US Army Corps of Engineers®
Buffalo District

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Formerly Utilized Sites Remedial Action Program

RADON ASSESSMENT TECHNICAL MEMORANDUM

FOR THE NIAGARA FALLS STORAGE SITE LEWISTON, NEW YORK

FINAL

January 2012

RADON ASSESSMENT TECHNICAL MEMORANDUM
FOR THE
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK

FINAL

Prepared for:
U.S. Army Corps of Engineers
Buffalo District

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LIST OF ABBREVIATIONS AND ACRONYMS

CAP88	Clean Air Act Assessment Package 1988
CFR	*Code of Federal Regulations*
Ci	curie
cm	centimeter
USDOE	U. S. Department of Energy
EPA	U. S. Environmental Protection Agency
FS	Feasibility Study
ft	feet
g	gram
(g)	gravitational acceleration
hr	hour
in.	inch
IWCS	Interim Waste Containment Structure
km	kilometer
L	liter
m	meter
mi	mile
min	minute
mph	miles per hour
NFSS	Niagara Falls Storage Site
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
OU	operable unit
%	percent
pCi/g	picocuries per gram
pCi/L	picocuries per liter
$pCi/m^2/sec$	picocuries per square meter per second
PGA	peak ground acceleration
RESRAD	RESidual RADiation Code
sec	second
USACE	U. S. Army Corps of Engineers
WCS	Waste Containment Structure
WL	working level
yd^3	cubic yards

GLOSSARY

ACTIVITY: A measure of the rate at which radioactive material is undergoing radioactive decay; usually given in terms of the number of nuclear disintegrations occurring in a given quantity of material over a unit of time. The special unit of activity is the curie (Ci).

ANNUAL LIMIT ON INTAKE: The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. Annual limits on intake is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rem or a committed dose equivalent of 50 rem to any individual organ or tissue.

ATMOSPHERIC STABILITY CLASS: The tendency of the atmosphere to resist or enhance vertical motion and, thus turbulence is termed stability. Stability classes are defined for different meteorological conditions and are characterized by wind speed, solar radiation (during the day), and cloud cover (during the night). Stability class conditions range from very unstable to very stable.

BACKGROUND CONCENTRATION (soil, groundwater, surface water, or sediment): A background concentration is a concentration that occurs in an area that is not impacted by site activities and contains characteristics similar to site conditions. The determination of background concentrations involves the establishment of a background data set by using results from samples collected in areas unimpacted by site activities for each medium and the calculation of a background value for each analyte within each medium.

BACKGROUND RADIATION: In this assessment, background radiation includes both the natural and man-made (e.g., fallout) radiation in the human environment. It includes cosmic rays and radiation from the naturally radioactive elements that occur both outside and inside the bodies of humans and animals. For persons living in the United States, the average annual individual dose from background radiation is approximately 620 millirem per year (mrem/year; 310 mrem/year from natural sources and 310 mrem/year from man-made sources) [National Council on Radiation Protection and Measurements Report No. 160].

COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT: This act was put into place in 1980 and is also known as Superfund. This act concerns releases of hazardous substances into the environment and the cleanup of these substances and hazardous waste sites. The U. S. Environmental Protection Agency website indicates that the act authorizes response actions and enabled the revision of the National Oil and Hazardous Substances Pollution Contingency Plan, more commonly referred to as the National Contingency Plan. The National Oil and Hazardous Substances Pollution Contingency Plan provided the guidelines and procedures needed to respond to releases and threatened releases of hazardous substances, pollutants, or contaminants. The National Oil and Hazardous Substances Pollution Contingency Plan also established the National Priorities List.

CONTAINMENT: Confining the radioactive wastes within prescribed boundaries (e.g., within a waste containment structure).

CURIE (Ci): A measure of the rate of radioactive decay. One curie is equal to 37 billion (3.7×10^{10}), disintegrations per second, which is approximately equal to the activity of 1 gram of radium-226.

CUT-OFF WALL: A low-permeability, engineered subsurface structure designed to minimize groundwater flow in a direction perpendicular to the wall.

GLOSSARY (Continued)

DAUGHTER: The immediate product of the radioactive decay of an element or isotope.

DECAY CHAIN (DECAY SERIES): The nuclides in the sequence of radioactive decay from one nuclide to another until a stable (non-radioactive) nuclide is reached. The uranium-238 decay chain starts with naturally radioactive uranium-238 and ends with stable lead-206. The term "decay" is also referred to as "disintegration" or "transformation."

DOSE: Total radiation delivered to a specific part of the body or to the body as a whole.

EMISSION RATE: The mass or activity of material released over a given time period. For this evaluation, radon emission rate is presented in units of activity released in 1 year (Ci/year). The amount of activity released is based on the radon flux and the size of the area that is emitting radon.

FEASIBILITY STUDY (FS): An FS develops, screens, and compares remedial alternatives for a site.

FLUX: The rate of flow of fluid, particles, or energy through a given surface. In the assessment of hypothetical scenarios discussed in this technical memorandum, flux is used to describe predicted rates at which radon is emitted from the Interim Waste Containment Structure (IWCS).

HALF-LIFE: The time required for half the nuclei in a sample of a specific radionuclide to undergo radioactive decay.

GROUNDWATER: Usually considered the water within the zone of saturation below the soil surface.

TAILINGS: Byproduct materials or refuse remaining after ore has been processed.

NOBLE GAS: Any of the elements in Group O of the periodic table whose particles (molecules) consist of single atoms and are largely chemically inert. Radon is a noble gas.

PEAK GROUND ACCELERATION (PGA): A metric for assessing the potential for earthquake damage. PGA is expressed as a fraction or percent of gravitational acceleration (g) and is accompanied by a probability of that PGA being exceeded in a given timeframe. PGA is not a measure of the total size of the earthquake but, rather, how hard the earth shakes in a given geographic area.

PROGENY: In this assessment, an isotope or group of isotopes derived from a parent isotope.

RADIONUCLIDE: An unstable nuclide that undergoes radioactive decay.

RADIONUCLIDE OF CONCERN (ROC): A radionuclide that has been identified as posing unacceptable risk to human health and the environment.

RADIATION: A very general term that covers many forms of particles and energy, from sunlight and radio waves to the energy that is released from inside an atom. Radiation can be in the form of electromagnetic waves (gamma rays and X-rays) or particles (alpha particles, beta particles, protons, and neutrons).

RADIOISOTOPE: An unstable isotope of an element that spontaneously loses particles and energy through radioactive decay.

GLOSSARY (Continued)

RADIUM-226: A radioactive solid produced by the decay of thorium-230. It is an alpha particle emitter and is hazardous when it gets into the body. Radium-226 has a half-life of 1,600 years and can accumulate in certain parts of the body such as bone.

RADON-222: A radioactive gas produced by the decay of radium-226. It is hazardous mainly because its solid decay products can be deposited in the lungs where they decay in a matter of minutes, emitting alpha particles that irradiate nearby tissue. Radon-222 has a half-life of 3.8 days.

REMEDIAL INVESTIGATION: A remedial investigation is a site investigation consisting of a records search, environmental sampling, risk assessment, and groundwater flow modeling to define the identity, amount, and location of contaminants at a site.

RESIDUES: For the IWCS, the K-65, L-30/F-32, and L-50 residues that resulted from the processing of uranium ores.

SECULAR EQUILIBRIUM: In a radioactive decay series, the state that prevails when the ratios between the amounts of successive members of the series remain constant over time.

SOURCE TERM: The quantity of radioactive material (or other pollutant) released to the environment at its point of release (source).

SPECIFIC ACTIVITY: The activity per unit mass of a pure substance (see ACTIVITY).

THORIUM-230: A radioactive solid produced by the decay of uranium-238. It has a half-life of 77,000 years.

URANIUM: A naturally occurring radioactive element that consists of 99.2830% by weight uranium-238, 0.7110% uranium-235, and 0.0054% uranium-234.

WORKING LEVEL MONTH: A unit of exposure to short-lived radon daughters equal to the exposure to one WL for one working month of 170 hours.

WORKING LEVEL (WL): One WL is defined as any combination of short-lived radon progeny in 1 L of air, under ambient temperature and pressure, that results in the ultimate emission of 1.3×10^5 million electron volts of alpha particle energy.

METRIC CONVERSION CHART

To Convert to Metric			To Convert from Metric		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092903	square meters	square meters	10.7639	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.40469	hectares	hectares	2.471	acres
square miles	2.58999	square kilometers	square kilometers	0.3861	square miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
gallons	0.00378	cubic meters	cubic meters	264.55	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.2046	pounds
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths then add 32	Fahrenheit
Radiation					
picocurie	0.037	Becquerel	Becquerel	27.027027	Picocuries
curie	3.70E+10	Becquerel	Becquerel	2.703E-11	Curies
rem	0.01	sievert	sievert	100	rem
RAD	0.01	Gray	Gray	100	RADs

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION

The U. S. Army Corps of Engineers (USACE), the lead Federal agency for implementing the Formerly Utilized Sites Remedial Action Program, is developing a series of technical memoranda as part of the Feasibility Study (FS) effort at the Niagara Falls Storage Site (NFSS). This Radon Assessment Technical Memorandum supports the development and assessment of remedial alternatives for the Interim Waste Containment Structure (IWCS) Operable Unit (OU) FS at NFSS.

ES.1.1 Background

NFSS was used by the wartime Manhattan Engineer District for storage of radioactive residues that resulted from the processing of uranium ores during the development of the atomic bomb. Due to Manhattan Engineer District and the Atomic Energy Commission activities, NFSS contained radioactive waste of varying activity and other types of contamination. During the 1980s, the U. S. Department of Energy (USDOE) consolidated the radioactive wastes and contaminated materials at NFSS into the IWCS. The IWCS occupies approximately 10 acres in the southwest portion of NFSS. The IWCS was engineered to inhibit radon emissions, infiltration from precipitation, and migration of contamination to groundwater.

The most significant radioactive wastes stored within the IWCS are the residues containing very large concentrations of radium-226. Through the decay of radium-226, radon gas (radon-222) is produced. Due to the elevated levels of radium-226 present in the IWCS residues, the effect of the radon gas emissions must be determined to support the development of the IWCS OU FS.

ES.1.2 Scope and Objective

This technical memorandum assesses potential radon levels for various hypothetical excavation and intrusion scenarios resulting in failure of the IWCS cap to contain radon gas releases to the environment. Predicted on- and off-site radon air concentrations resulting from the potential release of radon gas were compared to related Federal and state radon standards and guidelines to assess the possible impacts associated with the hypothetical scenarios. These results will be used in the development and detailed evaluation of various remedial alternatives for the IWCS OU FS.

ES.2 OCCURRENCE OF RADON IN THE ENVIRONMENT

Radon is a colorless, odorless, ubiquitous radioactive noble gas, originating in rock and soil containing naturally radioactive elements. Exposure to airborne radon can occur in residences, outdoors, indoors at work or school, or in vehicles. Indoor concentrations of radon can be considerably higher than those found outdoors, primarily due to the buildup of radon emanating from soil underneath a building and poor ventilation within the building. Typical indoor radon concentrations vary from 1.0 to 1.3 picocuries per liter (pCi/L).

Radon’s most common isotope, radon-222, is the primary radon isotope of concern at NFSS and is the subject of the evaluations documented in this technical memorandum. The primary source of radon at NFSS is the highly elevated levels of radium-226 waste materials (i.e., K-65, L-50, L-30, and other residues) stored within the IWCS. This technical memorandum uses the radium-226 concentrations in the materials stored in the IWCS to model outdoor air concentrations of radon and its progeny (i.e., decay products).

ES.3 RADON REGULATIONS AND GUIDELINES

To facilitate the assessment presented in this technical memorandum, Federal and state regulations and guidelines for radon emissions have been identified. Concentration limits identified in the regulations were selected for use in evaluating modeling results presented in this technical memorandum and are used for comparison purposes only to indicate which scenarios may result in unacceptable exposures. The selected concentration criteria represent regulations and guidelines that might be considered and used in the FS. Criteria selected for use in evaluating modeling results presented in this technical memorandum include the following:

- Title 40, *Code of Federal Regulations (CFR)*, Part 192 (40 *CFR* 192) for public annual average radon-222 levels above background (0.5 pCi/L) outside a disposal site;
- 10 *CFR* Part 20, Appendix B, Table 2, for public annual average radon-222 levels above background (0.1 pCi/L with daughters);
- USDOE Order 5400.5 for releases above background levels averaged over a year at any location outside a site, from long-term management of radiological materials (3 pCi/L);
- 10 *CFR* 20, Appendix B, Table 1, for occupational exposure to radon-222 above background levels (30 pCi/L with daughters present and 4,000 pCi/L with daughters removed); and
- An estimated above background short-term exposure limit of 100 pCi/L for a maximum cumulative duration of 8 hours.

Because there are no structures above the IWCS, nor were there any considered in the scenarios evaluated, the standards and guidelines that apply to habitable structures and indoor radon levels were not used in any of the evaluations presented in this technical memorandum.

The results presented in this technical memorandum regarding annual average radon-222 levels for long-term releases are compared to the 0.1, 0.5, and 3 pCi/L standards. Because no specific numeric standards were found regarding short-term releases that could be used for comparison of results, a numeric standard was estimated based on the long-term, annual average standards of 100 pCi/L. Values defined in 10 *CFR* 20, Appendix B, Table 1 for occupational exposure to radon-222 equate to 30 pCi/L with daughters present and 4,000 pCi/L with daughters removed. These limits are considered in the evaluation of on-site occupational exposures.

ES.4 HYPOTHETICAL SCENARIOS EVALUATED AND RATIONALE

Seven hypothetical scenarios were identified to assess the potential on- and off-site radon levels in support of developing and evaluating alternatives for the IWCS OU FS. Two general types of hypothetical scenarios were considered: excavation and intrusion.

The excavation scenarios will support the FS evaluation of potential remedial alternatives associated with the removal of waste materials from the IWCS. The intrusion scenarios will be used in evaluating the long-term effectiveness of the No Action, as well as any FS alternatives that might involve the residues and wastes remaining in their current location within the IWCS.

The hypothetical excavation scenarios assessed include:

- Removal of all K-65 residues within the IWCS,
- Removal of all residues within the IWCS, and
- Removal of the entire contents of the IWCS.

The hypothetical intrusion scenarios assessed include:

- Damage due to the use of heavy equipment,
- Damage due to an earthquake,
- Damage caused by drilling into the residues, and
- Damage from a burrowing animal.

ES.5 MODELING METHODOLOGY AND ASSUMPTIONS

For each of the hypothetical scenarios, both long- and short-term radon concentration levels were estimated at distances from the approximate site boundary (250 meters [m] or 820 feet [ft]) to a maximum distance of 75,000 m (47 miles [mi]). Also, radon levels were computed for eight hypothetical receptors in the vicinity of the NFSS including:

- West-Northwest School,
- West School,
- West-Southwest Resident,
- South-Southwest Resident,
- South-Southeast Greenhouse,
- South-Southeast Farm Resident,
- East-Southeast Off-site Landfill Worker, and
- East-Southeast Resident.

The analysis presented in this technical memorandum utilizes three sets of meteorological conditions to evaluate long- and short-term releases. Long-term releases occur for 30 days or more and are based on historical long-term weather conditions. Short-term releases occur for a duration of a few hours to no more than 30 days and are based on one of two sets of weather conditions: slightly unstable short-term weather conditions and extremely stable short-term weather conditions.

ES.6 MODELING RESULTS

Modeling results for the hypothetical excavation scenarios indicate that:

- Off-site radon-222 air concentration limits were exceeded for all excavation scenarios associated with long-term releases based on historical long-term weather conditions.
- Off-site radon-222 air concentration limits were exceeded for all excavation scenarios associated with short-term releases based on extremely stable short-term weather conditions.
- On-site occupational exposure limits were exceeded for all excavation scenarios associated with historical long-term weather wind speed (4.5 meters per second [m/sec] [10 miles per hour] [mph]) and extremely stable, short-term weather wind speed (1 m/sec [2.2 mph]); however, the 4,000 pCi/L standard (without daughters) was exceeded only for extremely stable, short-term weather wind speed.

Modeling results for the hypothetical intrusion scenarios indicate that:

- Off-site radon-222 air concentration limits were exceeded for only one intrusion scenario (damage to the IWCS due to heavy equipment) associated with long-term releases based on historical long-term weather conditions.
- On-site occupational exposure limits were exceeded for only one intrusion scenario (damage to the IWCS due to heavy equipment) associated with historical, long-term weather wind speed and extremely stable, short-term weather wind speed.

ES.7 GENERAL CONCLUSIONS

The evaluation of the hypothetical intrusion scenarios indicate that a No Action Alternative would not be protective of human health and the environment for one intrusion scenario (damage to the IWCS due to heavy equipment) based on uncontrolled site conditions and the predicted on-site and off-site radon air concentrations associated with historical, long-term weather conditions and extremely stable, short-term weather conditions.

Modeling results for the hypothetical excavation scenarios indicate that properly designed and fully functional radon abatement/control systems are likely to be necessary and may need to be in place prior to any actions associated with removal of residues from the IWCS. All IWCS FS removal alternatives that involve extraction of radium-bearing residues from the IWCS may need to include the costs associated with design, installation, operation, and maintenance of a radon abatement/control system.

Remedial action alternatives in the IWCS OU FS, including those alternatives that might involve the residues remaining in their current location within the IWCS or removal of the residues, must also fully consider comprehensive worker protection requirements that will need to be implemented, as well as added costs associated with possible reduction in worker efficiency.

1. INTRODUCTION

This technical memorandum supports the development and assessment of remedial alternatives for the Interim Waste Containment Structure (IWCS) Operable Unit (OU) Feasibility Study (FS) at the Niagara Falls Storage Site (NFSS). The purpose and background for conducting the radon assessment and completing this technical memorandum are presented below. Section 1.0 also presents the scope and objectives of the technical memorandum, as well as the organization and content of the document.

1.1 PURPOSE AND BACKGROUND

The U. S. Army Corps of Engineers (USACE), the lead Federal agency for implementing the Formerly Utilized Sites Remedial Action Program, is developing a series of technical memoranda as part of the FS effort at NFSS. The FS is being conducted pursuant to the protocols in the Comprehensive Environmental Response, Compensation, and Liability Act, and completion of the FS will be in accordance with guidance set forth in the U. S. Environmental Protection Agency's (EPA) *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988). The *Feasibility Study Work Plan for the Niagara Falls Storage Site, Lewiston, New York* (USACE 2009a) presents the approach for completing the NFSS FS under Comprehensive Environmental Response, Compensation, and Liability Act guidance, which includes the development and use of technical memoranda as a means to gather pertinent information needed to address remedial alternatives in the NFSS FS. The technical memoranda also will allow USACE to:

- Engage and inform the public on key technical issues in the early stages of the Comprehensive Environmental Response, Compensation, and Liability Act FS process so that public concerns will be considered during the development of the FS document.
- Allow the final IWCS OU FS publication to contain information and conclusions that have previously received input from the public, thus promoting a more efficient public review process for the IWCS OU FS document.

USACE requested and received public comments on the scope and objectives of this technical memorandum through the release of the *Radon Assessment Technical Memorandum Fact Sheet* (see Attachment 1). The public comments were evaluated during development of this technical memorandum and will be further addressed during the development of the IWCS OU FS document.

1.2 SITE BACKGROUND

NFSS, which is owned by the United States Government, is located at 1397 Pletcher Road, in the township of Lewiston, Niagara County, New York (Figure 1-1). The 191-acre parcel is part of the former Lake Ontario Ordnance Works that was used by the War Department beginning in 1942 for the production of trinitrotoluene. In 1944, the Manhattan Engineer District began using the site for storage of radioactive residues that resulted from the processing of uranium ores during the development of the atomic bomb. On January 1, 1947, the Atomic Energy Commission took over from the Manhattan Engineer District. Radioactive wastes and residues continued to be brought to the site for storage until 1954. Due to Manhattan Engineer District and Atomic Energy Commission activities, radioactive waste and residues of varying activity, contaminated soils and building debris, and other types of waste materials are located at the NFSS.

The U. S. Department of Energy (USDOE) assumed responsibility for NFSS in 1977 and, during the 1980s, consolidated the radioactive wastes and contaminated materials at NFSS into the IWCS. The IWCS occupies approximately 10 acres in the southwest portion of NFSS (Figures 1-2 and 1-3). The

structure was built over the former freshwater treatment plant (Building 411) and several buildings previously used by the Lake Ontario Ordnance Works (Figure 1-4). The IWCS was engineered to inhibit radon emissions, infiltration from precipitation, and migration of contamination to groundwater. The base of the IWCS consists of naturally occurring clay. A clay dike extends 0.46 to 0.61 m (1.5 to 2 feet [ft]) into the underlying gray clay and surrounds the stored radioactive materials. The residues containing low levels of radioisotopes (K-65, L-30, and F-32) were placed into the IWCS in the reinforced concrete basement of Building 411, which was designed to securely hold liquids as it was part of the former freshwater treatment plant. Before placing the materials in the basement of Building 411, drains, pipes, and openings in the basement were sealed (USDOE 1990). Buildings 413 and 414 were clarifier tanks at the former treatment plant and were upgraded and sealed as part of waste internment activities. Other buildings within the footprint area were demolished. The IWCS is covered with an interim clay cap consisting of three layers. The upper layer is a 0.5 m (1.6 feet [ft]) topsoil vegetative cover over 0.9 m (2.95 ft) of compacted clay that extends into the dike followed by a 0.3 m (1 ft) layer of fill. Additionally, waste clay of approximately 2.1 m (6.9 ft) and a sand layer of 0.31 m (1.0 ft) cover the K-65 residues stored in Building 411. In 1997, Congress transferred management of the Formerly Utilized Sites Remedial Action Program to USACE and the USACE Buffalo District became responsible for the NFSS. Additional information on the history of NFSS and the investigations conducted at the site can be found in the *Remedial Investigation Report for the Niagara Falls Storage Site, Lewiston, New York* (USACE 2007a).

Residues placed in the IWCS by USDOE are stored in the foundations of former Buildings 411, 413, and 414. A majority of the residues are stored in four bays (designated as Bays A, B, C, and D) formed within the foundation of former Building 411. The most significant radioactive wastes stored within the IWCS are the radioactive residues (i.e., K-65, L-50, L-30, and other residues) containing very large concentrations of radium-226. Through the decay of radium-226, radon gas (radon-222) is produced. Radon gas is considered hazardous mainly because its solid decay products can be deposited in the lungs where they decay in a matter of minutes, emitting alpha radiation that irradiates nearby tissue. Due to the elevated levels of radium-226 present in the IWCS residues, the effect of the radon gas must be determined to support the development of the IWCS OU FS.

1.3 SCOPE AND OBJECTIVES

The scope of this technical memorandum includes the evaluation of potential on-site (the point of release within the NFSS boundary) and off-site (beyond the NFSS boundary) radon air concentrations for several hypothetical scenarios. Hypothetical excavation scenarios evaluate conditions under which excavation would be used to remove radioactive residues and waste from the IWCS. Intrusion scenarios evaluate conditions that may result in failure of the IWCS cap to contain radon gas releases to the environment. The following three hypothetical excavation and four intrusion scenarios define and evaluate actions that expose the residues stored within the IWCS:

- Removal of all K-65 residues within the IWCS,
- Removal of all residues within the IWCS,
- Removal of the entire contents of the IWCS,
- Damage due to the use of heavy equipment,
- Damage due to an earthquake,
- Damage caused by drilling into the residues, and
- Damage from a burrowing animal.

The predicted on- and off-site radon concentrations resulting from the potential release of radon gas are compared to Federal and state radon standards and guidelines to assess possible impacts associated with

the hypothetical excavation and intrusion scenarios. These results will be used to support the development and detailed evaluation of various alternatives (e.g., removal actions, surveillance and monitoring, and No Action) for the IWCS OU FS.

This technical memorandum addresses only radon air concentrations associated with the various IWCS OU hypothetical scenarios presented herein and does not assess radon air concentrations and exposure potentials associated with the transport of residues and other radiological waste materials from the site.

1.4 REPORT ORGANIZATION AND CONTENT

This technical memorandum is composed of the following sections:

- Section 1.0 Discusses the purpose of this technical memorandum and the overall objectives and scope of the evaluation herein.
- Section 2.0 Presents background information on environmental radon and NFSS radon sources, discusses physical and chemical properties of radon, and potential health impacts from exposure to radon.
- Section 3.0 Summarizes radon regulatory standards and guidance and those selected for modeling comparisons.
- Section 4.0 Identifies the various IWCS OU scenarios evaluated and the rationale for including each specific hypothetical scenario in this assessment.
- Section 5.0 Details the radon modeling methodology and assumptions.
- Section 6.0 Presents the modeling results for each of the hypothetical IWCS OU scenarios.
- Section 7.0 Summarizes the conclusions of the radon assessment.
- Section 8.0 Provides a reference list for documents cited in this technical memorandum.

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2. OCCURRENCE OF RADON IN THE ENVIRONMENT

Sources of radon to the environment include sources such as those present in the IWCS as well as naturally occurring sources. Although radon at the IWCS is also naturally occurring, it involves materials that have been concentrated relative to other naturally occurring sources. Radioactive residues at NFSS primarily contain radium-226 and, through the decay of radium-226, radon gas (radon-222) is produced. To understand the need for a radon assessment for the IWCS, this section presents the physical and chemical properties of radon and its decay process, sources of radon in the environment including the typical indoor and outdoor radon concentrations, the sources of radon from the IWCS, and the potential health impacts from exposure to radon.

2.1 PHYSICAL AND CHEMICAL PROPERTIES OF RADON

Radon is a colorless, odorless, ubiquitous radioactive noble gas, originating in rock and soil containing naturally radioactive elements. There are several radon isotopes, but only three are relevant at NFSS due to the radioactive residues in the IWCS: radon-219, radon-220, and radon-222. Radon-219 is a short-lived decay product of actinium-227 in the Actinium Series and has a half-life of about 3.9 seconds (sec) [EPA 2003]. Radon-220 is a short-lived decay product of thorium-228 in the Thorium Series and has a half-life of 56 sec (EPA 2003). Radon-222 is the decay product of radium-226 in the Uranium Series, has a half-life of 3.82 days, and is most often associated with the term “radon” (EPA 2003). The short half-lives of radon-219 and radon-220 do not typically allow for significant migration from soil and are considered negligible at NFSS compared to the longer-lived radon-222 isotope[a]. The radioactive residues stored in the IWCS will produce radon-222 concentrations much higher than those for radon-219 and radon-220 combined. Therefore, the scope of this evaluation is limited to radon-222.

The radioactive decay of radon-222 is presented in Figure 2-1. Radon-222 is emitted in a gaseous state as it begins to decay, and the initial daughter product is polonium-218 in particulate form, which deposits from the emitted plume to the ground surface. Subsequent decay of polonium-218 (alpha, 3-minute [min] half life) results in the decay of lead-214 (beta, 27 min), bismuth-214 (beta, 20 min), and polonium-214 (alpha, 164 microseconds) before reaching a relatively stable lead-210 (22 years) isotope (NCRP 2009). When radon-222 is initially released to the environment, the daughter products (depicted in Figure 2-1) are not present in any significant concentrations. Figure 2-2 illustrates how quickly (within hours of the initial release), the concentrations of certain daughter products build up and reach the same activity level as radon-222.

2.2 SOURCES OF RADON

The following sections discuss natural and IWCS waste material sources for radon-222 and historical radon measurements collected at the NFSS.

2.2.1 Natural Sources

Radon-222 is a naturally occurring radioactive gas that most commonly appears due to the decay of uranium. Uranium is commonly found in ore-bearing rocks and soil produced from granitic rocks or shale all over the world. Radon gas migrates from rock faults and fragmented soil where traces of uranium are found. Exposure to radon from naturally occurring sources can occur outdoors or indoors (residences, at work, or school). In the open outdoors, radon is quickly diffused to the atmosphere; however, radon may

[a] The International Commission on Radiological Protection has indicated that the dose from inhaled thoron (i.e., radon-220) is about one-seventh of that from radon (i.e., radon-222) at the same concentration (ICRP 1981). Actinon (i.e., radon-219), with its relatively short half-life, would likely produce a small fraction of the thoron dose.

accumulate in caves, mines, and in poorly ventilated buildings. Radium-226, a member of the naturally occurring uranium series, decays to radon-222. Because radon is continuously produced by radioactive decay of radium-226 present in the subsurface, groundwater generally has a higher concentration of radon than surface water due to the radon off-gassing that occurs at the surface. Natural radon levels can be highly variable from location to location due to geologic conditions. Background radium-226 concentrations near NFSS are approximately 0.9 picocuries per gram (pCi/g) in surface soil (0 to 0.15 meters [m] or 0 to 0.5 ft) and 1.2 pCi/g in subsurface soil (0 to 3.3 m or 0 to 10 ft) [USACE 2007b].

Indoor concentrations of radon can be considerably higher than those found outdoors, primarily due to the potential buildup of radon emanating from soil underneath a building and poor ventilation within the building. Building materials and natural gas may also be minor sources of radon (NCRP 2009). Typical indoor radon concentrations range from 1.0 to 1.3 picocuries per liter (pCi/L) [EPA 1995; NCRP 1987; National Research Council 1999]. These average indoor levels are associated with natural background conditions. Indoor radon concentrations vary across the country and can vary dramatically by region, state, county, and even by neighborhood or parcel. Members of the uranium series are present in equilibrium such that uranium daughter products such as radium-226 decay with the same apparent half-life as the parent (i.e. uranium-238). As such, areas with higher uranium concentrations generally exhibit higher levels of radium-226 and radon-222. EPA published a nation-wide map (by county), and NFSS falls in a zone with predicted average indoor radon concentrations in the 2 to 4 pCi/L range (see Figure 2-3) [HPS 1994]. However, the actual concentration for any given structure, existing or planned, cannot be known without testing for radon (EPA 1995).

2.2.2 Sources within the Interim Waste Containment Structure

The primary sources of radon at NFSS are the highly elevated levels of radium-226 waste materials (i.e., K-65, L-50, L-30, and other residues) stored within the IWCS. Table 2-1 provides a summary of the average radium-226 concentrations for materials included in the assessment scenarios presented in this document. The most highly contaminated materials are the K-65 residues with an estimated average radium-226 concentration of 520,000 pCi/g (USACE 2007a). Table 2-2 provides a summary of volumes of waste and residues placed in the IWCS as reported in the 2007 Remedial Investigation Report (USACE 2007a). The K-65 residues account for only about 2 percent (%), by volume, of the wastes and residues stored in the IWCS; however, they contain 1,881 curies (Ci), of the total 1,982 Ci, of radium-226 present in all of the wastes and residues (Table 2-2). Approximately 145,000 m^3 (190,000 cubic yards [yd^3]) of residues, wastes, and debris were placed into the IWCS (Table 2-2).

2.2.3 Historical Radon Measurements at the Niagara Falls Storage Site

Historical radon measurements at NFSS were evaluated to determine if they could be used to support the assessment in this technical memorandum. In particular, the results were reviewed to determine if the storage configuration of the wastes and residues at the time of data collection were similar to any of the hypothetical scenarios evaluated in this technical memorandum.

During the 1970s, the K-65 residues currently stored in the IWCS were stored in an above-ground, tall, cylindrical, concrete silo at NFSS with a minimally exposed surface area at the top of the silo. From July 1984 through December 1985, the K-65 residues were hydraulically slurried and pumped from the storage silo to Building 411. Prior to the transfer, radon measurements were collected at the perimeter fences during May 1971 and August through September 1977. This configuration is different than the configuration of the residues stored in Bay A of Building 411, which involves the residues placed in a long rectangular concrete structure with a much larger exposed surface area should the materials above them be removed. Given that placement of wastes in Bay A of Building 411 was substantially different than waste placement in the silo, radon measurement data collected during May 1971 and August through

September 1977 when the K-65 residues were stored in the silo was determined to not be relevant to this technical assessment.

The radon monitoring results from the period when the K-65 residues were transferred to Building 411 appear to be relevant to this assessment. For a short period of time, the K-65 residues were exposed at the surface while being placed in Bay A of Building 411. The contents of Bay A were wet due to the slurry transfer, which decreases the amount of radon-222 released to the atmosphere. Even though these exact conditions do not currently exist, these radon monitoring results were used for comparison to modeling results presented in this technical memorandum for a similar configuration (i.e., excavation of K-65 residues from Bay A).

Radon monitoring was performed at NFSS from July 1984 through December 1985 during the K-65 transfer process from the storage silo to Building 411 of the IWCS (USDOE 1986f). Results of this monitoring were reported in a 1986 letter (USDOE 1986f) which contained a response to Dr. William Boeck's questions regarding the K-65 transfer process (see Attachment 2). According to this letter, results of on-site airborne monitoring conducted from January 1984 through September 1985 indicated that there was no significant difference between radon concentrations measured before the slurry transfer process (first and second quarters of 1984) and concentrations measured during the most productive period of the slurry transfer process (third and fourth quarters of 1984). However, during the second and third quarters of 1985, an increase in radon concentrations was identified at the monitoring stations downwind of and adjacent to Building 411. Table 1 of the USDOE 1986f (see Attachment 2) presents the on-site airborne radon-222 concentrations from 39 monitoring stations located throughout NFSS from the first quarter of 1984 through the third quarter of 1985. The radon-222 concentrations ranged from 0.09 to 5.90 pCi/L. The maximum radon-222 concentrations of 5.47 and 5.90 pCi/L occurred during the second and third quarters of 1985, respectively. The 1985 first quarter result for radon-222 was 0.18 pCi/L. This sharp increase in radon concentrations from the first quarter to the second and third quarters of 1985 was attributed to the mechanical dumping of the last of the residues into Building 411, which caused the release of radon emissions. Subsequent placement of fill-dirt over the residues significantly reduced radon emissions.

Table 2 of the USDOE 1986f (see Attachment 2) presents the off-site airborne radon-222 emissions from the same time period (first quarter of 1984 through the third quarter of 1985). The radon-222 concentrations from 29 off-site monitoring stations ranged from 0.02 to 2.58 pCi/L. The average of all off-site monitoring during the monitoring year was 0.31 pCi/L; the annual average background concentration was 0.19 pCi/L. Maximum radon concentrations reportedly occurred during October 1984, which corresponds to the peak of the slurry transfer operations (USDOE 1986f). As noted in the USDOE 1986f, radon emissions during the slurry transfer operations were expected to be minimized by wetting, or flooding, the residues. Therefore, it is likely that observed airborne radon concentrations might have been higher if the residues had not been slurried.

2.3 POTENTIAL HEALTH IMPACTS FROM EXPOSURE TO RADON

Because it is a noble gas that is generally inert, radon interacts very little with the environment and may be inhaled and exhaled with no ill human health effects. It is the short-lived, alpha-radiation-emitting decay products or progeny (i.e., polonium-218, lead-214, bismuth-214, and polonium-214) [see Figure 2-1] that are most commonly associated with human health impacts. Accumulated radiological dose takes place when electrostatically charged short-lived progeny attached to dust particles are inhaled by potential receptors, adhere to the lining of the lung, and impart radiation energy into sensitive lung tissue. The decay of these progeny, especially alpha emitting progeny, can damage sensitive cells, including killing the cell or breaking deoxyribonucleic acid strands. Deoxyribonucleic acid strand breaks can result in a mutated cell reproducing and leading to lung cancer. Therefore, the primary means for

reducing human health risks associated with radon is to limit exposure to the radon progeny. Conditions associated with the highest exposure potential include radium-226-contaminated soil in close proximity to habitable structures (short radon migration times), low indoor air turnover rates (with minimal filtration allowing for progeny ingrowth), and high occupancy times in impacted spaces. Conversely, exposures are reduced by longer soil-to-indoor-air migration times, air filtration and ventilation, and reduced occupancy of impacted spaces.

The unit "Working Level" (WL) was introduced in 1957 as a convenient one-parameter measure of radon progeny concentrations for quantifying potential human exposure (Shleien 1992). One WL is defined as any combination of short-lived radon progeny in 1 liter (L) of air, under ambient temperature and pressure, that results in the ultimate emission of 1.3×10^5 million electron volts of alpha particle energy. Under ambient conditions, this corresponds to 100 pCi/L of radon in secular equilibrium with its progeny. (Note that the term "equilibrium" in this document refers to secular equilibrium, unless otherwise specified.) The ultimate emission of alpha particle energy is the total alpha energy of all daughter nuclides in the decay chain (see Figure 2-1). For example, one polonium-218 atom will account for 6.0 million electron volts decaying to lead-214 and another 7.7 million electron volts when eventually decaying to polonium-214, for an ultimate alpha energy of 13.7 million electron volts. The number of atoms for each 100 pCi/L of radon is based on the assumptions of equilibrium with the progeny.

The relationship between WLs and airborne radon concentration in pCi/L depends on the extent to which radon daughters are in equilibrium with the parent radon (Brill et al. 1994). In a case where the radon daughters and the parent radon are at full equilibrium (100% equilibrium), 1 pCi/L results in a radon exposure of 0.01 WL. In a typical indoor environment, the assumption is made that equilibrium between the radon decay product and the parent radon is 50%. Thus, inside buildings, 1 pCi/L equals 0.005 WL (Brill et al. 1994).

The concept of WL is introduced here for informational purposes. This evaluation does not calculate WL, doses, or risks from radon. Estimates of WL, dose, and/or risk will be included in the comprehensive exposure evaluation for the IWCS to be completed as a separate technical memorandum.

3. RADON REGULATIONS AND GUIDELINES

Several Federal regulations and guidelines provide radon standards that may be applied to radon emanating from the IWCS. To facilitate the assessment presented in this technical memorandum, Federal regulations and guidelines for radon emissions have been identified. The state of New York also has provisions for radon testing and reporting. USDOE Orders were considered as well (although USACE is currently maintaining the facility and conducting Comprehensive Environmental Response, Compensation, and Liability Act activities) because USDOE will be the long-term steward of NFSS. This discussion is solely for evaluation of the radon assessment results and is not intended to define guidelines and regulations to be applied during the development of the NFSS FS. The following regulations describe the standards and guidelines as they apply to outdoor radon, indoor radon, and radon flux. A summary of the regulations and guidelines is presented in Table 3-1.

3.1 40 *CFR* PART 61 – NATIONAL EMISSION STANDARDS FOR HAZARDOUS POLLUTANTS

Section 112 of the Clean Air Act authorized EPA to develop and issue the National Emission Standards for Hazardous Air Pollutants, which are given in 40 *Code of Federal Regulations (CFR)* Part 61. The provisions in Subpart Q (*National Emission Standards for Radon Emissions from Department of Energy Facilities*) apply to the design and operation of storage and disposal facilities for radium-containing material owned or operated by USDOE, including NFSS. The standard states that the facility shall emit no more than 20 picocuries per square meter per second (pCi/m^2/sec) of radon into the air as an average for the entire source (54 Federal Register 51701, December 15, 1989, as amended at 65 Federal Register 62158, October 17, 2000).

3.2 40 *CFR* PART 192 – HEALTH AND ENVIRONMENTAL PROTECTION STANDARDS FOR URANIUM AND THORIUM MILL TAILINGS

Regulation 40 *CFR* 192 was used as the basis for the September 1986 Record of Decision for NFSS, which was described in USDOE's Final Environmental Impact Statement and formulated to be compliant with the National Environmental Policy Act. The 40 *CFR* Part 192 Health and Environmental Protection Standards for radon are described in two subparts: Subpart A for an inactive processing facility and Subpart B for environmental contamination due to the operation of the facility.

3.2.1 Subpart A: Standards for the Control of Residual Radioactive Materials from Inactive Uranium Processing Sites

Subpart A of 40 *CFR* Part 192 limits the average radon flux to 20 pCi/m^2/sec. This limit is an average over the entire surface of the disposal site (i.e., the IWCS), over a 1-year period, and includes emissions from both residual radioactive materials and from the materials covering them, such as uncontaminated soil. Subpart A also specifies that the annual average concentration of radon in air, at or above any location outside the disposal site, shall not increase by more than 0.5 pCi/L during material processing. Noted that this limit is expressed as a direct pCi/L measurement of radon and not a WL, which is typically associated with progeny and is a unit of measure used to determine cumulative exposure to radon. As a frame of reference, the average measured radon flux from the intact IWCS is reported as approximately 0.05 pCi/m^2/sec and the average measured outdoor radon level at NFSS, or background level, is reported to be less than 0.2 pCi/L (USACE 2009b).

Measurement of radon gas concentrations in air (combined contributions from radon-220 and radon-222) and monitoring of radon-222 flux (rate of radon-222 emission from the IWCS) is performed at NFSS as

part of USACE's Environmental Surveillance Program. USACE conducts this sampling and performs maintenance and security activities as part of its effort to ensure protection of human health and the environment as the planning process to develop a long-term remedy for the IWCS continues. Consistent with radon gas measurements from previous years, all site radon-222 results from the 2009 Environmental Surveillance Program were well below the USDOE off-site limit of 3.0 pCi/L above background (USACE 2010b). Radon flux results for 2009 ranged from non-detect to 0.10520 pCi/m^2/sec with an average (of detects and non-detects) result of 0.02645 pCi/m^2/sec (USACE 2010b). Background measured results were all non-detect. As in previous years, these results are well below the 20.0 pCi/m^2/sec standard specified in 40 *CFR* Part 61, Subpart Q, as well as comparable to background and demonstrate the effectiveness of the containment cell design and construction in mitigating radon-222 migration (USACE 2010a, 2010b).

3.2.2 Subpart B: Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites

Subpart B of 40 *CFR* Part 192 states, "The objective of remedial action shall be, and reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL. In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL." A value of 0.03 WL corresponds to approximately 6 pCi/L, assuming that radon progeny are present at 50% equilibrium with the radon parent. These values are for occupied or habitable structures; however, there are no occupied or habitable structures associated with the IWCS.

3.3 10 *CFR* PART 40 APPENDIX A – CRITERIA RELATING TO THE OPERATION OF URANIUM MILLS AND THE DISPOSITION OF TAILINGS OR WASTES

Appendix A of 10 *CFR* Part 40 provides criteria that limit the release of radon-222 from uranium byproduct materials, and radon-220 from thorium byproduct materials, to the atmosphere. According to this rule, release of radon is not to exceed an average release rate of 20 pCi/m^2/sec, to the extent practicable, throughout the effective design life of a closed waste disposal area.

3.4 29 *CFR* 1910.1096 – OCCUPATIONAL SAFETY AND HEALTH STANDARDS: IONIZING RADIATION

Occupational exposure to airborne radioactive material is regulated by the Occupational Safety and Health Administration (OSHA) under 29 *CFR* 1910.1096. This regulation references the criterion for radon included in Table 1 of Appendix B to 10 *CFR* Part 20.

1910.1096(c)(1) of OSHA's Ionizing Radiation standard, which the Agency issued in 1971, requires employers to limit radiation exposures to the levels specified in the Nuclear Regulatory Commission (NRC) radiation standards in effect at the time (10 *CFR* Part 20, Appendix B, Tables I and II). At the time the OSHA standards were set (1971), Table 1 of Appendix B to Part 20 set the maximum permissible concentration for radon-222 at 100 pCi/L. NRC updated 10 *CFR* Part 20 after OSHA adopted 29 *CFR* 1910.1096 in 1971. NRC defines the values listed on Table 3-1 as derived air concentrations intended to control chronic occupational exposures. NRC's updated derived air concentration for radon-222 is now 30 pCi/L; however, OSHA has not revised its standard since it was adopted. Therefore, the OSHA enforceable limit remains at 100 pCi/L. NRC regulations are more commonly used by health physicists in that they reflect more current dose criteria. The OSHA standard requires employers to ensure employees are not exposed to radon in excess of the average concentration for 40-hours (hr) in any workweek of seven consecutive days (§1910.1096(c)(1)). Because the OSHA standards have not been updated, the

current NRC values are listed on Table 3-1 and are the values used in the evaluations presented in this technical memorandum.

3.5 10 *CFR* PART 20 – ANNUAL LIMITS ON INTAKE (ALIS) AND DERIVED AIR CONCENTRATIONS OF RADIONUCLIDES FOR OCCUPATIONAL EXPOSURE

Occupational exposure limits for radon are included in Table 1 of Appendix B to 10 *CFR* Part 20. The values specified in this standard are referred to as annual limits on intake and are the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in 1 year. Annual limits on intake is the smaller value of intake of a given radionuclide in 1 year by the reference man that would result in a committed effective dose equivalent of 5 rem or a committed dose equivalent of 50 rem to any individual organ or tissue. The regulations specify that no worker within a restricted area be exposed to airborne radon-220 or radon-222 at concentrations exceeding 7,000 and 4,000 pCi/L, respectively, averaged over 40 hr in any work week of 7 consecutive days, not accounting for decay products, or radon daughters. If accounting for daughters, exposure to radon-220 and radon-222 over this same time period is limited to 9 and 30 pCi/L, respectively (see Table 1 of Appendix B to 10 *CFR* Part 20).

Table 2 of Appendix B to 10 *CFR* Part 20 provides radionuclide concentrations to assess the dose to the public via airborne effluent. The airborne effluent concentrations given in Table 2 are equivalent to the radionuclide concentrations which, if inhaled or ingested continuously over the course of 1 year, would produce a total effective dose equivalent of 0.05 rem. The annual, average, airborne effluent limits for radon-220 and radon-222, not accounting for daughters, are 20 and 10 pCi/L, respectively. Accounting for daughters, which are responsible for much of the exposure risk, the annual, average, airborne effluent limits for radon-220 and radon-222 are 0.03 and 0.1 pCi/L, respectively.

3.6 USDOE ORDER 5400.5 – RADIATION PROTECTION OF THE PUBLIC AND THE ENVIRONMENT

Section IV of DOE Order 5400.5 (*Residual Radioactive Material*) provides generic guidelines for concentrations of airborne radon progeny that mirror those in 40 *CFR* Part 192 (0.5 pCi/L; Table 3-1). However, specifications are provided for interim storage facilities such that radon concentrations in the atmosphere above facility surfaces or openings in addition to background levels will not exceed:

- 100 pCi/L at any given point,
- An annual average concentration of 30 pCi/L over the facility site, and
- An annual average concentration of 3 pCi/L at or above any location outside the facility site.

Additionally, flux from the storage of radon-producing wastes shall not exceed 20 pCi/m^2/sec, as required by 40 *CFR* Part 61. USDOE Order 5400.5 mimics National Emission Standards for Hazardous Air Pollutants, 10 CFR Part 40 Appendix A, and 40 CFR Part 192 Subpart A (Table 3-1), but adds guidelines for radon levels in, over, and adjacent to a facility (e.g., NFSS).

3.7 10 NYCRR 16.130 – RADON TESTING AND REPORTING

The state of New York has included provisions for indoor radon testing and reporting in Title 10 New York Codes, Rules, and Regulations 16.130. This rule states that, when any radon screening or long-term testing result exceeds 20 pCi/L or 0.1 WL, the radon testing firm shall advise the customer, if a resident of the state of New York, to contact the New York State Department of Health for further technical advice and assistance. Under this rule, all radon testing and mitigation firms are required to report screening and testing results and mitigation summaries to the state of New York.

3.8 GENERAL PUBLIC GUIDELINES

In October 1988, Congress enacted the Indoor Radon Abatement Act, which established a long-term goal that indoor radon levels be no greater than outdoor radon levels. The law authorized funding for radon-related activities at the state and Federal levels (EPA 2009; ATSDR 2010). The average indoor radon level ranges between 1.0 and 1.3 pCi/L (EPA 1995; NCRP 1987; National Research Council 1999); outdoor radon levels are generally about 0.4 pCi/L.

The 0.02-WL action levels, developed by EPA and issued in 40 *CFR* Part 192, also are promoted by EPA's Office of Air and Radiation in the *Citizen's Guide to Radon* (EPA 2009) and similar documentation designed to educate the public on the risk and remedial options associated with indoor radon. EPA recommends that action be taken to lower airborne radon if it exceeds 4 pCi/L in a home (EPA 2009). It is also noted that Federal radon regulations and guidelines are concentration based values and are not based on risk values or radiological dose. This is likely due to the relatively high risk associated with background levels of radon and progeny and the significant uncertainties associated with predicting indoor radon concentrations.

The World Health Organization recommended setting a national reference level as low as reasonably achievable for indoor radon levels in its *Handbook on Indoor Radon: A Public Health Perspective* (WHO 2009). In this document, World Health Organization proposes a recommended national reference level or action level for indoor radon of 2.7 pCi/L. If this level is unreachable due to prevailing country-specific conditions, then World Health Organization recommends a reference level not to exceed 8 pCi/L.

The International Commission on Radiological Protection has specified revised reference levels for homes and workplaces. The revised reference levels account for more recent epidemiological analyses and the use of dosimetric models for calculating doses. The upper value of the reference level for radon gas in dwellings has been revised from 16 to 8 pCi/L (Marsh et al. 2010). For workplaces, the reference level has been revised from 40 to 27 pCi/L. The International Commission on Radiological Protection refers to the revised reference level for the workplace as the entry point for applying occupational radiological protection requirements in existing exposure situations (Marsh et al. 2010).

3.9 CRITERIA SELECTION

Radon concentration criteria used for the evaluation of modeling results for this technical memorandum were selected based on the regulations identified (Table 3-1), conditions present at the IWCS, and the hypothetical excavation and intrusion scenarios proposed for assessment. This technical memorandum does not evaluate dose and risk associated with each of the hypothetical scenarios or compare the results to dose- and/or risk-based criteria. Additionally, the concentration limits selected for use in evaluating modeling results presented in this technical memorandum are used for comparison purposes only to indicate which scenarios may result in unacceptable exposures. The selected concentration criteria represent regulations and guidelines that might be considered and used in the FS.

The review of indoor radon regulations was presented since the public is generally familiar with issues related to indoor radon. But because there are no structures above the IWCS, nor were there any considered in the scenarios evaluated, the standards and guidelines in Table 3-1 that apply to habitable structures and indoor radon levels were not used in any of the radon evaluations. Although this document does not assess a resident building over the residues, the National Academy of Science did evaluate this scenario and concluded that the indoor radon levels and radiological exposure levels would be unacceptable (National Research Council 1995).

The annual average radon-222 limits for outdoor air were taken from 40 *CFR* Part 192, 10 *CFR* Part 20, and USDOE Order 5400.5. The annual average radon-222 level in 40 *CFR* Part 192 is 0.5 pCi/L and the annual average radon-222 level in 10 *CFR* Part 20 is 10 pCi/L without daughters and 0.1 pCi/L with daughters. Regulation 40 *CFR* 192 mandates that control of residual radioactive materials and their listed constituents shall be designed to provide reasonable assurance that releases of radon-222 from residual radioactive material to the atmosphere will not exceed an average release rate of 20 pCi/m^2/sec or increase the annual average concentration of radon-222 in air at or above any location outside the disposal site by more than 0.5 pCi/L. The range presented in 10 *CFR* Part 20, Appendix B (i.e., 0.1 to 10 pCi/L) depends on whether or not radon daughters are present. Because the regulations and guidelines that might be considered and used in the NFSS FS have not been established, both the EPA annual average value of 0.5 pCi/L, presented in 40 *CFR* Part 192, and the NRC annual average value of 0.1 pCi/L, presented in 10 *CFR* Part 20, were used for evaluation purposes. The USDOE standards regarding releases from long-term management of radiological materials include the 0.5 pCi/L limit on increases in average outdoor radon levels, which is consistent with 40 *CFR* Part 192. USDOE Order 5400.5 also has radon standards for interim storage as shown in Table 3-1. The standard for allowable off-site releases above background levels is an annual average of 3 pCi/L. The lower levels of each of these standards were selected and, therefore, the results presented in this technical memorandum regarding annual average radon-222 levels were compared to the 0.1, 0.5, and 3 pCi/L standards.

No specific numeric standards were found regarding short-term releases that could be used for comparison of results. Therefore, a numeric standard was estimated based on the long-term, annual average standards. The effluent concentration standard for radon-222 prescribed in 10 *CFR* 20, Appendix B equates to 0.1 pCi/L with daughters present and 10 pCi/L with daughters removed. Given that these levels are based on inhalation continuously over the course of 1 year (i.e., for a period of 8,760 hr/year) and using the more conservative assumption that daughters are present in equilibrium with the radon parent, a short-term maximum concentration of 100 pCi/L over a period of 8.8 hr would produce the equivalent exposure and level of protection. The exposure duration for the short-term releases is considered to be conservative for the wind speed modeled (1 meter per second [m/sec] [2.2 miles per hour [mph]]), as discussed in Section 5.0. Wind speed data for the Niagara Falls International Airport (located approximately 13 kilometers [km] [8 miles [mi]] to the southeast of NFSS) from 1970 to 2010 indicate that only 0.2% of all observations are for wind speeds <1 m/sec (2.2 mph). Therefore, very low-wind conditions are estimated to occur for up to 17.5 hr out of a total of 8,760 hr each year. However, it is likely that specific atmospheric conditions in combination with this wind speed would occur for less than 8 hr. As such, a short-term exposure limit of 100 pCi/L for a maximum cumulative duration of 8 hr (i.e., rounded down from 8.8 to 8 hr) is used for assessment purposes in this technical memorandum. Derived air concentrations defined in 10 *CFR* 20, Appendix B for occupational exposure to radon-222 equates to 30 pCi/L with daughters present and 4,000 pCi/L with daughters removed. These limits were considered in the evaluation of on-site occupational exposures for each radon assessment scenario. To put the radon air concentrations limits in perspective, the annual average background in the area is approximately 0.19 pCi/L (USDOE 1986f). This is slightly below the typical detection limit of 0.2 pCi/L for radon in air which is used in monitoring of NFSS (USACE 2010b). The lowest radon air limit of 0.1 pCi/L above background (a total radon concentration of 0.29 pCi/L) would be detectable using typical analytical methods.

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4. HYPOTHETICAL SCENARIOS EVALUATED AND RATIONALE

Seven hypothetical scenarios were identified to assess the potential on- and off-site radon air concentrations in support of developing and evaluating alternatives for the IWCS OU FS. Two general types of scenarios were considered: excavation and intrusion. Three hypothetical excavation scenarios were identified as being associated with the removal of materials from the IWCS and four hypothetical intrusion scenarios were identified to evaluate potential breaches of the IWCS cap.

The hypothetical excavation scenarios assessed include:

- Removal of all K-65 residues within the IWCS,
- Removal of all residues within the IWCS, and
- Removal of the entire contents of the IWCS.

The hypothetical intrusion scenarios assessed include:

- Damage due to the use of heavy equipment,
- Damage due to an earthquake,
- Damage caused by drilling into the residues, and
- Damage from a burrowing animal.

The rationale for selecting these hypothetical scenarios is discussed in the following sections.

4.1 IWCS HYPOTHETICAL EXCAVATION SCENARIOS

Three hypothetical excavation scenarios were identified to examine possible radon releases and associated radon air concentrations. The rationale for the assessment of these excavation scenarios is to support the development and evaluation of removal action alternatives (e.g., detailed descriptions, costs estimates, protectiveness, comparative evaluations, etc.) in the IWCS OU FS. Each of the three excavation scenarios are described in the following sections. For each of the three excavation scenarios, the on-site radon exposure levels that are estimated are as follows:

1. Worker radon exposure levels at the open surface of the excavation to assess worker protection needs.
2. Radon levels emanating from the excavation area to determine requirements of a radon containment/abatement system, subsequently allowing development of more accurate cost estimates for removal alternatives during the development of the IWCS OU FS. (Note that a radon containment/abatement system is a remedial technology that serves to prevent or minimize the release of radon gas to the atmosphere.)

Off-site releases are not expected for IWCS OU FS removal alternatives because the alternatives would include engineered controls (e.g., radon containment and abatement system) to protect human health and the environment. However, the rationale for this assessment is to understand the importance of engineered controls, off-site radon levels and associated potential off-site impacts for the scenarios in the event of radon containment/abatement system malfunction or failure. These results will also be considered in the IWCS OU FS for the development of removal alternatives.

4.1.1 Removal of All K-65 Residues within the Interim Waste Containment Structure

This hypothetical excavation scenario assesses the radon releases associated with removal of the K-65 residues. The K-65 residues are located in Bays A and C of former Building 411 as illustrated in

Figure 4-1. Location of the K-65 residues within Bays A and C is documented in IWCS Construction Reports from 1984 and 1985 as well as in a project report from 1985 (USDOE 1985 and 1986d; Campbell and Coxon 1985). However, some uncertainty exists as to whether the K-65 residues placed in Bay C have also have been placed in nearby portions of Bay B since only a baffle wall separates these two bays.

Although this scenario addresses only the removal of K-65 residues, USACE recognizes that there are other residues stored above the K-65 residues within IWCS Building 411 Bays A and C, and that any removal alternative associated with the K-65 residues would have to include the removal of the other residues and waste located above the K-65 residues.

4.1.2 Removal of All Residues within the Interim Waste Containment Structure

This hypothetical scenario involves excavation and removal of all of the residues (i.e., K-65, L-50, L-30, and others) stored within the IWCS as illustrated in Figure 4-1. The residues are located in the storage bays formed within the foundations of former Buildings 411 (Bays A, B, C, and D), 413, and 414.

4.1.3 Removal of All Waste Materials from the Interim Waste Containment Structure

This hypothetical scenario involves excavation and removal of all wastes (i.e., non-residue waste materials and debris, including the R-10 pile) and residues placed within the IWCS as illustrated in Figure 4-1. Unlike the two previous scenarios that focused on removal of only the residues, this scenario involves removal of additional waste that will require a much larger excavation area.

4.2 INTERIM WASTE CONTAINMENT STRUCTURE HYPOTHETICAL INTRUSION SCENARIOS

The primary rationale for assessing each of the hypothetical intrusion scenarios described in this section was to estimate the possible radon releases and associated concentrations in support of the evaluation of the No Action alternative in the IWCS OU FS. If the NFSS property is not adequately maintained, controlled, or secured, damage to the IWCS due to heavy equipment use, drilling into the residues, a burrowing animal, or an earthquake could occur and result in potential radon releases that may impact human health or the environment. Evaluation of the hypothetical intrusion scenarios aims to provide an indication of the possible radon releases associated with uncontrolled conditions at the NFSS as represented by the No Action alternative. The No Action alternative is required under the National Oil and Hazardous Substances Pollution Contingency Plan as a baseline scenario against which other alternatives can be compared. The Federal Government is committed to monitoring and maintaining the IWCS and, although the No Action alternative is an unrealistic scenario, it will be evaluated in the IWCS OU FS to understand the risk that may exist if land-use controls were not in place to be protective to the public. As such, the No Action alternative would leave NFSS, including the IWCS, as is with no actions taken regarding access or land-use controls. Additionally, under the No Action alternative, the physical mechanisms (e.g., IWCS cap and site security fencing) would not be maintained and environmental monitoring at the site would not be performed

The intrusion scenarios will also be used in evaluating the long-term effectiveness of any FS alternatives that might involve the residues and wastes remaining in their current location within the IWCS. Alternatives that will be considered include those that maintain the existing controls, surveillance, and monitoring already in place (Public Comment 1 – Attachment 1) or alternatives that involve additional monitoring and surveillance requirements and/or enhanced waste containment conditions beyond those currently in place.

The hypothetical intrusion scenario evaluations are also applicable to potential remedial action alternatives. The assessment of damage due to the use of heavy equipment can be applied to the evaluation of any removal alternatives that involve excavation of wastes and residues from the side of the IWCS (i.e., horizontally) versus from the top of the IWCS (i.e., vertically), which is the approach envisioned in the excavation scenarios. The hypothetical scenario evaluating drilling into the residues supports the development of any remedial alternatives that require further characterization of the IWCS contents such as the hypothetical installation of a well or the collection of a core sample from the residues. Characterization of the residues could provide a better understanding of the nature of the residues prior to performing any potential remedial actions. The drilling scenario assumes no more than limited control of the site and the installation of the well or collection of the residue sample is assumed to proceed in a manner that provides no protection to on-site workers from radon emissions.

The specific on-site radon exposure levels that will be estimated from the assessment of these hypothetical intrusion scenarios and the planned use of the information are discussed below for each intrusion scenario. Unlike the hypothetical excavation scenarios, off-site releases are expected for most of the hypothetical intrusion scenarios because these scenarios would involve inadvertent exposure to radon and would not include the implementation of engineered controls (e.g., radon containment and abatement system) to protect human health and the environment. The exception to this occurrence would involve the intrusion scenario that could be used to assess remedial alternatives that would require drilling into the residues (hypothetical core sampling of the residues or well installation) and heavy equipment use (evaluation of alternatives involving removal from the side of the IWCS) which would rely on engineered controls to protect human health and the environment.

4.2.1 Damage Due to Heavy Equipment

This hypothetical scenario involves damage to the IWCS cap and intrusion of one of the Building 411 storage bays containing the K-65 residues due to the use of heavy equipment (e.g., bulldozer, backhoe, etc.) as illustrated in Figure 4-2. Assessment of this type of damage to the IWCS is in support of an alternative where no mitigating site actions are taken and no controls are in place to preclude this type of an event. This assessment also can be used in evaluating any removal alternatives that involve removal from the side of the IWCS versus from the top of the IWCS, which is the approach envisioned in the excavation scenarios.

The specific radon exposure levels that will be estimated from the assessment of this intrusion scenario include the following:

1. On-site radon exposure levels at the open surface of the excavation to assess possible health impacts to an unprotected individual performing the excavation.
2. Off-site radon levels emanating from the exposed surface area of the excavation.

4.2.2 Damage Due to an Earthquake

For conservatism in evaluating effects of earthquake damage to the IWCS in this assessment, it is assumed that if a strong future earthquake occurs, it could damage the IWCS cap and possibly result in a crack across the IWCS. It was determined that a seismic event of such magnitude is not likely for the NFSS area based on the seismic setting, previous NFSS seismic studies, NFSS geographical and geological characteristics, NFSS IWCS analyses, and other landfill studies. Events triggering fissures that might breech the upper layers of the IWCS are even considered improbable. Each of the evaluation components and key observations regarding the hypothetical earthquake scenario are discussed below and form the basis for the selection of an alternate scenario modeled for the earthquake intrusion scenario.

4.2.2.1 Earthquake Scenario Evaluation

4.2.2.1.1 Seismic Setting

The NFSS is located in an area referred to as the Niagara seismic source zone, where the occurrence of earthquakes forms an elongated cluster of seismic activity (USDOE 1986a and USDOE 1994). This cluster is not easily correlated with known surface tectonic features (USDOE 1994). It has been suggested that some earthquakes in this zone may be due to stress concentrations in the earth's crust resulting from glacial unloading of the region (USDOE 1986b).

The nearest active fault to the NFSS is the Clarendon-Linden fault located 80.5 km (50 mi) to the east of the site. The Clarendon-Linden fault may be a chief source of earthquake activity observed in the Attica, NY area [Multidisciplinary Center for Earthquake Engineering Research (MCEER) 2009]. This fault zone is not part of a larger system of faults, nor is it as active or as great a threat as a fault system such as the San Andreas Fault in California (MCEER 2009). The Clarendon-Linden fault is a bedrock feature and glacial deposits overlying the bedrock are not affected. Because of the shallow depth of the Clarendon-Linden fault within the bedrock and its distance from the NFSS, the potential impact on the IWCS due to activity along this fault is considered to be minimal (USDOE 1994).

The NFSS lies within a region that is considered to be tectonically stable and that has historically experienced earthquake activity of moderate seismic intensity (USDOE 1986a, USDOE 1994). The earthquake history for the area includes:

- Magnitude 5.6 earthquake on August 12, 1929 (epicenter located near Attica, NY approximately 50 km (30 mi) southeast of Lewiston).
- Magnitude 3.0 earthquake on May 25, 1995 (epicenter in North Buffalo, NY).

These earthquakes were described to have caused minor damage to the area (www.buffalonian.com). Most recently, on June 23, 2010, a 5.0 magnitude earthquake occurred approximately 60 km (37 mi) north of Ottawa, Ontario, Canada (U.S. Geological Survey 2010). This earthquake caused minor earth shaking and minor building damage near the epicenter. Minor ground shaking from this earthquake was also felt in the region, including western New York State. However, no visible damage to the IWCS cap resulted from this earthquake.

Additionally, radon flux measurements from the IWCS cap, collected subsequent to the earthquake, did not exceed the 20 pCi/m^2/sec standard specified in 40 CFR Part 61, Subpart Q, and were comparable to background. These results further demonstrate the effectiveness of the containment cell design and construction in mitigating radon-222 migration.

Figures 4-3 and 4-4 present the probabilities of Richter scale magnitude 6.0 and 7.0 earthquakes, respectively. An earthquake with a magnitude of 6.0 or greater on the Richter scale is given a 10% probability of occurrence in the next 1,000 years, while a magnitude 7.0 or greater earthquake in the next 10,000 years is given a 0.02% probability. Thus, a 6.0 or 7.0 earthquake is conceivable for Niagara County, although its probability is very low.

A study by Ebel and Tuttle (2002) examined the occurrence of earthquakes in the Eastern Great Lakes Basin. The Eastern Great Lakes Basin region experiences relatively low but steady seismicity at the western edge of a broad zone of intra-plate earthquake activity that occurs along the Appalachian Mountains and Atlantic Seaboard. This study indicates the Eastern Great Lakes Basin has not been the center of a major earthquake (magnitude above 6.0) in historic time, and the largest documented

earthquakes in the basin have been less than an approximate magnitude 5.5. Information included in the study suggests the modern low seismicity rate may be characteristic of the long-term behavior of the region. If the Eastern Great Lakes Basin has the potential to generate earthquakes of magnitudes greater than 6.0, the recurrence interval of these large events may be longer than at least 12,000 years.

4.2.2.1.2 Peak Ground Acceleration

An important metric for assessing the potential for earthquake damage is peak ground acceleration (PGA). PGA is a measure of earthquake acceleration on the ground and an important input parameter for earthquake engineering. Unlike the Richter magnitude scale, it is not a measure of the total size of the earthquake, but rather how hard the earth shakes in a given geographic area. PGA is expressed as a fraction or percent of gravitational acceleration (g) and is accompanied by a probability of the PGA being exceeded in a given timeframe.

The 2008 USGS National Seismic Hazard Map website (http://geohazards.usgs.gov) provides map-based estimates of PGA probabilities for specific regions. Figure 4-5 and Figure 4-6 present the predicted PGA values for the NFSS region for the 90th percentile (10% probability of occurrence) and 98th percentile (2% probability of occurrence) earthquake events.

Predicted PGA values for Niagara County include 2-3% (g) for the 90th percentile event and 10-12% (g) for the 98th percentile event. The lower 90th percentile PGA value indicates this event is more likely (10% probability) than the higher 98th percentile PGA value (2% probability) within a 50-year period. By comparison, 90th percentile PGA values for San Francisco, CA and Miami, FL are 40% (g) and <1% (g), respectively. Empirical earthquake data and landfill surveys indicate that slope failure is not of concern for a PGA value of 10 – 15% (g) [Krinitzsky 1997].

4.2.2.1.3 Previous NFSS Seismic Studies

Prior to construction of the IWCS at the NFSS a design for a final long-term Waste Containment Structure (WCS) was completed for the site. The design for the closure system for the WCS included control and stabilization features to provide, to the extent reasonably achievable, an effective life of 1,000 yrs and a minimum service life of 200 yrs (USDOE 1994). The Failure Analysis Report (USDOE 1994) examined the effects of an earthquake on the stability of the final WCS design. The design elements for the final WCS included a long-term cap designed to withstand an earthquake with a gravitational acceleration of 15% (g), which is the PGA for a 2,400-year earthquake event (USDOE 1986b). However, the interim cap was built to withstand an earthquake with a gravitational acceleration of 10% (g) [USDOE 1994], which is the PGA corresponding to a 500-year earthquake event at the site (USDOE 1986b). The existing dike and cut-off walls were built to withstand an earthquake with a gravitational acceleration of 15% (g) [USDOE 1986c, USDOE 1994].

As part of the Failure Analysis Report (USDOE 1994), an earthquake with a gravitational acceleration of 20% (g) [approximate magnitude of 5.5 – 6.5 on the Richter scale (Geography Site Website 2010 and Mercalli XII, Inc. Website 2010)] was used as a study scenario considered to be representative of a 10,000-yr maximum credible event at NFSS. Failure mechanisms attributed to earthquake loading from the 10,000-yr maximum credible event include slope instability, slope deformation, and seismically induced settlement. According to the Failure Analysis Report (USDOE 1994), the movement from the maximum credible event is expected to be about 0.3 m (1ft), which will likely crack the final long-term closure cap but not cause a complete breach of the clay material.

The Final Environmental Impact Statement for the NFSS (USDOE 1986a) indicates a probable maximum seismic event with a modified Mercalli intensity of VI to VII (approximate magnitude of 5 to 6 on the

Richter scale) for a 10- to 200-year period. Possible damage to the cut-off wall, cap, and cap slopes would likely be repaired following such a seismic event. This same report also indicates a maximum potential seismic event with a modified Mercalli intensity of VIII (approximate magnitude of 6 to 7 on the Richter scale) for a 200- to 1,000-year period. This seismic event would likely result in damage to the cut-off wall, cracking of the cap and failure along cap slopes that would not be repaired in the long-term (USDOE 1986a). Although the 1986 USDOE report discusses possible damage to the site and the WCS should the NFSS experience effects of these probable seismic events, no specific indication was given as to the possible location of the epicenters associated with these earthquakes.

4.2.2.1.4 Liquefaction

Liquefaction describes the condition where soil behaves like a liquid and is caused by the stress induced by an earthquake causing the soil to lose its strength and stiffness. NFSS area soils are not associated with the type of material normally subject to liquefaction (saturated sandy/granulated material) and, therefore, the potential for soil liquefaction near the IWCS is considered to be negligible.

In the event of an earthquake failure of the IWCS would probably be due to seismic induced settlement or significant soil displacement, most likely in steeply sloped areas. The presence of internal structures within the IWCS, such as building walls, could tend to increase the resistance of the IWCS to such failure. Settlement and/or soil displacement are considered to be the most likely causes for a resulting fissure across the IWCS cap.

4.2.2.1.5 Ground Surface and IWCS Cap Fissures

The Failure Analysis Report (USDOE 1994) indicates that no traces of surface faults due to seismic activity have been reported in the Niagara region. The first and only known earthquake in eastern North America confirmed to have produced surface faulting occurred on December 25, 1989 in Ungava, Quebec in northern Canada. This 6.3 magnitude earthquake produced 8.5 m (28 ft) of surface faulting and a maximum throw (i.e., vertical displacement) of 1.8 m (5.9 ft) along its central segment (Natural Resources Canada Website 1990).

The potential for earthquake damage to the IWCS is further illustrated by the performance of engineered landfill caps in California during earthquakes in 1987, 1989 and 1994 (Krinitzsky 1997) as follows:

- In 1987, a magnitude 6.1 event occurred 4 km (2.5 mi) from a 76 m (225 ft) high landfill, where the associated PGA of 30% (g) caused some ground cracking of the cover.
- A magnitude 7.1 earthquake in 1989 resulted in PGA of up to 50% (g) at 17 landfills up to 75 m (225 ft) tall. Only minor damage was reported, typically consisting of minor cover soil down-slope movement and cover cracks (up to 7.5 cm [3 in]) which occurred at transition zones and at boundaries of different materials.
- In 1994 a magnitude 6.7 event caused minor or no damage in 17 of 22 locations surveyed. Damage included tears in a geo-membrane of up to 23 m (70 ft) long and cracking of the cover soils. These locations experienced PGA values ranging from 24% to over 40% (g).

Other studies of damages to 22 landfills of various fill design types (e.g., sand and gravel pit fill, side-hill fill, area fill, and canyon fill) from the 1994 Northridge earthquake in California found the surface crack length in the bench slope cover and bench roads at one landfill, where the ground acceleration was estimated to be 25 - 26% (g) [Matasovic et. al. 1995], ranged from 30 to 90 m (98 to 295 ft) [Matasovic et. al. 1998]. For most of the landfills where cover cracks occurred, the cracks were typically 12 to 75 mm (0.5 to 3 in.) wide with 12 to 75 mm (0.5 to 3 in.) of vertical relief (Matasovic et. al. 1995).

4.2.2.2 Selection of Hypothetical Earthquake Scenario

The conclusions of the earthquake scenario indicate an earthquake occurring at or near the NFSS would likely exhibit a magnitude that is relatively small to moderate (i.e., 5.6 to 5.8 or less on the Richter scale according to historic earthquake records) and would not likely reach a magnitude and intensity required to produce major ground fissuring resulting in a breach of the IWCS. Therefore, no on-site or off-site radon releases would be expected. This conclusion is supported by the following key observations:

- No traces of surface faults have been reported in the Niagara region (USDOE 1994). The first earthquake in eastern North America confirmed to have produced surface faulting occurred in 1989 in northern Canada (Natural Resources Canada Website 1990).
- USGS seismic probability maps indicate an earthquake is conceivable for Niagara County, though likely at a low magnitude (see Figures 4-3 and 4-4).
- The largest documented earthquakes in the Eastern Great Lakes Basin have been less than an approximate magnitude of 5.5 (Ebel and Tuttle 2002).
- Documented earthquake damage to landfills located in California, where seismic activity is more likely to occur than in eastern North America, was generally minor and mainly caused only minor cracking of some landfill covers (Krinitzsky 1997, Matasovic, N. et al. 1995).

In order to provide information to contingency planners, USACE chose to select an alternate hypothetical earthquake scenario for radon air modeling. An evaluation was conducted to assess what the minimum crack depth would need to be to begin to cause unacceptable, long-term radon concentration levels off-site. This evaluation is presented in Appendix E. The evaluation used a crack length of 50 m (164 ft) based on the results presented in Section 4.2.2.1.5 regarding other landfill cover cracks and the distances to the actual site boundaries versus nearest off-site receptors. The results found that the first impacted area is 185 m (607 ft) to the west of the IWCS and that a crack extending down 3.9 m (12.8 ft) would have to occur to exceed the off-site limit of 0.1 pCi/L. Even though a crack this deep is extremely unlikely based on documented experiences at other landfills and the earthquake analyses performed for the IWCS, USACE chose to use these results to establish the assumptions for assessing potential damage from an earthquake.

The alternate hypothetical scenario selected involves damage caused by an earthquake occurring at or near the NFSS that would cause a vertical crack or fissure in the cap of the IWCS that is assumed to reach the top of the K-65 residues in Bay A as illustrated in Figure 4-7. Assessment of this type of damage to the IWCS would be used to evaluate a No Action alternative where no mitigating site actions are taken and no controls are in place to negate the impacts of this type of event. This information will also be used in evaluating the long-term effectiveness any other FS alternatives that might involve the residues remaining in their current location within the IWCS. The specific radon exposure levels estimated from the assessment of this intrusion scenario include:

1. On-site radon exposure levels at the open surface of the fissure to assess possible impacts to an individual inspecting the IWCS after the occurrence of an earthquake or to a unprotected individual who enters the site to see what might have happened.

2. Off-site radon levels emanating from the open surface of the fissure.

4.2.3 Drilling into the Residues

This intrusion scenario involves drilling into the residues, as illustrated in Figure 4-8, under one of the following hypothetical situations:

- Installation of a well unaware of the waste materials below, and
- Collection of a core sample from the residues to better understand the characteristics of the residues prior to performing any potential remedial actions.

This scenario is necessary to support the development and evaluation of the IWCS No Action alternative and any alternatives (e.g., residue removal alternatives) involving the need for further characterization of the IWCS contents, particularly the residues. The specific radon exposure levels that will be estimated from the assessment of this intrusion scenario include the following:

1. On-site radon exposure levels at the top of the well casing to assess possible impacts to an unprotected individual who might be unaware of the contents of the IWCS and inadvertently drills into the residues.
2. On-site radon exposure levels to a worker collecting core samples of the residues in support of a remedial action alternative requiring further waste characterization.
3. Off-site radon levels originating from the exposed cylindrical surface area of the K-65 residues within the boring or well.

As previously mentioned, off-site releases are not expected for IWCS OU FS alternatives involving the need for core sampling of the residues because the alternative would include engineered controls to protect human health and the environment. However, off-site releases of radon are expected for the hypothetical scenario associated with inadvertent drilling into the residues.

4.2.4 Damage from a Burrowing Animal

This hypothetical scenario presents an animal that burrows into the IWCS cap as illustrated in Figure 4-9. This intrusion scenario is necessary to support the development and evaluation of the No Action alternative as well as any FS alternatives that might involve the residues remaining in their current location within the IWCS. The specific radon exposure levels that will be estimated from the assessment of this intrusion scenario include the following:

1. On-site radon exposure levels at the opening of the burrow to assess possible impacts to an individual who might be conducting routine inspections of the IWCS or a recreationist who is walking around the site and happens upon the opening of the burrow.
2. Off-site radon levels originating from the exposed surface area of the K-65 residues inside the den.

5. MODELING METHODOLOGY AND ASSUMPTIONS

The evaluation of radon migration through the IWCS and subsequent transport though the air included a combination of flux modeling and atmospheric modeling. Application of the flux model to a cap with many layers included combining methodologies to approximate the site conditions. Estimating radon emissions from scenarios describing some type of breach of the IWCS (either by intentional excavation or inadvertent intrusion) required application of estimates and assumptions within the methodology, as described in the following sections.

5.1 RADON MODELING METHODS

The radon assessment was conducted with the Residual Radiation Code (RESRAD) computer model for estimating on-site air concentrations and a flux attenuation model developed by NRC to model radon movement through the IWCS. The Clean Air Act Assessment Package 1988 (CAP88) computer model (EPA 2007) is utilized to estimate radon levels off-site. CAP88 is specifically designed to model radiological releases and to provide dose and air concentration estimates at downwind locations. Additionally, the model and has been used for the NFSS annual monitoring reports and incorporates a validated/verified meteorological dataset for the Niagara Falls vicinity**.**

RESRAD version 6.4 is a computer code developed at Argonne National Laboratory for USDOE with significant contributions by NRC. RESRAD is used to evaluate exposures to residual radiation in various media. Models such as RESRAD can be used to estimate concentrations and associated exposure levels. The NRC modeling method is described in NRC Regulatory Guide 3.64, *Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers* (NRC 1989). A detailed calculation package, which included radon flux estimates from the IWCS, is included in the Failure Analysis Report (USDOE 1994). Both the NRC method used by in the 1994 report and the RESRAD model utilize diffusion-driven radon migration for estimating radon flux through soil; although, only RESRAD provides a model for estimating outdoor radon concentrations. Because the flux attenuation method developed by NRC provides more transparency and flexibility, it is used instead of RESRAD to estimate radon fluxes through NFSS media. RESRAD, however, utilizes straightforward formulae for estimating outdoor radon concentrations; thus, RESRAD was utilized to estimate breathing zone concentrations (in pCi/L).

5.2 GENERAL MODEL ASSUMPTIONS

Radon levels at off-site locations were estimated using the CAP88 model. CAP88 uses atmospheric data, along with a Gaussian plume model, to estimate concentration associated with radon emanating from the site. All three models (flux attenuation, RESRAD, and CAP88) plus additional factors are described in the following subsections.

The radon evaluation estimates several parameters. Radon flux is an estimate of radon activity released from a given area per unit of time (units of $pCi/m^2/sec$). The radon emission rate is the radon activity released per unit of time (units of Ci/year), and radon emission is the total activity released (units of Ci). For hypothetical scenarios evaluated, radon is assumed to be released constantly throughout the year and radon levels reach a steady-state condition. For this assessment, both long- and short-term releases were evaluated. Long-term releases are those releases that occur for 30 days or more and account for no corrective actions, thus the release could occur for the entire year or longer and are based on using historical long-term weather conditions. Short-term releases are those releases that occur for a duration of a few hours to no more than 30 days. These short-term releases are based on one of two specific sets of

weather conditions: slightly unstable short-term weather conditions and extremely stable short-term weather conditions with minimal dispersion.

For each of the hypothetical scenarios, both long- and short-term radon release concentration levels were estimated at distances from 250 m (820 ft) to a maximum of 75,000 m (47 mi). The CAP88 model will produce results for any distance; however, to be consistent with the NFSS annual environmental monitoring reports, a downwind distance of approximately 250 m or greater was used as a starting distance for this evaluation. On-site locations exist at a distance of 250 m (820 ft) north and east of Building 411 (i.e., the modeled source area); whereas, off-site locations at or near the site boundary exist to the west and south of Building 411 at slightly closer distances. For reference, the off-site locations to the west and south at a distance of 250 m (820 ft) from Building 411 are approximately 67 m (220 ft) and 25 m (82 ft) beyond the actual site boundary, respectively, and the nearest hypothetical receptor location with respect to the site boundary is 559 m (1,834 ft) to the southeast of Building 411. Therefore, no adjustments were made in using the 250 m (820 ft) minimum distance for these two directions in estimating radon concentration levels to off-site receptors. However, closer results are presented in Appendix B for comparative purposes.

Radon levels were also computed at eight designated hypothetical receptor locations consistent with those selected and evaluated for the annual NFSS National Emission Standards for Hazardous Air Pollutants report (USACE 2010a). The locations of hypothetical exposed individuals are shown on Figure 5-1, along with their distance and direction from Building 411 located within the IWCS. Distances between the Building 411 location and representative NFSS boundary locations are also shown on this figure. The eight hypothetical exposed individual receptors included in this evaluation and shown on Figure 5-1 are listed below:

- West-Northwest School (distance of 2,511 m [8,239 ft]),
- West School (distance of 2,273 m [7,458 ft]),
- West-Southwest Resident (distance of 1,030 m [3,378 ft]),
- South-Southwest Resident (distance of 662 m [2,171 ft]),
- South-Southeast Greenhouse (distance of 652 m [2,138 ft]),
- South-Southeast Farm Resident (distance of 959 m [3,145 ft]),
- East-Southeast Off-site Landfill Worker (distance of 559 m [1,833 ft]), and
- East-Southeast Resident (distance of 1,583 m [5,192 ft]).

Annual average radon concentrations (considered long-term release concentrations) received by the maximally exposed individual based on average wind and population data have been estimated as part of this assessment for each of the hypothetical scenarios. Additionally, short-term estimates are presented for the radon concentrations at the breathing zone within a radial pattern from the IWCS, assuming slightly unstable short-term weather conditions and extremely stable short-term weather conditions with minimal dispersion atmospheric conditions (e.g., stability class) and wind speed, independent of wind direction. To provide an estimate of the maximum off-site exposure concentrations, estimates have been projected out to at least a 3.2 km (2 mi) minimum radius and as far as a 75 km (47 mi) maximum radius. Concentrations were projected beyond a 3.2 km(2 mi) radius (up to a 75 km [47 mi] radius) if modeling results indicated that elevated levels of radon above background existed past the 3.2 km (2 mi) radius. Additionally, for locations directly on top of the IWCS, the maximum on-site radon exposure concentrations have been developed and presented for each IWCS OU scenario.

5.3 FLUX ATTENUATION MODEL

The IWCS cap was constructed using topsoil, clean clay, and low-level contaminated waste clay soil. Each of the three cover layers was compacted during cap construction, effectively increasing bulk densities while reducing soil moisture levels and porosities (USDOE 1986e). Compaction constricted the pore space through which radon flows and reduced the mean free path of radon by a factor of two or better[b]. The effect is that radon originating from the K-65 residues is delayed along the soil column long enough to decay and not contribute to outdoor radon levels.

The flux attenuation model was originally utilized at NFSS to predict radon releases from a final closure cap and is utilized here to estimate radon flux dependence on material properties, cover thicknesses, geotechnical properties, and other variables. The model is equipped to address multiple cover-like materials. Values used for each of the variables presented in the following equations are presented in Appendix A. The flux attenuation model is generally comprised by two main variables. First, the diffusion coefficient is a measure of the ability for radon gas to move through available pore space of a target medium, as shown in Equation 1:

$$D_j = 0.07 \times e^{-4\left(m_j - m_j n_j^2 + m_j^5\right)} \tag{1}$$

Where:

D_j = radon diffusion coefficient in the total pore space of medium "j" (cm^2/sec),
n_j = porosity of medium "j" (unitless),
m_j = moisture saturation fraction of medium "j" (unitless):

$$m_j = \frac{10^{-2} \times \rho_j \, w_j}{n_j \rho_w}$$

Where:

ρ_j = density of material "j" (gram [g]/cm^3),
ρ_w = the density of water (1 g/cm^3),
w_j = long-term average moisture content of medium "j" (%).

Second, the radon flux through a medium is a function of the thickness of the target medium, the radon decay rate, and other factors. Flux estimates are subdivided into those originating in a target medium plus those that migrate through cover layers. The flux through the target material (e.g., K-65 residues) is calculated as shown in Equation 2:

$$J_j = 10^4 R_j \rho_j E \sqrt{\lambda D_j} \tanh\left(x_j \sqrt{\frac{\lambda}{Dj}}\right) \tag{2}$$

Where:

J_j = radon flux from radon originating in medium "j" (pCi/m^2/sec),
Rj = radon-226 concentration in medium "j" (pCi/g),
ρ_j = density of material "j" (g/cm^3),
E = radon emanation coefficient (unitless),
λ = radon decay constant (sec^{-1}),
D_j = radon diffusion coefficient in the total pore space of medium "j" (cm^2/sec),
tanh = hyperbolic tangent,

[b] Calculated: mean free path in general soil ~0.8 m (2.6 ft) or ~0.4 m (1.3 ft) or less in compacted soil. A mean free path is defined here as the average distance a radon atom will travel through a medium before decaying.

x_j = thickness of medium "j" (centimeter [cm]).

Cover material impedes radon flow before it can be released into the atmosphere, thus reducing the flux, dependent on cover thickness and other factors. The equation for radon flux originating in the target material and through the cover material is calculated as shown in Equation 3:

$$J_c = \frac{2J_j e^{-b_c x_c}}{1 + \sqrt{\frac{a_j}{a_c}} \tanh\left(b_j x_j\right) + \left[1 - \sqrt{\frac{a_j}{a_c}} \tanh\left(b_j x_j\right)\right] e^{-2b_c x_c}} \quad (3)$$

Where:

J_c = radon flux through the cover material originating in material "j" (pCi/m^2/sec),
J_j = radon flux from radon originating in medium "j" (pCi/m^2/sec),
x_c = thickness of cover material (cm),
x_j = thickness of medium "j" (cm).
tanh = hyperbolic tangent,
b_c = inverse relaxation length of cover material (cm^{-1}):

$$b_c = \sqrt{\lambda / D_c} \ ,$$

λ = radon decay constant (sec^{-1}),
D_c = radon diffusion coefficient in the total pore space of the cover material (cm^2/sec),
b_j = inverse relaxation length of material "j" (cm^{-1}):

$$b_j = \sqrt{\lambda / D_j} \ ,$$

a_c = interface constant for the cover (cm^2/sec):

$$a_c = n_c^{\ 2} D_c \left[1 - (1-k) m_c\right]^2$$

n_c = porosity of the cover (unitless),
k = equilibrium distribution coefficient for radon in water and air (pCi/cm^3 water per pCi/cm^3 air),
m_c = moisture saturation fraction of the cover (unitless),
a_j = interface constant for medium "j" (cm^2/sec):

$$a_j = n_j^{\ 2} D_j \left[1 - (1-k) m_j\right]^2$$

n_j = porosity of material "j" (unitless),
m_j = moisture saturation fraction of material "j" (unitless).

Equations 2 and 3 were used in series for multiple layers so that each consecutive layer adds to the total radon flux emanating through a soil column. A cross-section of materials in and above IWCS Bays A through D represent multi-layered soil columns to which these equations were applied. For example, the Bay A soil column includes, from the surface of the IWCS, compacted topsoil, compacted clean clay, compacted waste clay, sand, and K-65 residues (Figure 4-1). The radon flux through the soil column includes:

- Radon originating in the topsoil;
- Radon originating in the clean clay that diffuses through the clean clay and topsoil;
- Radon originating in the waste clay that diffuses through the waste clay, clean clay, and topsoil;
- Radon originating in the sand that diffuses through the sand, waste clay, clean clay, and topsoil; and
- Radon originating in the K-65 residues that diffuses through the K-65 residues, sand, waste clay, clean clay, and topsoil.

For the topmost layer, the total flux (pCi/m^2/sec) to the atmosphere (J_t) is calculated as shown in Equation 4:

$$J_t = J_j + J_c \tag{4}$$

Where:

J_c = radon flux through the cover material originating in material "j" (pCi/m^2/sec),
J_j = radon flux from radon originating in medium "j" (pCi/m^2/sec).

The flux generated in the top cover layer (J_j) is assumed to be immediately released to the air. The flux from the lower layers (J_c) is attenuated through the top cover layers before reaching the atmosphere. The flux calculations were performed at uniform depths within each layer to provide estimates representative of systematic removal of layers during excavation.

5.4 ATMOSPHERIC CONDITIONS MODELED

Because the estimated downwind air concentrations are strongly dependent on the meteorological conditions during the radon release, a range of possible atmospheric conditions was investigated. The radon analysis considered both long- and short-term releases and utilized three sets of meteorological conditions to evaluate these releases, as discussed above. They are referred to as the historical long-term weather conditions (long-term releases), the slightly unstable short-term weather conditions (short-term releases), and the extremely stable short-term weather conditions (worst-case, short-term releases). Each of these conditions is discussed below.

For long-term releases, a meteorological data set was used that summarized several years of data suitable to estimating air concentrations in each of sixteen compass directions over an annual time period, thus providing an annual average exposure level. The analysis based on long-term atmospheric conditions is referred to as the historical long-term weather condition. The meteorological database used for evaluation of the historical long-term weather conditions was the CAP88 file for Niagara Falls International Airport. The Niagara Falls International Airport is located approximately 13 km [8 mi] to the southeast of NFSS [just south of Walmore, New York]). The historic data used represents the years 1955 through 1959. Although this data is historical, it has been through significant validation and verification. A meteorological data comparison from sources near NFSS to assess the variability and potential impact on assumptions was conducted (USACE 2011).

For short-term releases where winds might be focused in a single direction, a meteorological data set was used to reflect atmospheric conditions that might persist for a brief period of time. Data sets were created for CAP88 to simulate a wind of a constant speed in a single direction for a constant atmospheric stability class. Two stability classes were included in the short-term release analysis: the slightly unstable short-term weather conditions and the extremely stable short-term weather condition; both are discussed below.

The wind rose shown in Figure 5-2 illustrates the predominant wind speeds and wind direction for the NFSS area using wind data collected at the Niagara Falls International Airport during calendar years 2005 through 2009 [National Climatic Data Center (NCDC) 2010a]. The meteorological data set used to develop the wind rose represents a smaller dataset than that used for the radon modeling presented in this document. However, the wind rose is consistent with historic data.

Wind speed data from 1970 to 2010 (NCDC 2010b) indicates an average daily wind speed of approximately 4.5 m/sec (10 mph) with a maximum wind speed of 16 m/sec (36 mph) based on over 12,700 observations during a 40-year period (see Figure 5-3). The minimum wind speed during this time

period was 0.7 m/sec (1.6 mph), and the number of observations below 1 m/sec (2.2 mph) was 17, or less than 0.2 %. This information confirms the use of a 1 m/sec (2.2 mph) wind speed as representative of reasonably bounding low-wind conditions observed in the Niagara Falls area. Additional discussion of the conservative nature of this wind speed assumption, as it relates to air concentrations downwind of the IWCS, is presented in Appendix B.

The slightly unstable short-term weather conditions assumed a Stability Class C (typical atmospheric conditions expected) with a wind speed of 1 m/sec (2.2 mph). This reflects a typical stability with a 1 m/sec (2.2 mph) wind speed, which is well below the average wind speed of 4.5 m/sec (10 mph) at Niagara Falls International Airport in 2008. Class C conditions were selected to represent a conservative unstable atmosphere (Classes A, B, and C) which account for 15% of the observations in historical data from Niagara Falls International Airport. Although the meteorological dataset indicates a higher percentage of observations are Class D (57% historically and 36% recently), the low wind speeds modeled were more typically associated with the unstable atmospheric classes (A, B, and C) during conditions of slight solar radiation (see Table B-4). The Stability Class C weather condition is used to estimate reasonably conservative air concentrations for a single wind direction assuming slightly unstable short-term weather conditions. The Stability Class C is most often observed during partly cloudy daylight hours with moderate winds and is considered indicative of a slightly unstable atmosphere. Because of these instabilities in the atmosphere, parcels of air are more likely to collide and mix, which tends to distribute any airborne constituents more evenly within the plume. This has the effect of reducing the centerline concentration within the plume, and the mass of constituents is more evenly mixed throughout the atmosphere.

Appendix B presents air concentrations results for a unit emission for each of the Stability Classes (A through G) included in the CAP88 model (Table B-5). The extremely stable short-term weather conditions were simulated using an atmospheric Stability Class of G with a wind speed of 1 m/sec (2.2 mph). This reflects a very stable atmosphere, where limited dispersion of the plume could be expected, resulting in maximum plume centerline concentrations. Although E and F stability classes are often used to model short-term conditions, the air concentrations under Class G are over 2 times the values for Class F and nearly 5 times the values for Class E at a given receptor location with a wind speed of 1 m/s (Table B-5). Although atmospheric conditions for Stability Class G are unlikely, they are possible and since the model is capable of producing results for Class G results were included as they were the most conservative. This scenario was used to provide an upper bound estimate of potential short-term air concentrations associated with releases from the IWCS and is referred to as extremely stable short-term weather conditions with respect to atmospheric conditions. The Class G stability class is most often observed during lightly clouded nighttime hours with very low wind speeds and is associated with a very stable atmosphere where very little mixing of air parcels is occurring. As a result, constituents tend to remain concentrated along the centerline of an airborne plume and are not likely to be distributed laterally.

Results from these three meteorological data sets provide data for analysis of long-term releases (historical long-term weather conditions) and short-term releases (slightly unstable short-term weather conditions and extremely stable short-term weather conditions). These results bound the potential air concentrations associated with short-term releases from the IWCS and also provide long-term results for annual releases.

5.5 ON-SITE OUTDOOR RADON EVALUATION

Equations presented in Appendix C of the RESRAD manual (ANL 2001) convert flux in pCi/m^2/sec into on-site outdoor radon concentrations in pCi/L. These equations are dependent on environmental factors,

such as wind speed and mixing height, for dispersing radon and contaminated surface area and construction depth to geometrically scale radon levels in the breathing zone.

The on-site outdoor radon concentration (at the location at the source of the release of radon) for a given flux is a function of the assumed mixing height, the contaminated surface area, wind speed, and radiological decay rate, as described in Equation 5:

$$C_o = \frac{J_o F_{ao}}{1000 \times \lambda H_o}\left[1 - e^{-\left(\frac{\lambda X}{2U}\right)}\right] \tag{5}$$

Where:

C_o = outdoor radon concentration (pCi/L),
J_o = outdoor radon flux or flux through the top layer of the soil column (pCi/m^2/sec),
λ = radon decay constant (sec^{-1}),
H_o = height into which the radon plume is uniformly mixed (m),
1,000 = conversion factor from m^3 to L (L/m^3),
U = annual average wind speed (m/sec),
X = effective length of the contaminated area - $\sqrt{A}$ (m).

Where:

A = Area of contaminated zone (m^2),
F_{ao} = outdoor area factor (unitless).

Where:

F_{ao} = A/100, $0 \leq A < 100$ m^2 (1,080 ft^2) or
F_{ao} = 1.0, $A \geq 100$ m^2 (1,080 ft^2).

In Equation 5, the source area is used to derive the area factor (F_{ao}); however, it is the effective length of the source area that impacts the calculations for areas larger than 100 m^2 (1,080 ft^2). From Equation 5, the effective length is combined with the wind speed in the exponential term that is describing the buildup of radon, and subsequent radiological decay, of radon as it is transported across the source area and to the receptor. The distance traveled across the source area (calculated as half of the effective length) divided by the wind speed determines the time required to reach the receptor. The buildup term (i.e. $1-e^{-x}$) utilizes the radon travel time (and decay during transport) to calculate the rate of radon buildup during transport to the receptor, assumed to be at the center of the source area. Therefore, selection of the effective length of the source area has a significant impact on the results, with long narrow areas generating larger air concentrations than square or wider area geometries. The implications of the selected effective lengths are further discussed in Appendix A

Equation 5 assumes a source area that is directly exposed to the atmosphere, which is consistent with the excavation scenarios and the equipment damage scenario. However, the earthquake, drilling, and burrowing scenarios result in a source area that is not directly exposed to the atmosphere. The radon released in these scenarios is likely to have a tendency to remain below the ground surface (radon is significantly more dense than air) and, subsequently, diffuse to the atmosphere. Because of the uncertainty associated with these releases, results are presented for direct release to the atmosphere (convective flow) and for radon remaining below the ground surface (diffusive movement).

Outdoor radon air concentration estimates do not consider contributions from the surrounding soil that may release radon to the atmosphere at background levels. Because background contributions are ignored in this evaluation, the radon results presented are considered representative of concentrations above background.

The flux and outdoor air calculations were generated for both an assumed outdoor area factor of 1 and for calculated area factors that were calculated relative to the 100 m^2 (1,080 ft^2) source area used as the basis for the RESRAD model (see Appendix A).

5.6 OFF-SITE OUTDOOR RADON EVALUATION (CAP88)

The CAP88 model was used to estimate the outdoor radon concentrations beyond the area immediately adjacent to the site. CAP88 utilizes the Gaussian plume model, as adapted within CAP88 for a ground level release, to generate the steady-state plume centerline ground level radon concentration at downwind locations. The radon-emitting sources may be either elevated stacks, such as a smokestack, or uniform area sources, such as a pile of residues. Plume rise can be calculated assuming either a momentum-driven (e.g., release with significant exit velocity) or buoyant-driven (e.g., release is warmer than ambient air and has thermal buoyancy) plume. Although radon released from the IWCS likely would be impacted by temperature/momentum, these mechanisms result in a reduction of air concentrations at receptor locations and are neglected from this evaluation to provide higher-than-expected concentrations (see Appendix B). Assessments are performed for a range of distances downwind from the source area.

Off-site air concentrations were estimated by running simulation for releases of 1 Ci/year for the three atmospheric conditions modeled. The resulting unit air concentrations were then scaled up to represent the radon emission rate for the particular scenario under evaluation. The calculation of the unit air concentrations is presented in Appendix B, and the scaling of air concentrations for excavation and intrusion scenarios is provided in Appendix C.

The *Niagara Falls Storage Site 2008 Environmental Surveillance Technical Memorandum, Lewiston, New York* included the use of CAP88 (USACE 2009b). Results from these "runs" are for general soil and are not repeated here. However, the same wind files (IAG0906.WND) were used in the hypothetical IWCS cap excavation and intrusion scenarios. Additional simulations were conducted based on atmospheric conditions that might produce the worst-case concentrations over short-term release scenarios.

Plume modeling results were generated through direct CAP88 runs; therefore, the associated formulae are not presented here. Inputs, such as the emission rate and source surface area, are described in more detail in the following sections for the IWCS scenarios.

Appendix A presents the flux for specific layers within the IWCS, and Appendix B presents the air concentrations associated with unit emission rates. Assuming an exposed source area appropriate for the scenario under evaluation provides an instantaneous radon emission rate, which is then combined with the atmospheric modeling to provide air concentrations.

5.7 SCENARIO-SPECIFIC ASSUMPTIONS

This section summarizes the assumptions used for estimating radon emissions associated with the IWCS excavation scenarios and cap intrusion scenarios. The detailed descriptions of these hypothetical scenarios are presented in Sections 4.1 and 4.2, with some of the more key assumptions re-iterated below.

5.7.1 Interim Waste Containment Structure Emissions Associated with the Hypothetical Excavation Scenarios

Appendix A presents the flux for specific layers within the IWCS, which, when combined with an assumed exposed source area, provides an instantaneous radon emission rate. These short-term emission

rates are appropriate for estimating maximum air concentrations under extremely stable short-term weather conditions, slightly unstable short-term weather conditions, and historical long-term weather conditions. However, the atmospheric modeling (see Appendix C) is based on annual emissions (those emissions assumed to take place over the course of 1 year).

The estimated flux at various levels of excavation is presented in Appendix C for selected downwind distances under short-term release (extremely stable short-term weather conditions and slightly unstable short-term weather conditions) and long-term release (historical long-term weather) conditions.

The proposed means of excavation and extraction of residues will be determined during later phases of the IWCS OU FS. For modeling purposes, removal is assumed to be from the top, not the sides, thus providing a more direct release path to the environment. Therefore, excavation through the IWCS cap materials is assumed to occur in all hypothetical removal scenarios. Potential excavation of the residues could be conducted vertically from the top to the bottom of the residues, or the residues could be excavated using a horizontal mining approach. Radon emissions might be less if horizontal extraction was used to expose and remove the residues from the IWCS. However, vertical excavation of the residues from the top down was used in evaluations presented in this technical memorandum as a conservative case to account for what is envisioned to be the greatest level of radon emissions. The actual excavation areas may vary depending on which removal technology and approach are used. The excavation area used in this technical memorandum assumed that the remedial design would focus on limiting the amount of high-activity waste that would be exposed at any given time.

Based on the configuration of the Building 411 foundation where the high-activity residues are located, the excavation was assumed to be an opening of approximately 13.7 m (45 ft) long, which is the approximate inside dimension of Bays A, B, and C and is half of the width associated with Bay D (see Table 5-1). The width of the trench was assumed to be approximately 7.3 m (24 ft), thus providing a total exposed surface area of 100 m^2 (1,080 ft^2). This excavation area is used in assessing the removal of the residues from each of the bays, as discussed below, and, at any given time, only 100 m^2 (1,080 ft^2) is assumed to be exposed, unless stated otherwise below.

The estimated emission rate of radon due to excavation of the IWCS materials was based on the following hypothetical scenarios.

5.7.1.1 Removal of All K-65 Residues within the Interim Waste Containment Structure

In this hypothetical excavation scenario, IWCS cap materials above the storage location of the K-65 residues would be removed in 0.6 m (2 ft) lifts, as illustrated in Figure 4-1. Because the K-65 residues have high levels of radium-226, this scenario was assessed to present the worst-case conditions associated with the maximum possible radon flux and release from a single IWCS storage bay. Excavation of the cap materials would proceed in a sloping manner (e.g., 2:1 slope) to provide stability of the remaining cap material until the residues are exposed and removed. As discussed above, the exposed source area during excavation of residues from Bays A or C is assumed to be 100 m^2 (1,080 ft^2) [see Figure 5-4].

The assumptions developed for this scenario (removal of K-65 residues) are as follows:

- Includes the removal of contents from only Bays A and C.
- Excavation would proceed in a sloping manner to provide stability (e.g., 2:1 slope).
- Requires incremental exposure of a 100 m^2 (1,080 ft^2) area at various depths to complete excavation of a single bay.
- Each bay is removed individually; therefore, only 100 m^2 (1,080 ft^2) is exposed at any one time.

5.7.1.2 Removal of All Residues within the Interim Waste Containment Structure

Excavation would proceed through the IWCS cap materials, as discussed above, to the residues located in the storage bays formed within the foundations of former Buildings 411, 413, and 414. Only residues from Building 411 were modeled since Building 411 has the largest volume of high activity residues (K-65) which would result in the maximum concentrations for the modeled scenario. Materials above the storage bays would be removed in 0.6 m (2 ft) lifts, as illustrated in Figure 4-1. Excavation of the IWCS cap would progress in a sloping manner (e.g., 2:1 slope) to provide stability of the remaining cap material until the residues are exposed and removed. As discussed above, the exposed source area during excavation of residues from a bay is assumed to be 100 m^2 (1,080 ft^2), as shown in Figure 5-5.This removal will be an incremental process.

The assumptions developed for this scenario (removal of IWCS residues) are as follows:

- Includes the removal of contents from all bays (Bays A, B, C, and D).
- Excavation would proceed in a sloping manner to provide stability (e.g., 2:1 slope), which accounts for unanticipated exposure of additional waste material.
- Requires incremental excavation of a 100 m^2 (1,080 ft^2) area at various depths to complete excavation of a single bay (see Figure 5-5).
- Each bay is removed individually; therefore, only a source area of 100 m^2 (1,080 ft^2) is exposed at any one time.

5.7.1.3 Removal of the Entire Contents of the Interim Waste Containment Structure

This hypothetical scenario involves excavation and removal of all wastes (i.e., non-residue waste materials and debris) and residues stored within the IWCS. Only residues from Building 411 were modeled since Building 411 has the largest volume of high activity residues (K-65) which would result in the maximum concentrations for the modeled scenario. Materials placed above the waste materials stored in the IWCS would be removed in 0.6 m (2 ft) lifts, as illustrated in Figure 4-1. Excavation would progress in a sloping manner (e.g., 2:1 slope) to provide stability of the remaining IWCS cap material until the residues are exposed and removed.

This alternative conservatively assumes that the excavation of the entire IWCS contents begins at the south end and incrementally proceeds toward the north. The maximally exposed area of residues would occur when Building 411 is encountered. The assumption is that the excavations proceeding north cut across the entire IWCS. Therefore, when Building 411 is encountered, all four bays will initially be uncovered until Bay A is empty, then only Bays B, C, and D would be open. The maximum release would be associated when all four bays are open; therefore, the modeling is based on all four bays being open at the same time. The dimensions of the excavation opening over Bays A, B, C, and D would be the length (east to west direction) of all of the bays together and the width (north to south direction) of the excavation. The width of the excavation is assumed to be the same width, 7.3 m (24 ft), used for the excavations of each of the bays discussed in the previous sections. Therefore, the approximate dimensions of the opening across Bays A, B, C, and D would be 68.5 m (225 ft) by 7.3 m (24 ft) for a total exposed source area of 500 m^2 (5,400 ft^2). The maximum estimates of on- and off-site radon levels are based on a combination of the radon fluxes and releases from each of the four bays within former Building 411 at various excavation depths applied over the 500 m^2 (5,400 ft^2) area (see Figure 5-6).

The assumptions developed for this scenario (removal of all of the IWCS contents) are as follows:

- Includes the removal of all of the IWCS materials, including the contents of the R-10 pile and general contaminated soil.
- Excavation would proceed in a sloping manner to provide stability (e.g., 2:1 slope).
- Requires incremental excavation of a 500 m^2 (5,400 ft^2) area for complete removal of the residues from Building 411.
- Large area is removed at one time; therefore, emissions from all bays are simultaneous.

5.7.2 IWCS Emissions Associated with the Hypothetical Intrusion Scenarios

Potential breaching of the IWCS was evaluated for the following scenarios: earthquake, drilling, heavy equipment, and animal intrusions. The radon flux estimates previously generated for the excavation analysis of the IWCS layers were used as the basis for the emission rates for the intrusion scenarios, as discussed below. Downwind air concentrations were estimated utilizing CAP88 atmospheric modeling for a unit emission rate (see Appendices B and C).

The cap intrusions were assumed to impact Bay A where residues with the highest radium concentrations are stored. The estimated emission rate of radon was determined for the following hypothetical scenarios for which cap integrity of the IWCS may be compromised.

Unit area flux estimates previously generated for the hypothetical excavation scenarios were the basis for the radon emission rates from the IWCS layers and, subsequently, the downwind air concentrations for the hypothetical intrusion scenarios. The estimated flux associated with various layers within the IWCS is presented in Appendix B for selected downwind distances under extremely stable short-term weather conditions, slightly unstable short-term weather conditions, and historical long-term weather conditions (see Appendix C).

5.7.2.1 Damage Due to the Use of Heavy Equipment

This hypothetical scenario involves heavy equipment accidentally digging into the side of the IWCS and destroying part of the Bay A wall. Under this scenario, this damage is assumed to be caused by a person or persons unaware that high-activity residues are stored in the IWCS. Contact with the residues using heavy equipment could most easily be achieved on the east side of the IWCS where the residues in Bay B are closest to the cap materials. However, as a conservative, worst-case evaluation for this hypothetical scenario, it was assumed that the heavy equipment intrudes on the west side of the IWCS and encounters the Building 411 foundation just north of Bay A, which contains the K-65 residues (see Figure 1-4). When the heavy equipment encounters Building 411, it exposes the north face of Bay A. This failure scenario assumes that heavy construction equipment would pull down or otherwise destroy a significant portion of the Bay A north side sidewall. Although the western sidewall of Bay A would be likely be encountered first with this approach, it was determined that collapse of the north or south sidewall would be more conservative. Therefore, the north sidewall of Bay A was used for modeling purposes. Bay A runs approximately 14.9 m (49 ft) along the long dimension of the IWCS (Figure 5-7). Residues in Bay A are 4.9 m (16 ft) deep; thus, under this scenario, there is a potential to expose a 73 m^2 (784 ft^2) surface area of K-65 residues. To prevent total collapse of Building 411, portions of the corners are assumed to not be demolished during the intrusion; therefore, approximately 14.0 to 14.3 m (46 to 47 ft) are exposed and the exposed source area is assumed to be 69 m^2 (742 ft^2) of K-65 residue. The source is assumed to be directly exposed to the atmosphere.

Assuming negligible contributions from other materials within the IWCS and a unit rate of 0.51 pCi/m^2/sec per 1 pCi/g of radium-226, the radon emission rate through exposed residues is calculated as shown in Equation 6:

$$\left(0.51\frac{pCi_{Rn}\cdot g}{pCi_{Ra}\cdot m^2\cdot \sec}\right)\times\left(520{,}000\,pCi_{Ra}/g\right)\times\left(69m^2\right)=1.8\times10^7\ pCi_{Rn}/\sec \qquad (6)$$

A radon flux of 2.67×10^7 pCi/m^2/sec converts to 581 Ci/year through the 69 m^2 exposed wall.
The assumptions developed for this scenario (damage due to the use of heavy equipment) are as follows:

- A heavy equipment-induced failure of bay walls within the IWCS.
- Exposure of a 69 m^2 (742 ft^2) source area.
- Negligible contributions from other materials within the IWCS and a unit rate of 0.51 pCi/m^2/sec per 1 pCi/g of radium-226.
- A radon flux of 2.67×10^7 pCi/m^2/sec converts to 581 Ci/year through the exposed wall.
- A release height of 0 m (0 ft) was used for conservatism in the model.

5.7.2.2 Damage Due to an Earthquake

As discussed in Section 4.2.2, the likelihood of an earthquake occurring at NFSS that would cause any significant damage, other than minor cap cracks, would be rare. An earthquake occurring at or near the NFSS would likely exhibit a magnitude that is relatively small to moderate (i.e., 5.6 to 5.8 or less on the Richter scale) and would not likely reach the magnitude and intensity required to produce major ground fissuring resulting in a breach of the IWCS. Therefore, no on-site or off-site radon releases would be expected. However, USACE chose to evaluate an alternate hypothetical earthquake scenario to assess what the minimum crack depth would need to be to begin to cause unacceptable, long-term radon concentration levels off-site.

This hypothetical scenario involves earthquake vibrations that rupture buried structures and produce a breach in the IWCS cap thus exposing a small portion of the K-65 residues. Figure 4-7 shows a schematic of hypothetical development of fissures in the IWCS cap due to an earthquake. The details regarding the IWCS area associated with this crack, or fissure, are presented in Figure 5-8.

The radon flux in this hypothetical scenario is based on a concentration gradient that drives diffusive movement of radon through soil. As radon is heavier than air, radon would be likely to collect in the bottom of any subsurface void (in this case, a fissure) in the IWCS after diffusion into the area of zero radon concentration (immediately after the void, or fissure, appears). The radon would diffuse into the fissure from the surface of the exposed source area along the interior of the fissure. This surface area consists of two exposed surfaces of residues, one on each side of the fissure opening. The release of radon would come from both sides of the fissure.

For this scenario, an earthquake is assumed to open a 50 m (164 ft) fissure across the IWCS and Bay A, down to a depth of approximately 3.9 m (12.8 ft), which is a depth that would expose a small portion of the K-65 residues in Bay A, thus exposing two 195 m^2 (2,098 ft^2) walls to the open air. The assumed depth of the fissure is based on the minimum depth at which an unacceptable air concentration at the site boundary would occur (see Appendix E). The fissure width at the opening on the surface of the IWCS is assumed to be 0.31 m (1.0 ft) across, equal to an opening area of 15 m^2 (160 ft^2). The estimated radon flux for the earthquake fissure is 4,500 pCi/m^2/sec, which converts to 55 Ci/year for a 390 m^2 (4,196 ft^2) area, and is based on the average flux for all exposed layers of source material.

The assumptions developed for this scenario (damage due to an earthquake) are as follows:

- Loss of cap integrity due to a fissure from an earthquake.
- Exposed source area of 390 m^2 (4,196 ft^2) [see Figure 5-8].
- Average emission rate along the fissure depth of 1.8 x 10^6 pCi/m^2/sec (55 Ci/year).
- A release height of 0 m (0 ft) was used for conservatism in the model.

5.7.2.3 Damage Caused by Drilling into the Residues

This hypothetical scenario involves an inadvertent penetration, similar to what might be experienced through exploratory drilling or drilling associated with obtaining core samples of the residues within the IWCS. To provide for the maximum radon release potential, the drilling is assumed to occur over Bay A where the K-65 residues are stored, as illustrated in Figure 4-8.

The radon flux in this hypothetical scenario is based on a concentration gradient that drives diffusive movement of radon through soil. As radon is heavier than air, radon would be likely to collect in the bottom of any subsurface void (in this case, a drilled boring) in the IWCS after diffusion into the area of zero radon concentration (immediately after the void, or boring, is created). The radon would diffuse into the boring from the surface of the exposed source area along the interior of the boring. This surface area consists of a vertical cylindrical surface of residues within the boring. The release of radon would come from the entire length of the boring. The exposed source area is assumed to be within the K-65 residues in Bay A, which represents the worst case should the boring be drilled into Bay A.

The scenario assumes that a 0.15 m (0.5 ft)-diameter hole is drilled through the center of Bay A. In this assessment, the installation of the 0.15 m (0.5 ft) well represents the upper bounding conditions for both intrusion situations because it exposes a larger surface area for release of radon. The radon levels associated with a smaller drilling diameter (e.g., 0.05 m [0.16 ft] boring) are expected to be less than those associated with the 0.15 m (0.5 ft) boring; therefore, only modeling results for installation of the 0.15 m (0.5 ft) well are presented.

For this assessment, the exposed K-65 residue surface source area was assumed to be a 0.15 m (0.5 ft) diameter cylindrical surface with a depth of 4.9 m (16 ft) [height of the K-65 residues]. Assuming the radium-226 content in compacted contaminated soils is negligible relative to underlying K-65 residues, such action could expose a linear 4.9 m (16 ft) of K-65 residues for a total surface area[c] of 2.3 m^2 (24.7 ft^2) [see Figure 5-9]. With a unit rate of 0.51 pCi/m^2/sec per 1 pCi/g of radium-226, the radon emission rate through exposed residues and, ultimately, the surface of the IWCS is calculated as shown in Equation 7:

$$\left(0.51\frac{pCi_{Rn}\cdot g}{pCi_{Ra}\cdot m^2\cdot \sec}\right)\times\left(520{,}000\,pCi_{Ra}/g\right)\times\left(2.3m^2\right)=6.1\times10^5\ pCi_{Rn}/\sec \qquad (7)$$

A radon emission rate of 6.1×10^5 pCi/sec converts to 19.4 Ci/year through the borehole opening of 0.018 m^2 located approximately 18 m (60 ft) from the base of the IWCS.

[c] Area of cylinder = circumference × length = $2\pi R \times L$.

The assumptions developed for this scenario (damage caused by drilling into the residues) are as follows:

- Advancement of a boring through the cap, which is, subsequently, left unsealed.
- Exposure of a 2.3 m^2 (25 ft^2) [see Figure 5-9] source area consisting of the surface area of the boring walls.
- A unit rate of 0.51 pCi/m^2/sec per 1 pCi/g of radium-226.
- A radon emission rate of 6.1×10^5 pCi/sec converts to 19.4 Ci/year through the borehole opening of 0.018m^2 (0.19 ft^2).

5.7.2.4 Damage from a Burrowing Animal

This hypothetical scenario involves a burrowing animal penetrating into the IWCS and into the K-65 residues in Bay A. Figure 4-9 shows a schematic of hypothetical intrusion of the IWCS by a groundhog or some other burrowing animal. This scenario assumes that a groundhog (i.e., woodchuck) builds a den in the IWCS. A groundhog den consists of a network of tunnels and a nest. On average, the tunnel opening is approximately 0.31 m (1.0 ft) wide and narrows to approximately 0.15 m (0.5 ft) in diameter and ends in a 0.41 m (1.3 ft) wide by 0.36 m (1.2 ft) long or 0.38 m (1.25 ft) spherical nest (Schwartz 2001; Light 2001). The lengths of the tunnels vary but can be as long as 15 m (50 ft). In general, groundhogs do not develop their dens greater than 1.5 m (5 ft) deep; however, in this scenario, the worst-case is assumed and the groundhog penetrates the K-65 residues in Bay A. The source area for this scenario is the surface area of the nest only. For simplicity, the nest is considered to be a 0.41 m (1.3 ft) diameter sphere, which accounts for the largest dimension of a potential nest, as noted above. The nest area is approximately 0.53 m^2 (5.7 ft^2), as illustrated in Figure 5-10. The opening of the 0.31 m (1.0 ft) diameter tunnel on the surface of the IWCS is 0.073 m^3 (0.002 ft^3).

It is extremely unlikely that an animal could reach the residues because the K-65 residues are 3.8 m (12.46 ft) in Bay A and 6.5 m (21.32 ft) in Bay C; however, summary results presented in this section are based on this worst-case assumption. The burrowing animal is assumed to reach the K-65 residues. Results for a burrowing animal at various levels within Bay A are presented in Appendix C.

The radon flux in this hypothetical scenario is based on a concentration gradient that drives the diffusive movement of radon through soil. As radon is heavier than air, radon would be likely to collect in the bottom of any subsurface void (in this case, an animal den) in the IWCS after diffusion into the area of zero radon concentration (immediately after the void, or den, is created). The radon would diffuse into the den from the surface of the exposed source area along the interior of the den. This surface area consists of a cylindrical tunnel and an animal nest. However, only the nest is assumed to be located within the radium-bearing materials and, thus, the release of radon would only come from the exposed surface area of the nest. The exposed source area is assumed to be within the K-65 residues in Bay A, which represents the worst case should an animal burrow into Bay A.

Assuming the radium-226 content in compact contaminated soil is negligible relative to underlying K-65 residues, this scenario could expose a nest area of 0.53 m^2 (5.70 ft^2) of K-65 residue. Because only the nest is assumed to be located within the K-65 residue, only the area of the nest contributes to the source area, which is 0.53 m^2 (5.70 ft^2). With a unit rate of 0.51 pCi/m^2/sec per 1 pCi/g of radium-226, the radon flux through exposed residues, and ultimately the surface of the IWCS, is calculated as shown in Equation 8:

$$\left(0.51\frac{pCi_{Rn}\cdot g}{pCi_{Ra}\cdot m^2\cdot \sec}\right)\times\left(520{,}000\,pCi_{Ra}/g\right)\times\left(0.53m^2\right)=1.4\times10^5\ pCi_{Rn}/\sec \qquad (8)$$

A radon release rate of 1.4×10^5 pCi/sec converts to 4.5 Ci/year from the den area of 0.53 m^2 (5.7 ft^2) located within the K-65 residues.

The assumptions developed for this scenario (damage from a burrowing animal) are as follows:

- Habitation by an animal constructing an access tunnel and nest within the IWCS.
- Only the area of the nest contributes to the source area of emission, which is equal to 0.53 m^2 (5.70 ft^2).
- A unit rate of 0.51 pCi/m^2/sec per 1 pCi/g of radium-226.
- A radon release rate of 1.4×10^5 pCi/sec converts to 4.5 Ci/year through the tunnel opening coming from the den/nest area, which is 0.073 m^2 (0.81 ft^2) located within the K-65 residues.

5.8 OTHER SOURCES AND ASSUMPTIONS

Fluor Daniel Fernald estimated radon level reductions for residues stored at the Fernald facility that were covered with a layer of water (FDF 1998). The relationship is presented in inches of water, as shown in Equation 9:

$$WSF_{Rn} = e^{-(0.0717\times t_W)} \tag{9}$$

Where:

WSF_{radon} = the water-shielding function for radon (unitless),
0.0717 = derived coefficient relating water cover thickness to radon releases (in.$^{-1}$),
t_W = thickness of the water cover layer (in.).

The Fernald residues are likely sufficiently similar to the K-65 residues stored in the IWCS; therefore, the same radon flux relationship holds at NFSS.

The safety analysis associated with transfer of the K-65 residues to the IWCS (Keller 1986) cited literature values averaging 0.7 pCi/m^2/sec from uranium tailings and presented a design value of 0.6 pCi/m^2/sec per 1 pCi/g radium-226, as representative of wet K-65 residues. Using the wet value with a radium concentration of 520,000 pCi/g results in a predicted radon flux of 312,000 pCi/m^2/sec at the surface of the residues, which compares well with the estimated flux of 270,000 pCi/m^2/sec presented in Appendix A.

Measurements taken during the transfer of K-65 residues to the IWCS (Keller 1986) indicated maximum on-site average air concentrations of 6 pCi/L associated with mechanical dumping of the last of the residues into Building 411. With the exception of these elevated concentrations, the on-site averages during the transfer process were below 2 pCi/L, with the majority below 1 pCi/L. Most of the off-site average air concentrations during transfer were less than 1 pCi/L, with a maximum of 2.6 pCi/L during the peak of the transfer process in the fall of 1984.

5.9 UNCERTAINTIES

Uncertainties in the analysis include the following:

- Radium source concentration measurements;
- Calculation of radon emission within the IWCS layers;
- Estimated diffusion from the IWCS layers to the atmosphere;

- Mechanism for radon release from voids within the IWCS layers, created by the hypothetical intrusion scenarios;
- Use of a simplified box model for estimating on-site air concentrations;
- Assumptions regarding the effective source area length for on-site air concentrations;
- Basis of calculating area factors for on-site air concentrations; and
- CAP88 assumptions for off-site air concentration estimates.

The concentration measurements of the radium source are considered accurate; however, the maximum values are generally used to provide a conservative estimate and account for variability in the actual source concentration. For example, measurements of the K-65 during slurry transfer indicated concentrations were lower than those used in this evaluation (USDOE 1986f). There are uncertainties associated with the actual radon-222 concentration results using these average radium-226 concentrations. There may be isolated areas where the radium-226 concentrations are higher than the values used for the analyses, thus resulting in slightly higher radon-222 concentrations in those isolated areas. There may be isolated areas where the actual radium-226 concentrations are less than modeled, thus resulting in lower radon-222 concentrations in those areas.

The calculation of radon flux from the radium source material is based on validated models that are likely to provide an accurate estimate of the pore concentrations. The pore concentrations are then used to estimate the radon flux, which diffuses through the IWCS layers and is released to the atmosphere.

The IWCS flux estimates are based on homogeneous waste layers in terms of porosity, moisture content, etc. Although heterogeneity likely exists within the IWCS, over a long-term assessment period, these variations are likely to average out.

For releases from the IWCS during the hypothetical intrusion scenarios, significant uncertainty exists in the mechanism for radon movement to the atmosphere. Diffusive movement from the subsurface intrusion voids is the most likely transport mechanism but results in air concentrations several orders of magnitude lower than those for convective movement. Convective movement is likely to result in the most conservative estimates of air concentrations and is used as the basis for all calculations in this evaluation (see Appendix A).

The calculation of diffusive releases from the intrusion scenarios required the use an assumed air concentration within the subsurface void that is created. Since this concentration is unknown, several sources were investigated to provide a conservative value for this parameter. Data collected from the NFSS silo where the K-65 residues were stored, indicated a concentration in the headspace of 4 to 117 nanocuries (nCi/L) or $4x10^6$ to $1.2x10^8$ pCi/m^3 (USDOE 1981, p. 3-4). The analysis of radon emission from the K-65 in the FEIS indicated a maximum estimated radon air concentration of $2x10^8$ pCi/m^3 (USDOE, 1986a, Table 4-24) based on a radium concentration of 520,000 pCi/g in the K-65 residues. To provide a conservative estimate of potential radon releases due to diffusion, the maximum air concentration in the subsurface void was assumed to be $2x10^8$ pCi/m^3. However, this value is uncertain, and selection of a value within the range instead of using the maximum would result in significantly lower estimated air concentrations due to diffusion.

On-site air concentrations were estimated with the simplified box model from RESRAD, which required several assumptions regarding wind speed, source geometry, mixing height for the receptor, etc. Parameters used in the calculation were selected to provide conservative results but introduce uncertainty in the estimated air concentrations. Two key parameters are the source area (used to calculate the area factor) and the effective length of the source area (used in the radon decay term of the equation). The parameter values for the excavations and equipment damage scenarios are less uncertain because the

source material is directly exposed to the atmosphere. Appendix A presents the results for a range of source configurations. For the intrusion scenarios, where the source area is exposed to a void space below the ground surface, it is uncertain whether to use the source area or the area of the surface opening in assigning the parameter values. The area factors are assumed to be used based on the opening area because that is the source of the emitted radon. The effective lengths for the drilling and burrowing were the respective diameters of the surface opening and the lengths of the fissure for the earthquake scenario.

For the excavation scenarios, scaling factors are proposed to generate air concentration estimates for source areas of different sizes. Calculations were based on a 100 m^2 excavation; however, there are several instances where a larger area may be uncovered. The uncertainties associated with this approach are presented in Appendix A.

The use of CAP88 to estimate off-site air concentrations of radon and progeny requires several key assumptions to approximate site conditions:

- Emissions are assumed to occur from ground level.
- Wake effects from trees/structures are neglected.
- Stable atmospheric conditions (Class G) persist for extended periods of time to approximate upper bound conditions.
- Emissions have an exit velocity of 0 m/sec (0 mph) to provide upper bound estimates of downwind concentrations.
- Emissions from intrusions are based on convective transport of radon; however, diffusive movement is more likely.

These assumptions provide an estimate of emissions and downwind concentrations of radon associated with intrusions into the IWCS. The simultaneous occurrence of all of the assumed conditions is highly unlikely, as is the occurrence of any single assumption. However, the assumptions are used to provide an upper bound estimate unlikely to be exceeded. The use of a long-term model, such as CAP88, to estimate air concentrations on a shorter-term scale introduces uncertainty to the evaluation. The CAP88 model calculates an annual average air concentration that incorporates years of averaged meteorological data to represent a long-term steady-state condition. Modeling the dynamics of a radon release over a shorter time period (e.g., hours or days) would require similarly detailed meteorological data over these same time periods. Although the use of a short-term air model might result in more refined estimates of air concentrations, the use of conservative assumptions within the longer-term air model is not likely to result in significant underestimation of off-site air concentrations. This would especially be true for time periods of 24 hr or greater when any short-term effects would become less important.

Additional uncertainty exists in the use of the default CAP88 meteorological data set for Niagara Falls International Airport from the 1950s. It is not clear that this dataset is representative of current conditions. Although long-term trends in annual average wind speed were relatively consistent, the use of more recent meteorological data would reduce the uncertainty. Additionally, utilizing wind data collected specifically from the IWCS would further reduce the uncertainty, since specific ground structures (e.g. trees, buildings) would influence the measured wind speed and direction. However, although this data is historical, it has been through significant validation and verification.

Although no formal sensitivity analysis was performed on the model variables, the radon evaluation explored a range of atmospheric conditions to provide perspective on the impact of wind speed in estimated air concentrations. Results were generated for long-term meteorological conditions, as well as for extremely stable short-term weather conditions and slightly unstable short-term weather conditions. The magnitude of modeling sensitivity to wind speed and wind direction distribution is incorporated into

these results. The air concentration results are sensitive to the wind speed selected for both the on-site and off-site evaluation. Lower wind speeds result in higher estimated air concentrations. Although a minimum wind speed was selected based on historical meteorological information, there is uncertainty in the value for the minimum wind speed used in the evaluation.

The limitation in the models used also produced some uncertain results, particularly for the intrusion scenarios involving small source areas. The on-site model utilizes an area factor that reduces air concentrations based on the source size relative to a $100m^2$ area. Since the drilling and burrowing scenarios involve a small opening at the surface of the IWCS, predicted air concentrations are very small. This conflicts with the off-site modeling which predicts a higher concentration 250-m downwind than is estimated for on-site. The CAP88 model is a long distance, long term model that produces uncertain results at locations close to the source and may be overestimating the air concentration. The off-site results are also reported for the direction of maximum air concentration, while the on-site model assumes a wind distribution from all directions. If the off-site air concentration considered winds from all directions, the estimated air concentrations would likely be more consistent.

Air concentrations results for a unit emission for each of the Stability Classes (A through G) were included in the CAP88 model. For the bounding short-term off-site modeling results, the extremely stable short-term weather conditions were simulated using an atmospheric Stability Class of G with a wind speed of 1 m/sec (2.2 mph). Although E and F stability classes are often used to model short-term conditions**,** the air concentrations under Class G were included as they were the most conservative. If Class F at 1 m/s was assumed instead of Class G for the bounding condition, then the current air concentrations at 250 m would fall by a factor of approximately 2.4 (see Table B-6) from 137 pCi/L to approximately 58 pCi/L, which is below the 100 pCi/L limit for the hypothetical excavation scenario for removal of the K-65 residues and for the excavation of all residues scenario. The excavation scenario for removal of the entire IWCS contents would result in air concentrations of approximately 116 pCi/L which would also exceed the limit.

For the typical short-term off-site results, Class C conditions were selected to represent a conservative unstable atmosphere (Classes A, B, and C). Although the meteorological dataset indicates a higher percentage of observations are Class D, the low wind speeds modeled were more typically associated with the unstable atmospheric classes (A, B, and C) during conditions of slight solar radiation (see Table B-4). If Class D at 1 m/s was assumed instead of Class C for the typical condition, air concentrations would approximately double (see Table B-6) but would also not exceed the 100 pCi/L limit.

6. MODELING RESULTS

This section presents the results associated with the various scenarios discussed in Section 4.0. The detailed calculations supporting the results presented in this section are contained in Appendices A, B, C, and D. Evaluation results for each of the IWCS hypothetical scenarios indicate the specific purpose(s) for the results in terms of whether they support one or more of the following:

- FS alternative design considerations,
- Worker safety, or,
- Potential impacts to the public.

Modeling results for outdoor flux and outdoor air radon concentrations are provided for each 0.15 m (0.5 ft) layer of the IWCS assuming a total exposed area consistent with the scenario under evaluation. This approach assumes some future action, such as IWCS excavation, exposes contaminated soil to an unspecified depth. The results are only for the defined contaminated area and do not include contributions from average ambient outdoor radon levels. The objective is to estimate potential impacts from buried materials that, as discussed below, can produce radon at levels well above background. Background radon levels are, therefore, negligible for the purpose of this evaluation and are not included in the results presented.

6.1 SUMMARY OF MODELING COMPARISON CRITERIA

The results of the flux and air concentration modeling presented in the following sections are compared to selected regulations for radon-222 levels as presented in Section 3.9 and summarized below.

6.1.1 Flux Criteria

The criteria selected for comparison with flux modeling results states that states that the facility shall emit no more than 20 pCi/m^2/sec of radon into the air as an average for the entire source.

6.1.2 Air Concentration Criteria

Long-term releases are assumed to occur over a long period (e.g., several months to 1 year or more) where no corrective actions have been taken to reduce or eliminate the release of radon. The radon levels are expressed in terms of annual average results and are based on the historical long-term weather conditions used in this technical memorandum. As discussed previously in Section 3.0, there are two Federal standards regarding public annual average radon-222 levels: 40 *CFR* Part 192 (0.5 pCi/L) and 10 *CFR* Part 20 (10 pCi/L without daughters and 0.1 pCi/L with daughters).

The USDOE standard for allowable off-site releases above background levels is an annual average of 3 pCi/L. Therefore, the results presented in this technical memorandum regarding long-term releases (i.e., annual average levels using the historical long-term weather conditions) were compared to the 0.1, 0.5, and 3 pCi/L standards.

Short-term releases are assumed to occur for a short period (e.g., from a few hours or days to less than 1 month). Should the release continue for a significant period of time (e.g., corrective actions not taken), then the wind speed, wind direction, and atmospheric conditions (i.e., stability class) would be constantly changing over this longer period. At this point, the air concentration results would be those similar to, if not the same as, the off-site long-term release results based on annual average meteorological data. Two meteorological conditions were modeled to provide radon levels associated with short-term conditions.

These are the slightly unstable short-term weather conditions and the extremely stable short-term weather conditions (atmospheric conditions providing minimal dispersion of released materials). As discussed in Section 3.9, an estimated standard for short-term releases was developed based on the annual average NRC limit of 0.1 pCi/L. That value is 100 pCi/L of radon-222 for a cumulative exposure period of 8 hr. This value was used in the evaluation of the off-site, short-term release results.

The occupational standards (i.e., derived air concentrations) included in Table 3-1 for radon-222 are 4,000 pCi/L (without daughters) and 30 pCi/L (with daughters). These values, derived from 10 *CFR* 20, Appendix B, Table 1, correspond to the radon air concentration that would result in a total effective dose equivalent of 5 rem/year or an organ dose of 50 rem/year, whichever is more restrictive. The stated concentration is based on an exposure period of 2,000 hr/year. The 30 pCi/L radon standard is used in the assessments contained herein for occupational exposures. The 4,000 pCi/L value is used to assess exposures associated with the initial release of radon-222, which would have little to no daughters present.

6.2 SUMMARY OF FLUX MODELING RESULTS

The details regarding the flux modeling results are presented in Appendix A. The IWCS cap was constructed using the topsoil, clean clay, and low-level contaminated waste clay soils. Each of the three cover layers was compacted during cap construction, effectively increasing bulk waste densities while reducing soil moisture levels and porosities (USDOE 1986e). Compaction constricted the pore space through which radon flows and reduced the mean free path of radon by a factor of two or better[d]. The effect is that radon originating from the K-65 residues is delayed along the soil column long enough to decay and not contribute to outdoor radon levels, as confirmed by flux measurements taken across the surface of the IWCS (USACE 2009b). Over Bay A, for example, the modeled flux starting at an estimated 270,000 pCi/m^2/sec (at the K-65 residue boundary) is reduced to environmental levels within the clean clay layer about 3.2 m (10 ft) up the soil column or about 0.6 m (2 ft) from the top of the cap. These modeled results are consistent with, although more conservative than, observed environmental radon flux levels measured at the surface of the IWCS (USACE 2009b). These results also indicate that should the top 0.6 m (2 ft) of cover over the residues be removed, either intentionally or through erosion, the radon flux would exceed the standard of 20 pCi/m^2/sec as specified in Table 3-1.

Using the K-65 radon flux and radium-226 concentrations from Table A-1 in Appendix A, the estimated flux of radon from the K-65 residues is 0.51 pCi/m^2/sec per 1 pCi/g of radium-226. This value is slightly lower than the 0.6 pCi/m^2/sec per 1 pCi/g of radium-226 value predicted for Fernald residues (FDF 1998) but is consistent given the uncertainties and serves as a quality assurance checkpoint for the high range of radium-226 activity. The estimated radon flux value of 0.51 pCi/m^2/sec per 1 pCi/g of radium-226 is used for each of the hypothetical intrusion scenarios where contact is made with the K-65 residues, as discussed in the following sections.

6.3 SUMMARY OF AIR CONCENTRATION MODELING RESULTS

The maximum on-site air concentration estimates are presented in Table 6-1 for the evaluated excavation and intrusion scenarios, assuming a historical long-term weather wind speed of 4.5 m/sec (10 mph) and an extremely stable short-term weather conditions wind speed of 1 m/sec (2.2 mph). The on-site receptor is assumed to be directly over the center of the exposed source area for each scenario considered. On-site air concentrations for the 100 m^2 excavation scenarios at a wind speed of 4.5 m/sec, ranged from 0.0004 pCi/L at the top of the intact IWCS (see Appendix A) to 240 pCi/L when encountering the K-65

[d] Mean free path in general soil ~0.8 m (2.6 ft) or ~0.4 m (1.3 ft) or less in compacted soil. A mean free path is defined here as the average distance a radon atom will travel through a medium before decaying.

residues (Bay A or C). For a wind speed of 1 m/sec, the on-site excavation air concentrations ranged from 0.002 pCi/L at the top of the intact IWCS (see Appendix A) to 1,100 pCi/L in the K-65 residue.

On-site intrusion scenario air concentrations were generated for both convective and diffusive transport at two different wind speeds and are reported in Appendix A. The results based on convective radon transport are many orders of magnitude above the diffusion results and therefore are reported in Table 6-1. The maximum on-site air concentration is estimated to be approximately 810 pCi/L for equipment damage and convective transport at a wind speed of 1 m/sec. The lowest estimated on-site radon air concentration of 2.24E-06 pCi/L was associated with drilling and diffusive transport at a wind speed of 4.5 m/sec (see Appendix A). For comparison, the measured on-site radon air concentration above the IWCS in 2008 were mainly below the detection limit of 0.2 pCi/L but had a maximum of 0.3 pCi/L.

Off-site atmospheric modeling results are summarized in Table 6-2 for a unit emission to provide a comparison between air concentrations predicted for the three meteorological conditions evaluated: extremely stable short-term weather conditions (Stability Class G at 1 m/sec [2.2 mph]), slightly unstable short-term weather conditions (Stability Class C at 1 m/sec [2.2 mph), and historical long-term weather conditions (CAP88 file for Niagara Falls International Airport). Results for each meteorological condition showed a decrease of approximately 10 times when moving downwind from 250 m (820 ft) to 1,000 m (3,300 ft) [see Table 6-2]. Estimated air concentrations for the extremely stable short-term weather conditions are usually at least 10 times greater than those for the slightly unstable short-term weather conditions. This is expected because the extremely stable short-term weather conditions represent atmospheric conditions that have little movement and minimal dispersion of released materials and are anticipated to be more stable than slightly unstable short-term weather conditions. Similarly, the results for slightly unstable short-term weather conditions are usually at least 10 times greater than the results for the historical long-term weather conditions.

Each hypothetical excavation and intrusion scenario was evaluated to estimate the ground level radon air concentrations at various distances downwind of the IWCS. Off-site air concentration modeling results for specific excavation/intrusion scenarios are summarized in Table 6-3 for two downwind distances: the minimum site boundary (250 m [(820 ft]) and 2,000 m (6,600 ft). The latter distance of 2,000 m (6,600 ft) represents the distance where the annual average radon levels under historical long-term weather conditions were found to be well below the regulatory level of 0.5 pCi/L selected for comparison. Radon levels at this distance are also below the NRC limit of 0.1 pCi/L for all scenarios. The maximum concentration at 2,000 m (6,600 ft) with historical long-term weather conditions was less than 0.06 pCi/L for excavation of the entire IWCS (Bay A, B, C, D).

Table 6-3 also presents the off-site concentration of radon-222 at 250 m (820 ft) of 2.4 pCi/L under historic long-term weather conditions for excavation of waste in the entire IWCS (Bay A, B, C, D) which compares well to the actual measured fence line radon concentration of 2.58 pCi/L during the K-65 transfer (see Section 2.2.3). The actual measured fence line concentration of 2.58 pCi/L most likely occurred during the peak of the slurry transfer operations when the K-65 residues were placed in the Building 411 bays, prior to placement of overlying materials, and was associated with approximately a 1 to 2 month period. These conditions are similar to the hypothetical scenario where Bay A is exposed for removal of the K-65 residues. These results were compared to the long-term release results because those results are based on average atmospheric conditions expected at the site for periods longer than a few days. The short-term results were not used for comparison because they represent atmospheric conditions (e.g., steady wind speed, single atmospheric stability conditions with no changes, etc.) that would typically only be present for a very short time (e.g., hours to days) and not likely to exist throughout the entire time the residues were being transferred.

The results for modeling off-site air concentrations for various distances in 16 different wind rose directions are included in Appendix C. Air concentrations are plotted for each of the modeled locations, which are at distances of 250 m (820 ft) to 75 km (47 mi) from former Building 411. Figures 6-1 through 6-6 present air concentration results in comparison to the off-site annual average limits of 0.1, 0.5, and 3 pCi/L. The estimated air concentrations are generated from flux calculations (see Appendix A) and air dispersion modeling (see Appendices B and C). Tables 6-4, 6-5, and 6-6 present the modeling results for the specific hypothetical receptors for the historical long-term weather conditions, the slightly unstable short-term weather conditions, and the extremely stable short-term weather conditions, respectively. The results for the hypothetical off-site receptors locations are also presented in Figures 6-1 through 6-6.

6.4 AIR CONCENTRATION MODELING RESULTS FOR THE HYPOTHETICAL EXCAVATION SCENARIOS

Air concentrations were generated to determine the peak flux for layers within the IWCS and to assess average emission rates that might be encountered if excavation proceeded through all layers at an equal rate (see Appendix A). Results for the hypothetical excavation scenarios are described in the following sections. Figure 4-1 shows a schematic of how excavation of the IWCS cap layers would proceed for removal of the contents of the IWCS. This schematic is applicable to the three hypothetical removal scenarios discussed below. A summary of modeling results for off- and on-site releases for the excavation scenarios is presented in Tables 6-7 and 6-8, respectively.

6.4.1 Removal of K-65 Residues within the Interim Waste Containment Structure

Removal of K-65 residues within the IWCS assumes excavation proceeds within Bay A, followed by excavation of Bay C, with only 100 m^2 (1,080 ft^2) of a single bay exposed at any one time. Detailed results are presented in Appendices A, B and C, and are summarized below. These results were developed using the assumptions presented in Section 5.7.1.1.

6.4.1.1 Off-site Releases

Figure 6-1 presents the estimated ground level annual average air concentrations (in pCi/L) associated with long-term releases under historical long-term weather conditions for removal of the K-65 residues scenario. As illustrated in Figure 6-1, off-site radon-222 concentrations for this scenario exceed the 0.1 pCi/L standard, and these concentrations are considered to be unacceptable. The maximum off-site concentration is 1.1 pCi/L at 250 m (820 ft) [see Table 6-3]. Although not directly comparable to air concentration measurements taken during transfer of the K-65, modeling results are compared to these values for informational purposes. The maximum modeled off-site concentration of 1.1 pCi/L at 250-m downwind is in reasonable agreement with the measured value of 2.58 pCi/L during residue transfer (see Section 2.2.3). The 0.1 pCi/L standard is exceeded at one hypothetical exposed receptor location (ESE landfill worker) during the excavation of the K-65 residues (Bays A and/or C) [see Table 6-4].

Results for a short-term release using slightly unstable short-term weather conditions indicate that the 100 pCi/L level is not exceeded at the site boundary or at any of the eight hypothetical receptor locations (Tables 6-3 and 6-5). Results for a short-term release using extremely stable short-term weather conditions indicate that the 100 pCi/L level is exceeded at the site boundary (137 pCi/L) during excavation of the K-65 residues in Bays A or C but not at any of the eight hypothetical receptor locations (Tables 6-3 and 6-6).

Based on modeled off-site air concentrations for this scenario that indicate the potential to exceed concentration limits or standards, a radon control/abatement system may be required prior to removal of the residues.

6.4.1.2 On-site Releases

As shown in Table 6-1, the on-site air concentrations range up to 240 pCi/L for the historical long-term weather wind speed (4.5 m/sec [10 mph]) and up to 1,100 pCi/L for the extremely stable short-term weather conditions wind speed (1 m/sec [2.2 mph]) [see Appendix A]. The results indicate that concentrations would not exceed the radon-222 occupational exposure limit of 4,000 pCi/L (without daughters), which would be associated with the initial release of radon when the materials are encountered. Although not directly comparable to air concentration measurements taken during transfer of the K-65, modeling results are compared to these values for informational purposes. The maximum modeled on-site concentration of 1,100 pCi/L for the lowest wind speed, was significantly higher than the measured value of 5.9 pCi/L during residue transfer (see Section 2.2.3). The discrepancy may be due to the placement of the monitoring equipment downwind of the source, while the model is predicting the air concentration directly above the source. Additionally, the weather conditions (particularly wind speed) may not have been similar to those assumed in the modeling.

Results indicate that concentrations may exceed the radon-222 occupational exposure limit of 30 pCi/L (with daughters), which would be associated with continued exposures after the initial release because the radon daughters will begin to be present. Therefore, worker protection would be necessary under this hypothetical scenario.

