}			

Table 7-114. Summary of Cancer Risks and Noncancer Hazards for Well 699-26-33 (Within the NRDWL/SWL Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	5.7×10^{-5}	Arsenic (ELCR = 5.7×10^{-5}; 25%) I-129 (ELCR = 4.4×10^{-6}; 1.9%) Tritium (ELCR = 1.5×10^{-4}; 68%) U-234 (ELCR = 5.3×10^{-6}; 2.3%) U-238 (ELCR = 3.6×10^{-6}; 1.6%)	1.0	Arsenic (HQ = 0.30; 23%) Fluoride (HQ =0.13; 10%) Cr(VI) (HQ =0.25; 19%) Iron (HQ = 0.016; 1.2%) Nitrate (HQ = 0.085; 6.6%) Nitrite (HQ = 0.048; 3.7%) Strontium (HQ = 0.018; 1.4%) PCE (HQ = 0.070; 5.5%) TCE (HQ =0.13; 9.9%) Uranium (HQ = 0.081; 6.3%) Vanadium (HQ =0.12; 9.0%)
	Dermal Contact	4.3×10^{-7}		0.12	
	Inhalation of Volatiles	1.5×10^{-6}		0.14	
	Total	5.9×10^{-5}		1.3	
Radionuclides	Ingestion	4.2×10^{-5}		--	
	Inhalation of Volatiles	1.3×10^{-4}			
	Total	1.7×10^{-4}			
Total Cumulative		2.3×10^{-4}			

7.1.2.11 200-PO-1 Far Field Exposure Area

The total cumulative ELCR for the 200-PO-1 Far Field exposure area is 1.2×10^{-3}. The total ELCR for nonradiological analytes is 1.5×10^{-4} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 1.1×10^{-3} which is greater than the upper EPA risk threshold of 1×10^{-4}. Table 7-115 provides a summary of the cancer risks and noncancer hazards by exposure route for the 200-PO-1 Far Field exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are tritium (9.9×10^{-4}; 80 percent contribution), uranium-233/234 (4.6×10^{-5}; 3.7 percent contribution), uranium-238 (2.5×10^{-5}; 2.0 percent contribution) and dibromochloromethane (1.3×10^{-5}; 1.1 percent contribution). Contribution to ELCR is elevated for arsenic (1.2×10^{-4}; 9.8 percent contribution) where measured concentrations (6.2 µg/L) are within natural background values.

The HI for the 200-PO-1 Far Field exposure area is 7.0, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes (arsenic, bromomethane, cadmium, fluoride, lithium, nitrate, silver, tetrachloroethene, trichloroethene, uranium, and vanadium) contribute greater than one percent of the HI but also report a HQ less than 1. Contribution to HI is elevated for antimony (HQ = 3.7; 52 percent contribution) where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-115. Summary of Cancer Risks and Noncancer Hazards for the 200-PO-1 Far Field Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.3×10^{-4}	Arsenic (ELCR = 1.2×10^{-4}; 9.8%) Dibromochloromethane (ELCR = 1.3×10^{-5}; 1.1%) Tritium (ELCR = 9.9×10^{-4}; 80%) U-233/234 (ELCR = 4.6×10^{-5}; 3.7%) U-238 (ELCR = 2.5×10^{-5}; 2.0%)	5.8	Antimony (HQ = 3.7; 52%) Arsenic (HQ = 0.63; 8.9%) Bromomethane (HQ = 0.53; 7.5%) Cadmium (HQ = 0.30; 4.3%) Fluoride (HQ = 0.14; 2.0%) Lithium (HQ = 0.16; 2.2 %) Nitrate (HQ = 0.14; 2.0%) Silver (HQ = 0.12; 1.7%) PCE (HQ = 0.080; 1.1%) TCE (HQ = 0.57; 8.1%) Uranium (HQ = 0.22; 3.1%) Vanadium (HQ = 0.093; 1.3%)
	Dermal Contact	2.5×10^{-6}		0.28	
	Inhalation of Volatiles	2.2×10^{-5}		0.95	
	Total	1.5×10^{-4}		7.0	
Radionuclides	Ingestion	2.6×10^{-4}		--	
	Inhalation of Volatiles	8.1×10^{-4}			
	Total	1.1×10^{-3}			
Total Cumulative		1.2×10^{-3}			

7.1.2.12 200-PO-1 Far Field Exposure Area - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for 19 wells within the 200-PO-1 Far Field exposure area (499-S0-7, 499-S0-8, 499-S1-8J, 699-10-54A, 699-12-2C, 699-13-1A, 699-13-3A, 699-20-20, 699-29-4, 699-31-11, 699-32-22A, 699-32-22B, 699-32-43, 699-41-23, 699-S6-E4A, 699-S6-E4E, 699-S6-E4K, 699-S6-E4L, 699-S8-19), the calculated risks and noncancer hazards are presented in Table 7-116 through Table 7-134.

The total cumulative ELCR for the individual wells within the 200-PO-1 Far Field exposure area ranged between 5.2×10^{-3} and 7.2×10^{-7}. The total ELCR for nonradiological analytes ranged between 3.2×10^{-4} and 4.6×10^{-7}. Nonradiological ELCRs are less than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5} at well 699-32-22B. Nonradiological risk is not reported at wells 699-12-2C and 699-S6-E4E. The remaining 16 wells report an ELCR for nonradiological analytes greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}.

The total ELCR for radiological analytes ranged from 5.1×10^{-3} to 2.6×10^{-7}. Wells 699-12-2C, 699-13-3A, 699-20-20, 699-29-4, 699-31-11, 699-32-22A, 699-32-43, and 699-S6-E4L are greater than the upper EPA risk threshold of 1×10^{-4}. Wells 499-S0-7, 499-S0-8, 499-S1-8J, 699-10-54A, 699-41-23, 699-S6-E4A, 699-S6-E4E, and 699-S6-E4K are within the EPA risk range of 1×10^{-4} to 1×10^{-6}. Well 699-32-

22B is less than the lower EPA risk threshold of 1×10^{-6}. Radiological risks were not reported for wells 699-13-1A and 699-S8-19.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) include:

- Bromodichloromethane, chloroform, dibromochloromethane, tritium at wells 499-S0-7, 499-S0-8, and 499-S1-8J
- Technetium-99 and uranium-234 at well 699-10-54A
- Technetium-99 and tritium at wells 699-12-2C and 699-29-4
- Bromodichloromethane and chloroform at well 699-13-1A
- Tritium at wells 699-13-3A and 699-S6-E4E
- Iodine-129 and tritium at wells 699-20-20, 699-32-22A, and 699-41-23
- Iodine-129, technetium-99, and tritium at well 699-31-11
- Iodine -129, tritium, uranium-234, and uranium-238 at well 699-32-43
- Carbon tetrachloride, tritium, uranium-233/234, uranium-234, and uranium-238 at well 699-S6-E4A
- Bis(2-ethylhexyl) phthalate, carbon tetrachloride, technetium-99, tritium, uranium-233/234, uranium-234, and uranium-238 at well 699-S6-E4K
- Carbon tetrachloride, trichloroethene, tritium, uranium-233/234, uranium-234, uranium-235, and uranium-238 at well 699-S6-E4L

Contribution to ELCR is elevated for arsenic (2.9×10^{-4} to 4.4×10^{-5}) where the measured concentrations (2.3 µg/L to 15 µg/L) are within natural background values.

The HI for the individual wells within the 200-PO-1 Far Field exposure area ranged from 0.70 to 7.0. Three wells (499-S1-8J. 699-12-2C, and 699-S6-E4K) are less than the target HI of 1.0. The remaining 16 wells are greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes at these wells (barium, bromomethane, cadmium, carbon tetrachloride, chloroform, cobalt, fluoride, Cr(VI), iron, lithium, manganese, molybdenum, nickel, nitrate, nitrite, selenium, silver, strontium, trichloroethene, tetrachloroethene, uranium, vanadium, and zinc) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI is elevated for arsenic (HQ ranges between 0.26 and 1.5) where measured concentrations (2.3 µg/L to 15 µg/L) are within natural background values. Contribution to HI is elevated for antimony (HQ ranges between 2.6 and 5.1) at wells 699-13-3A, 699-S6-E4A, and 699-S6-E4E where measured concentrations reflect false positive results from the use of EPA Method 6010.

Table 7-116. Summary of Cancer Risks and Noncancer Hazards for Well 499-S0-7
(Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	5.6×10^{-5}	Arsenic (ELCR = 5.1×10^{-5}; 37%) Bromodichloromethane (ELCR = 1.6×10^{-5}; 11%) Chloroform (ELCR = 5.0×10^{-6}; 3.6%) Dibromochloromethane (ELCR =2.0×10^{-5}; 14%) Tritium (ELCR = 4.7×10^{-5}; 34%)	1.3	Arsenic (HQ = 0.26; 19%) Bromomethane (HQ = 0.039; 2.8%) Fluoride (HQ = 0.12; 8.9%) Lithium (HQ = 0.38; 27%) Manganese (HQ = 0.39; 28%) Molybdenum (HQ = 0.051; 3.7%) Nitrate (HQ = 0.016; 1.1%) Nitrite (HQ = 0.040; 2.9%) Uranium (HQ = 0.036; 2.6%)
	Dermal Contact	7.4×10^{-7}		0.057	
	Inhalation of Volatiles	3.4×10^{-5}		0.037	
	Total	9.1×10^{-5}		1.4	
Radionuclides	Ingestion	8.2×10^{-6}		--	
	Inhalation of Volatiles	3.8×10^{-5}			
	Total	4.7×10^{-5}			
Total Cumulative		1.4×10^{-4}			

Table 7-117. Summary of Cancer Risks and Noncancer Hazards for Well 499-S0-8
(Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	5.8×10^{-5}	Arsenic (ELCR = 5.3×10^{-5}; 41%) Bromodichloromethane (ELCR = 1.2×10^{-5}; 9.0%) Chloroform (ELCR = 3.4×10^{-6}; 2.6%) Dibromochloromethane (ELCR =1.7×10^{-5}; 13%) Tritium (ELCR = 4.5×10^{-5}; 34%)	1.0	Arsenic (HQ = 0.28; 26%) Bromomethane (HQ = 0.048; 4.5%) Fluoride (HQ = 0.12; 11%) Lithium (HQ = 0.36; 34 %) Manganese (HQ = 0.023; 2.1%) Molybdenum (HQ = 0.053; 5.0%) Nitrate (HQ = 0.070; 6.5%) Nitrite (HQ = 0.031; 2.9%) Uranium (HQ = 0.047; 4.4%)
	Dermal Contact	6.7×10^{-7}		0.010	
	Inhalation of Volatiles	2.7×10^{-5}		0.043	
	Total	8.6×10^{-5}		1.1	
Radionuclides	Ingestion	9.2×10^{-6}		--	

Table 7-117. Summary of Cancer Risks and Noncancer Hazards for Well 499-S0-8
(Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Inhalation of Volatiles	3.7×10^{-5}			
	Total	4.6×10^{-5}			
Total Cumulative		1.3×10^{-4}			

Table 7-118. Summary of Cancer Risks and Noncancer Hazards for Well 499-S1-8J
(Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	4.7×10^{-5}	Arsenic (ELCR = 4.4×10^{-5}; 54%) Bromodichloromethane (ELCR = 7.4×10^{-6}; 9.2%) Chloroform (ELCR = 2.1×10^{-6}; 2.6%) Dibromochloromethane (ELCR =1.3×10^{-5}; 16%) Tritium (ELCR = 1.4×10^{-5}; 17%)	0.88	--
	Dermal Contact	5.2×10^{-7}		0.0094	
	Inhalation of Volatiles	1.9×10^{-5}		0.034	
	Total	6.7×10^{-5}		0.92	
Radionuclides	Ingestion	2.5×10^{-6}		--	
	Inhalation of Volatiles	1.1×10^{-5}			
	Total	1.4×10^{-5}			
Total Cumulative		8.1×10^{-5}			

