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ECF-300NPL-11-0155
Revision 4

Comparison of the 300-FF-2 Source Operable Unit Exposure Point Concentrations to Preliminary Remediation Goals Protective of Groundwater and Preliminary Remediation Goals Protective of Surface Water

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

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Richland, Washington 99352

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INTERA, Inc.

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ENVIRONMENTAL CALCULATION COVER PAGE

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Revision No.	Description	Date	Affected Pages	ADD ROW
Draft A	Replaced STOMP 1D 50:50 with 100:0 PRGs for COPCs besides uranium; updated uranium PRGs; updated COPC list	10/10/2011	All	
Rev. 0	Incorp. revised COPCs (ECF-300NPL-11-0154 r.0) and revised PRGs (ECF-300FF5-11-0153 r.2; ECF-300FF5-11-0151 r.2)	5/10/2012	All	☒
Rev. 1	Incorp. revised uranium COPCs (ECF-300NPL-11-0154 r.1) and revised uranium 2D PRG values for GWP and SWP	10/22/2012	All	☒
Rev. 2	Incorp. revised GWP & SWP PRGs for COPCs with updated (12/2012) EPA toxicity values; used EPCs from Total_Uran_Isotopes	03/21/2013	All Tables	☒
Rev. 3	Added text & revised PRG comparison with EPC values to include dimensional scaling; no change in waste site disposition	02/25/2016	All	☒
Rev. 4	Identical to Rev. 3 (to re-issue to correct detailed tables)	03/09/2017	Attachment A	☒

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ENVIRONMENTAL CALCULATION COVER PAGE (CONTINUED)

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Terms

CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COPC	contaminant of potential concern
DOE	U.S. Department of Energy
ECF	environmental calculation file
EPA	Environmental Protection Agency
EPC	exposure point concentration
EQL	estimated quantification limit
FS	feasibility study
OU	Operable unit
PRG	preliminary remediation goal
RDL	required detection limit
RI	remedial investigation
STOMP	Subsurface Transport Over Multiple Phases

1 Purpose

This environmental calculation file (ECF) documents the methodology used to identify waste sites in the 300 Area where post-remediation soil sample results exceed soil preliminary remediation goals (PRGs) for the protection of groundwater and the protection of surface water. The 300 Area is associated with two source operable units (OUs): the 300-FF-1 OU and 300-FF-2 OU. These OUs are referred to collectively herein as the 300 Area Source OU. The exposure point concentrations (EPCs) for identified constituents of potential concern (COPCs) for each waste site decision unit in the 300 Area Source OU are compared to both groundwater protective and surface water protective PRGs for a native vegetation recharge scenario and an industrial recharge scenario. The waste sites where EPCs exceed a PRG will be evaluated through the remedial investigation/feasibility study (RI/FS) process being conducted for the 100 Areas and 300 Area under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA).

This ECF supports DOE/RL-2010-99, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*. A summary based upon the comparison of EPCs to PRGs described in this ECF will be presented in the RI/FS report.

2 Background

Based on agreements with the Senior Executive Council, modeling with the STOMP©[1] simulator (PNNL-15782, *STOMP Subsurface Transport Over Multiple Phases, Version 4.0: User's Guide*) was performed to provide a site-specific basis for estimating PRGs for groundwater protection and surface water protection. PRGs for the protection of groundwater and the protection of surface water were estimated with the STOMP 1D 70:30/100:0 Contaminant Source Model, which is a one-dimensional model that assumes either 70 percent contamination of the vadose zone (upper 70 percent contaminated, lower 30 percent uncontaminated [70:30]) or 100 percent contamination of the vadose zone (zero percent uncontaminated [100:0]) beneath a backfilled waste site. Source distributions are assigned based on analyte distribution coefficients (K_d). A 70:30 source distribution is assumed for analytes with a $K_d \geq 2$ mL/g and a 100:0 source distribution is assumed for analytes with a $K_d < 2$ mL/g. The STOMP 1D 70:30/100:0 Contaminant Source Model is an OU-specific model that assumes all contamination moves downward with no dispersion, volatilization, or credit for mixing with river water.

For determination of PRGs, the STOMP 1D 70:30/100:0 Contaminant Source Model was implemented for two separate recharge scenarios: a native vegetation recharge scenario and an industrial recharge scenario. The native vegetation recharge scenario is an infiltration rate history that trends from current bare soil surface conditions (operational land cover) to shrub steppe native vegetation recharge rates. The industrial recharge scenario is an infiltration rate history that trends from current bare soil surface conditions (operational land cover) to a permanently disturbed soil with cheat grass vegetation cover. Other modeling conditions used for the one-dimensional 70:30/100:0 model are described in ECF-300FF5-11-0153, *STOMP 1-D Modeling for Determination of Soil Screening Levels and Preliminary Remediation Goals for 300 Area Source Areas*.

