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ECF-200PO1-09-2007
Revision 2

200-PO-1 Operable Unit Remedial Investigation Report - Contaminant Fate and Transport Modeling in the Distal Portion of OU

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

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

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

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200-PO-1 Operable Unit Remedial Investigation Report - Contaminant Fate and Transport Modeling in the Distal Portion of OU

Document Type: RPT Program/Project: EP&SP

S. Mehta
CH2M HILL Plateau Remediation Company

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September 2011

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Environmental Calculation Cover Page

Part 1: Completed by the Responsible Manager

Project: 200-PO-1 Operable Unit RI **Date:** 8/26/2011

Calculation Title & Description: 200-PO-1 Operable Unit Remedial Investigation Report –Contaminant Fate and Transport Modeling in the Distal Portion of OU.

This calculation describes the purpose, inputs, and computational methodology for performing calculations to estimate the future concentration of contaminants found in groundwater within the distal portion of the 200-PO-1 Operable Unit (OU).

Preparer: S Mehta	**Basis of Qualification:** Education & experience
Checker: A Mayenna	**Basis of Qualification:** Education & experience
Senior Reviewer: WE Nichols	**Basis of Qualification:** Education & experience

Part 2: Completed by Preparer

Calculation No.: ECF-200PO1-09-2007 **Revision No.:** 2

Revision History:

Revision No.	Description	Date	Affected Pages
0	Initial Issue	April 26, 2010	All
1	Revisions to text to clarify calculation context (no change to calculation approach or results)	June 18, 2010	All
2	Text revised for clarity (no change to calculation approach or results)	August 26, 2011	All

Part 3: Document Review & Approval:

Preparer:

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ON RECORD 9/7/2011

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1 Purpose

The purpose of this calculation is to present the computational basis for simulation of the fate and transport of contaminants in groundwater in the distal portion of the 200-PO-1 Groundwater Operable Unit (OU) at the US Department of Energy's (DOE's) Hanford Site. The calculated results will be used to support the baseline risk assessment by estimating the future concentration of contaminants of potential concern in groundwater for the distal portion of the 200-PO-1 OU. This estimate also includes the effect of contaminants that originate within the near-field portion and migrate in groundwater to the distal portion of the OU. The predictive calculations are performed starting from calendar year (CY) 2009.

The distal portion is defined as that region of the 200-PO-1 OU that is outside of the detailed three-dimensional flow and transport model domain developed for the Hanford Central Plateau (in the vicinity of 200 Area), tentatively referred to as the Central Plateau model (ECF-200PO1-09-2352 Rev. 1, *200-PO-1 Remedial Investigation Report – Central Plateau Groundwater Fate & Transport Modeling*). The distal portion generally lies outside of the 200 Area but includes portions of the 600 Area and 400 Area. The geographic boundary of the 200-PO-1 OU, the distal portion of the 200-PO-1 OU, and the current extent of the plumes of tritium, ^{129}I, and nitrate are shown in Figure 1. The contaminants of potential concern (COPCs) that are simulated in the transport calculation are: tritium, ^{129}I, ^{99}Tc, ^{90}Sr, uranium, nitrate, and chlorinated hydrocarbons (tetrachloroethene, trichloroethene, and carbon tetrachloride).

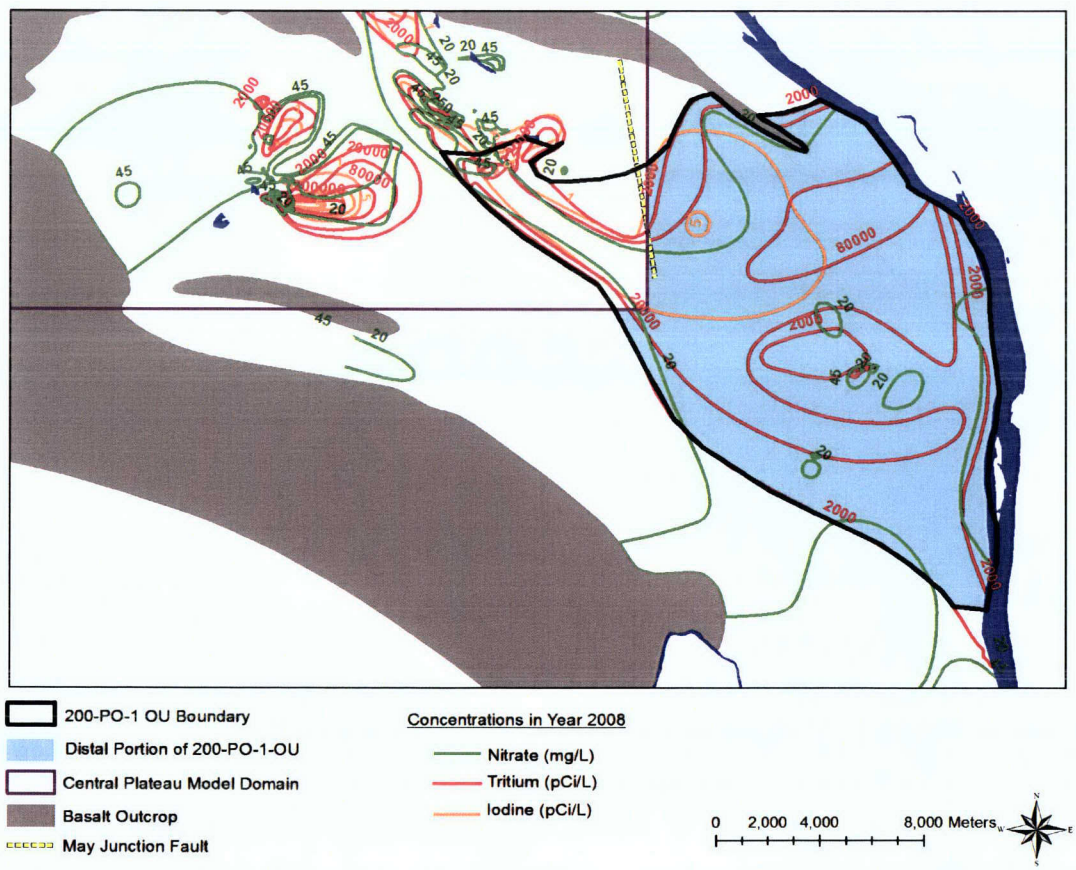


Figure 1. The 200-PO-1 Groundwater OU And the Distal Portion of the OU (shown in blue color) Along With the Extent of Plumes

2 Methodology

The contaminant fate and transport calculations for the distal portion of the 200-PO-1 OU are performed using GoldSim Pro 10.00 (SP2) (GoldSim Technology Group, 2009), an acquired computer software package. The Pipe Pathway elements in GoldSim contaminant transport module are used to calculate rates of contaminant transport along pathways that behave as stream tubes or fluid conduits. Pipe Pathways use a Laplace transform approach to provide analytical solutions to a broad range of advective-dominated mass transport systems involving one-dimensional advection, longitudinal dispersion, retardation, decay and ingrowth, and exchanges with immobile storage zones. The geometry of the pathway is defined by specifying length, a cross-sectional area, and a perimeter. Mass enters at one end of a Pipe (or along some specified length of Pipe), advects through (with dispersion, sorption, and diffusion within) the mobile zone of the Pipe, and then exits at the other end.

The distal portion of the 200-PO-1 OU simulates contaminant transport in the area away from the Hanford Central Plateau (essentially, the near field). The extent and discretization used in this calculation is guided by the location of wells used in the risk assessment calculations and by the current spatial extent of the plumes. The concentrations of COPCs in the distal portion are represented by introducing contaminant mass in the Pipe Pathways in such a manner that the groundwater concentrations observed in the past few years can be reasonably matched at the scale selected for the spatial discretization of the calculation domain. The mass of COPCs that may exit the Central Plateau model domain in the future is introduced at the starting location of the Pipe Pathways. The Central Plateau flow and transport model is described in ECF-200PO1-09-2352 Rev. 1, *200-PO-1 Remedial Investigation Report – Central Plateau Groundwater Fate & Transport Modeling.* It should be noted that the flow and transport modeling for the Central Plateau model is performed using MODFLOW-2000 (USGS, 2000) and MT3DMS (SERDP-99-1, 1999) and are described in separate environmental calculation reports.

The basic methodology for this calculation is as follows:

a. Construct a calculational representation of transport processes using Pipe Pathways using site-specific descriptions of the hydrostratigraphy and the hydraulic gradients in the distal portion of the OU. The Pipe Pathways are located near the southeast part of the Central Plateau and originate near the boundary of the Central Plateau model domain of the 200-PO-1 OU. Their location is chosen to capture the mass of COPCs arriving from the Central Plateau model domain and to transport them along the existing hydraulic gradients to the discharge areas near the Columbia River (Figure 2). Three Pipe Pathways are deemed adequate for estimating transport of contaminants in the distal portion: one oriented in the northeast direction; one towards east-northeast; and one towards the east-southeast.

b. The representativeness of the calculation is verified by comparing the construct to the available geologic descriptions, well logs, cross sections, and other appropriate sources of information. The variation in the saturated thickness of the unconfined aquifer and the hydrostratigraphic units (HSUs) present in the distal portion is used to determine the adequacy of the discretization applied. Figure 3 shows the distribution of various HSUs at the water table for the Year 2008 and Figure 4 shows the geologic cross-section along a line approximately parallel to the axis of the tritium plume. This information is used to develop the attributes for the calculation.

c. Appropriate initial conditions are established by introducing the mass of contaminants to match the concentration profile for years prior to CY 2009. A time-varying concentration boundary condition is applied based on the output of the Central Plateau model for predictive calculations.

The flow rates are based on the estimation of current hydraulic gradients assuming they would not change appreciably over the simulated time period.

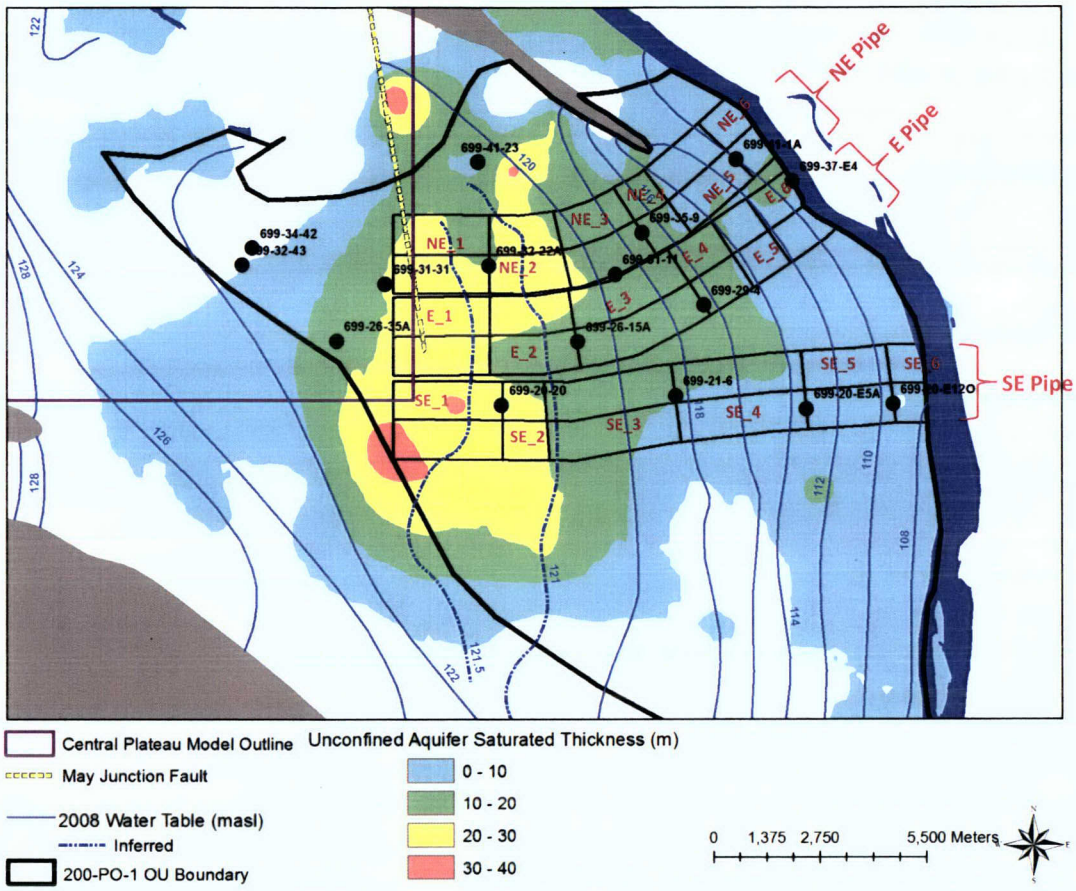


Figure 2. Spatial Discretization of the Pipe Pathways along with the Saturated Thickness Variation in the Unconfined Aquifer and Location of Wells Used in Risk Assessment Calculations.

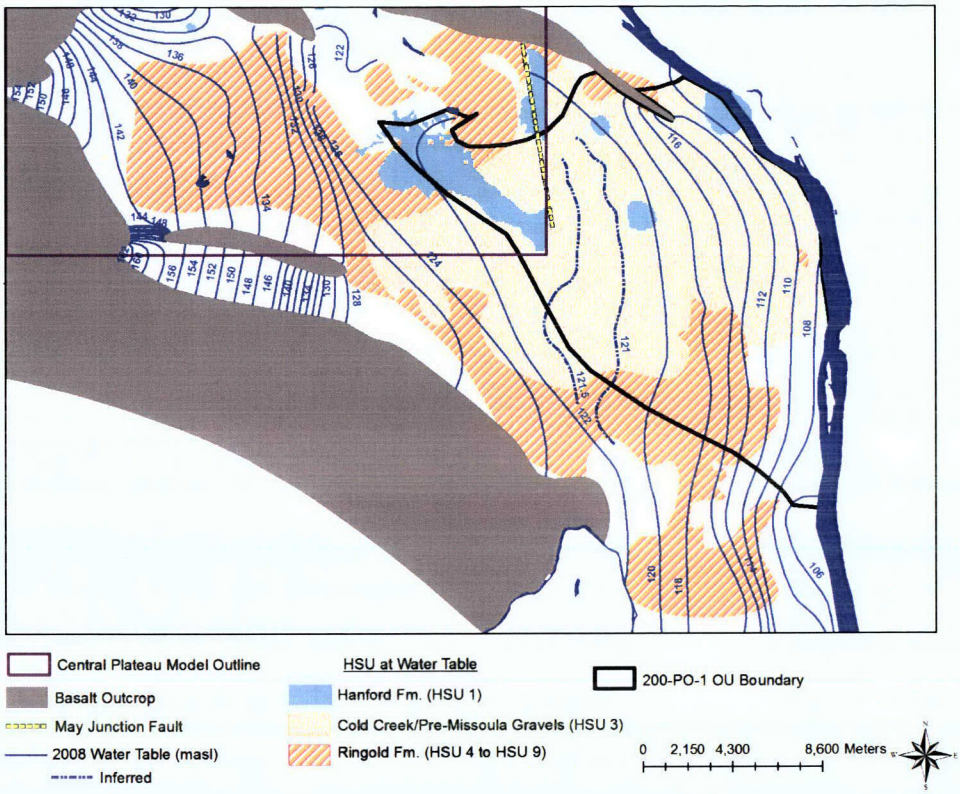


Figure 3. HSUs at 2008 Water Table

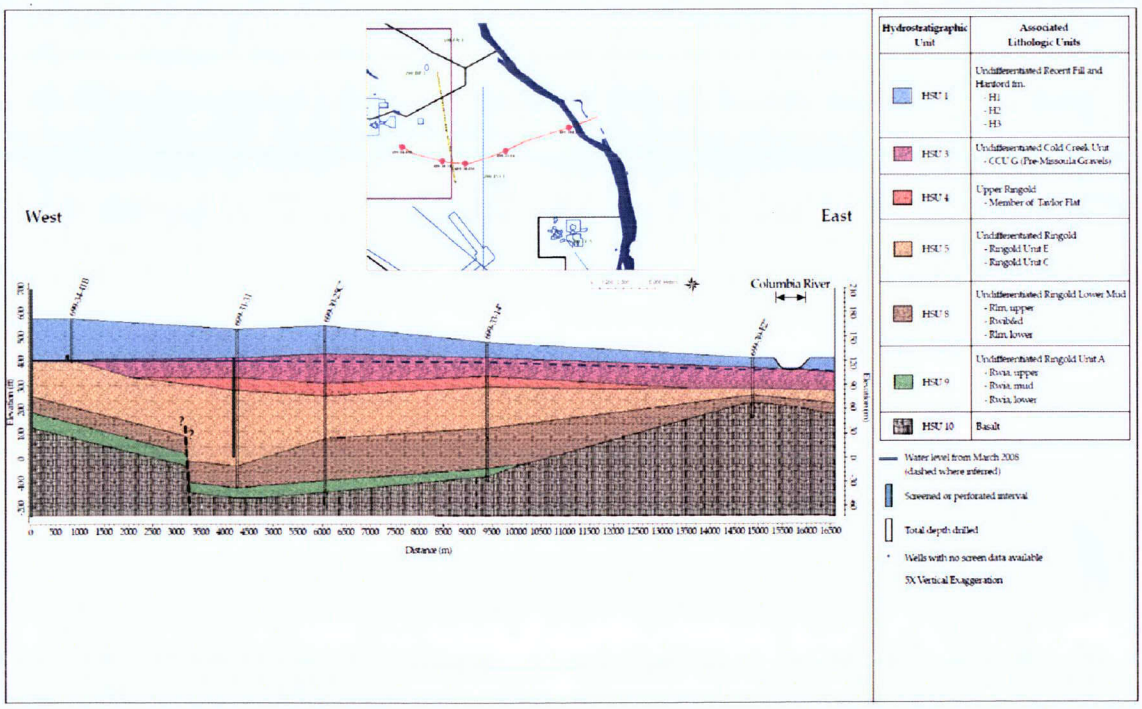


Figure 4. Geologic cross-section along a line (see inset) that approximately parallels the axis of the tritium plume in the distal portion of the 200-PO-1 OU.

3 Assumptions and Inputs

Domain

Three primary Pipe Pathways have been used to estimate contaminant transport based on the flow direction and designated as Transport_NE (Northeast Pipe), Transport_E (East-Northeast Pipe), and Transport_SE (East-Southeast Pipe), as shown in Figure 2. Each of the three Pipe Pathways are further discretized into six segments (Table 1), based on the three zones selected to represent the saturated thickness variation in the unconfined aquifer and the location of selected observation wells used in the risk assessment calculations for which future concentrations may be required. Thus, the concentration history can be obtained from eighteen locations (end of each Pipe segment). The saturated thickness of the unconfined aquifer varies over 30 m in the distal portion and is discretized at 10 m interval (three zones) to capture the spatial variability in thickness without unduly increasing the Pipe segments. The location of the Pipe Pathways along with their chosen lengths and widths are based on the spatial distribution of the current plumes of tritium, iodine-129, and nitrate in the distal portion of the OU. The location of the Transport_E Pipe Pathway is chosen to capture the highest concentration region within the tritium plume. It is also expected to capture most of the mass that would be exiting the Central Plateau model domain. The location of the other two Pipe Pathways is chosen to capture rest of the mass from the near-field model. The starting location of the Pipe Pathways is selected to be approximately 500 m inside the near-field model domain (from the eastern boundary) in order to capture the mass of contaminants without the effects of boundary conditions. The Pipe Pathway details are given in Table 1.

Each discretized segment in a Pipe Pathway, for the purpose of reference, is numbered from 1 through 6 towards the downgradient direction along with the Pipe Pathway prefix. For example, for the East Pipe Pathway, the Pipe segments are designated, from upgradient to the downgradient direction, as E_1, E_2, E_3, E_4, E_5, and E_6, respectively. The concentrations are calculated for the location at the end of each Pipe segment.

Hydrogeologic Units

The extent and geometry of various HSUs in the distal portion of 200-PO-1 Groundwater OU is based on the top and bottom elevation of each HSU at boreholes listed in the Hanford Geologic Contact Depths database (Hanford Geologic Contact Depths_2008-08-26.xls [PNNL, 2009]). This database provides a controlled dataset that identifies the HSU contacts in various boreholes on the Hanford site. It updates the existing datasets described by PNNL-14753, Rev. 1, *Groundwater Data Package for Hanford Assessment*. The top and bottom elevation data points taken from the database for a given HSU are interpolated using Ordinary kriging to develop the top and bottom surface of the HSU. Similarly, a water table surface is created based on the 2008 water level elevations at monitoring wells. The water table surface is compared to the top surface of HSU 1 (Hanford Fm), HSU 3 (Cold Creek/Pre Missoula unit), HSU 4 (Upper Ringold unit), and HSU 5 (Ringold E predominantly) to determine the unit at the water table and to determine the saturated thickness of the unconfined aquifer above Ringold Formation (HSU 4 through HSU 8).

The HSU at the water table is predominantly the Cold Creek/Pre-Missoula unit (HSU 3) in the distal portion of 200-PO-1 OU (Figure 3). This unit is underlain by a relatively thick (>10 m) semi-confining Upper Ringold unit (HSU 4) for most of the far field area (Figure 4). Since all of the contaminants of potential concern are highly mobile and occur at relatively low concentrations, they are likely to be constrained within the unconfined aquifer. Because of this the Pipe Pathways are considered representative of the unconfined aquifer (primarily the Cold Creek/Pre-Missoula unit). Since the

hydraulic gradients have remained relatively unchanged in the past decade, the current water table surface represents near steady-state conditions.

Parameters

Hydraulic conductivity used in this calculation are based on the pump-test data for the wells screened in unconfined aquifer (Hanford or Cold-Creek/Pre-Missoula units). Around twenty such pump-test based measurements are available in the distal portion of the 200-PO-1 OU, as presented in Figure 4-19 of PNNL-13641, *Uncertainty Analysis Framework – Hanford Site-Wide Groundwater Flow and Transport Model*). Of these, only thirteen wells are located within the spatial extent of the Pipe Pathways, where the water table is in the Cold-Creek/Pre-Missoula unit. Based on the reported transmissivity from the pump-test analyses, the hydraulic conductivity is calculated by dividing the transmissivity by the current estimate of saturated thickness of the unconfined aquifer (Dupuit assumption). The hydraulic conductivity values vary from about 5 m/day to 450 m/day (Figure 5). The data is fitted to a log-normal distribution that has a geometric mean of 61.98 m/d and standard deviation of 7.36 m/day. The original unbounded distribution is truncated at 5 m/day (lower bound) and 450 m/day (upper bound), leading to an adjusted mean of 97.16 m/day.

The volumetric discharge calculated for the first segment of the Pipe Pathway is maintained through the other segments of the Pipe Pathway to conserve the mass of water within a stream tube. Since no specific hydraulic conductivity measurement was available near the first segment of the NE and E Pipe Pathways (namely, Transport_E and Transport_NE) the adjusted mean hydraulic conductivity calculated above was used. However, the first segment of the SE Pipe Pathway (Transport_SE) is given a hydraulic conductivity of 120 m/day by rounding the pump-test derived hydraulic conductivity of 124.48 m/day for groundwater well 699-20-20 that is located near the middle of the pipe segment. The hydraulic conductivity values used in the Pipe Pathways are representative of Cold Creek unit and consistent with the values of 100 m/day used in the Central Plateau model based on model calibration (ECF-200PO1-09-2352 Rev. 1, *200-PO-1 Remedial Investigation Report – Central Plateau Groundwater Fate & Transport Modeling*). Well 699-18-21 that is located close to 699-20-20 has a calculated hydraulic conductivity of 20.4 m/day based on pump-test analysis. This value is part of the log-normal distribution indicating large spatial variability but is not deemed to be representative of the Cold Creek unit over the transport distances considered here.

The longitudinal dispersivity for each Pipe segment is based on initially assuming the value to be one-tenth of the length of the Pipe segment. But it is modified by attempting to match the actual measurements of tritium concentrations in wells located along the flow path in the distal portion of the OU. The reason for choosing tritium is that it is considered a conservative tracer (non-sorbing) and long-term measurements exist along these wells for a period extending over 20 years that allows for estimation of longitudinal dispersivity.

An initial attempt was made to calculate the longitudinal dispersivity from the tritium concentrations observed at selected wells located approximately along a flow path within the 200-PO-1 OU. The observed concentrations at the wells are plotted as breakthrough curves following the radioactive decay correction and by normalizing the concentration to the maximum observed value for that well. By assuming a constant source concentration upgradient, the breakthrough curve at the observation point (well) is assumed to follow a normal distribution. Based on the methodology given in Domenico & Schwartz (*Physical and Chemical Hydrogeology*, Section 18.2), the variance of the distribution can be calculated using the graphical method and the expected (mean) longitudinal dispersivity is determined. The longitudinal dispersivity calculated using this method ranged from 120 m (for transport distance of 2740 m) to 1450 m (for transport distance of 4060 m). Because of large variation in longitudinal

dispersivity compared to the transport distance it was deemed that longitudinal dispersivity values cannot be extrapolated to pipe segments where observation wells with long-term tritium records are not available. Thus the approach was simplified to initially assume the longitudinal dispersivity at one-tenth of the length of transport distance.

The other transport relevant parameters such as K_d, decay rate, effective porosity, and bulk density are taken from laboratory measurements and other modeling studies. These are summarized in Table 2. The K_d values applied are based on best estimates for sandy gravel sediment type in relatively uncontaminated sediments. This is because most of the transport is simulated in the portion of the aquifer that is far away from the source of contamination and therefore sorption capacity of the sediments in the aquifer is still much greater than the amount of contaminants in the dissolved phase. Furthermore, the chemical conditions (pH, ionic strength, etc.) in the aquifer away from the active source areas are expected to be near ambient conditions.

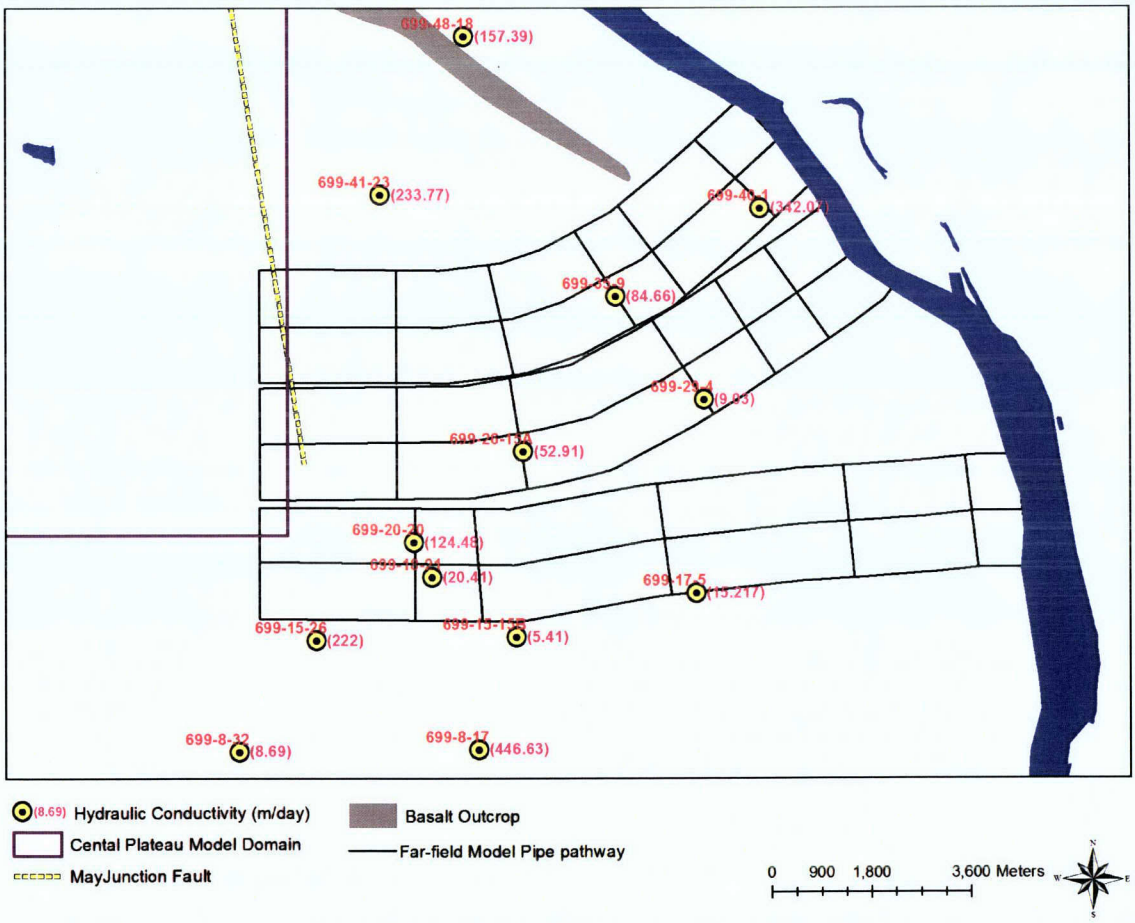


Figure 5. Hydraulic Conductivity Data Used In the Calculation Along with the Location of Wells in Relation to the Pipe Pathways.