Table 7-119. Summary of Cancer Risks and Noncancer Hazards for Well 699-10-54A (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	9.5×10^{-5}	Arsenic (ELCR = 9.5×10^{-5}; 95%) Tc-99 (ELCR = 2.6×10^{-6}; 2.6%) U-234 (ELCR = 1.2×10^{-6}; 1.2%	1.1	Arsenic (HQ = 0.49; 43%) Fluoride (HQ = 0.13; 11%) Cr(VI) (HQ = 0.053; 4.6%) Lithium (HQ = 0.090; 8.0 %) Molybdenum (HQ = 0.017; 1.5%) Nitrate (HQ = 0.089; 7.8%) Nitrite (HQ = 0.027; 2.4%) Selenium (HQ = 0.014; 1.2%) Uranium (HQ = 0.018; 1.6%) Vanadium (HQ = 0.18; 15%)
	Dermal Contact	5.3×10^{-7}		0.056	
	Inhalation of Volatiles	7.0×10^{-10}		<0.001	
	Total	9.5×10^{-5}		1.1	
Radionuclides	Ingestion	4.7×10^{-6}		--	
	Inhalation of Volatiles	--			
	Total	4.7×10^{-6}			
Total Cumulative		1.0×10^{-4}			

Table 7-120. Summary of Cancer Risks and Noncancer Hazards for Well 699-12-2C (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	--	Tc-99 (ELCR = 1.1×10^{-5}, 1.5%) Tritium (ELCR = 7.2×10^{-4}, 99%)	0.65	--
	Dermal Contact	--		0.05	
	Inhalation of Volatiles	--		--	
	Total	--		0.70	
Radionuclides	Ingestion	1.4×10^{-4}		--	
	Inhalation of Volatiles	5.9×10^{-4}			

Table 7-120. Summary of Cancer Risks and Noncancer Hazards for Well 699-12-2C (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Total	7.3×10^{-4}			
Total Cumulative		7.3×10^{-4}			

Table 7-121. Summary of Cancer Risks and Noncancer Hazards for Well 699-13-1A (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	2.9×10^{-4}	Arsenic (ELCR = 2.9×10^{-4}, 89%) Bromodichloromethane (ELCR = 4.2×10^{-6}, 1.3%) Chloroform (ELCR = 3.2×10^{-5}, 9.9%)	2.2	Arsenic (HQ = 1.5, 67%) Chloroform (HQ = 0.06, 2.6%) Fluoride (HQ = 0.14, 6.3%) Lithium (HQ = 0.14, 6.1%) Manganese (HQ = 0.07, 2.9%) Molybdenum (HQ = 0.04, 1.6%) Nitrate (HQ = 0.06, 2.7%) Uranium (HQ = 0.06, 2.7%) Vanadium (HQ = 0.15, 6.6%)
	Dermal Contact	1.9×10^{-6}		0.05	
	Inhalation of Volatiles	3.3×10^{-5}		0.03	
	Total	3.2×10^{-4}		2.2	
Radionuclides	Ingestion	--		--	
	Inhalation of Volatiles	--			
	Total	--			
Total Cumulative		3.2×10^{-4}			

Table 7-122. Summary of Cancer Risks and Noncancer Hazards for Well 699-13-3A (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	9.3×10^{-5}	Arsenic (ELCR = 9.3×10^{-5}; 1.8%) Tritium (ELCR = 5.1×10^{-3}; 98%)	4.6	Antimony (HQ = 2.6; 56%) Arsenic (HQ = 0.48; 10%) Cobalt (HQ = 0.090; 1.9%)

Table 7-122. Summary of Cancer Risks and Noncancer Hazards for Well 699-13-3A (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Dermal Contact	5.5×10^{-7}		0.17	Fluoride (HQ = 0.080; 1.7%) Cr(VI) (HQ = 0.091; 1.9%) Lithium (HQ = 0.47; 9.8%) Nitrate (HQ = 0.47; 9.8%) Silver (HQ = 0.12; 2.5%) Uranium (HQ = 0.10; 2.2%) Vanadium (HQ = 0.078; 1.7%)
	Inhalation of Volatiles	1.7×10^{-7}		<0.001	
	Total	9.3×10^{-5}		4.8	
Radionuclides	Ingestion	9.2×10^{-4}		--	
	Inhalation of Volatiles	4.2×10^{-3}			
	Total	5.1×10^{-3}			
Total Cumulative		5.2×10^{-3}			

Table 7-123. Summary of Cancer Risks and Noncancer Hazards for Well 699-20-20 (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	2.5×10^{-4}	Arsenic (ELCR = 2.5×10^{-4}, 48%) I-129 (ELCR = 9.0×10^{-6}, 1.7%) Tritium (ELCR = 2.6×10^{-4}, 50%)	2.2	Arsenic (HQ = 1.3, 59%) Fluoride (HQ = 0.15, 7.0%) Cr(VI) (HQ = 0.10, 4.7%) Lithium (HQ = 0.23, 10%) Molybdenum (HQ = 0.03, 1.6%) Nitrate (HQ = 0.15, 7.0%) Vanadium (HQ = 0.17, 7.8%)
	Dermal Contact	1.4×10^{-6}		0.08	
	Inhalation of Volatiles	--		--	
	Total	2.5×10^{-4}		2.2	
Radionuclides	Ingestion	5.7×10^{-5}		--	
	Inhalation of Volatiles	2.1×10^{-4}			
	Total	2.7×10^{-4}			

Table 7-123. Summary of Cancer Risks and Noncancer Hazards for Well 699-20-20
(Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Total Cumulative		5.2×10^{-4}			

Table 7-124. Summary of Cancer Risks and Noncancer Hazards for Well 699-29-4
(Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.7×10^{-4}	Arsenic (ELCR = 1.7×10^{-4}, 33%) Tc-99 (ELCR = 6.3×10^{-6}, 1.2%) Tritium (ELCR = 3.5×10^{-4}, 66%)	1.5	Arsenic (HQ = 0.90, 59%) Fluoride (HQ = 0.08, 5.4%) Cr(VI) (HQ = 0.06, 4.0%) Lithium (HQ = 0.13, 8.3%) Nitrate (HQ = 0.14, 9.4%) Vanadium (HQ = 0.17, 11%)
	Dermal Contact	9.6×10^{-7}		0.06	
	Inhalation of Volatiles	--		--	
	Total	1.7×10^{-4}		1.5	
Radionuclides	Ingestion	7.0×10^{-5}		--	
	Inhalation of Volatiles	2.9×10^{-4}			
	Total	3.5×10^{-4}			
Total Cumulative		5.3×10^{-4}			

Table 7-125. Summary of Cancer Risks and Noncancer Hazards for Well 699-31-11
(Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	8.0×10^{-5}	Arsenic (ELCR = 8.1×10^{-5}, 19%) I-129 (ELCR = 4.7×10^{-6}, 1.1%) Tc-99 (ELCR = 5.1×10^{-6}, 1.2%)	1.0	Arsenic (HQ = 0.42, 40%) Fluoride (HQ = 0.14, 13%) Cr(VI) (HQ = 0.04, 3.9%) Iron (HQ = 0.11, 11%) Lithium (HQ = 0.11, 10%)
	Dermal Contact	4.5×10^{-7}		0.03	

Table 7-125. Summary of Cancer Risks and Noncancer Hazards for Well 699-31-11 (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Inhalation of Volatiles	5.7×10^{-7}	Tritium (ELCR = 3.2×10^{-4}, 78%)	--	Manganese (HQ = 0.06, 5.3%) Molybdenum (HQ = 0.02, 1.8%) Nitrate (HQ = 0.12, 12%) Selenium (HQ = 0.01, 1.1%) Strontium (HQ = 0.01, 1.3%)
	Total	8.1×10^{-5}		1.1	
Radionuclides	Ingestion	6.7×10^{-5}		--	
	Inhalation of Volatiles	2.7×10^{-4}			
	Total	3.3×10^{-4}			
Total Cumulative		4.2×10^{-4}			

Table 7-126. Summary of Cancer Risks and Noncancer Hazards for Well 699-32-22A (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.1×10^{-4}	Arsenic (ELCR = 1.1×10^{-4}; 32%) I-129 (ELCR = 1.7×10^{-5}; 5.1%) Tritium (ELCR = 2.1×10^{-4}; 61%)	1.4	Arsenic (HQ = 0.58; 40%) Fluoride (HQ = 0.20; 14%) Cr(VI) (HQ = 0.10; 7.0%) Lithium (HQ = 0.17; 12%) Molybdenum (HQ = 0.049; 3.4%) Nitrate (HQ = 0.088; 6.2%) Nitrite (HQ = 0.020; 1.4%) Uranium (HQ = 0.027; 1.9%) Vanadium (HQ = 0.14; 9.7%)
	Dermal Contact	6.1×10^{-7}		0.066	
	Inhalation of Volatiles	--		--	
	Total	1.1×10^{-4}		1.4	
Radionuclides	Ingestion	6.0×10^{-5}		--	
	Inhalation of Volatiles	1.7×10^{-4}			
	Total	2.3×10^{-4}			

Table 7-126. Summary of Cancer Risks and Noncancer Hazards for Well 699-32-22A (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Total Cumulative		3.4×10^{-4}			

Table 7-127. Summary of Cancer Risks and Noncancer Hazards for Well 699-32-22B (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.8×10^{-7}	--	2.2	Barium (HQ = 0.04, 1.8%) Fluoride (HQ = 0.59, 26%) Iron (HQ = 0.25, 11%) Manganese (HQ = 0.66, 29%) Nitrite (HQ = 0.03, 1.4%) Zinc (HQ = 0.71, 31%)
	Dermal Contact	2.8×10^{-7}		0.10	
	Inhalation of Volatiles	--		--	
	Total	4.6×10^{-7}		2.3	
Radionuclides	Ingestion	2.6×10^{-7}		--	
	Inhalation of Volatiles	--			
	Total	2.6×10^{-7}			
Total Cumulative		7.2×10^{-7}			

Table 7-128 Summary of Cancer Risks and Noncancer Hazards for Well 699-32-43 (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	8.5×10^{-5}	Arsenic (ELCR = 8.5×10^{-5}, 38%) I-129 (ELCR = 3.6×10^{-6}, 1.6%) Tritium (ELCR = 1.3×10^{-4}, 56%)	1.7	Arsenic (HQ = 0.44, 24%) Cobalt (HQ = 0.42, 23%) Fluoride (HQ = 0.19, 10%) Cr(VI) (HQ = 0.35, 19%) Nitrate (HQ = 0.09, 4.8%)
	Dermal Contact	4.8×10^{-7}		0.16	

Table 7-128 Summary of Cancer Risks and Noncancer Hazards for Well 699-32-43 (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Inhalation of Volatiles	1.3×10^{-6}	U-234 (ELCR = 4.3×10^{-6}, 1.9%) U-238 (ELCR = 2.7×10^{-6}, 1.2%)	--	Nitrite (HQ = 0.03, 1.4%) Uranium (HQ = 0.07, 3.7%) Vanadium (HQ = 0.22, 12%)
	Total	8.6×10^{-5}		1.8	
Radionuclides	Ingestion	3.4×10^{-5}		--	
	Inhalation of Volatiles	1.0×10^{-4}			
	Total	1.4×10^{-4}			
Total Cumulative		2.2×10^{-4}			