Due to the geochemical complexity of uranium in 300 Area Source OU soils, as well as uncertainty associated with the OU-specific uranium K_d, the uranium PRGs for the protection of groundwater and the protection of surface water were estimated using the STOMP 2D Uranium Source Model. The STOMP 2D Uranium Source Model is a site-specific, two-dimensional model developed to simulate the fate and

[1] STOMP - Battelle Memorial Institute (Battelle) retains copyright on all versions, revisions, and operational modes of the Subsurface Transport Over Multiple Phases (STOMP©) software simulator, as permitted by the U.S. Department of Energy. STOMP© is used here under a limited government use license.

transport of uranium in the 300 Area vadose zone and unconfined groundwater aquifer. The 2D uranium model was used to calculate uranium PRGs for the same two recharge scenarios as discussed above for the one-dimensional model: a native vegetation recharge scenario and an industrial recharge scenario. Other modeling conditions used for the 2D uranium model are described in ECF-300FF5-11-0151, *Groundwater Flow and Uranium Transport Modeling in Support of the 300 Area FF-5 RI/FS Document.*

Comparisons are conducted herein between EPCs and the PRGs for both groundwater protection and surface water protection for the identified COPCs at each waste site decision unit in the 300-Area Source OU.

3 Methodology

This section describes the methodology used to compare EPCs for identified COPCs at each waste site decision unit to PRGs for groundwater protection and surface water protection.

Overburden and stockpile sites are not evaluated under this methodology. While sampled, this material does not remain in the location where it is sampled, but is used in backfilling waste sites. The models used as the basis of PRGs for the protection of groundwater and the protection of surface water using the STOMP 1D 70:30/100:0 contaminant source model presume that the sampled concentrations are present uniformly throughout the upper 70% or 100% of the vadose zone below the backfill. However, this assumption is not applicable to overburden and stockpile material, so derived preliminary remediation goals are not appropriate to apply in these instances.

To support this assumption, sensitivity cases were evaluated for the 100-D/H sites in ECF-HANFORD-11-0063 to determine if stockpile material used as backfill would have any impact on the SSLs and PRGs. The initial contaminant distribution model assumed that clean backfill was placed over the remaining soil column. The sensitivity cases assumed the backfill was contaminated to the same level as the remaining soil column. The results of the sensitivity cases showed that the backfill depth and contamination level (even when fully contaminated) did not affect the SSL or PRG values.

For all of the COPCs identified at the 300 Area waste site decision units, the following steps are performed:

1. Identify those COPCs and waste site decision units identified as exceeding SSLs.
2. Obtain unit-length PRGs for the protection of groundwater and the protection of surface water for the STOMP 1D 70:30/100:30 Contaminant Source Model industrial recharge scenario. Obtain the uranium PRGs for the protection of groundwater and the protection of surface water for the STOMP 2D Uranium Source Model native vegetation recharge scenario (note; these are not unit-length values).
3. Determine representative lineal dimensions in the general direction of groundwater flow of waste site decision units in the 300 Area Source OU.
4. Obtain EPC values for each waste site decision unit in the 300 Area Source OU.
5. Divide the unit-length PRG by the waste site dimension to obtain an evaluation PRG that is scaled to the waste site dimension in the direction of groundwater flow. Individually compare EPCs for each waste site decision unit in the 300 Area Source OU to soil PRGs for the protection of groundwater and the protection of surface water scaled to representative lineal dimension in the general direction of groundwater flow (truncating the scaled PRG level at required detection limit (RDL) or 90th percentile background value if scaled PRG is less than these limits), or directly compare without scaling in the case of uranium.

4 Assumptions and Inputs

Assumptions and inputs associated with COPCs, PRGs, and EPCs are described below.

Table 4-1 documents the sources of information for the PRGs.

Table 4-1. Reference Sources

Preliminary Remediation Goal	Pathway	Reference
STOMP 1D 70:30/100:0 Contaminant Source Model – native vegetation and industrial recharge scenarios	Groundwater	ECF-300FF5-11-0153
	Surface Water	ECF-300FF5-11-0153
STOMP 2D Uranium Source Model—native vegetation and industrial recharge scenarios	Groundwater	ECF-300FF5-11-0151
	Surface Water	ECF-300FF5-11-0151

Notes:

ECF-300FF5-11-0153, *STOMP 1-D Modeling for Determination of Soil Screening Levels and Preliminary Remediation Goals for 300 Area Source Areas.* The PRGs provided in this ECF are provided on a unit-length basis, and must be scaled by the representative lineal dimension of the waste site decision unit in the general direction of groundwater flow for evaluation use.

ECF-300FF5-11-0151, *Groundwater Flow and Uranium Transport Modeling in Support of the 300 Area FF-5 RI/FS Document.* The uranium PRGs provided in this ECF are derived from a site-specific two-dimensional model, and therefore used in evaluation without dimensional scaling.

4.1 Identification of COPCs

For the purposes of this ECF, a COPC is defined as an analyte suspected of being associated with site-related activities, which represents a potential threat to human health or the environment, and whose data are of sufficient quality for use in a quantitative baseline risk assessment.