Sorption of ^{129}I to the matrix of the unconfined aquifer is considered based on the observation that ^{129}I plume has moved little over the last ten years. To match the observed concentrations, a spatially varying K_d is applied that ranges from 0 ml/g to 0.35 ml/g. The K_d values for PCE and TCE (as shown in Table 2)

are calculated based on the partition coefficients with respect to the organic carbon adjusted by the fraction of organic carbon as described in PNNL-13560, *Assessment of carbon tetrachloride groundwater transport in support of the Hanford carbon tetrachloride innovative technology demonstration program* (Equations 1 & 2, page C.16), which are presented below for ready reference:

$$K_d = f_{oc} \times K_{oc} \qquad \text{.....(1)}$$

$$\text{Log}\,(K_{oc}) = 3.64 - 0.55 \times \log(S) \qquad \text{.....(2)}$$

Where f_{oc} is the mass fraction of organic carbon in the soil, K_{oc} is the partition coefficient for organic carbon and S is the water solubility of the organic compound. The f_{oc} is taken to be 2.7×10^{-4} based on the, low average organic carbon fraction measured for the Hanford sediments (PNNL-13560; Table 13). The aqueous solubility of PCE is taken to be 150 mg/L and that of TCE is taken to be 1100 mg/L.

The K_d for the carbon tetrachloride is based on PNNL-16100, Rev 1, *Carbon tetrachloride partition coefficients measured by aqueous sorption to Hanford sediments from Operable Units 200-UP-1 and 200-ZP-1* (for Slow (Phase 2) in Table 5.5). The average K_d of three sediments based on Slow (Phase 2) sorption fraction (as listed in Table 5.5 of PNNL-16100, Rev. 1) have been rounded up to 3×10^{-3} L/kg (as also discussed in Section 6 of that report). The values from the slower sorption phase are taken because they are based on experiments run over five days and therefore are more useful for transport simulations compared to the shorter duration experiments. The K_d for 200-UP-1 sediments were chosen as they lead to larger values compared to 200-ZP-1 sediments. This is perhaps because the batch sorption experiments were conducted for longer duration (five days) for the 200-UP-1 sediments compared to the three days for the 200-ZP-1 sediments.

Effective porosity for the Pipe Pathways is selected to be 0.227 based on the best-estimate site-wide data presented in Table 6.4 of PNNL-18564 (*Selection and Traceability of Parameters to Support Hanford-Specific RESRAD Analyses – An FY08 Status Report*). The bulk density value for the Pipe Pathway is selected to be 1930 kg/m^3 based on the best-estimate site-wide data presented in Table 6.2 of PNNL-SA-60991 (*Selection and Traceability of Parameters to Support Hanford-Specific RESRAD Analyses – Fiscal Year 2008 Status Report*). Both the effective porosity and bulk density values are selected to be representative of the sandy gravel sediment from Hanford Formation and are selected due to lack of information specific to Cold Creek unit in the distal portion of the 200-PO-1 OU. A single representative value is deemed adequate because of the averaging of the rock volumes over large transport distances.

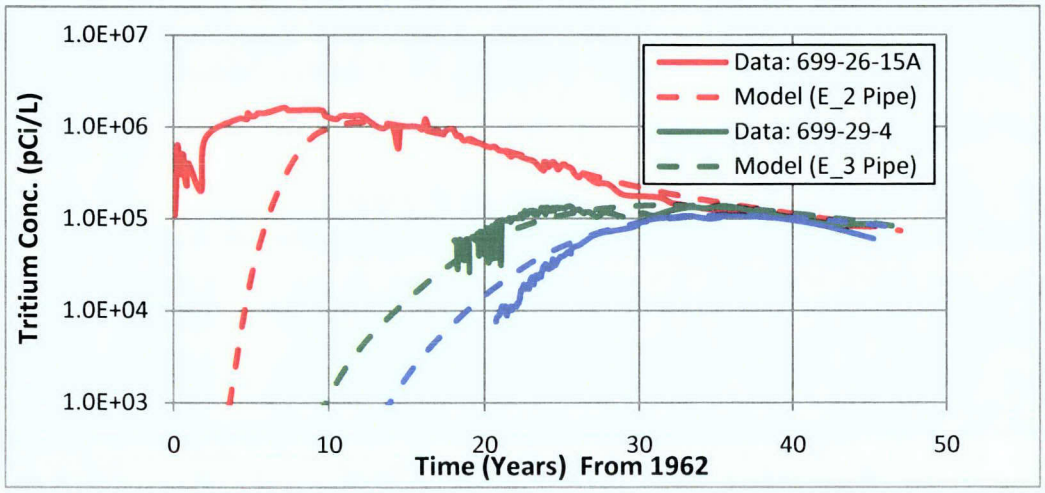
Contaminant Initial and Boundary Conditions

The initial conditions in the Pipe Pathways represent the current distribution of contaminant concentration. This is accomplished by mass loading of contaminants in the Pipe Pathways at desired concentrations and calculating transport through time until required concentration conditions are established. The initial conditions in the Pipe Pathways are established by introducing the mass of contaminants and flow rates in such a manner that the concentration profile for years prior to CY 2009 (starting time for predictive calculations) approximate the observed concentrations at the monitoring wells located in the Pipe Pathways and follow the general concentration trends, as observed in the wells. Because the discharge history of water from operations period and its effect on changing the hydraulic

gradients in the area of the Pipe Pathways is poorly understood, the flow rates that are assigned to match the past concentration profiles of the downgradient wells are somewhat arbitrary. Nevertheless, care is taken that the concentration at the starting locations when convolved with the flow rates lead to a reasonable agreement with the downstream concentrations for the history matching exercise and for setting up the initial conditions for the start of predictive calculations. History matching is attempted for tritium, nitrate, and ^{129}I by comparing the concentration at selected pipe segments (that correspond with the location of monitoring wells) with the historical concentration record available for the monitoring wells (Figures 6 a-c). For tritium, the upstream time varying concentration boundary is applied for all three Pipe Pathways based on the concentration history of well 699-31-31. For ^{129}I, the concentration history from well 699-32-43 is applied to all three Pipe Pathways. For nitrate, the concentration history from well 699-31-31 is applied to NE Pipe Pathway while the concentration history from well 699-32-43 is applied to E and SE Pipe Pathways. The selection of wells for upstream boundary concentrations is based on their relative location from the Pipe Pathways and the time duration of the concentration dataset available for a given analyte. Well selection was based on the availability of long-term monitoring record of concentrations. Some wells that were near the Pipe Pathways had either limited monitoring record or sporadic record and thus could not be used in model calibration.

For the predictive calculations, the volumetric discharge of water applied to each of the three Pipe Pathways is calculated based on the estimation of average hydraulic gradient, hydraulic conductivity, and cross-sectional area in the discretized region for the most upgradient Pipe segment. The same volumetric discharge is applied to the downgradient Pipe segments for the given Pipe Pathway even when the saturated thickness varies from one Pipe segment to the next, resulting in varying groundwater velocities. The volumetric discharge is held constant in order to preserve the stream tube geometry as the flow lines in the distal portion of the OU are observed to remain parallel, representing a nearly undisturbed water table condition with horizontal flow (Dupuit assumption).

For the predictive calculations, the input mass flux of contaminants at the boundary of the Pipe Pathways will be provided by the output of the Central Plateau model. For this, at each time step, the average concentration of contaminants from the near-field model domain grid nodes that correspond to the width of each of the three Pipe Pathways is calculated and applied as a boundary condition. In the vertical direction, the concentrations from only those grid blocks are averaged that correspond to the HSU 1 or HSU 3. The input from Central Plateau model starts at CY 2009 and lasts throughout the simulated time.



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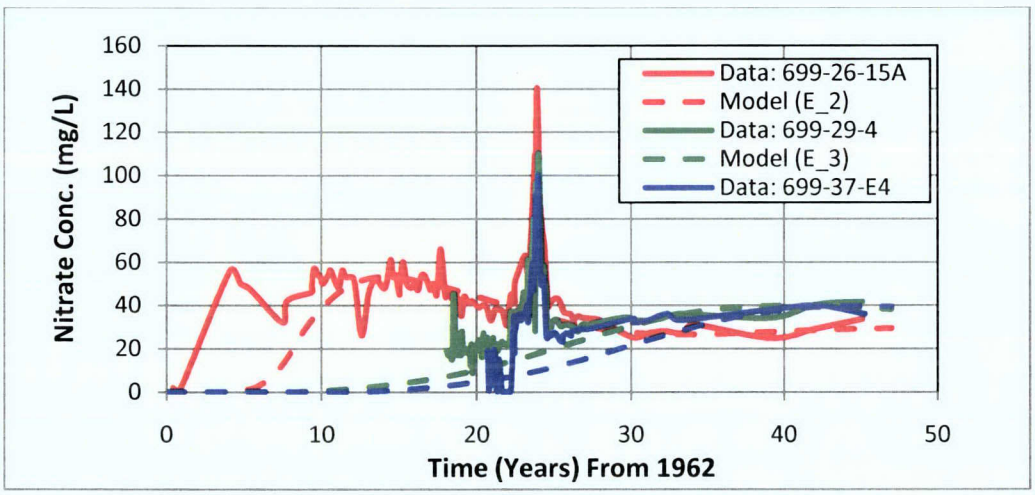

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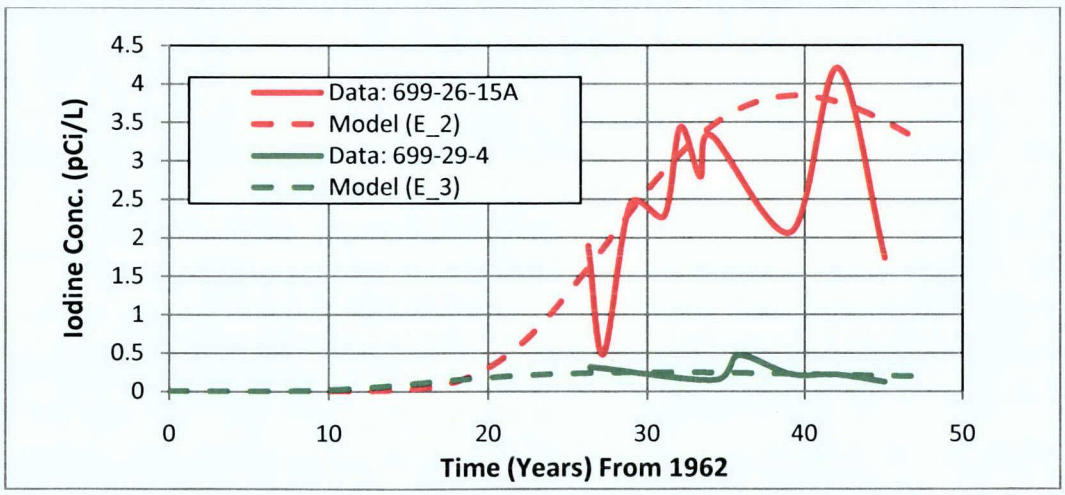

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Figure 6 Comparison of concentration time history of selected Pipe segments to collocated monitoring wells from mass loading to simulate the initial conditions. The Pipe Pathway shown here is the East Pipe Pathway (Transport_E).

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4 Software Application, Description, Installation & Checkout, and Statement of Validity

GoldSim PRO 10.00 (SP 2) software is used for the calculations presented here. It is approved software that is managed and used in compliance with the requirements of PRC-PRO-IRM-309, *Software Control Management*. Following supporting information is provided.

1. Description:

   - Software Title : GoldSim Pro
   - Software Version: 10.00 (SP 2)
   - HISI Identification Number: 2461 (Safety Software, Level C)
   - Authorized Workstation type and property number: DELL PC, SUNIL-PC (INTERA Property Tag 00362)
   - Authorized User: Sunil Mehta
   - CHPRC Software Control Documents:
     - CHPRC-00180 Rev 0, *GoldSim Pro Functional Requirements Document*
     - CHPRC-00175 Rev 1, *GoldSim Pro Software Management Plan*
     - CHPRC-00224 Rev 0, *GoldSim Pro Software Test Plan*
     - CHPRC-00256 Rev 0, *GoldSim Pro Requirements Traceability Matrix*
     - CHPRC-00262 Rev 0, *GoldSim Pro Acceptance Test Report*

2. Software Installation and Checkout:

   A copy of the Software Installation and Checkout form for the authorized user and authorized workstation used is included.

3. Statement of Valid Software Application:

   The software is appropriate for the application and used within the range of intended uses for which it was tested and accepted by CHPRC.

CHPRC SOFTWARE INSTALLATION AND CHECKOUT FORM

Software Owner Instructions:
Complete Fields 1-13, then run test cases in Field 14. Compare test case results listed in Field 15 to corresponding Test Report outputs. If results are the same, sign and date Field 19. If not, resolve differences and repeat above steps.

Software Subject Matter Expert Instructions:
Assign test personnel. Approve the installation of the code by signing and dating Field 21, then maintain form as part of the software support documentation.

GENERAL INFORMATION:

1. Software Name: GoldSim Pro 10.00(SP2) Software Version No.: 10.00

EXECUTABLE INFORMATION:

2. Executable Name (include path):

   C:\Program Files\GTC\GoldSim 10\GoldSim.exe

3. Executable Size (bytes): 1,441,000

COMPILATION INFORMATION:

4. Hardware System (i.e., property number or ID):

   Compiled by vendor

5. Operating System (include version number):

   Windows

INSTALLATION AND CHECKOUT INFORMATION:

6. Hardware System (i.e., property number or ID):

   SUNIL-PC (INTERA Property Tag 00362)

7. Operating System (include version number):

   Windows Vista Business SP1

8. Open Problem Report? (●) No ( ) Yes PR/CR No

TEST CASE INFORMATION:

9. Directory/Path:

   C:\Program Files\GTC\GoldSim 10\General Examples

10. Procedure(s):

    per CHPRC-00224 Rev 0, GoldSim Pro Software Test Plan

11. Libraries:

    N/A

12. Input Files:

    FirstModel.gsm

13. Output Files:

    FirstModel.gsm

14. Test Cases:

    GS-ITC-1

15. Test Case Results:

    Match expected results as presented in CHPRC-00224 Rev 0, GoldSim Pro Software Test Plan

16. Test Performed By: Sunil Mehta

17. Test Results: (●) Satisfactory, Accepted for Use ( ) Unsatisfactory

18. Disposition (include HISI update):

    Platform listing added to HISI entry

CHPRC SOFTWARE INSTALLATION AND CHECKOUT FORM (continued)

1. Software Name: GoldSim Pro 10.00(SP2) Software Version No.: 10.00

Prepared By:

19.	Software Owner (Signature)	W.E. Nichols (Print)	7/8/2007 (Date)

20. Test Personnel:

Sign	S. Mehta (Print)	7/8/07 (Date)
Sign	Print	Date
Sign	Print	Date

Approved By:

21	Software SME (Signature)	C.W. Cornell (Print)	7/19/07 (Date)

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5 Calculation

The transport calculations are performed by running two GoldSim files in a deterministic mode, one with the average concentration of COPCs applied at the upstream boundary and the other with the maximum concentration of COPCs applied at the upstream boundary. Besides the boundary concentrations the two GoldSim files are identical.

Initially, the predictive calculation time period is selected to be 125 years (starting at CY 2009), as most COPC concentrations are expected to decrease with time and drop well below half of the maximum contaminant level allowed in the groundwater per safe drinking water standards (½ MCL). Following the initial calculations, additional calculations were performed where the predictive calculation time period is extended to 1,000 years to investigate the long-term concentration for iodine-129, as it is found to persist near MCL of 1 pCi/L for period extending beyond 125 years. For traceability and configuration control, the GoldSim files for each simulation are saved separately.

The GoldSim files used for 125 year simulation are called:
200_PO_1_Far_Field_Transport_Model_Rev_2.gsm and
200_PO_1_Far_Field_Transport_Model_Rev_2_Max_Conc_Boundary.gsm

The GoldSim files used for 1,000 year simulation are called:
200_PO_1_Far_Field_Transport_Model_Rev_3.gsm and
200_PO_1_Far_Field_Transport_Model_Rev_3_Max_Conc_Boundary.gsm

The contaminant transport module is run with one-year time steps throughout the simulated time frame using the high solution precision setting in GoldSim. The radioactive decay (and any ingrowth) of the contaminant mass is automatically calculated by GoldSim. For the 125 year predictive calculations, total simulation time is set to 172 years so that the simulation start time is equivalent to beginning of CY 1962. The first 47 years of simulation (from CY 1962 to the end of CY 2008) are used for the purpose of loading the mass in the Pipe Pathways for setting up the initial conditions. The next 125 years of simulation is the predictive part that starts at the beginning of CY 2009 and ends in CY 2133. Similarly, for the 1,000 year predictive calculation, total simulation time is set to 1,047 years. A single run simulates the transport of all ten COPCs evaluated; these are tritium, ^{129}I, ^{99}Tc, ^{90}Sr, uranium, nitrate, tetrachloroethene, trichloroethene, and carbon tetrachloride. The concentrations are calculated for the location at the end of each Pipe segment.

For the predictive part of the simulation, the input concentration of COPCs at the upstream boundary of the Pipe Pathways is based on the simulated output of the MT3DMS calculations performed by the Central Plateau model. The grid blocks in the Central Plateau model that correspond to the spatial location of each of the three Pipe Pathways are identified and the concentrations computed by the corresponding block-centered nodes are either averaged (for average boundary concentration calculation) or maximum concentration is chosen (for maximum concentration boundary calculation) for each of the three Pipe Pathways. The selected grid blocks are located 500 m inside the Central Plateau model boundary to reduce the effects of boundary condition. In the vertical direction, only the grid blocks that are represented by HSU 1 (Hanford Formation) and HSU 3 (Cold Creek/Pre Missoula gravel unit) are selected because they represent the most transmissive part of the unconfined aquifer in the distal portion of the OU, where most of the contaminants are expected to be transported through along the hydraulic gradient. A total of 22 grid blocks are considered for the Northeast Pipe Pathway (Transport_NE), 33 grid blocks for the East Pipe Pathway (Transport_E), and 27 grid blocks for the Southeast Pipe Pathway (Transport_SE). All grid blocks for the East and Northeast Pipe Pathway are located along the N-S line

while all but two grid blocks for the Southeast Pipe Pathway are located along the E-W line (the remaining two grid blocks are located along the N-S line).

The concentration time history for each COPC that is applied at the upstream boundary for the Pipe Pathways is post-processed so that the starting time of 0 years as reported by MT3DMS is changed to 47 years for use in the current calculation (the start of predictive calculations). Other time steps are translated similarly.

6 Results and Conclusions

The results of the predictive transport calculations performed by applying average upstream boundary concentrations are presented in Tables 3 through 10. The concentration time history for the location at the end of each Pipe segment along with the upstream boundary concentration for the Pipe Pathway is presented. The predictive calculations start at CY 2009 that corresponds to time of zero years shown in the tables. The concentration time history results of COPCs from all three Pipe Pathway are presented in Figures 7–14. The concentration time history of ^{90}Sr is not presented as the input boundary concentration is practically zero (< 10^{-12} pCi/L).

For tritium, ^{129}I, and nitrate, the boundary concentrations applied are lower than the existing concentrations in the Pipe Pathways (resulting from the past releases). Therefore, the mass introduced at the upstream boundary does not greatly affect the future concentration. The tritium concentration in the various Pipe Pathways (Figure 7) declines rapidly due to short half-life of tritium (12.3 years). The tritium concentration in the down gradient pipe segments remains higher than the upstream boundary concentration throughout the simulated time. In contrast, ^{129}I concentration varies in the various segments of the Pipe Pathways (Figure 8) due to spatially varying K_d. Spatially varying K_d estimate is based on the concentration history matching exercise undertaken to establish the initial conditions in the Pipe Pathways during calibration. For example, in Figure 8b, the E_2 pipe segment concentration starts high but declines rapidly due to lower K_d value (0.02 ml/g) implemented compared to the pipe segments immediately upgradient (E_1) and down gradient (E_1), where the K_d value is chosen to be 0.35 ml/g. At later times, the concentration in E_2 Pipe Pathway is controlled by the concentration in the upstream E_1 Pipe Pathway. The ^{129}I concentration in the down gradient Pipe Pathway increases over time indicating slow down gradient movement of the plume. Because of long half-life compared to the simulation duration, the radioactive decay has negligible effect on ^{129}I concentration.

For ^{99}Tc and uranium (Figures 9 and 11), the upstream boundary concentration in the Pipe Pathway is the only source as these contaminants are not known to currently exist in the distal portion of the 200-PO-1 OU. Because ^{99}Tc is unretarded, the delay in peak concentration in the down gradient pipe segments are due to travel time and the reduction in peak concentration is due to dilution and dispersion. In comparison, the breakthrough curves for uranium concentration are considerably delayed due to retardation (K_d = 0.4 ml/g), leading to negligibly small breakthrough fraction past first pipe segment in all Pipe Pathways. The nitrate concentration in various Pipe Pathways (Figure 10) declines gradually over time as limited mass is added from the upstream boundary; nitrate is unretarded.

The concentration breakthrough curves for tetrachloroethene (Figure 12) shows affect of limited retardation (K_d = 0.075 ml/g) in the Pipe Pathways. The concentration of tetrachloroethene decreases with distance due to dilution and dispersion. Similar behavior is observed for trichloroethene (Figure 13) and carbon tetrachloride (Figure 14), however, the concentration of carbon tetrachloride shows additional decline due to a comparatively higher degradation rate.

The simulation results indicate that the peak concentrations that currently exist in the far field region generally decline with distance and time. Another way to demonstrate is through presentation of concentration results by spatial locations within the Pipe Pathway. An example of tritium concentration for the various pipe segments in the East Pipe Pathway is shown in Figure 15. For the COPCs that do not currently exist in the far field region but are injected at the upstream boundary, the peak concentrations in the far field remain lower than that at the upstream boundary suggesting decreasing risk, as shown by the example of ^{99}Tc concentration (Figure 16) for the various pipe segments in the East Pipe Pathway.

The results presented above are based on applying an average concentration derived from the output of the Central Plateau model. Although the calculations are representative of the average concentrations expected across the extent of each of the three Pipe Pathways, they do not provide the maximum concentration that may be present within the local flow path in a Pipe segment. In order to investigate the effect of local flow path that transports the maximum concentration observed at the upstream boundary, a separate set of calculations are performed where the maximum concentration from the block-centered nodes of the Central Plateau model are applied as the upstream boundary concentration instead of an average concentration. The maximum concentration from grid-block nodes corresponding to each of the three Pipe Pathways is calculated separately at each time step as an input boundary condition for the Pipe Pathways. This calculation therefore presents the theoretical maximum concentration possible in the Pipe Pathways and ignores the likely mixing of waters of varying concentrations due to hydrodynamic dispersion. The results of the calculations are presented in Tables 11–18 and shown in Figures 17–24. The results are qualitatively similar to those described earlier and demonstrate that the peak concentrations of COPCs that currently exist in the distal portion generally decline with distance and time. For the COPCs that do not currently exist in the distal portion of the OU but are injected at the upstream boundary, the peak concentrations in the distal portion remain lower than that at the boundary suggesting decreasing risk. It should be noted that these calculations are presented to determine the maximum possible concentration along a localized flow path without considering the effects of mixing of water packets of different concentrations either horizontally or vertically over transport lengths of several kilometers and by ignoring mass exchange from dispersion and diffusion. Therefore the results of these calculations are not deemed to be representative of the concentrations that can be expected within the extent of the Pipe Pathways. On the other hand, the calculations performed using the average upstream concentrations are more representative of the concentrations expected within the extent of the Pipe Pathways.