Table 7-129. Summary of Cancer Risks and Noncancer Hazards for Well 699-41-23 (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.0×10^{-4}	Arsenic (ELCR = 1.0×10^{-4}; 62%) I-129 (ELCR = 1.6×10^{-5}; 9.4%) Tritium (ELCR = 4.7×10^{-5}; 28%)	1.2	Arsenic (HQ = 0.54; 43%) Fluoride (HQ = 0.24; 19%) Iron (HQ = 0.027; 2.1%) Lithium (HQ = 0.15; 12%) Manganese (HQ = 0.041; 3.2%) Molybdenum (HQ = 0.063; 5.0%) Nitrate (HQ = 0.030; 2.3%) Nitrite (HQ = 0.023; 1.8%) Vanadium (HQ = 0.12; 9.2%)
	Dermal Contact	5.8×10^{-7}		0.034	
	Inhalation of Volatiles	4.1×10^{-7}		<0.001	
	Total	1.1×10^{-4}		1.3	
Radionuclides	Ingestion	2.6×10^{-5}		--	
	Inhalation of Volatiles	3.9×10^{-5}			
	Total	6.5×10^{-5}			
Total Cumulative		1.7×10^{-4}			

Table 7-130. Summary of Cancer Risks and Noncancer Hazards for Well 699-S6-E4A (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.3×10^{-4}	Arsenic (ELCR = 1.2×10^{-4}, 59%) CTET (ELCR = 1.0×10^{-5}, 5.0%) Tritium (ELCR = 5.4×10^{-5}, 27%) U-233/234 (ELCR = 5.1×10^{-6}, 2.5%) U-234 (ELCR = 5.2×10^{-6}, 2.5%) U-238 (ELCR = 5.4×10^{-6}, 2.7%)	6.7	Antimony (HQ = 5.1, 73%) Arsenic (HQ = 0.63, 9.0%) Cobalt (HQ = 0.10, 1.4%) Fluoride (HQ = 0.14, 2.1%) Cr(VI) (HQ = 0.08, 1.1%) Lithium (HQ = 0.33, 4.7%) Nitrate (HQ = 0.12, 1.8%) Uranium (HQ = 0.12, 1.7%) Vanadium (HQ = 0.10, 1.4%)
	Dermal Contact	1.8×10^{-6}		0.26	
	Inhalation of Volatiles	5.4×10^{-6}		0.02	
	Total	1.3×10^{-4}		7.0	
Radionuclides	Ingestion	2.7×10^{-5}		--	
	Inhalation of Volatiles	4.5×10^{-5}			
	Total	7.2×10^{-5}			
Total Cumulative		2.0×10^{-4}			

Table 7-131. Summary of Cancer Risks and Noncancer Hazards for Well 699-S6-E4E (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	--	Tritium (ELCR = 6.0×10^{-5}, 100%)	5.1	Antimony (HQ = 4.3, 81%) Cadmium (HQ = 0.30, 5.6%) Fluoride (HQ = 0.13, 2.5%) Cr(VI) (HQ = 0.16, 2.9%) Nitrate (HQ = 0.12, 2.2%) Uranium (HQ = 0.15, 2.7%) Vanadium (HQ = 0.10, 1.9%)
	Dermal Contact	--		0.27	
	Inhalation of Volatiles	--		--	
	Total	--		5.4	
Radionuclides	Ingestion	1.1×10^{-5}		--	
	Inhalation of Volatiles	4.9×10^{-5}			
	Total	6.0×10^{-5}			

Table 7-131. Summary of Cancer Risks and Noncancer Hazards for Well 699-S6-E4E (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Total Cumulative		6.0×10^{-5}			

Table 7-132. Summary of Cancer Risks and Noncancer Hazards for Well 699-S6-E4K (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	8.9×10^{-6}	BEHP (ELCR = 5.5×10^{-6}, 6.2%) CTET (ELCR = 1.6×10^{-5}, 19%) Tc-99 (ELCR = 1.0×10^{-6}, 1.2%) Tritium (ELCR = 5.0×10^{-5}, 56%) U-233/234 (ELCR = 6.1×10^{-6}, 6.9%) U-234 (ELCR = 5.3×10^{-6}, 6.0%) U-238 (ELCR = 3.9×10^{-6}, 4.4%)	0.67	--
	Dermal Contact	5.1×10^{-6}		0.10	
	Inhalation of Volatiles	7.9×10^{-6}		0.04	
	Total	2.2×10^{-5}		0.80	
Radionuclides	Ingestion	2.5×10^{-5}		--	
	Inhalation of Volatiles	4.1×10^{-5}			
	Total	6.6×10^{-5}			
Total Cumulative		8.8×10^{-5}			

Table 7-133. Summary of Cancer Risks and Noncancer Hazards for Well 699-S6-E4L (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	5.1×10^{-6}	CTET (ELCR = 8.8×10^{-6}, 4.6%) TCE (ELCR = 3.3×10^{-6}, 1.7%) Tritium (ELCR = 4.6×10^{-5}, 24%) U-233/234 (ELCR = 6.5×10^{-5}, 34%)	1.8	CTET (HQ = 0.06, 2.2%) Fluoride (HQ = 0.10, 4.0%) Cr(VI) (HQ = 0.11, 4.5%) Manganese (HQ = 0.04, 1.6%)
	Dermal Contact	1.3×10^{-6}		0.11	

Table 7-133. Summary of Cancer Risks and Noncancer Hazards for Well 699-S6-E4L (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
	Inhalation of Volatiles	6.1×10^{-6}	U-234 (ELCR = 7.7×10^{-6}, 4.0%) U-235 (ELCR = 3.2×10^{-6}, 1.7%) U-238 (ELCR = 5.6×10^{-5}, 29%)	0.62	Nickel (HQ = 0.12, 4.8%) Nitrate (HQ = 0.19, 7.5%) PCE (HQ = 0.08, 3.1%) TCE (HQ = 0.71, 28%) Uranium (HQ = 0.98, 39%) Vanadium (HQ = 0.08, 3.0%)
	Total	1.2×10^{-5}		2.6	
Radionuclides	Ingestion	1.4×10^{-4}		--	
	Inhalation of Volatiles	3.8×10^{-5}			
	Total	1.8×10^{-4}			
Total Cumulative		1.9×10^{-4}			

Table 7-134. Summary of Cancer Risks and Noncancer Hazards for Well 699-S8-19 (Within the 200-PO-1 Far Field Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	2.5×10^{-4}	Arsenic (ELCR = 2.5×10^{-4}, 99%)	2.4	Arsenic (HQ = 1.3, 51%) Fluoride (HQ = 0.45, 18%) Lithium (HQ = 0.35, 14%) Nitrate (HQ = 0.12, 4.7%) Uranium (HQ = 0.05, 1.8%) Vanadium (HQ = 0.15, 6.2%)
	Dermal Contact	2.2×10^{-6}		0.05	
	Inhalation of Volatiles	--		<0.001	
	Total	2.5×10^{-4}		2.5	
Radionuclides	Ingestion	--		--	
	Inhalation of Volatiles	--			
	Total	--			
Total Cumulative		2.5×10^{-4}			

7.1.2.13 200-PO-1 Near River Exposure Area

The total cumulative ELCR for the 200-PO-1 Near River exposure area is 3.9×10^{-4}. The total ELCR for nonradiological analytes is 8.4×10^{-5} which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. The total ELCR for radiological analytes is 3.0×10^{-4} which is greater than the upper EPA risk threshold of 1×10^{-4}. Table 7-135 provides a summary of the cancer risks and noncancer hazards by exposure route for the 200-PO-1 Near River exposure area.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) are tritium (2.8×10^{-4}; 73 percent contribution) selenium-79 (5.5×10^{-6}; 1.4 percent contribution). Contribution to ELCR is elevated for arsenic (8.4×10^{-5}; 22 percent contribution) where measured concentrations (4.3 µg/L) are within natural background values.

The HI for the 200-PO-1 Far Field exposure area is 2.1, which is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes (antimony, cobalt, fluoride, Cr(VI), iron, lithium, manganese, molybdenum, nitrate, uranium, and vanadium) contribute greater than one percent of the HI but also report a HQ less than 1. Contribution to HI from arsenic (HQ = 0.43; 21 percent contribution) reflects concentrations (4.3 µg/L) that are within natural background values.

Table 7-135. Summary of Cancer Risks and Noncancer Hazards for the 200-PO-1 Near River Exposure Area

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	8.3×10^{-5}	Arsenic (ELCR = 8.4×10^{-5}; 22%) Se-79 (ELCR = 5.5×10^{-6}; 1.4%) Tritium (ELCR = 2.8×10^{-4}; 73%)	2.0	Antimony (HQ = 0.45; 22%) Arsenic (HQ = 0.43; 21%) Cobalt (HQ = 0.031; 1.5%) Fluoride (HQ =0.13; 6.1%) Cr(VI) (HQ = 0.074; 3.5%) Iron (HQ =0.11; 5.3%) Lithium (HQ =0.32; 15%) Manganese (HQ = 0.10; 4.8%) Molybdenum (HQ = 0.070; 3.4%) Nitrate (HQ =0.11; 5.2%) Uranium (HQ = 0.069; 3.3%) Vanadium (HQ =0.11; 5.1%)
	Dermal Contact	4.6×10^{-7}		0.082	
	Inhalation of Volatiles	--		<0.001	
	Total	8.4×10^{-5}		2.1	
Radionuclides	Ingestion	7.1×10^{-5}		--	
	Inhalation of Volatiles	2.3×10^{-4}			
	Total	3.0×10^{-4}			
Total Cumulative		3.9×10^{-4}			

7.1.2.14 200-PO-1 Near River Exposure Area - Well-Specific Cancer Risks and Noncancer Hazard Results

Well-specific risks were calculated for two wells within the 200-PO-1 Near River exposure area (699-40-1 and 699-41-1A), the calculated risks and noncancer hazards are presented in Table 7-136 and Table 7-137, respectively.

The total cumulative ELCR for the individual wells within the 200-PO-1 Near River exposure area ranged between 2.8×10^{-4} and 4.5×10^{-4}. The total ELCR for nonradiological analytes was 1.1×10^{-4} at well 699-41-1A which is greater than the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173-340-708(5)]) cumulative risk threshold of 1×10^{-5}. Nonradiological carcinogenic analytes were not reported at well 699-40-1. The total ELCR for radiological analytes ranged between 2.8×10^{-4} and 3.4×10^{-4} which are greater than the upper EPA risk threshold of 1×10^{-4}.

The major contributors to the total cumulative ELCR (those analytes that contribute greater than 1 percent of total cumulative ELCR) is tritium at well 699-40-1 and include tritium, selenium-79, and technetium-99 at well 699-41-1A. Contribution to ELCR is elevated for arsenic at well 699-41-1A (1.1×10^{-4}) where measured concentrations (5.6 µg/L) are within natural background values.

The HI for the individual wells within the 200-PO-1 exposure area ranged from 0.27 to 1.1, well 699-40-1 is less than the target HI of 1.0 and well 699-41-1A is greater than the EPA target HI of 1.0 and the 2007 MTCA ("Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) target HI of 1. All individual analytes at well 699-41-1A (fluoride, Cr(VI), molybdenum, nitrate, nitrite, strontium, uranium, vanadium) that contribute greater than one percent of the HI also report a HQ less than 1. Contribution to HI from arsenic (HQ = 0.56; 50 percent contribution) reflects concentrations (5.6 µg/L) that are within natural background values.