6.4.2 Removal of all Residues within the Interim Waste Containment Structure

The excavation of all residues within the IWCS assumes that individual bays are removed with only 100 m^2 (1,080 ft^2) of a single bay exposed at any one time. Detailed results are presented in Appendices A, B, and C and are summarized below. These results were developed using the assumptions presented in Section 5.7.1.2.

6.4.2.1 Off-site Releases

Under this hypothetical scenario, removal of Bays A and C is the controlling factor and, thus, the results are the same as discussed above for removal of the K-65 residues. Therefore, as illustrated in Figure 6-1, off-site radon-222 concentrations for this scenario exceeds the 30 pCi/L (with daughters) standards using historical weather data, and these concentrations are considered to be unacceptable. Similarly, results for a short-term release using slightly unstable short-term weather conditions indicate that the 100 pCi/L level is not exceeded at the site boundary or at any of the eight hypothetical receptor locations (Tables 6-3 and 6-5). Results for a short-term release using extremely stable short-term weather conditions indicate that the 100 pCi/L level is exceeded at the site boundary (137 pCi/L) but not at any of the eight hypothetical receptor locations (Tables 6-3 and 6-6).

Based on modeled off-site air concentrations for this scenario that indicate the potential to exceed concentration limits or standards, a radon control/abatement system may be required prior to removal of the residues.

6.4.2.2 On-site Releases

As indicated in Table 6-1, modeled air concentrations exceed the radon-222 occupational exposure limits of 30 pCi/L (with daughters). Therefore, worker protection may be necessary under this hypothetical scenario.

6.4.3 Removal of the Entire Contents of the Interim Waste Containment Structure

Excavation of the entire contents of the IWCS is assumed to include removal of Bays A, B, C, and D simultaneously, thus resulting in exposure of a 500 m^2 (5,400 ft^2) source area, as discussed in Section 5.7.1. Detailed results are presented in Appendices A, B, and C and are summarized below. These results were developed using the assumptions presented in Section 5.7.1.3.

6.4.3.1 Off-site Releases

Figure 6-2 presents the estimated ground level annual average air concentrations (in pCi/L) associated with long-term releases under historical long-term weather conditions for hypothetical removal of all the residues and other waste materials within the IWCS. Tables 6-3 and 6-4 present the off-site results for the historical long-term weather conditions. As illustrated in Figure 6-2, off-site radon-222 concentrations for this scenario exceed the standards. The maximum off-site concentration is 2.4 pCi/L at 250 m (820 ft). The 0.1 pCi/L standard is exceeded at three of the eight hypothetical receptor locations closest to the site. The results for these locations ranged from 0.11 to 0.32 pCi/L.

Results for a short-term release using slightly unstable short-term weather conditions indicate that the 100 pCi/L level is not exceeded at the site boundary nor at any of the eight hypothetical receptor locations (Tables 6-3 and 6-5). Results for a short-term release using extremely stable short-term weather conditions indicate that the 100 pCi/L level is exceeded at the site boundary but not at any of the hypothetical receptor locations. Under this scenario, the off-site radon-222 concentration is 286 pCi/L at the site boundary and 48 pCi/L at the location of the nearest resident (SSW resident), which is 662 m (2,200 ft) to the south-southwest of the IWCS (Tables 6-3 and 6-6).

Based on modeled off-site air concentrations for this scenario that indicate the potential to exceed concentration limits or standards, a radon control/abatement system may be required prior to removal of the residues.

6.4.3.2 On-site Releases

Summing the air concentrations for the individual bays given in Table 6-1 indicates that modeled air concentrations for removal of the entire IWCS ranged from 506 to 2,320 pCi/L. These results indicate that the radon-222 occupational exposure limit of 4,000 pCi/L (without daughters) is not exceeded but will exceed 30 pCi/L (with daughters). Therefore, worker protection may be necessary under this hypothetical scenario.

6.5 AIR CONCENTRATION MODELING RESULTS FOR THE HYPOTHETICAL INTRUSION SCENARIOS

Emissions due to intrusions of the IWCS are based on direct flux from exposed material and do not consider attenuation by overlying soil (see Appendix A). These hypothetical scenarios are based on direct exposure of the K-65 residues in Bay A to the atmosphere. Emission rates are based on the assumed amount of area exposed and a uniform emission rate of 0.51 (pCi_{Rn} - g)/(pCi_{Ra} - m^2 -sec) directly relating the radium-226 concentration to radon flux, as discussed previously. The following sections describe modeling results for the intrusion scenarios. A summary of modeling results for off- and on-site releases for the intrusion scenarios is presented in Tables 6-9 and 6-10, respectively.

6.5.1 Damage Due to the Use of Heavy Equipment

The modeling results for off- and on-site releases associated with hypothetical damage to the IWCS due to the use of heavy equipment are discussed below. These results were developed using the assumptions presented in Section 5.7.2.1. Results presented in Table 6-1 include an area factor to account for an exposed source area (69 m^2 [740 ft^2]) that was smaller than 100 m^2 (1,080 ft^2) [see Section 5.5].

6.5.1.1 Off-site Releases

Figure 6-3 presents the estimated ground level annual average air concentrations (in pCi/L) associated with long-term releases under historical long-term weather conditions for potential intrusion of the IWCS by a heavy equipment operator. As illustrated in Figure 6-3, off-site radon-222 concentrations for this scenario exceed the standards, and these concentrations are considered to be unacceptable. The maximum off-site concentration is 0.78 pCi/L at 250 m (820 ft). The 0.1 pCi/L standard is exceeded at the hypothetical receptor location closest to the site. The result for this location (off-site ESE landfill worker) is 0.11 pCi/L.

The maximum concentrations for a short-term release using slightly unstable short-term weather and extremely stable short-term weather conditions at 250 m (820 ft) were 7.6 pCi/L and 95 pCi/L, respectively (Tables 6-3, 6-5, and 6-6). These results indicate that the 100 pCi/L level is not exceeded at the site boundary nor at any of the eight hypothetical receptor locations.

Therefore, having no controls in place to preclude damage to the IWCS due to the use of heavy equipment may result in unacceptable off-site impacts to human health and the environment. This would be relevant in evaluating the No Action alternative in the IWCS OU FS.

6.5.1.2 On-site Releases

As shown in Table 6-1, the on-site air concentrations range up to 180 pCi/L for the historical long-term weather wind speed (4.5 m/sec [10 mph]) and up to 810 pCi/L for the extremely stable short-term weather conditions wind speed (1 m/sec [2.2 mph]) [see Appendix A]. These concentrations exceed both the occupational exposure limit of 30 pCi/L with daughters prescribed in 10 CFR 20, Appendix B, Table 1, and the effluent limits for members of the public established in 10 CFR 20, Appendix B, Table 2. As such, constraints on access to areas with elevated radon concentrations must be employed to control exposures to members of the public in addition to occupational worker protection measures.

6.5.2 Damage Due to an Earthquake

The radon modeling results for off- and on-site releases associated with damage to the IWCS due to an hypothetical earthquake are discussed below. These results were developed using the assumptions presented in Section 5.7.2.2. and reflect conditions that were modeled under the alternate earthquake scenario. Results presented in Table 6-1 include an area factor to account for a fissure opening area (15 m^2) that was smaller than 100 m^2 (1,080 ft^2) [see Section 5.5].

6.5.2.1 Off-site Releases

Figure 6-4 presents the estimated ground level annual average air concentrations (in pCi/L) associated with long-term releases under historical long-term weather conditions for hypothetical development of fissures in the IWCS cap due to an earthquake. As illustrated in Figure 6-4, no off-site radon-222 concentrations exceed the standards for this scenario from 250 m (820 ft) and beyond, which includes the eight hypothetical receptor locations. The earthquake evaluation was based on establishing a crack depth

that would not result in air concentration exceeding the 0.1 pCi/L limit at any distance beyond the site boundary (see Appendix E) under long-term meteorological conditions.

Results for a short-term release using slightly unstable short-term weather conditions and extremely stable short-term weather conditions indicate that the 100 pCi/L level is not exceeded at the site boundary nor at any of the eight hypothetical receptor locations (Tables 6-3, 6-5, and 6-6).

The evaluation of a hypothetical earthquake at NFSS indicated that no off-site concentration limits or standards are expected to be exceeded, and it is likely that no controls or response actions are needed for long-term exposures should an earthquake occur. This information would be relevant in evaluating the long-term effectiveness of the No Action, as well as any FS alternatives that might involve the residues remaining in their current location within the IWCS.

6.5.2.2 On-site Releases

As shown in Table 6-1, the on-site air concentrations for the alternate earthquake scenario range up to 57 pCi/L for the historical long-term weather wind speed (4.5 m/sec [10 mph]) and up to 260 pCi/L for the extremely stable short-term weather conditions wind speed (1 m/sec [2.2 mph]) [see Appendix A]. The results indicate that concentrations exceed the radon-222 occupational exposure limit of 30 pCi/L (with daughters). Under these conditions, prolonged exposure to a worker performing inspections as part of any alternative that might include surveillance activities of the IWCS could be unacceptable. As such, remedial alternatives evaluated in the FS should consider that respiratory protection controls may be required. In addition, special controls may be required to prevent access to the site. This information will be used in evaluating the long-term effectiveness of the No Action, as well as any FS alternatives that might involve the residues remaining in their current location within the IWCS.

6.5.3 Damage Caused by Drilling into the Residues

The modeling results for off- and on-site releases associated with damage to the IWCS due to drilling into the residues are discussed below. These results were developed using the assumptions presented in Section 5.7.2.3. Results presented in Table 6-1 include an area factor to account for a borehole opening area (0.018 m^2) that was smaller than 100 m^2 (1,080 ft^2) [see Section 5.5].

6.5.3.1 Off-site Releases

Figure 6-5 presents the estimated ground level annual average air concentrations (in pCi/L) associated with long-term releases under historical long-term weather conditions for hypothetical drilling into the IWCS residues. As illustrated in Figure 6-5, no off-site radon-222 concentrations exceed the standards for this scenario. Results for a short-term release using slightly unstable short-term weather and extremely stable short-term weather conditions indicate that the 100 pCi/L level is not exceeded at the site boundary nor at any of the eight hypothetical receptor locations (Tables 6-3, 6-5, and 6-6).

Because modeling results for off-site releases indicate that no concentration limits or standards are expected to be exceeded under this scenario, it is likely that no controls would be needed to preclude potential drilling into the residues to protect human health and the environment. This would be relevant in evaluating the No Action alternative in the IWCS OU FS.

6.5.3.2 On-site Releases

As shown in Table 6-1, the on-site air concentrations range up to 0.06 pCi/L for the historical long-term weather wind speed (4.5 m/sec [10 mph]) and up to 0.27 pCi/L for the extremely stable short-term weather conditions wind speed (1 m/sec [2.2 mph]) [see Appendix A]. It is interesting to note that the air concentration estimates for on-site are smaller than the off-site for the drilling scenario. This is because the on-site model is very sensitive to the source area, as an area factor is incorporated into the calculation, greatly reducing estimated air concentrations for source areas smaller than $100m^2$. The off-site model considers the source area to be equivalent to a point source a relatively short downwind distances, and is therefore much less sensitive to changes in the source area size. Additionally, the air concentration estimate of the off-site model at the 250-m location is subject to greater uncertainty, as the model equations are more accurate at larger downwind distances.

Because modeling results for on-site releases indicate that no concentration limits or standards are expected to be exceeded under this scenario, it is likely that no controls would be needed to preclude potential drilling into the residues to protect human health and the environment. This would be relevant in evaluating the No Action alternative in the IWCS OU FS. Also, no special precautions would be needed when drilling into the IWCS for sampling of the residues. This would be relevant in considering potential remedial alternatives in the IWCS OU FS.

6.5.4 Damage from a Burrowing Animal

The modeling results for off- and on-site releases associated with damage to the IWCS due to a burrowing animal are discussed below. These results were developed using the assumptions presented in Section 5.7.2.4. Results presented in Table 6-1 include an area factor to account for a tunnel opening area ($0.073\ m^2$) that was smaller than $100\ m^2$ ($1{,}080\ ft^2$) [see Section 5.5].

6.5.4.1 Off-site Releases

Figure 6-6 presents the estimated ground level annual average air concentrations (in pCi/L) associated with long-term releases under historical long-term weather conditions for hypothetical intrusion of the IWCS by a groundhog or some other burrowing animal. As illustrated in Figure 6-6, no off-site radon-222 concentrations exceed the standards for this scenario. Results for a short-term release using slightly unstable short-term weather and extremely stable short-term weather conditions indicate that the 100 pCi/L level is not exceeded at the site boundary nor at any of the eight hypothetical receptor locations (Tables 6-3, 6-5, and 6-6).

Because modeling results for off-site releases indicate that no concentration limits or standards are expected to be exceeded under this scenario, it is likely that no controls would be needed to preclude animal burrowing to protect human health and the environment. This information will be used in evaluating the long-term effectiveness of the No Action, as well as any FS alternatives that might involve the residues remaining in their current location within the IWCS.

6.5.4.2 On-site Releases

As shown in Table 6-1, the on-site air concentrations range up to 0.03 pCi/L for the historical long-term weather wind speed (4.5 m/sec [10 mph]) and up to 0.13 pCi/L for the extremely stable short-term weather conditions wind speed (1 m/sec [2.2 mph]) [see Appendix A]. It is interesting to note that the air concentration estimates for on-site are smaller than the off-site for the burrowing scenario. This is because the on-site model is very sensitive to the source area, as an area factor is incorporated into the calculation, greatly reducing estimated air concentrations for source areas smaller than $100m^2$. The off-site model

considers the source area to be equivalent to a point source a relatively short downwind distances, and is therefore much less sensitive to changes in the source area size. Additionally, the air concentration estimate of the off-site model at the 250-m location is subject to greater uncertainty, as the model equations are more accurate at larger downwind distances.

Modeling results for on-site releases indicate that no concentration limits or standards are expected to be exceeded under this scenario. Therefore, it is likely that no controls or actions would need to be taken for a worker performing routine inspections when approaching an animal burrow opening in the IWCS. This information will be used in evaluating the long-term effectiveness of the No Action, as well as any FS alternatives that might involve the residues remaining in their current location within the IWCS.

7. CONCLUSIONS

The results of the radon assessment for seven hypothetical scenarios for excavation of residues and wastes from the IWCS and the hypothetical intrusion events were evaluated in this technical memorandum. The hypothetical excavation scenarios were identified to examine possible on- and off-site radon releases and associated radon concentrations in support of the assessment for the removal action alternatives (e.g., detailed descriptions, costs estimates, protectiveness, comparative evaluations, etc.) in the IWCS OU FS.

7.1 POTENTIAL EXPOSURE LEVELS OF HYPOTHETICAL EXCAVATION SCENARIOS

Three hypothetical excavation scenarios were evaluated, and the conclusions for the three scenario evaluations are discussed below.

7.1.1 On-Site Levels

Bays A, B, C, and D of Building 411 are areas within the IWCS that hold the most potential for radon generation. For excavation of the IWCS storage bays, all four bays (A, B, C, and D) were estimated to have radon flux above the annual average standard of 20 pCi/m^2/sec once an excavation depth of 1 m (3.28 ft) was reached. This depth corresponds with the lower portion of the compact clay IWCS cap beneath the topsoil. Results indicate that the cap must be maintained to meet the standard of 20 pCi/m^2/sec (Table 3-1). This information will be used in evaluating the long-term effectiveness of the No Action as well as any FS alternatives that might involve the residues remaining in their current location within the IWCS.

The on-site radon levels in the area where the exposed residues were located exceeded the NRC standards specified in Table 3-1 for worker protection. Therefore, development of any IWCS OU FS alternatives involving the excavation of the residues will need to account for the necessary levels of worker protection (e.g., pressure-demand respiratory protection). The need for worker protection and the possibility of reduced worker efficiency will impact the development of cost estimates for the alternative(s).

7.1.2 Off-Site Levels

Off-site results for long-term releases indicate that the radon-222 air concentration levels at several locations are expected to exceed the standards of 0.1 and 0.5 pCi/L for annual average radon-222 levels. The results indicate that a radon abatement/control system may need to be included in any IWCS OU FS alternatives involving the removal of the residues from the IWCS. These results will be used in developing the details of the radon abatement/control system and the associated costs. The radon abatement system would provide the necessary controls to preclude both on- and off-site unacceptable releases of radon. Also note that, regardless of the assurance of the radon abatement system, USACE would likely monitor the potential for off-site radon releases under an excavation scenario to ensure protection of human health and the environment.

The off-site results for short-term releases assuming slightly unstable short-term weather and extremely stable short-term weather conditions, independent of wind direction, indicate that there are a number of off-site locations that temporarily exceed the 0.1, 0.5, and 3 pCi/L annual average standards. Additionally, under the extremely stable short-term weather conditions, a few off-site locations exceed the 100 pCi/L level established in Section 3.9 when all bays are open at the same time. These short-term releases are assumed to travel in any direction and only last for a short period of time (e.g., few days to 1 month). Although these peak levels associated with short-term releases may exceed the annual average standards, the duration of exposure is very limited and is accompanied by periods of low exposure such that average

annual exposures attain standards. In addition, changes in wind direction and atmospheric stability also will tend to reduce exposures. Nonetheless, modeled results support the need for the radon abatement and controls.

7.2 POTENTIAL EXPOSURE LEVELS OF HYPOTHETICAL INTRUSION SCENARIOS

Four hypothetical intrusion scenarios were evaluated, and the conclusions for each of those scenario evaluations are discussed below.

7.2.1 Damage Due to Heavy Equipment

The on-site radon levels in the area of the exposed surface of the K-65 residues exceeded the NRC radon-222 standard of 30 pCi/L (with daughters) for worker protection. Therefore, the exposures to a non-worker are considered to be unacceptable under this hypothetical scenario. Some form of control(s) will likely be required to minimize the potential for occurrence of this scenario. These results will be used in evaluating the protectiveness of the No Action alternative in the IWCS OU FS.

The off-site results for long-term releases indicate that the annual average radon-222 standards of 0.1 and 0.5 pCi/L were exceeded at the site boundary. Therefore, some form of control(s) will likely be required to minimize the potential for occurrence of this scenario. These results will be used in evaluating the No Action alternative in the IWCS OU FS to show that it is not protective for this scenario.

The off-site results for short-term releases assuming slightly unstable short-term weather and extremely stable short-term weather conditions, independent of wind direction, did not exceed the 100 pCi/L standard. However, numerous off-site locations temporarily exceed the 0.1 and 0.5 pCi/L annual average standards. These short-term releases are assumed to occur in any modeled direction and only last for a short period of time (e.g., few days to 1 month). Although these peak levels associated with short-term releases may exceed the annual average standards, the duration of exposure is very limited and is accompanied by periods of low exposure such that average annual exposure standards might be attained. In addition, changes in wind direction and atmospheric stability also will tend to reduce exposures. No off-site locations under both short-term weather conditions exceed 100 pCi/L. These results will be used in the evaluation of protectiveness of the No Action alternative in the IWCS OU FS.

7.2.2 Damage Due to an Earthquake

Based upon the evaluation presented in Section 4.2.2, an earthquake occurring at or near the NFSS would likely exhibit a magnitude that is relatively small to moderate (i.e., 5.6 to 5.8 or less on the Richter scale) and would not likely reach the magnitude and intensity required to produce major ground fissuring resulting in a breach of the IWCS. Therefore, no on-site or off-site radon releases would be expected. However, USACE chose to evaluate an alternate earthquake scenario to assess what the minimum crack depth would need to be to begin to cause unacceptable, long-term radon concentration levels off-site. Although the fissure depth used in this assessment (3.9 m [12.8 ft]) is extremely unlikely based on documented experiences at other landfills and the analyses performed for the IWCS, USACE chose to use these results for contingency planning to establish the assumptions for assessing potential damage from an earthquake.

The results of the modeling of the alternate earthquake scenario indicated that the on-site radon levels in the area of the fissure, directly above the K-65 residues, exceeded the NRC standards for radon-222 for worker protection. Under these conditions, prolonged exposures to an individual (non-worker) at the release site would be considered to be unacceptable and some form of control(s) would likely be required. These results will be used in evaluating the long-term effectiveness of the No Action, as well as any FS

alternatives that might involve the residues remaining in their current location within the IWCS. Also, the results indicate that worker protection is likely to be needed for alternatives that would involve inspections and repairs for the IWCS cap.

The off-site results for long-term releases indicate that locations beyond the site boundary do not exceed the annual average standards of 0.1 and 0.5 pCi/L for radon-222. Because modeling results for on-site releases indicate that no concentration limits or standards are expected to be exceeded under the earthquake scenario, it is likely that no controls would be needed to minimize the potential impacts to human health and the environment. The results will be used in the development of the No Action alternative, as well as any FS alternatives that might involve the residues remaining in their current location within the IWCS.

The off-site results for short-term releases assuming slightly unstable short-term weather and extremely stable short-term weather conditions, independent of wind direction, did not exceed the 100 pCi/L standard. As anticipated (using the alternate earthquake scenario), the off-site results for short-term releases assuming slightly unstable short-term weather and extremely stable short-term weather conditions indicate that several off-site locations temporarily exceed the 0.1 and 0.5 pCi/L annual average standards. These short-term releases are assumed to occur in any modeled direction and only last for a short period of time (e.g., few days to 1 month). Although these peak levels associated with short-term releases may exceed the annual average standards, the duration of exposure is very limited and is accompanied by periods of low exposure such that average annual exposure standards might be attained. In addition, changes in wind direction and atmospheric stability also will tend to reduce exposures. These results will be used in the evaluation of protectiveness of the No Action alternative in the IWCS OU FS. The results also will be used in the development of any FS alternatives that might involve the residues remaining in their current location and which may involve cap inspections and repairs in terms of necessary worker protection and costs.

7.2.3 Damage Due to Drilling

The on-site radon levels, where drilling has encountered the K-65 residues, do not exceed the NRC radon-222 standard of 30 pCi/L (with daughters) for worker protection (Table 3-1). Because modeling results for on-site releases indicate that no concentration limits or standards are expected to be exceeded under this scenario, no controls are likely to be needed to preclude drilling to protect human health and the environment. The results also will be used in the development of any FS alternatives that might involve the residues remaining in their current location and which may involve cap inspections and repairs in terms of necessary worker protection and costs.

The off-site results for long-term releases indicate that the annual average radon-222 standards of 0.1 and 0.5 pCi/L were not exceeded at or beyond the site boundary. Therefore, no controls are likely to be needed to minimize the potential for occurrence of this scenario. These results will be used in evaluating the protectiveness of the No Action alternative in the IWCS OU FS.

The off-site results for short-term releases assuming slightly unstable short-term weather and extremely stable short-term weather conditions, independent of wind direction, did not exceed the 100 pCi/L standard. Under the slightly unstable short-term release conditions, no annual average or short-term air concentration standards were exceeded. However, the off-site results for short-term releases assuming extremely stable short-term weather conditions indicate that a few off-site locations temporarily exceed the 0.1 and 0.5 pCi/L annual average standards. These short-term releases are assumed to occur in any direction and only last for a short period of time (e.g., few days to 1 month). Although these peak levels associated with short-term releases may exceed the annual average standards, the duration of exposure is very limited and is accompanied by periods of low exposure such that average annual exposure standards

will most likely be attained based on the long-term release results discussed above. In addition, changes in wind direction and atmospheric stability also will tend to reduce exposures. These results will be relevant in evaluating the No Action alternative in the IWCS OU FS, as well as for determining necessary controls for minimizing short-term off-site releases during core sample drilling.

7.2.4 Damage Due to Burrowing Animal

The on-site radon levels at the opening of the burrow do not exceed the NRC radon-222 standard of 30 pCi/L (with daughters) for worker protection. Modeling results for on-site releases indicate that no concentration limits or standards are expected to be exceeded under this scenario. Therefore, it is likely that no controls or actions would need to be taken for a worker performing routine inspections when approaching an animal burrow opening in the IWCS. The results will be used in the development of any FS alternatives that might involve the residues remaining in their current location and which may involve cap inspections and repairs in terms of necessary worker protection and costs, as well as for evaluation of the No Action alternative where no surveillance would be conducted.

The off-site results for long-term releases indicate that the annual average radon-222 standards of 0.1 and 0.5 pCi/L were not exceeded at or beyond the site boundary. Therefore, it is likely that no controls would be necessary to minimize the potential for occurrence of this scenario. This information will be used in evaluating the long-term effectiveness of the No Action, as well as any FS alternatives that might involve the residues remaining in their current location within the IWCS.

The off-site results for short-term releases assuming slightly unstable short-term weather and extremely stable short-term weather conditions, independent of wind direction, did not exceed the 100 pCi/L standard. Under the slightly unstable short-term release conditions, no annual average or short-term air concentration standards were exceeded. The off-site results for short-term releases assuming extremely stable short-term weather conditions indicate that a few off-site locations temporarily exceed the 0.1 pCi/L annual average standards. These short-term releases are assumed to occur in any modeled direction and only last for a short period of time (e.g., few days to 1 month). Although these peak levels associated with short-term releases may exceed the annual average standards, the duration of exposure is very limited and is accompanied by periods of low exposure such that average annual exposure standards will most likely be attained based on the long-term release results discussed above. In addition, changes in wind direction and atmospheric stability also will tend to reduce exposures. These results will be relevant in evaluating the No Action alternative, as well as any FS alternatives that might involve the residues remaining in their current location within the IWCS.

7.3 OVERALL CONCLUSIONS

The radon assessment completed for the IWCS provided the following overall general conclusions:

1. A No Action alternative would not be protective of human health and the environment based on predicted on- and off-site radon-222 exposure levels associated with one (damage to the IWCS due to heavy equipment) of the four hypothetical intrusion scenarios evaluated.

2. Radon flux modeling indicates that the 20 pCi/m2/s limit would be exceeded if more than 1 m of the IWCS cap was removed. Therefore, properly designed and fully functional radon abatement/control systems are likely to be necessary and may need to be in place prior to any actions associated with removal of residues from the IWCS.

3. All IWCS removal alternatives that involve extraction of radium-bearing residues from the IWCS may need to include the costs associated with design, installation, operation, and maintenance of a radon abatement/control system.

4. Remedial action alternatives in the IWCS OU FS, including those alternatives that might involve the residues remaining in their current location within the IWCS or removal of the residues, must fully consider comprehensive worker protection requirements that will need to be implemented, as well as added costs associated with possible reduction in worker efficiency.

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FIGURES

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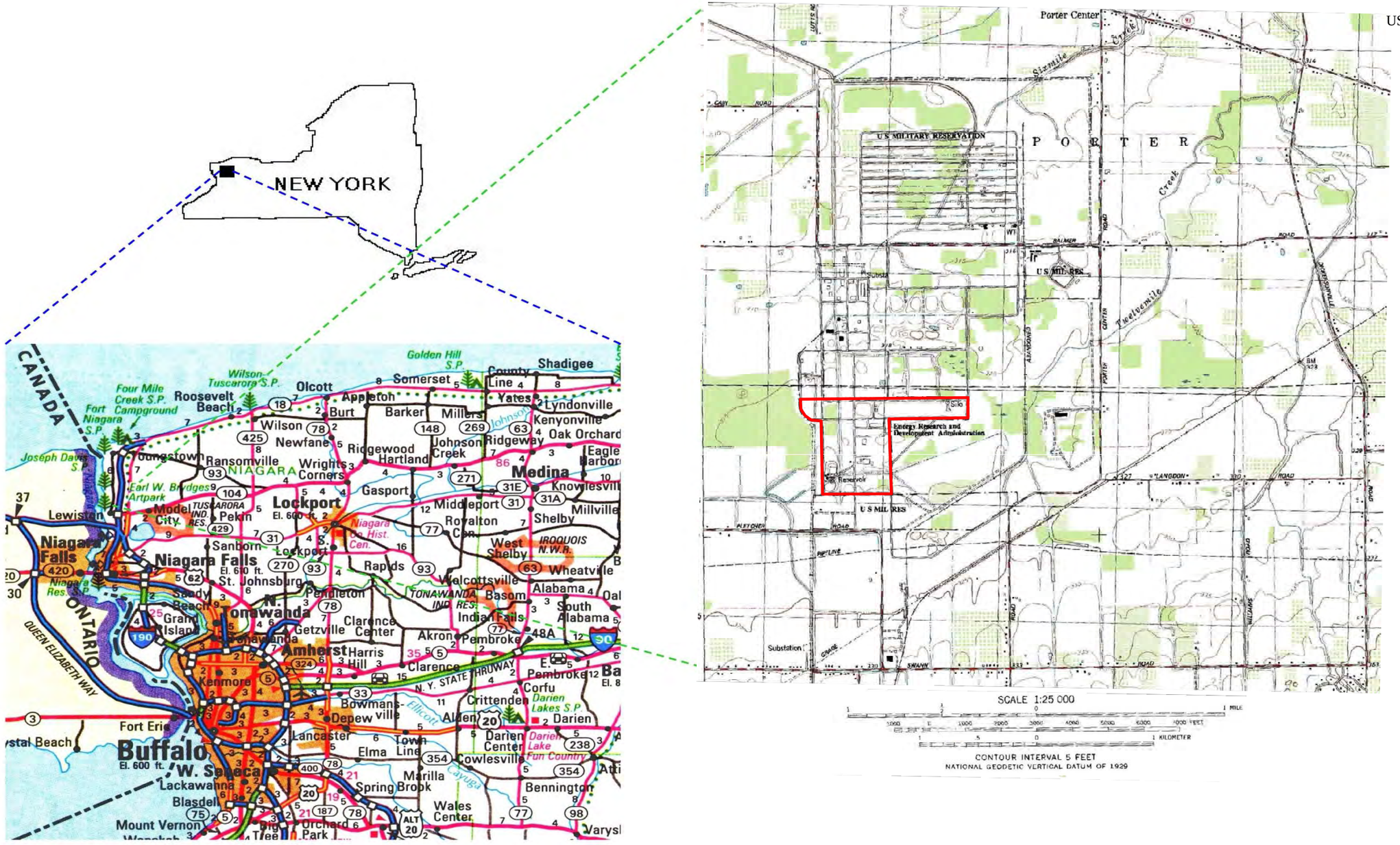


USGS Map from1980

Figure 1-1. Site Vicinity

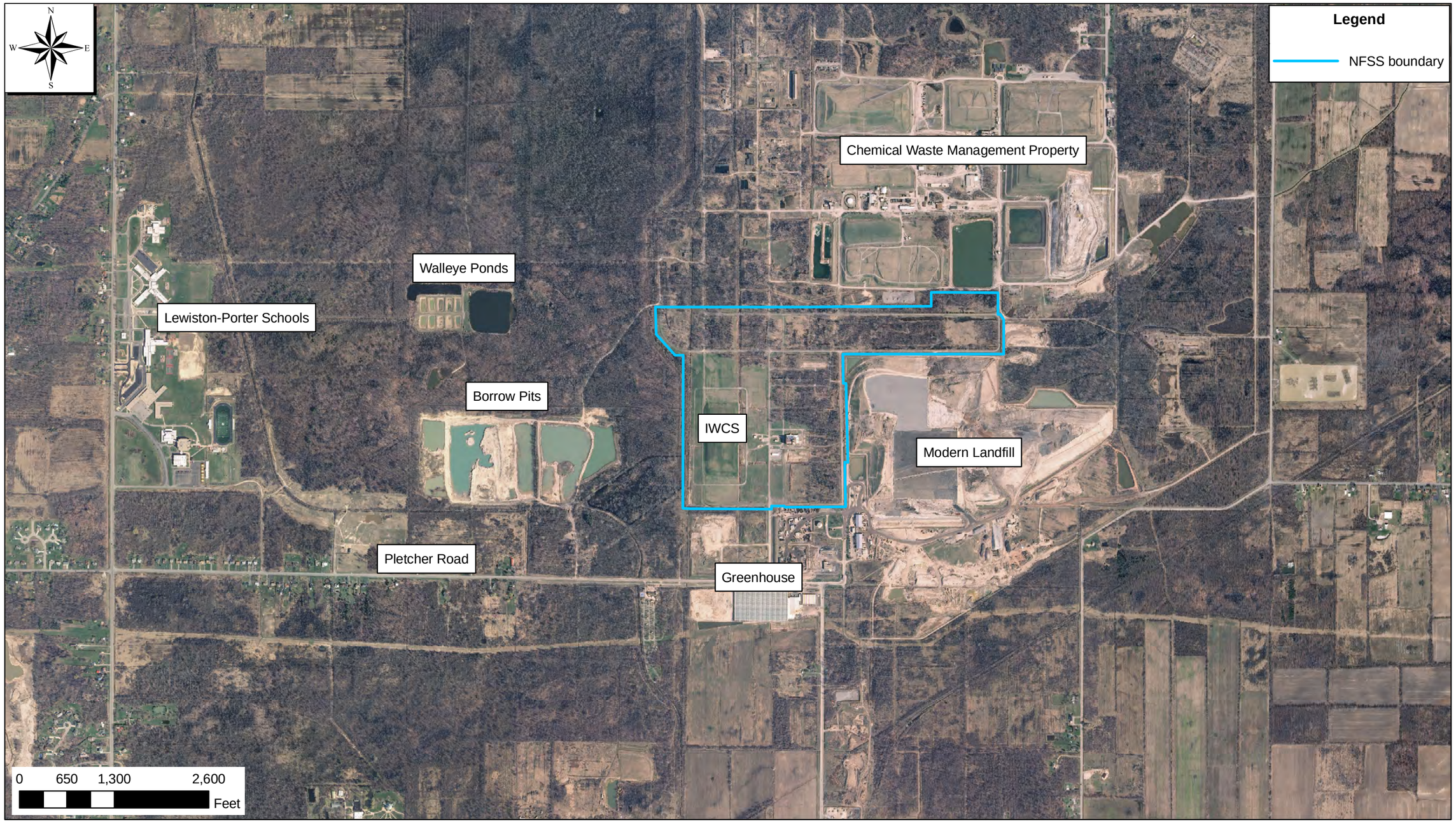


Figure 1-2. Regional Aerial View

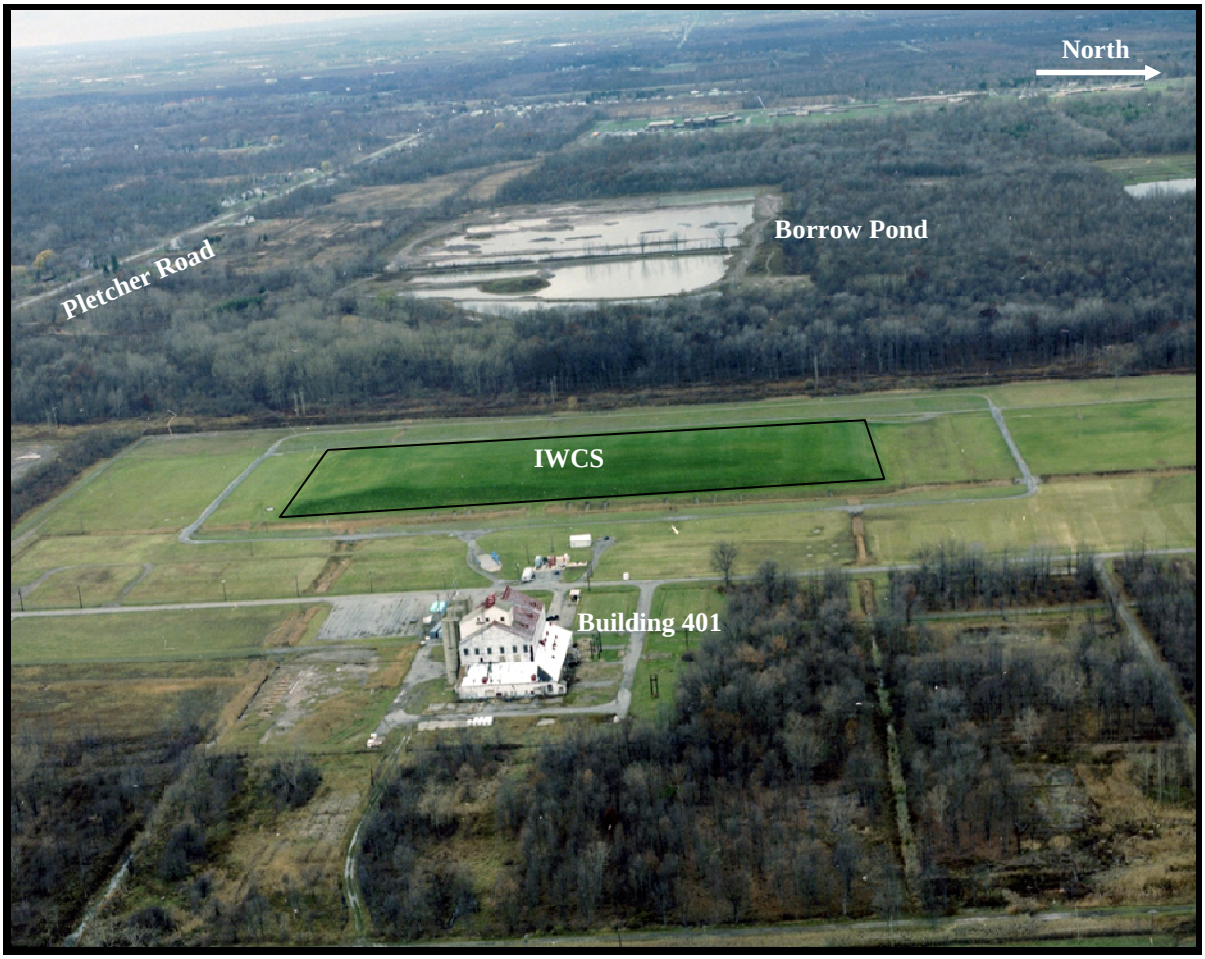


Figure 1-3. Interim Waste Containment Structure (2002 Aerial Photograph)

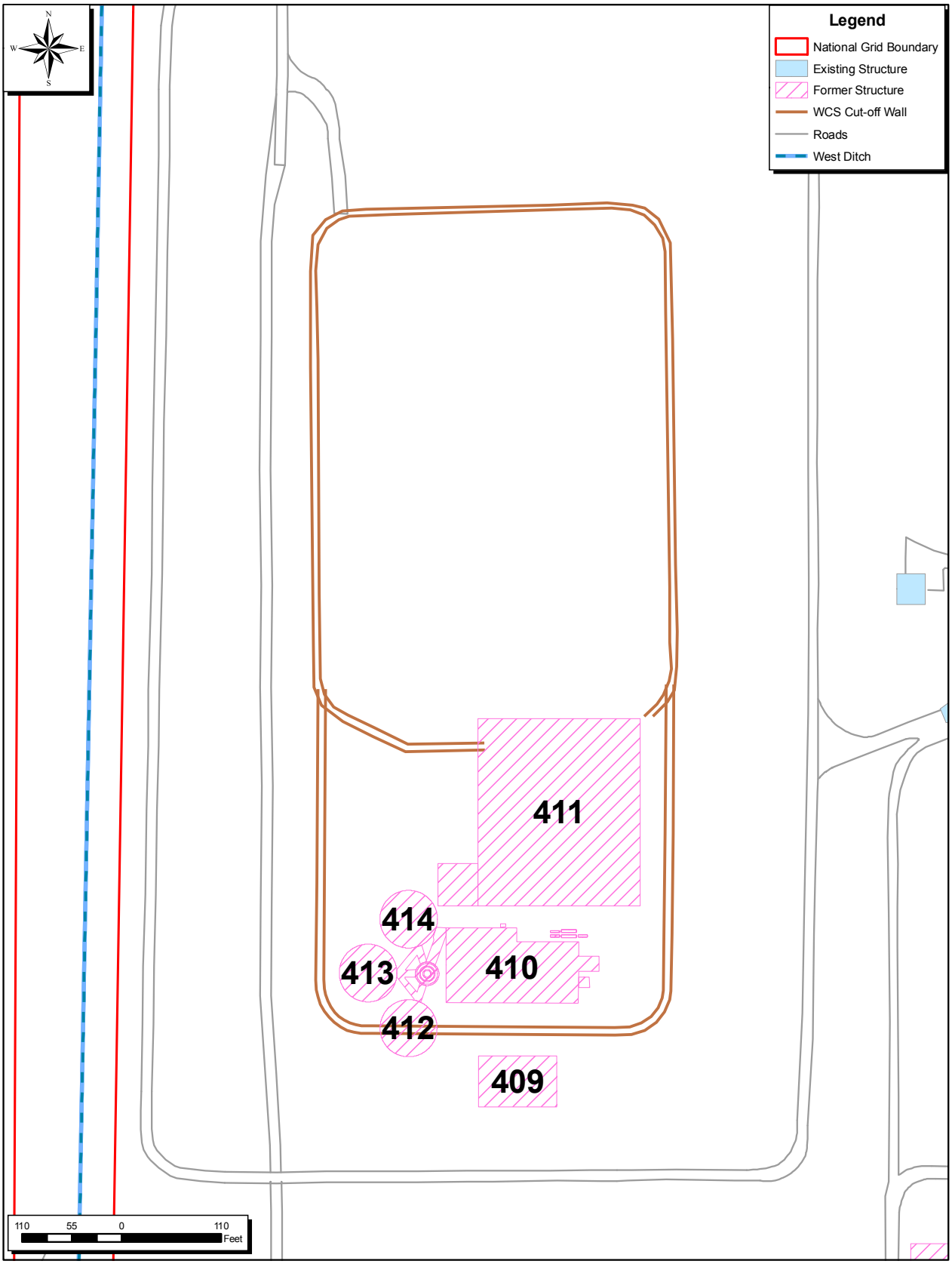


Figure 1-4. Layout of IWCS with Former Building Locations

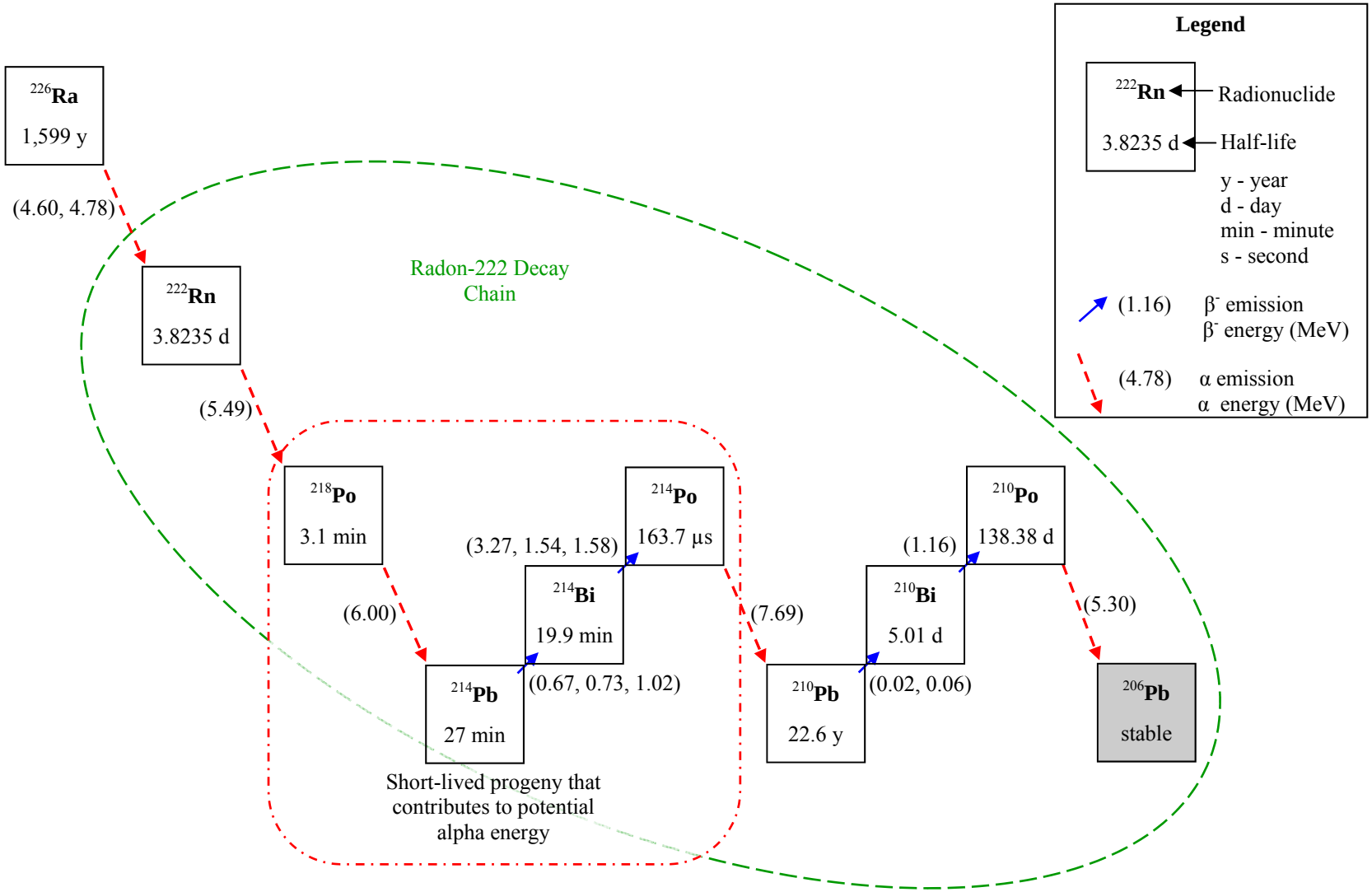


Figure developed using NCRP160 and Shleien et al 1998 for alpha (α) and beta (β^-) emission energies.
Note: radionuclide abbreviations are as follows; Ra - radium, Rn - radon, Po - polonium, Pb - lead, and Bi - bismuth.

Figure 2-1. Radon-222 Decay Chain

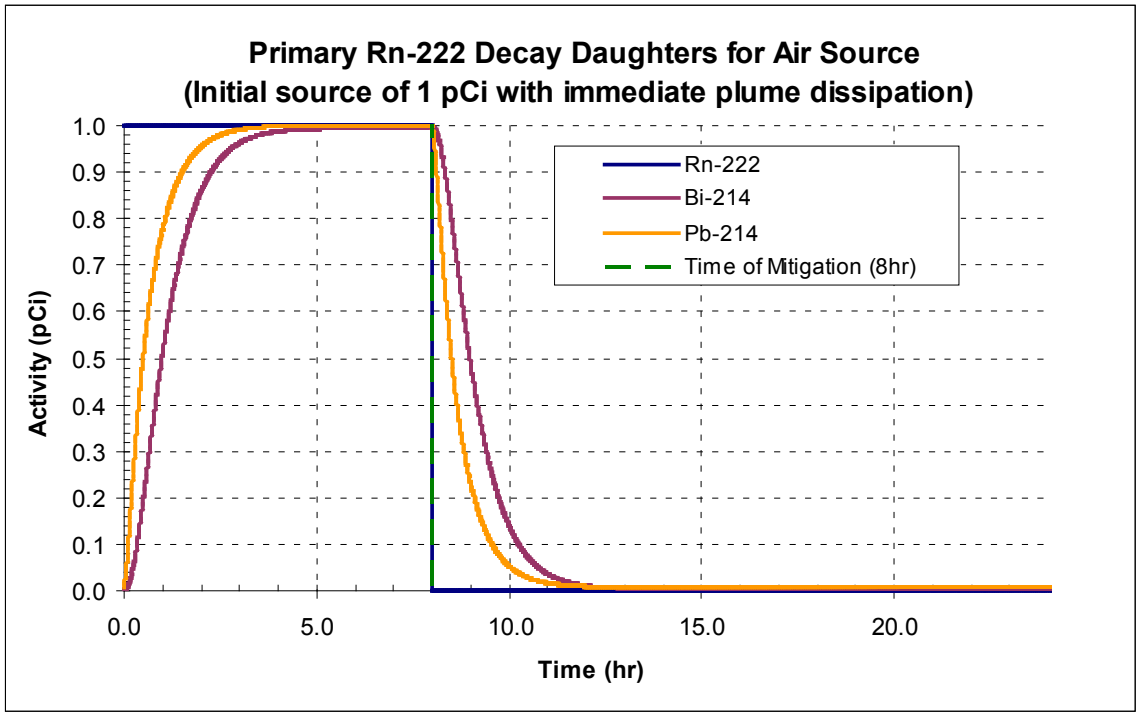
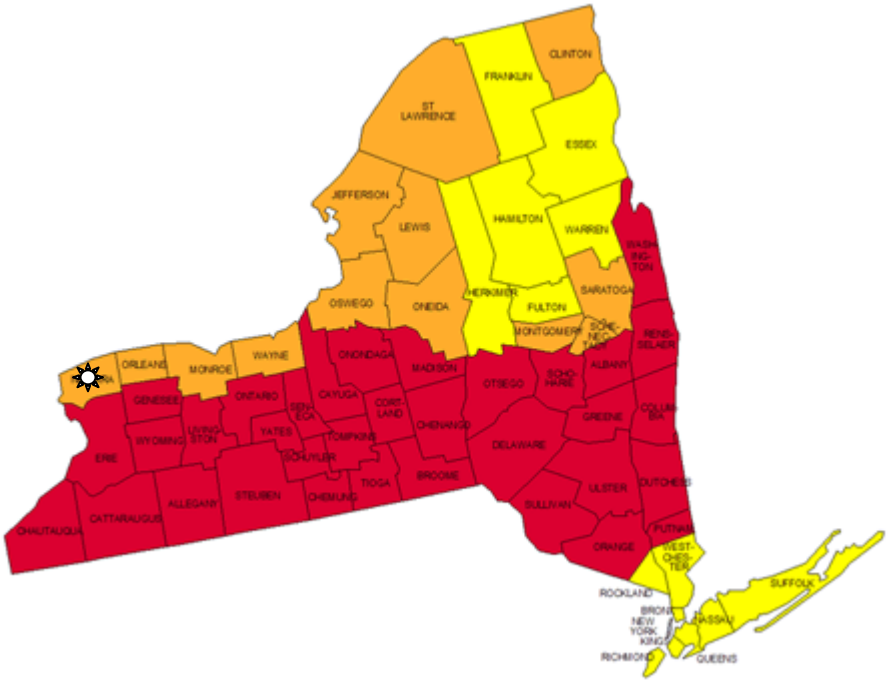


Figure 2-2. Radon and Daughter Decay Curves



	Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L (pico curies per liter) (red zones)	Highest Potential
	Zone 2 counties have a predicted average indoor radon screening level between 2 and 4 pCi/L (orange zones)	Moderate Potential
	Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L (yellow zones)	Low Potential

Source: http://www.epa.gov/radon/zonemap/newyork.htm

Figure 2-3. Predicted Indoor Radon Levels in the State of New York and at NFSS

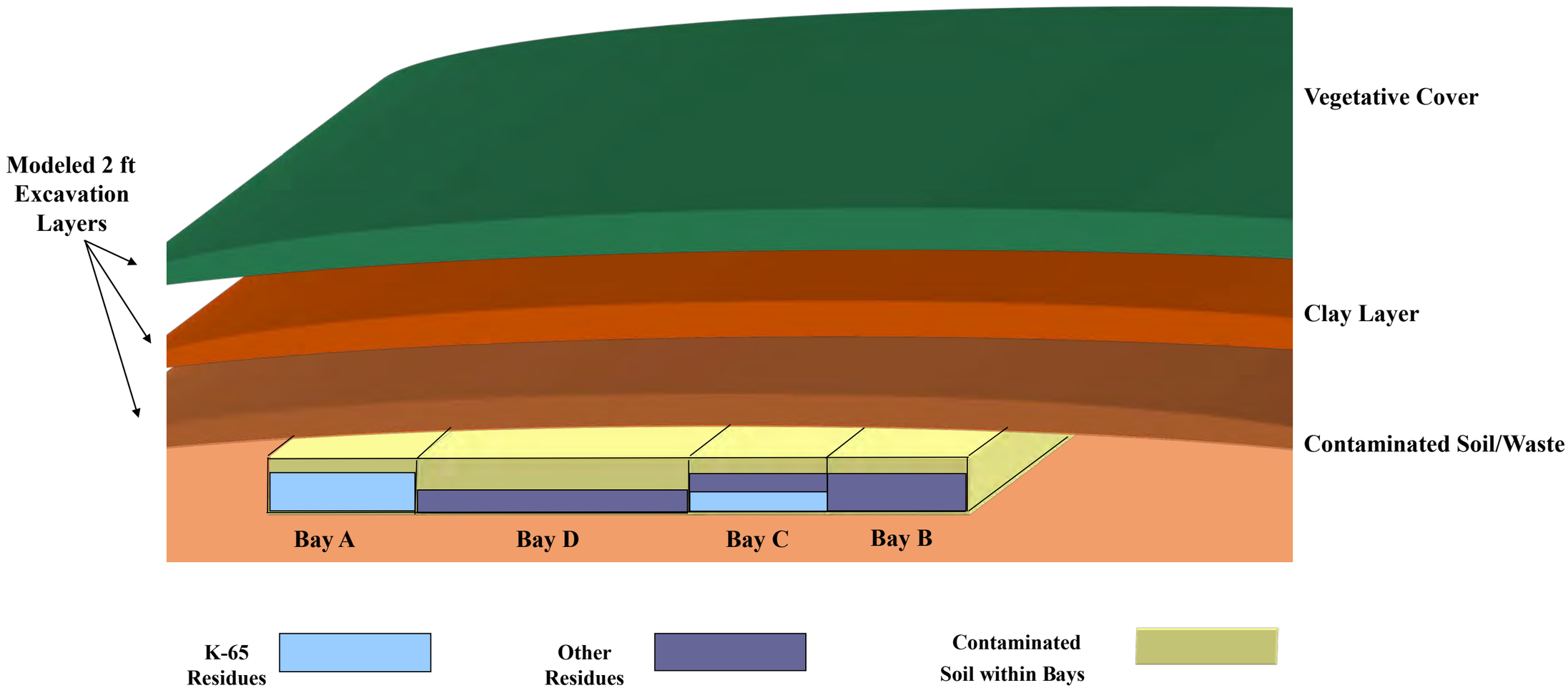
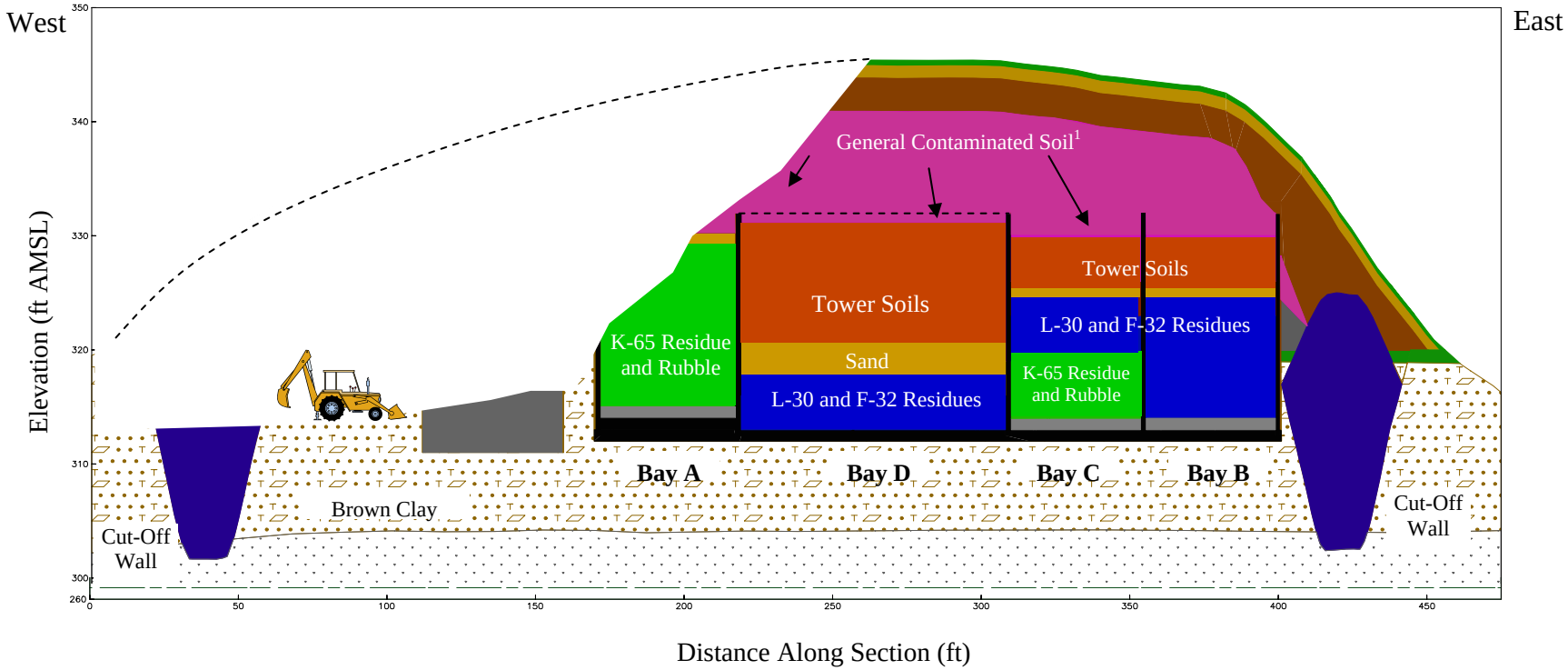


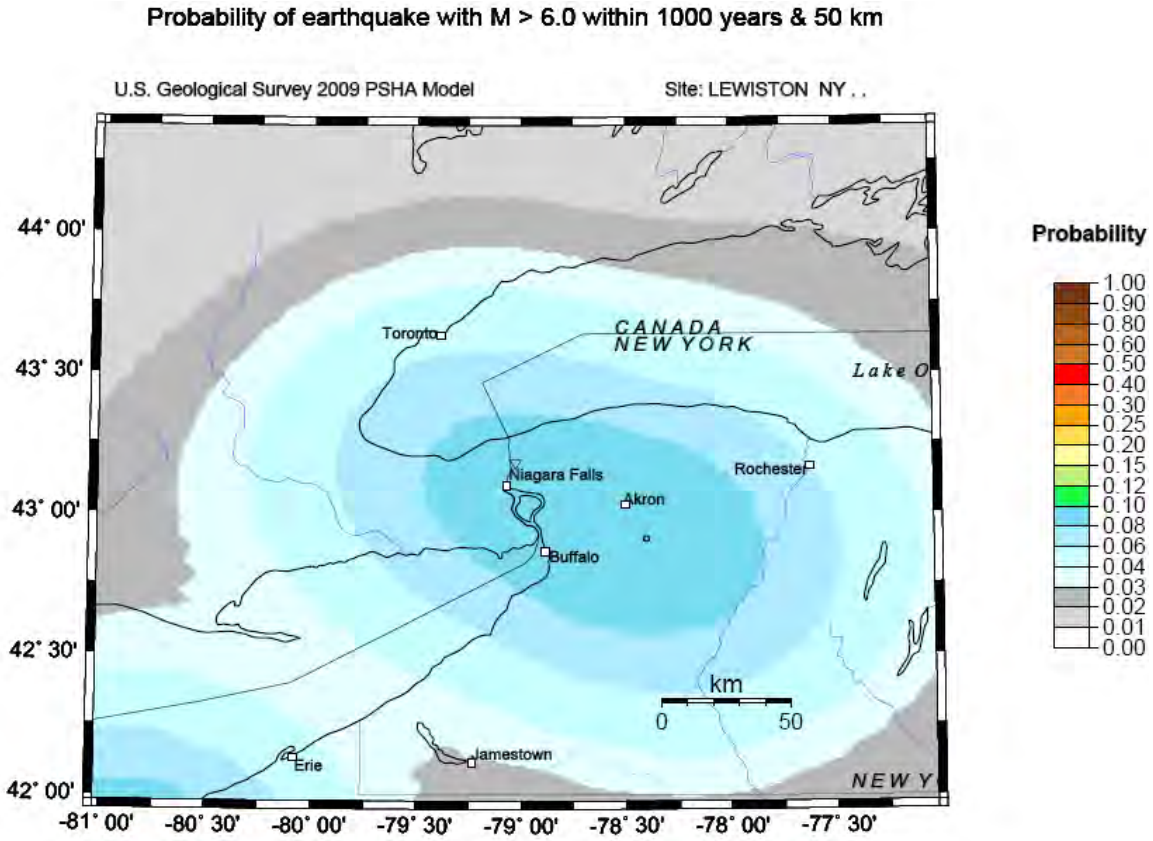
Figure 4-1. Schematic Showing Excavation of IWCS Cap Layers for Removal of Residues



Note: Depths are approximated.

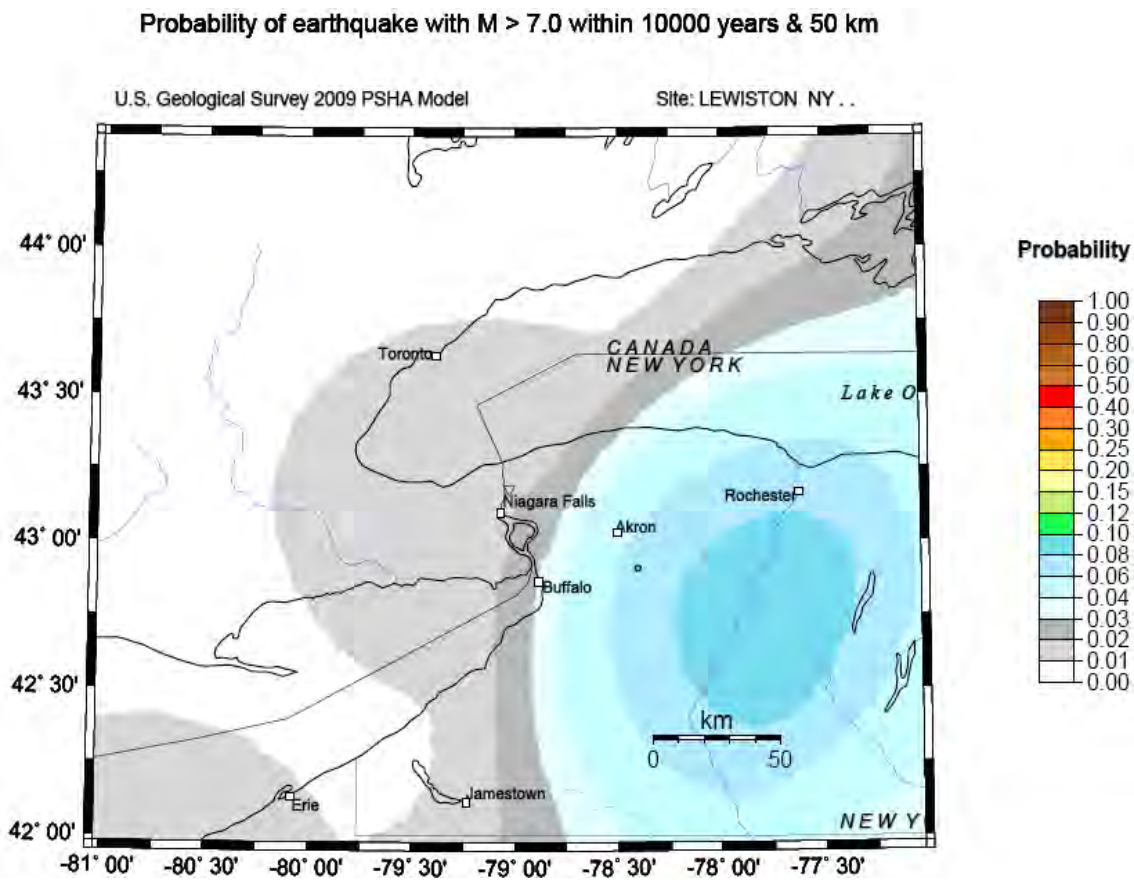
1 - Contaminated soil consists predominantly of waste clay.

Figure 4-2. Schematic of Hypothetical Intrusion of the IWCS by a Heavy Equipment Operator



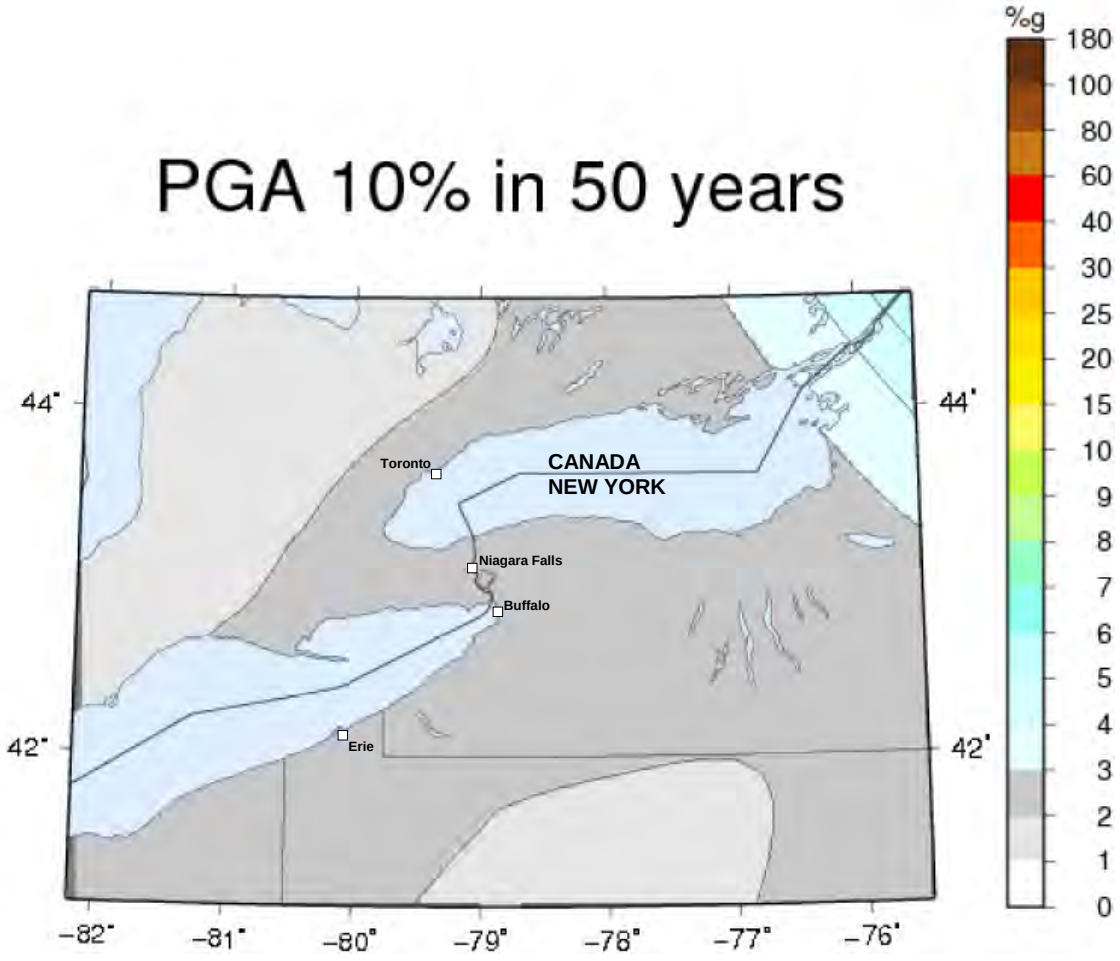
(http://geohazards.usgs.gov)

Figure 4-3. Earthquake Probability of a Magnitude greater than 6.0 for the Lewiston, New York, Area



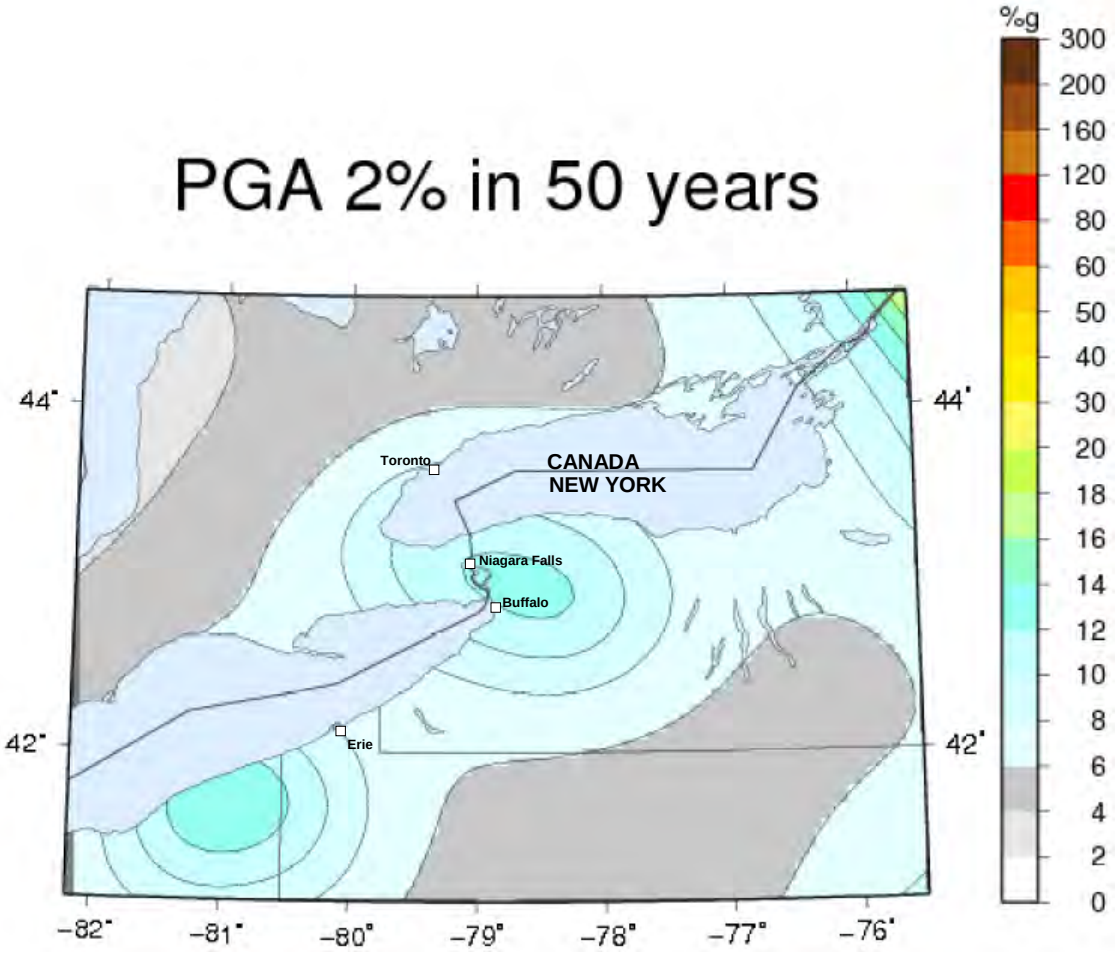
(http://geohazards.usgs.gov)

Figure 4-4. Earthquake Probability of a Magnitude greater than 7.0 for the Lewiston, New York, Area



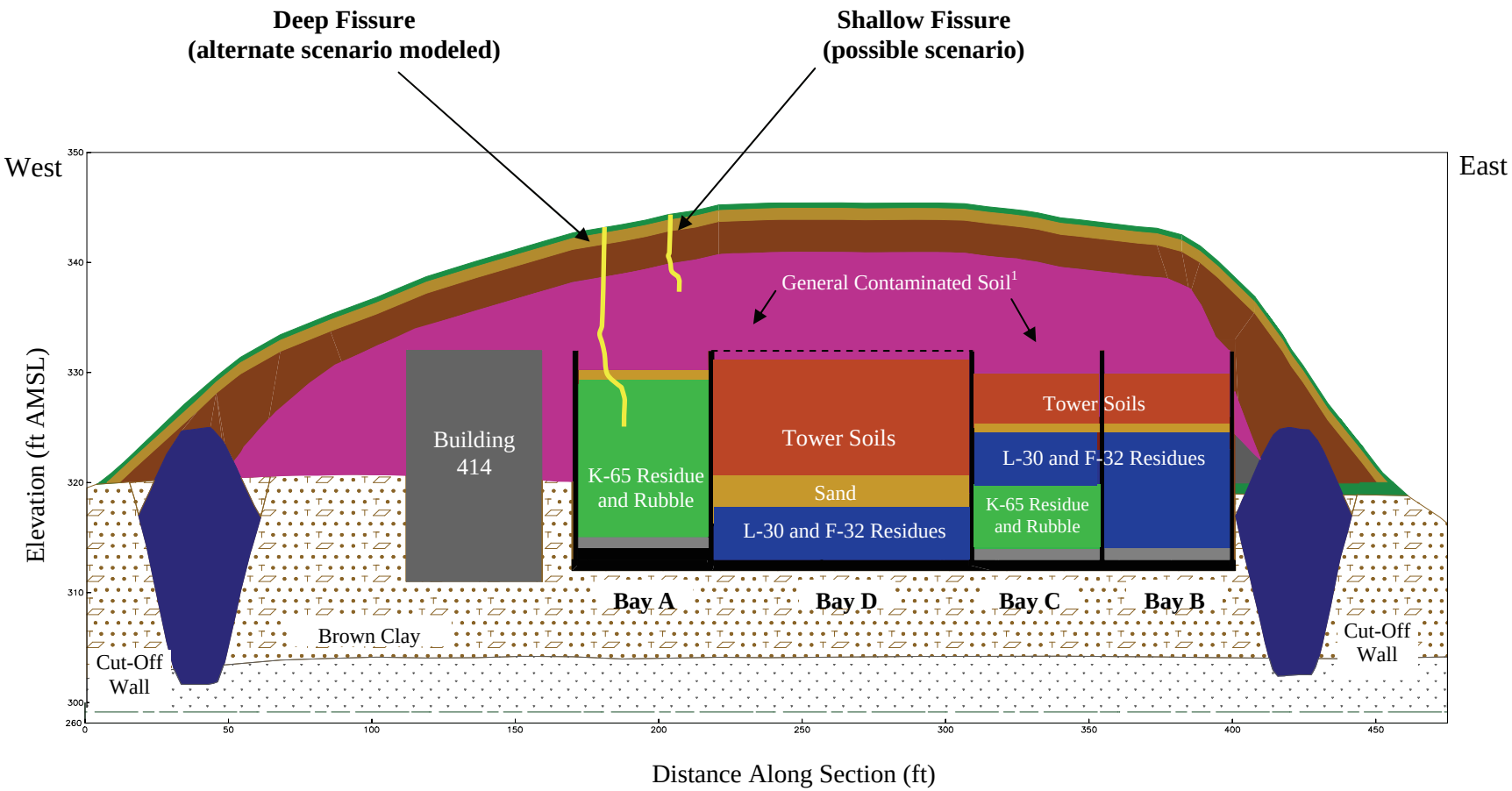
(**http://geohazards.usgs.gov**)

Figure 4-5. Predicted 90th Percentile Peak Ground Acceleration for the Lewiston, New York, Area



(http://geohazards.usgs.gov)

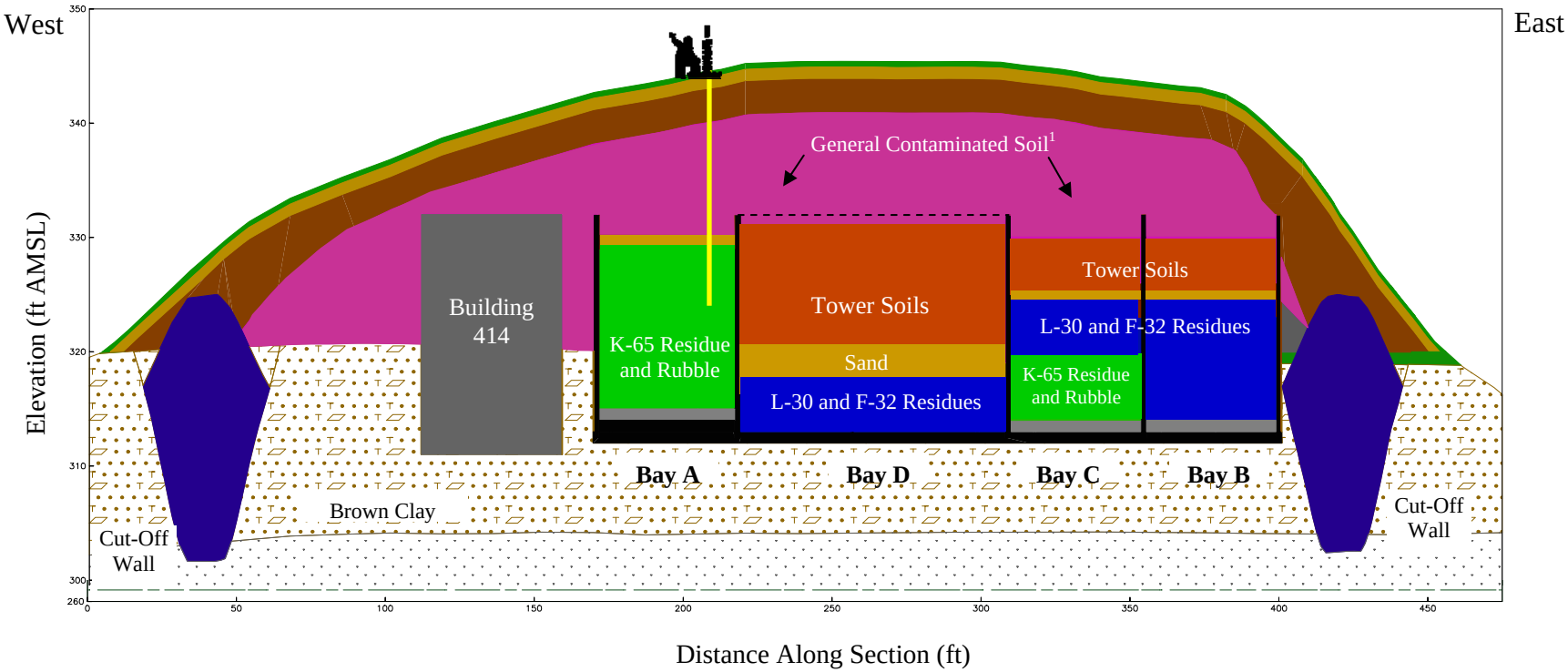
Figure 4-6. Predicted 98th Percentile Peak Ground Acceleration for the Lewiston, New York, Area



Note: Depths are approximated.

1 - Contaminated soil consists predominantly of waste clay.

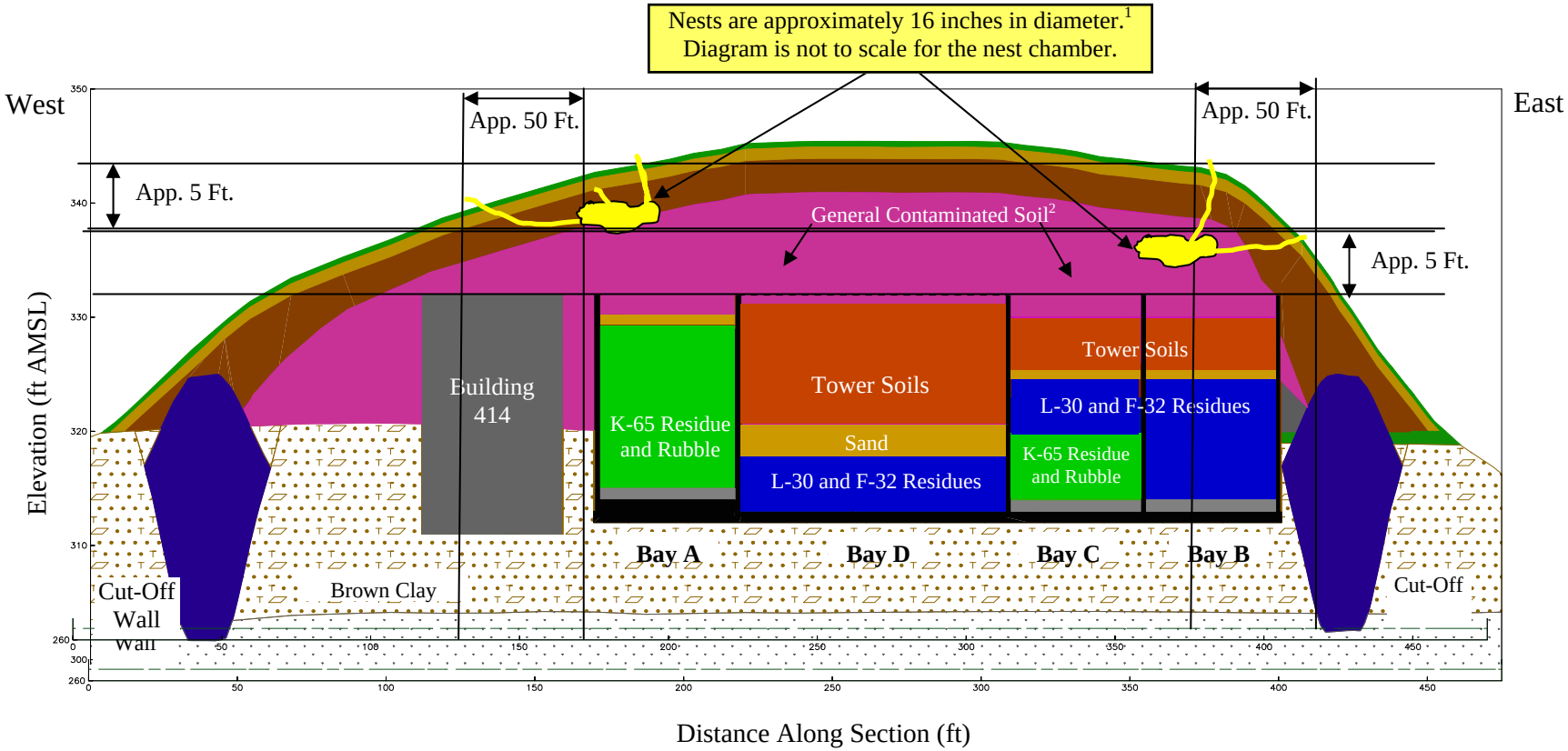
Figure 4-7. Schematic of Hypothetical Development of Fissures in the IWCS Cap due to an Earthquake



Note: Depths are approximated.

1 - Contaminated soil consists predominantly of waste clay.

Figure 4-8. Schematic of Hypothetical Intrusion of the IWCS due to Drilling Operations



Note: Depths are approximated.

1 - Depth, size, and total length of potential groundhog (*Marmota monax)* intrusion into IWCS from Schwartz 2001, Light 2001, and http://icwdm.org/handbook/rodents/Woodchucks.asp.

2 - Contaminated soil consists predominantly of waste clay.

Figure 4-9. Schematic of Hypothetical Intrusion of the IWCS by a Groundhog or Some Other Burrowing Animal

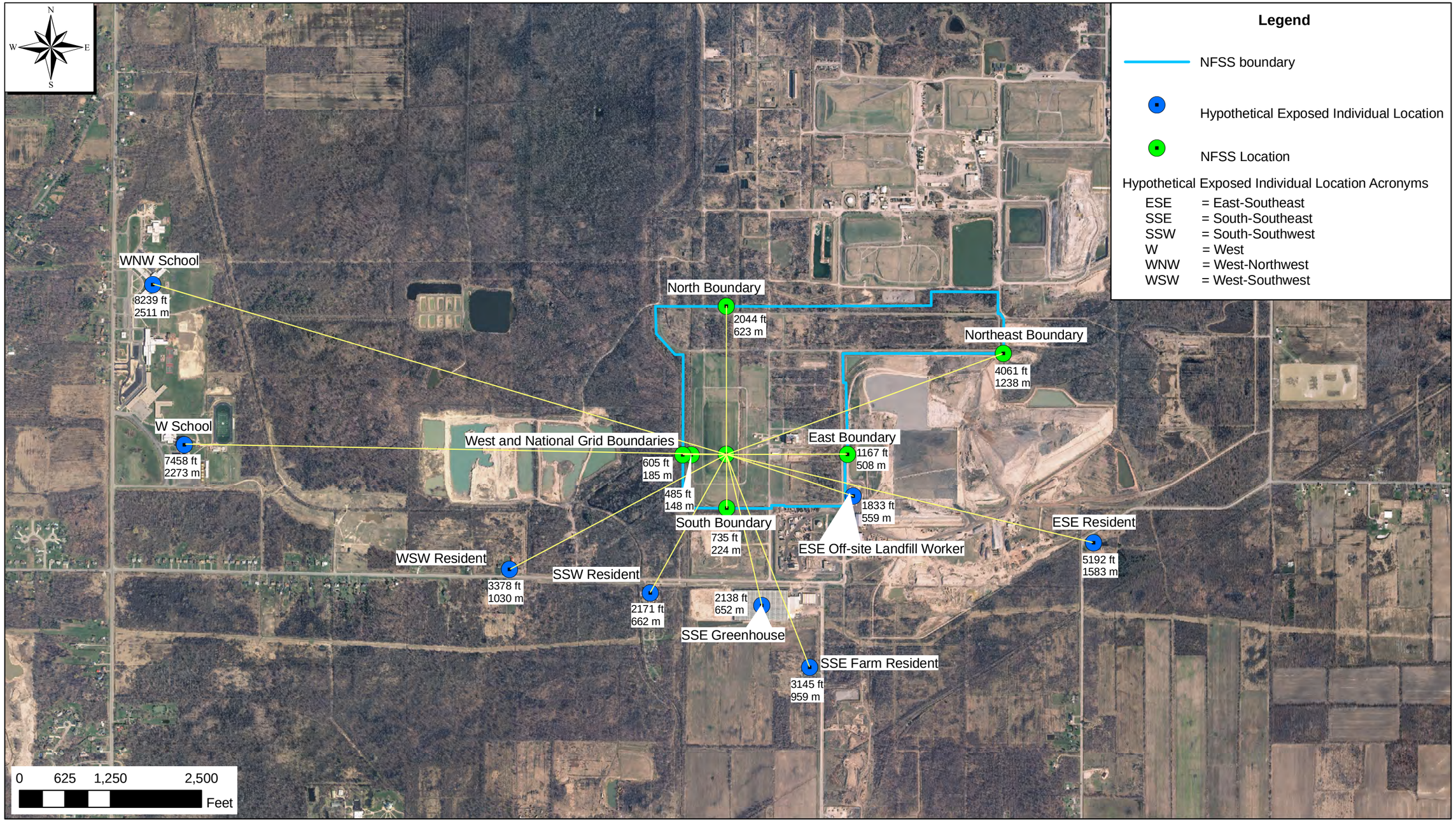
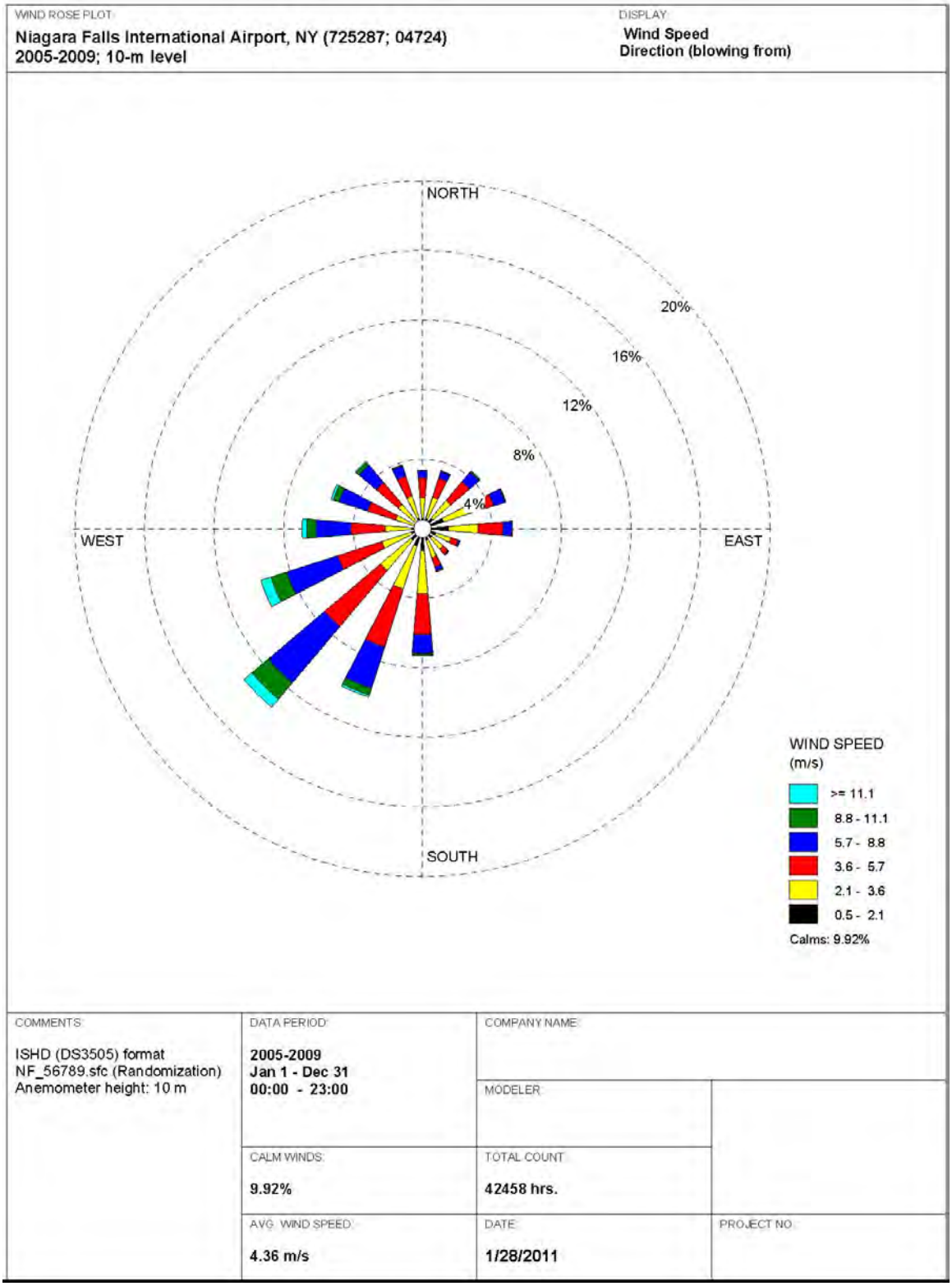
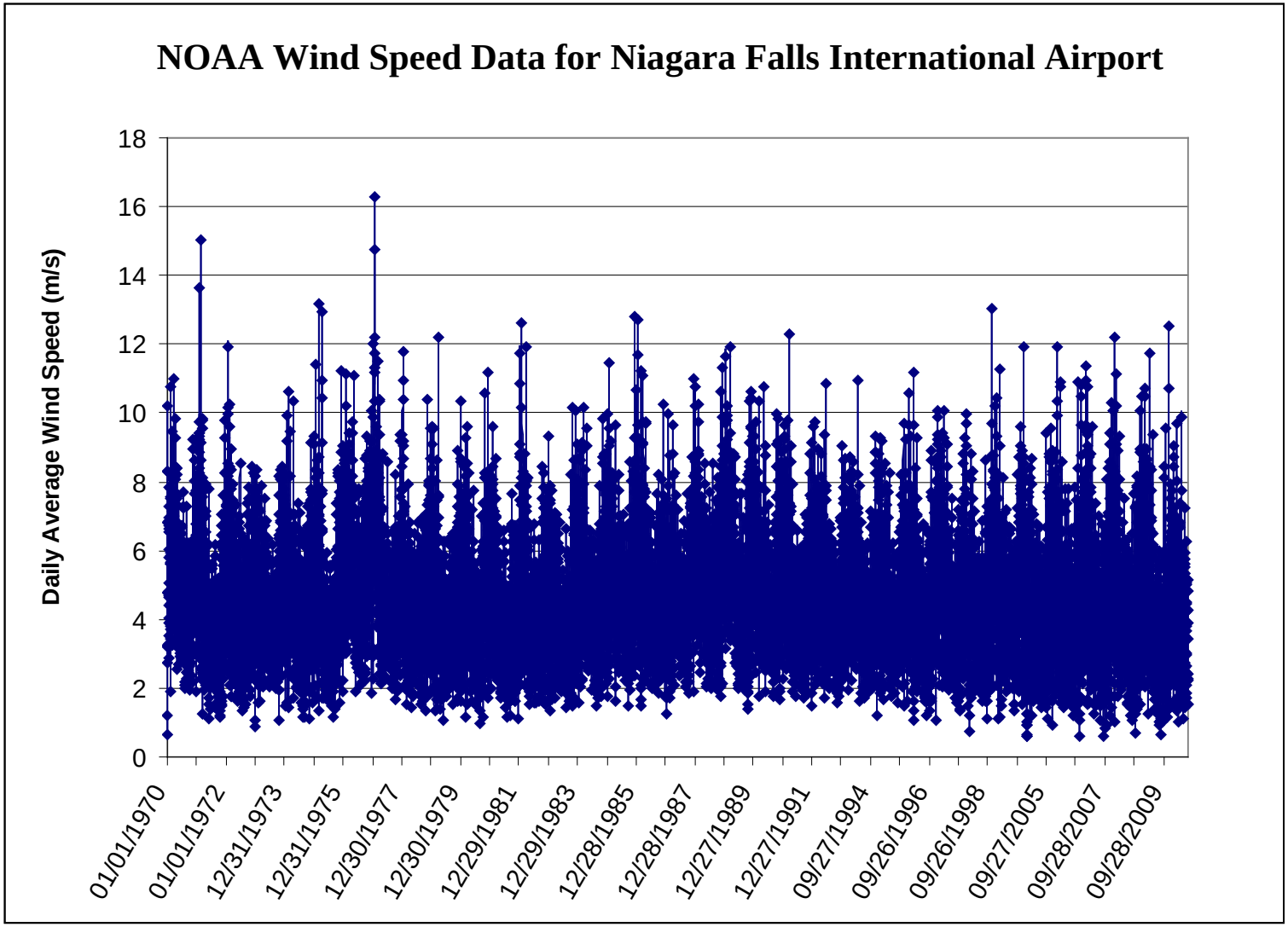


Figure 5-1. Aerial with Hypothetical Exposed Individual and NFSS Locations with Relative Distances from Building 411



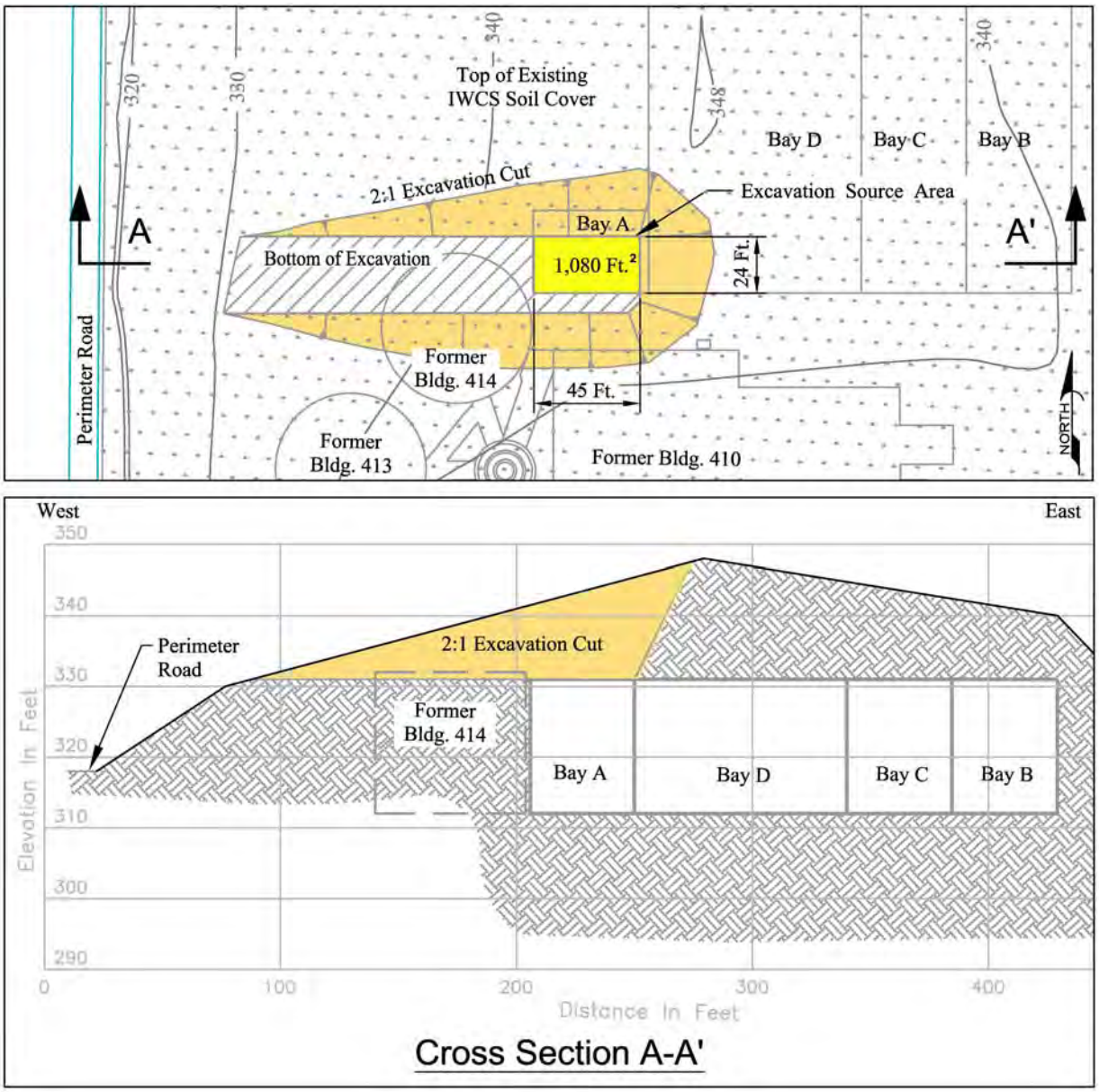
Data Source: NCDC 2010a

Figure 5-2. Wind Rose Diagram using Niagara Falls International Airport from Calendar Years 2005 through 2009



Data Source: NCDC 2010b

Figure 5-3. National Oceanic and Atmospheric Administration Wind Speed Data for Niagara Falls International Airport



Drawings not to scale.

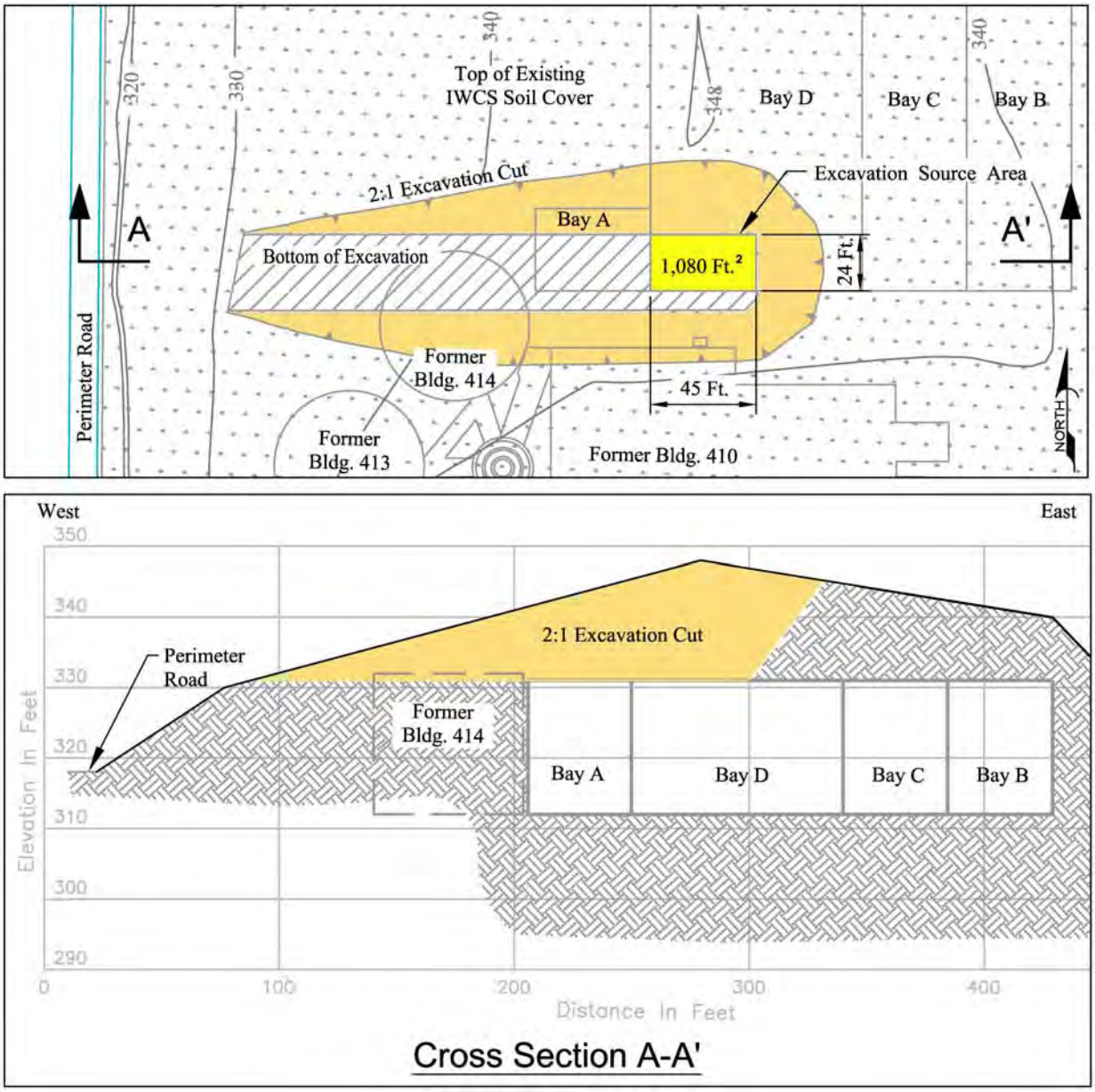
The excavation dimensions are 13.7 m (45 ft) in length and 7.3 m (24 ft) in width, which is directly proportional to the widths of Bays A, B, and C (~13.7 m [~45 ft]) and Bay D ~27 m (~90 ft).

Source Area = length (L) multiplied by the width (W)
L = 13.7 m
W = 7.3 m
Source Area= 13.7 x 7.3 = 100 m^2

The source area is estimated at 100 m^2 (1,080 ft^2).

Note: Model input values are in metric units. The corresponding English units are presented for reference only.

Figure 5-4. Source Area During Hypothetical Excavation of K-65 Residues



Drawings not to scale.

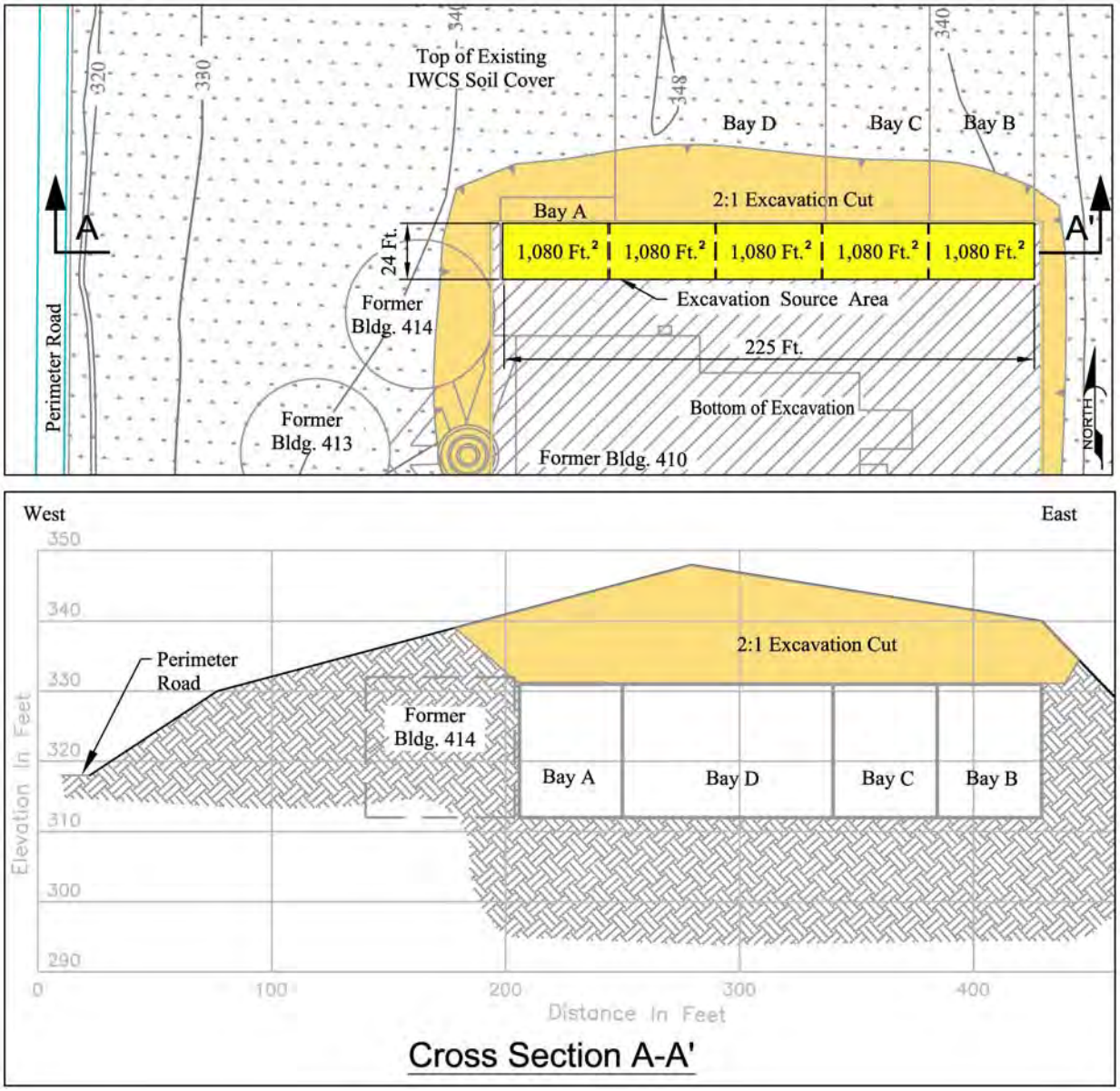
The excavation would proceed in an incremental approach and expose the same source area as the removal of just K-65 residues. The excavation dimensions are 13.7 m (45 ft) in length and 7.3 m (24 ft) in width, which is directly proportional to the widths of Bays A, B, and C (~ 13.7 m [~45 ft]) and Bay D ~ 27 m (~ 90 ft).

Source Area = length (L) multiplied by the width (W)
L = 13.7 m
W = 7.3 m
Source Area= 13.7 x 7.3= 100 m^2

The source area is estimated at 100 m^2 (1,080 ft^2).

Note: Model input values are in metric units. The corresponding English units are presented for reference only.

Figure 5-5. Source Area During Hypothetical Excavation of all Residues



Drawings not to scale.

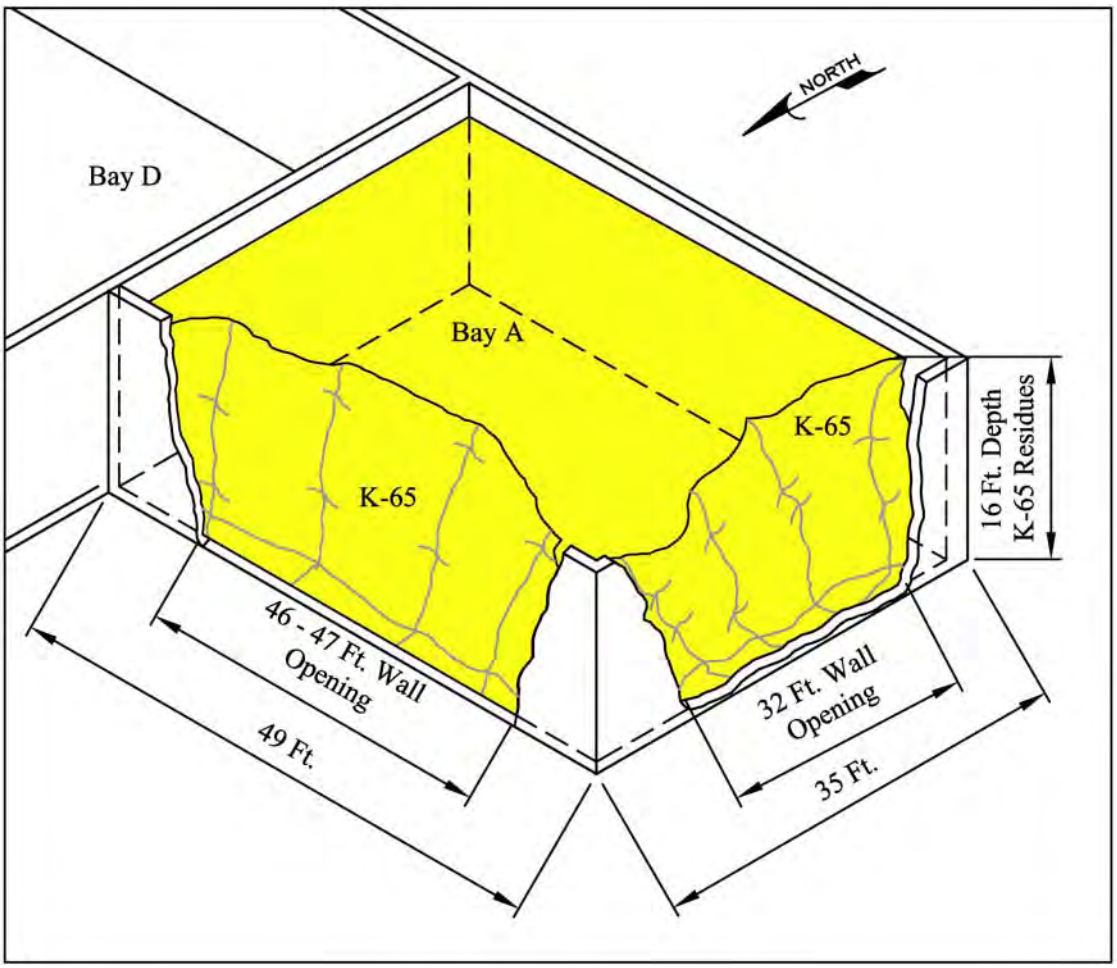
This alternative assumes excavation is from the south and a trench is excavated across all four bays. The trench is assumed to be 7.3 m (24 ft) in width and 68.5 m (225 ft) in length.

Source Area = length (L) multiplied by the width (W)
L = 68.5 m
W = 7.3 m
Source Area= 68.5 x 7.3 = 500 m^2

The source area is estimated at 500 m^2 (5,400 ft^2). The source area is estimated at 500 m^2 (5,400 ft^2). This 500 m^2 (5,400 ft^2) source area includes five 100 m^2 (1,080 ft^2) areas, one for each bay with the exception of Bay D, which is two 100 m^2 (1,080 ft^2) as shown above.

Note: Model input values are in metric units. The corresponding English units are presented for reference only.

Figure 5-6. Source Area During Hypothetical Excavation of All Waste Materials in the IWCS



Drawing not to scale.

Approximate area associated with Bay A that would be exposed during potential intrusion by heavy equipment. Approach to Bay A from the north would expose a larger area of K-65 than an approach from the west. In order to prevent total collapse of the building it is assumed part of the corners are not demolished during the intrusion; therefore, approximately 14.0-14.3 m (46-47 ft) are exposed.

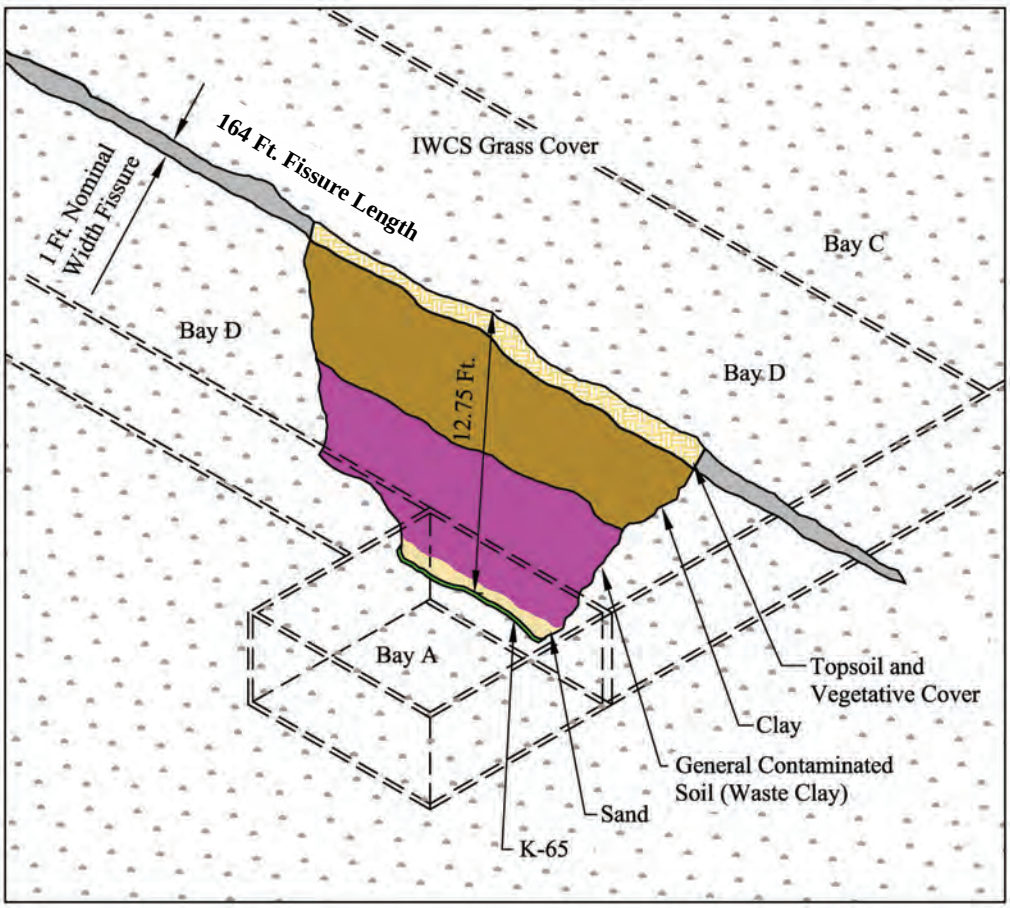
Source Area = length (L) of Bay A exposed multiplied by the height (h) of the K-65 residues in Bay A
L = 14 m
h = 4.9 m

Area= 14 x 4.9 ≈ 69 m^2

The source area is estimated at 69 m^2 (742 ft^2).

Note: Model input values are in metric units. The corresponding English units are presented for reference only.

Figure 5-7. Source Area of Hypothetical Intrusion of the IWCS by a Heavy Equipment Operator



Drawing not to scale.

Under the alternate earthquake scenario, it is assumed that a fissure is created that cracks the cap to the top of the K-65 residues in Bay A. This illustration presents a cutaway of a fissure sidewall. The fissure is assumed to be 50 m (164 ft) long and 3.9 m (12.75 ft) deep. The fissure exposes two walls. The source area due to the earthquake fissure is equal to the length and the depth of the fissure times two (number of walls exposed).

Surface Opening Area = length (L) times width (W) of the earthquake
L= 50 m
W= 0.31 m
Surface Opening Area= $50 \times 0.31 \approx 15\ m^2$

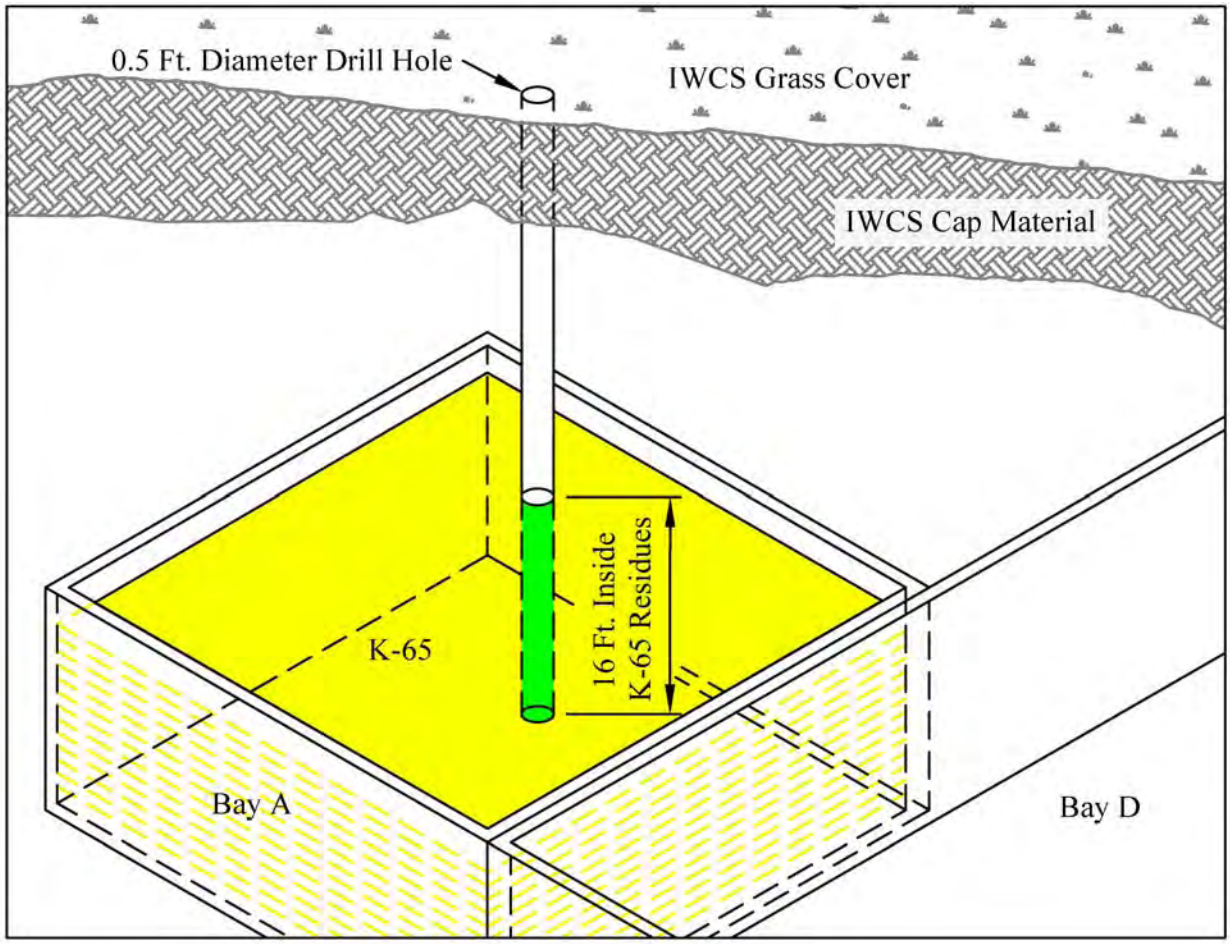
The surface opening area is assumed to be 15 m^2 (about 164 ft^2).

Source Area = two (walls) times (length [L] multiplied by depth [D] of the fissure)
L = 50 m
D = 3.9 m
Source Area= $2(50 \times 3.9) = 390\ m^2$

The source area assumed for the earthquake scenario is 390 m^2 (4,196 ft^2).

Note: Model input values are in metric units. The corresponding English units are presented for reference only.

Figure 5-8. Source Area of Hypothetical Intrusion of the IWCS by an Earthquake



Drawing not to scale.

Area of exposed K-65 surface (i.e. source area) is equal to the area of the cylindrical hole created by drilling through the thickness of the K-65 residues in Bay A. The diameter of the drill hole is 0.15 m (0.5 ft) and the length of the K-65 residues in Bay A is 4.9 m (16 ft).

Surface Opening Area = πr^2
Drill Hole Opening Diameter = 0.15 m
Surface Opening Area= $\pi \times (0.15/2)^2 = 0.018\ m^2$

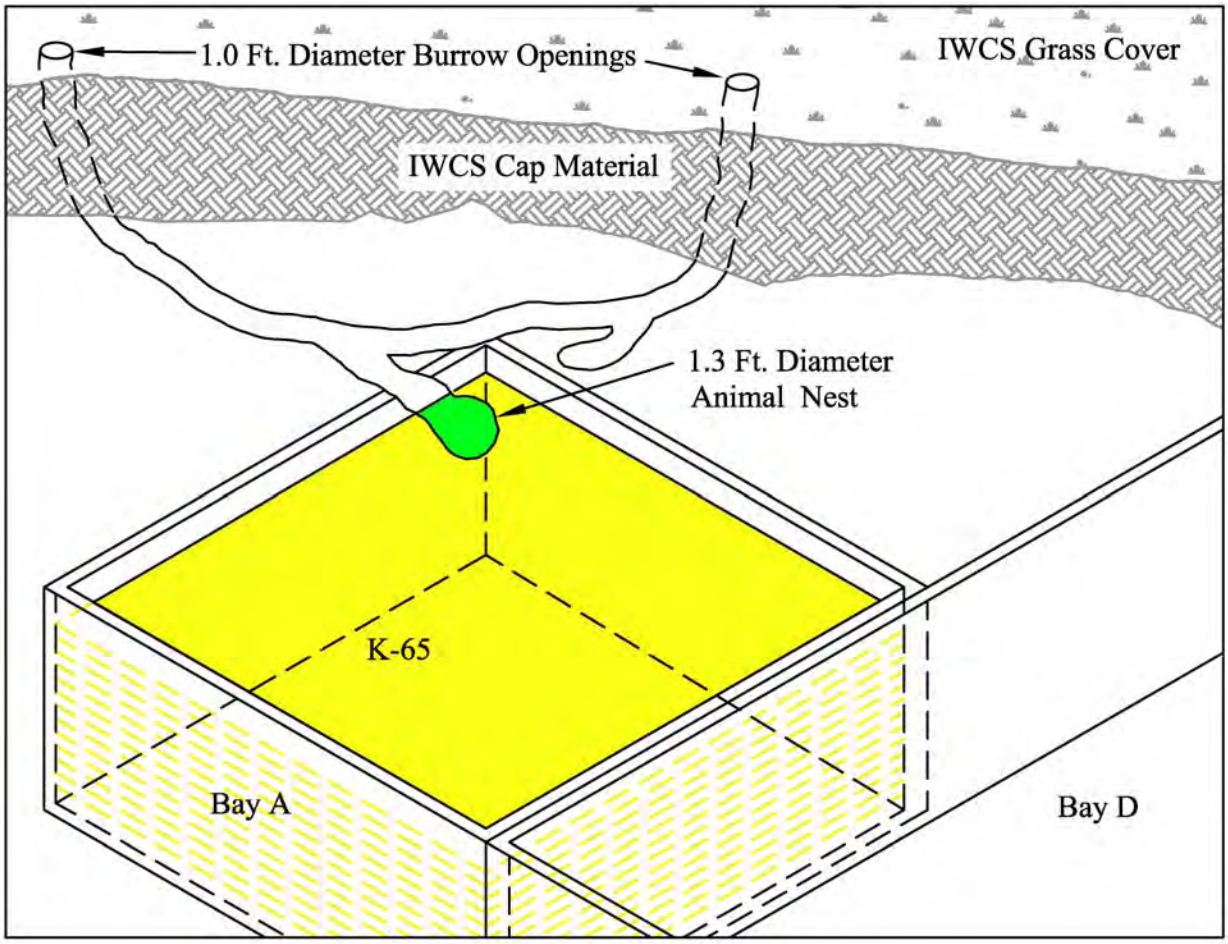
The surface opening area is assumed to be 0.018 m^2 (0.19 ft^2).

Source Area = (π) multiplied by the diameter (D) multiplied by the length (L)
D = 0.15 m
L = 4.9 m
Source Area= $\pi \times 0.15 \times 4.9 = 2.3\ m^2$

The source area is estimated at 2.3 m^2 (25 ft^2).

Note: Model input values are in metric units. The corresponding English units are presented for reference only.

Figure 5-9. Source Area of Hypothetical Intrusion of the IWCS by Drilling Operations



Drawing not to scale.

A groundhog den consists of a network of tunnels and a nest. The worst-case is assumed and the groundhog penetrates the K-65 residues in Bay A. The source area for this scenario is the surface area of the nest only; for simplicity the nest is considered a 0.41 m (16 inch [1.3 ft]) sphere, which accounts for the largest dimension of a potential nest.

Surface Opening Area = πr^2
Tunnel Opening Diameter = 0.305 m
Surface Opening Area= $\pi \times (0.305/2)^2 = 0.073\ m^2$

The surface opening area is assumed to be 0.073 m^2 (0.79 ft^2).

Source Area = $4\pi r^2$
Nest Diameter = 0.41 m
Source Area= $4 \times \pi \times (0.41/2)^2 = 0.53\ m^2$

The source area is assumed to be 0.53 m^2 (5.7 ft^2).

Note: Model input values are in metric units. The corresponding English units are presented for reference only.

Figure 5-10. Source Area of Hypothetical Intrusion of the IWCS by a Burrowing Animal

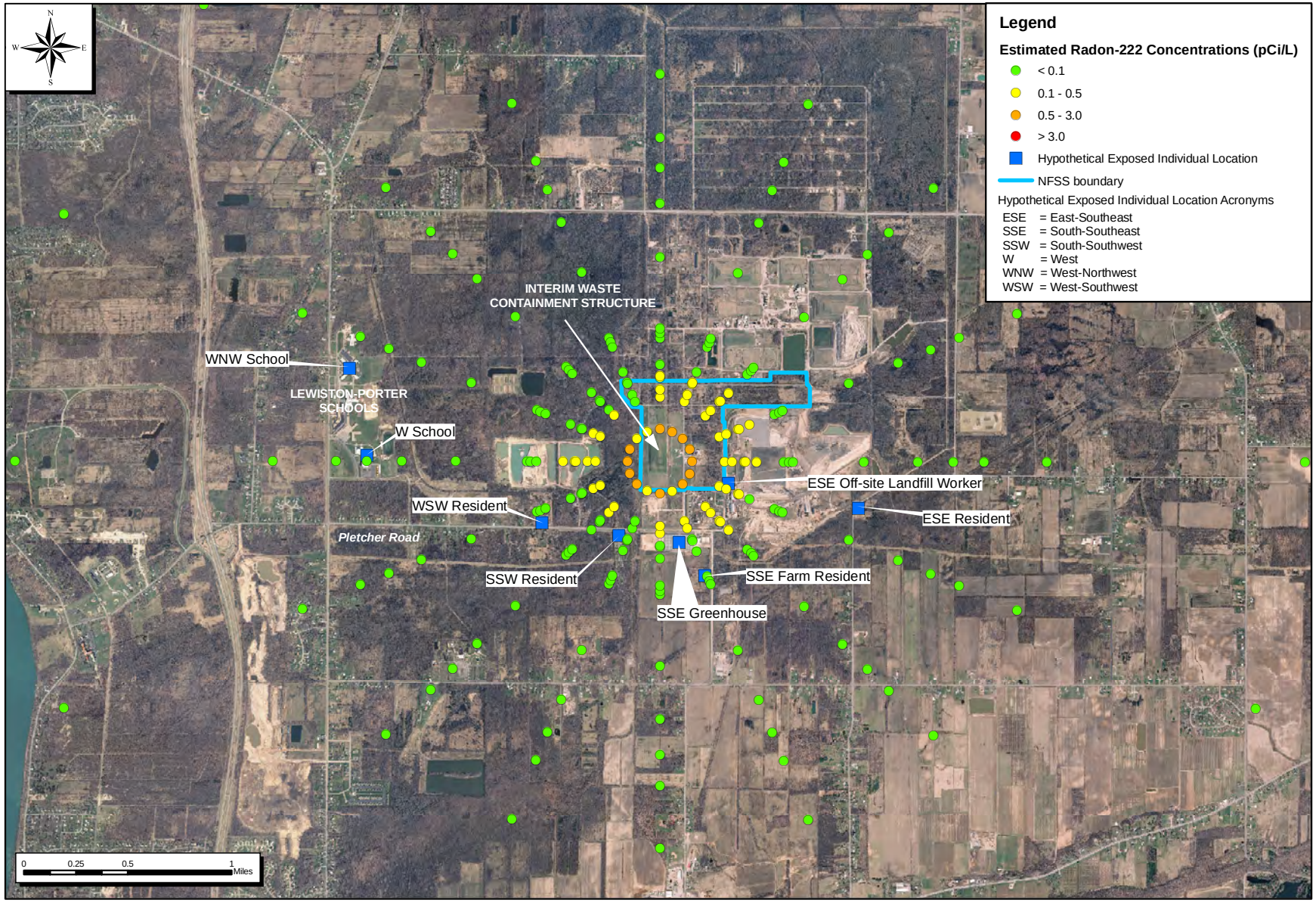


Figure 6-1. Annual Average Radon-222 Concentration Distribution for Hypothetical Removal of the K-65 Residues

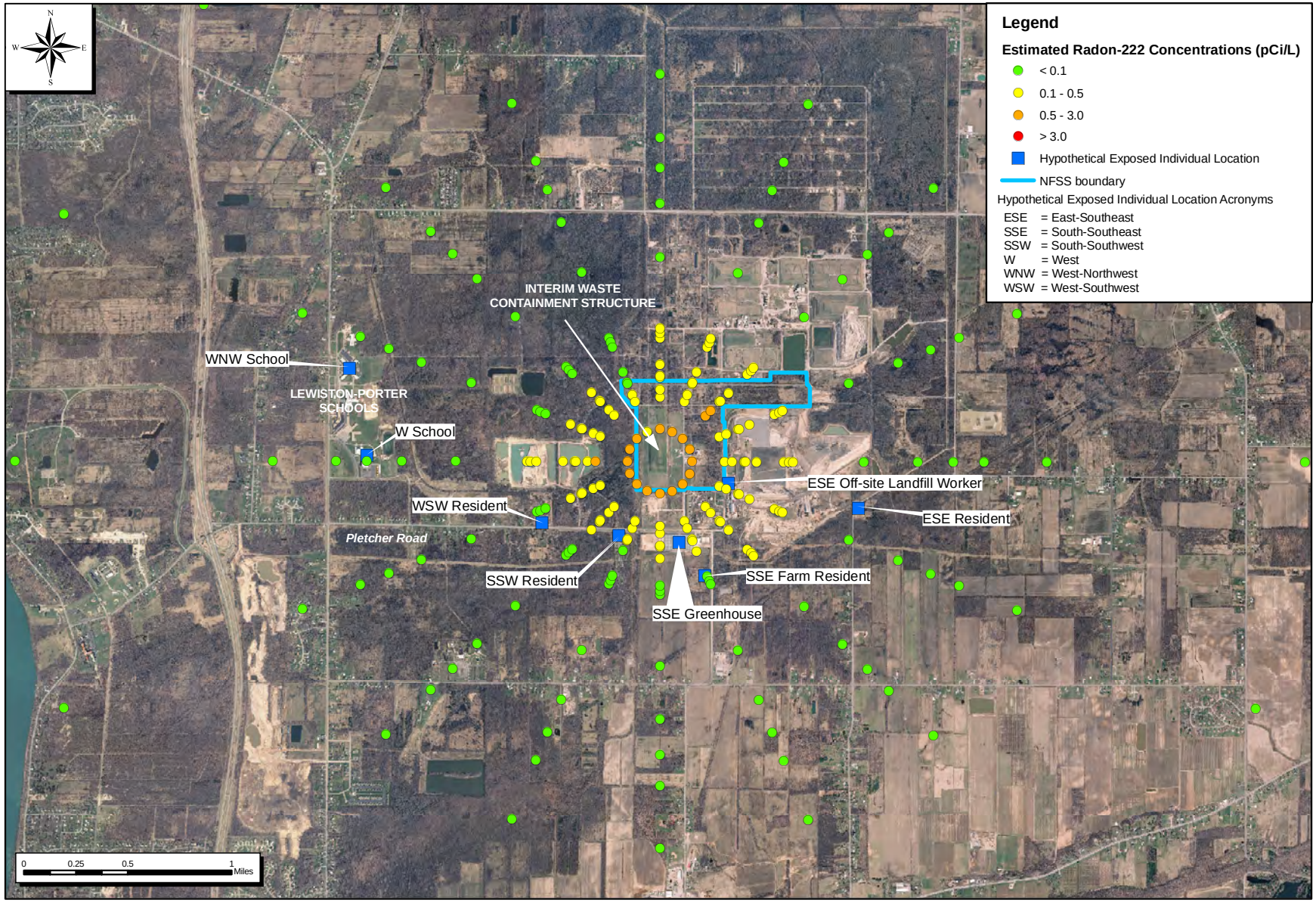


Figure 6-2. Annual Average Radon-222 Concentration Distribution for Hypothetical Removal of the Entire Contents of the IWCS

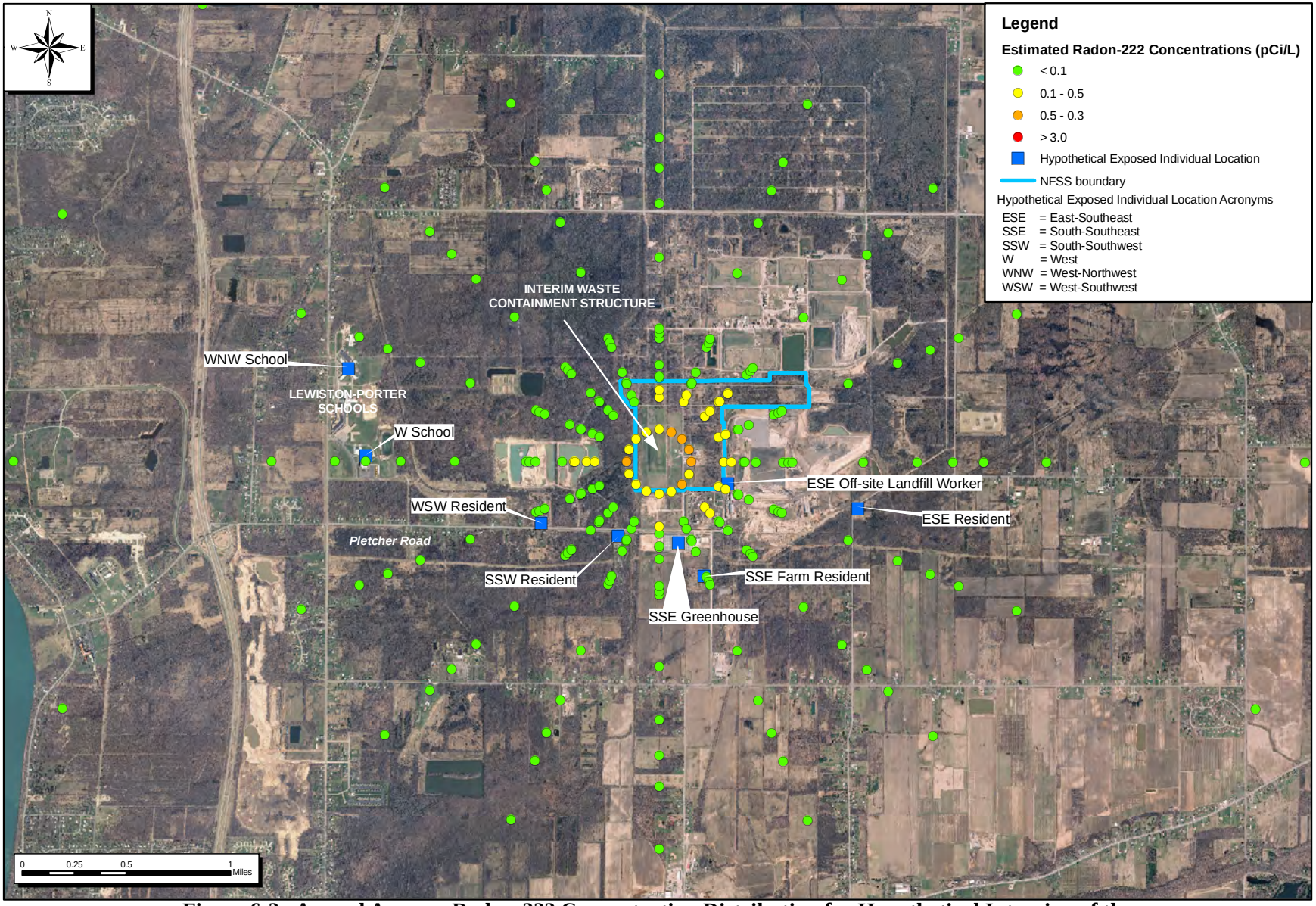


Figure 6-3. Annual Average Radon-222 Concentration Distribution for Hypothetical Intrusion of the IWCS by a Heavy Equipment Operator

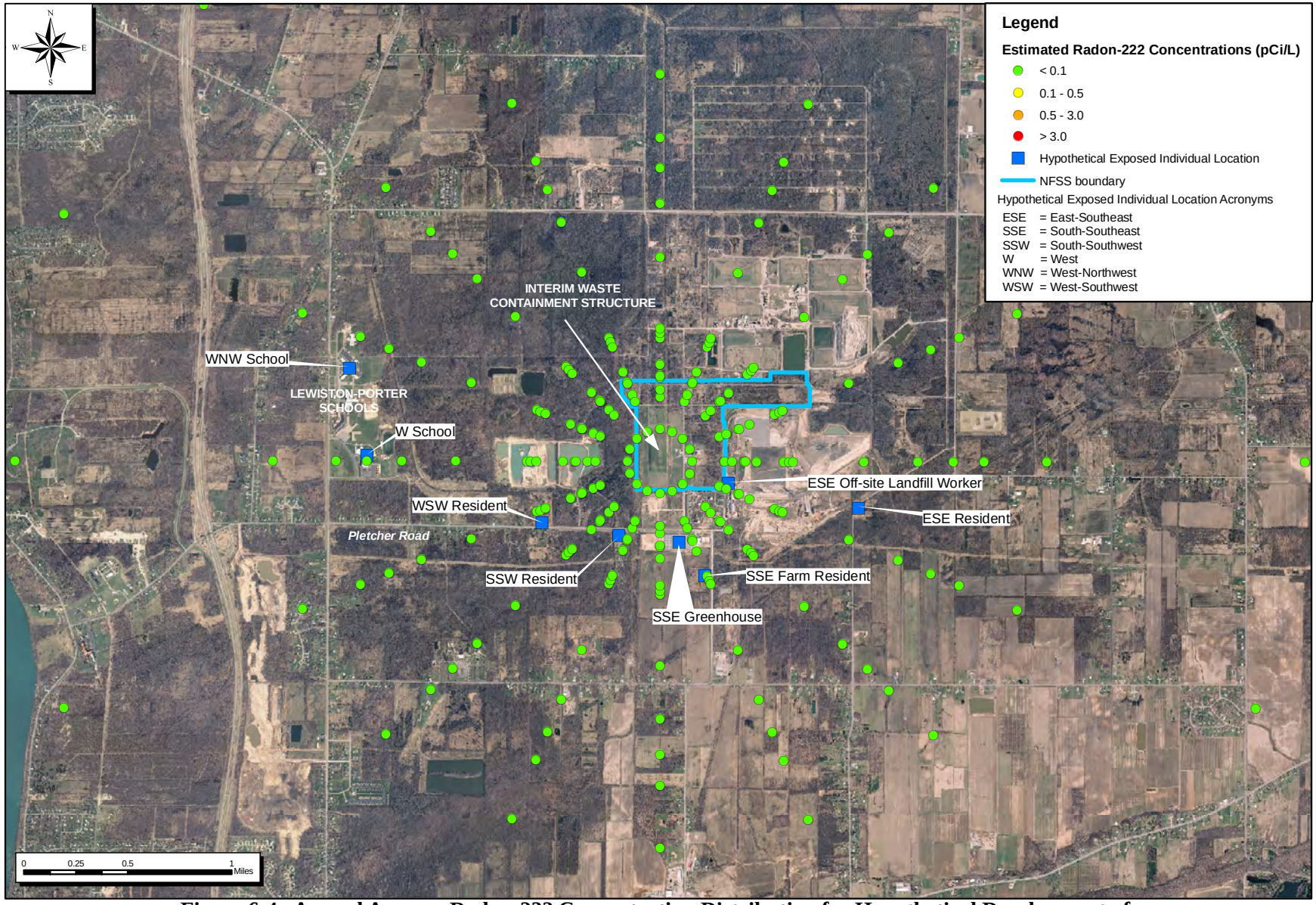


Figure 6-4. Annual Average Radon-222 Concentration Distribution for Hypothetical Development of Earthquake Fissures in the IWCS Cap

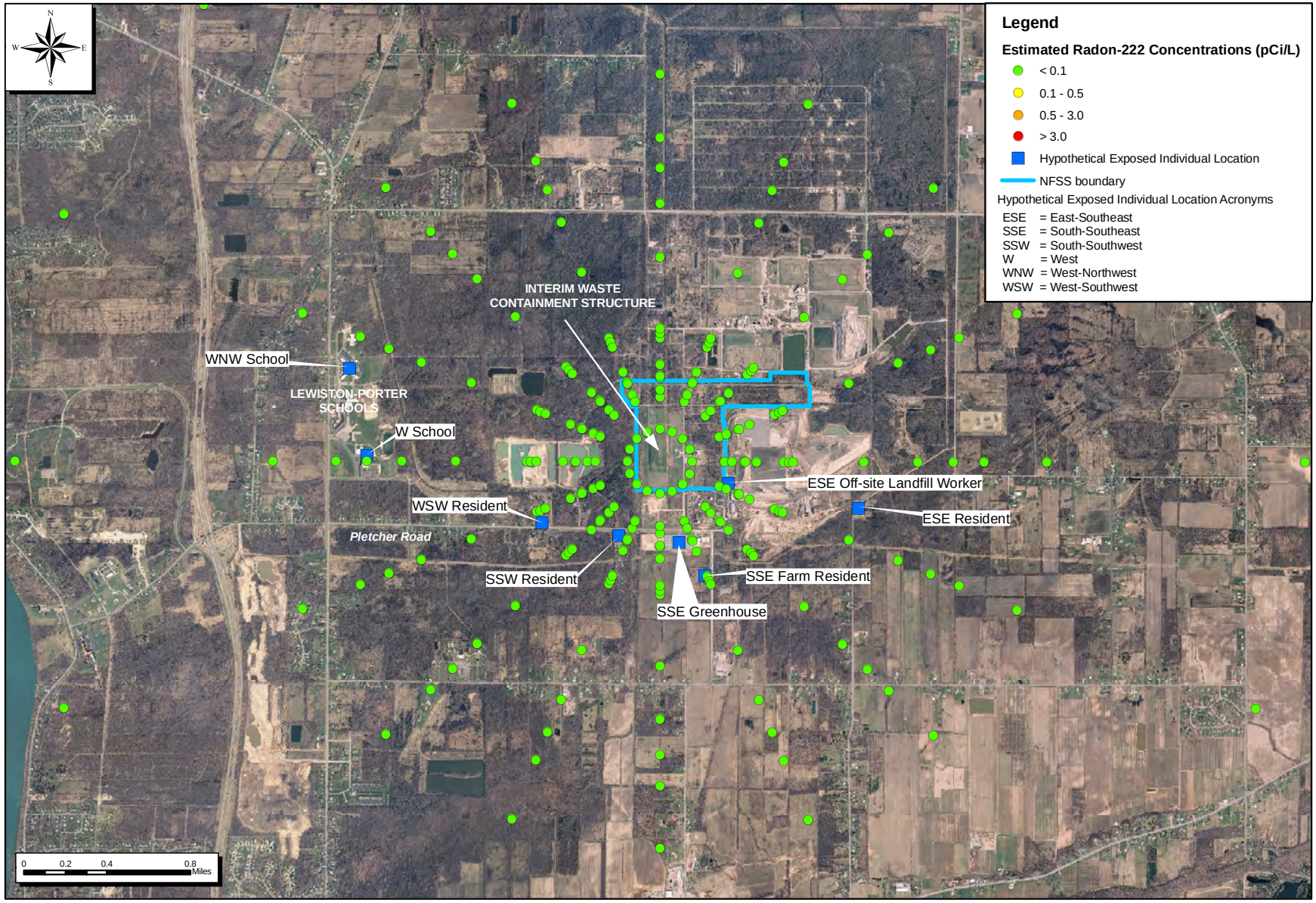


Figure 6-5. Annual Average Radon-222 Concentration Distribution for Hypothetical Drilling into the Residues

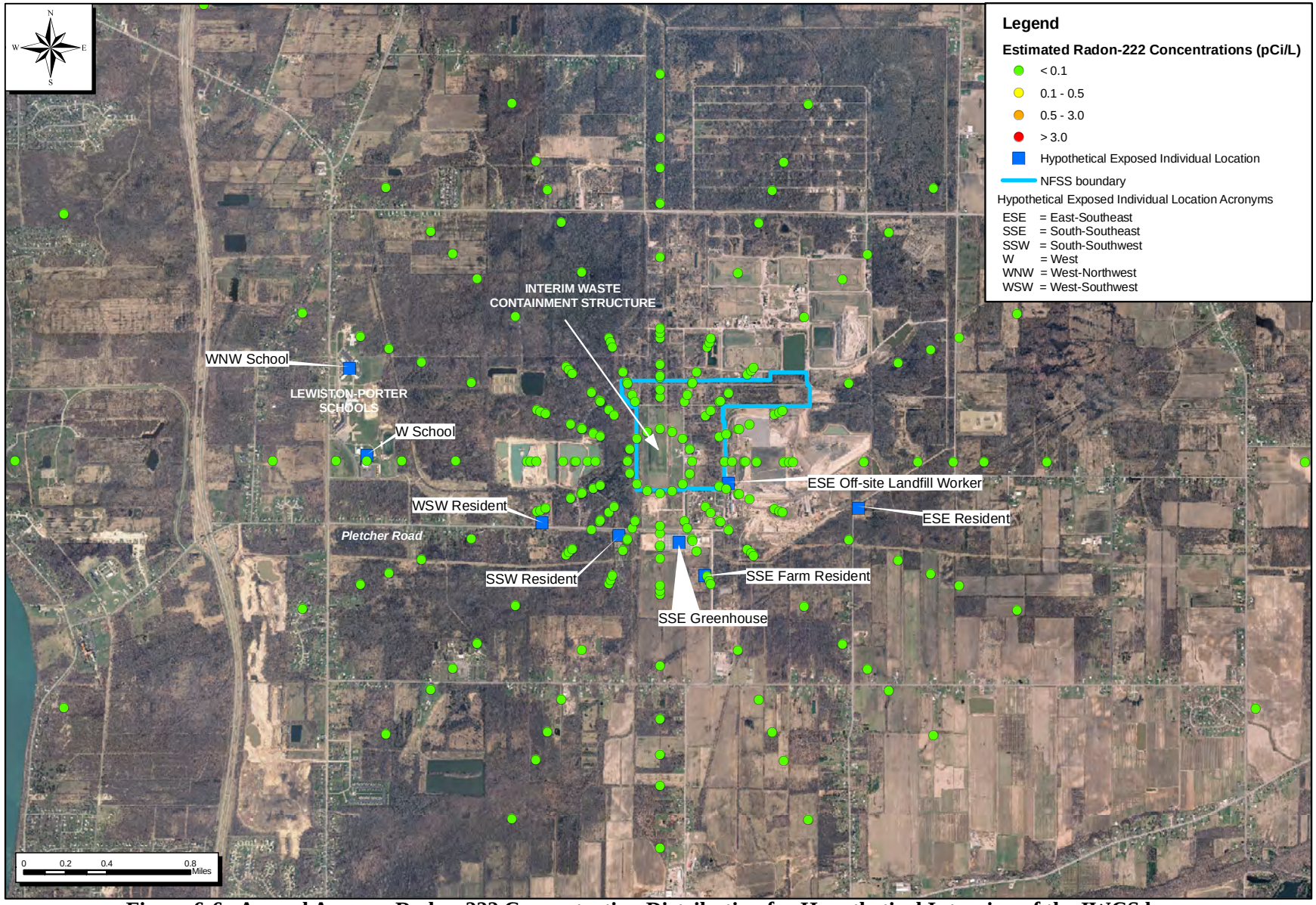


Figure 6-6. Annual Average Radon-222 Concentration Distribution for Hypothetical Intrusion of the IWCS by a Groundhog or Some Other Burrowing Animal

TABLES

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Table 2-1. Average Radium-226 Concentrations in Materials Stored in the IWCS at the NFSS

IWCS Material	Radium-226 (pCi/g) [a]
K-65	520,000
L-30	12,000
F-32	300
L-50	3,300
R-10	95
Tower Soils	10,400
Contaminated. Soils	16

[a] Radium-226 concentrations are referenced in the *Failure Analysis Report for the Niagara Falls Storage Site, Lewiston, New York* (BNI 1994), except for tower soils. "Tower soils" represent the K-65 contaminated material from around Building 434, the Thaw House, and Pond 434 that was added to the north end of Bay D. There is no known data regarding the radium concentration of the tower soils. The tower soils are assumed to have 2% of K-65 contaminant levels, based on an engineering best judgment estimate.