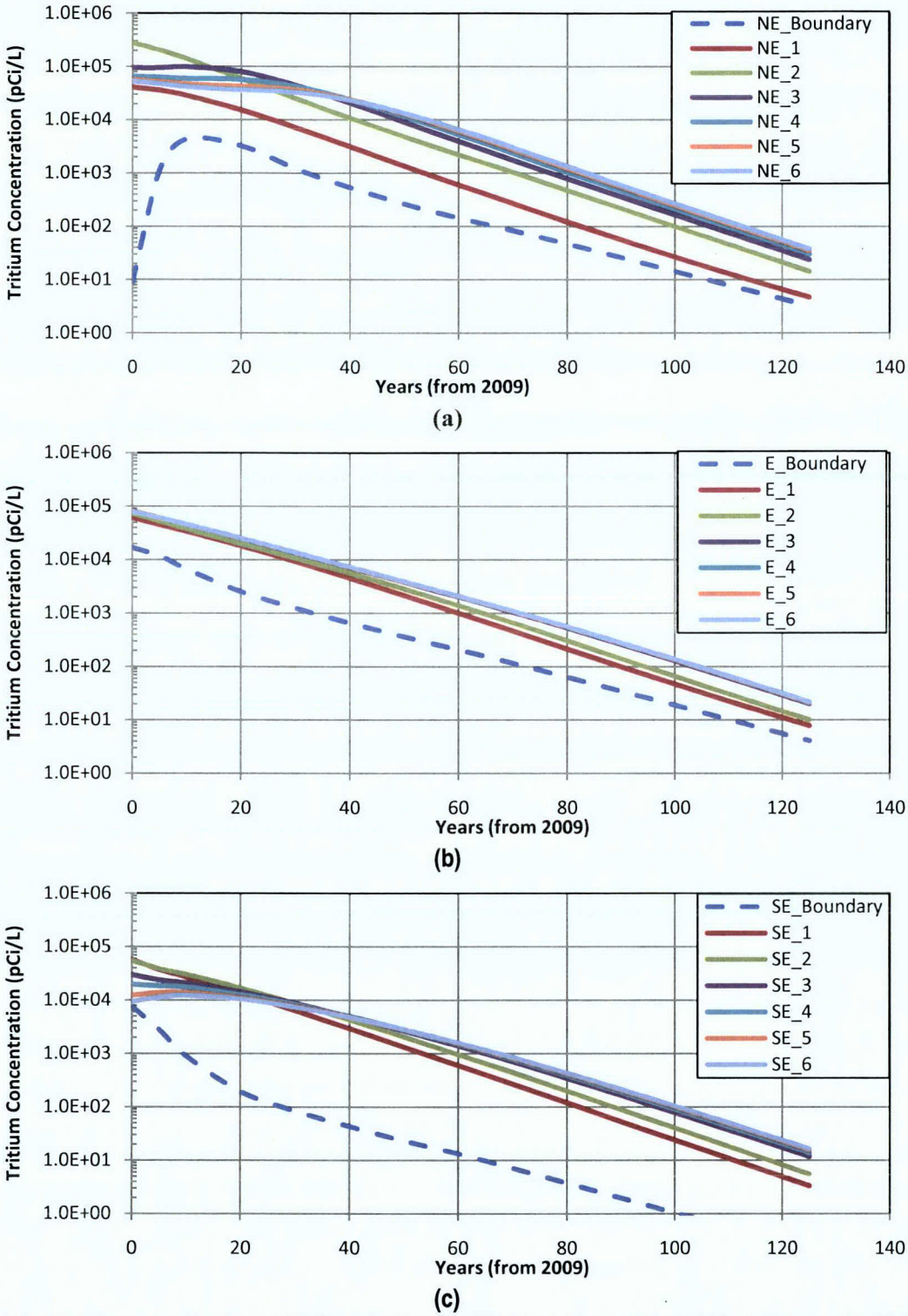
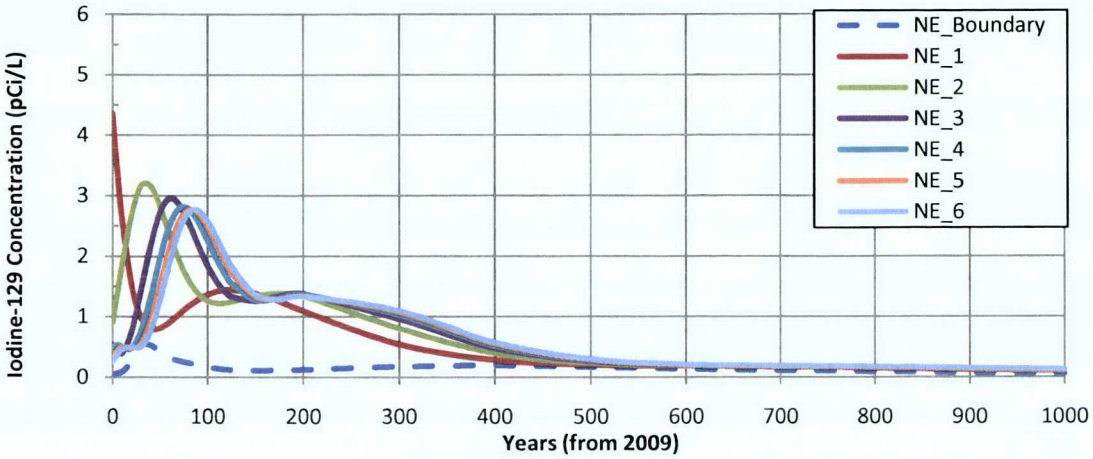
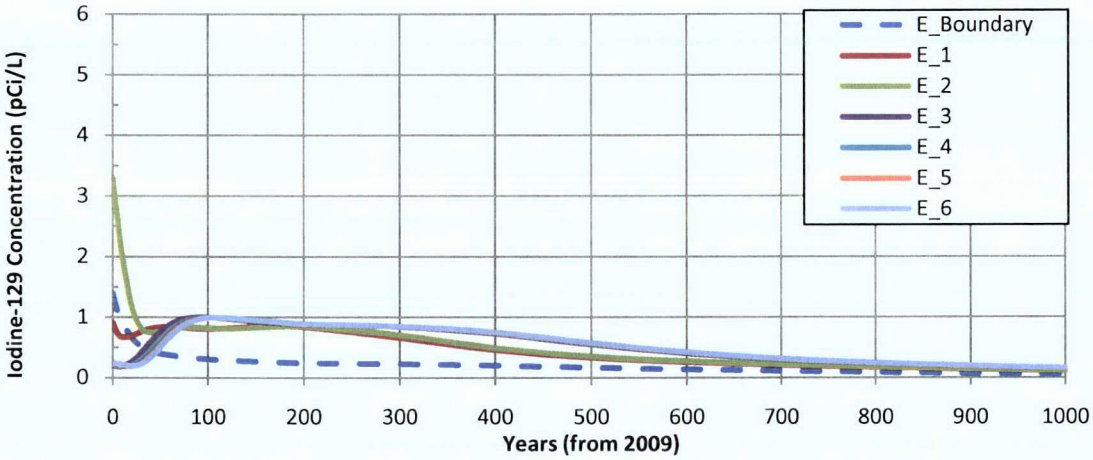


Figure 7. Predicted concentration of Tritium in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The calculation points correspond to the center of pipe segments shown in Figure 2. The boundary concentrations are the average concentrations at the upstream boundary of the Pipe Pathways.



(a)



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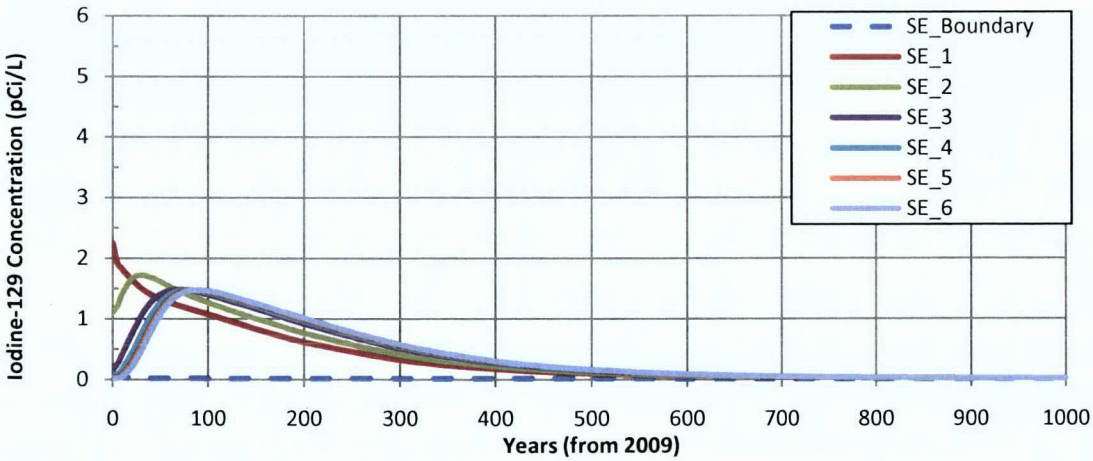


(c)

Figure 8. Predicted concentration of Iodine-129 in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The calculation points correspond to the center of pipe segments shown in Figure 2. The boundary concentrations are the average concentrations at the upstream boundary of the Pipe Pathways.

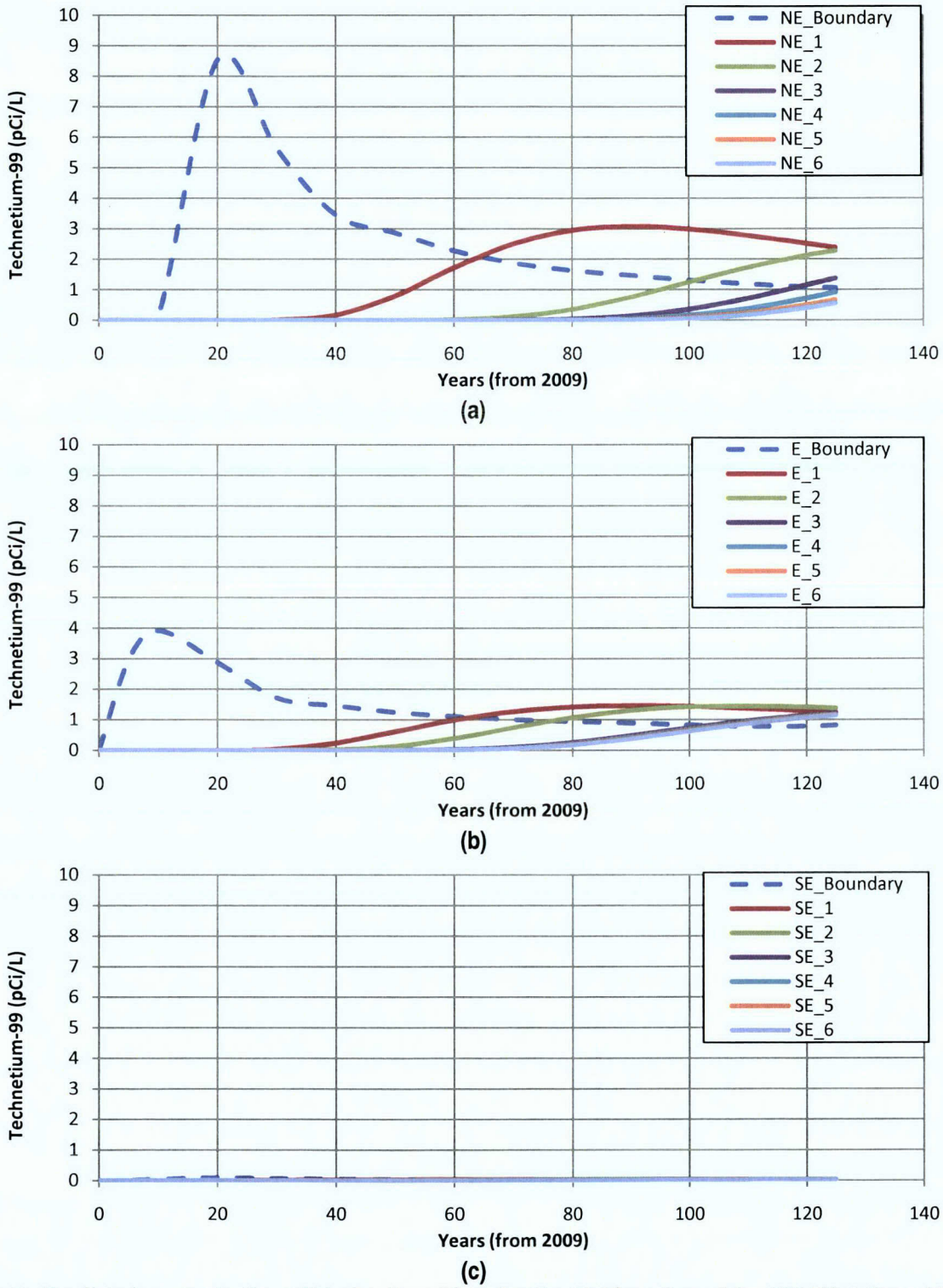
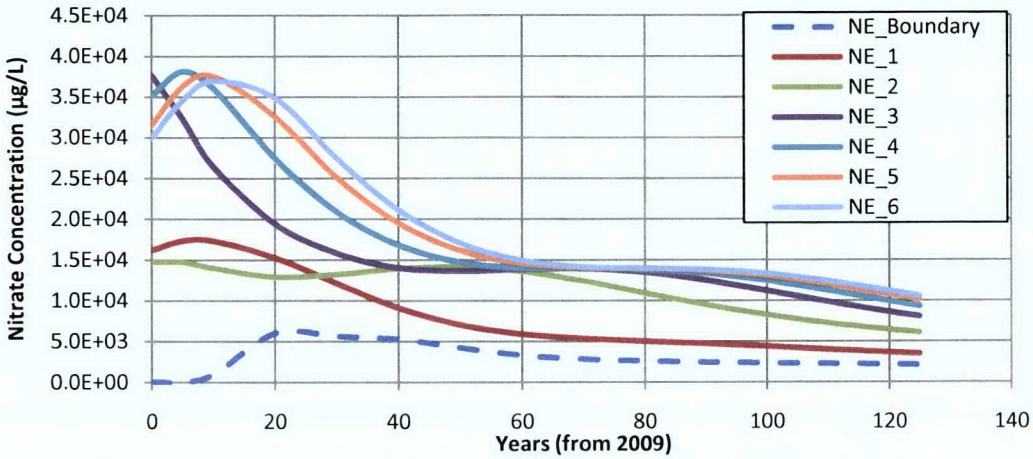
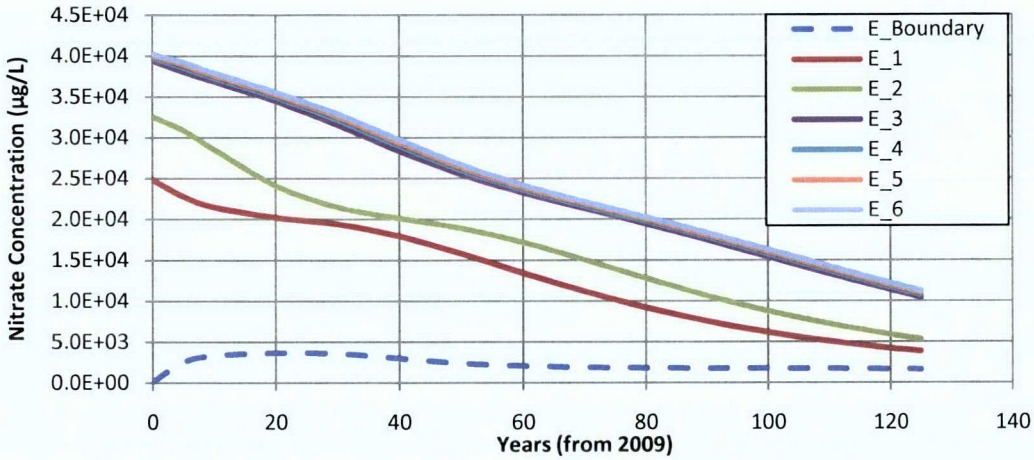


Figure 9. Predicted concentration of Technetium-99 in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The calculation points correspond to the center of pipe segments shown in Figure 2. The boundary concentrations are the average concentrations at the upstream boundary of the Pipe Pathways.



(a)



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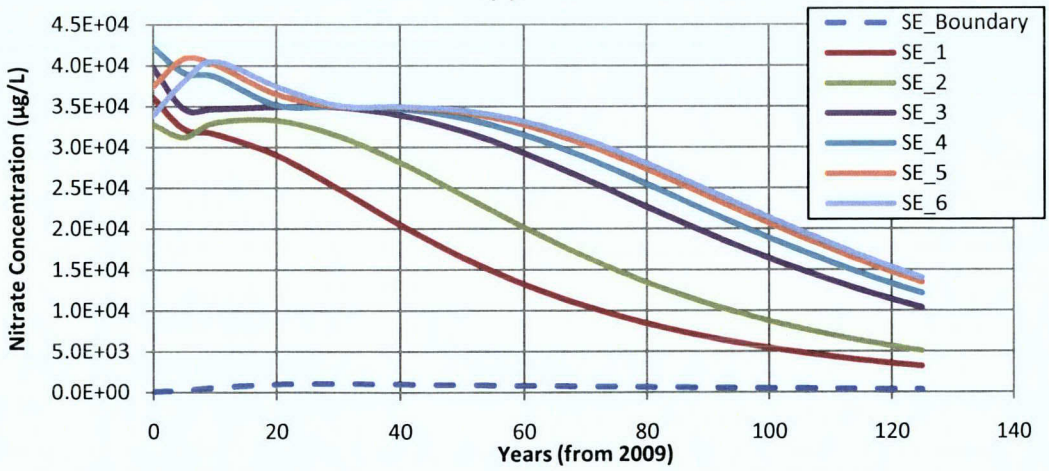


(c)

Figure 10. Predicted concentration of Nitrate in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The calculation points correspond to the center of pipe segments shown in Figure 2. The boundary concentrations are the average concentrations at the upstream boundary of the Pipe Pathways.

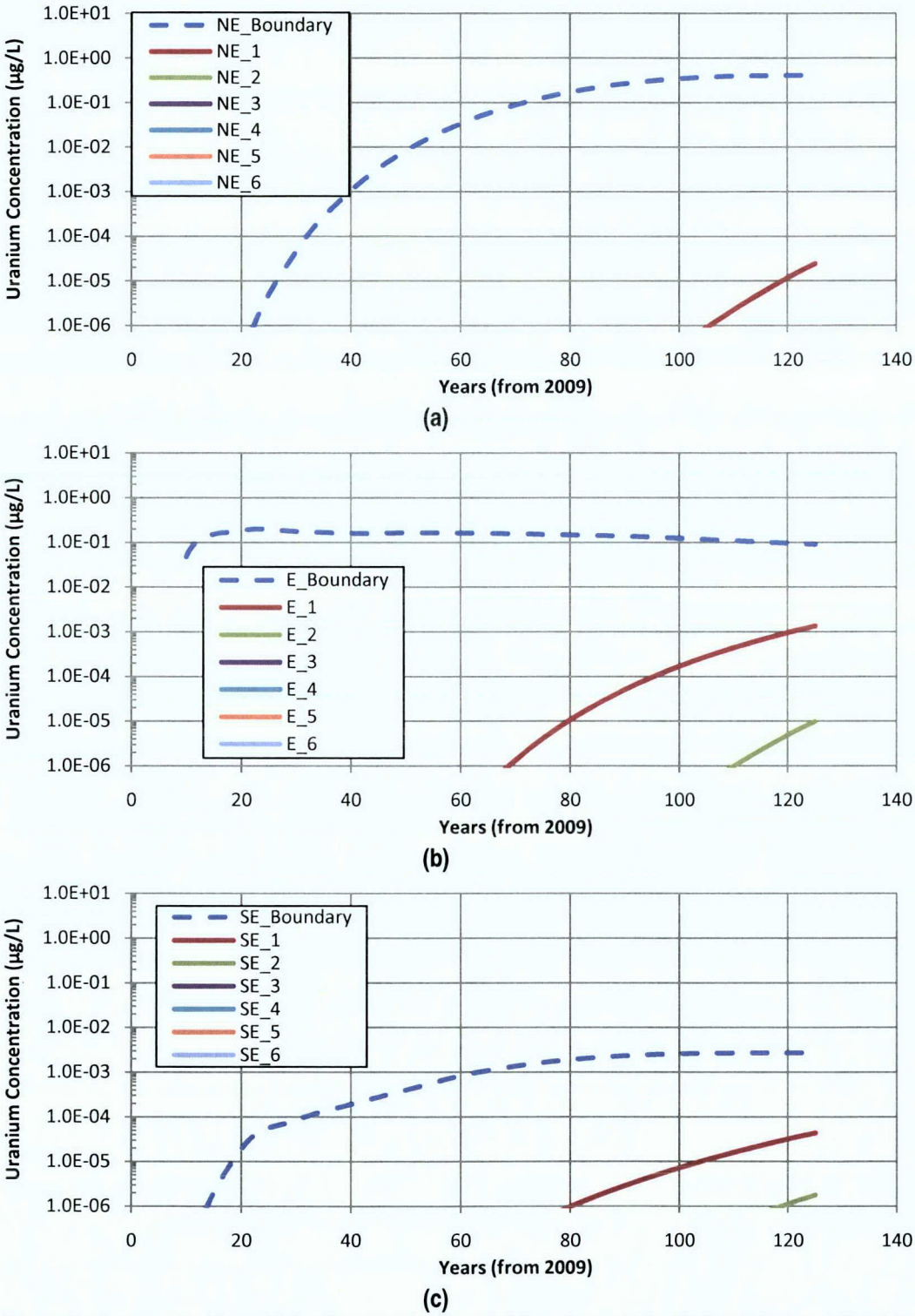


Figure 11. Predicted concentration of Uranium in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The calculation points correspond to the center of pipe segments shown in Figure 2. The boundary concentrations are the average concentrations at the upstream boundary of the Pipe Pathways.

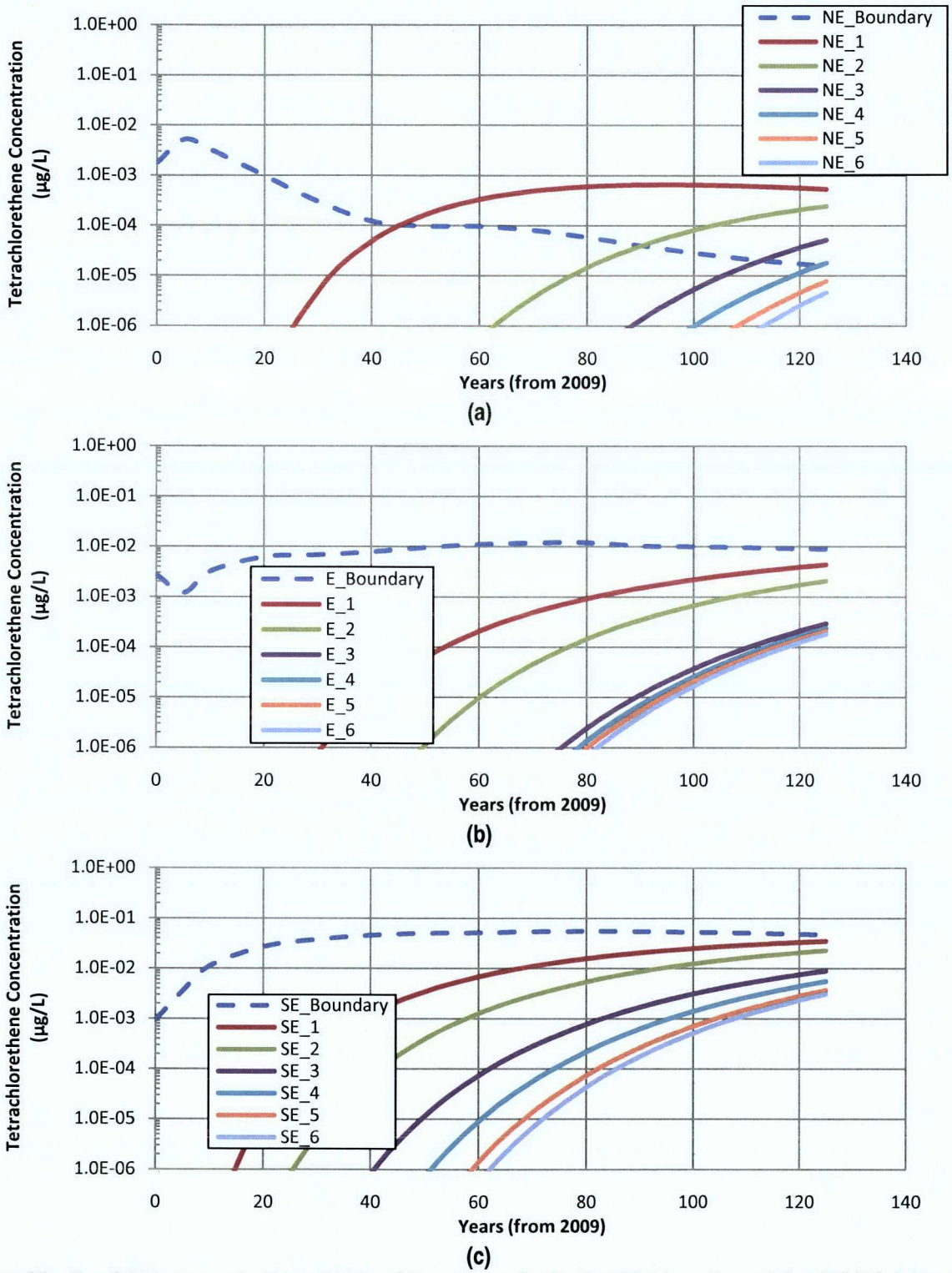


Figure 12. Predicted concentration of Tetrachloroethene in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The calculation points correspond to the center of pipe segments shown in Figure 2. The boundary concentrations are the average concentrations at the upstream boundary of the Pipe Pathways.

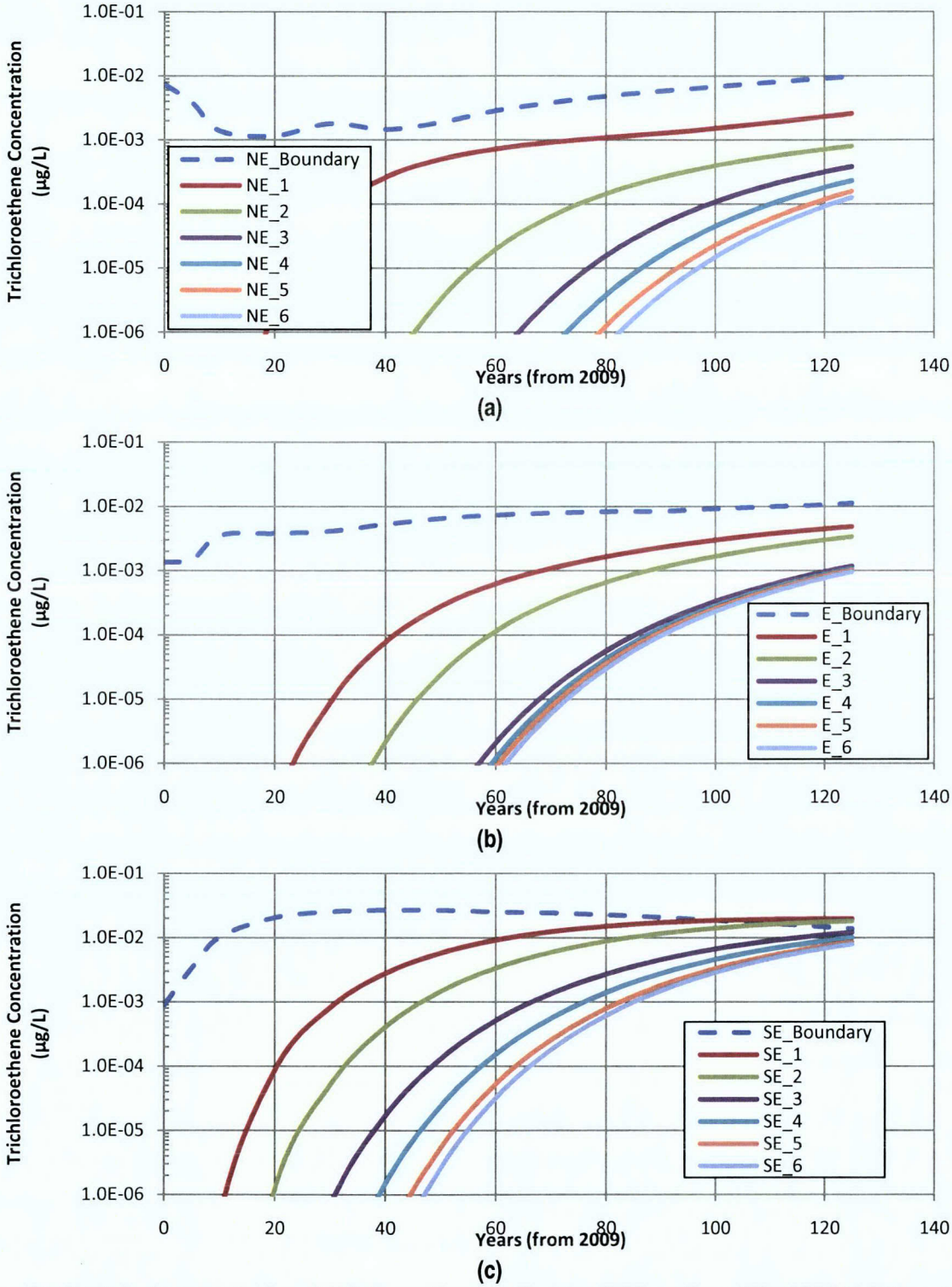


Figure 13. Predicted concentration of Trichloroethene in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The calculation points correspond to the center of pipe segments shown in Figure 2. The boundary concentrations are the average concentrations at the upstream boundary of the Pipe Pathways.