Table 7-136. Summary of Cancer Risks and Noncancer Hazards for Well 699-40-1 (Within the 200-PO-1 Near River Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	--	Tritium (ELCR = 2.7×10^{-4}; 99%)	0.27	--
	Dermal Contact	--		0.001	
	Inhalation of Volatiles	--		--	
	Total	--		0.27	
Radionuclides	Ingestion	5.0×10^{-5}		--	
	Inhalation of Volatiles	2.3×10^{-4}			
	Total	2.8×10^{-4}			
Total Cumulative		2.8×10^{-4}			

Table 7-137. Summary of Cancer Risks and Noncancer Hazards for Well 699-41-1A (Within the 200-PO-1 Near River Exposure Area)

Analyte Group	Exposure Route	ELCR	% Risk Contribution	HI	% HI Contribution
Nonradionuclides	Ingestion	1.1×10^{-4}	Arsenic (ELCR = 1.1×10^{-4}; 24%) Se-79 (ELCR = 5.5×10^{-6}; 1.2%) Tc-99 (ELCR = 5.8×10^{-6}; 1.3%) Tritium (ELCR = 3.2×10^{-4}; 71%)	1.1	Arsenic (HQ =0.56; 50%) Fluoride (HQ =0.13; 11%) Cr(VI) (HQ =0.053; 4.7%) Molybdenum (HQ =0.015; 1.3%) Nitrate (HQ =0.13; 12%) Nitrite (HQ =0.016; 1.4%) Strontium (HQ = 0.017; 1.5%) Uranium (HQ = 0.045; 4.0%) Vanadium (HQ =0.14; 12%)
	Dermal Contact	6.0×10^{-7}		0.049	
	Inhalation of Volatiles	--		--	
	Total	1.1×10^{-4}		1.1	
Radionuclides	Ingestion	7.9×10^{-5}		--	
	Inhalation of Volatiles	2.6×10^{-4}			
	Total	3.4×10^{-4}			
Total Cumulative		4.5×10^{-4}			

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Figure 6-1
HAND CALCULATIONS
(48 Sheets)

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200-BP-5 (299-E33-34)

Linda Carr 06/23/14 ①

Tap Water Ingestion: Carcinogenic

$$CDI = \frac{C_w \cdot IRW_{adj} \cdot EF}{AT \cdot CF1}$$

where, $IRW_{adj} = \frac{ED_c \cdot IRW_c}{BW_c} + \frac{(ED_a - ED_c) \cdot IRW_a}{BW_a}$

$RISK = CDI \cdot CSF_o$

→ Arsenic

$$IRW_{adj} = \frac{6y \cdot 0.78 \frac{L}{d}}{15\ kg} + \frac{(26y - 6y) \cdot 2.5 \frac{L}{d}}{80\ kg}$$

$$= 0.312 \frac{L \cdot y}{kg \cdot d} + 0.625 \frac{L \cdot y}{kg \cdot d} = 0.937 \frac{L \cdot y}{kg \cdot d}$$

$$CDI = \frac{0.00634 \frac{mg}{L} \cdot 0.937 \frac{L \cdot y}{kg \cdot d} \cdot 350 \frac{d}{y}}{70\ y \cdot 365 \frac{d}{y}} = 8.13E\text{-}05 \frac{mg}{kg \cdot d}$$

$$RISK = 8.13E\text{-}05 \frac{mg}{kg \cdot d} \cdot 1.50 \frac{kg \cdot d}{mg} = 1.22E\text{-}04$$ ✓

200-BP-5 (299-E33-34)

Linda Carr
06/24/14

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Tap Water Ingestion: Non-carcinogenic

$$CDI = \frac{C_w \cdot IRW_a \cdot EF \cdot ED_a}{BW_a \cdot AT \cdot CF1}$$

$$HQ = \frac{CDI}{RFD_o}$$

→ Nitrate

$$CDI = \frac{813\,\frac{mg}{L} \cdot 2.5\,\frac{L}{d} \cdot 350\,\frac{d}{y} \cdot 26\,y}{80\,kg \cdot 26\,y \cdot 365\,\frac{d}{y}} = 24.4\,\frac{mg}{kg \cdot d}$$

$$HQ = \frac{24.4\,\frac{mg}{kg \cdot d}}{7.10\,\frac{mg}{kg \cdot d}} = 3.43$$

200-BP-5 (299-E33-34)

Linda Carr
06/24/14

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Tap Water Ingestion: Radionuclides

$$CDI = C_w \cdot IRW_RAD_{adj} \cdot EF$$

where, $IRW_RAD_{adj} = (ED_c \cdot IRW_c) + ([ED_a - ED_c] \cdot IRW_a)$

$$RISK = CDI \cdot SF_o$$

→ tritium

$$CDI = 20{,}191 \frac{pCi}{L} \cdot 54.68 \frac{L \cdot y}{d} \cdot 350 \frac{d}{y} = 3.86E{+}08\ pCi$$

$$IRW_RAD_{adj} = \left(6y \cdot 0.78 \frac{L}{d}\right) + (26y - 6y) \cdot 2.5 \frac{L}{d}$$

$$= 54.68 \frac{L \cdot y}{d}$$

$$RISK = 3.86E{+}08\ pCi \cdot 5.07E{-}14 \frac{risk}{pCi} = 1.95E{-}05 \checkmark$$

200-BP-5 (299-E33-34)

Linda Carr (4)
06/28/14

Tap Water Inhalation of Volatiles: Carcinogenic

$$CDI = \frac{C_w \cdot ED_a \cdot EF \cdot ET_a \cdot CF2 \cdot VF \cdot 1000 \frac{ug}{mg}}{AT \cdot CF1}$$

$$RISK = CDI \cdot IUR$$

* Note: There are no analytes that have a risk value in this category.

Inhalation of Volatiles: Non-carcinogenic

$$CDI = \frac{C_w \cdot ED_a \cdot EF \cdot ET_a \cdot CF2 \cdot VF}{AT \cdot CF1}$$

$$HQ = \frac{CDI}{RFC}$$

→ Cyanide

$$CDI = \frac{0.45 \frac{mg}{L} \cdot 26y \cdot 350 \frac{d}{y} \cdot 24 \frac{h}{d} \cdot \frac{1d}{24h} \cdot 0.5 \frac{L}{m^3}}{26y \cdot 365 \frac{d}{Y}} = .216 \frac{mg}{m^3}$$

$$Risk = .216 \frac{mg}{m^3} \div 8.00E-04 \frac{mg}{m^3} = 270$$

200-BP-5 (299-E33-34) Linda Carr 06/25/14 (5)

Tap Water Inhalation of Volatiles: Radionuclides

$$CDI = C_w \cdot INH_RAD_{adj} \cdot VF \cdot EF \cdot ET_{adj} \cdot CF2$$

where, $INH_RAD_{adj} = (ED_c \cdot INH_c) + ((ED_a - ED_c) \cdot INH_a)$

and $ET_{adj} = \dfrac{(ET_c \cdot ED_c) + ((ED_a - ED_c) \cdot ET_a)}{ED_a}$

$$RISK = CDI \cdot SF_i$$

→ Tritium

$$INH_RAD_{adj} = \left(6y \cdot 10\frac{m^3}{d}\right) + \left((26y - 6y) \cdot 20\frac{m^3}{d}\right)$$

$$= 60\frac{m^3 \cdot y}{d} + 400\frac{m^3 \cdot y}{d} = 460\frac{m^3 \cdot y}{d}$$

$$ET_{adj} = \frac{\left(24\frac{h}{d} \cdot 6y\right) + \left((26y - 6y) \cdot 24\frac{h}{d}\right)}{26y} = 24\frac{h}{d}$$

$$CDI = 20{,}191\frac{pCi}{L} \cdot 460\frac{m^3 \cdot y}{d} \cdot 0.5\frac{L}{m^3} \cdot 350\frac{d}{y} \cdot 24\frac{h}{d} \cdot \frac{1\,d}{24h}$$

$$= 1.63E+09\ pCi$$

$$RISK = 1.63E+09\ pCi \cdot 5.62E-14\frac{risk}{pCi} = 9.13E-05 \checkmark$$

200-BP-5 (299-E33-34)

Linda Carr
06/24/14

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Tap Water Dermal Absorption: Carcinogenic, Organic

$$CDI = \frac{DA_{event} \cdot SA_{adj} \cdot EF}{AT \cdot CF1}$$

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

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

DA_{event}: If $ET \leq t^*$, $DA_{event} = 2 \cdot FA \cdot K_p \cdot C_w \cdot CF3 \cdot \sqrt{\frac{6 \cdot \tau \cdot ET_{adj}}{\pi}}$

If $ET > t^*$,

$$DA_{event} = FA \cdot K_p \cdot C_w \cdot CF3 \cdot \left[\frac{ET_{adj}}{1+B} + 2 \cdot \tau \cdot \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

$$Risk = CDI \cdot \frac{CSF_o}{GIABS}$$

* There are no analytes with a risk value that are carcinogenic

200-BP-5 (299-E33-34) Linda Carr 06/24/14 (7)

Tap Water Dermal Absorption: Carcinogenic, Inorganic

$$DA_{event} = K_p \cdot C_w \cdot ET_{adj} \cdot CF3$$

$$CDI = \frac{DA_{event} \cdot SA_{adj} \cdot EF}{AT \cdot CF1}$$

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

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

$$Risk = CDI \cdot \frac{CSF_o}{GIABS}$$

→ Arsenic

$$DA_{event} = 0.001 \frac{cm}{h} \cdot 0.0063 \frac{mg}{L} \cdot 0.671 \frac{h}{event} \cdot 0.001 \frac{L}{cm^3} = 4.23\,E\text{-}09 \frac{mg}{cm^2 \cdot event}$$

$$ET_{adj} = \frac{(0.54 \frac{h}{evnt} \cdot 6y) + ((26y - 6y) \cdot 0.71 \frac{h}{event})}{26y} = 0.671 \frac{h}{event}$$

$$SA_{adj} = \frac{6y \cdot 6{,}378\,cm^2 \cdot 1 \frac{event}{d}}{15\,Kg} + \frac{(26y - 6y) \cdot 20{,}900\,cm^2 \cdot 1 \frac{event}{d}}{80\,Kg}$$

$$= 2551 \frac{cm^2 \cdot y \cdot event}{} + 5{,}225 \frac{cm^2 \cdot y \cdot event}{} = 7776 \frac{cm^2 \cdot y \cdot evnt}{}$$

200-BP-5 (299-E33-34)

Linda Carr 06/24/14 (8)

$$CDI = \frac{4.23E\text{-}09 \frac{mg}{cm^2 \cdot event} \cdot 7{,}776 \frac{cm^2 \cdot y \cdot event}{kg \cdot d} \cdot 350 \frac{d}{y}}{70\,y \cdot 365 \frac{d}{y}}$$

$$= 4.51E\text{-}07 \frac{mg}{kg \cdot d}$$ (rounding)

$$RISK = 4.51E\text{-}07 \frac{mg}{kg \cdot d} \cdot 1.5 \frac{kg \cdot d}{mg} = 6.8E\text{-}07$$

Tap Water Dermal Absorption: Noncarcinogenic, Organic

* There are no analytes in this category that have HQ values in this exposure area

200-BP-5 (299-E33-34)

Linda Carr
06/24/14

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Tap Water Dermal Absorption: Non-carcinogen, Inorganic

$$CDI = \frac{DA_{event} \cdot SA_a \cdot EF \cdot ED_a \cdot EV}{BW_a \cdot AT \cdot CF1}$$

$$DA_{event} = Kp \cdot Cw \cdot ET \cdot CF3$$

$$HQ = \frac{CDI}{RFD_o \cdot GIABS}$$

→ Nitrate

$$DA_{event} = .001 \frac{cm}{h} \cdot 813 \frac{mg}{L} \cdot \left(.71 \frac{h}{event}\right) \cdot \left(.001 \frac{L}{cm^3}\right) = 5.77E\text{-}04 \frac{mg}{cm^2 \cdot event}$$

$$CDI = \frac{5.77E\text{-}04 \frac{mg}{cm^2 \cdot event} \cdot 20{,}900\ cm^2 \cdot 350 \frac{d}{y} \cdot 26y \cdot 1 \frac{event}{d}}{80\ kg \cdot 26y \cdot 365 \frac{d}{y}}$$

$$= 1.45E\text{-}01 \frac{mg}{kg \cdot d}$$

$$HQ = \frac{1.45E\text{-}01 \frac{mg}{kg \cdot d}}{7.10 \frac{mg}{kg \cdot d} \cdot 1} = 2.04E\text{-}02$$