Table 2-2. Volumes of Waste and Residues Placed in the IWCS at the NFSS

Waste/Residue Classification	Volume (yd^3) [a]	Ra-226 Inventory (Ci) [a]
K-65	3,200	1,881
L-30	7,960	87
F-32	440	0.2
L-50	2,150	6
R-10 Residues and Soil	59,500	5
Middlesex Sands	230	<0.01 µg/kg
Remaining Contaminated Soils	116,900	3
Total	**190,380**	**1,982**

[a] Waste volumes in cubic yards (yd^3) and radium-226 inventory values (Ci) listed on this table are presented in Table 1-1 of the Remedial Investigation Report for the Niagara Falls Storage Site (USACE 2007a).
µg/kg = microgram per kilogram

Table 3-1. Summary of NFSS Evaluation Criteria for Radon

Description	Criterion	Comment	Reference
State or Federal Regulations/Orders			
Radon Flux	20 pCi/m^2/sec	Yearly average over the IWCS	40 CFR Part 61 (NESHAP;Subparts Q, T, and W) 10 CFR Part 40 Appendix A 40 CFR Part 192 DOE Order 5400.5
Outdoor Radon	0.5 pCi/L	Limit on the increase in average outdoor radon levels	40 CFR Part 192 DOE Order 5400.5 (long-term management)
	3 pCi/L	Annual average at or above any point outside the facility site	DOE Order 5400.5 (interim storage)
	30 pCi/L	Annual average over the facility site	DOE Order 5400.5 (interim storage)
	100 pCi/L	At any given point	DOE Order 5400.5 (interim storage)
Remedial Action at Former Inactive Uranium Processing Sites (occupied or habitable structures)	0.02 WL 0.03 WL (including background)	Annual average radon decay product concentration not to exceed 0.02 WL; in any case, not to exceed 0.03 WL (including background).	40 CFR Part 192, Subpart B
Occupational Radon [1] (40 hrs in any work week of 7 consecutive days)	7,000 pCi/L 9 pCi/L 4,000 pCi/L 30 pCi/L	Radon-220 (without daughters) Radon-220 (with daughters) Radon-222 (without daughters) Radon-222 (with daughters)	10 CFR 20 (Appendix B) Table 1
Public Annual Average Effluent Air Concentration [2]	20 pCi/L 0.03 pCi/L 10 pCi/L 0.1 pCi/L	Radon-220 (without daughters) Radon-220 (with daughters) Radon-222 (without daughters) Radon-222 (with daughters)	10 CFR 20 (Appendix B) Table 2
New York State Radon Testing and Reporting (Indoor)	20 pCi/L (0.1 WL)	If results of indoor radon screening or long-term testing exceed criterion, resident is advised to contact the New York State Department of Health for further technical advice and assistance.	10 NYCRR 16.130
Public Guidelines			
Indoor Radon (National Goal)	0.4 pCi/L	The Indoor Radon Abatement Act (USEPA 1988) established a long-term goal of indoor air as radon-free as the ambient, outside air (~ 0.4 pCi/L).	Radon Toxicity (ATSDR 2010) A Citizen's Guide to Radon (USEPA 2009)
Indoor Radon (Residential)	4 pCi/L	The U.S. EPA recommends that action be taken to lower airborne radon if it exceeds 4 pCi/L in a home. Radon levels less than 4 pCi/L still pose a risk, and in may cases may be reduced.	A Citizen's Guide to Radon (USEPA 2009)
Indoor Radon (Proposed National Reference Level for Residential)	2.7 pCi/L	Reference level of 2.7 pCi/L (100 Bq/m^3) is preferred; not to exceed 8 pCi/L (300 Bq/m^3) if the lower level is unreachable due to prevailing country-specific conditions.	World Health Organization Handbook on Indoor Radon: A Public Health Perspective (2009)

Table 3-1. Summary of NFSS Evaluation Criteria for Radon (Continued)

Description	Criterion	Comment	Reference
Indoor Radon (Proposed Reference Level for Residential and Workplace)	8 pCi/L 27 pCi/L	Upper reference level in dwellings revised from 16 pCi/L (600 Bq/m^3) to 8 pCi/L (300 Bq/m^3). Workplace reference level, 27 pCi/L (1,000 Bq/m^3), entry point for radiological protection requirements in existing exposure situations.	International Commission on Radiological Protection (Radiation Safety Journal October 2010)

[1] The limits given are for exposure to the concentrations specified for 40 hours in any workweek of 7 consecutive days. Note: 1910.1096(c)(1) of OSHA's Ionizing Radiation standard, which the Agency issued in 1971, requires employers to limit radiation exposures to the levels specified in the Nuclear Regulatory Commission (NRC) radiation standards in effect at the time (10 CFR Part 20, Appendix B, Table I and II). At the time the OSHA standards were set (1971), Table 1 of Appendix B to Part 20 set the maximum permissible concentration for radon-222 at 100 pCi/L. The NRC updated 10 CFR Part 20 after OSHA adopted 29 CFR 1910.1096 in 1971. The NRC defines the values listed on Table 3-1 as derived air concentrations intended to control chronic occupational exposures. NRC's updated derived air concentration for radon-222 is now 30 pCi/L, however, OSHA has not revised its standard since it was adopted, so the OSHA enforceable limit remains at 100 pCi/L. NRC regulations are more commonly used by health physicists in that they reflect more current dose criteria. The OSHA standard requires employers to ensure employees are not exposed to radon in excess of the average concentration for 40-hours in any workweek of seven consecutive days (§1910.1096(c)(1)). The current NRC values are listed on Table 3-1 and used in the evaluations presented in this technical memorandum.

[2] The concentration values given are equivalent to the radionuclide concentration which, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent of 0.05 rem.

Table 5-1. Approximate Interior Measurements of Building 411 Storage Bays[1]

Bay	Length[2] (ft)	Width[2] (ft)
A (Recarbonation Pit)	35.0	47.0
B	200	43.5
C	200	43.5
D	200	89.0

[1] Adapted from The Niagara Falls Storage Site Remedial Action Project (DOE 1985)
[2] Two foot (2 ft) exterior wall on all sides and for each bay dividing wall.

Table 6-1. On-Site Radon Air Concentrations (pCi/L) for Hypothetical Excavation and Intrusion Scenarios for Various Meteorological Conditions

Scenario	Wind Speed	
	Short-term Wind Speed (1 m/s)	Historical Long-term Average Wind Speed (4.5 m/s)
Excavation		
Bay A	1,100	240
Bay B	46	10
Bay C	1,100	240
Bay D	36	8.1
Excavation of IWCS (Bays A, B, C and D)	2,320	506
Intrusion		
Heavy Equipment Damage	810	180
Earthquake Damage	260	57
Drilling Damage	0.27	0.06
Burrowing Animal Damage	0.13	0.03

Note:
Excavation results are based on the maximum radon flux within a given bay (see Appendix A).

IWCS removal results are based on the sum of releases from 100 m^2 excavations in Bays A, B, C and 200 m^2 in Bay D. Values are based on layer of maximum emission in each bay, which is conservative for an excavation across all bays since the maximum layers do not necessarily correspond to the same depth in each bay.

Intrusion results are based on the radon flux from K-65 residues, with the exception of the earthquake scenario (see Appendix E).

Results presented are for the convective release model (see Appendix A). Excavation results are from Tables A-2, 4, 6, and 8 for each bay respectively. For the intrusion scenarios, results are from Table A-11 and A-12 for the historical and stable weather respectively with area factors included.

For the on-site calculations, a wind speed representing a short-term minimum was used to provide the most conservative results (similar to the typical and bounding short-term conditions modeled for the short-term off-site locations) as well as a long-term average (similar to the default meteorological dataset used for long-term off-site modeling) representing many years of observations in the area.

Table 6-2. Unit Off-Site Radon Air Concentrations at Downwind Locations for Various Meteorological Conditions

Distance (m)	Unit Air Concentration (pCi/L per Ci/yr)		
	Short-term Release Based on Extremely Stable Short-term Weather Conditions (Class G at 1 m/s)	Short-term Release Based on Slightly Unstable Short-term Weather Conditions (Class C at 1 m/s)	Long-term Release Based on Historical Long-term Weather Conditions
250	0.16	0.013	0.0014
500	0.046	0.0034	0.00038
750	0.023	0.0015	0.00018
1,000	0.013	0.00087	0.00010
2,000	0.0041	0.00025	0.000033
3,000	0.0021	0.00012	0.000017
5,000	0.0010	0.000046	0.0000080
10,000	0.00040	0.000013	0.0000030
15,000	0.00025	0.0000069	0.0000018
30,000	0.00012	0.0000027	0.00000076
45,000	0.000075	0.0000018	0.00000047
75,000	0.000043	0.0000011	0.00000026

Note:
Values are for a unit emission of 1Ci/yr (see Table B-10).
Class G atmospheric stability class at 1 m/s represents bounding short-term conditions
Class C atmospheric stability class at 1 m/s represents more slightly unstable short-term weather conditions
Historical long-term weather conditions represent long-term average data from 1955-1959 at Niagara Falls International Airport, with maximum concentrations to the northeast of the source

Table 6-3. Summary of Off-Site Radon Air Concentrations for the Three Weather Conditions Modeled

	Extremely Stable Short-term Weather Conditions		Slightly Unstable Short-term Weather Conditions		Historical Long-term Weather Conditions		Emitting Area	Max Flux
Downwind Distance	**250 m**	**2000 m**	**250 m**	**2000 m**	**250 m**	**2000 m**	**(m^2)**	**(Ci/yr)**
Unit Data								
Unit Conc (pCi/L per Ci/yr)	0.16	0.004	0.013	0.00025	0.0014	0.000033	--	--
Excavation								
Bay A - Max Conc (pCi/L)	137	3.5	11	0.21	1.1	0.028	100	842
Bay B - Max Conc (pCi/L)	6.3	0.16	0.50	0.01	0.052	0.0013	100	39
Bay C - Max Conc (pCi/L)	137	3.5	11	0.21	1.1	0.028	100	842
Bay D - Max Conc (pCi/L)	4.7	0.12	0.37	0.007	0.039	0.00095	100	29
Bay A, B, C, D - Max Conc (pCi/L)	286	7.2	23	0.44	2.4	0.058	500	1755
Intrusion								
Bay A – Heavy Equipment - Max Conc (pCi/L)	95	2.4	7.6	0.14	0.78	0.019	69	581
Bay A - Earthquake - Max Conc (pCi/L)	9.0	0.23	0.72	0.014	0.074	0.0018	390	55
Bay A - Drilling - Max Conc (pCi/L)	3.2	0.08	0.25	0.005	0.026	0.00064	2.3	19
Bay A - Burrowing - Max Conc (pCi/L)	0.73	0.019	0.06	0.001	0.0061	0.00015	0.53	4.5

Notes:
Extremely stable short-term weather condition is Class G at 1 m/s to North, slightly unstable short-term weather condition is Class C at 1 m/s, and historical long-term weather condition has maximum concentrations to the Northeast.
Flux data are from Appendix A, excavation/intrusion air concentration values are from Appendix B, and unit air concentrations are from Appendix C.
Class G atmospheric stability class at 1 m/s represents extremely stable short-term weather condition
Class C atmospheric stability class at 1 m/s represents more slightly unstable short-term weather conditions
Historical long-term weather conditions represent long-term average data from 1955-1959 at Niagara Falls International Airport, with maximum concentrations to the northeast of the source
Unit Conc - The unit concentrations are the predicted air concentrations (see Appendix B) based on an emission rate of 1 Ci/yr for each of the atmospheric conditions. Unit air concentrations were then scaled based on scenario specific emission rates to provide results.
Max Conc - The maximum air concentration is that predicted assuming the maximum emission rate from the source, which corresponds with the K-65 residue layer within IWCS.

Table 6-4. Summary of Air Concentrations at Hypothetical Receptor Locations for Historical Long-term Weather Conditions

	Location/Receptor	**Off-Site Landfill Worker**	**Green-house**	**Resident**	**Farm Resident**	**Resident**	**Resident**	**School**	**School**
	Direction	ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
	Distance (m)	559	652	662	959	1030	1583	2273	2511
	Unit Air Conc (pCi/L per Ci/yr)	0.00018	0.000097	0.000065	0.000047	0.000044	0.000029	0.000021	0.000010
Scenario	**Emission Rate (Ci/yr)**	**Air Concentrations (pCi/L)**							
Excavation - Bay A (max flux)	842	0.15	0.081	0.054	0.040	0.037	0.025	0.018	0.0086
Excavation - Bay B (max flux)	39	0.0071	0.0037	0.0025	0.0018	0.0017	0.0011	0.00081	0.00039
Excavation - Bay C (max flux)	842	0.15	0.081	0.054	0.040	0.037	0.025	0.018	0.0086
Excavation - Bay D (max flux)	29	0.0053	0.0028	0.0018	0.0014	0.0013	0.00084	0.00060	0.00029
Excavation - All Bays (max flux)	1755	0.32	0.17	0.11	0.083	0.078	0.052	0.037	0.018
Bay A - Heavy Equipment (max flux)	581	0.11	0.056	0.038	0.027	0.026	0.017	0.012	0.0059
Bay A - Earthquake (max flux)	55	0.010	0.0053	0.0036	0.0026	0.0024	0.0016	0.0012	0.00056
Bay A - Drilling (max flux)	19	0.0036	0.0019	0.0013	0.00092	0.00086	0.00057	0.00041	0.00020
Bay A - Burrowing (max flux)	4.5	0.00083	0.00043	0.00029	0.00021	0.00020	0.00013	0.000095	0.000046

Notes:
Historical long-term weather - Unit Air Conc is the result of modeling a unit emission of 1 Ci/yr for the historical long-term weather dataset, which represents a long-term release.
Air concentrations are calculated from the unit air concentration based on the scenario-specific emission rate.
All values represent maximum flux (max flux).

Table 6-5. Summary of Air Concentrations at Hypothetical Receptor Locations for Slightly Unstable Short-term Weather Conditions

	Location/Receptor	**Off-Site Landfill Worker**	**Green-house**	**Resident**	**Farm Resident**	**Resident**	**Resident**	**School**	**School**
	Direction	ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
	Distance (m)	559	652	662	959	1030	1583	2273	2511
	Unit Air Conc (pCi/L per Ci/yr)	0.0027	0.0020	0.0020	0.00095	0.00084	0.00038	0.00020	0.00016
Scenario	**Emission Rate (Ci/yr)**	**Air Concentrations (pCi/L)**							
Excavation - Bay A (max flux)	842	2.3	1.7	1.7	0.80	0.71	0.32	0.17	0.14
Excavation - Bay B (max flux)	39	0.10	0.078	0.075	0.037	0.032	0.015	0.0076	0.0063
Excavation - Bay C (max flux)	842	2.3	1.7	1.7	0.80	0.71	0.32	0.17	0.14
Excavation - Bay D (max flux)	29	0.078	0.058	0.056	0.027	0.024	0.011	0.0056	0.0047
Excavation - All Bays (max flux)	1755	4.8	3.5	3.4	1.7	1.5	0.67	0.35	0.29
Bay A - Heavy Equipment (max flux)	581	1.6	1.2	1.1	0.55	0.49	0.22	0.11	0.095
Bay A - Earthquake (max flux)	55	0.15	0.11	0.11	0.052	0.046	0.021	0.011	0.0090
Bay A - Drilling (max flux)	19	0.053	0.039	0.038	0.018	0.016	0.0074	0.0038	0.0032
Bay A - Burrowing (max flux)	4.5	0.012	0.0091	0.0088	0.0043	0.0038	0.0017	0.00089	0.00074

Notes:
Slightly unstable short-term weather conditions - Unit Air Conc is the result of modeling a unit emission of 1 Ci/yr for the slightly unstable short-term weather conditions dataset (stability class C at 1 m/s).
Air concentrations are calculated from the unit air concentration based on the scenario-specific emission rate.

Table 6-6. Summary of Air Concentrations at Hypothetical Receptor Locations for Extremely Stable Short-term Weather Condition

	Location/Receptor	**Off-Site Landfill Worker**	**Green-house**	**Resident**	**Farm Resident**	**Resident**	**Resident**	**School**	**School**
	Direction	ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
	Distance (m)	559	652	662	959	1030	1583	2273	2511
	Unit Air Conc (pCi/L per Ci/yr)	0.038	0.028	0.028	0.014	0.012	0.0061	0.0033	0.0028
Scenario	**Emission Rate (Ci/yr)**	**Air Concentrations (pCi/L)**							
Excavation - Bay A (max flux)	842	32	24	23	12	10	5.1	2.8	2.4
Excavation - Bay B (max flux)	39	1.4	1.1	1.1	0.54	0.47	0.23	0.13	0.11
Excavation - Bay C (max flux)	842	32	24	23	12	10	5.1	2.8	2.4
Excavation - Bay D (max flux)	29	1.1	0.81	0.79	0.40	0.35	0.17	0.095	0.081
Excavation - All Bays (max flux)	1755	66	50	48	25	22	11	5.8	4.9
Bay A - Heavy Equipment (max flux)	581	22	16	16	8.1	7.1	3.5	1.9	1.6
Bay A - Earthquake (max flux)	55	2.1	1.6	1.5	0.77	0.68	0.33	0.18	0.16
Bay A - Drilling (max flux)	19	0.73	0.55	0.53	0.27	0.24	0.12	0.065	0.055
Bay A - Burrowing (max flux)	4.5	0.17	0.13	0.12	0.063	0.055	0.027	0.015	0.013

Notes:
Extremely stable short-term weather condition - Unit Air Conc is the result of modeling a unit emission of 1 Ci/yr for the extremely stable short-term weather condition dataset (stability class G at 1 m/s).
Air concentrations are calculated from the unit air concentration based on the scenario-specific emission rate.

Table 6-7. Atmospheric Modeling Results for Potential Off-site Releases Associated with IWCS Excavation Scenarios

Scenario	Radon-222 Concentration Limits Exceeded?	Off-site Releases		
		Long-term Releases based on Historical Long-term Weather Conditions [a]	**Short-term Releases based on Slightly Unstable Short-term Weather Conditions [b]**	**Short-term Releases based on Extremely Stable Short-term Weather Conditions [b]**
Removal of K-65 Residues	Yes (See summary to right and details in Section 6.3.1.)	*Radon-222 concentration limits exceeded.* • The maximum modeled concentration is 1.1 pCi/L at 250 m (820 ft) to the northeast of the IWCS. • The 0.1 pCi/L standard is only exceeded at the nearest hypothetical receptor location. • Predicted air concentrations at receptor locations ranged from 0.0086 to 0.15 pCi/L.	*Radon-222 concentration limits not exceeded.* • The 100 pCi/L level is not exceeded at modeled locations as near as 250 m (820 ft) downwind. • Predicted air concentrations at receptor locations ranged from 0.14 to 2.3 pCi/L.	*Radon-222 concentration limits exceeded.* • The 100 pCi/L level is exceeded at modeled locations as near as 250 m (820 ft) downwind (137 pCi/L). • Predicted air concentrations at receptor locations ranged from 2.4 to 32 pCi/L.
Removal of all Residues (Results are the same as for Removal of K-65 Residues)	Yes (See summary to right and details in Section 6.3.2.)	*Radon-222 concentration limits exceeded.* • The maximum modeled concentration is 1.1 pCi/L at 250 m (820 ft) to the northeast of the IWCS. • The 0.1 pCi/L standard is only exceeded at the nearest hypothetical receptor location. • Predicted air concentrations at receptor locations ranged from 0.0086 to 0.15 pCi/L.	*Radon-222 concentration limits not exceeded.* • The 100 pCi/L level is not exceeded at modeled locations as near as 250 m (820 ft) downwind. • Predicted air concentrations at receptor locations ranged from 0.14 to 2.3 pCi/L	*Radon-222 concentration limits exceeded.* • The 100 pCi/L level is exceeded at modeled locations as near as 250 m (820 ft) downwind (137 pCi/L). • Predicted air concentrations at receptor locations ranged from 2.4 to 32 pCi/L.

Table 6-7. Atmospheric Modeling Results for Potential Off-site Releases Associated with IWCS Excavation Scenarios (Continued)

Scenario	Radon-222 Concentration Limits Exceeded?	Off-site Releases		
		Long-term Releases based on Historical Long-term Weather Conditions [a]	**Short-term Releases based on Slightly Unstable Short-term Weather Conditions [b]**	**Short-term Releases based on Extremely Stable Short-term Weather Conditions [b]**
Removal of Entire IWCS Contents	Yes (See summary to right and details in Section 6.3.3.)	*Radon-222 concentration limits exceeded.* • The maximum modeled concentration is 2.4 pCi/L at 250 m (820 ft) to the northeast of the IWCS. • The 0.1 pCi/L standard is exceeded at the three closest hypothetical receptor locations. • Predicted air concentrations at receptor locations ranged from 0.018 to 0.32 pCi/L.	*Radon-222 concentration limits not exceeded.* • The 100 pCi/L level is not exceeded at modeled locations as near as 250 m (820 ft) downwind. • Predicted air concentrations at receptor locations ranged from 0.29 to 4.8 pCi/L.	*Radon-222 concentration limits exceeded.* • The 100 pCi/L level is exceeded at modeled locations as near as 250 m (820 ft) downwind (286 pCi/L). • Predicted air concentrations at receptor locations ranged from 4.9 to 66 pCi/L.

Notes:
a – Criterion of 0.1 pCi/L is referenced in 10 CFR Part 20.
b – Criterion of 100 pCi/L is referenced in DOE Order 5400.5.
The scenario for removal of K-65 residue assumes a 100 m^2 excavation into Bays A and C consecutively. The removal of all residues assumes a 100 m^2 excavation into each of the bays consecutively. The removal of the IWCS is based on 100 m^2 excavations in Bays A through C, and a 200 m^2 excavation into Bay D, concurrently.
The long-term modeling was based on years of atmospheric data collected in the area. The short term conditions were based on conditions expected to occur for brief durations during a year and represent slightly stable atmospheres (Class C stability at 1 m/s wind speed) and extremely stable (Class G stability at 1 m/s wind speed) meteorological conditions.

Table 6-8. Atmospheric Modeling Results for Potential On-site Releases Associated with IWCS Excavation Scenarios

Scenario	Radon-222 Concentration Limits Exceeded?	On-site Releases	
		Historical Long-term Weather Wind Speed (4.5 m/s)	Extremely Stable Short-term Weather Wind Speed (1 m/s)
Removal of K-65 Residues	Yes (See summary to right and details in Section 6.3.1.)	*Radon-222 occupational exposure limits exceeded.* • On-site concentrations range up to 240 pCi/L, which is less than the radon-222 occupational exposure limit of 4,000 pCi/L (without daughters), but greater than radon-222 occupational exposure limit of 30 pCi/L (with daughters).	*Radon-222 occupational exposure limits exceeded.* • On-site concentrations range up to 1,100 pCi/L, which is less than the radon-222 occupational exposure limit of 4,000 pCi/L (without daughters) but greater than the radon-222 occupational exposure limit of 30 pCi/L (with daughters).
Removal of all Residues (Results are the same as for Removal of K-65 Residues)	Yes (See summary to right and details in Section 6.3.2.)	*Radon-222 occupational exposure limits exceeded.* • On-site concentrations range up to 240 pCi/L, which is less than the radon-222 occupational exposure limit of 4,000 pCi/L (without daughters), but greater than radon-222 occupational exposure limit of 30 pCi/L (with daughters).	*Radon-222 occupational exposure limits exceeded.* • On-site concentrations range up to 1,100 pCi/L, which is less than the radon-222 occupational exposure limit of 4,000 pCi/L (without daughters) but greater than the radon-222 occupational exposure limit of 30 pCi/L (with daughters).
Removal of Entire IWCS Contents	Yes (See summary to right and details in Section 6.3.3.)	*Radon-222 occupational exposure limits exceeded.* • On-site concentrations range up to 506 pCi/L, which is less than the radon-222 occupational exposure limit of 4,000 pCi/L (without daughters), but greater than radon-222 occupational exposure limit of 30 pCi/L (with daughters).	*Radon-222 occupational exposure limits exceeded.* • On-site concentrations range up to 2,320 pCi/L, which is less than the radon-222 occupational exposure limit of 4,000 pCi/L (without daughters) but greater than radon-222 occupational exposure limit of 30 pCi/L (with daughters).

Note:
The radon -222 occupational exposure limit of 4,000 pCi/L [without daughters (10 CFR 20 Appendix B Table 1)] would be associated with the initial release of radon when the waste materials are encountered, since the radon daughters would not yet be present.

The radon -222 occupational exposure limit of 30 pCi/L (with daughters, (10 CFR 20 Appendix B Table 1)] would be associated with continued exposures following the initial release of radon, since the radon daughters will begin to be present.

The scenario for removal of K-65 residue assumes a 100m^2 excavation into Bays A and C consecutively. The removal of all residues assumes a 100m^2 excavation into each of the bays consecutively. The removal of the IWCS is based on 100m^2 excavations in Bays A through C, and a 200 m^2 excavation into Bay D, concurrently.

On-site modeling considered two wind speeds to represent the long-term averages (4.5 m/s) and short term conditions (1 m/s).

Table 6-9. Atmospheric Modeling Results for Potential Off-site Releases Associated with IWCS Intrusion Scenarios

Scenario	Radon-222 Concentration Limits Exceeded?	Off-site Releases		
		Long-term Releases based on Historical Long-term Weather Conditions [a]	**Short-term Releases based on Slightly Unstable Short-term Weather Conditions [b]**	**Short-term Releases based on Extremely Stable Short-term Weather Conditions [b]**
Damage Due to the Use of Heavy Equipment	Yes (See summary to right and details in Section 6.4.1.)	*Radon-222 concentration limits exceeded.* • The maximum modeled concentration is 0.78 pCi/L at 250 m (820 ft) to the northeast of the IWCS. • The 0.1 pCi/L standard is exceeded at the hypothetical receptor location closest to the site. • Predicted air concentrations at receptor locations ranged from 0.0059 to 0.11 pCi/L.	*Radon-222 concentration limits not exceeded.* • The 100 pCi/L level is not exceeded at modeled locations as near as 250 m (820 ft) downwind. • Predicted air concentrations at receptor locations ranged from 0.095 to 1.6 pCi/L.	*Radon-222 concentration limits not exceeded.* • The 100 pCi/L level is not exceeded at modeled locations as near as 250 m (820 ft) downwind. • Predicted air concentrations at receptor locations ranged from 1.6 to 22 pCi/L.
Damage Due to an Earthquake	No (See summary to right and details in Sections 4.2.2. and 6.4.2.)	*Radon-222 concentration limits not exceeded.* *Under an alternate scenario modeled:* • No radon-222 concentrations exceed the standards for this scenario at modeled locations as near as 250 m (820 ft) downwind. • Predicted air concentrations at receptor locations ranged from 0.00056 to 0.010 pCi/L.	*Radon-222 concentration limits not exceeded.* *Under an alternate scenario modeled:* • The 100 pCi/L level is not exceeded at modeled locations as near as 250 m (820 ft) downwind. • Predicted air concentrations at receptor locations ranged from 0.009 to 0.15 pCi/L.	*Radon-222 concentration limits not exceeded.* *Under an alternate scenario modeled:* • The 100 pCi/L level is not exceeded at modeled locations as near as 250 m (820 ft) downwind. • Predicted air concentrations at receptor locations ranged from 0.16 to 2.1 pCi/L.
Damage Caused by Drilling into the Residues	No (See summary to right and details in Section 6.4.3.)	*Radon-222 concentration limits not exceeded.* • No radon-222 concentrations exceed the standards for this scenario at modeled locations as near as 250 m (820 ft) downwind. • Predicted air concentrations at receptor locations ranged from 0.00020 to 0.0036 pCi/L.	*Radon-222 concentration limits not exceeded.* • The 100 pCi/L level is not exceeded at modeled locations as near as 250 m (820 ft) downwind • Predicted air concentrations at receptor locations ranged from 0.0032 to 0.053 pCi/L.	*Radon-222 concentration limits not exceeded.* • The 100 pCi/L level is not exceeded at modeled locations as near as 250 m (820 ft) downwind. • Predicted air concentrations at receptor locations ranged from 0.055 to 0.73 pCi/L.

Table 6-9. Atmospheric Modeling Results for Potential Off-site Releases Associated with IWCS Intrusion Scenarios (Continued)

Scenario	Radon-222 Concentration Limits Exceeded?	Off-site Releases		
		Long-term Releases based on Historical Long-term Weather Conditions [a]	Short-term Releases based on Slightly Unstable Short-term Weather Conditions [b]	Short-term Releases based on Extremely Stable Short-term Weather Conditions [b]
Damage from a Burrowing Animal	No (See summary to right and details in Section 6.4.4.)	*Radon-222 concentration limits not exceeded.* • No radon-222 concentrations exceed the standards for this scenario at modeled locations as near as 250 m (820 ft) downwind. • Predicted air concentrations at receptor locations ranged from 0.000046 to 0.00083 pCi/L.	*Radon-222 concentration limits not exceeded.* • The 100 pCi/L level is not exceeded at modeled locations as near as 250 m (820 ft) downwind. • Predicted air concentrations at receptor locations ranged from 0.00074 to 0.012 pCi/L.	*Radon-222 concentration limits not exceeded.* • The 100 pCi/L level is not exceeded at modeled locations as near as 250 m (820 ft) downwind. • Predicted air concentrations at receptor locations ranged from 0.013 to 0.17 pCi/L.

Notes:
a – Criterion of 0.1 pCi/L is referenced in 10 CFR Part 20. b – Criterion of 100 pCi/L is referenced in DOE Order 5400.5.

The intrusion scenarios are based on an exposed source area of 69 m^2 for equipment damage, 390 m^2 for the earthquake (see Appendix E), 2.3 m^2 for the drilling, and 0.53 m^2 for the animal burrow. The radon emission rates for these scenarios are based on convective flow from the source area to the atmosphere as presented in Appendix A and Appendix C. For the earthquake scenario, the emission rate was established to achieve an air concentration of 0.1 pCi/L at the site boundary under default meteorological condition (see Appendix E).

The long-tem modeling was based on years of atmospheric data collected in the area. The short-term conditions were based on conditions expected to occur for brief durations during a year and represent slightly stable atmospheres (Class C stability at 1 m/s wind speed) and extremely stable (Class G stability at 1 m/s wind speed) meteorological conditions.

Table 6-10. Atmospheric Modeling Results for Potential On-site Releases Associated with IWCS Intrusion Scenarios

Scenario	Radon-222 Concentration Limits Exceeded?	On-site Releases	
		Historical Long-term Weather Wind Speed (4.5 m/s)	Extremely Stable Short-term Weather Wind Speed (1 m/s)
Damage Due to the Use of Heavy Equipment	Yes (See summary to right and details in Section 6.4.1.)	*Radon-222 concentration limits exceeded.* • On-site air concentrations range up to 180 pCi/L for the historical long-term weather conditions; therefore, the radon-222 occupational exposure limit of 30 pCi/L (with daughters) is exceeded, although the exposure limit of 4,000 pCi/L (without daughters) is not exceeded.	*Radon-222 concentration limits exceeded.* • On-site air concentrations range up to 810 pCi/L for the extremely stable short-term weather condition wind speed (1 m/s [2.2 mph]); therefore, the radon-222 occupational exposure limit of 30 pCi/L (with daughters) is exceeded, although the exposure limit of 4,000 pCi/L (without daughters) is not exceeded.
Damage Due to an Earthquake	No (See summary to right and details in Sections 4.2.2 and 6.4.2.)	*Radon-222 concentration limits not exceeded.* • *Under an alternate scenario modeled*, on-site air concentrations range up to 57 pCi/L for the historical long-term weather conditions; therefore, the radon-222 occupational exposure limit of 30 pCi/L (with daughters) is exceeded. although the exposure limit of 4,000 pCi/L (without daughters) is not exceeded.	*Radon-222 concentration limits not exceeded.* • *Under an alternate scenario modeled*, on-site air concentrations range up to 260 pCi/L for the extremely stable short-term weather condition wind speed (1 m/s [2.2 mph]); therefore, the radon-222 occupational exposure limit of 30 pCi/L (with daughters) is exceeded, although the exposure limit of 4,000 pCi/L (without daughters) is not exceeded.
Damage Caused by Drilling into the Residues	No (See summary to right and details in Section 6.4.3.)	*Radon-222 concentration limits not exceeded.* • On-site air concentrations range up to 0.06 pCi/L for the historical long-term weather conditions and wind speed (4.5 m/s); therefore, the radon-222 occupational exposure limits of 30 pCi/L (with daughters) and 4,000 pCi/L (without daughters) are not exceeded.	*Radon-222 concentration limits not exceeded.* • On-site air concentrations range up to 0.27 pCi/L for the extremely stable short-term weather condition wind speed (1 m/s); therefore, the radon-222 occupational exposure limits of 30 pCi/L (with daughters) and 4,000 pCi/L (without daughters) are not exceeded.

Table 6-10. Atmospheric Modeling Results for Potential On-site Releases Associated with IWCS Intrusion Scenarios (Continued)

Scenario	Radon-222 Concentration Limits Exceeded?	On-site Releases	
		Historical Long-term Weather Wind Speed (4.5 m/s)	Extremely Stable Short-term Weather Wind Speed (1 m/s)
Damage from a Burrowing Animal	No (See summary to right and details in Section 6.4.4.)	*Radon-222 concentration limits not exceeded.* • On-site air concentrations range up to 0.03 pCi/L for the historical long-term weather conditions and wind speed (4.5 m/s); therefore, the radon-222 occupational exposure limits of 30 pCi/L (with daughters) and 4,000 pCi/L (without daughters) are not exceeded.	*Radon-222 concentration limits not exceeded.* • On-site air concentrations range up to 0.13 pCi/L for the extremely stable short-term weather condition wind speed (1 m/s); therefore, the radon-222 occupational exposure limits of 30 pCi/L (with daughters) and 4,000 pCi/L (without daughters) are not exceeded.

Note:
The radon -222 occupational exposure limit of 4,000 pCi/L [without daughters (10 CFR 20 Appendix B Table 1)] would be associated with the initial release of radon when the waste materials are encountered, since the radon daughters would not yet be present.

The radon -222 occupational exposure limit of 30 pCi/L (with daughters, (10 CFR 20 Appendix B Table 1)] would be associated with continued exposures following the initial release of radon, since the radon daughters will begin to be present.

On-site modeling considered two wind speeds to represent the long-term averages (4.5 m/s) and short term conditions (1 m/s).

The intrusion scenarios are based on an exposed source area of 69m^2 for equipment damage, 390 m^2 for the earthquake (see Appendix E), 2.3 m^2 for the drilling, and 0.53 m^2 for the animal burrow. The radon emission rates for these scenarios are based on convective flow from the source area to the atmosphere, and include consideration of the area factor, as presented in Appendix A. For the earthquake scenario, the emission rate was established to achieve an air concentration of 0.1 pCi/L at the site boundary under default meteorological conditions (see Appendix E).

ATTACHMENT 1

Radon Assessment Technical Memorandum Fact Sheet and Public Comments and Responses

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Niagara Falls Storage Site

U.S. Army Corps of Engineers
Buffalo District

Building Strong®

Formerly Utilized Sites Remedial Action Program (FUSRAP)

June 2010

Development of Radon Assessment Technical Memorandum

Purpose

The purpose of this fact sheet is to announce that the US Army Corps of Engineers will be developing a Radon Assessment Technical Memorandum as part of their efforts in conducting the Feasibility Study (FS) for the Niagara Falls Storage Site (NFSS). The FS is the study that will evaluate technologies that can be used to remediate the site. The Radon Assessment Technical Memorandum will predict levels of radon emissions under various scenarios as outlined in the "Radon Assessment Technical Memorandum Objective" section, below. By release of the this Fact Sheet, the Corps is soliciting input from the public on the objective of the radon assessment so that the Corps can address public concerns during the development and finalization of the technical memorandum. The Corps is currently scheduled to have the Random Assessment Technical Memorandum completed and available to the public in the spring of 2011.

NFSS: Interim Waste Containment Structure

Project Background

The NFSS is a 191-acre federal property containing a 10-acre interim waste containment structure (IWCS). The IWCS holds radioactive residues and wastes brought to the site by the Manhattan Engineering District (MED) and the Atomic Energy Commission (AEC) during the 1940s and 1950s.

The Corps is the lead federal agency addressing environmental issues at the site under the authority of the Formerly Utilized Sites Remedial Action Program (FUSRAP) and in accordance with the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). As previously announced, the Corps has begun transitioning into the FS phase under CERCLA. The Corps indicated that our approach was to develop a number of technical memoranda that will be made available to the public prior to the development and release of the FS. In this manner, the public will be given the opportunity for review and comment as we progress through the development of the FS. The Radon Assessment Technical Memorandum is the first of the various technical memoranda to be developed.

Radon Assessment Technical Memorandum Objective

The objective of this technical memorandum will be to predict potential radon levels across the NFSS including the IWCS under various scenarios and then compare them to federal radon standards and guidelines to assess potential health impacts from human exposures. The primary focus of this technical memorandum will be the estimation of radon levels emanating from residues currently stored in the IWCS under various scenarios.

The various scenarios associated with the IWCS that will be assessed and incorporated into the technical memorandum include the following:

- Removal of the entire contents of the IWCS
- Removal of the K-65 residues
- Removal of all residues (includes the K-65, F-32, L-50, and L-30 residues) excluding the R-10 Pile
- IWCS damage due to heavy equipment (both with and without corrective actions associated with stopping further radon releases)
- Earthquake damage (both with and without corrective actions associated with stopping further radon releases)
- Drilling into the residues (both with and without corrective actions associated with stopping further radon releases)
- Burrowing animal (both with and without corrective actions associated with stopping further radon releases)

Public Input Regarding the Technical Memorandum

The Corps appreciates input from the public regarding the objective of this specific technical memorandum. Input should be provided to the Corps by July 23, 2010, to allow the Corps to consider the input while developing and finalizing the technical memorandum. The final technical memorandum will also be released for public input. Responses to public comments on each technical memorandum and fact sheet will be made available on the project website. Public comments received will be considered during the development of the Feasibility Study for the IWCS. Input can be sent via e-mail to fusrap@usace.army.mil (please be sure to note “Radon Assessment Technical Memorandum” in the subject of the e mail) or mail your comments to the FUSRAP Team at the address noted below.

Administrative Record File

The Administrative Record File for the NFSS FUSRAP Site contains the Remedial Investigation Report, Baseline Risk Assessment, Groundwater Flow and Contaminant Transport Modeling and other CERCLA-related documentation for the NFSS. Reports and documents in the Administrative Record may be viewed at the following locations:

US Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207 (by appointment only)

Town of Lewiston Public Library
305 South 8th Street
Lewiston, NY 14092

Youngstown Free Library
240 Lockport Street
Youngstown, NY 14174

U.S. ARMY CORPS OF ENGINEERS – BUFFALO DISTRICT FUSRAP TEAM
1776 NIAGARA STREET, BUFFALO, N.Y. 14207
Phone: 800-833-6390 (Option 4)
Email: fusrap@usace.army.mil
Website: www.lrb.usace.army.mil/fusrap/nfss/index.htm

Attachment 1
Responses to Public Comments on the Radon Assessment Technical Memorandum Fact Sheet

Comment No.	Comment	Response
1	No action scenario. Evaluate radon releases taking into account the recently released information that many peizometer tubes are still in the IWCS cover(documentation providing tube locations is on USACE web site). Assume a worst case that the bentonite seals have dried out and shrunk and soil gases including radon can exhaust from the tubes.	USACE has an environmental surveillance program that involves the monitoring of radon on a routine basis to assess whether (1) there have been any changes from previous results and (2) there is an isolated area where radon levels have unexpectedly increased. This latter point would be an indicator that remedial action is necessary to locate the source and take corrective actions. This would apply to any situation where a pathway occurs that allows for radon to be released to the surface, which would include releases due to the peizometer tubes remaining in the IWCS cover and the bentonite seals failing as suggested in the comment. USACE is also preparing a technical memorandum addressing potential radon releases from various scenarios as indicated in the June 2010 Fact Sheet regarding this effort.
2	All partial removal scenarios: In all these scenarios, install groundwater extraction wells in each IWCS quadrant north of Building 411 because that would not be excavated in these scenarios. These wells would be deep enough to extract groundwater in order to guarantee a negative groundwater gradient at the clay cut off walls to prevent any leakage. Consider 2 sub-cases of Hydraulic mining of residues inside a negative pressure enclosure: a) Immediate stabilization with concrete and shipment off site and, b) Separation of radium contaminated sulfates which would then be sealed into containers. This separation would remove the source of new radon from the tailings which could be sent to an existing uranium mill for uranium extraction and placement of tailings in that facilities' tailing piles.	These suggestions will be taken into consideration during the screening of various technologies (including resource recovery) and the development of the various alternatives to be evaluated in detail in the Feasibility Study for the IWCS. Any residue excavation alternatives will include some form of containment with a radon control/abatement system so as to minimize any potential releases of radon from the site during remedial actions.

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ATTACHMENT 2

Response to Dr. Boeck Regarding the K-65 Transfer Process
(Letter from Bechtel National Inc. to U.S. Department of Energy. February 26, 1986
[USDOE 1986f])

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FILE (NFSS)

Bill
Anthony

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FROM Nemec TO Keller

SUBJECT Response to Dr. Baer Regarding the K-65 Transfer Process

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Bechtel National, Inc.
Engineers – Constructors

Jackson Plaza Tower
800 Oak Ridge Turnpike
Oak Ridge, Tennessee

Mail Address: P.O. Box 350, Oak Ridge, TN 37831-0350
Telex: 3785873

FEB 26 1986

U.S. Department of Energy
Oak Ridge Operations
Post Office Box E
Oak Ridge, Tennessee 37831

ATTN: E. L. Keller, Director
Technical Services Division

SUBJECT: Bechtel Job No. 14501, FUSRAP Project
DOE Contract No. DE-AC05-81OR20722
Response to Dr. Boeck Regarding the K-65 Transfer Process
File No. 062

REFERENCE: 1. Letter, P. Merry-Libby to J. Wing, "ANL Comments on DOE/BNI Draft Response to Questions from Dr. Boeck Regarding the K-65 Transfer at NFSS," 12/13/85

2. U.S. Environmental Protection Agency, "Workbook of Atmospheric Dispersion Estimates," 1970.

Dear Mr. Keller:

At the request of your staff (Ref. 1), Bechtel has reviewed Argonne National Laboratory's comments on the subject paper. A revised paper that incorporates these comments is attached for your review.

All atmospheric dispersion modeling was independently reviewed to address specific ANL comments. Two of ANL's comments, dealing with "wake" effects and vertical dispersion, are not specifically addressed in the text of the paper. They are, however, elaborated on in the following for your information.

- The comment that "wake effect may be important" is assumed to refer to aerodynamic downwash, or building turbulence. Downwash and turbulence are usually the result of a short

stack height in comparison to surrounding structures (Ref. 2). Since the K-65 Tower was at least 30 meters taller than its immediate surroundings (primarily vegetation), we assumed no significant effects from either downwash or turbulence.

- The phrase "vertical dispersion," as used in the original paper, refers to the vertical distance ("L" from Ref. 2) from ground level to the base of a stable atmospheric layer. This layer acts to restrict vertical (upward) diffusion via the "lid" effect. Consequently, as L increases (increasing height of the "lid") more vertical diffusion is permitted, with a resulting decrease in ground-level concentration. The height of the stable layer (L) is, therefore, included in the denominator of the Gaussian Distribution Equation. ANL's question that "If vertical dispersion was ignored, how could ground-level concentrations be calculated for releases from the top of the tower" was, therefore, not clearly understood. When Bechtel used the phrase "ignoring vertical dispersion," it was simply intended to note maximization of the effect (use of unity in the Gaussian Distribution equation, hence "ignoring"). This approach results in calculation of maximum ground-level concentrations. None-the-less, all references to vertical dispersion have been omitted from the paper. In lieu of this lengthy explanation, we have only used and/or referred to maximum values.

In view of the foregoing and the independent review, Bechtel recommends that the prediction values be left as previously stated. We have, however, expanded upon the bases and assumptions used to make these predictions.

All on- and off-site radon-222 concentration measurement data were reorganized by monitoring station for pertinent time periods, and displayed in tabular form. Individual datum points are not reported, due to excessive volume. Average and range values, however, have been included to give the reader a fuller understanding.

For your convenience, Bechtel has enclosed a proposed letter to Dr. Boeck should you find the paper acceptable. If you have any questions concerning this matter, please contact Bill Borden at 6-3998.

Very truly yours,

Joseph F. Nemec

Joseph F. Nemec
Program Manager - FUSRAP

WCB:daw

Attachments: As Stated

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Department of Energy
Oak Ridge Operations
P. O. Box E
Oak Ridge, Tennessee 37831

Dr. William L. Boeck
Professor of Computer and Information Sciences
Professor of Physics
Niagara University
Niagara University, New York 14109

Dear Dr. Boeck:

The attached comparisons of predicted versus measured radiological values for the K-65 residue transfer are herewith submitted in response to your conversations with Mr. W. C. Borden of Bechtel National, Inc. These comparisons indicate that the safety analysis quite accurately predicted actual conditions experienced during the transfer. The safety analysis was in fact used as the basis for a decision to not provide expensive engineering controls to mitigate radon emissions from the K-65 tower. As a result, the transfer was completed in a much more cost-effective manner, with a minimum impact on the environment.

If you have any questions concerning the attached comparisons, please contact Mr. J. F. Wing of my staff at (615) 576-0707.

Sincerely,

E. L. Keller, Director
Technical Services Division

CE-53:Wing

Enclosure:
As Stated

cc w/encl:
J. F. Nemec

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COMPARISONS

of

PREDICTED vs. ACTUAL VALUES

for

SAFETY ANALYSIS
FOR
THE K-65 RESIDUE TRANSFER

In 1984 and 1985 the K-65 residues stored in the silo-shaped Building 434 at the Niagara Falls Storage Site (NFSS), Lewiston, New York were transferred to Building 411. The following is a summary comparison of the assumptions made for planning purposes prior to the transfer and field measurements made before, during, and after the transfer.

SOURCE TERM

According to historical information, the radium-226 content of the K-65 residues in general ranged from 200 to 828 mg/t (Ref. 1). Using a specific activity of 0.988 Ci/g for radium-226 (Ref. 2), a conversion factor of approximately 1,089 pCi of radium-226 per gram of residue per milligram per ton was derived. Using this conversion factor, the equivalent radium-226 specific activity of the K-65 residues was calculated to range from 218,000 to 902,000 pCi/g. Battelle reported the specific activity of the K-65 residues in Building 434 as 220,000 pCi/g (Ref. 3).

The quantity of K-65 residues in Building 434 was reported as 3,891 tons (1,166 tons in the upper section, and 2,725 tons in the lower section) (Ref. 4). The radium content of these residues was not found in the available literature. It was suggested in Reference 1, however, that the radium content was probably between 200 and 300 mg/t, or approximately 218,000 to 327,000 pCi/g. Over 4,000 tons of K-65 residues (presumably the more radioactive) are stored at the Fernald Feed Materials Plant in Fernald, Ohio.

For planning purposes, the quantity of residues was assumed to be 3,891 tons and the specific activity to be 220,000 pCi/g. These values were used to arrive at a source term value of 780 Ci (rounded from a calculated value of 776.4 Ci).

Bechtel National, Inc. (BNI) performed extensive sampling of the K-65 residues before and during the slurry transfer. Preliminary analyses of the samples indicated a heterogeneous radium-226 content

ranging from 110,000 to 440,000 pCi/g with an average of 287,000 pCi/g. The equivalent source term ranged from 390 to 1,550 Ci with an average of approximately 1,000 Ci. While these values show fair agreement with those reported in the literature, they are to be regarded as preliminary until they are verified by an independent laboratory.

EXPOSURE RATE

Exposure rates during shipping and interim storage of the K-65 residues are well documented (Ref. 5). Values ranging from 200 to 900 mR/h were reported from individual 55-gal drums filled with the residue. Although it was not explicitly stated in the referenced report, it was assumed that these measurements were made at drum surfaces. These values are consistent with, and in direct proportion to, the reported radium concentration, or approximately 1.0×10^{-6} R/h per pCi/g.

The reported data did not, however, lend themselves directly to estimation of exposure rates at Building 434: First, the radium content was not precisely known and, second, the geometry had changed from a 55-gal drum to a large planar source. Consequently, an infinite source conversion factor of 1.8×10^{-6} R/h per pCi of radium-226 per gram of residues (Ref. 6) was used to estimate the exposure rate at 1 m above the residues. The specific activity of 220,000 pCi/g reported by Battelle was used to arrive at a rate of 396 mR/h at 1 m, which was rounded to 400 mR/h for planning purposes.

Before the transfer began, BNI measured the exposure rate inside Building 434 using TLD chips lowered through a small penetration in the top of the building. Total exposure values were obtained with groups of five TLD chips placed at seven 0.3-m increments, from the top of the Building down to approximately 1.83 m below the top. At the point of measurement the top of the residues was estimated to be about 2.5 m below the top of the building. The readings of the five TLD chips at each distance increment were averaged and divided by

the length of exposure to produce the exposure rate for each distance increment. The exposure rates ranged from 108 to 453 mR/h with an average of 356 mR/h (Ref. 7). These measurements compare well with the projected value of 400 mR/h and tend to confirm the estimated range of specific activities.

RADON EMISSIONS

The release of radon-222 that would accompany the opening of Building 434 was the source of exposure that was of primary concern to both the workers and the public. The release of particulate radioactive materials was of secondary concern, because the residues were to be transferred in the form of a very wet slurry (less than 30 percent solids). Searches of available literature yielded no useful information concerning radon concentrations during loading of the building. Reference 8, however, reported emanation rates, measured at 23 inactive uranium mill tailings piles, that ranged from 1.0 to a 2,860 $pCi/m^2/s$. Associated radium-226 concentrations were reported as calculated values based on measured ore grade concentrations. Averaging the ratios of emanation rate to radium-226 concentration produced an approximate emanation constant of 0.7 $pCi/m^2/s$ per pCi of radium-226. This value compared well with earlier experimental values reported by Goldsmith et al. that ranged up to 1.2 $pCi/m^2/s$ per pCi/g, as a function of contained moisture and thickness of the tailings pile (Ref. 9). Given these data, the decision was made to flood the residues before starting the slurry transfer, thus minimizing -- if not preventing -- radon emanation during nonoperational periods. The mechanical action of the hydraulic mining unit was, however, expected to promote radon emanation even with a water cover over the residues. Consequently, the maximum emanation value for "wet" residues of 0.6 $pCi/m^2/s$ per pCi/g reported by Goldsmith was used as the basis for calculating the source term. Given this emanation rate, specific activity of 220,000 pCi/g, and a residue area of 105.36 m^2 (the inside diameter of the building was 11.58 m), a total surface emanation rate of 1.4×10^{-5} Ci/s was predicted.

Estimates of ground-level radon-222 concentrations were derived using the methodology and data presented in Reference 10, the source term (Q) of 1.4×10^{-5} Ci/s, and meteorological data (wind speed - $\bar{u}$) collected from on-site measurements (Ref. 11). This approach was used to perform two primary analyses (worst case and most probable case) before establishing locations for off-site monitoring stations to be operated during the residue transfer.

Worst Case

The following assumptions were used in this analysis: constant stability category "A" conditions (a constant wind velocity of 0.33 m/s, and a solar altitude greater than 60° with clear skies); an emission height of 50 m (Building 434 was 50.3 m high); and a constant emission rate equal to the surface emanation rate of 1.4×10^{-5} Ci/s. The resultant $\chi u/Q$ value of $5.8 \times 10^{-5}/m^2$ was the maximum possible for a category "A" 50-m-tall tower. Solving the expression $\chi u/Q = 5.8 \times 10^{-5}/m^2$ for χ and substituting the values of $\bar{u}$ and Q given above yielded a maximum ground-level radon-222 concentration of 2.5×10^{-9} Ci/m^3 (2.5 pCi/l) at a downwind distance of approximately 0.25 km.

Most Probable Case

Historical wind velocities measured at the NFSS were used for this model. Each stability category maximum $\chi u/Q$ value given in Reference 10 was weighted by the probability of occurrence of each corresponding wind velocity category. Each $\chi u/Q$ value thus weighted was divided by the annual average wind velocity for the applicable stability category, and multiplied by the emission rate of 1.4×10^{-5} Ci/s. These values were then summed over all stability categories. The result was a predicted annual average radon-222 concentration of 0.5 pCi/l above natural background.

In both the foregoing analyses, no credit was taken for the reduced emission rates projected for nonoperational periods.

The off-site monitoring station siting plan was developed using calculated values of distance as a function of maximum ground-level concentrations for each stability category, and wind frequency distribution histories. The result was an annulus, centered on Building 434, with a minor radius of 0.2 km and a major radius of 2.0 km. Monitoring station locations were then biased by predominant historical wind directions with the resultant pattern modified to account for emissions that might occur as a result of discharging K-65 slurries into Building 411. Off-site monitoring stations are shown in Figure 1; on-site stations are shown in Figure 2. To minimize radon-222 releases, residues were to be discharged into Building 411 under a quiescent water cover 0.3 to 0.9 m deep. Thus, the radon emanation rate from Building 411 was projected to be minimal in comparison with that from Building 434. To provide early warning of excessive emission rates, additional real-time monitoring stations were located on top of Building 434 and at the edge of Building 411.

Monitoring was performed continuously from July 1984 through December 1985. The 12-month period from July 1984 through June 1985 covered the entirety of the K-65 residue transfer and comprises the monitoring period reported herein.

The slurry transfer was in operation from July 1984 through January 1985 at which time cold weather and mechanical difficulties dictated cessation of all activities. During the second and third quarters of 1985, however, the last of the K-65 residues (approximately 350 yd^3) were mechanically removed from the bottom of Building 434 and deposited in Building 411. The latter operation required a reduction in the minimum water cover over the K-65 residues in Building 411 from 30 cm to 10 cm for a short period of time.

Table 1 presents on-site airborne radon-222 concentrations for the period from January 1984 through September 1985. As predicted, there was no significant difference between radon-222 concentrations measured during the period before the slurry transfer (first and

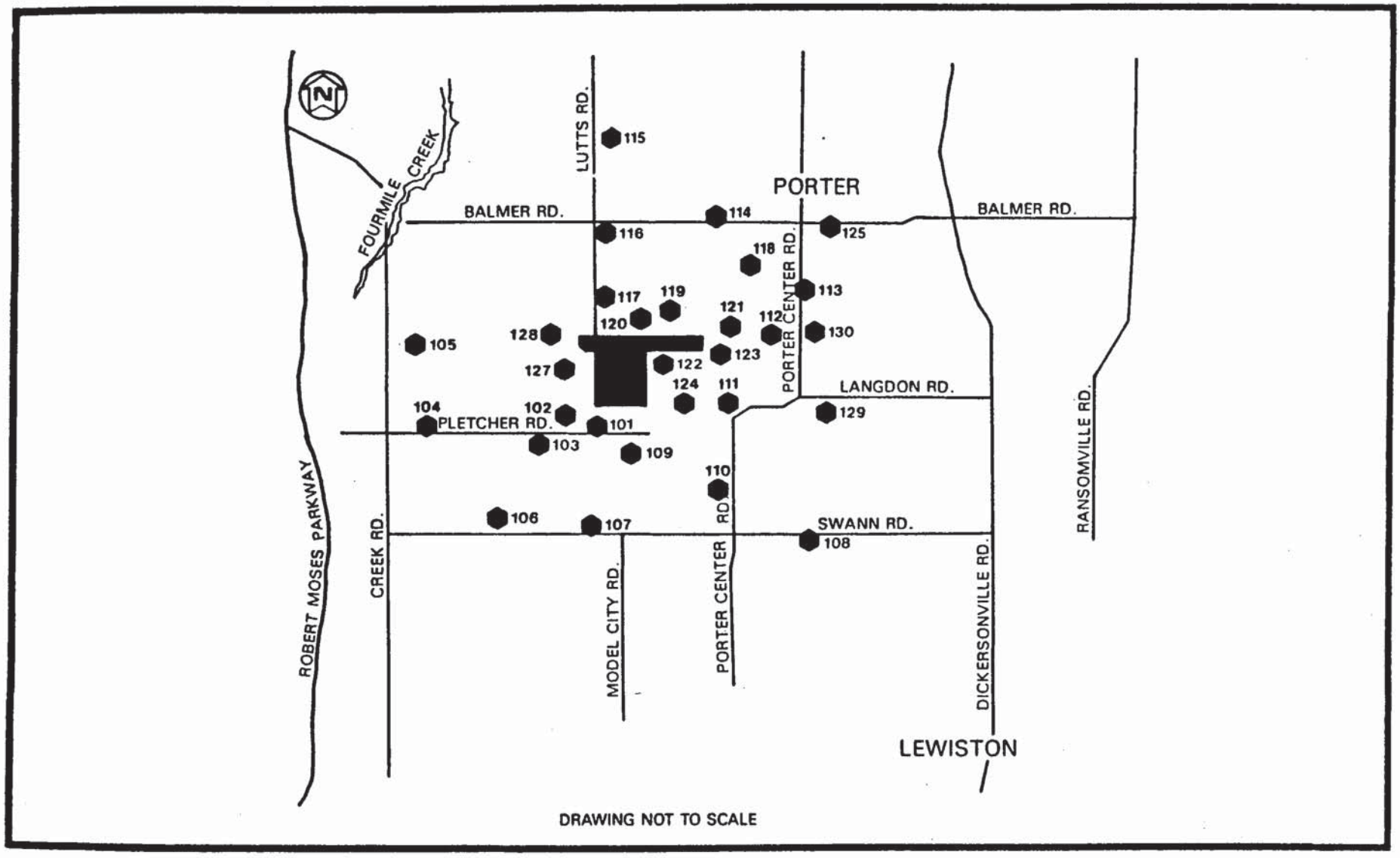

FIGURE 1 RADON (TRACK ETCH) AND DIRECT GAMMA (TLD) OFF-SITE MONITORING LOCATIONS

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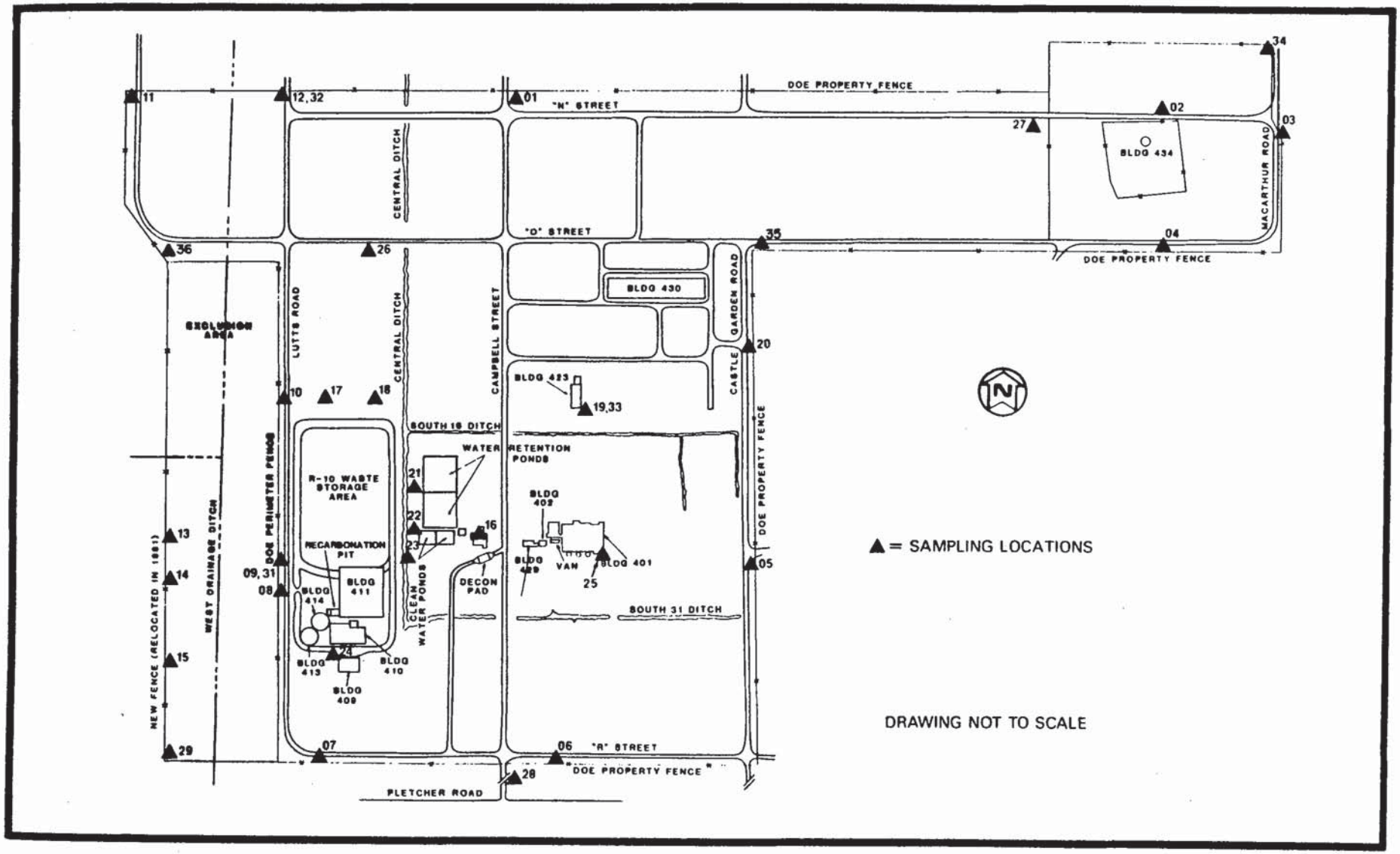

FIGURE 2 ON-SITE MONITORING STATION LOCATIONS

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TABLE 1

AIRBORNE RADON-222 MEASUREMENTS

ONSITE

Monitoring Station Number	Concentration of Radon-222 (pCi/l) 1Q-84	2Q-84	3Q-84	4Q-84	1Q-85	2Q-85	3Q-85
01	.62	.60	1.08	1.27	.18	.43	.80
02	.35	.16	1.36	.26	.24	.67	.67
03	.51	.76	.50	.88	.38	.49	.63
04	.53	.34	.82	.58	.21	.45	.38
05	.44	.38	.61	.61	.09	.21	.56
06	.38	.51	.60	.45	.20	.49	.61
07	.37	.39	1.09	.29	.41	.38	.64
08	.66	.72	.62	.94	.26	.41	.76
09	.51	.69	.57	.58	.45	.32	.61
10	.54	.34	.55	.51	.28	.58	.72
11	.36	.48	.29	.24	.28	.27	.79
12	.58	.36	.41	.40	.29	.37	.80
13	1.50	.53	.33	.49	.09	.66	.76
14	.74	.22	.36	.55	.12	.31	.43
15	.96	.32	.32	.36	.18	.26	.45
16	1.10	.74	.45	.53	1.17	.63	.93
17	.82	.52	.89	.43	.12	1.10	1.39
18	.52	.50	.39	.42	.18	5.47	5.90
19	.54	.61	.53	.40	.18	1.00	1.26
20	.42	.44	.41	.54	.26	.48	.71
21	.56	.74	.84	.66	.43	.77	1.17
22	.71	1.79	.71	.81	.45	.96	1.80
23	.53	.63	1.29	1.01	.25	.59	1.25
24	.27	.47	.52	.68	.11	.65	1.14
25	.31	.26	.48	.45	.15	.42	.32
26	.21	.49	.76	.67	.14	.42	.68
27	.75	.36	.51	.61	.28	.49	.71
28	.82	.34	.55	.40	.22	.68	.54
29	.48	.25	.51	.37	.26	.35	.62
30	.75	1.95	.59	.81	.22	.37	.39
31	.65	1.15	.44	.57	.19	.84	.82
32	.96	.95	.51	1.72	.12	.44	.81
33	.43	.38	.47	.61	.37	.78	.68
34	.31	.78	.30	.45	.96	.46	.60
35	.29	.44	.44	.43	.22	.42	.39
36	.37	.76	.27	.40	.24	.44	.68

second quarters of 1984) and those during the most productive period of the slurry transfer (third and fourth quarters of 1984). During the second and third quarters of 1985, however, a sharp increase in radon-222 concentrations was noted at monitoring stations immediately downwind of and adjacent to Building 411 (stations 17-19 and 21-24). This was attributed to radon emanation during the mechanical dumping of the last of the residues into Building 411, and the previously mentioned shallow water cover. Placement of fill-dirt on top of the residues significantly reduced radon emanation.

Table 2 presents off-site airborne radon-222 concentrations normalized to calendar quarters (monitoring results were initially recorded monthly and were later recorded quarterly). Calculated from these data, the average of all off-site monitoring stations for the monitoring year is 0.31 pCi/l above an annual average background of 0.19 pCi/l. Individual measurements ranged from background concentrations to a maximum of 4.94 pCi/l. Although the latter value was thought to be anomalous, it was nevertheless used in computing the average for station number 115 for the fourth quarter of 1984. Figure 3 illustrates period-averaged data for the monitoring year. Maximum radon concentrations occurred during the period of peak slurry transfer operation, i.e., October 1984.

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TABLE 2

AIRBORNE RADON-222 MEASUREMENTS

OFFSITE

Monitoring Station Number	Concentration of Radon-222 (pCi/l) 3Q-84	4Q-84	1Q-85	2Q-85	3Q-85
101	1.09	2.04	.20	.27	.42
102	1.55	1.10	.11	.16	.34
103	.86	.57	.20	.16	.36
104	.59	.55	.47	.22	.31
105	.66	.44	.23	.27	M
106	.52	.27	.20	.14	.27
107	.36	.53	.11	M	.19
108	.47	.38	.11	.14	.31
109	.63	.46	.14	.16	.29
110	.55	.43	.25	.14	.42
111	.78	.28	.28	.12	.55
112	.69	.49	.12	.29	M
113	.42	.58	.02	.16	.59
114	.33	.56	.22	.10	.17
115	.39	2.58	.15	.16	.31
116	.48	.51	.09	.18	.31
117	.41	.58	.06	.22	.17
118	.39	.68	.09	.27	.23
119	.39	.54	.09	.18	1.14
120	.33	.45	.02	.20	.25
121	.47	.45	.02	.22	.19
122	.39	.32	.29	M	M
123	.69	.74	.19	.27	.42
124	.26	.58	.25	M	.29
125	.52	.61	.09	.20	.21
127	1.05	1.18	.17	.22	M
128	1.14	.51	.26	.20	M
129	.44	.36	.09	.12	.44
130	.54	1.04	.12	.35	.42

M - Detector Missing

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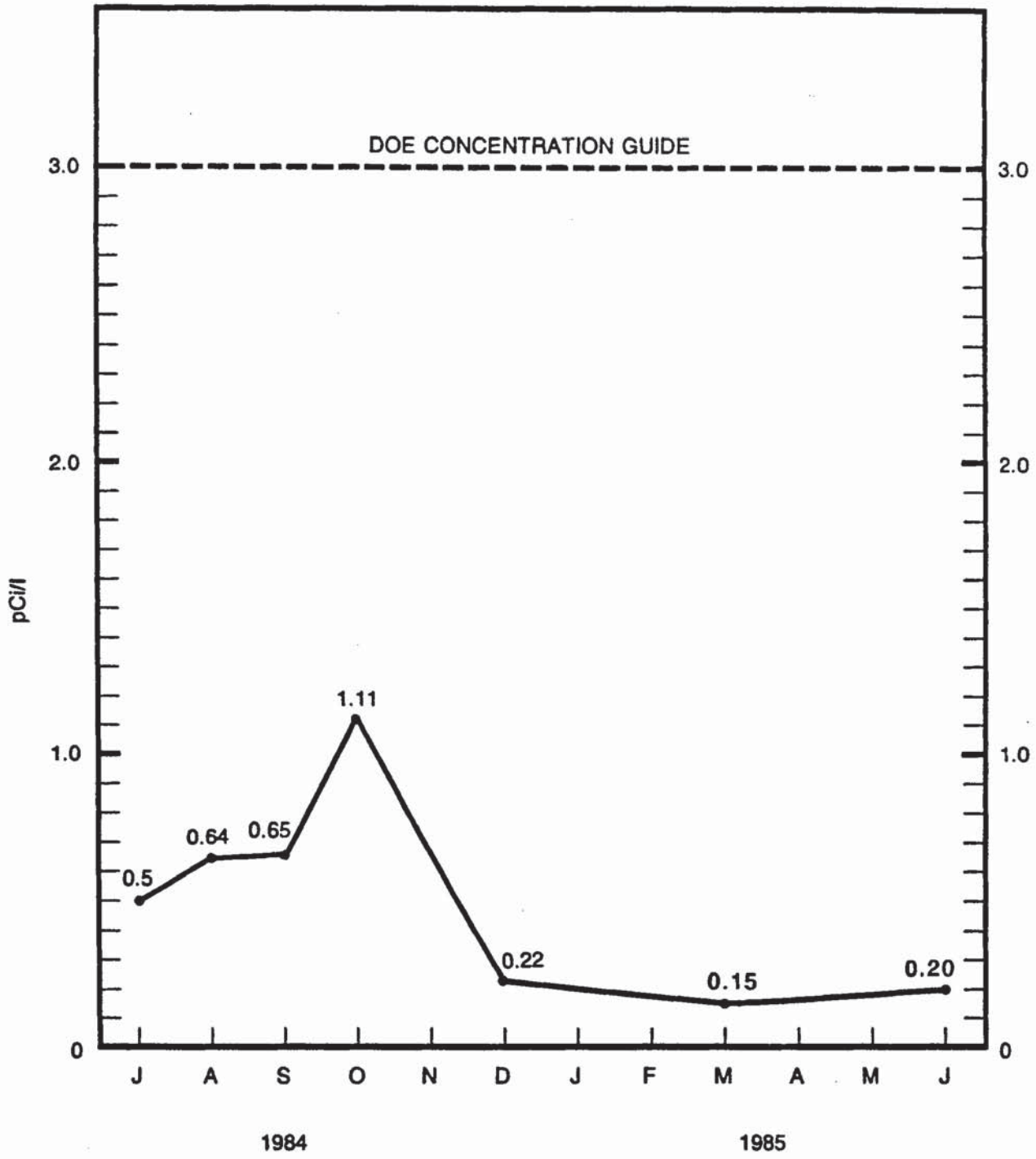

FIGURE 3 AVERAGE RADON – 222 CONCENTRATIONS FOR LOCATIONS ON FIGURE 1

SUMMARY

The data presented herein demonstrate that the transfer of the K-65 residues was accomplished with minimum impact on the immediate environs of the NFSS. Given the uncertainties associated with the applicable models, conversion factors, and historical information, the predictions made during the planning phase of this project were found to be remarkably accurate, as shown by the comparison below.

Parameter	Predicted Value	Measured Value
Source Term (pCi/g)	220,000	110,000 - 440,000 range 287,000 average
Exposure Rate (mR/h at 1 m above residues)	400	108 - 453 range 356 average
Environmental radon-222 concentrations (annual average in pCi/l)	0.5	Background - 4.94 (instantaneous value range) 0.31 average

REFERENCES

1. Letter, Merril Eisenbud, Director, Health and Safety Division, New York Operations Office, Atomic Energy Commission, to F. M. Belmore, Director, Production Division, New York Operations Office, Atomic Energy Commission. "Freight Car Loading of Radium Bearing Sludge (K-65) at LOSA," July 28, 1982.

2. U.S. Department of Health, Education, and Welfare. Radiological Health Handbook, U.S. Government Printing Office, Washington, DC, January 1970.

3. Anderson, T.L., J. F. Dettorre, D. R. Jackson, and B. S. Ausmus. A Comprehensive Characterization and Hazard Assessment of the DOE Niagara Falls Storage Site, Battelle Columbus Laboratories, BMI-2074, Columbus, OH, June 1981.

4. Letter, D. S. Neil, Director, Engineering and Construction Division, New York Operations Office, Atomic Energy Commission, to File. "Niagara Site - K-65 Silo Loading," July 28, 1959.

5. Heatherton, R.C. Report of K-65 Unloading Operations at Lake Ontario Ordnance Works - Modeltown, N.Y., New York Operations Office, Atomic Energy Commission, April 26, 1949.

6. National Council on Radiation Protection. Environmental Radiation Measurements, NCRP Report No. 50, December 27, 1976.

7. Letter, F. F. Haywood, Eberline Analytical Corporation, to R. D. Glenn, Bechtel National, Inc. "Performance of Task No. 1, K-65 Residue Transfer," June 18, 1984.

8. U.S. Environmental Protection Agency. Draft Environmental Impact Statement for Remedial Action Standards for Inactive Uranium Processing Sites, EPA 520/4-80-011, December 1980.

9. Goldsmith, W.A., Bechtel National, Inc., personal communication with W.C. Borden, Bechtel National, Inc., October 1983.

10. U.S. Environmental Protection Agency. Work Book of Atmospheric Dispersion Estimates, Washington, DC, 1970.

11. Bechtel National, Inc. Engineering Evaluation of Alternatives for the Disposition of Niagara Falls Storage Site, Its Residues and Wastes, DOE/OR/20722-1, Oak Ridge, TN, January 1984.

October 16, 1985

TERRADEX

TERRADEX CORPORATION

460 N. Wiget Lane
Walnut Creek, CA 94598, U.S.A
(415) 938-2545 • Telex 33-7793

Mr. William Borden
Bechtel National, Inc.
P.O. Box 350
Oak Ridge, TENN 37831-0350

Dear Mr. Borden,

Enclosed are two copies of the Track Etch results on your radon monitoring program dated October 11, 1985. Thirty-nine Type SF detectors were exposed. The results are given in average picoCuries per liter months and WLM.

The reported results are based on extensive calibrations of Track Etch detectors performed at radon test chambers operated by a variety of U.S. and other government agencies.

Terradex does not accept responsibility for financial or health consequences of subsequent action taken by the client or its consultants based on these results, nor are we responsible for the results of improper placement of detectors.

It is a pleasure to be of service to you, and we look forward to serving you again in the near future. Please let us know if you have any questions or comments about this report.

Sincerely,

H. Ward Alter
President

HWA:jl
Enclosures

cc: A. F. Zimbrich
Bechtel National, Inc.
Niagara Falls Storage Site
1397 Pletcher Rd.
Youngstown, NY 14174

TERRADEX CORPORATION

PERSONNEL MONITORING REPORT

PREPARED FOR EBERLINE BECHTEL KIMMINS

REPORT DATE 10/11/85 39 DETECTORS

EXPOSURE PERIOD- BEGIN: 04/08/85 END: 07/10/85

SERIAL NUMBER	PCI/L MONTHS	WLM	NOTES
312514	.65	.003	HEVRDEYS W BN1 BLDG 434 7-10-85
312515	.20	.001	PIERCE T KIMMINS BLDG 434 7-10-85
312516	4.25	.021	CODY C KIMMINS BLDG 434 7-10-85
312517	1.55	.008	FARMER S KIMMINS BLDG 434 7-10-85
312518	11.46	.057	LESTER S BLDG 434 OUTER ISSUED 6-21
312519	4.25	.021	FARMER JR KIMMINS BLDG 434 7-10-85
312520	.20	.001	MACDOUGALL I KIMMINS BLDG 434 7-10-85
312521	4.25	.021	LESTER S KIMMINS BLDG 434 7-10-85
312522	1.10	.006	MACDOUGALL I BLDG 434 OUTER ISSUED 6-24
312524	3.80	.019	LESTER C KIMMINS BLDG 434 7-24-85
312525	5.15	.026	SLANGO P KIMMINS BLDG 434 7-22-85
312526	1.10	.006	WOODRICH G BN1 BLDG 434 7-23-85
312527	.20	.001	CONTROL BLDG 434 7-10-85
312528	1.10	.006	JOHNSON L EAC BLDG 434 7-10-85
312529	2.00	.010	BORDEN W BN1 BLDG 434 7-10-85
312530	2.00	.010	KNOKE C BN1 BLDG 434 7-10-85
312532	17.31	.087	MANUSE R EAC BLDG 434 7-10-85
312533	3.80	.019	DAVIS D EAC BLDG 434 7-10-85
312551	1.55	.008	JOHNSON L BLDG 434 OUTER ISSED 5-15
312552	2.00	.010	MCDOUGALL M BLDG 434 OUTER ISSUED 5-13
312553	1.10	.006	WOODRICH G BLDG 434 OUTER ISSUED 5-10
312555	11.46	.057	CODY C BLDG 434 OUTER ISSUED 6-24
312561	18.66	.093	SIEJKA J BLDG 434 OUTER ISSUED 6-24
312563	.65	.003	KNOKE C BLDG 434 OUTER ISSUED 5-15
312564	2.00	.010	BORDEN W BLDG 434 OUTER ISSUED 5-15
312568	3.35	.017	MACDOUGALL I BLDG 434 OUTER ISSUED 5-14
316793	5.10	.025	CORRA D BLDG 434 TOWER INSIDE
316795	6.19	.031	HEVRDEYS W BLDG 434 OUTER
316796	.19	.001	CONTROL BLDG 434
316800	24.71	.124	HOOT R BLDG 434 OUTER
316801	7.82	.039	MANUSE R BLDG 434 OUTER
316802	.74	.004	HOFFMAN R BLDG 434 OUTER
316806	105.35	.527	DAVIS D BLDG 434 OUTER
316807	2.37	.012	KUBINIEC C BLDG 434 OUTER
316810	31.26	.156	SLANGO D BLDG 434 OUTER ISSUED 4-8
316811	26.35	.132	FARMER S JR BLDG 434 OUTER
316812	24.17	.121	CORRA D BLDG 434 OUTER
316813	2.92	.015	CONTROL
316814	10.55	.053	HOBLER C BLDG 434 OUTER

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APPENDIX A

Estimated Radon Flux and Onsite Air Concentrations

Including:

Appendix A-1: Text
Appendix A-2: Tables
Appendix A-3: Figures

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APPENDIX A-1

Estimated Radon Flux and On-site Air Concentrations

Text

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A.1 INTRODUCTION

This appendix presents the estimated radon flux and air concentration associated with the IWCS. Flux and air concentration calculations were performed for various excavation/intrusion scenarios, assumed wind speeds, and release mechanisms (convective or diffusive).

The flux estimates generated in this appendix were also used to estimate the emission rates from specific layers within the IWCS, which were also utilized to evaluate off-site air concentrations (see Appendix C).

A.2 FLUX CALCULATIONS PERFORMED

Emission of radon was estimated utilizing equations presented in Section 5.0 of the technical memorandum, and were performed for:

- IWCS Bay A
  - Table A-1 IWCS Bay A - Calculations Supporting Flux Estimates
  - Table A-2 NFSS Predicted Radon Levels for Bay A Soils
  - Figure A-1 Total Radon Flux by Depth over NFSS Bay A
  - Figure A-2 On-Site Radon Air Concentration by Depth over NFSS Bay A for 4.5 m/s Wind Speed
  - Figure A-3 On-Site Radon Air Concentration by Depth over NFSS Bay A for 1 m/s Wind Speed
- IWCS Bay B
  - Table A-3 IWCS Bay B - Calculations Supporting Flux Estimates
  - Table A-4 NFSS Predicted Radon Levels for Bay B Soils
  - Figure A-4 Total Radon Flux by Depth over NFSS Bay B
  - Figure A-5 On-Site Radon Air Concentration by Depth over NFSS Bay B for 4.5 m/s Wind Speed
  - Figure A-6 On-Site Radon Air Concentration by Depth over NFSS Bay B for 1 m/s Wind Speed
- IWCS Bay C
  - Table A-5 IWCS Bay C - Calculations Supporting Flux Estimates
  - Table A-6 NFSS Predicted Radon Levels for Bay C Soils
  - Figure A-7 Total Radon Flux by Depth over NFSS Bay C
  - Figure A-8 On-Site Radon Air Concentration by Depth over NFSS Bay C for 4.5 m/s Wind Speed
  - Figure A-9 On-Site Radon Air Concentration by Depth over NFSS Bay C for 1 m/s Wind Speed
- IWCS Bay D
  - Table A-7 IWCS Bay D - Calculations Supporting Flux Estimates
  - Table A-8 NFSS Predicted Radon Levels for Bay D Soils
  - Figure A-10 Total Radon Flux by Depth over NFSS Bay D
  - Figure A-11 On-Site Radon Air Concentration by Depth over NFSS Bay D for 4.5 m/s Wind Speed
  - Figure A-12 On-Site Radon Air Concentration by Depth over NFSS Bay D for 1 m/s Wind Speed

The flux estimates presented in this appendix are based on results generated for each layer within each of the IWCS bays. The flux calculations are performed in approximately 15 cm depth increments to develop a flux profile for each bay (see Figures A-1, A-3, A-5, and A-7).

A.2.1 Excavation Scenarios

Three excavation scenarios were evaluated:

- Removal of K-65 residues within the IWCS,
- Removal of all residues within the IWCS, and
- Removal of entire contents of the IWCS.

The bay dimensions are based on the approximate dimensions of the Building 411 foundation where the high activity residues are located, the assumption was made that the excavation would be an opening of approximately 13.7 m long, which is the approximate inside dimension of Bays A, B and C and is half of the width associated with Bay D. The excavation scenario evaluation required additional assumptions regarding the likely excavation methods, as discussed in the following sections.

A.2.1.1 Removal of K-65 Residues within the IWCS

For the removal of K-65 residues, it was assumed that no excavation would be greater than 100 m^2 in area. The 100 m^2 area was assumed to be 7.3 m wide by 13.7 m in length, which are consistent with the dimensions of the IWCS bays. Bay A is 14.3 m by 10.7 m and Bay C is 13.7 m by 61 m. Excavation of each of these bays could be accomplished by advancing consecutive 100 m^2 areas through the entirety of the bay (approximately 2 excavations in Bay A and 9 in Bay C). A 100 m^2 excavation source area is considered a reasonable size, based on the need to limit the exposed source area in order to reduce radon emissions. Use of a 100 m^2 source area also provides a convenient basis for scaling the results to represent excavation areas of different sizes, as discussed later in this section.

A.2.1.2 Removal of All Residues within the IWCS

The removal of all residues was similarly based on an assumed 100 m^2 excavation source area in each bay, in sequence. Bay B is 13.7 m wide by 61 m in length and Bay D is 27.4 m wide by 61 m in length. These bays are assumed to be excavated in areas of 7.3 m in width and 13.7 m in length. For Bay D, that requires two 100 m^2 excavations to span the entire width.

A.2.1.3 Removal of Entire Contents of the IWCS

The removal of the entire contents of the IWCS assumed an excavation that is 7.3 m wide was advanced across the entire IWCS. The excavations within individual bays would include;

- Bay A: 100 m^2 area which is 7.3 m by 13.7 m
- Bay B: 100 m^2 area which is 7.3 m by 13.7 m
- Bay C: 100 m^2 area which is 7.3 m by 13.7 m
- Bay D: 200 m^2 area which is 7.3 m by 27.4 m

Because the Bay D excavation in this scenario is twice the size of the 100 m^2 source area for the other scenarios the 100 m^2 source area results were scaled up, as discussed in the following section.

From the flux estimates that were generated for each layer within the IWCS, on-site air concentrations are developed based on the methods presented in Section 5.0, and assuming;

- A 1.7 m air mixing zone height above the IWCS,
- An average wind speed of 4.5 m/s above the exposed source area, and
- A source area of 100 m^2 for individual bays, or 500 m^2 for combined excavation.

Figures A-2, A-4, A-6, and A-8 present the estimated air concentrations with depth for each of the IWCS bays. These results are representative of excavation scenarios within the IWCS, where successive layer would be removed, resulting in varying radon flux and air concentrations.

The annual release rates are also used with the atmospheric modeling results to generate scenario specific air concentrations. Unit modeling for short and long-term meteorological conditions are presented in Appendix B and the calculation of scenario-specific results is presented in Appendix C.

Additional consideration was given to estimating flux and air concentration from particular intrusion scenarios, as described below.

A.2.2 Intrusion Scenarios

The intrusion scenarios evaluated for the IWCS are described in Section 4.0 and the following sections. The intrusion scenarios include:

- Damage due to the use of heavy equipment
- Damage due to an earthquake
- Damage caused by drilling into the residues
- Damage from a burrowing animal

The equipment damage scenario assumes that a source area is directly exposed to the atmosphere. The other three intrusion scenarios include emission from an exposed source into a subsurface void and subsequent emission from the void to the atmosphere through a smaller surface opening in the IWCS. The radon flow from the subsurface void would be the result of convective movement of air through the opening, and/or diffusive movement out of the opening. Radon movement from the void space may be based on one of the following:

- A temperature difference between radon contaminated air within the subsurface void and the atmosphere, inducing convective flow due to buoyancy,
- A pressure difference between radon contaminated air within the subsurface void and the atmosphere, inducing convective flow (The pressure gradient may be due to a low pressure weather system, or due to wind turbulence across the void opening at the surface of the IWCS), and
- A radon concentration gradient between the air in the subsurface void and the atmosphere, and the associated diffusive movement from the void opening in the IWCS surface.

The results of the flux, emission rate, and air concentration calculations are presented for both the convective and diffusive emission scenarios. The convective calculations assume that all radon emitted into the subsurface void are emitted directly to the atmosphere, which represents a conservative scenario that would require a specific set of atmospheric conditions that are unlikely to persist for extended periods of time. Convective results would therefore be more representative of short-term air concentration on the IWCS. The diffusive results reflect a more likely set of emission conditions that would be representative of long-term releases due to intrusion scenarios in the IWCS.

For the four intrusion scenarios, it was assumed the exposed source was the K-65 residues, resulting in radon flux estimates of 2.7E+05 pCi/m^2/s, which is conservative for intrusion into other less contaminated layers. The emission rate (the mass of radon emitted per unit time) was based on the particular scenario under evaluation, and the associated assumptions (e.g. exposed source area, emission opening size).

Emission from the intrusions were estimated for both convective movement of radon out of the IWCS (considered the limiting condition), as well as for diffusive movement from the surface area of the intrusion (e.g. opening of the borehole to the atmosphere). For diffusive movement, there is a build up of radon to a maximum concentration which drives the concentration gradient based transport. Available information from uranium

mines and direct measurements taken of the source material were used to estimate the maximum void concentration (DOE 1986a).

Calculated flux, emission rates, and air concentrations on the IWCS are presented in Tables A-9 to A-12 present results for the convective emission for wind speeds of 4.5 and 1 m/s respectively both with and without area factors. The use of area factors is specific to calculating the on-site air concentration and is discussed in Section 5.3. These specific wind speeds correspond to an annual average and bounding values from the meteorological data (see Appendix B). Tables A-13 to A-16 present the results for the diffusive modeling at various wind speeds (both with and without area factors), and Table A-17 provides details of the calculated diffusive emissions from the intrusion opening in the IWCS.

The results for the diffusive transport (see Table A-17) are based on a one dimensional solution of Fick's equation;

$$J = D * dC/dx \qquad \text{Eq. A-1}$$

Where:

J = flux (pCi/m^2/s)
D = radon diffusion coefficient in air (m^2/s)
dC/dx = concentration gradient, or concentration change per meter (pCi/m^3 per m)

The concentration gradient used in the calculation of radon diffusive flux, is based on an assumed air concentration within the intrusion void (i.e. concentration within the open borehole volume) and a height above the IWCS at which the radon concentration is assumed to be negligible with respect to the concentration in the subsurface intrusion void. The radon air concentration is assumed to be 2E+08 pCi/m^3 within the subsurface void, and zero at 1.7 m above the IWCS, which is consistent with the assumed mixing zone height for the air concentration calculations. The assumed void concentration is based on estimates from the Final Environmental Impact Statement (USDOE 1986a) and was selected to provide a conservative estimate of the diffusion that is unlikely to be exceeded.

Damage Due to the Use of Heavy Equipment

Since the breech of Bay A assumes 69 m^2 of K-65 residues are exposed to air at a flux of 2.7E+05 pCi/m^2/s, resulting in an emission rate of 1.8E+07 pCi/s or 581 Ci/yr. In this case, the entire surface of the source is exposed to the atmosphere, unlike the other intrusion scenarios.

Damage Due to an Earthquake

The earthquake induced fissure within Bay A assumes a 390 m^2 area of K-65 residue is exposed (see Appendix E), consisting of two 195 m^2 walls on each side of a crack, assumed to be 0.31 m wide by 50 m long, at the surface of the IWCS. The depth of the crack is a calculated value based on an emission rate of 55 Ci/yr, which is assumed for this scenario because it corresponds to an off-site air concentration of 0.1 pCi/L, as fully described in Appendix E. Although a total emission rate of 1.8E+06 pCi/s (55 Ci/yr) is assumed to enter the crack, only a fraction is likely to be emitted to the atmosphere through the 15 m^2 opening on the surface. Convective movement of air within the crack might be caused by temperature or pressure differences between the IWCS and the atmosphere (see Appendix B). However, it is more likely that the emission would be due to diffusive movement from the radon within the crack to the atmosphere through the opening at the surface of the IWCS. Convective estimates are conservative, as they assume that the entire radon content of the crack is emitted to the atmosphere each second.

Damage Caused by Drilling into the Residues

The drilling damage scenario assumes that a 0.15 m diameter boring is advanced 4.9 m into the K-65 residue, resulting in the emission of 6.2E+05 pCi/s (19.4 Ci/yr) into the borehole. Although the borehole wall area source is 2.3 m^2, the opening at the surface of the IWCS would be only 0.018 m^2. Convective movement of air within the borehole might be caused by temperature or pressure differences between the IWCS and the atmosphere (see Appendix B). However, it is more likely that the emission would be due to diffusive movement from the radon within the borehole to the atmosphere through the opening at the surface of the IWCS. Convective estimates are conservative, as they assume that the entire radon content of the crack is emitted to the atmosphere each second. Convective and diffusive estimates also conservatively assumed that the source is K-65 residue, although it is likely that the exposed source would consist of other less contaminated layers as well.

Damage from a Burrowing Animal

The burrowing animal scenario assumes that a 0.31 m diameter, 15 m long tunnel, culminating in a spherical den with a 0.41 m diameter, is excavated into the K-65 residue. The total exposed source area of 0.53 m^2 results in emission of 1.4E+05 pCi/s (4.5 Ci/yr) into the burrow. Although the den exposes a K-65 source of 0.53 m^2, the area of the tunnel opening (diameter 0.31 m) on the surface of the IWCS would be only 0.073 m^2. Convective movement of air within the burrow might be caused by temperature or pressure differences between the IWCS and the atmosphere (see Appendix B). However, it is more likely that the emission would be due to diffusive movement from the radon within the burrow to the atmosphere through the opening at the surface of the IWCS. Convective estimates are conservative, as they assume that the entire radon content of the crack is emitted to the atmosphere each second. Convective and diffusive estimates also conservatively assumed that the source is K-65 residue, although it is likely that the exposed source would consist of other less contaminated layers as well.

A.2.3 Summary of Results

The flux calculations presented in this Appendix are the basis for modeling of off-site air concentrations (see Appendix B, C and D). The most conservative flux estimates (convective flow from intrusion into K-65 residue) were used to generate off-site air concentration and provide bounding results at receptor locations.

The flux and on-site air concentration estimates for each layer in each of the four bays are presented in Table/Figure A-1 to A-8. These calculations are representative of the excavation scenarios for the IWCS, where successive layers of material would be removed in a controlled manner.

The intrusion scenario flux estimates (presented in Table/Figure A-9 to A-12 for convective releases, and Tables A-13 to A-17 for diffusive releases) are summarized in Table A-18, and indicate that the convective model is orders of magnitude more conservative than the diffusive model. These calculations represent accident scenarios, where IWCS material may be exposed in an uncontrolled manner. Additional discussion of the flux and on-site air concentration estimates are provided below

Flux Estimates

The estimate of radon-222 flux indicates that the maximum values of 2.7E+05 pCi/m^2/s are associated with the K-65 residues. At the top of the IWCS, the flux is estimated to be 0.44 pCi/m^2/s, which is below the DOE standard of an annual average of 20 pCi/m^2/s.

The maximum measured radon flux at IWCS in 2008 (USACE, 2008) was 0.23 pCi/m^2/s, compared with the soil flux model predicted maximum radon-222 flux of 0.44 pCi/m^2/s. The modeled flux overestimated the measured flux by a factor of 2, indicating that the model is conservative and provides bounding results.

On-Site Air Concentrations

Measured on-site radon air concentration above the IWCS in 2008 were mainly below the detection limit of 0.2 pCi/L but had a maximum of 0.3 pCi/L.

On-site air concentrations for the 100 m^2 excavation scenarios at a wind speed of 4.5 m/s, ranged from 0.003 pCi/L at the top of the intact IWCS to 240 pCi/L when encountering the K-65 residues. For a wind speed of 1 m/s, the on-site excavation air concentrations ranged from 0.01 pCi/L at the surface to 1,100 pCi/L in the K-65 residue. Results are presented in Table/Figure A-1 to A-8 for the excavation scenarios.

On-site intrusion scenario air concentrations are summarized in Table A-18, for both convective and diffusive transport at two different wind speeds. Results are also presented both with and without the use of area factors to adjust the calculations based on source areas less than the 100 m^2 used as the basis for the RESRAD equations. The results based on convective radon transport are many orders of magnitude above the diffusion based results and the area factors further reduce air concentrations several orders of magnitude. The maximum air concentration is estimated to be approximately 1,700 pCi/L for convective transport from earthquake damage with a wind speed of 1 m/s (see Table A-10). The lowest estimated onsite radon air concentration of 0.000002 pCi/L was associated with drilling and diffusive transport at a wind speed of 4.5 m/s with area factors included (see Table A-15)

A.2.4 Scaling of Results for 100 m^2 Source Area

The results generated for an area of 100 m^2 can be scaled to represent excavations of different size areas. The scaling factors are different for the on-site and off-site air concentrations. The on-site model uses the effective length of the source area in the calculations and results are directly proportional to this variable. The off-site model results are based on the annual emission rate of radon which is directly proportional to the source area size. The adjustment of air concentration results based on scaling factors derived from these variables is presented in the following sections.

A.2.4.1 On-site Air Concentration Scaling

For the onsite air concentrations, the results increase proportionally to the increase in the effective length of the source area. Table A-19 presents results generated for several possible source area configurations and sizes to provide a basis for comparison. The results presented are for the intact IWCS above Bay A with a wind speed of 1 m/s (see Section A.5).

The first row presents the assumed 100 m^2 area which is 7.3 m by 13.7 m. In the second row are results for a more conservative but less plausible area of 5 m wide by 20 m long to illustrate the impact on the results when the geometry of the source is modified. In the next two rows are results for a 10 m by 10 m square, as well as for a 20 m wide by 5 m long rectangular source area. From comparison of the on-site air concentrations presented for a 100 m^2 source area, the 7.3 m by 13.7 m geometry is both plausible and conservative.

Also presented in Table A-19 are on-site air concentrations for source areas both larger and smaller than 100 m^2. For the areas larger than 100 m^2, the on-site air concentrations scale approximately with the increase in the source area effective length. Two sets of results are presented for the 200 m^2 area, the first assuming proportions identical to the 100 m^2 area, and the second based on a longer and narrower source area that approximates the assumed excavation into Bay D previously discussed. The results indicate that the Bay D source configuration (7.3 m by 27.4 m) would require a scaling factor of 2, compared with the scaling factor of 1.4 for a wider rectangle (19.3 m by 10.4 m).

Confirmation of the scaling approach is provided in the last two columns. The second to last column presents the ratio between the larger area air concentration and the air concentration from the 100 m^2 source area. The last column presents the predicted air concentration increase based on the increase in the effective length of the source

area. The similarity between the values in the last two columns indicates that use of effective length based scaling of on-site air concentrations is appropriate.

The scaling of source areas less than 100 m^2 also requires application of an area factor (see Section A-19). The last four rows present results for these smaller source areas, and include both rectangular and square geometries for comparison. In all cases, the similarity of values in the last two columns indicates that the effective length of the source area is an appropriate basis for the scaling factor.

A.2.4.2 Off-site Air Concentration Scaling

The off-site air concentrations are proportional to the size of the source area, since the source area and emission rate of radon are directly proportional. An increase in source area from 100 m^2 to 200 m^2 would results in an increase in air concentrations by a factor of 2 (see Table A-19). Since the radon flux is expressed in units of $pCi/m^2/s$, it is apparent that an increase in the emitting area size would directly increase the amount of radon emitted and subsequently the air concentration. The method of scaling unit air concentration results based on the radon emissions is utilized in Appendix C to convert radon flux from the IWCS to off-site air concentrations.

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APPENDIX A-2

Estimated Radon Flux

Tables

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Table A-1. IWCS BAY A

Bay A Soils Constants

100	A = assumed area of *exposed* contaminated zone (m^2)
0.26	k = assumed equilibrium distribution coefficient for the total pore space (unitless); USDOE 1994
0.25	E = assumed radon emanation coefficient (unitless); conservative RESRAD default
0.01	C_1 = constant (unitless); USDOE 1994
10000	C_2 = constant (cm^2/m^2)
0.35	E_1 = assumed radon emanation coefficient for K-65 residues and other source materials (unitless; USDOE 1994)
1.00	Fao = calculated outdoor area factor (unitless); see RESRAD Manual Eq. C.8 (ANL 2001)
1.7	Ho = assumed height into which plume is uniformly mixed (m); adjusted to produce measured average outdoor radon concentration (USACE 2001)
13.7	X = calculated effective length of the contaminated area (m); see RESRAD Manual Eq. C-7 (ANL 2001) and Section A.2.1
4.5	U = measured annual average wind speed (m/sec); NOAA average for Lewiston, NY
2.10E-06	λ = radon-222 decay constant (per sec)

Bay A Soils Variables

IWCS Medium	Bulk Density ρ (g/cm^3)	Percent Moisture M (%)	Porosity p (frac.)	Saturation Fraction m (frac.)	Diffusion Coefficient D (cm^2/sec)	Interface Constant a (cm^2/sec)	1/Relaxation Length b (1/cm)	Ra-226 Conc. R (pCi/g)	Thickness (in)	Thickness x (cm)	Flux by Single Medium J ($pCi/m^2/sec$)
Topsoil	1.89	12.1	0.32	0.706	2.76E-03	6.61E-05	2.76E-02	1.2	18	45.7	3.7E-01
Clay	1.92	12.3	0.26	0.900	2.32E-04	1.79E-06	9.51E-02	1.2	36	91.4	1.3E-01
Waste Clay	1.81	13.5	0.36	0.683	3.58E-03	1.12E-04	2.42E-02	16	84	213.4	8.8E+00
Sand	1.52	15.0	0.43	0.530	1.05E-02	7.17E-04	1.41E-02	1.2	12	30.5	2.8E-01
K-65	1.60	16.0	0.38	0.674	4.01E-03	1.45E-04	2.29E-02	520,000	192	488	2.7E+05

For topsoil, clay, and waste clay: density and % moisture after compaction [Appendix 5-C of *Interim Cap Construction, Waste Containment Area Monitoring System and Permeability Testing* (USDOE 1986e)]

For topsoil, clay, and waste clay: porosity = uncompacted porosity * uncompacted density / compacted density; uncompacted values from USDOE 1994

Values for variables; m, D, a, b, are calculated (see Section 4.3) and Ra-226 concentrations are from Table 2.3.

Flux calculation methods defined in REG/G-3.64, *Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers* (NRC 1989)

Unless otherwise noted, flux calculation parameters defined in Appendix C to the *Failure Analysis Report for the Niagara Falls Storage Site, Lewiston, NY* (USDOE 1994)

Outdoor radon concentration based on methods described in the RESRAD Manual (ANL 2001)

Table A-2. NFSS Predicted Radon Levels for Bay A Soils

Radon Flux (pCi/m^2/sec) by Medium and Depth - Bay A						
Medium	Thickness (cm)	Depth (cm)	Flux$_T$ (J_T) pCi/m^2/sec	Flux$_i$ (J_i) pCi/m^2/sec	Outdoor Air @ 4.5 m/s (pCi/L)	Outdoor Air @ 1 m/s (pCi/L)
Topsoil	45.7	0.0	4.4E-01	3.7E-01	3.9E-04	1.8E-03
Topsoil	30.7	0.7	4.0E-01	3.0E-01	3.6E-04	1.6E-03
Topsoil	15.7	15.7	3.1E-01	1.8E-01	2.8E-04	1.2E-03
Topsoil	0.7	30.7	1.6E-01	8.6E-03	1.5E-04	6.6E-04
Topsoil	0.0	45.7	1.5E-01	0.0E+00	1.4E-04	6.2E-04
Clay	91.4	45.7	1.5E-01	1.3E-01	1.4E-04	6.2E-04
Clay	76.4	47.2	2.5E-01	1.3E-01	2.2E-04	9.9E-04
Clay	61.4	62.2	6.4E-01	1.3E-01	5.7E-04	2.6E-03
Clay	46.4	77.2	2.5E+00	1.3E-01	2.2E-03	1.0E-02
Clay	31.4	92.2	1.2E+01	1.3E-01	1.1E-02	4.9E-02
Clay	16.4	107.2	7.8E+01	1.2E-01	6.9E-02	3.1E-01
Clay	1.4	122.2	6.9E+02	1.7E-02	6.2E-01	2.8E+00
Clay	0.0	137.2	7.2E+02	0.0E+00	6.5E-01	2.9E+00
Waste Clay	213.4	137.2	7.2E+02	8.8E+00	6.5E-01	2.9E+00
Waste Clay	198.4	140.5	1.0E+03	8.8E+00	9.3E-01	4.2E+00
Waste Clay	183.4	155.5	1.5E+03	8.8E+00	1.3E+00	6.0E+00
Waste Clay	168.4	170.5	2.2E+03	8.8E+00	1.9E+00	8.7E+00
Waste Clay	153.4	185.5	3.1E+03	8.8E+00	2.8E+00	1.3E+01
Waste Clay	138.4	200.5	4.5E+03	8.8E+00	4.0E+00	1.8E+01
Waste Clay	123.4	215.5	6.6E+03	8.7E+00	5.9E+00	2.7E+01
Waste Clay	108.4	230.5	9.7E+03	8.7E+00	8.7E+00	3.9E+01
Waste Clay	93.4	245.5	1.4E+04	8.6E+00	1.3E+01	5.8E+01
Waste Clay	78.4	260.5	2.2E+04	8.4E+00	2.0E+01	8.8E+01
Waste Clay	63.4	275.5	3.4E+04	8.0E+00	3.1E+01	1.4E+02
Waste Clay	48.4	290.5	5.6E+04	7.2E+00	5.0E+01	2.2E+02
Waste Clay	33.4	305.5	9.4E+04	5.9E+00	8.4E+01	3.8E+02
Waste Clay	18.4	320.5	1.6E+05	3.7E+00	1.4E+02	6.4E+02
Waste Clay	3.4	335.5	2.2E+05	7.1E-01	1.9E+02	8.7E+02
Waste Clay	0.0	350.5	2.2E+05	0.0E+00	2.0E+02	8.9E+02

Table A-2. NFSS Predicted Radon Levels for Bay A Soils (continued)

Radon Flux (pCi/m^2/sec) by Medium and Depth - Bay A						
Medium	Thickness (cm)	Depth (cm)	Flux$_T$ (J_T) pCi/m^2/sec	Flux$_i$ (J_i) pCi/m^2/sec	Outdoor Air @ 4.5 m/s (pCi/L)	Outdoor Air @ 1 m/s (pCi/L)
Sand	30.5	350.5	2.2E+05	2.8E-01	2.0E+02	8.9E+02
Sand	15.5	351.0	2.5E+05	1.5E-01	2.3E+02	1.0E+03
Sand	0.48	366.0	2.7E+05	4.6E-03	2.4E+02	1.1E+03
Sand	0.0	381.0	2.7E+05	0.0E+00	2.4E+02	1.1E+03
K-65	487.7	381.0	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	472.7	388.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	457.7	403.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	442.7	418.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	427.7	433.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	412.7	448.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	397.7	463.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	382.7	478.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	367.7	493.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	352.7	508.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	337.7	523.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	322.7	538.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	307.7	553.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	292.7	568.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	277.7	583.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	262.7	598.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	247.7	613.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	232.7	628.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	217.7	643.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	202.7	658.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	187.7	673.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	172.7	688.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	157.7	703.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	142.7	718.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	127.7	733.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	112.7	748.7	2.6E+05	2.6E+05	2.4E+02	1.1E+03
K-65	97.7	763.7	2.6E+05	2.6E+05	2.3E+02	1.1E+03

Table A-2. NFSS Predicted Radon Levels for Bay A Soils (continued)

Radon Flux ($pCi/m^2/sec$) by Medium and Depth - Bay A						
Medium	Thickness (cm)	Depth (cm)	$Flux_T$ (J_T) $pCi/m^2/sec$	$Flux_i$ (J_i) $pCi/m^2/sec$	Outdoor Air @ 4.5 m/s (pCi/L)	Outdoor Air @ 1 m/s (pCi/L)
K-65	82.7	778.7	2.6E+05	2.6E+05	2.3E+02	1.0E+03
K-65	67.7	793.7	2.4E+05	2.4E+05	2.2E+02	9.8E+02
K-65	52.7	808.7	2.2E+05	2.2E+05	2.0E+02	9.0E+02
K-65	37.7	823.7	1.9E+05	1.9E+05	1.7E+02	7.5E+02
K-65	22.7	838.7	1.3E+05	1.3E+05	1.1E+02	5.1E+02
K-65	7.7	853.7	4.6E+04	4.6E+04	4.2E+01	1.9E+02
K-65	0.0	868.7	0.0E+00	0.0E+00	0.0E+00	0.0E+00

$Flux_T$ = total flux from all media

$Flux_j$ = flux only originating in medium "j"

See main text of appendix for equations used to generate results

Table A-3. IWCS Bay B - Calculations Supporting Flux Estimates

Bay B Soils Constants

100	A = assumed area of *exposed* contaminated zone (m^2)
0.26	k = assumed equilibrium distribution coefficient for the total pore space (unitless); USDOE 1994
0.25	E = assumed radon emanation coefficient (unitless); conservative RESRAD default
0.01	C_1 = constant (unitless); USDOE 1994
10000	C_2 = constant (cm^2/m^2)
0.35	E_1 = assumed radon emanation coefficient for K-65 residues and other source materials (unitless; USDOE 1994)
1.00	Fao = calculated outdoor area factor (unitless); see RESRAD Manual Eq. C.8 (ANL 2001)
1.7	Ho = assumed height into which plume is uniformly mixed (m); adjusted to produce measured average outdoor radon concentration (USACE 2001)
13.7	X = calculated effective length of the contaminated area (m); see RESRAD Manual Eq. C-7 (ANL 2001) and Section A.2.1
4.5	U = measured annual average wind speed (m/sec); NOAA average for Lewiston, NY
2.10E-06	λ = radon-222 decay constant (per sec)

Bay B Soils Variables

IWCS Medium	Bulk Density ρ (g/cm^3)	Percent Moisture M (%)	Porosity p (frac.)	Saturation Fraction m (frac.)	Diffusion Coefficient D (cm^2/sec)	Interface Constant a (cm^2/sec)	1/Relaxation Length b (1/cm)	Ra-226 Conc. R (pCi/g)	Thickness (in)	Thickness x (cm)	Flux by Single Medium J ($pCi/m^2/sec$)
Topsoil	1.89	12.1	0.32	0.706	2.76E-03	6.61E-05	2.76E-02	1.2	18	45.7	3.7E-01
Clay	1.92	12.3	0.26	0.900	2.32E-04	1.79E-06	9.51E-02	1.2	36	91.4	1.3E-01
Waste Clay	1.81	13.5	0.36	0.683	3.58E-03	1.12E-04	2.42E-02	16	84	213	8.8E+00
Tower Soils	1.44	15.0	0.45	0.480	1.37E-02	1.15E-03	1.24E-02	10,400	48	122	8.1E+03
Sand	1.52	15.0	0.43	0.530	1.05E-02	7.17E-04	1.41E-02	1.2	12	30.5	2.8E-01
L-30/F-32	1.15	15.0	0.45	0.383	1.99E-02	2.07E-03	1.03E-02	12,000	144	366	9.9E+03

For topsoil, clay, and waste clay: density and % moisture after compaction [Appendix 5-C of *Interim Cap Construction, Waste Containment Area Monitoring System and Permeability Testing* (USDOE 1986e)]

For topsoil, clay, and waste clay: porosity = uncompacted porosity * uncompacted density / compacted density; uncompacted values from USDOE 1994

Values for variables; m, D, a, b, are calculated (see Section 4.3) and Ra-226 concentrations are from Table 2.3.

Flux calculation methods defined in REG/G-3.64, *Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers* (NRC 1989)

Unless otherwise noted, flux calculation parameters defined in Appendix C to the *Failure Analysis Report for the Niagara Falls Storage Site, Lewiston, NY* (USDOE 1994)

Outdoor radon concentration based on methods described in the RESRAD Manual (ANL 2001)

Table A-4. NFSS Predicted Radon Levels for Bay B Soils

Radon Flux (pCi/m^2/sec) by Medium and Depth - Bay B						
Medium	Thickness (cm)	Depth (cm)	Flux$_T$ (J_T) pCi/m^2/sec	Flux$_i$ (J_i) pCi/m^2/sec	Outdoor Air @ 4.5 m/s (pCi/L)	Outdoor Air @ 1 m/s (pCi/L)
Topsoil	45.7	0.0	4.5E-01	3.7E-01	4.0E-04	1.8E-03
Topsoil	30.7	0.7	4.1E-01	3.0E-01	3.7E-04	1.6E-03
Topsoil	15.7	15.7	3.2E-01	1.8E-01	2.8E-04	1.3E-03
Topsoil	0.7	30.7	1.6E-01	8.6E-03	1.4E-04	6.5E-04
Topsoil	0.0	45.7	1.5E-01	0.0E+00	1.4E-04	6.2E-04
Clay	91.4	45.7	1.5E-01	1.3E-01	1.4E-04	6.2E-04
Clay	76.4	47.2	2.4E-01	1.3E-01	2.1E-04	9.5E-04
Clay	61.4	62.2	5.8E-01	1.3E-01	5.2E-04	2.4E-03
Clay	46.4	77.2	2.0E+00	1.3E-01	1.8E-03	8.3E-03
Clay	31.4	92.2	8.2E+00	1.3E-01	7.4E-03	3.3E-02
Clay	16.4	107.2	3.3E+01	1.2E-01	2.9E-02	1.3E-01
Clay	1.4	122.2	8.2E+01	1.7E-02	7.3E-02	3.3E-01
Clay	0.0	137.2	8.3E+01	0.0E+00	7.4E-02	3.3E-01
Waste Clay	213.4	137.2	8.3E+01	8.8E+00	7.4E-02	3.3E-01
Waste Clay	198.4	140.5	1.2E+02	8.8E+00	1.1E-01	4.8E-01
Waste Clay	183.4	155.5	1.7E+02	8.8E+00	1.5E-01	6.9E-01
Waste Clay	168.4	170.5	2.5E+02	8.8E+00	2.2E-01	1.0E+00
Waste Clay	153.4	185.5	3.7E+02	8.8E+00	3.3E-01	1.5E+00
Waste Clay	138.4	200.5	5.4E+02	8.8E+00	4.9E-01	2.2E+00
Waste Clay	123.4	215.5	8.1E+02	8.7E+00	7.2E-01	3.2E+00
Waste Clay	108.4	230.5	1.2E+03	8.7E+00	1.1E+00	4.8E+00
Waste Clay	93.4	245.5	1.8E+03	8.6E+00	1.6E+00	7.2E+00
Waste Clay	78.4	260.5	2.6E+03	8.4E+00	2.4E+00	1.1E+01
Waste Clay	63.4	275.5	3.9E+03	8.0E+00	3.5E+00	1.6E+01
Waste Clay	48.4	290.5	5.7E+03	7.2E+00	5.1E+00	2.3E+01
Waste Clay	33.4	305.5	7.9E+03	5.9E+00	7.1E+00	3.2E+01
Waste Clay	18.4	320.5	1.0E+04	3.7E+00	9.1E+00	4.1E+01
Waste Clay	3.4	335.5	1.1E+04	7.1E-01	1.0E+01	4.6E+01
Waste Clay	0.0	350.5	1.1E+04	0.0E+00	1.0E+01	4.6E+01

Table A-4. NFSS Predicted Radon Levels for Bay B Soils (continued)

Radon Flux (pCi/m^2/sec) by Medium and Depth - Bay B						
Medium	**Thickness (cm)**	**Depth (cm)**	**Flux$_T$ (J_T) pCi/m^2/sec**	**Flux$_i$ (J_i) pCi/m^2/sec**	**Outdoor Air @ 4.5 m/s (pCi/L)**	**Outdoor Air @ 1 m/s (pCi/L)**
Tower Soils	121.9	350.5	1.1E+04	8.1E+03	1.0E+01	4.6E+01
Tower Soils	106.9	352.4	1.2E+04	7.7E+03	1.1E+01	4.7E+01
Tower Soils	91.9	367.4	1.2E+04	7.2E+03	1.1E+01	4.9E+01
Tower Soils	76.9	382.4	1.2E+04	6.6E+03	1.1E+01	4.9E+01
Tower Soils	61.9	397.4	1.2E+04	5.7E+03	1.1E+01	4.9E+01
Tower Soils	46.9	412.4	1.2E+04	4.7E+03	1.1E+01	4.8E+01
Tower Soils	31.9	427.4	1.1E+04	3.3E+03	1.0E+01	4.6E+01
Tower Soils	16.9	442.4	1.0E+04	1.8E+03	9.2E+00	4.1E+01
Tower Soils	1.9	457.4	8.9E+03	2.1E+02	7.9E+00	3.6E+01
Tower Soils	0.0	472.4	8.6E+03	0.0E+00	7.7E+00	3.5E+01
Sand	30.5	472.4	8.6E+03	2.8E-01	7.7E+00	3.5E+01
Sand	15.5	472.9	9.5E+03	1.5E-01	8.5E+00	3.8E+01
Sand	0.48	487.9	9.9E+03	4.6E-03	8.8E+00	4.0E+01
Sand	0.0	502.9	9.9E+03	0.0E+00	8.8E+00	4.0E+01
L-30/F-32	365.8	502.9	9.9E+03	9.9E+03	8.8E+00	4.0E+01
L-30/F-32	350.8	508.7	9.9E+03	9.9E+03	8.8E+00	4.0E+01
L-30/F-32	335.8	523.7	9.9E+03	9.9E+03	8.8E+00	4.0E+01
L-30/F-32	320.8	538.7	9.9E+03	9.9E+03	8.8E+00	4.0E+01
L-30/F-32	305.8	553.7	9.8E+03	9.8E+03	8.8E+00	4.0E+01
L-30/F-32	290.8	568.7	9.8E+03	9.8E+03	8.8E+00	4.0E+01
L-30/F-32	275.8	583.7	9.8E+03	9.8E+03	8.8E+00	4.0E+01
L-30/F-32	260.8	598.7	9.8E+03	9.8E+03	8.8E+00	3.9E+01
L-30/F-32	245.8	613.7	9.8E+03	9.8E+03	8.7E+00	3.9E+01
L-30/F-32	230.8	628.7	9.7E+03	9.7E+03	8.7E+00	3.9E+01
L-30/F-32	215.8	643.7	9.6E+03	9.6E+03	8.6E+00	3.9E+01
L-30/F-32	200.8	658.7	9.6E+03	9.6E+03	8.6E+00	3.9E+01
L-30/F-32	185.8	673.7	9.5E+03	9.5E+03	8.5E+00	3.8E+01
L-30/F-32	170.8	688.7	9.3E+03	9.3E+03	8.3E+00	3.7E+01
L-30/F-32	155.8	703.7	9.1E+03	9.1E+03	8.2E+00	3.7E+01
L-30/F-32	140.8	718.7	8.8E+03	8.8E+03	7.9E+00	3.6E+01

Table A-4. NFSS Predicted Radon Levels for Bay B Soils (continued)

Radon Flux (pCi/m^2/sec) by Medium and Depth - Bay B						
Medium	Thickness (cm)	Depth (cm)	Flux$_T$ (J_T) pCi/m^2/sec	Flux$_i$ (J_i) pCi/m^2/sec	Outdoor Air @ 4.5 m/s (pCi/L)	Outdoor Air @ 1 m/s (pCi/L)
L-30/F-32	125.8	733.7	8.5E+03	8.5E+03	7.6E+00	3.4E+01
L-30/F-32	110.8	748.7	8.0E+03	8.0E+03	7.2E+00	3.2E+01
L-30/F-32	95.8	763.7	7.5E+03	7.5E+03	6.7E+00	3.0E+01
L-30/F-32	80.8	778.7	6.7E+03	6.7E+03	6.0E+00	2.7E+01
L-30/F-32	65.8	793.7	5.8E+03	5.8E+03	5.2E+00	2.3E+01
L-30/F-32	50.8	808.7	4.7E+03	4.7E+03	4.2E+00	1.9E+01
L-30/F-32	35.8	823.7	3.5E+03	3.5E+03	3.1E+00	1.4E+01
L-30/F-32	20.8	838.7	2.1E+03	2.1E+03	1.9E+00	8.4E+00
L-30/F-32	5.8	853.7	5.8E+02	5.8E+02	5.2E-01	2.4E+00
L-30/F-32	0.0	868.7	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Flux$_T$ = total flux from all media

Flux$_j$ = flux only originating in medium "j"

See main text of appendix for equations used to generate results

Table A-5. IWCS Bay C - Calculations Supporting Flux Estimates

Bay C Soils Constants

100	A = assumed area of *exposed* contaminated zone (m^2)
0.26	k = assumed equilibrium distribution coefficient for the total pore space (unitless); USDOE 1994
0.25	E = assumed radon emanation coefficient (unitless); conservative RESRAD default
0.01	C_1 = constant (unitless); USDOE 1994
10000	C_2 = constant (cm^2/m^2)
0.35	E_1 = assumed radon emanation coefficient for K-65 residues and other source materials (unitless; USDOE 1994)
1.00	Fao = calculated outdoor area factor (unitless); see RESRAD Manual Eq. C.8 (ANL 2001)
1.7	Ho = assumed height into which plume is uniformly mixed (m); adjusted to produce measured average outdoor radon concentration (USACE 2001)
13.7	X = calculated effective length of the contaminated area (m); see RESRAD Manual Eq. C-7 (ANL 2001) and Section A.2.1
4.5	U = measured annual average wind speed (m/sec); NOAA average for Lewiston, NY
2.10E-06	λ = radon-222 decay constant (per sec)

Bay C Soils Variables

IWCS Medium	Bulk Density ρ (g/cm^3)	Percent Moisture M (%)	Porosity p (frac.)	Saturation Fraction m (frac.)	Diffusion Coefficient D (cm^2/sec)	Interface Constant a (cm^2/sec)	1/Relaxation Length b (1/cm)	Ra-226 Conc. R (pCi/g)	Thickness (in)	Thickness x (cm)	Flux by Single Medium J ($pCi/m^2/sec$)
Topsoil	1.89	12.1	0.32	0.706	2.76E-03	6.61E-05	2.76E-02	1.2	18	45.7	3.7E-01
Clay	1.92	12.3	0.26	0.900	2.32E-04	1.79E-06	9.51E-02	1.2	36	91.4	1.3E-01
Waste Clay	1.81	13.5	0.36	0.683	3.58E-03	1.12E-04	2.42E-02	16	84	213	8.8E+00
Tower Soils	1.44	15.0	0.45	0.480	1.37E-02	1.15E-03	1.24E-02	10,400	48	122	8.1E+03
Sand	1.52	15.0	0.43	0.530	1.05E-02	7.17E-04	1.41E-02	1.2	12	30.5	2.8E-01
L30/F-32	1.15	15.0	0.45	0.383	1.99E-02	2.07E-03	1.03E-02	12,000	60	152	9.1E+03
K-65	1.60	16.0	0.38	0.674	4.01E-03	1.45E-04	2.29E-02	520,000	84	213	2.7E+05

For topsoil, clay, and waste clay: density and % moisture after compaction [Appendix 5-C of *Interim Cap Construction, Waste Containment Area Monitoring System and Permeability Testing* (USDOE 1986e)]

For topsoil, clay, and waste clay: porosity = uncompacted porosity * uncompacted density / compacted density; uncompacted values from USDOE 1994

Values for variables; m, D, a, b, are calculated (see Section 4.3) and Ra-226 concentrations are from Table 2.3.

Flux calculation methods defined in REG/G-3.64, *Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers* (NRC 1989)

Unless otherwise noted, flux calculation parameters defined in Appendix C to the *Failure Analysis Report for the Niagara Falls Storage Site, Lewiston, NY* (USDOE 1994)

Outdoor adon concentration based on methods described in the RESRAD Manual (ANL 2001)

Table A-6. NFSS Predicted Radon Levels for Bay C Soils

Radon Flux (pCi/m^2/sec) by Medium and Depth - Bay C						
Medium	Thickness (cm)	Depth (cm)	Flux$_T$ (J_T) pCi/m^2/sec	Flux$_i$ (J_i) pCi/m^2/sec	Outdoor Air @ 4.5 m/s (pCi/L)	Outdoor Air @ 1 m/s (pCi/L)
Topsoil	45.7	0.0	4.3E-01	3.7E-01	3.8E-04	1.7E-03
Topsoil	30.7	0.7	3.8E-01	3.0E-01	3.4E-04	1.5E-03
Topsoil	15.7	15.7	2.9E-01	1.8E-01	2.6E-04	1.2E-03
Topsoil	0.7	30.7	1.4E-01	8.6E-03	1.2E-04	5.6E-04
Topsoil	0.0	45.7	1.3E-01	0.0E+00	1.2E-04	5.3E-04
Clay	91.4	45.7	1.3E-01	1.3E-01	1.2E-04	5.3E-04
Clay	76.4	47.2	1.4E-01	1.3E-01	1.3E-04	5.7E-04
Clay	61.4	62.2	1.8E-01	1.3E-01	1.7E-04	7.4E-04
Clay	46.4	77.2	3.9E-01	1.3E-01	3.5E-04	1.6E-03
Clay	31.4	92.2	1.5E+00	1.3E-01	1.3E-03	5.9E-03
Clay	16.4	107.2	8.7E+00	1.2E-01	7.8E-03	3.5E-02
Clay	1.4	122.2	7.7E+01	1.7E-02	6.9E-02	3.1E-01
Clay	0.0	137.2	8.0E+01	0.0E+00	7.2E-02	3.2E-01
Waste Clay	213.4	137.2	8.0E+01	8.8E+00	7.2E-02	3.2E-01
Waste Clay	198.4	140.5	1.1E+02	8.8E+00	1.0E-01	4.5E-01
Waste Clay	183.4	155.5	1.6E+02	8.8E+00	1.4E-01	6.4E-01
Waste Clay	168.4	170.5	2.3E+02	8.8E+00	2.0E-01	9.1E-01
Waste Clay	153.4	185.5	3.2E+02	8.8E+00	2.9E-01	1.3E+00
Waste Clay	138.4	200.5	4.7E+02	8.8E+00	4.2E-01	1.9E+00
Waste Clay	123.4	215.5	6.8E+02	8.7E+00	6.1E-01	2.8E+00
Waste Clay	108.4	230.5	1.0E+03	8.7E+00	9.1E-01	4.1E+00
Waste Clay	93.4	245.5	1.5E+03	8.6E+00	1.4E+00	6.1E+00
Waste Clay	78.4	260.5	2.3E+03	8.4E+00	2.1E+00	9.4E+00
Waste Clay	63.4	275.5	3.7E+03	8.0E+00	3.3E+00	1.5E+01
Waste Clay	48.4	290.5	6.1E+03	7.2E+00	5.5E+00	2.5E+01
Waste Clay	33.4	305.5	1.1E+04	5.9E+00	9.5E+00	4.3E+01
Waste Clay	18.4	320.5	1.8E+04	3.7E+00	1.6E+01	7.4E+01
Waste Clay	3.4	335.5	2.6E+04	7.1E-01	2.3E+01	1.0E+02
Waste Clay	0.0	350.5	2.6E+04	0.0E+00	2.3E+01	1.1E+02

Table A-6. NFSS Predicted Radon Levels for Bay C Soils (continued)

Radon Flux (pCi/m^2/sec) by Medium and Depth - Bay C						
Medium	**Thickness (cm)**	**Depth (cm)**	**Flux$_T$ (J_T) pCi/m^2/sec**	**Flux$_j$ (J_j) pCi/m^2/sec**	**Outdoor Air @ 4.5 m/s (pCi/L)**	**Outdoor Air @ 1 m/s (pCi/L)**
Tower Soils	121.9	350.5	2.6E+04	8.1E+03	2.3E+01	1.1E+02
Tower Soils	106.9	352.4	3.0E+04	7.7E+03	2.7E+01	1.2E+02
Tower Soils	91.9	367.4	3.4E+04	7.2E+03	3.1E+01	1.4E+02
Tower Soils	76.9	382.4	4.0E+04	6.6E+03	3.5E+01	1.6E+02
Tower Soils	61.9	397.4	4.6E+04	5.7E+03	4.1E+01	1.9E+02
Tower Soils	46.9	412.4	5.4E+04	4.7E+03	4.8E+01	2.2E+02
Tower Soils	31.9	427.4	6.3E+04	3.3E+03	5.6E+01	2.5E+02
Tower Soils	16.9	442.4	7.0E+04	1.8E+03	6.2E+01	2.8E+02
Tower Soils	1.9	457.4	7.2E+04	2.1E+02	6.5E+01	2.9E+02
Tower Soils	0.0	472.4	7.2E+04	0.0E+00	6.4E+01	2.9E+02
Sand	30.5	472.4	7.2E+04	2.8E-01	6.4E+01	2.9E+02
Sand	15.5	472.9	8.8E+04	1.5E-01	7.9E+01	3.5E+02
Sand	0.48	487.9	9.5E+04	4.6E-03	8.5E+01	3.8E+02
Sand	0.0	502.9	9.5E+04	0.0E+00	8.5E+01	3.8E+02
L-30/F-32	152.4	502.9	9.5E+04	9.1E+03	8.5E+01	3.8E+02
L-30/F-32	137.4	505.3	1.1E+05	8.8E+03	9.7E+01	4.4E+02
L-30/F-32	122.4	520.3	1.2E+05	8.4E+03	1.1E+02	5.0E+02
L-30/F-32	107.4	535.3	1.4E+05	7.9E+03	1.3E+02	5.6E+02
L-30/F-32	92.4	550.3	1.6E+05	7.3E+03	1.4E+02	6.4E+02
L-30/F-32	77.4	565.3	1.8E+05	6.5E+03	1.6E+02	7.2E+02
L-30/F-32	62.4	580.3	2.0E+05	5.6E+03	1.8E+02	8.1E+02
L-30/F-32	47.4	595.3	2.2E+05	4.5E+03	2.0E+02	8.9E+02
L-30/F-32	32.4	610.3	2.4E+05	3.2E+03	2.2E+02	9.8E+02
L-30/F-32	17.4	625.3	2.6E+05	1.7E+03	2.3E+02	1.0E+03
L-30/F-32	2.4	640.3	2.7E+05	2.4E+02	2.4E+02	1.1E+03
L-30/F-32	0.0	655.3	2.7E+05	0.0E+00	2.4E+02	1.1E+03
K-65	213.4	655.3	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	198.4	658.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	183.4	673.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	168.4	688.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03

Table A-6. NFSS Predicted Radon Levels for Bay C Soils (continued)

Radon Flux (pCi/m^2/sec) by Medium and Depth - Bay C						
Medium	**Thickness (cm)**	**Depth (cm)**	**Flux$_T$ (J_T) pCi/m^2/sec**	**Flux$_j$ (J_j) pCi/m^2/sec**	**Outdoor Air @ 4.5 m/s (pCi/L)**	**Outdoor Air @ 1 m/s (pCi/L)**
K-65	153.4	703.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	138.4	718.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	123.4	733.7	2.7E+05	2.7E+05	2.4E+02	1.1E+03
K-65	108.4	748.7	2.6E+05	2.6E+05	2.4E+02	1.1E+03
K-65	93.4	763.7	2.6E+05	2.6E+05	2.3E+02	1.0E+03
K-65	78.4	778.7	2.5E+05	2.5E+05	2.3E+02	1.0E+03
K-65	63.4	793.7	2.4E+05	2.4E+05	2.1E+02	9.6E+02
K-65	48.4	808.7	2.1E+05	2.1E+05	1.9E+02	8.6E+02
K-65	33.4	823.7	1.7E+05	1.7E+05	1.5E+02	6.9E+02
K-65	18.4	838.7	1.1E+05	1.1E+05	9.5E+01	4.3E+02
K-65	3.4	853.7	2.1E+04	2.1E+04	1.8E+01	8.3E+01
K-65	0.0	868.7	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Flux$_T$ = total flux from all media

Flux$_j$ = flux only originating in medium "j"

See main text of appendix for equations used to generate results

Table A-7. IWCS Bay D - Calculations Supporting Flux Estimates

Bay D Soils Constants

100	A = assumed area of *exposed* contaminated zone (m^2)
0.26	k = assumed equilibrium distribution coefficient for the total pore space (unitless); USDOE 1994
0.25	E = assumed radon emanation coefficient (unitless); conservative RESRAD default
0.01	C_1 = constant (unitless); USDOE 1994
10000	C_2 = constant (cm^2/m^2)
0.35	E_1 = assumed radon emanation coefficient for K-65 residues and other source materials (unitless; USDOE 1994)
1.00	Fao = calculated outdoor area factor (unitless); see RESRAD Manual Eq. C.8 (ANL 2001)
1.7	Ho = assumed height into which plume is uniformly mixed (m); adjusted to produce measured average outdoor radon concentration (USACE 2001)
13.7	X = calculated effective length of the contaminated area (m); see RESRAD Manual Eq. C-7 (ANL 2001) and Section A.2.1
4.5	U = measured annual average wind speed (m/sec); NOAA average for Lewiston, NY
2.10E-06	λ = radon-222 decay constant (per sec)

Bay D Soils Variables

IWCS Medium	Bulk Density ρ (g/cm^3)	Percent Moisture M (%)	Porosity p (frac.)	Saturation Fraction m (frac.)	Diffusion Coefficient D (cm^2/sec)	Interface Constant a (cm^2/sec)	1/Relaxation Length b (1/cm)	Ra-226 Conc. R (pCi/g)	Thickness (in)	Thickness x (cm)	Flux by Single Medium J ($pCi/m^2/sec$)
Topsoil	1.89	12.1	0.32	0.706	2.76E-03	6.61E-05	2.76E-02	1.2	18	45.7	3.7E-01
Clay	1.92	12.3	0.26	0.900	2.32E-04	1.79E-06	9.51E-02	1.2	36	91.4	1.3E-01
Waste Clay	1.81	13.5	0.36	0.683	3.58E-03	1.12E-04	2.42E-02	16	104	264	8.8E+00
Tower Soils	1.44	15.0	0.45	0.480	1.37E-02	1.15E-03	1.24E-02	10,400	120	305	8.9E+03
Sand	1.52	15.0	0.43	0.530	1.05E-02	7.17E-04	1.41E-02	1.2	36	91.4	5.8E-01
L30/F-32	1.15	15.0	0.45	0.383	1.99E-02	2.07E-03	1.03E-02	12,000	60	152	9.1E+03

For topsoil, clay, and waste clay: density and % moisture after compaction [Appendix 5-C of *Interim Cap Construction, Waste Containment Area Monitoring System and Permeability Testing* (USDOE 1986e)]

For topsoil, clay, and waste clay: porosity = uncompacted porosity * uncompacted density / compacted density; uncompacted values from USDOE1994

Values for variables; m, D, a, b, are calculated (see Section 4.3) and Ra-226 concentrations are from Table 2.3.

Flux calculation methods defined in REG/G-3.64, *Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers* (NRC 1989)
Unless otherwise noted, flux calculation parameters defined in Appendix C to the *Failure Analysis Report for the Niagara Falls Storage Site, Lewiston, NY* (USDOE 1994)

Outdoor radon concentration based on methods described in the RESRAD Manual (ANL 2001)

Table A-8. NFSS Predicted Radon Levels for Bay D Soils

Radon Flux (pCi/m^2/sec) by Medium and Depth - Bay D						
Medium	Thickness (cm)	Depth (cm)	Flux$_T$ (J_T) pCi/m^2/sec	Flux$_i$ (J_i) pCi/m^2/sec	Outdoor Air @ 4.5 m/s (pCi/L)	Outdoor Air @ 1 m/s (pCi/L)
Topsoil	45.7	0.0	4.3E-01	3.7E-01	3.8E-04	1.7E-03
Topsoil	30.7	0.7	3.8E-01	3.0E-01	3.4E-04	1.5E-03
Topsoil	15.7	15.7	2.9E-01	1.8E-01	2.6E-04	1.2E-03
Topsoil	0.7	30.7	1.4E-01	8.6E-03	1.2E-04	5.5E-04
Topsoil	0.0	45.7	1.3E-01	0.0E+00	1.1E-04	5.2E-04
Clay	91.4	45.7	1.3E-01	1.3E-01	1.1E-04	5.2E-04
Clay	76.4	47.2	1.3E-01	1.3E-01	1.2E-04	5.2E-04
Clay	61.4	62.2	1.4E-01	1.3E-01	1.2E-04	5.6E-04
Clay	46.4	77.2	1.8E-01	1.3E-01	1.6E-04	7.2E-04
Clay	31.4	92.2	3.9E-01	1.3E-01	3.5E-04	1.6E-03
Clay	16.4	107.2	1.8E+00	1.2E-01	1.6E-03	7.3E-03
Clay	1.4	122.2	1.5E+01	1.7E-02	1.4E-02	6.1E-02
Clay	0.0	137.2	1.6E+01	0.0E+00	1.4E-02	6.4E-02
Waste Clay	264.2	137.2	1.6E+01	8.8E+00	1.4E-02	6.4E-02
Waste Clay	249.2	146.3	1.9E+01	8.8E+00	1.7E-02	7.7E-02
Waste Clay	234.2	161.3	2.4E+01	8.8E+00	2.1E-02	9.5E-02
Waste Clay	219.2	176.3	3.0E+01	8.8E+00	2.7E-02	1.2E-01
Waste Clay	204.2	191.3	3.9E+01	8.8E+00	3.5E-02	1.6E-01
Waste Clay	189.2	206.3	5.3E+01	8.8E+00	4.7E-02	2.1E-01
Waste Clay	174.2	221.3	7.3E+01	8.8E+00	6.5E-02	2.9E-01
Waste Clay	159.2	236.3	1.0E+02	8.8E+00	9.1E-02	4.1E-01
Waste Clay	144.2	251.3	1.4E+02	8.8E+00	1.3E-01	5.8E-01
Waste Clay	129.2	266.3	2.1E+02	8.8E+00	1.9E-01	8.3E-01
Waste Clay	114.2	281.3	3.0E+02	8.7E+00	2.7E-01	1.2E+00
Waste Clay	99.2	296.3	4.5E+02	8.6E+00	4.0E-01	1.8E+00
Waste Clay	84.2	311.3	6.8E+02	8.5E+00	6.1E-01	2.7E+00
Waste Clay	69.2	326.3	1.1E+03	8.2E+00	9.5E-01	4.3E+00
Waste Clay	54.2	341.3	1.7E+03	7.6E+00	1.5E+00	6.9E+00

Table A-8. NFSS Predicted Radon Levels for Bay D Soils (continued)

Radon Flux (pCi/m^2/sec) by Medium and Depth - Bay D						
Medium	Thickness (cm)	Depth (cm)	Flux$_T$ (J_T) pCi/m^2/sec	Flux$_i$ (J_i) pCi/m^2/sec	Outdoor Air @ 4.5 m/s (pCi/L)	Outdoor Air @ 1 m/s (pCi/L)
Waste Clay	39.2	356.3	2.9E+03	6.5E+00	2.6E+00	1.2E+01
Waste Clay	24.2	371.3	5.1E+03	4.6E+00	4.6E+00	2.1E+01
Waste Clay	9.2	386.3	8.1E+03	1.9E+00	7.2E+00	3.3E+01
Waste Clay	0.0	401.3	8.9E+03	0.0E+00	8.0E+00	3.6E+01
Tower Soils	304.8	401.3	8.9E+03	8.9E+03	8.0E+00	3.6E+01
Tower Soils	289.8	406.1	8.9E+03	8.9E+03	8.0E+00	3.6E+01
Tower Soils	274.8	421.1	8.9E+03	8.9E+03	8.0E+00	3.6E+01
Tower Soils	259.8	436.1	9.0E+03	8.9E+03	8.0E+00	3.6E+01
Tower Soils	244.8	451.1	9.0E+03	8.8E+03	8.0E+00	3.6E+01
Tower Soils	229.8	466.1	9.0E+03	8.8E+03	8.0E+00	3.6E+01
Tower Soils	214.8	481.1	9.0E+03	8.8E+03	8.0E+00	3.6E+01
Tower Soils	199.8	496.1	9.0E+03	8.8E+03	8.0E+00	3.6E+01
Tower Soils	184.8	511.1	9.0E+03	8.7E+03	8.0E+00	3.6E+01
Tower Soils	169.8	526.1	8.9E+03	8.6E+03	8.0E+00	3.6E+01
Tower Soils	154.8	541.1	8.9E+03	8.5E+03	7.9E+00	3.6E+01
Tower Soils	139.8	556.1	8.8E+03	8.3E+03	7.9E+00	3.5E+01
Tower Soils	124.8	571.1	8.7E+03	8.1E+03	7.7E+00	3.5E+01
Tower Soils	109.8	586.1	8.4E+03	7.8E+03	7.6E+00	3.4E+01
Tower Soils	94.8	601.1	8.1E+03	7.3E+03	7.3E+00	3.3E+01
Tower Soils	79.8	616.1	7.7E+03	6.7E+03	6.9E+00	3.1E+01
Tower Soils	64.8	631.1	7.1E+03	5.9E+03	6.4E+00	2.9E+01
Tower Soils	49.8	646.1	6.4E+03	4.9E+03	5.7E+00	2.6E+01
Tower Soils	34.8	661.1	5.4E+03	3.6E+03	4.8E+00	2.2E+01
Tower Soils	19.8	676.1	4.2E+03	2.1E+03	3.8E+00	1.7E+01
Tower Soils	4.8	691.1	2.7E+03	5.3E+02	2.5E+00	1.1E+01
Tower Soils	0.0	706.1	2.2E+03	0.0E+00	2.0E+00	9.0E+00
Sand	91.4	706.1	2.2E+03	5.8E-01	2.0E+00	9.0E+00
Sand	76.4	707.6	2.9E+03	5.4E-01	2.6E+00	1.2E+01
Sand	61.4	722.6	3.9E+03	4.7E-01	3.5E+00	1.6E+01
Sand	46.4	737.6	5.2E+03	3.9E-01	4.6E+00	2.1E+01

Table A-8. NFSS Predicted Radon Levels for Bay D Soils (continued)

Radon Flux (pCi/m^2/sec) by Medium and Depth - Bay D						
Medium	**Thickness (cm)**	**Depth (cm)**	**Flux$_T$ (J_T) pCi/m^2/sec**	**Flux$_i$ (J_i) pCi/m^2/sec**	**Outdoor Air @ 4.5 m/s (pCi/L)**	**Outdoor Air @ 1 m/s (pCi/L)**
Sand	31.4	752.6	6.7E+03	2.8E-01	6.0E+00	2.7E+01
Sand	16.4	767.6	8.3E+03	1.5E-01	7.4E+00	3.3E+01
Sand	1.4	782.6	9.0E+03	1.4E-02	8.1E+00	3.6E+01
Sand	0.0	797.6	9.1E+03	0.0E+00	8.1E+00	3.6E+01
L-30/F-32	152.4	797.6	9.1E+03	9.1E+03	8.1E+00	3.6E+01
L-30/F-32	137.4	800.0	8.8E+03	8.8E+03	7.9E+00	3.5E+01
L-30/F-32	122.4	815.0	8.4E+03	8.4E+03	7.5E+00	3.4E+01
L-30/F-32	107.4	830.0	7.9E+03	7.9E+03	7.1E+00	3.2E+01
L-30/F-32	92.4	845.0	7.3E+03	7.3E+03	6.5E+00	2.9E+01
L-30/F-32	77.4	860.0	6.5E+03	6.5E+03	5.8E+00	2.6E+01
L-30/F-32	62.4	875.0	5.6E+03	5.6E+03	5.0E+00	2.3E+01
L-30/F-32	47.4	890.0	4.5E+03	4.5E+03	4.0E+00	1.8E+01
L-30/F-32	32.4	905.0	3.2E+03	3.2E+03	2.8E+00	1.3E+01
L-30/F-32	17.4	920.0	1.7E+03	1.7E+03	1.6E+00	7.0E+00
L-30/F-32	2.4	935.0	2.4E+02	2.4E+02	2.2E-01	9.8E-01
L-30/F-32	0.0	950.0	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Flux$_T$ = total flux from all media

Flux$_j$ = flux only originating in medium "j"

See main text of appendix for equations used to generate results

Table A-9. On-site Air Concentration from Convective Soil Emissions - Wind Speed of 4.5 m/s

		Intrusion Scenario				
Parameter	**Units**	**Equipment Damage**	**Earthquake Fissure**	**Drilling Damage**	**Animal Burrow**	**Basis**
Radon flux rate	$pCi/m^2/s$	2.67E+05	4.50E+03	2.67E+05	2.67E+05	flux from K-65 residue
Source area	m^2	6.90E+01	3.90E+02	2.30E+00	5.30E-01	assumed for scenario
Emission from source	pCi/s	1.84E+07	1.76E+06	6.14E+05	1.42E+05	calculated from K-65 source and area
Emission from source	Ci/yr	5.81E+02	5.53E+01	1.94E+01	4.46E+00	calculated from K-65 source and area
Emission opening area	m^2	6.90E+01	1.50E+01	1.77E-02	7.31E-02	area of opening at IWCS surface
Calculated flux through opening	$pCi/m^2/s$	2.67E+05	1.17E+05	3.48E+07	1.94E+06	calculated from total emission and opening area
wind speed	m/s	4.50E+00	4.50E+00	4.50E+00	4.50E+00	average wind speed
mixing height	m/s	1.70E+00	1.70E+00	1.70E+00	1.70E+00	assumed for site
site length	m	1.50E+01	5.00E+01	1.50E-01	3.05E-01	assumed for scenario
decay constant	1/s	2.10E-06	2.10E-06	2.10E-06	2.10E-06	based on Rn-222 half life of 3.8 days
Fao	unitless	1.00E+00	1.00E+00	1.00E+00	1.00E+00	assumed to be 1 for all scenarios
Outdoor air concentration	pCi/L	2.61E+02	3.81E+02	3.40E+02	3.85E+01	calculated from RESRAD methods

Note:
Earthquake fissure radon flux is the average for the exposed layers, as presented in Appendix E (Table E-3), and is based on a crack extending to the top of the K-65 residues.
See Appendix A text for further discussion regarding the parameter values and Section 5.3 for the supporting equations.