All analytes identified as exceeding background soil concentrations and soil screening levels in a waste site decision unit are identified as COPCs because the soil sample results represent post-remediation conditions. COPCs for the 300 Area Source OU are identified in ECF-300NPL-11-0154, *Comparison of 300-FF-2 Source Operable Unit Exposure Point Concentrations to Soil Screening Levels Protective of Groundwater and Soil Screening Levels Protective of Surface Water*. The COPCs for groundwater protection for each waste site decision unit are presented in Table 4-2 (Attachment A). The COPCs for surface water protection for each waste site decision unit are presented in Table 4-3 (Attachment A).

4.2 Preliminary Remediation Goals

4.2.1 Preliminary Remediation Goals for the Protection of Groundwater

With the exception of uranium, PRGs for the protection of groundwater at and near the 300 Area Source OU have been derived using the following models:

- STOMP 1D 70:30/100:0 Contaminant Source Model, native vegetation recharge scenario
- STOMP 1D 70:30/100:0 Contaminant Source Model, industrial recharge scenario

The STOMP 1D 70:30/100:0 Contaminant Source Model assumes that either the upper 70 percent of the vadose zone (for $K_d \geq 2$ mL/g analytes) or the entire vadose zone (for $K_d < 2$ mL/g analytes) is contaminated below a clean fill layer. The recharge rate for the native vegetation recharge scenario

represents a site with native vegetation (shrub steppe) land cover. The recharge rate for the industrial recharge scenario represents a site with permanently disturbed soil with cheat grass vegetation cover. OU-specific PRGs protective of groundwater for the 300 Area Source OU calculated using the STOMP 1D 70:30/100:0 Contaminant Source Model are documented in ECF-300FF5-11-0153. The STOMP 1D 70:30/100:0 groundwater protective PRGs are presented in Table 4-4 (Attachment A).

4.2.2 Uranium Preliminary Remediation Goal for the Protection of Groundwater

Due to the geochemical complexity of uranium in 300 Area Source OU soils, as well as uncertainty associated with the OU-specific uranium K_d, the uranium PRG for the protection of groundwater is estimated using the STOMP 2D Uranium Source Model as documented in ECF-300FF5-11-0151. Groundwater protective uranium PRGs are calculated for the same two recharge scenarios as discussed above for the one-dimensional model: a native vegetation recharge scenario and an industrial recharge scenario. The groundwater protective PRGs for uranium are presented in Table 4-5 (Attachment A).

4.2.3 Preliminary Remediation Goals for the Protection of Surface Water

With the exception of uranium, PRGs for the protection of surface water at and near the 300 Area Source OU have been derived using the following models:

- STOMP 1D 70:30/100:0 Contaminant Source Model, native vegetation recharge scenario
- STOMP 1D 70:30/100:0 Contaminant Source Model, industrial recharge scenario

The STOMP 1D 70:30/100:0 Contaminant Source Model assumes that either the upper 70 percent of the vadose zone (for $K_d \geq 2$ mL/g analytes) or the entire vadose zone (for $K_d < 2$ mL/g analytes) is contaminated below clean fill. The recharge rate for the native vegetation recharge scenario represents a site with native vegetation (shrub steppe) land cover. The recharge rate for the industrial recharge scenario represents a site with permanently disturbed soil with cheat grass vegetation cover. The model takes no credit for dilution of groundwater by mixing with surface water. OU-specific PRGs protective of surface water for the 300 Area Source OU calculated using the STOMP 1D 70:30/100:0 Contaminant Source Model are documented in ECF300FF5-11-0153. The STOMP 1D 70:30/100:0 surface water protective PRGs are presented in Table 4-6 (Attachment A).

4.2.4 Uranium Preliminary Remediation Goal for the Protection of Surface Water

Due to the geochemical complexity of uranium in 300 Area Source OU soils, as well as uncertainty associated with the OU-specific uranium K_d, the uranium PRG for the protection of surface water is estimated using the STOMP 2D Uranium Source Model as documented in ECF-F300FF5-11-0151. Surface water protective uranium PRGs are calculated for the same two recharge scenarios as discussed above for the one-dimensional model: a native vegetation recharge scenario and an industrial recharge scenario. The surface water protective PRGs for uranium are presented in Table 4-7 (Attachment A).

4.3 Representative Lineal Dimensions

Waste site dimensions parallel to general groundwater flow are determined by review of waste site maps in the relevant cleanup verification packages for waste sites. The analyst would use the waste site maps and scales provided to determine a representative distance in the general direction of groundwater flow based on visual evaluation of water table contours for the vicinity of each waste site. The qualifier "representative" as applied to distance denote that only rarely is a waste site a perfect rectangle oriented to the direction of groundwater flow, which itself is not constant. Thus, a representative lineal distance across the waste site was selected with recognition that irregularly shaped and/or obliquely aligned waste sites will have portions with shorter, and longer, distances across the waste site in the general direction of

groundwater flow. The objective was to select a distance that represents an approximate central tendency for the waste site in this dimension for scaling purposes. Some waste site receive additional consideration in this regard; for example, pipelines and similar features are maintained at 1 m because these lineal features would not be expected to remain aligned to the groundwater flow direction consistently. If additional information provided in the cleanup verification package description provided a basis to infer a more appropriate distance in the general direction of groundwater flow, this would be considered in the evaluation as well. The waste site dimensions for each waste site decision unit are presented in Table 4-8 (Attachment A).