200-BP-5 (299-E33-34)

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06/24/14

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TOTAL RISKS

Cancer	Ingestion		Inhalation	Dermal	Total Risk
Tritium:	1.96E-05	+	9.13E-05		= 1.11 E-04 ✓
Arsenic:	1.22E-04			+ 6.8E-07	= 1.23 E-04 ✓

noncancer			TOTAL HQ
Nitrate:	3.43	+ 2.04E-02	= 3.45 ✓
Cyanide:	(2.25E+01)	+ (2.70E+02) + (1.33E-01)	= 293 ✓

:00-BP-5 (WMAC Unconfined)

Linda Carr
06/23/14

(1)

Tap Water Equations

Ingestion - Carcinogenic

Ingestion - Noncarcinogenic

Ingestion - Radionuclides

Inhalation of Volatiles - Carcinogenic

Inhalation of Volatiles - Noncarcinogenic

Inhalation of Volatiles - Radionuclides

Dermal Absorption - Carcinogenic, Organic

Dermal Absorption - Carcinogenic, Inorganic

Dermal Absorption - Noncarcinogenic, Organic

Dermal Absorption - Noncarcinogenic, Inorganic

Totals

00-BP-5 (WMAC Uncontined)

Linda Carr (2)
06/23/14

Tap Water Ingestion: Carcinogenic

$$CDI = \frac{C_w \cdot IRW_{adj} \cdot EF}{AT \cdot CF1}$$

where, $$IRW_{adj} = \frac{ED_c \cdot IRW_c}{BW_c} + \frac{(ED_a - ED_c) \cdot IRW_a}{BW_a}$$

$$RISK = CDI \cdot CSF_o$$

→ Carbon Tetrachloride

$$IRW_{adj} = \frac{6y \cdot 0.78 \frac{L}{d}}{15\ Kg} + \frac{(26y - 6y) \cdot 2.5 \frac{L}{d}}{80\ Kg}$$

$$= 0.312 \frac{L \cdot y}{Kg \cdot d} + 0.625 \frac{L \cdot y}{Kg \cdot d}$$

$$= 0.937 \frac{L \cdot y}{Kg \cdot d}$$

$$CDI = \frac{.0013 \frac{mg}{L} \cdot \left(.937 \frac{L \cdot y}{Kg \cdot d}\right) \cdot 350 \frac{d}{y}}{70y \cdot 365 \frac{d}{y}}$$

$$= 1.66E-05 \frac{mg}{Kg \cdot d}$$

$$Risk = 1.66E-05 \frac{mg}{Kg \cdot d} \cdot 7.00E-02 \frac{Kg \cdot d}{mg} = 1.16E-06 \checkmark$$

200-BP-5 (WMA C Unconfined)

Linda Carr 06/23/14 (3)

Tap Water Ingestion: Non-carcinogenic

$$CDI = \frac{C_w \cdot IRW_a \cdot EF \cdot ED_a}{BW_a \cdot AT \cdot CF1}$$

$$HQ = \frac{CDI}{RfD_o}$$

→ Cyanide

$$CDI = \frac{0.0067 \frac{mg}{L} \cdot 2.5 \frac{L}{d} \cdot 350 \frac{d}{y} \cdot 26 y}{80 \text{ kg} \cdot 26 y \cdot 365 \frac{d}{y}}$$

$$= 2.01 \text{ E-04} \frac{mg}{kg \cdot d}$$

$$HQ = \frac{2.01 \text{ E-04} \frac{mg}{kg \cdot d}}{6.00 \text{ E-04} \frac{mg}{kg \cdot d}} = 3.35 \text{ E-01} \checkmark$$

200-BP-5 (WMA C Unconfined) Linda Carr 06/23/14 (4)

Tap Water Ingestion: Radionuclides

$$CDI = C_w \cdot IRW_RAD_{adj} \cdot EF$$

where, $IRW_RAD_{adj} = (ED_c \cdot IRW_c) + ([ED_a - ED_c] \cdot IRW_a)$

$$RISK = CDI \cdot SF_o$$

→ technetium-99

$$CDI = 5{,}981 \frac{pCi}{L} \cdot 54.68 \frac{L \cdot y}{d} \cdot 350 \frac{d}{y} = 1.14E+08\ pCi$$

$$IRW_RAD_{adj} = \left(6y \cdot 0.78 \frac{L}{d}\right) + \left([26y - 6y] \cdot 2.5 \frac{L}{d}\right)$$

$$= 4.68 \frac{L \cdot y}{d} + 50 \frac{L \cdot y}{d} = 54.68 \frac{L \cdot y}{d}$$

$$Risk = 1.14E+08\ pCi \cdot 2.75E-12 \frac{risk}{pCi} = 3.15E-04$$ ✓

200-BP-5 (WMA C Unconfined)

Linda Carr
06/23/14

(5)

Tap Water Inhalation of Volatiles: Carcinogenic

$$CDI = \frac{C_W \cdot ED_a \cdot EF \cdot ET_a \cdot CF2 \cdot VF \cdot 1000 \frac{ug}{mg}}{AT \cdot CF1}$$

$$RISK = CDI \cdot IUR$$

→ Carbon tetrachloride

$$CDI = \frac{0.0013 \frac{mg}{L} \cdot 26y \cdot 350 \frac{d}{y} \cdot 24 \frac{hr}{d} \cdot \frac{1d}{24hr} \cdot 0.5 \frac{L}{m^3} \cdot 1000 \frac{ug}{mg}}{70\ yr \cdot 365 \frac{d}{yr}}$$

$$= 0.232 \frac{ug}{m^3}$$

$$RISK = 0.232 \frac{ug}{m^3} \cdot 6.00E\text{-}06 \frac{m^3}{ug} = 1.4E\text{-}06$$ ✓

200-BP-5 (WMA C Unconfined) Linda Carr 06/23/14 (6)

Tap Water Inhalation of Volatiles: Non-carcinogenic

$$CDI = \frac{C_W \cdot ED_a \cdot EF \cdot ET_a \cdot CF2 \cdot VF}{AT \cdot CF1}$$

$$HQ = \frac{CDI}{RfC}$$

→ Cyanide

$$CDI = \frac{0.0067 \frac{mg}{L} \cdot 26y \cdot 350 \frac{d}{y} \cdot 24 \frac{hr}{d} \cdot \frac{1d}{24hr} \cdot 0.5 \frac{L}{m^3}}{26\ yr \cdot 365 \frac{d}{yr}}$$

$$= 3.21\ E\text{-}03 \frac{mg}{m^3}$$

$$HQ = \frac{3.21\ E\text{-}03 \frac{mg}{m^3}}{8.00\ E\text{-}04 \frac{mg}{m^3}} = 4.02 \checkmark$$

(rounding)

200-BP-5 (WMA C Unconfined) Linda Carr 06/23/14 (7)

Tap Water Inhalation of Volatiles: Radionuclides

$$CDI = C_W \cdot INH_RAD_{adj} \cdot VF \cdot EF \cdot ET_{adj} \cdot CF2$$

where, $INH_RAD_{adj} = (ED_c \cdot INH_c) + ([ED_a - ED_c] \cdot INH_a)$

and $ET_{adj} = \dfrac{(ET_c \cdot ED_c) + ((ED_a - ED_c) \cdot ET_a)}{ED_a}$

$$RISK = CDI \cdot SF_i$$

→ Tritium

$$INH_RAD_{adj} = \left(6y \cdot 10\frac{m^3}{d}\right) + \left((26y - 6y) \cdot 20\frac{m^3}{d}\right)$$

$$= 60\frac{m^3 \cdot y}{d} + 400\frac{m^3 \cdot y}{d} = 460\frac{m^3 \cdot y}{d}$$

$$ET_{adj} = \frac{\left(24\frac{hr}{d} \cdot 6y\right) + \left((26y - 6y) \cdot 24\frac{hr}{d}\right)}{26y} = 24\frac{hr}{d}$$

$$CDI = 1{,}074\frac{pCi}{L} \cdot 460\frac{m^3 \cdot y}{d} \cdot 0.5\frac{L}{m^3} \cdot 350\frac{d}{y} \cdot 24\frac{hr}{d} \cdot \frac{1\,d}{24\,hr}$$

$$= 8.65E{+}07\ pCi$$

$$Risk = 8.65E{+}07\ pCi \cdot 5.62E{-}14\frac{risk}{pCi} = 4.8E{-}06$$ ✓

200-BP-5 (WMA C Unconfined) Linda Carr 06/23/14 (8)

Tap Water Dermal Absorption: Carcinogenic, Organic

$$CDI = \frac{DA_{event} \cdot SA_{adj} \cdot EF}{AT \cdot CF1}$$

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

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

DA_{event}: If $ET \leq t^*$, $DA_{event} = 2 \cdot FA \cdot K_p \cdot C_w \cdot CF3 \cdot \sqrt{\frac{6 \cdot \tau \cdot ET_{adj}}{\pi}}$

If $ET > t^*$,

$$DA_{event} = FA \cdot K_p \cdot C_w \cdot CF3 \cdot \left[\frac{ET_{adj}}{1+B} + 2 \cdot \tau \cdot \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

$$RISK = CDI \cdot \frac{CSFo}{GIABS}$$

→ Carbon tetrachloride

$$ET_{adj} = \frac{(0.54 \frac{h}{event} \cdot 6y) + (26y - 6y) \cdot 0.71 \frac{h}{event}}{26y} = .671 \frac{h}{event}$$

$$DA_{event} = 2 \cdot 1 \cdot \left(0.016 \frac{cm}{h}\right) \cdot \left(.0013 \frac{mg}{L}\right) \cdot \left(0.001 \frac{L}{cm^3}\right) \cdot \sqrt{\frac{6 \left(.78 \frac{h}{event}\right) \cdot \left(.671 \frac{h}{event}\right)}{3.14}}$$

$$= 4.16E\text{-}08 \frac{mg}{h \cdot cm^2} \sqrt{1.0 \frac{h}{event}} = 4.2E\text{-}08 \frac{mg}{cm^2 \cdot event}$$

200-BP-5 (WMA C Unconfined) Linda Carr 06/23/14 (9)

$$SA_{adj} = \frac{6y \cdot 6{,}378\,cm^2 \cdot 1\frac{event}{d}}{15\,kg} + \frac{(26y - 6y) \cdot 20{,}900\,cm^2 \cdot 1\frac{event}{d}}{80\,kg}$$

$$= 2{,}551\,\frac{cm^2 \cdot y \cdot event}{kg \cdot d} + 5{,}225\,\frac{cm^2 \cdot y \cdot event}{kg \cdot d}$$

$$= 7{,}776\,\frac{cm^2 \cdot y \cdot event}{kg \cdot d}$$

$$CDI = \frac{4.2E\text{-}08\,\frac{mg}{h \cdot cm^2} \cdot 7{,}776\,\frac{cm^2 \cdot y \cdot event}{kg \cdot d} \cdot 350\,\frac{d}{y}}{70\,y \cdot 365\,\frac{d}{y}} = 4.4E\text{-}06\,\frac{mg}{kg \cdot d}$$

$$RISK = 4.4E\text{-}06\,\frac{mg}{kg \cdot d} \cdot \frac{7.0E\text{-}02\,\frac{kg \cdot d}{mg}}{1} = 3.1E\text{-}07 \checkmark$$

Tap Water Dermal Absorption: Carcinogenic, Inorganic

$$DA_{event} = K_p \cdot C_w \cdot ET_{adj} \cdot CF3$$

$$CDI = \frac{DA_{event} \cdot SA_{adj} \cdot EF}{AT \cdot CF1}$$

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

$$RISK = CDI \cdot \frac{CSF_o}{GIABS}$$

$$ET_{adj} = \frac{(ET_c \cdot ED_c) + ([ED_a - ED_c] \cdot ET_a)}{ED_a}$$

200-BP-5 (WMA C Unconfined)