Table A-10. On-site Air Concentration from Convective Soil Emissions - Wind Speed of 1 m/s

		Intrusion Scenario				
Parameter	**Units**	**Equipment Damage**	**Earthquake Fissure**	**Drilling Damage**	**Animal Burrow**	**Basis**
Radon flux rate	$pCi/m^2/s$	2.67E+05	4.50E+03	2.67E+05	2.67E+05	flux from K-65 residue
Source area	m^2	6.90E+01	3.90E+02	2.30E+00	5.30E-01	assumed for scenario
Emission from source	pCi/s	1.84E+07	1.76E+06	6.14E+05	1.42E+05	calculated from K-65 source and area
Emission from source	Ci/yr	5.81E+02	5.53E+01	1.94E+01	4.46E+00	calculated from K-65 source and area
Emission opening area	m^2	6.90E+01	1.50E+01	1.77E-02	7.31E-02	area of opening at IWCS surface
Calculated flux through opening	$pCi/m^2/s$	2.67E+05	1.17E+05	3.48E+07	1.94E+06	calculated from total emission and opening area
wind speed	m/s	1.00E+00	1.00E+00	1.00E+00	1.00E+00	bounding wind speed for conservatism
mixing height	m/s	1.70E+00	1.70E+00	1.70E+00	1.70E+00	assumed for site
site length	m	1.50E+01	5.00E+01	1.50E-01	3.05E-01	assumed for scenario
decay constant	1/s	2.10E-06	2.10E-06	2.10E-06	2.10E-06	based on Rn-222 half life of 3.8 days
Fao	unitless	1.00E+00	1.00E+00	1.00E+00	1.00E+00	assumed to be 1 for all scenarios
Outdoor air concentration	pCi/L	1.17E+03	1.72E+03	1.53E+03	1.73E+02	calculated from RESRAD methods

Note:
Earthquake fissure radon flux is the average for the exposed layers, as presented in Appendix E (Table E-3), and is based on a crack extending to the top of the K-65 residues.

See Appendix A text for further discussion regarding the parameter values and Section 5.3 for the supporting equations.

Table A-11. On-site Air Concentration from Convective Soil Emissions - Wind Speed of 4.5 m/s (with area factors)

		Intrusion Scenario				
Parameter	**Units**	**Equipment Damage**	**Earthquake Fissure**	**Drilling Damage**	**Animal Burrow**	**Basis**
Radon flux rate	$pCi/m^2/s$	2.67E+05	4.50E+03	2.67E+05	2.67E+05	flux from K-65 residue
Source area	m^2	6.90E+01	3.90E+02	2.30E+00	5.30E-01	assumed for scenario
Emission from source	pCi/s	1.84E+07	1.76E+06	6.14E+05	1.42E+05	calculated from K-65 source and area
Emission from source	Ci/yr	5.81E+02	5.53E+01	1.94E+01	4.46E+00	calculated from K-65 source and area
Emission opening area	m^2	6.90E+01	1.50E+01	1.77E-02	7.31E-02	area of opening at IWCS surface
Calculated flux through opening	$pCi/m^2/s$	2.67E+05	1.17E+05	3.48E+07	1.94E+06	calculated from total emission and opening area
wind speed	m/s	4.50E+00	4.50E+00	4.50E+00	4.50E+00	average wind speed
mixing height	m/s	1.70E+00	1.70E+00	1.70E+00	1.70E+00	assumed for site
site length	m	1.50E+01	5.00E+01	1.50E-01	3.05E-01	assumed for scenario
decay constant	1/s	2.10E-06	2.10E-06	2.10E-06	2.10E-06	based on Rn222 half life of 3.8 days
Fao	unitless	6.90E-01	1.50E-01	1.77E-04	7.31E-04	calculated as area opening/100 from RESRAD
Outdoor air concentration	pCi/L	1.80E+02	5.72E+01	6.00E-02	2.81E-02	calculated from RESRAD methods

Note:
Earthquake fissure radon flux is the average for the exposed layers, as presented in Appendix E (Table E-3), and is based on a crack extending to the top of the K-65 residues.
The area factor is based on the surface area of the opening at the surface of the IWCS.
See Appendix A text for further discussion regarding the parameter values and Section 5.3 for the supporting equations.

Table A-12. On-site Air Concentration from Convective Soil Emissions - Wind Speed of 1 m/s (with area factors)

		Intrusion Scenario				
Parameter	**Units**	**Equipment Damage**	**Earthquake Fissure**	**Drilling Damage**	**Animal Burrow**	**Basis**
Radon flux	$pCi/m^2/s$	2.67E+05	4.50E+03	2.67E+05	2.67E+05	flux from K-65 residue
Source area	m^2	6.90E+01	3.90E+02	2.30E+00	5.30E-01	assumed for scenario
Emission from source	pCi/s	1.84E+07	1.76E+06	6.14E+05	1.42E+05	calculated from K-65 source and area
Emission from source	Ci/yr	5.81E+02	5.53E+01	1.94E+01	4.46E+00	calculated from K-65 source and area
Emission opening area	m^2	6.90E+01	1.50E+01	1.77E-02	7.31E-02	area of opening at IWCS surface
Calculated flux through opening	$pCi/m^2/s$	2.67E+05	1.17E+05	3.48E+07	1.94E+06	calculated from total emission and opening area
wind speed	m/s	1.00E+00	1.00E+00	1.00E+00	1.00E+00	bounding wind speed for conservatism
mixing height	m/s	1.70E+00	1.70E+00	1.70E+00	1.70E+00	assumed for site
site length	m	1.50E+01	5.00E+01	1.50E-01	3.05E-01	assumed for scenario
decay constant	1/s	2.10E-06	2.10E-06	2.10E-06	2.10E-06	based on Rn222 half life of 3.8 days
Fao	unitless	6.90E-01	1.50E-01	1.77E-04	7.31E-04	calculated as area opening/100 from RESRAD
Outdoor air concentration	pCi/L	8.10E+02	2.57E+02	2.70E-01	1.27E-01	calculated from RESRAD methods

Note:
Earthquake fissure radon flux is the average for the exposed layers, as presented in Appendix E (Table E-3), and is based on a crack extending to the top of the K-65 residues.
The area factor is based on the surface area of the opening at the surface of the IWCS.
See Appendix A text for further discussion regarding the parameter values and Section 5.3 for the supporting equations.

Table A-13. On-site Air Concentration from Diffusive Soil Emissions - Wind Speed of 4.5 m/s

		Intrusion Scenario				
Parameter	**Units**	**Equipment Damage**	**Earthquake Fissure**	**Drilling Damage**	**Animal Burrow**	**Basis**
Calculated flux through opening	$pCi/m^2/s$	na	1.29E+03	1.29E+03	1.29E+03	calculated for diffusion (see Table A-17)
Area of opening	m^2	6.90E+01	1.50E+01	1.77E-02	7.31E-02	scenario specific
wind speed	m/s	4.50E+00	4.50E+00	4.50E+00	4.50E+00	average wind speed
mixing height	m/s	1.70E+00	1.70E+00	1.70E+00	1.70E+00	assumed for site
site length	m	1.50E+01	5.00E+01	1.50E-01	3.05E-01	assumed for scenario
decay constant	1/s	2.10E-06	2.10E-06	2.10E-06	2.10E-06	based on Rn222 half life of 3.8 days
Fao	unitless	1.00E+00	1.00E+00	1.00E+00	1.00E+00	assumed to be 1 for all scenarios
Outdoor air concentration	pCi/L	na	4.22E+00	1.26E-02	2.57E-02	calculated from RESRAD methods

Note:
Calculated flux is from diffusive calculations presented in Table A-17.
See Appendix A for further discussion regarding the parameter values.
na - The equipment damage scenario involves direct exposure of the source to the atmosphere resulting in convective movement of radon.

Table A-14. On-site Air Concentration from Diffusive Soil Emissions - Wind Speed of 1 m/s

		Intrusion Scenario				
Parameter	**Units**	**Equipment Damage**	**Earthquake Fissure**	**Drilling Damage**	**Animal Burrow**	**Basis**
Calculated flux through opening	$pCi/m^2/s$	na	1.29E+03	1.29E+03	1.29E+03	calculated for diffusion (see Table A-17)
Area of opening	m^2	6.90E+01	1.50E+01	1.77E-02	7.31E-02	scenario specific
wind speed	m/s	1.00E+00	1.00E+00	1.00E+00	1.00E+00	bounding wind speed for conservatism
mixing height	m/s	1.70E+00	1.70E+00	1.70E+00	1.70E+00	assumed for site
site length	m	1.50E+01	5.00E+01	1.50E-01	3.05E-01	assumed for scenario
decay constant	1/s	2.10E-06	2.10E-06	2.10E-06	2.10E-06	based on Rn222 half life of 3.8 days
Fao	unitless	1.00E+00	1.00E+00	1.00E+00	1.00E+00	assumed to be 1 for all scenarios
Outdoor air concentration	pCi/L	na	1.90E+01	5.69E-02	1.16E-01	calculated from RESRAD methods

Note:
Calculated flux is from diffusive calculations presented in Table A-17.
See Appendix A for further discussion regarding the parameter values.
na - The equipment damage scenario involves direct exposure of the source to the atmosphere resulting in convective movement of radon.

Table A-15. On-site Air Concentration from Diffusive Soil Emissions - Wind Speed of 4.5 m/s (with area factors)

		Intrusion Scenario				
Parameter	**Units**	**Equipment Damage**	**Earthquake Fissure**	**Drilling Damage**	**Animal Burrow**	**Basis**
Calculated flux through opening	$pCi/m^2/s$	na	1.29E+03	1.29E+03	1.29E+03	calculated for diffusion (see Table A-17)
Area of opening	m^2	6.90E+01	1.50E+01	1.77E-02	7.31E-02	scenario specific
wind speed	m/s	4.50E+00	4.50E+00	4.50E+00	4.50E+00	average wind speed
mixing height	m/s	1.70E+00	1.70E+00	1.70E+00	1.70E+00	assumed for site
site length	m	1.50E+01	5.00E+01	1.50E-01	3.05E-01	assumed for scenario
decay constant	1/s	2.10E-06	2.10E-06	2.10E-06	2.10E-06	based on Rn222 half life of 3.8 days
Fao	unitless	6.90E-01	1.50E-01	1.77E-04	7.31E-04	calculated as area opening/100 from RESRAD
Outdoor air concentration	pCi/L	na	6.32E-01	2.24E-06	1.88E-05	calculated from RESRAD methods

Note:
Calculated flux is from diffusive calculations presented in Table A-17.
The area factor is based on the surface area of the opening at the surface of the IWCS.
See Appendix A for further discussion regarding the parameter values.
na - The equipment damage scenario involves direct exposure of the source to the atmosphere resulting in convective movement of radon.

Table A-16. On-site Air Concentration from Diffusive Soil Emissions - Wind Speed of 1 m/s (with area factors)

		Intrusion Scenario				
Parameter	**Units**	**Equipment Damage**	**Earthquake Fissure**	**Drilling Damage**	**Animal Burrow**	**Basis**
Calculated flux through opening	$pCi/m^2/s$	na	1.29E+03	1.29E+03	1.29E+03	calculated for diffusion (see Table A-17)
Area of opening	m^2	6.90E+01	1.50E+01	1.77E-02	7.31E-02	scenario specific
wind speed	m/s	1.00E+00	1.00E+00	1.00E+00	1.00E+00	bounding wind speed for conservatism
mixing height	m/s	1.70E+00	1.70E+00	1.70E+00	1.70E+00	assumed for site
site length	m	1.50E+01	5.00E+01	1.50E-01	3.05E-01	assumed for scenario
decay constant	1/s	2.10E-06	2.10E-06	2.10E-06	2.10E-06	based on Rn222 half life of 3.8 days
Fao	unitless	6.90E-01	1.50E-01	1.77E-04	7.31E-04	calculated as area opening/100 from RESRAD
Outdoor air concentration	pCi/L	na	2.85E+00	1.01E-05	8.46E-05	calculated from RESRAD methods

Note:
Calculated flux is from diffusive calculations presented in Table A-17.
The area factor is based on the surface area of the opening at the surface of the IWCS.
See Appendix A for further discussion regarding the parameter values.
na - The equipment damage scenario involves direct exposure of the source to the atmosphere resulting in convective movement of radon.

Table A-17. Calculation of Radon Emission Rate for Diffusion to Atmosphere from Intrusion Scenarios

		Intrusion Scenario				
Parameter	**Units**	**Equipment Damage**	**Earthquake Fissure**	**Drilling Damage**	**Animal Burrow**	**Basis**
Subsurface air concentration in void	pCi/m^3	na	2.00E+08	2.00E+08	2.00E+08	assumed upper bound within subsurface intrusion void
Mixing height	m	1.70E+00	1.70E+00	1.70E+00	1.70E+00	assumed location of negligible air concentration compared with soil void
Radon diffusion coefficient in air	m^2/s	1.10E-05	1.10E-05	1.10E-05	1.10E-05	http://www.wise-uranium.org/ctbh.html
Concentration gradient	pCi/m^3 per m	na	1.18E+08	1.18E+08	1.18E+08	assumed air concentration of 0 pCi/m3 at the x=mixing height
Calculated flux from diffusion	***pCi/m^2/s***	***na***	***1.29E+03***	***1.29E+03***	***1.29E+03***	***from Fick's law and assumed concentration gradient***
Emission opening area	m^2	6.90E+01	1.50E+01	1.77E-02	7.31E-02	scenario specific
Calculated emission rate from opening	pCi/s	na	1.94E+04	2.29E+01	9.46E+01	calculated from diffusion flux and area of opening
Calculated emission rate from opening	Ci/yr	na	6.12E-01	7.21E-04	2.98E-03	calculated for annual emission rate

Notes:

diffusive flux from one dimensional solution to Ficks equation approximated as J = -D * dC/dx (http://www.wise-uranium.org/ctbh.html)

where: J = flux (pCi/m^2/s)
D = radon diffusion coefficient in air (m^2/s)
dC/dx = radon concentration gradient (pCi/m^3 per m)

na - equipment damage scenario assumed source is open to atmosphere, so calculation for a subsurface void are not applicable.

Table A-18. Summary of On-site Air Concentrations for Intrusion Scenarios (pCi/L)

		Intrusion Scenario			
Transport mechanism	**Wind speed (m/s)**	**Equipment Damage**	**Earthquake Fissure**	**Drilling Damage**	**Animal Burrow**
Convection	4.5	2.61E+02	3.81E+02	3.40E+02	3.85E+01
	1.0	1.17E+03	1.72E+03	1.53E+03	1.73E+02
	4.5 (with area factors)	1.80E+02	5.72E+01	6.00E-02	2.81E-02
	1.0 (with area factors)	8.10E+02	2.57E+02	2.70E-01	1.27E-01
Diffusion	4.5	na	4.22E+00	1.26E-02	2.57E-02
	1.0	na	1.90E+01	5.69E-02	1.16E-01
	4.5 (with area factors)	na	6.32E-01	2.24E-06	1.88E-05
	1.0 (with area factors)	na	2.85E+00	1.01E-05	8.46E-05

Note:
Area factors account for the smaller source area than the 100 m^2 assumed for the RESRAD model.
na - equipment damage scenario assumed source is open to atmosphere, so calculation for a subsurface void are not applicable.

Table A-19. On-site Air Concentrations Based on Scaling of 100 m^2 Results

Source Area (m^2)	Effective Length of Contaminated Area (m)	Calculated Width of Contaminated Area (m)	On-site Air Concentration (pCi/L)	Ratio of Air Concentrations	Ratio of Effective Lengths
Configurations for 100 m^2 Source Area					
100	**13.7**	**7.3**	**1.8E-03**	**na**	**na**
100	20.0	5.0	2.5E-03		
100	10.0	10.0	1.3E-03	na	1
100	5.0	20.0	6.4E-04	na	1
Source Areas Larger Than 100 m^2					
200	19.3	10.4	2.4E-03	1.33E+00	1.41E+00
200	***27.4***	***7.3***	***3.5E-03***	***1.94E+00***	***2.00E+00***
300	23.2	12.9	2.9E-03	1.61E+00	1.69E+00
400	27.4	14.6	3.4E-03	1.89E+00	2.00E+00
500	30.6	16.3	3.8E-03	2.11E+00	2.23E+00
Source Areas Smaller Than 100 m^2					
10	1.37	7.30	1.7E-05	9.44E-03	1.00E-02
10	3.16	3.16	4.0E-05	2.22E-02	2.31E-02
1	0.14	7.30	1.7E-07	9.44E-05	1.00E-04
1	1.00	1.00	1.3E-06	7.22E-04	7.30E-04

Note:

Results are based on the surface of the IWCS above Bay A assuming a 1 m/s wind speed. The source area for the modeling (in bold) is assumed to be 100 m^2 with an effective length of 13.7 m to correspond with the geometry of the IWCS bays (see Section 4).

The equations used to calculate the air concentration are presented in Section 5.3.

For the source areas less than 100 m^2, the calculation of effective length relative to 13.7 m includes the area factor (equal to the source area divided by 100 m^2) to provide a number that is comparable to the scaling factor which also includes an area factor.

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APPENDIX A-3

Estimated Radon Flux

Figures

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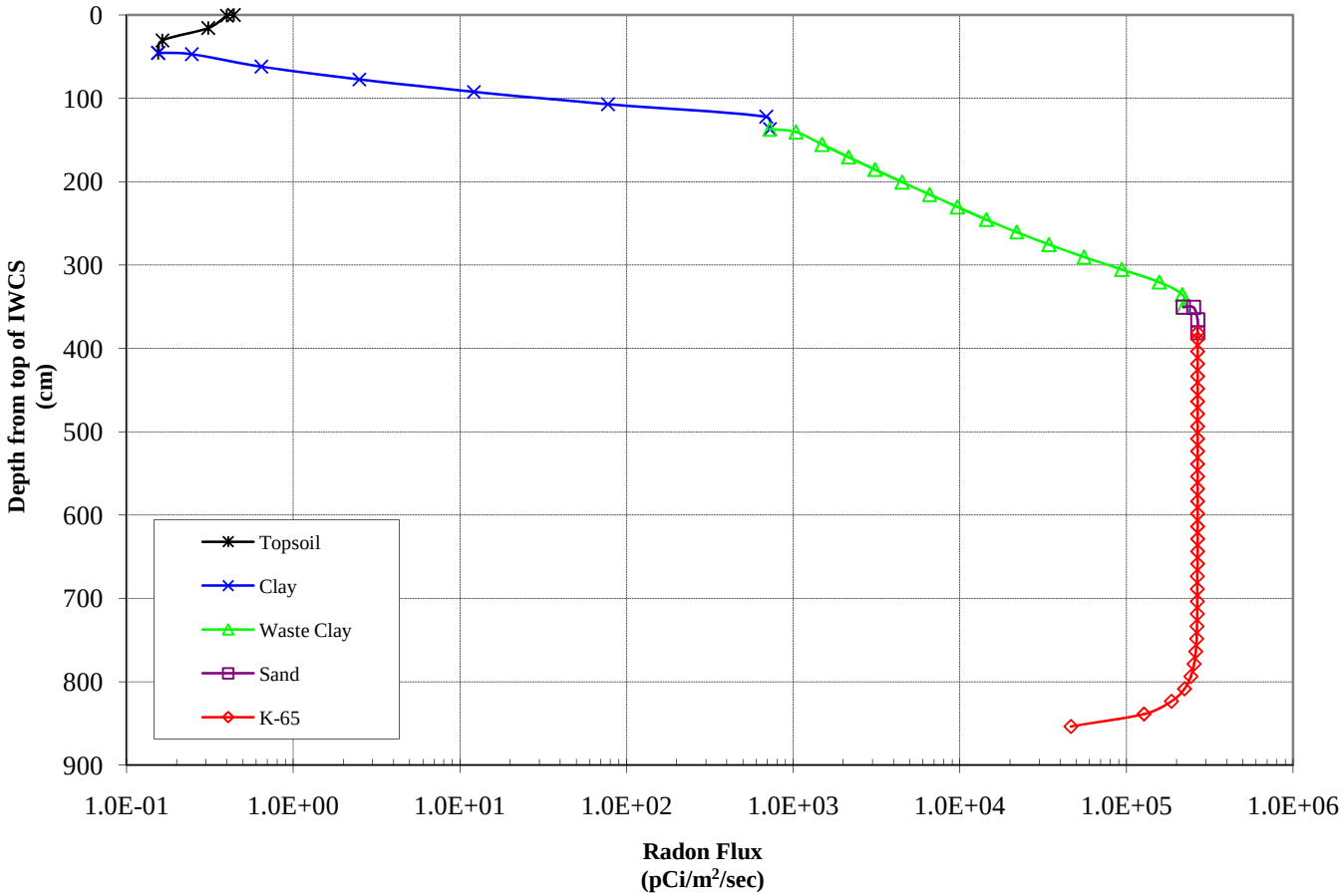

Figure A-1. Total Radon Flux by Depth over NFSS Bay A

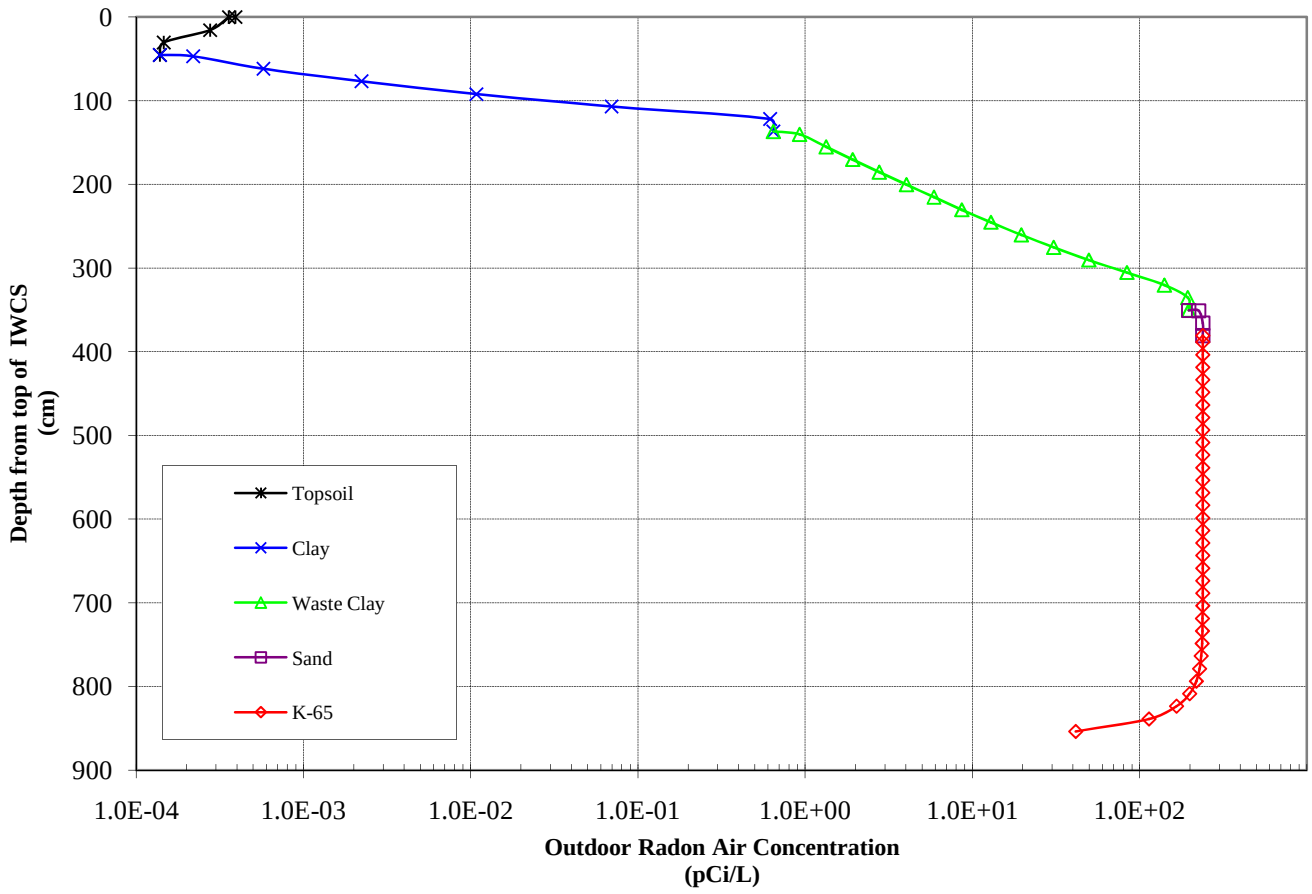

Figure A-2. Outdoor Radon Air Concentration by Depth over NFSS Bay A for 4.5 m/s Wind Speed

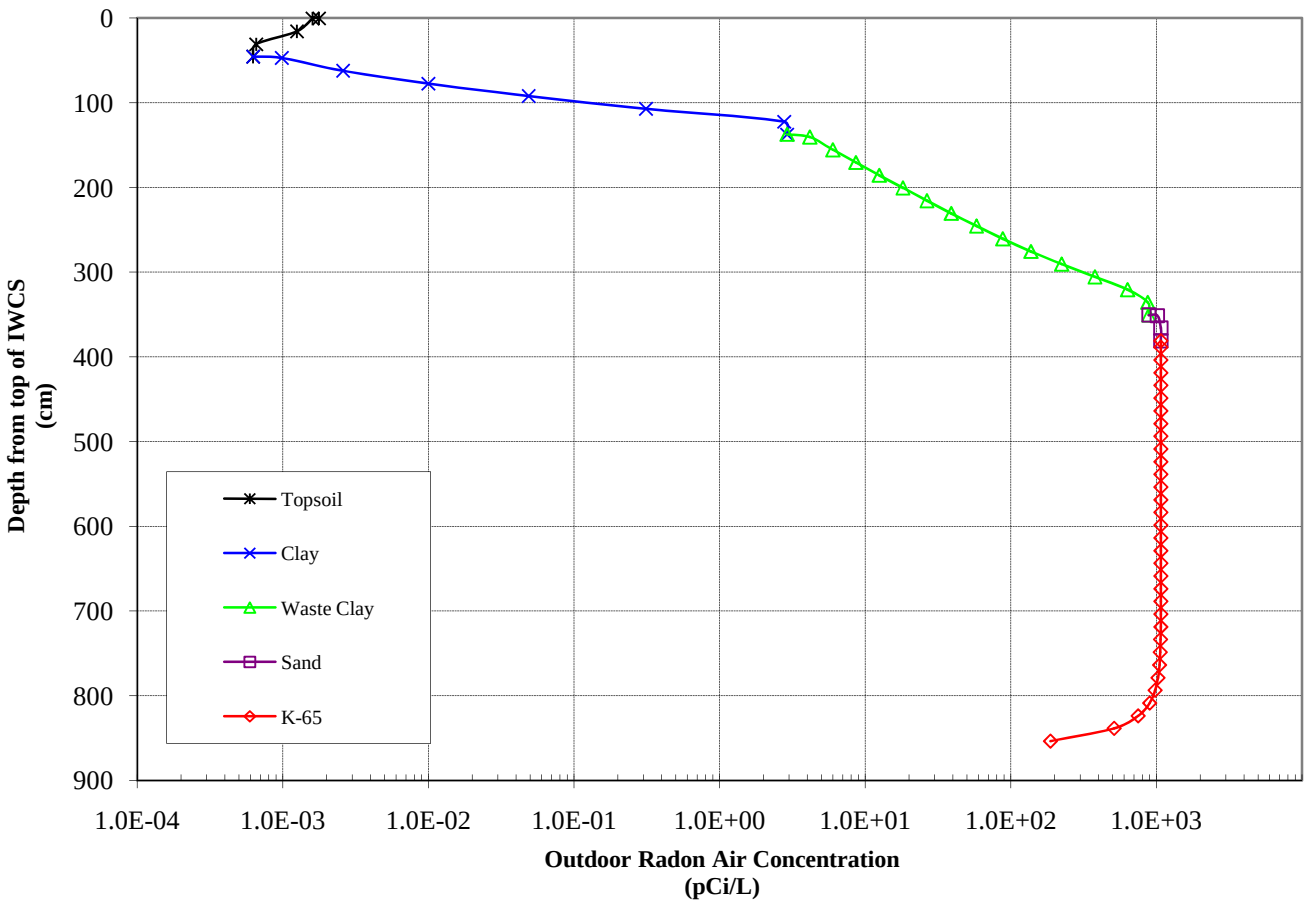

Figure A-3. Outdoor Radon Air Concentration by Depth over NFSS Bay A for 1 m/s Wind Speed

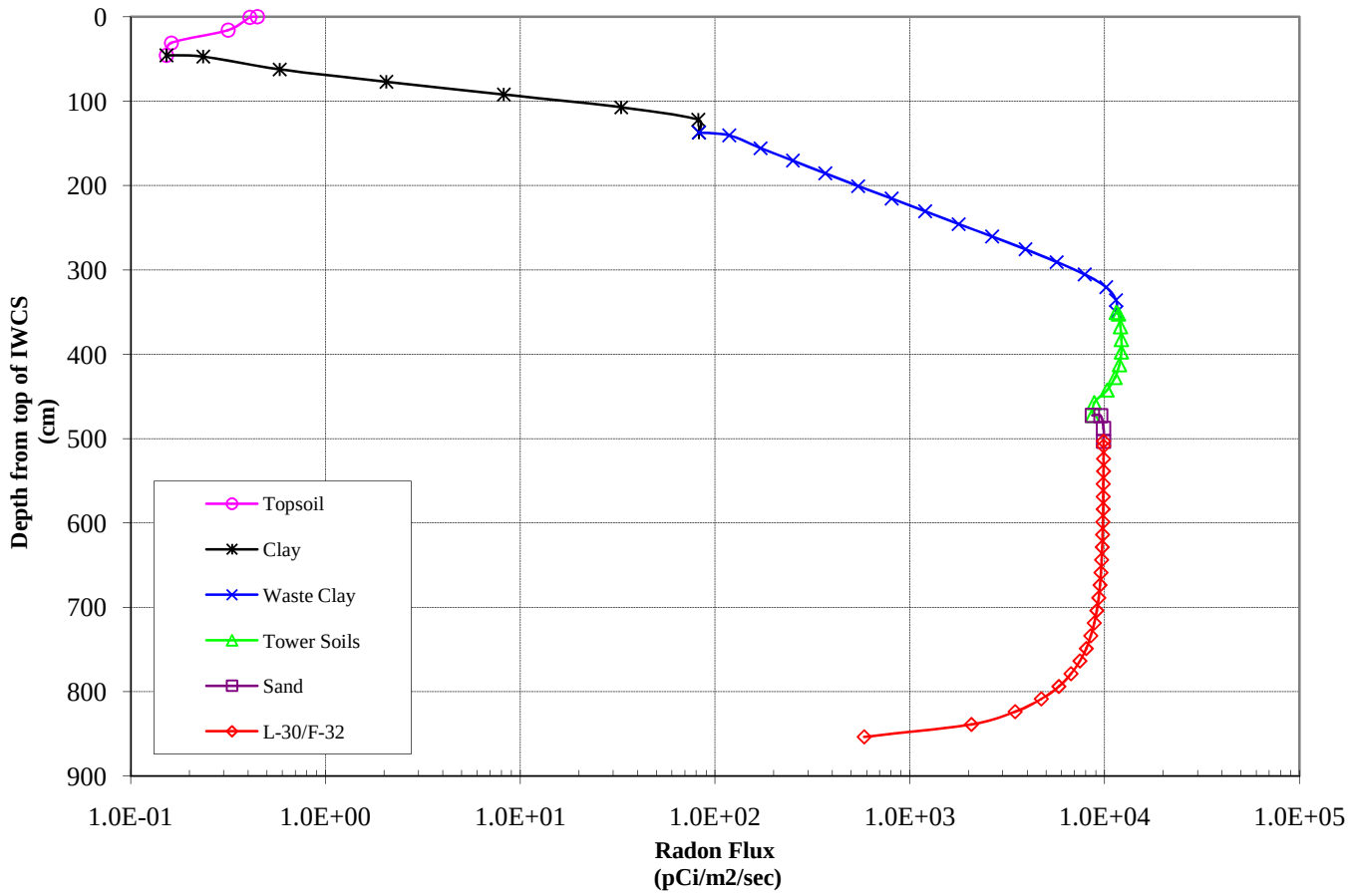

Figure A-4. Total Radon Flux by Depth over NFSS Bay B

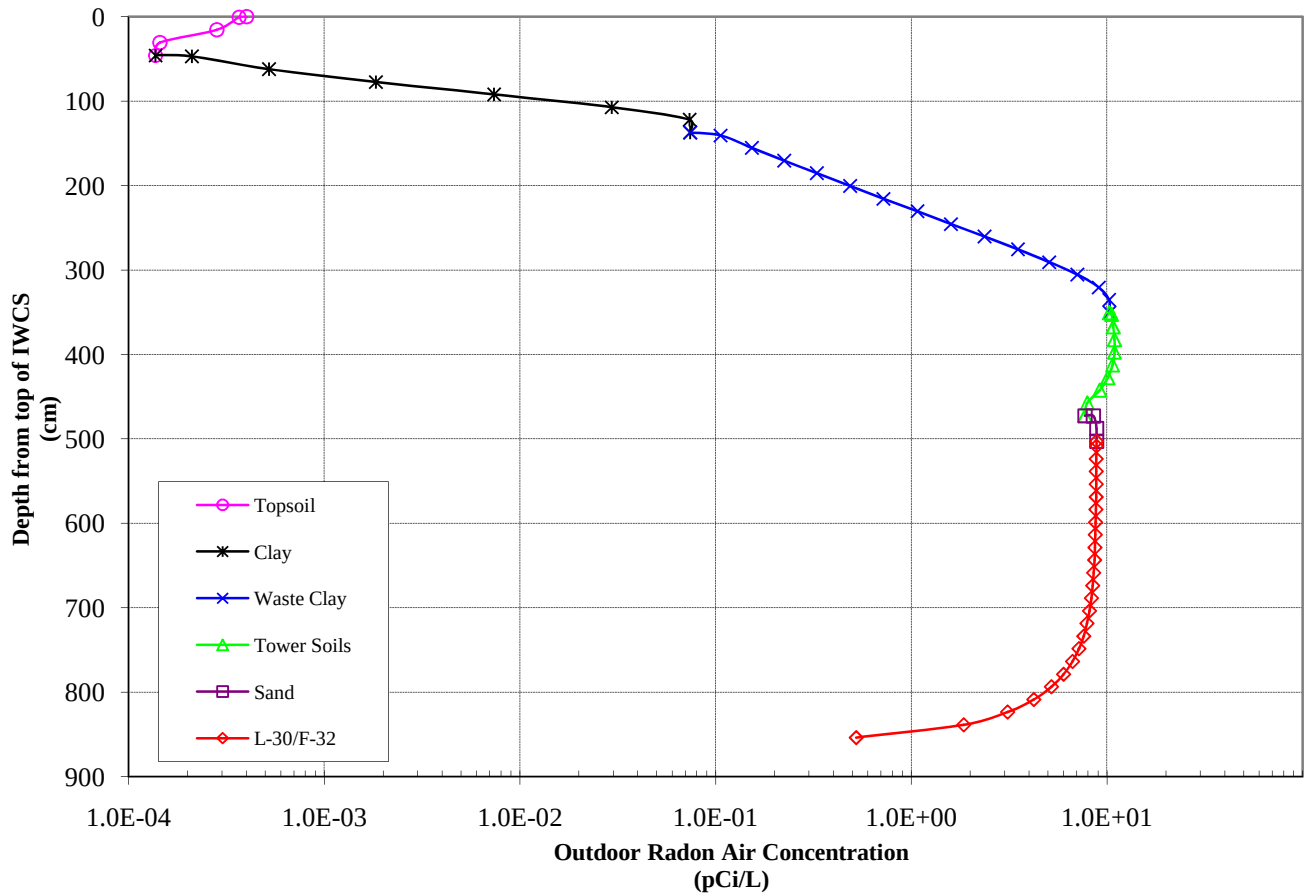

Figure A-5. Outdoor Radon Air Concentration by Depth over NFSS Bay B for 4.5 m/s Wind Speed

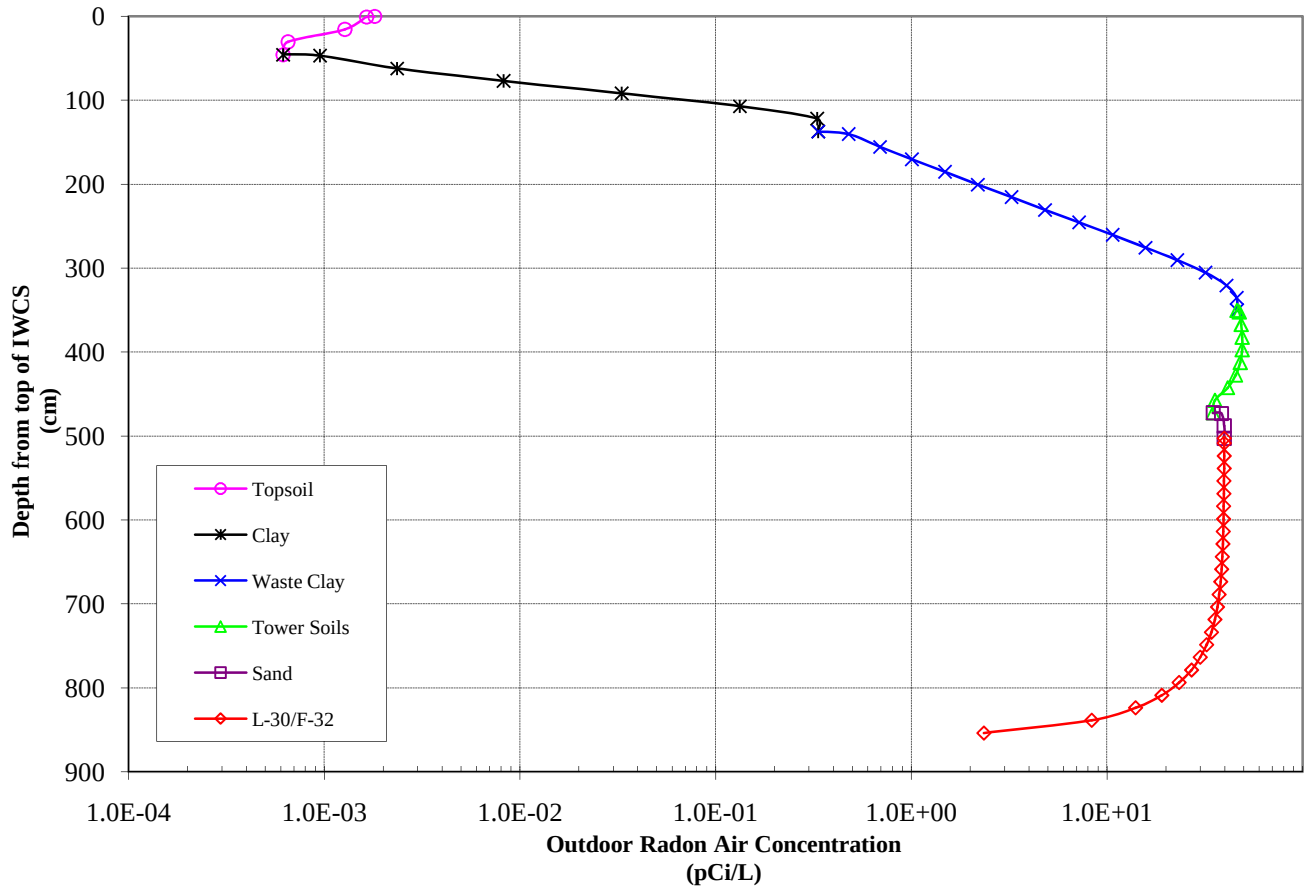

Figure A-6. Outdoor Radon Air Concentration by Depth over NFSS Bay B for 1 m/s Wind Speed

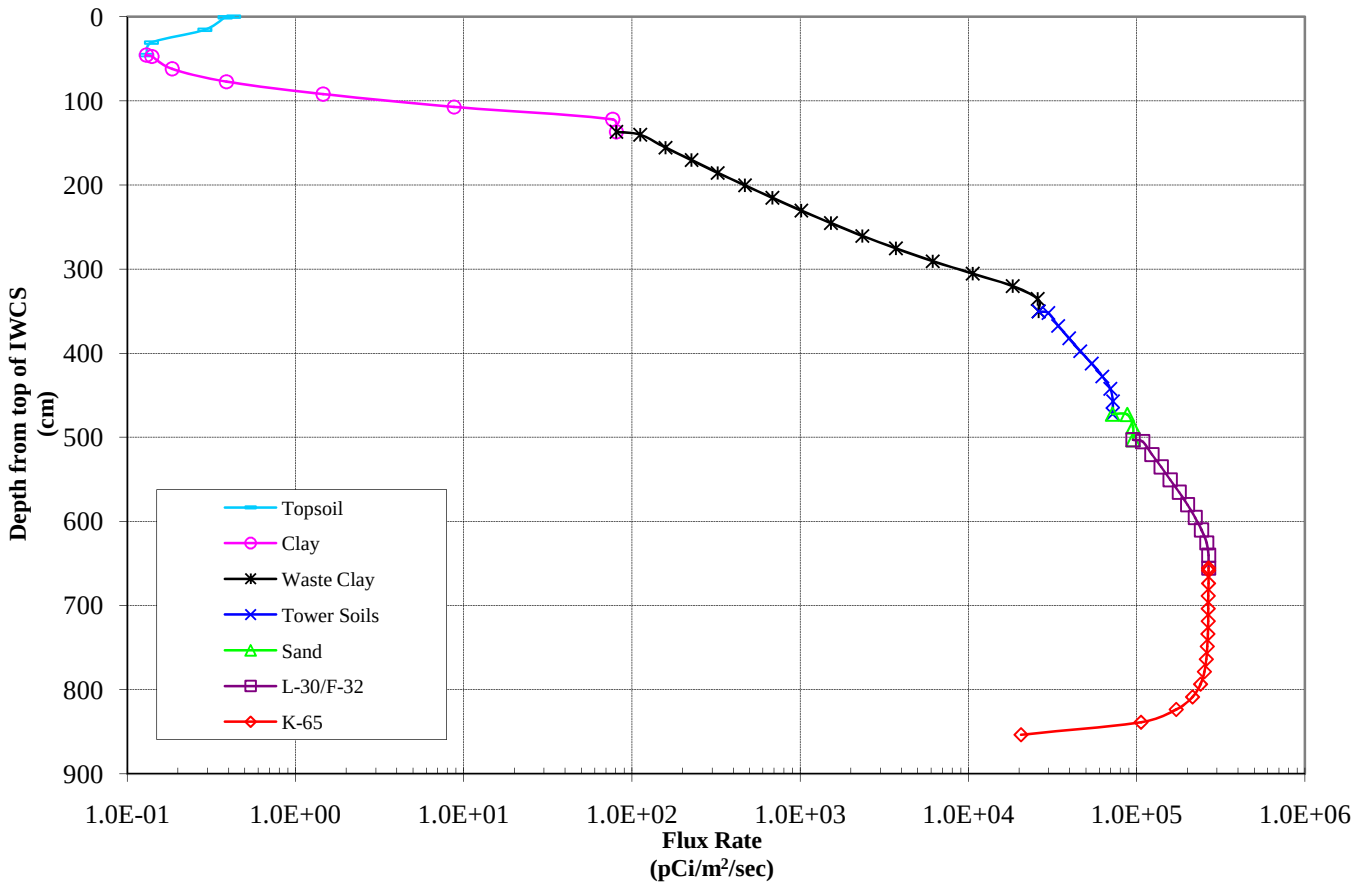

Figure A-7. Total Flux Rate by Depth over NFSS Bay C

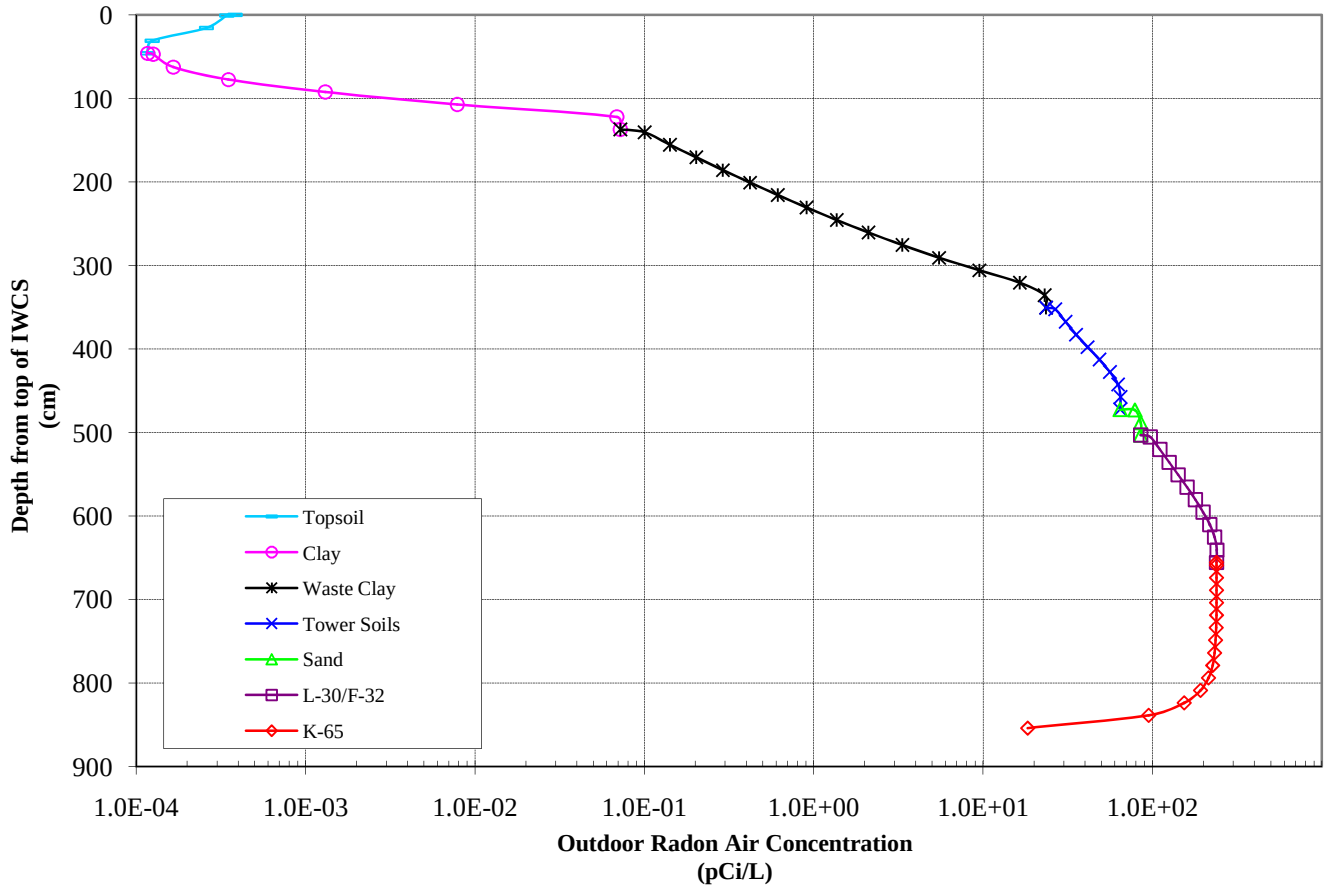

Figure A-8. Outdoor Radon Air Concentration by Depth over NFSS Bay C for 4.5 m/s Wind Speed

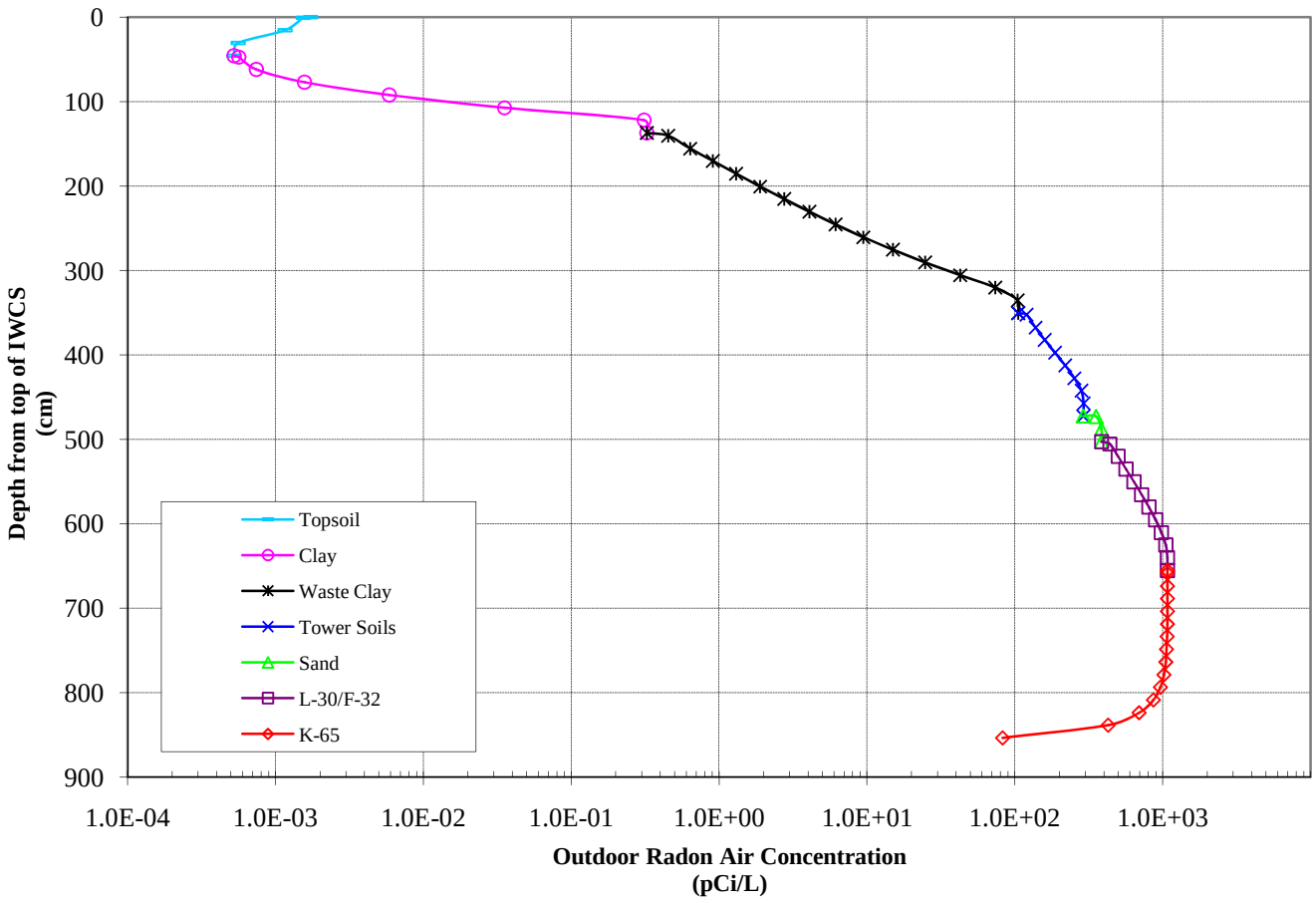

Figure A-9. Outdoor Radon Air Concentration by Depth over NFSS Bay C for 1 m/s Wind Speed

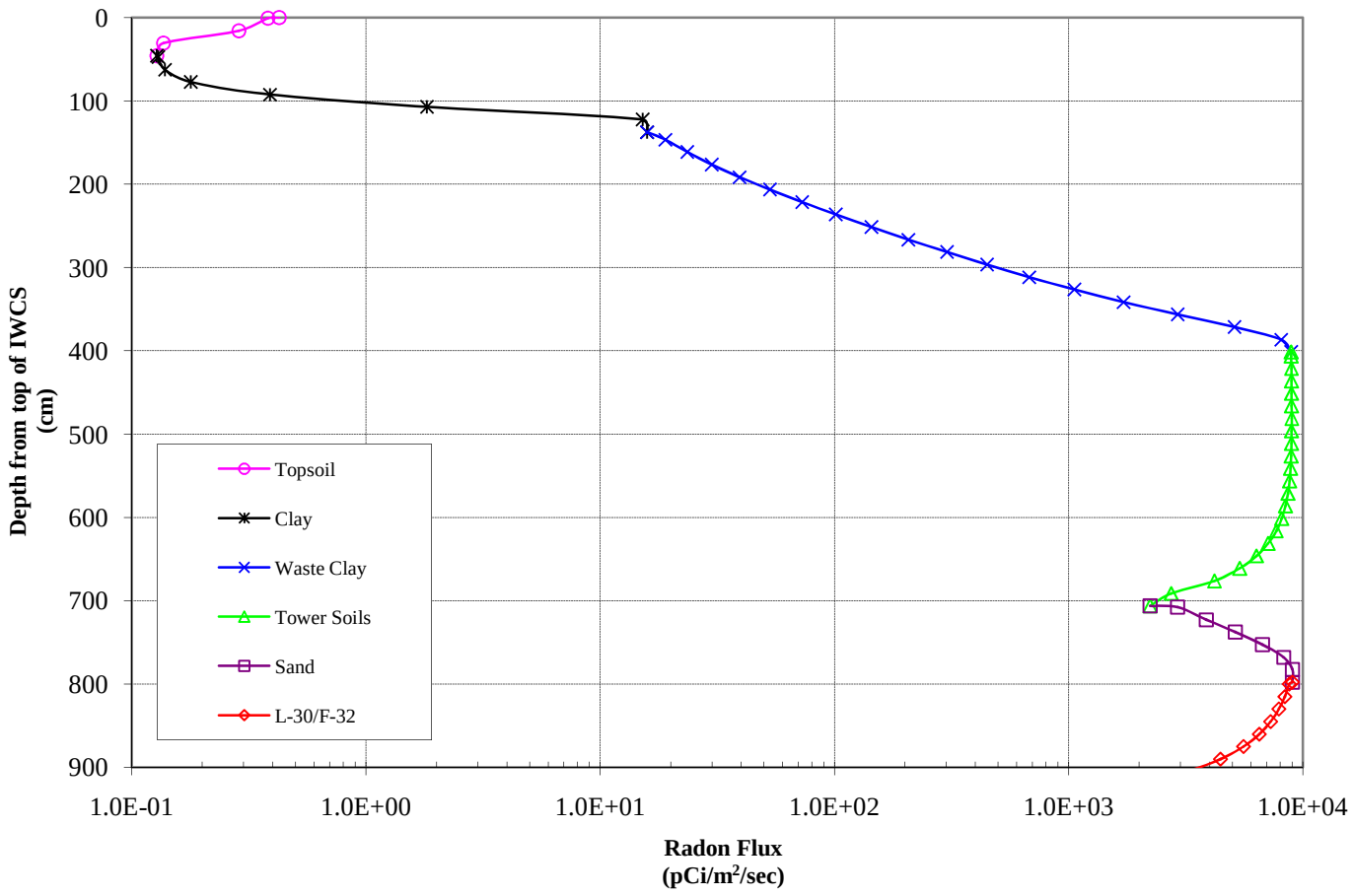

Figure A-10. Total Radon Flux by Depth over NFSS Bay D

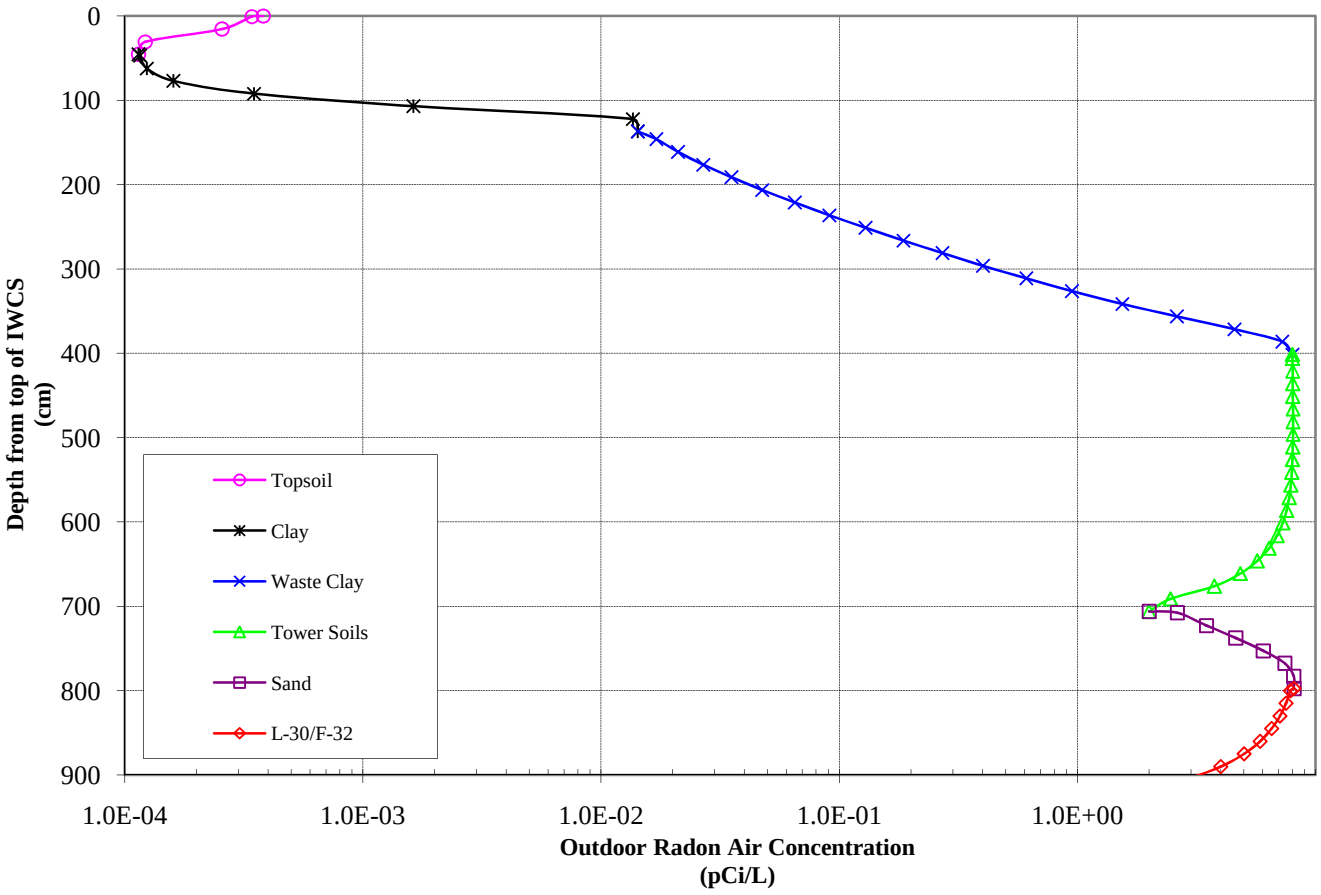

Figure A-11. Outdoor Radon Air Concentration by Depth over NFSS Bay D for 4.5 m/s Wind Speed

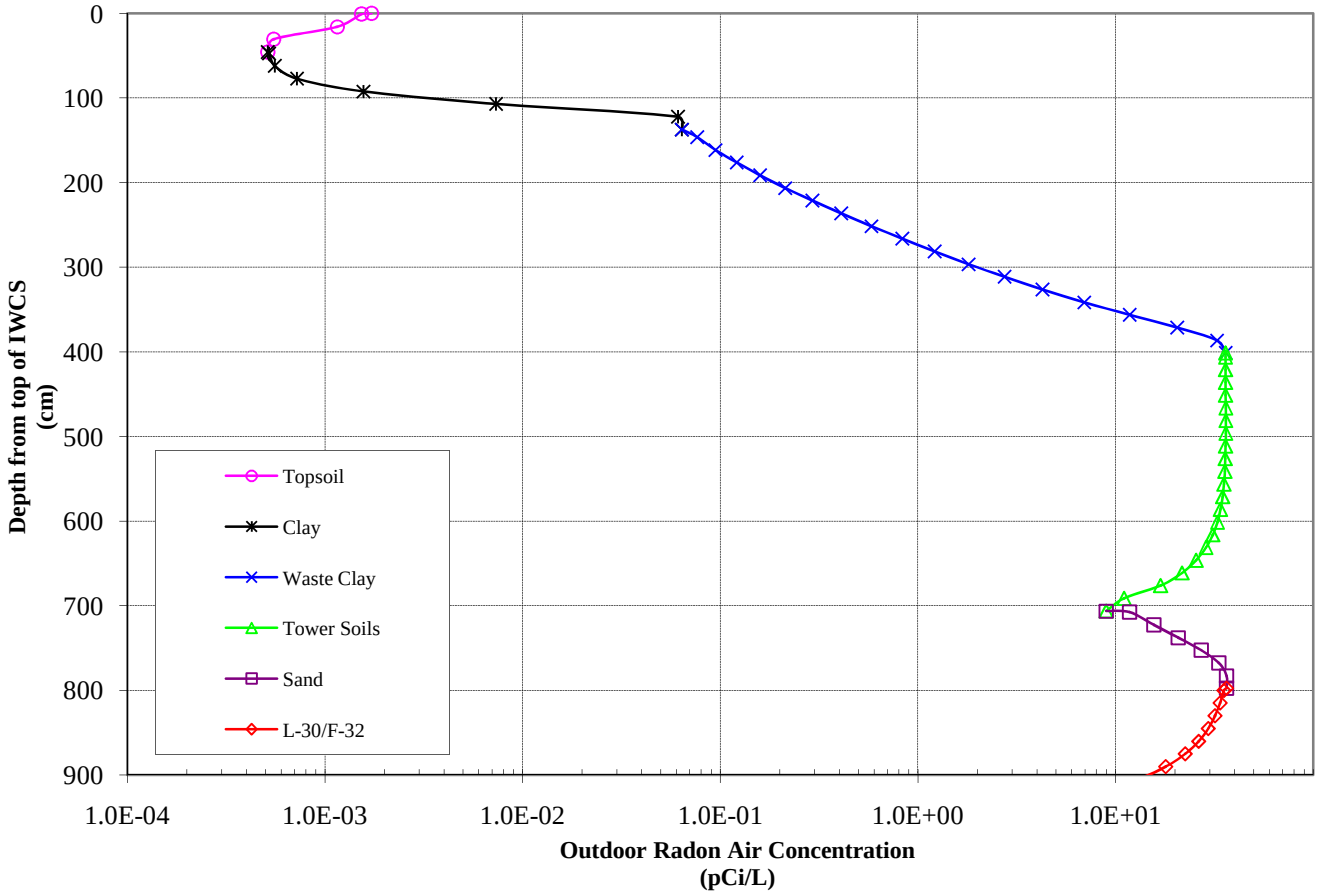

Figure A-12. Outdoor Radon Air Concentration by Depth over NFSS Bay D for 1 m/s Wind Speed

APPENDIX B

Evaluation of Limiting Stability Class, Wind Speed, and Exit Velocity in Calculation of Radon Air Concentrations Downwind of the IWCS

Including:

Appendix B-1: Text
Appendix B-2: Tables
Appendix B-3: Figures
Attachment B-1

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APPENDIX B-1

Evaluation of Limiting Stability Class, Wind Speed, and Exit Velocity in Calculation of Radon Air Concentrations Downwind of the IWCS

Text

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B.1 CAP88PC MODELING OF LIMITING ATMOSPHERIC CONDITIONS

Modeling of the NFSS IWCS acute release scenarios included CAP88 simulations for a range of wind speeds and atmospheric stability classes to determine the most conservative scenario likely to be associated with a fissure release.

The following assumptions were used in the CAP88 model for the NFSS IWCS:

- Concentrations achieve steady-state quickly, after the initial release,
- The selected wind speed/stability class condition persists throughout the duration of the release, for bounding conditions,
- The average precipitation is 100 cm/yr,
- The average atmospheric temperature is 10 degrees C,
- The average lid height is 1,000 m, and
- The average absolute humidity is 8 g/m^3.

It was also assumed that all releases occur at ground level. Ground level releases result in the largest downwind air concentrations. This assumption is applied to all emission modeling to provide conservative modeling results, including analysis of releases with an initial exit velocity greater than zero.

The CAP88 model will produce results for any distance; however, to be consistent with the NFSS annual environmental monitoring reports, a downwind distance of approximately 250 m was used as a starting distance for this evaluation. However, closer results are presented in some figures in Appendix B for comparative purposes.

The evaluation of limiting atmospheric conditions explored the effects of stability class, wind speed, and emission velocity on the predicted downwind air concentrations as follows.

B.1.1 Site Meteorological Data

Available site data include the default meteorological dataset in CAP88 for Niagara Falls International Airport, which reflects data collected from 1955 to 1959. These data are presented in Table B-1 for the average wind speed and direction frequency and Table B-2 for the atmospheric stability class frequencies. From Table B-1, the most frequent wind is toward the northeast (14% of observations) with a maximum average of 4.3 m/s associated with Stability Class D and a minimum average of 1 m/s associated with Stability Class A. From Table B-2, the most frequent stability class is Class D (57% of observations). Tables B-3 and B-4 present general definitions of the various stability classes and the general meteorological conditions associated with their occurrence. Class C conditions were selected to represent a conservative unstable atmosphere (Classes A, B, and C) which account for 15% of the observations in historical data from Niagara Falls International Airport. Although the meteorological dataset indicates a higher percentage of observations are Class D (57% historically and 36% recently), the low wind speeds modeled were more typically associated with the unstable atmospheric classes (A, B, and C) during conditions of slight solar radiation (see Table B-4). The available site data were considered along with the evaluations presented below, to determine the representative atmospheric conditions to use in off-site radon transport modeling.

B.1.2 Stability Class Evaluation

The initial step in determination of the limiting atmospheric conditions was to model various stability classes at the same assumed wind speed. Table B-5 and Figure B-1 present the results of that evaluation as further described below.

Table B-5 provides the plume centerline ground level concentrations of radon-222 from an assumed ground level release of 1 Ci/yr at several distances from the source, for various atmospheric stability classes (assuming a 1 m/s wind persists). The air concentration for a unit release of 1 Ci/yr was 0.2 pCi/L, at a location 250 m downwind (for Class G at 1 m/s). At locations 500 m and 1,000 m downwind under similar atmospheric conditions, the maximum concentrations from a 1 Ci/yr release were 0.05 and 0.01 pCi/L, respectively. For the Class C conditions, all results were approximately an order of magnitude lower than the Class G results. Similarly, the default meteorological data provided maximum results and order of magnitude below the Class C results. Table B-6 presents unit emission air concentration results out to a downwind distance of 75 km.

Figure B-1 presents the plume centerline ground level concentrations of radon-222 from an assumed ground level release of 1 Ci/yr at several distances from the source, for various atmospheric stability classes (assuming a 1 m/s wind persists). As presented in the figure, the highest concentrations are associated with most stable classes (F and G). Figure B-2 provides similar data out to a downwind distance of 75 km.

Although E and F stability classes are often used to model short-term conditions, the air concentrations under Class G are over 2 times the values for Class F and nearly 5 times the values for Class E at a given receptor location with a wind speed of 1 m/s (Table B-5). Although atmospheric conditions for Stability Class G are unlikely, they are possible and since the model is capable of producing results for Class G results were included as they were the most conservative.

B.1.3 Wind Speed Evaluation

Figure B-3 presents the plume centerline ground level concentrations of radon-222 from an assumed ground level release of 1 Ci/yr at several distances from the source, for various wind speeds (assuming atmospheric Stability Class G persists). As presented in the figure, the highest concentrations are associated with the lowest wind speed (1 m/s). Therefore, upper bound estimates of radon-222 concentrations will be generated utilizing a Stability Class G with a wind speed of 1 m/s. Table B-7 provides a summary of the same data described above.

B.1.4 Emission Velocity Evaluation – Failure Scenarios

In the event of an acute release from the IWCS, there is the potential for movement of gases due to not only diffusion through the overlying material, but also due to advective, or horizontal, movement through cracks and fissures that might develop in the IWCS cover. The gas movement would be associated with pressure or temperature differentials between the soil pores and the atmosphere in a manner similar to stack flow associated with flue gasses (see Equation B-1 and Appendix A). Table B-8 presents results for various exit velocities.

B.1.4.1 Stack Effect Flow Rate Calculation

$$Q = CA\sqrt{2gh\frac{Ti - To}{Ti}} \qquad \text{Eq. B-1}$$

Where:

Q = volumetric flow rate through stack (m^3/s)
C = discharge coefficient from stack (unitless)
A = flow area from stack (m^2)
g = gravitational constant (9.81 m/s^2)
h = stack height (m)
T_i = temperature at the stack bottom (Kelvin)
T_o = ambient temperature (Kelvin)

The exit velocity (V) can be calculated from the volumetric flow rate (Q) divided by the flow area (A). Table B-9 presents calculated exit velocities for several assumed temperature differentials. For information, these calculations were compared with analyses completed for the Seaway Landfill which indicated velocities of 0.025 to 0.3 m/s for passive landfill gas ventilation systems (USACE 2000). The exit velocities used for the IWCS evaluation were therefore considered representative of conditions that might encompass emissions driven by both pressure and thermal effects.

All CAP88 simulations were based on ground level emission sources. In order to evaluate the uncertainty in the analysis, and to ensure conservatism in the results, simulations which included a range of exit velocities for the emissions are included in Appendix B. Within CAP88, the dispersion calculations are simplified by converting the exit velocity to an equivalent stack.

B.1.4.2 Equivalent Stack Height Calculation

$$\Delta h = \frac{Vd}{\mu} \qquad \text{Eq. B-2}$$

Where:

Δh = increase in equivalent stack height (m)
V = stack exit velocity (m/s)
d = stack diameter (m)
μ = atmospheric wind speed (m/s)

The use of an equivalent stack height results in ground level concentrations that are small in close proximity to the source for elevated release velocities as illustrated in Figure B-4. Because of the equivalent stack height (due to the momentum of the plume), if you are very near the source, the vertical dispersion from the overhead plume to the ground is minimal for higher release velocities/stack heights. As the receptor location moves downwind, although the plume centerline concentration is decreasing, the small air concentration at the ground surface (orders of magnitude below the plume centerline concentration) is increasing due to greater diffusion. Additionally, the model conserves mass by assuming that pollutants diffusing to the ground surface are reflected back into the air, further contributing to increasing concentrations at the ground level. At a point several hundred meters downwind these effects are negated and air concentrations diminish in proportion to the plume centerline. Therefore, the calculation of air concentrations from the radon emissions, all release velocities were assumed to be zero to provide conservative results.

B.2 SUMMARY AND CONCLUSIONS

The evaluation indicates that utilizing atmospheric Stability Class G, with 1 m/s wind speed and an exit velocity of zero, produced the most conservative estimate of the downwind air concentrations. Downwind results were generated for distances from 1 m to 75 km, however due to near field limitations of CAP88, results focused on downwind distances of 250 m or greater.

The calculation of upper bound air concentrations for various release and intrusion scenarios were based on atmospheric Stability Class G at 1 m/s for a unit emission of 1 Ci/yr with zero exit velocity. The unit emission results from this Appendix were used in combination with emission rate evaluation for various release/intrusion scenarios (see Appendix A) to arrive at final upper bound air concentrations (see Appendix C).

For comparison, the simulation was also conducted to generate unit air concentrations using the CAP88 default meteorological dataset, as well as results for a more common occurrence of atmospheric Stability Class C. The results for the default atmospheric dataset indicate that the maximum concentrations occur to the northeast. A summary of results for the evaluated atmospheric conditions, are presented in Table B-10 and Figure B-5. Also

presented on Figures B-5 are results based on atmospheric Stability Class G and Class C at a wind speed of 1 m/s for comparison.

Inspection of Figures B-5, B-6, and B-7 indicate that the bounding condition results in air concentrations that are several orders of magnitude higher than those for the default conditions for distances up to 50 km downwind.

B.3 UNCERTAINTY

Very stable atmospheric conditions are generally observed at night, and rarely during the daylight hours for any substantial duration. This makes the presence of such an atmospheric condition during the time of excavations unlikely, unless construction activities are proceeding around the clock. It is further likely that under an excavation scenario, material will be rapidly removed and will not be exposed to the atmosphere for extended periods of time. During excavation a containment could be utilized to further reduce the likelihood of an atmospheric release if radon.

The impact of including the stack effect calculations is large in close proximity to the source, but is negligible at a distance of approximately 500 m, based on the wind speed and release rate selected. This is an uncertainty in the predicted air concentrations.

Flow through a fissure may also be induced by a Venturi effect, as atmospheric flow over a surface opening may generate a localized area of relatively low pressure. As the assumed surface wind speeds are relatively low (1 m/s) for the worst case diffusion model, Venturi effects were assumed to be transient and were neglected.

All releases are assumed to be from ground level for conservatism. Additionally, CAP88 treats all sources as point sources once a downwind distance of 2.5 times the source radius is reached. For the excavation scenarios involving an exposed source area (see Section 6.0), whether defined as a point or area source, the model calculations are identical at a downwind distance of ~25 m (83 ft). The primary implication of using different areas with a stack source, are the calculation of equivalent emission heights associated with exit velocities which are dependent on stack diameter (Appendix B.1.3).

Use of the default CAP88 meteorological file as representative of typical conditions is uncertain due to the limited number of years of data available. Including a larger number of data over a longer span of time would produce more representative results. However, results generated from modeling with the default meteorological dataset are utilized because of the extensive quality assurance and verification that was conducted on the CAP88 input files and because the data reflect a longer term average (for 1955 to 1959) by combining several years of measurements. A meteorological data comparison from various sources near NFSS to assess the variability and potential impact on assumptions will be conducted in a forthcoming technical memorandum.

The model is not designed for estimating air concentrations directly on the site, so on-site modeling results incorporate greater uncertainty. The evaluation of limiting atmospheric conditions explored the effects of stability class, wind speed, and emission velocity on the predicted downwind air concentrations and the results are presented in the following tables and figures.

B.4 REFERENCES

USACE (U. S. Army Corps of Engineers) 2000. *Technical Memorandum, Estimates of Air Quality Impacts of Radon in Landfill Gas, Seaway Site, Areas A, B, and C, Tonawanda, New York.* U.S. Army Corps of Engineers, Buffalo District, June 22, 2000.

APPENDIX B-2

Evaluation of Limiting Stability Class, Wind Speed, and Exit Velocity in Calculation of Radon Air Concentrations Downwind of the IWCS

Tables

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Table B-1. Average Wind Speed for IWCS Modeling of Default Conditions (in m/s)

Wind Direction Toward	Pasquill Stability Classes							Frequency
	A	B	C	D	E	F	G	
N	1.0	1.5	2.2	3.4	1.3	0.0	0.0	0.06
NNW	1.0	1.4	2.2	3.2	1.2	0.0	0.0	0.02
NW	1.0	1.4	1.4	2.2	1.2	0.0	0.0	0.03
WNW	1.1	1.4	1.9	2.3	1.1	0.0	0.0	0.03
W	1.0	1.5	2.0	2.8	1.2	0.0	0.0	0.06
WSW	1.0	1.5	2.3	3.0	1.3	0.0	0.0	0.04
SW	1.0	1.8	2.3	2.9	1.3	0.0	0.0	0.05
SSW	1.0	1.8	2.6	2.6	1.3	0.0	0.0	0.03
S	1.0	1.7	2.4	2.8	1.2	0.0	0.0	0.05
SSE	1.0	1.8	2.5	3.1	1.3	0.0	0.0	0.05
SE	1.0	1.6	2.4	3.0	1.3	0.0	0.0	0.08
ESE	1.0	2.0	2.6	3.6	1.3	0.0	0.0	0.08
E	1.0	1.4	2.1	3.5	1.4	0.0	0.0	0.09
ENE	1.0	1.5	2.7	4.3	1.5	0.0	0.0	0.10
NE	1.0	1.7	3.0	4.3	1.5	0.0	0.0	0.14
NNE	1.0	1.9	3.1	4.6	1.4	0.0	0.0	0.09

Note:
Values are from the default meteorological dataset in CAP88 for Niagara Falls from 1955-59.

Table B-2. Summary of Stability Class Frequencies for IWCS Modeling of Default Conditions

Wind Direction Toward	Pasquill Stability Classes						
	A	B	C	D	E	F	G
N	0.01	0.04	0.08	0.53	0.34	0.00	0.00
NNW	0.01	0.06	0.09	0.57	0.27	0.00	0.00
NW	0.02	0.07	0.11	0.48	0.33	0.00	0.00
WNW	0.00	0.04	0.10	0.40	0.46	0.00	0.00
W	0.00	0.03	0.08	0.45	0.43	0.00	0.00
WSW	0.00	0.03	0.08	0.53	0.35	0.00	0.00
SW	0.01	0.04	0.11	0.52	0.32	0.00	0.00
SSW	0.01	0.07	0.12	0.55	0.25	0.00	0.00
S	0.02	0.08	0.14	0.46	0.30	0.00	0.00
SSE	0.01	0.07	0.13	0.55	0.24	0.00	0.00
SE	0.02	0.06	0.11	0.55	0.26	0.00	0.00
ESE	0.01	0.04	0.11	0.60	0.24	0.00	0.00
E	0.01	0.04	0.05	0.63	0.27	0.00	0.00
ENE	0.01	0.03	0.08	0.67	0.22	0.00	0.00
NE	0.01	0.03	0.10	0.62	0.25	0.00	0.00
NNE	0.01	0.02	0.10	0.62	0.25	0.00	0.00
Total Frequency	0.01	0.04	0.10	0.57	0.28	0.00	0.00

Note:
Values are from the default meteorological dataset in CAP88 for Niagara Falls from 1955-59.

Table B-3. Description of Pasquill Stability Classes

Stability Class	Definition
A	very unstable
B	unstable
C	slightly unstable
D	neutral
E	slightly stable
F	stable

Note:
Stability Class G is utilized by CAP88 for extreme stability and is calculated from Classes E and F.

Table B-4. Meteorological Conditions that Define the Pasquill Stability Classes

Surface Windspeed		Daytime Incoming Solar Radiation			Nighttime Cloud Cover	
m/s	**mi/h**	**Strong**	**Moderate**	**Slight**	**> 50%**	**< 50%**
< 2	< 5	A	A – B	B	E	F
2 – 3	5 – 7	A – B	B	C	E	F
3 – 5	7 – 11	B	B – C	C	D	E
5 – 6	11 – 13	C	C – D	D	D	D
> 6	> 13	C	D	D	D	D

Note:
Class D applies to heavily overcast skies, at any wind speed day or night

Table B-5. Radon-222 Unit Concentrations in Air (pCi/L per Ci/yr) from a 1 m/s Wind for Selected Stability Classes – up to 2 km Downwind

	Distance from Source (m)											
Stability	**1**	**10**	**50**	**100**	**250**	**500**	**750**	**1000**	**1250**	**1500**	**1750**	**2000**
Class G	4E+03	6E+01	3E+00	9E-01	2E-01	5E-02	2E-02	1E-02	9E-03	7E-03	5E-03	4E-03
Class F	2E+03	3E+01	1E+00	4E-01	7E-02	2E-02	9E-03	5E-03	3E-03	3E-03	2E-03	2E-03
Class E	1E+03	1E+01	7E-01	2E-01	3E-02	9E-03	4E-03	3E-03	2E-03	1E-03	1E-03	8E-04
Class D	5E+02	7E+00	4E-01	1E-01	2E-02	6E-03	3E-03	2E-03	1E-03	9E-04	7E-04	6E-04
Class C	6E+02	7E+00	3E-01	8E-02	1E-02	3E-03	2E-03	9E-04	6E-04	4E-04	3E-04	2E-04
Class B	5E+02	5E+00	2E-01	5E-02	8E-03	2E-03	9E-04	5E-04	3E-04	2E-04	2E-04	1E-04
Class A	3E+02	3E+00	1E-01	3E-02	5E-03	1E-03	6E-04	3E-04	2E-04	1E-04	1E-04	8E-05

Note:
Concentrations are at ground-level on the plume centerline under steady state conditions with wind from only one direction. Values are for a unit emission rate of 1 Ci/yr from ground level.

Table B-6. Radon-222 Unit Concentrations in Air (pCi/L per Ci/yr) from a 1 m/s Wind for Selected Stability Classes – up to 75 km Downwind

	Distance from Source (m)											
Stability	**250**	**500**	**750**	**1000**	**2000**	**3000**	**5000**	**10000**	**15000**	**30000**	**45000**	**75000**
Class G	2E-01	5E-02	2E-02	1E-02	4E-03	2E-03	1E-03	4E-04	3E-04	1E-04	8E-05	4E-05
Class F	7E-02	2E-02	9E-03	5E-03	2E-03	8E-04	4E-04	2E-04	1E-04	5E-05	3E-05	2E-05
Class E	3E-02	9E-03	4E-03	3E-03	8E-04	4E-04	2E-04	8E-05	5E-05	2E-05	2E-05	9E-06
Class D	2E-02	6E-03	3E-03	2E-03	6E-04	3E-04	1E-04	5E-05	3E-05	9E-06	3E-06	2E-06
Class C	1E-02	3E-03	2E-03	9E-04	2E-04	1E-04	5E-05	1E-05	7E-06	3E-06	2E-06	1E-06
Class B	8E-03	2E-03	9E-04	5E-04	1E-04	6E-05	2E-05	8E-06	5E-06	3E-06	2E-06	1E-06
Class A	5E-03	1E-03	6E-04	3E-04	8E-05	4E-05	2E-05	8E-06	5E-06	3E-06	2E-06	1E-06

Note:
Concentrations are at ground level on the plume centerline under steady state conditions with wind from only one direction. Values are for a unit emission rate of 1 Ci/yr from ground level.

Table B-7. Radon-222 Unit Concentration in Air (pCi/L per Ci/yr) from Stability Class G for Selected Wind Speeds

	Distance from Source (m)											
Wind Speed	**1**	**10**	**50**	**100**	**250**	**500**	**750**	**1000**	**1250**	**1500**	**1750**	**2000**
1 mph	4E+03	6E+01	3E+00	9E-01	2E-01	5E-02	2E-02	1E-02	9E-03	7E-03	5E-03	4E-03
3 mph	1E+03	2E+01	1E+00	3E-01	5E-02	2E-02	7E-03	4E-03	3E-03	2E-03	2E-03	1E-03
5 mph	8E+02	1E+01	6E-01	2E-01	3E-02	9E-03	4E-03	3E-03	2E-03	1E-03	1E-03	8E-04
10 mph	4E+02	6E+00	3E-01	9E-02	2E-02	5E-03	2E-03	1E-03	9E-04	7E-04	5E-04	4E-04

Note:
Concentrations are at ground level on the plume centerline under steady state conditions with a wind from only one direction.
Values are for a unit emission rate of 1 Ci/yr from ground level.

Table B-8. Radon-222 Unit Concentration in Air (pCi/L per Ci/yr) from Stability Class G at 1 m/s for Selected Release Velocities

Downwind Distance (m)	**50**	**100**	**250**	**500**	**750**	**1000**	**1250**	**1500**	**1750**	**2000**
0 m/s Release Velocity	3E+00	9E-01	2E-01	5E-02	2E-02	1E-02	9E-03	7E-03	5E-03	4E-03
1 m/s Release Velocity	6E-01	5E-01	1E-01	4E-02	2E-02	1E-02	9E-03	7E-03	5E-03	4E-03
2 m/s Release Velocity	4E-03	1E-01	1E-01	4E-02	2E-02	1E-02	9E-03	6E-03	5E-03	4E-03
3 m/s Release Velocity	1E-06	8E-03	6E-02	3E-02	2E-02	1E-02	8E-03	6E-03	5E-03	4E-03

Note:
Concentrations are at ground level on the plume centerline under steady state conditions with a wind from only one direction.
Values are for a unit emission rate of 1 Ci/yr from ground level.

Table B-9. Calculation of Stack Effect Flow Rate, Exit Velocity and Equivalent Stack Height for Selected Temperature Differences

Temperature Difference (C)	Flow Rate (m^3/s)	Exit Velocity (m/s)	Equivalent Stack Height (m)
7	0.2	1.0	1.1
30	0.4	2.0	2.3
75	0.6	3.1	3.4

Note: Assumes a 0.2 m^2 (2 ft^2) opening area (0.5 m [1.5 ft] diameter circular opening), and a 5 m (16 ft) opening length below the surface of the IWCS.

Table B-10. Comparison of Results for Range of Atmospheric Conditions Evaluated

	Unit Air Concentration (pCi/L per Ci/yr)		
Distance (m)	Class G at 1 m/s	Class C at 1 m/s	Default Met
250	1.63E-01	1.31E-02	1.35E-03
500	4.60E-02	3.39E-03	3.75E-04
750	2.19E-02	1.53E-03	1.78E-04
1,000	1.30E-02	8.74E-04	1.04E-04
2,000	4.12E-03	2.49E-04	3.32E-05
3,000	2.11E-03	1.18E-04	1.70E-05
5,000	1.04E-03	4.64E-05	8.04E-06
10,000	3.99E-04	1.30E-05	2.95E-06
15,000	2.54E-04	6.94E-06	1.78E-06
30,000	1.18E-04	2.65E-06	7.63E-07
45,000	7.51E-05	1.77E-06	4.70E-07
75,000	4.26E-05	1.06E-06	2.56E-07

Note:
Values are for a unit emission of 1 Ci/yr from a ground-level source with no release velocity.

APPENDIX B-3

Evaluation of Limiting Stability Class, Wind Speed, and Exit Velocity in Calculation of Radon Air Concentrations Downwind of the IWCS

Figures

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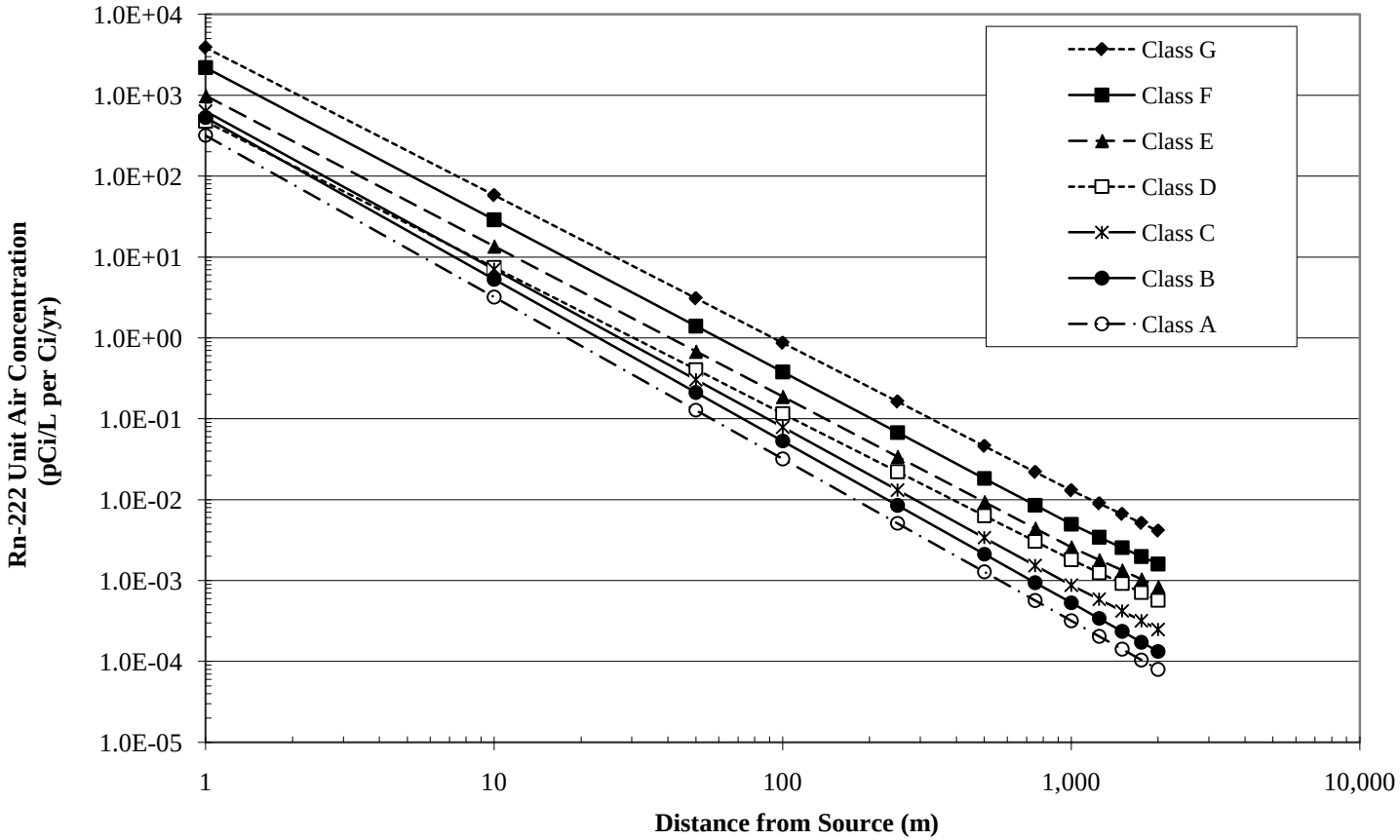

Figure B-1. Air Concentrations from a Unit Release of Radon for Various Stability Classes – Up to 2km Downwind

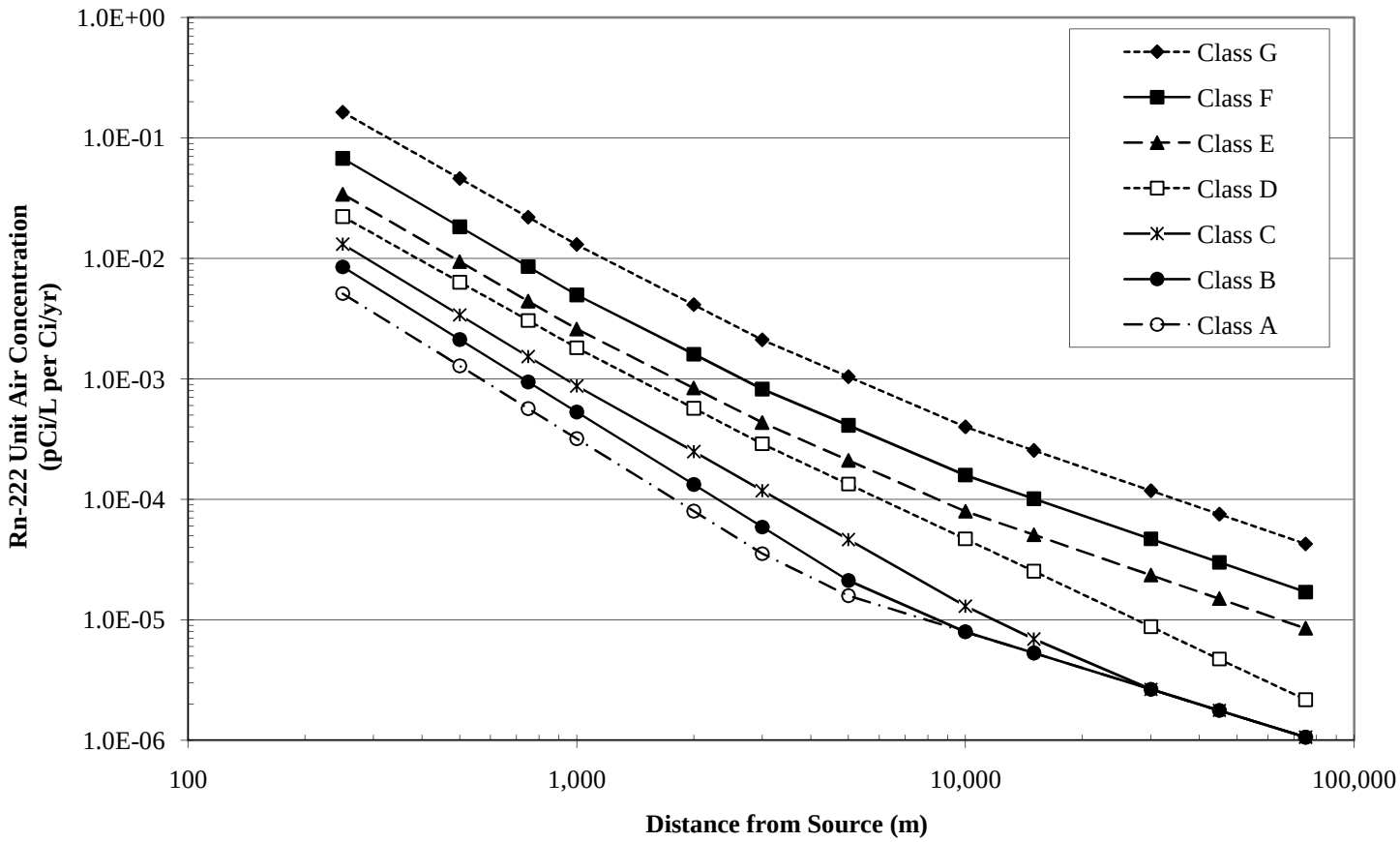

Figure B-2. Air Concentrations from a Unit Release of Radon for Various Stability Classes – Up to 75km Downwind

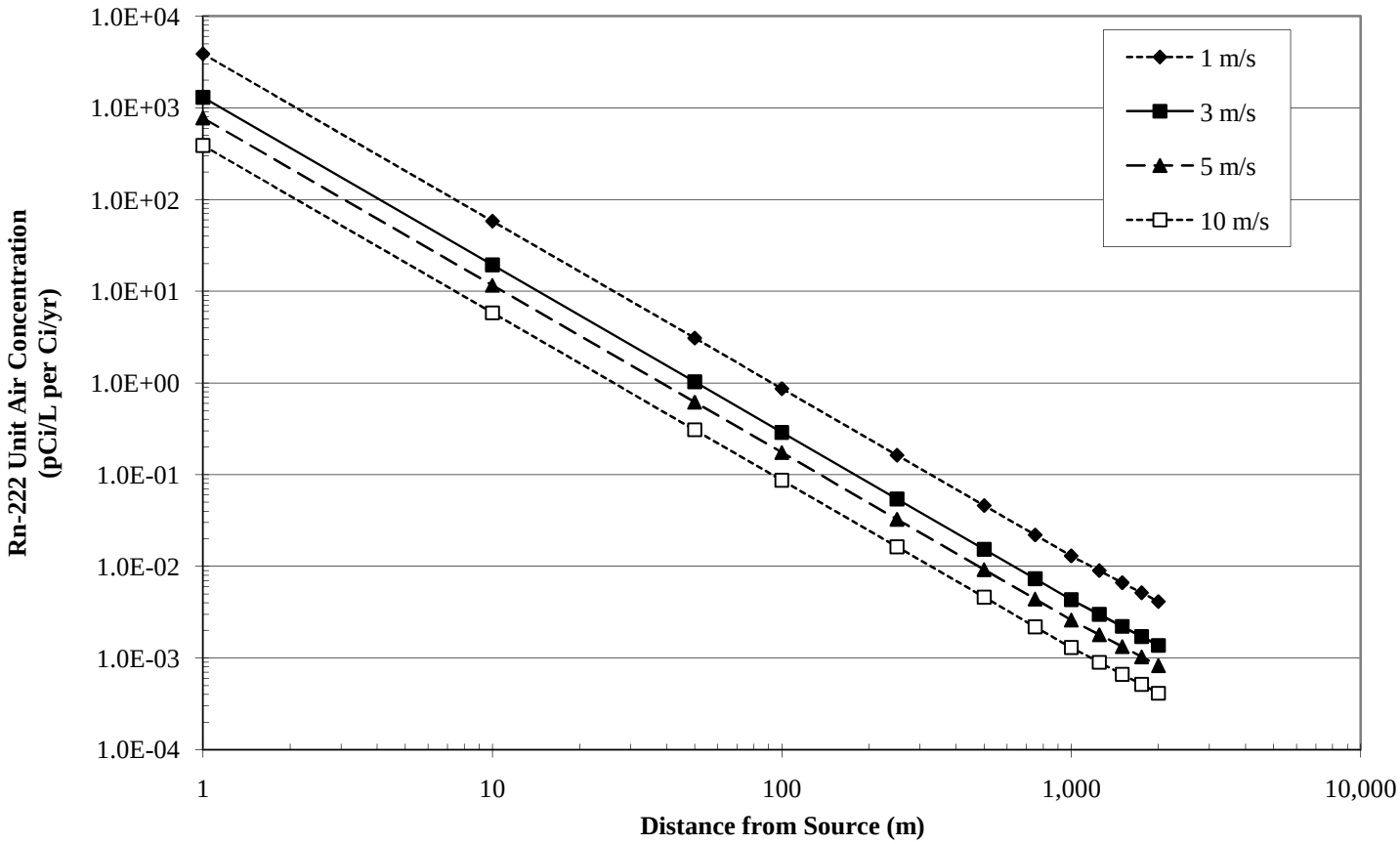

Figure B-3. Air Concentrations from a Unit Release of Radon for Class G at Various Wind Speeds – Up to 2 km Downwind

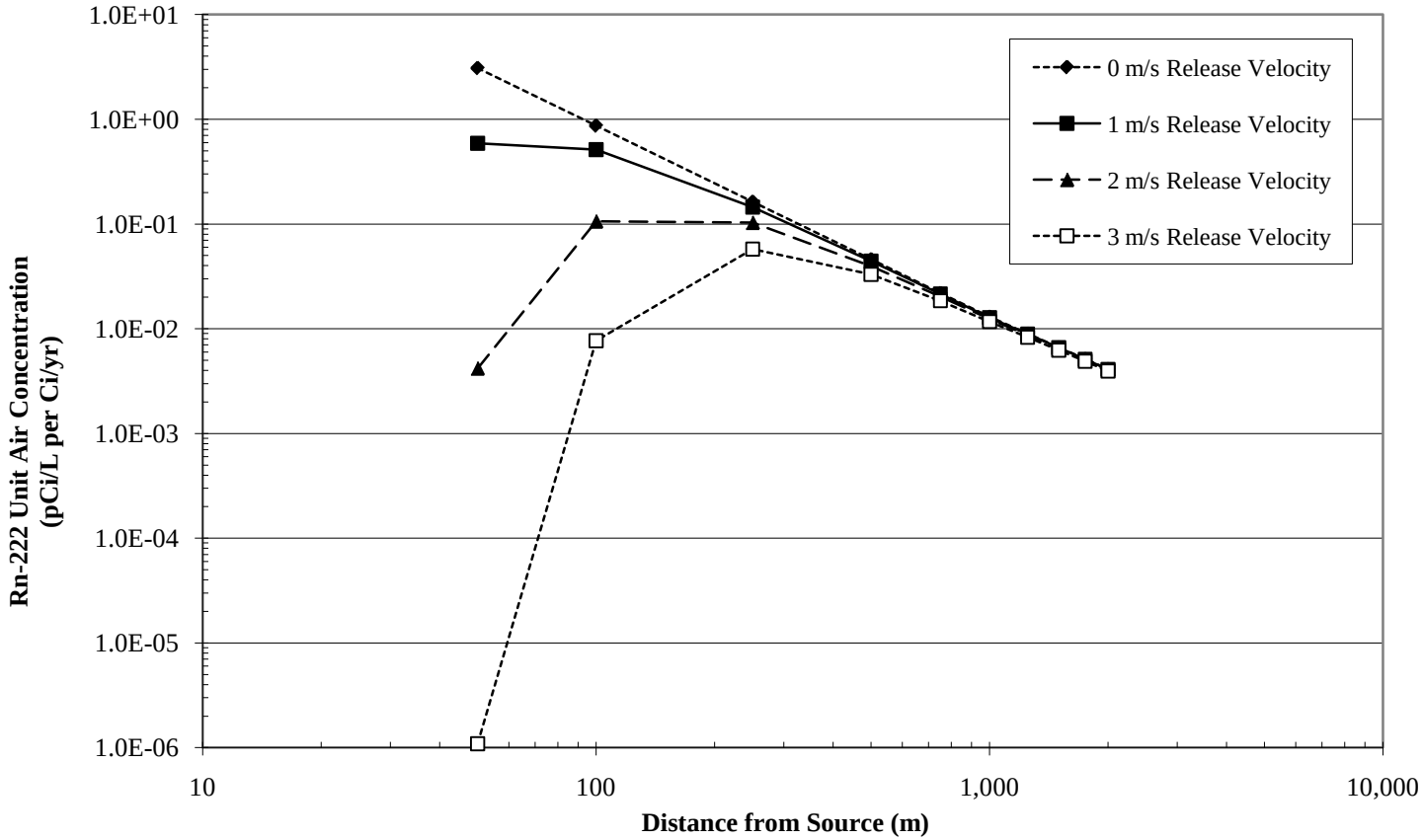

Figure B-4. Air Concentrations from a Unit Release of Radon for Various Release Velocities – Up to 2km Downwind

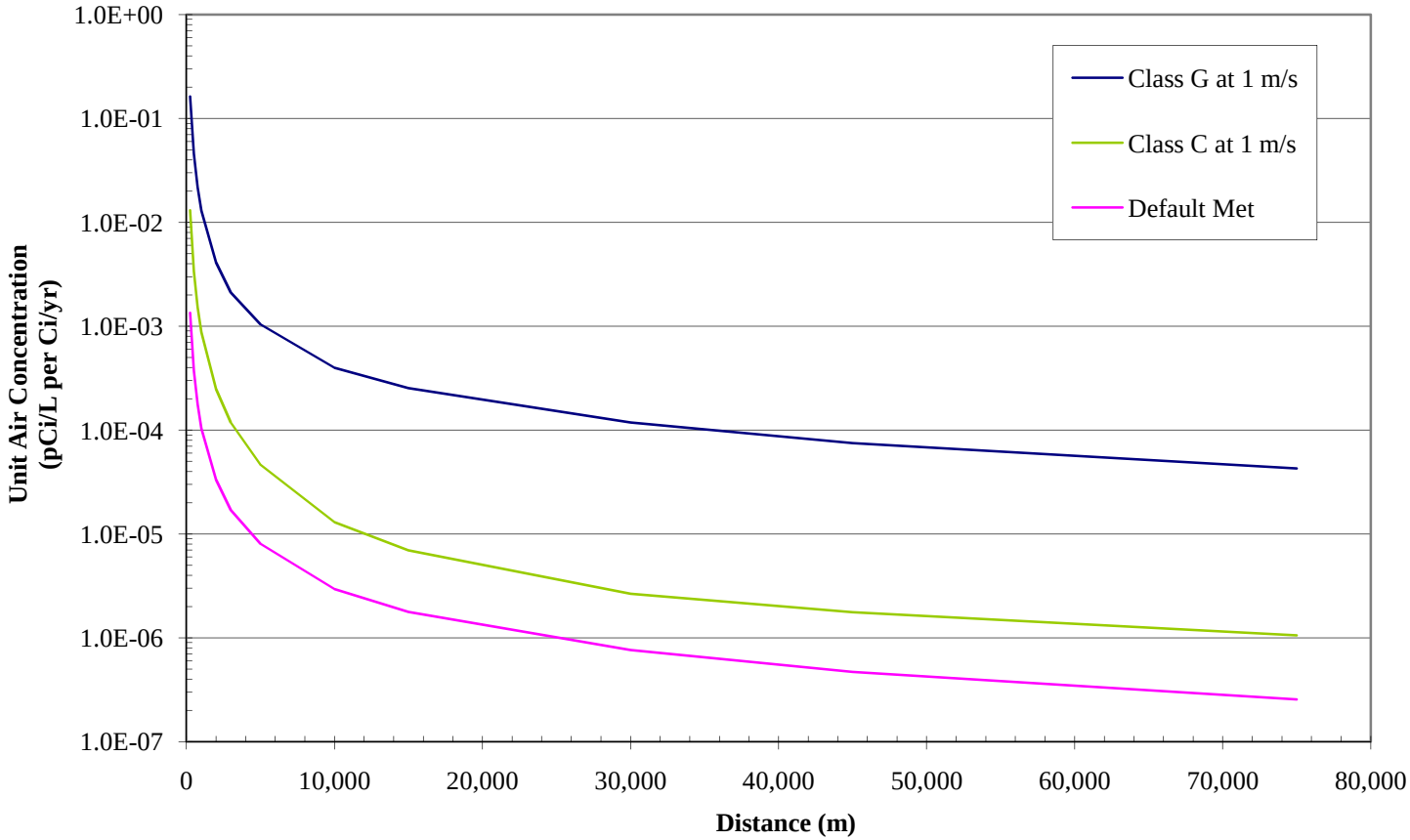

Figure B-5. Air Concentrations from a Unit Release of Radon for Bounding (Class G), Typical (Class C), and Default Meteorological Data – Up to 75km Downwind

ATTACHMENT B-1

Contents of Electronic Attachment to Appendix B

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NFSS Radon TM - Contents of Electronic Attachment to Appendix B

The following electronic files are provided in support of the CAP88 modeling of the IWCS radon release scenarios, as described below. Simulations were conducted for each of the atmospheric Stability Classes (A through G), Class G at various wind speeds, Class G at 1 m/s for various release velocities, and a simulation utilizing the default meteorological dataset available in CAP88 PC (Version 3.0). As described in Section 6.0 and Appendix B, the results for Stability Class G at 1 m/s (3.3 ft/s) and no exit velocity were used to estimate upper bound air concentrations, while the default meteorological data were used for central tendency estimates.

Exposures were calculated for an individual and were evaluated relative to the location of maximum results, based on the particular meteorological file under consideration. The electronic files include the following:

Filename	Description
NFSSA1	Class A at 1 m/s North for unit release of 1 Ci/yr.
NFSSB1	Class B at 1 m/s North for unit release of 1 Ci/yr.
NFSSC1	Class C at 1 m/s North for unit release of 1 Ci/yr.
NFSSD1	Class D at 1 m/s North for unit release of 1 Ci/yr.
NFSSE1	Class E at 1 m/s North for unit release of 1 Ci/yr.
NFSSF1	Class F at 1 m/s North for unit release of 1 Ci/yr.
NFSSG1	Class G at 1 m/s North for unit release of 1 Ci/yr.
NFSSG3	Class G at 3 m/s North for unit release of 1 Ci/yr.
NFSSG5	Class G at 5 m/s North for unit release of 1 Ci/yr.
NFSSG10	Class G at 10 m/s North for unit release of 1 Ci/yr.
NFSSG1_1	Class G at 1 m/s North and 1 m/s release velocity for unit release of 1 Ci/yr.
NFSSG1_2	Class G at 1 m/s North and 2 m/s release velocity for unit release of 1 Ci/yr.
NFSSG1_3	Class G at 1 m/s North and 3 m/s release velocity for unit release of 1 Ci/yr.
NFSS_DEF	Default CAP88 Meteorological dataset for a unit release of 1 Ci/yr.

There are 9 files associated with each of the filenames listed above, as follows;

File Extensions	CAP88 File Type
DAT	Input - Exposure/Emission Parameters
WND	Input - Wind Data
CHI	Output - Chi/Q Values
CON	Output – Air, Deposition, and Ground Concentrations
FAC	Output –Conversion Factors
GEN	Output – Nuclide Parameters, Source Activity, General Model Parameters
SUM	Output – Summary of Health Effects
SYN	Output – Synopsis of Radiological Results
WEA	Output – Weather Input Echo

The files listed above are provided on the attached CD of supporting information.

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APPENDIX C

Estimated Plume Centerline Downwind Air Concentration with Upper Bound, Typical and Default Meteorological Conditions for Hypothetical Excavation/Intrusion Scenarios

Including:

Appendix C-1: Text
Appendix C-2: Tables
Appendix C-3: Figures

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APPENDIX C-1

Estimated Plume Centerline Downwind Air Concentration Estimates with Upper Bound, Typical and Default Meteorological Conditions for Excavation/Intrusion Scenarios

Text

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C.1 AIR CONCENTRATION ESTIMATES

This appendix presents the estimation of plume centerline air concentrations downwind of the IWCS that result from excavation/intrusion scenarios. The calculations combine emission rate estimates for each scenario (see Section 5.0 and Appendix A) with the simulated downwind air concentrations from CAP88, to generate results for bounding, typical and default meteorological conditions (see Appendix B). Estimated unit air concentrations at locations lateral to the plume centerline are presented in Appendix D, to provide and evaluation of the effects of plume dispersion on the centerline concentrations.

C.1.1 Meteorological Data

Because the estimated downwind air concentrations are strongly dependent on the meteorological conditions during the radon release, a range of possible atmospheric conditions were investigated. The radon analysis considered both short-term and long-term releases, and utilized three sets of meteorological conditions to evaluate the release scenarios. These three atmospheric conditions were considered representative of the range of possible conditions present at the IWCS during radon releases, as further discussed below.

For long-term releases, a meteorological dataset was used that summarized several years of data suitable to estimating air concentrations in the sixteen compass directions over an annual time period. The analysis based on historical long-term atmospheric conditions is referred to as the default condition within this appendix. The meteorological database used for evaluation of the default condition was the CAP88 file for Niagara Falls International Airport, which represents the years 1955-1959. Although this data is historical, it has been through significant validation and verification.

For shorter term releases, where winds might be focused in a single direction, a meteorological data set was used to reflect an atmospheric condition that might persist for a brief period of time. Data sets were created for CAP88 to simulate a wind of a constant speed in a single direction for a constant atmospheric stability class. Two stability classes were included in the short-term analysis, one for an extremely stable atmosphere (the bounding condition) and one for a slightly unstable atmosphere (the typical condition), which are described below.

The extremely stable short-term atmosphere (bounding condition) was simulated using an atmospheric stability class of G with a wind speed of 1 m/s. This reflects a very stable atmosphere, where limited dispersion of the plume could be expected, resulting in maximum plume centerline concentrations. This scenario was used to provide upper bound estimated of potential short-term air concentrations associated with releases from IWCS. The Class G stability class is most often observed during lightly clouded nighttime hours with very low wind speeds and is associated with a very stable atmosphere where very little mixing of air parcels is occurring. As a result, constituents tend to remain concentrated along the centerline of an airborne plume and are less likely to be distributed laterally.

The slightly unstable short-term atmosphere (typical condition) assumed a stability class of C with a wind speed of 1 m/s. This reflects a typical stability with a 1 m/s windspeed, which is well below the average windspeed of 4.5 m/s at Niagara Falls International Airport in 2008. The typical condition is used to estimate a reasonably conservative air concentration for a single wind direction. The Class C stability class is most often observed during partly cloudy daylight hours with moderate winds and is considered indicative of a slightly unstable atmosphere. Because of these instabilities in the atmosphere, parcels of air are more likely to collide and mix, which tends to distribute any airborne constituents more evenly within the plume. This has the effect of reducing the centerline concentration within the plume and that mass of constituents is more evenly mixed throughout the atmosphere.

Results from these three meteorological datasets provide data for historical long-term (default condition), slightly unstable shorter term (bounding), and extremely stable (typical conditions) release analysis. These results bound the potential air concentrations associated with short-term releases from IWCS and also provide long-term results for annual releases.

C.1.2 Emission Rate Estimates

The calculation of the radon emission rate for each exposure scenario is dependent on the exposed source area and the radon flux from the source material. Appendix A presents the estimated flux from each layer within the IWCS bays and indicates that the maximum flux (2.7E5 pCi/m^2/s) is associated with the K-65 residues. The maximum flux is then combined with the estimated exposed source area to determine the emission rate for each scenario.

The assumed exposed source areas are as follows:

- Excavation of Residues — Area of 100 m^2, sequentially through Bays A, B, C and D
- Excavation of IWCS — Area of 500 m^2, concurrently 100 m^2 in Bays A, B, C and 200 m^2 in D
- Heavy Equipment — Area of 69 m^2 exposed in Bay A
- Earthquake — Area of 390 m^2 exposed in Bay A
- Drilling — Area of 2.3 m^2 exposed in Bay A
- Animal Burrow — Area of 0.53 m^2 exposed in Bay A

Additional details for each scenario and the determination of the exposed source areas are presented in Section 5.0 and Appendix A of this technical memorandum. Assuming that the exposed source is K-65 emitting 2.7E5 pCi/m^2/s, combined with the assumed source areas, produces the emission rate in units of pCi/s, converted to Ci/yr (see Summary Table C-25). For example, the animal burrow exposed a source area of 0.53 m^2 emitting 2.7E5 pCi/m^2/s, resulting in an emission rate of 1.4E5 pCi/s which is equal to 4.5 Ci/yr (based on 1E-12 Ci/pCi and 3.2E7 s/yr). The exception is the earthquake scenario where an emission rate was assumed (55 Ci/yr) to correspond with an acceptable off-site air concentration (0.1 pCi/L). This approach was utilized to allow for prediction of releases relative to earthquake magnitudes and different depths that a fissure might reach within the IWCS. Results presented in the section reflect the results presented in Appendix E for the earthquake scenario.

Additional considerations for the estimation of radon emission rates is the mechanism of release from voids created within the IWCS from earthquake fissures, drilling, or animal burrowing. Radon may be emitted based on convective or diffusive transport. For the intrusion scenarios, results presented in Appendix C are based on convective movement of the radon from the subsurface void (created by the intrusion) to the atmosphere as calculated in Appendix A. Results based on radon diffusion through an intrusion opening would likely be orders of magnitude lower than those based on convection, as discussed in Appendix A.

C.1.3 Air Concentrations

Tables C-1 to C-8, present the calculated air concentrations for each of the scenarios under bounding atmospheric conditions for a range of distances from the source. Tables C-9 to C-16 and Tables C-17 to C-24 are for typical and default conditions respectively. Table C-25 summarizes the results for the range of distances. Tables C-26 to C-49 present similar results for specific receptor locations under each of the atmospheric conditions, which are then summarized in Tables C-50 through C-52.

Figures C-1 to C-24 present the air concentration results for the various scenarios and atmospheric conditions. The figures illustrate the variability in radon concentrations due to variation of radon emission within the IWCS layers. From Figure C-1, at the bottom of the IWCS in Bay A the radon flux increases in the lower layer until reaching a maximum (see Appendix A) within the K-65. As the radon diffuses into the sand and waste clay layers above the K-65, these layers generate less radon as well as providing increased resistance to diffustion allowing more radon to decay. The radon flux increases again in the topsoil layer due to an assumed background concentration of radium-226 in this layer and the relatively low resistance to diffusion, allowing easy diffusion to the atmosphere.

The air concentration estimates are generated with the following equation:

$$C = C_e \times F_a \times A \qquad \text{Eq. C-1}$$

Where:

C = air concentration of radon pCi/L
C_e = air concentration of radon per unit emission (pCi/L per Ci/yr)
F_a = radon flux (pCi/s per m^2)
A = area of exposed source (m^2)

Where the product of radon flux (pCi/m^2/s) and source area (m^2) is the emission rate (Ci/yr) discussed in the previous section.

Calculations were performed for each scenario and for each distance downwind from the source for both the bounding and default atmospheric conditions. The radon flux is calculated in Appendix A, and the unit air concentrations are from Appendix B for the specific stability class under consideration.

For example, the first column of Table C-25 provides results for the bounding atmospheric condition at 250 m downwind. The unit air concentration from the CAP88 modeling is 0.16 pCi/L per Ci/yr, the burrowing animal source area is 0.53 m^2, and the K-65 residue radon flux is 2.7E5 pCi/m^2/s. Utilizing the equation above gives an air concentration as follows;

C (pCi/L) = 0.16 (pCi/L per Ci/yr) x 2.7E5 (pCi/m^2/s) x 0.53 (m^2) x 1E-12 (Ci/pCi) x 3.2E7 s/yr = 0.73 (pCi/L)

The resulting air concentrations were summarized and are discussed in the following sections for each of the meteorological conditions evaluated.

C.1.4 Results Summary

The results of the estimated air concentrations at 250 m and 2,000 m downwind of the IWCS are summarized in Table C-25 for the bounding, typical, and default meteorological conditions. Results from the bounding and typical conditions reflect short-term releases, and are compared with the USDOE radon maximum concentration standard of 100 pCi/L (see Table 3-1), at any location near an interim storage facility. Air concentrations, that were estimated using annual meteorological data for the default condition, were also compared with the USDOE annual average radon standard (3 pCi/L for locations near interim storage facilities).

Bounding Conditions

For the bounding scenario at 250 m downwind, the air concentration exceeded 100 pCi/L for excavation of Bay A and C (137 pCi/L), as well as for excavation of the IWCS (266 pCi/L). At 2,000 m, air concentrations were below 100 pCi/L for all scenarios under bounding conditions.

Typical Conditions

Typical conditions resulted in air concentrations below 100 pCi/L, for all scenarios and distances from the source. At 2,000 m from the source all air concentrations were below 1 pCi/L under typical conditions.

Default Conditions

Under default conditions air concentrations were below 100 pCi/L for all scenarios, at both 250 m and 2,000 m. Air concentrations exceeded 1 pCi/L at 250 m for the removal of Bays A and C (1.1 pCi/L), and excavation of the IWCS (2.4 pCi/L). Air concentrations were below 3 pCi/L for all scenarios at 2,000 m. Air concentrations reported in Table C-25 for the default condition are those estimated for the northeast direction, which represented the highest annual average concentrations.

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APPENDIX C-2

Estimated Plume Centerline Downwind Air Concentrations with Upper Bound, Typical and Default Meteorological Conditions for Hypothetical Excavation/Intrusion Scenarios

Tables

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Air Concentrations

Bounding Conditions

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Table C-1. Air Concentration Estimates for Excavation in Bay A – Bounding Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.4E-01	1.4E-03	2.3E-04	6.4E-05	3.0E-05	1.8E-05	5.7E-06	2.9E-06	1.4E-06
0.7	4.0E-01	1.3E-03	2.0E-04	5.8E-05	2.8E-05	1.6E-05	5.2E-06	2.7E-06	1.3E-06
15.7	3.1E-01	9.8E-04	1.6E-04	4.5E-05	2.1E-05	1.3E-05	4.0E-06	2.1E-06	1.0E-06
30.7	1.6E-01	5.2E-04	8.4E-05	2.4E-05	1.1E-05	6.7E-06	2.1E-06	1.1E-06	5.4E-07
45.7	1.5E-01	4.9E-04	8.0E-05	2.2E-05	1.1E-05	6.4E-06	2.0E-06	1.0E-06	5.1E-07
45.7	1.5E-01	4.9E-04	8.0E-05	2.2E-05	1.1E-05	6.4E-06	2.0E-06	1.0E-06	5.1E-07
47.2	2.5E-01	7.7E-04	1.3E-04	3.6E-05	1.7E-05	1.0E-05	3.2E-06	1.6E-06	8.0E-07
62.2	6.4E-01	2.0E-03	3.3E-04	9.3E-05	4.4E-05	2.6E-05	8.3E-06	4.3E-06	2.1E-06
77.2	2.5E+00	7.8E-03	1.3E-03	3.6E-04	1.7E-04	1.0E-04	3.2E-05	1.7E-05	8.1E-06
92.2	1.2E+01	3.8E-02	6.2E-03	1.8E-03	8.4E-04	5.0E-04	1.6E-04	8.0E-05	4.0E-05
107.2	7.8E+01	2.4E-01	4.0E-02	1.1E-02	5.4E-03	3.2E-03	1.0E-03	5.2E-04	2.5E-04
122.2	6.9E+02	2.2E+00	3.5E-01	1.0E-01	4.8E-02	2.8E-02	9.0E-03	4.6E-03	2.3E-03
137.2	7.2E+02	2.3E+00	3.7E-01	1.0E-01	5.0E-02	3.0E-02	9.4E-03	4.8E-03	2.4E-03
137.2	7.2E+02	2.3E+00	3.7E-01	1.0E-01	5.0E-02	3.0E-02	9.4E-03	4.8E-03	2.4E-03
140.5	1.0E+03	3.3E+00	5.3E-01	1.5E-01	7.2E-02	4.3E-02	1.3E-02	6.9E-03	3.4E-03
155.5	1.5E+03	4.7E+00	7.7E-01	2.2E-01	1.0E-01	6.1E-02	1.9E-02	9.9E-03	4.9E-03
170.5	2.2E+03	6.8E+00	1.1E+00	3.1E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	7.1E-03
185.5	3.1E+03	9.8E+00	1.6E+00	4.5E-01	2.1E-01	1.3E-01	4.0E-02	2.1E-02	1.0E-02
200.5	4.5E+03	1.4E+01	2.3E+00	6.5E-01	3.1E-01	1.8E-01	5.9E-02	3.0E-02	1.5E-02
215.5	6.6E+03	2.1E+01	3.4E+00	9.6E-01	4.5E-01	2.7E-01	8.6E-02	4.4E-02	2.2E-02
230.5	9.7E+03	3.1E+01	5.0E+00	1.4E+00	6.7E-01	4.0E-01	1.3E-01	6.4E-02	3.2E-02
245.5	1.4E+04	4.6E+01	7.4E+00	2.1E+00	1.0E+00	5.9E-01	1.9E-01	9.6E-02	4.7E-02
260.5	2.2E+04	6.9E+01	1.1E+01	3.2E+00	1.5E+00	9.0E-01	2.9E-01	1.5E-01	7.2E-02
275.5	3.4E+04	1.1E+02	1.8E+01	5.0E+00	2.4E+00	1.4E+00	4.5E-01	2.3E-01	1.1E-01
290.5	5.6E+04	1.8E+02	2.9E+01	8.1E+00	3.8E+00	2.3E+00	7.2E-01	3.7E-01	1.8E-01
305.5	9.4E+04	3.0E+02	4.8E+01	1.4E+01	6.5E+00	3.8E+00	1.2E+00	6.2E-01	3.1E-01
320.5	1.6E+05	5.0E+02	8.1E+01	2.3E+01	1.1E+01	6.5E+00	2.0E+00	1.0E+00	5.2E-01
335.5	2.2E+05	6.8E+02	1.1E+02	3.1E+01	1.5E+01	8.9E+00	2.8E+00	1.4E+00	7.1E-01
350.5	2.2E+05	6.9E+02	1.1E+02	3.2E+01	1.5E+01	9.0E+00	2.9E+00	1.5E+00	7.2E-01
350.5	2.2E+05	6.9E+02	1.1E+02	3.2E+01	1.5E+01	9.0E+00	2.9E+00	1.5E+00	7.2E-01
351.0	2.5E+05	8.0E+02	1.3E+02	3.7E+01	1.7E+01	1.0E+01	3.3E+00	1.7E+00	8.3E-01
366.0	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01

Table C-1. Air Concentration Estimates for Excavation in Bay A – Bounding Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
381.0	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
381.0	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
388.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
403.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
418.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
433.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
448.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
463.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
478.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
493.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
508.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
523.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
538.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
553.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
568.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
583.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
598.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
613.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
628.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
643.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
658.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
673.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
688.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
703.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.7E-01
718.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.7E-01
733.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.7E-01
748.7	2.6E+05	8.3E+02	1.4E+02	3.8E+01	1.8E+01	1.1E+01	3.4E+00	1.8E+00	8.7E-01
763.7	2.6E+05	8.2E+02	1.3E+02	3.8E+01	1.8E+01	1.1E+01	3.4E+00	1.7E+00	8.6E-01
778.7	2.6E+05	8.0E+02	1.3E+02	3.7E+01	1.8E+01	1.0E+01	3.3E+00	1.7E+00	8.4E-01
793.7	2.4E+05	7.7E+02	1.3E+02	3.5E+01	1.7E+01	1.0E+01	3.2E+00	1.6E+00	8.0E-01
808.7	2.2E+05	7.0E+02	1.1E+02	3.2E+01	1.5E+01	9.1E+00	2.9E+00	1.5E+00	7.3E-01
823.7	1.9E+05	5.9E+02	9.6E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.1E-01
838.7	1.3E+05	4.0E+02	6.6E+01	1.8E+01	8.8E+00	5.2E+00	1.7E+00	8.5E-01	4.2E-01
853.7	4.6E+04	1.5E+02	2.4E+01	6.7E+00	3.2E+00	1.9E+00	6.0E-01	3.1E-01	1.5E-01

Table C-2. Air Concentration Estimates for Excavation in Bay B – Bounding Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.5E-01	1.4E-03	2.3E-04	6.5E-05	3.1E-05	1.8E-05	5.8E-06	3.0E-06	1.5E-06
0.7	4.1E-01	1.3E-03	2.1E-04	5.9E-05	2.8E-05	1.7E-05	5.3E-06	2.7E-06	1.3E-06
15.7	3.2E-01	1.0E-03	1.6E-04	4.6E-05	2.2E-05	1.3E-05	4.1E-06	2.1E-06	1.0E-06
30.7	1.6E-01	5.1E-04	8.3E-05	2.3E-05	1.1E-05	6.6E-06	2.1E-06	1.1E-06	5.3E-07
45.7	1.5E-01	4.8E-04	7.9E-05	2.2E-05	1.1E-05	6.3E-06	2.0E-06	1.0E-06	5.0E-07
45.7	1.5E-01	4.8E-04	7.9E-05	2.2E-05	1.1E-05	6.3E-06	2.0E-06	1.0E-06	5.0E-07
47.2	2.4E-01	7.4E-04	1.2E-04	3.4E-05	1.6E-05	9.7E-06	3.1E-06	1.6E-06	7.7E-07
62.2	5.8E-01	1.8E-03	3.0E-04	8.5E-05	4.0E-05	2.4E-05	7.6E-06	3.9E-06	1.9E-06
77.2	2.0E+00	6.5E-03	1.1E-03	3.0E-04	1.4E-04	8.4E-05	2.7E-05	1.4E-05	6.7E-06
92.2	8.2E+00	2.6E-02	4.2E-03	1.2E-03	5.7E-04	3.4E-04	1.1E-04	5.5E-05	2.7E-05
107.2	3.3E+01	1.0E-01	1.7E-02	4.8E-03	2.3E-03	1.3E-03	4.3E-04	2.2E-04	1.1E-04
122.2	8.2E+01	2.6E-01	4.2E-02	1.2E-02	5.7E-03	3.4E-03	1.1E-03	5.5E-04	2.7E-04
137.2	8.3E+01	2.6E-01	4.3E-02	1.2E-02	5.7E-03	3.4E-03	1.1E-03	5.5E-04	2.7E-04
137.2	8.3E+01	2.6E-01	4.3E-02	1.2E-02	5.7E-03	3.4E-03	1.1E-03	5.5E-04	2.7E-04
140.5	1.2E+02	3.7E-01	6.1E-02	1.7E-02	8.2E-03	4.9E-03	1.5E-03	7.9E-04	3.9E-04
155.5	1.7E+02	5.4E-01	8.8E-02	2.5E-02	1.2E-02	7.0E-03	2.2E-03	1.1E-03	5.6E-04
170.5	2.5E+02	7.9E-01	1.3E-01	3.6E-02	1.7E-02	1.0E-02	3.3E-03	1.7E-03	8.2E-04
185.5	3.7E+02	1.2E+00	1.9E-01	5.3E-02	2.5E-02	1.5E-02	4.8E-03	2.4E-03	1.2E-03
200.5	5.4E+02	1.7E+00	2.8E-01	7.9E-02	3.8E-02	2.2E-02	7.1E-03	3.6E-03	1.8E-03
215.5	8.1E+02	2.5E+00	4.1E-01	1.2E-01	5.6E-02	3.3E-02	1.0E-02	5.4E-03	2.6E-03
230.5	1.2E+03	3.8E+00	6.2E-01	1.7E-01	8.3E-02	4.9E-02	1.6E-02	8.0E-03	3.9E-03
245.5	1.8E+03	5.6E+00	9.2E-01	2.6E-01	1.2E-01	7.3E-02	2.3E-02	1.2E-02	5.8E-03
260.5	2.6E+03	8.4E+00	1.4E+00	3.8E-01	1.8E-01	1.1E-01	3.4E-02	1.8E-02	8.7E-03
275.5	3.9E+03	1.2E+01	2.0E+00	5.7E-01	2.7E-01	1.6E-01	5.1E-02	2.6E-02	1.3E-02
290.5	5.7E+03	1.8E+01	2.9E+00	8.2E-01	3.9E-01	2.3E-01	7.4E-02	3.8E-02	1.9E-02
305.5	7.9E+03	2.5E+01	4.1E+00	1.1E+00	5.5E-01	3.2E-01	1.0E-01	5.3E-02	2.6E-02
320.5	1.0E+04	3.2E+01	5.2E+00	1.5E+00	7.0E-01	4.2E-01	1.3E-01	6.8E-02	3.3E-02
335.5	1.1E+04	3.6E+01	5.9E+00	1.7E+00	7.9E-01	4.7E-01	1.5E-01	7.6E-02	3.7E-02
350.5	1.1E+04	3.6E+01	5.9E+00	1.7E+00	7.9E-01	4.7E-01	1.5E-01	7.6E-02	3.8E-02
350.5	1.1E+04	3.6E+01	5.9E+00	1.7E+00	7.9E-01	4.7E-01	1.5E-01	7.6E-02	3.8E-02
352.4	1.2E+04	3.7E+01	6.1E+00	1.7E+00	8.1E-01	4.8E-01	1.5E-01	7.8E-02	3.9E-02
367.4	1.2E+04	3.8E+01	6.2E+00	1.7E+00	8.3E-01	4.9E-01	1.6E-01	8.0E-02	4.0E-02

Table C-2. Air Concentration Estimates for Excavation in Bay B – Bounding Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
382.4	1.2E+04	3.8E+01	6.3E+00	1.8E+00	8.4E-01	5.0E-01	1.6E-01	8.1E-02	4.0E-02
397.4	1.2E+04	3.8E+01	6.3E+00	1.8E+00	8.4E-01	5.0E-01	1.6E-01	8.1E-02	4.0E-02
412.4	1.2E+04	3.8E+01	6.1E+00	1.7E+00	8.2E-01	4.9E-01	1.5E-01	7.9E-02	3.9E-02
427.4	1.1E+04	3.6E+01	5.8E+00	1.6E+00	7.8E-01	4.6E-01	1.5E-01	7.5E-02	3.7E-02
442.4	1.0E+04	3.2E+01	5.3E+00	1.5E+00	7.1E-01	4.2E-01	1.3E-01	6.8E-02	3.4E-02
457.4	8.9E+03	2.8E+01	4.6E+00	1.3E+00	6.1E-01	3.6E-01	1.2E-01	5.9E-02	2.9E-02
472.4	8.6E+03	2.7E+01	4.4E+00	1.3E+00	6.0E-01	3.5E-01	1.1E-01	5.8E-02	2.8E-02
472.4	8.6E+03	2.7E+01	4.4E+00	1.3E+00	6.0E-01	3.5E-01	1.1E-01	5.8E-02	2.8E-02
472.9	9.5E+03	3.0E+01	4.9E+00	1.4E+00	6.6E-01	3.9E-01	1.2E-01	6.3E-02	3.1E-02
487.9	9.9E+03	3.1E+01	5.1E+00	1.4E+00	6.8E-01	4.0E-01	1.3E-01	6.6E-02	3.2E-02
502.9	9.9E+03	3.1E+01	5.1E+00	1.4E+00	6.8E-01	4.0E-01	1.3E-01	6.6E-02	3.2E-02
502.9	9.9E+03	3.1E+01	5.1E+00	1.4E+00	6.8E-01	4.0E-01	1.3E-01	6.6E-02	3.2E-02
508.7	9.9E+03	3.1E+01	5.1E+00	1.4E+00	6.8E-01	4.0E-01	1.3E-01	6.6E-02	3.2E-02
523.7	9.9E+03	3.1E+01	5.1E+00	1.4E+00	6.8E-01	4.0E-01	1.3E-01	6.6E-02	3.2E-02
538.7	9.9E+03	3.1E+01	5.1E+00	1.4E+00	6.8E-01	4.0E-01	1.3E-01	6.6E-02	3.2E-02
553.7	9.8E+03	3.1E+01	5.1E+00	1.4E+00	6.8E-01	4.0E-01	1.3E-01	6.6E-02	3.2E-02
568.7	9.8E+03	3.1E+01	5.1E+00	1.4E+00	6.8E-01	4.0E-01	1.3E-01	6.5E-02	3.2E-02
583.7	9.8E+03	3.1E+01	5.0E+00	1.4E+00	6.8E-01	4.0E-01	1.3E-01	6.5E-02	3.2E-02
598.7	9.8E+03	3.1E+01	5.0E+00	1.4E+00	6.8E-01	4.0E-01	1.3E-01	6.5E-02	3.2E-02
613.7	9.8E+03	3.1E+01	5.0E+00	1.4E+00	6.7E-01	4.0E-01	1.3E-01	6.5E-02	3.2E-02
628.7	9.7E+03	3.1E+01	5.0E+00	1.4E+00	6.7E-01	4.0E-01	1.3E-01	6.5E-02	3.2E-02
643.7	9.6E+03	3.0E+01	5.0E+00	1.4E+00	6.7E-01	4.0E-01	1.3E-01	6.4E-02	3.2E-02
658.7	9.6E+03	3.0E+01	4.9E+00	1.4E+00	6.6E-01	3.9E-01	1.2E-01	6.4E-02	3.1E-02
673.7	9.5E+03	3.0E+01	4.9E+00	1.4E+00	6.5E-01	3.9E-01	1.2E-01	6.3E-02	3.1E-02
688.7	9.3E+03	2.9E+01	4.8E+00	1.4E+00	6.4E-01	3.8E-01	1.2E-01	6.2E-02	3.1E-02
703.7	9.1E+03	2.9E+01	4.7E+00	1.3E+00	6.3E-01	3.7E-01	1.2E-01	6.1E-02	3.0E-02
718.7	8.8E+03	2.8E+01	4.5E+00	1.3E+00	6.1E-01	3.6E-01	1.1E-01	5.9E-02	2.9E-02
733.7	8.5E+03	2.7E+01	4.4E+00	1.2E+00	5.9E-01	3.5E-01	1.1E-01	5.7E-02	2.8E-02
748.7	8.0E+03	2.5E+01	4.1E+00	1.2E+00	5.6E-01	3.3E-01	1.0E-01	5.3E-02	2.6E-02
763.7	7.5E+03	2.4E+01	3.8E+00	1.1E+00	5.1E-01	3.1E-01	9.7E-02	5.0E-02	2.4E-02
778.7	6.7E+03	2.1E+01	3.5E+00	9.7E-01	4.6E-01	2.8E-01	8.7E-02	4.5E-02	2.2E-02
793.7	5.8E+03	1.8E+01	3.0E+00	8.4E-01	4.0E-01	2.4E-01	7.6E-02	3.9E-02	1.9E-02

Table C-2. Air Concentration Estimates for Excavation in Bay B – Bounding Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
808.7	4.7E+03	1.5E+01	2.4E+00	6.9E-01	3.3E-01	1.9E-01	6.1E-02	3.1E-02	1.6E-02
823.7	3.5E+03	1.1E+01	1.8E+00	5.0E-01	2.4E-01	1.4E-01	4.5E-02	2.3E-02	1.1E-02
838.7	2.1E+03	6.5E+00	1.1E+00	3.0E-01	1.4E-01	8.5E-02	2.7E-02	1.4E-02	6.8E-03
853.7	5.8E+02	1.8E+00	3.0E-01	8.5E-02	4.0E-02	2.4E-02	7.6E-03	3.9E-03	1.9E-03

Table C-3. Air Concentration Estimates for Excavation in Bay C – Bounding Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.3E-01	1.3E-03	2.2E-04	6.2E-05	3.0E-05	1.8E-05	5.6E-06	2.8E-06	1.4E-06
0.7	3.8E-01	1.2E-03	2.0E-04	5.6E-05	2.6E-05	1.6E-05	5.0E-06	2.5E-06	1.3E-06
15.7	2.9E-01	9.1E-04	1.5E-04	4.2E-05	2.0E-05	1.2E-05	3.7E-06	1.9E-06	9.5E-07
30.7	1.4E-01	4.4E-04	7.1E-05	2.0E-05	9.6E-06	5.7E-06	1.8E-06	9.2E-07	4.6E-07
45.7	1.3E-01	4.1E-04	6.7E-05	1.9E-05	9.0E-06	5.3E-06	1.7E-06	8.7E-07	4.3E-07
45.7	1.3E-01	4.1E-04	6.7E-05	1.9E-05	9.0E-06	5.3E-06	1.7E-06	8.7E-07	4.3E-07
47.2	1.4E-01	4.4E-04	7.2E-05	2.0E-05	9.7E-06	5.8E-06	1.8E-06	9.3E-07	4.6E-07
62.2	1.8E-01	5.8E-04	9.5E-05	2.7E-05	1.3E-05	7.6E-06	2.4E-06	1.2E-06	6.1E-07
77.2	3.9E-01	1.2E-03	2.0E-04	5.7E-05	2.7E-05	1.6E-05	5.1E-06	2.6E-06	1.3E-06
92.2	1.5E+00	4.6E-03	7.5E-04	2.1E-04	1.0E-04	6.0E-05	1.9E-05	9.7E-06	4.8E-06
107.2	8.7E+00	2.8E-02	4.5E-03	1.3E-03	6.0E-04	3.6E-04	1.1E-04	5.8E-05	2.9E-05
122.2	7.7E+01	2.4E-01	4.0E-02	1.1E-02	5.3E-03	3.2E-03	1.0E-03	5.1E-04	2.5E-04
137.2	8.0E+01	2.5E-01	4.1E-02	1.2E-02	5.6E-03	3.3E-03	1.0E-03	5.4E-04	2.6E-04
137.2	8.0E+01	2.5E-01	4.1E-02	1.2E-02	5.6E-03	3.3E-03	1.0E-03	5.4E-04	2.6E-04
140.5	1.1E+02	3.5E-01	5.8E-02	1.6E-02	7.8E-03	4.6E-03	1.5E-03	7.5E-04	3.7E-04
155.5	1.6E+02	5.0E-01	8.1E-02	2.3E-02	1.1E-02	6.5E-03	2.1E-03	1.1E-03	5.2E-04
170.5	2.3E+02	7.1E-01	1.2E-01	3.3E-02	1.6E-02	9.2E-03	2.9E-03	1.5E-03	7.4E-04
185.5	3.2E+02	1.0E+00	1.7E-01	4.7E-02	2.2E-02	1.3E-02	4.2E-03	2.2E-03	1.1E-03
200.5	4.7E+02	1.5E+00	2.4E-01	6.8E-02	3.2E-02	1.9E-02	6.1E-03	3.1E-03	1.5E-03
215.5	6.8E+02	2.2E+00	3.5E-01	9.9E-02	4.7E-02	2.8E-02	8.9E-03	4.6E-03	2.2E-03
230.5	1.0E+03	3.2E+00	5.2E-01	1.5E-01	7.0E-02	4.2E-02	1.3E-02	6.7E-03	3.3E-03
245.5	1.5E+03	4.8E+00	7.8E-01	2.2E-01	1.1E-01	6.2E-02	2.0E-02	1.0E-02	5.0E-03
260.5	2.3E+03	7.4E+00	1.2E+00	3.4E-01	1.6E-01	9.6E-02	3.0E-02	1.6E-02	7.7E-03
275.5	3.7E+03	1.2E+01	1.9E+00	5.4E-01	2.6E-01	1.5E-01	4.8E-02	2.5E-02	1.2E-02
290.5	6.1E+03	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
305.5	1.1E+04	3.3E+01	5.5E+00	1.5E+00	7.3E-01	4.3E-01	1.4E-01	7.1E-02	3.5E-02
320.5	1.8E+04	5.8E+01	9.4E+00	2.7E+00	1.3E+00	7.5E-01	2.4E-01	1.2E-01	6.0E-02
335.5	2.6E+04	8.1E+01	1.3E+01	3.7E+00	1.8E+00	1.1E+00	3.4E-01	1.7E-01	8.5E-02
350.5	2.6E+04	8.3E+01	1.3E+01	3.8E+00	1.8E+00	1.1E+00	3.4E-01	1.7E-01	8.6E-02
350.5	2.6E+04	8.3E+01	1.3E+01	3.8E+00	1.8E+00	1.1E+00	3.4E-01	1.7E-01	8.6E-02
352.4	3.0E+04	9.4E+01	1.5E+01	4.3E+00	2.1E+00	1.2E+00	3.9E-01	2.0E-01	9.8E-02
367.4	3.4E+04	1.1E+02	1.8E+01	5.0E+00	2.4E+00	1.4E+00	4.4E-01	2.3E-01	1.1E-01