4.4 Exposure Point Concentrations

OSWER 9285.6-10, *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites*, states that, "an exposure point concentration (EPC) is a conservative estimate of the average chemical concentration in an exposure medium." OSWER Publication 9285.7-081, *Supplemental Guidance to RAGS: Calculating the Concentration Term,* states that, "because of the uncertainty associated with estimating the true average concentration at a site, the 95 percent upper confidence limit (UCL) of the arithmetic mean should be used for this variable."

The EPCs used for comparison to PRGs are the analyte-specific values computed from the post-remediation soil sample results for each waste site decision unit in the 300 Area Source OU, as described in ECF-300NPL-11-0137, *Computation of Exposure Point Concentrations for the 300-FF-2 Source Operable Unit*. The EPCs corresponding to the identified COPCs for each waste site decision unit in the 300 Area Source OU are presented in Tables 4-2 and 4-3 (Attachment A).

4.5 Estimated Quantitation Limits

The estimated quantitation limit (EQL) is the lowest concentration that can be reliably measured within specific limits of accuracy and precision under routine laboratory operating conditions. The EQL is specified by the laboratory and is typically 5 – 10 times greater than the method detection limit. In some cases, the EQL is equal to the concentration of the lowest calibration standard. The EQLs presented in this ECF were obtained from DOE/RL-2009-43, *Sampling and Analysis Plan for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units Remedial Investigation/Feasibility Study*, Appendix A. The analyte-specific EQL values are presented in Table 4-2 (Attachment A).

5 Software Applications

Microsoft Excel® was used to tabulate the data in electronic spreadsheets. These spreadsheets are provided as detailed analysis tables in this ECF (Attachment A). Microsoft Excel is used as a desktop utility calculation tool and its use in this ECF meets the following criteria (PRC-PRO-IRM-309):

- Does not contain any macros or programming
- All inputs, formulas, and output data are reviewed during the checking of the calculation
- Each calculation is reviewed and signed

As such, the controlled software procedure requirements do not apply for this software application.

® Microsoft Excel is a registered product of the Microsoft Corporation.

6 Calculation

Comparison of EPCs to PRGs is conducted as described in Section 3 to determine which COPCs exceed a PRG. Results of the comparisons are presented in the accompanying tables, as discussed in Section 7. The tables share a similar format, providing both the values being compared as well as a "Yes/No" column indicating the outcome of the comparison.

7 Results/Conclusions

No comparison of 300 Area Source OU waste site decision unit COPCs (other than uranium) is necessary because no non-uranium EPC values exceed the groundwater protective soil screening levels for these COPCs (ECF-300NPL-11-0154).

A summary of the 300 Area Source OU waste site decision unit COPCs (other than uranium) with EPCs that exceed PRGs protective of surface water is presented in Table 7-1.

A summary of the 300 Area Source OU waste site decision units with uranium EPCs that exceed PRGs protective of groundwater water is presented in Table 7-2.

No comparison of 300 Area Source OU uranium EPCs to PRGs protective of surface water is necessary because no uranium EPC values exceeded the surface water protective uranium soil screening level (ECF-300NPL-11-0154).

8 References

DOE/RL-2010-99, 2012, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at:
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ECF-300NPL-11-0154, 2012, *Comparison of 300-FF-2 Source Operable Unit Exposure Point Concentrations to Soil Screening Levels Protective of Groundwater and Soil Screening Levels Protective of Surface Water,* Rev. 3, CH2M HILL Plateau Remediation Company, Richland, Washington.

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OSWER 9285.6-10, 2002, *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites*, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://epa.gov/oswer/riskassessment/pdf/ucl.pdf.

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PNNL-15782, 2006, *STOMP Subsurface Transport Over Multiple Phases, Version 4.0: User's Guide*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://stomp.pnnl.gov/.

Attachment A

Detailed Analysis Tables

List of Detailed Analysis Tables

Note: Tables are numbered as presented in the ECF. Table 4-1 is presented in the main body of the ECF, while all others are presented in this attachment due to their size and format.