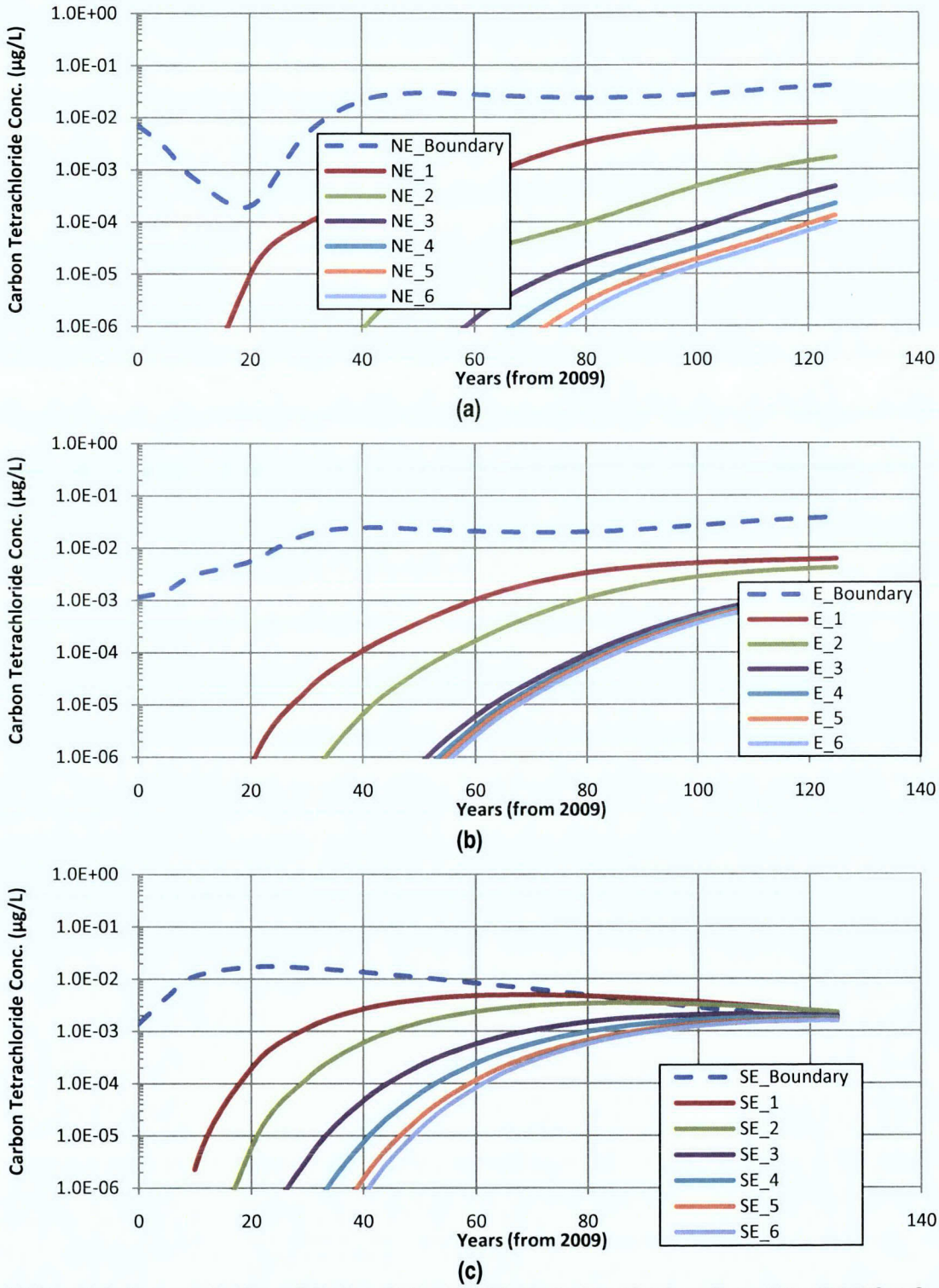


Figure 14. Predicted concentration of Carbon Tetrachloride in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The calculation points correspond to the center of pipe segments shown in Figure 2. The boundary concentrations are the average concentrations at the upstream boundary of the Pipe Pathways.

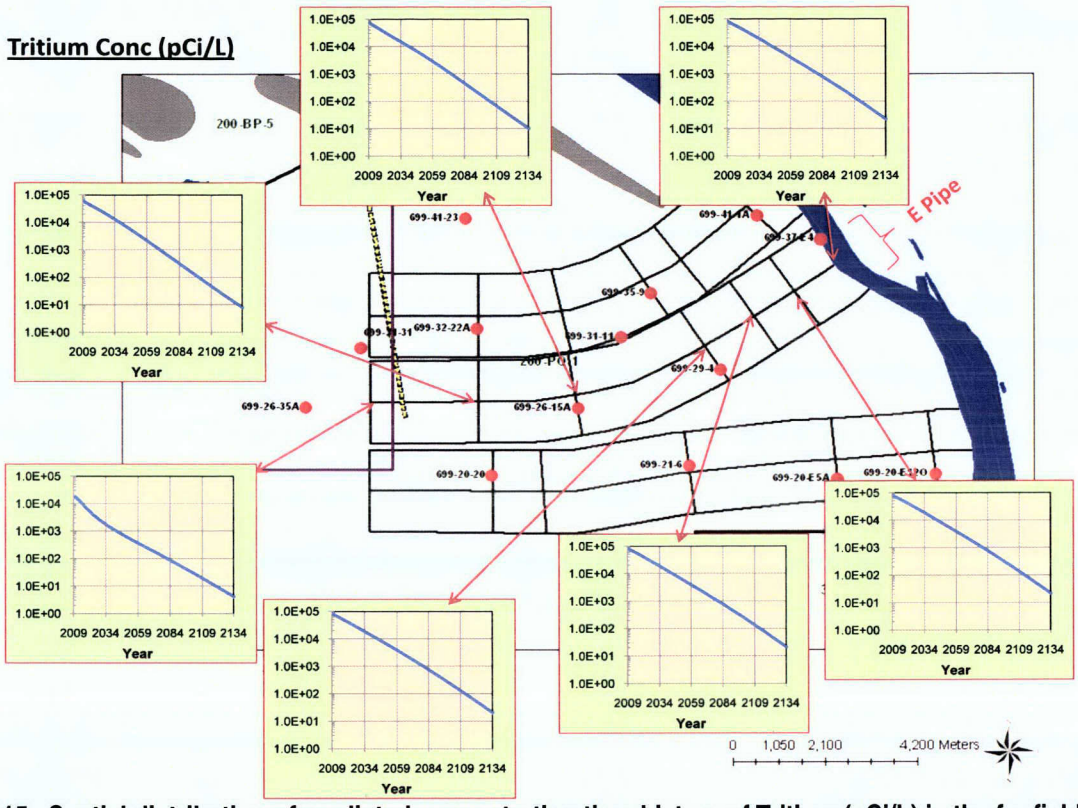


Figure 15. Spatial distribution of predicted concentration time history of Tritium (pCi/L) in the far field portion of 200-PO-1 OU for the various Pipe segments in the East Pipe Pathway

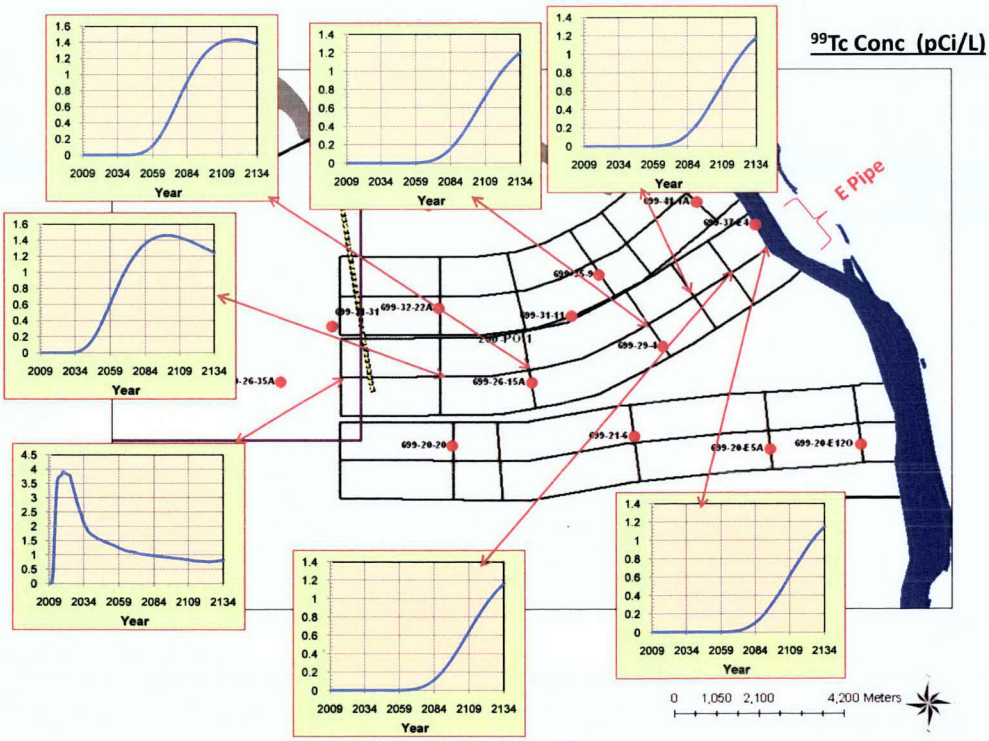


Figure 16. Spatial distribution of predicted concentration time history of ^{99}Tc (pCi/L) in the far field portion of 200-PO-1 OU for the various Pipe segments in the East Pipe Pathway

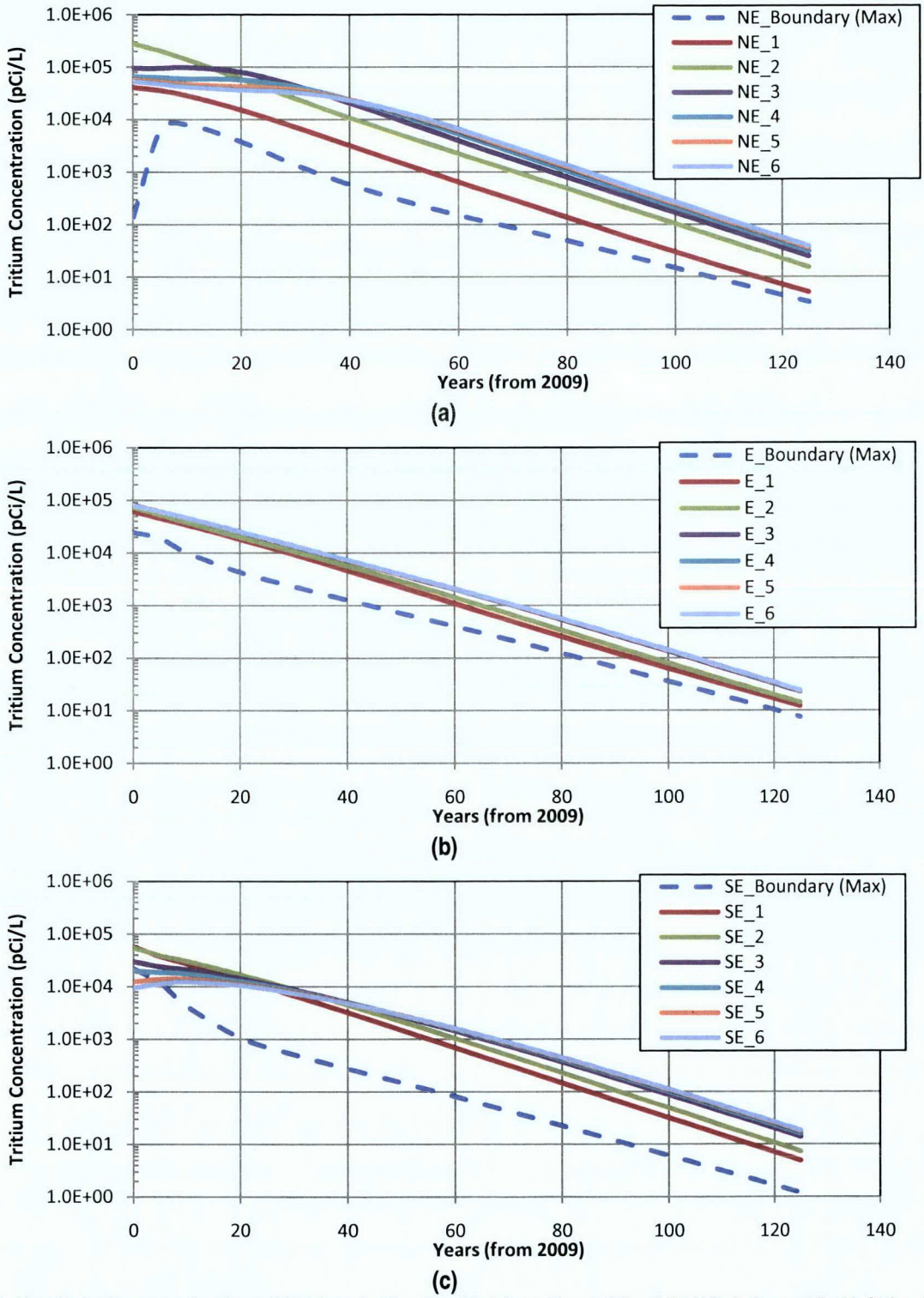


Figure 17. Predicted concentration of Tritium in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The boundary concentration applied is the maximum concentration taken from the grid-block nodes of the Central Plateau Model domain corresponding to each of the Pipe Pathways.

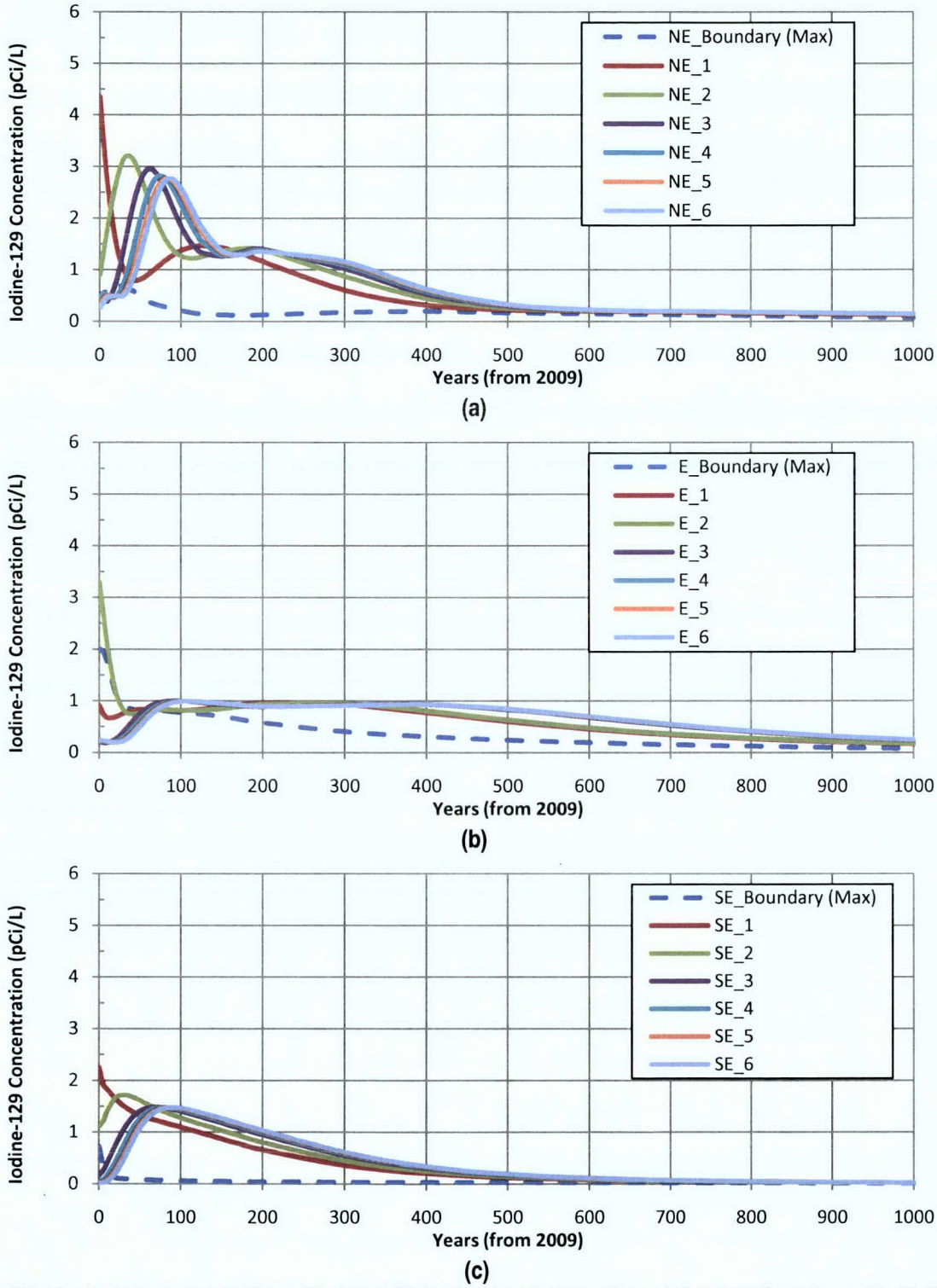


Figure 18. Predicted concentration of Iodine-129 in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The boundary concentration applied is the maximum concentration taken from the grid-block nodes of the Central Plateau Model domain corresponding to each of the Pipe Pathways.

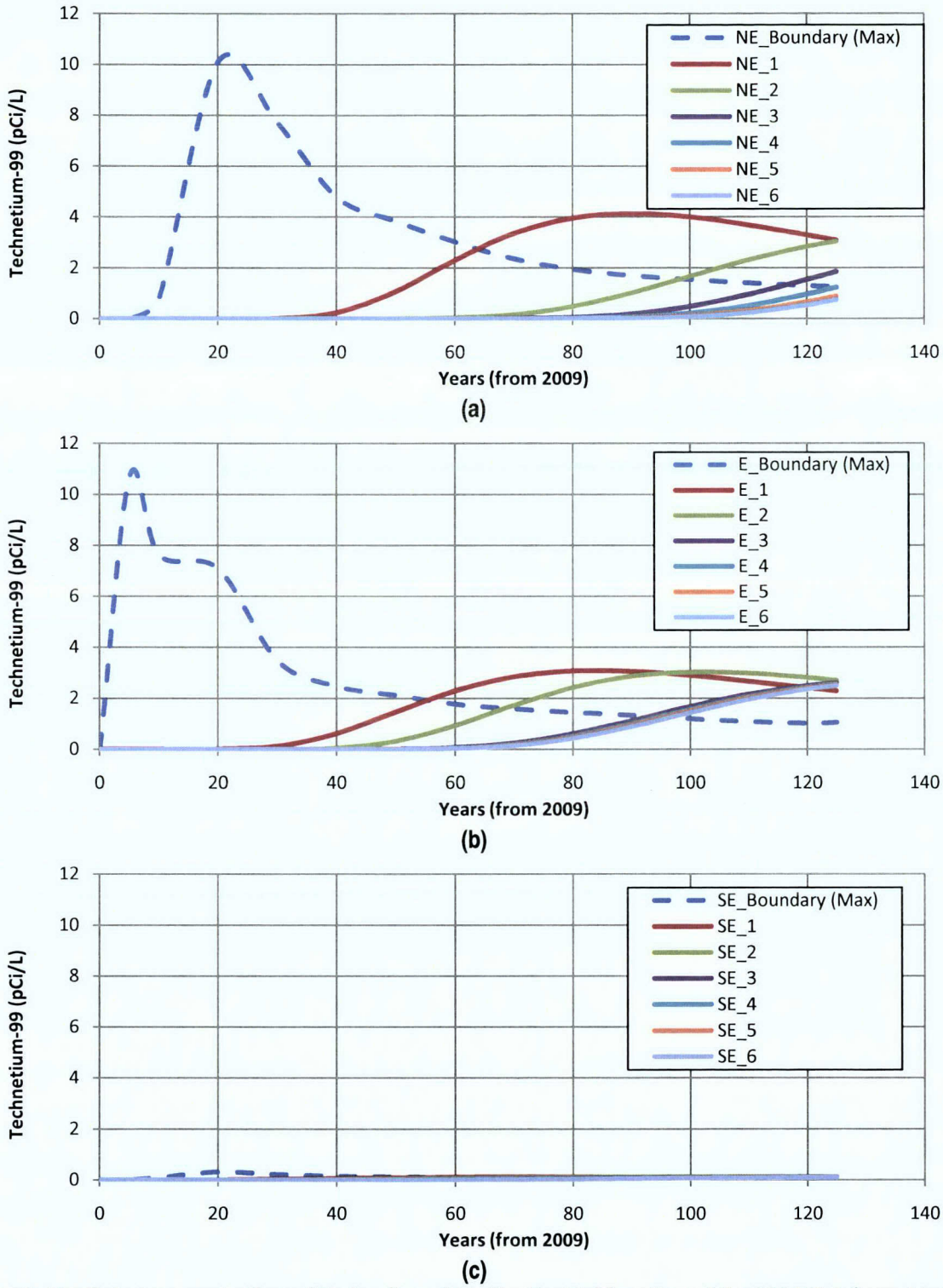


Figure 19. Predicted concentration of Technetium-99 in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The boundary concentration applied is the maximum concentration taken from the grid-block nodes of the Central Plateau Model domain corresponding to each of the Pipe Pathways.

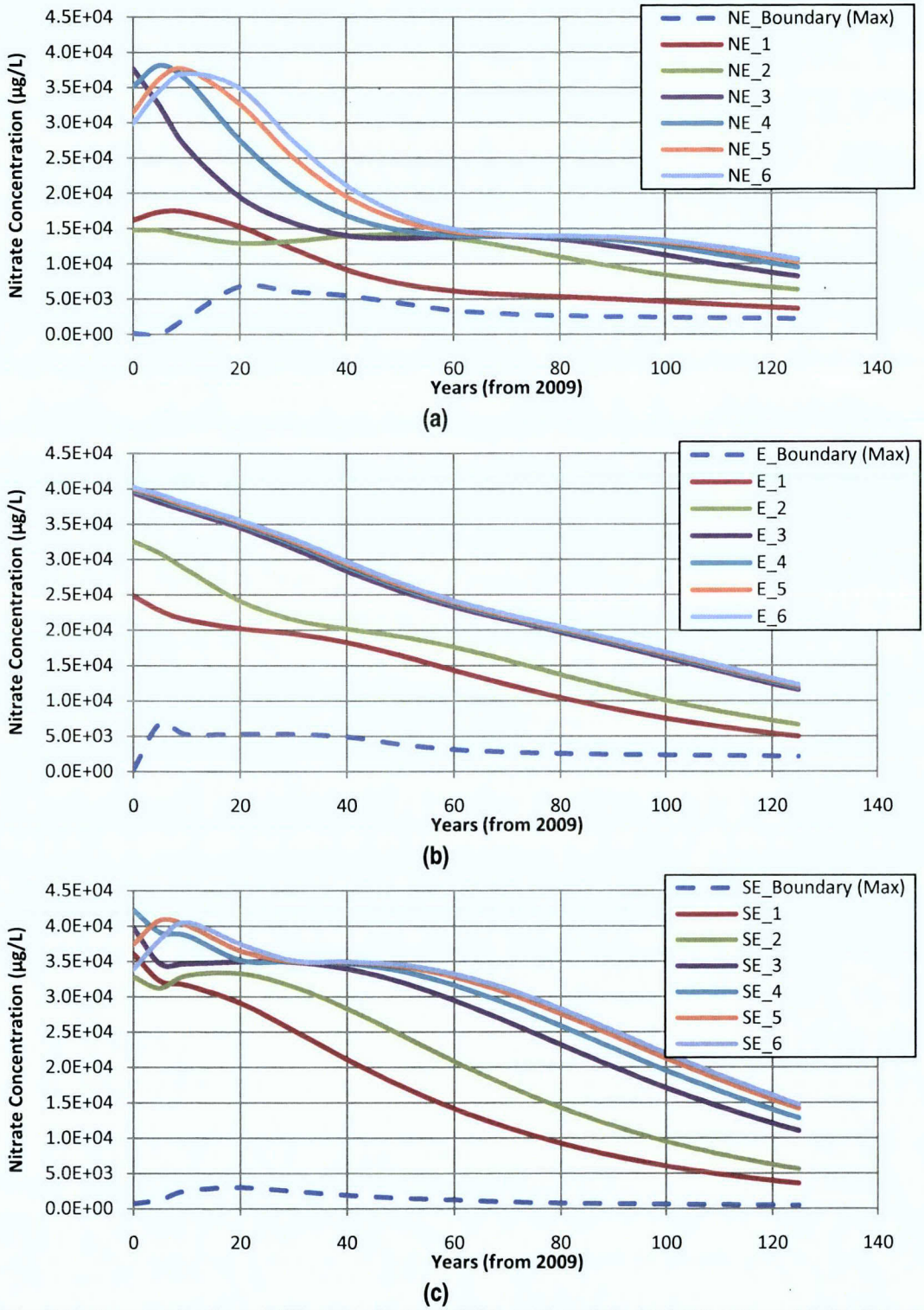


Figure 20. Predicted concentration of Nitrate in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The boundary concentration applied is the maximum concentration taken from the grid-block nodes of the Central Plateau Model domain corresponding to each of the Pipe Pathways.