Table C-3. Air Concentration Estimates for Excavation in Bay C – Bounding Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
382.4	4.0E+04	1.2E+02	2.0E+01	5.7E+00	2.7E+00	1.6E+00	5.1E-01	2.6E-01	1.3E-01
397.4	4.6E+04	1.5E+02	2.4E+01	6.7E+00	3.2E+00	1.9E+00	6.0E-01	3.1E-01	1.5E-01
412.4	5.4E+04	1.7E+02	2.8E+01	7.8E+00	3.7E+00	2.2E+00	7.0E-01	3.6E-01	1.8E-01
427.4	6.3E+04	2.0E+02	3.2E+01	9.1E+00	4.3E+00	2.6E+00	8.1E-01	4.2E-01	2.1E-01
442.4	7.0E+04	2.2E+02	3.6E+01	1.0E+01	4.8E+00	2.9E+00	9.1E-01	4.6E-01	2.3E-01
457.4	7.2E+04	2.3E+02	3.7E+01	1.0E+01	5.0E+00	3.0E+00	9.4E-01	4.8E-01	2.4E-01
472.4	7.2E+04	2.3E+02	3.7E+01	1.0E+01	5.0E+00	3.0E+00	9.4E-01	4.8E-01	2.4E-01
472.4	7.2E+04	2.3E+02	3.7E+01	1.0E+01	5.0E+00	3.0E+00	9.4E-01	4.8E-01	2.4E-01
472.9	8.8E+04	2.8E+02	4.5E+01	1.3E+01	6.1E+00	3.6E+00	1.1E+00	5.9E-01	2.9E-01
487.9	9.5E+04	3.0E+02	4.9E+01	1.4E+01	6.6E+00	3.9E+00	1.2E+00	6.3E-01	3.1E-01
502.9	9.5E+04	3.0E+02	4.9E+01	1.4E+01	6.6E+00	3.9E+00	1.2E+00	6.3E-01	3.1E-01
502.9	9.5E+04	3.0E+02	4.9E+01	1.4E+01	6.6E+00	3.9E+00	1.2E+00	6.3E-01	3.1E-01
505.3	1.1E+05	3.4E+02	5.6E+01	1.6E+01	7.5E+00	4.4E+00	1.4E+00	7.2E-01	3.6E-01
520.3	1.2E+05	3.9E+02	6.3E+01	1.8E+01	8.5E+00	5.1E+00	1.6E+00	8.2E-01	4.0E-01
535.3	1.4E+05	4.4E+02	7.2E+01	2.0E+01	9.7E+00	5.7E+00	1.8E+00	9.3E-01	4.6E-01
550.3	1.6E+05	5.0E+02	8.1E+01	2.3E+01	1.1E+01	6.5E+00	2.1E+00	1.1E+00	5.2E-01
565.3	1.8E+05	5.6E+02	9.2E+01	2.6E+01	1.2E+01	7.3E+00	2.3E+00	1.2E+00	5.9E-01
580.3	2.0E+05	6.3E+02	1.0E+02	2.9E+01	1.4E+01	8.2E+00	2.6E+00	1.3E+00	6.6E-01
595.3	2.2E+05	7.0E+02	1.1E+02	3.2E+01	1.5E+01	9.1E+00	2.9E+00	1.5E+00	7.3E-01
610.3	2.4E+05	7.7E+02	1.3E+02	3.5E+01	1.7E+01	1.0E+01	3.2E+00	1.6E+00	8.0E-01
625.3	2.6E+05	8.2E+02	1.3E+02	3.8E+01	1.8E+01	1.1E+01	3.4E+00	1.7E+00	8.5E-01
640.3	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
655.3	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
655.3	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
658.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
673.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
688.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.8E-01
703.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.7E-01
718.7	2.7E+05	8.4E+02	1.4E+02	3.9E+01	1.8E+01	1.1E+01	3.5E+00	1.8E+00	8.7E-01
733.7	2.7E+05	8.4E+02	1.4E+02	3.8E+01	1.8E+01	1.1E+01	3.4E+00	1.8E+00	8.7E-01
748.7	2.6E+05	8.3E+02	1.4E+02	3.8E+01	1.8E+01	1.1E+01	3.4E+00	1.8E+00	8.6E-01
763.7	2.6E+05	8.2E+02	1.3E+02	3.8E+01	1.8E+01	1.1E+01	3.4E+00	1.7E+00	8.5E-01

Table C-3. Air Concentration Estimates for Excavation in Bay C – Bounding Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
778.7	2.5E+05	8.0E+02	1.3E+02	3.7E+01	1.7E+01	1.0E+01	3.3E+00	1.7E+00	8.3E-01
793.7	2.4E+05	7.5E+02	1.2E+02	3.5E+01	1.7E+01	9.8E+00	3.1E+00	1.6E+00	7.8E-01
808.7	2.1E+05	6.8E+02	1.1E+02	3.1E+01	1.5E+01	8.8E+00	2.8E+00	1.4E+00	7.0E-01
823.7	1.7E+05	5.4E+02	8.8E+01	2.5E+01	1.2E+01	7.0E+00	2.2E+00	1.1E+00	5.6E-01
838.7	1.1E+05	3.3E+02	5.5E+01	1.5E+01	7.3E+00	4.3E+00	1.4E+00	7.1E-01	3.5E-01
853.7	2.1E+04	6.5E+01	1.1E+01	3.0E+00	1.4E+00	8.4E-01	2.7E-01	1.4E-01	6.7E-02

Table C-4. Air Concentration Estimates for Excavation in Bay D – Bounding Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.3E-01	1.3E-03	2.2E-04	6.2E-05	2.9E-05	1.7E-05	5.5E-06	2.8E-06	1.4E-06
0.7	3.8E-01	1.2E-03	2.0E-04	5.5E-05	2.6E-05	1.6E-05	5.0E-06	2.5E-06	1.2E-06
15.7	2.9E-01	9.0E-04	1.5E-04	4.2E-05	2.0E-05	1.2E-05	3.7E-06	1.9E-06	9.4E-07
30.7	1.4E-01	4.3E-04	7.0E-05	2.0E-05	9.4E-06	5.6E-06	1.8E-06	9.1E-07	4.5E-07
45.7	1.3E-01	4.0E-04	6.6E-05	1.9E-05	8.8E-06	5.2E-06	1.7E-06	8.5E-07	4.2E-07
45.7	1.3E-01	4.0E-04	6.6E-05	1.9E-05	8.8E-06	5.2E-06	1.7E-06	8.5E-07	4.2E-07
47.2	1.3E-01	4.1E-04	6.7E-05	1.9E-05	9.0E-06	5.3E-06	1.7E-06	8.6E-07	4.3E-07
62.2	1.4E-01	4.4E-04	7.1E-05	2.0E-05	9.6E-06	5.7E-06	1.8E-06	9.2E-07	4.5E-07
77.2	1.8E-01	5.6E-04	9.2E-05	2.6E-05	1.2E-05	7.3E-06	2.3E-06	1.2E-06	5.9E-07
92.2	3.9E-01	1.2E-03	2.0E-04	5.7E-05	2.7E-05	1.6E-05	5.1E-06	2.6E-06	1.3E-06
107.2	1.8E+00	5.7E-03	9.4E-04	2.6E-04	1.3E-04	7.5E-05	2.4E-05	1.2E-05	6.0E-06
122.2	1.5E+01	4.8E-02	7.8E-03	2.2E-03	1.0E-03	6.2E-04	2.0E-04	1.0E-04	5.0E-05
137.2	1.6E+01	5.0E-02	8.2E-03	2.3E-03	1.1E-03	6.5E-04	2.1E-04	1.1E-04	5.2E-05
137.2	1.6E+01	5.0E-02	8.2E-03	2.3E-03	1.1E-03	6.5E-04	2.1E-04	1.1E-04	5.2E-05
146.3	1.9E+01	6.0E-02	9.8E-03	2.8E-03	1.3E-03	7.8E-04	2.5E-04	1.3E-04	6.2E-05
161.3	2.4E+01	7.4E-02	1.2E-02	3.4E-03	1.6E-03	9.6E-04	3.1E-04	1.6E-04	7.7E-05
176.3	3.0E+01	9.5E-02	1.5E-02	4.4E-03	2.1E-03	1.2E-03	3.9E-04	2.0E-04	9.8E-05
191.3	3.9E+01	1.2E-01	2.0E-02	5.7E-03	2.7E-03	1.6E-03	5.1E-04	2.6E-04	1.3E-04
206.3	5.3E+01	1.7E-01	2.7E-02	7.7E-03	3.7E-03	2.2E-03	6.9E-04	3.5E-04	1.7E-04
221.3	7.3E+01	2.3E-01	3.7E-02	1.1E-02	5.0E-03	3.0E-03	9.5E-04	4.8E-04	2.4E-04
236.3	1.0E+02	3.2E-01	5.2E-02	1.5E-02	7.0E-03	4.2E-03	1.3E-03	6.8E-04	3.3E-04
251.3	1.4E+02	4.5E-01	7.4E-02	2.1E-02	1.0E-02	5.9E-03	1.9E-03	9.6E-04	4.7E-04
266.3	2.1E+02	6.5E-01	1.1E-01	3.0E-02	1.4E-02	8.5E-03	2.7E-03	1.4E-03	6.8E-04
281.3	3.0E+02	9.5E-01	1.6E-01	4.4E-02	2.1E-02	1.2E-02	3.9E-03	2.0E-03	9.9E-04
296.3	4.5E+02	1.4E+00	2.3E-01	6.5E-02	3.1E-02	1.8E-02	5.8E-03	3.0E-03	1.5E-03
311.3	6.8E+02	2.1E+00	3.5E-01	9.9E-02	4.7E-02	2.8E-02	8.8E-03	4.5E-03	2.2E-03
326.3	1.1E+03	3.3E+00	5.5E-01	1.5E-01	7.3E-02	4.3E-02	1.4E-02	7.1E-03	3.5E-03
341.3	1.7E+03	5.4E+00	8.8E-01	2.5E-01	1.2E-01	7.1E-02	2.2E-02	1.1E-02	5.6E-03
356.3	2.9E+03	9.2E+00	1.5E+00	4.2E-01	2.0E-01	1.2E-01	3.8E-02	1.9E-02	9.6E-03
371.3	5.1E+03	1.6E+01	2.6E+00	7.4E-01	3.5E-01	2.1E-01	6.6E-02	3.4E-02	1.7E-02
386.3	8.1E+03	2.5E+01	4.2E+00	1.2E+00	5.6E-01	3.3E-01	1.0E-01	5.4E-02	2.6E-02
401.3	8.9E+03	2.8E+01	4.6E+00	1.3E+00	6.2E-01	3.7E-01	1.2E-01	5.9E-02	2.9E-02

Table C-4. Air Concentration Estimates for Excavation in Bay D – Bounding Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
406.1	8.9E+03	2.8E+01	4.6E+00	1.3E+00	6.2E-01	3.7E-01	1.2E-01	5.9E-02	2.9E-02
421.1	8.9E+03	2.8E+01	4.6E+00	1.3E+00	6.2E-01	3.7E-01	1.2E-01	6.0E-02	2.9E-02
436.1	9.0E+03	2.8E+01	4.6E+00	1.3E+00	6.2E-01	3.7E-01	1.2E-01	6.0E-02	2.9E-02
451.1	9.0E+03	2.8E+01	4.6E+00	1.3E+00	6.2E-01	3.7E-01	1.2E-01	6.0E-02	2.9E-02
466.1	9.0E+03	2.8E+01	4.6E+00	1.3E+00	6.2E-01	3.7E-01	1.2E-01	6.0E-02	2.9E-02
481.1	9.0E+03	2.8E+01	4.6E+00	1.3E+00	6.2E-01	3.7E-01	1.2E-01	6.0E-02	2.9E-02
496.1	9.0E+03	2.8E+01	4.6E+00	1.3E+00	6.2E-01	3.7E-01	1.2E-01	6.0E-02	2.9E-02
511.1	9.0E+03	2.8E+01	4.6E+00	1.3E+00	6.2E-01	3.7E-01	1.2E-01	6.0E-02	2.9E-02
526.1	8.9E+03	2.8E+01	4.6E+00	1.3E+00	6.2E-01	3.7E-01	1.2E-01	5.9E-02	2.9E-02
541.1	8.9E+03	2.8E+01	4.6E+00	1.3E+00	6.1E-01	3.6E-01	1.2E-01	5.9E-02	2.9E-02
556.1	8.8E+03	2.8E+01	4.5E+00	1.3E+00	6.1E-01	3.6E-01	1.1E-01	5.8E-02	2.9E-02
571.1	8.7E+03	2.7E+01	4.4E+00	1.3E+00	6.0E-01	3.5E-01	1.1E-01	5.8E-02	2.8E-02
586.1	8.4E+03	2.7E+01	4.3E+00	1.2E+00	5.8E-01	3.5E-01	1.1E-01	5.6E-02	2.8E-02
601.1	8.1E+03	2.6E+01	4.2E+00	1.2E+00	5.6E-01	3.3E-01	1.1E-01	5.4E-02	2.7E-02
616.1	7.7E+03	2.4E+01	4.0E+00	1.1E+00	5.3E-01	3.2E-01	1.0E-01	5.1E-02	2.5E-02
631.1	7.1E+03	2.2E+01	3.7E+00	1.0E+00	4.9E-01	2.9E-01	9.2E-02	4.7E-02	2.3E-02
646.1	6.4E+03	2.0E+01	3.3E+00	9.2E-01	4.4E-01	2.6E-01	8.3E-02	4.2E-02	2.1E-02
661.1	5.4E+03	1.7E+01	2.8E+00	7.8E-01	3.7E-01	2.2E-01	7.0E-02	3.6E-02	1.8E-02
676.1	4.2E+03	1.3E+01	2.2E+00	6.1E-01	2.9E-01	1.7E-01	5.5E-02	2.8E-02	1.4E-02
691.1	2.7E+03	8.7E+00	1.4E+00	4.0E-01	1.9E-01	1.1E-01	3.6E-02	1.8E-02	9.0E-03
706.1	2.2E+03	7.0E+00	1.1E+00	3.2E-01	1.5E-01	9.1E-02	2.9E-02	1.5E-02	7.3E-03
706.1	2.2E+03	7.0E+00	1.1E+00	3.2E-01	1.5E-01	9.1E-02	2.9E-02	1.5E-02	7.3E-03
707.6	2.9E+03	9.2E+00	1.5E+00	4.2E-01	2.0E-01	1.2E-01	3.8E-02	1.9E-02	9.6E-03
722.6	3.9E+03	1.2E+01	2.0E+00	5.6E-01	2.7E-01	1.6E-01	5.0E-02	2.6E-02	1.3E-02
737.6	5.2E+03	1.6E+01	2.7E+00	7.5E-01	3.6E-01	2.1E-01	6.7E-02	3.4E-02	1.7E-02
752.6	6.7E+03	2.1E+01	3.5E+00	9.8E-01	4.7E-01	2.8E-01	8.8E-02	4.5E-02	2.2E-02
767.6	8.3E+03	2.6E+01	4.3E+00	1.2E+00	5.7E-01	3.4E-01	1.1E-01	5.5E-02	2.7E-02
782.6	9.0E+03	2.9E+01	4.7E+00	1.3E+00	6.2E-01	3.7E-01	1.2E-01	6.0E-02	3.0E-02
797.6	9.1E+03	2.9E+01	4.7E+00	1.3E+00	6.3E-01	3.7E-01	1.2E-01	6.0E-02	3.0E-02
797.6	9.1E+03	2.9E+01	4.7E+00	1.3E+00	6.3E-01	3.7E-01	1.2E-01	6.0E-02	3.0E-02
800.0	8.8E+03	2.8E+01	4.5E+00	1.3E+00	6.1E-01	3.6E-01	1.1E-01	5.8E-02	2.9E-02
815.0	8.4E+03	2.6E+01	4.3E+00	1.2E+00	5.8E-01	3.4E-01	1.1E-01	5.6E-02	2.8E-02

Table C-4. Air Concentration Estimates for Excavation in Bay D – Bounding Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
830.0	7.9E+03	2.5E+01	4.1E+00	1.1E+00	5.5E-01	3.2E-01	1.0E-01	5.3E-02	2.6E-02
845.0	7.3E+03	2.3E+01	3.8E+00	1.1E+00	5.0E-01	3.0E-01	9.5E-02	4.9E-02	2.4E-02
860.0	6.5E+03	2.1E+01	3.4E+00	9.5E-01	4.5E-01	2.7E-01	8.5E-02	4.3E-02	2.1E-02
875.0	5.6E+03	1.8E+01	2.9E+00	8.1E-01	3.9E-01	2.3E-01	7.3E-02	3.7E-02	1.8E-02
890.0	4.5E+03	1.4E+01	2.3E+00	6.5E-01	3.1E-01	1.8E-01	5.8E-02	3.0E-02	1.5E-02
905.0	3.2E+03	1.0E+01	1.6E+00	4.6E-01	2.2E-01	1.3E-01	4.1E-02	2.1E-02	1.0E-02
920.0	1.7E+03	5.5E+00	9.0E-01	2.5E-01	1.2E-01	7.2E-02	2.3E-02	1.2E-02	5.7E-03
935.0	2.4E+02	7.7E-01	1.3E-01	3.5E-02	1.7E-02	1.0E-02	3.2E-03	1.6E-03	8.0E-04

Table C-5. Air Concentration Estimates for Excavation in Bays A, B, C and D Concurrently – Bounding Meteorology

Depth (cm)	Emissions (500 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
		250m	500m	750m	1000m	2000m	3000m	5000m
0.0	6.8E-03	1.1E-03	3.1E-04	1.5E-04	8.9E-05	2.8E-05	1.4E-05	7.1E-06
0.7	6.2E-03	1.0E-03	2.8E-04	1.3E-04	8.0E-05	2.5E-05	1.3E-05	6.4E-06
15.7	4.7E-03	7.6E-04	2.2E-04	1.0E-04	6.1E-05	1.9E-05	9.9E-06	4.9E-06
30.7	2.3E-03	3.8E-04	1.1E-04	5.1E-05	3.0E-05	9.6E-06	4.9E-06	2.4E-06
45.7	2.2E-03	3.6E-04	1.0E-04	4.8E-05	2.8E-05	9.0E-06	4.6E-06	2.3E-06
45.7	2.2E-03	3.6E-04	1.0E-04	4.8E-05	2.8E-05	9.0E-06	4.6E-06	2.3E-06
47.2	2.8E-03	4.5E-04	1.3E-04	6.1E-05	3.6E-05	1.1E-05	5.9E-06	2.9E-06
62.2	5.3E-03	8.7E-04	2.4E-04	1.2E-04	6.9E-05	2.2E-05	1.1E-05	5.5E-06
77.2	1.7E-02	2.7E-03	7.7E-04	3.6E-04	2.2E-04	6.9E-05	3.5E-05	1.7E-05
92.2	7.1E-02	1.2E-02	3.3E-03	1.6E-03	9.2E-04	2.9E-04	1.5E-04	7.4E-05
107.2	3.9E-01	6.3E-02	1.8E-02	8.5E-03	5.0E-03	1.6E-03	8.2E-04	4.0E-04
122.2	2.8E+00	4.5E-01	1.3E-01	6.1E-02	3.6E-02	1.1E-02	5.9E-03	2.9E-03
137.2	2.9E+00	4.7E-01	1.3E-01	6.3E-02	3.8E-02	1.2E-02	6.1E-03	3.0E-03
137.2	2.9E+00	4.7E-01	1.3E-01	6.3E-02	3.8E-02	1.2E-02	6.1E-03	3.0E-03
146.3	4.1E+00	6.7E-01	1.9E-01	9.0E-02	5.4E-02	1.7E-02	8.7E-03	4.3E-03
161.3	5.9E+00	9.6E-01	2.7E-01	1.3E-01	7.7E-02	2.4E-02	1.2E-02	6.1E-03
176.3	8.5E+00	1.4E+00	3.9E-01	1.9E-01	1.1E-01	3.5E-02	1.8E-02	8.8E-03
191.3	1.2E+01	2.0E+00	5.6E-01	2.7E-01	1.6E-01	5.0E-02	2.6E-02	1.3E-02
206.3	1.8E+01	2.9E+00	8.2E-01	3.9E-01	2.3E-01	7.3E-02	3.7E-02	1.8E-02
221.3	2.6E+01	4.2E+00	1.2E+00	5.7E-01	3.4E-01	1.1E-01	5.5E-02	2.7E-02
236.3	3.8E+01	6.2E+00	1.8E+00	8.4E-01	5.0E-01	1.6E-01	8.1E-02	4.0E-02
251.3	5.7E+01	9.3E+00	2.6E+00	1.2E+00	7.4E-01	2.3E-01	1.2E-01	5.9E-02
266.3	8.6E+01	1.4E+01	4.0E+00	1.9E+00	1.1E+00	3.6E-01	1.8E-01	9.0E-02
281.3	1.3E+02	2.2E+01	6.2E+00	2.9E+00	1.7E+00	5.5E-01	2.8E-01	1.4E-01
296.3	2.2E+02	3.5E+01	9.9E+00	4.7E+00	2.8E+00	8.9E-01	4.5E-01	2.2E-01
311.3	3.6E+02	5.8E+01	1.7E+01	7.9E+00	4.7E+00	1.5E+00	7.6E-01	3.7E-01
326.3	5.9E+02	9.7E+01	2.7E+01	1.3E+01	7.7E+00	2.4E+00	1.3E+00	6.2E-01
341.3	8.1E+02	1.3E+02	3.7E+01	1.8E+01	1.1E+01	3.3E+00	1.7E+00	8.5E-01
356.3	9.5E+02	1.5E+02	4.4E+01	2.1E+01	1.2E+01	3.9E+00	2.0E+00	9.8E-01
371.3	1.0E+03	1.7E+02	4.7E+01	2.2E+01	1.3E+01	4.2E+00	2.2E+00	1.1E+00
386.3	1.1E+03	1.7E+02	4.9E+01	2.3E+01	1.4E+01	4.4E+00	2.2E+00	1.1E+00

Table C-5. Air Concentration Estimates for Excavation in Bays A, B, C and D Concurrently – Bounding Meteorology (continued)

Depth (cm)	Emissions (500 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
		250m	500m	750m	1000m	2000m	3000m	5000m
401.3	1.1E+03	1.8E+02	5.0E+01	2.4E+01	1.4E+01	4.5E+00	2.3E+00	1.1E+00
406.1	1.1E+03	1.8E+02	5.0E+01	2.4E+01	1.4E+01	4.5E+00	2.3E+00	1.1E+00
421.1	1.1E+03	1.8E+02	5.1E+01	2.4E+01	1.4E+01	4.6E+00	2.3E+00	1.2E+00
436.1	1.1E+03	1.8E+02	5.2E+01	2.5E+01	1.5E+01	4.7E+00	2.4E+00	1.2E+00
451.1	1.2E+03	1.9E+02	5.3E+01	2.5E+01	1.5E+01	4.7E+00	2.4E+00	1.2E+00
466.1	1.2E+03	1.9E+02	5.3E+01	2.5E+01	1.5E+01	4.8E+00	2.4E+00	1.2E+00
481.1	1.2E+03	2.0E+02	5.5E+01	2.6E+01	1.6E+01	5.0E+00	2.5E+00	1.3E+00
496.1	1.2E+03	2.0E+02	5.7E+01	2.7E+01	1.6E+01	5.1E+00	2.6E+00	1.3E+00
511.1	1.3E+03	2.1E+02	5.9E+01	2.8E+01	1.7E+01	5.2E+00	2.7E+00	1.3E+00
526.1	1.3E+03	2.1E+02	6.1E+01	2.9E+01	1.7E+01	5.4E+00	2.8E+00	1.4E+00
541.1	1.4E+03	2.2E+02	6.3E+01	3.0E+01	1.8E+01	5.6E+00	2.9E+00	1.4E+00
556.1	1.4E+03	2.3E+02	6.6E+01	3.1E+01	1.9E+01	5.9E+00	3.0E+00	1.5E+00
571.1	1.5E+03	2.4E+02	6.9E+01	3.3E+01	1.9E+01	6.1E+00	3.1E+00	1.6E+00
586.1	1.6E+03	2.5E+02	7.2E+01	3.4E+01	2.0E+01	6.4E+00	3.3E+00	1.6E+00
601.1	1.6E+03	2.6E+02	7.5E+01	3.6E+01	2.1E+01	6.7E+00	3.4E+00	1.7E+00
616.1	1.7E+03	2.8E+02	7.8E+01	3.7E+01	2.2E+01	7.0E+00	3.6E+00	1.8E+00
631.1	1.7E+03	2.8E+02	8.0E+01	3.8E+01	2.3E+01	7.2E+00	3.7E+00	1.8E+00
646.1	1.8E+03	2.9E+02	8.1E+01	3.8E+01	2.3E+01	7.2E+00	3.7E+00	1.8E+00
661.1	1.7E+03	2.8E+02	8.0E+01	3.8E+01	2.3E+01	7.2E+00	3.7E+00	1.8E+00
676.1	1.7E+03	2.8E+02	8.0E+01	3.8E+01	2.3E+01	7.2E+00	3.7E+00	1.8E+00
691.1	1.7E+03	2.8E+02	8.0E+01	3.8E+01	2.2E+01	7.1E+00	3.7E+00	1.8E+00
706.1	1.7E+03	2.8E+02	7.9E+01	3.8E+01	2.2E+01	7.1E+00	3.6E+00	1.8E+00
706.1	1.7E+03	2.8E+02	7.9E+01	3.8E+01	2.2E+01	7.1E+00	3.6E+00	1.8E+00
707.6	1.7E+03	2.8E+02	8.0E+01	3.8E+01	2.2E+01	7.1E+00	3.6E+00	1.8E+00
722.6	1.7E+03	2.8E+02	8.0E+01	3.8E+01	2.3E+01	7.1E+00	3.7E+00	1.8E+00
737.6	1.7E+03	2.8E+02	8.0E+01	3.8E+01	2.3E+01	7.1E+00	3.7E+00	1.8E+00
752.6	1.7E+03	2.8E+02	8.0E+01	3.8E+01	2.3E+01	7.1E+00	3.7E+00	1.8E+00
767.6	1.7E+03	2.8E+02	7.9E+01	3.8E+01	2.2E+01	7.1E+00	3.6E+00	1.8E+00
782.6	1.7E+03	2.7E+02	7.7E+01	3.7E+01	2.2E+01	6.9E+00	3.5E+00	1.7E+00
797.6	1.6E+03	2.6E+02	7.4E+01	3.5E+01	2.1E+01	6.6E+00	3.4E+00	1.7E+00
797.6	1.6E+03	2.6E+02	7.4E+01	3.5E+01	2.1E+01	6.6E+00	3.4E+00	1.7E+00

Table C-5. Air Concentration Estimates for Excavation in Bays A, B, C and D Concurrently – Bounding Meteorology (continued)

Depth (cm)	Emissions (500 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
		250m	500m	750m	1000m	2000m	3000m	5000m
800.0	1.6E+03	2.6E+02	7.4E+01	3.5E+01	2.1E+01	6.6E+00	3.4E+00	1.7E+00
815.0	1.4E+03	2.4E+02	6.7E+01	3.2E+01	1.9E+01	6.0E+00	3.1E+00	1.5E+00
830.0	1.2E+03	1.9E+02	5.5E+01	2.6E+01	1.5E+01	4.9E+00	2.5E+00	1.2E+00
845.0	7.9E+02	1.3E+02	3.6E+01	1.7E+01	1.0E+01	3.3E+00	1.7E+00	8.2E-01
860.0	2.5E+02	4.1E+01	1.2E+01	5.6E+00	3.3E+00	1.0E+00	5.4E-01	2.6E-01
875.0	3.5E+01	5.7E+00	1.6E+00	7.7E-01	4.6E-01	1.5E-01	7.4E-02	3.7E-02
890.0	2.8E+01	4.6E+00	1.3E+00	6.2E-01	3.7E-01	1.2E-01	5.9E-02	2.9E-02
905.0	2.0E+01	3.3E+00	9.2E-01	4.4E-01	2.6E-01	8.2E-02	4.2E-02	2.1E-02
920.0	1.1E+01	1.8E+00	5.1E-01	2.4E-01	1.4E-01	4.5E-02	2.3E-02	1.1E-02
935.0	1.5E+00	2.5E-01	7.1E-02	3.4E-02	2.0E-02	6.3E-03	3.2E-03	1.6E-03

Table C-6. Air Concentration Estimates for Wall Collapse in Bay A – Bounding Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (69 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.4E-01	9.6E-04	1.6E-04	4.4E-05	2.1E-05	1.2E-05	3.9E-06	2.0E-06	9.9E-07
0.7	4.0E-01	8.7E-04	1.4E-04	4.0E-05	1.9E-05	1.1E-05	3.6E-06	1.8E-06	9.0E-07
15.7	3.1E-01	6.7E-04	1.1E-04	3.1E-05	1.5E-05	8.8E-06	2.8E-06	1.4E-06	7.0E-07
30.7	1.6E-01	3.6E-04	5.8E-05	1.6E-05	7.8E-06	4.6E-06	1.5E-06	7.5E-07	3.7E-07
45.7	1.5E-01	3.4E-04	5.5E-05	1.6E-05	7.4E-06	4.4E-06	1.4E-06	7.1E-07	3.5E-07
45.7	1.5E-01	3.4E-04	5.5E-05	1.6E-05	7.4E-06	4.4E-06	1.4E-06	7.1E-07	3.5E-07
47.2	2.5E-01	5.3E-04	8.7E-05	2.5E-05	1.2E-05	6.9E-06	2.2E-06	1.1E-06	5.6E-07
62.2	6.4E-01	1.4E-03	2.3E-04	6.4E-05	3.1E-05	1.8E-05	5.8E-06	2.9E-06	1.5E-06
77.2	2.5E+00	5.4E-03	8.8E-04	2.5E-04	1.2E-04	7.0E-05	2.2E-05	1.1E-05	5.6E-06
92.2	1.2E+01	2.6E-02	4.3E-03	1.2E-03	5.8E-04	3.4E-04	1.1E-04	5.6E-05	2.7E-05
107.2	7.8E+01	1.7E-01	2.8E-02	7.8E-03	3.7E-03	2.2E-03	7.0E-04	3.6E-04	1.8E-04
122.2	6.9E+02	1.5E+00	2.4E-01	6.9E-02	3.3E-02	2.0E-02	6.2E-03	3.2E-03	1.6E-03
137.2	7.2E+02	1.6E+00	2.6E-01	7.2E-02	3.4E-02	2.0E-02	6.5E-03	3.3E-03	1.6E-03
137.2	7.2E+02	1.6E+00	2.6E-01	7.2E-02	3.4E-02	2.0E-02	6.5E-03	3.3E-03	1.6E-03
140.5	1.0E+03	2.3E+00	3.7E-01	1.0E-01	4.9E-02	2.9E-02	9.3E-03	4.8E-03	2.3E-03
155.5	1.5E+03	3.2E+00	5.3E-01	1.5E-01	7.1E-02	4.2E-02	1.3E-02	6.9E-03	3.4E-03
170.5	2.2E+03	4.7E+00	7.6E-01	2.2E-01	1.0E-01	6.1E-02	1.9E-02	9.9E-03	4.9E-03
185.5	3.1E+03	6.8E+00	1.1E+00	3.1E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	7.0E-03
200.5	4.5E+03	9.8E+00	1.6E+00	4.5E-01	2.2E-01	1.3E-01	4.0E-02	2.1E-02	1.0E-02
215.5	6.6E+03	1.4E+01	2.3E+00	6.6E-01	3.1E-01	1.9E-01	5.9E-02	3.0E-02	1.5E-02
230.5	9.7E+03	2.1E+01	3.4E+00	9.7E-01	4.6E-01	2.7E-01	8.7E-02	4.4E-02	2.2E-02
245.5	1.4E+04	3.1E+01	5.1E+00	1.4E+00	6.9E-01	4.1E-01	1.3E-01	6.6E-02	3.3E-02
260.5	2.2E+04	4.8E+01	7.8E+00	2.2E+00	1.0E+00	6.2E-01	2.0E-01	1.0E-01	5.0E-02
275.5	3.4E+04	7.5E+01	1.2E+01	3.4E+00	1.6E+00	9.7E-01	3.1E-01	1.6E-01	7.8E-02
290.5	5.6E+04	1.2E+02	2.0E+01	5.6E+00	2.7E+00	1.6E+00	5.0E-01	2.6E-01	1.3E-01
305.5	9.4E+04	2.0E+02	3.3E+01	9.4E+00	4.5E+00	2.7E+00	8.4E-01	4.3E-01	2.1E-01
320.5	1.6E+05	3.4E+02	5.6E+01	1.6E+01	7.5E+00	4.5E+00	1.4E+00	7.2E-01	3.6E-01
335.5	2.2E+05	4.7E+02	7.7E+01	2.2E+01	1.0E+01	6.1E+00	1.9E+00	1.0E+00	4.9E-01
350.5	2.2E+05	4.8E+02	7.8E+01	2.2E+01	1.0E+01	6.2E+00	2.0E+00	1.0E+00	5.0E-01
350.5	2.2E+05	4.8E+02	7.8E+01	2.2E+01	1.0E+01	6.2E+00	2.0E+00	1.0E+00	5.0E-01
351.0	2.5E+05	5.5E+02	9.0E+01	2.5E+01	1.2E+01	7.1E+00	2.3E+00	1.2E+00	5.7E-01
366.0	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
381.0	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
381.0	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
388.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
403.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01

Table C-6. Air Concentration Estimates for Wall Collapse in Bay A – Bounding Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (69 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
418.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
433.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
448.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
463.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
478.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
493.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
508.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
523.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
538.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
553.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
568.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
583.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
598.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
613.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
628.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
643.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
658.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
673.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.6E+00	2.4E+00	1.2E+00	6.0E-01
688.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.5E+00	2.4E+00	1.2E+00	6.0E-01
703.7	2.7E+05	5.8E+02	9.5E+01	2.7E+01	1.3E+01	7.5E+00	2.4E+00	1.2E+00	6.0E-01
718.7	2.7E+05	5.8E+02	9.4E+01	2.7E+01	1.3E+01	7.5E+00	2.4E+00	1.2E+00	6.0E-01
733.7	2.7E+05	5.8E+02	9.4E+01	2.7E+01	1.3E+01	7.5E+00	2.4E+00	1.2E+00	6.0E-01
748.7	2.6E+05	5.7E+02	9.4E+01	2.6E+01	1.3E+01	7.5E+00	2.4E+00	1.2E+00	6.0E-01
763.7	2.6E+05	5.7E+02	9.3E+01	2.6E+01	1.2E+01	7.4E+00	2.3E+00	1.2E+00	5.9E-01
778.7	2.6E+05	5.6E+02	9.1E+01	2.6E+01	1.2E+01	7.2E+00	2.3E+00	1.2E+00	5.8E-01
793.7	2.4E+05	5.3E+02	8.7E+01	2.4E+01	1.2E+01	6.9E+00	2.2E+00	1.1E+00	5.5E-01
808.7	2.2E+05	4.9E+02	7.9E+01	2.2E+01	1.1E+01	6.3E+00	2.0E+00	1.0E+00	5.1E-01
823.7	1.9E+05	4.1E+02	6.6E+01	1.9E+01	8.9E+00	5.3E+00	1.7E+00	8.6E-01	4.2E-01
838.7	1.3E+05	2.8E+02	4.5E+01	1.3E+01	6.1E+00	3.6E+00	1.1E+00	5.9E-01	2.9E-01
853.7	4.6E+04	1.0E+02	1.6E+01	4.7E+00	2.2E+00	1.3E+00	4.2E-01	2.1E-01	1.1E-01

Table C-7. Air Concentration Estimates for Drilling in Bay A – Bounding Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (2.3 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.4E-01	3.2E-05	5.2E-06	1.5E-06	7.0E-07	4.1E-07	1.3E-07	6.7E-08	3.3E-08
0.7	4.0E-01	2.9E-05	4.7E-06	1.3E-06	6.3E-07	3.8E-07	1.2E-07	6.1E-08	3.0E-08
15.7	3.1E-01	2.2E-05	3.7E-06	1.0E-06	4.9E-07	2.9E-07	9.3E-08	4.7E-08	2.3E-08
30.7	1.6E-01	1.2E-05	1.9E-06	5.5E-07	2.6E-07	1.5E-07	4.9E-08	2.5E-08	1.2E-08
45.7	1.5E-01	1.1E-05	1.8E-06	5.2E-07	2.5E-07	1.5E-07	4.6E-08	2.4E-08	1.2E-08
45.7	1.5E-01	1.1E-05	1.8E-06	5.2E-07	2.5E-07	1.5E-07	4.6E-08	2.4E-08	1.2E-08
47.2	2.5E-01	1.8E-05	2.9E-06	8.2E-07	3.9E-07	2.3E-07	7.3E-08	3.8E-08	1.9E-08
62.2	6.4E-01	4.7E-05	7.6E-06	2.1E-06	1.0E-06	6.1E-07	1.9E-07	9.8E-08	4.8E-08
77.2	2.5E+00	1.8E-04	2.9E-05	8.3E-06	3.9E-06	2.3E-06	7.4E-07	3.8E-07	1.9E-07
92.2	1.2E+01	8.8E-04	1.4E-04	4.0E-05	1.9E-05	1.1E-05	3.6E-06	1.9E-06	9.1E-07
107.2	7.8E+01	5.6E-03	9.2E-04	2.6E-04	1.2E-04	7.3E-05	2.3E-05	1.2E-05	5.8E-06
122.2	6.9E+02	5.0E-02	8.2E-03	2.3E-03	1.1E-03	6.5E-04	2.1E-04	1.1E-04	5.2E-05
137.2	7.2E+02	5.2E-02	8.5E-03	2.4E-03	1.1E-03	6.8E-04	2.2E-04	1.1E-04	5.5E-05
137.2	7.2E+02	5.2E-02	8.5E-03	2.4E-03	1.1E-03	6.8E-04	2.2E-04	1.1E-04	5.5E-05
140.5	1.0E+03	7.5E-02	1.2E-02	3.5E-03	1.6E-03	9.8E-04	3.1E-04	1.6E-04	7.8E-05
155.5	1.5E+03	1.1E-01	1.8E-02	5.0E-03	2.4E-03	1.4E-03	4.5E-04	2.3E-04	1.1E-04
170.5	2.2E+03	1.6E-01	2.5E-02	7.2E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
185.5	3.1E+03	2.3E-01	3.7E-02	1.0E-02	4.9E-03	2.9E-03	9.3E-04	4.8E-04	2.3E-04
200.5	4.5E+03	3.3E-01	5.3E-02	1.5E-02	7.2E-03	4.3E-03	1.3E-03	6.9E-04	3.4E-04
215.5	6.6E+03	4.8E-01	7.8E-02	2.2E-02	1.0E-02	6.2E-03	2.0E-03	1.0E-03	5.0E-04
230.5	9.7E+03	7.0E-01	1.1E-01	3.2E-02	1.5E-02	9.1E-03	2.9E-03	1.5E-03	7.3E-04
245.5	1.4E+04	1.0E+00	1.7E-01	4.8E-02	2.3E-02	1.4E-02	4.3E-03	2.2E-03	1.1E-03
260.5	2.2E+04	1.6E+00	2.6E-01	7.3E-02	3.5E-02	2.1E-02	6.6E-03	3.4E-03	1.7E-03
275.5	3.4E+04	2.5E+00	4.1E-01	1.1E-01	5.4E-02	3.2E-02	1.0E-02	5.2E-03	2.6E-03
290.5	5.6E+04	4.0E+00	6.6E-01	1.9E-01	8.8E-02	5.2E-02	1.7E-02	8.5E-03	4.2E-03
305.5	9.4E+04	6.8E+00	1.1E+00	3.1E-01	1.5E-01	8.9E-02	2.8E-02	1.4E-02	7.1E-03
320.5	1.6E+05	1.1E+01	1.9E+00	5.3E-01	2.5E-01	1.5E-01	4.7E-02	2.4E-02	1.2E-02
335.5	2.2E+05	1.6E+01	2.6E+00	7.2E-01	3.4E-01	2.0E-01	6.5E-02	3.3E-02	1.6E-02
350.5	2.2E+05	1.6E+01	2.6E+00	7.3E-01	3.5E-01	2.1E-01	6.6E-02	3.4E-02	1.7E-02
350.5	2.2E+05	1.6E+01	2.6E+00	7.3E-01	3.5E-01	2.1E-01	6.6E-02	3.4E-02	1.7E-02
351.0	2.5E+05	1.8E+01	3.0E+00	8.4E-01	4.0E-01	2.4E-01	7.5E-02	3.9E-02	1.9E-02
366.0	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02

Table C-7. Air Concentration Estimates for Drilling in Bay A – Bounding Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (2.3 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
381.0	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
381.0	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
388.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
403.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
418.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
433.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
448.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
463.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
478.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
493.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
508.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
523.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
538.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
553.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
568.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
583.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
598.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
613.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
628.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
643.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
658.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
673.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
688.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
703.7	2.7E+05	1.9E+01	3.2E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
718.7	2.7E+05	1.9E+01	3.1E+00	8.9E-01	4.2E-01	2.5E-01	8.0E-02	4.1E-02	2.0E-02
733.7	2.7E+05	1.9E+01	3.1E+00	8.9E-01	4.2E-01	2.5E-01	7.9E-02	4.1E-02	2.0E-02
748.7	2.6E+05	1.9E+01	3.1E+00	8.8E-01	4.2E-01	2.5E-01	7.9E-02	4.0E-02	2.0E-02
763.7	2.6E+05	1.9E+01	3.1E+00	8.7E-01	4.1E-01	2.5E-01	7.8E-02	4.0E-02	2.0E-02
778.7	2.6E+05	1.9E+01	3.0E+00	8.5E-01	4.1E-01	2.4E-01	7.6E-02	3.9E-02	1.9E-02
793.7	2.4E+05	1.8E+01	2.9E+00	8.1E-01	3.9E-01	2.3E-01	7.3E-02	3.7E-02	1.8E-02
808.7	2.2E+05	1.6E+01	2.6E+00	7.4E-01	3.5E-01	2.1E-01	6.7E-02	3.4E-02	1.7E-02
823.7	1.9E+05	1.4E+01	2.2E+00	6.2E-01	3.0E-01	1.8E-01	5.6E-02	2.9E-02	1.4E-02

Table C-7. Air Concentration Estimates for Drilling in Bay A – Bounding Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (2.3 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
838.7	1.3E+05	9.2E+00	1.5E+00	4.3E-01	2.0E-01	1.2E-01	3.8E-02	2.0E-02	9.6E-03
853.7	4.6E+04	3.4E+00	5.5E-01	1.6E-01	7.4E-02	4.4E-02	1.4E-02	7.1E-03	3.5E-03

Table C-8. Air Concentration Estimates for Burrowing in Bay A – Bounding Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (0.53 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.4E-01	7.3E-06	1.2E-06	3.4E-07	1.6E-07	9.5E-08	3.0E-08	1.5E-08	7.6E-09
0.7	4.0E-01	6.7E-06	1.1E-06	3.1E-07	1.5E-07	8.7E-08	2.7E-08	1.4E-08	6.9E-09
15.7	3.1E-01	5.2E-06	8.4E-07	2.4E-07	1.1E-07	6.7E-08	2.1E-08	1.1E-08	5.4E-09
30.7	1.6E-01	2.7E-06	4.5E-07	1.3E-07	6.0E-08	3.6E-08	1.1E-08	5.8E-09	2.8E-09
45.7	1.5E-01	2.6E-06	4.2E-07	1.2E-07	5.7E-08	3.4E-08	1.1E-08	5.5E-09	2.7E-09
45.7	1.5E-01	2.6E-06	4.2E-07	1.2E-07	5.7E-08	3.4E-08	1.1E-08	5.5E-09	2.7E-09
47.2	2.5E-01	4.1E-06	6.7E-07	1.9E-07	9.0E-08	5.3E-08	1.7E-08	8.6E-09	4.3E-09
62.2	6.4E-01	1.1E-05	1.7E-06	4.9E-07	2.3E-07	1.4E-07	4.4E-08	2.3E-08	1.1E-08
77.2	2.5E+00	4.2E-05	6.8E-06	1.9E-06	9.1E-07	5.4E-07	1.7E-07	8.8E-08	4.3E-08
92.2	1.2E+01	2.0E-04	3.3E-05	9.3E-06	4.4E-06	2.6E-06	8.3E-07	4.3E-07	2.1E-07
107.2	7.8E+01	1.3E-03	2.1E-04	6.0E-05	2.8E-05	1.7E-05	5.3E-06	2.7E-06	1.3E-06
122.2	6.9E+02	1.2E-02	1.9E-03	5.3E-04	2.5E-04	1.5E-04	4.8E-05	2.4E-05	1.2E-05
137.2	7.2E+02	1.2E-02	2.0E-03	5.6E-04	2.6E-04	1.6E-04	5.0E-05	2.5E-05	1.3E-05
137.2	7.2E+02	1.2E-02	2.0E-03	5.6E-04	2.6E-04	1.6E-04	5.0E-05	2.5E-05	1.3E-05
140.5	1.0E+03	1.7E-02	2.8E-03	8.0E-04	3.8E-04	2.3E-04	7.1E-05	3.7E-05	1.8E-05
155.5	1.5E+03	2.5E-02	4.1E-03	1.1E-03	5.5E-04	3.2E-04	1.0E-04	5.3E-05	2.6E-05
170.5	2.2E+03	3.6E-02	5.9E-03	1.7E-03	7.9E-04	4.7E-04	1.5E-04	7.6E-05	3.7E-05
185.5	3.1E+03	5.2E-02	8.5E-03	2.4E-03	1.1E-03	6.8E-04	2.1E-04	1.1E-04	5.4E-05
200.5	4.5E+03	7.5E-02	1.2E-02	3.5E-03	1.7E-03	9.8E-04	3.1E-04	1.6E-04	7.8E-05
215.5	6.6E+03	1.1E-01	1.8E-02	5.1E-03	2.4E-03	1.4E-03	4.5E-04	2.3E-04	1.1E-04
230.5	9.7E+03	1.6E-01	2.6E-02	7.5E-03	3.5E-03	2.1E-03	6.7E-04	3.4E-04	1.7E-04
245.5	1.4E+04	2.4E-01	3.9E-02	1.1E-02	5.3E-03	3.1E-03	9.9E-04	5.1E-04	2.5E-04
260.5	2.2E+04	3.7E-01	6.0E-02	1.7E-02	8.0E-03	4.8E-03	1.5E-03	7.7E-04	3.8E-04
275.5	3.4E+04	5.7E-01	9.3E-02	2.6E-02	1.3E-02	7.4E-03	2.4E-03	1.2E-03	6.0E-04
290.5	5.6E+04	9.3E-01	1.5E-01	4.3E-02	2.0E-02	1.2E-02	3.8E-03	2.0E-03	9.7E-04
305.5	9.4E+04	1.6E+00	2.6E-01	7.2E-02	3.4E-02	2.0E-02	6.5E-03	3.3E-03	1.6E-03
320.5	1.6E+05	2.6E+00	4.3E-01	1.2E-01	5.8E-02	3.4E-02	1.1E-02	5.6E-03	2.7E-03
335.5	2.2E+05	3.6E+00	5.9E-01	1.7E-01	7.9E-02	4.7E-02	1.5E-02	7.7E-03	3.8E-03
350.5	2.2E+05	3.7E+00	6.0E-01	1.7E-01	8.0E-02	4.8E-02	1.5E-02	7.8E-03	3.8E-03
350.5	2.2E+05	3.7E+00	6.0E-01	1.7E-01	8.0E-02	4.8E-02	1.5E-02	7.8E-03	3.8E-03
351.0	2.5E+05	4.2E+00	6.9E-01	1.9E-01	9.2E-02	5.5E-02	1.7E-02	8.9E-03	4.4E-03
366.0	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03

Table C-8. Air Concentration Estimates for Burrowing in Bay A – Bounding Meteorology (continued)

Depth	FluxT (JT)	Emissions (0.53 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
(cm)	(pCi/m^2/sec)	(Ci/yr)	250m	500m	750m	1000m	2000m	3000m	5000m
381.0	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
381.0	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
388.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
403.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
418.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
433.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
448.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
463.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
478.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
493.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
508.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
523.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
538.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
553.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
568.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
583.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
598.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
613.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
628.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
643.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
658.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
673.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
688.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
703.7	2.7E+05	4.5E+00	7.3E-01	2.1E-01	9.8E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
718.7	2.7E+05	4.5E+00	7.3E-01	2.0E-01	9.7E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
733.7	2.7E+05	4.4E+00	7.2E-01	2.0E-01	9.7E-02	5.8E-02	1.8E-02	9.4E-03	4.6E-03
748.7	2.6E+05	4.4E+00	7.2E-01	2.0E-01	9.7E-02	5.7E-02	1.8E-02	9.3E-03	4.6E-03
763.7	2.6E+05	4.4E+00	7.1E-01	2.0E-01	9.6E-02	5.7E-02	1.8E-02	9.2E-03	4.5E-03
778.7	2.6E+05	4.3E+00	7.0E-01	2.0E-01	9.3E-02	5.5E-02	1.8E-02	9.0E-03	4.4E-03
793.7	2.4E+05	4.1E+00	6.6E-01	1.9E-01	8.9E-02	5.3E-02	1.7E-02	8.6E-03	4.2E-03
808.7	2.2E+05	3.7E+00	6.1E-01	1.7E-01	8.2E-02	4.8E-02	1.5E-02	7.9E-03	3.9E-03
823.7	1.9E+05	3.1E+00	5.1E-01	1.4E-01	6.8E-02	4.0E-02	1.3E-02	6.6E-03	3.2E-03

Table C-8. Air Concentration Estimates for Burrowing in Bay A – Bounding Meteorology (continued)

Depth	FluxT (JT)	Emissions (0.53 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
(cm)	(pCi/m^2/sec)	(Ci/yr)	250m	500m	750m	1000m	2000m	3000m	5000m
838.7	1.3E+05	2.1E+00	3.5E-01	9.8E-02	4.7E-02	2.8E-02	8.8E-03	4.5E-03	2.2E-03
853.7	4.6E+04	7.8E-01	1.3E-01	3.6E-02	1.7E-02	1.0E-02	3.2E-03	1.6E-03	8.1E-04

Air Concentrations

Typical Conditions

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Table C-9. Air Concentration Estimates for Excavation in Bay A – Typical Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.4E-01	1.4E-03	1.8E-05	4.7E-06	2.1E-06	1.2E-06	3.4E-07	1.6E-07	6.4E-08
0.7	4.0E-01	1.3E-03	1.6E-05	4.3E-06	1.9E-06	1.1E-06	3.1E-07	1.5E-07	5.8E-08
15.7	3.1E-01	9.8E-04	1.3E-05	3.3E-06	1.5E-06	8.5E-07	2.4E-07	1.2E-07	4.5E-08
30.7	1.6E-01	5.2E-04	6.8E-06	1.7E-06	7.9E-07	4.5E-07	1.3E-07	6.1E-08	2.4E-08
45.7	1.5E-01	4.9E-04	6.4E-06	1.7E-06	7.5E-07	4.3E-07	1.2E-07	5.8E-08	2.3E-08
45.7	1.5E-01	4.9E-04	6.4E-06	1.7E-06	7.5E-07	4.3E-07	1.2E-07	5.8E-08	2.3E-08
47.2	2.5E-01	7.7E-04	1.0E-05	2.6E-06	1.2E-06	6.8E-07	1.9E-07	9.1E-08	3.6E-08
62.2	6.4E-01	2.0E-03	2.7E-05	6.9E-06	3.1E-06	1.8E-06	5.0E-07	2.4E-07	9.4E-08
77.2	2.5E+00	7.8E-03	1.0E-04	2.7E-05	1.2E-05	6.8E-06	2.0E-06	9.2E-07	3.6E-07
92.2	1.2E+01	3.8E-02	5.0E-04	1.3E-04	5.8E-05	3.3E-05	9.5E-06	4.5E-06	1.8E-06
107.2	7.8E+01	2.4E-01	3.2E-03	8.3E-04	3.7E-04	2.1E-04	6.1E-05	2.9E-05	1.1E-05
122.2	6.9E+02	2.2E+00	2.9E-02	7.4E-03	3.3E-03	1.9E-03	5.4E-04	2.6E-04	1.0E-04
137.2	7.2E+02	2.3E+00	3.0E-02	7.7E-03	3.5E-03	2.0E-03	5.7E-04	2.7E-04	1.1E-04
137.2	7.2E+02	2.3E+00	3.0E-02	7.7E-03	3.5E-03	2.0E-03	5.7E-04	2.7E-04	1.1E-04
140.5	1.0E+03	3.3E+00	4.3E-02	1.1E-02	5.0E-03	2.9E-03	8.1E-04	3.9E-04	1.5E-04
155.5	1.5E+03	4.7E+00	6.2E-02	1.6E-02	7.2E-03	4.1E-03	1.2E-03	5.6E-04	2.2E-04
170.5	2.2E+03	6.8E+00	8.9E-02	2.3E-02	1.0E-02	5.9E-03	1.7E-03	8.0E-04	3.1E-04
185.5	3.1E+03	9.8E+00	1.3E-01	3.3E-02	1.5E-02	8.6E-03	2.4E-03	1.2E-03	4.5E-04
200.5	4.5E+03	1.4E+01	1.9E-01	4.8E-02	2.2E-02	1.2E-02	3.5E-03	1.7E-03	6.6E-04
215.5	6.6E+03	2.1E+01	2.7E-01	7.0E-02	3.2E-02	1.8E-02	5.2E-03	2.5E-03	9.6E-04
230.5	9.7E+03	3.1E+01	4.0E-01	1.0E-01	4.7E-02	2.7E-02	7.6E-03	3.6E-03	1.4E-03
245.5	1.4E+04	4.6E+01	6.0E-01	1.5E-01	7.0E-02	4.0E-02	1.1E-02	5.4E-03	2.1E-03
260.5	2.2E+04	6.9E+01	9.1E-01	2.3E-01	1.1E-01	6.0E-02	1.7E-02	8.2E-03	3.2E-03
275.5	3.4E+04	1.1E+02	1.4E+00	3.7E-01	1.7E-01	9.4E-02	2.7E-02	1.3E-02	5.0E-03
290.5	5.6E+04	1.8E+02	2.3E+00	5.9E-01	2.7E-01	1.5E-01	4.4E-02	2.1E-02	8.1E-03
305.5	9.4E+04	3.0E+02	3.9E+00	1.0E+00	4.5E-01	2.6E-01	7.4E-02	3.5E-02	1.4E-02
320.5	1.6E+05	5.0E+02	6.5E+00	1.7E+00	7.6E-01	4.3E-01	1.2E-01	5.9E-02	2.3E-02
335.5	2.2E+05	6.8E+02	9.0E+00	2.3E+00	1.0E+00	6.0E-01	1.7E-01	8.1E-02	3.2E-02
350.5	2.2E+05	6.9E+02	9.1E+00	2.4E+00	1.1E+00	6.1E-01	1.7E-01	8.2E-02	3.2E-02

Table C-9. Air Concentration Estimates for Excavation in Bay A – Typical Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
351.0	2.5E+05	8.0E+02	1.0E+01	2.7E+00	1.2E+00	7.0E-01	2.0E-01	9.4E-02	3.7E-02
366.0	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
381.0	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
381.0	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
388.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
403.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
418.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
433.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
448.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
463.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
478.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
493.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
508.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
523.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
538.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
553.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
568.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
583.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
598.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
613.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
628.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
643.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
658.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
673.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
688.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
703.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
718.7	2.7E+05	8.4E+02	1.1E+01	2.8E+00	1.3E+00	7.3E-01	2.1E-01	9.9E-02	3.9E-02
733.7	2.7E+05	8.4E+02	1.1E+01	2.8E+00	1.3E+00	7.3E-01	2.1E-01	9.9E-02	3.9E-02
748.7	2.6E+05	8.3E+02	1.1E+01	2.8E+00	1.3E+00	7.3E-01	2.1E-01	9.8E-02	3.9E-02
763.7	2.6E+05	8.2E+02	1.1E+01	2.8E+00	1.3E+00	7.2E-01	2.0E-01	9.7E-02	3.8E-02
778.7	2.6E+05	8.0E+02	1.1E+01	2.7E+00	1.2E+00	7.0E-01	2.0E-01	9.5E-02	3.7E-02

Table C-9. Air Concentration Estimates for Excavation in Bay A – Typical Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
793.7	2.4E+05	7.7E+02	1.0E+01	2.6E+00	1.2E+00	6.7E-01	1.9E-01	9.1E-02	3.6E-02
808.7	2.2E+05	7.0E+02	9.2E+00	2.4E+00	1.1E+00	6.2E-01	1.8E-01	8.3E-02	3.3E-02
823.7	1.9E+05	5.9E+02	7.7E+00	2.0E+00	9.0E-01	5.1E-01	1.5E-01	6.9E-02	2.7E-02
838.7	1.3E+05	4.0E+02	5.3E+00	1.4E+00	6.1E-01	3.5E-01	1.0E-01	4.7E-02	1.9E-02
853.7	4.6E+04	1.5E+02	1.9E+00	5.0E-01	2.2E-01	1.3E-01	3.7E-02	1.7E-02	6.8E-03

Table C-10. Air Concentration Estimates for Excavation in Bay B –Typical Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.5E-01	1.4E-03	1.9E-05	4.8E-06	2.2E-06	1.2E-06	3.5E-07	1.7E-07	6.6E-08
0.7	4.1E-01	1.3E-03	1.7E-05	4.4E-06	2.0E-06	1.1E-06	3.2E-07	1.5E-07	6.0E-08
15.7	3.2E-01	1.0E-03	1.3E-05	3.4E-06	1.5E-06	8.7E-07	2.5E-07	1.2E-07	4.6E-08
30.7	1.6E-01	5.1E-04	6.7E-06	1.7E-06	7.8E-07	4.4E-07	1.3E-07	6.0E-08	2.4E-08
45.7	1.5E-01	4.8E-04	6.3E-06	1.6E-06	7.4E-07	4.2E-07	1.2E-07	5.7E-08	2.2E-08
45.7	1.5E-01	4.8E-04	6.3E-06	1.6E-06	7.4E-07	4.2E-07	1.2E-07	5.7E-08	2.2E-08
47.2	2.4E-01	7.4E-04	9.7E-06	2.5E-06	1.1E-06	6.5E-07	1.8E-07	8.8E-08	3.4E-08
62.2	5.8E-01	1.8E-03	2.4E-05	6.2E-06	2.8E-06	1.6E-06	4.6E-07	2.2E-07	8.5E-08
77.2	2.0E+00	6.5E-03	8.5E-05	2.2E-05	9.9E-06	5.7E-06	1.6E-06	7.6E-07	3.0E-07
92.2	8.2E+00	2.6E-02	3.4E-04	8.8E-05	4.0E-05	2.3E-05	6.5E-06	3.1E-06	1.2E-06
107.2	3.3E+01	1.0E-01	1.4E-03	3.5E-04	1.6E-04	9.1E-05	2.6E-05	1.2E-05	4.8E-06
122.2	8.2E+01	2.6E-01	3.4E-03	8.8E-04	4.0E-04	2.3E-04	6.4E-05	3.1E-05	1.2E-05
137.2	8.3E+01	2.6E-01	3.4E-03	8.9E-04	4.0E-04	2.3E-04	6.5E-05	3.1E-05	1.2E-05
137.2	8.3E+01	2.6E-01	3.4E-03	8.9E-04	4.0E-04	2.3E-04	6.5E-05	3.1E-05	1.2E-05
140.5	1.2E+02	3.7E-01	4.9E-03	1.3E-03	5.7E-04	3.3E-04	9.3E-05	4.4E-05	1.7E-05
155.5	1.7E+02	5.4E-01	7.1E-03	1.8E-03	8.3E-04	4.7E-04	1.3E-04	6.4E-05	2.5E-05
170.5	2.5E+02	7.9E-01	1.0E-02	2.7E-03	1.2E-03	6.9E-04	2.0E-04	9.3E-05	3.7E-05
185.5	3.7E+02	1.2E+00	1.5E-02	3.9E-03	1.8E-03	1.0E-03	2.9E-04	1.4E-04	5.4E-05
200.5	5.4E+02	1.7E+00	2.2E-02	5.8E-03	2.6E-03	1.5E-03	4.3E-04	2.0E-04	8.0E-05
215.5	8.1E+02	2.5E+00	3.3E-02	8.6E-03	3.9E-03	2.2E-03	6.3E-04	3.0E-04	1.2E-04
230.5	1.2E+03	3.8E+00	5.0E-02	1.3E-02	5.8E-03	3.3E-03	9.4E-04	4.5E-04	1.8E-04
245.5	1.8E+03	5.6E+00	7.4E-02	1.9E-02	8.6E-03	4.9E-03	1.4E-03	6.6E-04	2.6E-04
260.5	2.6E+03	8.4E+00	1.1E-01	2.8E-02	1.3E-02	7.3E-03	2.1E-03	9.9E-04	3.9E-04
275.5	3.9E+03	1.2E+01	1.6E-01	4.2E-02	1.9E-02	1.1E-02	3.1E-03	1.5E-03	5.7E-04
290.5	5.7E+03	1.8E+01	2.3E-01	6.1E-02	2.7E-02	1.6E-02	4.5E-03	2.1E-03	8.3E-04
305.5	7.9E+03	2.5E+01	3.3E-01	8.4E-02	3.8E-02	2.2E-02	6.2E-03	2.9E-03	1.2E-03
320.5	1.0E+04	3.2E+01	4.2E-01	1.1E-01	4.9E-02	2.8E-02	8.0E-03	3.8E-03	1.5E-03
335.5	1.1E+04	3.6E+01	4.7E-01	1.2E-01	5.5E-02	3.2E-02	9.0E-03	4.3E-03	1.7E-03
350.5	1.1E+04	3.6E+01	4.7E-01	1.2E-01	5.5E-02	3.2E-02	9.0E-03	4.3E-03	1.7E-03
350.5	1.1E+04	3.6E+01	4.7E-01	1.2E-01	5.5E-02	3.2E-02	9.0E-03	4.3E-03	1.7E-03
352.4	1.2E+04	3.7E+01	4.9E-01	1.3E-01	5.7E-02	3.2E-02	9.3E-03	4.4E-03	1.7E-03

Table C-10. Air Concentration Estimates for Excavation in Bay B –Typical Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
367.4	1.2E+04	3.8E+01	5.0E-01	1.3E-01	5.8E-02	3.3E-02	9.5E-03	4.5E-03	1.8E-03
382.4	1.2E+04	3.8E+01	5.0E-01	1.3E-01	5.9E-02	3.4E-02	9.6E-03	4.5E-03	1.8E-03
397.4	1.2E+04	3.8E+01	5.0E-01	1.3E-01	5.9E-02	3.4E-02	9.6E-03	4.5E-03	1.8E-03
412.4	1.2E+04	3.8E+01	4.9E-01	1.3E-01	5.7E-02	3.3E-02	9.4E-03	4.4E-03	1.7E-03
427.4	1.1E+04	3.6E+01	4.7E-01	1.2E-01	5.5E-02	3.1E-02	8.9E-03	4.2E-03	1.7E-03
442.4	1.0E+04	3.2E+01	4.2E-01	1.1E-01	5.0E-02	2.8E-02	8.1E-03	3.8E-03	1.5E-03
457.4	8.9E+03	2.8E+01	3.7E-01	9.5E-02	4.3E-02	2.4E-02	7.0E-03	3.3E-03	1.3E-03
472.4	8.6E+03	2.7E+01	3.6E-01	9.2E-02	4.2E-02	2.4E-02	6.8E-03	3.2E-03	1.3E-03
472.4	8.6E+03	2.7E+01	3.6E-01	9.2E-02	4.2E-02	2.4E-02	6.8E-03	3.2E-03	1.3E-03
472.9	9.5E+03	3.0E+01	3.9E-01	1.0E-01	4.6E-02	2.6E-02	7.5E-03	3.5E-03	1.4E-03
487.9	9.9E+03	3.1E+01	4.1E-01	1.1E-01	4.8E-02	2.7E-02	7.8E-03	3.7E-03	1.4E-03
502.9	9.9E+03	3.1E+01	4.1E-01	1.1E-01	4.8E-02	2.7E-02	7.8E-03	3.7E-03	1.4E-03
502.9	9.9E+03	3.1E+01	4.1E-01	1.1E-01	4.8E-02	2.7E-02	7.8E-03	3.7E-03	1.4E-03
508.7	9.9E+03	3.1E+01	4.1E-01	1.1E-01	4.8E-02	2.7E-02	7.7E-03	3.7E-03	1.4E-03
523.7	9.9E+03	3.1E+01	4.1E-01	1.1E-01	4.8E-02	2.7E-02	7.7E-03	3.7E-03	1.4E-03
538.7	9.9E+03	3.1E+01	4.1E-01	1.1E-01	4.8E-02	2.7E-02	7.7E-03	3.7E-03	1.4E-03
553.7	9.8E+03	3.1E+01	4.1E-01	1.1E-01	4.8E-02	2.7E-02	7.7E-03	3.7E-03	1.4E-03
568.7	9.8E+03	3.1E+01	4.1E-01	1.1E-01	4.7E-02	2.7E-02	7.7E-03	3.7E-03	1.4E-03
583.7	9.8E+03	3.1E+01	4.1E-01	1.0E-01	4.7E-02	2.7E-02	7.7E-03	3.7E-03	1.4E-03
598.7	9.8E+03	3.1E+01	4.0E-01	1.0E-01	4.7E-02	2.7E-02	7.7E-03	3.6E-03	1.4E-03
613.7	9.8E+03	3.1E+01	4.0E-01	1.0E-01	4.7E-02	2.7E-02	7.7E-03	3.6E-03	1.4E-03
628.7	9.7E+03	3.1E+01	4.0E-01	1.0E-01	4.7E-02	2.7E-02	7.6E-03	3.6E-03	1.4E-03
643.7	9.6E+03	3.0E+01	4.0E-01	1.0E-01	4.7E-02	2.7E-02	7.6E-03	3.6E-03	1.4E-03
658.7	9.6E+03	3.0E+01	4.0E-01	1.0E-01	4.6E-02	2.6E-02	7.5E-03	3.6E-03	1.4E-03
673.7	9.5E+03	3.0E+01	3.9E-01	1.0E-01	4.6E-02	2.6E-02	7.4E-03	3.5E-03	1.4E-03
688.7	9.3E+03	2.9E+01	3.8E-01	9.9E-02	4.5E-02	2.6E-02	7.3E-03	3.5E-03	1.4E-03
703.7	9.1E+03	2.9E+01	3.8E-01	9.7E-02	4.4E-02	2.5E-02	7.2E-03	3.4E-03	1.3E-03
718.7	8.8E+03	2.8E+01	3.7E-01	9.5E-02	4.3E-02	2.4E-02	6.9E-03	3.3E-03	1.3E-03
733.7	8.5E+03	2.7E+01	3.5E-01	9.1E-02	4.1E-02	2.3E-02	6.7E-03	3.2E-03	1.2E-03
748.7	8.0E+03	2.5E+01	3.3E-01	8.6E-02	3.9E-02	2.2E-02	6.3E-03	3.0E-03	1.2E-03
763.7	7.5E+03	2.4E+01	3.1E-01	8.0E-02	3.6E-02	2.1E-02	5.9E-03	2.8E-03	1.1E-03

Table C-10. Air Concentration Estimates for Excavation in Bay B –Typical Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
778.7	6.7E+03	2.1E+01	2.8E-01	7.2E-02	3.2E-02	1.9E-02	5.3E-03	2.5E-03	9.8E-04
793.7	5.8E+03	1.8E+01	2.4E-01	6.2E-02	2.8E-02	1.6E-02	4.6E-03	2.2E-03	8.5E-04
808.7	4.7E+03	1.5E+01	2.0E-01	5.1E-02	2.3E-02	1.3E-02	3.7E-03	1.8E-03	6.9E-04
823.7	3.5E+03	1.1E+01	1.4E-01	3.7E-02	1.7E-02	9.6E-03	2.7E-03	1.3E-03	5.1E-04
838.7	2.1E+03	6.5E+00	8.6E-02	2.2E-02	1.0E-02	5.7E-03	1.6E-03	7.7E-04	3.0E-04
853.7	5.8E+02	1.8E+00	2.4E-02	6.2E-03	2.8E-03	1.6E-03	4.6E-04	2.2E-04	8.5E-05

Table C-11. Air Concentration Estimates for Excavation in Bay C –Typical Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.3E-01	1.3E-03	1.8E-05	4.6E-06	2.1E-06	1.2E-06	3.4E-07	1.6E-07	6.3E-08
0.7	3.8E-01	1.2E-03	1.6E-05	4.1E-06	1.8E-06	1.1E-06	3.0E-07	1.4E-07	5.6E-08
15.7	2.9E-01	9.1E-04	1.2E-05	3.1E-06	1.4E-06	8.0E-07	2.3E-07	1.1E-07	4.2E-08
30.7	1.4E-01	4.4E-04	5.7E-06	1.5E-06	6.7E-07	3.8E-07	1.1E-07	5.2E-08	2.0E-08
45.7	1.3E-01	4.1E-04	5.4E-06	1.4E-06	6.3E-07	3.6E-07	1.0E-07	4.8E-08	1.9E-08
45.7	1.3E-01	4.1E-04	5.4E-06	1.4E-06	6.3E-07	3.6E-07	1.0E-07	4.8E-08	1.9E-08
47.2	1.4E-01	4.4E-04	5.8E-06	1.5E-06	6.8E-07	3.9E-07	1.1E-07	5.2E-08	2.1E-08
62.2	1.8E-01	5.8E-04	7.6E-06	2.0E-06	8.9E-07	5.1E-07	1.4E-07	6.9E-08	2.7E-08
77.2	3.9E-01	1.2E-03	1.6E-05	4.2E-06	1.9E-06	1.1E-06	3.1E-07	1.5E-07	5.7E-08
92.2	1.5E+00	4.6E-03	6.0E-05	1.6E-05	7.0E-06	4.0E-06	1.1E-06	5.4E-07	2.1E-07
107.2	8.7E+00	2.8E-02	3.6E-04	9.3E-05	4.2E-05	2.4E-05	6.9E-06	3.3E-06	1.3E-06
122.2	7.7E+01	2.4E-01	3.2E-03	8.2E-04	3.7E-04	2.1E-04	6.0E-05	2.9E-05	1.1E-05
137.2	8.0E+01	2.5E-01	3.3E-03	8.6E-04	3.9E-04	2.2E-04	6.3E-05	3.0E-05	1.2E-05
137.2	8.0E+01	2.5E-01	3.3E-03	8.6E-04	3.9E-04	2.2E-04	6.3E-05	3.0E-05	1.2E-05
140.5	1.1E+02	3.5E-01	4.6E-03	1.2E-03	5.4E-04	3.1E-04	8.8E-05	4.2E-05	1.6E-05
155.5	1.6E+02	5.0E-01	6.5E-03	1.7E-03	7.6E-04	4.4E-04	1.2E-04	5.9E-05	2.3E-05
170.5	2.3E+02	7.1E-01	9.3E-03	2.4E-03	1.1E-03	6.2E-04	1.8E-04	8.4E-05	3.3E-05
185.5	3.2E+02	1.0E+00	1.3E-02	3.5E-03	1.6E-03	8.9E-04	2.5E-04	1.2E-04	4.7E-05
200.5	4.7E+02	1.5E+00	1.9E-02	5.0E-03	2.3E-03	1.3E-03	3.7E-04	1.7E-04	6.9E-05
215.5	6.8E+02	2.2E+00	2.8E-02	7.3E-03	3.3E-03	1.9E-03	5.4E-04	2.5E-04	1.0E-04
230.5	1.0E+03	3.2E+00	4.2E-02	1.1E-02	4.9E-03	2.8E-03	8.0E-04	3.8E-04	1.5E-04
245.5	1.5E+03	4.8E+00	6.3E-02	1.6E-02	7.3E-03	4.2E-03	1.2E-03	5.7E-04	2.2E-04
260.5	2.3E+03	7.4E+00	9.7E-02	2.5E-02	1.1E-02	6.5E-03	1.8E-03	8.7E-04	3.4E-04
275.5	3.7E+03	1.2E+01	1.5E-01	4.0E-02	1.8E-02	1.0E-02	2.9E-03	1.4E-03	5.4E-04
290.5	6.1E+03	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
305.5	1.1E+04	3.3E+01	4.4E-01	1.1E-01	5.1E-02	2.9E-02	8.3E-03	3.9E-03	1.6E-03
320.5	1.8E+04	5.8E+01	7.6E-01	2.0E-01	8.8E-02	5.0E-02	1.4E-02	6.8E-03	2.7E-03
335.5	2.6E+04	8.1E+01	1.1E+00	2.8E-01	1.2E-01	7.1E-02	2.0E-02	9.6E-03	3.8E-03
350.5	2.6E+04	8.3E+01	1.1E+00	2.8E-01	1.3E-01	7.2E-02	2.1E-02	9.7E-03	3.8E-03
350.5	2.6E+04	8.3E+01	1.1E+00	2.8E-01	1.3E-01	7.2E-02	2.1E-02	9.7E-03	3.8E-03
352.4	3.0E+04	9.4E+01	1.2E+00	3.2E-01	1.4E-01	8.2E-02	2.3E-02	1.1E-02	4.4E-03

Table C-11. Air Concentration Estimates for Excavation in Bay C –Typical Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
367.4	3.4E+04	1.1E+02	1.4E+00	3.6E-01	1.6E-01	9.4E-02	2.7E-02	1.3E-02	5.0E-03
382.4	4.0E+04	1.2E+02	1.6E+00	4.2E-01	1.9E-01	1.1E-01	3.1E-02	1.5E-02	5.8E-03
397.4	4.6E+04	1.5E+02	1.9E+00	4.9E-01	2.2E-01	1.3E-01	3.6E-02	1.7E-02	6.8E-03
412.4	5.4E+04	1.7E+02	2.2E+00	5.8E-01	2.6E-01	1.5E-01	4.2E-02	2.0E-02	7.9E-03
427.4	6.3E+04	2.0E+02	2.6E+00	6.7E-01	3.0E-01	1.7E-01	4.9E-02	2.3E-02	9.2E-03
442.4	7.0E+04	2.2E+02	2.9E+00	7.4E-01	3.4E-01	1.9E-01	5.5E-02	2.6E-02	1.0E-02
457.4	7.2E+04	2.3E+02	3.0E+00	7.7E-01	3.5E-01	2.0E-01	5.7E-02	2.7E-02	1.1E-02
472.4	7.2E+04	2.3E+02	3.0E+00	7.7E-01	3.5E-01	2.0E-01	5.7E-02	2.7E-02	1.1E-02
472.4	7.2E+04	2.3E+02	3.0E+00	7.7E-01	3.5E-01	2.0E-01	5.7E-02	2.7E-02	1.1E-02
472.9	8.8E+04	2.8E+02	3.6E+00	9.4E-01	4.2E-01	2.4E-01	6.9E-02	3.3E-02	1.3E-02
487.9	9.5E+04	3.0E+02	3.9E+00	1.0E+00	4.6E-01	2.6E-01	7.5E-02	3.5E-02	1.4E-02
502.9	9.5E+04	3.0E+02	3.9E+00	1.0E+00	4.6E-01	2.6E-01	7.5E-02	3.5E-02	1.4E-02
502.9	9.5E+04	3.0E+02	3.9E+00	1.0E+00	4.6E-01	2.6E-01	7.5E-02	3.5E-02	1.4E-02
505.3	1.1E+05	3.4E+02	4.5E+00	1.2E+00	5.2E-01	3.0E-01	8.5E-02	4.0E-02	1.6E-02
520.3	1.2E+05	3.9E+02	5.1E+00	1.3E+00	6.0E-01	3.4E-01	9.7E-02	4.6E-02	1.8E-02
535.3	1.4E+05	4.4E+02	5.8E+00	1.5E+00	6.8E-01	3.9E-01	1.1E-01	5.2E-02	2.0E-02
550.3	1.6E+05	5.0E+02	6.5E+00	1.7E+00	7.6E-01	4.4E-01	1.2E-01	5.9E-02	2.3E-02
565.3	1.8E+05	5.6E+02	7.4E+00	1.9E+00	8.6E-01	4.9E-01	1.4E-01	6.6E-02	2.6E-02
580.3	2.0E+05	6.3E+02	8.3E+00	2.1E+00	9.6E-01	5.5E-01	1.6E-01	7.4E-02	2.9E-02
595.3	2.2E+05	7.0E+02	9.2E+00	2.4E+00	1.1E+00	6.1E-01	1.7E-01	8.3E-02	3.2E-02
610.3	2.4E+05	7.7E+02	1.0E+01	2.6E+00	1.2E+00	6.7E-01	1.9E-01	9.1E-02	3.6E-02
625.3	2.6E+05	8.2E+02	1.1E+01	2.8E+00	1.3E+00	7.2E-01	2.0E-01	9.7E-02	3.8E-02
640.3	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
655.3	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
655.3	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
658.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
673.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
688.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.4E-01	2.1E-01	9.9E-02	3.9E-02
703.7	2.7E+05	8.4E+02	1.1E+01	2.9E+00	1.3E+00	7.3E-01	2.1E-01	9.9E-02	3.9E-02
718.7	2.7E+05	8.4E+02	1.1E+01	2.8E+00	1.3E+00	7.3E-01	2.1E-01	9.9E-02	3.9E-02
733.7	2.7E+05	8.4E+02	1.1E+01	2.8E+00	1.3E+00	7.3E-01	2.1E-01	9.9E-02	3.9E-02

Table C-11. Air Concentration Estimates for Excavation in Bay C –Typical Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
748.7	2.6E+05	8.3E+02	1.1E+01	2.8E+00	1.3E+00	7.3E-01	2.1E-01	9.8E-02	3.9E-02
763.7	2.6E+05	8.2E+02	1.1E+01	2.8E+00	1.3E+00	7.2E-01	2.0E-01	9.7E-02	3.8E-02
778.7	2.5E+05	8.0E+02	1.0E+01	2.7E+00	1.2E+00	7.0E-01	2.0E-01	9.4E-02	3.7E-02
793.7	2.4E+05	7.5E+02	9.9E+00	2.6E+00	1.2E+00	6.6E-01	1.9E-01	8.9E-02	3.5E-02
808.7	2.1E+05	6.8E+02	8.9E+00	2.3E+00	1.0E+00	5.9E-01	1.7E-01	8.0E-02	3.1E-02
823.7	1.7E+05	5.4E+02	7.1E+00	1.8E+00	8.3E-01	4.7E-01	1.3E-01	6.4E-02	2.5E-02
838.7	1.1E+05	3.3E+02	4.4E+00	1.1E+00	5.1E-01	2.9E-01	8.3E-02	3.9E-02	1.6E-02
853.7	2.1E+04	6.5E+01	8.5E-01	2.2E-01	9.9E-02	5.7E-02	1.6E-02	7.6E-03	3.0E-03

Table C-12. Air Concentration Estimates for Excavation in Bay D –Typical Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.3E-01	1.3E-03	1.8E-05	4.6E-06	2.1E-06	1.2E-06	3.3E-07	1.6E-07	6.2E-08
0.7	3.8E-01	1.2E-03	1.6E-05	4.1E-06	1.8E-06	1.1E-06	3.0E-07	1.4E-07	5.6E-08
15.7	2.9E-01	9.0E-04	1.2E-05	3.1E-06	1.4E-06	7.9E-07	2.2E-07	1.1E-07	4.2E-08
30.7	1.4E-01	4.3E-04	5.6E-06	1.5E-06	6.6E-07	3.8E-07	1.1E-07	5.1E-08	2.0E-08
45.7	1.3E-01	4.0E-04	5.3E-06	1.4E-06	6.2E-07	3.5E-07	1.0E-07	4.8E-08	1.9E-08
45.7	1.3E-01	4.0E-04	5.3E-06	1.4E-06	6.2E-07	3.5E-07	1.0E-07	4.8E-08	1.9E-08
47.2	1.3E-01	4.1E-04	5.4E-06	1.4E-06	6.3E-07	3.6E-07	1.0E-07	4.8E-08	1.9E-08
62.2	1.4E-01	4.4E-04	5.7E-06	1.5E-06	6.7E-07	3.8E-07	1.1E-07	5.2E-08	2.0E-08
77.2	1.8E-01	5.6E-04	7.4E-06	1.9E-06	8.6E-07	4.9E-07	1.4E-07	6.7E-08	2.6E-08
92.2	3.9E-01	1.2E-03	1.6E-05	4.2E-06	1.9E-06	1.1E-06	3.1E-07	1.5E-07	5.7E-08
107.2	1.8E+00	5.7E-03	7.5E-05	1.9E-05	8.8E-06	5.0E-06	1.4E-06	6.8E-07	2.7E-07
122.2	1.5E+01	4.8E-02	6.3E-04	1.6E-04	7.3E-05	4.2E-05	1.2E-05	5.7E-06	2.2E-06
137.2	1.6E+01	5.0E-02	6.6E-04	1.7E-04	7.7E-05	4.4E-05	1.2E-05	5.9E-06	2.3E-06
137.2	1.6E+01	5.0E-02	6.6E-04	1.7E-04	7.7E-05	4.4E-05	1.2E-05	5.9E-06	2.3E-06
146.3	1.9E+01	6.0E-02	7.9E-04	2.0E-04	9.2E-05	5.2E-05	1.5E-05	7.1E-06	2.8E-06
161.3	2.4E+01	7.4E-02	9.7E-04	2.5E-04	1.1E-04	6.5E-05	1.8E-05	8.8E-06	3.4E-06
176.3	3.0E+01	9.5E-02	1.2E-03	3.2E-04	1.4E-04	8.3E-05	2.4E-05	1.1E-05	4.4E-06
191.3	3.9E+01	1.2E-01	1.6E-03	4.2E-04	1.9E-04	1.1E-04	3.1E-05	1.5E-05	5.8E-06
206.3	5.3E+01	1.7E-01	2.2E-03	5.7E-04	2.6E-04	1.5E-04	4.2E-05	2.0E-05	7.8E-06
221.3	7.3E+01	2.3E-01	3.0E-03	7.8E-04	3.5E-04	2.0E-04	5.7E-05	2.7E-05	1.1E-05
236.3	1.0E+02	3.2E-01	4.2E-03	1.1E-03	4.9E-04	2.8E-04	8.0E-05	3.8E-05	1.5E-05
251.3	1.4E+02	4.5E-01	6.0E-03	1.5E-03	7.0E-04	4.0E-04	1.1E-04	5.4E-05	2.1E-05
266.3	2.1E+02	6.5E-01	8.6E-03	2.2E-03	1.0E-03	5.7E-04	1.6E-04	7.7E-05	3.0E-05
281.3	3.0E+02	9.5E-01	1.2E-02	3.2E-03	1.5E-03	8.3E-04	2.4E-04	1.1E-04	4.4E-05
296.3	4.5E+02	1.4E+00	1.9E-02	4.8E-03	2.2E-03	1.2E-03	3.5E-04	1.7E-04	6.6E-05
311.3	6.8E+02	2.1E+00	2.8E-02	7.3E-03	3.3E-03	1.9E-03	5.3E-04	2.5E-04	9.9E-05
326.3	1.1E+03	3.3E+00	4.4E-02	1.1E-02	5.1E-03	2.9E-03	8.3E-04	3.9E-04	1.6E-04
341.3	1.7E+03	5.4E+00	7.1E-02	1.8E-02	8.3E-03	4.7E-03	1.4E-03	6.4E-04	2.5E-04
356.3	2.9E+03	9.2E+00	1.2E-01	3.1E-02	1.4E-02	8.0E-03	2.3E-03	1.1E-03	4.3E-04
371.3	5.1E+03	1.6E+01	2.1E-01	5.5E-02	2.5E-02	1.4E-02	4.0E-03	1.9E-03	7.5E-04
386.3	8.1E+03	2.5E+01	3.3E-01	8.6E-02	3.9E-02	2.2E-02	6.3E-03	3.0E-03	1.2E-03

Table C-12. Air Concentration Estimates for Excavation in Bay D –Typical Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
401.3	8.9E+03	2.8E+01	3.7E-01	9.5E-02	4.3E-02	2.5E-02	7.0E-03	3.3E-03	1.3E-03
406.1	8.9E+03	2.8E+01	3.7E-01	9.6E-02	4.3E-02	2.5E-02	7.0E-03	3.3E-03	1.3E-03
421.1	8.9E+03	2.8E+01	3.7E-01	9.6E-02	4.3E-02	2.5E-02	7.0E-03	3.3E-03	1.3E-03
436.1	9.0E+03	2.8E+01	3.7E-01	9.6E-02	4.3E-02	2.5E-02	7.0E-03	3.3E-03	1.3E-03
451.1	9.0E+03	2.8E+01	3.7E-01	9.6E-02	4.3E-02	2.5E-02	7.0E-03	3.3E-03	1.3E-03
466.1	9.0E+03	2.8E+01	3.7E-01	9.6E-02	4.3E-02	2.5E-02	7.0E-03	3.3E-03	1.3E-03
481.1	9.0E+03	2.8E+01	3.7E-01	9.6E-02	4.3E-02	2.5E-02	7.0E-03	3.3E-03	1.3E-03
496.1	9.0E+03	2.8E+01	3.7E-01	9.6E-02	4.3E-02	2.5E-02	7.0E-03	3.3E-03	1.3E-03
511.1	9.0E+03	2.8E+01	3.7E-01	9.6E-02	4.3E-02	2.5E-02	7.0E-03	3.3E-03	1.3E-03
526.1	8.9E+03	2.8E+01	3.7E-01	9.5E-02	4.3E-02	2.5E-02	7.0E-03	3.3E-03	1.3E-03
541.1	8.9E+03	2.8E+01	3.7E-01	9.5E-02	4.3E-02	2.4E-02	7.0E-03	3.3E-03	1.3E-03
556.1	8.8E+03	2.8E+01	3.6E-01	9.4E-02	4.2E-02	2.4E-02	6.9E-03	3.3E-03	1.3E-03
571.1	8.7E+03	2.7E+01	3.6E-01	9.2E-02	4.2E-02	2.4E-02	6.8E-03	3.2E-03	1.3E-03
586.1	8.4E+03	2.7E+01	3.5E-01	9.0E-02	4.1E-02	2.3E-02	6.6E-03	3.1E-03	1.2E-03
601.1	8.1E+03	2.6E+01	3.4E-01	8.7E-02	3.9E-02	2.2E-02	6.4E-03	3.0E-03	1.2E-03
616.1	7.7E+03	2.4E+01	3.2E-01	8.2E-02	3.7E-02	2.1E-02	6.1E-03	2.9E-03	1.1E-03
631.1	7.1E+03	2.2E+01	2.9E-01	7.6E-02	3.4E-02	2.0E-02	5.6E-03	2.6E-03	1.0E-03
646.1	6.4E+03	2.0E+01	2.6E-01	6.8E-02	3.1E-02	1.8E-02	5.0E-03	2.4E-03	9.3E-04
661.1	5.4E+03	1.7E+01	2.2E-01	5.8E-02	2.6E-02	1.5E-02	4.2E-03	2.0E-03	7.9E-04
676.1	4.2E+03	1.3E+01	1.7E-01	4.5E-02	2.0E-02	1.2E-02	3.3E-03	1.6E-03	6.1E-04
691.1	2.7E+03	8.7E+00	1.1E-01	2.9E-02	1.3E-02	7.6E-03	2.2E-03	1.0E-03	4.0E-04
706.1	2.2E+03	7.0E+00	9.2E-02	2.4E-02	1.1E-02	6.1E-03	1.8E-03	8.3E-04	3.3E-04
706.1	2.2E+03	7.0E+00	9.2E-02	2.4E-02	1.1E-02	6.1E-03	1.8E-03	8.3E-04	3.3E-04
707.6	2.9E+03	9.2E+00	1.2E-01	3.1E-02	1.4E-02	8.1E-03	2.3E-03	1.1E-03	4.3E-04
722.6	3.9E+03	1.2E+01	1.6E-01	4.1E-02	1.9E-02	1.1E-02	3.0E-03	1.4E-03	5.7E-04
737.6	5.2E+03	1.6E+01	2.1E-01	5.5E-02	2.5E-02	1.4E-02	4.1E-03	1.9E-03	7.6E-04
752.6	6.7E+03	2.1E+01	2.8E-01	7.2E-02	3.3E-02	1.9E-02	5.3E-03	2.5E-03	9.9E-04
767.6	8.3E+03	2.6E+01	3.4E-01	8.8E-02	4.0E-02	2.3E-02	6.5E-03	3.1E-03	1.2E-03
782.6	9.0E+03	2.9E+01	3.7E-01	9.7E-02	4.4E-02	2.5E-02	7.1E-03	3.4E-03	1.3E-03
797.6	9.1E+03	2.9E+01	3.7E-01	9.7E-02	4.4E-02	2.5E-02	7.1E-03	3.4E-03	1.3E-03
797.6	9.1E+03	2.9E+01	3.7E-01	9.7E-02	4.4E-02	2.5E-02	7.1E-03	3.4E-03	1.3E-03

Table C-12. Air Concentration Estimates for Excavation in Bay D –Typical Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
800.0	8.8E+03	2.8E+01	3.6E-01	9.4E-02	4.2E-02	2.4E-02	6.9E-03	3.3E-03	1.3E-03
815.0	8.4E+03	2.6E+01	3.5E-01	9.0E-02	4.1E-02	2.3E-02	6.6E-03	3.1E-03	1.2E-03
830.0	7.9E+03	2.5E+01	3.3E-01	8.5E-02	3.8E-02	2.2E-02	6.2E-03	2.9E-03	1.2E-03
845.0	7.3E+03	2.3E+01	3.0E-01	7.8E-02	3.5E-02	2.0E-02	5.7E-03	2.7E-03	1.1E-03
860.0	6.5E+03	2.1E+01	2.7E-01	7.0E-02	3.2E-02	1.8E-02	5.1E-03	2.4E-03	9.6E-04
875.0	5.6E+03	1.8E+01	2.3E-01	6.0E-02	2.7E-02	1.5E-02	4.4E-03	2.1E-03	8.2E-04
890.0	4.5E+03	1.4E+01	1.8E-01	4.8E-02	2.2E-02	1.2E-02	3.5E-03	1.7E-03	6.5E-04
905.0	3.2E+03	1.0E+01	1.3E-01	3.4E-02	1.5E-02	8.7E-03	2.5E-03	1.2E-03	4.6E-04
920.0	1.7E+03	5.5E+00	7.2E-02	1.9E-02	8.4E-03	4.8E-03	1.4E-03	6.5E-04	2.6E-04
935.0	2.4E+02	7.7E-01	1.0E-02	2.6E-03	1.2E-03	6.7E-04	1.9E-04	9.1E-05	3.6E-05

Table C-13. Air Concentration Estimates for Excavation in Bay A, B, C, D –Typical Meteorology

Depth (cm)	Emissions (500 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
		250m	500m	750m	1000m	2000m	3000m	5000m
0.0	6.8E-03	9.0E-05	2.3E-05	1.0E-05	6.0E-06	1.7E-06	8.1E-07	3.2E-07
0.7	6.2E-03	8.1E-05	2.1E-05	9.4E-06	5.4E-06	1.5E-06	7.3E-07	2.9E-07
15.7	4.7E-03	6.1E-05	1.6E-05	7.2E-06	4.1E-06	1.2E-06	5.5E-07	2.2E-07
30.7	2.3E-03	3.0E-05	7.9E-06	3.6E-06	2.0E-06	5.8E-07	2.7E-07	1.1E-07
45.7	2.2E-03	2.9E-05	7.4E-06	3.3E-06	1.9E-06	5.4E-07	2.6E-07	1.0E-07
45.7	2.2E-03	2.9E-05	7.4E-06	3.3E-06	1.9E-06	5.4E-07	2.6E-07	1.0E-07
47.2	2.8E-03	3.6E-05	9.4E-06	4.2E-06	2.4E-06	6.9E-07	3.3E-07	1.3E-07
62.2	5.3E-03	7.0E-05	1.8E-05	8.1E-06	4.6E-06	1.3E-06	6.3E-07	2.5E-07
77.2	1.7E-02	2.2E-04	5.6E-05	2.5E-05	1.5E-05	4.1E-06	2.0E-06	7.7E-07
92.2	7.1E-02	9.3E-04	2.4E-04	1.1E-04	6.2E-05	1.8E-05	8.4E-06	3.3E-06
107.2	3.9E-01	5.1E-03	1.3E-03	5.9E-04	3.4E-04	9.6E-05	4.6E-05	1.8E-05
122.2	2.8E+00	3.6E-02	9.4E-03	4.2E-03	2.4E-03	6.9E-04	3.3E-04	1.3E-04
137.2	2.9E+00	3.8E-02	9.8E-03	4.4E-03	2.5E-03	7.2E-04	3.4E-04	1.3E-04
137.2	2.9E+00	3.8E-02	9.8E-03	4.4E-03	2.5E-03	7.2E-04	3.4E-04	1.3E-04
146.3	4.1E+00	5.4E-02	1.4E-02	6.3E-03	3.6E-03	1.0E-03	4.9E-04	1.9E-04
161.3	5.9E+00	7.7E-02	2.0E-02	9.0E-03	5.2E-03	1.5E-03	7.0E-04	2.7E-04
176.3	8.5E+00	1.1E-01	2.9E-02	1.3E-02	7.4E-03	2.1E-03	1.0E-03	3.9E-04
191.3	1.2E+01	1.6E-01	4.1E-02	1.9E-02	1.1E-02	3.0E-03	1.4E-03	5.7E-04
206.3	1.8E+01	2.3E-01	6.0E-02	2.7E-02	1.6E-02	4.4E-03	2.1E-03	8.2E-04
221.3	2.6E+01	3.4E-01	8.8E-02	4.0E-02	2.3E-02	6.5E-03	3.1E-03	1.2E-03
236.3	3.8E+01	5.0E-01	1.3E-01	5.8E-02	3.3E-02	9.5E-03	4.5E-03	1.8E-03
251.3	5.7E+01	7.5E-01	1.9E-01	8.7E-02	5.0E-02	1.4E-02	6.7E-03	2.6E-03
266.3	8.6E+01	1.1E+00	2.9E-01	1.3E-01	7.5E-02	2.1E-02	1.0E-02	4.0E-03
281.3	1.3E+02	1.8E+00	4.5E-01	2.1E-01	1.2E-01	3.3E-02	1.6E-02	6.2E-03
296.3	2.2E+02	2.8E+00	7.3E-01	3.3E-01	1.9E-01	5.4E-02	2.5E-02	1.0E-02
311.3	3.6E+02	4.7E+00	1.2E+00	5.5E-01	3.1E-01	8.9E-02	4.2E-02	1.7E-02
326.3	5.9E+02	7.8E+00	2.0E+00	9.1E-01	5.2E-01	1.5E-01	7.0E-02	2.8E-02
341.3	8.1E+02	1.1E+01	2.8E+00	1.2E+00	7.1E-01	2.0E-01	9.6E-02	3.8E-02
356.3	9.5E+02	1.2E+01	3.2E+00	1.4E+00	8.3E-01	2.4E-01	1.1E-01	4.4E-02
371.3	1.0E+03	1.3E+01	3.5E+00	1.6E+00	8.9E-01	2.5E-01	1.2E-01	4.7E-02
386.3	1.1E+03	1.4E+01	3.6E+00	1.6E+00	9.2E-01	2.6E-01	1.2E-01	4.9E-02

Table C-13. Air Concentration Estimates for Excavation in Bay A, B, C, D –Typical Meteorology (continued)

Depth (cm)	Emissions (500 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
		250m	500m	750m	1000m	2000m	3000m	5000m
401.3	1.1E+03	1.4E+01	3.7E+00	1.7E+00	9.5E-01	2.7E-01	1.3E-01	5.0E-02
401.3	1.1E+03	1.4E+01	3.7E+00	1.7E+00	9.5E-01	2.7E-01	1.3E-01	5.0E-02
406.1	1.1E+03	1.4E+01	3.7E+00	1.7E+00	9.5E-01	2.7E-01	1.3E-01	5.0E-02
421.1	1.1E+03	1.5E+01	3.8E+00	1.7E+00	9.7E-01	2.8E-01	1.3E-01	5.1E-02
436.1	1.1E+03	1.5E+01	3.8E+00	1.7E+00	9.9E-01	2.8E-01	1.3E-01	5.3E-02
451.1	1.2E+03	1.5E+01	3.9E+00	1.8E+00	1.0E+00	2.9E-01	1.4E-01	5.3E-02
466.1	1.2E+03	1.5E+01	3.9E+00	1.8E+00	1.0E+00	2.9E-01	1.4E-01	5.4E-02
481.1	1.2E+03	1.6E+01	4.1E+00	1.8E+00	1.1E+00	3.0E-01	1.4E-01	5.6E-02
496.1	1.2E+03	1.6E+01	4.2E+00	1.9E+00	1.1E+00	3.1E-01	1.5E-01	5.7E-02
511.1	1.3E+03	1.7E+01	4.3E+00	1.9E+00	1.1E+00	3.2E-01	1.5E-01	5.9E-02
526.1	1.3E+03	1.7E+01	4.5E+00	2.0E+00	1.2E+00	3.3E-01	1.6E-01	6.1E-02
541.1	1.4E+03	1.8E+01	4.6E+00	2.1E+00	1.2E+00	3.4E-01	1.6E-01	6.4E-02
556.1	1.4E+03	1.9E+01	4.8E+00	2.2E+00	1.2E+00	3.6E-01	1.7E-01	6.6E-02
571.1	1.5E+03	2.0E+01	5.1E+00	2.3E+00	1.3E+00	3.7E-01	1.8E-01	6.9E-02
586.1	1.6E+03	2.0E+01	5.3E+00	2.4E+00	1.4E+00	3.9E-01	1.8E-01	7.2E-02
601.1	1.6E+03	2.1E+01	5.5E+00	2.5E+00	1.4E+00	4.0E-01	1.9E-01	7.5E-02
616.1	1.7E+03	2.2E+01	5.7E+00	2.6E+00	1.5E+00	4.2E-01	2.0E-01	7.8E-02
631.1	1.7E+03	2.3E+01	5.9E+00	2.7E+00	1.5E+00	4.3E-01	2.1E-01	8.1E-02
646.1	1.8E+03	2.3E+01	5.9E+00	2.7E+00	1.5E+00	4.4E-01	2.1E-01	8.1E-02
661.1	1.7E+03	2.3E+01	5.9E+00	2.7E+00	1.5E+00	4.4E-01	2.1E-01	8.1E-02
676.1	1.7E+03	2.3E+01	5.9E+00	2.7E+00	1.5E+00	4.3E-01	2.1E-01	8.1E-02
691.1	1.7E+03	2.3E+01	5.9E+00	2.6E+00	1.5E+00	4.3E-01	2.0E-01	8.0E-02
706.1	1.7E+03	2.3E+01	5.8E+00	2.6E+00	1.5E+00	4.3E-01	2.0E-01	8.0E-02
706.1	1.7E+03	2.3E+01	5.8E+00	2.6E+00	1.5E+00	4.3E-01	2.0E-01	8.0E-02
707.6	1.7E+03	2.3E+01	5.9E+00	2.6E+00	1.5E+00	4.3E-01	2.0E-01	8.0E-02
722.6	1.7E+03	2.3E+01	5.9E+00	2.6E+00	1.5E+00	4.3E-01	2.0E-01	8.0E-02
737.6	1.7E+03	2.3E+01	5.9E+00	2.7E+00	1.5E+00	4.3E-01	2.0E-01	8.0E-02
752.6	1.7E+03	2.3E+01	5.9E+00	2.6E+00	1.5E+00	4.3E-01	2.0E-01	8.0E-02
767.6	1.7E+03	2.3E+01	5.8E+00	2.6E+00	1.5E+00	4.3E-01	2.0E-01	8.0E-02
782.6	1.7E+03	2.2E+01	5.7E+00	2.6E+00	1.5E+00	4.2E-01	2.0E-01	7.8E-02
797.6	1.6E+03	2.1E+01	5.4E+00	2.4E+00	1.4E+00	4.0E-01	1.9E-01	7.4E-02

Table C-13. Air Concentration Estimates for Excavation in Bay A, B, C, D –Typical Meteorology (continued)

Depth (cm)	Emissions (500 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
		250m	500m	750m	1000m	2000m	3000m	5000m
797.6	1.6E+03	2.1E+01	5.4E+00	2.4E+00	1.4E+00	4.0E-01	1.9E-01	7.4E-02
800.0	1.6E+03	2.1E+01	5.4E+00	2.4E+00	1.4E+00	4.0E-01	1.9E-01	7.4E-02
815.0	1.4E+03	1.9E+01	4.9E+00	2.2E+00	1.3E+00	3.6E-01	1.7E-01	6.7E-02
830.0	1.2E+03	1.6E+01	4.0E+00	1.8E+00	1.0E+00	3.0E-01	1.4E-01	5.5E-02
845.0	7.9E+02	1.0E+01	2.7E+00	1.2E+00	6.9E-01	2.0E-01	9.3E-02	3.7E-02
860.0	2.5E+02	3.3E+00	8.6E-01	3.9E-01	2.2E-01	6.3E-02	3.0E-02	1.2E-02
875.0	3.5E+01	4.6E-01	1.2E-01	5.4E-02	3.1E-02	8.8E-03	4.2E-03	1.6E-03
890.0	2.8E+01	3.7E-01	9.5E-02	4.3E-02	2.5E-02	7.0E-03	3.3E-03	1.3E-03
905.0	2.0E+01	2.6E-01	6.8E-02	3.1E-02	1.7E-02	5.0E-03	2.4E-03	9.3E-04
920.0	1.1E+01	1.4E-01	3.7E-02	1.7E-02	9.6E-03	2.7E-03	1.3E-03	5.1E-04
935.0	1.5E+00	2.0E-02	5.2E-03	2.3E-03	1.3E-03	3.8E-04	1.8E-04	7.1E-05

Table C-14. Air Concentration Estimates for Wall Collapse in Bay A – Typical Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (69 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.4E-01	9.6E-04	1.3E-05	3.2E-06	1.5E-06	8.3E-07	2.4E-07	1.1E-07	4.4E-08
0.7	4.0E-01	8.7E-04	1.1E-05	2.9E-06	1.3E-06	7.6E-07	2.2E-07	1.0E-07	4.0E-08
15.7	3.1E-01	6.7E-04	8.8E-06	2.3E-06	1.0E-06	5.9E-07	1.7E-07	8.0E-08	3.1E-08
30.7	1.6E-01	3.6E-04	4.7E-06	1.2E-06	5.4E-07	3.1E-07	8.9E-08	4.2E-08	1.7E-08
45.7	1.5E-01	3.4E-04	4.4E-06	1.1E-06	5.2E-07	2.9E-07	8.4E-08	4.0E-08	1.6E-08
45.7	1.5E-01	3.4E-04	4.4E-06	1.1E-06	5.2E-07	2.9E-07	8.4E-08	4.0E-08	1.6E-08
47.2	2.5E-01	5.3E-04	7.0E-06	1.8E-06	8.2E-07	4.7E-07	1.3E-07	6.3E-08	2.5E-08
62.2	6.4E-01	1.4E-03	1.8E-05	4.7E-06	2.1E-06	1.2E-06	3.5E-07	1.6E-07	6.5E-08
77.2	2.5E+00	5.4E-03	7.1E-05	1.8E-05	8.3E-06	4.7E-06	1.3E-06	6.4E-07	2.5E-07
92.2	1.2E+01	2.6E-02	3.4E-04	8.9E-05	4.0E-05	2.3E-05	6.6E-06	3.1E-06	1.2E-06
107.2	7.8E+01	1.7E-01	2.2E-03	5.7E-04	2.6E-04	1.5E-04	4.2E-05	2.0E-05	7.8E-06
122.2	6.9E+02	1.5E+00	2.0E-02	5.1E-03	2.3E-03	1.3E-03	3.7E-04	1.8E-04	7.0E-05
137.2	7.2E+02	1.6E+00	2.1E-02	5.3E-03	2.4E-03	1.4E-03	3.9E-04	1.9E-04	7.3E-05
137.2	7.2E+02	1.6E+00	2.1E-02	5.3E-03	2.4E-03	1.4E-03	3.9E-04	1.9E-04	7.3E-05
140.5	1.0E+03	2.3E+00	3.0E-02	7.7E-03	3.5E-03	2.0E-03	5.6E-04	2.7E-04	1.0E-04
155.5	1.5E+03	3.2E+00	4.3E-02	1.1E-02	5.0E-03	2.8E-03	8.1E-04	3.8E-04	1.5E-04
170.5	2.2E+03	4.7E+00	6.1E-02	1.6E-02	7.2E-03	4.1E-03	1.2E-03	5.5E-04	2.2E-04
185.5	3.1E+03	6.8E+00	8.9E-02	2.3E-02	1.0E-02	5.9E-03	1.7E-03	8.0E-04	3.1E-04
200.5	4.5E+03	9.8E+00	1.3E-01	3.3E-02	1.5E-02	8.6E-03	2.4E-03	1.2E-03	4.6E-04
215.5	6.6E+03	1.4E+01	1.9E-01	4.9E-02	2.2E-02	1.3E-02	3.6E-03	1.7E-03	6.6E-04
230.5	9.7E+03	2.1E+01	2.8E-01	7.1E-02	3.2E-02	1.8E-02	5.3E-03	2.5E-03	9.8E-04
245.5	1.4E+04	3.1E+01	4.1E-01	1.1E-01	4.8E-02	2.7E-02	7.8E-03	3.7E-03	1.5E-03
260.5	2.2E+04	4.8E+01	6.3E-01	1.6E-01	7.3E-02	4.2E-02	1.2E-02	5.6E-03	2.2E-03
275.5	3.4E+04	7.5E+01	9.8E-01	2.5E-01	1.1E-01	6.5E-02	1.9E-02	8.8E-03	3.5E-03
290.5	5.6E+04	1.2E+02	1.6E+00	4.1E-01	1.9E-01	1.1E-01	3.0E-02	1.4E-02	5.6E-03
305.5	9.4E+04	2.0E+02	2.7E+00	6.9E-01	3.1E-01	1.8E-01	5.1E-02	2.4E-02	9.5E-03
320.5	1.6E+05	3.4E+02	4.5E+00	1.2E+00	5.2E-01	3.0E-01	8.5E-02	4.0E-02	1.6E-02
335.5	2.2E+05	4.7E+02	6.2E+00	1.6E+00	7.2E-01	4.1E-01	1.2E-01	5.6E-02	2.2E-02
350.5	2.2E+05	4.8E+02	6.3E+00	1.6E+00	7.3E-01	4.2E-01	1.2E-01	5.6E-02	2.2E-02
350.5	2.2E+05	4.8E+02	6.3E+00	1.6E+00	7.3E-01	4.2E-01	1.2E-01	5.6E-02	2.2E-02
351.0	2.5E+05	5.5E+02	7.2E+00	1.9E+00	8.4E-01	4.8E-01	1.4E-01	6.5E-02	2.5E-02

Table C-14. Air Concentration Estimates for Wall Collapse in Bay A – Typical Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (69 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
366.0	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
381.0	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
381.0	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
388.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
403.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
418.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
433.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
448.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
463.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
478.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
493.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
508.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
523.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
538.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
553.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
568.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
583.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
598.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
613.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
628.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
643.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
658.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
673.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
688.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.9E-02	2.7E-02
703.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.8E-02	2.7E-02
718.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.9E-01	5.1E-01	1.4E-01	6.8E-02	2.7E-02
733.7	2.7E+05	5.8E+02	7.6E+00	2.0E+00	8.8E-01	5.1E-01	1.4E-01	6.8E-02	2.7E-02
748.7	2.6E+05	5.7E+02	7.5E+00	1.9E+00	8.8E-01	5.0E-01	1.4E-01	6.8E-02	2.7E-02
763.7	2.6E+05	5.7E+02	7.4E+00	1.9E+00	8.7E-01	5.0E-01	1.4E-01	6.7E-02	2.6E-02
778.7	2.6E+05	5.6E+02	7.3E+00	1.9E+00	8.5E-01	4.9E-01	1.4E-01	6.6E-02	2.6E-02
793.7	2.4E+05	5.3E+02	7.0E+00	1.8E+00	8.1E-01	4.6E-01	1.3E-01	6.3E-02	2.5E-02

Table C-14. Air Concentration Estimates for Wall Collapse in Bay A – Typical Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (69 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
808.7	2.2E+05	4.9E+02	6.4E+00	1.6E+00	7.4E-01	4.2E-01	1.2E-01	5.7E-02	2.3E-02
823.7	1.9E+05	4.1E+02	5.3E+00	1.4E+00	6.2E-01	3.5E-01	1.0E-01	4.8E-02	1.9E-02
838.7	1.3E+05	2.8E+02	3.6E+00	9.4E-01	4.2E-01	2.4E-01	6.9E-02	3.3E-02	1.3E-02
853.7	4.6E+04	1.0E+02	1.3E+00	3.4E-01	1.5E-01	8.8E-02	2.5E-02	1.2E-02	4.7E-03

Table C-15. Air Concentration Estimates for Drilling in Bay A –Typical Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (2.3 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.4E-01	3.2E-05	4.2E-07	1.1E-07	4.9E-08	2.8E-08	7.9E-09	3.8E-09	1.5E-09
0.7	4.0E-01	2.9E-05	3.8E-07	9.8E-08	4.4E-08	2.5E-08	7.2E-09	3.4E-09	1.3E-09
15.7	3.1E-01	2.2E-05	2.9E-07	7.6E-08	3.4E-08	2.0E-08	5.6E-09	2.7E-09	1.0E-09
30.7	1.6E-01	1.2E-05	1.6E-07	4.0E-08	1.8E-08	1.0E-08	3.0E-09	1.4E-09	5.5E-10
45.7	1.5E-01	1.1E-05	1.5E-07	3.8E-08	1.7E-08	9.8E-09	2.8E-09	1.3E-09	5.2E-10
45.7	1.5E-01	1.1E-05	1.5E-07	3.8E-08	1.7E-08	9.8E-09	2.8E-09	1.3E-09	5.2E-10
47.2	2.5E-01	1.8E-05	2.3E-07	6.0E-08	2.7E-08	1.6E-08	4.4E-09	2.1E-09	8.3E-10
62.2	6.4E-01	4.7E-05	6.1E-07	1.6E-07	7.1E-08	4.1E-08	1.2E-08	5.5E-09	2.2E-09
77.2	2.5E+00	1.8E-04	2.4E-06	6.1E-07	2.8E-07	1.6E-07	4.5E-08	2.1E-08	8.4E-09
92.2	1.2E+01	8.8E-04	1.1E-05	3.0E-06	1.3E-06	7.7E-07	2.2E-07	1.0E-07	4.1E-08
107.2	7.8E+01	5.6E-03	7.4E-05	1.9E-05	8.6E-06	4.9E-06	1.4E-06	6.6E-07	2.6E-07
122.2	6.9E+02	5.0E-02	6.6E-04	1.7E-04	7.7E-05	4.4E-05	1.2E-05	5.9E-06	2.3E-06
137.2	7.2E+02	5.2E-02	6.9E-04	1.8E-04	8.0E-05	4.6E-05	1.3E-05	6.2E-06	2.4E-06
137.2	7.2E+02	5.2E-02	6.9E-04	1.8E-04	8.0E-05	4.6E-05	1.3E-05	6.2E-06	2.4E-06
140.5	1.0E+03	7.5E-02	9.9E-04	2.6E-04	1.2E-04	6.6E-05	1.9E-05	8.9E-06	3.5E-06
155.5	1.5E+03	1.1E-01	1.4E-03	3.7E-04	1.7E-04	9.5E-05	2.7E-05	1.3E-05	5.0E-06
170.5	2.2E+03	1.6E-01	2.0E-03	5.3E-04	2.4E-04	1.4E-04	3.9E-05	1.8E-05	7.2E-06
185.5	3.1E+03	2.3E-01	3.0E-03	7.6E-04	3.5E-04	2.0E-04	5.6E-05	2.7E-05	1.0E-05
200.5	4.5E+03	3.3E-01	4.3E-03	1.1E-03	5.0E-04	2.9E-04	8.1E-05	3.9E-05	1.5E-05
215.5	6.6E+03	4.8E-01	6.3E-03	1.6E-03	7.3E-04	4.2E-04	1.2E-04	5.6E-05	2.2E-05
230.5	9.7E+03	7.0E-01	9.2E-03	2.4E-03	1.1E-03	6.1E-04	1.8E-04	8.3E-05	3.3E-05
245.5	1.4E+04	1.0E+00	1.4E-02	3.6E-03	1.6E-03	9.2E-04	2.6E-04	1.2E-04	4.9E-05
260.5	2.2E+04	1.6E+00	2.1E-02	5.4E-03	2.4E-03	1.4E-03	4.0E-04	1.9E-04	7.4E-05
275.5	3.4E+04	2.5E+00	3.3E-02	8.4E-03	3.8E-03	2.2E-03	6.2E-04	2.9E-04	1.2E-04
290.5	5.6E+04	4.0E+00	5.3E-02	1.4E-02	6.2E-03	3.5E-03	1.0E-03	4.8E-04	1.9E-04
305.5	9.4E+04	6.8E+00	8.9E-02	2.3E-02	1.0E-02	6.0E-03	1.7E-03	8.0E-04	3.2E-04
320.5	1.6E+05	1.1E+01	1.5E-01	3.9E-02	1.7E-02	1.0E-02	2.8E-03	1.3E-03	5.3E-04
335.5	2.2E+05	1.6E+01	2.1E-01	5.3E-02	2.4E-02	1.4E-02	3.9E-03	1.9E-03	7.3E-04
350.5	2.2E+05	1.6E+01	2.1E-01	5.4E-02	2.4E-02	1.4E-02	4.0E-03	1.9E-03	7.4E-04
350.5	2.2E+05	1.6E+01	2.1E-01	5.4E-02	2.4E-02	1.4E-02	4.0E-03	1.9E-03	7.4E-04
351.0	2.5E+05	1.8E+01	2.4E-01	6.2E-02	2.8E-02	1.6E-02	4.6E-03	2.2E-03	8.5E-04

Table C-15. Air Concentration Estimates for Drilling in Bay A –Typical Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (2.3 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
366.0	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
381.0	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
381.0	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
388.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
403.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
418.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
433.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
448.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
463.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
478.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
493.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
508.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
523.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
538.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
553.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
568.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
583.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
598.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
613.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
628.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
643.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
658.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
673.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
688.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
703.7	2.7E+05	1.9E+01	2.5E-01	6.6E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
718.7	2.7E+05	1.9E+01	2.5E-01	6.5E-02	3.0E-02	1.7E-02	4.8E-03	2.3E-03	9.0E-04
733.7	2.7E+05	1.9E+01	2.5E-01	6.5E-02	2.9E-02	1.7E-02	4.8E-03	2.3E-03	8.9E-04
748.7	2.6E+05	1.9E+01	2.5E-01	6.5E-02	2.9E-02	1.7E-02	4.8E-03	2.3E-03	8.9E-04
763.7	2.6E+05	1.9E+01	2.5E-01	6.4E-02	2.9E-02	1.7E-02	4.7E-03	2.2E-03	8.8E-04
778.7	2.6E+05	1.9E+01	2.4E-01	6.3E-02	2.8E-02	1.6E-02	4.6E-03	2.2E-03	8.6E-04
793.7	2.4E+05	1.8E+01	2.3E-01	6.0E-02	2.7E-02	1.5E-02	4.4E-03	2.1E-03	8.2E-04

Table C-15. Air Concentration Estimates for Drilling in Bay A –Typical Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (2.3 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
808.7	2.2E+05	1.6E+01	2.1E-01	5.5E-02	2.5E-02	1.4E-02	4.0E-03	1.9E-03	7.5E-04
823.7	1.9E+05	1.4E+01	1.8E-01	4.6E-02	2.1E-02	1.2E-02	3.4E-03	1.6E-03	6.3E-04
838.7	1.3E+05	9.2E+00	1.2E-01	3.1E-02	1.4E-02	8.1E-03	2.3E-03	1.1E-03	4.3E-04
853.7	4.6E+04	3.4E+00	4.4E-02	1.1E-02	5.2E-03	2.9E-03	8.4E-04	4.0E-04	1.6E-04

Table C-16. Air Concentration Estimates for Burrowing in Bay A –Typical Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (0.53 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.4E-01	7.3E-06	9.6E-08	2.5E-08	1.1E-08	6.4E-09	1.8E-09	8.7E-10	3.4E-10
0.7	4.0E-01	6.7E-06	8.7E-08	2.3E-08	1.0E-08	5.8E-09	1.7E-09	7.9E-10	3.1E-10
15.7	3.1E-01	5.2E-06	6.8E-08	1.8E-08	7.9E-09	4.5E-09	1.3E-09	6.1E-10	2.4E-10
30.7	1.6E-01	2.7E-06	3.6E-08	9.3E-09	4.2E-09	2.4E-09	6.8E-10	3.2E-10	1.3E-10
45.7	1.5E-01	2.6E-06	3.4E-08	8.8E-09	4.0E-09	2.3E-09	6.4E-10	3.1E-10	1.2E-10
45.7	1.5E-01	2.6E-06	3.4E-08	8.8E-09	4.0E-09	2.3E-09	6.4E-10	3.1E-10	1.2E-10
47.2	2.5E-01	4.1E-06	5.4E-08	1.4E-08	6.3E-09	3.6E-09	1.0E-09	4.8E-10	1.9E-10
62.2	6.4E-01	1.1E-05	1.4E-07	3.6E-08	1.6E-08	9.4E-09	2.7E-09	1.3E-09	5.0E-10
77.2	2.5E+00	4.2E-05	5.4E-07	1.4E-07	6.4E-08	3.6E-08	1.0E-08	4.9E-09	1.9E-09
92.2	1.2E+01	2.0E-04	2.6E-06	6.9E-07	3.1E-07	1.8E-07	5.0E-08	2.4E-08	9.4E-09
107.2	7.8E+01	1.3E-03	1.7E-05	4.4E-06	2.0E-06	1.1E-06	3.2E-07	1.5E-07	6.0E-08
122.2	6.9E+02	1.2E-02	1.5E-04	3.9E-05	1.8E-05	1.0E-05	2.9E-06	1.4E-06	5.4E-07
137.2	7.2E+02	1.2E-02	1.6E-04	4.1E-05	1.8E-05	1.1E-05	3.0E-06	1.4E-06	5.6E-07
137.2	7.2E+02	1.2E-02	1.6E-04	4.1E-05	1.8E-05	1.1E-05	3.0E-06	1.4E-06	5.6E-07
140.5	1.0E+03	1.7E-02	2.3E-04	5.9E-05	2.7E-05	1.5E-05	4.3E-06	2.0E-06	8.0E-07
155.5	1.5E+03	2.5E-02	3.3E-04	8.5E-05	3.8E-05	2.2E-05	6.2E-06	2.9E-06	1.2E-06
170.5	2.2E+03	3.6E-02	4.7E-04	1.2E-04	5.5E-05	3.1E-05	9.0E-06	4.2E-06	1.7E-06
185.5	3.1E+03	5.2E-02	6.8E-04	1.8E-04	8.0E-05	4.5E-05	1.3E-05	6.1E-06	2.4E-06
200.5	4.5E+03	7.5E-02	9.9E-04	2.6E-04	1.2E-04	6.6E-05	1.9E-05	8.9E-06	3.5E-06
215.5	6.6E+03	1.1E-01	1.4E-03	3.7E-04	1.7E-04	9.6E-05	2.7E-05	1.3E-05	5.1E-06
230.5	9.7E+03	1.6E-01	2.1E-03	5.5E-04	2.5E-04	1.4E-04	4.0E-05	1.9E-05	7.5E-06
245.5	1.4E+04	2.4E-01	3.2E-03	8.2E-04	3.7E-04	2.1E-04	6.0E-05	2.8E-05	1.1E-05
260.5	2.2E+04	3.7E-01	4.8E-03	1.2E-03	5.6E-04	3.2E-04	9.1E-05	4.3E-05	1.7E-05
275.5	3.4E+04	5.7E-01	7.5E-03	1.9E-03	8.8E-04	5.0E-04	1.4E-04	6.8E-05	2.7E-05
290.5	5.6E+04	9.3E-01	1.2E-02	3.2E-03	1.4E-03	8.1E-04	2.3E-04	1.1E-04	4.3E-05
305.5	9.4E+04	1.6E+00	2.1E-02	5.3E-03	2.4E-03	1.4E-03	3.9E-04	1.9E-04	7.3E-05
320.5	1.6E+05	2.6E+00	3.5E-02	8.9E-03	4.0E-03	2.3E-03	6.6E-04	3.1E-04	1.2E-04
335.5	2.2E+05	3.6E+00	4.8E-02	1.2E-02	5.5E-03	3.2E-03	9.0E-04	4.3E-04	1.7E-04
350.5	2.2E+05	3.7E+00	4.8E-02	1.2E-02	5.6E-03	3.2E-03	9.1E-04	4.3E-04	1.7E-04
350.5	2.2E+05	3.7E+00	4.8E-02	1.2E-02	5.6E-03	3.2E-03	9.1E-04	4.3E-04	1.7E-04
351.0	2.5E+05	4.2E+00	5.5E-02	1.4E-02	6.5E-03	3.7E-03	1.1E-03	5.0E-04	2.0E-04

Table C-16. Air Concentration Estimates for Burrowing in Bay A –Typical Meteorology(continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (0.53 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
366.0	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
381.0	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
381.0	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
388.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
403.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
418.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
433.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
448.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
463.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
478.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
493.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
508.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
523.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
538.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
553.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
568.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
583.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
598.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
613.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
628.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
643.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
658.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
673.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
688.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
703.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
718.7	2.7E+05	4.5E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.3E-04	2.1E-04
733.7	2.7E+05	4.4E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.2E-04	2.1E-04
748.7	2.6E+05	4.4E+00	5.8E-02	1.5E-02	6.8E-03	3.9E-03	1.1E-03	5.2E-04	2.0E-04
763.7	2.6E+05	4.4E+00	5.7E-02	1.5E-02	6.7E-03	3.8E-03	1.1E-03	5.1E-04	2.0E-04
778.7	2.6E+05	4.3E+00	5.6E-02	1.4E-02	6.5E-03	3.7E-03	1.1E-03	5.0E-04	2.0E-04
793.7	2.4E+05	4.1E+00	5.3E-02	1.4E-02	6.2E-03	3.6E-03	1.0E-03	4.8E-04	1.9E-04

Table C-16. Air Concentration Estimates for Burrowing in Bay A –Typical Meteorology(continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (0.53 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
808.7	2.2E+05	3.7E+00	4.9E-02	1.3E-02	5.7E-03	3.3E-03	9.3E-04	4.4E-04	1.7E-04
823.7	1.9E+05	3.1E+00	4.1E-02	1.1E-02	4.8E-03	2.7E-03	7.8E-04	3.7E-04	1.4E-04
838.7	1.3E+05	2.1E+00	2.8E-02	7.2E-03	3.3E-03	1.9E-03	5.3E-04	2.5E-04	9.9E-05
853.7	4.6E+04	7.8E-01	1.0E-02	2.6E-03	1.2E-03	6.8E-04	1.9E-04	9.2E-05	3.6E-05
868.7	0.0E+00								

Air Concentrations

Default Meteorology

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Table C-17. Air Concentration Estimates for Excavation in Bay A – Default Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.4E-01	1.4E-03	1.9E-06	5.2E-07	2.5E-07	1.4E-07	4.6E-08	2.4E-08	1.1E-08
0.7	4.0E-01	1.3E-03	1.7E-06	4.7E-07	2.2E-07	1.3E-07	4.2E-08	2.1E-08	1.0E-08
15.7	3.1E-01	9.8E-04	1.3E-06	3.7E-07	1.7E-07	1.0E-07	3.2E-08	1.7E-08	7.9E-09
30.7	1.6E-01	5.2E-04	7.0E-07	1.9E-07	9.2E-08	5.4E-08	1.7E-08	8.8E-09	4.1E-09
45.7	1.5E-01	4.9E-04	6.6E-07	1.8E-07	8.7E-08	5.1E-08	1.6E-08	8.3E-09	3.9E-09
45.7	1.5E-01	4.9E-04	6.6E-07	1.8E-07	8.7E-08	5.1E-08	1.6E-08	8.3E-09	3.9E-09
47.2	2.5E-01	7.7E-04	1.0E-06	2.9E-07	1.4E-07	8.0E-08	2.6E-08	1.3E-08	6.2E-09
62.2	6.4E-01	2.0E-03	2.7E-06	7.6E-07	3.6E-07	2.1E-07	6.7E-08	3.4E-08	1.6E-08
77.2	2.5E+00	7.8E-03	1.1E-05	2.9E-06	1.4E-06	8.1E-07	2.6E-07	1.3E-07	6.3E-08
92.2	1.2E+01	3.8E-02	5.2E-05	1.4E-05	6.8E-06	4.0E-06	1.3E-06	6.5E-07	3.1E-07
107.2	7.8E+01	2.4E-01	3.3E-04	9.2E-05	4.4E-05	2.5E-05	8.1E-06	4.2E-06	2.0E-06
122.2	6.9E+02	2.2E+00	2.9E-03	8.2E-04	3.9E-04	2.3E-04	7.2E-05	3.7E-05	1.8E-05
137.2	7.2E+02	2.3E+00	3.1E-03	8.5E-04	4.1E-04	2.4E-04	7.6E-05	3.9E-05	1.8E-05
137.2	7.2E+02	2.3E+00	3.1E-03	8.5E-04	4.1E-04	2.4E-04	7.6E-05	3.9E-05	1.8E-05
140.5	1.0E+03	3.3E+00	4.4E-03	1.2E-03	5.8E-04	3.4E-04	1.1E-04	5.6E-05	2.6E-05
155.5	1.5E+03	4.7E+00	6.4E-03	1.8E-03	8.4E-04	4.9E-04	1.6E-04	8.0E-05	3.8E-05
170.5	2.2E+03	6.8E+00	9.2E-03	2.5E-03	1.2E-03	7.1E-04	2.3E-04	1.2E-04	5.5E-05
185.5	3.1E+03	9.8E+00	1.3E-02	3.7E-03	1.7E-03	1.0E-03	3.3E-04	1.7E-04	7.9E-05
200.5	4.5E+03	1.4E+01	1.9E-02	5.3E-03	2.5E-03	1.5E-03	4.7E-04	2.4E-04	1.1E-04
215.5	6.6E+03	2.1E+01	2.8E-02	7.8E-03	3.7E-03	2.2E-03	6.9E-04	3.5E-04	1.7E-04
230.5	9.7E+03	3.1E+01	4.1E-02	1.1E-02	5.4E-03	3.2E-03	1.0E-03	5.2E-04	2.5E-04
245.5	1.4E+04	4.6E+01	6.2E-02	1.7E-02	8.1E-03	4.7E-03	1.5E-03	7.7E-04	3.7E-04
260.5	2.2E+04	6.9E+01	9.3E-02	2.6E-02	1.2E-02	7.2E-03	2.3E-03	1.2E-03	5.6E-04
275.5	3.4E+04	1.1E+02	1.5E-01	4.1E-02	1.9E-02	1.1E-02	3.6E-03	1.8E-03	8.7E-04
290.5	5.6E+04	1.8E+02	2.4E-01	6.6E-02	3.1E-02	1.8E-02	5.8E-03	3.0E-03	1.4E-03
305.5	9.4E+04	3.0E+02	4.0E-01	1.1E-01	5.3E-02	3.1E-02	9.8E-03	5.0E-03	2.4E-03
320.5	1.6E+05	5.0E+02	6.7E-01	1.9E-01	8.8E-02	5.2E-02	1.7E-02	8.4E-03	4.0E-03
335.5	2.2E+05	6.8E+02	9.2E-01	2.6E-01	1.2E-01	7.1E-02	2.3E-02	1.2E-02	5.5E-03
350.5	2.2E+05	6.9E+02	9.4E-01	2.6E-01	1.2E-01	7.2E-02	2.3E-02	1.2E-02	5.6E-03
350.5	2.2E+05	6.9E+02	9.4E-01	2.6E-01	1.2E-01	7.2E-02	2.3E-02	1.2E-02	5.6E-03
351.0	2.5E+05	8.0E+02	1.1E+00	3.0E-01	1.4E-01	8.3E-02	2.6E-02	1.4E-02	6.4E-03

Table C-17. Air Concentration Estimates for Excavation in Bay A – Default Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
366.0	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
381.0	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
381.0	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
388.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
403.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
418.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
433.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
448.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
463.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
478.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
493.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
508.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
523.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
538.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
553.7	2.7E+05	8.423E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
568.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
583.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
598.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
613.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
628.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
643.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
658.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
673.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
688.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
703.7	2.7E+05	8.4E+02	1.1E+00	3.2E-01	1.5E-01	8.7E-02	2.8E-02	1.4E-02	6.8E-03
718.7	2.7E+05	8.4E+02	1.1E+00	3.1E-01	1.5E-01	8.7E-02	2.8E-02	1.4E-02	6.8E-03
733.7	2.7E+05	8.4E+02	1.1E+00	3.1E-01	1.5E-01	8.7E-02	2.8E-02	1.4E-02	6.7E-03
748.7	2.6E+05	8.3E+02	1.1E+00	3.1E-01	1.5E-01	8.7E-02	2.8E-02	1.4E-02	6.7E-03
763.7	2.6E+05	8.2E+02	1.1E+00	3.1E-01	1.5E-01	8.6E-02	2.7E-02	1.4E-02	6.6E-03
778.7	2.6E+05	8.0E+02	1.1E+00	3.0E-01	1.4E-01	8.4E-02	2.7E-02	1.4E-02	6.5E-03
793.7	2.4E+05	7.7E+02	1.0E+00	2.9E-01	1.4E-01	8.0E-02	2.6E-02	1.3E-02	6.2E-03

Table C-17. Air Concentration Estimates for Excavation in Bay A – Default Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
808.7	2.2E+05	7.0E+02	9.5E-01	2.6E-01	1.3E-01	7.3E-02	2.3E-02	1.2E-02	5.7E-03
823.7	1.9E+05	5.9E+02	7.9E-01	2.2E-01	1.0E-01	6.1E-02	2.0E-02	1.0E-02	4.7E-03
838.7	1.3E+05	4.0E+02	5.4E-01	1.5E-01	7.2E-02	4.2E-02	1.3E-02	6.8E-03	3.2E-03
853.7	4.6E+04	1.5E+02	2.0E-01	5.5E-02	2.6E-02	1.5E-02	4.9E-03	2.5E-03	1.2E-03

Table C-18. Air Concentration Estimates for Excavation in Bay B – Default Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.5E-01	1.41E-03	1.9E-06	5.3E-07	2.5E-07	1.5E-07	4.7E-08	2.4E-08	1.1E-08
0.7	4.1E-01	1.29E-03	1.7E-06	4.8E-07	2.3E-07	1.3E-07	4.3E-08	2.2E-08	1.0E-08
15.7	3.2E-01	9.96E-04	1.3E-06	3.7E-07	1.8E-07	1.0E-07	3.3E-08	1.7E-08	8.0E-09
30.7	1.6E-01	5.09E-04	6.9E-07	1.9E-07	9.1E-08	5.3E-08	1.7E-08	8.7E-09	4.1E-09
45.7	1.5E-01	4.82E-04	6.5E-07	1.8E-07	8.6E-08	5.0E-08	1.6E-08	8.2E-09	3.9E-09
45.7	1.5E-01	4.82E-04	6.5E-07	1.8E-07	8.6E-08	5.0E-08	1.6E-08	8.2E-09	3.9E-09
47.2	2.4E-01	7.42E-04	1.0E-06	2.8E-07	1.3E-07	7.7E-08	2.5E-08	1.3E-08	6.0E-09
62.2	5.8E-01	1.84E-03	2.5E-06	6.9E-07	3.3E-07	1.9E-07	6.1E-08	3.1E-08	1.5E-08
77.2	2.0E+00	6.46E-03	8.7E-06	2.4E-06	1.2E-06	6.7E-07	2.1E-07	1.1E-07	5.2E-08
92.2	8.2E+00	2.59E-02	3.5E-05	9.7E-06	4.6E-06	2.7E-06	8.6E-07	4.4E-07	2.1E-07
107.2	3.3E+01	1.04E-01	1.4E-04	3.9E-05	1.8E-05	1.1E-05	3.4E-06	1.8E-06	8.3E-07
122.2	8.2E+01	2.59E-01	3.5E-04	9.7E-05	4.6E-05	2.7E-05	8.6E-06	4.4E-06	2.1E-06
137.2	8.3E+01	2.61E-01	3.5E-04	9.8E-05	4.6E-05	2.7E-05	8.7E-06	4.4E-06	2.1E-06
137.2	8.3E+01	2.61E-01	3.5E-04	9.8E-05	4.6E-05	2.7E-05	8.7E-06	4.4E-06	2.1E-06
140.5	1.2E+02	3.74E-01	5.0E-04	1.4E-04	6.6E-05	3.9E-05	1.2E-05	6.4E-06	3.0E-06
155.5	1.7E+02	5.41E-01	7.3E-04	2.0E-04	9.6E-05	5.6E-05	1.8E-05	9.2E-06	4.3E-06
170.5	2.5E+02	7.90E-01	1.1E-03	3.0E-04	1.4E-04	8.2E-05	2.6E-05	1.3E-05	6.3E-06
185.5	3.7E+02	1.16E+00	1.6E-03	4.4E-04	2.1E-04	1.2E-04	3.9E-05	2.0E-05	9.3E-06
200.5	5.4E+02	1.71E+00	2.3E-03	6.4E-04	3.1E-04	1.8E-04	5.7E-05	2.9E-05	1.4E-05
215.5	8.1E+02	2.54E+00	3.4E-03	9.5E-04	4.5E-04	2.6E-04	8.4E-05	4.3E-05	2.0E-05
230.5	1.2E+03	3.78E+00	5.1E-03	1.4E-03	6.7E-04	3.9E-04	1.3E-04	6.4E-05	3.0E-05
245.5	1.8E+03	5.62E+00	7.6E-03	2.1E-03	1.0E-03	5.8E-04	1.9E-04	9.6E-05	4.5E-05
260.5	2.6E+03	8.36E+00	1.1E-02	3.1E-03	1.5E-03	8.7E-04	2.8E-04	1.4E-04	6.7E-05
275.5	3.9E+03	1.23E+01	1.7E-02	4.6E-03	2.2E-03	1.3E-03	4.1E-04	2.1E-04	9.9E-05
290.5	5.7E+03	1.79E+01	2.4E-02	6.7E-03	3.2E-03	1.9E-03	5.9E-04	3.0E-04	1.4E-04
305.5	7.9E+03	2.49E+01	3.4E-02	9.3E-03	4.4E-03	2.6E-03	8.3E-04	4.2E-04	2.0E-04
320.5	1.0E+04	3.20E+01	4.3E-02	1.2E-02	5.7E-03	3.3E-03	1.1E-03	5.4E-04	2.6E-04
335.5	1.1E+04	3.61E+01	4.9E-02	1.4E-02	6.4E-03	3.7E-03	1.2E-03	6.1E-04	2.9E-04
350.5	1.1E+04	3.62E+01	4.9E-02	1.4E-02	6.4E-03	3.8E-03	1.2E-03	6.2E-04	2.9E-04
350.5	1.1E+04	3.62E+01	4.9E-02	1.4E-02	6.4E-03	3.8E-03	1.2E-03	6.2E-04	2.9E-04
352.4	1.2E+04	3.72E+01	5.0E-02	1.4E-02	6.6E-03	3.9E-03	1.2E-03	6.3E-04	3.0E-04

Table C-18. Air Concentration Estimates for Excavation in Bay B – Default Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
367.4	1.2E+04	3.80E+01	5.1E-02	1.4E-02	6.8E-03	4.0E-03	1.3E-03	6.5E-04	3.1E-04
382.4	1.221E+04	3.85E+01	5.2E-02	1.4E-02	6.9E-03	4.0E-03	1.3E-03	6.5E-04	3.1E-04
397.4	1.2E+04	3.84E+01	5.2E-02	1.4E-02	6.8E-03	4.0E-03	1.3E-03	6.5E-04	3.1E-04
412.4	1.2E+04	3.76E+01	5.1E-02	1.4E-02	6.7E-03	3.9E-03	1.2E-03	6.4E-04	3.0E-04
427.4	1.1E+04	3.56E+01	4.8E-02	1.3E-02	6.3E-03	3.7E-03	1.2E-03	6.1E-04	2.9E-04
442.4	1.0E+04	3.24E+01	4.4E-02	1.2E-02	5.8E-03	3.4E-03	1.1E-03	5.5E-04	2.6E-04
457.4	8.9E+03	2.79E+01	3.8E-02	1.0E-02	5.0E-03	2.9E-03	9.3E-04	4.7E-04	2.2E-04
472.4	8.6E+03	2.73E+01	3.7E-02	1.0E-02	4.9E-03	2.8E-03	9.1E-04	4.6E-04	2.2E-04
472.4	8.6E+03	2.73E+01	3.7E-02	1.0E-02	4.9E-03	2.8E-03	9.1E-04	4.6E-04	2.2E-04
472.9	9.5E+03	3.00E+01	4.1E-02	1.1E-02	5.3E-03	3.1E-03	1.0E-03	5.1E-04	2.4E-04
487.9	9.9E+03	3.11E+01	4.2E-02	1.2E-02	5.5E-03	3.2E-03	1.0E-03	5.3E-04	2.5E-04
502.9	9.9E+03	3.11E+01	4.2E-02	1.2E-02	5.5E-03	3.2E-03	1.0E-03	5.3E-04	2.5E-04
502.9	9.9E+03	3.11E+01	4.2E-02	1.2E-02	5.5E-03	3.2E-03	1.0E-03	5.3E-04	2.5E-04
508.7	9.9E+03	3.11E+01	4.2E-02	1.2E-02	5.5E-03	3.2E-03	1.0E-03	5.3E-04	2.5E-04
523.7	9.9E+03	3.11E+01	4.2E-02	1.2E-02	5.5E-03	3.2E-03	1.0E-03	5.3E-04	2.5E-04
538.7	9.9E+03	3.11E+01	4.2E-02	1.2E-02	5.5E-03	3.2E-03	1.0E-03	5.3E-04	2.5E-04
553.7	9.8E+03	3.10E+01	4.2E-02	1.2E-02	5.5E-03	3.2E-03	1.0E-03	5.3E-04	2.5E-04
568.7	9.8E+03	3.10E+01	4.2E-02	1.2E-02	5.5E-03	3.2E-03	1.0E-03	5.3E-04	2.5E-04
583.7	9.8E+03	3.10E+01	4.2E-02	1.2E-02	5.5E-03	3.2E-03	1.0E-03	5.3E-04	2.5E-04
598.7	9.8E+03	3.09E+01	4.2E-02	1.2E-02	5.5E-03	3.2E-03	1.0E-03	5.2E-04	2.5E-04
613.7	9.8E+03	3.08E+01	4.2E-02	1.2E-02	5.5E-03	3.2E-03	1.0E-03	5.2E-04	2.5E-04
628.7	9.7E+03	3.06E+01	4.1E-02	1.1E-02	5.5E-03	3.2E-03	1.0E-03	5.2E-04	2.5E-04
643.7	9.6E+03	3.04E+01	4.1E-02	1.1E-02	5.4E-03	3.2E-03	1.0E-03	5.2E-04	2.4E-04
658.7	9.6E+03	3.02E+01	4.1E-02	1.1E-02	5.4E-03	3.1E-03	1.0E-03	5.1E-04	2.4E-04
673.7	9.5E+03	2.98E+01	4.0E-02	1.1E-02	5.3E-03	3.1E-03	9.9E-04	5.1E-04	2.4E-04
688.7	9.3E+03	2.93E+01	4.0E-02	1.1E-02	5.2E-03	3.1E-03	9.7E-04	5.0E-04	2.4E-04
703.7	9.1E+03	2.87E+01	3.9E-02	1.1E-02	5.1E-03	3.0E-03	9.5E-04	4.9E-04	2.3E-04
718.7	8.8E+03	2.79E+01	3.8E-02	1.0E-02	5.0E-03	2.9E-03	9.3E-04	4.7E-04	2.2E-04
733.7	8.5E+03	2.68E+01	3.6E-02	1.0E-02	4.8E-03	2.8E-03	8.9E-04	4.6E-04	2.2E-04
748.7	8.0E+03	2.53E+01	3.4E-02	9.5E-03	4.5E-03	2.6E-03	8.4E-04	4.3E-04	2.0E-04
763.7	7.5E+03	2.35E+01	3.2E-02	8.8E-03	4.2E-03	2.4E-03	7.8E-04	4.0E-04	1.9E-04

Table C-18. Air Concentration Estimates for Excavation in Bay B – Default Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
778.7	6.7E+03	2.12E+01	2.9E-02	7.9E-03	3.8E-03	2.2E-03	7.0E-04	3.6E-04	1.7E-04
793.7	5.8E+03	1.83E+01	2.5E-02	6.9E-03	3.3E-03	1.9E-03	6.1E-04	3.1E-04	1.5E-04
808.7	4.7E+03	1.49E+01	2.0E-02	5.6E-03	2.7E-03	1.6E-03	5.0E-04	2.5E-04	1.2E-04
823.7	3.5E+03	1.10E+01	1.5E-02	4.1E-03	1.9E-03	1.1E-03	3.6E-04	1.9E-04	8.8E-05
838.7	2.1E+03	6.54E+00	8.8E-03	2.5E-03	1.2E-03	6.8E-04	2.2E-04	1.1E-04	5.3E-05
853.7	5.8E+02	1.84E+00	2.5E-03	6.9E-04	3.3E-04	1.9E-04	6.1E-05	3.1E-05	1.5E-05

Table C-19. Air Concentration Estimates for Excavation in Bay C – Default Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.28E-01	1.35E-03	1.8E-06	5.1E-07	2.4E-07	1.4E-07	4.5E-08	2.3E-08	1.1E-08
0.7	3.83E-01	1.21E-03	1.6E-06	4.5E-07	2.1E-07	1.3E-07	4.0E-08	2.1E-08	9.7E-09
15.7	2.88E-01	9.10E-04	1.2E-06	3.4E-07	1.6E-07	9.5E-08	3.0E-08	1.5E-08	7.3E-09
30.7	1.39E-01	4.38E-04	5.9E-07	1.6E-07	7.8E-08	4.6E-08	1.5E-08	7.4E-09	3.5E-09
45.7	1.30E-01	4.11E-04	5.5E-07	1.5E-07	7.3E-08	4.3E-08	1.4E-08	7.0E-09	3.3E-09
45.7	1.30E-01	4.11E-04	5.5E-07	1.5E-07	7.3E-08	4.3E-08	1.4E-08	7.0E-09	3.3E-09
47.2	1.40E-01	4.43E-04	6.0E-07	1.7E-07	7.9E-08	4.6E-08	1.5E-08	7.5E-09	3.6E-09
62.2	1.85E-01	5.82E-04	7.9E-07	2.2E-07	1.0E-07	6.1E-08	1.9E-08	9.9E-09	4.7E-09
77.2	3.90E-01	1.23E-03	1.7E-06	4.6E-07	2.2E-07	1.3E-07	4.1E-08	2.1E-08	9.9E-09
92.2	1.46E+00	4.60E-03	6.2E-06	1.7E-06	8.2E-07	4.8E-07	1.5E-07	7.8E-08	3.7E-08
107.2	8.74E+00	2.76E-02	3.7E-05	1.0E-05	4.9E-06	2.9E-06	9.1E-07	4.7E-07	2.2E-07
122.2	7.69E+01	2.42E-01	3.3E-04	9.1E-05	4.3E-05	2.5E-05	8.0E-06	4.1E-06	1.9E-06
137.2	8.05E+01	2.54E-01	3.4E-04	9.5E-05	4.5E-05	2.6E-05	8.4E-06	4.3E-06	2.0E-06
137.2	8.05E+01	2.54E-01	3.4E-04	9.5E-05	4.5E-05	2.6E-05	8.4E-06	4.3E-06	2.0E-06
140.5	1.12E+02	3.54E-01	4.8E-04	1.3E-04	6.3E-05	3.7E-05	1.2E-05	6.0E-06	2.8E-06
155.5	1.58E+02	4.99E-01	6.7E-04	1.9E-04	8.9E-05	5.2E-05	1.7E-05	8.5E-06	4.0E-06
170.5	2.25E+02	7.11E-01	9.6E-04	2.7E-04	1.3E-04	7.4E-05	2.4E-05	1.2E-05	5.7E-06
185.5	3.24E+02	1.02E+00	1.4E-03	3.8E-04	1.8E-04	1.1E-04	3.4E-05	1.7E-05	8.2E-06
200.5	4.68E+02	1.48E+00	2.0E-03	5.5E-04	2.6E-04	1.5E-04	4.9E-05	2.5E-05	1.2E-05
215.5	6.85E+02	2.16E+00	2.9E-03	8.1E-04	3.8E-04	2.2E-04	7.2E-05	3.7E-05	1.7E-05
230.5	1.01E+03	3.19E+00	4.3E-03	1.2E-03	5.7E-04	3.3E-04	1.1E-04	5.4E-05	2.6E-05
245.5	1.52E+03	4.80E+00	6.5E-03	1.8E-03	8.5E-04	5.0E-04	1.6E-04	8.2E-05	3.9E-05
260.5	2.34E+03	7.38E+00	1.0E-02	2.8E-03	1.3E-03	7.7E-04	2.5E-04	1.3E-04	5.9E-05
275.5	3.71E+03	1.17E+01	1.6E-02	4.4E-03	2.1E-03	1.2E-03	3.9E-04	2.0E-04	9.4E-05
290.5	6.14E+03	1.94E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
305.5	1.06E+04	3.35E+01	4.5E-02	1.3E-02	6.0E-03	3.5E-03	1.1E-03	5.7E-04	2.7E-04
320.5	1.83E+04	5.78E+01	7.8E-02	2.2E-02	1.0E-02	6.0E-03	1.9E-03	9.8E-04	4.6E-04
335.5	2.58E+04	8.14E+01	1.1E-01	3.1E-02	1.4E-02	8.5E-03	2.7E-03	1.4E-03	6.5E-04
350.5	2.62E+04	8.26E+01	1.1E-01	3.1E-02	1.5E-02	8.6E-03	2.7E-03	1.4E-03	6.6E-04
350.5	2.62E+04	8.26E+01	1.1E-01	3.1E-02	1.5E-02	8.6E-03	2.7E-03	1.4E-03	6.6E-04
352.4	2.98E+04	9.38E+01	1.3E-01	3.5E-02	1.7E-02	9.8E-03	3.1E-03	1.6E-03	7.5E-04

