

**FUSRAP
NIAGARA FALLS STORAGE SITE**

2006

(January 05, 2006 to January 09, 2007)

**ENVIRONMENTAL SURVEILLANCE
TECHNICAL MEMORANDUM**



**US Army Corps
of Engineers ®**

Buffalo District

September 2007

CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY	1
1.0 INTRODUCTION	2
1.1 Measured Parameters	2
1.2 Unit Conversions	3
2.0 REGULATORY GUIDELINES	4
2.1 External Gamma Radiation and Air (Radon Gas and Airborne Particulate)	4
2.1.1 USDOE Order 5400.5	4
2.1.2 USEPA Standards and USEPA Guidance	5
2.2 Sediment, Surface Water, and Groundwater - Radioactive Constituents	5
2.2.1 USDOE Order 5400.5	5
2.2.2 Safe Drinking Water Act (SDWA)	5
2.3 Groundwater - Chemical Parameters	6
2.3.1 Safe Drinking Water Act	7
2.3.2 New York State Department of Environmental Conservation (NYSDEC) Water Quality Criteria for Groundwater	7
3.0 SAMPLING LOCATIONS AND RATIONALE	8
4.0 SURVEILLANCE METHODOLOGY	9
5.0 ANALYTICAL DATA AND INTERPRETATION OF RESULTS	10
5.1 External Gamma Radiation	11
5.2 Radon Gas	11
5.3 Radon-222 Flux	12
5.4 Airborne Particulate Dose	12
5.5 Surface Water and Sediment	13
5.5.1 Surface Water	14
5.5.2 Sediment	15
5.6 Groundwater	17
5.6.1 Groundwater Flow System	17
5.6.2 Groundwater Analytical Results	21
6.0 CONCLUSIONS	25
6.1 External Gamma Radiation	25
6.2 Radon Gas	25
6.3 Radon-222 Flux	25
6.4 Airborne Particulate Dose	25
6.5 Cumulative Dose from External Gamma Radiation and Airborne Particulates	25
6.6 Surface Water	26
6.7 Sediment	26
6.8 Groundwater	26
7.0 REFERENCES	27

CONTENTS (continued)

Appendix A- Environmental Monitoring at NFSS

-TABLES and FIGURES (See the below and following pages for listings.)

Appendix B- 2006 Calculation of External Gamma Radiation Dose Rates for NFSS

Appendix C- FUSRAP 2006 NESHAP Annual Report for NFSS

<u>List of Tables for Niagara Falls Storage Site</u>	<u>Page</u>
Table A A.1&2 Units of Measurement and Conversion Factors (Dose and Radioactivity & Mass, Length, Area, and Volume)	T-1
Table B External Gamma Radiation and Air (Radon Gas and Airborne Particulates)	T-1
Table C Summary of Radiological Standards and Guidelines - Water and Sediment	T-2
Table D Groundwater – Chemical Parameters	T-3
Table E FUSRAP Instruction Guides used for Environmental Surveillance Activities	T-3
Table 1 1a-c: 2006 Environmental Surveillance Summary	T-4
Table 2: 2006 External Gamma Radiation Dose Rates	T-7
Table 3: 2006 Radon Gas Concentrations	T-8
Table 4: 2006 Radon Flux Monitoring Results	T-9
Table 5: 2006 Surface Water Analytical Results - Radioactive Constituents	T-11
Table 6: 2006 Sediment Analytical Results - Radioactive Constituents	T-13
Table 7: 2006 Field Parameter Summary	T-15
Table 8: 2006 Groundwater Quality Results	T-16
Table 9: 2006 Groundwater Analytical Results - Radioactive Constituents	T-19
Table 10: 2006 Groundwater Analytical Results - Metals	T-22