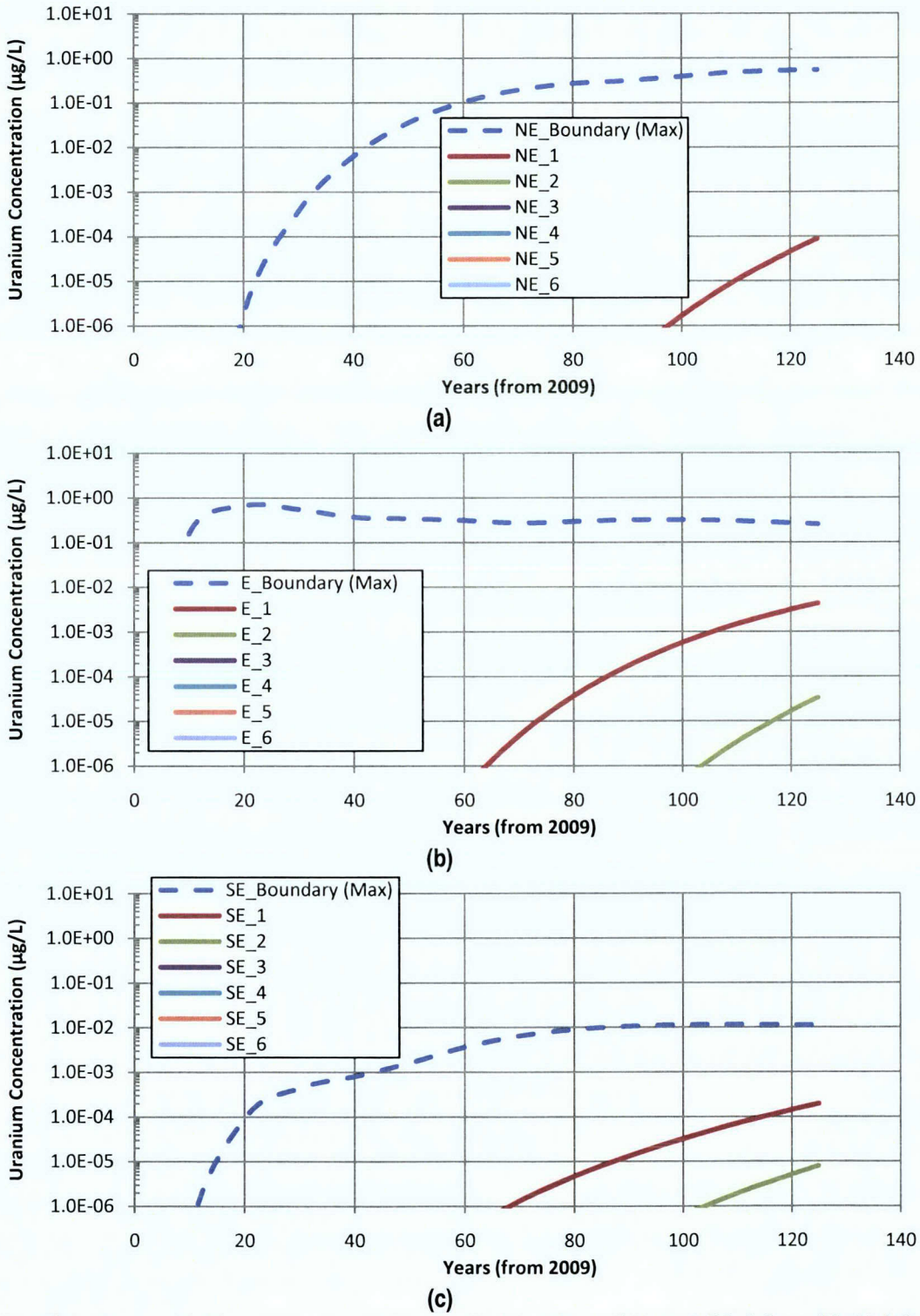
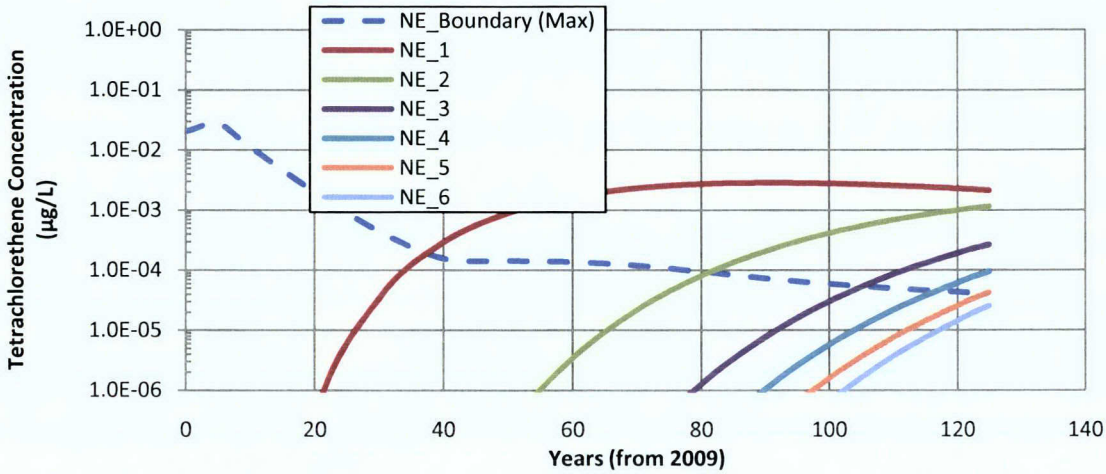


Figure 21. Predicted concentration of Uranium in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The boundary concentration applied is the maximum concentration taken from the grid-block nodes of the Central Plateau Model domain corresponding to each of the Pipe Pathways.



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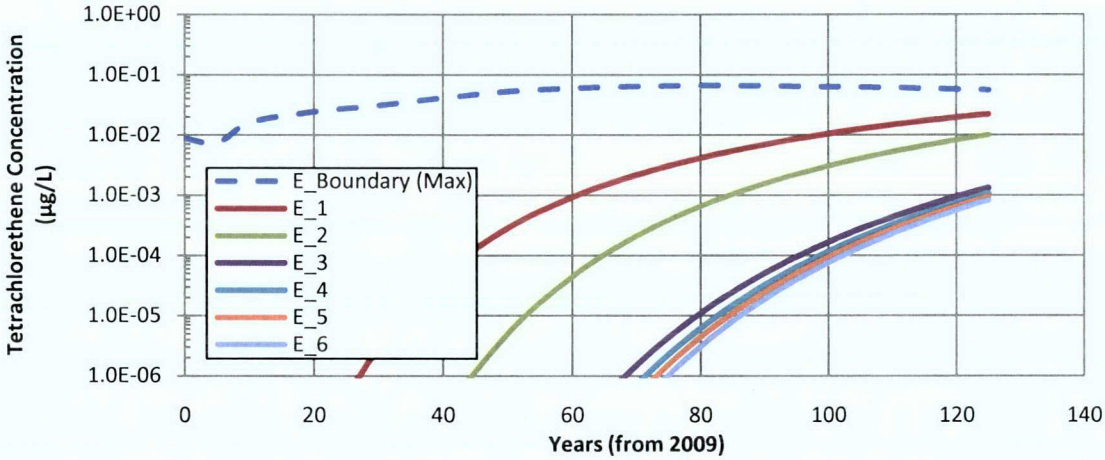

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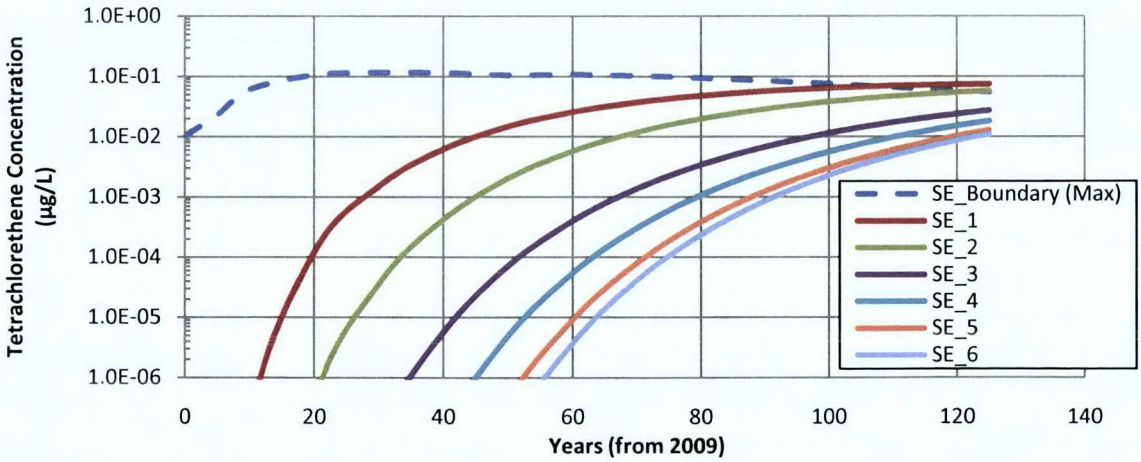

(c)

Figure 22. Predicted concentration of Tetrachloroethene in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The boundary concentration applied is the maximum concentration taken from the grid-block nodes of the Central Plateau Model domain corresponding to each of the Pipe Pathways.

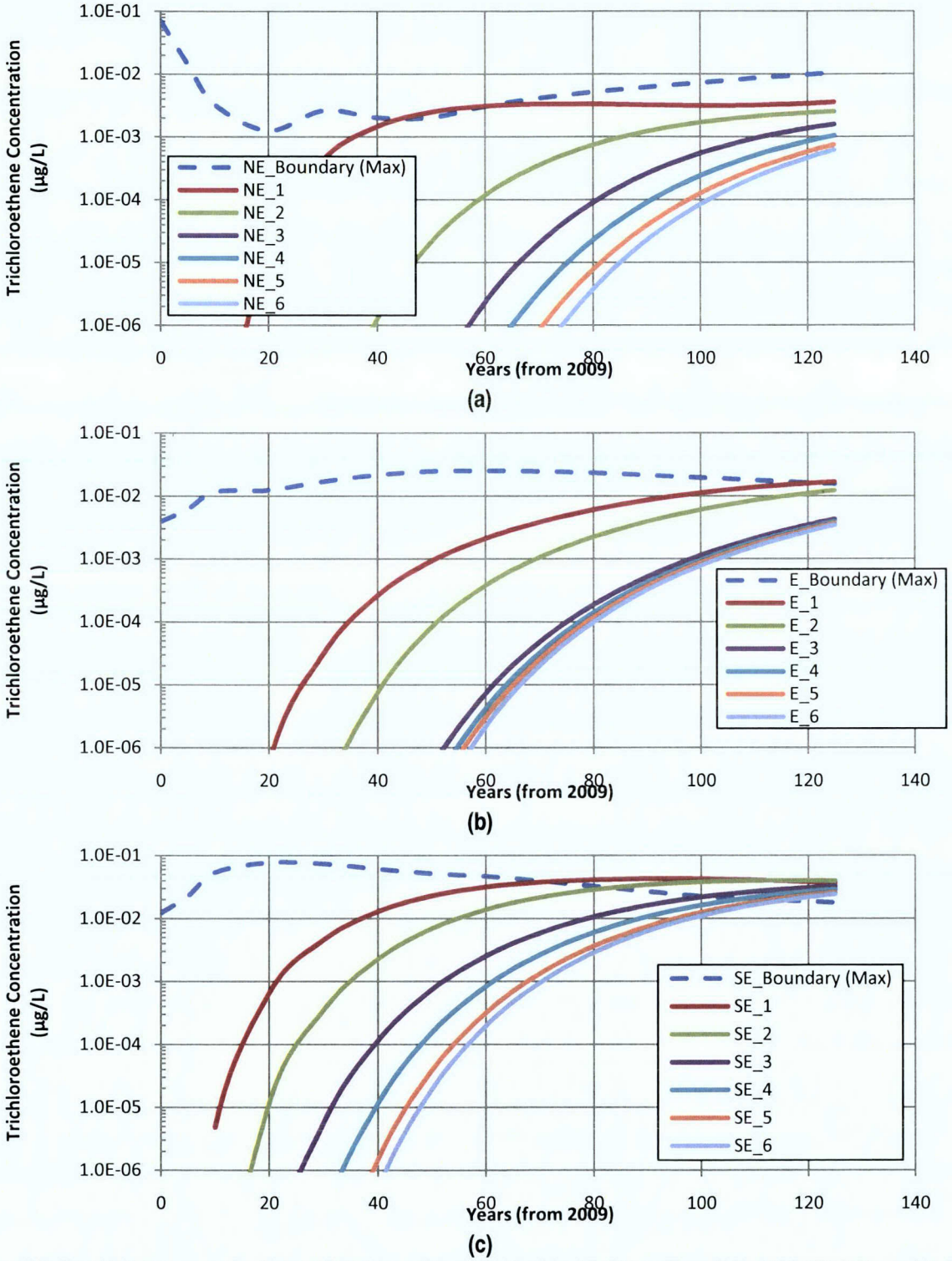

Figure 23. Predicted concentration of Trichloroethene in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The boundary concentration applied is the maximum concentration taken from the grid-block nodes of the Central Plateau Model domain corresponding to each of the Pipe Pathways.

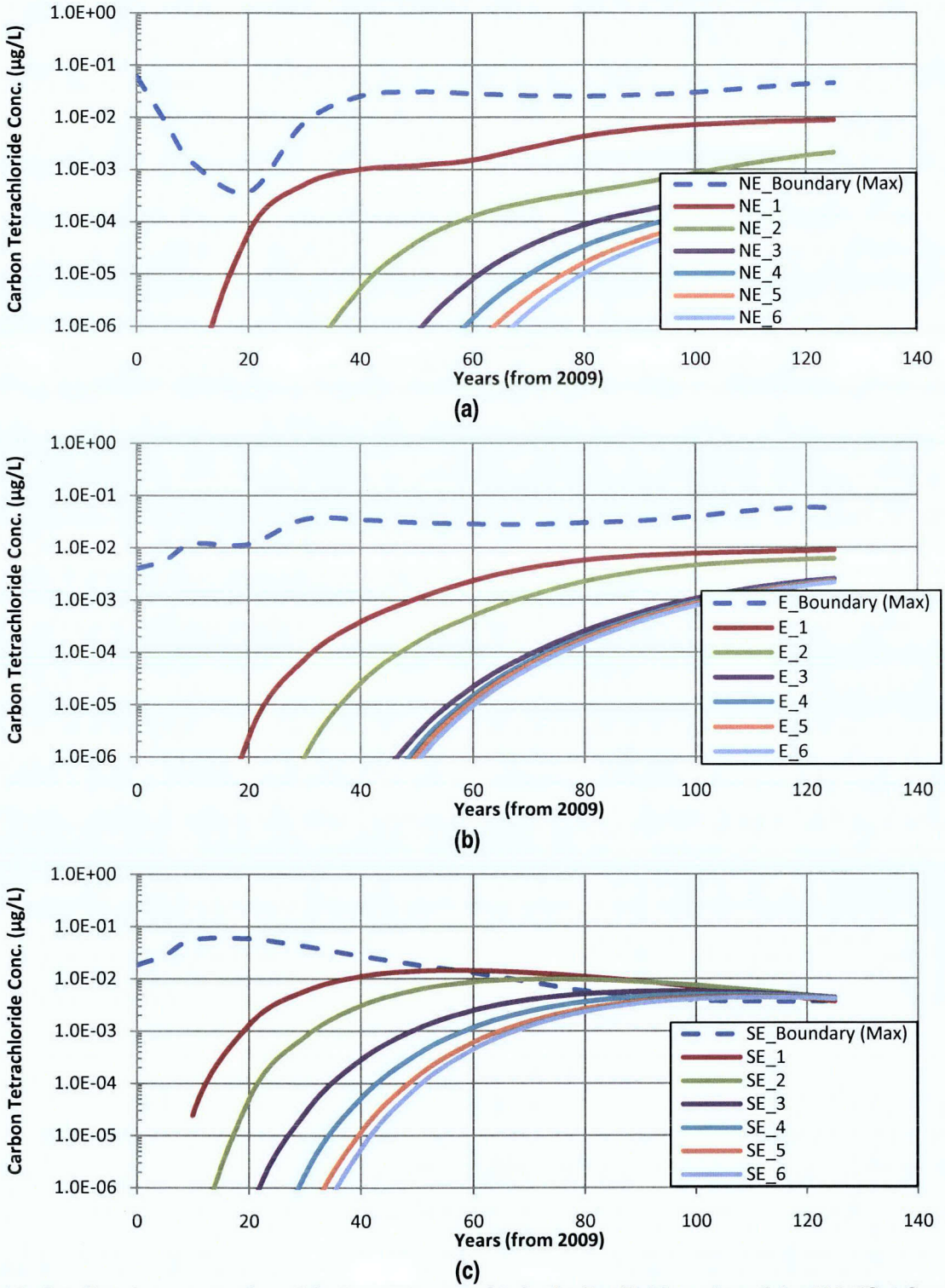

Figure 24. Predicted concentration of Carbon Tetrachloride in the Far Field portion of the 200-PO-1 Operable Unit for (a) Northeast Pipe Pathway, (b) East Pipe Pathway, and (c) Southeast Pipe Pathway. The boundary concentration applied is the maximum concentration taken from the grid-block nodes of the Central Plateau Model domain corresponding to each of the Pipe Pathways.

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Table 1. Pipe Pathway Property Details

Transport_NE Pipe	Zone 1		Zone 2		Zone 3	
Length of NE Pipe (m)	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6
	2457	1876	2012	976	1988	961
Width (m)	2000		2000		2000	
Average Depth (m)	25		15		5	
Hydraulic Gradient	2.5e-4					

Transport_E Pipe	Zone 1	Zone 2			Zone 3	
Length of E Pipe (m)	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6
	2983	1661	3194	1339	1102	1102
Width (m)	2000	2000			2000	
Average Depth (m)	25	15			5	
Hydraulic Gradient	2.5e-4					

Transport_SE Pipe	Zone 1		Zone 2	Zone 3		
Length of SE Pipe (m)	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6
	2793	1133	3367	3336	2235	898
Width (m)	2000		2000	2000		
Average Depth (m)	25		15	5		
Hydraulic Gradient	2.5e-4					

Table 2. Transport Parameter Values for the Calculation

Final COPCs	Kd (ml/g)	Half-Life (yr)	Half-Life (day)	First Order Decay Rate (1/day)	Reference for Kd	Reference for Degradation Rate
Iodine-129	1.00E-01¥	1.57E+07	5.73E+09	1.21E-10	PNNL-18564, Table 6.9, Sandy Gravel sediment type	
Nitrate	0.00E+00			No Decay	PNNL-18564, Table 6.9, Sandy Gravel sediment type	
Strontium	1.20E+01	2.88E+01	1.05E+04	6.59E-05	PNNL-18564, Table 6.9, Sandy Gravel sediment type	
Technetium-99	0.00E+00	2.11E+05	7.71E+07	8.99E-09	PNNL-18564, Table 6.9, Sandy Gravel sediment type	
Tritium	0.00E+00	1.23E+01	4.50E+03	1.54E-04	PNNL-18564, Table 6.9, Sandy Gravel sediment type	
Uranium	4.00E-01	4.47E+09	1.63E+12	4.25E-13	PNNL-18564, Table 6.9, Sandy Gravel sediment type	
Tetrachloroethene (PCE)	7.49E-02			No Decay	Based on empirical calculation	No Hanford relevant reference
Trichloroethene (TCE)	2.50E-02			No Decay	Based on empirical calculation	No Hanford relevant reference
Carbon Tetrachloride	3.00E-03	4.13E+01	1.51E+04	4.60E-05	PNNL-16100 (Rev 1), 200-UP-1 sediments, Phase 2 (Table 5.5)	PNNL-13560, Table 18, Most Probable Value

Table 2. Transport Parameter Values for the Calculation (continued)

Property	HSU1*	HSU 3*	HSU 5**	Reference
Effective Porosity	0.227	0.227	0.267	PNNL-18564, Table 6.4, Site Wide
Bulk Density (g/cm3)	1.93	1.93	1.90	PNNL-18564, Table 6.2, Site Wide

¥ The K_d for ^{129}I is varied spatially from 0 ml/g to 0.35 ml/g based on calibration exercise

□ The empirical calculation is based on PNNL-13560 (Equations 1 & 2, p. C.16), assuming f_{oc} = 0.00027, solubility of PCE of 150 mg/L, and solubility of TCE of 1100 mg/L.

* Value based on Hanford Formation sandy gravel sediment class

** Value based on Ringold Formation sandy gravel. Applied to other HSUs in the Ringold Formation

Table 3. Predicted Concentration of Tritium (pCi/L) for the various Pipe Pathways By Applying the Average Input Boundary Concentration

Time (yr)	NE_Boundary	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	8.91E+00	4.04E+04	2.76E+05	9.42E+04	6.50E+04	5.59E+04	5.22E+04	1.66E+04	6.08E+04	7.32E+04	8.04E+04	8.00E+04	7.93E+04	7.87E+04	7.49E+03	5.62E+04	5.41E+04	2.98E+04	1.95E+04	1.22E+04	9.33E+03
5	1.17E+03	3.52E+04	2.01E+05	9.42E+04	6.24E+04	5.11E+04	4.68E+04	1.17E+04	4.48E+04	5.25E+04	6.07E+04	6.08E+04	6.07E+04	6.07E+04	2.79E+03	3.72E+04	3.83E+04	2.38E+04	1.83E+04	1.37E+04	1.12E+04
10	4.32E+03	2.80E+04	1.37E+05	9.76E+04	5.92E+04	4.61E+04	4.11E+04	6.55E+03	3.33E+04	3.76E+04	4.53E+04	4.56E+04	4.56E+04	4.57E+04	8.83E+02	2.68E+04	3.01E+04	2.08E+04	1.72E+04	1.37E+04	1.21E+04
20	3.20E+03	1.50E+04	5.87E+04	7.92E+04	5.64E+04	4.19E+04	3.58E+04	2.49E+03	1.79E+04	1.98E+04	2.47E+04	2.50E+04	2.51E+04	2.52E+04	1.91E+02	1.33E+04	1.67E+04	1.41E+04	1.23E+04	1.09E+04	1.03E+04
30	1.19E+03	7.02E+03	2.46E+04	4.38E+04	4.17E+04	3.59E+04	3.23E+04	1.22E+03	9.12E+03	1.07E+04	1.32E+04	1.34E+04	1.35E+04	1.36E+04	8.23E+01	6.29E+03	8.60E+03	8.62E+03	8.13E+03	7.57E+03	7.30E+03
40	5.27E+02	3.08E+03	1.06E+04	2.04E+04	2.36E+04	2.36E+04	2.31E+04	6.44E+02	4.45E+03	5.60E+03	7.07E+03	7.17E+03	7.21E+03	7.26E+03	4.24E+01	2.90E+03	4.24E+03	4.91E+03	4.91E+03	4.79E+03	4.72E+03
50	2.60E+02	1.34E+03	4.75E+03	8.93E+03	1.15E+04	1.27E+04	1.31E+04	3.57E+02	2.11E+03	2.82E+03	3.77E+03	3.83E+03	3.85E+03	3.88E+03	2.28E+01	1.31E+03	2.03E+03	2.65E+03	2.77E+03	2.80E+03	2.80E+03
60	1.42E+02	5.90E+02	2.18E+03	3.88E+03	5.20E+03	6.05E+03	6.46E+03	2.04E+02	9.87E+02	1.37E+03	1.99E+03	2.03E+03	2.04E+03	2.06E+03	1.31E+01	5.89E+02	9.45E+02	1.38E+03	1.49E+03	1.55E+03	1.57E+03
70	8.24E+01	2.65E+02	1.01E+03	1.72E+03	2.31E+03	2.74E+03	2.96E+03	1.14E+02	4.56E+02	6.51E+02	1.03E+03	1.06E+03	1.07E+03	1.08E+03	6.98E+00	2.64E+02	4.34E+02	6.93E+02	7.69E+02	8.16E+02	8.33E+02
80	4.67E+01	1.21E+02	4.68E+02	7.76E+02	1.03E+03	1.22E+03	1.32E+03	6.28E+01	2.11E+02	3.04E+02	5.25E+02	5.39E+02	5.45E+02	5.53E+02	3.71E+00	1.18E+02	1.98E+02	3.41E+02	3.86E+02	4.16E+02	4.28E+02
90	2.60E+01	5.62E+01	2.16E+02	3.56E+02	4.64E+02	5.46E+02	5.90E+02	3.46E+01	9.82E+01	1.41E+02	2.61E+02	2.69E+02	2.73E+02	2.77E+02	1.96E+00	5.31E+01	8.94E+01	1.65E+02	1.89E+02	2.06E+02	2.13E+02
100	1.42E+01	2.67E+01	9.93E+01	1.64E+02	2.12E+02	2.47E+02	2.66E+02	1.88E+01	4.64E+01	6.54E+01	1.27E+02	1.32E+02	1.34E+02	1.36E+02	1.03E+00	2.39E+01	4.03E+01	7.83E+01	9.12E+01	1.00E+02	1.04E+02
110	7.87E+00	1.31E+01	4.56E+01	7.56E+01	9.73E+01	1.13E+02	1.21E+02	1.01E+01	2.23E+01	3.06E+01	6.11E+01	6.34E+01	6.45E+01	6.58E+01	5.46E-01	1.08E+01	1.82E+01	3.69E+01	4.33E+01	4.81E+01	5.01E+01
120	4.33E+00	6.59E+00	2.10E+01	3.48E+01	4.48E+01	5.20E+01	5.57E+01	5.51E+00	1.10E+01	1.45E+01	2.91E+01	3.03E+01	3.08E+01	3.14E+01	2.88E-01	4.91E+00	8.21E+00	1.73E+01	2.04E+01	2.28E+01	2.38E+01
125	3.24E+00	4.72E+00	1.43E+01	2.36E+01	3.04E+01	3.53E+01	3.78E+01	4.06E+00	7.75E+00	1.01E+01	2.01E+01	2.08E+01	2.12E+01	2.17E+01	2.10E-01	3.31E+00	5.52E+00	1.18E+01	1.40E+01	1.56E+01	1.63E+01

Table 4. Predicted Concentration of Iodine-129 (pCi/L) for the various Pipe Pathways By Applying the Average Input Boundary Concentration

Time (yr)	NE_Boundary	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	1.89E-02	4.35E+00	8.90E-01	5.25E-01	4.74E-01	3.26E-01	2.47E-01	1.39E+00	9.04E-01	3.29E+00	1.92E-01	2.23E-01	2.34E-01	2.36E-01	1.12E-01	2.24E+00	1.10E+00	1.59E-01	3.27E-02	6.89E-03	2.95E-03
5	5.83E-02	3.41E+00	1.39E+00	4.13E-01	5.27E-01	4.43E-01	3.74E-01	1.09E+00	7.31E-01	2.64E+00	1.81E-01	2.04E-01	2.20E-01	2.27E-01	4.28E-02	1.92E+00	1.21E+00	2.53E-01	7.82E-02	2.49E-02	1.29E-02
10	8.47E-02	2.60E+00	1.87E+00	3.87E-01	4.96E-01	4.93E-01	4.58E-01	9.05E-01	6.65E-01	2.01E+00	1.85E-01	1.89E-01	2.03E-01	2.10E-01	2.63E-02	1.82E+00	1.41E+00	4.08E-01	1.67E-01	6.66E-02	4.17E-02
20	2.58E-01	1.52E+00	2.69E+00	7.48E-01	4.73E-01	4.71E-01	4.85E-01	6.49E-01	6.83E-01	1.16E+00	2.55E-01	1.96E-01	1.86E-01	1.86E-01	1.58E-02	1.64E+00	1.66E+00	7.39E-01	4.26E-01	2.49E-01	1.91E-01
30	5.12E-01	9.87E-01	3.16E+00	1.43E+00	7.68E-01	5.56E-01	4.97E-01	5.06E-01	7.52E-01	8.11E-01	4.03E-01	2.83E-01	2.35E-01	2.19E-01	1.34E-02	1.50E+00	1.71E+00	1.04E+00	7.47E-01	5.39E-01	4.57E-01
40	5.19E-01	8.00E-01	3.16E+00	2.17E+00	1.34E+00	9.27E-01	7.60E-01	4.28E-01	8.05E-01	7.38E-01	5.82E-01	4.37E-01	3.63E-01	3.31E-01	1.21E-02	1.40E+00	1.68E+00	1.26E+00	1.04E+00	8.54E-01	7.74E-01
50	4.06E-01	8.04E-01	2.82E+00	2.72E+00	1.99E+00	1.51E+00	1.28E+00	3.90E-01	8.29E-01	7.63E-01	7.45E-01	6.13E-01	5.35E-01	4.98E-01	1.12E-02	1.32E+00	1.61E+00	1.39E+00	1.26E+00	1.12E+00	1.06E+00
60	3.12E-01	9.02E-01	2.36E+00	2.95E+00	2.52E+00	2.11E+00	1.90E+00	3.66E-01	8.32E-01	8.00E-01	8.65E-01	7.67E-01	7.02E-01	6.69E-01	1.14E-02	1.26E+00	1.53E+00	1.46E+00	1.39E+00	1.31E+00	1.27E+00
70	2.61E-01	1.03E+00	1.93E+00	2.85E+00	2.79E+00	2.57E+00	2.42E+00	3.43E-01	8.24E-01	8.21E-01	9.39E-01	8.78E-01	8.33E-01	8.09E-01	1.10E-02	1.21E+00	1.45E+00	1.48E+00	1.45E+00	1.42E+00	1.39E+00
80	2.26E-01	1.16E+00	1.59E+00	2.55E+00	2.78E+00	2.76E+00	2.72E+00	3.22E-01	8.14E-01	8.27E-01	9.77E-01	9.46E-01	9.20E-01	9.05E-01	1.05E-02	1.16E+00	1.38E+00	1.46E+00	1.47E+00	1.46E+00	1.46E+00
90	1.92E-01	1.28E+00	1.38E+00	2.18E+00	2.56E+00	2.70E+00	2.75E+00	3.11E-01	8.06E-01	8.22E-01	9.90E-01	9.79E-01	9.67E-01	9.60E-01	9.93E-03	1.12E+00	1.32E+00	1.43E+00	1.46E+00	1.47E+00	1.47E+00
100	1.60E-01	1.36E+00	1.26E+00	1.83E+00	2.24E+00	2.47E+00	2.57E+00	2.96E-01	8.03E-01	8.14E-01	9.90E-01	9.90E-01	9.87E-01	9.84E-01	9.35E-03	1.07E+00	1.26E+00	1.39E+00	1.43E+00	1.45E+00	1.46E+00
110	1.35E-01	1.41E+00	1.22E+00	1.56E+00	1.92E+00	2.16E+00	2.28E+00	2.87E-01	8.04E-01	8.07E-01	9.81E-01	9.88E-01	9.90E-01	9.90E-01	8.85E-03	1.02E+00	1.21E+00	1.35E+00	1.39E+00	1.42E+00	1.43E+00
120	1.19E-01	1.44E+00	1.22E+00	1.38E+00	1.65E+00	1.86E+00	1.97E+00	2.79E-01	8.10E-01	8.04E-01	9.69E-01	9.79E-01	9.83E-01	9.85E-01	8.40E-03	9.73E-01	1.16E+00	1.30E+00	1.35E+00	1.38E+00	1.39E+00
125	1.14E-01	1.44E+00	1.24E+00	1.32E+00	1.55E+00	1.73E+00	1.83E+00	2.76E-01	8.14E-01	8.05E-01	9.62E-01	9.73E-01	9.78E-01	9.80E-01	8.22E-03	9.49E-01	1.13E+00	1.28E+00	1.32E+00	1.35E+00	1.37E+00
150	1.05E-01	1.38E+00	1.34E+00	1.25E+00	1.28E+00	1.33E+00	1.36E+00	2.60E-01	8.35E-01	8.19E-01	9.26E-01	9.38E-01	9.44E-01	9.47E-01	7.51E-03	8.28E-01	1.00E+00	1.16E+00	1.21E+00	1.24E+00	1.25E+00