Table C-19. Air Concentration Estimates for Excavation in Bay C – Default Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
367.4	3.41E+04	1.08E+02	1.5E-01	4.0E-02	1.9E-02	1.1E-02	3.6E-03	1.8E-03	8.7E-04
382.4	3.96E+04	1.25E+02	1.7E-01	4.7E-02	2.2E-02	1.3E-02	4.1E-03	2.1E-03	1.0E-03
397.4	4.62E+04	1.46E+02	2.0E-01	5.5E-02	2.6E-02	1.5E-02	4.8E-03	2.5E-03	1.2E-03
412.4	5.41E+04	1.71E+02	2.3E-01	6.4E-02	3.0E-02	1.8E-02	5.7E-03	2.9E-03	1.4E-03
427.4	6.26E+04	1.97E+02	2.7E-01	7.4E-02	3.5E-02	2.1E-02	6.6E-03	3.4E-03	1.6E-03
442.4	6.97E+04	2.20E+02	3.0E-01	8.2E-02	3.9E-02	2.3E-02	7.3E-03	3.7E-03	1.8E-03
457.4	7.21E+04	2.28E+02	3.1E-01	8.5E-02	4.0E-02	2.4E-02	7.6E-03	3.9E-03	1.8E-03
472.4	7.20E+04	2.27E+02	3.1E-01	8.5E-02	4.0E-02	2.4E-02	7.5E-03	3.9E-03	1.8E-03
472.4	7.20E+04	2.27E+02	3.1E-01	8.5E-02	4.0E-02	2.4E-02	7.5E-03	3.9E-03	1.8E-03
472.9	8.79E+04	2.77E+02	3.7E-01	1.0E-01	4.9E-02	2.9E-02	9.2E-03	4.7E-03	2.2E-03
487.9	9.52E+04	3.00E+02	4.1E-01	1.1E-01	5.3E-02	3.1E-02	1.0E-02	5.1E-03	2.4E-03
502.9	9.53E+04	3.00E+02	4.1E-01	1.1E-01	5.3E-02	3.1E-02	1.0E-02	5.1E-03	2.4E-03
502.9	9.53E+04	3.00E+02	4.1E-01	1.1E-01	5.3E-02	3.1E-02	1.0E-02	5.1E-03	2.4E-03
505.3	1.08E+05	3.42E+02	4.6E-01	1.3E-01	6.1E-02	3.6E-02	1.1E-02	5.8E-03	2.8E-03
520.3	1.23E+05	3.89E+02	5.3E-01	1.5E-01	6.9E-02	4.0E-02	1.3E-02	6.6E-03	3.1E-03
535.3	1.40E+05	4.42E+02	6.0E-01	1.7E-01	7.9E-02	4.6E-02	1.5E-02	7.5E-03	3.6E-03
550.3	1.58E+05	5.00E+02	6.7E-01	1.9E-01	8.9E-02	5.2E-02	1.7E-02	8.5E-03	4.0E-03
565.3	1.79E+05	5.63E+02	7.6E-01	2.1E-01	1.0E-01	5.9E-02	1.9E-02	9.6E-03	4.5E-03
580.3	2.00E+05	6.31E+02	8.5E-01	2.4E-01	1.1E-01	6.6E-02	2.1E-02	1.1E-02	5.1E-03
595.3	2.22E+05	7.00E+02	9.5E-01	2.6E-01	1.2E-01	7.3E-02	2.3E-02	1.2E-02	5.6E-03
610.3	2.43E+05	7.67E+02	1.0E+00	2.9E-01	1.4E-01	8.0E-02	2.5E-02	1.3E-02	6.2E-03
625.3	2.60E+05	8.20E+02	1.1E+00	3.1E-01	1.5E-01	8.5E-02	2.7E-02	1.4E-02	6.6E-03
640.3	2.67E+05	8.42E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
655.3	2.67E+05	8.42E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
655.3	2.67E+05	8.42E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
658.7	2.67E+05	8.42E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
673.7	2.67E+05	8.42E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
688.7	2.67E+05	8.42E+02	1.1E+00	3.2E-01	1.5E-01	8.8E-02	2.8E-02	1.4E-02	6.8E-03
703.7	2.67E+05	8.41E+02	1.1E+00	3.2E-01	1.5E-01	8.7E-02	2.8E-02	1.4E-02	6.8E-03
718.7	2.66E+05	8.39E+02	1.1E+00	3.1E-01	1.5E-01	8.7E-02	2.8E-02	1.4E-02	6.7E-03
733.7	2.65E+05	8.36E+02	1.1E+00	3.1E-01	1.5E-01	8.7E-02	2.8E-02	1.4E-02	6.7E-03
748.7	2.63E+05	8.31E+02	1.1E+00	3.1E-01	1.5E-01	8.6E-02	2.8E-02	1.4E-02	6.7E-03

Table C-19. Air Concentration Estimates for Excavation in Bay C – Default Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
763.7	2.60E+05	8.19E+02	1.1E+00	3.1E-01	1.5E-01	8.5E-02	2.7E-02	1.4E-02	6.6E-03
778.7	2.53E+05	7.97E+02	1.1E+00	3.0E-01	1.4E-01	8.3E-02	2.6E-02	1.4E-02	6.4E-03
793.7	2.39E+05	7.55E+02	1.0E+00	2.8E-01	1.3E-01	7.8E-02	2.5E-02	1.3E-02	6.1E-03
808.7	2.14E+05	6.76E+02	9.1E-01	2.5E-01	1.2E-01	7.0E-02	2.2E-02	1.1E-02	5.4E-03
823.7	1.72E+05	5.42E+02	7.3E-01	2.0E-01	9.6E-02	5.6E-02	1.8E-02	9.2E-03	4.4E-03
838.7	1.06E+05	3.35E+02	4.5E-01	1.3E-01	6.0E-02	3.5E-02	1.1E-02	5.7E-03	2.7E-03
853.7	2.05E+04	6.47E+01	8.7E-02	2.4E-02	1.2E-02	6.7E-03	2.1E-03	1.1E-03	5.2E-04

Table C-20. Air Concentration Estimates for Excavation in Bay D – Default Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.27E-01	1.35E-03	1.8E-06	5.0E-07	2.4E-07	1.4E-07	4.5E-08	2.3E-08	1.1E-08
0.7	3.81E-01	1.20E-03	1.6E-06	4.5E-07	2.1E-07	1.2E-07	4.0E-08	2.0E-08	9.7E-09
15.7	2.86E-01	9.03E-04	1.2E-06	3.4E-07	1.6E-07	9.4E-08	3.0E-08	1.5E-08	7.3E-09
30.7	1.36E-01	4.30E-04	5.8E-07	1.6E-07	7.7E-08	4.5E-08	1.4E-08	7.3E-09	3.5E-09
45.7	1.28E-01	4.03E-04	5.4E-07	1.5E-07	7.2E-08	4.2E-08	1.3E-08	6.9E-09	3.2E-09
45.7	1.28E-01	4.03E-04	5.4E-07	1.5E-07	7.2E-08	4.2E-08	1.3E-08	6.9E-09	3.2E-09
47.2	1.30E-01	4.09E-04	5.5E-07	1.5E-07	7.3E-08	4.3E-08	1.4E-08	7.0E-09	3.3E-09
62.2	1.39E-01	4.37E-04	5.9E-07	1.6E-07	7.8E-08	4.5E-08	1.5E-08	7.4E-09	3.5E-09
77.2	1.79E-01	5.65E-04	7.6E-07	2.1E-07	1.0E-07	5.9E-08	1.9E-08	9.6E-09	4.5E-09
92.2	3.90E-01	1.23E-03	1.7E-06	4.6E-07	2.2E-07	1.3E-07	4.1E-08	2.1E-08	9.9E-09
107.2	1.82E+00	5.74E-03	7.7E-06	2.2E-06	1.0E-06	6.0E-07	1.9E-07	9.8E-08	4.6E-08
122.2	1.52E+01	4.79E-02	6.5E-05	1.8E-05	8.5E-06	5.0E-06	1.6E-06	8.1E-07	3.9E-07
137.2	1.59E+01	5.01E-02	6.8E-05	1.9E-05	8.9E-06	5.2E-06	1.7E-06	8.5E-07	4.0E-07
137.2	1.59E+01	5.01E-02	6.8E-05	1.9E-05	8.9E-06	5.2E-06	1.7E-06	8.5E-07	4.0E-07
146.3	1.90E+01	6.00E-02	8.1E-05	2.2E-05	1.1E-05	6.2E-06	2.0E-06	1.0E-06	4.8E-07
161.3	2.35E+01	7.42E-02	1.0E-04	2.8E-05	1.3E-05	7.7E-06	2.5E-06	1.3E-06	6.0E-07
176.3	3.00E+01	9.47E-02	1.3E-04	3.6E-05	1.7E-05	9.8E-06	3.1E-06	1.6E-06	7.6E-07
191.3	3.94E+01	1.24E-01	1.7E-04	4.7E-05	2.2E-05	1.3E-05	4.1E-06	2.1E-06	1.0E-06
206.3	5.30E+01	1.67E-01	2.3E-04	6.3E-05	3.0E-05	1.7E-05	5.6E-06	2.8E-06	1.3E-06
221.3	7.28E+01	2.30E-01	3.1E-04	8.6E-05	4.1E-05	2.4E-05	7.6E-06	3.9E-06	1.8E-06
236.3	1.02E+02	3.21E-01	4.3E-04	1.2E-04	5.7E-05	3.3E-05	1.1E-05	5.4E-06	2.6E-06
251.3	1.44E+02	4.54E-01	6.1E-04	1.7E-04	8.1E-05	4.7E-05	1.5E-05	7.7E-06	3.7E-06
266.3	2.07E+02	6.53E-01	8.8E-04	2.4E-04	1.2E-04	6.8E-05	2.2E-05	1.1E-05	5.3E-06
281.3	3.02E+02	9.53E-01	1.3E-03	3.6E-04	1.7E-04	9.9E-05	3.2E-05	1.6E-05	7.7E-06
296.3	4.48E+02	1.41E+00	1.9E-03	5.3E-04	2.5E-04	1.5E-04	4.7E-05	2.4E-05	1.1E-05
311.3	6.80E+02	2.14E+00	2.9E-03	8.0E-04	3.8E-04	2.2E-04	7.1E-05	3.6E-05	1.7E-05
326.3	1.06E+03	3.34E+00	4.5E-03	1.3E-03	6.0E-04	3.5E-04	1.1E-04	5.7E-05	2.7E-05
341.3	1.72E+03	5.42E+00	7.3E-03	2.0E-03	9.7E-04	5.6E-04	1.8E-04	9.2E-05	4.4E-05
356.3	2.92E+03	9.21E+00	1.2E-02	3.5E-03	1.6E-03	9.6E-04	3.1E-04	1.6E-04	7.4E-05
371.3	5.10E+03	1.61E+01	2.2E-02	6.0E-03	2.9E-03	1.7E-03	5.3E-04	2.7E-04	1.3E-04
386.3	8.08E+03	2.55E+01	3.4E-02	9.6E-03	4.5E-03	2.6E-03	8.5E-04	4.3E-04	2.0E-04

Table C-20. Air Concentration Estimates for Excavation in Bay D – Default Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
401.3	8.93E+03	2.82E+01	3.8E-02	1.1E-02	5.0E-03	2.9E-03	9.3E-04	4.8E-04	2.3E-04
406.1	8.94E+03	2.82E+01	3.8E-02	1.1E-02	5.0E-03	2.9E-03	9.4E-04	4.8E-04	2.3E-04
421.1	8.94E+03	2.82E+01	3.8E-02	1.1E-02	5.0E-03	2.9E-03	9.4E-04	4.8E-04	2.3E-04
436.1	8.95E+03	2.82E+01	3.8E-02	1.1E-02	5.0E-03	2.9E-03	9.4E-04	4.8E-04	2.3E-04
451.1	8.96E+03	2.83E+01	3.8E-02	1.1E-02	5.0E-03	2.9E-03	9.4E-04	4.8E-04	2.3E-04
466.1	8.97E+03	2.83E+01	3.8E-02	1.1E-02	5.0E-03	2.9E-03	9.4E-04	4.8E-04	2.3E-04
481.1	8.97E+03	2.83E+01	3.8E-02	1.1E-02	5.0E-03	2.9E-03	9.4E-04	4.8E-04	2.3E-04
496.1	8.97E+03	2.83E+01	3.8E-02	1.1E-02	5.0E-03	2.9E-03	9.4E-04	4.8E-04	2.3E-04
511.1	8.95E+03	2.82E+01	3.8E-02	1.1E-02	5.0E-03	2.9E-03	9.4E-04	4.8E-04	2.3E-04
526.1	8.93E+03	2.82E+01	3.8E-02	1.1E-02	5.0E-03	2.9E-03	9.3E-04	4.8E-04	2.3E-04
541.1	8.88E+03	2.80E+01	3.8E-02	1.0E-02	5.0E-03	2.9E-03	9.3E-04	4.8E-04	2.3E-04
556.1	8.79E+03	2.77E+01	3.7E-02	1.0E-02	4.9E-03	2.9E-03	9.2E-04	4.7E-04	2.2E-04
571.1	8.65E+03	2.73E+01	3.7E-02	1.0E-02	4.9E-03	2.8E-03	9.1E-04	4.6E-04	2.2E-04
586.1	8.44E+03	2.66E+01	3.6E-02	1.0E-02	4.7E-03	2.8E-03	8.8E-04	4.5E-04	2.1E-04
601.1	8.14E+03	2.57E+01	3.5E-02	9.6E-03	4.6E-03	2.7E-03	8.5E-04	4.4E-04	2.1E-04
616.1	7.70E+03	2.43E+01	3.3E-02	9.1E-03	4.3E-03	2.5E-03	8.1E-04	4.1E-04	2.0E-04
631.1	7.12E+03	2.24E+01	3.0E-02	8.4E-03	4.0E-03	2.3E-03	7.5E-04	3.8E-04	1.8E-04
646.1	6.35E+03	2.00E+01	2.7E-02	7.5E-03	3.6E-03	2.1E-03	6.7E-04	3.4E-04	1.6E-04
661.1	5.39E+03	1.70E+01	2.3E-02	6.4E-03	3.0E-03	1.8E-03	5.6E-04	2.9E-04	1.4E-04
676.1	4.19E+03	1.32E+01	1.8E-02	5.0E-03	2.4E-03	1.4E-03	4.4E-04	2.2E-04	1.1E-04
691.1	2.75E+03	8.66E+00	1.2E-02	3.2E-03	1.5E-03	9.0E-04	2.9E-04	1.5E-04	7.0E-05
706.1	2.23E+03	7.03E+00	9.5E-03	2.6E-03	1.3E-03	7.3E-04	2.3E-04	1.2E-04	5.7E-05
706.1	2.23E+03	7.03E+00	9.5E-03	2.6E-03	1.3E-03	7.3E-04	2.3E-04	1.2E-04	5.7E-05
707.6	2.93E+03	9.23E+00	1.2E-02	3.5E-03	1.6E-03	9.6E-04	3.1E-04	1.6E-04	7.4E-05
722.6	3.88E+03	1.22E+01	1.7E-02	4.6E-03	2.2E-03	1.3E-03	4.1E-04	2.1E-04	9.8E-05
737.6	5.16E+03	1.63E+01	2.2E-02	6.1E-03	2.9E-03	1.7E-03	5.4E-04	2.8E-04	1.3E-04
752.6	6.74E+03	2.12E+01	2.9E-02	8.0E-03	3.8E-03	2.2E-03	7.1E-04	3.6E-04	1.7E-04
767.6	8.28E+03	2.61E+01	3.5E-02	9.8E-03	4.6E-03	2.7E-03	8.7E-04	4.4E-04	2.1E-04
782.6	9.05E+03	2.85E+01	3.9E-02	1.1E-02	5.1E-03	3.0E-03	9.5E-04	4.9E-04	2.3E-04
797.6	9.05E+03	2.86E+01	3.9E-02	1.1E-02	5.1E-03	3.0E-03	9.5E-04	4.9E-04	2.3E-04
797.6	9.05E+03	2.86E+01	3.9E-02	1.1E-02	5.1E-03	3.0E-03	9.5E-04	4.9E-04	2.3E-04

Table C-20. Air Concentration Estimates for Excavation in Bay D – Default Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (100 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
800.0	8.77E+03	2.77E+01	3.7E-02	1.0E-02	4.9E-03	2.9E-03	9.2E-04	4.7E-04	2.2E-04
815.0	8.40E+03	2.65E+01	3.6E-02	9.9E-03	4.7E-03	2.8E-03	8.8E-04	4.5E-04	2.1E-04
830.0	7.92E+03	2.50E+01	3.4E-02	9.4E-03	4.4E-03	2.6E-03	8.3E-04	4.2E-04	2.0E-04
845.0	7.30E+03	2.30E+01	3.1E-02	8.6E-03	4.1E-03	2.4E-03	7.6E-04	3.9E-04	1.9E-04
860.0	6.53E+03	2.06E+01	2.8E-02	7.7E-03	3.7E-03	2.1E-03	6.8E-04	3.5E-04	1.7E-04
875.0	5.59E+03	1.76E+01	2.4E-02	6.6E-03	3.1E-03	1.8E-03	5.8E-04	3.0E-04	1.4E-04
890.0	4.46E+03	1.41E+01	1.9E-02	5.3E-03	2.5E-03	1.5E-03	4.7E-04	2.4E-04	1.1E-04
905.0	3.17E+03	1.00E+01	1.3E-02	3.7E-03	1.8E-03	1.0E-03	3.3E-04	1.7E-04	8.0E-05
920.0	1.75E+03	5.51E+00	7.4E-03	2.1E-03	9.8E-04	5.7E-04	1.8E-04	9.4E-05	4.4E-05
935.0	2.43E+02	7.68E-01	1.0E-03	2.9E-04	1.4E-04	8.0E-05	2.5E-05	1.3E-05	6.2E-06

Table C-21. Air Concentration Estimates for Excavation in Bays A, B, C and D Concurrently – Default Meteorology

Depth (cm)	Emissions (500 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
		250m	500m	750m	1000m	2000m	3000m	5000m
0.0	6.837E-03	9.2E-06	2.6E-06	1.2E-06	7.1E-07	2.3E-07	1.2E-07	5.5E-08
0.7	6.156E-03	8.3E-06	2.3E-06	1.1E-06	6.4E-07	2.0E-07	1.0E-07	4.9E-08
15.7	4.688E-03	6.3E-06	1.8E-06	8.3E-07	4.9E-07	1.6E-07	8.0E-08	3.8E-08
30.7	2.322E-03	3.1E-06	8.7E-07	4.1E-07	2.4E-07	7.7E-08	3.9E-08	1.9E-08
45.7	2.188E-03	3.0E-06	8.2E-07	3.9E-07	2.3E-07	7.3E-08	3.7E-08	1.8E-08
45.7	2.188E-03	3.0E-06	8.2E-07	3.9E-07	2.3E-07	7.3E-08	3.7E-08	1.8E-08
47.2	2.777E-03	3.7E-06	1.0E-06	4.9E-07	2.9E-07	9.2E-08	4.7E-08	2.2E-08
62.2	5.320E-03	7.2E-06	2.0E-06	9.5E-07	5.5E-07	1.8E-07	9.0E-08	4.3E-08
77.2	1.666E-02	2.2E-05	6.2E-06	3.0E-06	1.7E-06	5.5E-07	2.8E-07	1.3E-07
92.2	7.112E-02	9.6E-05	2.7E-05	1.3E-05	7.4E-06	2.4E-06	1.2E-06	5.7E-07
107.2	3.874E-01	5.2E-04	1.5E-04	6.9E-05	4.0E-05	1.3E-05	6.6E-06	3.1E-06
122.2	2.774E+00	3.7E-03	1.0E-03	4.9E-04	2.9E-04	9.2E-05	4.7E-05	2.2E-05
137.2	2.895E+00	3.9E-03	1.1E-03	5.2E-04	3.0E-04	9.6E-05	4.9E-05	2.3E-05
137.2	2.895E+00	3.9E-03	1.1E-03	5.2E-04	3.0E-04	9.6E-05	4.9E-05	2.3E-05
146.3	4.120E+00	5.6E-03	1.5E-03	7.3E-04	4.3E-04	1.4E-04	7.0E-05	3.3E-05
161.3	5.894E+00	8.0E-03	2.2E-03	1.0E-03	6.1E-04	2.0E-04	1.0E-04	4.7E-05
176.3	8.473E+00	1.1E-02	3.2E-03	1.5E-03	8.8E-04	2.8E-04	1.4E-04	6.8E-05
191.3	1.224E+01	1.7E-02	4.6E-03	2.2E-03	1.3E-03	4.1E-04	2.1E-04	9.8E-05
206.3	1.776E+01	2.4E-02	6.7E-03	3.2E-03	1.8E-03	5.9E-04	3.0E-04	1.4E-04
221.3	2.593E+01	3.5E-02	9.7E-03	4.6E-03	2.7E-03	8.6E-04	4.4E-04	2.1E-04
236.3	3.818E+01	5.2E-02	1.4E-02	6.8E-03	4.0E-03	1.3E-03	6.5E-04	3.1E-04
251.3	5.689E+01	7.7E-02	2.1E-02	1.0E-02	5.9E-03	1.9E-03	9.7E-04	4.6E-04
266.3	8.626E+01	1.2E-01	3.2E-02	1.5E-02	9.0E-03	2.9E-03	1.5E-03	6.9E-04
281.3	1.341E+02	1.8E-01	5.0E-02	2.4E-02	1.4E-02	4.5E-03	2.3E-03	1.1E-03
296.3	2.154E+02	2.9E-01	8.1E-02	3.8E-02	2.2E-02	7.2E-03	3.7E-03	1.7E-03
311.3	3.587E+02	4.8E-01	1.3E-01	6.4E-02	3.7E-02	1.2E-02	6.1E-03	2.9E-03
326.3	5.935E+02	8.0E-01	2.2E-01	1.1E-01	6.2E-02	2.0E-02	1.0E-02	4.8E-03
341.3	8.126E+02	1.1E+00	3.0E-01	1.4E-01	8.5E-02	2.7E-02	1.4E-02	6.5E-03
356.3	9.457E+02	1.3E+00	3.5E-01	1.7E-01	9.8E-02	3.1E-02	1.6E-02	7.6E-03

Table C-21. Air Concentration Estimates for Excavation in Bays A, B, C and D Concurrently – Default Meteorology (continued)

Depth (cm)	Emissions (500 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
		250m	500m	750m	1000m	2000m	3000m	5000m
371.3	1.020E+03	1.4E+00	3.8E-01	1.8E-01	1.1E-01	3.4E-02	1.7E-02	8.2E-03
386.3	1.056E+03	1.4E+00	4.0E-01	1.9E-01	1.1E-01	3.5E-02	1.8E-02	8.5E-03
401.3	1.083E+03	1.5E+00	4.1E-01	1.9E-01	1.1E-01	3.6E-02	1.8E-02	8.7E-03
401.3	1.083E+03	1.5E+00	4.1E-01	1.9E-01	1.1E-01	3.6E-02	1.8E-02	8.7E-03
406.1	1.083E+03	1.5E+00	4.1E-01	1.9E-01	1.1E-01	3.6E-02	1.8E-02	8.7E-03
421.1	1.107E+03	1.5E+00	4.2E-01	2.0E-01	1.2E-01	3.7E-02	1.9E-02	8.9E-03
436.1	1.132E+03	1.5E+00	4.2E-01	2.0E-01	1.2E-01	3.8E-02	1.9E-02	9.1E-03
451.1	1.151E+03	1.6E+00	4.3E-01	2.0E-01	1.2E-01	3.8E-02	2.0E-02	9.3E-03
466.1	1.154E+03	1.6E+00	4.3E-01	2.1E-01	1.2E-01	3.8E-02	2.0E-02	9.3E-03
481.1	1.206E+03	1.6E+00	4.5E-01	2.1E-01	1.3E-01	4.0E-02	2.1E-02	9.7E-03
496.1	1.230E+03	1.7E+00	4.6E-01	2.2E-01	1.3E-01	4.1E-02	2.1E-02	9.9E-03
511.1	1.272E+03	1.7E+00	4.8E-01	2.3E-01	1.3E-01	4.2E-02	2.2E-02	1.0E-02
526.1	1.319E+03	1.8E+00	4.9E-01	2.3E-01	1.4E-01	4.4E-02	2.2E-02	1.1E-02
541.1	1.371E+03	1.9E+00	5.1E-01	2.4E-01	1.4E-01	4.6E-02	2.3E-02	1.1E-02
556.1	1.429E+03	1.9E+00	5.4E-01	2.5E-01	1.5E-01	4.7E-02	2.4E-02	1.1E-02
571.1	1.491E+03	2.0E+00	5.6E-01	2.7E-01	1.6E-01	4.9E-02	2.5E-02	1.2E-02
586.1	1.557E+03	2.1E+00	5.8E-01	2.8E-01	1.6E-01	5.2E-02	2.6E-02	1.3E-02
601.1	1.625E+03	2.2E+00	6.1E-01	2.9E-01	1.7E-01	5.4E-02	2.8E-02	1.3E-02
616.1	1.689E+03	2.3E+00	6.3E-01	3.0E-01	1.8E-01	5.6E-02	2.9E-02	1.4E-02
631.1	1.738E+03	2.3E+00	6.5E-01	3.1E-01	1.8E-01	5.8E-02	3.0E-02	1.4E-02
646.1	1.755E+03	2.4E+00	6.6E-01	3.1E-01	1.8E-01	5.8E-02	3.0E-02	1.4E-02
661.1	1.748E+03	2.4E+00	6.6E-01	3.1E-01	1.8E-01	5.8E-02	3.0E-02	1.4E-02
676.1	1.740E+03	2.3E+00	6.5E-01	3.1E-01	1.8E-01	5.8E-02	3.0E-02	1.4E-02
691.1	1.730E+03	2.3E+00	6.5E-01	3.1E-01	1.8E-01	5.7E-02	2.9E-02	1.4E-02
706.1	1.725E+03	2.3E+00	6.5E-01	3.1E-01	1.8E-01	5.7E-02	2.9E-02	1.4E-02
706.1	1.725E+03	2.3E+00	6.5E-01	3.1E-01	1.8E-01	5.7E-02	2.9E-02	1.4E-02
707.6	1.729E+03	2.3E+00	6.5E-01	3.1E-01	1.8E-01	5.7E-02	2.9E-02	1.4E-02
722.6	1.732E+03	2.3E+00	6.5E-01	3.1E-01	1.8E-01	5.7E-02	2.9E-02	1.4E-02
737.6	1.733E+03	2.3E+00	6.5E-01	3.1E-01	1.8E-01	5.8E-02	2.9E-02	1.4E-02
752.6	1.731E+03	2.3E+00	6.5E-01	3.1E-01	1.8E-01	5.7E-02	2.9E-02	1.4E-02

Table C-21. Air Concentration Estimates for Excavation in Bays A, B, C and D Concurrently – Default Meteorology (continued)

Depth (cm)	Emissions (500 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
		250m	500m	750m	1000m	2000m	3000m	5000m
767.6	1.718E+03	2.3E+00	6.4E-01	3.1E-01	1.8E-01	5.7E-02	2.9E-02	1.4E-02
782.6	1.680E+03	2.3E+00	6.3E-01	3.0E-01	1.7E-01	5.6E-02	2.9E-02	1.4E-02
797.6	1.600E+03	2.2E+00	6.0E-01	2.8E-01	1.7E-01	5.3E-02	2.7E-02	1.3E-02
797.6	1.600E+03	2.2E+00	6.0E-01	2.8E-01	1.7E-01	5.3E-02	2.7E-02	1.3E-02
800.0	1.598E+03	2.2E+00	6.0E-01	2.8E-01	1.7E-01	5.3E-02	2.7E-02	1.3E-02
815.0	1.448E+03	2.0E+00	5.4E-01	2.6E-01	1.5E-01	4.8E-02	2.5E-02	1.2E-02
830.0	1.190E+03	1.6E+00	4.5E-01	2.1E-01	1.2E-01	4.0E-02	2.0E-02	9.6E-03
845.0	7.891E+02	1.1E+00	3.0E-01	1.4E-01	8.2E-02	2.6E-02	1.3E-02	6.3E-03
860.0	2.543E+02	3.4E-01	9.5E-02	4.5E-02	2.6E-02	8.4E-03	4.3E-03	2.0E-03
875.0	3.523E+01	4.8E-02	1.3E-02	6.3E-03	3.7E-03	1.2E-03	6.0E-04	2.8E-04
890.0	2.814E+01	3.8E-02	1.1E-02	5.0E-03	2.9E-03	9.3E-04	4.8E-04	2.3E-04
905.0	2.000E+01	2.7E-02	7.5E-03	3.6E-03	2.1E-03	6.6E-04	3.4E-04	1.6E-04
920.0	1.101E+01	1.5E-02	4.1E-03	2.0E-03	1.1E-03	3.7E-04	1.9E-04	8.9E-05
935.0	1.535E+00	2.1E-03	5.8E-04	2.7E-04	1.6E-04	5.1E-05	2.6E-05	1.2E-05

Table C-22. Air Concentration Estimates for Wall Collapse in Bay A – Default Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (69 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.4E-01	9.6E-04	1.3E-06	3.6E-07	1.7E-07	9.9E-08	3.2E-08	1.6E-08	7.7E-09
0.7	4.0E-01	8.7E-04	1.2E-06	3.3E-07	1.5E-07	9.0E-08	2.9E-08	1.5E-08	7.0E-09
15.7	3.1E-01	6.7E-04	9.1E-07	2.5E-07	1.2E-07	7.0E-08	2.2E-08	1.1E-08	5.4E-09
30.7	1.6E-01	3.6E-04	4.8E-07	1.3E-07	6.3E-08	3.7E-08	1.2E-08	6.0E-09	2.9E-09
45.7	1.5E-01	3.4E-04	4.6E-07	1.3E-07	6.0E-08	3.5E-08	1.1E-08	5.7E-09	2.7E-09
45.7	1.5E-01	3.4E-04	4.6E-07	1.3E-07	6.0E-08	3.5E-08	1.1E-08	5.7E-09	2.7E-09
47.2	2.5E-01	5.3E-04	7.2E-07	2.0E-07	9.5E-08	5.6E-08	1.8E-08	9.1E-09	4.3E-09
62.2	6.4E-01	1.4E-03	1.9E-06	5.2E-07	2.5E-07	1.5E-07	4.6E-08	2.4E-08	1.1E-08
77.2	2.5E+00	5.4E-03	7.3E-06	2.0E-06	9.6E-07	5.6E-07	1.8E-07	9.2E-08	4.3E-08
92.2	1.2E+01	2.6E-02	3.6E-05	9.9E-06	4.7E-06	2.7E-06	8.7E-07	4.5E-07	2.1E-07
107.2	7.8E+01	1.7E-01	2.3E-04	6.3E-05	3.0E-05	1.8E-05	5.6E-06	2.9E-06	1.4E-06
122.2	6.9E+02	1.5E+00	2.0E-03	5.6E-04	2.7E-04	1.6E-04	5.0E-05	2.6E-05	1.2E-05
137.2	7.2E+02	1.6E+00	2.1E-03	5.9E-04	2.8E-04	1.6E-04	5.2E-05	2.7E-05	1.3E-05
137.2	7.2E+02	1.6E+00	2.1E-03	5.9E-04	2.8E-04	1.6E-04	5.2E-05	2.7E-05	1.3E-05
140.5	1.0E+03	2.3E+00	3.0E-03	8.5E-04	4.0E-04	2.3E-04	7.5E-05	3.8E-05	1.8E-05
155.5	1.5E+03	3.2E+00	4.4E-03	1.2E-03	5.8E-04	3.4E-04	1.1E-04	5.5E-05	2.6E-05
170.5	2.2E+03	4.7E+00	6.3E-03	1.8E-03	8.3E-04	4.9E-04	1.6E-04	8.0E-05	3.8E-05
185.5	3.1E+03	6.8E+00	9.1E-03	2.5E-03	1.2E-03	7.0E-04	2.2E-04	1.2E-04	5.4E-05
200.5	4.5E+03	9.8E+00	1.3E-02	3.7E-03	1.7E-03	1.0E-03	3.3E-04	1.7E-04	7.9E-05
215.5	6.6E+03	1.4E+01	1.9E-02	5.4E-03	2.6E-03	1.5E-03	4.8E-04	2.4E-04	1.2E-04
230.5	9.7E+03	2.1E+01	2.8E-02	7.9E-03	3.8E-03	2.2E-03	7.0E-04	3.6E-04	1.7E-04
245.5	1.4E+04	3.1E+01	4.2E-02	1.2E-02	5.6E-03	3.3E-03	1.0E-03	5.3E-04	2.5E-04
260.5	2.2E+04	4.8E+01	6.4E-02	1.8E-02	8.5E-03	5.0E-03	1.6E-03	8.1E-04	3.8E-04
275.5	3.4E+04	7.5E+01	1.0E-01	2.8E-02	1.3E-02	7.8E-03	2.5E-03	1.3E-03	6.0E-04
290.5	5.6E+04	1.2E+02	1.6E-01	4.5E-02	2.2E-02	1.3E-02	4.0E-03	2.1E-03	9.7E-04
305.5	9.4E+04	2.0E+02	2.8E-01	7.7E-02	3.6E-02	2.1E-02	6.8E-03	3.5E-03	1.6E-03
320.5	1.6E+05	3.4E+02	4.6E-01	1.3E-01	6.1E-02	3.6E-02	1.1E-02	5.8E-03	2.8E-03
335.5	2.2E+05	4.7E+02	6.4E-01	1.8E-01	8.4E-02	4.9E-02	1.6E-02	8.0E-03	3.8E-03
350.5	2.2E+05	4.8E+02	6.5E-01	1.8E-01	8.5E-02	5.0E-02	1.6E-02	8.1E-03	3.8E-03
350.5	2.2E+05	4.8E+02	6.5E-01	1.8E-01	8.5E-02	5.0E-02	1.6E-02	8.1E-03	3.8E-03

Table C-22. Air Concentration Estimates for Wall Collapse in Bay A – Default Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (69 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
351.0	2.5E+05	5.5E+02	7.4E-01	2.1E-01	9.8E-02	5.7E-02	1.8E-02	9.3E-03	4.4E-03
366.0	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
381.0	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
381.0	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
388.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
403.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
418.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
433.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
448.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
463.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
478.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
493.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
508.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
523.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
538.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
553.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
568.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
583.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
598.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
613.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
628.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
643.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
658.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
673.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
688.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
703.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
718.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.9E-03	4.7E-03
733.7	2.7E+05	5.8E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.8E-03	4.6E-03
748.7	2.6E+05	5.7E+02	7.8E-01	2.2E-01	1.0E-01	6.0E-02	1.9E-02	9.8E-03	4.6E-03
763.7	2.6E+05	5.7E+02	7.7E-01	2.1E-01	1.0E-01	5.9E-02	1.9E-02	9.7E-03	4.6E-03
778.7	2.6E+05	5.6E+02	7.5E-01	2.1E-01	9.9E-02	5.8E-02	1.8E-02	9.4E-03	4.5E-03

Table C-22. Air Concentration Estimates for Wall Collapse in Bay A – Default Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (69 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
793.7	2.4E+05	5.3E+02	7.2E-01	2.0E-01	9.5E-02	5.5E-02	1.8E-02	9.0E-03	4.3E-03
808.7	2.2E+05	4.9E+02	6.6E-01	1.8E-01	8.6E-02	5.1E-02	1.6E-02	8.3E-03	3.9E-03
823.7	1.9E+05	4.1E+02	5.5E-01	1.5E-01	7.2E-02	4.2E-02	1.3E-02	6.9E-03	3.3E-03
838.7	1.3E+05	2.8E+02	3.7E-01	1.0E-01	4.9E-02	2.9E-02	9.2E-03	4.7E-03	2.2E-03
853.7	4.6E+04	1.0E+02	1.4E-01	3.8E-02	1.8E-02	1.1E-02	3.4E-03	1.7E-03	8.1E-04
868.7	0.0E+00								

Table C-23. Air Concentration Estimates for Drilling in Bay A – Default Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (2.3 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.4E-01	3.2E-05	4.3E-08	1.2E-08	5.7E-09	3.3E-09	1.1E-09	5.4E-10	2.6E-10
0.7	4.0E-01	2.9E-05	3.9E-08	1.1E-08	5.1E-09	3.0E-09	9.6E-10	4.9E-10	2.3E-10
15.7	3.1E-01	2.2E-05	3.0E-08	8.4E-09	4.0E-09	2.3E-09	7.5E-10	3.8E-10	1.8E-10
30.7	1.6E-01	1.2E-05	1.6E-08	4.4E-09	2.1E-09	1.2E-09	3.9E-10	2.0E-10	9.5E-11
45.7	1.5E-01	1.1E-05	1.5E-08	4.2E-09	2.0E-09	1.2E-09	3.7E-10	1.9E-10	9.0E-11
45.7	1.5E-01	1.1E-05	1.5E-08	4.2E-09	2.0E-09	1.2E-09	3.7E-10	1.9E-10	9.0E-11
47.2	2.5E-01	1.8E-05	2.4E-08	6.7E-09	3.2E-09	1.9E-09	5.9E-10	3.0E-10	1.4E-10
62.2	6.4E-01	4.7E-05	6.3E-08	1.7E-08	8.3E-09	4.8E-09	1.5E-09	7.9E-10	3.7E-10
77.2	2.5E+00	1.8E-04	2.4E-07	6.8E-08	3.2E-08	1.9E-08	6.0E-09	3.1E-09	1.4E-09
92.2	1.2E+01	8.8E-04	1.2E-06	3.3E-07	1.6E-07	9.1E-08	2.9E-08	1.5E-08	7.1E-09
107.2	7.8E+01	5.6E-03	7.6E-06	2.1E-06	1.0E-06	5.8E-07	1.9E-07	9.6E-08	4.5E-08
122.2	6.9E+02	5.0E-02	6.8E-05	1.9E-05	8.9E-06	5.2E-06	1.7E-06	8.5E-07	4.0E-07
137.2	7.2E+02	5.2E-02	7.1E-05	2.0E-05	9.3E-06	5.5E-06	1.7E-06	8.9E-07	4.2E-07
137.2	7.2E+02	5.2E-02	7.1E-05	2.0E-05	9.3E-06	5.5E-06	1.7E-06	8.9E-07	4.2E-07
140.5	1.0E+03	7.5E-02	1.0E-04	2.8E-05	1.3E-05	7.8E-06	2.5E-06	1.3E-06	6.1E-07
155.5	1.5E+03	1.1E-01	1.5E-04	4.1E-05	1.9E-05	1.1E-05	3.6E-06	1.8E-06	8.7E-07
170.5	2.2E+03	1.6E-01	2.1E-04	5.9E-05	2.8E-05	1.6E-05	5.2E-06	2.7E-06	1.3E-06
185.5	3.1E+03	2.3E-01	3.0E-04	8.5E-05	4.0E-05	2.3E-05	7.5E-06	3.8E-06	1.8E-06
200.5	4.5E+03	3.3E-01	4.4E-04	1.2E-04	5.8E-05	3.4E-05	1.1E-05	5.6E-06	2.6E-06
215.5	6.6E+03	4.8E-01	6.4E-04	1.8E-04	8.5E-05	5.0E-05	1.6E-05	8.1E-06	3.8E-06
230.5	9.7E+03	7.0E-01	9.5E-04	2.6E-04	1.3E-04	7.3E-05	2.3E-05	1.2E-05	5.7E-06
245.5	1.4E+04	1.0E+00	1.4E-03	3.9E-04	1.9E-04	1.1E-04	3.5E-05	1.8E-05	8.4E-06
260.5	2.2E+04	1.6E+00	2.1E-03	6.0E-04	2.8E-04	1.7E-04	5.3E-05	2.7E-05	1.3E-05
275.5	3.4E+04	2.5E+00	3.4E-03	9.3E-04	4.4E-04	2.6E-04	8.3E-05	4.2E-05	2.0E-05
290.5	5.6E+04	4.0E+00	5.4E-03	1.5E-03	7.2E-04	4.2E-04	1.3E-04	6.9E-05	3.2E-05
305.5	9.4E+04	6.8E+00	9.2E-03	2.6E-03	1.2E-03	7.1E-04	2.3E-04	1.2E-04	5.5E-05
320.5	1.6E+05	1.1E+01	1.5E-02	4.3E-03	2.0E-03	1.2E-03	3.8E-04	1.9E-04	9.2E-05
335.5	2.2E+05	1.6E+01	2.1E-02	5.9E-03	2.8E-03	1.6E-03	5.2E-04	2.7E-04	1.3E-04
350.5	2.2E+05	1.6E+01	2.2E-02	6.0E-03	2.8E-03	1.7E-03	5.3E-04	2.7E-04	1.3E-04
350.5	2.2E+05	1.6E+01	2.2E-02	6.0E-03	2.8E-03	1.7E-03	5.3E-04	2.7E-04	1.3E-04
351.0	2.5E+05	1.8E+01	2.5E-02	6.9E-03	3.3E-03	1.9E-03	6.1E-04	3.1E-04	1.5E-04

Table C-23. Air Concentration Estimates for Drilling in Bay A – Default Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (2.3 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
366.0	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
381.0	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
381.0	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
388.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
403.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
418.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
433.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
448.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
463.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
478.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
493.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
508.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
523.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
538.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
553.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
568.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
583.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
598.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
613.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
628.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
643.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
658.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
673.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
688.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
703.7	2.7E+05	1.9E+01	2.6E-02	7.3E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
718.7	2.7E+05	1.9E+01	2.6E-02	7.2E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.6E-04
733.7	2.7E+05	1.9E+01	2.6E-02	7.2E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.5E-04
748.7	2.6E+05	1.9E+01	2.6E-02	7.2E-03	3.4E-03	2.0E-03	6.4E-04	3.3E-04	1.5E-04
763.7	2.6E+05	1.9E+01	2.6E-02	7.1E-03	3.4E-03	2.0E-03	6.3E-04	3.2E-04	1.5E-04
778.7	2.6E+05	1.9E+01	2.5E-02	6.9E-03	3.3E-03	1.9E-03	6.1E-04	3.1E-04	1.5E-04
793.7	2.4E+05	1.8E+01	2.4E-02	6.6E-03	3.2E-03	1.8E-03	5.9E-04	3.0E-04	1.4E-04

Table C-23. Air Concentration Estimates for Drilling in Bay A – Default Meteorology (continued)

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (2.3 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
808.7	2.2E+05	1.6E+01	2.2E-02	6.1E-03	2.9E-03	1.7E-03	5.4E-04	2.8E-04	1.3E-04
823.7	1.9E+05	1.4E+01	1.8E-02	5.1E-03	2.4E-03	1.4E-03	4.5E-04	2.3E-04	1.1E-04
838.7	1.3E+05	9.2E+00	1.2E-02	3.5E-03	1.6E-03	9.6E-04	3.1E-04	1.6E-04	7.4E-05
853.7	4.6E+04	3.4E+00	4.6E-03	1.3E-03	6.0E-04	3.5E-04	1.1E-04	5.7E-05	2.7E-05
868.7	0.0E+00								

Table C-24. Air Concentration Estimates for Burrowing in Bay A – Default Meteorology

Depth (cm)	FluxT (JT) ($pCi/m^2/sec$)	Emissions (0.53 m^2) (Ci/yr)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
			250m	500m	750m	1000m	2000m	3000m	5000m
0.0	4.4E-01	7.3E-06	9.9E-09	2.8E-09	1.3E-09	7.6E-10	2.4E-10	1.2E-10	5.9E-11
0.7	4.0E-01	6.7E-06	9.0E-09	2.5E-09	1.2E-09	6.9E-10	2.2E-10	1.1E-10	5.4E-11
15.7	3.1E-01	5.2E-06	7.0E-09	1.9E-09	9.2E-10	5.4E-10	1.7E-10	8.8E-11	4.2E-11
30.7	1.6E-01	2.7E-06	3.7E-09	1.0E-09	4.9E-10	2.8E-10	9.1E-11	4.6E-11	2.2E-11
45.7	1.5E-01	2.6E-06	3.5E-09	9.7E-10	4.6E-10	2.7E-10	8.6E-11	4.4E-11	2.1E-11
45.7	1.5E-01	2.6E-06	3.5E-09	9.7E-10	4.6E-10	2.7E-10	8.6E-11	4.4E-11	2.1E-11
47.2	2.5E-01	4.1E-06	5.5E-09	1.5E-09	7.3E-10	4.3E-10	1.4E-10	7.0E-11	3.3E-11
62.2	6.4E-01	1.1E-05	1.4E-08	4.0E-09	1.9E-09	1.1E-09	3.6E-10	1.8E-10	8.6E-11
77.2	2.5E+00	4.2E-05	5.6E-08	1.6E-08	7.4E-09	4.3E-09	1.4E-09	7.1E-10	3.3E-10
92.2	1.2E+01	2.0E-04	2.7E-07	7.6E-08	3.6E-08	2.1E-08	6.7E-09	3.4E-09	1.6E-09
107.2	7.8E+01	1.3E-03	1.7E-06	4.9E-07	2.3E-07	1.3E-07	4.3E-08	2.2E-08	1.0E-08
122.2	6.9E+02	1.2E-02	1.6E-05	4.3E-06	2.1E-06	1.2E-06	3.8E-07	2.0E-07	9.3E-08
137.2	7.2E+02	1.2E-02	1.6E-05	4.5E-06	2.2E-06	1.3E-06	4.0E-07	2.1E-07	9.7E-08
137.2	7.2E+02	1.2E-02	1.6E-05	4.5E-06	2.2E-06	1.3E-06	4.0E-07	2.1E-07	9.7E-08
140.5	1.0E+03	1.7E-02	2.3E-05	6.5E-06	3.1E-06	1.8E-06	5.8E-07	2.9E-07	1.4E-07
155.5	1.5E+03	2.5E-02	3.4E-05	9.4E-06	4.4E-06	2.6E-06	8.3E-07	4.2E-07	2.0E-07
170.5	2.2E+03	3.6E-02	4.9E-05	1.3E-05	6.4E-06	3.7E-06	1.2E-06	6.1E-07	2.9E-07
185.5	3.1E+03	5.2E-02	7.0E-05	1.9E-05	9.3E-06	5.4E-06	1.7E-06	8.8E-07	4.2E-07
200.5	4.5E+03	7.5E-02	1.0E-04	2.8E-05	1.3E-05	7.8E-06	2.5E-06	1.3E-06	6.1E-07
215.5	6.6E+03	1.1E-01	1.5E-04	4.1E-05	2.0E-05	1.1E-05	3.7E-06	1.9E-06	8.8E-07
230.5	9.7E+03	1.6E-01	2.2E-04	6.1E-05	2.9E-05	1.7E-05	5.4E-06	2.8E-06	1.3E-06
245.5	1.4E+04	2.4E-01	3.3E-04	9.1E-05	4.3E-05	2.5E-05	8.0E-06	4.1E-06	1.9E-06
260.5	2.2E+04	3.7E-01	5.0E-04	1.4E-04	6.5E-05	3.8E-05	1.2E-05	6.2E-06	2.9E-06
275.5	3.4E+04	5.7E-01	7.7E-04	2.1E-04	1.0E-04	6.0E-05	1.9E-05	9.7E-06	4.6E-06
290.5	5.6E+04	9.3E-01	1.3E-03	3.5E-04	1.7E-04	9.7E-05	3.1E-05	1.6E-05	7.5E-06
305.5	9.4E+04	1.6E+00	2.1E-03	5.9E-04	2.8E-04	1.6E-04	5.2E-05	2.7E-05	1.3E-05
320.5	1.6E+05	2.6E+00	3.6E-03	9.9E-04	4.7E-04	2.7E-04	8.7E-05	4.5E-05	2.1E-05
335.5	2.2E+05	3.6E+00	4.9E-03	1.4E-03	6.5E-04	3.8E-04	1.2E-04	6.2E-05	2.9E-05
350.5	2.2E+05	3.7E+00	5.0E-03	1.4E-03	6.5E-04	3.8E-04	1.2E-04	6.2E-05	3.0E-05
350.5	2.2E+05	3.7E+00	5.0E-03	1.4E-03	6.5E-04	3.8E-04	1.2E-04	6.2E-05	3.0E-05
351.0	2.5E+05	4.2E+00	5.7E-03	1.6E-03	7.5E-04	4.4E-04	1.4E-04	7.2E-05	3.4E-05

Table C-24. Air Concentration Estimates for Burrowing in Bay A – Default Meteorology (continued)

Depth	FluxT (JT)	Emissions (0.53 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
(cm)	($pCi/m^2/sec$)	(Ci/yr)	250m	500m	750m	1000m	2000m	3000m	5000m
366.0	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
381.0	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
381.0	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
388.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
403.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
418.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
433.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
448.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
463.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
478.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
493.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
508.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
523.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
538.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
553.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
568.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
583.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
598.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
613.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
628.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
643.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
658.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
673.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
688.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
703.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
718.7	2.7E+05	4.5E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.6E-05	3.6E-05
733.7	2.7E+05	4.4E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.5E-05	3.6E-05
748.7	2.6E+05	4.4E+00	6.0E-03	1.7E-03	7.9E-04	4.6E-04	1.5E-04	7.5E-05	3.5E-05
763.7	2.6E+05	4.4E+00	5.9E-03	1.6E-03	7.8E-04	4.5E-04	1.4E-04	7.4E-05	3.5E-05
778.7	2.6E+05	4.3E+00	5.8E-03	1.6E-03	7.6E-04	4.4E-04	1.4E-04	7.3E-05	3.4E-05
793.7	2.4E+05	4.1E+00	5.5E-03	1.5E-03	7.3E-04	4.2E-04	1.4E-04	6.9E-05	3.3E-05

Table C-24. Air Concentration Estimates for Burrowing in Bay A – Default Meteorology (continued)

Depth	FluxT (JT)	Emissions (0.53 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)						
(cm)	($pCi/m^2/sec$)	(Ci/yr)	250m	500m	750m	1000m	2000m	3000m	5000m
808.7	2.2E+05	3.7E+00	5.0E-03	1.4E-03	6.6E-04	3.9E-04	1.2E-04	6.3E-05	3.0E-05
823.7	1.9E+05	3.1E+00	4.2E-03	1.2E-03	5.5E-04	3.2E-04	1.0E-04	5.3E-05	2.5E-05
838.7	1.3E+05	2.1E+00	2.9E-03	8.0E-04	3.8E-04	2.2E-04	7.1E-05	3.6E-05	1.7E-05
853.7	4.6E+04	7.8E-01	1.0E-03	2.9E-04	1.4E-04	8.1E-05	2.6E-05	1.3E-05	6.2E-06
868.7	0.0E+00								

Table C-25. Summary of Air Concentration Results for Bounding, Typical and Default Conditions

	Bounding Met		Typical Met		Default Met		Emitting Area	Max Flux
Downwind Distance	**250m**	**2000m**	**250m**	**2000m**	**250m**	**2000m**	**(m^2)**	**(Ci/yr)**
Unit Data								
Unit Conc (pCi/L per Ci/yr)	1.63E-01	4.12E-03	1.31E-02	2.49E-04	1.35E-03	3.32E-05	--	--
Excavation								
Bay A - Max Conc (pCi/L)	1.37E+02	3.47E+00	1.10E+01	2.10E-01	1.14E+00	2.80E-02	1.00E+02	8.42E+02
Bay B - Max Conc (pCi/L)	6.28E+00	1.59E-01	5.04E-01	9.59E-03	5.20E-02	1.28E-03	1.00E+02	3.85E+01
Bay C - Max Conc (pCi/L)	1.37E+02	3.47E+00	1.10E+01	2.10E-01	1.14E+00	2.80E-02	1.00E+02	8.42E+02
Bay D - Max Conc (pCi/L)	4.66E+00	1.18E-01	3.75E-01	7.12E-03	3.86E-02	9.50E-04	1.00E+02	2.86E+01
Bay A, B, C, D - Max Conc (pCi/L)	2.86E+02	7.23E+00	2.30E+01	4.37E-01	2.37E+00	5.83E-02	5.00E+02	1.76E+03
Intrusion								
Bay A - Wall Failure - Max Conc (pCi/L)	9.47E+01	2.39E+00	7.61E+00	1.45E-01	7.84E-01	1.93E-02	6.90E+01	5.81E+02
Bay A - Earthquake Fissure - Max Conc (pCi/L)	8.97E+00	2.27E-01	7.21E-01	1.37E-02	7.43E-02	1.83E-03	3.90E+02	5.50E+01
Bay A - Drilling - Max Conc (pCi/L)	3.16E+00	7.99E-02	2.54E-01	4.83E-03	2.62E-02	6.44E-04	2.30E+00	1.94E+01
Bay A - Burrowing - Max Conc (pCi/L)	7.34E-01	1.85E-02	5.90E-02	1.12E-03	6.08E-03	1.49E-04	5.30E-01	4.50E+00

Notes:
Bounding met is Class G at 1-m/s to North, typical met is Class C at 1-m/s, and default met has maximum concentrations to the Northeast.
Flux data are from Appendix A, excavation/intrusion air concentration values are from Appendix B, and unit air concentrations are from Appendix C.
Earthquake concentrations are from Appendix E.

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Bounding Meterology at Receptor Locations

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Table C-26. Air Concentration Estimates for Excavation in Bay A – Bounding Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.4E-01	1.4E-03	5.2E-05	3.9E-05	3.8E-05	1.9E-05	1.7E-05	8.4E-06	4.6E-06	3.9E-06
0.7	4.0E-01	1.3E-03	4.7E-05	3.6E-05	3.5E-05	1.8E-05	1.5E-05	7.6E-06	4.2E-06	3.5E-06
15.7	3.1E-01	9.8E-04	3.7E-05	2.8E-05	2.7E-05	1.4E-05	1.2E-05	5.9E-06	3.3E-06	2.8E-06
30.7	1.6E-01	5.2E-04	1.9E-05	1.5E-05	1.4E-05	7.2E-06	6.3E-06	3.1E-06	1.7E-06	1.5E-06
45.7	1.5E-01	4.9E-04	1.8E-05	1.4E-05	1.3E-05	6.8E-06	6.0E-06	3.0E-06	1.6E-06	1.4E-06
45.7	1.5E-01	4.9E-04	1.8E-05	1.4E-05	1.3E-05	6.8E-06	6.0E-06	3.0E-06	1.6E-06	1.4E-06
47.2	2.5E-01	7.7E-04	2.9E-05	2.2E-05	2.1E-05	1.1E-05	9.5E-06	4.7E-06	2.6E-06	2.2E-06
62.2	6.4E-01	2.0E-03	7.6E-05	5.7E-05	5.6E-05	2.8E-05	2.5E-05	1.2E-05	6.7E-06	5.7E-06
77.2	2.5E+00	7.8E-03	2.9E-04	2.2E-04	2.2E-04	1.1E-04	9.6E-05	4.7E-05	2.6E-05	2.2E-05
92.2	1.2E+01	3.8E-02	1.4E-03	1.1E-03	1.0E-03	5.3E-04	4.7E-04	2.3E-04	1.3E-04	1.1E-04
107.2	7.8E+01	2.4E-01	9.2E-03	6.9E-03	6.7E-03	3.4E-03	3.0E-03	1.5E-03	8.1E-04	6.9E-04
122.2	6.9E+02	2.2E+00	8.2E-02	6.2E-02	6.0E-02	3.0E-02	2.7E-02	1.3E-02	7.2E-03	6.1E-03
137.2	7.2E+02	2.3E+00	8.5E-02	6.5E-02	6.3E-02	3.2E-02	2.8E-02	1.4E-02	7.6E-03	6.4E-03
137.2	7.2E+02	2.3E+00	8.5E-02	6.5E-02	6.3E-02	3.2E-02	2.8E-02	1.4E-02	7.6E-03	6.4E-03
140.5	1.0E+03	3.3E+00	1.2E-01	9.3E-02	9.0E-02	4.6E-02	4.0E-02	2.0E-02	1.1E-02	9.2E-03
155.5	1.5E+03	4.7E+00	1.8E-01	1.3E-01	1.3E-01	6.6E-02	5.8E-02	2.9E-02	1.6E-02	1.3E-02
170.5	2.2E+03	6.8E+00	2.5E-01	1.9E-01	1.9E-01	9.5E-02	8.3E-02	4.1E-02	2.3E-02	1.9E-02
185.5	3.1E+03	9.8E+00	3.7E-01	2.8E-01	2.7E-01	1.4E-01	1.2E-01	5.9E-02	3.3E-02	2.8E-02
200.5	4.5E+03	1.4E+01	5.3E-01	4.0E-01	3.9E-01	2.0E-01	1.8E-01	8.6E-02	4.7E-02	4.0E-02
215.5	6.6E+03	2.1E+01	7.8E-01	5.9E-01	5.7E-01	2.9E-01	2.6E-01	1.3E-01	6.9E-02	5.9E-02
230.5	9.7E+03	3.1E+01	1.1E+00	8.6E-01	8.4E-01	4.3E-01	3.8E-01	1.9E-01	1.0E-01	8.6E-02
245.5	1.4E+04	4.6E+01	1.7E+00	1.3E+00	1.3E+00	6.4E-01	5.6E-01	2.8E-01	1.5E-01	1.3E-01
260.5	2.2E+04	6.9E+01	2.6E+00	2.0E+00	1.9E+00	9.7E-01	8.5E-01	4.2E-01	2.3E-01	2.0E-01
275.5	3.4E+04	1.1E+02	4.1E+00	3.1E+00	3.0E+00	1.5E+00	1.3E+00	6.6E-01	3.6E-01	3.0E-01
290.5	5.6E+04	1.8E+02	6.6E+00	5.0E+00	4.8E+00	2.5E+00	2.2E+00	1.1E+00	5.8E-01	4.9E-01
305.5	9.4E+04	3.0E+02	1.1E+01	8.4E+00	8.1E+00	4.1E+00	3.6E+00	1.8E+00	9.9E-01	8.3E-01
320.5	1.6E+05	5.0E+02	1.9E+01	1.4E+01	1.4E+01	7.0E+00	6.1E+00	3.0E+00	1.7E+00	1.4E+00
335.5	2.2E+05	6.8E+02	2.6E+01	1.9E+01	1.9E+01	9.6E+00	8.4E+00	4.1E+00	2.3E+00	1.9E+00

Table C-26. Air Concentration Estimates for Excavation in Bay A – Bounding Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
350.5	2.2E+05	6.9E+02	2.6E+01	2.0E+01	1.9E+01	9.7E+00	8.5E+00	4.2E+00	2.3E+00	2.0E+00
350.5	2.2E+05	6.9E+02	2.6E+01	2.0E+01	1.9E+01	9.7E+00	8.5E+00	4.2E+00	2.3E+00	2.0E+00
351.0	2.5E+05	8.0E+02	3.0E+01	2.3E+01	2.2E+01	1.1E+01	9.8E+00	4.8E+00	2.7E+00	2.2E+00
366.0	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
381.0	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
381.0	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
388.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
403.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
418.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
433.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
448.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
463.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
478.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
493.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
508.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
523.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
538.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
553.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
568.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
583.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
598.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
613.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
628.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
643.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
658.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
673.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
688.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
703.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
718.7	2.7E+05	8.4E+02	3.1E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
733.7	2.7E+05	8.4E+02	3.1E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
748.7	2.6E+05	8.3E+02	3.1E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.0E+00	2.8E+00	2.3E+00

Table C-26. Air Concentration Estimates for Excavation in Bay A – Bounding Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
763.7	2.6E+05	8.2E+02	3.1E+01	2.3E+01	2.3E+01	1.2E+01	1.0E+01	5.0E+00	2.7E+00	2.3E+00
778.7	2.6E+05	8.0E+02	3.0E+01	2.3E+01	2.2E+01	1.1E+01	9.9E+00	4.9E+00	2.7E+00	2.3E+00
793.7	2.4E+05	7.7E+02	2.9E+01	2.2E+01	2.1E+01	1.1E+01	9.5E+00	4.7E+00	2.6E+00	2.2E+00
808.7	2.2E+05	7.0E+02	2.6E+01	2.0E+01	1.9E+01	9.9E+00	8.7E+00	4.3E+00	2.3E+00	2.0E+00
823.7	1.9E+05	5.9E+02	2.2E+01	1.7E+01	1.6E+01	8.2E+00	7.2E+00	3.6E+00	2.0E+00	1.7E+00
838.7	1.3E+05	4.0E+02	1.5E+01	1.1E+01	1.1E+01	5.6E+00	4.9E+00	2.4E+00	1.3E+00	1.1E+00
853.7	4.6E+04	1.5E+02	5.5E+00	4.1E+00	4.0E+00	2.1E+00	1.8E+00	8.9E-01	4.9E-01	4.1E-01

Table C-27. Air Concentration Estimates for Excavation in Bay B – Bounding Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.5E-01	1.4E-03	5.3E-05	4.0E-05	3.9E-05	2.0E-05	1.7E-05	8.6E-06	4.7E-06	4.0E-06
0.7	4.1E-01	1.3E-03	4.8E-05	3.6E-05	3.5E-05	1.8E-05	1.6E-05	7.8E-06	4.3E-06	3.6E-06
15.7	3.2E-01	1.0E-03	3.7E-05	2.8E-05	2.7E-05	1.4E-05	1.2E-05	6.0E-06	3.3E-06	2.8E-06
30.7	1.6E-01	5.1E-04	1.9E-05	1.4E-05	1.4E-05	7.1E-06	6.3E-06	3.1E-06	1.7E-06	1.4E-06
45.7	1.5E-01	4.8E-04	1.8E-05	1.4E-05	1.3E-05	6.8E-06	5.9E-06	2.9E-06	1.6E-06	1.4E-06
45.7	1.5E-01	4.8E-04	1.8E-05	1.4E-05	1.3E-05	6.8E-06	5.9E-06	2.9E-06	1.6E-06	1.4E-06
47.2	2.4E-01	7.4E-04	2.8E-05	2.1E-05	2.0E-05	1.0E-05	9.1E-06	4.5E-06	2.5E-06	2.1E-06
62.2	5.8E-01	1.8E-03	6.9E-05	5.2E-05	5.1E-05	2.6E-05	2.3E-05	1.1E-05	6.1E-06	5.2E-06
77.2	2.0E+00	6.5E-03	2.4E-04	1.8E-04	1.8E-04	9.1E-05	8.0E-05	3.9E-05	2.2E-05	1.8E-05
92.2	8.2E+00	2.6E-02	9.7E-04	7.3E-04	7.1E-04	3.6E-04	3.2E-04	1.6E-04	8.6E-05	7.3E-05
107.2	3.3E+01	1.0E-01	3.9E-03	2.9E-03	2.9E-03	1.5E-03	1.3E-03	6.3E-04	3.5E-04	2.9E-04
122.2	8.2E+01	2.6E-01	9.7E-03	7.3E-03	7.1E-03	3.6E-03	3.2E-03	1.6E-03	8.6E-04	7.3E-04
137.2	8.3E+01	2.6E-01	9.8E-03	7.4E-03	7.2E-03	3.7E-03	3.2E-03	1.6E-03	8.7E-04	7.4E-04
137.2	8.3E+01	2.6E-01	9.8E-03	7.4E-03	7.2E-03	3.7E-03	3.2E-03	1.6E-03	8.7E-04	7.4E-04
140.5	1.2E+02	3.7E-01	1.4E-02	1.1E-02	1.0E-02	5.2E-03	4.6E-03	2.3E-03	1.2E-03	1.1E-03
155.5	1.7E+02	5.4E-01	2.0E-02	1.5E-02	1.5E-02	7.6E-03	6.7E-03	3.3E-03	1.8E-03	1.5E-03
170.5	2.5E+02	7.9E-01	3.0E-02	2.2E-02	2.2E-02	1.1E-02	9.7E-03	4.8E-03	2.6E-03	2.2E-03
185.5	3.7E+02	1.2E+00	4.4E-02	3.3E-02	3.2E-02	1.6E-02	1.4E-02	7.0E-03	3.9E-03	3.3E-03
200.5	5.4E+02	1.7E+00	6.4E-02	4.9E-02	4.7E-02	2.4E-02	2.1E-02	1.0E-02	5.7E-03	4.8E-03
215.5	8.1E+02	2.5E+00	9.5E-02	7.2E-02	7.0E-02	3.6E-02	3.1E-02	1.5E-02	8.5E-03	7.2E-03
230.5	1.2E+03	3.8E+00	1.4E-01	1.1E-01	1.0E-01	5.3E-02	4.6E-02	2.3E-02	1.3E-02	1.1E-02
245.5	1.8E+03	5.6E+00	2.1E-01	1.6E-01	1.5E-01	7.9E-02	6.9E-02	3.4E-02	1.9E-02	1.6E-02
260.5	2.6E+03	8.4E+00	3.1E-01	2.4E-01	2.3E-01	1.2E-01	1.0E-01	5.1E-02	2.8E-02	2.4E-02
275.5	3.9E+03	1.2E+01	4.6E-01	3.5E-01	3.4E-01	1.7E-01	1.5E-01	7.5E-02	4.1E-02	3.5E-02
290.5	5.7E+03	1.8E+01	6.7E-01	5.1E-01	4.9E-01	2.5E-01	2.2E-01	1.1E-01	6.0E-02	5.0E-02
305.5	7.9E+03	2.5E+01	9.3E-01	7.0E-01	6.8E-01	3.5E-01	3.1E-01	1.5E-01	8.3E-02	7.0E-02

Table C-27. Air Concentration Estimates for Excavation in Bay B – Bounding Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
320.5	1.0E+04	3.2E+01	1.2E+00	9.1E-01	8.8E-01	4.5E-01	3.9E-01	1.9E-01	1.1E-01	9.0E-02
335.5	1.1E+04	3.6E+01	1.4E+00	1.0E+00	9.9E-01	5.0E-01	4.4E-01	2.2E-01	1.2E-01	1.0E-01
350.5	1.1E+04	3.6E+01	1.4E+00	1.0E+00	1.0E+00	5.1E-01	4.5E-01	2.2E-01	1.2E-01	1.0E-01
350.5	1.1E+04	3.6E+01	1.4E+00	1.0E+00	1.0E+00	5.1E-01	4.5E-01	2.2E-01	1.2E-01	1.0E-01
352.4	1.2E+04	3.7E+01	1.4E+00	1.1E+00	1.0E+00	5.2E-01	4.6E-01	2.3E-01	1.2E-01	1.0E-01
367.4	1.2E+04	3.8E+01	1.4E+00	1.1E+00	1.0E+00	5.3E-01	4.7E-01	2.3E-01	1.3E-01	1.1E-01
382.4	1.2E+04	3.8E+01	1.4E+00	1.1E+00	1.1E+00	5.4E-01	4.7E-01	2.3E-01	1.3E-01	1.1E-01
397.4	1.2E+04	3.8E+01	1.4E+00	1.1E+00	1.1E+00	5.4E-01	4.7E-01	2.3E-01	1.3E-01	1.1E-01
412.4	1.2E+04	3.8E+01	1.4E+00	1.1E+00	1.0E+00	5.3E-01	4.6E-01	2.3E-01	1.3E-01	1.1E-01
427.4	1.1E+04	3.6E+01	1.3E+00	1.0E+00	9.8E-01	5.0E-01	4.4E-01	2.2E-01	1.2E-01	1.0E-01
442.4	1.0E+04	3.2E+01	1.2E+00	9.2E-01	8.9E-01	4.5E-01	4.0E-01	2.0E-01	1.1E-01	9.1E-02
457.4	8.9E+03	2.8E+01	1.0E+00	7.9E-01	7.7E-01	3.9E-01	3.4E-01	1.7E-01	9.3E-02	7.9E-02
472.4	8.6E+03	2.7E+01	1.0E+00	7.7E-01	7.5E-01	3.8E-01	3.4E-01	1.7E-01	9.1E-02	7.7E-02
472.4	8.6E+03	2.7E+01	1.0E+00	7.7E-01	7.5E-01	3.8E-01	3.4E-01	1.7E-01	9.1E-02	7.7E-02
472.9	9.5E+03	3.0E+01	1.1E+00	8.5E-01	8.3E-01	4.2E-01	3.7E-01	1.8E-01	1.0E-01	8.5E-02
487.9	9.9E+03	3.1E+01	1.2E+00	8.8E-01	8.6E-01	4.4E-01	3.8E-01	1.9E-01	1.0E-01	8.8E-02
502.9	9.9E+03	3.1E+01	1.2E+00	8.8E-01	8.6E-01	4.4E-01	3.8E-01	1.9E-01	1.0E-01	8.8E-02
502.9	9.9E+03	3.1E+01	1.2E+00	8.8E-01	8.6E-01	4.4E-01	3.8E-01	1.9E-01	1.0E-01	8.8E-02
508.7	9.9E+03	3.1E+01	1.2E+00	8.8E-01	8.6E-01	4.4E-01	3.8E-01	1.9E-01	1.0E-01	8.8E-02
523.7	9.9E+03	3.1E+01	1.2E+00	8.8E-01	8.6E-01	4.4E-01	3.8E-01	1.9E-01	1.0E-01	8.8E-02
538.7	9.9E+03	3.1E+01	1.2E+00	8.8E-01	8.5E-01	4.4E-01	3.8E-01	1.9E-01	1.0E-01	8.8E-02
553.7	9.8E+03	3.1E+01	1.2E+00	8.8E-01	8.5E-01	4.3E-01	3.8E-01	1.9E-01	1.0E-01	8.8E-02
568.7	9.8E+03	3.1E+01	1.2E+00	8.8E-01	8.5E-01	4.3E-01	3.8E-01	1.9E-01	1.0E-01	8.7E-02
583.7	9.8E+03	3.1E+01	1.2E+00	8.8E-01	8.5E-01	4.3E-01	3.8E-01	1.9E-01	1.0E-01	8.7E-02
598.7	9.8E+03	3.1E+01	1.2E+00	8.7E-01	8.5E-01	4.3E-01	3.8E-01	1.9E-01	1.0E-01	8.7E-02
613.7	9.8E+03	3.1E+01	1.2E+00	8.7E-01	8.5E-01	4.3E-01	3.8E-01	1.9E-01	1.0E-01	8.7E-02
628.7	9.7E+03	3.1E+01	1.1E+00	8.7E-01	8.4E-01	4.3E-01	3.8E-01	1.9E-01	1.0E-01	8.6E-02
643.7	9.6E+03	3.0E+01	1.1E+00	8.6E-01	8.4E-01	4.3E-01	3.7E-01	1.8E-01	1.0E-01	8.6E-02
658.7	9.6E+03	3.0E+01	1.1E+00	8.5E-01	8.3E-01	4.2E-01	3.7E-01	1.8E-01	1.0E-01	8.5E-02
673.7	9.5E+03	3.0E+01	1.1E+00	8.4E-01	8.2E-01	4.2E-01	3.7E-01	1.8E-01	9.9E-02	8.4E-02

Table C-27. Air Concentration Estimates for Excavation in Bay B – Bounding Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
688.7	9.3E+03	2.9E+01	1.1E+00	8.3E-01	8.1E-01	4.1E-01	3.6E-01	1.8E-01	9.8E-02	8.3E-02
703.7	9.1E+03	2.9E+01	1.1E+00	8.1E-01	7.9E-01	4.0E-01	3.5E-01	1.7E-01	9.6E-02	8.1E-02
718.7	8.8E+03	2.8E+01	1.0E+00	7.9E-01	7.7E-01	3.9E-01	3.4E-01	1.7E-01	9.3E-02	7.9E-02
733.7	8.5E+03	2.7E+01	1.0E+00	7.6E-01	7.4E-01	3.7E-01	3.3E-01	1.6E-01	8.9E-02	7.6E-02
748.7	8.0E+03	2.5E+01	9.5E-01	7.2E-01	7.0E-01	3.5E-01	3.1E-01	1.5E-01	8.4E-02	7.1E-02
763.7	7.5E+03	2.4E+01	8.8E-01	6.7E-01	6.5E-01	3.3E-01	2.9E-01	1.4E-01	7.8E-02	6.6E-02
778.7	6.7E+03	2.1E+01	7.9E-01	6.0E-01	5.8E-01	3.0E-01	2.6E-01	1.3E-01	7.1E-02	6.0E-02
793.7	5.8E+03	1.8E+01	6.9E-01	5.2E-01	5.0E-01	2.6E-01	2.3E-01	1.1E-01	6.1E-02	5.2E-02
808.7	4.7E+03	1.5E+01	5.6E-01	4.2E-01	4.1E-01	2.1E-01	1.8E-01	9.0E-02	5.0E-02	4.2E-02
823.7	3.5E+03	1.1E+01	4.1E-01	3.1E-01	3.0E-01	1.5E-01	1.3E-01	6.6E-02	3.6E-02	3.1E-02
838.7	2.1E+03	6.5E+00	2.5E-01	1.9E-01	1.8E-01	9.2E-02	8.0E-02	4.0E-02	2.2E-02	1.8E-02
853.7	5.8E+02	1.8E+00	6.9E-02	5.2E-02	5.1E-02	2.6E-02	2.3E-02	1.1E-02	6.1E-03	5.2E-03

Table C-28. Air Concentration Estimates for Excavation in Bay C – Bounding Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.3E-01	1.3E-03	5.1E-05	3.8E-05	3.7E-05	1.9E-05	1.7E-05	8.2E-06	4.5E-06	3.8E-06
0.7	3.8E-01	1.2E-03	4.5E-05	3.4E-05	3.3E-05	1.7E-05	1.5E-05	7.3E-06	4.0E-06	3.4E-06
15.7	2.9E-01	9.1E-04	3.4E-05	2.6E-05	2.5E-05	1.3E-05	1.1E-05	5.5E-06	3.0E-06	2.6E-06
30.7	1.4E-01	4.4E-04	1.6E-05	1.2E-05	1.2E-05	6.1E-06	5.4E-06	2.7E-06	1.5E-06	1.2E-06
45.7	1.3E-01	4.1E-04	1.5E-05	1.2E-05	1.1E-05	5.8E-06	5.1E-06	2.5E-06	1.4E-06	1.2E-06
45.7	1.3E-01	4.1E-04	1.5E-05	1.2E-05	1.1E-05	5.8E-06	5.1E-06	2.5E-06	1.4E-06	1.2E-06
47.2	1.4E-01	4.4E-04	1.7E-05	1.3E-05	1.2E-05	6.2E-06	5.4E-06	2.7E-06	1.5E-06	1.2E-06
62.2	1.8E-01	5.8E-04	2.2E-05	1.6E-05	1.6E-05	8.1E-06	7.2E-06	3.5E-06	1.9E-06	1.6E-06
77.2	3.9E-01	1.2E-03	4.6E-05	3.5E-05	3.4E-05	1.7E-05	1.5E-05	7.4E-06	4.1E-06	3.5E-06
92.2	1.5E+00	4.6E-03	1.7E-04	1.3E-04	1.3E-04	6.4E-05	5.7E-05	2.8E-05	1.5E-05	1.3E-05
107.2	8.7E+00	2.8E-02	1.0E-03	7.8E-04	7.6E-04	3.9E-04	3.4E-04	1.7E-04	9.2E-05	7.8E-05
122.2	7.7E+01	2.4E-01	9.1E-03	6.9E-03	6.7E-03	3.4E-03	3.0E-03	1.5E-03	8.1E-04	6.8E-04
137.2	8.0E+01	2.5E-01	9.5E-03	7.2E-03	7.0E-03	3.6E-03	3.1E-03	1.5E-03	8.5E-04	7.2E-04
137.2	8.0E+01	2.5E-01	9.5E-03	7.2E-03	7.0E-03	3.6E-03	3.1E-03	1.5E-03	8.5E-04	7.2E-04
140.5	1.1E+02	3.5E-01	1.3E-02	1.0E-02	9.7E-03	5.0E-03	4.4E-03	2.1E-03	1.2E-03	1.0E-03
155.5	1.6E+02	5.0E-01	1.9E-02	1.4E-02	1.4E-02	7.0E-03	6.1E-03	3.0E-03	1.7E-03	1.4E-03
170.5	2.3E+02	7.1E-01	2.7E-02	2.0E-02	2.0E-02	1.0E-02	8.7E-03	4.3E-03	2.4E-03	2.0E-03
185.5	3.2E+02	1.0E+00	3.8E-02	2.9E-02	2.8E-02	1.4E-02	1.3E-02	6.2E-03	3.4E-03	2.9E-03
200.5	4.7E+02	1.5E+00	5.5E-02	4.2E-02	4.1E-02	2.1E-02	1.8E-02	9.0E-03	4.9E-03	4.2E-03
215.5	6.8E+02	2.2E+00	8.1E-02	6.1E-02	5.9E-02	3.0E-02	2.7E-02	1.3E-02	7.2E-03	6.1E-03
230.5	1.0E+03	3.2E+00	1.2E-01	9.0E-02	8.8E-02	4.5E-02	3.9E-02	1.9E-02	1.1E-02	9.0E-03
245.5	1.5E+03	4.8E+00	1.8E-01	1.4E-01	1.3E-01	6.7E-02	5.9E-02	2.9E-02	1.6E-02	1.4E-02
260.5	2.3E+03	7.4E+00	2.8E-01	2.1E-01	2.0E-01	1.0E-01	9.1E-02	4.5E-02	2.5E-02	2.1E-02
275.5	3.7E+03	1.2E+01	4.4E-01	3.3E-01	3.2E-01	1.6E-01	1.4E-01	7.1E-02	3.9E-02	3.3E-02
290.5	6.1E+03	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.4E-02	5.5E-02
305.5	1.1E+04	3.3E+01	1.3E+00	9.5E-01	9.2E-01	4.7E-01	4.1E-01	2.0E-01	1.1E-01	9.4E-02

Table C-28. Air Concentration Estimates for Excavation in Bay C – Bounding Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
320.5	1.8E+04	5.8E+01	2.2E+00	1.6E+00	1.6E+00	8.1E-01	7.1E-01	3.5E-01	1.9E-01	1.6E-01
335.5	2.6E+04	8.1E+01	3.1E+00	2.3E+00	2.2E+00	1.1E+00	1.0E+00	4.9E-01	2.7E-01	2.3E-01
350.5	2.6E+04	8.3E+01	3.1E+00	2.3E+00	2.3E+00	1.2E+00	1.0E+00	5.0E-01	2.7E-01	2.3E-01
350.5	2.6E+04	8.3E+01	3.1E+00	2.3E+00	2.3E+00	1.2E+00	1.0E+00	5.0E-01	2.7E-01	2.3E-01
352.4	3.0E+04	9.4E+01	3.5E+00	2.7E+00	2.6E+00	1.3E+00	1.2E+00	5.7E-01	3.1E-01	2.6E-01
367.4	3.4E+04	1.1E+02	4.0E+00	3.0E+00	3.0E+00	1.5E+00	1.3E+00	6.5E-01	3.6E-01	3.0E-01
382.4	4.0E+04	1.2E+02	4.7E+00	3.5E+00	3.4E+00	1.7E+00	1.5E+00	7.6E-01	4.2E-01	3.5E-01
397.4	4.6E+04	1.5E+02	5.5E+00	4.1E+00	4.0E+00	2.0E+00	1.8E+00	8.8E-01	4.9E-01	4.1E-01
412.4	5.4E+04	1.7E+02	6.4E+00	4.8E+00	4.7E+00	2.4E+00	2.1E+00	1.0E+00	5.7E-01	4.8E-01
427.4	6.3E+04	2.0E+02	7.4E+00	5.6E+00	5.4E+00	2.8E+00	2.4E+00	1.2E+00	6.6E-01	5.6E-01
442.4	7.0E+04	2.2E+02	8.2E+00	6.2E+00	6.0E+00	3.1E+00	2.7E+00	1.3E+00	7.3E-01	6.2E-01
457.4	7.2E+04	2.3E+02	8.5E+00	6.4E+00	6.3E+00	3.2E+00	2.8E+00	1.4E+00	7.6E-01	6.4E-01
472.4	7.2E+04	2.3E+02	8.5E+00	6.4E+00	6.2E+00	3.2E+00	2.8E+00	1.4E+00	7.6E-01	6.4E-01
472.4	7.2E+04	2.3E+02	8.5E+00	6.4E+00	6.2E+00	3.2E+00	2.8E+00	1.4E+00	7.6E-01	6.4E-01
472.9	8.8E+04	2.8E+02	1.0E+01	7.8E+00	7.6E+00	3.9E+00	3.4E+00	1.7E+00	9.2E-01	7.8E-01
487.9	9.5E+04	3.0E+02	1.1E+01	8.5E+00	8.3E+00	4.2E+00	3.7E+00	1.8E+00	1.0E+00	8.5E-01
502.9	9.5E+04	3.0E+02	1.1E+01	8.5E+00	8.3E+00	4.2E+00	3.7E+00	1.8E+00	1.0E+00	8.5E-01
502.9	9.5E+04	3.0E+02	1.1E+01	8.5E+00	8.3E+00	4.2E+00	3.7E+00	1.8E+00	1.0E+00	8.5E-01
505.3	1.1E+05	3.4E+02	1.3E+01	9.7E+00	9.4E+00	4.8E+00	4.2E+00	2.1E+00	1.1E+00	9.6E-01
520.3	1.2E+05	3.9E+02	1.5E+01	1.1E+01	1.1E+01	5.4E+00	4.8E+00	2.4E+00	1.3E+00	1.1E+00
535.3	1.4E+05	4.4E+02	1.7E+01	1.2E+01	1.2E+01	6.2E+00	5.4E+00	2.7E+00	1.5E+00	1.2E+00
550.3	1.6E+05	5.0E+02	1.9E+01	1.4E+01	1.4E+01	7.0E+00	6.1E+00	3.0E+00	1.7E+00	1.4E+00
565.3	1.8E+05	5.6E+02	2.1E+01	1.6E+01	1.5E+01	7.9E+00	6.9E+00	3.4E+00	1.9E+00	1.6E+00
580.3	2.0E+05	6.3E+02	2.4E+01	1.8E+01	1.7E+01	8.8E+00	7.8E+00	3.8E+00	2.1E+00	1.8E+00
595.3	2.2E+05	7.0E+02	2.6E+01	2.0E+01	1.9E+01	9.8E+00	8.6E+00	4.2E+00	2.3E+00	2.0E+00
610.3	2.4E+05	7.7E+02	2.9E+01	2.2E+01	2.1E+01	1.1E+01	9.4E+00	4.6E+00	2.6E+00	2.2E+00
625.3	2.6E+05	8.2E+02	3.1E+01	2.3E+01	2.3E+01	1.1E+01	1.0E+01	5.0E+00	2.7E+00	2.3E+00
640.3	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
655.3	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
655.3	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00

Table C-28. Air Concentration Estimates for Excavation in Bay C – Bounding Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
658.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
673.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
688.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
703.7	2.7E+05	8.4E+02	3.2E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
718.7	2.7E+05	8.4E+02	3.1E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
733.7	2.7E+05	8.4E+02	3.1E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.1E+00	2.8E+00	2.4E+00
748.7	2.6E+05	8.3E+02	3.1E+01	2.4E+01	2.3E+01	1.2E+01	1.0E+01	5.0E+00	2.8E+00	2.3E+00
763.7	2.6E+05	8.2E+02	3.1E+01	2.3E+01	2.3E+01	1.1E+01	1.0E+01	5.0E+00	2.7E+00	2.3E+00
778.7	2.5E+05	8.0E+02	3.0E+01	2.3E+01	2.2E+01	1.1E+01	9.8E+00	4.8E+00	2.7E+00	2.2E+00
793.7	2.4E+05	7.5E+02	2.8E+01	2.1E+01	2.1E+01	1.1E+01	9.3E+00	4.6E+00	2.5E+00	2.1E+00
808.7	2.1E+05	6.8E+02	2.5E+01	1.9E+01	1.9E+01	9.5E+00	8.3E+00	4.1E+00	2.3E+00	1.9E+00
823.7	1.7E+05	5.4E+02	2.0E+01	1.5E+01	1.5E+01	7.6E+00	6.7E+00	3.3E+00	1.8E+00	1.5E+00
838.7	1.1E+05	3.3E+02	1.3E+01	9.5E+00	9.2E+00	4.7E+00	4.1E+00	2.0E+00	1.1E+00	9.4E-01
853.7	2.1E+04	6.5E+01	2.4E+00	1.8E+00	1.8E+00	9.1E-01	8.0E-01	3.9E-01	2.2E-01	1.8E-01

Table C-29. Air Concentration Estimates for Excavation in Bay D – Bounding Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.3E-01	1.3E-03	5.0E-05	3.8E-05	3.7E-05	1.9E-05	1.7E-05	8.2E-06	4.5E-06	3.8E-06
0.7	3.8E-01	1.2E-03	4.5E-05	3.4E-05	3.3E-05	1.7E-05	1.5E-05	7.3E-06	4.0E-06	3.4E-06
15.7	2.9E-01	9.0E-04	3.4E-05	2.6E-05	2.5E-05	1.3E-05	1.1E-05	5.5E-06	3.0E-06	2.5E-06
30.7	1.4E-01	4.3E-04	1.6E-05	1.2E-05	1.2E-05	6.0E-06	5.3E-06	2.6E-06	1.4E-06	1.2E-06
45.7	1.3E-01	4.0E-04	1.5E-05	1.1E-05	1.1E-05	5.6E-06	5.0E-06	2.4E-06	1.3E-06	1.1E-06
45.7	1.3E-01	4.0E-04	1.5E-05	1.1E-05	1.1E-05	5.6E-06	5.0E-06	2.4E-06	1.3E-06	1.1E-06
47.2	1.3E-01	4.1E-04	1.5E-05	1.2E-05	1.1E-05	5.7E-06	5.0E-06	2.5E-06	1.4E-06	1.2E-06
62.2	1.4E-01	4.4E-04	1.6E-05	1.2E-05	1.2E-05	6.1E-06	5.4E-06	2.6E-06	1.5E-06	1.2E-06
77.2	1.8E-01	5.6E-04	2.1E-05	1.6E-05	1.6E-05	7.9E-06	6.9E-06	3.4E-06	1.9E-06	1.6E-06
92.2	3.9E-01	1.2E-03	4.6E-05	3.5E-05	3.4E-05	1.7E-05	1.5E-05	7.5E-06	4.1E-06	3.5E-06
107.2	1.8E+00	5.7E-03	2.2E-04	1.6E-04	1.6E-04	8.0E-05	7.1E-05	3.5E-05	1.9E-05	1.6E-05
122.2	1.5E+01	4.8E-02	1.8E-03	1.4E-03	1.3E-03	6.7E-04	5.9E-04	2.9E-04	1.6E-04	1.4E-04
137.2	1.6E+01	5.0E-02	1.9E-03	1.4E-03	1.4E-03	7.0E-04	6.2E-04	3.0E-04	1.7E-04	1.4E-04
137.2	1.6E+01	5.0E-02	1.9E-03	1.4E-03	1.4E-03	7.0E-04	6.2E-04	3.0E-04	1.7E-04	1.4E-04
146.3	1.9E+01	6.0E-02	2.2E-03	1.7E-03	1.6E-03	8.4E-04	7.4E-04	3.6E-04	2.0E-04	1.7E-04
161.3	2.4E+01	7.4E-02	2.8E-03	2.1E-03	2.0E-03	1.0E-03	9.1E-04	4.5E-04	2.5E-04	2.1E-04
176.3	3.0E+01	9.5E-02	3.6E-03	2.7E-03	2.6E-03	1.3E-03	1.2E-03	5.7E-04	3.2E-04	2.7E-04
191.3	3.9E+01	1.2E-01	4.7E-03	3.5E-03	3.4E-03	1.7E-03	1.5E-03	7.5E-04	4.1E-04	3.5E-04
206.3	5.3E+01	1.7E-01	6.3E-03	4.7E-03	4.6E-03	2.3E-03	2.1E-03	1.0E-03	5.6E-04	4.7E-04
221.3	7.3E+01	2.3E-01	8.6E-03	6.5E-03	6.3E-03	3.2E-03	2.8E-03	1.4E-03	7.6E-04	6.5E-04
236.3	1.0E+02	3.2E-01	1.2E-02	9.1E-03	8.8E-03	4.5E-03	3.9E-03	1.9E-03	1.1E-03	9.0E-04
251.3	1.4E+02	4.5E-01	1.7E-02	1.3E-02	1.2E-02	6.4E-03	5.6E-03	2.8E-03	1.5E-03	1.3E-03
266.3	2.1E+02	6.5E-01	2.4E-02	1.8E-02	1.8E-02	9.1E-03	8.0E-03	4.0E-03	2.2E-03	1.8E-03
281.3	3.0E+02	9.5E-01	3.6E-02	2.7E-02	2.6E-02	1.3E-02	1.2E-02	5.8E-03	3.2E-03	2.7E-03
296.3	4.5E+02	1.4E+00	5.3E-02	4.0E-02	3.9E-02	2.0E-02	1.7E-02	8.6E-03	4.7E-03	4.0E-03
311.3	6.8E+02	2.1E+00	8.0E-02	6.1E-02	5.9E-02	3.0E-02	2.6E-02	1.3E-02	7.1E-03	6.0E-03

Table C-29. Air Concentration Estimates for Excavation in Bay D – Bounding Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
326.3	1.1E+03	3.3E+00	1.3E-01	9.5E-02	9.2E-02	4.7E-02	4.1E-02	2.0E-02	1.1E-02	9.4E-03
341.3	1.7E+03	5.4E+00	2.0E-01	1.5E-01	1.5E-01	7.6E-02	6.7E-02	3.3E-02	1.8E-02	1.5E-02
356.3	2.9E+03	9.2E+00	3.5E-01	2.6E-01	2.5E-01	1.3E-01	1.1E-01	5.6E-02	3.1E-02	2.6E-02
371.3	5.1E+03	1.6E+01	6.0E-01	4.6E-01	4.4E-01	2.3E-01	2.0E-01	9.7E-02	5.4E-02	4.5E-02
386.3	8.1E+03	2.5E+01	9.6E-01	7.2E-01	7.0E-01	3.6E-01	3.1E-01	1.5E-01	8.5E-02	7.2E-02
401.3	8.9E+03	2.8E+01	1.1E+00	8.0E-01	7.7E-01	3.9E-01	3.5E-01	1.7E-01	9.4E-02	7.9E-02
401.3	8.9E+03	2.8E+01	1.1E+00	8.0E-01	7.7E-01	3.9E-01	3.5E-01	1.7E-01	9.4E-02	7.9E-02
406.1	8.9E+03	2.8E+01	1.1E+00	8.0E-01	7.8E-01	3.9E-01	3.5E-01	1.7E-01	9.4E-02	7.9E-02
421.1	8.9E+03	2.8E+01	1.1E+00	8.0E-01	7.8E-01	3.9E-01	3.5E-01	1.7E-01	9.4E-02	8.0E-02
436.1	9.0E+03	2.8E+01	1.1E+00	8.0E-01	7.8E-01	4.0E-01	3.5E-01	1.7E-01	9.4E-02	8.0E-02
451.1	9.0E+03	2.8E+01	1.1E+00	8.0E-01	7.8E-01	4.0E-01	3.5E-01	1.7E-01	9.4E-02	8.0E-02
466.1	9.0E+03	2.8E+01	1.1E+00	8.0E-01	7.8E-01	4.0E-01	3.5E-01	1.7E-01	9.4E-02	8.0E-02
481.1	9.0E+03	2.8E+01	1.1E+00	8.0E-01	7.8E-01	4.0E-01	3.5E-01	1.7E-01	9.4E-02	8.0E-02
496.1	9.0E+03	2.8E+01	1.1E+00	8.0E-01	7.8E-01	4.0E-01	3.5E-01	1.7E-01	9.4E-02	8.0E-02
511.1	9.0E+03	2.8E+01	1.1E+00	8.0E-01	7.8E-01	4.0E-01	3.5E-01	1.7E-01	9.4E-02	8.0E-02
526.1	8.9E+03	2.8E+01	1.1E+00	8.0E-01	7.7E-01	3.9E-01	3.5E-01	1.7E-01	9.4E-02	7.9E-02
541.1	8.9E+03	2.8E+01	1.0E+00	7.9E-01	7.7E-01	3.9E-01	3.4E-01	1.7E-01	9.3E-02	7.9E-02
556.1	8.8E+03	2.8E+01	1.0E+00	7.8E-01	7.6E-01	3.9E-01	3.4E-01	1.7E-01	9.2E-02	7.8E-02
571.1	8.7E+03	2.7E+01	1.0E+00	7.7E-01	7.5E-01	3.8E-01	3.4E-01	1.7E-01	9.1E-02	7.7E-02
586.1	8.4E+03	2.7E+01	1.0E+00	7.5E-01	7.3E-01	3.7E-01	3.3E-01	1.6E-01	8.9E-02	7.5E-02
601.1	8.1E+03	2.6E+01	9.6E-01	7.3E-01	7.1E-01	3.6E-01	3.2E-01	1.6E-01	8.5E-02	7.2E-02
616.1	7.7E+03	2.4E+01	9.1E-01	6.9E-01	6.7E-01	3.4E-01	3.0E-01	1.5E-01	8.1E-02	6.9E-02
631.1	7.1E+03	2.2E+01	8.4E-01	6.4E-01	6.2E-01	3.1E-01	2.8E-01	1.4E-01	7.5E-02	6.3E-02
646.1	6.4E+03	2.0E+01	7.5E-01	5.7E-01	5.5E-01	2.8E-01	2.5E-01	1.2E-01	6.7E-02	5.6E-02
661.1	5.4E+03	1.7E+01	6.4E-01	4.8E-01	4.7E-01	2.4E-01	2.1E-01	1.0E-01	5.7E-02	4.8E-02
676.1	4.2E+03	1.3E+01	5.0E-01	3.7E-01	3.6E-01	1.9E-01	1.6E-01	8.0E-02	4.4E-02	3.7E-02
691.1	2.7E+03	8.7E+00	3.2E-01	2.5E-01	2.4E-01	1.2E-01	1.1E-01	5.2E-02	2.9E-02	2.4E-02
706.1	2.2E+03	7.0E+00	2.6E-01	2.0E-01	1.9E-01	9.8E-02	8.7E-02	4.3E-02	2.3E-02	2.0E-02
706.1	2.2E+03	7.0E+00	2.6E-01	2.0E-01	1.9E-01	9.8E-02	8.7E-02	4.3E-02	2.3E-02	2.0E-02
707.6	2.9E+03	9.2E+00	3.5E-01	2.6E-01	2.5E-01	1.3E-01	1.1E-01	5.6E-02	3.1E-02	2.6E-02

Table C-29. Air Concentration Estimates for Excavation in Bay D – Bounding Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
722.6	3.9E+03	1.2E+01	4.6E-01	3.5E-01	3.4E-01	1.7E-01	1.5E-01	7.4E-02	4.1E-02	3.5E-02
737.6	5.2E+03	1.6E+01	6.1E-01	4.6E-01	4.5E-01	2.3E-01	2.0E-01	9.9E-02	5.4E-02	4.6E-02
752.6	6.7E+03	2.1E+01	8.0E-01	6.0E-01	5.8E-01	3.0E-01	2.6E-01	1.3E-01	7.1E-02	6.0E-02
767.6	8.3E+03	2.6E+01	9.8E-01	7.4E-01	7.2E-01	3.7E-01	3.2E-01	1.6E-01	8.7E-02	7.4E-02
782.6	9.0E+03	2.9E+01	1.1E+00	8.1E-01	7.8E-01	4.0E-01	3.5E-01	1.7E-01	9.5E-02	8.0E-02
797.6	9.1E+03	2.9E+01	1.1E+00	8.1E-01	7.9E-01	4.0E-01	3.5E-01	1.7E-01	9.5E-02	8.1E-02
797.6	9.1E+03	2.9E+01	1.1E+00	8.1E-01	7.9E-01	4.0E-01	3.5E-01	1.7E-01	9.5E-02	8.1E-02
800.0	8.8E+03	2.8E+01	1.0E+00	7.8E-01	7.6E-01	3.9E-01	3.4E-01	1.7E-01	9.2E-02	7.8E-02
815.0	8.4E+03	2.6E+01	9.9E-01	7.5E-01	7.3E-01	3.7E-01	3.3E-01	1.6E-01	8.8E-02	7.5E-02
830.0	7.9E+03	2.5E+01	9.4E-01	7.1E-01	6.9E-01	3.5E-01	3.1E-01	1.5E-01	8.3E-02	7.0E-02
845.0	7.3E+03	2.3E+01	8.6E-01	6.5E-01	6.3E-01	3.2E-01	2.8E-01	1.4E-01	7.7E-02	6.5E-02
860.0	6.5E+03	2.1E+01	7.7E-01	5.8E-01	5.7E-01	2.9E-01	2.5E-01	1.2E-01	6.9E-02	5.8E-02
875.0	5.6E+03	1.8E+01	6.6E-01	5.0E-01	4.8E-01	2.5E-01	2.2E-01	1.1E-01	5.9E-02	5.0E-02
890.0	4.5E+03	1.4E+01	5.3E-01	4.0E-01	3.9E-01	2.0E-01	1.7E-01	8.5E-02	4.7E-02	4.0E-02
905.0	3.2E+03	1.0E+01	3.7E-01	2.8E-01	2.7E-01	1.4E-01	1.2E-01	6.1E-02	3.3E-02	2.8E-02
920.0	1.7E+03	5.5E+00	2.1E-01	1.6E-01	1.5E-01	7.7E-02	6.8E-02	3.3E-02	1.8E-02	1.6E-02
935.0	2.4E+02	7.7E-01	2.9E-02	2.2E-02	2.1E-02	1.1E-02	9.4E-03	4.7E-03	2.6E-03	2.2E-03

Table C-30. Air Concentration Estimates for Excavation in Bays A, B, C and D Concurrently – Bounding Meteorology at Receptor Locations

Depth	Emissions (500 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
		ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	6.8E-03	2.6E-04	1.9E-04	1.9E-04	9.6E-05	8.4E-05	4.1E-05	2.3E-05	1.9E-05
0.7	6.2E-03	2.3E-04	1.7E-04	1.7E-04	8.6E-05	7.6E-05	3.7E-05	2.0E-05	1.7E-05
15.7	4.7E-03	1.8E-04	1.3E-04	1.3E-04	6.6E-05	5.8E-05	2.8E-05	1.6E-05	1.3E-05
30.7	2.3E-03	8.7E-05	6.6E-05	6.4E-05	3.3E-05	2.9E-05	1.4E-05	7.7E-06	6.5E-06
45.7	2.2E-03	8.2E-05	6.2E-05	6.0E-05	3.1E-05	2.7E-05	1.3E-05	7.3E-06	6.2E-06
45.7	2.2E-03	8.2E-05	6.2E-05	6.0E-05	3.1E-05	2.7E-05	1.3E-05	7.3E-06	6.2E-06
47.2	2.8E-03	1.0E-04	7.9E-05	7.6E-05	3.9E-05	3.4E-05	1.7E-05	9.2E-06	7.8E-06
62.2	5.3E-03	2.0E-04	1.5E-04	1.5E-04	7.4E-05	6.5E-05	3.2E-05	1.8E-05	1.5E-05
77.2	1.7E-02	6.2E-04	4.7E-04	4.6E-04	2.3E-04	2.0E-04	1.0E-04	5.5E-05	4.7E-05
92.2	7.1E-02	2.7E-03	2.0E-03	2.0E-03	1.0E-03	8.7E-04	4.3E-04	2.4E-04	2.0E-04
107.2	3.9E-01	1.5E-02	1.1E-02	1.1E-02	5.4E-03	4.8E-03	2.3E-03	1.3E-03	1.1E-03
122.2	2.8E+00	1.0E-01	7.9E-02	7.6E-02	3.9E-02	3.4E-02	1.7E-02	9.2E-03	7.8E-03
137.2	2.9E+00	1.1E-01	8.2E-02	8.0E-02	4.1E-02	3.6E-02	1.8E-02	9.6E-03	8.2E-03
137.2	2.9E+00	1.1E-01	8.2E-02	8.0E-02	4.1E-02	3.6E-02	1.8E-02	9.6E-03	8.2E-03
146.3	4.1E+00	1.5E-01	1.2E-01	1.1E-01	5.8E-02	5.1E-02	2.5E-02	1.4E-02	1.2E-02
161.3	5.9E+00	2.2E-01	1.7E-01	1.6E-01	8.3E-02	7.2E-02	3.6E-02	2.0E-02	1.7E-02
176.3	8.5E+00	3.2E-01	2.4E-01	2.3E-01	1.2E-01	1.0E-01	5.1E-02	2.8E-02	2.4E-02
191.3	1.2E+01	4.6E-01	3.5E-01	3.4E-01	1.7E-01	1.5E-01	7.4E-02	4.1E-02	3.5E-02
206.3	1.8E+01	6.7E-01	5.0E-01	4.9E-01	2.5E-01	2.2E-01	1.1E-01	5.9E-02	5.0E-02
221.3	2.6E+01	9.7E-01	7.3E-01	7.1E-01	3.6E-01	3.2E-01	1.6E-01	8.6E-02	7.3E-02
236.3	3.8E+01	1.4E+00	1.1E+00	1.0E+00	5.3E-01	4.7E-01	2.3E-01	1.3E-01	1.1E-01
251.3	5.7E+01	2.1E+00	1.6E+00	1.6E+00	8.0E-01	7.0E-01	3.4E-01	1.9E-01	1.6E-01
266.3	8.6E+01	3.2E+00	2.4E+00	2.4E+00	1.2E+00	1.1E+00	5.2E-01	2.9E-01	2.4E-01
281.3	1.3E+02	5.0E+00	3.8E+00	3.7E+00	1.9E+00	1.6E+00	8.1E-01	4.5E-01	3.8E-01
296.3	2.2E+02	8.1E+00	6.1E+00	5.9E+00	3.0E+00	2.7E+00	1.3E+00	7.2E-01	6.1E-01

Table C-30. Air Concentration Estimates for Excavation in Bays A, B, C and D Concurrently – Bounding Meteorology at Receptor Locations (continued)

Depth	Emissions (500 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
		ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
311.3	3.6E+02	1.3E+01	1.0E+01	9.9E+00	5.0E+00	4.4E+00	2.2E+00	1.2E+00	1.0E+00
326.3	5.9E+02	2.2E+01	1.7E+01	1.6E+01	8.3E+00	7.3E+00	3.6E+00	2.0E+00	1.7E+00
341.3	8.1E+02	3.0E+01	2.3E+01	2.2E+01	1.1E+01	1.0E+01	4.9E+00	2.7E+00	2.3E+00
356.3	9.5E+02	3.5E+01	2.7E+01	2.6E+01	1.3E+01	1.2E+01	5.7E+00	3.1E+00	2.7E+00
371.3	1.0E+03	3.8E+01	2.9E+01	2.8E+01	1.4E+01	1.3E+01	6.2E+00	3.4E+00	2.9E+00
386.3	1.1E+03	4.0E+01	3.0E+01	2.9E+01	1.5E+01	1.3E+01	6.4E+00	3.5E+00	3.0E+00
401.3	1.1E+03	4.1E+01	3.1E+01	3.0E+01	1.5E+01	1.3E+01	6.6E+00	3.6E+00	3.1E+00
401.3	1.1E+03	4.1E+01	3.1E+01	3.0E+01	1.5E+01	1.3E+01	6.6E+00	3.6E+00	3.1E+00
406.1	1.1E+03	4.1E+01	3.1E+01	3.0E+01	1.5E+01	1.3E+01	6.6E+00	3.6E+00	3.1E+00
421.1	1.1E+03	4.2E+01	3.1E+01	3.0E+01	1.5E+01	1.4E+01	6.7E+00	3.7E+00	3.1E+00
436.1	1.1E+03	4.2E+01	3.2E+01	3.1E+01	1.6E+01	1.4E+01	6.9E+00	3.8E+00	3.2E+00
451.1	1.2E+03	4.3E+01	3.3E+01	3.2E+01	1.6E+01	1.4E+01	7.0E+00	3.8E+00	3.2E+00
466.1	1.2E+03	4.3E+01	3.3E+01	3.2E+01	1.6E+01	1.4E+01	7.0E+00	3.8E+00	3.3E+00
481.1	1.2E+03	4.5E+01	3.4E+01	3.3E+01	1.7E+01	1.5E+01	7.3E+00	4.0E+00	3.4E+00
496.1	1.2E+03	4.6E+01	3.5E+01	3.4E+01	1.7E+01	1.5E+01	7.5E+00	4.1E+00	3.5E+00
511.1	1.3E+03	4.8E+01	3.6E+01	3.5E+01	1.8E+01	1.6E+01	7.7E+00	4.2E+00	3.6E+00
526.1	1.3E+03	4.9E+01	3.7E+01	3.6E+01	1.8E+01	1.6E+01	8.0E+00	4.4E+00	3.7E+00
541.1	1.4E+03	5.1E+01	3.9E+01	3.8E+01	1.9E+01	1.7E+01	8.3E+00	4.6E+00	3.9E+00
556.1	1.4E+03	5.4E+01	4.0E+01	3.9E+01	2.0E+01	1.8E+01	8.7E+00	4.8E+00	4.0E+00
571.1	1.5E+03	5.6E+01	4.2E+01	4.1E+01	2.1E+01	1.8E+01	9.0E+00	5.0E+00	4.2E+00
586.1	1.6E+03	5.8E+01	4.4E+01	4.3E+01	2.2E+01	1.9E+01	9.4E+00	5.2E+00	4.4E+00
601.1	1.6E+03	6.1E+01	4.6E+01	4.5E+01	2.3E+01	2.0E+01	9.8E+00	5.4E+00	4.6E+00
616.1	1.7E+03	6.3E+01	4.8E+01	4.6E+01	2.4E+01	2.1E+01	1.0E+01	5.6E+00	4.8E+00
631.1	1.7E+03	6.5E+01	4.9E+01	4.8E+01	2.4E+01	2.1E+01	1.1E+01	5.8E+00	4.9E+00
646.1	1.8E+03	6.6E+01	5.0E+01	4.8E+01	2.5E+01	2.2E+01	1.1E+01	5.8E+00	4.9E+00
661.1	1.7E+03	6.6E+01	4.9E+01	4.8E+01	2.4E+01	2.2E+01	1.1E+01	5.8E+00	4.9E+00
676.1	1.7E+03	6.5E+01	4.9E+01	4.8E+01	2.4E+01	2.1E+01	1.1E+01	5.8E+00	4.9E+00
691.1	1.7E+03	6.5E+01	4.9E+01	4.8E+01	2.4E+01	2.1E+01	1.0E+01	5.8E+00	4.9E+00
706.1	1.7E+03	6.5E+01	4.9E+01	4.7E+01	2.4E+01	2.1E+01	1.0E+01	5.7E+00	4.9E+00
706.1	1.7E+03	6.5E+01	4.9E+01	4.7E+01	2.4E+01	2.1E+01	1.0E+01	5.7E+00	4.9E+00

Table C-30. Air Concentration Estimates for Excavation in Bays A, B, C and D Concurrently – Bounding Meteorology at Receptor Locations (continued)

Depth	Emissions (500 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
		ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
707.6	1.7E+03	6.5E+01	4.9E+01	4.8E+01	2.4E+01	2.1E+01	1.0E+01	5.8E+00	4.9E+00
722.6	1.7E+03	6.5E+01	4.9E+01	4.8E+01	2.4E+01	2.1E+01	1.0E+01	5.8E+00	4.9E+00
737.6	1.7E+03	6.5E+01	4.9E+01	4.8E+01	2.4E+01	2.1E+01	1.1E+01	5.8E+00	4.9E+00
752.6	1.7E+03	6.5E+01	4.9E+01	4.8E+01	2.4E+01	2.1E+01	1.0E+01	5.8E+00	4.9E+00
767.6	1.7E+03	6.4E+01	4.9E+01	4.7E+01	2.4E+01	2.1E+01	1.0E+01	5.7E+00	4.8E+00
782.6	1.7E+03	6.3E+01	4.8E+01	4.6E+01	2.4E+01	2.1E+01	1.0E+01	5.6E+00	4.7E+00
797.6	1.6E+03	6.0E+01	4.5E+01	4.4E+01	2.2E+01	2.0E+01	9.7E+00	5.3E+00	4.5E+00
797.6	1.6E+03	6.0E+01	4.5E+01	4.4E+01	2.2E+01	2.0E+01	9.7E+00	5.3E+00	4.5E+00
800.0	1.6E+03	6.0E+01	4.5E+01	4.4E+01	2.2E+01	2.0E+01	9.7E+00	5.3E+00	4.5E+00
815.0	1.4E+03	5.4E+01	4.1E+01	4.0E+01	2.0E+01	1.8E+01	8.8E+00	4.8E+00	4.1E+00
830.0	1.2E+03	4.5E+01	3.4E+01	3.3E+01	1.7E+01	1.5E+01	7.2E+00	4.0E+00	3.4E+00
845.0	7.9E+02	3.0E+01	2.2E+01	2.2E+01	1.1E+01	9.7E+00	4.8E+00	2.6E+00	2.2E+00
860.0	2.5E+02	9.5E+00	7.2E+00	7.0E+00	3.6E+00	3.1E+00	1.5E+00	8.5E-01	7.2E-01
875.0	3.5E+01	1.3E+00	1.0E+00	9.7E-01	4.9E-01	4.3E-01	2.1E-01	1.2E-01	9.9E-02
890.0	2.8E+01	1.1E+00	8.0E-01	7.7E-01	3.9E-01	3.5E-01	1.7E-01	9.4E-02	7.9E-02
905.0	2.0E+01	7.5E-01	5.7E-01	5.5E-01	2.8E-01	2.5E-01	1.2E-01	6.7E-02	5.6E-02
920.0	1.1E+01	4.1E-01	3.1E-01	3.0E-01	1.5E-01	1.4E-01	6.7E-02	3.7E-02	3.1E-02
935.0	1.5E+00	5.8E-02	4.3E-02	4.2E-02	2.1E-02	1.9E-02	9.3E-03	5.1E-03	4.3E-03

Table C-31. Air Concentration Estimates for Wall Collapse in Bay A – Bounding Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (69 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.4E-01	9.6E-04	3.6E-05	2.7E-05	2.6E-05	1.3E-05	1.2E-05	5.8E-06	3.2E-06	2.7E-06
0.7	4.0E-01	8.7E-04	3.3E-05	2.5E-05	2.4E-05	1.2E-05	1.1E-05	5.3E-06	2.9E-06	2.4E-06
15.7	3.1E-01	6.7E-04	2.5E-05	1.9E-05	1.9E-05	9.4E-06	8.3E-06	4.1E-06	2.2E-06	1.9E-06
30.7	1.6E-01	3.6E-04	1.3E-05	1.0E-05	9.8E-06	5.0E-06	4.4E-06	2.2E-06	1.2E-06	1.0E-06
45.7	1.5E-01	3.4E-04	1.3E-05	9.5E-06	9.3E-06	4.7E-06	4.1E-06	2.0E-06	1.1E-06	9.5E-07
45.7	1.5E-01	3.4E-04	1.3E-05	9.5E-06	9.3E-06	4.7E-06	4.1E-06	2.0E-06	1.1E-06	9.5E-07
47.2	2.5E-01	5.3E-04	2.0E-05	1.5E-05	1.5E-05	7.5E-06	6.6E-06	3.2E-06	1.8E-06	1.5E-06
62.2	6.4E-01	1.4E-03	5.2E-05	4.0E-05	3.8E-05	2.0E-05	1.7E-05	8.5E-06	4.7E-06	3.9E-06
77.2	2.5E+00	5.4E-03	2.0E-04	1.5E-04	1.5E-04	7.6E-05	6.7E-05	3.3E-05	1.8E-05	1.5E-05
92.2	1.2E+01	2.6E-02	9.9E-04	7.4E-04	7.2E-04	3.7E-04	3.2E-04	1.6E-04	8.8E-05	7.4E-05
107.2	7.8E+01	1.7E-01	6.3E-03	4.8E-03	4.6E-03	2.4E-03	2.1E-03	1.0E-03	5.6E-04	4.8E-04
122.2	6.9E+02	1.5E+00	5.6E-02	4.3E-02	4.1E-02	2.1E-02	1.8E-02	9.1E-03	5.0E-03	4.2E-03
137.2	7.2E+02	1.6E+00	5.9E-02	4.5E-02	4.3E-02	2.2E-02	1.9E-02	9.5E-03	5.2E-03	4.4E-03
137.2	7.2E+02	1.6E+00	5.9E-02	4.5E-02	4.3E-02	2.2E-02	1.9E-02	9.5E-03	5.2E-03	4.4E-03
140.5	1.0E+03	2.3E+00	8.5E-02	6.4E-02	6.2E-02	3.2E-02	2.8E-02	1.4E-02	7.5E-03	6.4E-03
155.5	1.5E+03	3.2E+00	1.2E-01	9.2E-02	8.9E-02	4.5E-02	4.0E-02	2.0E-02	1.1E-02	9.2E-03
170.5	2.2E+03	4.7E+00	1.8E-01	1.3E-01	1.3E-01	6.6E-02	5.8E-02	2.8E-02	1.6E-02	1.3E-02
185.5	3.1E+03	6.8E+00	2.5E-01	1.9E-01	1.9E-01	9.5E-02	8.3E-02	4.1E-02	2.3E-02	1.9E-02
200.5	4.5E+03	9.8E+00	3.7E-01	2.8E-01	2.7E-01	1.4E-01	1.2E-01	6.0E-02	3.3E-02	2.8E-02
215.5	6.6E+03	1.4E+01	5.4E-01	4.1E-01	3.9E-01	2.0E-01	1.8E-01	8.7E-02	4.8E-02	4.0E-02
230.5	9.7E+03	2.1E+01	7.9E-01	6.0E-01	5.8E-01	3.0E-01	2.6E-01	1.3E-01	7.0E-02	5.9E-02
245.5	1.4E+04	3.1E+01	1.2E+00	8.9E-01	8.6E-01	4.4E-01	3.9E-01	1.9E-01	1.0E-01	8.9E-02
260.5	2.2E+04	4.8E+01	1.8E+00	1.4E+00	1.3E+00	6.7E-01	5.9E-01	2.9E-01	1.6E-01	1.3E-01
275.5	3.4E+04	7.5E+01	2.8E+00	2.1E+00	2.1E+00	1.0E+00	9.2E-01	4.5E-01	2.5E-01	2.1E-01
290.5	5.6E+04	1.2E+02	4.5E+00	3.4E+00	3.3E+00	1.7E+00	1.5E+00	7.3E-01	4.0E-01	3.4E-01
305.5	9.4E+04	2.0E+02	7.7E+00	5.8E+00	5.6E+00	2.9E+00	2.5E+00	1.2E+00	6.8E-01	5.8E-01

Table C-31. Air Concentration Estimates for Wall Collapse in Bay A – Bounding Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (69 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
320.5	1.6E+05	3.4E+02	1.3E+01	9.7E+00	9.4E+00	4.8E+00	4.2E+00	2.1E+00	1.1E+00	9.7E-01
335.5	2.2E+05	4.7E+02	1.8E+01	1.3E+01	1.3E+01	6.6E+00	5.8E+00	2.9E+00	1.6E+00	1.3E+00
350.5	2.2E+05	4.8E+02	1.8E+01	1.4E+01	1.3E+01	6.7E+00	5.9E+00	2.9E+00	1.6E+00	1.3E+00
350.5	2.2E+05	4.8E+02	1.8E+01	1.4E+01	1.3E+01	6.7E+00	5.9E+00	2.9E+00	1.6E+00	1.3E+00
351.0	2.5E+05	5.5E+02	2.1E+01	1.6E+01	1.5E+01	7.7E+00	6.8E+00	3.3E+00	1.8E+00	1.5E+00
366.0	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
381.0	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
381.0	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
388.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
403.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
418.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
433.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
448.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
463.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
478.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
493.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
508.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
523.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
538.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
553.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
568.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
583.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
598.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
613.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
628.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
643.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
658.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
673.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
688.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
703.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00

Table C-31. Air Concentration Estimates for Wall Collapse in Bay A – Bounding Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (69 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
718.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
733.7	2.7E+05	5.8E+02	2.2E+01	1.6E+01	1.6E+01	8.1E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
748.7	2.6E+05	5.7E+02	2.2E+01	1.6E+01	1.6E+01	8.0E+00	7.1E+00	3.5E+00	1.9E+00	1.6E+00
763.7	2.6E+05	5.7E+02	2.1E+01	1.6E+01	1.6E+01	8.0E+00	7.0E+00	3.4E+00	1.9E+00	1.6E+00
778.7	2.6E+05	5.6E+02	2.1E+01	1.6E+01	1.5E+01	7.8E+00	6.8E+00	3.4E+00	1.8E+00	1.6E+00
793.7	2.4E+05	5.3E+02	2.0E+01	1.5E+01	1.5E+01	7.4E+00	6.5E+00	3.2E+00	1.8E+00	1.5E+00
808.7	2.2E+05	4.9E+02	1.8E+01	1.4E+01	1.3E+01	6.8E+00	6.0E+00	2.9E+00	1.6E+00	1.4E+00
823.7	1.9E+05	4.1E+02	1.5E+01	1.1E+01	1.1E+01	5.7E+00	5.0E+00	2.5E+00	1.4E+00	1.1E+00
838.7	1.3E+05	2.8E+02	1.0E+01	7.8E+00	7.6E+00	3.9E+00	3.4E+00	1.7E+00	9.2E-01	7.8E-01
853.7	4.6E+04	1.0E+02	3.8E+00	2.9E+00	2.8E+00	1.4E+00	1.2E+00	6.1E-01	3.4E-01	2.9E-01

Table C-32. Air Concentration Estimates for Drilling in Bay A – Bounding Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (2.3 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.4E-01	3.2E-05	1.2E-06	9.0E-07	8.8E-07	4.5E-07	3.9E-07	1.9E-07	1.1E-07	9.0E-08
0.7	4.0E-01	2.9E-05	1.1E-06	8.2E-07	8.0E-07	4.0E-07	3.6E-07	1.8E-07	9.6E-08	8.2E-08
15.7	3.1E-01	2.2E-05	8.4E-07	6.4E-07	6.2E-07	3.1E-07	2.8E-07	1.4E-07	7.5E-08	6.3E-08
30.7	1.6E-01	1.2E-05	4.4E-07	3.4E-07	3.3E-07	1.7E-07	1.5E-07	7.2E-08	3.9E-08	3.3E-08
45.7	1.5E-01	1.1E-05	4.2E-07	3.2E-07	3.1E-07	1.6E-07	1.4E-07	6.8E-08	3.7E-08	3.2E-08
45.7	1.5E-01	1.1E-05	4.2E-07	3.2E-07	3.1E-07	1.6E-07	1.4E-07	6.8E-08	3.7E-08	3.2E-08
47.2	2.5E-01	1.8E-05	6.7E-07	5.0E-07	4.9E-07	2.5E-07	2.2E-07	1.1E-07	5.9E-08	5.0E-08
62.2	6.4E-01	4.7E-05	1.7E-06	1.3E-06	1.3E-06	6.5E-07	5.7E-07	2.8E-07	1.6E-07	1.3E-07
77.2	2.5E+00	1.8E-04	6.8E-06	5.1E-06	5.0E-06	2.5E-06	2.2E-06	1.1E-06	6.0E-07	5.1E-07
92.2	1.2E+01	8.8E-04	3.3E-05	2.5E-05	2.4E-05	1.2E-05	1.1E-05	5.3E-06	2.9E-06	2.5E-06
107.2	7.8E+01	5.6E-03	2.1E-04	1.6E-04	1.5E-04	7.9E-05	6.9E-05	3.4E-05	1.9E-05	1.6E-05
122.2	6.9E+02	5.0E-02	1.9E-03	1.4E-03	1.4E-03	7.0E-04	6.2E-04	3.0E-04	1.7E-04	1.4E-04
137.2	7.2E+02	5.2E-02	2.0E-03	1.5E-03	1.4E-03	7.3E-04	6.4E-04	3.2E-04	1.7E-04	1.5E-04
137.2	7.2E+02	5.2E-02	2.0E-03	1.5E-03	1.4E-03	7.3E-04	6.4E-04	3.2E-04	1.7E-04	1.5E-04
140.5	1.0E+03	7.5E-02	2.8E-03	2.1E-03	2.1E-03	1.1E-03	9.3E-04	4.6E-04	2.5E-04	2.1E-04
155.5	1.5E+03	1.1E-01	4.1E-03	3.1E-03	3.0E-03	1.5E-03	1.3E-03	6.6E-04	3.6E-04	3.1E-04
170.5	2.2E+03	1.6E-01	5.9E-03	4.4E-03	4.3E-03	2.2E-03	1.9E-03	9.5E-04	5.2E-04	4.4E-04
185.5	3.1E+03	2.3E-01	8.5E-03	6.4E-03	6.2E-03	3.2E-03	2.8E-03	1.4E-03	7.5E-04	6.4E-04
200.5	4.5E+03	3.3E-01	1.2E-02	9.3E-03	9.0E-03	4.6E-03	4.0E-03	2.0E-03	1.1E-03	9.2E-04
215.5	6.6E+03	4.8E-01	1.8E-02	1.4E-02	1.3E-02	6.7E-03	5.9E-03	2.9E-03	1.6E-03	1.3E-03
230.5	9.7E+03	7.0E-01	2.6E-02	2.0E-02	1.9E-02	9.8E-03	8.6E-03	4.3E-03	2.3E-03	2.0E-03
245.5	1.4E+04	1.0E+00	3.9E-02	3.0E-02	2.9E-02	1.5E-02	1.3E-02	6.3E-03	3.5E-03	3.0E-03
260.5	2.2E+04	1.6E+00	6.0E-02	4.5E-02	4.4E-02	2.2E-02	2.0E-02	9.6E-03	5.3E-03	4.5E-03
275.5	3.4E+04	2.5E+00	9.3E-02	7.0E-02	6.8E-02	3.5E-02	3.1E-02	1.5E-02	8.3E-03	7.0E-03
290.5	5.6E+04	4.0E+00	1.5E-01	1.1E-01	1.1E-01	5.6E-02	5.0E-02	2.4E-02	1.3E-02	1.1E-02
305.5	9.4E+04	6.8E+00	2.6E-01	1.9E-01	1.9E-01	9.5E-02	8.4E-02	4.1E-02	2.3E-02	1.9E-02

Table C-32. Air Concentration Estimates for Drilling in Bay A – Bounding Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (2.3 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
320.5	1.6E+05	1.1E+01	4.3E-01	3.2E-01	3.1E-01	1.6E-01	1.4E-01	6.9E-02	3.8E-02	3.2E-02
335.5	2.2E+05	1.6E+01	5.9E-01	4.5E-01	4.3E-01	2.2E-01	1.9E-01	9.5E-02	5.2E-02	4.4E-02
350.5	2.2E+05	1.6E+01	6.0E-01	4.5E-01	4.4E-01	2.2E-01	2.0E-01	9.7E-02	5.3E-02	4.5E-02
350.5	2.2E+05	1.6E+01	6.0E-01	4.5E-01	4.4E-01	2.2E-01	2.0E-01	9.7E-02	5.3E-02	4.5E-02
351.0	2.5E+05	1.8E+01	6.9E-01	5.2E-01	5.0E-01	2.6E-01	2.3E-01	1.1E-01	6.1E-02	5.2E-02
366.0	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
381.0	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
381.0	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
388.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
403.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
418.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
433.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
448.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
463.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
478.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
493.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
508.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
523.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
538.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
553.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
568.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
583.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
598.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
613.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
628.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
643.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.5E-02	5.5E-02
658.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.4E-02	5.5E-02
673.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.4E-02	5.5E-02
688.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.4E-02	5.5E-02
703.7	2.7E+05	1.9E+01	7.3E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.4E-02	5.5E-02

Table C-32. Air Concentration Estimates for Drilling in Bay A – Bounding Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (2.3 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
718.7	2.7E+05	1.9E+01	7.2E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.4E-02	5.4E-02
733.7	2.7E+05	1.9E+01	7.2E-01	5.5E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.4E-02	5.4E-02
748.7	2.6E+05	1.9E+01	7.2E-01	5.4E-01	5.3E-01	2.7E-01	2.4E-01	1.2E-01	6.4E-02	5.4E-02
763.7	2.6E+05	1.9E+01	7.1E-01	5.4E-01	5.2E-01	2.7E-01	2.3E-01	1.1E-01	6.3E-02	5.3E-02
778.7	2.6E+05	1.9E+01	6.9E-01	5.2E-01	5.1E-01	2.6E-01	2.3E-01	1.1E-01	6.2E-02	5.2E-02
793.7	2.4E+05	1.8E+01	6.6E-01	5.0E-01	4.9E-01	2.5E-01	2.2E-01	1.1E-01	5.9E-02	5.0E-02
808.7	2.2E+05	1.6E+01	6.1E-01	4.6E-01	4.5E-01	2.3E-01	2.0E-01	9.8E-02	5.4E-02	4.6E-02
823.7	1.9E+05	1.4E+01	5.1E-01	3.8E-01	3.7E-01	1.9E-01	1.7E-01	8.2E-02	4.5E-02	3.8E-02
838.7	1.3E+05	9.2E+00	3.5E-01	2.6E-01	2.5E-01	1.3E-01	1.1E-01	5.6E-02	3.1E-02	2.6E-02
853.7	4.6E+04	3.4E+00	1.3E-01	9.5E-02	9.3E-02	4.7E-02	4.1E-02	2.0E-02	1.1E-02	9.5E-03

Table C-33. Air Concentration Estimates for Burrowing in Bay A – Bounding Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (0.53 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.4E-01	7.3E-06	2.8E-07	2.1E-07	2.0E-07	1.0E-07	9.0E-08	4.4E-08	2.4E-08	2.1E-08
0.7	4.0E-01	6.7E-06	2.5E-07	1.9E-07	1.8E-07	9.3E-08	8.2E-08	4.0E-08	2.2E-08	1.9E-08
15.7	3.1E-01	5.2E-06	1.9E-07	1.5E-07	1.4E-07	7.2E-08	6.4E-08	3.1E-08	1.7E-08	1.5E-08
30.7	1.6E-01	2.7E-06	1.0E-07	7.7E-08	7.5E-08	3.8E-08	3.4E-08	1.7E-08	9.1E-09	7.7E-09
45.7	1.5E-01	2.6E-06	9.7E-08	7.3E-08	7.1E-08	3.6E-08	3.2E-08	1.6E-08	8.6E-09	7.3E-09
45.7	1.5E-01	2.6E-06	9.7E-08	7.3E-08	7.1E-08	3.6E-08	3.2E-08	1.6E-08	8.6E-09	7.3E-09
47.2	2.5E-01	4.1E-06	1.5E-07	1.2E-07	1.1E-07	5.7E-08	5.0E-08	2.5E-08	1.4E-08	1.2E-08
62.2	6.4E-01	1.1E-05	4.0E-07	3.0E-07	3.0E-07	1.5E-07	1.3E-07	6.5E-08	3.6E-08	3.0E-08
77.2	2.5E+00	4.2E-05	1.6E-06	1.2E-06	1.1E-06	5.8E-07	5.1E-07	2.5E-07	1.4E-07	1.2E-07
92.2	1.2E+01	2.0E-04	7.6E-06	5.7E-06	5.6E-06	2.8E-06	2.5E-06	1.2E-06	6.7E-07	5.7E-07
107.2	7.8E+01	1.3E-03	4.9E-05	3.7E-05	3.6E-05	1.8E-05	1.6E-05	7.9E-06	4.3E-06	3.7E-06
122.2	6.9E+02	1.2E-02	4.3E-04	3.3E-04	3.2E-04	1.6E-04	1.4E-04	7.0E-05	3.8E-05	3.3E-05
137.2	7.2E+02	1.2E-02	4.5E-04	3.4E-04	3.3E-04	1.7E-04	1.5E-04	7.3E-05	4.0E-05	3.4E-05
137.2	7.2E+02	1.2E-02	4.5E-04	3.4E-04	3.3E-04	1.7E-04	1.5E-04	7.3E-05	4.0E-05	3.4E-05
140.5	1.0E+03	1.7E-02	6.5E-04	4.9E-04	4.8E-04	2.4E-04	2.1E-04	1.1E-04	5.8E-05	4.9E-05
155.5	1.5E+03	2.5E-02	9.4E-04	7.1E-04	6.9E-04	3.5E-04	3.1E-04	1.5E-04	8.3E-05	7.0E-05
170.5	2.2E+03	3.6E-02	1.3E-03	1.0E-03	9.9E-04	5.0E-04	4.4E-04	2.2E-04	1.2E-04	1.0E-04
185.5	3.1E+03	5.2E-02	1.9E-03	1.5E-03	1.4E-03	7.3E-04	6.4E-04	3.1E-04	1.7E-04	1.5E-04
200.5	4.5E+03	7.5E-02	2.8E-03	2.1E-03	2.1E-03	1.1E-03	9.3E-04	4.6E-04	2.5E-04	2.1E-04
215.5	6.6E+03	1.1E-01	4.1E-03	3.1E-03	3.0E-03	1.5E-03	1.4E-03	6.7E-04	3.7E-04	3.1E-04
230.5	9.7E+03	1.6E-01	6.1E-03	4.6E-03	4.5E-03	2.3E-03	2.0E-03	9.8E-04	5.4E-04	4.6E-04
245.5	1.4E+04	2.4E-01	9.1E-03	6.8E-03	6.6E-03	3.4E-03	3.0E-03	1.5E-03	8.0E-04	6.8E-04
260.5	2.2E+04	3.7E-01	1.4E-02	1.0E-02	1.0E-02	5.1E-03	4.5E-03	2.2E-03	1.2E-03	1.0E-03
275.5	3.4E+04	5.7E-01	2.1E-02	1.6E-02	1.6E-02	8.0E-03	7.0E-03	3.5E-03	1.9E-03	1.6E-03
290.5	5.6E+04	9.3E-01	3.5E-02	2.6E-02	2.6E-02	1.3E-02	1.1E-02	5.6E-03	3.1E-03	2.6E-03
305.5	9.4E+04	1.6E+00	5.9E-02	4.4E-02	4.3E-02	2.2E-02	1.9E-02	9.5E-03	5.2E-03	4.4E-03

Table C-33. Air Concentration Estimates for Burrowing in Bay A – Bounding Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (0.53 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
320.5	1.6E+05	2.6E+00	9.9E-02	7.5E-02	7.2E-02	3.7E-02	3.2E-02	1.6E-02	8.8E-03	7.4E-03
335.5	2.2E+05	3.6E+00	1.4E-01	1.0E-01	1.0E-01	5.1E-02	4.5E-02	2.2E-02	1.2E-02	1.0E-02
350.5	2.2E+05	3.7E+00	1.4E-01	1.0E-01	1.0E-01	5.1E-02	4.5E-02	2.2E-02	1.2E-02	1.0E-02
350.5	2.2E+05	3.7E+00	1.4E-01	1.0E-01	1.0E-01	5.1E-02	4.5E-02	2.2E-02	1.2E-02	1.0E-02
351.0	2.5E+05	4.2E+00	1.6E-01	1.2E-01	1.2E-01	5.9E-02	5.2E-02	2.6E-02	1.4E-02	1.2E-02
366.0	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
381.0	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
381.0	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
388.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
403.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
418.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
433.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
448.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
463.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
478.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
493.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
508.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
523.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
538.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
553.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
568.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
583.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
598.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
613.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
628.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
643.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
658.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
673.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
688.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
703.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02

Table C-33. Air Concentration Estimates for Burrowing in Bay A – Bounding Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (0.53 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
718.7	2.7E+05	4.5E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
733.7	2.7E+05	4.4E+00	1.7E-01	1.3E-01	1.2E-01	6.2E-02	5.5E-02	2.7E-02	1.5E-02	1.3E-02
748.7	2.6E+05	4.4E+00	1.7E-01	1.2E-01	1.2E-01	6.2E-02	5.4E-02	2.7E-02	1.5E-02	1.2E-02
763.7	2.6E+05	4.4E+00	1.6E-01	1.2E-01	1.2E-01	6.1E-02	5.4E-02	2.6E-02	1.5E-02	1.2E-02
778.7	2.6E+05	4.3E+00	1.6E-01	1.2E-01	1.2E-01	6.0E-02	5.2E-02	2.6E-02	1.4E-02	1.2E-02
793.7	2.4E+05	4.1E+00	1.5E-01	1.2E-01	1.1E-01	5.7E-02	5.0E-02	2.5E-02	1.4E-02	1.2E-02
808.7	2.2E+05	3.7E+00	1.4E-01	1.1E-01	1.0E-01	5.2E-02	4.6E-02	2.3E-02	1.2E-02	1.1E-02
823.7	1.9E+05	3.1E+00	1.2E-01	8.8E-02	8.6E-02	4.4E-02	3.8E-02	1.9E-02	1.0E-02	8.8E-03
838.7	1.3E+05	2.1E+00	8.0E-02	6.0E-02	5.9E-02	3.0E-02	2.6E-02	1.3E-02	7.1E-03	6.0E-03
853.7	4.6E+04	7.8E-01	2.9E-02	2.2E-02	2.1E-02	1.1E-02	9.6E-03	4.7E-03	2.6E-03	2.2E-03

Typical Meterology at Receptor Locations

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Table C-34. Air Concentration Estimates for Excavation in Bay A – Typical Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.4E-01	1.4E-03	3.8E-06	2.8E-06	2.7E-06	1.3E-06	1.2E-06	5.3E-07	2.7E-07	2.3E-07
0.7	4.0E-01	1.3E-03	3.4E-06	2.5E-06	2.5E-06	1.2E-06	1.1E-06	4.8E-07	2.5E-07	2.1E-07
15.7	3.1E-01	9.8E-04	2.7E-06	2.0E-06	1.9E-06	9.3E-07	8.2E-07	3.7E-07	1.9E-07	1.6E-07
30.7	1.6E-01	5.2E-04	1.4E-06	1.0E-06	1.0E-06	4.9E-07	4.3E-07	2.0E-07	1.0E-07	8.5E-08
45.7	1.5E-01	4.9E-04	1.3E-06	9.9E-07	9.6E-07	4.6E-07	4.1E-07	1.9E-07	9.6E-08	8.0E-08
45.7	1.5E-01	4.9E-04	1.3E-06	9.9E-07	9.6E-07	4.6E-07	4.1E-07	1.9E-07	9.6E-08	8.0E-08
47.2	2.5E-01	7.7E-04	2.1E-06	1.6E-06	1.5E-06	7.3E-07	6.5E-07	3.0E-07	1.5E-07	1.3E-07
62.2	6.4E-01	2.0E-03	5.5E-06	4.1E-06	4.0E-06	1.9E-06	1.7E-06	7.7E-07	4.0E-07	3.3E-07
77.2	2.5E+00	7.8E-03	2.1E-05	1.6E-05	1.5E-05	7.4E-06	6.6E-06	3.0E-06	1.5E-06	1.3E-06
92.2	1.2E+01	3.8E-02	1.0E-04	7.7E-05	7.5E-05	3.6E-05	3.2E-05	1.5E-05	7.5E-06	6.3E-06
107.2	7.8E+01	2.4E-01	6.7E-04	4.9E-04	4.8E-04	2.3E-04	2.1E-04	9.3E-05	4.8E-05	4.0E-05
122.2	6.9E+02	2.2E+00	5.9E-03	4.4E-03	4.3E-03	2.1E-03	1.8E-03	8.3E-04	4.3E-04	3.6E-04
137.2	7.2E+02	2.3E+00	6.2E-03	4.6E-03	4.5E-03	2.2E-03	1.9E-03	8.7E-04	4.5E-04	3.7E-04
137.2	7.2E+02	2.3E+00	6.2E-03	4.6E-03	4.5E-03	2.2E-03	1.9E-03	8.7E-04	4.5E-04	3.7E-04
140.5	1.0E+03	3.3E+00	8.9E-03	6.6E-03	6.4E-03	3.1E-03	2.7E-03	1.2E-03	6.4E-04	5.4E-04
155.5	1.5E+03	4.7E+00	1.3E-02	9.5E-03	9.2E-03	4.5E-03	3.9E-03	1.8E-03	9.3E-04	7.7E-04
170.5	2.2E+03	6.8E+00	1.8E-02	1.4E-02	1.3E-02	6.4E-03	5.7E-03	2.6E-03	1.3E-03	1.1E-03
185.5	3.1E+03	9.8E+00	2.7E-02	2.0E-02	1.9E-02	9.3E-03	8.2E-03	3.7E-03	1.9E-03	1.6E-03
200.5	4.5E+03	1.4E+01	3.9E-02	2.9E-02	2.8E-02	1.4E-02	1.2E-02	5.4E-03	2.8E-03	2.3E-03
215.5	6.6E+03	2.1E+01	5.6E-02	4.2E-02	4.1E-02	2.0E-02	1.7E-02	7.9E-03	4.1E-03	3.4E-03
230.5	9.7E+03	3.1E+01	8.3E-02	6.2E-02	6.0E-02	2.9E-02	2.6E-02	1.2E-02	6.0E-03	5.0E-03
245.5	1.4E+04	4.6E+01	1.2E-01	9.2E-02	8.9E-02	4.3E-02	3.8E-02	1.7E-02	9.0E-03	7.5E-03
260.5	2.2E+04	6.9E+01	1.9E-01	1.4E-01	1.4E-01	6.6E-02	5.8E-02	2.6E-02	1.4E-02	1.1E-02
275.5	3.4E+04	1.1E+02	2.9E-01	2.2E-01	2.1E-01	1.0E-01	9.1E-02	4.1E-02	2.1E-02	1.8E-02
290.5	5.6E+04	1.8E+02	4.8E-01	3.5E-01	3.4E-01	1.7E-01	1.5E-01	6.7E-02	3.5E-02	2.9E-02
305.5	9.4E+04	3.0E+02	8.1E-01	6.0E-01	5.8E-01	2.8E-01	2.5E-01	1.1E-01	5.8E-02	4.9E-02
320.5	1.6E+05	5.0E+02	1.4E+00	1.0E+00	9.7E-01	4.7E-01	4.2E-01	1.9E-01	9.8E-02	8.2E-02
335.5	2.2E+05	6.8E+02	1.9E+00	1.4E+00	1.3E+00	6.5E-01	5.7E-01	2.6E-01	1.3E-01	1.1E-01
350.5	2.2E+05	6.9E+02	1.9E+00	1.4E+00	1.4E+00	6.6E-01	5.8E-01	2.6E-01	1.4E-01	1.1E-01
350.5	2.2E+05	6.9E+02	1.9E+00	1.4E+00	1.4E+00	6.6E-01	5.8E-01	2.6E-01	1.4E-01	1.1E-01

Table C-34. Air Concentration Estimates for Excavation in Bay A – Typical Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
351.0	2.5E+05	8.0E+02	2.2E+00	1.6E+00	1.6E+00	7.6E-01	6.7E-01	3.0E-01	1.6E-01	1.3E-01
366.0	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
381.0	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
381.0	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
388.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
403.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
418.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
433.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
448.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
463.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
478.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
493.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
508.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
523.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
538.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
553.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
568.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
583.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
598.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
613.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
628.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
643.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
658.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
673.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
688.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.6E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
703.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.6E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
718.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.6E+00	8.0E-01	7.0E-01	3.2E-01	1.7E-01	1.4E-01
733.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.6E+00	7.9E-01	7.0E-01	3.2E-01	1.6E-01	1.4E-01
748.7	2.6E+05	8.3E+02	2.3E+00	1.7E+00	1.6E+00	7.9E-01	7.0E-01	3.2E-01	1.6E-01	1.4E-01
763.7	2.6E+05	8.2E+02	2.2E+00	1.7E+00	1.6E+00	7.8E-01	6.9E-01	3.1E-01	1.6E-01	1.4E-01

Table C-34. Air Concentration Estimates for Excavation in Bay A – Typical Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
778.7	2.6E+05	8.0E+02	2.2E+00	1.6E+00	1.6E+00	7.6E-01	6.8E-01	3.1E-01	1.6E-01	1.3E-01
793.7	2.4E+05	7.7E+02	2.1E+00	1.6E+00	1.5E+00	7.3E-01	6.5E-01	2.9E-01	1.5E-01	1.3E-01
808.7	2.2E+05	7.0E+02	1.9E+00	1.4E+00	1.4E+00	6.7E-01	5.9E-01	2.7E-01	1.4E-01	1.2E-01
823.7	1.9E+05	5.9E+02	1.6E+00	1.2E+00	1.2E+00	5.6E-01	4.9E-01	2.2E-01	1.2E-01	9.6E-02
838.7	1.3E+05	4.0E+02	1.1E+00	8.1E-01	7.9E-01	3.8E-01	3.4E-01	1.5E-01	7.9E-02	6.6E-02
853.7	4.6E+04	1.5E+02	4.0E-01	3.0E-01	2.9E-01	1.4E-01	1.2E-01	5.6E-02	2.9E-02	2.4E-02