Table 4-2	Summary of COPCs and EPCs for Groundwater Protection for the 300 Area Source Operable Unit
Table 4-3	Summary of COPCs and EPCs for Surface Water Protection for the 300 Area Source Operable Unit
Table 4-4	STOMP 1D 70:30/100:0 Contaminant Source Model Preliminary Remediation Goals for Groundwater Protection for Identified COPCs at the 300 Area Source Operable Unit
Table 4-5	STOMP 2D Uranium Source Model Preliminary Remediation Goals for Groundwater Protection at the 300 Area Source Operable Unit
Table 4-6	STOMP 1D 70:30/100:0 Contaminant Source Model Preliminary Remediation Goals for Surface Water Protection for Identified COPCs at the 300 Area Source Operable Unit
Table 4-7	STOMP 2D Uranium Source Model Preliminary Remediation Goals for Surface Water Protection at the 300 Area
Table 4-8	Representative Length of Waste Site Decision Units in the General Direction of Groundwater Flow
Table 7-1	Comparison of EPCs for 300 Area Source Operable Unit COPCs to STOMP 1D 70:30/100:0 Contaminant Source Model Preliminary Remediation Goals Protective of Surface Water
Table 7-2	Comparison of Uranium EPCs for 300 Area Source Operable Unit to STOMP 2D Uranium Source Model Preliminary Remediation Goals Protective of Groundwater

Table 4-2. Summary of COPCs and EPCs for Groundwater Protection for the 300 Area Source Operable Unit

Waste Site/Decision Unit	Analyte Group	COPC[a]	CAS No.	Units	Exposure Point Concentration[b]
316-2_Shallow_1	non-Rad	Total_U_Isotopes	Total_U_Isotopes	µg/kg	210,452
316-2_Shallow_2	non-Rad	Total_U_Isotopes	Total_U_Isotopes	µg/kg	291,369
316-5_Shallow_1	non-Rad	Total_U_Isotopes	Total_U_Isotopes	µg/kg	271,835
316-5_Shallow_2	non-Rad	Total_U_Isotopes	Total_U_Isotopes	µg/kg	204,701
316-5_Shallow_Focused	non-Rad	Total_U_Isotopes	Total_U_Isotopes	µg/kg	138,095
618-1_Deep_Focused	non-Rad	Total_U_Isotopes	Total_U_Isotopes	µg/kg	196,154
618-2_Deep	non-Rad	Total_U_Isotopes	Total_U_Isotopes	µg/kg	491,176
618-2_Deep_Focused	non-Rad	Total_U_Isotopes	Total_U_Isotopes	µg/kg	150,259
618-3_Shallow_Focused	non-Rad	Total_U_Isotopes	Total_U_Isotopes	µg/kg	238,577

Notes:

a. ECF-300NPL-11-0154, *Comparison of 300-FF-2 Source Operable Unit Exposure Point Concentrations to Soil Screening Levels Protective of Groundwater and Soil Screening Levels Protective of Surface Water.*

b. ECF-300NPL-11-0137, *Computation of Exposure Point Concentrations for the 300-FF-2 Source Operable Unit.*

Table 4-3. Summary of COPCs and EPCs for Surface Water Protection for the 300 Area Source Operable Unit

Waste Site/Decision Unit	Analyte Group	COPC[a]	CAS No.	Units	Exposure Point Concentration[b]
316-1_Shallow_3	non-Rad	Copper	7440-50-8	µg/kg	1,366,370
618-9_Shallow_Focused	non-Rad	Aldrin	309-00-2	µg/kg	390

Notes:

a. ECF-300NPL-11-0154, *Comparison of 300-FF-2 Source Operable Unit Exposure Point Concentrations to Soil Screening Levels Protective of Groundwater and Soil Screening Levels Protective of Surface Water.*

b. ECF-300NPL-11-0137, *Computation of Exposure Point Concentrations for the 300-FF-2 Source Operable Unit.*

Table 4-4. STOMP 1D 70:30/100:0 Contaminant Source Model Preliminary Remediation Goals for Groundwater Protection for Identified COPCs at the 300 Area Source Operable Unit

COPC[a]	CAS No.	Unit-Length STOMP 1D 70:30/100:0 Contaminant Source Model Native Vegetation Recharge GWP Preliminary Remediation Goal[b] (µg·m/kg)	Unit-Length STOMP 1D 70:30/100:0 Contaminant Source Model Industrial Recharge GWP Preliminary Remediation Goal[b] (µg·m/kg)
Copper	7440-50-8	NR[c]	NR[c]
Aldrin	309-00-2	NR[c]	NR[c]

Notes:

a. ECF-300NPL-11-0154, *Comparison of 300-FF-2 Source Operable Unit Exposure Point Concentrations to Soil Screening Levels Protective of Groundwater and Soil Screening Levels Protective of Surface Water.*

b. ECF-300FF5-11-0153, *STOMP 1D Modeling for Determination of Soil Screening Levels and Preliminary Remediation Goals for 300 Area Source Areas.* A 70:30 source distribtuion is used for analytes with Kd ≥ 2 mL/g; a 100:0 source distribution is used for analytes with Kd < 2 mL/g. "Native vegetation recharge" is an infiltration rate history that trends from current bare soil surface conditions (operational land cover) to shrub steppe native vegetation recharge rates. "Industrial recharge" is an infiltration rate history that trends from current bare soil surface conditions (operational land cover) to a permanently disturbed soil with cheat grass vegetation cover.

c. The calculated PRG for the analyte is considered non-representative because: (1) breakthrough is simulated within 1,000 years for some soil columns while other soil columns (a majority) show no breakthrough (breakthrough defined as concentrations below 1E-04 µg/L or activity below 1E-04 pCi/L), and/or (2) the calculated residual mass of contaminant in the pore volume is high enough to represent a substantial (and physically improbable) reduction in porosity.