Time (yr)	NE_Boundary	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
175	1.10E-01	1.25E+00	1.38E+00	1.33E+00	1.29E+00	1.28E+00	1.28E+00	2.46E-01	8.45E-01	8.38E-01	8.95E-01	9.04E-01	9.10E-01	9.13E-01	7.05E-03	7.14E-01	8.80E-01	1.04E+00	1.08E+00	1.12E+00	1.13E+00
200	1.18E-01	1.09E+00	1.34E+00	1.37E+00	1.36E+00	1.34E+00	1.33E+00	2.35E-01	8.35E-01	8.44E-01	8.72E-01	8.79E-01	8.83E-01	8.85E-01	6.69E-03	6.11E-01	7.63E-01	9.16E-01	9.62E-01	9.94E-01	1.01E+00
300	1.68E-01	5.40E-01	8.01E-01	9.53E-01	1.03E+00	1.07E+00	1.09E+00	2.17E-01	6.54E-01	6.98E-01	8.36E-01	8.40E-01	8.42E-01	8.43E-01	6.27E-03	3.16E-01	4.05E-01	5.08E-01	5.41E-01	5.63E-01	5.73E-01
400	1.88E-01	2.78E-01	3.91E-01	4.72E-01	5.19E-01	5.49E-01	5.65E-01	1.93E-01	4.51E-01	4.86E-01	7.20E-01	7.34E-01	7.41E-01	7.44E-01	5.97E-03	1.64E-01	2.09E-01	2.65E-01	2.82E-01	2.95E-01	3.00E-01
500	1.60E-01	2.00E-01	2.31E-01	2.57E-01	2.74E-01	2.85E-01	2.91E-01	1.57E-01	3.24E-01	3.44E-01	5.43E-01	5.58E-01	5.65E-01	5.69E-01	5.04E-03	8.81E-02	1.11E-01	1.39E-01	1.48E-01	1.54E-01	1.57E-01
600	1.28E-01	1.83E-01	1.91E-01	1.96E-01	2.00E-01	2.03E-01	2.04E-01	1.26E-01	2.52E-01	2.64E-01	3.96E-01	4.06E-01	4.12E-01	4.15E-01	4.08E-03	4.93E-02	6.10E-02	7.53E-02	7.98E-02	8.30E-02	8.43E-02
700	1.05E-01	1.68E-01	1.77E-01	1.81E-01	1.82E-01	1.83E-01	1.84E-01	1.01E-01	2.03E-01	2.11E-01	2.98E-01	3.05E-01	3.08E-01	3.10E-01	3.36E-03	2.86E-02	3.49E-02	4.25E-02	4.48E-02	4.65E-02	4.72E-02
800	8.47E-02	1.46E-01	1.58E-01	1.63E-01	1.66E-01	1.67E-01	1.68E-01	8.14E-02	1.64E-01	1.71E-01	2.33E-01	2.38E-01	2.40E-01	2.42E-01	2.67E-03	1.73E-02	2.08E-02	2.49E-02	2.62E-02	2.71E-02	2.74E-02
900	6.59E-02	1.22E-01	1.34E-01	1.40E-01	1.43E-01	1.45E-01	1.46E-01	6.33E-02	1.33E-01	1.38E-01	1.87E-01	1.90E-01	1.92E-01	1.93E-01	2.06E-03	1.08E-02	1.28E-02	1.52E-02	1.59E-02	1.64E-02	1.66E-02
1000	5.03E-02	1.00E-01	1.11E-01	1.17E-01	1.20E-01	1.22E-01	1.23E-01	4.83E-02	1.07E-01	1.12E-01	1.50E-01	1.53E-01	1.54E-01	1.55E-01	1.58E-03	7.01E-03	8.20E-03	9.57E-03	9.99E-03	1.03E-02	1.04E-02

Table 5. Predicted Concentration of Technetium-99 (pCi/L) for the various Pipe Pathways By Applying the Average Input Boundary Concentration

Time (yr)	NE_Boundary	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	8.94E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.24E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.10E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	3.58E-05	1.36E-19	2.85E-33	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.97E+00	6.51E-15	2.82E-20	3.05E-31	2.58E-33	1.90E-34	2.37E-35	1.19E-03	1.77E-13	7.81E-20	1.37E-25	1.37E-31	3.34E-37	1.28E-39
10	2.12E-01	1.46E-15	6.13E-26	1.61E-35	5.66E-39	0.00E+00	0.00E+00	3.90E+00	5.90E-10	1.55E-16	1.97E-22	8.15E-24	1.29E-24	2.05E-25	3.26E-02	1.35E-07	1.51E-11	6.90E-17	3.35E-22	1.48E-26	1.95E-28
20	8.53E+00	2.18E-06	2.88E-16	6.05E-24	9.55E-27	6.63E-29	7.08E-31	2.86E+00	5.65E-04	8.98E-08	7.85E-14	4.31E-15	8.54E-16	1.60E-16	8.35E-02	2.90E-04	2.99E-06	4.57E-09	1.19E-11	5.82E-14	3.41E-15
30	5.61E+00	6.21E-03	3.40E-09	6.46E-15	1.32E-17	1.14E-19	1.68E-21	1.71E+00	3.76E-02	3.74E-04	6.66E-08	1.31E-08	5.28E-09	1.92E-09	5.79E-02	4.90E-03	3.40E-04	4.86E-06	1.42E-07	6.46E-09	1.32E-09
40	3.45E+00	1.62E-01	1.35E-05	1.71E-09	1.81E-11	5.29E-13	2.80E-14	1.45E+00	2.39E-01	1.64E-02	5.14E-05	2.00E-05	1.18E-05	6.54E-06	3.99E-02	1.59E-02	3.21E-03	1.82E-04	2.06E-05	2.98E-06	1.13E-06
50	2.86E+00	7.87E-01	1.25E-03	2.44E-06	8.87E-08	6.66E-09	8.78E-10	1.24E+00	6.10E-01	1.22E-01	2.15E-03	1.20E-03	8.64E-04	6.03E-04	3.33E-02	2.62E-02	1.02E-02	1.39E-03	3.52E-04	1.04E-04	5.69E-05
60	2.27E+00	1.72E+00	1.94E-02	2.19E-04	1.83E-05	2.67E-06	6.51E-07	1.10E+00	9.91E-01	3.81E-01	2.12E-02	1.46E-02	1.18E-02	9.35E-03	3.04E-02	3.21E-02	1.87E-02	4.69E-03	1.94E-03	8.88E-04	6.07E-04
70	1.87E+00	2.50E+00	1.12E-01	4.24E-03	6.40E-04	1.49E-04	5.41E-05	9.99E-01	1.27E+00	7.33E-01	9.30E-02	7.24E-02	6.29E-02	5.40E-02	2.82E-02	3.43E-02	2.57E-02	9.89E-03	5.61E-03	3.38E-03	2.65E-03
80	1.62E+00	2.95E+00	3.51E-01	3.20E-02	7.51E-03	2.46E-03	1.18E-03	9.33E-01	1.42E+00	1.06E+00	2.47E-01	2.09E-01	1.90E-01	1.71E-01	2.66E-02	3.44E-02	3.01E-02	1.57E-02	1.09E-02	7.87E-03	6.74E-03
90	1.46E+00	3.07E+00	7.49E-01	1.31E-01	4.30E-02	1.83E-02	1.06E-02	8.79E-01	1.46E+00	1.29E+00	4.72E-01	4.22E-01	3.96E-01	3.70E-01	2.55E-02	3.35E-02	3.22E-02	2.10E-02	1.66E-02	1.35E-02	1.22E-02
100	1.30E+00	2.98E+00	1.24E+00	3.52E-01	1.50E-01	7.81E-02	5.23E-02	8.21E-01	1.43E+00	1.41E+00	7.26E-01	6.74E-01	6.46E-01	6.17E-01	2.37E-02	3.22E-02	3.28E-02	2.50E-02	2.17E-02	1.90E-02	1.78E-02
110	1.18E+00	2.77E+00	1.72E+00	7.04E-01	3.70E-01	2.25E-01	1.67E-01	7.71E-01	1.37E+00	1.44E+00	9.58E-01	9.13E-01	8.89E-01	8.63E-01	2.25E-02	3.07E-02	3.24E-02	2.77E-02	2.55E-02	2.35E-02	2.26E-02
120	1.08E+00	2.51E+00	2.12E+00	1.14E+00	7.08E-01	4.87E-01	3.92E-01	7.76E-01	1.28E+00	1.40E+00	1.14E+00	1.10E+00	1.09E+00	1.07E+00	2.14E-02	2.93E-02	3.14E-02	2.93E-02	2.80E-02	2.67E-02	2.61E-02
125	1.06E+00	2.38E+00	2.27E+00	1.37E+00	9.10E-01	6.59E-01	5.47E-01	8.12E-01	1.24E+00	1.37E+00	1.20E+00	1.18E+00	1.16E+00	1.15E+00	2.16E-02	2.85E-02	3.09E-02	2.97E-02	2.88E-02	2.78E-02	2.73E-02

Table 6. Predicted Concentration of Nitrate (µg/L) for the various Pipe Pathways By Applying the Average Input Boundary Concentration

Time (yr)	NE_Boundary	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	1.00E+01	1.62E+04	1.47E+04	3.76E+04	3.51E+04	3.15E+04	2.99E+04	1.02E+02	2.48E+04	3.25E+04	3.94E+04	3.98E+04	4.00E+04	4.02E+04	5.27E+01	3.60E+04	3.28E+04	3.97E+04	4.22E+04	3.74E+04	3.39E+04
5	5.86E+00	1.73E+04	1.47E+04	3.23E+04	3.81E+04	3.62E+04	3.45E+04	2.49E+03	2.28E+04	3.09E+04	3.80E+04	3.86E+04	3.89E+04	3.92E+04	2.11E+02	3.22E+04	3.12E+04	3.46E+04	3.91E+04	4.08E+04	3.80E+04
10	9.56E+02	1.73E+04	1.39E+04	2.63E+04	3.59E+04	3.75E+04	3.69E+04	3.27E+03	2.14E+04	2.85E+04	3.68E+04	3.73E+04	3.76E+04	3.79E+04	5.64E+02	3.16E+04	3.30E+04	3.46E+04	3.86E+04	4.01E+04	4.05E+04
20	5.99E+03	1.52E+04	1.29E+04	1.94E+04	2.74E+04	3.26E+04	3.48E+04	3.61E+03	2.02E+04	2.41E+04	3.45E+04	3.50E+04	3.52E+04	3.55E+04	9.50E+02	2.90E+04	3.32E+04	3.49E+04	3.51E+04	3.65E+04	3.74E+04
30	5.60E+03	1.21E+04	1.32E+04	1.58E+04	2.08E+04	2.51E+04	2.73E+04	3.51E+03	1.94E+04	2.14E+04	3.15E+04	3.22E+04	3.25E+04	3.29E+04	1.04E+03	2.49E+04	3.13E+04	3.48E+04	3.49E+04	3.50E+04	3.51E+04
40	5.22E+03	9.09E+03	1.39E+04	1.40E+04	1.68E+04	1.95E+04	2.11E+04	2.94E+03	1.79E+04	2.01E+04	2.83E+04	2.90E+04	2.93E+04	2.97E+04	9.89E+02	2.05E+04	2.81E+04	3.39E+04	3.47E+04	3.49E+04	3.49E+04
50	4.19E+03	7.03E+03	1.41E+04	1.36E+04	1.47E+04	1.61E+04	1.70E+04	2.35E+03	1.58E+04	1.89E+04	2.55E+04	2.60E+04	2.63E+04	2.66E+04	8.95E+02	1.65E+04	2.41E+04	3.20E+04	3.35E+04	3.43E+04	3.45E+04
60	3.26E+03	5.89E+03	1.35E+04	1.38E+04	1.40E+04	1.45E+04	1.49E+04	2.04E+03	1.34E+04	1.72E+04	2.32E+04	2.37E+04	2.39E+04	2.41E+04	8.03E+02	1.32E+04	2.02E+04	2.92E+04	3.15E+04	3.27E+04	3.31E+04
70	2.80E+03	5.34E+03	1.24E+04	1.39E+04	1.39E+04	1.40E+04	1.41E+04	1.87E+03	1.12E+04	1.50E+04	2.13E+04	2.17E+04	2.19E+04	2.21E+04	7.23E+02	1.05E+04	1.65E+04	2.60E+04	2.87E+04	3.03E+04	3.09E+04
80	2.57E+03	5.02E+03	1.09E+04	1.34E+04	1.38E+04	1.39E+04	1.39E+04	1.78E+03	9.17E+03	1.27E+04	1.94E+04	1.98E+04	2.00E+04	2.02E+04	6.33E+02	8.39E+03	1.34E+04	2.26E+04	2.54E+04	2.73E+04	2.80E+04
90	2.42E+03	4.72E+03	9.45E+03	1.25E+04	1.33E+04	1.37E+04	1.38E+04	1.75E+03	7.50E+03	1.06E+04	1.74E+04	1.78E+04	1.81E+04	1.83E+04	5.47E+02	6.71E+03	1.08E+04	1.94E+04	2.21E+04	2.39E+04	2.47E+04
100	2.31E+03	4.38E+03	8.20E+03	1.12E+04	1.24E+04	1.30E+04	1.33E+04	1.72E+03	6.13E+03	8.72E+03	1.54E+04	1.58E+04	1.60E+04	1.63E+04	4.65E+02	5.39E+03	8.70E+03	1.63E+04	1.88E+04	2.06E+04	2.14E+04
110	2.23E+03	4.01E+03	7.19E+03	9.81E+03	1.12E+04	1.20E+04	1.24E+04	1.69E+03	5.03E+03	7.14E+03	1.33E+04	1.37E+04	1.39E+04	1.42E+04	3.97E+02	4.34E+03	6.99E+03	1.37E+04	1.59E+04	1.75E+04	1.82E+04
120	2.16E+03	3.65E+03	6.39E+03	8.57E+03	9.92E+03	1.08E+04	1.12E+04	1.63E+03	4.17E+03	5.85E+03	1.13E+04	1.17E+04	1.19E+04	1.22E+04	3.35E+02	3.51E+03	5.63E+03	1.13E+04	1.33E+04	1.47E+04	1.53E+04
125	2.10E+03	3.48E+03	6.05E+03	8.02E+03	9.30E+03	1.01E+04	1.05E+04	1.60E+03	3.82E+03	5.30E+03	1.04E+04	1.08E+04	1.10E+04	1.12E+04	3.09E+02	3.16E+03	5.05E+03	1.03E+04	1.21E+04	1.34E+04	1.40E+04

Table 7. Predicted Concentration of Uranium (µg/L) for the various Pipe Pathways By Applying the Average Input Boundary Concentration

Time (yr)	NE_Boundary	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	3.50E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.80E-06	1.32E-31	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.37E-16	1.36E-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	1.02E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.74E-02	5.60E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.73E-08	4.83E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	1.59E-07	5.11E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.79E-01	4.95E-15	7.92E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.89E-05	4.04E-19	8.11E-27	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30	4.55E-05	2.44E-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.73E-01	1.46E-14	4.13E-19	2.74E-31	0.00E+00	0.00E+00	0.00E+00	8.29E-05	3.08E-13	1.53E-20	1.76E-28	0.00E+00	0.00E+00	0.00E+00
40	1.05E-03	1.62E-17	2.35E-30	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.57E-01	3.24E-12	3.34E-17	4.33E-25	1.06E-27	1.24E-29	8.61E-32	1.88E-04	1.41E-10	1.46E-15	7.37E-23	3.03E-30	0.00E+00	0.00E+00
50	8.14E-03	9.43E-16	1.26E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.62E-01	1.61E-09	3.68E-16	4.87E-22	9.45E-24	5.62E-25	2.33E-26	3.91E-04	4.60E-09	7.43E-13	2.10E-18	9.14E-25	1.70E-30	0.00E+00
60	3.30E-02	3.57E-13	3.95E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.60E-01	8.55E-08	3.79E-14	3.83E-20	2.26E-21	3.17E-22	3.50E-23	8.19E-04	4.76E-08	4.08E-11	1.34E-15	1.64E-20	3.23E-25	4.38E-28
70	8.75E-02	3.87E-11	3.06E-22	4.88E-30	0.00E+00	0.00E+00	0.00E+00	1.54E-01	1.37E-06	9.37E-12	8.14E-19	9.22E-20	2.18E-20	4.36E-21	1.36E-03	2.62E-07	7.03E-10	1.20E-13	1.36E-17	2.42E-21	1.33E-23
80	1.70E-01	1.55E-09	2.40E-20	1.57E-27	5.52E-31	0.00E+00	0.00E+00	1.45E-01	1.06E-05	5.43E-10	6.37E-17	2.26E-18	5.01E-19	1.34E-19	1.89E-03	9.74E-07	6.02E-09	3.40E-12	1.86E-15	1.58E-18	2.43E-20
90	2.62E-01	2.92E-08	4.93E-18	1.60E-25	1.39E-28	4.58E-31	0.00E+00	1.36E-01	5.02E-05	1.21E-08	1.08E-14	3.90E-16	4.58E-17	5.52E-18	2.30E-03	2.85E-06	3.26E-08	4.58E-11	8.09E-14	2.17E-16	7.14E-18
100	3.39E-01	3.17E-07	5.37E-16	1.27E-23	1.34E-26	7.85E-29	6.63E-31	1.23E-01	1.68E-04	1.38E-07	6.66E-13	4.11E-14	6.69E-15	9.67E-16	2.54E-03	7.16E-06	1.29E-07	3.70E-10	1.61E-12	1.05E-14	6.09E-16
110	3.86E-01	2.26E-06	2.78E-14	2.05E-21	1.20E-24	6.76E-27	8.87E-29	1.08E-01	4.39E-04	9.83E-07	1.87E-11	1.78E-12	3.89E-13	7.71E-14	2.65E-03	1.59E-05	4.10E-07	2.07E-09	1.84E-11	2.42E-13	2.17E-14
120	4.00E-01	1.17E-05	7.84E-13	2.51E-19	1.87E-22	7.48E-25	7.58E-27	9.51E-02	9.54E-04	4.87E-06	2.92E-10	3.91E-11	1.09E-11	2.76E-12	2.67E-03	3.17E-05	1.11E-06	8.83E-09	1.39E-10	3.21E-12	4.09E-13
125	3.97E-01	2.42E-05	3.44E-12	2.19E-18	2.13E-21	9.36E-24	8.05E-26	8.90E-02	1.33E-03	9.72E-06	9.70E-10	1.50E-10	4.60E-11	1.30E-11	2.66E-03	4.31E-05	1.75E-06	1.69E-08	3.39E-10	9.94E-12	1.47E-12

Table 8. Predicted Concentration of Tetrachloroethene (µg/L) for the various Pipe Pathways By Applying the Average Input Boundary Concentration

Time (yr)	NE_Boundary	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	1.76E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.69E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.34E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	5.12E-03	1.01E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.18E-03	1.37E-19	4.83E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.52E-03	6.35E-14	3.71E-20	9.95E-27	0.00E+00	0.00E+00	0.00E+00
10	3.20E-03	1.91E-14	4.63E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.16E-03	1.09E-15	5.45E-22	9.76E-30	4.07E-32	0.00E+00	0.00E+00	1.10E-02	1.60E-08	8.98E-14	4.03E-21	5.55E-27	6.84E-32	0.00E+00
20	9.66E-04	3.70E-08	1.57E-19	8.13E-28	3.61E-31	0.00E+00	0.00E+00	6.13E-03	4.67E-09	5.59E-15	2.91E-23	1.02E-24	1.79E-25	3.24E-26	2.66E-02	1.48E-05	3.94E-08	4.69E-12	2.92E-16	3.59E-20	2.08E-22
30	2.94E-04	4.86E-06	2.69E-13	8.46E-21	1.88E-24	3.26E-27	1.83E-29	6.71E-03	7.28E-07	2.48E-10	2.75E-16	1.12E-17	1.52E-18	1.80E-19	3.71E-02	2.46E-04	4.73E-06	1.18E-08	3.72E-11	1.64E-13	7.70E-15
40	1.20E-04	4.81E-05	4.16E-10	2.13E-15	4.06E-18	2.70E-20	2.65E-22	7.77E-03	1.06E-05	4.73E-08	2.72E-12	3.64E-13	1.03E-13	2.68E-14	4.48E-02	1.23E-03	6.92E-05	7.76E-07	1.61E-08	4.58E-10	6.63E-11
50	9.64E-05	1.64E-04	3.22E-08	3.86E-12	3.21E-14	6.93E-16	2.43E-17	9.42E-03	6.08E-05	1.11E-06	6.44E-10	1.66E-10	7.18E-11	2.96E-11	4.94E-02	3.39E-03	3.86E-04	1.13E-05	6.83E-07	5.49E-08	1.48E-08
60	9.54E-05	3.28E-04	5.36E-07	5.37E-10	1.23E-11	6.08E-13	5.04E-14	1.09E-02	2.04E-04	9.60E-06	2.44E-08	9.19E-09	5.09E-09	2.73E-09	5.04E-02	6.72E-03	1.25E-03	7.28E-05	8.84E-06	1.37E-06	5.31E-07
70	7.99E-05	4.85E-04	3.67E-06	1.67E-08	8.05E-10	7.23E-11	1.09E-11	1.17E-02	4.82E-04	4.56E-05	3.32E-07	1.59E-07	1.02E-07	6.46E-08	5.33E-02	1.09E-02	2.89E-03	2.80E-04	5.56E-05	1.35E-05	6.67E-06
80	5.76E-05	5.94E-04	1.44E-05	2.02E-07	1.70E-08	2.41E-09	5.55E-10	1.19E-02	9.09E-04	1.44E-04	2.39E-06	1.35E-06	9.58E-07	6.73E-07	5.44E-02	1.56E-02	5.38E-03	7.72E-04	2.18E-04	7.28E-05	4.27E-05
90	3.97E-05	6.45E-04	3.88E-05	1.29E-06	1.69E-07	3.39E-08	1.07E-08	1.02E-02	1.48E-03	3.43E-04	1.10E-05	7.00E-06	5.36E-06	4.06E-06	5.41E-02	2.03E-02	8.61E-03	1.68E-03	6.17E-04	2.61E-04	1.73E-04
100	2.83E-05	6.47E-04	8.07E-05	5.29E-06	9.80E-07	2.60E-07	1.04E-07	9.90E-03	2.18E-03	6.68E-04	3.67E-05	2.55E-05	2.06E-05	1.66E-05	5.25E-02	2.48E-02	1.24E-02	3.11E-03	1.39E-03	7.00E-04	5.07E-04
110	2.14E-05	6.14E-04	1.39E-04	1.57E-05	3.86E-06	1.29E-06	6.16E-07	9.52E-03	2.99E-03	1.13E-03	9.57E-05	7.15E-05	6.02E-05	5.05E-05	5.05E-02	2.91E-02	1.64E-02	5.07E-03	2.64E-03	1.52E-03	1.17E-03
120	1.72E-05	5.62E-04	2.07E-04	3.64E-05	1.14E-05	4.56E-06	2.52E-06	9.02E-03	3.87E-03	1.72E-03	2.08E-04	1.64E-04	1.43E-04	1.23E-04	4.78E-02	3.29E-02	2.06E-02	7.53E-03	4.41E-03	2.82E-03	2.29E-03
125	1.57E-05	5.31E-04	2.43E-04	5.16E-05	1.79E-05	7.76E-06	4.55E-06	8.84E-03	4.32E-03	2.06E-03	2.90E-04	2.33E-04	2.06E-04	1.81E-04	4.65E-02	3.45E-02	2.26E-02	8.92E-03	5.49E-03	3.66E-03	3.04E-03

Table 9. Predicted Concentration of Trichloroethene (µg/L) for the various Pipe Pathways by Applying the Average Input Boundary Concentration