Table C-35. Air Concentration Estimates for Excavation in Bay B – Typical Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.5E-01	1.4E-03	3.8E-06	2.9E-06	2.8E-06	1.3E-06	1.2E-06	5.4E-07	2.8E-07	2.3E-07
0.7	4.1E-01	1.3E-03	3.5E-06	2.6E-06	2.5E-06	1.2E-06	1.1E-06	4.9E-07	2.5E-07	2.1E-07
15.7	3.2E-01	1.0E-03	2.7E-06	2.0E-06	2.0E-06	9.5E-07	8.4E-07	3.8E-07	2.0E-07	1.6E-07
30.7	1.6E-01	5.1E-04	1.4E-06	1.0E-06	1.0E-06	4.8E-07	4.3E-07	1.9E-07	1.0E-07	8.3E-08
45.7	1.5E-01	4.8E-04	1.3E-06	9.7E-07	9.5E-07	4.6E-07	4.0E-07	1.8E-07	9.5E-08	7.9E-08
45.7	1.5E-01	4.8E-04	1.3E-06	9.7E-07	9.5E-07	4.6E-07	4.0E-07	1.8E-07	9.5E-08	7.9E-08
47.2	2.4E-01	7.4E-04	2.0E-06	1.5E-06	1.5E-06	7.0E-07	6.2E-07	2.8E-07	1.5E-07	1.2E-07
62.2	5.8E-01	1.8E-03	5.0E-06	3.7E-06	3.6E-06	1.7E-06	1.5E-06	7.0E-07	3.6E-07	3.0E-07
77.2	2.0E+00	6.5E-03	1.8E-05	1.3E-05	1.3E-05	6.1E-06	5.4E-06	2.5E-06	1.3E-06	1.1E-06
92.2	8.2E+00	2.6E-02	7.0E-05	5.2E-05	5.1E-05	2.5E-05	2.2E-05	9.9E-06	5.1E-06	4.2E-06
107.2	3.3E+01	1.0E-01	2.8E-04	2.1E-04	2.0E-04	9.9E-05	8.7E-05	4.0E-05	2.0E-05	1.7E-05
122.2	8.2E+01	2.6E-01	7.0E-04	5.2E-04	5.1E-04	2.5E-04	2.2E-04	9.9E-05	5.1E-05	4.2E-05
137.2	8.3E+01	2.6E-01	7.1E-04	5.3E-04	5.1E-04	2.5E-04	2.2E-04	1.0E-04	5.1E-05	4.3E-05
137.2	8.3E+01	2.6E-01	7.1E-04	5.3E-04	5.1E-04	2.5E-04	2.2E-04	1.0E-04	5.1E-05	4.3E-05
140.5	1.2E+02	3.7E-01	1.0E-03	7.5E-04	7.3E-04	3.5E-04	3.1E-04	1.4E-04	7.4E-05	6.1E-05
155.5	1.7E+02	5.4E-01	1.5E-03	1.1E-03	1.1E-03	5.1E-04	4.5E-04	2.1E-04	1.1E-04	8.9E-05
170.5	2.5E+02	7.9E-01	2.1E-03	1.6E-03	1.5E-03	7.5E-04	6.6E-04	3.0E-04	1.6E-04	1.3E-04
185.5	3.7E+02	1.2E+00	3.2E-03	2.3E-03	2.3E-03	1.1E-03	9.7E-04	4.4E-04	2.3E-04	1.9E-04
200.5	5.4E+02	1.7E+00	4.7E-03	3.5E-03	3.4E-03	1.6E-03	1.4E-03	6.5E-04	3.4E-04	2.8E-04
215.5	8.1E+02	2.5E+00	6.9E-03	5.1E-03	5.0E-03	2.4E-03	2.1E-03	9.7E-04	5.0E-04	4.2E-04
230.5	1.2E+03	3.8E+00	1.0E-02	7.6E-03	7.4E-03	3.6E-03	3.2E-03	1.4E-03	7.4E-04	6.2E-04
245.5	1.8E+03	5.6E+00	1.5E-02	1.1E-02	1.1E-02	5.3E-03	4.7E-03	2.1E-03	1.1E-03	9.2E-04
260.5	2.6E+03	8.4E+00	2.3E-02	1.7E-02	1.6E-02	7.9E-03	7.0E-03	3.2E-03	1.6E-03	1.4E-03
275.5	3.9E+03	1.2E+01	3.4E-02	2.5E-02	2.4E-02	1.2E-02	1.0E-02	4.7E-03	2.4E-03	2.0E-03
290.5	5.7E+03	1.8E+01	4.9E-02	3.6E-02	3.5E-02	1.7E-02	1.5E-02	6.8E-03	3.5E-03	2.9E-03
305.5	7.9E+03	2.5E+01	6.8E-02	5.0E-02	4.9E-02	2.4E-02	2.1E-02	9.5E-03	4.9E-03	4.1E-03
320.5	1.0E+04	3.2E+01	8.7E-02	6.5E-02	6.3E-02	3.0E-02	2.7E-02	1.2E-02	6.3E-03	5.2E-03
335.5	1.1E+04	3.6E+01	9.8E-02	7.3E-02	7.1E-02	3.4E-02	3.0E-02	1.4E-02	7.1E-03	5.9E-03
350.5	1.1E+04	3.6E+01	9.8E-02	7.3E-02	7.1E-02	3.4E-02	3.0E-02	1.4E-02	7.1E-03	5.9E-03
350.5	1.1E+04	3.6E+01	9.8E-02	7.3E-02	7.1E-02	3.4E-02	3.0E-02	1.4E-02	7.1E-03	5.9E-03

Table C-35. Air Concentration Estimates for Excavation in Bay B – Typical Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
352.4	1.2E+04	3.7E+01	1.0E-01	7.5E-02	7.3E-02	3.5E-02	3.1E-02	1.4E-02	7.3E-03	6.1E-03
367.4	1.2E+04	3.8E+01	1.0E-01	7.7E-02	7.4E-02	3.6E-02	3.2E-02	1.5E-02	7.5E-03	6.2E-03
382.4	1.2E+04	3.8E+01	1.0E-01	7.8E-02	7.5E-02	3.7E-02	3.2E-02	1.5E-02	7.6E-03	6.3E-03
397.4	1.2E+04	3.8E+01	1.0E-01	7.8E-02	7.5E-02	3.6E-02	3.2E-02	1.5E-02	7.6E-03	6.3E-03
412.4	1.2E+04	3.8E+01	1.0E-01	7.6E-02	7.4E-02	3.6E-02	3.2E-02	1.4E-02	7.4E-03	6.2E-03
427.4	1.1E+04	3.6E+01	9.7E-02	7.2E-02	7.0E-02	3.4E-02	3.0E-02	1.4E-02	7.0E-03	5.8E-03
442.4	1.0E+04	3.2E+01	8.8E-02	6.5E-02	6.4E-02	3.1E-02	2.7E-02	1.2E-02	6.4E-03	5.3E-03
457.4	8.9E+03	2.8E+01	7.6E-02	5.6E-02	5.5E-02	2.6E-02	2.3E-02	1.1E-02	5.5E-03	4.6E-03
472.4	8.6E+03	2.7E+01	7.4E-02	5.5E-02	5.3E-02	2.6E-02	2.3E-02	1.0E-02	5.4E-03	4.5E-03
472.4	8.6E+03	2.7E+01	7.4E-02	5.5E-02	5.3E-02	2.6E-02	2.3E-02	1.0E-02	5.4E-03	4.5E-03
472.9	9.5E+03	3.0E+01	8.2E-02	6.1E-02	5.9E-02	2.9E-02	2.5E-02	1.1E-02	5.9E-03	4.9E-03
487.9	9.9E+03	3.1E+01	8.5E-02	6.3E-02	6.1E-02	3.0E-02	2.6E-02	1.2E-02	6.1E-03	5.1E-03
502.9	9.9E+03	3.1E+01	8.5E-02	6.3E-02	6.1E-02	3.0E-02	2.6E-02	1.2E-02	6.1E-03	5.1E-03
502.9	9.9E+03	3.1E+01	8.5E-02	6.3E-02	6.1E-02	3.0E-02	2.6E-02	1.2E-02	6.1E-03	5.1E-03
508.7	9.9E+03	3.1E+01	8.5E-02	6.3E-02	6.1E-02	3.0E-02	2.6E-02	1.2E-02	6.1E-03	5.1E-03
523.7	9.9E+03	3.1E+01	8.5E-02	6.3E-02	6.1E-02	3.0E-02	2.6E-02	1.2E-02	6.1E-03	5.1E-03
538.7	9.9E+03	3.1E+01	8.5E-02	6.3E-02	6.1E-02	2.9E-02	2.6E-02	1.2E-02	6.1E-03	5.1E-03
553.7	9.8E+03	3.1E+01	8.4E-02	6.3E-02	6.1E-02	2.9E-02	2.6E-02	1.2E-02	6.1E-03	5.1E-03
568.7	9.8E+03	3.1E+01	8.4E-02	6.3E-02	6.1E-02	2.9E-02	2.6E-02	1.2E-02	6.1E-03	5.1E-03
583.7	9.8E+03	3.1E+01	8.4E-02	6.3E-02	6.1E-02	2.9E-02	2.6E-02	1.2E-02	6.1E-03	5.1E-03
598.7	9.8E+03	3.1E+01	8.4E-02	6.2E-02	6.1E-02	2.9E-02	2.6E-02	1.2E-02	6.1E-03	5.1E-03
613.7	9.8E+03	3.1E+01	8.4E-02	6.2E-02	6.0E-02	2.9E-02	2.6E-02	1.2E-02	6.1E-03	5.0E-03
628.7	9.7E+03	3.1E+01	8.3E-02	6.2E-02	6.0E-02	2.9E-02	2.6E-02	1.2E-02	6.0E-03	5.0E-03
643.7	9.6E+03	3.0E+01	8.3E-02	6.1E-02	6.0E-02	2.9E-02	2.6E-02	1.2E-02	6.0E-03	5.0E-03
658.7	9.6E+03	3.0E+01	8.2E-02	6.1E-02	5.9E-02	2.9E-02	2.5E-02	1.2E-02	5.9E-03	4.9E-03
673.7	9.5E+03	3.0E+01	8.1E-02	6.0E-02	5.8E-02	2.8E-02	2.5E-02	1.1E-02	5.9E-03	4.9E-03
688.7	9.3E+03	2.9E+01	8.0E-02	5.9E-02	5.8E-02	2.8E-02	2.5E-02	1.1E-02	5.8E-03	4.8E-03
703.7	9.1E+03	2.9E+01	7.8E-02	5.8E-02	5.6E-02	2.7E-02	2.4E-02	1.1E-02	5.7E-03	4.7E-03
718.7	8.8E+03	2.8E+01	7.6E-02	5.6E-02	5.5E-02	2.6E-02	2.3E-02	1.1E-02	5.5E-03	4.6E-03

Table C-35. Air Concentration Estimates for Excavation in Bay B – Typical Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
733.7	8.5E+03	2.7E+01	7.3E-02	5.4E-02	5.2E-02	2.5E-02	2.2E-02	1.0E-02	5.3E-03	4.4E-03
748.7	8.0E+03	2.5E+01	6.9E-02	5.1E-02	5.0E-02	2.4E-02	2.1E-02	9.7E-03	5.0E-03	4.2E-03
763.7	7.5E+03	2.4E+01	6.4E-02	4.7E-02	4.6E-02	2.2E-02	2.0E-02	9.0E-03	4.6E-03	3.9E-03
778.7	6.7E+03	2.1E+01	5.8E-02	4.3E-02	4.2E-02	2.0E-02	1.8E-02	8.1E-03	4.2E-03	3.5E-03
793.7	5.8E+03	1.8E+01	5.0E-02	3.7E-02	3.6E-02	1.7E-02	1.5E-02	7.0E-03	3.6E-03	3.0E-03
808.7	4.7E+03	1.5E+01	4.1E-02	3.0E-02	2.9E-02	1.4E-02	1.3E-02	5.7E-03	2.9E-03	2.4E-03
823.7	3.5E+03	1.1E+01	3.0E-02	2.2E-02	2.1E-02	1.0E-02	9.2E-03	4.2E-03	2.2E-03	1.8E-03
838.7	2.1E+03	6.5E+00	1.8E-02	1.3E-02	1.3E-02	6.2E-03	5.5E-03	2.5E-03	1.3E-03	1.1E-03
853.7	5.8E+02	1.8E+00	5.0E-03	3.7E-03	3.6E-03	1.7E-03	1.5E-03	7.0E-04	3.6E-04	3.0E-04

Table C-36. Air Concentration Estimates for Excavation in Bay C – Typical Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.3E-01	1.3E-03	3.7E-06	2.7E-06	2.6E-06	1.3E-06	1.1E-06	5.2E-07	2.7E-07	2.2E-07
0.7	3.8E-01	1.2E-03	3.3E-06	2.4E-06	2.4E-06	1.1E-06	1.0E-06	4.6E-07	2.4E-07	2.0E-07
15.7	2.9E-01	9.1E-04	2.5E-06	1.8E-06	1.8E-06	8.6E-07	7.6E-07	3.5E-07	1.8E-07	1.5E-07
30.7	1.4E-01	4.4E-04	1.2E-06	8.8E-07	8.6E-07	4.2E-07	3.7E-07	1.7E-07	8.6E-08	7.2E-08
45.7	1.3E-01	4.1E-04	1.1E-06	8.3E-07	8.1E-07	3.9E-07	3.4E-07	1.6E-07	8.1E-08	6.7E-08
45.7	1.3E-01	4.1E-04	1.1E-06	8.3E-07	8.1E-07	3.9E-07	3.4E-07	1.6E-07	8.1E-08	6.7E-08
47.2	1.4E-01	4.4E-04	1.2E-06	8.9E-07	8.7E-07	4.2E-07	3.7E-07	1.7E-07	8.7E-08	7.3E-08
62.2	1.8E-01	5.8E-04	1.6E-06	1.2E-06	1.1E-06	5.5E-07	4.9E-07	2.2E-07	1.1E-07	9.5E-08
77.2	3.9E-01	1.2E-03	3.3E-06	2.5E-06	2.4E-06	1.2E-06	1.0E-06	4.7E-07	2.4E-07	2.0E-07
92.2	1.5E+00	4.6E-03	1.3E-05	9.3E-06	9.0E-06	4.4E-06	3.9E-06	1.8E-06	9.1E-07	7.5E-07
107.2	8.7E+00	2.8E-02	7.5E-05	5.6E-05	5.4E-05	2.6E-05	2.3E-05	1.1E-05	5.4E-06	4.5E-06
122.2	7.7E+01	2.4E-01	6.6E-04	4.9E-04	4.8E-04	2.3E-04	2.0E-04	9.3E-05	4.8E-05	4.0E-05
137.2	8.0E+01	2.5E-01	6.9E-04	5.1E-04	5.0E-04	2.4E-04	2.1E-04	9.7E-05	5.0E-05	4.2E-05
137.2	8.0E+01	2.5E-01	6.9E-04	5.1E-04	5.0E-04	2.4E-04	2.1E-04	9.7E-05	5.0E-05	4.2E-05
140.5	1.1E+02	3.5E-01	9.6E-04	7.2E-04	6.9E-04	3.4E-04	3.0E-04	1.4E-04	7.0E-05	5.8E-05
155.5	1.6E+02	5.0E-01	1.4E-03	1.0E-03	9.8E-04	4.7E-04	4.2E-04	1.9E-04	9.8E-05	8.2E-05
170.5	2.3E+02	7.1E-01	1.9E-03	1.4E-03	1.4E-03	6.7E-04	6.0E-04	2.7E-04	1.4E-04	1.2E-04
185.5	3.2E+02	1.0E+00	2.8E-03	2.1E-03	2.0E-03	9.7E-04	8.6E-04	3.9E-04	2.0E-04	1.7E-04
200.5	4.7E+02	1.5E+00	4.0E-03	3.0E-03	2.9E-03	1.4E-03	1.2E-03	5.6E-04	2.9E-04	2.4E-04
215.5	6.8E+02	2.2E+00	5.9E-03	4.4E-03	4.2E-03	2.0E-03	1.8E-03	8.2E-04	4.3E-04	3.5E-04
230.5	1.0E+03	3.2E+00	8.7E-03	6.5E-03	6.3E-03	3.0E-03	2.7E-03	1.2E-03	6.3E-04	5.2E-04
245.5	1.5E+03	4.8E+00	1.3E-02	9.7E-03	9.4E-03	4.6E-03	4.0E-03	1.8E-03	9.5E-04	7.9E-04
260.5	2.3E+03	7.4E+00	2.0E-02	1.5E-02	1.4E-02	7.0E-03	6.2E-03	2.8E-03	1.5E-03	1.2E-03
275.5	3.7E+03	1.2E+01	3.2E-02	2.4E-02	2.3E-02	1.1E-02	9.8E-03	4.5E-03	2.3E-03	1.9E-03
290.5	6.1E+03	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
305.5	1.1E+04	3.3E+01	9.1E-02	6.8E-02	6.6E-02	3.2E-02	2.8E-02	1.3E-02	6.6E-03	5.5E-03
320.5	1.8E+04	5.8E+01	1.6E-01	1.2E-01	1.1E-01	5.5E-02	4.8E-02	2.2E-02	1.1E-02	9.5E-03
335.5	2.6E+04	8.1E+01	2.2E-01	1.6E-01	1.6E-01	7.7E-02	6.8E-02	3.1E-02	1.6E-02	1.3E-02
350.5	2.6E+04	8.3E+01	2.2E-01	1.7E-01	1.6E-01	7.8E-02	6.9E-02	3.2E-02	1.6E-02	1.4E-02
350.5	2.6E+04	8.3E+01	2.2E-01	1.7E-01	1.6E-01	7.8E-02	6.9E-02	3.2E-02	1.6E-02	1.4E-02

Table C-36. Air Concentration Estimates for Excavation in Bay C – Typical Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
352.4	3.0E+04	9.4E+01	2.6E-01	1.9E-01	1.8E-01	8.9E-02	7.9E-02	3.6E-02	1.8E-02	1.5E-02
367.4	3.4E+04	1.1E+02	2.9E-01	2.2E-01	2.1E-01	1.0E-01	9.0E-02	4.1E-02	2.1E-02	1.8E-02
382.4	4.0E+04	1.2E+02	3.4E-01	2.5E-01	2.4E-01	1.2E-01	1.0E-01	4.8E-02	2.5E-02	2.0E-02
397.4	4.6E+04	1.5E+02	4.0E-01	2.9E-01	2.9E-01	1.4E-01	1.2E-01	5.6E-02	2.9E-02	2.4E-02
412.4	5.4E+04	1.7E+02	4.6E-01	3.4E-01	3.3E-01	1.6E-01	1.4E-01	6.5E-02	3.4E-02	2.8E-02
427.4	6.3E+04	2.0E+02	5.4E-01	4.0E-01	3.9E-01	1.9E-01	1.7E-01	7.5E-02	3.9E-02	3.2E-02
442.4	7.0E+04	2.2E+02	6.0E-01	4.4E-01	4.3E-01	2.1E-01	1.8E-01	8.4E-02	4.3E-02	3.6E-02
457.4	7.2E+04	2.3E+02	6.2E-01	4.6E-01	4.5E-01	2.2E-01	1.9E-01	8.7E-02	4.5E-02	3.7E-02
472.4	7.2E+04	2.3E+02	6.2E-01	4.6E-01	4.4E-01	2.2E-01	1.9E-01	8.7E-02	4.5E-02	3.7E-02
472.4	7.2E+04	2.3E+02	6.2E-01	4.6E-01	4.4E-01	2.2E-01	1.9E-01	8.7E-02	4.5E-02	3.7E-02
472.9	8.8E+04	2.8E+02	7.5E-01	5.6E-01	5.4E-01	2.6E-01	2.3E-01	1.1E-01	5.5E-02	4.5E-02
487.9	9.5E+04	3.0E+02	8.2E-01	6.1E-01	5.9E-01	2.9E-01	2.5E-01	1.1E-01	5.9E-02	4.9E-02
502.9	9.5E+04	3.0E+02	8.2E-01	6.1E-01	5.9E-01	2.9E-01	2.5E-01	1.1E-01	5.9E-02	4.9E-02
502.9	9.5E+04	3.0E+02	8.2E-01	6.1E-01	5.9E-01	2.9E-01	2.5E-01	1.1E-01	5.9E-02	4.9E-02
505.3	1.1E+05	3.4E+02	9.3E-01	6.9E-01	6.7E-01	3.2E-01	2.9E-01	1.3E-01	6.7E-02	5.6E-02
520.3	1.2E+05	3.9E+02	1.1E+00	7.9E-01	7.6E-01	3.7E-01	3.3E-01	1.5E-01	7.7E-02	6.4E-02
535.3	1.4E+05	4.4E+02	1.2E+00	8.9E-01	8.7E-01	4.2E-01	3.7E-01	1.7E-01	8.7E-02	7.2E-02
550.3	1.6E+05	5.0E+02	1.4E+00	1.0E+00	9.8E-01	4.7E-01	4.2E-01	1.9E-01	9.8E-02	8.2E-02
565.3	1.8E+05	5.6E+02	1.5E+00	1.1E+00	1.1E+00	5.3E-01	4.7E-01	2.2E-01	1.1E-01	9.2E-02
580.3	2.0E+05	6.3E+02	1.7E+00	1.3E+00	1.2E+00	6.0E-01	5.3E-01	2.4E-01	1.2E-01	1.0E-01
595.3	2.2E+05	7.0E+02	1.9E+00	1.4E+00	1.4E+00	6.6E-01	5.9E-01	2.7E-01	1.4E-01	1.1E-01
610.3	2.4E+05	7.7E+02	2.1E+00	1.5E+00	1.5E+00	7.3E-01	6.4E-01	2.9E-01	1.5E-01	1.3E-01
625.3	2.6E+05	8.2E+02	2.2E+00	1.7E+00	1.6E+00	7.8E-01	6.9E-01	3.1E-01	1.6E-01	1.3E-01
640.3	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
655.3	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
655.3	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
658.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
673.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.7E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
688.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.6E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01
703.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.6E+00	8.0E-01	7.1E-01	3.2E-01	1.7E-01	1.4E-01

Table C-36. Air Concentration Estimates for Excavation in Bay C – Typical Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
718.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.6E+00	8.0E-01	7.0E-01	3.2E-01	1.7E-01	1.4E-01
733.7	2.7E+05	8.4E+02	2.3E+00	1.7E+00	1.6E+00	7.9E-01	7.0E-01	3.2E-01	1.6E-01	1.4E-01
748.7	2.6E+05	8.3E+02	2.3E+00	1.7E+00	1.6E+00	7.9E-01	7.0E-01	3.2E-01	1.6E-01	1.4E-01
763.7	2.6E+05	8.2E+02	2.2E+00	1.7E+00	1.6E+00	7.8E-01	6.9E-01	3.1E-01	1.6E-01	1.3E-01
778.7	2.5E+05	8.0E+02	2.2E+00	1.6E+00	1.6E+00	7.6E-01	6.7E-01	3.0E-01	1.6E-01	1.3E-01
793.7	2.4E+05	7.5E+02	2.1E+00	1.5E+00	1.5E+00	7.2E-01	6.3E-01	2.9E-01	1.5E-01	1.2E-01
808.7	2.1E+05	6.8E+02	1.8E+00	1.4E+00	1.3E+00	6.4E-01	5.7E-01	2.6E-01	1.3E-01	1.1E-01
823.7	1.7E+05	5.4E+02	1.5E+00	1.1E+00	1.1E+00	5.1E-01	4.5E-01	2.1E-01	1.1E-01	8.9E-02
838.7	1.1E+05	3.3E+02	9.1E-01	6.8E-01	6.6E-01	3.2E-01	2.8E-01	1.3E-01	6.6E-02	5.5E-02
853.7	2.1E+04	6.5E+01	1.8E-01	1.3E-01	1.3E-01	6.1E-02	5.4E-02	2.5E-02	1.3E-02	1.1E-02

Table C-37. Air Concentration Estimates for Excavation in Bay D – Typical Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.3E-01	1.3E-03	3.7E-06	2.7E-06	2.6E-06	1.3E-06	1.1E-06	5.1E-07	2.7E-07	2.2E-07
0.7	3.8E-01	1.2E-03	3.3E-06	2.4E-06	2.4E-06	1.1E-06	1.0E-06	4.6E-07	2.4E-07	2.0E-07
15.7	2.9E-01	9.0E-04	2.5E-06	1.8E-06	1.8E-06	8.6E-07	7.6E-07	3.4E-07	1.8E-07	1.5E-07
30.7	1.4E-01	4.3E-04	1.2E-06	8.7E-07	8.4E-07	4.1E-07	3.6E-07	1.6E-07	8.5E-08	7.1E-08
45.7	1.3E-01	4.0E-04	1.1E-06	8.1E-07	7.9E-07	3.8E-07	3.4E-07	1.5E-07	7.9E-08	6.6E-08
45.7	1.3E-01	4.0E-04	1.1E-06	8.1E-07	7.9E-07	3.8E-07	3.4E-07	1.5E-07	7.9E-08	6.6E-08
47.2	1.3E-01	4.1E-04	1.1E-06	8.3E-07	8.0E-07	3.9E-07	3.4E-07	1.6E-07	8.1E-08	6.7E-08
62.2	1.4E-01	4.4E-04	1.2E-06	8.8E-07	8.6E-07	4.1E-07	3.7E-07	1.7E-07	8.6E-08	7.2E-08
77.2	1.8E-01	5.6E-04	1.5E-06	1.1E-06	1.1E-06	5.4E-07	4.7E-07	2.2E-07	1.1E-07	9.3E-08
92.2	3.9E-01	1.2E-03	3.3E-06	2.5E-06	2.4E-06	1.2E-06	1.0E-06	4.7E-07	2.4E-07	2.0E-07
107.2	1.8E+00	5.7E-03	1.6E-05	1.2E-05	1.1E-05	5.4E-06	4.8E-06	2.2E-06	1.1E-06	9.4E-07
122.2	1.5E+01	4.8E-02	1.3E-04	9.7E-05	9.4E-05	4.5E-05	4.0E-05	1.8E-05	9.4E-06	7.9E-06
137.2	1.6E+01	5.0E-02	1.4E-04	1.0E-04	9.8E-05	4.8E-05	4.2E-05	1.9E-05	9.9E-06	8.2E-06
137.2	1.6E+01	5.0E-02	1.4E-04	1.0E-04	9.8E-05	4.8E-05	4.2E-05	1.9E-05	9.9E-06	8.2E-06
146.3	1.9E+01	6.0E-02	1.6E-04	1.2E-04	1.2E-04	5.7E-05	5.0E-05	2.3E-05	1.2E-05	9.8E-06
161.3	2.4E+01	7.4E-02	2.0E-04	1.5E-04	1.5E-04	7.0E-05	6.2E-05	2.8E-05	1.5E-05	1.2E-05
176.3	3.0E+01	9.5E-02	2.6E-04	1.9E-04	1.9E-04	9.0E-05	7.9E-05	3.6E-05	1.9E-05	1.6E-05
191.3	3.9E+01	1.2E-01	3.4E-04	2.5E-04	2.4E-04	1.2E-04	1.0E-04	4.7E-05	2.4E-05	2.0E-05
206.3	5.3E+01	1.7E-01	4.5E-04	3.4E-04	3.3E-04	1.6E-04	1.4E-04	6.4E-05	3.3E-05	2.7E-05
221.3	7.3E+01	2.3E-01	6.2E-04	4.6E-04	4.5E-04	2.2E-04	1.9E-04	8.8E-05	4.5E-05	3.8E-05
236.3	1.0E+02	3.2E-01	8.7E-04	6.5E-04	6.3E-04	3.0E-04	2.7E-04	1.2E-04	6.3E-05	5.3E-05
251.3	1.4E+02	4.5E-01	1.2E-03	9.2E-04	8.9E-04	4.3E-04	3.8E-04	1.7E-04	9.0E-05	7.5E-05
266.3	2.1E+02	6.5E-01	1.8E-03	1.3E-03	1.3E-03	6.2E-04	5.5E-04	2.5E-04	1.3E-04	1.1E-04
281.3	3.0E+02	9.5E-01	2.6E-03	1.9E-03	1.9E-03	9.0E-04	8.0E-04	3.6E-04	1.9E-04	1.6E-04
296.3	4.5E+02	1.4E+00	3.8E-03	2.9E-03	2.8E-03	1.3E-03	1.2E-03	5.4E-04	2.8E-04	2.3E-04
311.3	6.8E+02	2.1E+00	5.8E-03	4.3E-03	4.2E-03	2.0E-03	1.8E-03	8.2E-04	4.2E-04	3.5E-04
326.3	1.1E+03	3.3E+00	9.1E-03	6.8E-03	6.6E-03	3.2E-03	2.8E-03	1.3E-03	6.6E-04	5.5E-04
341.3	1.7E+03	5.4E+00	1.5E-02	1.1E-02	1.1E-02	5.1E-03	4.6E-03	2.1E-03	1.1E-03	8.9E-04
356.3	2.9E+03	9.2E+00	2.5E-02	1.9E-02	1.8E-02	8.7E-03	7.7E-03	3.5E-03	1.8E-03	1.5E-03
371.3	5.1E+03	1.6E+01	4.4E-02	3.2E-02	3.2E-02	1.5E-02	1.3E-02	6.1E-03	3.2E-03	2.6E-03
386.3	8.1E+03	2.5E+01	6.9E-02	5.1E-02	5.0E-02	2.4E-02	2.1E-02	9.7E-03	5.0E-03	4.2E-03

Table C-37. Air Concentration Estimates for Excavation in Bay D – Typical Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
401.3	8.9E+03	2.8E+01	7.7E-02	5.7E-02	5.5E-02	2.7E-02	2.4E-02	1.1E-02	5.5E-03	4.6E-03
401.3	8.9E+03	2.8E+01	7.7E-02	5.7E-02	5.5E-02	2.7E-02	2.4E-02	1.1E-02	5.5E-03	4.6E-03
406.1	8.9E+03	2.8E+01	7.7E-02	5.7E-02	5.5E-02	2.7E-02	2.4E-02	1.1E-02	5.6E-03	4.6E-03
421.1	8.9E+03	2.8E+01	7.7E-02	5.7E-02	5.5E-02	2.7E-02	2.4E-02	1.1E-02	5.6E-03	4.6E-03
436.1	9.0E+03	2.8E+01	7.7E-02	5.7E-02	5.5E-02	2.7E-02	2.4E-02	1.1E-02	5.6E-03	4.6E-03
451.1	9.0E+03	2.8E+01	7.7E-02	5.7E-02	5.5E-02	2.7E-02	2.4E-02	1.1E-02	5.6E-03	4.6E-03
466.1	9.0E+03	2.8E+01	7.7E-02	5.7E-02	5.5E-02	2.7E-02	2.4E-02	1.1E-02	5.6E-03	4.6E-03
481.1	9.0E+03	2.8E+01	7.7E-02	5.7E-02	5.5E-02	2.7E-02	2.4E-02	1.1E-02	5.6E-03	4.6E-03
496.1	9.0E+03	2.8E+01	7.7E-02	5.7E-02	5.5E-02	2.7E-02	2.4E-02	1.1E-02	5.6E-03	4.6E-03
511.1	9.0E+03	2.8E+01	7.7E-02	5.7E-02	5.5E-02	2.7E-02	2.4E-02	1.1E-02	5.6E-03	4.6E-03
526.1	8.9E+03	2.8E+01	7.7E-02	5.7E-02	5.5E-02	2.7E-02	2.4E-02	1.1E-02	5.5E-03	4.6E-03
541.1	8.9E+03	2.8E+01	7.6E-02	5.7E-02	5.5E-02	2.7E-02	2.3E-02	1.1E-02	5.5E-03	4.6E-03
556.1	8.8E+03	2.8E+01	7.5E-02	5.6E-02	5.4E-02	2.6E-02	2.3E-02	1.1E-02	5.5E-03	4.5E-03
571.1	8.7E+03	2.7E+01	7.4E-02	5.5E-02	5.3E-02	2.6E-02	2.3E-02	1.0E-02	5.4E-03	4.5E-03
586.1	8.4E+03	2.7E+01	7.2E-02	5.4E-02	5.2E-02	2.5E-02	2.2E-02	1.0E-02	5.2E-03	4.4E-03
601.1	8.1E+03	2.6E+01	7.0E-02	5.2E-02	5.0E-02	2.4E-02	2.2E-02	9.8E-03	5.1E-03	4.2E-03
616.1	7.7E+03	2.4E+01	6.6E-02	4.9E-02	4.8E-02	2.3E-02	2.0E-02	9.3E-03	4.8E-03	4.0E-03
631.1	7.1E+03	2.2E+01	6.1E-02	4.5E-02	4.4E-02	2.1E-02	1.9E-02	8.6E-03	4.4E-03	3.7E-03
646.1	6.4E+03	2.0E+01	5.4E-02	4.0E-02	3.9E-02	1.9E-02	1.7E-02	7.7E-03	3.9E-03	3.3E-03
661.1	5.4E+03	1.7E+01	4.6E-02	3.4E-02	3.3E-02	1.6E-02	1.4E-02	6.5E-03	3.3E-03	2.8E-03
676.1	4.2E+03	1.3E+01	3.6E-02	2.7E-02	2.6E-02	1.3E-02	1.1E-02	5.1E-03	2.6E-03	2.2E-03
691.1	2.7E+03	8.7E+00	2.4E-02	1.7E-02	1.7E-02	8.2E-03	7.3E-03	3.3E-03	1.7E-03	1.4E-03
706.1	2.2E+03	7.0E+00	1.9E-02	1.4E-02	1.4E-02	6.7E-03	5.9E-03	2.7E-03	1.4E-03	1.2E-03
706.1	2.2E+03	7.0E+00	1.9E-02	1.4E-02	1.4E-02	6.7E-03	5.9E-03	2.7E-03	1.4E-03	1.2E-03
707.6	2.9E+03	9.2E+00	2.5E-02	1.9E-02	1.8E-02	8.8E-03	7.7E-03	3.5E-03	1.8E-03	1.5E-03
722.6	3.9E+03	1.2E+01	3.3E-02	2.5E-02	2.4E-02	1.2E-02	1.0E-02	4.7E-03	2.4E-03	2.0E-03
737.6	5.2E+03	1.6E+01	4.4E-02	3.3E-02	3.2E-02	1.5E-02	1.4E-02	6.2E-03	3.2E-03	2.7E-03
752.6	6.7E+03	2.1E+01	5.8E-02	4.3E-02	4.2E-02	2.0E-02	1.8E-02	8.1E-03	4.2E-03	3.5E-03
767.6	8.3E+03	2.6E+01	7.1E-02	5.3E-02	5.1E-02	2.5E-02	2.2E-02	1.0E-02	5.1E-03	4.3E-03
782.6	9.0E+03	2.9E+01	7.8E-02	5.8E-02	5.6E-02	2.7E-02	2.4E-02	1.1E-02	5.6E-03	4.7E-03
797.6	9.1E+03	2.9E+01	7.8E-02	5.8E-02	5.6E-02	2.7E-02	2.4E-02	1.1E-02	5.6E-03	4.7E-03

Table C-37. Air Concentration Estimates for Excavation in Bay D – Typical Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
797.6	9.1E+03	2.9E+01	7.8E-02	5.8E-02	5.6E-02	2.7E-02	2.4E-02	1.1E-02	5.6E-03	4.7E-03
800.0	8.8E+03	2.8E+01	7.5E-02	5.6E-02	5.4E-02	2.6E-02	2.3E-02	1.1E-02	5.4E-03	4.5E-03
815.0	8.4E+03	2.6E+01	7.2E-02	5.4E-02	5.2E-02	2.5E-02	2.2E-02	1.0E-02	5.2E-03	4.3E-03
830.0	7.9E+03	2.5E+01	6.8E-02	5.0E-02	4.9E-02	2.4E-02	2.1E-02	9.5E-03	4.9E-03	4.1E-03
845.0	7.3E+03	2.3E+01	6.3E-02	4.7E-02	4.5E-02	2.2E-02	1.9E-02	8.8E-03	4.5E-03	3.8E-03
860.0	6.5E+03	2.1E+01	5.6E-02	4.2E-02	4.0E-02	2.0E-02	1.7E-02	7.9E-03	4.1E-03	3.4E-03
875.0	5.6E+03	1.8E+01	4.8E-02	3.6E-02	3.5E-02	1.7E-02	1.5E-02	6.7E-03	3.5E-03	2.9E-03
890.0	4.5E+03	1.4E+01	3.8E-02	2.8E-02	2.8E-02	1.3E-02	1.2E-02	5.4E-03	2.8E-03	2.3E-03
905.0	3.2E+03	1.0E+01	2.7E-02	2.0E-02	2.0E-02	9.5E-03	8.4E-03	3.8E-03	2.0E-03	1.6E-03
920.0	1.7E+03	5.5E+00	1.5E-02	1.1E-02	1.1E-02	5.2E-03	4.6E-03	2.1E-03	1.1E-03	9.0E-04
935.0	2.4E+02	7.7E-01	2.1E-03	1.6E-03	1.5E-03	7.3E-04	6.4E-04	2.9E-04	1.5E-04	1.3E-04

Table C-38. Air Concentration Estimates for Excavation in Bays A, B, C and D Concurrently – Typical Meteorology at Receptor Locations

Depth	Emissions (500 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
		ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	6.8E-03	1.9E-05	1.4E-05	1.3E-05	6.5E-06	5.7E-06	2.6E-06	1.3E-06	1.1E-06
0.7	6.2E-03	1.7E-05	1.2E-05	1.2E-05	5.8E-06	5.2E-06	2.4E-06	1.2E-06	1.0E-06
15.7	4.7E-03	1.3E-05	9.5E-06	9.2E-06	4.4E-06	3.9E-06	1.8E-06	9.2E-07	7.7E-07
30.7	2.3E-03	6.3E-06	4.7E-06	4.6E-06	2.2E-06	1.9E-06	8.9E-07	4.6E-07	3.8E-07
45.7	2.2E-03	6.0E-06	4.4E-06	4.3E-06	2.1E-06	1.8E-06	8.4E-07	4.3E-07	3.6E-07
45.7	2.2E-03	6.0E-06	4.4E-06	4.3E-06	2.1E-06	1.8E-06	8.4E-07	4.3E-07	3.6E-07
47.2	2.8E-03	7.6E-06	5.6E-06	5.4E-06	2.6E-06	2.3E-06	1.1E-06	5.5E-07	4.6E-07
62.2	5.3E-03	1.4E-05	1.1E-05	1.0E-05	5.0E-06	4.5E-06	2.0E-06	1.0E-06	8.7E-07
77.2	1.7E-02	4.5E-05	3.4E-05	3.3E-05	1.6E-05	1.4E-05	6.4E-06	3.3E-06	2.7E-06
92.2	7.1E-02	1.9E-04	1.4E-04	1.4E-04	6.7E-05	6.0E-05	2.7E-05	1.4E-05	1.2E-05
107.2	3.9E-01	1.1E-03	7.8E-04	7.6E-04	3.7E-04	3.3E-04	1.5E-04	7.6E-05	6.4E-05
122.2	2.8E+00	7.5E-03	5.6E-03	5.4E-03	2.6E-03	2.3E-03	1.1E-03	5.5E-04	4.5E-04
137.2	2.9E+00	7.9E-03	5.8E-03	5.7E-03	2.7E-03	2.4E-03	1.1E-03	5.7E-04	4.7E-04
137.2	2.9E+00	7.9E-03	5.8E-03	5.7E-03	2.7E-03	2.4E-03	1.1E-03	5.7E-04	4.7E-04
146.3	4.1E+00	1.1E-02	8.3E-03	8.1E-03	3.9E-03	3.5E-03	1.6E-03	8.1E-04	6.8E-04
161.3	5.9E+00	1.6E-02	1.2E-02	1.2E-02	5.6E-03	4.9E-03	2.3E-03	1.2E-03	9.7E-04
176.3	8.5E+00	2.3E-02	1.7E-02	1.7E-02	8.0E-03	7.1E-03	3.2E-03	1.7E-03	1.4E-03
191.3	1.2E+01	3.3E-02	2.5E-02	2.4E-02	1.2E-02	1.0E-02	4.7E-03	2.4E-03	2.0E-03
206.3	1.8E+01	4.8E-02	3.6E-02	3.5E-02	1.7E-02	1.5E-02	6.8E-03	3.5E-03	2.9E-03
221.3	2.6E+01	7.1E-02	5.2E-02	5.1E-02	2.5E-02	2.2E-02	9.9E-03	5.1E-03	4.3E-03
236.3	3.8E+01	1.0E-01	7.7E-02	7.5E-02	3.6E-02	3.2E-02	1.5E-02	7.5E-03	6.3E-03
251.3	5.7E+01	1.5E-01	1.1E-01	1.1E-01	5.4E-02	4.8E-02	2.2E-02	1.1E-02	9.3E-03
266.3	8.6E+01	2.3E-01	1.7E-01	1.7E-01	8.2E-02	7.2E-02	3.3E-02	1.7E-02	1.4E-02
281.3	1.3E+02	3.6E-01	2.7E-01	2.6E-01	1.3E-01	1.1E-01	5.1E-02	2.6E-02	2.2E-02
296.3	2.2E+02	5.9E-01	4.4E-01	4.2E-01	2.0E-01	1.8E-01	8.2E-02	4.2E-02	3.5E-02
311.3	3.6E+02	9.8E-01	7.2E-01	7.0E-01	3.4E-01	3.0E-01	1.4E-01	7.1E-02	5.9E-02
326.3	5.9E+02	1.6E+00	1.2E+00	1.2E+00	5.6E-01	5.0E-01	2.3E-01	1.2E-01	9.7E-02
341.3	8.1E+02	2.2E+00	1.6E+00	1.6E+00	7.7E-01	6.8E-01	3.1E-01	1.6E-01	1.3E-01
356.3	9.5E+02	2.6E+00	1.9E+00	1.9E+00	9.0E-01	7.9E-01	3.6E-01	1.9E-01	1.6E-01

Table C-38. Air Concentration Estimates for Excavation in Bays A, B, C and D Concurrently – Typical Meteorology at Receptor Locations (continued)

Depth	Emissions (500 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
		ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
371.3	1.0E+03	2.8E+00	2.1E+00	2.0E+00	9.7E-01	8.6E-01	3.9E-01	2.0E-01	1.7E-01
386.3	1.1E+03	2.9E+00	2.1E+00	2.1E+00	1.0E+00	8.9E-01	4.0E-01	2.1E-01	1.7E-01
401.3	1.1E+03	2.9E+00	2.2E+00	2.1E+00	1.0E+00	9.1E-01	4.1E-01	2.1E-01	1.8E-01
401.3	1.1E+03	2.9E+00	2.2E+00	2.1E+00	1.0E+00	9.1E-01	4.1E-01	2.1E-01	1.8E-01
406.1	1.1E+03	2.9E+00	2.2E+00	2.1E+00	1.0E+00	9.1E-01	4.1E-01	2.1E-01	1.8E-01
421.1	1.1E+03	3.0E+00	2.2E+00	2.2E+00	1.1E+00	9.3E-01	4.2E-01	2.2E-01	1.8E-01
436.1	1.1E+03	3.1E+00	2.3E+00	2.2E+00	1.1E+00	9.5E-01	4.3E-01	2.2E-01	1.9E-01
451.1	1.2E+03	3.1E+00	2.3E+00	2.3E+00	1.1E+00	9.7E-01	4.4E-01	2.3E-01	1.9E-01
466.1	1.2E+03	3.1E+00	2.3E+00	2.3E+00	1.1E+00	9.7E-01	4.4E-01	2.3E-01	1.9E-01
481.1	1.2E+03	3.3E+00	2.4E+00	2.4E+00	1.1E+00	1.0E+00	4.6E-01	2.4E-01	2.0E-01
496.1	1.2E+03	3.3E+00	2.5E+00	2.4E+00	1.2E+00	1.0E+00	4.7E-01	2.4E-01	2.0E-01
511.1	1.3E+03	3.5E+00	2.6E+00	2.5E+00	1.2E+00	1.1E+00	4.9E-01	2.5E-01	2.1E-01
526.1	1.3E+03	3.6E+00	2.7E+00	2.6E+00	1.3E+00	1.1E+00	5.0E-01	2.6E-01	2.2E-01
541.1	1.4E+03	3.7E+00	2.8E+00	2.7E+00	1.3E+00	1.2E+00	5.2E-01	2.7E-01	2.2E-01
556.1	1.4E+03	3.9E+00	2.9E+00	2.8E+00	1.4E+00	1.2E+00	5.5E-01	2.8E-01	2.3E-01
571.1	1.5E+03	4.1E+00	3.0E+00	2.9E+00	1.4E+00	1.3E+00	5.7E-01	2.9E-01	2.4E-01
586.1	1.6E+03	4.2E+00	3.1E+00	3.1E+00	1.5E+00	1.3E+00	5.9E-01	3.1E-01	2.6E-01
601.1	1.6E+03	4.4E+00	3.3E+00	3.2E+00	1.5E+00	1.4E+00	6.2E-01	3.2E-01	2.7E-01
616.1	1.7E+03	4.6E+00	3.4E+00	3.3E+00	1.6E+00	1.4E+00	6.5E-01	3.3E-01	2.8E-01
631.1	1.7E+03	4.7E+00	3.5E+00	3.4E+00	1.6E+00	1.5E+00	6.6E-01	3.4E-01	2.9E-01
646.1	1.8E+03	4.8E+00	3.5E+00	3.4E+00	1.7E+00	1.5E+00	6.7E-01	3.5E-01	2.9E-01
661.1	1.7E+03	4.8E+00	3.5E+00	3.4E+00	1.7E+00	1.5E+00	6.7E-01	3.4E-01	2.9E-01
676.1	1.7E+03	4.7E+00	3.5E+00	3.4E+00	1.7E+00	1.5E+00	6.6E-01	3.4E-01	2.9E-01
691.1	1.7E+03	4.7E+00	3.5E+00	3.4E+00	1.6E+00	1.5E+00	6.6E-01	3.4E-01	2.8E-01
706.1	1.7E+03	4.7E+00	3.5E+00	3.4E+00	1.6E+00	1.4E+00	6.6E-01	3.4E-01	2.8E-01
706.1	1.7E+03	4.7E+00	3.5E+00	3.4E+00	1.6E+00	1.4E+00	6.6E-01	3.4E-01	2.8E-01
707.6	1.7E+03	4.7E+00	3.5E+00	3.4E+00	1.6E+00	1.5E+00	6.6E-01	3.4E-01	2.8E-01
722.6	1.7E+03	4.7E+00	3.5E+00	3.4E+00	1.6E+00	1.5E+00	6.6E-01	3.4E-01	2.8E-01
737.6	1.7E+03	4.7E+00	3.5E+00	3.4E+00	1.6E+00	1.5E+00	6.6E-01	3.4E-01	2.8E-01
752.6	1.7E+03	4.7E+00	3.5E+00	3.4E+00	1.6E+00	1.5E+00	6.6E-01	3.4E-01	2.8E-01

Table C-38. Air Concentration Estimates for Excavation in Bays A, B, C and D Concurrently – Typical Meteorology at Receptor Locations (continued)

Depth	Emissions (500 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
		ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
767.6	1.7E+03	4.7E+00	3.5E+00	3.4E+00	1.6E+00	1.4E+00	6.6E-01	3.4E-01	2.8E-01
782.6	1.7E+03	4.6E+00	3.4E+00	3.3E+00	1.6E+00	1.4E+00	6.4E-01	3.3E-01	2.8E-01
797.6	1.6E+03	4.4E+00	3.2E+00	3.1E+00	1.5E+00	1.3E+00	6.1E-01	3.2E-01	2.6E-01
797.6	1.6E+03	4.4E+00	3.2E+00	3.1E+00	1.5E+00	1.3E+00	6.1E-01	3.2E-01	2.6E-01
800.0	1.6E+03	4.3E+00	3.2E+00	3.1E+00	1.5E+00	1.3E+00	6.1E-01	3.1E-01	2.6E-01
815.0	1.4E+03	3.9E+00	2.9E+00	2.8E+00	1.4E+00	1.2E+00	5.5E-01	2.9E-01	2.4E-01
830.0	1.2E+03	3.2E+00	2.4E+00	2.3E+00	1.1E+00	1.0E+00	4.5E-01	2.3E-01	2.0E-01
845.0	7.9E+02	2.1E+00	1.6E+00	1.5E+00	7.5E-01	6.6E-01	3.0E-01	1.6E-01	1.3E-01
860.0	2.5E+02	6.9E-01	5.1E-01	5.0E-01	2.4E-01	2.1E-01	9.7E-02	5.0E-02	4.2E-02
875.0	3.5E+01	9.6E-02	7.1E-02	6.9E-02	3.3E-02	3.0E-02	1.3E-02	6.9E-03	5.8E-03
890.0	2.8E+01	7.7E-02	5.7E-02	5.5E-02	2.7E-02	2.4E-02	1.1E-02	5.5E-03	4.6E-03
905.0	2.0E+01	5.4E-02	4.0E-02	3.9E-02	1.9E-02	1.7E-02	7.6E-03	3.9E-03	3.3E-03
920.0	1.1E+01	3.0E-02	2.2E-02	2.2E-02	1.0E-02	9.2E-03	4.2E-03	2.2E-03	1.8E-03
935.0	1.5E+00	4.2E-03	3.1E-03	3.0E-03	1.5E-03	1.3E-03	5.9E-04	3.0E-04	2.5E-04

Table C-39. Air Concentration Estimates for Wall Collapse in Bay A – Typical Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (69 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.4E-01	9.6E-04	2.6E-06	1.9E-06	1.9E-06	9.1E-07	8.0E-07	3.6E-07	1.9E-07	1.6E-07
0.7	4.0E-01	8.7E-04	2.4E-06	1.8E-06	1.7E-06	8.2E-07	7.3E-07	3.3E-07	1.7E-07	1.4E-07
15.7	3.1E-01	6.7E-04	1.8E-06	1.4E-06	1.3E-06	6.4E-07	5.7E-07	2.6E-07	1.3E-07	1.1E-07
30.7	1.6E-01	3.6E-04	9.7E-07	7.2E-07	7.0E-07	3.4E-07	3.0E-07	1.4E-07	7.0E-08	5.8E-08
45.7	1.5E-01	3.4E-04	9.2E-07	6.8E-07	6.6E-07	3.2E-07	2.8E-07	1.3E-07	6.6E-08	5.5E-08
45.7	1.5E-01	3.4E-04	9.2E-07	6.8E-07	6.6E-07	3.2E-07	2.8E-07	1.3E-07	6.6E-08	5.5E-08
47.2	2.5E-01	5.3E-04	1.5E-06	1.1E-06	1.0E-06	5.1E-07	4.5E-07	2.0E-07	1.1E-07	8.8E-08
62.2	6.4E-01	1.4E-03	3.8E-06	2.8E-06	2.7E-06	1.3E-06	1.2E-06	5.3E-07	2.8E-07	2.3E-07
77.2	2.5E+00	5.4E-03	1.5E-05	1.1E-05	1.1E-05	5.1E-06	4.5E-06	2.1E-06	1.1E-06	8.9E-07
92.2	1.2E+01	2.6E-02	7.2E-05	5.3E-05	5.2E-05	2.5E-05	2.2E-05	1.0E-05	5.2E-06	4.3E-06
107.2	7.8E+01	1.7E-01	4.6E-04	3.4E-04	3.3E-04	1.6E-04	1.4E-04	6.4E-05	3.3E-05	2.8E-05
122.2	6.9E+02	1.5E+00	4.1E-03	3.0E-03	2.9E-03	1.4E-03	1.3E-03	5.7E-04	3.0E-04	2.5E-04
137.2	7.2E+02	1.6E+00	4.3E-03	3.2E-03	3.1E-03	1.5E-03	1.3E-03	6.0E-04	3.1E-04	2.6E-04
137.2	7.2E+02	1.6E+00	4.3E-03	3.2E-03	3.1E-03	1.5E-03	1.3E-03	6.0E-04	3.1E-04	2.6E-04
140.5	1.0E+03	2.3E+00	6.1E-03	4.6E-03	4.4E-03	2.1E-03	1.9E-03	8.6E-04	4.4E-04	3.7E-04
155.5	1.5E+03	3.2E+00	8.8E-03	6.6E-03	6.4E-03	3.1E-03	2.7E-03	1.2E-03	6.4E-04	5.3E-04
170.5	2.2E+03	4.7E+00	1.3E-02	9.5E-03	9.2E-03	4.4E-03	3.9E-03	1.8E-03	9.2E-04	7.7E-04
185.5	3.1E+03	6.8E+00	1.8E-02	1.4E-02	1.3E-02	6.4E-03	5.7E-03	2.6E-03	1.3E-03	1.1E-03
200.5	4.5E+03	9.8E+00	2.7E-02	2.0E-02	1.9E-02	9.3E-03	8.2E-03	3.8E-03	1.9E-03	1.6E-03
215.5	6.6E+03	1.4E+01	3.9E-02	2.9E-02	2.8E-02	1.4E-02	1.2E-02	5.5E-03	2.8E-03	2.4E-03
230.5	9.7E+03	2.1E+01	5.7E-02	4.3E-02	4.1E-02	2.0E-02	1.8E-02	8.1E-03	4.2E-03	3.5E-03
245.5	1.4E+04	3.1E+01	8.6E-02	6.3E-02	6.2E-02	3.0E-02	2.6E-02	1.2E-02	6.2E-03	5.2E-03
260.5	2.2E+04	4.8E+01	1.3E-01	9.6E-02	9.4E-02	4.5E-02	4.0E-02	1.8E-02	9.4E-03	7.8E-03
275.5	3.4E+04	7.5E+01	2.0E-01	1.5E-01	1.5E-01	7.1E-02	6.3E-02	2.8E-02	1.5E-02	1.2E-02
290.5	5.6E+04	1.2E+02	3.3E-01	2.4E-01	2.4E-01	1.1E-01	1.0E-01	4.6E-02	2.4E-02	2.0E-02
305.5	9.4E+04	2.0E+02	5.6E-01	4.1E-01	4.0E-01	1.9E-01	1.7E-01	7.8E-02	4.0E-02	3.4E-02
320.5	1.6E+05	3.4E+02	9.3E-01	6.9E-01	6.7E-01	3.3E-01	2.9E-01	1.3E-01	6.8E-02	5.6E-02
335.5	2.2E+05	4.7E+02	1.3E+00	9.5E-01	9.3E-01	4.5E-01	4.0E-01	1.8E-01	9.3E-02	7.7E-02
350.5	2.2E+05	4.8E+02	1.3E+00	9.7E-01	9.4E-01	4.5E-01	4.0E-01	1.8E-01	9.4E-02	7.8E-02
350.5	2.2E+05	4.8E+02	1.3E+00	9.7E-01	9.4E-01	4.5E-01	4.0E-01	1.8E-01	9.4E-02	7.8E-02

Table C-39. Air Concentration Estimates for Wall Collapse in Bay A – Typical Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (69 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
351.0	2.5E+05	5.5E+02	1.5E+00	1.1E+00	1.1E+00	5.2E-01	4.6E-01	2.1E-01	1.1E-01	9.0E-02
366.0	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
381.0	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
381.0	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
388.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
403.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
418.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
433.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
448.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
463.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
478.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
493.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
508.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
523.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
538.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
553.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
568.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
583.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
598.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
613.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
628.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
643.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
658.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
673.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
688.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
703.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
718.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.9E-01	2.2E-01	1.1E-01	9.5E-02
733.7	2.7E+05	5.8E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.8E-01	2.2E-01	1.1E-01	9.5E-02
748.7	2.6E+05	5.7E+02	1.6E+00	1.2E+00	1.1E+00	5.5E-01	4.8E-01	2.2E-01	1.1E-01	9.4E-02
763.7	2.6E+05	5.7E+02	1.5E+00	1.1E+00	1.1E+00	5.4E-01	4.8E-01	2.2E-01	1.1E-01	9.3E-02

Table C-39. Air Concentration Estimates for Wall Collapse in Bay A – Typical Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (69 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
778.7	2.6E+05	5.6E+02	1.5E+00	1.1E+00	1.1E+00	5.3E-01	4.7E-01	2.1E-01	1.1E-01	9.1E-02
793.7	2.4E+05	5.3E+02	1.4E+00	1.1E+00	1.0E+00	5.0E-01	4.5E-01	2.0E-01	1.0E-01	8.7E-02
808.7	2.2E+05	4.9E+02	1.3E+00	9.8E-01	9.5E-01	4.6E-01	4.1E-01	1.9E-01	9.6E-02	8.0E-02
823.7	1.9E+05	4.1E+02	1.1E+00	8.2E-01	7.9E-01	3.8E-01	3.4E-01	1.5E-01	8.0E-02	6.6E-02
838.7	1.3E+05	2.8E+02	7.5E-01	5.6E-01	5.4E-01	2.6E-01	2.3E-01	1.1E-01	5.5E-02	4.5E-02
853.7	4.6E+04	1.0E+02	2.8E-01	2.0E-01	2.0E-01	9.6E-02	8.5E-02	3.9E-02	2.0E-02	1.7E-02
868.7	0.0E+00									

Table C-40. Air Concentration Estimates for Drilling in Bay A – Typical Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions ($2.3\ m^2$)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	($pCi/m^2/sec$)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.4E-01	3.2E-05	8.7E-08	6.4E-08	6.2E-08	3.0E-08	2.7E-08	1.2E-08	6.3E-09	5.2E-09
0.7	4.0E-01	2.9E-05	7.9E-08	5.8E-08	5.7E-08	2.7E-08	2.4E-08	1.1E-08	5.7E-09	4.7E-09
15.7	3.1E-01	2.2E-05	6.1E-08	4.5E-08	4.4E-08	2.1E-08	1.9E-08	8.6E-09	4.4E-09	3.7E-09
30.7	1.6E-01	1.2E-05	3.2E-08	2.4E-08	2.3E-08	1.1E-08	9.9E-09	4.5E-09	2.3E-09	1.9E-09
45.7	1.5E-01	1.1E-05	3.1E-08	2.3E-08	2.2E-08	1.1E-08	9.4E-09	4.3E-09	2.2E-09	1.8E-09
45.7	1.5E-01	1.1E-05	3.1E-08	2.3E-08	2.2E-08	1.1E-08	9.4E-09	4.3E-09	2.2E-09	1.8E-09
47.2	2.5E-01	1.8E-05	4.8E-08	3.6E-08	3.5E-08	1.7E-08	1.5E-08	6.8E-09	3.5E-09	2.9E-09
62.2	6.4E-01	4.7E-05	1.3E-07	9.4E-08	9.1E-08	4.4E-08	3.9E-08	1.8E-08	9.2E-09	7.6E-09
77.2	2.5E+00	1.8E-04	4.9E-07	3.6E-07	3.5E-07	1.7E-07	1.5E-07	6.9E-08	3.6E-08	3.0E-08
92.2	1.2E+01	8.8E-04	2.4E-06	1.8E-06	1.7E-06	8.3E-07	7.4E-07	3.4E-07	1.7E-07	1.4E-07
107.2	7.8E+01	5.6E-03	1.5E-05	1.1E-05	1.1E-05	5.3E-06	4.7E-06	2.1E-06	1.1E-06	9.2E-07
122.2	6.9E+02	5.0E-02	1.4E-04	1.0E-04	9.8E-05	4.8E-05	4.2E-05	1.9E-05	9.9E-06	8.2E-06
137.2	7.2E+02	5.2E-02	1.4E-04	1.1E-04	1.0E-04	5.0E-05	4.4E-05	2.0E-05	1.0E-05	8.6E-06
137.2	7.2E+02	5.2E-02	1.4E-04	1.1E-04	1.0E-04	5.0E-05	4.4E-05	2.0E-05	1.0E-05	8.6E-06
140.5	1.0E+03	7.5E-02	2.0E-04	1.5E-04	1.5E-04	7.1E-05	6.3E-05	2.9E-05	1.5E-05	1.2E-05
155.5	1.5E+03	1.1E-01	2.9E-04	2.2E-04	2.1E-04	1.0E-04	9.1E-05	4.1E-05	2.1E-05	1.8E-05
170.5	2.2E+03	1.6E-01	4.2E-04	3.2E-04	3.1E-04	1.5E-04	1.3E-04	6.0E-05	3.1E-05	2.6E-05
185.5	3.1E+03	2.3E-01	6.1E-04	4.6E-04	4.4E-04	2.1E-04	1.9E-04	8.6E-05	4.4E-05	3.7E-05
200.5	4.5E+03	3.3E-01	8.9E-04	6.6E-04	6.4E-04	3.1E-04	2.7E-04	1.3E-04	6.4E-05	5.4E-05
215.5	6.6E+03	4.8E-01	1.3E-03	9.6E-04	9.4E-04	4.5E-04	4.0E-04	1.8E-04	9.4E-05	7.8E-05
230.5	9.7E+03	7.0E-01	1.9E-03	1.4E-03	1.4E-03	6.7E-04	5.9E-04	2.7E-04	1.4E-04	1.2E-04
245.5	1.4E+04	1.0E+00	2.9E-03	2.1E-03	2.1E-03	9.9E-04	8.8E-04	4.0E-04	2.1E-04	1.7E-04
260.5	2.2E+04	1.6E+00	4.3E-03	3.2E-03	3.1E-03	1.5E-03	1.3E-03	6.1E-04	3.1E-04	2.6E-04
275.5	3.4E+04	2.5E+00	6.8E-03	5.0E-03	4.9E-03	2.4E-03	2.1E-03	9.5E-04	4.9E-04	4.1E-04
290.5	5.6E+04	4.0E+00	1.1E-02	8.1E-03	7.9E-03	3.8E-03	3.4E-03	1.5E-03	7.9E-04	6.6E-04
305.5	9.4E+04	6.8E+00	1.9E-02	1.4E-02	1.3E-02	6.5E-03	5.7E-03	2.6E-03	1.3E-03	1.1E-03
320.5	1.6E+05	1.1E+01	3.1E-02	2.3E-02	2.2E-02	1.1E-02	9.6E-03	4.4E-03	2.3E-03	1.9E-03
335.5	2.2E+05	1.6E+01	4.3E-02	3.2E-02	3.1E-02	1.5E-02	1.3E-02	6.0E-03	3.1E-03	2.6E-03
350.5	2.2E+05	1.6E+01	4.3E-02	3.2E-02	3.1E-02	1.5E-02	1.3E-02	6.1E-03	3.1E-03	2.6E-03
350.5	2.2E+05	1.6E+01	4.3E-02	3.2E-02	3.1E-02	1.5E-02	1.3E-02	6.1E-03	3.1E-03	2.6E-03

Table C-40. Air Concentration Estimates for Drilling in Bay A – Typical Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (2.3 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
351.0	2.5E+05	1.8E+01	5.0E-02	3.7E-02	3.6E-02	1.7E-02	1.5E-02	7.0E-03	3.6E-03	3.0E-03
366.0	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
381.0	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
381.0	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
388.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
403.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
418.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
433.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
448.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
463.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
478.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
493.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
508.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
523.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
538.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
553.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
568.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
583.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
598.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
613.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
628.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
643.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
658.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
673.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
688.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
703.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
718.7	2.7E+05	1.9E+01	5.3E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
733.7	2.7E+05	1.9E+01	5.2E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.4E-03	3.8E-03	3.2E-03
748.7	2.6E+05	1.9E+01	5.2E-02	3.9E-02	3.8E-02	1.8E-02	1.6E-02	7.3E-03	3.8E-03	3.1E-03
763.7	2.6E+05	1.9E+01	5.2E-02	3.8E-02	3.7E-02	1.8E-02	1.6E-02	7.2E-03	3.7E-03	3.1E-03

Table C-40. Air Concentration Estimates for Drilling in Bay A – Typical Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (2.3 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
778.7	2.6E+05	1.9E+01	5.0E-02	3.7E-02	3.6E-02	1.8E-02	1.6E-02	7.1E-03	3.6E-03	3.0E-03
793.7	2.4E+05	1.8E+01	4.8E-02	3.6E-02	3.5E-02	1.7E-02	1.5E-02	6.8E-03	3.5E-03	2.9E-03
808.7	2.2E+05	1.6E+01	4.4E-02	3.3E-02	3.2E-02	1.5E-02	1.4E-02	6.2E-03	3.2E-03	2.7E-03
823.7	1.9E+05	1.4E+01	3.7E-02	2.7E-02	2.6E-02	1.3E-02	1.1E-02	5.2E-03	2.7E-03	2.2E-03
838.7	1.3E+05	9.2E+00	2.5E-02	1.9E-02	1.8E-02	8.8E-03	7.8E-03	3.5E-03	1.8E-03	1.5E-03
853.7	4.6E+04	3.4E+00	9.2E-03	6.8E-03	6.6E-03	3.2E-03	2.8E-03	1.3E-03	6.6E-04	5.5E-04

Table C-41. Air Concentration Estimates for Burrowing in Bay A – Typical Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (0.53 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.4E-01	7.3E-06	2.0E-08	1.5E-08	1.4E-08	7.0E-09	6.2E-09	2.8E-09	1.4E-09	1.2E-09
0.7	4.0E-01	6.7E-06	1.8E-08	1.3E-08	1.3E-08	6.3E-09	5.6E-09	2.5E-09	1.3E-09	1.1E-09
15.7	3.1E-01	5.2E-06	1.4E-08	1.0E-08	1.0E-08	4.9E-09	4.3E-09	2.0E-09	1.0E-09	8.5E-10
30.7	1.6E-01	2.7E-06	7.4E-09	5.5E-09	5.4E-09	2.6E-09	2.3E-09	1.0E-09	5.4E-10	4.5E-10
45.7	1.5E-01	2.6E-06	7.0E-09	5.2E-09	5.1E-09	2.5E-09	2.2E-09	9.9E-10	5.1E-10	4.2E-10
45.7	1.5E-01	2.6E-06	7.0E-09	5.2E-09	5.1E-09	2.5E-09	2.2E-09	9.9E-10	5.1E-10	4.2E-10
47.2	2.5E-01	4.1E-06	1.1E-08	8.3E-09	8.0E-09	3.9E-09	3.4E-09	1.6E-09	8.1E-10	6.7E-10
62.2	6.4E-01	1.1E-05	2.9E-08	2.2E-08	2.1E-08	1.0E-08	9.0E-09	4.1E-09	2.1E-09	1.8E-09
77.2	2.5E+00	4.2E-05	1.1E-07	8.4E-08	8.1E-08	3.9E-08	3.5E-08	1.6E-08	8.2E-09	6.8E-09
92.2	1.2E+01	2.0E-04	5.5E-07	4.1E-07	4.0E-07	1.9E-07	1.7E-07	7.7E-08	4.0E-08	3.3E-08
107.2	7.8E+01	1.3E-03	3.5E-06	2.6E-06	2.5E-06	1.2E-06	1.1E-06	5.0E-07	2.6E-07	2.1E-07
122.2	6.9E+02	1.2E-02	3.1E-05	2.3E-05	2.3E-05	1.1E-05	9.7E-06	4.4E-06	2.3E-06	1.9E-06
137.2	7.2E+02	1.2E-02	3.3E-05	2.4E-05	2.4E-05	1.1E-05	1.0E-05	4.6E-06	2.4E-06	2.0E-06
137.2	7.2E+02	1.2E-02	3.3E-05	2.4E-05	2.4E-05	1.1E-05	1.0E-05	4.6E-06	2.4E-06	2.0E-06
140.5	1.0E+03	1.7E-02	4.7E-05	3.5E-05	3.4E-05	1.6E-05	1.5E-05	6.6E-06	3.4E-06	2.8E-06
155.5	1.5E+03	2.5E-02	6.8E-05	5.0E-05	4.9E-05	2.4E-05	2.1E-05	9.5E-06	4.9E-06	4.1E-06
170.5	2.2E+03	3.6E-02	9.8E-05	7.3E-05	7.0E-05	3.4E-05	3.0E-05	1.4E-05	7.1E-06	5.9E-06
185.5	3.1E+03	5.2E-02	1.4E-04	1.0E-04	1.0E-04	4.9E-05	4.4E-05	2.0E-05	1.0E-05	8.5E-06
200.5	4.5E+03	7.5E-02	2.1E-04	1.5E-04	1.5E-04	7.2E-05	6.3E-05	2.9E-05	1.5E-05	1.2E-05
215.5	6.6E+03	1.1E-01	3.0E-04	2.2E-04	2.2E-04	1.0E-04	9.2E-05	4.2E-05	2.2E-05	1.8E-05
230.5	9.7E+03	1.6E-01	4.4E-04	3.3E-04	3.2E-04	1.5E-04	1.4E-04	6.2E-05	3.2E-05	2.7E-05
245.5	1.4E+04	2.4E-01	6.6E-04	4.9E-04	4.7E-04	2.3E-04	2.0E-04	9.2E-05	4.8E-05	4.0E-05
260.5	2.2E+04	3.7E-01	1.0E-03	7.4E-04	7.2E-04	3.5E-04	3.1E-04	1.4E-04	7.2E-05	6.0E-05
275.5	3.4E+04	5.7E-01	1.6E-03	1.2E-03	1.1E-03	5.4E-04	4.8E-04	2.2E-04	1.1E-04	9.4E-05
290.5	5.6E+04	9.3E-01	2.5E-03	1.9E-03	1.8E-03	8.8E-04	7.8E-04	3.6E-04	1.8E-04	1.5E-04
305.5	9.4E+04	1.6E+00	4.3E-03	3.2E-03	3.1E-03	1.5E-03	1.3E-03	6.0E-04	3.1E-04	2.6E-04
320.5	1.6E+05	2.6E+00	7.2E-03	5.3E-03	5.2E-03	2.5E-03	2.2E-03	1.0E-03	5.2E-04	4.3E-04
335.5	2.2E+05	3.6E+00	9.9E-03	7.3E-03	7.1E-03	3.4E-03	3.0E-03	1.4E-03	7.1E-04	5.9E-04
350.5	2.2E+05	3.7E+00	1.0E-02	7.4E-03	7.2E-03	3.5E-03	3.1E-03	1.4E-03	7.2E-04	6.0E-04
350.5	2.2E+05	3.7E+00	1.0E-02	7.4E-03	7.2E-03	3.5E-03	3.1E-03	1.4E-03	7.2E-04	6.0E-04

Table C-41. Air Concentration Estimates for Burrowing in Bay A – Typical Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (0.53 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
351.0	2.5E+05	4.2E+00	1.1E-02	8.5E-03	8.3E-03	4.0E-03	3.5E-03	1.6E-03	8.3E-04	6.9E-04
366.0	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
381.0	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
381.0	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
388.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
403.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
418.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
433.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
448.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
463.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
478.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
493.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
508.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
523.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
538.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
553.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
568.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
583.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
598.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
613.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
628.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
643.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
658.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
673.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
688.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
703.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
718.7	2.7E+05	4.5E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.8E-04	7.3E-04
733.7	2.7E+05	4.4E+00	1.2E-02	9.0E-03	8.7E-03	4.2E-03	3.7E-03	1.7E-03	8.7E-04	7.3E-04
748.7	2.6E+05	4.4E+00	1.2E-02	8.9E-03	8.6E-03	4.2E-03	3.7E-03	1.7E-03	8.7E-04	7.2E-04
763.7	2.6E+05	4.4E+00	1.2E-02	8.8E-03	8.6E-03	4.1E-03	3.7E-03	1.7E-03	8.6E-04	7.2E-04

Table C-41. Air Concentration Estimates for Burrowing in Bay A – Typical Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (0.53 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
778.7	2.6E+05	4.3E+00	1.2E-02	8.6E-03	8.4E-03	4.0E-03	3.6E-03	1.6E-03	8.4E-04	7.0E-04
793.7	2.4E+05	4.1E+00	1.1E-02	8.2E-03	8.0E-03	3.9E-03	3.4E-03	1.6E-03	8.0E-04	6.7E-04
808.7	2.2E+05	3.7E+00	1.0E-02	7.5E-03	7.3E-03	3.5E-03	3.1E-03	1.4E-03	7.3E-04	6.1E-04
823.7	1.9E+05	3.1E+00	8.5E-03	6.3E-03	6.1E-03	3.0E-03	2.6E-03	1.2E-03	6.1E-04	5.1E-04
838.7	1.3E+05	2.1E+00	5.8E-03	4.3E-03	4.2E-03	2.0E-03	1.8E-03	8.1E-04	4.2E-04	3.5E-04
853.7	4.6E+04	7.8E-01	2.1E-03	1.6E-03	1.5E-03	7.4E-04	6.5E-04	3.0E-04	1.5E-04	1.3E-04

Default Meterology at Receptor Locations

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Table C-42. Air Concentration Estimates for Excavation in Bay A – Default Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.4E-01	1.4E-03	2.5E-07	1.3E-07	8.9E-08	6.5E-08	6.1E-08	4.1E-08	2.9E-08	1.4E-08
0.7	4.0E-01	1.3E-03	2.3E-07	1.2E-07	8.1E-08	5.9E-08	5.6E-08	3.7E-08	2.6E-08	1.3E-08
15.7	3.1E-01	9.8E-04	1.8E-07	9.4E-08	6.3E-08	4.6E-08	4.3E-08	2.9E-08	2.1E-08	1.0E-08
30.7	1.6E-01	5.2E-04	9.5E-08	5.0E-08	3.3E-08	2.4E-08	2.3E-08	1.5E-08	1.1E-08	5.3E-09
45.7	1.5E-01	4.9E-04	9.0E-08	4.7E-08	3.2E-08	2.3E-08	2.2E-08	1.4E-08	1.0E-08	5.0E-09
45.7	1.5E-01	4.9E-04	9.0E-08	4.7E-08	3.2E-08	2.3E-08	2.2E-08	1.4E-08	1.0E-08	5.0E-09
47.2	2.5E-01	7.7E-04	1.4E-07	7.5E-08	5.0E-08	3.7E-08	3.4E-08	2.3E-08	1.6E-08	7.9E-09
62.2	6.4E-01	2.0E-03	3.7E-07	2.0E-07	1.3E-07	9.6E-08	9.0E-08	6.0E-08	4.3E-08	2.1E-08
77.2	2.5E+00	7.8E-03	1.4E-06	7.6E-07	5.1E-07	3.7E-07	3.5E-07	2.3E-07	1.6E-07	8.0E-08
92.2	1.2E+01	3.8E-02	7.0E-06	3.7E-06	2.5E-06	1.8E-06	1.7E-06	1.1E-06	8.0E-07	3.9E-07
107.2	7.8E+01	2.4E-01	4.5E-05	2.4E-05	1.6E-05	1.2E-05	1.1E-05	7.2E-06	5.1E-06	2.5E-06
122.2	6.9E+02	2.2E+00	4.0E-04	2.1E-04	1.4E-04	1.0E-04	9.6E-05	6.4E-05	4.6E-05	2.2E-05
137.2	7.2E+02	2.3E+00	4.2E-04	2.2E-04	1.5E-04	1.1E-04	1.0E-04	6.7E-05	4.8E-05	2.3E-05
137.2	7.2E+02	2.3E+00	4.2E-04	2.2E-04	1.5E-04	1.1E-04	1.0E-04	6.7E-05	4.8E-05	2.3E-05
140.5	1.0E+03	3.3E+00	6.0E-04	3.2E-04	2.1E-04	1.5E-04	1.4E-04	9.6E-05	6.9E-05	3.3E-05
155.5	1.5E+03	4.7E+00	8.7E-04	4.5E-04	3.0E-04	2.2E-04	2.1E-04	1.4E-04	9.9E-05	4.8E-05
170.5	2.2E+03	6.8E+00	1.2E-03	6.5E-04	4.4E-04	3.2E-04	3.0E-04	2.0E-04	1.4E-04	6.9E-05
185.5	3.1E+03	9.8E+00	1.8E-03	9.5E-04	6.3E-04	4.6E-04	4.3E-04	2.9E-04	2.1E-04	1.0E-04
200.5	4.5E+03	1.4E+01	2.6E-03	1.4E-03	9.2E-04	6.7E-04	6.3E-04	4.2E-04	3.0E-04	1.5E-04
215.5	6.6E+03	2.1E+01	3.8E-03	2.0E-03	1.3E-03	9.8E-04	9.2E-04	6.1E-04	4.4E-04	2.1E-04
230.5	9.7E+03	3.1E+01	5.6E-03	2.9E-03	2.0E-03	1.4E-03	1.4E-03	9.0E-04	6.4E-04	3.1E-04
245.5	1.4E+04	4.6E+01	8.4E-03	4.4E-03	2.9E-03	2.2E-03	2.0E-03	1.3E-03	9.6E-04	4.6E-04
260.5	2.2E+04	6.9E+01	1.3E-02	6.7E-03	4.5E-03	3.3E-03	3.1E-03	2.0E-03	1.5E-03	7.1E-04
275.5	3.4E+04	1.1E+02	2.0E-02	1.0E-02	7.0E-03	5.1E-03	4.8E-03	3.2E-03	2.3E-03	1.1E-03
290.5	5.6E+04	1.8E+02	3.2E-02	1.7E-02	1.1E-02	8.3E-03	7.8E-03	5.2E-03	3.7E-03	1.8E-03
305.5	9.4E+04	3.0E+02	5.4E-02	2.9E-02	1.9E-02	1.4E-02	1.3E-02	8.7E-03	6.2E-03	3.0E-03
320.5	1.6E+05	5.0E+02	9.1E-02	4.8E-02	3.2E-02	2.4E-02	2.2E-02	1.5E-02	1.0E-02	5.1E-03
335.5	2.2E+05	6.8E+02	1.3E-01	6.6E-02	4.4E-02	3.2E-02	3.0E-02	2.0E-02	1.4E-02	7.0E-03
350.5	2.2E+05	6.9E+02	1.3E-01	6.7E-02	4.5E-02	3.3E-02	3.1E-02	2.0E-02	1.5E-02	7.1E-03
350.5	2.2E+05	6.9E+02	1.3E-01	6.7E-02	4.5E-02	3.3E-02	3.1E-02	2.0E-02	1.5E-02	7.1E-03

Table C-42. Air Concentration Estimates for Excavation in Bay A – Default Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
351.0	2.5E+05	8.0E+02	1.5E-01	7.7E-02	5.1E-02	3.8E-02	3.5E-02	2.3E-02	1.7E-02	8.1E-03
366.0	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
381.0	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
381.0	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
388.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
403.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
418.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
433.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
448.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
463.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
478.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
493.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
508.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
523.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
538.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
553.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
568.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
583.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
598.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
613.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
628.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
643.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
658.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
673.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
688.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
703.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
718.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
733.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.5E-03
748.7	2.6E+05	8.3E+02	1.5E-01	8.0E-02	5.4E-02	3.9E-02	3.7E-02	2.4E-02	1.7E-02	8.5E-03
763.7	2.6E+05	8.2E+02	1.5E-01	7.9E-02	5.3E-02	3.9E-02	3.6E-02	2.4E-02	1.7E-02	8.4E-03
778.7	2.6E+05	8.0E+02	1.5E-01	7.8E-02	5.2E-02	3.8E-02	3.6E-02	2.4E-02	1.7E-02	8.2E-03

Table C-42. Air Concentration Estimates for Excavation in Bay A – Default Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
793.7	2.4E+05	7.7E+02	1.4E-01	7.4E-02	5.0E-02	3.6E-02	3.4E-02	2.3E-02	1.6E-02	7.9E-03
808.7	2.2E+05	7.0E+02	1.3E-01	6.8E-02	4.5E-02	3.3E-02	3.1E-02	2.1E-02	1.5E-02	7.2E-03
823.7	1.9E+05	5.9E+02	1.1E-01	5.7E-02	3.8E-02	2.8E-02	2.6E-02	1.7E-02	1.2E-02	6.0E-03
838.7	1.3E+05	4.0E+02	7.4E-02	3.9E-02	2.6E-02	1.9E-02	1.8E-02	1.2E-02	8.4E-03	4.1E-03
853.7	4.6E+04	1.5E+02	2.7E-02	1.4E-02	9.5E-03	6.9E-03	6.5E-03	4.3E-03	3.1E-03	1.5E-03

Table C-43. Air Concentration Estimates for Excavation in Bay B – Default Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.5E-01	1.4E-03	2.6E-07	1.4E-07	9.1E-08	6.7E-08	6.3E-08	4.2E-08	3.0E-08	1.4E-08
0.7	4.1E-01	1.3E-03	2.4E-07	1.2E-07	8.3E-08	6.1E-08	5.7E-08	3.8E-08	2.7E-08	1.3E-08
15.7	3.2E-01	1.0E-03	1.8E-07	9.6E-08	6.4E-08	4.7E-08	4.4E-08	2.9E-08	2.1E-08	1.0E-08
30.7	1.6E-01	5.1E-04	9.4E-08	4.9E-08	3.3E-08	2.4E-08	2.3E-08	1.5E-08	1.1E-08	5.2E-09
45.7	1.5E-01	4.8E-04	8.9E-08	4.7E-08	3.1E-08	2.3E-08	2.1E-08	1.4E-08	1.0E-08	4.9E-09
45.7	1.5E-01	4.8E-04	8.9E-08	4.7E-08	3.1E-08	2.3E-08	2.1E-08	1.4E-08	1.0E-08	4.9E-09
47.2	2.4E-01	7.4E-04	1.4E-07	7.2E-08	4.8E-08	3.5E-08	3.3E-08	2.2E-08	1.6E-08	7.6E-09
62.2	5.8E-01	1.8E-03	3.4E-07	1.8E-07	1.2E-07	8.7E-08	8.1E-08	5.4E-08	3.9E-08	1.9E-08
77.2	2.0E+00	6.5E-03	1.2E-06	6.2E-07	4.2E-07	3.1E-07	2.9E-07	1.9E-07	1.4E-07	6.6E-08
92.2	8.2E+00	2.6E-02	4.8E-06	2.5E-06	1.7E-06	1.2E-06	1.1E-06	7.6E-07	5.4E-07	2.6E-07
107.2	3.3E+01	1.0E-01	1.9E-05	1.0E-05	6.7E-06	4.9E-06	4.6E-06	3.1E-06	2.2E-06	1.1E-06
122.2	8.2E+01	2.6E-01	4.8E-05	2.5E-05	1.7E-05	1.2E-05	1.1E-05	7.6E-06	5.4E-06	2.6E-06
137.2	8.3E+01	2.6E-01	4.8E-05	2.5E-05	1.7E-05	1.2E-05	1.2E-05	7.7E-06	5.5E-06	2.7E-06
137.2	8.3E+01	2.6E-01	4.8E-05	2.5E-05	1.7E-05	1.2E-05	1.2E-05	7.7E-06	5.5E-06	2.7E-06
140.5	1.2E+02	3.7E-01	6.9E-05	3.6E-05	2.4E-05	1.8E-05	1.7E-05	1.1E-05	7.8E-06	3.8E-06
155.5	1.7E+02	5.4E-01	9.9E-05	5.2E-05	3.5E-05	2.6E-05	2.4E-05	1.6E-05	1.1E-05	5.5E-06
170.5	2.5E+02	7.9E-01	1.5E-04	7.6E-05	5.1E-05	3.7E-05	3.5E-05	2.3E-05	1.7E-05	8.1E-06
185.5	3.7E+02	1.2E+00	2.1E-04	1.1E-04	7.5E-05	5.5E-05	5.1E-05	3.4E-05	2.4E-05	1.2E-05
200.5	5.4E+02	1.7E+00	3.2E-04	1.7E-04	1.1E-04	8.1E-05	7.6E-05	5.0E-05	3.6E-05	1.7E-05
215.5	8.1E+02	2.5E+00	4.7E-04	2.5E-04	1.6E-04	1.2E-04	1.1E-04	7.5E-05	5.3E-05	2.6E-05
230.5	1.2E+03	3.8E+00	7.0E-04	3.6E-04	2.4E-04	1.8E-04	1.7E-04	1.1E-04	7.9E-05	3.9E-05
245.5	1.8E+03	5.6E+00	1.0E-03	5.4E-04	3.6E-04	2.7E-04	2.5E-04	1.7E-04	1.2E-04	5.7E-05
260.5	2.6E+03	8.4E+00	1.5E-03	8.1E-04	5.4E-04	4.0E-04	3.7E-04	2.5E-04	1.8E-04	8.5E-05
275.5	3.9E+03	1.2E+01	2.3E-03	1.2E-03	8.0E-04	5.8E-04	5.5E-04	3.6E-04	2.6E-04	1.3E-04
290.5	5.7E+03	1.8E+01	3.3E-03	1.7E-03	1.2E-03	8.5E-04	7.9E-04	5.3E-04	3.8E-04	1.8E-04
305.5	7.9E+03	2.5E+01	4.6E-03	2.4E-03	1.6E-03	1.2E-03	1.1E-03	7.3E-04	5.2E-04	2.5E-04
320.5	1.0E+04	3.2E+01	5.9E-03	3.1E-03	2.1E-03	1.5E-03	1.4E-03	9.4E-04	6.7E-04	3.3E-04
335.5	1.1E+04	3.6E+01	6.6E-03	3.5E-03	2.3E-03	1.7E-03	1.6E-03	1.1E-03	7.6E-04	3.7E-04
350.5	1.1E+04	3.6E+01	6.7E-03	3.5E-03	2.3E-03	1.7E-03	1.6E-03	1.1E-03	7.6E-04	3.7E-04
350.5	1.1E+04	3.6E+01	6.7E-03	3.5E-03	2.3E-03	1.7E-03	1.6E-03	1.1E-03	7.6E-04	3.7E-04

Table C-43. Air Concentration Estimates for Excavation in Bay B – Default Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
352.4	1.2E+04	3.7E+01	6.8E-03	3.6E-03	2.4E-03	1.8E-03	1.6E-03	1.1E-03	7.8E-04	3.8E-04
367.4	1.2E+04	3.8E+01	7.0E-03	3.7E-03	2.5E-03	1.8E-03	1.7E-03	1.1E-03	8.0E-04	3.9E-04
382.4	1.2E+04	3.8E+01	7.1E-03	3.7E-03	2.5E-03	1.8E-03	1.7E-03	1.1E-03	8.1E-04	3.9E-04
397.4	1.2E+04	3.8E+01	7.1E-03	3.7E-03	2.5E-03	1.8E-03	1.7E-03	1.1E-03	8.1E-04	3.9E-04
412.4	1.2E+04	3.8E+01	6.9E-03	3.6E-03	2.4E-03	1.8E-03	1.7E-03	1.1E-03	7.9E-04	3.8E-04
427.4	1.1E+04	3.6E+01	6.6E-03	3.4E-03	2.3E-03	1.7E-03	1.6E-03	1.0E-03	7.5E-04	3.6E-04
442.4	1.0E+04	3.2E+01	6.0E-03	3.1E-03	2.1E-03	1.5E-03	1.4E-03	9.5E-04	6.8E-04	3.3E-04
457.4	8.9E+03	2.8E+01	5.1E-03	2.7E-03	1.8E-03	1.3E-03	1.2E-03	8.2E-04	5.9E-04	2.8E-04
472.4	8.6E+03	2.7E+01	5.0E-03	2.6E-03	1.8E-03	1.3E-03	1.2E-03	8.0E-04	5.7E-04	2.8E-04
472.4	8.6E+03	2.7E+01	5.0E-03	2.6E-03	1.8E-03	1.3E-03	1.2E-03	8.0E-04	5.7E-04	2.8E-04
472.9	9.5E+03	3.0E+01	5.5E-03	2.9E-03	1.9E-03	1.4E-03	1.3E-03	8.8E-04	6.3E-04	3.1E-04
487.9	9.9E+03	3.1E+01	5.7E-03	3.0E-03	2.0E-03	1.5E-03	1.4E-03	9.2E-04	6.5E-04	3.2E-04
502.9	9.9E+03	3.1E+01	5.7E-03	3.0E-03	2.0E-03	1.5E-03	1.4E-03	9.2E-04	6.5E-04	3.2E-04
502.9	9.9E+03	3.1E+01	5.7E-03	3.0E-03	2.0E-03	1.5E-03	1.4E-03	9.2E-04	6.5E-04	3.2E-04
508.7	9.9E+03	3.1E+01	5.7E-03	3.0E-03	2.0E-03	1.5E-03	1.4E-03	9.1E-04	6.5E-04	3.2E-04
523.7	9.9E+03	3.1E+01	5.7E-03	3.0E-03	2.0E-03	1.5E-03	1.4E-03	9.1E-04	6.5E-04	3.2E-04
538.7	9.9E+03	3.1E+01	5.7E-03	3.0E-03	2.0E-03	1.5E-03	1.4E-03	9.1E-04	6.5E-04	3.2E-04
553.7	9.8E+03	3.1E+01	5.7E-03	3.0E-03	2.0E-03	1.5E-03	1.4E-03	9.1E-04	6.5E-04	3.2E-04
568.7	9.8E+03	3.1E+01	5.7E-03	3.0E-03	2.0E-03	1.5E-03	1.4E-03	9.1E-04	6.5E-04	3.2E-04
583.7	9.8E+03	3.1E+01	5.7E-03	3.0E-03	2.0E-03	1.5E-03	1.4E-03	9.1E-04	6.5E-04	3.2E-04
598.7	9.8E+03	3.1E+01	5.7E-03	3.0E-03	2.0E-03	1.5E-03	1.4E-03	9.1E-04	6.5E-04	3.1E-04
613.7	9.8E+03	3.1E+01	5.7E-03	3.0E-03	2.0E-03	1.5E-03	1.4E-03	9.0E-04	6.5E-04	3.1E-04
628.7	9.7E+03	3.1E+01	5.6E-03	3.0E-03	2.0E-03	1.4E-03	1.4E-03	9.0E-04	6.4E-04	3.1E-04
643.7	9.6E+03	3.0E+01	5.6E-03	2.9E-03	2.0E-03	1.4E-03	1.3E-03	8.9E-04	6.4E-04	3.1E-04
658.7	9.6E+03	3.0E+01	5.6E-03	2.9E-03	1.9E-03	1.4E-03	1.3E-03	8.9E-04	6.3E-04	3.1E-04
673.7	9.5E+03	3.0E+01	5.5E-03	2.9E-03	1.9E-03	1.4E-03	1.3E-03	8.8E-04	6.3E-04	3.0E-04
688.7	9.3E+03	2.9E+01	5.4E-03	2.8E-03	1.9E-03	1.4E-03	1.3E-03	8.6E-04	6.2E-04	3.0E-04
703.7	9.1E+03	2.9E+01	5.3E-03	2.8E-03	1.9E-03	1.4E-03	1.3E-03	8.4E-04	6.0E-04	2.9E-04
718.7	8.8E+03	2.8E+01	5.1E-03	2.7E-03	1.8E-03	1.3E-03	1.2E-03	8.2E-04	5.9E-04	2.8E-04
733.7	8.5E+03	2.7E+01	4.9E-03	2.6E-03	1.7E-03	1.3E-03	1.2E-03	7.9E-04	5.6E-04	2.7E-04
748.7	8.0E+03	2.5E+01	4.7E-03	2.4E-03	1.6E-03	1.2E-03	1.1E-03	7.5E-04	5.3E-04	2.6E-04

Table C-43. Air Concentration Estimates for Excavation in Bay B – Default Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
763.7	7.5E+03	2.4E+01	4.3E-03	2.3E-03	1.5E-03	1.1E-03	1.0E-03	6.9E-04	4.9E-04	2.4E-04
778.7	6.7E+03	2.1E+01	3.9E-03	2.0E-03	1.4E-03	1.0E-03	9.4E-04	6.2E-04	4.4E-04	2.2E-04
793.7	5.8E+03	1.8E+01	3.4E-03	1.8E-03	1.2E-03	8.7E-04	8.1E-04	5.4E-04	3.8E-04	1.9E-04
808.7	4.7E+03	1.5E+01	2.7E-03	1.4E-03	9.6E-04	7.1E-04	6.6E-04	4.4E-04	3.1E-04	1.5E-04
823.7	3.5E+03	1.1E+01	2.0E-03	1.1E-03	7.1E-04	5.2E-04	4.9E-04	3.2E-04	2.3E-04	1.1E-04
838.7	2.1E+03	6.5E+00	1.2E-03	6.3E-04	4.2E-04	3.1E-04	2.9E-04	1.9E-04	1.4E-04	6.7E-05
853.7	5.8E+02	1.8E+00	3.4E-04	1.8E-04	1.2E-04	8.7E-05	8.2E-05	5.4E-05	3.9E-05	1.9E-05

Table C-44. Air Concentration Estimates for Excavation in Bay C – Default Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.3E-01	1.3E-03	2.5E-07	1.3E-07	8.7E-08	6.4E-08	6.0E-08	4.0E-08	2.8E-08	1.4E-08
0.7	3.8E-01	1.2E-03	2.2E-07	1.2E-07	7.8E-08	5.7E-08	5.3E-08	3.5E-08	2.5E-08	1.2E-08
15.7	2.9E-01	9.1E-04	1.7E-07	8.8E-08	5.9E-08	4.3E-08	4.0E-08	2.7E-08	1.9E-08	9.3E-09
30.7	1.4E-01	4.4E-04	8.1E-08	4.2E-08	2.8E-08	2.1E-08	1.9E-08	1.3E-08	9.2E-09	4.5E-09
45.7	1.3E-01	4.1E-04	7.6E-08	4.0E-08	2.7E-08	1.9E-08	1.8E-08	1.2E-08	8.6E-09	4.2E-09
45.7	1.3E-01	4.1E-04	7.6E-08	4.0E-08	2.7E-08	1.9E-08	1.8E-08	1.2E-08	8.6E-09	4.2E-09
47.2	1.4E-01	4.4E-04	8.1E-08	4.3E-08	2.9E-08	2.1E-08	2.0E-08	1.3E-08	9.3E-09	4.5E-09
62.2	1.8E-01	5.8E-04	1.1E-07	5.6E-08	3.8E-08	2.8E-08	2.6E-08	1.7E-08	1.2E-08	5.9E-09
77.2	3.9E-01	1.2E-03	2.3E-07	1.2E-07	7.9E-08	5.8E-08	5.4E-08	3.6E-08	2.6E-08	1.3E-08
92.2	1.5E+00	4.6E-03	8.5E-07	4.4E-07	3.0E-07	2.2E-07	2.0E-07	1.4E-07	9.7E-08	4.7E-08
107.2	8.7E+00	2.8E-02	5.1E-06	2.7E-06	1.8E-06	1.3E-06	1.2E-06	8.1E-07	5.8E-07	2.8E-07
122.2	7.7E+01	2.4E-01	4.5E-05	2.3E-05	1.6E-05	1.1E-05	1.1E-05	7.1E-06	5.1E-06	2.5E-06
137.2	8.0E+01	2.5E-01	4.7E-05	2.4E-05	1.6E-05	1.2E-05	1.1E-05	7.5E-06	5.3E-06	2.6E-06
137.2	8.0E+01	2.5E-01	4.7E-05	2.4E-05	1.6E-05	1.2E-05	1.1E-05	7.5E-06	5.3E-06	2.6E-06
140.5	1.1E+02	3.5E-01	6.5E-05	3.4E-05	2.3E-05	1.7E-05	1.6E-05	1.0E-05	7.4E-06	3.6E-06
155.5	1.6E+02	5.0E-01	9.2E-05	4.8E-05	3.2E-05	2.4E-05	2.2E-05	1.5E-05	1.0E-05	5.1E-06
170.5	2.3E+02	7.1E-01	1.3E-04	6.9E-05	4.6E-05	3.4E-05	3.1E-05	2.1E-05	1.5E-05	7.2E-06
185.5	3.2E+02	1.0E+00	1.9E-04	9.8E-05	6.6E-05	4.8E-05	4.5E-05	3.0E-05	2.1E-05	1.0E-05
200.5	4.7E+02	1.5E+00	2.7E-04	1.4E-04	9.5E-05	7.0E-05	6.5E-05	4.3E-05	3.1E-05	1.5E-05
215.5	6.8E+02	2.2E+00	4.0E-04	2.1E-04	1.4E-04	1.0E-04	9.6E-05	6.3E-05	4.5E-05	2.2E-05
230.5	1.0E+03	3.2E+00	5.9E-04	3.1E-04	2.1E-04	1.5E-04	1.4E-04	9.4E-05	6.7E-05	3.3E-05
245.5	1.5E+03	4.8E+00	8.8E-04	4.6E-04	3.1E-04	2.3E-04	2.1E-04	1.4E-04	1.0E-04	4.9E-05
260.5	2.3E+03	7.4E+00	1.4E-03	7.1E-04	4.8E-04	3.5E-04	3.3E-04	2.2E-04	1.6E-04	7.5E-05
275.5	3.7E+03	1.2E+01	2.2E-03	1.1E-03	7.6E-04	5.5E-04	5.2E-04	3.4E-04	2.5E-04	1.2E-04
290.5	6.1E+03	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
305.5	1.1E+04	3.3E+01	6.2E-03	3.2E-03	2.2E-03	1.6E-03	1.5E-03	9.8E-04	7.0E-04	3.4E-04
320.5	1.8E+04	5.8E+01	1.1E-02	5.6E-03	3.7E-03	2.7E-03	2.6E-03	1.7E-03	1.2E-03	5.9E-04
335.5	2.6E+04	8.1E+01	1.5E-02	7.9E-03	5.3E-03	3.9E-03	3.6E-03	2.4E-03	1.7E-03	8.3E-04
350.5	2.6E+04	8.3E+01	1.5E-02	8.0E-03	5.3E-03	3.9E-03	3.7E-03	2.4E-03	1.7E-03	8.4E-04
350.5	2.6E+04	8.3E+01	1.5E-02	8.0E-03	5.3E-03	3.9E-03	3.7E-03	2.4E-03	1.7E-03	8.4E-04
352.4	3.0E+04	9.4E+01	1.7E-02	9.1E-03	6.1E-03	4.4E-03	4.2E-03	2.8E-03	2.0E-03	9.6E-04

Table C-44. Air Concentration Estimates for Excavation in Bay C – Default Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
367.4	3.4E+04	1.1E+02	2.0E-02	1.0E-02	7.0E-03	5.1E-03	4.8E-03	3.2E-03	2.3E-03	1.1E-03
382.4	4.0E+04	1.2E+02	2.3E-02	1.2E-02	8.1E-03	5.9E-03	5.5E-03	3.7E-03	2.6E-03	1.3E-03
397.4	4.6E+04	1.5E+02	2.7E-02	1.4E-02	9.4E-03	6.9E-03	6.5E-03	4.3E-03	3.1E-03	1.5E-03
412.4	5.4E+04	1.7E+02	3.1E-02	1.6E-02	1.1E-02	8.1E-03	7.6E-03	5.0E-03	3.6E-03	1.7E-03
427.4	6.3E+04	2.0E+02	3.6E-02	1.9E-02	1.3E-02	9.3E-03	8.7E-03	5.8E-03	4.1E-03	2.0E-03
442.4	7.0E+04	2.2E+02	4.0E-02	2.1E-02	1.4E-02	1.0E-02	9.7E-03	6.5E-03	4.6E-03	2.2E-03
457.4	7.2E+04	2.3E+02	4.2E-02	2.2E-02	1.5E-02	1.1E-02	1.0E-02	6.7E-03	4.8E-03	2.3E-03
472.4	7.2E+04	2.3E+02	4.2E-02	2.2E-02	1.5E-02	1.1E-02	1.0E-02	6.7E-03	4.8E-03	2.3E-03
472.4	7.2E+04	2.3E+02	4.2E-02	2.2E-02	1.5E-02	1.1E-02	1.0E-02	6.7E-03	4.8E-03	2.3E-03
472.9	8.8E+04	2.8E+02	5.1E-02	2.7E-02	1.8E-02	1.3E-02	1.2E-02	8.2E-03	5.8E-03	2.8E-03
487.9	9.5E+04	3.0E+02	5.5E-02	2.9E-02	1.9E-02	1.4E-02	1.3E-02	8.8E-03	6.3E-03	3.1E-03
502.9	9.5E+04	3.0E+02	5.5E-02	2.9E-02	1.9E-02	1.4E-02	1.3E-02	8.8E-03	6.3E-03	3.1E-03
502.9	9.5E+04	3.0E+02	5.5E-02	2.9E-02	1.9E-02	1.4E-02	1.3E-02	8.8E-03	6.3E-03	3.1E-03
505.3	1.1E+05	3.4E+02	6.3E-02	3.3E-02	2.2E-02	1.6E-02	1.5E-02	1.0E-02	7.2E-03	3.5E-03
520.3	1.2E+05	3.9E+02	7.2E-02	3.8E-02	2.5E-02	1.8E-02	1.7E-02	1.1E-02	8.2E-03	4.0E-03
535.3	1.4E+05	4.4E+02	8.1E-02	4.3E-02	2.9E-02	2.1E-02	2.0E-02	1.3E-02	9.3E-03	4.5E-03
550.3	1.6E+05	5.0E+02	9.2E-02	4.8E-02	3.2E-02	2.4E-02	2.2E-02	1.5E-02	1.0E-02	5.1E-03
565.3	1.8E+05	5.6E+02	1.0E-01	5.4E-02	3.6E-02	2.7E-02	2.5E-02	1.7E-02	1.2E-02	5.7E-03
580.3	2.0E+05	6.3E+02	1.2E-01	6.1E-02	4.1E-02	3.0E-02	2.8E-02	1.9E-02	1.3E-02	6.4E-03
595.3	2.2E+05	7.0E+02	1.3E-01	6.8E-02	4.5E-02	3.3E-02	3.1E-02	2.1E-02	1.5E-02	7.1E-03
610.3	2.4E+05	7.7E+02	1.4E-01	7.4E-02	5.0E-02	3.6E-02	3.4E-02	2.3E-02	1.6E-02	7.8E-03
625.3	2.6E+05	8.2E+02	1.5E-01	7.9E-02	5.3E-02	3.9E-02	3.6E-02	2.4E-02	1.7E-02	8.4E-03
640.3	2.7E+05	8.4E+02	1.6E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
655.3	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
655.3	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
658.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
673.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
688.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
703.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
718.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.6E-03
733.7	2.7E+05	8.4E+02	1.5E-01	8.1E-02	5.4E-02	4.0E-02	3.7E-02	2.5E-02	1.8E-02	8.5E-03

Table C-44. Air Concentration Estimates for Excavation in Bay C – Default Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
748.7	2.6E+05	8.3E+02	1.5E-01	8.0E-02	5.4E-02	3.9E-02	3.7E-02	2.4E-02	1.7E-02	8.5E-03
763.7	2.6E+05	8.2E+02	1.5E-01	7.9E-02	5.3E-02	3.9E-02	3.6E-02	2.4E-02	1.7E-02	8.4E-03
778.7	2.5E+05	8.0E+02	1.5E-01	7.7E-02	5.1E-02	3.8E-02	3.5E-02	2.3E-02	1.7E-02	8.1E-03
793.7	2.4E+05	7.5E+02	1.4E-01	7.3E-02	4.9E-02	3.6E-02	3.3E-02	2.2E-02	1.6E-02	7.7E-03
808.7	2.1E+05	6.8E+02	1.2E-01	6.5E-02	4.4E-02	3.2E-02	3.0E-02	2.0E-02	1.4E-02	6.9E-03
823.7	1.7E+05	5.4E+02	1.0E-01	5.2E-02	3.5E-02	2.6E-02	2.4E-02	1.6E-02	1.1E-02	5.5E-03
838.7	1.1E+05	3.3E+02	6.2E-02	3.2E-02	2.2E-02	1.6E-02	1.5E-02	9.8E-03	7.0E-03	3.4E-03
853.7	2.1E+04	6.5E+01	1.2E-02	6.2E-03	4.2E-03	3.1E-03	2.9E-03	1.9E-03	1.4E-03	6.6E-04

Table C-45. Air Concentration Estimates for Excavation in Bay D – Default Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.3E-01	1.3E-03	2.5E-07	1.3E-07	8.7E-08	6.4E-08	6.0E-08	4.0E-08	2.8E-08	1.4E-08
0.7	3.8E-01	1.2E-03	2.2E-07	1.2E-07	7.8E-08	5.7E-08	5.3E-08	3.5E-08	2.5E-08	1.2E-08
15.7	2.9E-01	9.0E-04	1.7E-07	8.7E-08	5.8E-08	4.3E-08	4.0E-08	2.7E-08	1.9E-08	9.2E-09
30.7	1.4E-01	4.3E-04	7.9E-08	4.1E-08	2.8E-08	2.0E-08	1.9E-08	1.3E-08	9.0E-09	4.4E-09
45.7	1.3E-01	4.0E-04	7.4E-08	3.9E-08	2.6E-08	1.9E-08	1.8E-08	1.2E-08	8.5E-09	4.1E-09
45.7	1.3E-01	4.0E-04	7.4E-08	3.9E-08	2.6E-08	1.9E-08	1.8E-08	1.2E-08	8.5E-09	4.1E-09
47.2	1.3E-01	4.1E-04	7.5E-08	4.0E-08	2.6E-08	1.9E-08	1.8E-08	1.2E-08	8.6E-09	4.2E-09
62.2	1.4E-01	4.4E-04	8.0E-08	4.2E-08	2.8E-08	2.1E-08	1.9E-08	1.3E-08	9.2E-09	4.5E-09
77.2	1.8E-01	5.6E-04	1.0E-07	5.4E-08	3.6E-08	2.7E-08	2.5E-08	1.7E-08	1.2E-08	5.8E-09
92.2	3.9E-01	1.2E-03	2.3E-07	1.2E-07	7.9E-08	5.8E-08	5.4E-08	3.6E-08	2.6E-08	1.3E-08
107.2	1.8E+00	5.7E-03	1.1E-06	5.5E-07	3.7E-07	2.7E-07	2.5E-07	1.7E-07	1.2E-07	5.9E-08
122.2	1.5E+01	4.8E-02	8.8E-06	4.6E-06	3.1E-06	2.3E-06	2.1E-06	1.4E-06	1.0E-06	4.9E-07
137.2	1.6E+01	5.0E-02	9.2E-06	4.8E-06	3.2E-06	2.4E-06	2.2E-06	1.5E-06	1.1E-06	5.1E-07
137.2	1.6E+01	5.0E-02	9.2E-06	4.8E-06	3.2E-06	2.4E-06	2.2E-06	1.5E-06	1.1E-06	5.1E-07
146.3	1.9E+01	6.0E-02	1.1E-05	5.8E-06	3.9E-06	2.8E-06	2.7E-06	1.8E-06	1.3E-06	6.1E-07
161.3	2.4E+01	7.4E-02	1.4E-05	7.2E-06	4.8E-06	3.5E-06	3.3E-06	2.2E-06	1.6E-06	7.6E-07
176.3	3.0E+01	9.5E-02	1.7E-05	9.1E-06	6.1E-06	4.5E-06	4.2E-06	2.8E-06	2.0E-06	9.7E-07
191.3	3.9E+01	1.2E-01	2.3E-05	1.2E-05	8.0E-06	5.9E-06	5.5E-06	3.7E-06	2.6E-06	1.3E-06
206.3	5.3E+01	1.7E-01	3.1E-05	1.6E-05	1.1E-05	7.9E-06	7.4E-06	4.9E-06	3.5E-06	1.7E-06
221.3	7.3E+01	2.3E-01	4.2E-05	2.2E-05	1.5E-05	1.1E-05	1.0E-05	6.7E-06	4.8E-06	2.3E-06
236.3	1.0E+02	3.2E-01	5.9E-05	3.1E-05	2.1E-05	1.5E-05	1.4E-05	9.4E-06	6.7E-06	3.3E-06
251.3	1.4E+02	4.5E-01	8.4E-05	4.4E-05	2.9E-05	2.1E-05	2.0E-05	1.3E-05	9.5E-06	4.6E-06
266.3	2.1E+02	6.5E-01	1.2E-04	6.3E-05	4.2E-05	3.1E-05	2.9E-05	1.9E-05	1.4E-05	6.7E-06
281.3	3.0E+02	9.5E-01	1.8E-04	9.2E-05	6.2E-05	4.5E-05	4.2E-05	2.8E-05	2.0E-05	9.7E-06
296.3	4.5E+02	1.4E+00	2.6E-04	1.4E-04	9.1E-05	6.7E-05	6.3E-05	4.2E-05	3.0E-05	1.4E-05
311.3	6.8E+02	2.1E+00	3.9E-04	2.1E-04	1.4E-04	1.0E-04	9.5E-05	6.3E-05	4.5E-05	2.2E-05
326.3	1.1E+03	3.3E+00	6.2E-04	3.2E-04	2.2E-04	1.6E-04	1.5E-04	9.8E-05	7.0E-05	3.4E-05
341.3	1.7E+03	5.4E+00	1.0E-03	5.2E-04	3.5E-04	2.6E-04	2.4E-04	1.6E-04	1.1E-04	5.5E-05
356.3	2.9E+03	9.2E+00	1.7E-03	8.9E-04	5.9E-04	4.4E-04	4.1E-04	2.7E-04	1.9E-04	9.4E-05
371.3	5.1E+03	1.6E+01	3.0E-03	1.6E-03	1.0E-03	7.6E-04	7.1E-04	4.7E-04	3.4E-04	1.6E-04
386.3	8.1E+03	2.5E+01	4.7E-03	2.5E-03	1.6E-03	1.2E-03	1.1E-03	7.5E-04	5.4E-04	2.6E-04

Table C-45. Air Concentration Estimates for Excavation in Bay D – Default Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
401.3	8.9E+03	2.8E+01	5.2E-03	2.7E-03	1.8E-03	1.3E-03	1.2E-03	8.3E-04	5.9E-04	2.9E-04
401.3	8.9E+03	2.8E+01	5.2E-03	2.7E-03	1.8E-03	1.3E-03	1.2E-03	8.3E-04	5.9E-04	2.9E-04
406.1	8.9E+03	2.8E+01	5.2E-03	2.7E-03	1.8E-03	1.3E-03	1.2E-03	8.3E-04	5.9E-04	2.9E-04
421.1	8.9E+03	2.8E+01	5.2E-03	2.7E-03	1.8E-03	1.3E-03	1.2E-03	8.3E-04	5.9E-04	2.9E-04
436.1	9.0E+03	2.8E+01	5.2E-03	2.7E-03	1.8E-03	1.3E-03	1.3E-03	8.3E-04	5.9E-04	2.9E-04
451.1	9.0E+03	2.8E+01	5.2E-03	2.7E-03	1.8E-03	1.3E-03	1.3E-03	8.3E-04	5.9E-04	2.9E-04
466.1	9.0E+03	2.8E+01	5.2E-03	2.7E-03	1.8E-03	1.3E-03	1.3E-03	8.3E-04	5.9E-04	2.9E-04
481.1	9.0E+03	2.8E+01	5.2E-03	2.7E-03	1.8E-03	1.3E-03	1.3E-03	8.3E-04	5.9E-04	2.9E-04
496.1	9.0E+03	2.8E+01	5.2E-03	2.7E-03	1.8E-03	1.3E-03	1.3E-03	8.3E-04	5.9E-04	2.9E-04
511.1	9.0E+03	2.8E+01	5.2E-03	2.7E-03	1.8E-03	1.3E-03	1.3E-03	8.3E-04	5.9E-04	2.9E-04
526.1	8.9E+03	2.8E+01	5.2E-03	2.7E-03	1.8E-03	1.3E-03	1.2E-03	8.3E-04	5.9E-04	2.9E-04
541.1	8.9E+03	2.8E+01	5.2E-03	2.7E-03	1.8E-03	1.3E-03	1.2E-03	8.2E-04	5.9E-04	2.9E-04
556.1	8.8E+03	2.8E+01	5.1E-03	2.7E-03	1.8E-03	1.3E-03	1.2E-03	8.1E-04	5.8E-04	2.8E-04
571.1	8.7E+03	2.7E+01	5.0E-03	2.6E-03	1.8E-03	1.3E-03	1.2E-03	8.0E-04	5.7E-04	2.8E-04
586.1	8.4E+03	2.7E+01	4.9E-03	2.6E-03	1.7E-03	1.3E-03	1.2E-03	7.8E-04	5.6E-04	2.7E-04
601.1	8.1E+03	2.6E+01	4.7E-03	2.5E-03	1.7E-03	1.2E-03	1.1E-03	7.5E-04	5.4E-04	2.6E-04
616.1	7.7E+03	2.4E+01	4.5E-03	2.3E-03	1.6E-03	1.1E-03	1.1E-03	7.1E-04	5.1E-04	2.5E-04
631.1	7.1E+03	2.2E+01	4.1E-03	2.2E-03	1.5E-03	1.1E-03	9.9E-04	6.6E-04	4.7E-04	2.3E-04
646.1	6.4E+03	2.0E+01	3.7E-03	1.9E-03	1.3E-03	9.5E-04	8.9E-04	5.9E-04	4.2E-04	2.0E-04
661.1	5.4E+03	1.7E+01	3.1E-03	1.6E-03	1.1E-03	8.0E-04	7.5E-04	5.0E-04	3.6E-04	1.7E-04
676.1	4.2E+03	1.3E+01	2.4E-03	1.3E-03	8.5E-04	6.3E-04	5.9E-04	3.9E-04	2.8E-04	1.3E-04
691.1	2.7E+03	8.7E+00	1.6E-03	8.4E-04	5.6E-04	4.1E-04	3.8E-04	2.5E-04	1.8E-04	8.8E-05
706.1	2.2E+03	7.0E+00	1.3E-03	6.8E-04	4.5E-04	3.3E-04	3.1E-04	2.1E-04	1.5E-04	7.2E-05
706.1	2.2E+03	7.0E+00	1.3E-03	6.8E-04	4.5E-04	3.3E-04	3.1E-04	2.1E-04	1.5E-04	7.2E-05
707.6	2.9E+03	9.2E+00	1.7E-03	8.9E-04	6.0E-04	4.4E-04	4.1E-04	2.7E-04	1.9E-04	9.4E-05
722.6	3.9E+03	1.2E+01	2.3E-03	1.2E-03	7.9E-04	5.8E-04	5.4E-04	3.6E-04	2.6E-04	1.2E-04
737.6	5.2E+03	1.6E+01	3.0E-03	1.6E-03	1.1E-03	7.7E-04	7.2E-04	4.8E-04	3.4E-04	1.7E-04
752.6	6.7E+03	2.1E+01	3.9E-03	2.1E-03	1.4E-03	1.0E-03	9.4E-04	6.2E-04	4.5E-04	2.2E-04
767.6	8.3E+03	2.6E+01	4.8E-03	2.5E-03	1.7E-03	1.2E-03	1.2E-03	7.7E-04	5.5E-04	2.7E-04
782.6	9.0E+03	2.9E+01	5.2E-03	2.8E-03	1.8E-03	1.3E-03	1.3E-03	8.4E-04	6.0E-04	2.9E-04
797.6	9.1E+03	2.9E+01	5.3E-03	2.8E-03	1.8E-03	1.4E-03	1.3E-03	8.4E-04	6.0E-04	2.9E-04

Table C-45. Air Concentration Estimates for Excavation in Bay D – Default Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (100 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
797.6	9.1E+03	2.9E+01	5.3E-03	2.8E-03	1.8E-03	1.4E-03	1.3E-03	8.4E-04	6.0E-04	2.9E-04
800.0	8.8E+03	2.8E+01	5.1E-03	2.7E-03	1.8E-03	1.3E-03	1.2E-03	8.1E-04	5.8E-04	2.8E-04
815.0	8.4E+03	2.6E+01	4.9E-03	2.6E-03	1.7E-03	1.3E-03	1.2E-03	7.8E-04	5.6E-04	2.7E-04
830.0	7.9E+03	2.5E+01	4.6E-03	2.4E-03	1.6E-03	1.2E-03	1.1E-03	7.3E-04	5.2E-04	2.5E-04
845.0	7.3E+03	2.3E+01	4.2E-03	2.2E-03	1.5E-03	1.1E-03	1.0E-03	6.8E-04	4.8E-04	2.3E-04
860.0	6.5E+03	2.1E+01	3.8E-03	2.0E-03	1.3E-03	9.7E-04	9.1E-04	6.1E-04	4.3E-04	2.1E-04
875.0	5.6E+03	1.8E+01	3.2E-03	1.7E-03	1.1E-03	8.3E-04	7.8E-04	5.2E-04	3.7E-04	1.8E-04
890.0	4.5E+03	1.4E+01	2.6E-03	1.4E-03	9.1E-04	6.7E-04	6.2E-04	4.1E-04	3.0E-04	1.4E-04
905.0	3.2E+03	1.0E+01	1.8E-03	9.6E-04	6.5E-04	4.7E-04	4.4E-04	2.9E-04	2.1E-04	1.0E-04
920.0	1.7E+03	5.5E+00	1.0E-03	5.3E-04	3.6E-04	2.6E-04	2.4E-04	1.6E-04	1.2E-04	5.6E-05
935.0	2.4E+02	7.7E-01	1.4E-04	7.4E-05	5.0E-05	3.6E-05	3.4E-05	2.3E-05	1.6E-05	7.8E-06

Table C-46. Air Concentration Estimates for Excavation in Bays A, B, C and D Concurrently – Default Meteorology

Depth	Emissions (500 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
		ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	6.8E-03	1.3E-06	6.6E-07	4.4E-07	3.2E-07	3.0E-07	2.0E-07	1.4E-07	7.0E-08
0.7	6.2E-03	1.1E-06	5.9E-07	4.0E-07	2.9E-07	2.7E-07	1.8E-07	1.3E-07	6.3E-08
15.7	4.7E-03	8.6E-07	4.5E-07	3.0E-07	2.2E-07	2.1E-07	1.4E-07	9.8E-08	4.8E-08
30.7	2.3E-03	4.3E-07	2.2E-07	1.5E-07	1.1E-07	1.0E-07	6.8E-08	4.9E-08	2.4E-08
45.7	2.2E-03	4.0E-07	2.1E-07	1.4E-07	1.0E-07	9.7E-08	6.4E-08	4.6E-08	2.2E-08
45.7	2.2E-03	4.0E-07	2.1E-07	1.4E-07	1.0E-07	9.7E-08	6.4E-08	4.6E-08	2.2E-08
47.2	2.8E-03	5.1E-07	2.7E-07	1.8E-07	1.3E-07	1.2E-07	8.2E-08	5.8E-08	2.8E-08
62.2	5.3E-03	9.8E-07	5.1E-07	3.4E-07	2.5E-07	2.4E-07	1.6E-07	1.1E-07	5.4E-08
77.2	1.7E-02	3.1E-06	1.6E-06	1.1E-06	7.9E-07	7.4E-07	4.9E-07	3.5E-07	1.7E-07
92.2	7.1E-02	1.3E-05	6.9E-06	4.6E-06	3.4E-06	3.2E-06	2.1E-06	1.5E-06	7.3E-07
107.2	3.9E-01	7.1E-05	3.7E-05	2.5E-05	1.8E-05	1.7E-05	1.1E-05	8.1E-06	4.0E-06
122.2	2.8E+00	5.1E-04	2.7E-04	1.8E-04	1.3E-04	1.2E-04	8.2E-05	5.8E-05	2.8E-05
137.2	2.9E+00	5.3E-04	2.8E-04	1.9E-04	1.4E-04	1.3E-04	8.5E-05	6.1E-05	3.0E-05
137.2	2.9E+00	5.3E-04	2.8E-04	1.9E-04	1.4E-04	1.3E-04	8.5E-05	6.1E-05	3.0E-05
146.3	4.1E+00	7.6E-04	4.0E-04	2.7E-04	1.9E-04	1.8E-04	1.2E-04	8.7E-05	4.2E-05
161.3	5.9E+00	1.1E-03	5.7E-04	3.8E-04	2.8E-04	2.6E-04	1.7E-04	1.2E-04	6.0E-05
176.3	8.5E+00	1.6E-03	8.2E-04	5.5E-04	4.0E-04	3.8E-04	2.5E-04	1.8E-04	8.6E-05
191.3	1.2E+01	2.3E-03	1.2E-03	7.9E-04	5.8E-04	5.4E-04	3.6E-04	2.6E-04	1.2E-04
206.3	1.8E+01	3.3E-03	1.7E-03	1.1E-03	8.4E-04	7.9E-04	5.2E-04	3.7E-04	1.8E-04
221.3	2.6E+01	4.8E-03	2.5E-03	1.7E-03	1.2E-03	1.1E-03	7.6E-04	5.4E-04	2.6E-04
236.3	3.8E+01	7.0E-03	3.7E-03	2.5E-03	1.8E-03	1.7E-03	1.1E-03	8.0E-04	3.9E-04
251.3	5.7E+01	1.0E-02	5.5E-03	3.7E-03	2.7E-03	2.5E-03	1.7E-03	1.2E-03	5.8E-04
266.3	8.6E+01	1.6E-02	8.3E-03	5.6E-03	4.1E-03	3.8E-03	2.5E-03	1.8E-03	8.8E-04
281.3	1.3E+02	2.5E-02	1.3E-02	8.7E-03	6.3E-03	5.9E-03	3.9E-03	2.8E-03	1.4E-03
296.3	2.2E+02	4.0E-02	2.1E-02	1.4E-02	1.0E-02	9.5E-03	6.3E-03	4.5E-03	2.2E-03
311.3	3.6E+02	6.6E-02	3.5E-02	2.3E-02	1.7E-02	1.6E-02	1.1E-02	7.5E-03	3.7E-03
326.3	5.9E+02	1.1E-01	5.7E-02	3.8E-02	2.8E-02	2.6E-02	1.7E-02	1.2E-02	6.1E-03
341.3	8.1E+02	1.5E-01	7.8E-02	5.2E-02	3.8E-02	3.6E-02	2.4E-02	1.7E-02	8.3E-03
356.3	9.5E+02	1.7E-01	9.1E-02	6.1E-02	4.5E-02	4.2E-02	2.8E-02	2.0E-02	9.6E-03
371.3	1.0E+03	1.9E-01	9.8E-02	6.6E-02	4.8E-02	4.5E-02	3.0E-02	2.1E-02	1.0E-02

Table C-46. Air Concentration Estimates for Excavation in Bays A, B, C and D Concurrently – Default Meteorology (continued)

Depth	Emissions (500 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
		ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
386.3	1.1E+03	1.9E-01	1.0E-01	6.8E-02	5.0E-02	4.7E-02	3.1E-02	2.2E-02	1.1E-02
401.3	1.1E+03	2.0E-01	1.0E-01	7.0E-02	5.1E-02	4.8E-02	3.2E-02	2.3E-02	1.1E-02
401.3	1.1E+03	2.0E-01	1.0E-01	7.0E-02	5.1E-02	4.8E-02	3.2E-02	2.3E-02	1.1E-02
406.1	1.1E+03	2.0E-01	1.0E-01	7.0E-02	5.1E-02	4.8E-02	3.2E-02	2.3E-02	1.1E-02
421.1	1.1E+03	2.0E-01	1.1E-01	7.2E-02	5.2E-02	4.9E-02	3.3E-02	2.3E-02	1.1E-02
436.1	1.1E+03	2.1E-01	1.1E-01	7.3E-02	5.4E-02	5.0E-02	3.3E-02	2.4E-02	1.2E-02
451.1	1.2E+03	2.1E-01	1.1E-01	7.4E-02	5.4E-02	5.1E-02	3.4E-02	2.4E-02	1.2E-02
466.1	1.2E+03	2.1E-01	1.1E-01	7.5E-02	5.5E-02	5.1E-02	3.4E-02	2.4E-02	1.2E-02
481.1	1.2E+03	2.2E-01	1.2E-01	7.8E-02	5.7E-02	5.3E-02	3.5E-02	2.5E-02	1.2E-02
496.1	1.2E+03	2.3E-01	1.2E-01	7.9E-02	5.8E-02	5.5E-02	3.6E-02	2.6E-02	1.3E-02
511.1	1.3E+03	2.3E-01	1.2E-01	8.2E-02	6.0E-02	5.6E-02	3.7E-02	2.7E-02	1.3E-02
526.1	1.3E+03	2.4E-01	1.3E-01	8.5E-02	6.2E-02	5.8E-02	3.9E-02	2.8E-02	1.3E-02
541.1	1.4E+03	2.5E-01	1.3E-01	8.9E-02	6.5E-02	6.1E-02	4.0E-02	2.9E-02	1.4E-02
556.1	1.4E+03	2.6E-01	1.4E-01	9.2E-02	6.8E-02	6.3E-02	4.2E-02	3.0E-02	1.5E-02
571.1	1.5E+03	2.7E-01	1.4E-01	9.6E-02	7.1E-02	6.6E-02	4.4E-02	3.1E-02	1.5E-02
586.1	1.6E+03	2.9E-01	1.5E-01	1.0E-01	7.4E-02	6.9E-02	4.6E-02	3.3E-02	1.6E-02
601.1	1.6E+03	3.0E-01	1.6E-01	1.0E-01	7.7E-02	7.2E-02	4.8E-02	3.4E-02	1.7E-02
616.1	1.7E+03	3.1E-01	1.6E-01	1.1E-01	8.0E-02	7.5E-02	5.0E-02	3.5E-02	1.7E-02
631.1	1.7E+03	3.2E-01	1.7E-01	1.1E-01	8.2E-02	7.7E-02	5.1E-02	3.6E-02	1.8E-02
646.1	1.8E+03	3.2E-01	1.7E-01	1.1E-01	8.3E-02	7.8E-02	5.2E-02	3.7E-02	1.8E-02
661.1	1.7E+03	3.2E-01	1.7E-01	1.1E-01	8.3E-02	7.7E-02	5.1E-02	3.7E-02	1.8E-02
676.1	1.7E+03	3.2E-01	1.7E-01	1.1E-01	8.2E-02	7.7E-02	5.1E-02	3.7E-02	1.8E-02
691.1	1.7E+03	3.2E-01	1.7E-01	1.1E-01	8.2E-02	7.7E-02	5.1E-02	3.6E-02	1.8E-02
706.1	1.7E+03	3.2E-01	1.7E-01	1.1E-01	8.2E-02	7.6E-02	5.1E-02	3.6E-02	1.8E-02
706.1	1.7E+03	3.2E-01	1.7E-01	1.1E-01	8.2E-02	7.6E-02	5.1E-02	3.6E-02	1.8E-02
707.6	1.7E+03	3.2E-01	1.7E-01	1.1E-01	8.2E-02	7.7E-02	5.1E-02	3.6E-02	1.8E-02
722.6	1.7E+03	3.2E-01	1.7E-01	1.1E-01	8.2E-02	7.7E-02	5.1E-02	3.6E-02	1.8E-02
737.6	1.7E+03	3.2E-01	1.7E-01	1.1E-01	8.2E-02	7.7E-02	5.1E-02	3.6E-02	1.8E-02
752.6	1.7E+03	3.2E-01	1.7E-01	1.1E-01	8.2E-02	7.7E-02	5.1E-02	3.6E-02	1.8E-02
767.6	1.7E+03	3.2E-01	1.7E-01	1.1E-01	8.1E-02	7.6E-02	5.1E-02	3.6E-02	1.8E-02

Table C-46. Air Concentration Estimates for Excavation in Bays A, B, C and D Concurrently – Default Meteorology (continued)

Depth	Emissions (500 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
		ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
782.6	1.7E+03	3.1E-01	1.6E-01	1.1E-01	7.9E-02	7.4E-02	4.9E-02	3.5E-02	1.7E-02
797.6	1.6E+03	2.9E-01	1.5E-01	1.0E-01	7.6E-02	7.1E-02	4.7E-02	3.4E-02	1.6E-02
797.6	1.6E+03	2.9E-01	1.5E-01	1.0E-01	7.6E-02	7.1E-02	4.7E-02	3.4E-02	1.6E-02
800.0	1.6E+03	2.9E-01	1.5E-01	1.0E-01	7.6E-02	7.1E-02	4.7E-02	3.4E-02	1.6E-02
815.0	1.4E+03	2.7E-01	1.4E-01	9.4E-02	6.8E-02	6.4E-02	4.3E-02	3.0E-02	1.5E-02
830.0	1.2E+03	2.2E-01	1.1E-01	7.7E-02	5.6E-02	5.3E-02	3.5E-02	2.5E-02	1.2E-02
845.0	7.9E+02	1.5E-01	7.6E-02	5.1E-02	3.7E-02	3.5E-02	2.3E-02	1.7E-02	8.0E-03
860.0	2.5E+02	4.7E-02	2.5E-02	1.6E-02	1.2E-02	1.1E-02	7.5E-03	5.3E-03	2.6E-03
875.0	3.5E+01	6.5E-03	3.4E-03	2.3E-03	1.7E-03	1.6E-03	1.0E-03	7.4E-04	3.6E-04
890.0	2.8E+01	5.2E-03	2.7E-03	1.8E-03	1.3E-03	1.2E-03	8.3E-04	5.9E-04	2.9E-04
905.0	2.0E+01	3.7E-03	1.9E-03	1.3E-03	9.5E-04	8.9E-04	5.9E-04	4.2E-04	2.0E-04
920.0	1.1E+01	2.0E-03	1.1E-03	7.1E-04	5.2E-04	4.9E-04	3.2E-04	2.3E-04	1.1E-04
935.0	1.5E+00	2.8E-04	1.5E-04	9.9E-05	7.3E-05	6.8E-05	4.5E-05	3.2E-05	1.6E-05

Table C-47. Air Concentration Estimates for Wall Collapse in Bay A – Default Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (69 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.4E-01	9.6E-04	1.8E-07	9.2E-08	6.2E-08	4.5E-08	4.2E-08	2.8E-08	2.0E-08	9.7E-09
0.7	4.0E-01	8.7E-04	1.6E-07	8.4E-08	5.6E-08	4.1E-08	3.8E-08	2.6E-08	1.8E-08	8.8E-09
15.7	3.1E-01	6.7E-04	1.2E-07	6.5E-08	4.4E-08	3.2E-08	3.0E-08	2.0E-08	1.4E-08	6.9E-09
30.7	1.6E-01	3.6E-04	6.5E-08	3.4E-08	2.3E-08	1.7E-08	1.6E-08	1.0E-08	7.5E-09	3.6E-09
45.7	1.5E-01	3.4E-04	6.2E-08	3.3E-08	2.2E-08	1.6E-08	1.5E-08	9.9E-09	7.1E-09	3.4E-09
45.7	1.5E-01	3.4E-04	6.2E-08	3.3E-08	2.2E-08	1.6E-08	1.5E-08	9.9E-09	7.1E-09	3.4E-09
47.2	2.5E-01	5.3E-04	9.8E-08	5.2E-08	3.4E-08	2.5E-08	2.4E-08	1.6E-08	1.1E-08	5.4E-09
62.2	6.4E-01	1.4E-03	2.6E-07	1.3E-07	9.0E-08	6.6E-08	6.2E-08	4.1E-08	2.9E-08	1.4E-08
77.2	2.5E+00	5.4E-03	9.9E-07	5.2E-07	3.5E-07	2.6E-07	2.4E-07	1.6E-07	1.1E-07	5.5E-08
92.2	1.2E+01	2.6E-02	4.8E-06	2.5E-06	1.7E-06	1.2E-06	1.2E-06	7.7E-07	5.5E-07	2.7E-07
107.2	7.8E+01	1.7E-01	3.1E-05	1.6E-05	1.1E-05	8.0E-06	7.5E-06	5.0E-06	3.5E-06	1.7E-06
122.2	6.9E+02	1.5E+00	2.8E-04	1.4E-04	9.7E-05	7.1E-05	6.7E-05	4.4E-05	3.2E-05	1.5E-05
137.2	7.2E+02	1.6E+00	2.9E-04	1.5E-04	1.0E-04	7.4E-05	7.0E-05	4.6E-05	3.3E-05	1.6E-05
137.2	7.2E+02	1.6E+00	2.9E-04	1.5E-04	1.0E-04	7.4E-05	7.0E-05	4.6E-05	3.3E-05	1.6E-05
140.5	1.0E+03	2.3E+00	4.2E-04	2.2E-04	1.5E-04	1.1E-04	1.0E-04	6.6E-05	4.7E-05	2.3E-05
155.5	1.5E+03	3.2E+00	6.0E-04	3.1E-04	2.1E-04	1.5E-04	1.4E-04	9.5E-05	6.8E-05	3.3E-05
170.5	2.2E+03	4.7E+00	8.6E-04	4.5E-04	3.0E-04	2.2E-04	2.1E-04	1.4E-04	9.8E-05	4.8E-05
185.5	3.1E+03	6.8E+00	1.2E-03	6.5E-04	4.4E-04	3.2E-04	3.0E-04	2.0E-04	1.4E-04	6.9E-05
200.5	4.5E+03	9.8E+00	1.8E-03	9.5E-04	6.3E-04	4.6E-04	4.3E-04	2.9E-04	2.1E-04	1.0E-04
215.5	6.6E+03	1.4E+01	2.6E-03	1.4E-03	9.3E-04	6.8E-04	6.3E-04	4.2E-04	3.0E-04	1.5E-04
230.5	9.7E+03	2.1E+01	3.9E-03	2.0E-03	1.4E-03	1.0E-03	9.3E-04	6.2E-04	4.4E-04	2.2E-04
245.5	1.4E+04	3.1E+01	5.8E-03	3.0E-03	2.0E-03	1.5E-03	1.4E-03	9.2E-04	6.6E-04	3.2E-04
260.5	2.2E+04	4.8E+01	8.8E-03	4.6E-03	3.1E-03	2.3E-03	2.1E-03	1.4E-03	1.0E-03	4.9E-04
275.5	3.4E+04	7.5E+01	1.4E-02	7.2E-03	4.8E-03	3.5E-03	3.3E-03	2.2E-03	1.6E-03	7.6E-04
290.5	5.6E+04	1.2E+02	2.2E-02	1.2E-02	7.8E-03	5.7E-03	5.4E-03	3.6E-03	2.5E-03	1.2E-03
305.5	9.4E+04	2.0E+02	3.8E-02	2.0E-02	1.3E-02	9.7E-03	9.1E-03	6.0E-03	4.3E-03	2.1E-03
320.5	1.6E+05	3.4E+02	6.3E-02	3.3E-02	2.2E-02	1.6E-02	1.5E-02	1.0E-02	7.2E-03	3.5E-03
335.5	2.2E+05	4.7E+02	8.7E-02	4.6E-02	3.1E-02	2.2E-02	2.1E-02	1.4E-02	9.9E-03	4.8E-03
350.5	2.2E+05	4.8E+02	8.8E-02	4.6E-02	3.1E-02	2.3E-02	2.1E-02	1.4E-02	1.0E-02	4.9E-03
350.5	2.2E+05	4.8E+02	8.8E-02	4.6E-02	3.1E-02	2.3E-02	2.1E-02	1.4E-02	1.0E-02	4.9E-03
351.0	2.5E+05	5.5E+02	1.0E-01	5.3E-02	3.5E-02	2.6E-02	2.4E-02	1.6E-02	1.2E-02	5.6E-03

Table C-47. Air Concentration Estimates for Wall Collapse in Bay A – Default Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (69 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
366.0	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
381.0	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
381.0	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
388.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
403.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
418.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
433.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
448.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
463.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
478.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
493.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
508.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
523.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
538.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
553.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
568.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
583.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
598.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
613.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
628.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
643.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
658.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
673.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
688.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.8E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
703.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.7E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
718.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.7E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
733.7	2.7E+05	5.8E+02	1.1E-01	5.6E-02	3.7E-02	2.7E-02	2.6E-02	1.7E-02	1.2E-02	5.9E-03
748.7	2.6E+05	5.7E+02	1.1E-01	5.5E-02	3.7E-02	2.7E-02	2.5E-02	1.7E-02	1.2E-02	5.9E-03
763.7	2.6E+05	5.7E+02	1.0E-01	5.5E-02	3.7E-02	2.7E-02	2.5E-02	1.7E-02	1.2E-02	5.8E-03
778.7	2.6E+05	5.6E+02	1.0E-01	5.4E-02	3.6E-02	2.6E-02	2.5E-02	1.6E-02	1.2E-02	5.7E-03
793.7	2.4E+05	5.3E+02	9.8E-02	5.1E-02	3.4E-02	2.5E-02	2.4E-02	1.6E-02	1.1E-02	5.4E-03

Table C-47. Air Concentration Estimates for Wall Collapse in Bay A – Default Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (69 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
808.7	2.2E+05	4.9E+02	8.9E-02	4.7E-02	3.1E-02	2.3E-02	2.2E-02	1.4E-02	1.0E-02	5.0E-03
823.7	1.9E+05	4.1E+02	7.5E-02	3.9E-02	2.6E-02	1.9E-02	1.8E-02	1.2E-02	8.5E-03	4.1E-03
838.7	1.3E+05	2.8E+02	5.1E-02	2.7E-02	1.8E-02	1.3E-02	1.2E-02	8.2E-03	5.8E-03	2.8E-03
853.7	4.6E+04	1.0E+02	1.9E-02	9.8E-03	6.5E-03	4.8E-03	4.5E-03	3.0E-03	2.1E-03	1.0E-03
868.7	0.0E+00									

Table C-48. Air Concentration Estimates for Drilling in Bay A – Default Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (2.3 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.4E-01	3.2E-05	5.9E-09	3.1E-09	2.1E-09	1.5E-09	1.4E-09	9.4E-10	6.7E-10	3.2E-10
0.7	4.0E-01	2.9E-05	5.3E-09	2.8E-09	1.9E-09	1.4E-09	1.3E-09	8.5E-10	6.1E-10	2.9E-10
15.7	3.1E-01	2.2E-05	4.1E-09	2.2E-09	1.5E-09	1.1E-09	9.9E-10	6.6E-10	4.7E-10	2.3E-10
30.7	1.6E-01	1.2E-05	2.2E-09	1.1E-09	7.7E-10	5.6E-10	5.3E-10	3.5E-10	2.5E-10	1.2E-10
45.7	1.5E-01	1.1E-05	2.1E-09	1.1E-09	7.3E-10	5.3E-10	5.0E-10	3.3E-10	2.4E-10	1.1E-10
45.7	1.5E-01	1.1E-05	2.1E-09	1.1E-09	7.3E-10	5.3E-10	5.0E-10	3.3E-10	2.4E-10	1.1E-10
47.2	2.5E-01	1.8E-05	3.3E-09	1.7E-09	1.1E-09	8.4E-10	7.9E-10	5.2E-10	3.7E-10	1.8E-10
62.2	6.4E-01	4.7E-05	8.6E-09	4.5E-09	3.0E-09	2.2E-09	2.1E-09	1.4E-09	9.8E-10	4.7E-10
77.2	2.5E+00	1.8E-04	3.3E-08	1.7E-08	1.2E-08	8.5E-09	8.0E-09	5.3E-09	3.8E-09	1.8E-09
92.2	1.2E+01	8.8E-04	1.6E-07	8.5E-08	5.7E-08	4.2E-08	3.9E-08	2.6E-08	1.8E-08	9.0E-09
107.2	7.8E+01	5.6E-03	1.0E-06	5.4E-07	3.6E-07	2.7E-07	2.5E-07	1.7E-07	1.2E-07	5.7E-08
122.2	6.9E+02	5.0E-02	9.2E-06	4.8E-06	3.2E-06	2.4E-06	2.2E-06	1.5E-06	1.1E-06	5.1E-07
137.2	7.2E+02	5.2E-02	9.6E-06	5.1E-06	3.4E-06	2.5E-06	2.3E-06	1.5E-06	1.1E-06	5.3E-07
137.2	7.2E+02	5.2E-02	9.6E-06	5.1E-06	3.4E-06	2.5E-06	2.3E-06	1.5E-06	1.1E-06	5.3E-07
140.5	1.0E+03	7.5E-02	1.4E-05	7.3E-06	4.9E-06	3.6E-06	3.3E-06	2.2E-06	1.6E-06	7.7E-07
155.5	1.5E+03	1.1E-01	2.0E-05	1.0E-05	7.0E-06	5.1E-06	4.8E-06	3.2E-06	2.3E-06	1.1E-06
170.5	2.2E+03	1.6E-01	2.9E-05	1.5E-05	1.0E-05	7.4E-06	6.9E-06	4.6E-06	3.3E-06	1.6E-06
185.5	3.1E+03	2.3E-01	4.1E-05	2.2E-05	1.5E-05	1.1E-05	1.0E-05	6.6E-06	4.7E-06	2.3E-06
200.5	4.5E+03	3.3E-01	6.0E-05	3.2E-05	2.1E-05	1.5E-05	1.4E-05	9.6E-06	6.9E-06	3.3E-06
215.5	6.6E+03	4.8E-01	8.8E-05	4.6E-05	3.1E-05	2.3E-05	2.1E-05	1.4E-05	1.0E-05	4.9E-06
230.5	9.7E+03	7.0E-01	1.3E-04	6.8E-05	4.5E-05	3.3E-05	3.1E-05	2.1E-05	1.5E-05	7.2E-06
245.5	1.4E+04	1.0E+00	1.9E-04	1.0E-04	6.8E-05	5.0E-05	4.6E-05	3.1E-05	2.2E-05	1.1E-05
260.5	2.2E+04	1.6E+00	2.9E-04	1.5E-04	1.0E-04	7.5E-05	7.1E-05	4.7E-05	3.3E-05	1.6E-05
275.5	3.4E+04	2.5E+00	4.6E-04	2.4E-04	1.6E-04	1.2E-04	1.1E-04	7.3E-05	5.2E-05	2.5E-05
290.5	5.6E+04	4.0E+00	7.4E-04	3.9E-04	2.6E-04	1.9E-04	1.8E-04	1.2E-04	8.5E-05	4.1E-05
305.5	9.4E+04	6.8E+00	1.3E-03	6.6E-04	4.4E-04	3.2E-04	3.0E-04	2.0E-04	1.4E-04	6.9E-05
320.5	1.6E+05	1.1E+01	2.1E-03	1.1E-03	7.4E-04	5.4E-04	5.1E-04	3.4E-04	2.4E-04	1.2E-04
335.5	2.2E+05	1.6E+01	2.9E-03	1.5E-03	1.0E-03	7.4E-04	7.0E-04	4.6E-04	3.3E-04	1.6E-04
350.5	2.2E+05	1.6E+01	2.9E-03	1.5E-03	1.0E-03	7.5E-04	7.1E-04	4.7E-04	3.3E-04	1.6E-04
350.5	2.2E+05	1.6E+01	2.9E-03	1.5E-03	1.0E-03	7.5E-04	7.1E-04	4.7E-04	3.3E-04	1.6E-04

Table C-48. Air Concentration Estimates for Drilling in Bay A – Default Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (2.3 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
351.0	2.5E+05	1.8E+01	3.4E-03	1.8E-03	1.2E-03	8.7E-04	8.1E-04	5.4E-04	3.8E-04	1.9E-04
366.0	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
381.0	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
381.0	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
388.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
403.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
418.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
433.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
448.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
463.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
478.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
493.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
508.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
523.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
538.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
553.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
568.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
583.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
598.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
613.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
628.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
643.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
658.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
673.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
688.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.3E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
703.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.2E-03	9.2E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
718.7	2.7E+05	1.9E+01	3.6E-03	1.9E-03	1.2E-03	9.1E-04	8.6E-04	5.7E-04	4.1E-04	2.0E-04
733.7	2.7E+05	1.9E+01	3.5E-03	1.9E-03	1.2E-03	9.1E-04	8.5E-04	5.7E-04	4.0E-04	2.0E-04
748.7	2.6E+05	1.9E+01	3.5E-03	1.8E-03	1.2E-03	9.1E-04	8.5E-04	5.6E-04	4.0E-04	2.0E-04
763.7	2.6E+05	1.9E+01	3.5E-03	1.8E-03	1.2E-03	9.0E-04	8.4E-04	5.6E-04	4.0E-04	1.9E-04

Table C-48. Air Concentration Estimates for Drilling in Bay A – Default Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (2.3 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
778.7	2.6E+05	1.9E+01	3.4E-03	1.8E-03	1.2E-03	8.8E-04	8.2E-04	5.4E-04	3.9E-04	1.9E-04
793.7	2.4E+05	1.8E+01	3.3E-03	1.7E-03	1.1E-03	8.4E-04	7.8E-04	5.2E-04	3.7E-04	1.8E-04
808.7	2.2E+05	1.6E+01	3.0E-03	1.6E-03	1.0E-03	7.7E-04	7.2E-04	4.8E-04	3.4E-04	1.7E-04
823.7	1.9E+05	1.4E+01	2.5E-03	1.3E-03	8.7E-04	6.4E-04	6.0E-04	4.0E-04	2.8E-04	1.4E-04
838.7	1.3E+05	9.2E+00	1.7E-03	8.9E-04	6.0E-04	4.4E-04	4.1E-04	2.7E-04	1.9E-04	9.4E-05
853.7	4.6E+04	3.4E+00	6.2E-04	3.3E-04	2.2E-04	1.6E-04	1.5E-04	9.9E-05	7.1E-05	3.4E-05

Table C-49. Air Concentration Estimates for Burrowing in Bay A – Default Meteorology at Receptor Locations

Depth	FluxT (JT)	Emissions (0.53 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
0.0	4.4E-01	7.3E-06	1.4E-09	7.1E-10	4.7E-10	3.5E-10	3.3E-10	2.2E-10	1.5E-10	7.5E-11
0.7	4.0E-01	6.7E-06	1.2E-09	6.4E-10	4.3E-10	3.2E-10	3.0E-10	2.0E-10	1.4E-10	6.8E-11
15.7	3.1E-01	5.2E-06	9.5E-10	5.0E-10	3.3E-10	2.4E-10	2.3E-10	1.5E-10	1.1E-10	5.3E-11
30.7	1.6E-01	2.7E-06	5.0E-10	2.6E-10	1.8E-10	1.3E-10	1.2E-10	8.0E-11	5.7E-11	2.8E-11
45.7	1.5E-01	2.6E-06	4.8E-10	2.5E-10	1.7E-10	1.2E-10	1.1E-10	7.6E-11	5.4E-11	2.6E-11
45.7	1.5E-01	2.6E-06	4.8E-10	2.5E-10	1.7E-10	1.2E-10	1.1E-10	7.6E-11	5.4E-11	2.6E-11
47.2	2.5E-01	4.1E-06	7.5E-10	4.0E-10	2.6E-10	1.9E-10	1.8E-10	1.2E-10	8.6E-11	4.2E-11
62.2	6.4E-01	1.1E-05	2.0E-09	1.0E-09	6.9E-10	5.1E-10	4.8E-10	3.2E-10	2.3E-10	1.1E-10
77.2	2.5E+00	4.2E-05	7.6E-09	4.0E-09	2.7E-09	2.0E-09	1.8E-09	1.2E-09	8.7E-10	4.2E-10
92.2	1.2E+01	2.0E-04	3.7E-08	2.0E-08	1.3E-08	9.6E-09	9.0E-09	5.9E-09	4.2E-09	2.1E-09
107.2	7.8E+01	1.3E-03	2.4E-07	1.3E-07	8.4E-08	6.1E-08	5.7E-08	3.8E-08	2.7E-08	1.3E-08
122.2	6.9E+02	1.2E-02	2.1E-06	1.1E-06	7.5E-07	5.5E-07	5.1E-07	3.4E-07	2.4E-07	1.2E-07
137.2	7.2E+02	1.2E-02	2.2E-06	1.2E-06	7.8E-07	5.7E-07	5.4E-07	3.6E-07	2.5E-07	1.2E-07
137.2	7.2E+02	1.2E-02	2.2E-06	1.2E-06	7.8E-07	5.7E-07	5.4E-07	3.6E-07	2.5E-07	1.2E-07
140.5	1.0E+03	1.7E-02	3.2E-06	1.7E-06	1.1E-06	8.2E-07	7.7E-07	5.1E-07	3.6E-07	1.8E-07
155.5	1.5E+03	2.5E-02	4.6E-06	2.4E-06	1.6E-06	1.2E-06	1.1E-06	7.3E-07	5.2E-07	2.5E-07
170.5	2.2E+03	3.6E-02	6.6E-06	3.5E-06	2.3E-06	1.7E-06	1.6E-06	1.1E-06	7.5E-07	3.7E-07
185.5	3.1E+03	5.2E-02	9.6E-06	5.0E-06	3.4E-06	2.5E-06	2.3E-06	1.5E-06	1.1E-06	5.3E-07
200.5	4.5E+03	7.5E-02	1.4E-05	7.3E-06	4.9E-06	3.6E-06	3.3E-06	2.2E-06	1.6E-06	7.7E-07
215.5	6.6E+03	1.1E-01	2.0E-05	1.1E-05	7.1E-06	5.2E-06	4.9E-06	3.2E-06	2.3E-06	1.1E-06
230.5	9.7E+03	1.6E-01	3.0E-05	1.6E-05	1.0E-05	7.7E-06	7.2E-06	4.8E-06	3.4E-06	1.7E-06
245.5	1.4E+04	2.4E-01	4.4E-05	2.3E-05	1.6E-05	1.1E-05	1.1E-05	7.1E-06	5.1E-06	2.5E-06
260.5	2.2E+04	3.7E-01	6.7E-05	3.5E-05	2.4E-05	1.7E-05	1.6E-05	1.1E-05	7.7E-06	3.7E-06
275.5	3.4E+04	5.7E-01	1.1E-04	5.5E-05	3.7E-05	2.7E-05	2.5E-05	1.7E-05	1.2E-05	5.8E-06
290.5	5.6E+04	9.3E-01	1.7E-04	9.0E-05	6.0E-05	4.4E-05	4.1E-05	2.7E-05	2.0E-05	9.5E-06
305.5	9.4E+04	1.6E+00	2.9E-04	1.5E-04	1.0E-04	7.4E-05	7.0E-05	4.6E-05	3.3E-05	1.6E-05
320.5	1.6E+05	2.6E+00	4.8E-04	2.5E-04	1.7E-04	1.2E-04	1.2E-04	7.7E-05	5.5E-05	2.7E-05
335.5	2.2E+05	3.6E+00	6.7E-04	3.5E-04	2.3E-04	1.7E-04	1.6E-04	1.1E-04	7.6E-05	3.7E-05
350.5	2.2E+05	3.7E+00	6.8E-04	3.5E-04	2.4E-04	1.7E-04	1.6E-04	1.1E-04	7.7E-05	3.7E-05
350.5	2.2E+05	3.7E+00	6.8E-04	3.5E-04	2.4E-04	1.7E-04	1.6E-04	1.1E-04	7.7E-05	3.7E-05

Table C-49. Air Concentration Estimates for Burrowing in Bay A – Default Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (0.53 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
351.0	2.5E+05	4.2E+00	7.8E-04	4.1E-04	2.7E-04	2.0E-04	1.9E-04	1.2E-04	8.9E-05	4.3E-05
366.0	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
381.0	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
381.0	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
388.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
403.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
418.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
433.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
448.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
463.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
478.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
493.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
508.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
523.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
538.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
553.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
568.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
583.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
598.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
613.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
628.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
643.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
658.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
673.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
688.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.6E-05
703.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.4E-05	4.5E-05
718.7	2.7E+05	4.5E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.3E-05	4.5E-05
733.7	2.7E+05	4.4E+00	8.2E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.3E-05	4.5E-05
748.7	2.6E+05	4.4E+00	8.1E-04	4.3E-04	2.9E-04	2.1E-04	2.0E-04	1.3E-04	9.3E-05	4.5E-05
763.7	2.6E+05	4.4E+00	8.0E-04	4.2E-04	2.8E-04	2.1E-04	1.9E-04	1.3E-04	9.2E-05	4.5E-05

Table C-49. Air Concentration Estimates for Burrowing in Bay A – Default Meteorology at Receptor Locations (continued)

Depth	FluxT (JT)	Emissions (0.53 m^2)	Downwind Concentration (pCi/L) at Selected Downwind Distances (m)							
			ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
(cm)	(pCi/m^2/sec)	(Ci/yr)	559 m	652 m	662 m	959 m	1030 m	1583 m	2273 m	2511 m
778.7	2.6E+05	4.3E+00	7.8E-04	4.1E-04	2.8E-04	2.0E-04	1.9E-04	1.3E-04	9.0E-05	4.4E-05
793.7	2.4E+05	4.1E+00	7.5E-04	3.9E-04	2.6E-04	1.9E-04	1.8E-04	1.2E-04	8.6E-05	4.2E-05
808.7	2.2E+05	3.7E+00	6.9E-04	3.6E-04	2.4E-04	1.8E-04	1.7E-04	1.1E-04	7.8E-05	3.8E-05
823.7	1.9E+05	3.1E+00	5.7E-04	3.0E-04	2.0E-04	1.5E-04	1.4E-04	9.2E-05	6.5E-05	3.2E-05
838.7	1.3E+05	2.1E+00	3.9E-04	2.1E-04	1.4E-04	1.0E-04	9.4E-05	6.3E-05	4.5E-05	2.2E-05
853.7	4.6E+04	7.8E-01	1.4E-04	7.5E-05	5.0E-05	3.7E-05	3.4E-05	2.3E-05	1.6E-05	7.9E-06

Table C-50. Summary of Air Concentrations at Hypothetical Receptor Locations for Bounding Met Conditions

	Location/Receptor	Off-Site Landfill Worker	Green-house	Resident	Farm Resident	Resident	Resident	School	School
	Direction	ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
	Distance (m)	559	652	662	959	1030	1583	2273	2511
	Bounding Met - Unit Air Conc (pCi/L per Ci/yr)	3.75E-02	2.83E-02	2.75E-02	1.40E-02	1.23E-02	6.06E-03	3.33E-03	2.82E-03
Scenario	**Emission Rate (Ci/yr)**	**Air Concentrations (pCi/L)**							
Excavation - Bay A (max flux for 100 m^2)	842	3.16E+01	2.38E+01	2.32E+01	1.18E+01	1.04E+01	5.10E+00	2.80E+00	2.37E+00
Excavation - Bay B (max flux for 100 m^2)	38.5	1.44E+00	1.09E+00	1.06E+00	5.39E-01	4.74E-01	2.33E-01	1.28E-01	1.09E-01
Excavation - Bay C (max flux for 100 m^2)	842	3.16E+01	2.38E+01	2.32E+01	1.18E+01	1.04E+01	5.10E+00	2.80E+00	2.37E+00
Excavation - Bay D (max flux for 100 m^2)	28.6	1.07E+00	8.09E-01	7.87E-01	4.00E-01	3.52E-01	1.73E-01	9.52E-02	8.07E-02
Excavation - All Bays (max flux for 500 m^2)	1755	6.58E+01	4.97E+01	4.83E+01	2.46E+01	2.16E+01	1.06E+01	5.84E+00	4.95E+00
Bay A - Wall Collapse (max flux for 69 m^2)	581	2.18E+01	1.64E+01	1.60E+01	8.13E+00	7.15E+00	3.52E+00	1.93E+00	1.64E+00
Bay A - Earthquake (average flux for 390 m^2)	55	2.06E+00	1.56E+00	1.51E+00	7.70E-01	6.77E-01	3.33E-01	1.83E-01	1.55E-01
Bay A - Drilling (max flux for 2.3 m^2)	19.4	7.28E-01	5.49E-01	5.34E-01	2.72E-01	2.39E-01	1.18E-01	6.46E-02	5.47E-02
Bay A - Burrowing (max flux for 0.53 m^2)	4.5	1.69E-01	1.27E-01	1.24E-01	6.30E-02	5.54E-02	2.73E-02	1.50E-02	1.27E-02

Notes:
Bounding met - Unit Air Conc is the result of modeling a unit emission of 1 Ci/yr for the bounding meteorological dataset (stability class G at 1 m/s).
Air concentrations are calculated from the unit air concentration based on the scenario-specific emission rate.
For all scenarios the max flux of 2.7E5 pCi/m2/s is associated with the K-65 residues, with the exception of the earthquake scenario which is based on an average flux of 4,500 pCi/m^2/s (see Table A-9 and Appendix A).
Earthquake concentrations are from Appendix E.