Table 4-5. STOMP 2D Uranium Source Model Preliminary Remediation Goals for Groundwater Protection at the 300 Area Source Operable Unit

COPC[a]	CAS No.	STOMP 2D Uranium Source Model Native Vegetation Recharge GWP Preliminary Remediation Goal[b] (µg/kg)	STOMP 2D Uranium Source Model Industrial Recharge GWP Preliminary Remediation Goal[b] (µg/kg)
Total_U_Isotopes	Total_U_Isotopes	179,860	157,000

Notes:

a. ECF-300NPL-11-0154, *Comparison of 300-FF-2 Source Operable Unit Exposure Point Concentrations to Soil Screening Levels Protective of Groundwater and Soil Screening Levels Protective of Surface Water.*

b. ECF-300FF5-11-0151, *Groundwater Flow and Uranium Transport Modeling in Support of the 300 Area FF-5 RI/FS Document* . "Native vegetation recharge" is an infiltration rate history that trends from current bare soil surface conditions (operational land cover) to shrub steppe native vegetation recharge rates. "Industrial recharge" is an infiltration rate history that trends from current bare soil surface conditions (operational land cover) to a permanently disturbed soil with cheat grass vegetation cover.

Table 4-6. STOMP 1D 70:30/100:0 Contaminant Source Model Preliminary Remediation Goals for Surface Water Protection for Identified COPCs at the 300 Area Source Operable Unit

COPC[a]	CAS No.	Unit-Length STOMP 1D 70:30/100:0 Contaminant Source Model Native Vegetation Recharge SWP Preliminary Remediation Goal[b] (µg·m/kg)	Unit-Length STOMP 1D 70:30/100:0 Contaminant Source Model Industrial Recharge SWP Preliminary Remediation Goal[b] (µg·m/kg)
Copper	7440-50-8	NR[c]	NR[c]
Aldrin	309-00-2	NR[c]	NR[c]

Notes:

a. ECF-300NPL-11-0154, *Comparison of 300-FF-2 Source Operable Unit Exposure Point Concentrations to Soil Screening Levels Protective of Groundwater and Soil Screening Levels Protective of Surface Water.*

b. ECF-300FF5-11-0153, *STOMP 1D Modeling for Determination of Soil Screening Levels and Preliminary Remediation Goals for 300 Area Source Areas.* A 70:30 source distribtuion is used for analytes with Kd ≥ 2 mL/g; a 100:0 source distribution is used for analytes with Kd < 2 mL/g. "Native vegetation recharge" is an infiltration rate history that trends from current bare soil surface conditions (operational land cover) to shrub steppe native vegetation recharge rates. "Industrial recharge" is an infiltration rate history that trends from current bare soil surface conditions (operational land cover) to a permanently disturbed soil with cheat grass vegetation cover.

c. The calculated PRG for the analyte is considered non-representative because: (1) breakthrough is simulated within 1,000 years for some soil columns while other soil columns (a majority) show no breakthrough (breakthrough defined as concentrations below 1E-04 µg/L or activity below 1E-04 pCi/L), and/or (2) the calculated residual mass of contaminant in the pore volume is high enough to represent a substantial (and physically improbable) reduction in porosity.

Table 4-7. STOMP 2D Uranium Source Model Preliminary Remediation Goals for Surface Water Protection at the 300 Area

COPC[a]	CAS No.	STOMP 2D Uranium Source Model Native Vegetation Recharge SWP Preliminary Remediation Goal[b] (µg/kg)	STOMP 2D Uranium Source Model Industrial Recharge SWP Preliminary Remediation Goal[b] (µg/kg)
Total_U_Isotopes	Total_U_Isotopes	4.68E+06	4.08E+06

Notes:

a. ECF-300NPL-11-0154, *Comparison of 300-FF-2 Source Operable Unit Exposure Point Concentrations to Soil Screening Levels Protective of Groundwater and Soil Screening Levels Protective of Surface Water.*

b. ECF-300FF5-11-0151, *Groundwater Flow and Uranium Transport Modeling in Support of the 300 Area FF-5 RI/FS Document* . "Native vegetation recharge" is an infiltration rate history that trends from current bare soil surface conditions (operational land cover) to shrub steppe native vegetation recharge rates. "Industrial recharge" is an infiltration rate history that trends from current bare soil surface conditions (operational land cover) to a permanently disturbed soil with cheat grass vegetation cover.