Time (yr)	NE_Boundary	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	7.27E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.33E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.83E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	3.71E-03	1.49E-17	8.20E-28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.49E-03	1.45E-18	2.06E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.40E-03	3.18E-11	4.50E-18	6.34E-24	3.29E-30	0.00E+00	0.00E+00
10	1.36E-03	1.05E-10	2.00E-22	4.80E-31	0.00E+00	0.00E+00	0.00E+00	3.51E-03	1.51E-12	3.80E-20	1.01E-25	2.94E-27	3.83E-28	4.00E-29	1.01E-02	4.11E-07	6.02E-11	1.83E-16	2.54E-22	6.77E-27	5.76E-29
20	1.15E-03	3.01E-06	3.35E-14	2.28E-22	1.32E-25	1.25E-27	1.96E-29	3.76E-03	1.50E-07	1.39E-11	3.23E-18	9.72E-20	1.40E-20	1.74E-21	2.03E-02	8.48E-05	1.19E-06	1.71E-09	2.58E-12	6.22E-15	2.20E-16
30	1.78E-03	6.87E-05	1.13E-09	9.76E-15	2.48E-17	2.14E-19	2.93E-21	4.06E-03	8.71E-06	3.80E-08	2.39E-12	3.40E-13	1.09E-13	3.13E-14	2.50E-02	8.11E-04	5.05E-05	6.61E-07	1.62E-08	5.35E-10	8.54E-11
40	1.45E-03	2.59E-04	1.81E-07	7.18E-11	1.05E-12	3.65E-14	2.14E-15	5.22E-03	7.71E-05	2.12E-06	2.18E-09	6.63E-10	3.30E-10	1.55E-10	2.66E-02	2.77E-03	4.03E-04	1.68E-05	1.47E-06	1.69E-07	5.58E-08
50	1.87E-03	4.97E-04	3.27E-06	1.30E-08	5.80E-10	4.92E-11	7.02E-12	6.42E-03	2.79E-04	2.40E-05	1.35E-07	6.08E-08	3.82E-08	2.33E-08	2.63E-02	5.75E-03	1.45E-03	1.29E-04	2.38E-05	5.41E-06	2.60E-06
60	2.83E-03	7.22E-04	1.97E-05	3.56E-07	3.38E-08	5.27E-09	1.33E-09	7.28E-03	6.25E-04	1.14E-04	2.10E-06	1.20E-06	8.70E-07	6.17E-07	2.48E-02	9.15E-03	3.34E-03	5.12E-04	1.52E-04	5.31E-05	3.19E-05
70	3.77E-03	9.17E-04	6.43E-05	3.29E-06	5.38E-07	1.29E-07	4.77E-08	7.79E-03	1.09E-03	3.19E-04	1.43E-05	9.56E-06	7.58E-06	5.93E-06	2.40E-02	1.24E-02	5.90E-03	1.34E-03	5.51E-04	2.57E-04	1.79E-04
80	4.79E-03	1.09E-03	1.45E-04	1.56E-05	3.80E-06	1.26E-06	6.01E-07	8.22E-03	1.65E-03	6.53E-04	5.64E-05	4.20E-05	3.55E-05	2.97E-05	2.24E-02	1.51E-02	8.76E-03	2.70E-03	1.39E-03	7.92E-04	6.09E-04
90	5.74E-03	1.27E-03	2.59E-04	4.74E-05	1.57E-05	6.60E-06	3.79E-06	8.30E-03	2.29E-03	1.10E-03	1.55E-04	1.24E-04	1.09E-04	9.58E-05	2.05E-02	1.71E-02	1.15E-02	4.53E-03	2.74E-03	1.80E-03	1.48E-03
100	6.74E-03	1.51E-03	3.97E-04	1.07E-04	4.47E-05	2.27E-05	1.49E-05	9.08E-03	3.00E-03	1.65E-03	3.31E-04	2.80E-04	2.54E-04	2.30E-04	1.84E-02	1.85E-02	1.40E-02	6.65E-03	4.55E-03	3.31E-03	2.86E-03
110	7.85E-03	1.86E-03	5.50E-04	1.98E-04	9.85E-05	5.75E-05	4.16E-05	9.82E-03	3.74E-03	2.28E-03	5.98E-04	5.24E-04	4.85E-04	4.49E-04	1.65E-02	1.94E-02	1.60E-02	8.89E-03	6.66E-03	5.23E-03	4.68E-03
120	9.07E-03	2.31E-03	7.14E-04	3.15E-04	1.80E-04	1.18E-04	9.14E-05	1.05E-02	4.48E-03	2.98E-03	9.59E-04	8.61E-04	8.10E-04	7.61E-04	1.46E-02	1.97E-02	1.75E-02	1.10E-02	8.87E-03	7.38E-03	6.78E-03
125	9.76E-03	2.58E-03	8.03E-04	3.81E-04	2.31E-04	1.58E-04	1.26E-04	1.12E-02	4.84E-03	3.34E-03	1.17E-03	1.06E-03	1.01E-03	9.52E-04	1.37E-02	1.96E-02	1.80E-02	1.21E-02	9.96E-03	8.48E-03	7.89E-03

Table 10. Predicted Concentration of Carbon Tetrachloride (µg/L) for the various Pipe Pathways by Applying the Average Input Boundary Concentration

Time (yr)	NE_Boundary	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	7.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.12E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.37E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	2.57E-03	7.25E-17	7.57E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.49E-03	3.02E-18	2.09E-21	1.65E-30	1.87E-32	0.00E+00	0.00E+00	4.48E-03	7.38E-10	9.56E-16	1.37E-22	7.32E-28	1.27E-32	0.00E+00
10	6.93E-04	2.14E-09	2.52E-21	2.09E-28	3.33E-32	0.00E+00	0.00E+00	2.98E-03	3.98E-11	1.29E-18	3.89E-24	2.57E-25	5.33E-26	9.46E-27	1.12E-02	2.23E-06	1.44E-09	3.09E-14	4.42E-19	3.08E-23	3.52E-25
20	1.97E-04	9.13E-06	3.03E-12	5.82E-19	3.33E-22	1.22E-24	1.21E-26	5.47E-03	6.09E-07	3.58E-10	1.16E-15	7.87E-17	1.76E-17	3.50E-18	1.69E-02	1.90E-04	5.72E-06	2.49E-08	1.51E-10	1.34E-12	1.03E-13
30	4.63E-03	9.01E-05	1.55E-08	1.47E-12	1.14E-14	2.41E-16	8.67E-18	1.78E-02	1.84E-05	2.48E-07	8.99E-11	2.11E-11	9.28E-12	3.73E-12	1.61E-02	1.12E-03	1.22E-04	3.45E-06	2.00E-07	1.52E-08	3.97E-09
40	2.07E-02	1.95E-04	8.29E-07	1.99E-09	7.00E-11	4.92E-12	5.90E-13	2.41E-02	1.07E-04	6.48E-06	2.45E-08	1.02E-08	6.20E-09	3.60E-09	1.34E-02	2.62E-03	5.96E-04	4.61E-05	7.46E-06	1.51E-06	6.82E-07
50	2.91E-02	2.71E-04	6.96E-06	1.15E-07	1.04E-08	1.56E-09	3.83E-10	2.26E-02	3.65E-04	4.35E-05	6.81E-07	3.82E-07	2.76E-07	1.94E-07	1.06E-02	3.96E-03	1.43E-03	2.15E-04	6.30E-05	2.18E-05	1.31E-05
60	2.69E-02	5.85E-04	2.32E-05	1.33E-06	2.29E-07	5.75E-08	2.19E-08	2.05E-02	1.00E-03	1.64E-04	5.86E-06	3.90E-06	3.11E-06	2.44E-06	8.22E-03	4.72E-03	2.34E-03	5.61E-04	2.39E-04	1.15E-04	8.16E-05
70	2.45E-02	1.61E-03	4.87E-05	6.21E-06	1.68E-06	6.04E-07	3.07E-07	1.94E-02	2.07E-03	4.77E-04	2.72E-05	1.98E-05	1.67E-05	1.39E-05	6.39E-03	4.88E-03	3.02E-03	1.02E-03	5.59E-04	3.35E-04	2.64E-04
80	2.35E-02	3.30E-03	9.50E-05	1.68E-05	6.25E-06	2.91E-06	1.80E-06	1.98E-02	3.30E-03	1.08E-03	9.15E-05	7.03E-05	6.08E-05	5.22E-05	4.85E-03	4.62E-03	3.36E-03	1.48E-03	9.59E-04	6.66E-04	5.63E-04
90	2.43E-02	5.06E-03	2.14E-04	3.51E-05	1.54E-05	8.51E-06	5.96E-06	2.21E-02	4.34E-03	1.91E-03	2.42E-04	1.95E-04	1.73E-04	1.52E-04	3.67E-03	4.14E-03	3.39E-03	1.82E-03	1.34E-03	1.03E-03	9.13E-04
100	2.70E-02	6.39E-03	4.75E-04	7.37E-05	3.25E-05	1.91E-05	1.42E-05	2.64E-02	5.05E-03	2.74E-03	5.13E-04	4.31E-04	3.91E-04	3.54E-04	2.78E-03	3.56E-03	3.18E-03	2.01E-03	1.61E-03	1.34E-03	1.23E-03
110	3.24E-02	7.22E-03	8.98E-04	1.64E-04	6.99E-05	4.03E-05	3.00E-05	3.14E-02	5.50E-03	3.42E-03	8.88E-04	7.76E-04	7.19E-04	6.64E-04	2.18E-03	2.97E-03	2.84E-03	2.05E-03	1.75E-03	1.54E-03	1.44E-03
120	3.83E-02	7.73E-03	1.43E-03	3.40E-04	1.53E-04	8.82E-05	6.52E-05	3.56E-02	5.84E-03	3.89E-03	1.31E-03	1.18E-03	1.11E-03	1.04E-03	1.78E-03	2.43E-03	2.45E-03	1.97E-03	1.77E-03	1.61E-03	1.54E-03
125	4.07E-02	7.95E-03	1.70E-03	4.65E-04	2.19E-04	1.29E-04	9.62E-05	3.77E-02	6.02E-03	4.06E-03	1.51E-03	1.38E-03	1.31E-03	1.24E-03	1.65E-03	2.18E-03	2.25E-03	1.89E-03	1.74E-03	1.61E-03	1.55E-03

Table 11. Predicted Concentration of Tritium (pCi/L) for the various Pipe Pathways by Applying the Maximum Input Boundary Concentration

Time (yr)	NE_Boundary (Max)	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary (Max)	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary (Max)	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	1.36E+02	4.04E+04	2.76E+05	9.42E+04	6.50E+04	5.59E+04	5.22E+04	2.40E+04	6.08E+04	7.32E+04	8.04E+04	8.00E+04	7.93E+04	7.87E+04	2.16E+04	5.62E+04	5.41E+04	2.98E+04	1.95E+04	1.22E+04	9.33E+03
5	6.08E+03	3.52E+04	2.01E+05	9.42E+04	6.24E+04	5.11E+04	4.68E+04	1.86E+04	4.48E+04	5.25E+04	6.07E+04	6.08E+04	6.07E+04	6.07E+04	1.16E+04	3.72E+04	3.83E+04	2.38E+04	1.83E+04	1.37E+04	1.12E+04
10	7.82E+03	2.80E+04	1.37E+05	9.76E+04	5.92E+04	4.61E+04	4.11E+04	9.90E+03	3.33E+04	3.76E+04	4.53E+04	4.56E+04	4.56E+04	4.57E+04	4.08E+03	2.68E+04	3.01E+04	2.08E+04	1.72E+04	1.37E+04	1.21E+04
20	3.72E+03	1.50E+04	5.87E+04	7.92E+04	5.64E+04	4.19E+04	3.58E+04	4.19E+03	1.79E+04	1.98E+04	2.47E+04	2.50E+04	2.51E+04	2.52E+04	1.04E+03	1.35E+04	1.67E+04	1.41E+04	1.23E+04	1.09E+04	1.03E+04
30	1.34E+03	7.06E+03	2.46E+04	4.38E+04	4.17E+04	3.59E+04	3.23E+04	2.24E+03	9.16E+03	1.07E+04	1.32E+04	1.34E+04	1.35E+04	1.36E+04	4.97E+02	6.63E+03	8.69E+03	8.63E+03	8.13E+03	7.57E+03	7.30E+03
40	5.69E+02	3.15E+03	1.06E+04	2.04E+04	2.36E+04	2.36E+04	2.31E+04	1.24E+03	4.53E+03	5.60E+03	7.07E+03	7.17E+03	7.21E+03	7.26E+03	2.67E+02	3.15E+03	4.37E+03	4.93E+03	4.92E+03	4.79E+03	4.72E+03
50	2.75E+02	1.40E+03	4.75E+03	8.93E+03	1.15E+04	1.27E+04	1.31E+04	6.97E+02	2.20E+03	2.84E+03	3.77E+03	3.83E+03	3.85E+03	3.88E+03	1.46E+02	1.47E+03	2.14E+03	2.69E+03	2.79E+03	2.81E+03	2.81E+03
60	1.47E+02	6.35E+02	2.19E+03	3.88E+03	5.20E+03	6.05E+03	6.46E+03	3.96E+02	1.07E+03	1.41E+03	2.00E+03	2.03E+03	2.04E+03	2.06E+03	7.92E+01	6.76E+02	1.02E+03	1.41E+03	1.51E+03	1.56E+03	1.58E+03
70	8.50E+01	2.91E+02	1.02E+03	1.72E+03	2.31E+03	2.74E+03	2.96E+03	2.21E+02	5.15E+02	6.85E+02	1.04E+03	1.06E+03	1.07E+03	1.08E+03	4.19E+01	3.12E+02	4.80E+02	7.22E+02	7.91E+02	8.32E+02	8.47E+02
80	4.82E+01	1.34E+02	4.74E+02	7.77E+02	1.03E+03	1.22E+03	1.32E+03	1.21E+02	2.51E+02	3.32E+02	5.32E+02	5.45E+02	5.51E+02	5.58E+02	2.21E+01	1.44E+02	2.24E+02	3.61E+02	4.03E+02	4.30E+02	4.41E+02
90	2.68E+01	6.24E+01	2.20E+02	3.57E+02	4.64E+02	5.46E+02	5.90E+02	6.61E+01	1.24E+02	1.61E+02	2.68E+02	2.76E+02	2.79E+02	2.83E+02	1.16E+01	6.71E+01	1.04E+02	1.77E+02	2.01E+02	2.17E+02	2.23E+02
100	1.46E+01	2.95E+01	1.02E+02	1.66E+02	2.13E+02	2.48E+02	2.67E+02	3.56E+01	6.26E+01	7.90E+01	1.34E+02	1.38E+02	1.39E+02	1.42E+02	6.02E+00	3.14E+01	4.85E+01	8.60E+01	9.84E+01	1.07E+02	1.11E+02
110	8.07E+00	1.43E+01	4.76E+01	7.70E+01	9.82E+01	1.14E+02	1.22E+02	1.93E+01	3.21E+01	3.93E+01	6.60E+01	6.81E+01	6.90E+01	7.01E+01	3.16E+00	1.48E+01	2.27E+01	4.14E+01	4.77E+01	5.23E+01	5.43E+01
120	4.44E+00	7.15E+00	2.21E+01	3.58E+01	4.55E+01	5.26E+01	5.63E+01	1.03E+01	1.67E+01	1.99E+01	3.26E+01	3.36E+01	3.41E+01	3.46E+01	1.64E+00	7.06E+00	1.06E+01	1.98E+01	2.29E+01	2.53E+01	2.63E+01
125	3.31E+00	5.09E+00	1.51E+01	2.44E+01	3.10E+01	3.58E+01	3.83E+01	7.54E+00	1.21E+01	1.42E+01	2.29E+01	2.36E+01	2.39E+01	2.43E+01	1.19E+00	4.88E+00	7.29E+00	1.37E+01	1.59E+01	1.75E+01	1.82E+01

Table 12. Predicted Concentration of Iodine-129 (pCi/L) for the various Pipe Pathways by Applying the Maximum Input Boundary Concentration

Time (yr)	NE_Boundary (Max)	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary (Max)	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary (Max)	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	3.01E-01	4.35E+00	8.90E-01	5.25E-01	4.74E-01	3.26E-01	2.47E-01	2.00E+00	9.04E-01	3.29E+00	1.92E-01	2.23E-01	2.34E-01	2.36E-01	7.14E-01	2.24E+00	1.10E+00	1.59E-01	3.27E-02	6.89E-03	2.95E-03
5	5.54E-01	3.41E+00	1.39E+00	4.13E-01	5.27E-01	4.43E-01	3.74E-01	1.93E+00	7.31E-01	2.64E+00	1.81E-01	2.04E-01	2.20E-01	2.27E-01	3.40E-01	1.92E+00	1.21E+00	2.53E-01	7.82E-02	2.49E-02	1.29E-02
10	5.66E-01	2.60E+00	1.87E+00	3.87E-01	4.96E-01	4.93E-01	4.58E-01	1.68E+00	6.65E-01	2.01E+00	1.85E-01	1.89E-01	2.03E-01	2.10E-01	1.95E-01	1.82E+00	1.41E+00	4.08E-01	1.67E-01	6.66E-02	4.17E-02
20	7.11E-01	1.52E+00	2.69E+00	7.48E-01	4.73E-01	4.71E-01	4.85E-01	1.14E+00	6.83E-01	1.16E+00	2.55E-01	1.96E-01	1.86E-01	1.86E-01	1.06E-01	1.64E+00	1.66E+00	7.39E-01	4.26E-01	2.49E-01	1.91E-01
30	6.46E-01	9.87E-01	3.16E+00	1.43E+00	7.68E-01	5.56E-01	4.97E-01	9.22E-01	7.52E-01	8.11E-01	4.03E-01	2.83E-01	2.35E-01	2.19E-01	8.88E-02	1.50E+00	1.71E+00	1.04E+00	7.47E-01	5.39E-01	4.57E-01
40	5.90E-01	8.00E-01	3.16E+00	2.17E+00	1.34E+00	9.27E-01	7.60E-01	8.33E-01	8.05E-01	7.38E-01	5.82E-01	4.37E-01	3.63E-01	3.31E-01	8.01E-02	1.40E+00	1.68E+00	1.26E+00	1.04E+00	8.54E-01	7.74E-01
50	4.88E-01	8.04E-01	2.82E+00	2.72E+00	1.99E+00	1.51E+00	1.28E+00	8.10E-01	8.29E-01	7.63E-01	7.45E-01	6.13E-01	5.35E-01	4.98E-01	7.39E-02	1.32E+00	1.61E+00	1.39E+00	1.26E+00	1.12E+00	1.06E+00
60	3.75E-01	9.02E-01	2.36E+00	2.95E+00	2.52E+00	2.11E+00	1.90E+00	8.17E-01	8.32E-01	8.00E-01	8.65E-01	7.67E-01	7.02E-01	6.69E-01	6.99E-02	1.27E+00	1.53E+00	1.46E+00	1.39E+00	1.31E+00	1.27E+00
70	3.14E-01	1.03E+00	1.93E+00	2.85E+00	2.79E+00	2.57E+00	2.42E+00	8.11E-01	8.24E-01	8.21E-01	9.39E-01	8.78E-01	8.33E-01	8.09E-01	6.62E-02	1.22E+00	1.46E+00	1.48E+00	1.45E+00	1.42E+00	1.39E+00
80	2.75E-01	1.17E+00	1.59E+00	2.55E+00	2.78E+00	2.76E+00	2.72E+00	7.99E-01	8.14E-01	8.27E-01	9.77E-01	9.46E-01	9.20E-01	9.05E-01	6.21E-02	1.18E+00	1.39E+00	1.46E+00	1.47E+00	1.46E+00	1.46E+00
90	2.40E-01	1.28E+00	1.38E+00	2.18E+00	2.56E+00	2.70E+00	2.75E+00	7.84E-01	8.08E-01	8.22E-01	9.90E-01	9.79E-01	9.67E-01	9.60E-01	5.82E-02	1.13E+00	1.33E+00	1.43E+00	1.46E+00	1.47E+00	1.47E+00
100	2.04E-01	1.36E+00	1.26E+00	1.83E+00	2.24E+00	2.47E+00	2.57E+00	7.65E-01	8.07E-01	8.15E-01	9.90E-01	9.90E-01	9.87E-01	9.84E-01	5.43E-02	1.09E+00	1.27E+00	1.40E+00	1.43E+00	1.45E+00	1.46E+00
110	1.73E-01	1.42E+00	1.22E+00	1.56E+00	1.92E+00	2.16E+00	2.28E+00	7.57E-01	8.13E-01	8.10E-01	9.81E-01	9.88E-01	9.90E-01	9.90E-01	5.09E-02	1.05E+00	1.22E+00	1.35E+00	1.39E+00	1.42E+00	1.43E+00
120	1.50E-01	1.45E+00	1.22E+00	1.38E+00	1.65E+00	1.86E+00	1.97E+00	7.41E-01	8.25E-01	8.10E-01	9.69E-01	9.79E-01	9.83E-01	9.85E-01	4.78E-02	1.00E+00	1.17E+00	1.31E+00	1.35E+00	1.38E+00	1.39E+00
125	1.42E-01	1.46E+00	1.24E+00	1.33E+00	1.55E+00	1.73E+00	1.83E+00	7.36E-01	8.33E-01	8.12E-01	9.62E-01	9.73E-01	9.78E-01	9.80E-01	4.65E-02	9.78E-01	1.15E+00	1.29E+00	1.33E+00	1.36E+00	1.37E+00
150	1.21E-01	1.42E+00	1.35E+00	1.26E+00	1.28E+00	1.33E+00	1.36E+00	6.90E-01	8.79E-01	8.42E-01	9.27E-01	9.38E-01	9.45E-01	9.48E-01	4.12E-02	8.63E-01	1.03E+00	1.17E+00	1.22E+00	1.25E+00	1.26E+00

Time (yr)	NE_Boundary (Max)	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary (Max)	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary (Max)	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
175	1.18E-01	1.30E+00	1.40E+00	1.34E+00	1.30E+00	1.28E+00	1.28E+00	6.28E-01	9.23E-01	8.88E-01	8.97E-01	9.06E-01	9.11E-01	9.13E-01	3.74E-02	7.52E-01	9.11E-01	1.06E+00	1.10E+00	1.13E+00	1.15E+00
200	1.22E-01	1.16E+00	1.38E+00	1.39E+00	1.37E+00	1.35E+00	1.34E+00	5.73E-01	9.53E-01	9.30E-01	8.78E-01	8.83E-01	8.86E-01	8.88E-01	3.44E-02	6.50E-01	7.99E-01	9.45E-01	9.89E-01	1.02E+00	1.03E+00
300	1.73E-01	5.99E-01	8.66E-01	1.02E+00	1.09E+00	1.13E+00	1.15E+00	4.00E-01	9.24E-01	9.44E-01	9.13E-01	9.08E-01	9.05E-01	9.04E-01	2.89E-02	3.53E-01	4.43E-01	5.47E-01	5.79E-01	6.02E-01	6.11E-01
400	1.94E-01	3.11E-01	4.38E-01	5.25E-01	5.75E-01	6.07E-01	6.23E-01	3.03E-01	7.69E-01	8.03E-01	9.22E-01	9.26E-01	9.27E-01	9.28E-01	2.58E-02	1.94E-01	2.42E-01	2.99E-01	3.18E-01	3.30E-01	3.36E-01
500	1.64E-01	2.17E-01	2.55E-01	2.86E-01	3.06E-01	3.19E-01	3.26E-01	2.36E-01	5.95E-01	6.28E-01	8.24E-01	8.35E-01	8.41E-01	8.43E-01	2.11E-02	1.14E-01	1.38E-01	1.68E-01	1.77E-01	1.84E-01	1.86E-01
600	1.44E-01	1.93E-01	2.04E-01	2.12E-01	2.17E-01	2.20E-01	2.22E-01	1.87E-01	4.49E-01	4.75E-01	6.73E-01	6.86E-01	6.93E-01	6.96E-01	1.69E-02	7.05E-02	8.37E-02	9.94E-02	1.04E-01	1.08E-01	1.09E-01
700	1.24E-01	1.76E-01	1.85E-01	1.90E-01	1.92E-01	1.94E-01	1.94E-01	1.46E-01	3.40E-01	3.59E-01	5.23E-01	5.35E-01	5.41E-01	5.44E-01	1.38E-02	4.62E-02	5.37E-02	6.25E-02	6.52E-02	6.72E-02	6.79E-02
800	1.04E-01	1.57E-01	1.67E-01	1.72E-01	1.74E-01	1.76E-01	1.77E-01	1.17E-01	2.62E-01	2.76E-01	4.00E-01	4.09E-01	4.14E-01	4.17E-01	1.10E-02	3.16E-02	3.61E-02	4.13E-02	4.30E-02	4.41E-02	4.45E-02
900	8.53E-02	1.38E-01	1.48E-01	1.53E-01	1.55E-01	1.57E-01	1.58E-01	9.24E-02	2.04E-01	2.14E-01	3.07E-01	3.14E-01	3.17E-01	3.19E-01	8.51E-03	2.24E-02	2.53E-02	2.85E-02	2.95E-02	3.02E-02	3.05E-02
1000	6.84E-02	1.18E-01	1.28E-01	1.33E-01	1.36E-01	1.37E-01	1.38E-01	7.08E-02	1.60E-01	1.68E-01	2.37E-01	2.42E-01	2.45E-01	2.46E-01	6.53E-03	1.63E-02	1.83E-02	2.04E-02	2.10E-02	2.15E-02	2.17E-02

Table 13. Predicted Concentration of Technetium-99 (pCi/L) for the various Pipe Pathways by Applying the Maximum Input Boundary Concentration

Time (yr)	NE_Boundary (Max)	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary (Max)	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary (Max)	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	1.07E-21	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.10E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.11E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	3.41E-04	1.30E-18	2.72E-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E+01	2.29E-14	9.55E-20	1.07E-30	9.05E-33	6.66E-34	8.30E-35	4.89E-03	2.94E-12	1.22E-18	2.23E-24	2.29E-30	5.57E-36	2.14E-38
10	7.96E-01	9.56E-15	5.75E-25	1.35E-34	5.24E-38	0.00E+00	0.00E+00	7.61E+00	1.94E-09	5.09E-16	6.37E-22	2.66E-23	4.26E-24	6.78E-25	8.41E-02	1.80E-06	2.29E-10	1.10E-15	5.46E-21	2.41E-25	3.18E-27
20	1.01E+01	8.93E-06	2.23E-15	3.85E-23	6.55E-26	4.89E-28	5.62E-30	7.06E+00	1.84E-03	2.90E-07	2.53E-13	1.39E-14	2.77E-15	5.21E-16	3.04E-01	1.03E-03	1.75E-05	4.47E-08	1.51E-10	8.07E-13	4.86E-14
30	7.71E+00	1.11E-02	1.22E-08	3.72E-14	8.49E-17	7.80E-19	1.22E-20	3.47E+00	1.09E-01	1.19E-03	2.16E-07	4.25E-08	1.71E-08	6.23E-09	2.06E-01	1.55E-02	1.11E-03	1.97E-05	8.06E-07	4.84E-08	1.12E-08
40	4.77E+00	2.32E-01	2.73E-05	4.94E-09	6.18E-11	2.04E-12	1.21E-13	2.46E+00	6.08E-01	4.75E-02	1.62E-04	6.36E-05	3.76E-05	2.10E-05	1.43E-01	5.29E-02	1.03E-02	5.86E-04	7.16E-05	1.17E-05	4.79E-06
50	3.83E+00	1.06E+00	2.01E-03	4.79E-06	1.92E-07	1.57E-08	2.24E-09	2.11E+00	1.45E+00	3.17E-01	6.25E-03	3.55E-03	2.58E-03	1.81E-03	1.22E-01	8.98E-02	3.38E-02	4.50E-03	1.13E-03	3.38E-04	1.88E-04
60	3.01E+00	2.29E+00	2.80E-02	3.56E-04	3.18E-05	4.88E-06	1.25E-06	1.76E+00	2.29E+00	9.26E-01	5.69E-02	3.96E-02	3.23E-02	2.59E-02	1.05E-01	1.11E-01	6.35E-02	1.56E-02	6.33E-03	2.86E-03	1.95E-03
70	2.34E+00	3.34E+00	1.53E-01	6.24E-03	9.83E-04	2.37E-04	8.86E-05	1.57E+00	2.84E+00	1.72E+00	2.34E-01	1.84E-01	1.61E-01	1.39E-01	9.86E-02	1.20E-01	8.84E-02	3.34E-02	1.87E-02	1.11E-02	8.69E-03
80	1.92E+00	3.95E+00	4.73E-01	4.48E-02	1.08E-02	3.61E-03	1.76E-03	1.43E+00	3.07E+00	2.42E+00	5.97E-01	5.08E-01	4.64E-01	4.21E-01	9.45E-02	1.21E-01	1.05E-01	5.38E-02	3.70E-02	2.65E-02	2.26E-02
90	1.68E+00	4.12E+00	1.00E+00	1.78E-01	5.95E-02	2.56E-02	1.50E-02	1.32E+00	3.05E+00	2.85E+00	1.11E+00	9.97E-01	9.38E-01	8.79E-01	9.14E-02	1.18E-01	1.13E-01	7.24E-02	5.70E-02	4.60E-02	4.15E-02
100	1.52E+00	3.99E+00	1.66E+00	4.74E-01	2.04E-01	1.07E-01	7.19E-02	1.18E+00	2.89E+00	3.02E+00	1.66E+00	1.55E+00	1.49E+00	1.43E+00	8.57E-02	1.13E-01	1.15E-01	8.68E-02	7.49E-02	6.53E-02	6.11E-02
110	1.39E+00	3.67E+00	2.30E+00	9.44E-01	4.98E-01	3.04E-01	2.27E-01	1.07E+00	2.66E+00	2.97E+00	2.14E+00	2.05E+00	2.00E+00	1.95E+00	8.24E-02	1.08E-01	1.13E-01	9.66E-02	8.85E-02	8.13E-02	7.81E-02
120	1.28E+00	3.28E+00	2.83E+00	1.53E+00	9.49E-01	6.54E-01	5.27E-01	1.01E+00	2.40E+00	2.80E+00	2.48E+00	2.42E+00	2.39E+00	2.35E+00	7.98E-02	1.04E-01	1.10E-01	1.02E-01	9.75E-02	9.29E-02	9.07E-02
125	1.25E+00	3.08E+00	3.03E+00	1.84E+00	1.22E+00	8.84E-01	7.35E-01	1.04E+00	2.28E+00	2.69E+00	2.58E+00	2.54E+00	2.52E+00	2.49E+00	8.17E-02	1.01E-01	1.09E-01	1.04E-01	1.00E-01	9.70E-02	9.52E-02