Table C-51. Summary of Air Concentrations at Hypothetical Receptor Locations for Typical Met Conditions

	Location/Receptor	Off-Site Landfill Worker	Green-house	Resident	Farm Resident	Resident	Resident	School	School
	Direction	ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
	Distance (m)	559	652	662	959	1030	1583	2273	2511
	Typical Met - Unit Air Conc (pCi/L per Ci/yr)	2.72E-03	2.02E-03	1.96E-03	9.49E-04	8.39E-04	3.82E-04	1.97E-04	1.64E-04
Scenario	**Emission Rate (Ci/yr)**	**Air Concentrations (pCi/L)**							
Excavation - Bay A (max flux for 100 m^2)	842	2.29E+00	1.70E+00	1.65E+00	7.99E-01	7.06E-01	3.22E-01	1.66E-01	1.38E-01
Excavation - Bay B (max flux for 100 m^2)	38.5	1.05E-01	7.78E-02	7.55E-02	3.65E-02	3.23E-02	1.47E-02	7.58E-03	6.31E-03
Excavation - Bay C (max flux for 100 m^2)	842	2.29E+00	1.70E+00	1.65E+00	7.99E-01	7.06E-01	3.22E-01	1.66E-01	1.38E-01
Excavation - Bay D (max flux for 100 m^2)	28.6	7.78E-02	5.78E-02	5.61E-02	2.71E-02	2.40E-02	1.09E-02	5.63E-03	4.69E-03
Excavation - All Bays (max flux for 500 m^2)	1755	4.77E+00	3.55E+00	3.44E+00	1.67E+00	1.47E+00	6.70E-01	3.46E-01	2.88E-01
Bay A - Wall Collapse (max flux for 69 m^2)	581	1.58E+00	1.17E+00	1.14E+00	5.51E-01	4.87E-01	2.22E-01	1.14E-01	9.53E-02
Bay A - Earthquake (average flux for 390 m^2)	55	1.50E-01	1.11E-01	1.08E-01	5.22E-02	4.61E-02	2.10E-02	1.08E-02	9.02E-03
Bay A - Drilling (max flux for 2.3 m^2)	19.4	5.28E-02	3.92E-02	3.80E-02	1.84E-02	1.63E-02	7.41E-03	3.82E-03	3.18E-03
Bay A - Burrowing (max flux for 0.53 m^2)	4.5	1.22E-02	9.09E-03	8.82E-03	4.27E-03	3.78E-03	1.72E-03	8.87E-04	7.38E-04

Notes:
Typical met - Unit Air Conc is the result of modeling a unit emission of 1 Ci/yr for the typical meteorological dataset (stability class C at 1 m/s).
Air concentrations are calculated from the unit air concentration based on the scenario-specific emission rate.
For all scenarios the max flux of 2.7E5 pCi/m^2/s is associated with the K-65 residues, with the exception of the earthquake scenario which is based on an average flux of 4,500 pCi/m^2/s (see Table A-9 and Appendix A).
Earthquake concentrations are from Appendix E.

Table C-52. Summary of Air Concentrations at Hypothetical Receptor Locations for Default Met Conditions

	Location/Receptor	Off-Site Landfill Worker	Green-house	Resident	Farm Resident	Resident	Resident	School	School
	Direction	ESE	SSE	SSW	SSE	WSW	ESE	W	WNW
	Distance (m)	559	652	662	959	1030	1583	2273	2511
	Default Met - Unit Air Conc (pCi/L per Ci/yr)	1.84E-04	9.65E-05	6.46E-05	4.73E-05	4.43E-05	2.94E-05	2.10E-05	1.02E-05
Scenario	**Emission Rate (Ci/yr)**	**Air Concentrations (pCi/L)**							
Excavation - Bay A (max flux for 100 m^2)	842	1.55E-01	8.13E-02	5.44E-02	3.98E-02	3.73E-02	2.48E-02	1.77E-02	8.59E-03
Excavation - Bay B (max flux for 100 m^2)	38.5	7.08E-03	3.72E-03	2.49E-03	1.82E-03	1.71E-03	1.13E-03	8.09E-04	3.93E-04
Excavation - Bay C (max flux for 100 m^2)	842	1.55E-01	8.13E-02	5.44E-02	3.98E-02	3.73E-02	2.48E-02	1.77E-02	8.59E-03
Excavation - Bay D (max flux for 100 m^2)	28.6	5.26E-03	2.76E-03	1.85E-03	1.35E-03	1.27E-03	8.41E-04	6.01E-04	2.92E-04
Excavation - All Bays (max flux for 500 m^2)	1755	3.23E-01	1.69E-01	1.13E-01	8.30E-02	7.77E-02	5.16E-02	3.69E-02	1.79E-02
Bay A - Wall Collapse (max flux for 69 m^2)	581	1.07E-01	5.61E-02	3.75E-02	2.75E-02	2.57E-02	1.71E-02	1.22E-02	5.93E-03
Bay A - Earthquake (average flux for 390 m^2)	55	1.01E-02	5.31E-03	3.55E-03	2.60E-03	2.44E-03	1.62E-03	1.16E-03	5.61E-04
Bay A - Drilling (max flux for 2.3 m^2)	19.4	3.57E-03	1.87E-03	1.25E-03	9.18E-04	8.59E-04	5.70E-04	4.07E-04	1.98E-04
Bay A - Burrowing (max flux for 0.53 m^2)	4.5	8.28E-04	4.34E-04	2.91E-04	2.13E-04	1.99E-04	1.32E-04	9.45E-05	4.59E-05

Notes:
Default met - Unit Air Conc is the result of modeling a unit emission of 1 Ci/yr for the default meteorological dataset, which represents a long term release.
Air concentrations are calculated from the unit air concentration based on the scenario-specific emission rate.
For all scenarios the max flux of 2.7E5 pCi/m2/s is associated with the K-65 residues, with the exception of the earthquake scenario which is based on an average flux of 4,500 pCi/m^2/s (see Table A-9 and Appendix A).
Earthquake concentrations are from Appendix E.

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APPENDIX C-3

Estimated Plume Centerline Downwind Air Concentrations with Upper Bound, Typical and Default Meteorological Conditions for Hypothetical Excavation/Intrusion Scenarios

Figures

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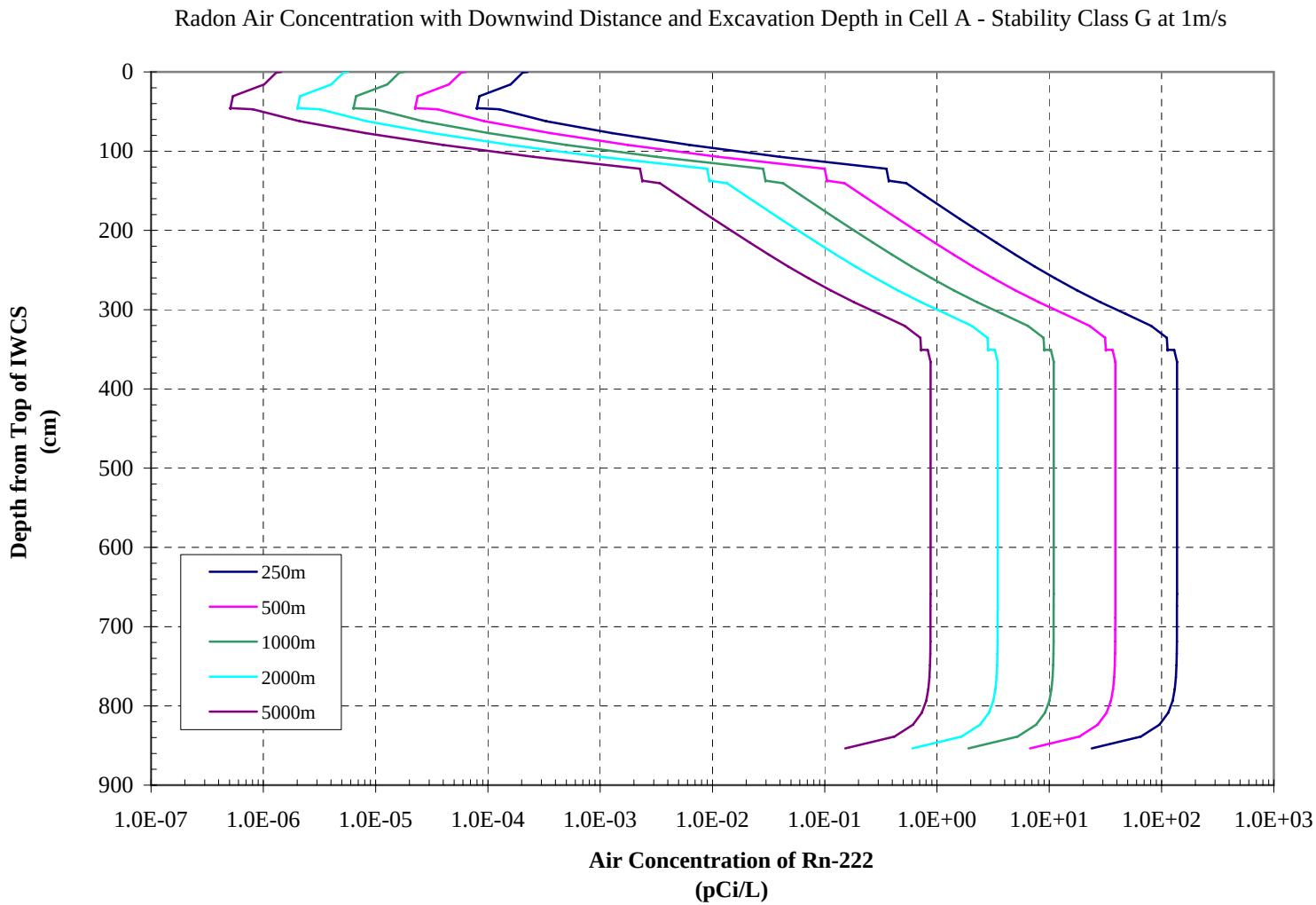

Figure C-1. Air Concentration Estimates for Excavation in Bay A – Bounding Meteorology

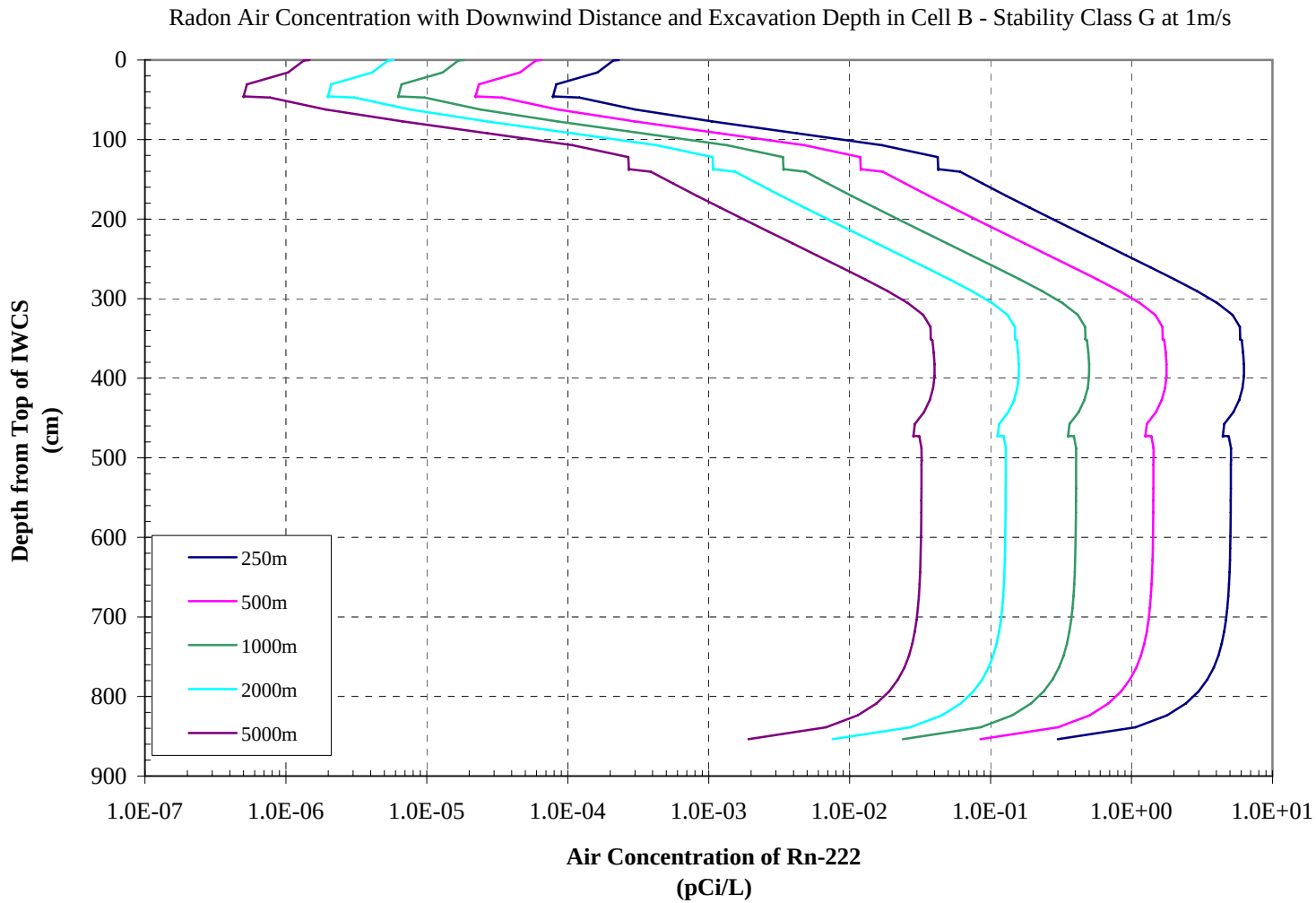

Figure C-2. Air Concentration Estimates for Excavation in Bay B – Bounding Meteorology

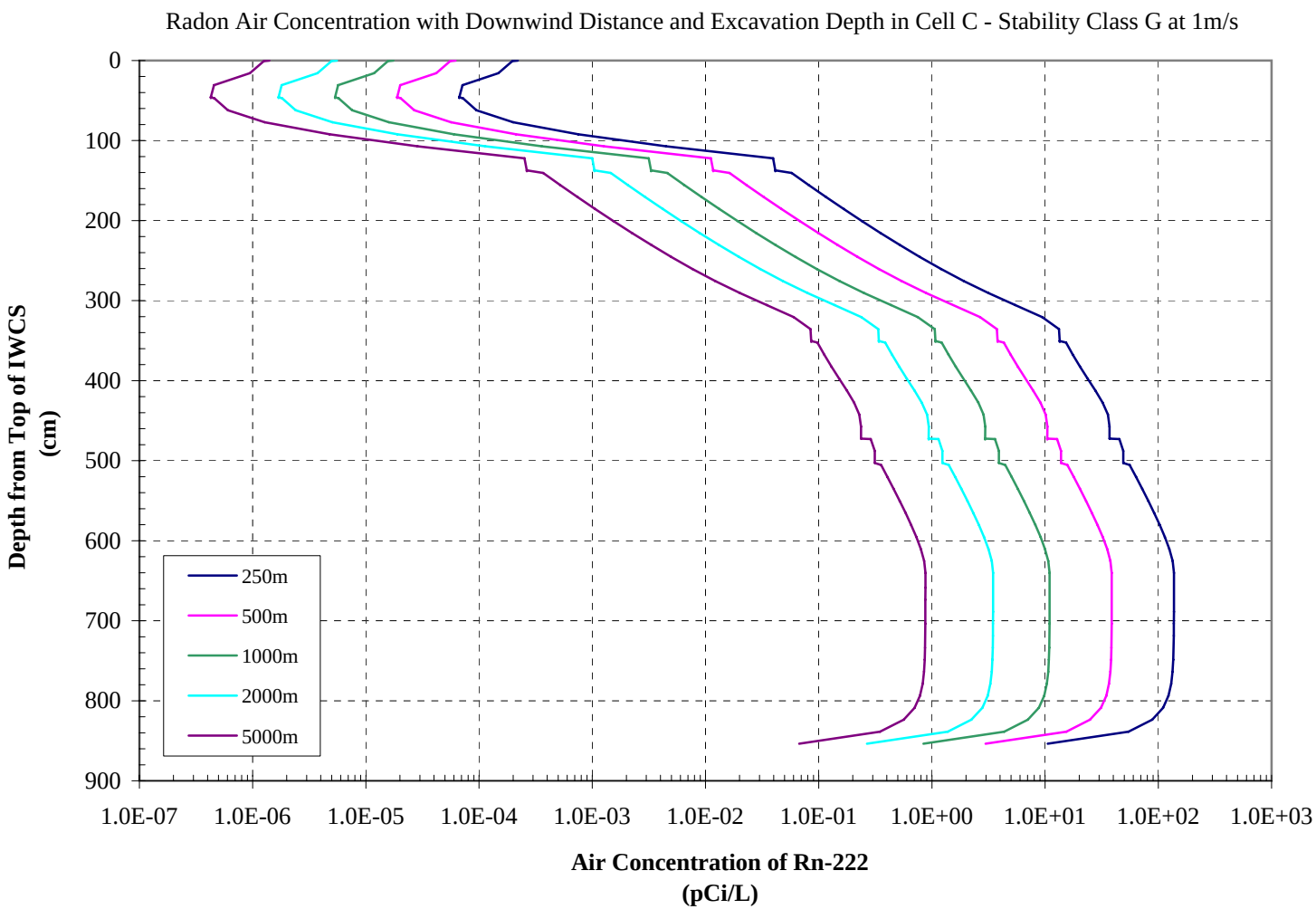

Figure C-3. Air Concentration Estimates for Excavation in Bay C – Bounding Meteorology

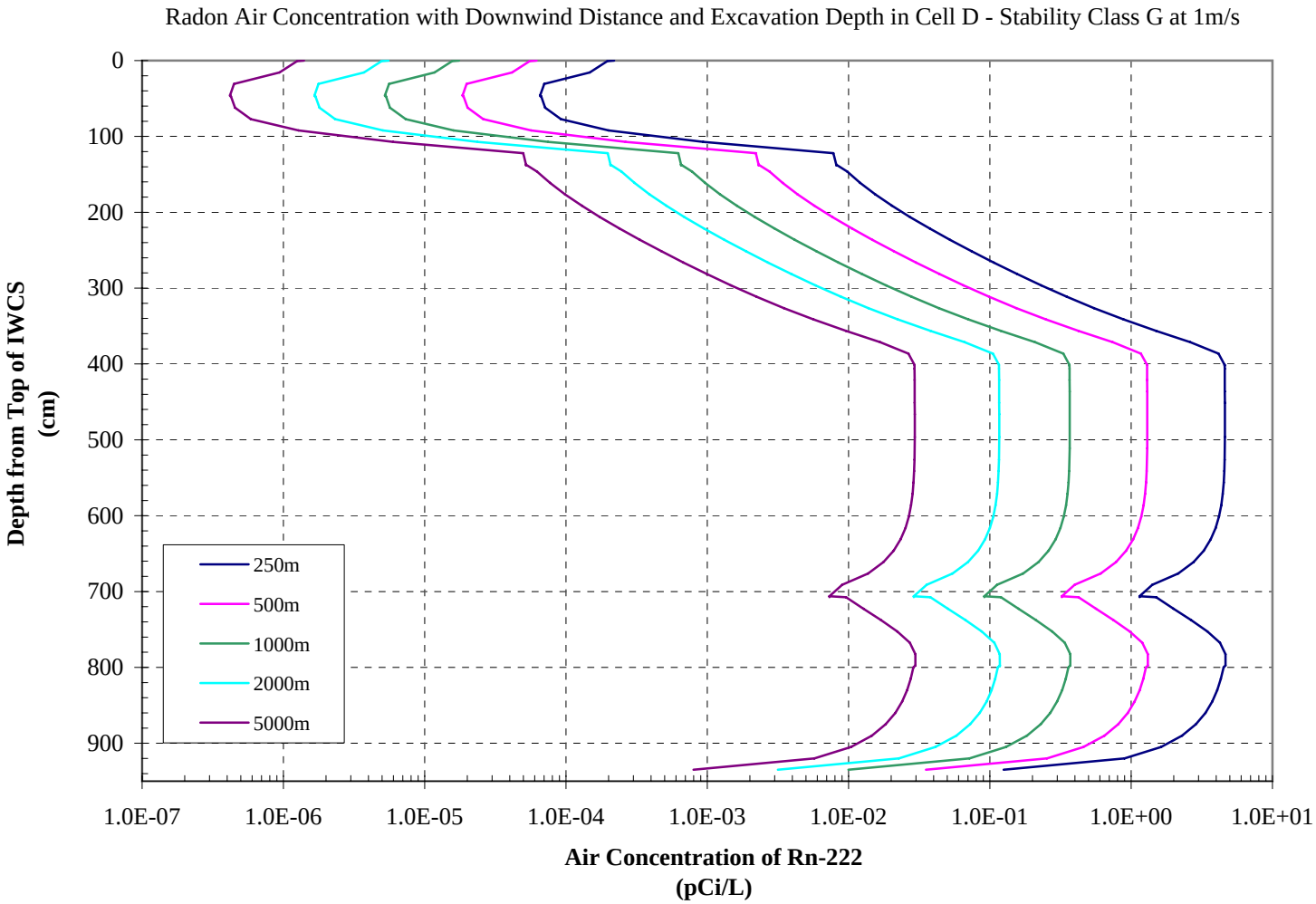

Figure C-4. Air Concentration Estimates for Excavation in Bay D – Bounding Meteorology

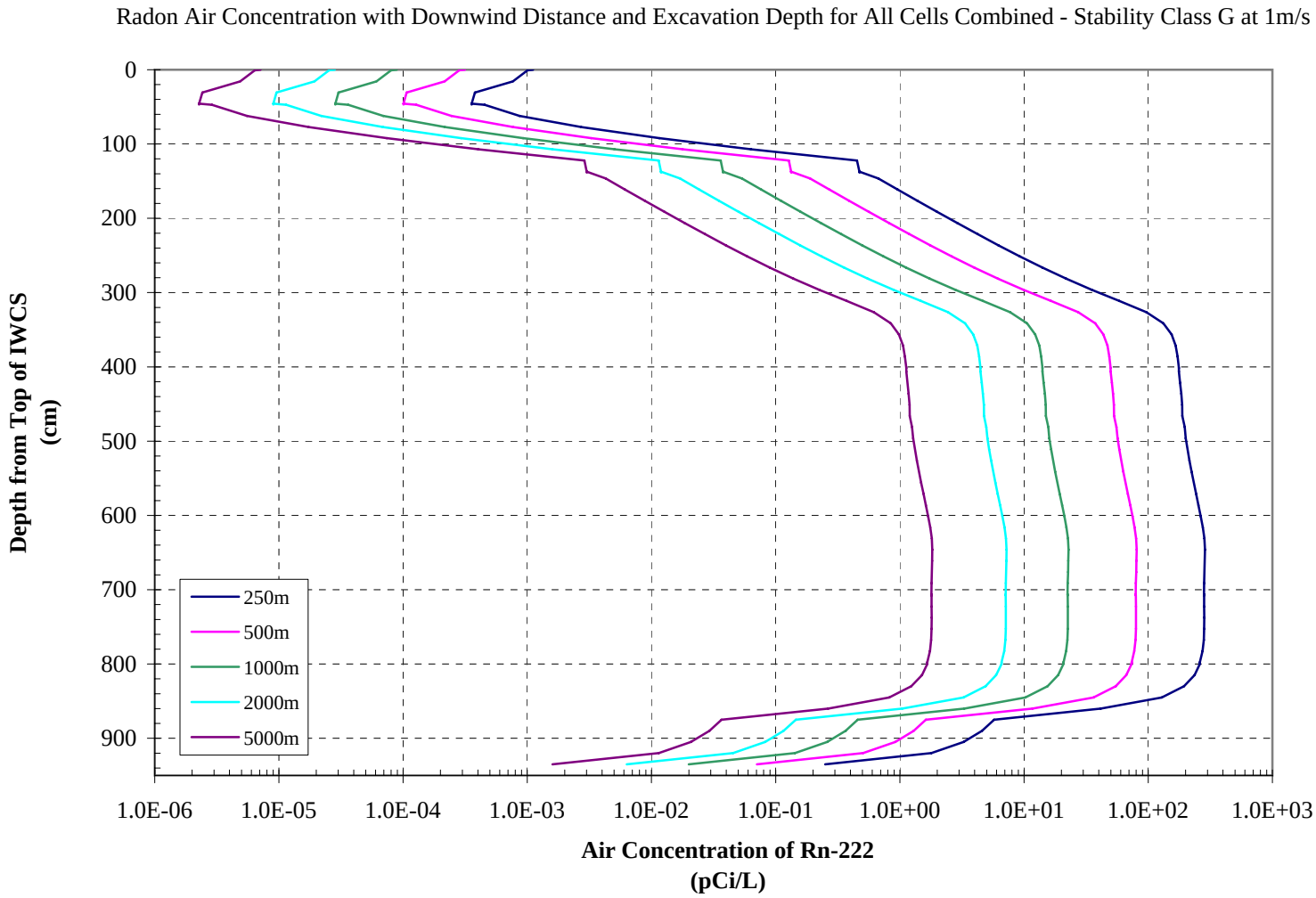

Figure C-5. Air Concentration Estimates for Excavation in Bays A, B, C, D – Bounding Meteorology

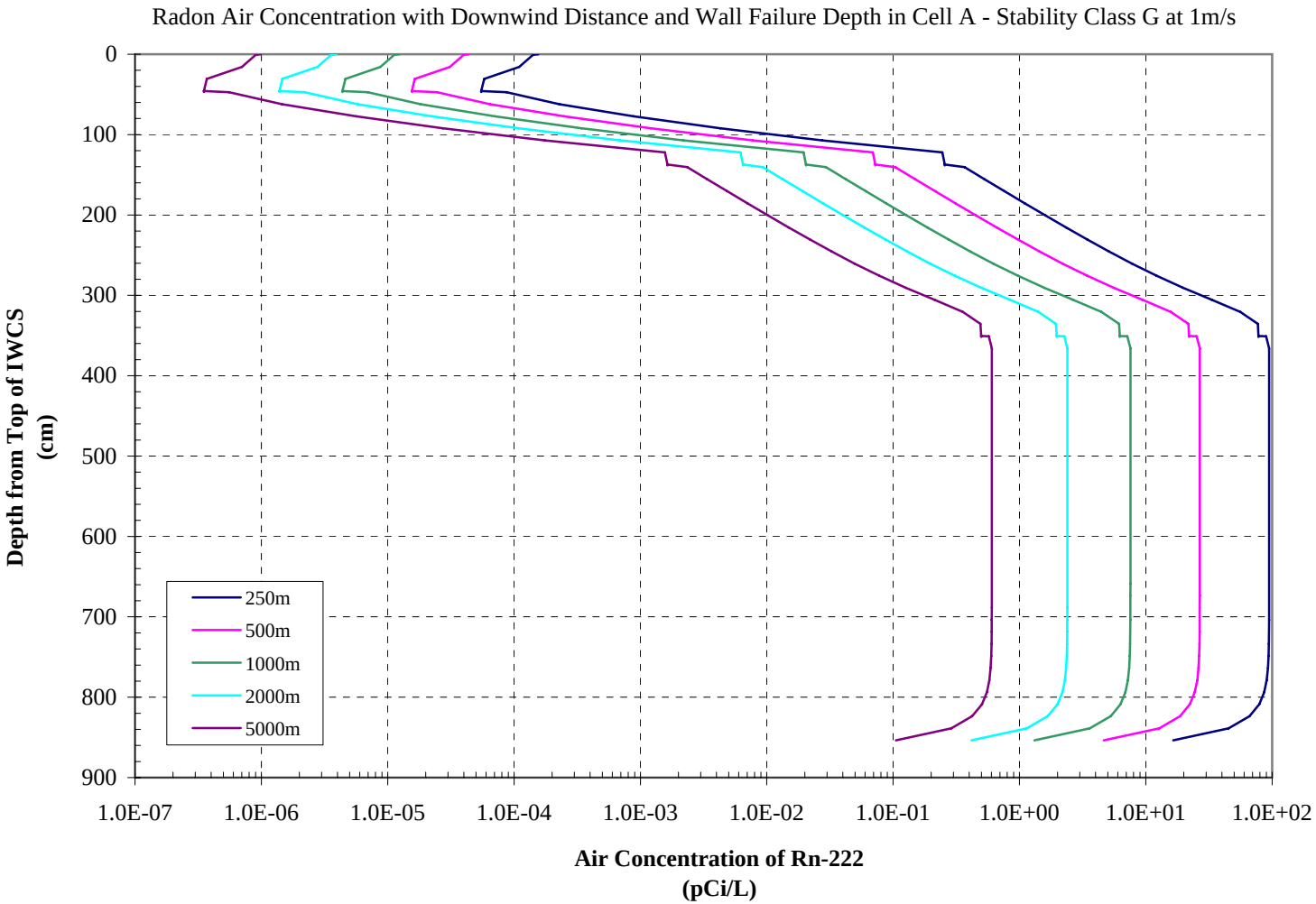

Figure C-6. Air Concentration Estimates for Wall Failure in Bay A – Bounding Meteorology

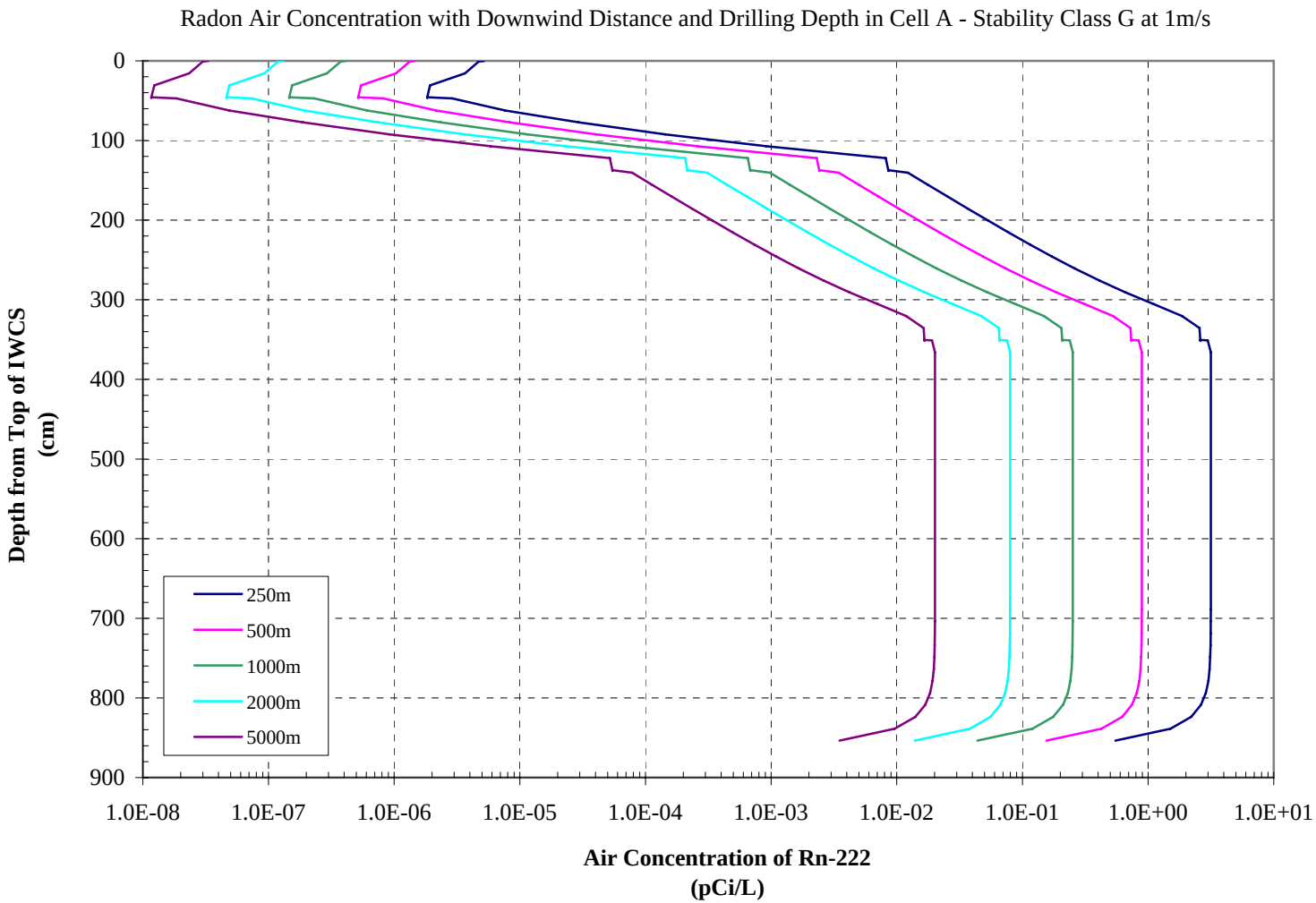

Figure C-7. Air Concentration Estimates for Drilling in Bay A – Bounding Meteorology

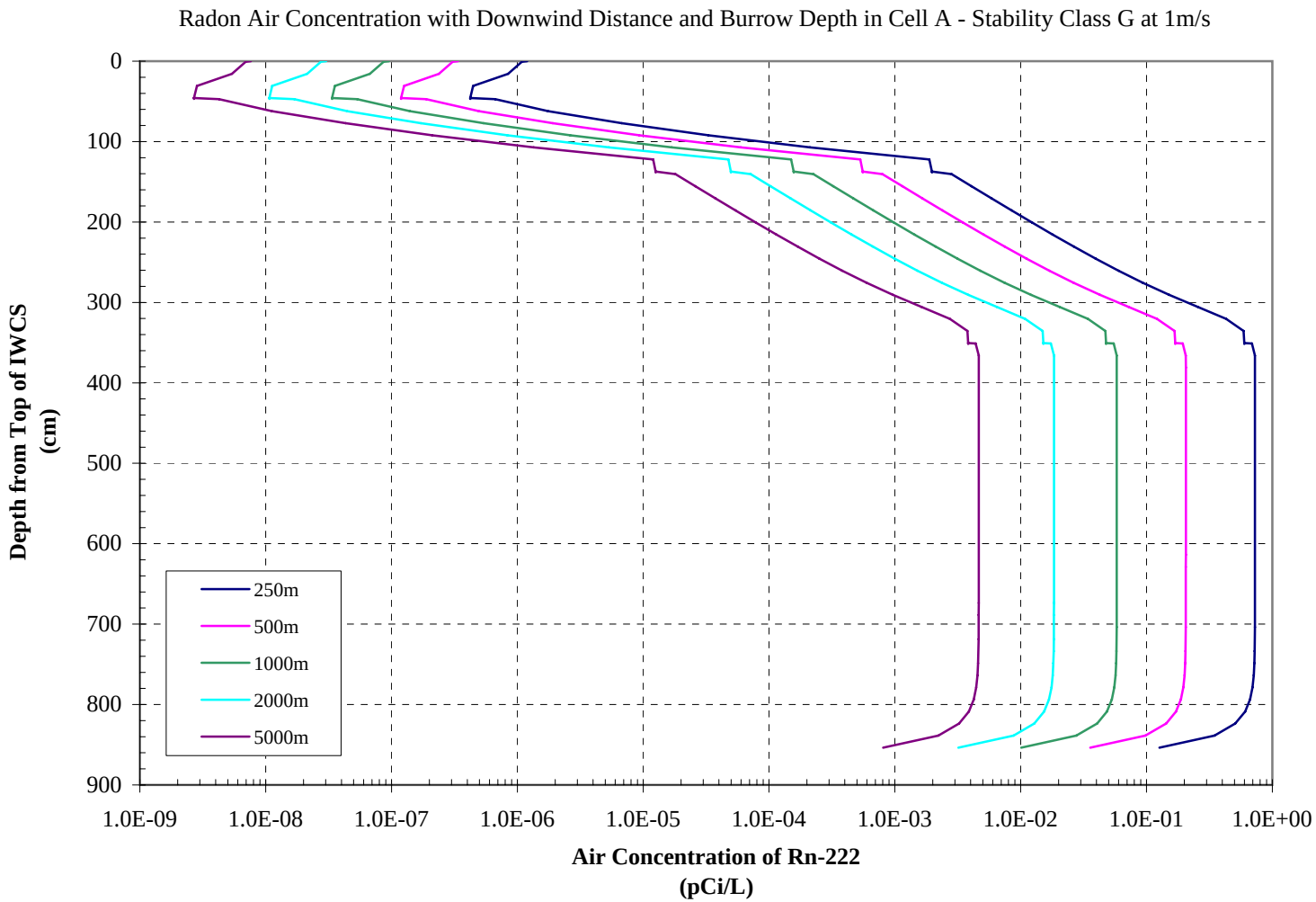

Figure C-8. Air Concentration Estimates for Burrowing in Bay A – Bounding Meteorology

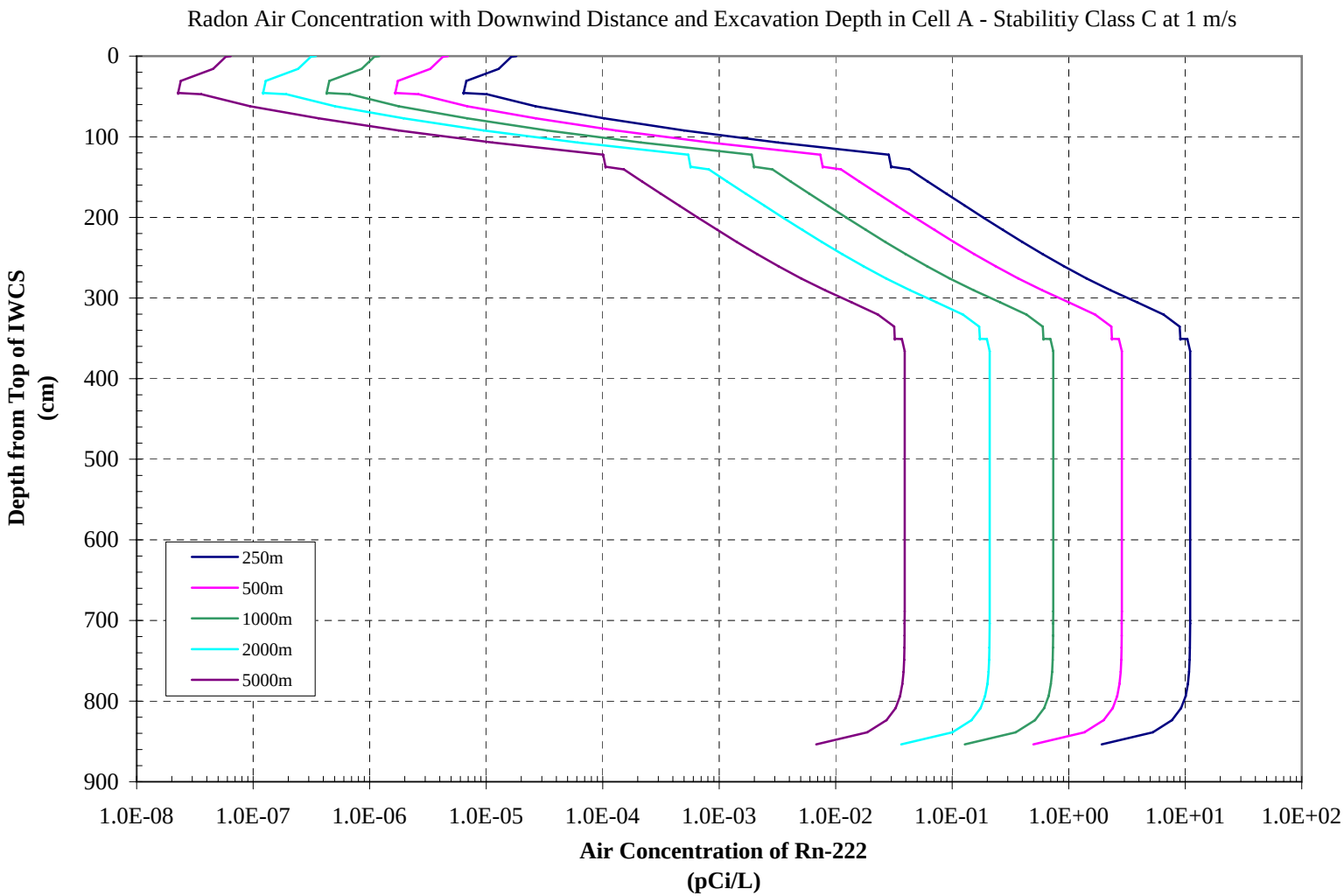

Figure C-9. Air Concentration Estimates Excavation in Bay A – Typical Meteorology

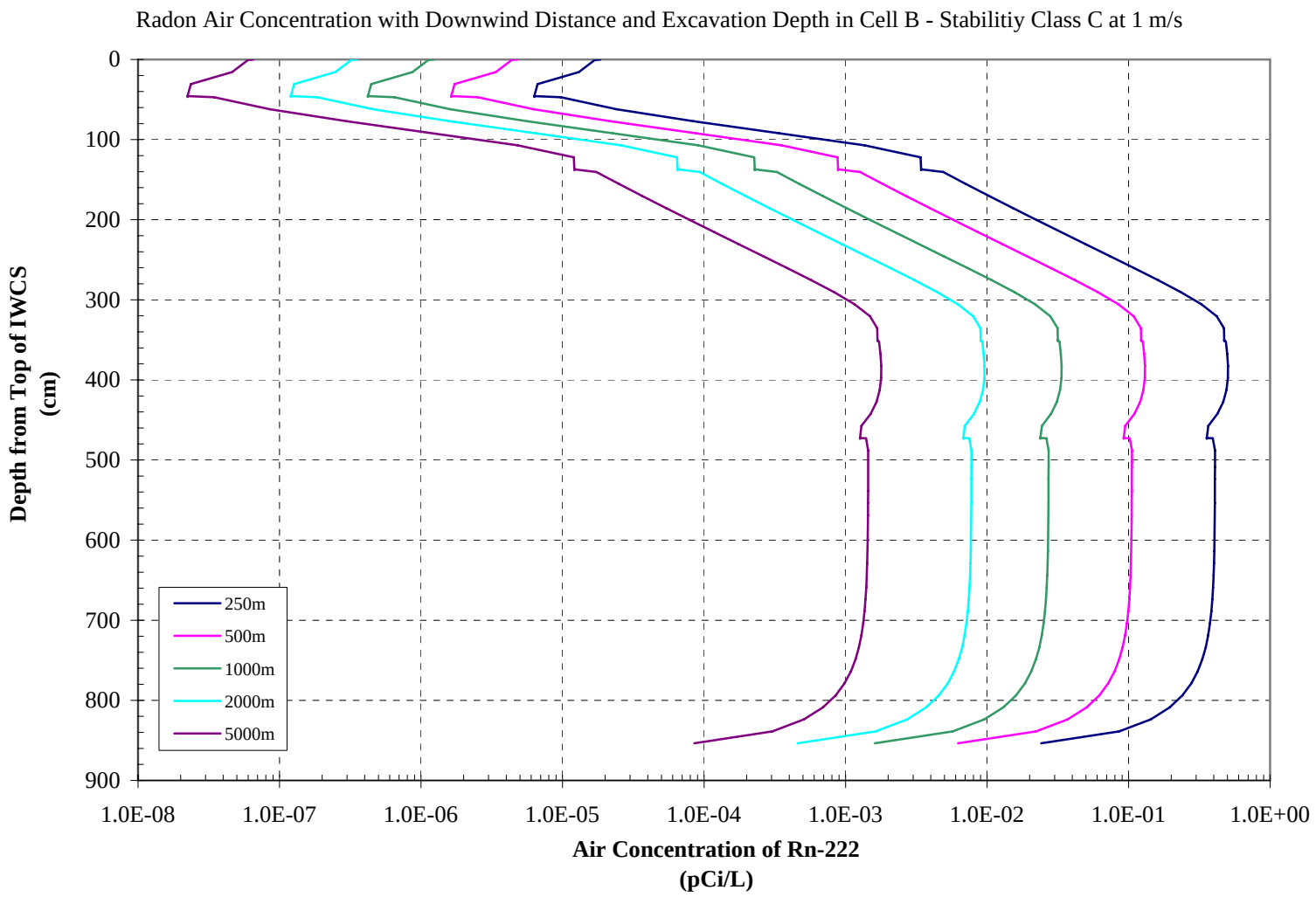

Figure C-10. Air Concentration Estimates for Excavation in Bay B – Typical Meteorology

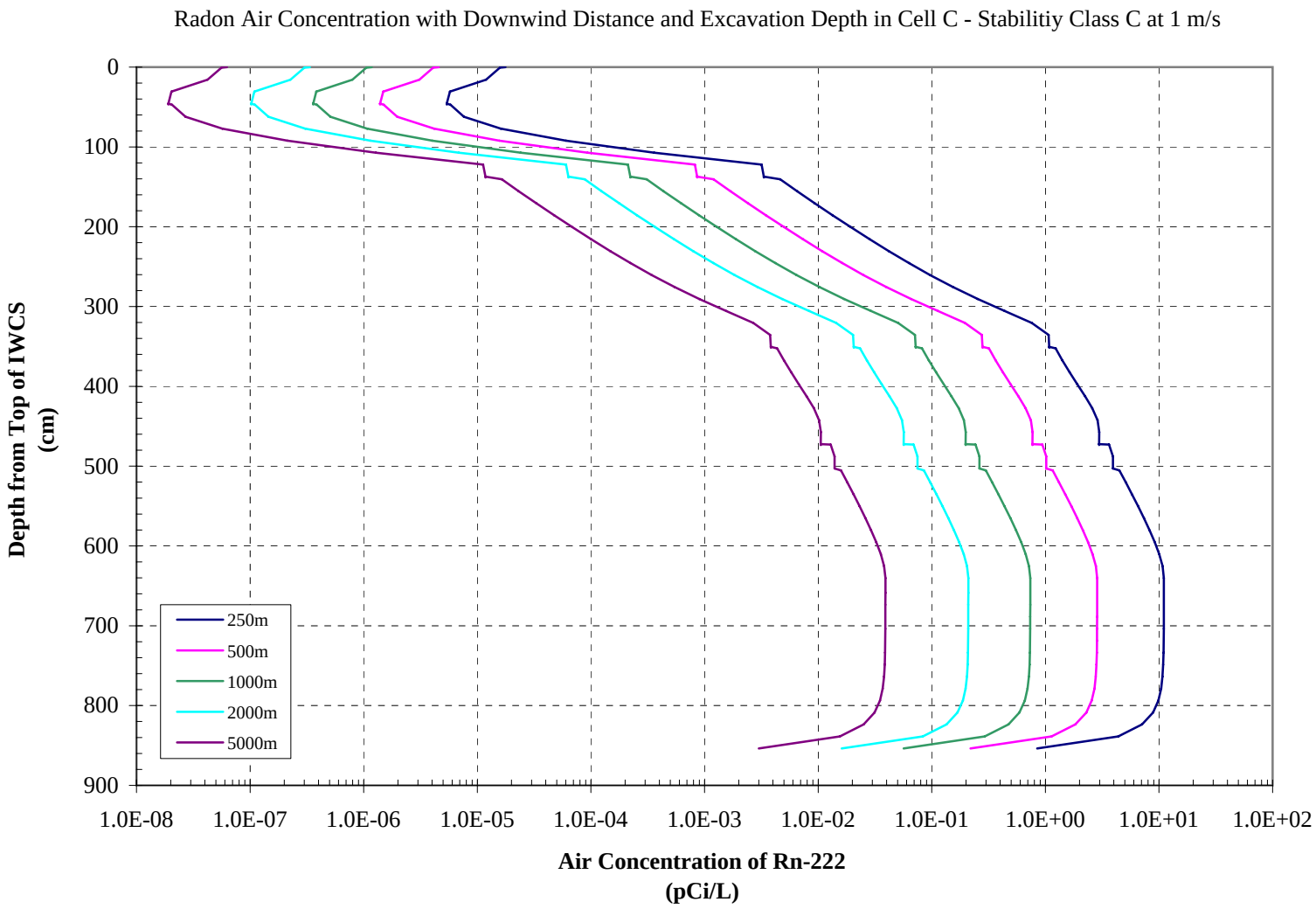

Figure C-11. Air Concentration Estimates for Excavation in Bay C – Typical Meteorology

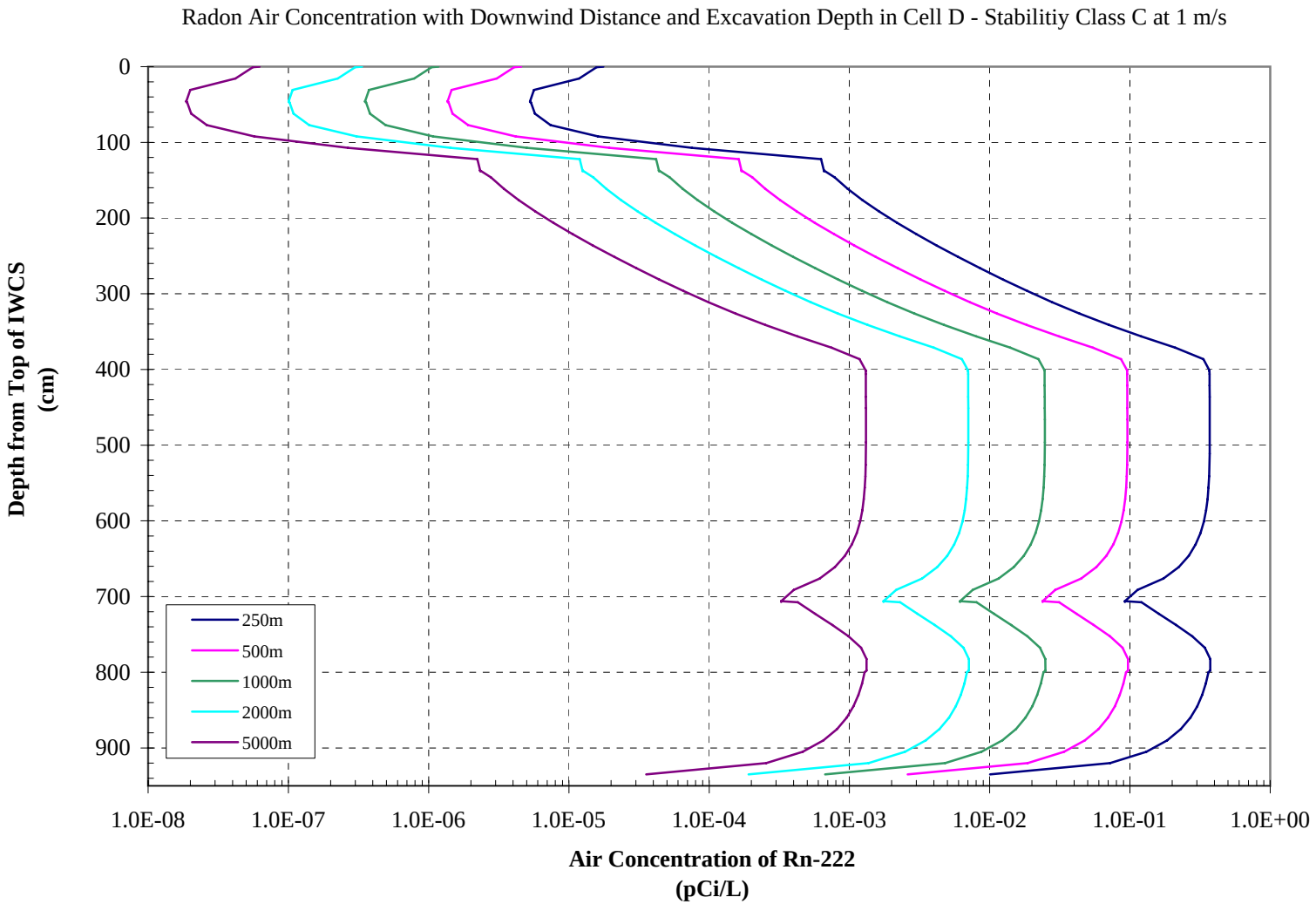

Figure C-12. Air Concentration Estimates for Excavation in Bay D – Typical Meteorology

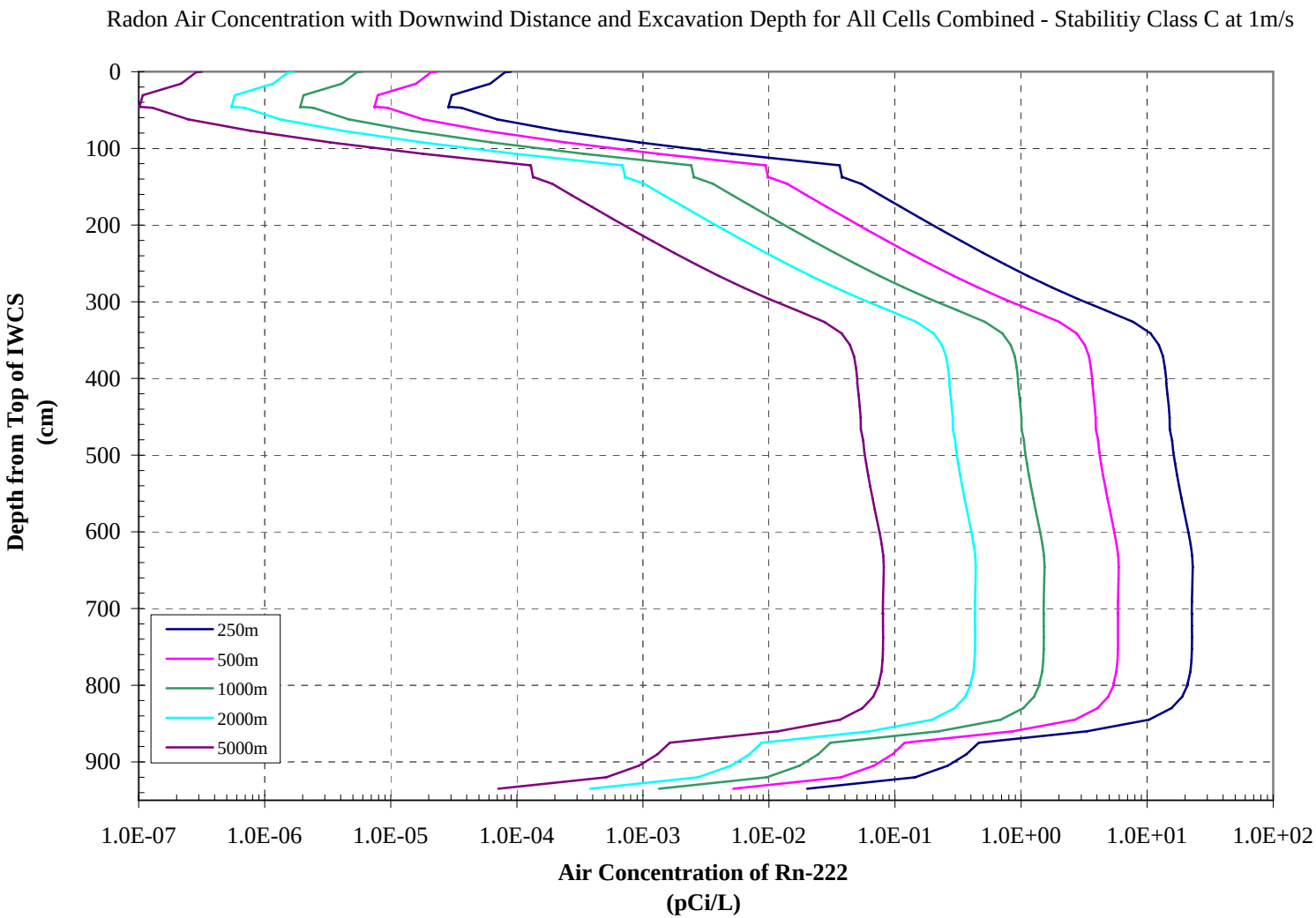

Figure C-13. Air Concentration Estimates for Excavation in Bays A, B, C, and D – Typical Meteorology

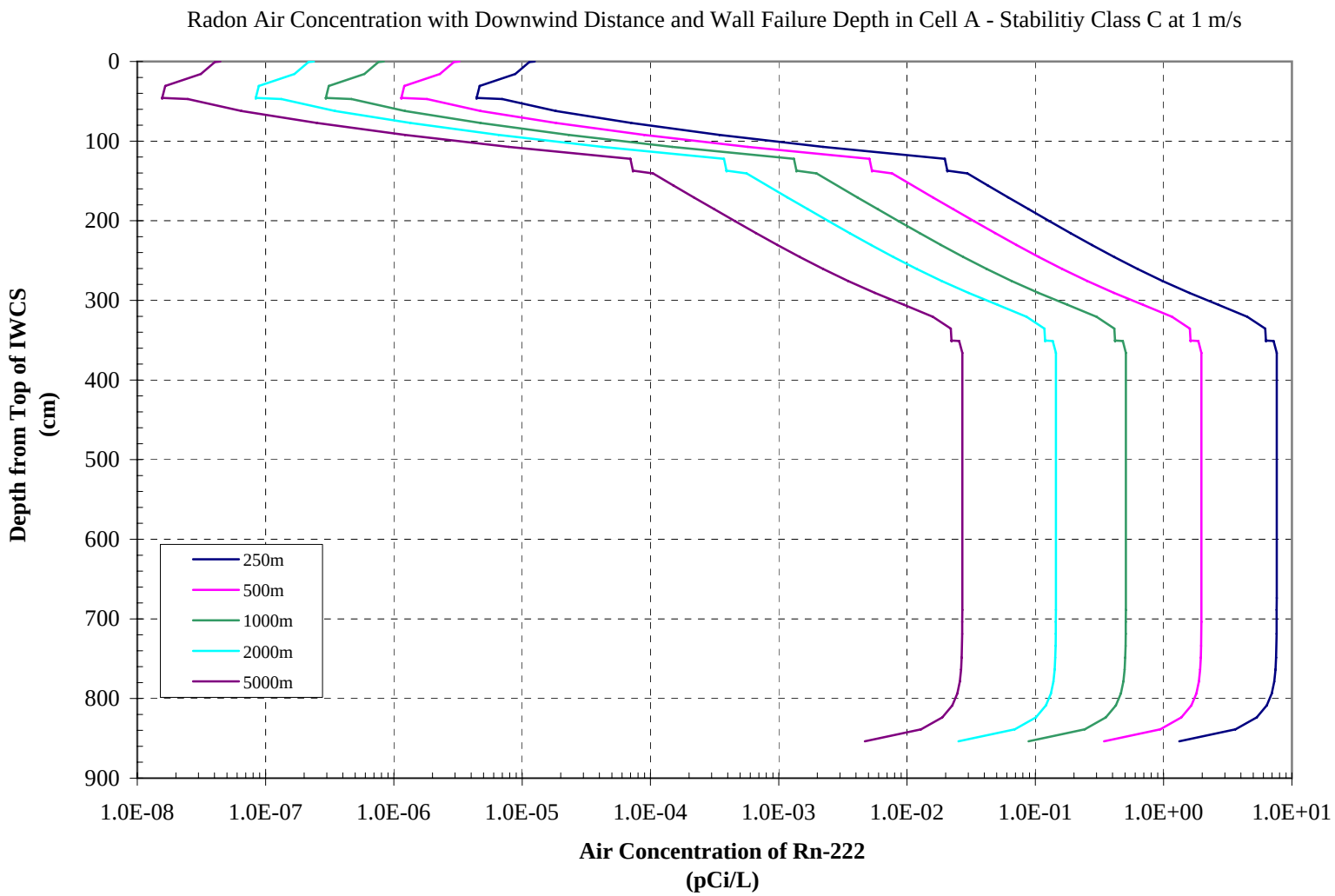

Figure C-14. Air Concentration Estimates for Wall Failure in Bay A – Typical Meteorology

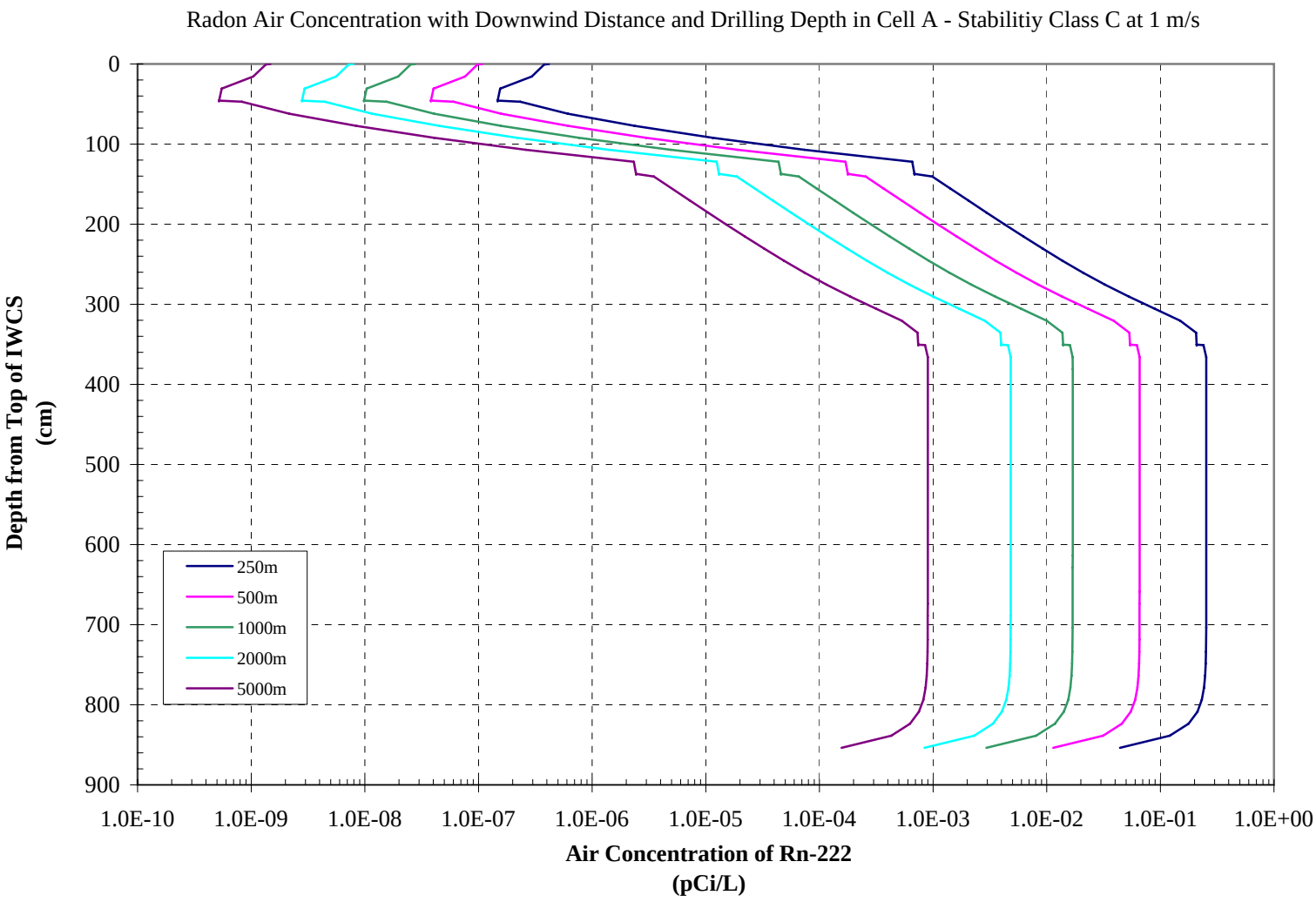

Figure C-15. Air Concentration Estimates for Drilling in Bay A – Typical Meteorology

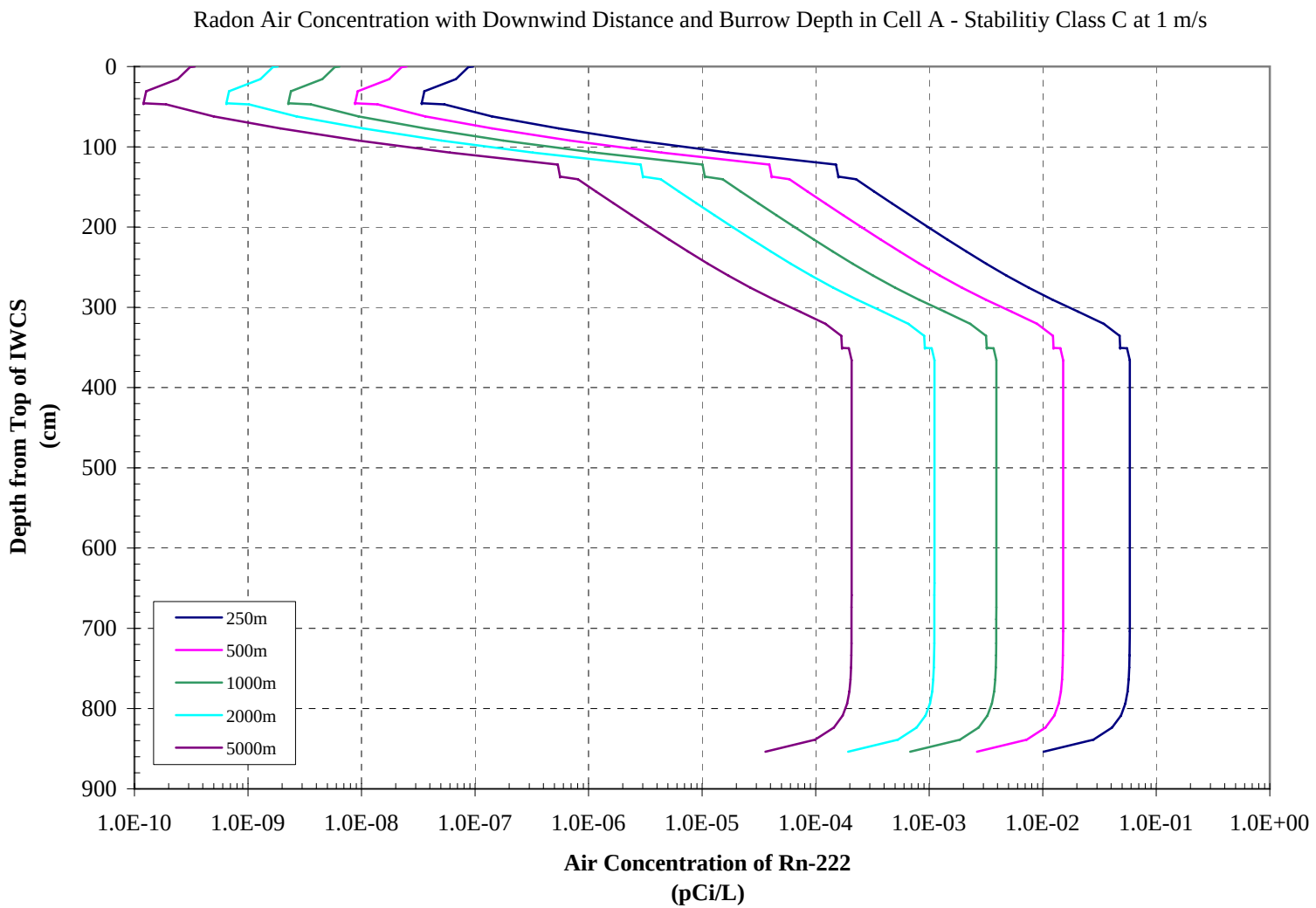

Figure C-16. Air Concentration Estimates for Burrowing in Bay A – Typical Meteorology

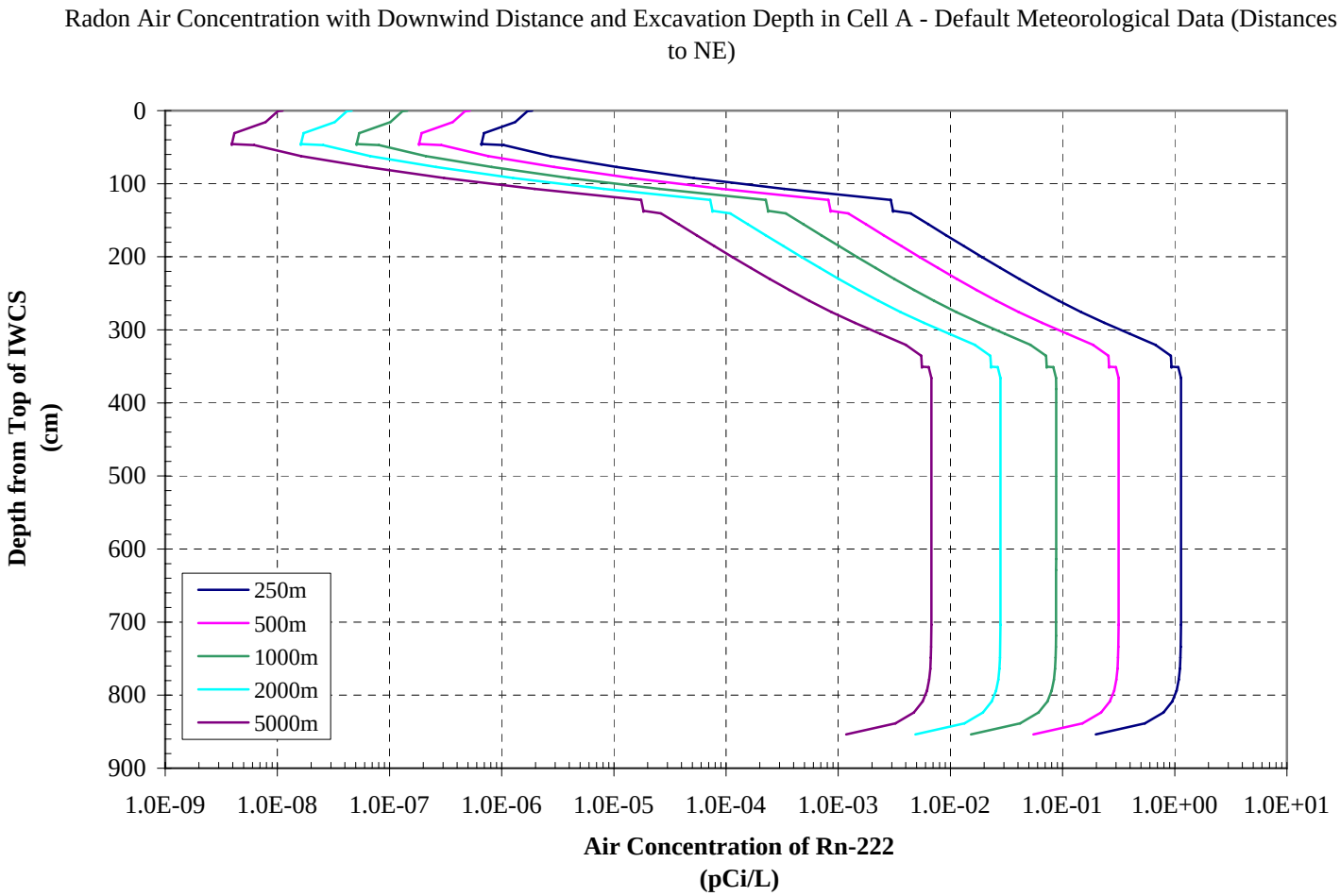

Figure C-17. Air Concentration Estimates for Excavation in Bay A – Default Meteorology

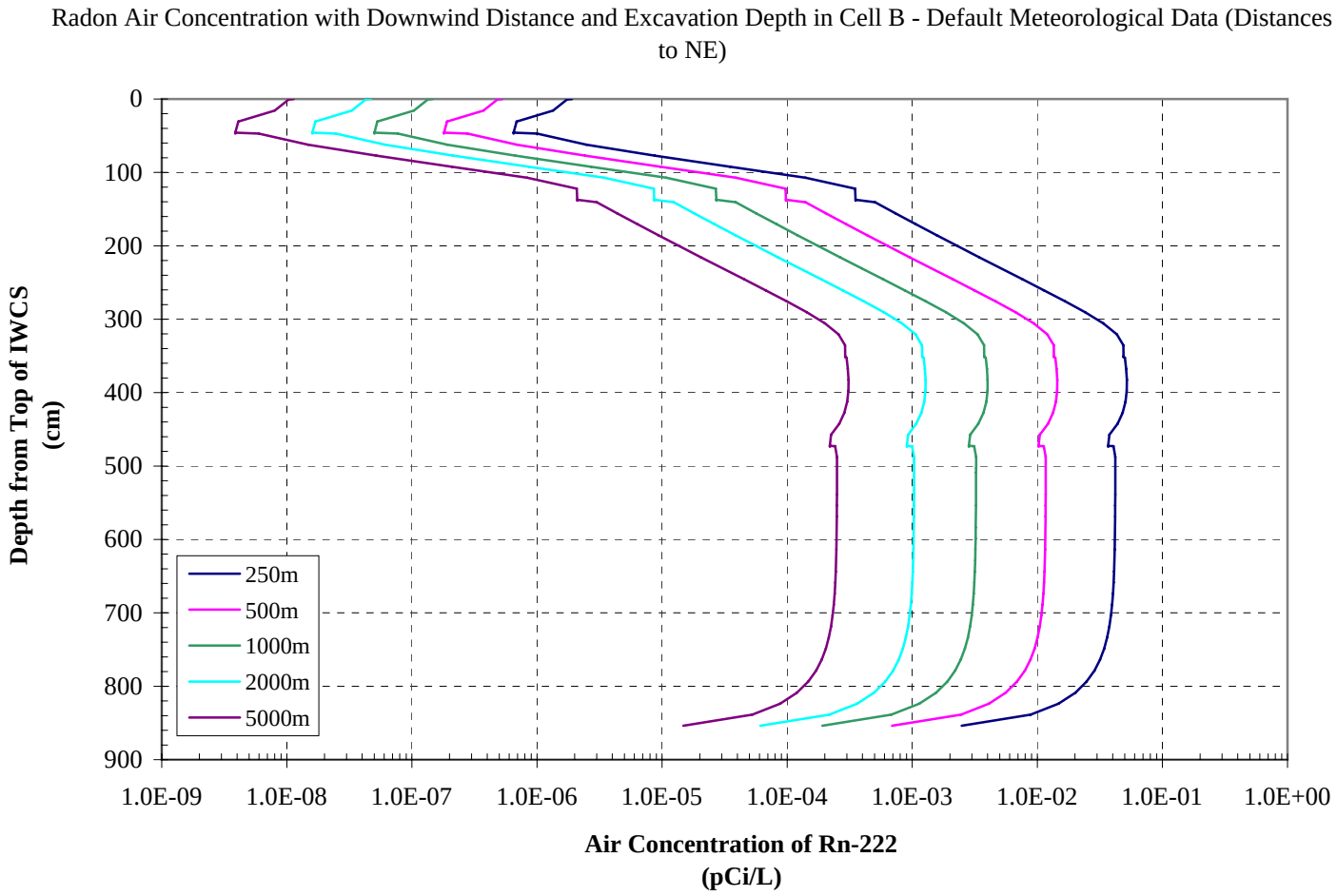

Figure C-18. Air Concentration Estimates for Excavation in Bay B – Default Meteorology

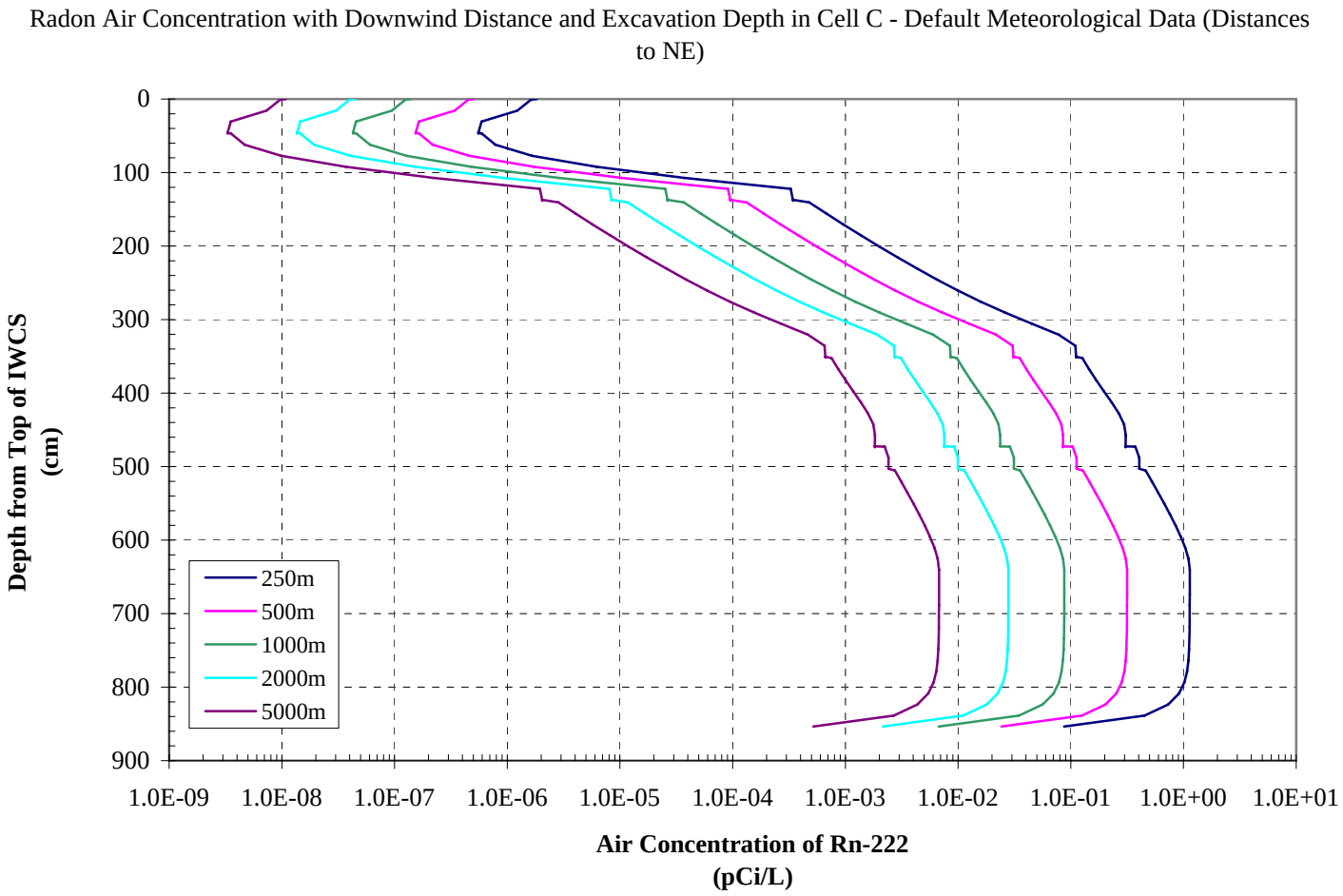

Figure C-19. Air Concentration Estimates for Excavation in Bay C – Default Meteorology

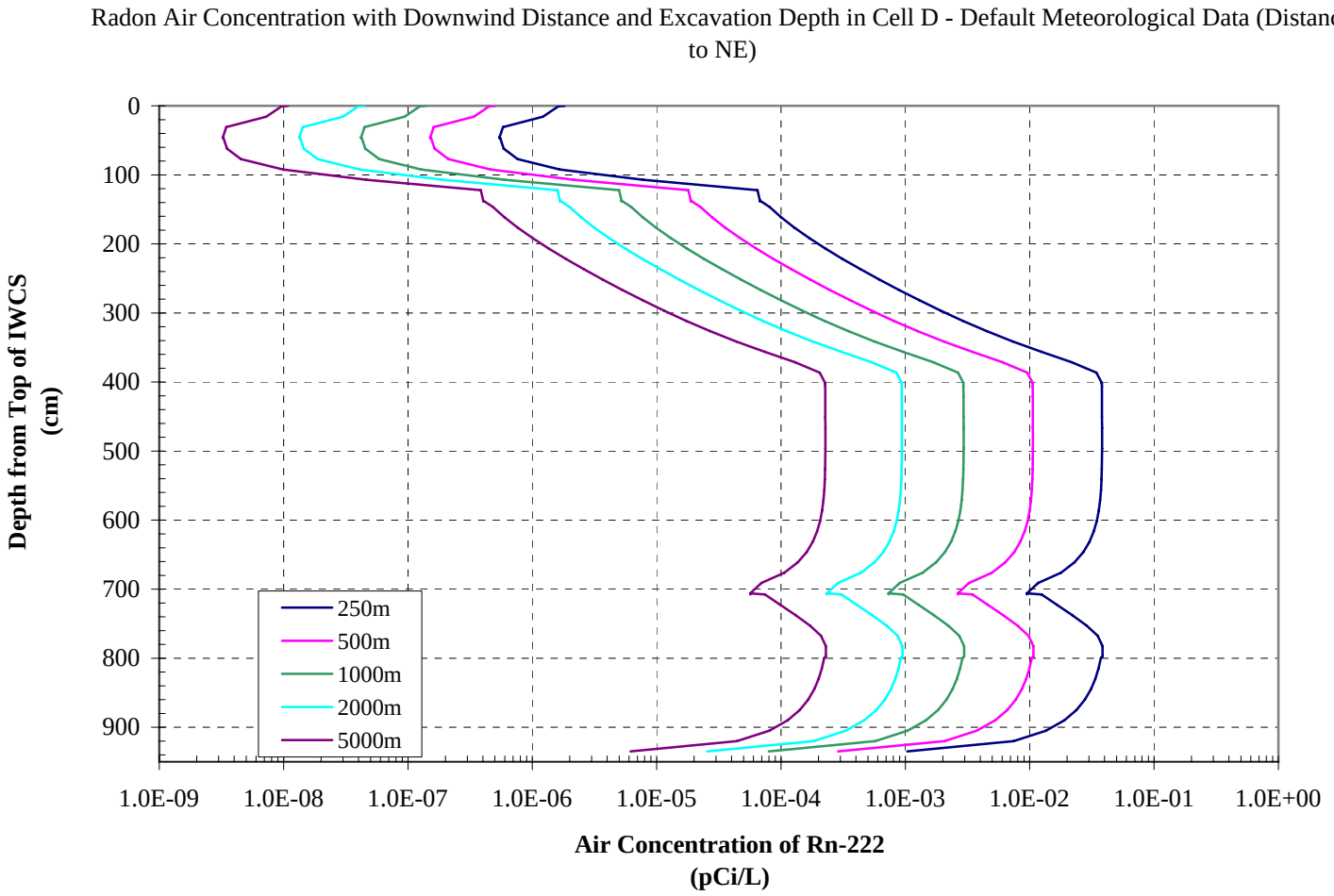

Figure C-20. Air Concentration Estimates for Excavation in Bay D – Default Meteorology

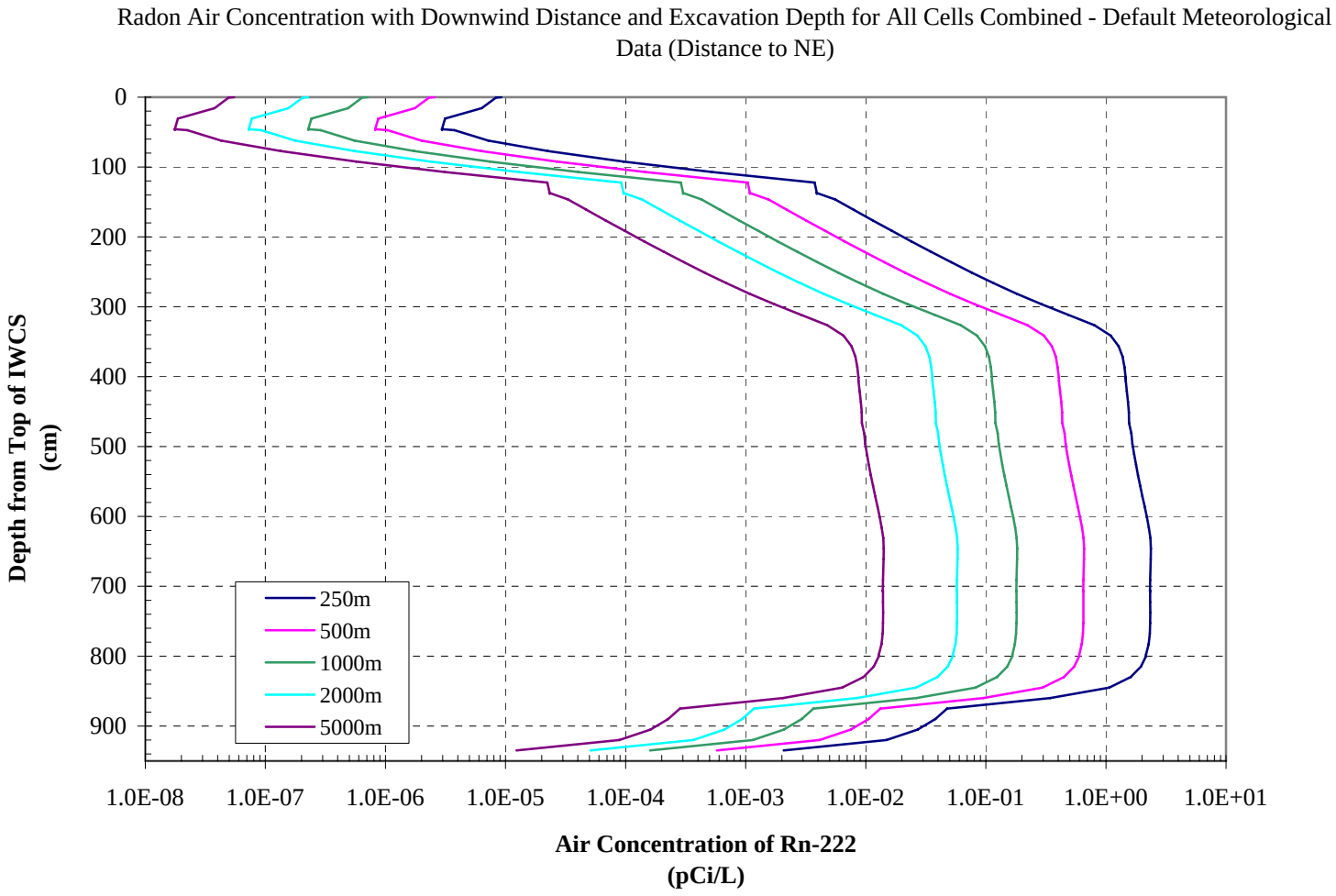

Figure C-21. Air Concentration Estimates for Excavation in Bays A, B, C, D– Default Meteorology

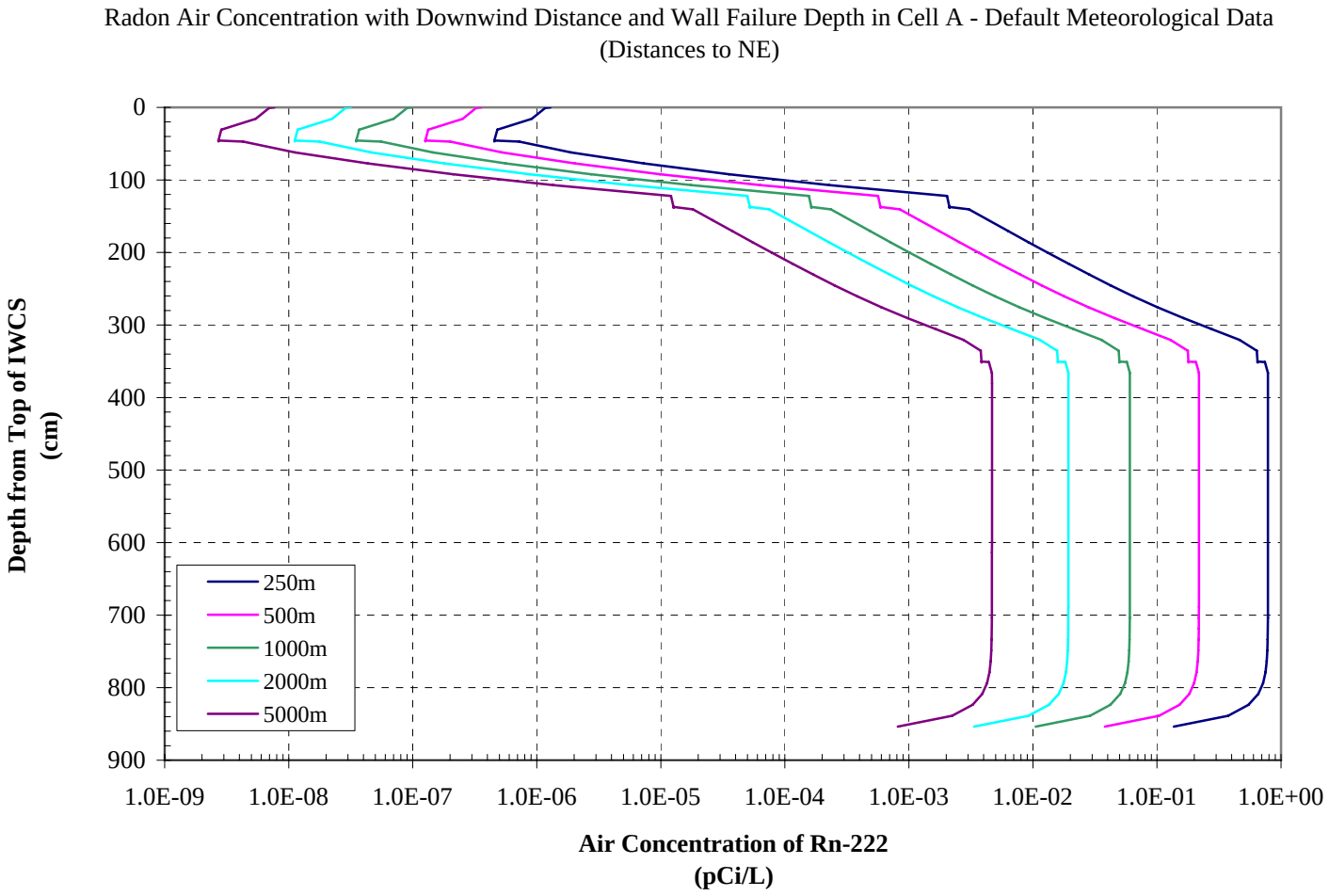

Figure C-22. Air Concentration Estimates for Wall Failure in Bay A – Default Meteorology

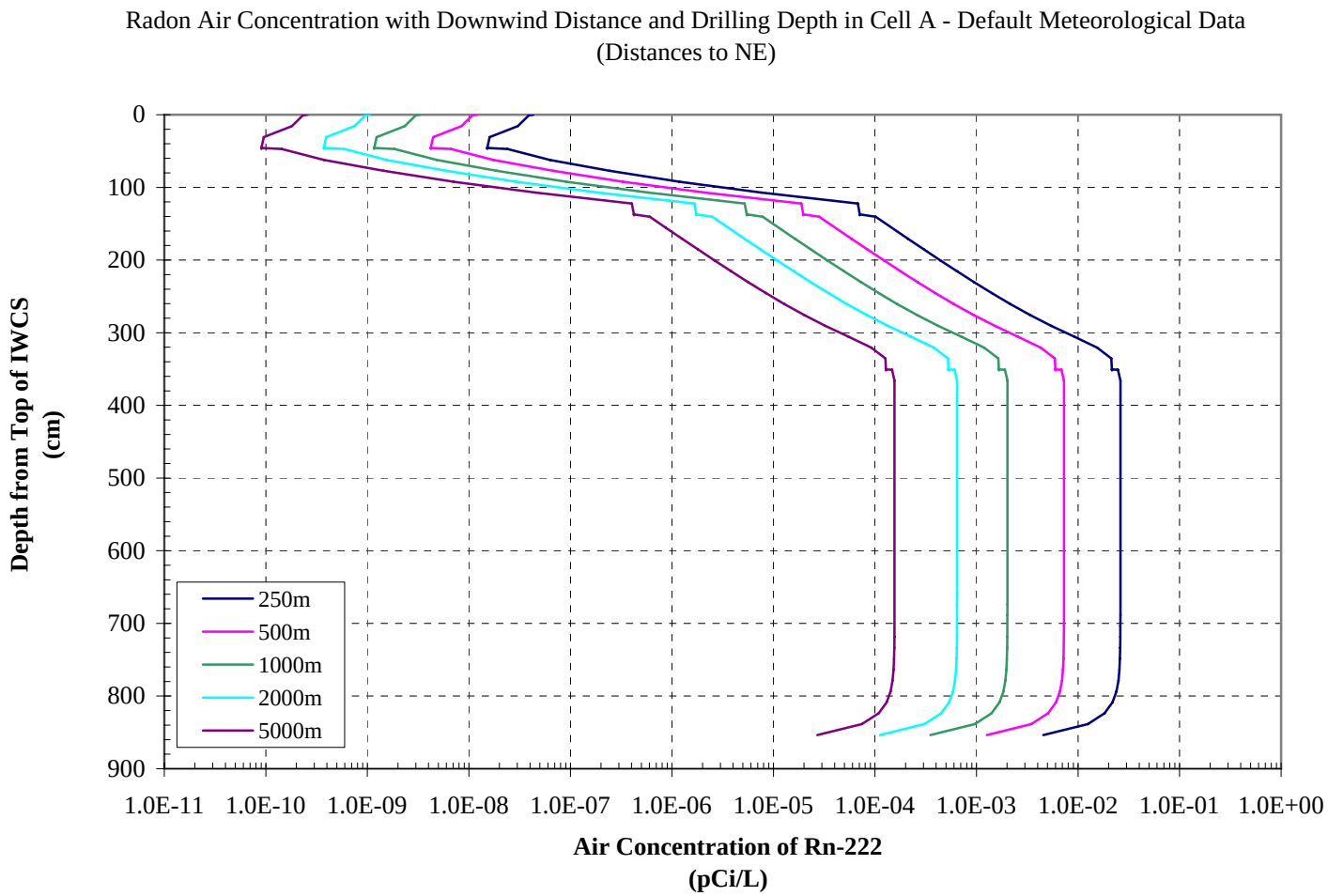

Figure C-23. Air Concentration Estimates for Drilling in Bay A – Default Meteorology

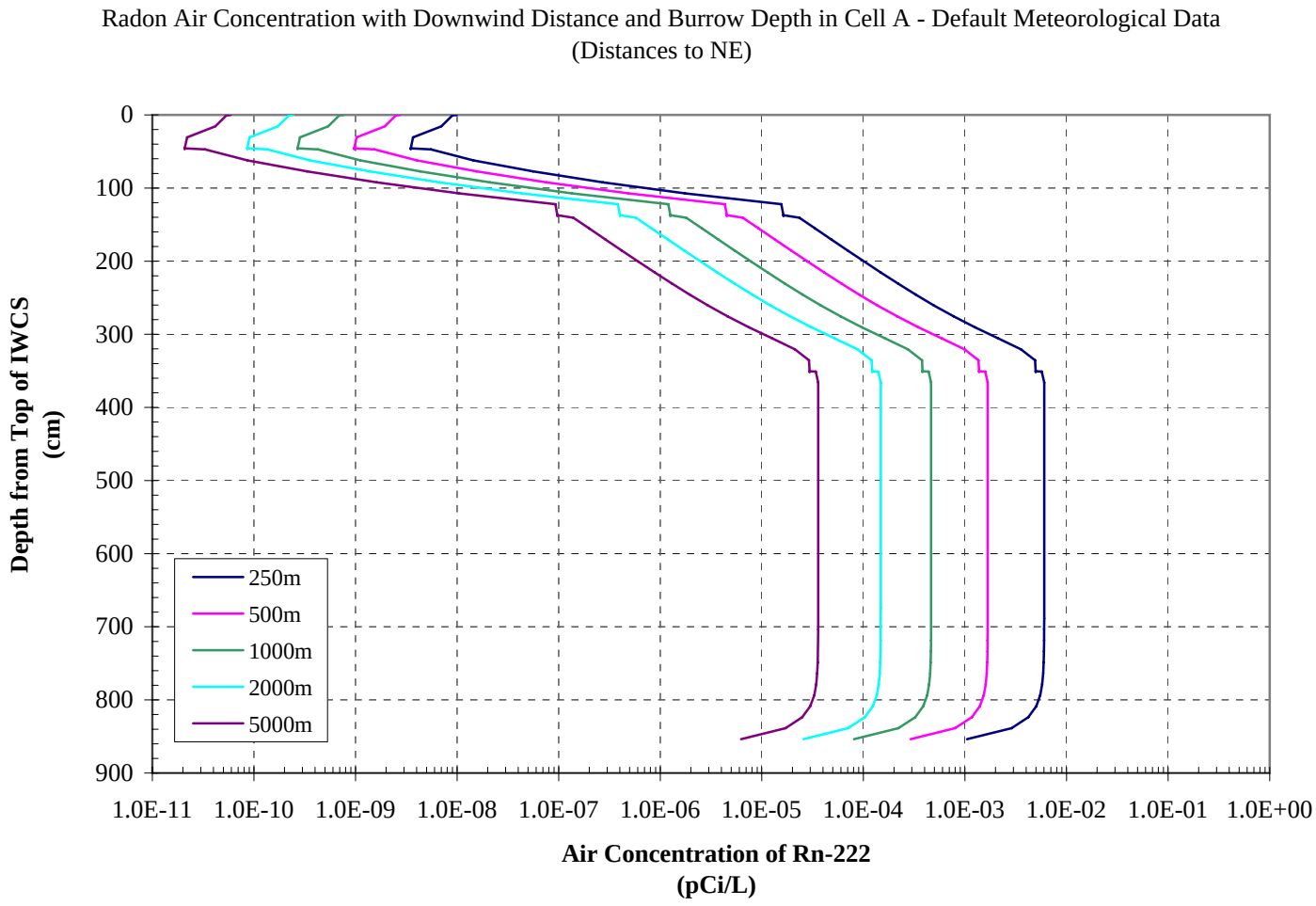

Figure C-24. Air Concentration Estimates for Burrowing in Bay A – Default Meteorology

APPENDIX D

Estimated Downwind Unit Air Concentrations
Lateral to Plume Centerline under Bounding Conditions

Including:

Appendix D-1: Text
Appendix D-2: Table
Appendix D-3: Figures

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APPENDIX D-1

Estimated Downwind Unit Air Concentrations
Lateral to Plume Centerline under Bounding Conditions

Text

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D.1 INTRODUCTION

The estimated air concentrations presented in the previous appendices (Appendix A through C) have been based on the steady-state plume centerline at ground level (assuming a ground level emission source). The air concentration calculations utilized in the CAP88 computer code are more detailed, in that they account for radioactive decay and atmospheric scavenging, which are not included in the equations below. This appendix presents the evaluation of air concentrations at locations lateral to the plume centerline at ground level, using simplified equations that allow comparison of relative concentrations across the plume.

Additionally, the calculations in this appendix are applicable to the bounding case, where the wind is from a single prevailing direction and lateral dispersion can be directly evaluated. In the case of the default meteorology, the data are a composite of several years of data and are based on average wind speeds, directional frequency, and various atmospheric stability classes for any given wind direction, which is not conducive for the evaluation of bounding plume dispersion as presented in the following appendix.

D.2 CALCULATION OF LATERAL DISPERSION

The air concentrations at locations lateral to the plume centerline were calculated using the basic equations presented in the CAP88 users guide (pp.55 and 61), as follows:

$$\text{Air Concentration } (x,y,z) = Q/(\pi\, \upsilon\, \sigma_y \sigma_z)\{\exp[-1/2((y^2/\sigma_y^2)+(z^2/\sigma_z^2))]\} \qquad \text{Eq. D-1}$$

Where:

x, y, z = distances in horizontal, lateral, and vertical directions (m)
Q = emission rate (Ci/s), assumed to be 1 Ci/s for unit calculations
Π = ratio of a circle's circumference to its diameter (~3.141593)
υ = wind speed (m/s)
σ_y, σ_z = dispersion coefficients in the lateral and vertical directions

The simple equation above does not account for reductions in air concentration related to radioactive decay or atmospheric scavenging, but provides relative concentrations that allow evaluation of lateral dispersion within the plume.

As can be seen in Equation D-1 the emission rate (Q) is directly related to air concentration, so increases in emission rate result in a proportional increase in air concentrations. The wind speed (υ) is inversely proportional to concentration, so greater wind speeds result in lower concentrations at all horizontal, lateral and vertical locations. For the calculation of ground level concentrations that are the focus of this appendix, the vertical height (z) is set to zero.

The lateral dispersion coefficient and the vertical dispersion coefficient were calculated utilizing the following equations.

CAP88 Dispersion Coefficient Equations

Stability Class Category	Horizontal σy (m)	Vertical σz (m)
A	$0.22X\ (1 + 0.0001X)^{-1/2}$	$0.20X$
B	$0.16X\ (1 + 0.0001X)^{-1/2}$	$0.12X$
C	$0.11X\ (1 + 0.0001X)^{-1/2}$	$0.08X\ (1 + 0.0002X)^{-1/2}$
D	$0.08X\ (1 + 0.0001X)^{-1/2}$	$0.06X\ (1 + 0.0015X)^{-1/2}$
E	$0.06X\ (1 + 0.0001X)^{-1/2}$	$0.03X\ (1 + 0.0003X)^{-1}$
F	$0.04X\ (1 + 0.0001X)^{-1/2}$	$0.016X\ (1 + 0.0003X)^{-1}$
G	calculated by subtracting half the difference between values for categories E and F from the value for category F.	

Where X (in meters), is the downwind distance along the centerline. The calculated dispersion coefficients for atmospheric Stability Classes A, C and G are presented in Table D-1 for several downwind distances. As can be seen from the equations, the dispersion coefficients are dependent only on the stability class and downwind distance. It is the product of the vertical and horizontal dispersion coefficients that appear in the denominator in Equation D-1, indicating that larger values for these parameters result in decreased air concentrations.

D.3 RESULTS

The equations above were used to generate the results in Table D-1, which summarize the unit air concentrations for steady state conditions at ground level (z=0) for various atmospheric stability classes at specific downwind distances and lateral distances from the plume centerline. The calculations assume a unit emission of 1 Ci/yr and a wind speed of 1 m/s.

Figures D-1, D-2 and D-3 plot the unit air concentrations for Stability Classes A, C and G, respectively. The figures were generated for a unit emission rate (1 Ci/yr) and wind speed (1-m/s) at the ground surface, and show the greater dispersion for unstable atmospheres (Class A) as compared with stable air (Class G).

D.4 SUMMARY

As presented in Table D-1, Stability Class A results in the greatest dispersion, with air concentrations that are more uniform out to lateral distances of 50 m. At a downwind distance of 200 m, there is very little change in the air concentration when moving laterally through the plume under Class A conditions.

As presented in Table D-1, the horizontal dispersion is greater for Class A (22 m) than Class C (11 m) at a downwind distance of 100 m; however, the vertical dispersion for Class A (2.0 m) is less than Class C (7.9 m). As previously indicated, it is the product of the dispersion coefficients that appears in the denominator of the air concentration Equation D-1.

As expected, based on the dispersion coefficients presented for Classes A and C, the air concentrations for Class C are lower than those for Class A at all locations. Additionally, with less lateral dispersion, the higher air concentrations within the plume are more prevalent near the centerline (Figure D-2) at 100 m downwind. At a downwind distance of 400 m, the lateral concentrations are nearly equivalent under Class C conditions.

For Class G conditions, the horizontal (3.0 m) and vertical (0.87 m) dispersion coefficients at 100 m downwind are lower than for any other class (Table D-1). Correspondingly, the calculated air concentrations along the centerline are the largest among all atmospheric classes. However, due to the limited dispersion, the plume is narrow near the source and air concentrations drop rapidly when moving laterally through the plume (Figure D-3).

At a distance of 1,000 m downwind from the source, the lateral concentration difference is still evident in Figure D-3.

Overall, the largest centerline ground level concentration for a unit emission is observed for Stability Class G. The Class G plume is narrow, even at 400 m from the source, and concentrations drop several orders of magnitude at 10 m lateral from the centerline. However, the Class G plume centerline concentration is several orders of magnitude above that for Classes A and C at all distances.

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APPENDIX D-2

Estimated Downwind Unit Air Concentrations
Lateral to Plume Centerline under Bounding Conditions

Table

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Table D-1. Summary of Steady State Ground Level Unit Air Concentrations for Downwind Locations and Lateral Distances

Downwind Distance (m)	Horizontal Dispersion (m)	Vertical Dispersion (m)	Unit Air Concentration (pCi/L) at Lateral Distance from Centerline (m)						
			-50	-25	-10	0	+10	+25	+50
Class A									
100	2.2E+01	2.0E+00	5.4E-07	3.8E-06	6.6E-06	7.3E-06	6.6E-06	3.8E-06	5.4E-07
200	4.4E+01	4.0E+00	9.5E-07	1.5E-06	1.8E-06	1.8E-06	1.8E-06	1.5E-06	9.5E-07
400	8.6E+01	8.0E+00	3.9E-07	4.4E-07	4.6E-07	4.6E-07	4.6E-07	4.4E-07	3.9E-07
1000	2.1E+02	2.0E+01	7.4E-08	7.5E-08	7.6E-08	7.6E-08	7.6E-08	7.5E-08	7.4E-08
Class C									
100	1.1E+01	7.9E+00	1.1E-10	2.7E-07	2.4E-06	3.7E-06	2.4E-06	2.7E-07	1.1E-10
200	2.2E+01	1.6E+01	6.7E-08	4.8E-07	8.4E-07	9.3E-07	8.4E-07	4.8E-07	6.7E-08
400	4.3E+01	3.1E+01	1.2E-07	2.0E-07	2.3E-07	2.4E-07	2.3E-07	2.0E-07	1.2E-07
1000	1.0E+02	7.3E+01	3.7E-08	4.0E-08	4.1E-08	4.2E-08	4.1E-08	4.0E-08	3.7E-08
Class G									
100	3.0E+00	8.7E-01	1.5E-65	7.2E-20	4.5E-07	1.2E-04	4.5E-07	7.2E-20	1.5E-65
200	5.9E+00	1.7E+00	1.3E-20	4.5E-09	7.7E-06	3.2E-05	7.7E-06	4.5E-09	1.3E-20
400	1.2E+01	3.2E+00	1.0E-09	8.8E-07	5.9E-06	8.4E-06	5.9E-06	8.8E-07	1.0E-09
1000	2.9E+01	6.9E+00	3.5E-07	1.1E-06	1.5E-06	1.6E-06	1.5E-06	1.1E-06	3.5E-07

Note: Calculations assumed a 1 m/s wind speed and a unit emission of 1 Ci/yr from a ground level source.

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APPENDIX D-3

Estimated Downwind Unit Air Concentrations
Lateral to Plume Centerline under Bounding Conditions

Figures

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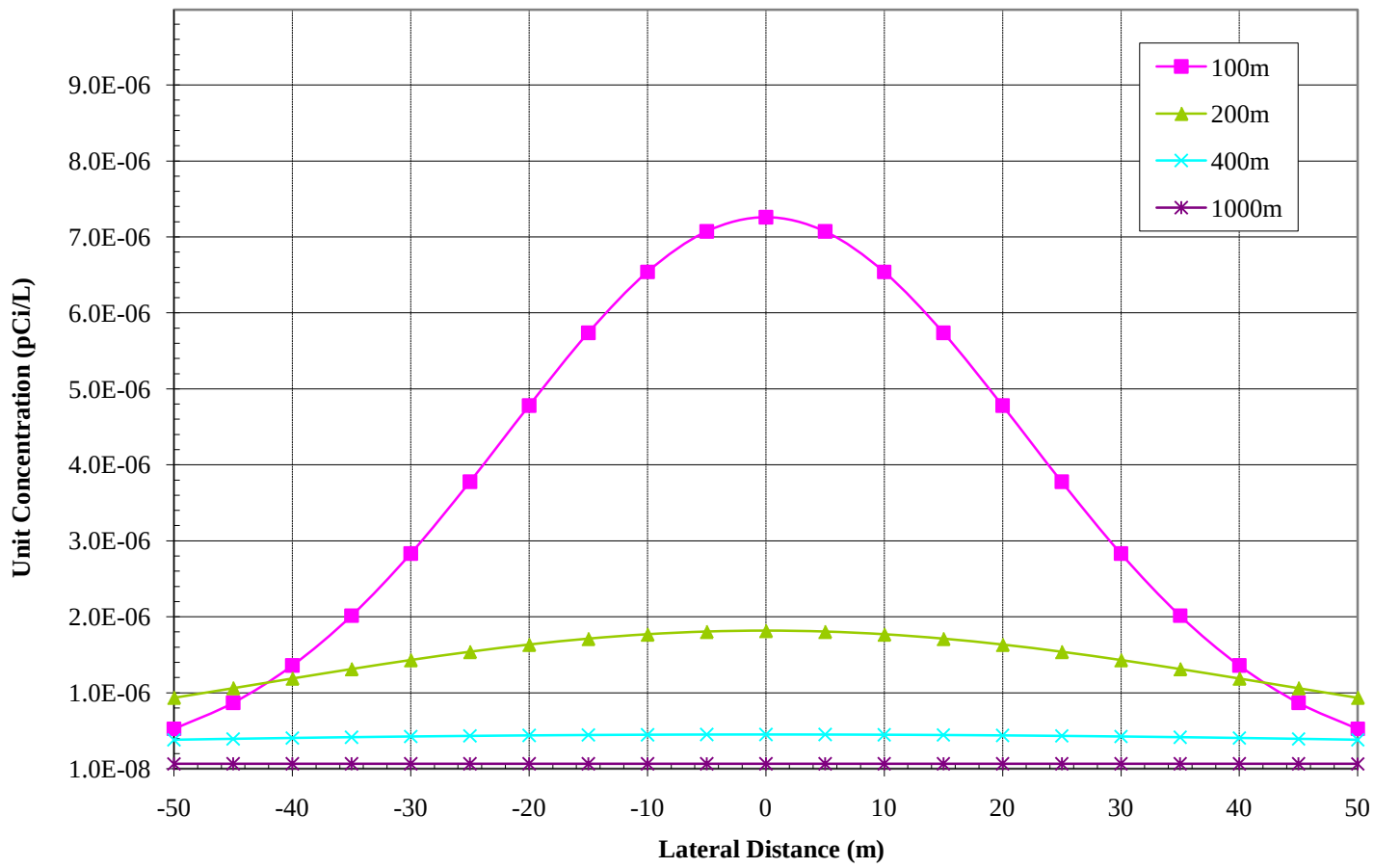

Figure D-1. Steady State Ground Level Radon Unit Air Concentrations with Lateral Dispersion at Downwind Distances (Class A at 1m/s for a 1Ci/yr emission rate)

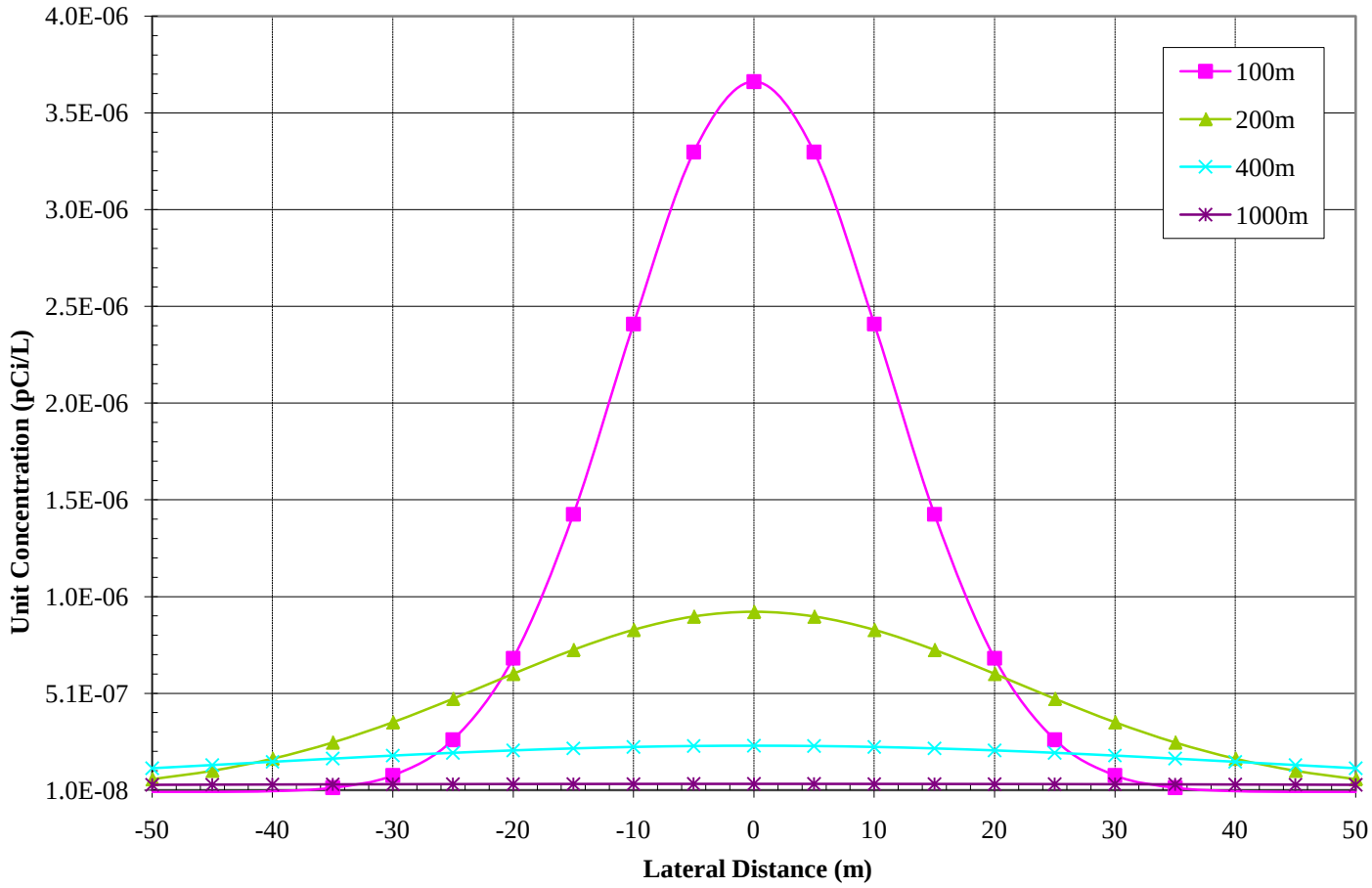

Figure D-2. Steady State Ground Level Radon Unit Air Concentrations with Lateral Dispersion at Downwind Distances (Class C at 1m/s for a 1Ci/yr emission rate)

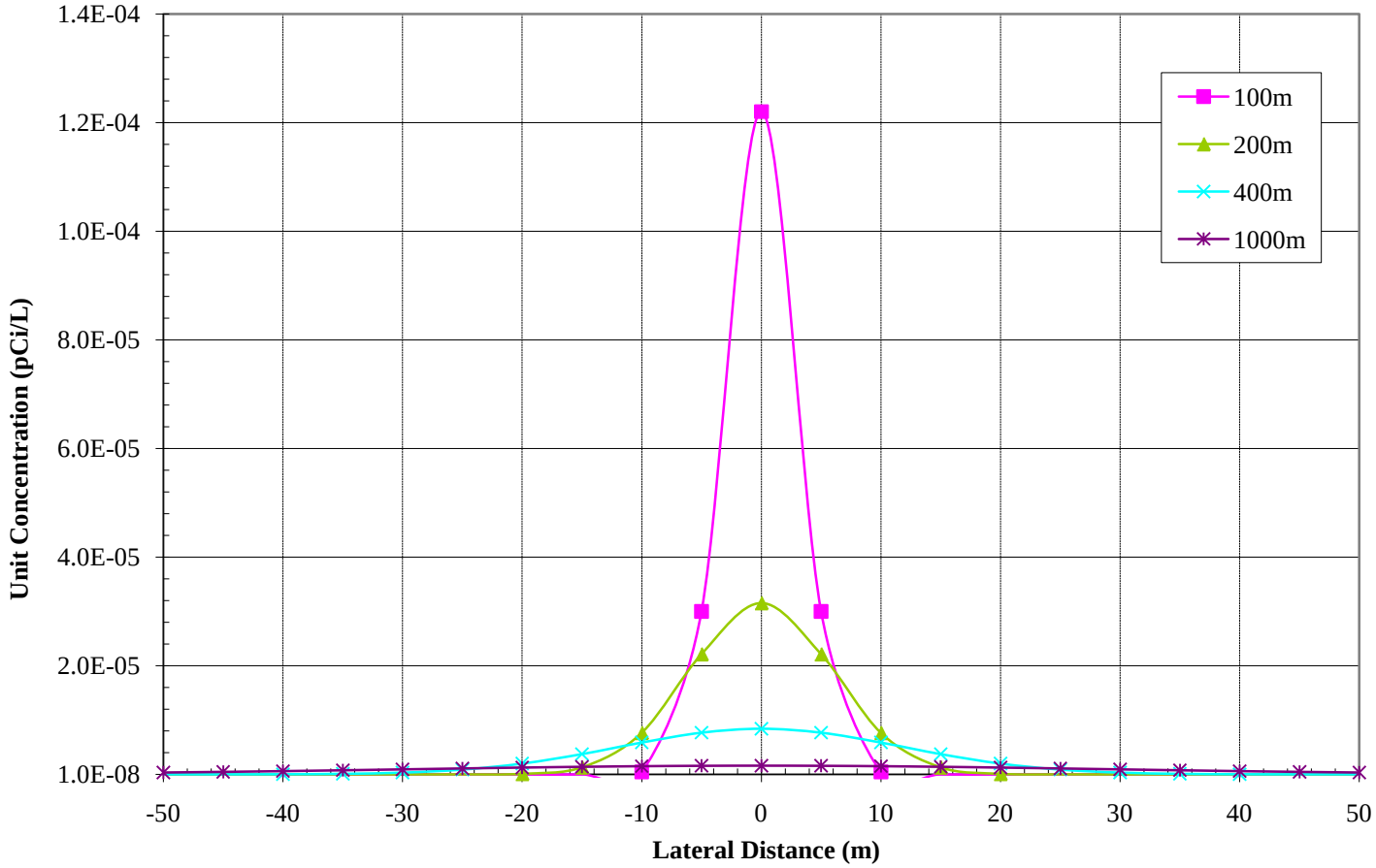

Figure D-3. Steady State Ground Level Radon Unit Air Concentrations with Lateral Dispersion at Downwind Distances (Class G at 1m/s for a 1Ci/yr emission rate)

APPENDIX E

Earthquake Scenario Evaluation

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Appendix E-1: Text
Appendix E-2: Tables

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APPENDIX E-1

Earthquake Scenario Evaluation

Text

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E.1 INTRODUCTION

The alternate earthquake scenario is based on the creation of a fissure in the IWCS that opens to the atmosphere and provides a transport pathway for radon migration from the K-65 residues. In order to provide information to contingency planners, this evaluation predicts the depth that a fissure would have to reach within the IWCS before air concentration criteria at off-site locations were exceeded. The calculations were performed by combining the radon flux estimates from Appendix A with unit air concentrations from Appendix B as discussed in the following sections.

E.2 ASSUMPTIONS

The radon release mechanism is conservatively assumed to be convective movement of radon out of the earthquake fissure, which is the equivalent of the exposed source material emitting radon directly to the atmosphere. However, it is more likely that the radon will diffuse into the fissure opening and then diffuse to the atmosphere through the opening at the top of the fissure. Radon is heavier than air and is likely to accumulate within the fissure before the concentration gradient between the void and the atmosphere induces diffusion out of the crack opening. The comparison of convective and diffusive release is discussed in Appendix A and presented in the summary sections of this evaluation.

The following assumptions formed the basis for the analysis;

- The fissure length is 50 m, which is assumed to crack the cap over Bay A to a depth calculated in this appendix. A location over Bay A was selected because the layers in this area produce the highest radon flux as compared with other bays (see Appendix A).

- The average flux is calculated assuming that exposure of the contents of Bay A are representative of a conservative scenario for the 50 m long fissure, which may incorporate a number of bays.

- The earthquake fissure is a void into which radon diffuses from the surrounding exposed source material.

- The radon is emitted from the fissure to the atmosphere based on convective movement, where the entire volume of the subsurface void is emitted to the atmosphere each second (i.e., the source material is assumed to be directly exposed to the atmosphere). Results based on diffusive emission through only the crack opening at the top of the IWCS, a more realistic condition, are also presented for comparative purposes.

- The estimated air concentrations are based on long-term meteorological conditions in order to establish the depth to reach a particular air concentration. Additional evaluations of alternative atmospheric conditions are included based on the established depth to provide perspective regarding the results.

The significance of the assumed meteorological conditions is further discussed in the following section. The methodology section describes how these assumptions are incorporated into the air concentration estimates.

E.3 METEOROLOGICAL CONDITIONS

Because the estimated downwind air concentrations are strongly dependent on the meteorological conditions during the radon release, a range of possible atmospheric conditions were investigated. The radon analysis considered both short-term and long-term releases, and utilized three sets of meteorological conditions to evaluate the release scenarios. These three atmospheric conditions were considered representative of the range of possible conditions present at the IWCS during radon releases, as further discussed below.

For long-term releases (greater than 30 days), a meteorological dataset was used that summarized several years of data suitable to estimating air concentrations in the sixteen compass directions over an annual time period. The

analysis based on historical long-term atmospheric conditions is referred to as the default condition within this appendix. The meteorological database used for evaluation of the default condition was the CAP88 file for Niagara Falls International Airport, which represents the years 1955-1959. Although this data is historical, it has been through significant validation and verification.

For shorter term releases (less than 30 days), where winds might be focused in a single direction, a meteorological dataset was used to reflect an atmospheric condition that might persist for a brief period of time. Datasets were created for CAP88 to simulate a wind of a constant speed in a single direction for a constant atmospheric stability class. Two stability classes were included in the short-term analysis, one for a extremely stable atmosphere (the bounding condition) and one for a slightly unstable atmosphere (the typical condition), which are described below.

The extremely stable short-term atmosphere (bounding condition) was simulated using an atmospheric stability class of G with a wind speed of 1 m/s. This reflects a very stable atmosphere, where limited dispersion of the plume could be expected, resulting in maximum plume centerline concentrations. This scenario was used to provide upper bound estimates of potential short-term air concentrations associated with releases from IWCS. The Class G stability class is most often observed during lightly clouded nighttime hours with very low wind speeds and is associated with a very stable atmosphere where very little mixing of air parcels is occurring. As a result, constituents tend to remain concentrated along the centerline of an airborne plume and are not likely to be distributed laterally.

The slightly unstable short-term atmosphere (typical condition) assumed a Stability Class C with a wind speed of 1 m/s. This reflects a typical stability with a 1 m/s wind speed, which is well below the average wind speed of 4.5 m/s at Niagara Falls International Airport in 2008. The typical condition is used to estimate a reasonably conservative air concentration for a single wind direction. Stability Class C is most often observed during partly cloudy daylight hours with moderate winds and is considered indicative of a slightly unstable atmosphere. Because of these instabilities in the atmosphere, parcels of air are more likely to collide and mix, which tends to distribute any airborne constituents more evenly within the plume. This has the effect of reducing the centerline concentration within the plume and that mass of constituents is more evenly mixed throughout the atmosphere.

Results from these three meteorological datasets provide data for historical long-term (default condition), slightly unstable short term (typical conditions), and extremely stable (bounding conditions) release analysis. These results bound the potential air concentrations associated with short-term releases from IWCS and also provide long-term results for annual releases.

The basis for the estimated air concentration for an earthquake fissure is a simulation utilizing the historical long-term meteorological conditions for the off-site location in all sixteen compass directions. Table E-1 presents the distances and directions to the IWCS boundary which were input to the CAP88 model assuming a unit release of 1 Ci/yr of radon. Table E-1 also presents the estimated unit air concentrations at the off-site locations and indicates the maximum of 0.00181 pCi/L per Ci/yr is predicted at the site boundary which is 185 m to the west of the center of former Building 411 in the IWCS. A discussion of the air concentrations resulting from use of the short-term meteorological conditions is included in the summary section.

E.4 METHODOLOGY

The methodology outlined in this section is used to determine the acceptable emission rate from the earthquake fissure that would result in an off-site air concentration of 0.1 or 0.5 pCi/L. The air concentration of 0.1 pCi/L is the concentration limit for annual effluent for radon-222 (10 CFR Part 20), and the limit for increase of radon-222, with daughters, is 0.5 pCi/L (40 CFR Part 192), which is further described in Section 3.0 and Table 3-1. These criteria air concentrations form the basis for the analysis presented below.

Target Emission Rate

From the following equation, the limiting emission rate is determined as;

Limiting Emission rate (Ci/yr) = Criteria Air Concentration (pCi/L) / Unit Air Concentration (pCi/L per Ci/yr) Eq. E-1

For a target of 0.1 pCi/L, the limiting emission rate is calculated as;

Limiting Emission rate = 0.1 (pCi/L) / 0.00181 (pCi/L per Ci/yr) = 55 Ci/yr = 1,750,000 pCi/s Eq. E-2

For an air concentration of 0.5 pCi/L, the limiting emission rate is calculated as;

Limiting Emission rate = 0.5 (pCi/L) / 0.00181 (pCi/L per Ci/yr) = 276 Ci/yr = 8,760,000 pCi/s Eq. E-3

The limiting emission rate (see Table E-2) is then used as the basis for calculating the depth of an earthquake fissure that would not exceed the target off-site air concentration. Incorporated into the estimate is the assumption that the fissure is 50 m long, which equates to a total length of 100 m when considering that the exposed source is present on both sides of the opening.

The following equation is used to calculate the limiting flux for each unit of fissure depth;

Limiting Emission rate (pCi/s) = Average Fissure Flux (pCi/m^2/s) x Fissure Length (m) x Fissure Depth (m) Eq. E-4

The average fissure flux is based on the flux from each layer of exposed source material, as well as the thickness of each layer. Because the average flux is dependent on the depth of the fissure, average fluxes were generated for various depths until the target emission rate and off-site air concentration were obtained.

Table E-3 presents the calculated average flux and emission rate and indicates that an off-site air concentration of 0.1 pCi/L would be exceeded if an earthquake fissure reached 3.8 m into Bay A, or approximately 0.02 m into the K-65 layer. For an off-site air concentration of 0.5 pCi/L, the fissure depth could be approximately 3.9 m, which is 0.08 m into the K-65 residue layer (see Table E-4).

Calculation Check

The estimated depth can be checked by using the following equations to calculate the air concentration;

Air Concentration (pCi/L) = Unit Air Concentration (pCi/L per Ci/yr) x Fissure Length (m) x Fissure Depth (m) x Average Flux (pCi/m^2/s) x Conversion (pCi/s per Ci/yr) Eq. E-5

= 0.00181 (pCi/L per Ci/yr) x 100 (m) x 3.8 (m) x 4,500 (pCi/m^2/s) x 1E-12 (Ci/pCi) x 3.2E+07 (s/yr)

= 0.1 pCi/L

Results are presented in Table E-3 for calculation of the acceptable fissure depth for the example above. These estimates are conservative in nature and present a worst case scenario that is unlikely to be exceeded, as discussed in the following sections.

E.5 ADDITIONAL CONSIDERATIONS

The above evaluation was based on long-term atmospheric information to determine the location of maximum air concentrations. The potential for shorter term meteorological conditions that may result in higher air

concentration is explored in this section. Additionally, the analysis was based on convective movement of the radon out of the earthquake fissure. A more likely mechanism of radon emission, diffusive release from the crack in the IWCS to the atmosphere, is also presented in the following section.

Short-term Meteorological Conditions

The air concentrations predicted for the long-term conditions are generally lower than those for the shorter term. The typical conditions result in air concentrations an order of magnitude higher than the long-term, and the bounding conditions are an order of magnitude higher than the typical conditions (see Appendix B). Therefore the limiting flux would have to be correspondingly lowered to achieve the target air concentrations.

The limiting emission rates for 0.1 and 0.5 pCi/L are 175,000 and 876,000 pCi/s for typical short-term conditions, and 17,500 and 87,600 pCi/s for bounding short-term conditions. For typical and bounding short-term conditions, any fissure reaching the K-65 would exceed both 0.1 and 0.5 pCi/L at the off-site location. However, since the emission rate from the layer just above the K-65 is 7,290 pCi/s (see Table E-3), a fissure that penetrates all layers except the K-65 residue does not exceed the target air concentrations under any meteorological conditions.

Radon Emission Mechanism

The radon emission mechanism is a key assumption and significantly effects the conclusions of the evaluation. Based on convective emission, a crack reaching the K-65 would exceed target air criteria. For comparison, the limiting emission rate for bounding conditions (17,500 pCi/s) is exceeded by the estimated emission rate for diffusion from the earthquake crack of 19,000 pCi/s (see Appendix A, Table A-17). These results show that under diffusive radon transport from an earthquake fissure that reaches the bottom of the IWCS (through the K-65) under bounding conditions would slightly exceed the 0.1 pCi/L criteria. However, under all other conditions radon diffusing from a crack extended through the K-65 residues will not exceed radon air concentration criteria off-site.

E.6 CONCLUSIONS

For the most conservative scenario (long-term meteorology and convective emissions), the target air concentrations are exceeded at the off-site location when the earthquake fissure reaches the K-65 residues within the IWCS. Similarly, for short-term meteorological conditions (bounding and typical) the off-site target air concentrations are exceeded if the fissure reaches the K-65 layer. However, results based on a diffusive release of radon from the fissure indicate that off-site air concentrations would remain below the target levels for all atmospheric conditions modeled and all depths within the IWCS, with the exception of the bounding meteorological condition.

It is important to note that the earthquake fissure evaluation is hypothetical and that a seismic event of such magnitude is not likely for the area (see Section 4.2.2). Events triggering fissures that might breech the upper layers of the IWCS are even considered improbable. The alternate earthquake scenario results are presented for informational purposes.

APPENDIX E-2

Earthquake Scenario Evaluation

Tables

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Table E-1. Estimated Radon Unit Air Concentrations at Off-site Locations

Direction from IWCS	N	NNE	NE	ENE	E	ESE	SE	SSE
Distance to Site Boundary (m)	625	670	890	540	510	540	305	250
Unit Air Concentration (pCi/L per Ci/yr)	1.5E-04	1.4E-04	1.3E-04	2.2E-04	2.6E-04	2.0E-04	6.3E-04	5.7E-04

Direction from IWCS	S	SSW	SW	WSW	**W**	WNW	NW	NNW
Distance to Site Boundary (m)	225	250	250	200	**185**	200	250	665
Unit Air Concentration (pCi/L per Ci/yr)	8.0E-04	3.9E-04	6.1E-04	9.1E-04	**1.8E-03**	9.2E-04	4.7E-04	4.1E-05

Notes:

Results are based on the long-term meteorological conditions as represented by the default dataset in the CAP88 model for Niagara Falls International Airport.

Peak unit air concentration (185 m to the west) is the basis for determining the acceptable depth of flux for the earthquake scenario evaluation.

Distances are estimates from the center of former Building 411 in the IWCS to the site boundary.

Table E-2. Evaluation of Acceptable Flux from Earthquake Fissure

Target Air Concentration (pCi/L)	Unit Air Concentration at Off-site Location (pCi/L per Ci/yr)	Target Emission Rate (Ci/yr)	Target Emission Rate (pCi/s)
0.1	1.81E-03	5.52E+01	1.75E+06
0.5	1.81E-03	2.76E+02	8.76E+06

Note:
Conversion of Ci/yr to pCi/s based on 3.2E+07 s/yr and 1E-12 Ci/pCi.
Off-site concentration is for a location that is 185 m to the west of the IWCS.

Table E-3. Calculation of Average Flux for Earthquake Fissure in Bay A for 0.1 pCi/L Criteria

Bay A Layer	Thickness (m)	Total Depth in IWCS (m)	Flux ($pCi/m^2/s$)	Thickness Weighted Flux (pCi/m/s)	Average Flux ($pCi/m^2/s$)	Exposed source area (m^2)	Total Emission (pCi/s)	Total Emission (Ci/yr)	Off-site Concentration (pCi/L)
Topsoil	4.6E-01	4.6E-01	3.7E-01	1.7E-01	1.7E-01	4.6E+01	3.5E+00	1.1E-04	2.0E-07
Clay	9.1E-01	1.4E+00	1.3E-01	1.2E-01	2.1E-01	1.4E+02	3.9E+01	1.2E-03	2.3E-06
Waste Clay	2.1E+00	3.5E+00	8.8E+00	1.9E+01	5.4E+00	3.5E+02	6.7E+03	2.1E-01	3.9E-04
Sand	3.0E-01	3.8E+00	2.8E-01	8.4E-02	5.0E+00	3.8E+02	7.3E+03	2.3E-01	4.2E-04
K-65	1.7E-02	3.8E+00	2.7E+05	4.5E+03	1.2E+03	3.8E+02	1.7E+06	5.6E+01	1.0E-01

Note:

Results are based on the long term meteorological conditions as represented by the default CAP88 data for Niagara Falls International Airport.

Thickness weighted flux is flux for a particular layer, times the thickness of that layer.

Average flux is sum of the weighted flux, divided by the total thickness at that layer.

Exposed source is based on a crack length of 50 m and includes source on both sides of the crack, or 100 m times the total depth in IWCS.

Total Emission is converted to an off-site air concentration based on the unit air concentration of 1.81E-03 pCi/L per Ci/yr.

Conversion of Ci/yr to pCi/s based on 3.2E+07 s/yr and 1E-12 Ci/pCi.

Off-site concentration is for a location that is 185 m to the west of the IWCS that produced the maximum unit air concentration.

Table E-4. Calculation of Average Flux for Earthquake Fissure in Bay A for 0.5 pCi/L Criteria

Bay A Layer	Thickness (m)	Total Depth in IWCS (m)	Flux ($pCi/m^2/s$)	Thickness Weighted Flux (pCi/m/s)	Average Flux ($pCi/m^2/s$)	Exposed source area (m^2)	Total Emission (pCi/s)	Total Emission (Ci/yr)	Off-site Concentration (pCi/L)
Topsoil	4.6E-01	4.6E-01	3.7E-01	1.7E-01	1.7E-01	4.6E+01	3.5E+00	1.1E-04	2.0E-07
Clay	9.1E-01	1.4E+00	1.3E-01	1.2E-01	2.1E-01	1.4E+02	3.9E+01	1.2E-03	2.3E-06
Waste Clay	2.1E+00	3.5E+00	8.8E+00	1.9E+01	5.4E+00	3.5E+02	6.7E+03	2.1E-01	3.9E-04
Sand	3.0E-01	3.8E+00	2.8E-01	8.4E-02	5.0E+00	3.8E+02	7.3E+03	2.3E-01	4.2E-04
K-65	8.3E-02	3.9E+00	2.7E+05	2.2E+04	5.7E+03	3.9E+02	8.6E+06	2.8E+02	5.0E-01

Note:

Results are based on the long term meteorological conditions as represented by the default CAP88 data for Niagara Falls International Airport.

Thickness weighted flux is flux for a particular layer, times the thickness of that layer.

Average flux is sum of the weighted flux, divided by the total thickness at that layer.

Exposed source is based on a crack length of 50 m and includes source on both sides of the crack, or 100 m times the total depth in IWCS.

Total Emission is converted to an off-site air concentration based on the unit air concentration of 1.81E-03 pCi/L per Ci/yr.

Conversion of Ci/yr to pCi/s based on 3.2E+07 s/yr and 1E-12 Ci/pCi.

Off-site concentration is for a location that is 185 m to the west of the IWCS that produced the maximum unit air concentration.