Table 4-8. Representative Length of Waste Site Decision Units in the General Direction of Groundwater Flow

300 OU Waste Site/Decision Units	Representative Length (m)	Source of Site Length
300 ASH PITS_Shallow	50.0	QMAP along GW gradient
300 VTS_Shallow	24.7	Sampling Maps (using scale)
300-10_Shallow_Focused	38.6	Sampling Maps (using scale)
300-109_Shallow_Focused	1.0	Sampling Locations
300-109_Staging Pile Area_Focused	1.0	Sampling Locations
300-18_Shallow	13.5	Sampling Maps (using scale)
300-223_Shallow_Focused	1.0	No Information
300-23_Shallow_Focused	5.0	Sampling Locations
300-259_Shallow	58.3	Sampling Locations
300-260_Shallow_Focused	33.0	Sampling Locations
300-272_Overburden_Focused	1.0	No Information
300-272_Shallow_Focused	1.0	No Information
300-275_Shallow_1	43.0	Sampling Locations
300-275_Shallow_2	7.9	Sampling Locations
300-33, 300-41, 300-256_Shallow	117.4	Sampling Locations
300-33, 300-41, 300-256_Shallow_Focused	68.5	Sampling Locations
300-37_Shallow_Focused	1.0	No Information
300-44_Overburden_Focused	1.0	No Information
300-44_Shallow_Focused	1.0	Sampling Locations
300-45_Shallow_Focused	5.0	Sampling Locations
300-49_Overburden	5.0	QMAP along GW gradient
300-49_Shallow	75.0	Sampling Maps (using scale)
300-50_Overburden	15.0	Sampling Maps (using scale) NW/SE
300-50_Shallow	50.0	Sampling Maps (using scale) NW/SE
300-8_Shallow	136.7	Sampling Maps (using scale)
316-1_Overburden	20.0	Not mapped; assumed 20 m
316-1_Shallow_1	60.0	Assume Shallow_1 is "ACL"; Scaling Maps W/E
316-1_Shallow_3	50.0	Assume Shallow_3 is "BCL"; Scaling Maps W/E
316-1_Shallow_4	30.0	Sampling Maps (for trenches) estimated W/E from Scale
316-2_Shallow_1	71.0	Sampling Locations
316-2_Shallow_2	117.0	Sampling Locations
316-2_Shallow_3	167.5	Sampling Locations
316-5_Shallow_1	68.0	Sampling Maps (using scale)
316-5_Shallow_2	68.0	Sampling Maps (using scale)
316-5_Shallow_Focused	68.0	Sampling Maps (using scale)
331 LSLDF_Shallow_Focused	1.0	Sampling Maps (using scale)
600-243_Shallow	40.3	Sampling Locations
600-259_Overburden	10.3	Sampling Maps (using scale)
600-259_Shallow	17.0	Sampling Maps (using scale)
600-259_Shallow_Focused	17.0	Sampling Maps (using scale)
600-47_Shallow	22.0	Sampling Maps (using scale)
618-1_Deep	32.0	Sampling Locations (using scale) W/E
618-1_Deep_Focused	25.0	Sampling Maps (using scale); approx. E/W net
618-1_Shallow	40.0	Sampling Locations (using scale) approx. W/E
618-1_Shallow_Focused	40.0	Sampling Locations (using scale) approx. W/E
618-12_Shallow	130.0	Sampling Locations
618-13_Shallow	40.0	Sampling Maps (using scale)
618-13_Shallow_Focused	40.0	Sampling Maps (using scale)
618-2_Deep	47.7	Sampling Maps (using scale)
618-2_Deep_Focused	47.7	Sampling Maps (using scale)
618-2_Overburden	35.2	Sampling Maps (using scale)
618-2_Shallow	60.2	Sampling Maps (using scale)

Table 4-8. Representative Length of Waste Site Decision Units in the General Direction of Groundwater Flow

300 OU Waste Site/Decision Units	Representative Length (m)	Source of Site Length
618-2_Staging Pile	140.0	Sampling Maps (using scale)
618-3_Shallow	52.3	Sampling Maps (using scale)
618-3_Shallow_Focused	52.3	Sampling Maps (using scale)
618-4_Deep	47.3	Sampling Maps (using scale)
618-4_Deep_Focused	47.3	Sampling Maps (using scale)
618-4_Overburden_2	20.0	Sampling Maps (using scale)
618-4_Overburden_3	16.8	Sampling Maps (using scale)
618-4_Overburden_4	33.0	Sampling Maps (using scale)
618-4_Shallow	30.0	Sampling Maps (using scale) approx. NW/SE
618-5_Deep	34.2	Sampling Locations
618-5_Deep_Focused	14.1	Sampling Locations
618-5_Overburden	42.1	Sampling Locations
618-5_Shallow	50.0	QMAP along GW gradient NW/SE
618-5_Staging Pile_4	13.7	Sampling Locations
618-5_Staging Pile_5	88.3	Sampling Locations
618-7_Shallow_1	92.0	Sampling Maps (using scale)
618-7_Shallow_2	11.0	Sampling Maps (using scale)
618-7_Shallow_3	21.0	Sampling Maps (using scale)
618-7_Shallow_4	48.0	Sampling Maps (using scale)
618-7_Shallow_Focused	240.0	Sampling Maps (using scale)
618-8_Shallow	28.8	Sampling Maps (using scale)
618-9_Shallow_Focused	7.0	Sampling Maps (using scale)
628-4_Overburden	49.0	Sampling Maps (using scale)
628-4_Shallow	49.0	Sampling Maps (using scale)
UPR-300-17_Shallow	8.0	Sampling Maps (using scale)
UPR-300-46_Shallow	21.0	Sampling Maps (using scale)