Linda Carr
06/23/14

(10)

→ Arsenic

$$DA_{event} = .001 \frac{cm}{h} \cdot \left(.0065 \frac{mg}{L}\right) \cdot \left(.671 \frac{h}{event}\right) \cdot \left(0.001 \frac{L}{cm^3}\right)$$

$$= 4.4E-09 \frac{mg}{cm^2 \cdot event}$$

$$CDI = \frac{4.4E-09 \frac{mg}{cm^2 \cdot event} \cdot 7{,}776 \frac{cm^2 \cdot y \cdot event}{kg \cdot d} \cdot 350 \frac{d}{y}}{70 y \cdot 365 \frac{d}{y}}$$

$$= 4.7E-07 \frac{mg}{kg \cdot d}$$

$$Risk = 4.7E-07 \frac{mg}{kg \cdot d} \cdot \frac{1.5 \frac{kg \cdot d}{mg}}{1} = 7.0E-07 \checkmark$$

200-BP-5 (WMA C Unconfined)

Linda Carr
06/23/14

(11)

Tap Water Dermal Absorption: Noncarcinogen, Organic

$$CDI = \frac{DA_{event} \cdot SA_a \cdot EF \cdot ED_a \cdot EV}{BW_a \cdot AT \cdot CF1}$$

$$HQ = \frac{CDI}{RFD_o \cdot GIABS}$$

If $ET \leq t^*$, $DA_{event} = 2 \cdot FA \cdot K_p \cdot C_w \cdot CF3 \sqrt{\frac{6 \cdot \tau \cdot ET}{\pi}}$

If $ET > t^*$,

$$DA_{event} = FA \cdot K_p \cdot C_w \cdot CF3 \left[\frac{ET}{1+B} + 2 \cdot \tau \cdot \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

→ Carbon tetrachloride

$$DA_{event} = 2 \cdot 1 \cdot \left(.016 \frac{cm}{h}\right) \cdot \left(.0013 \frac{mg}{L}\right) \cdot \left(.001 \frac{L}{cm^3}\right) \sqrt{\frac{6\left(.78 \frac{h}{event}\right)\left(.71 \frac{h}{event}\right)}{3.14}}$$

$$= 4.16E-08 \frac{mg}{h \cdot cm^2} \sqrt{1.06 \frac{h}{event}} = 4.28E-08 \frac{mg}{cm^2 \cdot event}$$

$$CDI = \frac{4.28E-08 \frac{mg}{cm^2 \cdot event} \cdot 20{,}900\, cm^2 \cdot 350 \frac{d}{y} \cdot 26\, y \cdot 1 \frac{event}{d}}{80\, Kg \cdot 26\, y \cdot 365 \frac{d}{y}} = \frac{1.07E-05}{\cancel{4.4E-06}\ \frac{mg}{Kg \cdot d}}$$

$$HQ = \frac{1.07E-05 \ \cancel{4.4E-06} \frac{mg}{Kg \cdot d}}{4.00E-03 \frac{mg}{Kg \cdot d} \cdot 1} = \cancel{2.68E-03}\ 2.68E-03$$

200-BP-5 (WMA C Unconfined) Linda Carr 06/23/14 (12)

Tap Water Dermal Absorption: Noncarcinogen, Inorganic

$$CDI = \frac{DA_{event} \cdot SA_a \cdot EF \cdot ED_a \cdot EV}{BW_a \cdot AT \cdot CF1}$$

$$HQ = \frac{CDI}{RFD_o \cdot GIABS}$$

For Inorganics, $DA_{event} = Kp \cdot Cw \cdot ET \cdot CF3$

→ Cyanide

$$DA_{event} = 0.001 \frac{cm}{h} \cdot \left(.0067 \frac{mg}{L}\right) \cdot 0.71 \frac{h}{event} \cdot \left(0.001 \frac{L}{cm^3}\right) = 4.76E\text{-}09 \frac{mg}{cm^2 \cdot event}$$

$$CDI = \frac{4.76E\text{-}09 \frac{mg}{cm^2 \cdot event} \cdot 20{,}900\, cm^2 \cdot 350 \frac{d}{y} \cdot 26\, y \cdot 1 \frac{event}{d}}{80\, kg \cdot 26\, y \cdot 365 \frac{d}{y}}$$

$$= 1.2E\text{-}06 \frac{mg}{kg \cdot d}$$

$$HQ = \frac{1.2E\text{-}06 \frac{mg}{kg \cdot d}}{6.00E\text{-}04 \frac{mg}{kg \cdot d} \cdot 1} = 2.0E\text{-}03 \checkmark$$

200-BP-5 (WMA C Unconfined)

Linda Carr (13)
06/23/14

Totals

Cancer	Ingestion	Inhalation	Dermal	Total Risk
Carbon tetrachloride:	1.17E-06 +	1.39E-06 +	3.10E-07 =	2.87E-06 ✓
Tech-99:	3.15E-04		=	3.15E-04 ✓
tritium:	1.04E-06 +	4.86E-06	=	5.9E-06 ✓

noncancer				Total HQ
cyanide:	3.36E-01 +	4.04 +	2.0E-03 =	4.38 ✓
Carbon tetrachloride:	9.74E-03 +	6.23E-03 +	2.68E-03 =	1.87E-02 ✓

200-PO-1 (499-50-8)

Linda Carr
6/26/14

(1)

Tap Water Ingestion: Carcinogen

$$CDI = \frac{C_w \cdot IRW_{adj} \cdot EF}{AT \cdot CF1}$$

where, $IRW_{adj} = \frac{ED_c \cdot IRW_c}{BW_c} + \frac{(ED_a - ED_c) \cdot IRW_a}{BW_a}$

$RISK = CDI \cdot CSF_o$

→ Dibromochloromethane

$$IRW_{adj} = \frac{6y \cdot 0.78 \frac{L}{d}}{15\,Kg} + \frac{(26y - 6y) \cdot 2.5 \frac{L}{d}}{80\,Kg}$$

$$= 0.312 \frac{L \cdot y}{Kg \cdot d} + 0.625 \frac{L \cdot y}{Kg \cdot d} = 0.937 \frac{L \cdot y}{Kg \cdot d}$$

$$CDI = \frac{0.0028 \frac{mg}{L} \cdot 0.937 \frac{L \cdot y}{Kg \cdot d} \cdot 350 \frac{d}{y}}{70y \cdot 365 \frac{d}{y}} = 3.59E\text{-}05 \frac{mg}{Kg \cdot d}$$

$$RISK = 3.59E\text{-}05 \frac{mg}{Kg \cdot d} \cdot 8.40E\text{-}02 \frac{Kg \cdot d}{mg} = 3.0E\text{-}06 \checkmark$$

200-PO-1(499-SO-8)

Linda Carr
6/26/14

(2)

Tap Water Ingestion: Noncarcinogen

$$CDI = \frac{C_w \cdot IRW_a \cdot EF \cdot ED_a}{BW_a \cdot AT \cdot CF1}$$

$$HQ = \frac{CDI}{RfD_o}$$

→ fluoride

$$CDI = \frac{0.23\,\frac{mg}{L} \cdot 2.5\,\frac{L}{d} \cdot 350\,\frac{d}{y} \cdot 26\,y}{80\,kg \cdot 26\,y \cdot 365\,\frac{d}{y}} = 6.89E\text{-}03\,\frac{mg}{Kg.d}$$

$$HQ = \frac{6.89E\text{-}03\,\frac{mg}{Kg.d}}{6.00E\text{-}02\,\frac{mg}{Kg.d}} = 0.115 \checkmark$$

200-PO-1 (499-50-8)

Linda Carr
6/26/14

(3)

Tap Water Ingestion: Radionuclides

$CDI = C_w \cdot IRW_RAD_{adj} \cdot EF$

where, $IRW_RAD_{adj} = (ED_c \cdot IRW_c) + ([ED_a - ED_c] \cdot IRW_a)$

$RISK = CDI \cdot SF_o$

→ tritium

$IRW_{adj} = 6y \cdot 0.78 \frac{L}{d} + (26y - 6y) \cdot 2.5 \frac{L}{d}$

$= 54.68 \frac{L \cdot y}{d}$

$CDI = 8{,}131 \frac{pCi}{L} \cdot 54.68 \frac{L}{d} \cdot 350 \frac{d}{y} = 1.56E+08\ pCi$

$RISK = 1.56E+08\ pCi \cdot 5.07E-14 \frac{risk}{pCi} = 7.91E-06$ ✓
(rounding)

200-PO-1 (499-S0-8)

Linda Carr
6/26/14

(4)

Tap Water Inhalation of Volatiles: Carcinogen

$$CDI = \frac{C_W \cdot ED \cdot EF \cdot ET \cdot CF2 \cdot VF \cdot 1000 \frac{ug}{mg}}{AT \cdot CF1}$$

$$RISK = CDI \cdot IUR$$

→ Dibromochloromethane

$$CDI = \frac{0.0028 \frac{mg}{L} \cdot 26y \cdot 350 \frac{d}{y} \cdot 24 \frac{h}{d} \cdot \frac{1 d}{24 h} \cdot 0.5 \frac{L}{m^3} \cdot 1000 \frac{ug}{mg}}{70y \cdot 365 \frac{d}{Y}}$$

$$= 0.499 \frac{ug}{m^3}$$

$$RISK = 0.499 \frac{ug}{m^3} \cdot 2.70E\text{-}05 \frac{m^3}{ug} = 1.34E\text{-}05$$

200-PO-1 (499-S0-8)

Linda Carr
6/26/14

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Tap Water Inhalation of Volatiles: Non-carcinogen

$$CDI = \frac{C_w \cdot ED_a \cdot EF \cdot ET_a \cdot CF2 \cdot VF}{AT \cdot CF1}$$

$$HQ = \frac{CDI}{RFC}$$

→ Bromomethane

$$CDI = \frac{.00041 \frac{mg}{L} \cdot 26y \cdot 350 \frac{d}{y} \cdot 24 \frac{h}{d} \cdot \frac{1d}{24h} \cdot 0.5 \frac{L}{m^3}}{26y \cdot 365 \frac{d}{y}}$$

$$= 1.97E-04 \frac{mg}{m^3}$$

$$HQ = \frac{1.97E-04 \frac{mg}{m^3}}{5.0E-03 \frac{mg}{m^3}} = 3.93E-02$$

200-PO-1 (499-50-8)

Linda Carr (6)
6/26/14

Tap Water Inhalation of volatiles: Radionuclides

$$CDI = C_w \cdot INH_RAD_{adj} \cdot VF \cdot EF \cdot ET_{adj} \cdot CF2$$

where, $INH_RAD_{adj} = (ED_c \cdot INH_c) + ((ED_a - ED_c) \cdot INH_a)$

and $ET_{adj} = \dfrac{(ET_c \cdot ED_c) + ((ED_a - ED_c) \cdot ET_a)}{ED_a}$

$$RISK = CDI \cdot SF_i$$

→ tritium

$$INH_RAD_{adj} = \left(6y \cdot 10\frac{m^3}{d}\right) + \left((26y - 6y) \cdot 20\frac{m^3}{d}\right)$$

$$= 60\,\frac{m^3 \cdot y}{d} + 400\,\frac{m^3 \cdot y}{d} = 460\,\frac{m^3 \cdot y}{d}$$

$$ET_{adj} = \frac{\left(24\frac{h}{d} \cdot 6y\right) + \left((26y - 6y) \cdot 24\frac{h}{d}\right)}{26y} = 24\,\frac{h}{d}$$

$$CDI = 8{,}131\,\frac{pCi}{L} \cdot 460\,\frac{m^3 \cdot y}{d} \cdot 0.5\,\frac{L}{m^3} \cdot 350\,\frac{d}{y} \cdot 24\,\frac{h}{d} \cdot \frac{1\,d}{24\,h}$$

$$= 6.55E{+}08\ pCi$$

$$RISK = 6.55E{+}08\ pCi \cdot 5.62E{-}14\,\frac{risk}{pCi} = 3.67E{-}05$$

200-PO-1 (499-SO-8) Linda Carr 6/26/14 (7)