Table 14. Predicted Concentration of Nitrate (µg/L) for the various Pipe Pathways by Applying the Maximum Input Boundary Concentration

Time (yr)	NE_Boundary (Max)	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary (Max)	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary (Max)	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	7.38E+01	1.62E+04	1.47E+04	3.76E+04	3.51E+04	3.15E+04	2.99E+04	2.71E+02	2.48E+04	3.25E+04	3.94E+04	3.98E+04	4.00E+04	4.02E+04	6.88E+02	3.60E+04	3.28E+04	3.97E+04	4.22E+04	3.74E+04	3.39E+04
5	2.17E+01	1.73E+04	1.47E+04	3.23E+04	3.81E+04	3.62E+04	3.45E+04	6.73E+03	2.28E+04	3.09E+04	3.80E+04	3.86E+04	3.89E+04	3.92E+04	1.23E+03	3.22E+04	3.12E+04	3.46E+04	3.91E+04	4.08E+04	3.80E+04
10	2.31E+03	1.73E+04	1.39E+04	2.63E+04	3.59E+04	3.75E+04	3.69E+04	5.19E+03	2.14E+04	2.85E+04	3.68E+04	3.73E+04	3.76E+04	3.79E+04	2.50E+03	3.16E+04	3.30E+04	3.46E+04	3.86E+04	4.01E+04	4.05E+04
20	6.74E+03	1.52E+04	1.29E+04	1.94E+04	2.74E+04	3.26E+04	3.48E+04	5.27E+03	2.02E+04	2.41E+04	3.45E+04	3.50E+04	3.52E+04	3.55E+04	2.93E+03	2.91E+04	3.32E+04	3.49E+04	3.51E+04	3.65E+04	3.74E+04
30	5.97E+03	1.21E+04	1.32E+04	1.58E+04	2.08E+04	2.51E+04	2.73E+04	5.23E+03	1.95E+04	2.14E+04	3.15E+04	3.22E+04	3.25E+04	3.29E+04	2.42E+03	2.52E+04	3.14E+04	3.48E+04	3.49E+04	3.50E+04	3.51E+04
40	5.46E+03	9.16E+03	1.39E+04	1.40E+04	1.68E+04	1.95E+04	2.11E+04	4.85E+03	1.82E+04	2.01E+04	2.83E+04	2.90E+04	2.93E+04	2.97E+04	1.86E+03	2.11E+04	2.83E+04	3.39E+04	3.47E+04	3.49E+04	3.49E+04
50	4.37E+03	7.19E+03	1.41E+04	1.36E+04	1.47E+04	1.61E+04	1.70E+04	3.79E+03	1.64E+04	1.91E+04	2.55E+04	2.60E+04	2.63E+04	2.66E+04	1.46E+03	1.73E+04	2.46E+04	3.20E+04	3.36E+04	3.43E+04	3.45E+04
60	3.35E+03	6.14E+03	1.36E+04	1.38E+04	1.40E+04	1.45E+04	1.49E+04	3.07E+03	1.43E+04	1.76E+04	2.33E+04	2.37E+04	2.39E+04	2.42E+04	1.21E+03	1.41E+04	2.08E+04	2.94E+04	3.16E+04	3.28E+04	3.32E+04
70	2.87E+03	5.63E+03	1.24E+04	1.39E+04	1.39E+04	1.40E+04	1.41E+04	2.71E+03	1.23E+04	1.57E+04	2.14E+04	2.18E+04	2.20E+04	2.22E+04	9.49E+02	1.14E+04	1.73E+04	2.64E+04	2.89E+04	3.05E+04	3.10E+04
80	2.62E+03	5.32E+03	1.10E+04	1.34E+04	1.38E+04	1.39E+04	1.40E+04	2.52E+03	1.05E+04	1.37E+04	1.97E+04	2.00E+04	2.02E+04	2.04E+04	7.59E+02	9.22E+03	1.43E+04	2.32E+04	2.58E+04	2.76E+04	2.82E+04
90	2.48E+03	5.00E+03	9.57E+03	1.25E+04	1.34E+04	1.37E+04	1.38E+04	2.39E+03	8.86E+03	1.18E+04	1.79E+04	1.83E+04	1.85E+04	1.87E+04	7.06E+02	7.43E+03	1.16E+04	2.00E+04	2.26E+04	2.44E+04	2.51E+04
100	2.37E+03	4.62E+03	8.37E+03	1.12E+04	1.25E+04	1.30E+04	1.33E+04	2.29E+03	7.49E+03	1.00E+04	1.60E+04	1.64E+04	1.66E+04	1.68E+04	6.37E+02	5.99E+03	9.47E+03	1.71E+04	1.95E+04	2.12E+04	2.19E+04
110	2.28E+03	4.21E+03	7.40E+03	9.92E+03	1.13E+04	1.20E+04	1.24E+04	2.21E+03	6.33E+03	8.49E+03	1.42E+04	1.46E+04	1.48E+04	1.50E+04	5.61E+02	4.84E+03	7.67E+03	1.44E+04	1.66E+04	1.82E+04	1.88E+04
120	2.22E+03	3.82E+03	6.62E+03	8.72E+03	1.00E+04	1.08E+04	1.12E+04	2.14E+03	5.38E+03	7.18E+03	1.24E+04	1.27E+04	1.29E+04	1.31E+04	4.87E+02	3.92E+03	6.21E+03	1.20E+04	1.40E+04	1.54E+04	1.60E+04
125	2.15E+03	3.63E+03	6.28E+03	8.19E+03	9.42E+03	1.02E+04	1.06E+04	2.08E+03	4.97E+03	6.61E+03	1.15E+04	1.19E+04	1.21E+04	1.23E+04	4.50E+02	3.53E+03	5.58E+03	1.10E+04	1.28E+04	1.41E+04	1.47E+04

Table 15. Predicted Concentration of Uranium (µg/L) for the various Pipe Pathways by Applying the Maximum Input Boundary Concentration

Time (yr)	NE_Boundary (Max)	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary (Max)	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary (Max)	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	6.73E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.23E-05	7.36E-31	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.22E-15	2.12E-31	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	1.72E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.53E-01	4.28E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.88E-07	3.35E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	1.87E-06	7.27E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.60E-01	1.64E-14	2.92E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.11E-05	1.92E-18	6.08E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30	3.75E-04	2.39E-18	1.37E-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.45E-01	5.18E-14	1.51E-18	1.01E-30	0.00E+00	0.00E+00	0.00E+00	4.38E-04	1.42E-12	7.47E-20	8.29E-28	0.00E+00	0.00E+00	0.00E+00
40	6.32E-03	1.16E-16	2.98E-29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.62E-01	1.15E-11	1.16E-16	1.60E-24	3.90E-27	4.59E-29	3.18E-31	8.00E-04	6.52E-10	6.72E-15	3.50E-22	1.40E-29	0.00E+00	0.00E+00
50	3.55E-02	9.24E-15	1.38E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.37E-01	5.51E-09	1.28E-15	1.75E-21	3.45E-23	2.06E-24	8.57E-26	1.60E-03	2.24E-08	3.43E-12	9.64E-18	4.29E-24	7.99E-30	0.00E+00
60	1.03E-01	3.46E-12	3.72E-23	2.76E-32	0.00E+00	0.00E+00	0.00E+00	3.07E-01	2.91E-07	1.32E-13	1.34E-19	8.03E-21	1.13E-21	1.26E-22	3.62E-03	2.42E-07	1.95E-10	6.18E-15	7.55E-20	1.51E-24	2.06E-27
70	1.92E-01	3.20E-10	2.42E-21	5.22E-29	0.00E+00	0.00E+00	0.00E+00	2.68E-01	4.70E-06	3.20E-11	2.84E-18	3.22E-19	7.64E-20	1.54E-20	6.41E-03	1.31E-06	3.49E-09	5.66E-13	6.28E-17	1.11E-20	6.13E-23
80	2.69E-01	1.10E-08	2.19E-19	1.50E-26	5.77E-30	0.00E+00	0.00E+00	2.90E-01	3.65E-05	1.85E-09	2.21E-16	7.90E-18	1.75E-18	4.69E-19	8.91E-03	4.68E-06	3.03E-08	1.65E-11	8.72E-15	7.27E-18	1.12E-19
90	3.13E-01	1.78E-07	4.64E-17	1.35E-24	1.30E-27	4.61E-30	1.93E-32	3.14E-01	1.72E-04	4.12E-08	3.69E-14	1.34E-15	1.58E-16	1.92E-17	1.05E-02	1.31E-05	1.62E-07	2.28E-10	3.88E-13	1.02E-15	3.31E-17
100	3.88E-01	1.66E-06	4.55E-15	1.11E-22	1.13E-25	7.10E-28	6.46E-30	3.16E-01	5.71E-04	4.74E-07	2.27E-12	1.40E-13	2.29E-14	3.31E-15	1.13E-02	3.20E-05	6.22E-07	1.86E-09	7.92E-12	5.02E-14	2.87E-15
110	4.83E-01	1.02E-05	2.10E-13	1.92E-20	1.07E-23	5.71E-26	7.82E-28	2.97E-01	1.47E-03	3.37E-06	6.38E-11	6.05E-12	1.33E-12	2.63E-13	1.15E-02	7.07E-05	1.91E-06	1.03E-08	9.19E-11	1.18E-12	1.05E-13
120	5.32E-01	4.56E-05	5.30E-12	2.18E-18	1.73E-21	6.85E-24	6.52E-26	2.67E-01	3.12E-03	1.67E-05	1.00E-09	1.34E-10	3.70E-11	9.42E-12	1.12E-02	1.42E-04	5.07E-06	4.29E-08	6.97E-10	1.59E-11	2.01E-12
125	5.39E-01	8.72E-05	2.20E-11	1.82E-17	1.92E-20	8.66E-23	7.23E-25	2.51E-01	4.30E-03	3.32E-05	3.32E-09	5.14E-10	1.57E-10	4.45E-11	1.11E-02	1.94E-04	7.91E-06	8.08E-08	1.69E-09	4.96E-11	7.28E-12

Table 16. Predicted Concentration of Tetrachloroethene (µg/L) for the various Pipe Pathways by Applying the Maximum Input Boundary Concentration

Time (yr)	NE_Boundary (Max)	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary (Max)	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary (Max)	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	2.04E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.62E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.02E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	2.68E-02	7.09E-18	4.61E-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.30E-03	5.60E-19	1.55E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.30E-02	6.94E-13	3.99E-19	1.09E-25	0.00E+00	0.00E+00	0.00E+00
10	1.10E-02	2.11E-13	4.91E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.58E-02	3.73E-15	1.89E-21	3.15E-29	1.31E-31	0.00E+00	0.00E+00	6.02E-02	1.70E-07	9.79E-13	4.39E-20	6.05E-26	7.47E-31	0.00E+00
20	1.97E-03	3.18E-07	1.63E-18	7.97E-27	3.75E-30	0.00E+00	0.00E+00	2.41E-02	1.64E-08	1.84E-14	1.19E-22	3.86E-24	6.40E-25	1.11E-25	1.05E-01	1.18E-04	3.75E-07	4.86E-11	3.14E-15	3.90E-19	2.27E-21
30	4.36E-04	3.36E-05	2.48E-12	8.71E-20	1.92E-23	3.10E-26	1.67E-28	3.06E-02	3.02E-06	8.83E-10	9.22E-16	3.73E-17	5.03E-18	5.98E-19	1.16E-01	1.49E-03	3.54E-05	1.05E-07	3.62E-10	1.68E-12	8.00E-14
40	1.54E-04	2.87E-04	3.29E-09	1.93E-14	3.85E-17	2.64E-19	2.65E-21	4.07E-02	4.86E-05	1.90E-07	9.78E-12	1.28E-12	3.59E-13	9.30E-14	1.14E-01	6.15E-03	4.20E-04	5.66E-06	1.34E-07	4.14E-09	6.21E-10
50	1.42E-04	8.84E-04	2.25E-07	3.11E-11	2.71E-13	6.06E-15	2.19E-16	5.18E-02	2.80E-04	4.95E-06	2.54E-09	6.39E-10	2.73E-10	1.11E-10	1.04E-01	1.46E-02	2.00E-03	7.00E-05	4.83E-06	4.27E-07	1.20E-07
60	1.35E-04	1.64E-03	3.42E-06	3.92E-09	9.45E-11	4.82E-12	4.12E-13	5.90E-02	9.18E-04	4.42E-05	1.05E-07	3.87E-08	2.12E-08	1.12E-08	1.06E-01	2.54E-02	5.68E-03	3.92E-04	5.39E-05	9.13E-06	3.71E-06
70	1.18E-04	2.29E-03	2.17E-05	1.12E-07	5.67E-09	5.27E-10	8.17E-11	6.31E-02	2.15E-03	2.08E-04	1.50E-06	7.11E-07	4.54E-07	2.84E-07	1.01E-01	3.68E-02	1.17E-02	1.35E-03	3.00E-04	7.89E-05	4.07E-05
80	9.31E-05	2.68E-03	8.01E-05	1.27E-06	1.12E-07	1.63E-08	3.86E-09	6.54E-02	4.11E-03	6.49E-04	1.09E-05	6.15E-06	4.37E-06	3.06E-06	9.33E-02	4.73E-02	1.97E-02	3.36E-03	1.06E-03	3.81E-04	2.32E-04
90	7.21E-05	2.81E-03	2.05E-04	7.63E-06	1.04E-06	2.16E-07	6.98E-08	6.44E-02	6.87E-03	1.54E-03	5.01E-05	3.19E-05	2.45E-05	1.86E-05	8.41E-02	5.64E-02	2.86E-02	6.68E-03	2.71E-03	1.24E-03	8.46E-04
100	5.83E-05	2.74E-03	4.09E-04	2.97E-05	5.74E-06	1.57E-06	6.43E-07	6.26E-02	1.04E-02	3.03E-03	1.66E-04	1.16E-04	9.36E-05	7.52E-05	7.47E-02	6.39E-02	3.78E-02	1.13E-02	5.59E-03	3.02E-03	2.26E-03
110	4.92E-05	2.53E-03	6.79E-04	8.43E-05	2.16E-05	7.41E-06	3.62E-06	6.03E-02	1.47E-02	5.22E-03	4.31E-04	3.22E-04	2.72E-04	2.28E-04	6.58E-02	6.95E-02	4.65E-02	1.71E-02	9.76E-03	6.02E-03	4.79E-03
120	4.30E-05	2.26E-03	9.84E-04	1.89E-04	6.11E-05	2.52E-05	1.42E-05	5.70E-02	1.95E-02	8.17E-03	9.41E-04	7.40E-04	6.43E-04	5.57E-04	5.82E-02	7.32E-02	5.42E-02	2.36E-02	1.51E-02	1.03E-02	8.61E-03
125	4.04E-05	2.11E-03	1.14E-03	2.63E-04	9.44E-05	4.21E-05	2.51E-05	5.55E-02	2.20E-02	9.92E-03	1.32E-03	1.06E-03	9.32E-04	8.18E-04	5.51E-02	7.43E-02	5.76E-02	2.70E-02	1.81E-02	1.29E-02	1.10E-02

Table 17. Predicted Concentration of Trichloroethene (µg/L) for the various Pipe Pathways by Applying the Maximum Input Boundary Concentration

Time (yr)	NE_Boundary (Max)	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary (Max)	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary (Max)	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	6.82E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.89E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	1.42E-02	9.30E-17	7.69E-27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.11E-03	5.52E-18	6.13E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.26E-02	4.38E-10	6.11E-17	8.64E-23	4.54E-29	0.00E+00	0.00E+00
10	3.20E-03	9.55E-10	1.73E-21	4.47E-30	0.00E+00	0.00E+00	0.00E+00	1.15E-02	4.50E-12	1.30E-19	3.05E-25	8.75E-27	1.14E-27	1.19E-28	5.34E-02	4.80E-06	7.85E-10	2.48E-15	3.47E-21	9.18E-26	7.83E-28
20	1.24E-03	2.24E-05	2.95E-13	2.07E-21	1.15E-24	1.10E-26	1.74E-28	1.23E-02	5.18E-07	4.38E-11	9.72E-18	2.92E-19	4.19E-20	5.23E-21	7.67E-02	6.38E-04	1.14E-05	1.90E-08	3.14E-11	7.92E-14	2.85E-15
30	2.59E-03	4.33E-04	8.81E-09	8.30E-14	2.15E-16	1.89E-18	2.61E-20	1.69E-02	3.09E-05	1.33E-07	7.79E-12	1.10E-12	3.49E-13	9.93E-14	7.30E-02	4.54E-03	3.51E-04	5.64E-06	1.59E-07	5.72E-09	9.46E-10
40	2.00E-03	1.45E-03	1.27E-06	5.56E-10	8.42E-12	2.98E-13	1.78E-14	2.15E-02	2.59E-04	7.50E-06	7.63E-09	2.30E-09	1.14E-09	5.31E-10	6.05E-02	1.28E-02	2.24E-03	1.13E-04	1.15E-05	1.46E-06	5.05E-07
50	2.01E-03	2.46E-03	2.10E-05	9.23E-08	4.27E-09	3.71E-10	5.40E-11	2.46E-02	9.14E-04	8.18E-05	4.77E-07	2.16E-07	1.36E-07	8.25E-08	5.13E-02	2.27E-02	6.85E-03	7.28E-04	1.52E-04	3.79E-05	1.90E-05
60	3.02E-03	3.09E-03	1.17E-04	2.35E-06	2.32E-07	3.70E-08	9.52E-09	2.50E-02	2.10E-03	3.76E-04	7.26E-06	4.18E-06	3.03E-06	2.16E-06	4.64E-02	3.14E-02	1.38E-02	2.50E-03	8.28E-04	3.14E-04	1.96E-04
70	4.09E-03	3.33E-03	3.56E-04	2.04E-05	3.46E-06	8.53E-07	3.20E-07	2.45E-02	3.81E-03	1.06E-03	4.80E-05	3.23E-05	2.57E-05	2.01E-05	3.93E-02	3.74E-02	2.15E-02	5.84E-03	2.65E-03	1.33E-03	9.54E-04
80	5.12E-03	3.32E-03	7.41E-04	9.05E-05	2.30E-05	7.82E-06	3.81E-06	2.33E-02	6.00E-03	2.23E-03	1.87E-04	1.40E-04	1.18E-04	9.88E-05	3.22E-02	4.09E-02	2.85E-02	1.06E-02	5.97E-03	3.63E-03	2.87E-03
90	6.12E-03	3.21E-03	1.21E-03	2.59E-04	8.96E-05	3.89E-05	2.28E-05	2.13E-02	8.52E-03	3.90E-03	5.18E-04	4.14E-04	3.64E-04	3.19E-04	2.66E-02	4.24E-02	3.40E-02	1.60E-02	1.06E-02	7.42E-03	6.27E-03
100	7.18E-03	3.14E-03	1.68E-03	5.47E-04	2.41E-04	1.26E-04	8.46E-05	1.94E-02	1.11E-02	6.02E-03	1.13E-03	9.50E-04	8.60E-04	7.75E-04	2.21E-02	4.21E-02	3.77E-02	2.15E-02	1.60E-02	1.24E-02	1.10E-02
110	8.48E-03	3.19E-03	2.09E-03	9.33E-04	4.97E-04	3.02E-04	2.24E-04	1.78E-02	1.36E-02	8.44E-03	2.10E-03	1.83E-03	1.69E-03	1.55E-03	2.01E-02	4.04E-02	3.96E-02	2.65E-02	2.15E-02	1.78E-02	1.63E-02
120	9.78E-03	3.40E-03	2.40E-03	1.36E-03	8.46E-04	5.78E-04	4.61E-04	1.61E-02	1.57E-02	1.10E-02	3.44E-03	3.08E-03	2.89E-03	2.70E-03	1.86E-02	3.80E-02	3.99E-02	3.05E-02	2.64E-02	2.31E-02	2.17E-02
125	1.04E-02	3.57E-03	2.52E-03	1.57E-03	1.04E-03	7.48E-04	6.15E-04	1.56E-02	1.66E-02	1.22E-02	4.25E-03	3.84E-03	3.63E-03	3.42E-03	1.77E-02	3.65E-02	3.96E-02	3.20E-02	2.85E-02	2.55E-02	2.42E-02

Table 18. Predicted Concentration of Carbon Tetrachloride (µg/L) for the various Pipe Pathways by Applying the Maximum Input Boundary Concentration

Time (yr)	NE_Boundary (Max)	NE_1	NE_2	NE_3	NE_4	NE_5	NE_6	E_Boundary (Max)	E_1	E_2	E_3	E_4	E_5	E_6	SE_Boundary (Max)	SE_1	SE_2	SE_3	SE_4	SE_5	SE_6
0	5.91E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.93E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.82E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	8.48E-03	5.44E-16	6.29E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.68E-03	1.20E-17	7.51E-21	5.80E-30	6.56E-32	0.00E+00	0.00E+00	2.82E-02	9.71E-09	1.27E-14	1.78E-21	9.68E-27	1.69E-31	0.00E+00
10	1.33E-03	1.71E-08	1.91E-20	1.72E-27	2.76E-31	0.00E+00	0.00E+00	1.17E-02	1.43E-10	4.63E-18	1.41E-23	9.23E-25	1.90E-25	3.37E-26	5.51E-02	2.40E-05	1.77E-08	3.99E-13	5.81E-18	4.07E-22	4.65E-24
20	3.66E-04	5.95E-05	2.34E-11	4.72E-18	2.71E-21	9.92E-24	9.61E-26	1.15E-02	2.43E-06	1.36E-09	4.21E-15	2.84E-16	6.32E-17	1.26E-17	5.76E-02	1.29E-03	4.92E-05	2.54E-07	1.70E-09	1.59E-11	1.25E-12
30	7.76E-03	5.05E-04	1.06E-07	1.09E-11	8.67E-14	1.87E-15	6.78E-17	3.46E-02	7.30E-05	9.93E-07	3.49E-10	8.10E-11	3.55E-11	1.42E-11	4.11E-02	5.70E-03	7.63E-04	2.63E-05	1.76E-06	1.47E-07	3.97E-08
40	2.51E-02	9.87E-04	5.12E-06	1.35E-08	4.89E-10	3.51E-11	4.28E-12	3.38E-02	3.79E-04	2.56E-05	9.80E-08	4.07E-08	2.47E-08	1.43E-08	2.67E-02	1.09E-02	2.98E-03	2.78E-04	5.14E-05	1.15E-05	5.42E-06
50	3.05E-02	1.17E-03	3.97E-05	7.17E-07	6.73E-08	1.03E-08	2.58E-09	2.97E-02	1.05E-03	1.57E-04	2.69E-06	1.52E-06	1.10E-06	7.73E-07	1.81E-02	1.39E-02	6.06E-03	1.09E-03	3.56E-04	1.34E-04	8.37E-05
60	2.80E-02	1.49E-03	1.24E-04	7.78E-06	1.38E-06	3.55E-07	1.38E-07	2.82E-02	2.31E-03	4.96E-04	2.17E-05	1.47E-05	1.18E-05	9.33E-06	1.28E-02	1.42E-02	8.55E-03	2.45E-03	1.15E-03	6.00E-04	4.39E-04
70	2.58E-02	2.56E-03	2.36E-04	3.42E-05	9.58E-06	3.52E-06	1.82E-06	2.76E-02	4.04E-03	1.18E-03	8.91E-05	6.69E-05	5.70E-05	4.81E-05	8.55E-03	1.29E-02	9.67E-03	3.94E-03	2.36E-03	1.52E-03	1.23E-03
80	2.51E-02	4.25E-03	3.59E-04	8.65E-05	3.37E-05	1.61E-05	1.01E-05	2.95E-02	5.70E-03	2.25E-03	2.54E-04	2.02E-04	1.78E-04	1.55E-04	5.73E-03	1.09E-02	9.55E-03	5.07E-03	3.60E-03	2.66E-03	2.31E-03
90	2.66E-02	5.92E-03	5.35E-04	1.57E-04	7.69E-05	4.43E-05	3.17E-05	3.21E-02	6.91E-03	3.49E-03	5.71E-04	4.74E-04	4.28E-04	3.84E-04	4.71E-03	8.80E-03	8.62E-03	5.64E-03	4.50E-03	3.67E-03	3.34E-03
100	2.98E-02	7.14E-03	8.35E-04	2.46E-04	1.35E-04	8.79E-05	6.85E-05	3.92E-02	7.64E-03	4.57E-03	1.06E-03	9.10E-04	8.38E-04	7.68E-04	3.82E-03	6.87E-03	7.33E-03	5.66E-03	4.90E-03	4.29E-03	4.03E-03
110	3.57E-02	7.89E-03	1.28E-03	3.76E-04	2.12E-04	1.46E-04	1.19E-04	4.98E-02	8.10E-03	5.34E-03	1.64E-03	1.46E-03	1.37E-03	1.28E-03	3.61E-03	5.29E-03	5.97E-03	5.26E-03	4.85E-03	4.47E-03	4.30E-03
120	4.26E-02	8.37E-03	1.81E-03	5.80E-04	3.28E-04	2.27E-04	1.86E-04	5.73E-02	8.55E-03	5.84E-03	2.23E-03	2.04E-03	1.94E-03	1.84E-03	3.60E-03	4.09E-03	4.74E-03	4.64E-03	4.48E-03	4.28E-03	4.19E-03
125	4.48E-02	8.60E-03	2.07E-03	7.15E-04	4.07E-04	2.82E-04	2.32E-04	5.46E-02	8.84E-03	6.03E-03	2.50E-03	2.31E-03	2.20E-03	2.10E-03	3.68E-03	3.62E-03	4.20E-03	4.29E-03	4.21E-03	4.09E-03	4.03E-03