Table 7-1. Comparison of EPCs for 300 Area Source Operable Unit COPCs to STOMP 1D 70:30/100:0 Contaminant Source Model Preliminary Remediation Goals Protective of Surface Water

Waste Site/Decision Unit	Analyte Group	COPC	CAS No.	Units	Exposure Point Concentration	Representative Length in Direction of Groundwater Flow (m)	Unit-Length STOMP 1D 70:30/100:0 Contaminant Source Model Native Vegetation Recharge SWP Preliminary Remediation Goal	Scaled STOMP 1D 70:30/100:0 Contaminant Source Model Native Vegetation Recharge SWP Preliminary Remediation Goal	Is EPC > Native Vegetation Recharge PRG Protective of Surface Water?	Unit-Length STOMP 1D 70:30/100:0 Contaminant Source Model Industrial Recharge SWP Preliminary Remediation Goal	Scaled STOMP 1D 70:30/100:0 Contaminant Source Model Industrial Recharge SWP Preliminary Remediation Goal	Is EPC > Industrial Recharge PRG Protective of Surface Water?
316-1_Shallow_3	non-Rad	Copper	7440-50-8	µg/kg	1.37E+06	50.0	NR[a]	NR[a]	No	NR[a]	NR[a]	No
618-9_Shallow_Focused	non-Rad	Aldrin	309-00-2	µg/kg	390	7.0	NR[a]	NR[a]	No	NR[a]	NR[a]	No

Notes:

a. The calculated PRG for the analyte is considered non-representative because: (1) breakthrough is simulated within 1,000 years for some soil columns while other soil columns (a majority) show no breakthrough (breakthrough defined as concentrations below 1E-04 µg/L or activity below 1E-04 pCi/L), and/or (2) the calculated residual mass of contaminant in the pore volume is high enough to represent a substantial (and physically improbable) reduction in porosity.

Table 7-2. Comparison of Uranium EPCs for 300 Area Source Operable Unit to STOMP 2D Uranium Source Model Preliminary Remediation Goals Protective of Groundwater

Waste Site/Decision Unit	Analyte Group	COPC	CAS No.	Units	Exposure Point Concentration	Representative Length in Direction of Groundwater Flow (m)	Unit-Length STOMP 2D Uranium Source Model Native Vegetation Recharge GWP Preliminary Remediation Goal	Scaled STOMP 2D Uranium Source Model Native Vegetation Recharge GWP Preliminary Remediation Goal	Is EPC > Native Vegetation Recharge PRG Protective of Groundwater	Unit-Length STOMP 2D Uranium Source Model Industrial Recharge GWP Preliminary Remediation Goal	Scaled STOMP 2D Uranium Source Model Industrial Recharge GWP Preliminary Remediation Goal	Is EPC > Industrial Recharge PRG Protective of Groundwater
316-2_Shallow_1	non-Rad	Total_U_Isotopes	Total_U_Isotopes	ug/kg	210,452	71.0	179,860	179,860	Yes [a]	157,000	157,000	Yes [a]
316-2_Shallow_2	non-Rad	Total_U_Isotopes	Total_U_Isotopes	ug/kg	291,369	117.0	179,860	179,860	Yes [a]	157,000	157,000	Yes [a]
316-5_Shallow_1	non-Rad	Total_U_Isotopes	Total_U_Isotopes	ug/kg	271,835	68.0	179,860	179,860	Yes [a]	157,000	157,000	Yes [a]
316-5_Shallow_2	non-Rad	Total_U_Isotopes	Total_U_Isotopes	ug/kg	204,701	68.0	179,860	179,860	Yes [a]	157,000	157,000	Yes [a]
316-5_Shallow_Focused	non-Rad	Total_U_Isotopes	Total_U_Isotopes	ug/kg	138,095	68.0	179,860	179,860	No [a]	157,000	157,000	No [a]
618-1_Deep_Focused	non-Rad	Total_U_Isotopes	Total_U_Isotopes	ug/kg	196,154	25.0	179,860	179,860	Yes [a]	157,000	157,000	Yes [a]
618-2_Deep	non-Rad	Total_U_Isotopes	Total_U_Isotopes	ug/kg	491,176	47.7	179,860	179,860	Yes [a]	157,000	157,000	Yes [a]
618-2_Deep_Focused	non-Rad	Total_U_Isotopes	Total_U_Isotopes	ug/kg	150,259	47.7	179,860	179,860	No [a]	157,000	157,000	No [a]
618-3_Shallow_Focused	non-Rad	Total_U_Isotopes	Total_U_Isotopes	ug/kg	238,577	52.3	179,860	179,860	Yes [a]	157,000	157,000	Yes [a]

Notes:

a. Uranium PRG values are not scaled by representative dimension because these were developed using a site-specific 2D model (ECF-300FFS-11-0151).