Tap Water Dermal Absorption: Carcinogenic, organic

$$CDI = \frac{DA_{event} \cdot SA_{adj} \cdot EF}{AT \cdot CF1}$$

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

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

DA_{event}: If $ET \leq t^*$, $DA_{event} = 2 \cdot FA \cdot Kp \cdot C_w \cdot CF3 \cdot \sqrt{\frac{6 \cdot \tau \cdot ET_{adj}}{\pi}}$

If $ET > t^*$,

$$DA_{event} = FA \cdot Kp \cdot C_w \cdot CF3 \left[\frac{ET_{adj}}{1+B} + 2 \cdot \tau \cdot \left(\frac{1 + 3B + 3B^2}{(1+B)^2} \right) \right]$$

$$RISK = CDI \cdot \frac{CSF_o}{GIABS}$$

200-PO-1 (499-S0-8)

Linda Carr
6/26/14

(8)

→ Dibromochloromethane

$$DA_{event} = 2 \cdot 1 \cdot \left(.0032 \frac{cm}{h}\right) \cdot \left(.0028 \frac{mg}{L}\right) \cdot \left(.001 \frac{L}{cm^3}\right) \sqrt{\frac{6 \cdot \left(1.57 \frac{h}{evnt}\right) \cdot 0.671 \frac{h}{event}}{3.14}}$$

$$= 1.79E\text{-}08 \frac{mg}{cm^2 \cdot h} \cdot 1.42 \frac{h}{event} = 2.54E\text{-}08 \frac{mg}{cm^2 \cdot event}$$

$$ET_{adj} = \frac{\left(0.54 \frac{h}{event} \cdot 6y\right) + \left((26y - 6y) \cdot 0.71 \frac{h}{event}\right)}{26y} = 0.671 \frac{h}{event}$$

$$SA_{adj} = \frac{6y \cdot 6{,}378\ cm^2 \cdot 1 \frac{event}{d}}{15\ Kg} + \frac{(26y - 6y) \cdot 20{,}900\ cm^2 \cdot 1 \frac{event}{d}}{80\ Kg}$$

$$= 2{,}551 \frac{cm^2 \cdot y \cdot event}{Kg \cdot d} + 5{,}225 \frac{cm^2 \cdot y \cdot event}{Kg \cdot d} = 7{,}776 \frac{cm^2 \cdot y \cdot event}{Kg \cdot d}$$

$$CDI = \frac{2.54E\text{-}08 \frac{mg}{cm^2 \cdot event} \cdot 7{,}776 \frac{cm^2 \cdot y \cdot event}{Kg \cdot d} \cdot 350 \frac{d}{y}}{70y \cdot 365 \frac{d}{y}} = 2.7E\text{-}06 \frac{mg}{Kg \cdot d}$$

$$RISK = 2.7E\text{-}06 \frac{mg}{Kg \cdot d} \cdot \frac{8.40E\text{-}02 \frac{Kg \cdot d}{mg}}{1} = 2.27E\text{-}07$$

200-PO-1 (499-S0-8) Linda Carr 6/26/14 (9)

Tap Water Dermal Absorption: Carcinogenic, Inorganic

$$DA_{event} = K_p \cdot C_w \cdot ET_{adj} \cdot CF3$$

$$CDI = \frac{DA_{event} \cdot SA_{adj} \cdot EF}{AT \cdot CF1}$$

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

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

$$RISK = CDI \cdot \frac{CSF_o}{GIABS}$$

→ Arsenic

$$DA_{event} = .001 \frac{cm}{h} \cdot 0.0028 \frac{mg}{L} \cdot 0.671 \frac{h}{event} \cdot 0.001 \frac{L}{cm^3} = 1.88E\text{-}09 \frac{mg}{cm^2 \cdot event}$$

$$ET_{adj} = \frac{(0.54 \frac{h}{event} \cdot 6y) + (26y - 6y) \cdot 0.71 \frac{h}{event}}{26y} = 0.671 \frac{h}{event}$$

$$SA_{adj} = \frac{6y \cdot 6{,}378 cm^2 \cdot 1 \frac{event}{d}}{15 Kg} + \frac{(26y - 6y) \cdot 20{,}900 cm^2 \cdot 1 \frac{event}{d}}{80 Kg} = 7{,}776 \frac{cm^2 \cdot y \cdot event}{Kg \cdot d}$$

200-PO-1 (499-S0-8)

Linda Carr
6/26/14

(10)

$$CDI = \frac{1.88E\text{-}09 \frac{mg}{cm^2 \cdot event} \cdot 7{,}776 \frac{cm^2 \cdot y \cdot event}{kg \cdot d} \cdot 350 \frac{d}{y}}{70\,y \cdot 365 \frac{d}{y}}$$

$$= 2E\text{-}07 \frac{mg}{kg \cdot d}$$

$$RISK = 2.0E\text{-}07 \frac{mg}{kg \cdot d} \cdot \frac{1.50 \frac{kg \cdot d}{mg}}{1} = 3.0E\text{-}09$$ ✓

Tap Water Dermal Absorption: Noncarcinogen, Organic

$$CDI = \frac{DA_{event} \cdot SA_a \cdot EF \cdot ED_a \cdot EV}{BW_a \cdot AT \cdot CF1}$$

$$HQ = \frac{CDI}{RFD_o \cdot GIABS}$$

DA_{event}: If $ET \le t^*$, $DA_{event} = 2 \cdot FA \cdot Kp \cdot Cw \cdot CF3 \cdot \sqrt{\frac{6 \cdot \tau \cdot ET}{\pi}}$

If $ET > t^*$,

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

200-PO-1 (499-S0-8)

Linda Carr
6/26/14

(11)

→ Dibromochloromethane

$$A_{event} = 2.1 \cdot \left(.0032 \frac{cm}{h}\right) \cdot \left(0.0028 \frac{mg}{L}\right) \cdot 0.001 \frac{L}{cm^3} \sqrt{\frac{6(1.57)(0.71)h/event}{\pi}}$$

$$= 1.79E\text{-}08 \frac{mg}{cm^2 \cdot event} \cdot \sqrt{2.13 \frac{h}{event}} = 2.61E\text{-}08 \frac{mg}{cm^2 \cdot event}$$

$$CDI = \frac{2.61E\text{-}08 \frac{mg}{cm^2 \cdot event} \cdot 20{,}900\, cm^2 \cdot 350 \frac{d}{y} \cdot 26\, y \cdot 1 \frac{event}{d}}{80\, kg \cdot 26\, y \cdot 365 \frac{d}{y}}$$

$$= 6.5E\text{-}06 \frac{mg}{kg \cdot d}$$

$$HQ = \frac{6.5E\text{-}06 \frac{mg}{kg \cdot d}}{2.0E\text{-}02 \frac{mg}{kg \cdot d} \cdot 1} = 3.27E\text{-}04 \checkmark$$

200-PO-1 (499-S0-8)

Linda Carr
6/26/14

(12)

Tap Water Dermal Absorption: Noncarcinogen, Inorganic

$$CDI = \frac{DA_{event} \cdot SA_a \cdot EF \cdot ED_a \cdot EV}{BW_a \cdot AT \cdot CF1}$$

$$HQ = \frac{CDI}{RfD_o \cdot GIABS}$$

$$DA_{event} = K_p \cdot C_w \cdot ET \cdot CF3$$

→ fluoride

$$DA_{event} = 0.001 \frac{cm}{h} \cdot 0.23 \frac{mg}{L} \cdot 0.71 \frac{h}{event} \cdot 0.001 \frac{L}{cm^3} = 1.63E-07 \frac{mg}{cm^2 \cdot event}$$

$$CDI = \frac{1.63E-07 \frac{mg}{cm^2 \cdot event} \cdot 20{,}900 cm^2 \cdot 350 \frac{d}{y} \cdot 26 y \cdot 1 \frac{event}{d}}{80 kg \cdot 26 y \cdot 365 \frac{d}{y}}$$

$$= 4.09E-05 \frac{mg}{kg \cdot d}$$

$$HQ = \frac{4.09E-05 \frac{mg}{kg \cdot d}}{6.00E-02 \frac{mg}{kg \cdot d} \cdot 1} = 6.82E-04$$

200-PO-1 (499-50-8)

Linda Carr (13)
6/26/14

Totals

Cancer	Ingestion		Inhalation		Dermal		Total Risk
dibromochloromethane	3.0E-06	+	1.34E-05	+	2.27E-07	=	1.66E-05 ✓
Tritium	7.9E-06	+	3.68E-05			=	4.47E-05 ✓

Noncancer					Total HQ
fluoride	1.15E-01	+		6.82E-04 =	.116 ✓
~~dibromochloromethane~~					
bromomethane	8.78E-03	+	3.93E-02	+ 2.87E-04 =	4.84E-02 ✓
dibromochloromethane	4.20E-3			+ 3.27E-04 =	4.53E-03 ✓

200-PO-1 (WMA A/AX)

Linda Carr (i)
6/30/14

Tap Water Ingestion: Carcinogen

$$CDI = \frac{C_w \cdot IRW_{adj} \cdot EF}{AT \cdot CF1}$$

where, $IRW_{adj} = \frac{ED_c \cdot IRW_c}{BW_c} + \frac{(ED_a - ED_c) \cdot IRW_a}{BW_a}$

$RISK = CDI \cdot CSF_o$

→ Arsenic

$$IRW_{adj} = \frac{6y \cdot 0.78 \frac{L}{d}}{15\ kg} + \frac{(26y - 6y) \cdot 2.5 \frac{L}{d}}{80\ kg}$$

$$= 0.312 \frac{L \cdot y}{kg \cdot d} + 0.625 \frac{L \cdot y}{kg \cdot d} = 0.937 \frac{L \cdot y}{kg \cdot d}$$

$$CDI = \frac{0.0079 \frac{mg}{L} \cdot 0.937 \frac{L \cdot y}{kg \cdot d} \cdot 350 \frac{d}{y}}{70y \cdot 365 \frac{d}{y}} = 1.01E-04 \frac{mg}{kg \cdot d}$$

$$RISK = 1.01E-04 \frac{mg}{kg \cdot d} \cdot 1.5 \frac{kg \cdot d}{mg} = 1.52E-04$$

200-PO-1 (WMA A/AX)

Linda Carr
7/1/14

(2)

Tap Water Ingestion: Noncarcinogen

$$CDI = \frac{C_w \cdot IRW_a \cdot EF \cdot ED_a}{BW_a \cdot AT \cdot CF1}$$

$$HQ = \frac{CDI}{RFD_o}$$

→ 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin

$$CDI = \frac{1.70E\text{-}09 \frac{mg}{L} \cdot 2.5 \frac{L}{d} \cdot 350 \frac{d}{y} \cdot 26y}{80\,kg \cdot 26y \cdot 365 \frac{d}{y}} = 5.09E\text{-}11 \frac{mg}{kg \cdot d}$$

$$HQ = \frac{5.09E\text{-}11 \frac{mg}{kg \cdot d}}{7.0E\text{-}09 \frac{mg}{kg \cdot d}} = 7.28E\text{-}03$$

200-PO-1 (WMA A/AX)

Linda Carr 7/1/14 (3)

Tap Water Ingestion: Radionuclides

$CDI = C_w \cdot IRW_RAD_{adj} \cdot EF$

where, $IRW_RAD_{adj} = (ED_c \cdot IRW_c) + ([ED_a - ED_c] \cdot IRW_a)$

$RISK = CDI \cdot SF_o$

→ Selenium-79

$IRW_{adj} = 6y \cdot 0.78 \frac{L}{d} + (26y - 6y) \cdot 2.5 \frac{L}{d} = 54.68 \frac{L \cdot y}{d}$

$CDI = 32.8 \frac{pCi}{L} \cdot 54.68 \frac{L}{d} \cdot 350 \frac{d}{y} = 6.28E+05\ pCi$

$RISK = 6.28E+05\ pCi \cdot 7.29E-12 \frac{risk}{pCi} = 4.58E-06$ ✓

200-PO-1 (WMA A/AX) Linda Carr 7/11/14 (4)

Tap Water Inhalation of Volatiles: Carcinogen

* No analytes in this category have a risk value

Inhalation of volatiles: Noncarcinogen

$$CDI = \frac{C_w \cdot ED_a \cdot EF \cdot ET_a \cdot CF2 \cdot VF}{AT \cdot CF1}$$

$$HQ = \frac{CDI}{RfC}$$

→ toluene

$$CDI = \frac{2.90E\text{-}05 \frac{mg}{L} \cdot 26y \cdot 350\frac{d}{y} \cdot 24\frac{h}{d} \cdot \frac{1d}{24h} \cdot 0.5\frac{L}{m^3}}{26y \cdot 365\frac{d}{y}}$$

$$= 1.39E\text{-}05 \frac{mg}{m^3}$$

$$HQ = \frac{1.39E\text{-}05 \frac{mg}{m^3}}{5.0 \frac{mg}{m^3}} = 2.79E\text{-}06$$

200-PO-1 (WMA A/AX)

Linda Carr (5)
7/1/14

Tap Water Inhalation of Volatiles: Radionuclides

$$CDI = C_w \cdot INH_RAD_{adj} \cdot VF \cdot EF \cdot ET_{adj} \cdot CF2$$

where, $INH_RAD_{adj} = (ED_c \cdot INH_c) + ((ED_a - ED_c) \cdot INH_a)$

and $ET_{adj} = \dfrac{(ET_c \cdot ED_c) + ((ED_a - ED_c) \cdot ET_a)}{ED_a}$

$$RISK = CDI \cdot SF_i$$

→ tritium

$$INH_RAD_{adj} = (6y \cdot 10\tfrac{m^3}{d}) + ((26y - 6y) \cdot 20\tfrac{m^3}{d}) = 60\tfrac{m^3 \cdot y}{d} + 400\tfrac{m^3 \cdot y}{d}$$

$$= 460\tfrac{m^3}{y \cdot d}$$

$$ET_{adj} = \frac{(24\tfrac{h}{d} \cdot 6y) + ((26y - 6y) \cdot 24\tfrac{h}{d})}{26y} = 24\tfrac{h}{d}$$

$$CDI = 6{,}649\,\tfrac{pCi}{L} \cdot 460\,\tfrac{m^3 \cdot y}{d} \cdot 0.5\tfrac{L}{m^3} \cdot 350\,\tfrac{d}{y} \cdot 24\tfrac{h}{d} \cdot \tfrac{1d}{24h}$$

$$= 5.35E+08\,pCi$$

$$RISK = 5.35E+08\,pCi \cdot 5.62E-14\,\tfrac{risk}{pCi} = 3.01E-05 \checkmark$$

200-PO-1 (WMA A/AX)

Linda Carr
7/1/14

(6)

Tap Water Dermal Absorption : Carcinogen Organic

$$CDI = \frac{DA_{event} \cdot SA_{adj} \cdot EF}{AT \cdot CF1}$$

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

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

$DA_{event} =$

If $ET \leq t^*$, $DA_{event} = 2 \cdot FA \cdot Kp \cdot Cw \cdot CF3 \sqrt{\frac{6 \cdot \tau \cdot ET_{adj}}{\pi}}$

If $ET > t^*$, $DA_{event} = FA \cdot Kp \cdot Cw \cdot CF3 \left[\frac{ET_{adj}}{1+B} + 2 \cdot \tau \cdot \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$

$$RISK = CDI \cdot \frac{CSF_o}{GIABS}$$

200-PO-1 (WMA A/AX)

Linda Carr ①
7/1/14

→ 1,2,3,4,7,8- Hexachlorodibenzo-p-dioxin

$$DA_{event} = 2 \cdot (0.5)\left(0.81 \frac{cm}{h}\right)\left(1.70E-09 \frac{mg}{L}\right)\left(.001 \frac{L}{cm^3}\right)\sqrt{\frac{6(6.82 \frac{h}{event})(.671 \frac{h}{event})}{\pi}}$$

$$= 1.38E-12 \frac{mg}{cm^2 \cdot event} \cdot 2.96 \qquad = 4.08E-12 \frac{mg}{cm^2 \cdot event}$$

$$ET_{adj} = \frac{(0.54 \frac{h}{event} \cdot 6y) + ((26y-6y) \cdot 0.71 \frac{h}{event})}{26y} = 0.671 \frac{h}{event}$$

$$SA_{adj} = \frac{6y \cdot 6378\ cm^2 \cdot 1 \frac{event}{d}}{15\ kg} + \frac{(26y-6y) \cdot 20{,}900\ cm^2 \cdot 1 \frac{event}{d}}{80\ kg}$$

$$= 2{,}551 \frac{cm^2 \cdot y \cdot event}{Kg \cdot d} + 5{,}225 \frac{cm^2 \cdot y \cdot event}{Kg \cdot d} = 7{,}776 \frac{cm^2 \cdot y \cdot event}{Kg \cdot d}$$

$$CDI = \frac{4.08E-12 \frac{mg}{cm^2 \cdot event} \cdot 7{,}776 \frac{cm^2 \cdot y \cdot event}{Kg \cdot d} \cdot 350 \frac{d}{y}}{70\ y \cdot 365 \frac{d}{y}} = 4.35E-10 \frac{mg}{kg \cdot d}$$

$$RISK = 4.35E-10 \frac{mg}{Kg \cdot d} \cdot \frac{1.30E+04}{1} \frac{kg \cdot d}{mg} = 5.65E-06$$

200-PO-1 (WMA A/AX)

Linda Carr (8)
7/1/14

Tap Water Dermal Absorption: Carcinogenic, Inorganic

$$DA_{event} = K_p \cdot C_w \cdot ET_{adj} \cdot CF3$$

$$CDI = \frac{DA_{event} \cdot SA_{adj} \cdot EF}{AT \cdot CF1}$$

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

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

$$RISK = CDI \cdot \frac{CSF_o}{GIABS}$$

→ Arsenic

$$DA_{event} = .001 \frac{cm}{h} \cdot 0.0079 \frac{mg}{L} \cdot 0.671 \frac{h}{event} \cdot 0.001 \frac{L}{cm^3} = 5.30E-09 \frac{mg}{cm^2 \cdot event}$$

$$ET_{adj} = \frac{(0.54 \frac{h}{event} \cdot 6y) + (26y - 6y)(0.71 \frac{h}{event})}{26y} = 0.671 \frac{h}{event}$$

$$SA_{adj} = \frac{6y \cdot 6378 cm^2 \cdot 1 \frac{event}{d}}{15 kg} + \frac{(26y - 6y) \cdot 20{,}900 cm^2 \cdot 1 \frac{event}{d}}{80 kg} = 7{,}776 \frac{cm^2 \cdot y \cdot event}{kg \cdot d}$$

200-PO-1 (WMA A/AX)

Linda Carr ⑨
7/1/14

$$CDI = \frac{5.30E\text{-}09 \frac{mg}{cm^2 \cdot event} \cdot 7{,}776 \frac{cm^2 \cdot y \cdot event}{kg \cdot d} \cdot 350 \frac{d}{y}}{70y \cdot 365 \frac{d}{y}} = 5.65E\text{-}09 \frac{mg}{kg \cdot d}$$

$$RISK = 5.65E\text{-}09 \frac{mg}{kg \cdot d} \cdot \frac{1.50 \frac{kg \cdot d}{mg}}{1} = 8.47E\text{-}09$$ ✓

<u>Tap Water Dermal Absorption: Noncarcinogen, Organic</u>

$$CDI = \frac{DA_{event} \cdot SA_a \cdot EF \cdot ED_a \cdot EV}{BW_a \cdot AT \cdot CF1}$$

$$HQ = \frac{CDI}{RFD_o \cdot GIABS}$$

DA_{event}: If $ET \leq t^*$, $DA_{event} = 2 \cdot FA \cdot K_p \cdot C_w \cdot CF3 \sqrt{\frac{6 \cdot \tau \cdot ET}{\pi}}$

If $ET > t^*$, $DA_{event} = FA \cdot K_p \cdot C_w \cdot CF3 \left[\frac{ET}{1+B} + 2 \cdot \tau \cdot \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right]$

200-PO-1 (WMA A/AX)

Linda Carr (10)
7/3/14

→ 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin

$$DA_{event} = 2 \cdot (0.5) \cdot 0.81 \frac{cm}{h} \cdot 1.70E-09 \frac{mg}{L} \cdot 0.001 \frac{L}{cm^3} \sqrt{\frac{6 \cdot 6.82 \frac{h}{event} \cdot 0.71 \frac{h}{event}}{\pi}}$$

$$= 1.38E-12 \frac{mg}{cm^2 \cdot event} \cdot 3.04 = 4.20E-12 \frac{mg}{cm^2 \cdot event}$$

$$CDI = \frac{4.20E-12 \frac{mg}{cm^2 \cdot event} \cdot 20{,}900 cm^2 \cdot 350 \frac{d}{y} \cdot 26y \cdot 1 \frac{event}{d}}{80 kg \cdot 26y \cdot \cancel{0.001 \frac{L}{cm^3}} \cdot 365 \frac{d}{y}}$$

$$= 1.05E-09 \frac{mg}{kg \cdot d}$$

$$HQ = \frac{1.05E-09 \frac{mg}{kg \cdot d}}{7.00E-09 \frac{mg}{kg \cdot d} \cdot 1} = 0.150 \checkmark$$

200-PO-1 (WMA A/AX)

Linda Carr 7/3/14 (11)

Tap Water Dermal Absorption: Noncarcinogen, Inorganic

$$CDI = \frac{DA_{event} \cdot SA_a \cdot EF \cdot ED_a \cdot EV}{BW_a \cdot AT \cdot CF1}$$

$$HQ = \frac{CDI}{RFD_o \cdot GI\,ABS} \qquad DA_{event} = K_p \cdot C_w \cdot ET \cdot CF3$$

→ Antimony

$$DA_{event} = 0.001\,\frac{cm}{h} \cdot 0.043\,\frac{mg}{L} \cdot 0.71\,\frac{h}{event} \cdot 0.001\,\frac{L}{cm^3} = 3.05E\text{-}08\,\frac{mg}{cm^2 \cdot event}$$

$$CDI = \frac{3.05E\text{-}08\,\frac{mg}{cm^2 \cdot event} \cdot 20{,}900\,cm^2 \cdot 350\,\frac{d}{y} \cdot 26\,y \cdot 1\,\frac{event}{d}}{80\,kg \cdot 26\,y \cdot 365\,\frac{d}{y}}$$

$$= 7.65E\text{-}06\,\frac{mg}{kg \cdot d}$$

$$HQ = \frac{7.65E\text{-}06\,\frac{mg}{kg \cdot d}}{4.0E\text{-}04\,\frac{mg}{kg \cdot d} \cdot 1.50E\text{-}01} = 0.127$$

200-PO-1 (WMA A/AX)

Linda Carr (12)
7/3/14

Totals

Cancer	Ingestion	Inhalation	Dermal	Total Risk
Arsenic	1.52E-04		+ 8.49E-07 =	1.53E-04
tritium	6.45E-06	+ 3.01E-05		= 3.66E-05

Noncarcinogen				Total HQ
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	7.28E-03 +		0.150 =	0.157
toluene	1.09E-05 +	2.78E-06 +	3.88E-06 =	1.76E-05
Antimony	3.20		+ 0.127 =	3.33