<u>List of Figures</u>	<u>Page</u>
Figure 1: Site Location NFSS	F-1
Figure 2: Niagara Falls Storage Site Environmental Surveillance Sampling Locations: External Gamma Radiation, Radon-220/Radon-222 Concentration, Radon Flux, Groundwater, and Surface Water/Sediment	F-2
Figure 3: Seasonal High Potentiometric Surface Map (May 17, 2006) Lower Groundwater System	F-3
Figure 4: Seasonal High Potentiometric Surface Map (February 21, 2006) Upper Groundwater System	F-4
Figure 5: Seasonal Low Potentiometric Surface Map (October 18, 2006) Lower Groundwater System	F-5
Figure 6: Seasonal Low Potentiometric Surface Map (August 16, 2006) Upper Groundwater System	F-6
Figure 7: Schematic of Conceptualized Hydrostratigraphy	F-7
Figure 8: Census Data	F-8
Figure 9: External Gamma Radiation Dose Rates at NFSS Perimeter	F-9
Figure 10: External Gamma Radiation Dose Rates at IWCS Perimeter	F-10
Figure 11: Radon Gas Concentrations at NFSS Perimeter (January-July Interval)	F-11
Figure 12: Radon Gas Concentrations at NFSS Perimeter (July-January Interval)	F-12
Figure 13: Radon Gas Concentrations at IWCS Perimeter (January-July Interval)	F-13
Figure 14: Radon Gas Concentrations at IWCS Perimeter (July-January Interval)	F-14
Figure 15: Total Radium (Radium-226 and Radium-228) Concentration in Surface Water	F-15
Figure 16: Thorium-230 Concentration in Surface Water	F-16
Figure 17: Thorium-232 Concentration in Surface Water	F-17
Figure 18: Total Uranium Concentration in Surface Water	F-18
Figure 19: Total Radium (Radium-226 and Radium-228) Concentration in Sediment	F-19
Figure 20: Thorium-230 Concentration in Sediment	F-20
Figure 21: Thorium-232 Concentration in Sediment	F-21
Figure 22: Total Uranium Concentration in Sediment	F-22
Figure 23: Total Radium (Radium-226 and Radium-228) Concentration in Groundwater at NFSS	F-23
Figure 24: Thorium-230 Concentration in Groundwater at NFSS	F-24
Figure 25: Thorium-232 Concentration in Groundwater at NFSS	F-25
Figure 26: Total Uranium Concentration in Groundwater at NFSS	F-26

ACRONYMS

ALARA	as low as reasonably achievable
ANL	Argonne National Laboratory
ARAR	applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
CAP88-PC	Clean Air Act Assessment Package – 1988 (USEPA)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DCG	derived concentration guide
EML	Environmental Measurements Laboratory
ESP	environmental surveillance plan
FFA	federal facility agreement
FSRD	Former Sites Restoration Division
FUSRAP	Formerly Utilized Sites Remedial Action Program
IG	instruction guide
IWCS	interim waste containment structure
MCL	maximum contaminant level
MDA	Minimal Detectable Activity
MED	Manhattan Engineer District
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants (USEPA)
NFSS	Niagara Falls Storage Site
NIST	National Institute for Standards and Technology
NPDES	National Pollutant Discharge Elimination System
NYSDEC	New York State Department of Environmental Conservation
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
RPD	relative percent difference
SDWA	Safe Drinking Water Act
TDS	total dissolved solids
TETLD	tissue-equivalent thermoluminescent dosimeter
TLD	thermoluminescent dosimeter
USACE	United States Army Corps of Engineers
USAEC	United States Atomic Energy Commission
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USNRC	United States Nuclear Regulatory Commission

EXECUTIVE SUMMARY

In 1974, the United States Atomic Energy Commission (USAEC), a predecessor to the U.S. Department of Energy (USDOE), instituted the Formerly Utilized Sites Remedial Action Program (FUSRAP). This program is now managed by United States Army Corps of Engineers (USACE) to identify and clean up, or otherwise control, sites where residual radioactivity remains from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized USACE to remedy under FUSRAP. In October 1997, Congress transferred the responsibility for FUSRAP from the USDOE to the USACE.

This memorandum presents results obtained as part of the 2006 environmental surveillance program for the Niagara Falls Storage Site (NFSS) under the FUSRAP. Because radioactive wastes and residues are stored in the interim waste containment structure (IWCS) at the NFSS, the environmental surveillance program at the site includes sampling of air, water, and streambed sediment to ensure that onsite waste does not pose a threat to human health and the environment. The discussion below provides a comparative analysis of local background conditions and regulatory criteria to results reported for external gamma radiation and for samples from the media investigated. Data tables and figures referenced in the text are included at the end of this document.

The USDOE and United States Environmental Protection Agency (USEPA) guidelines are cited throughout this report to aid in the evaluation of environmental data. This memorandum compares data with USDOE guidelines because the USDOE has “property accountability” for the site. The guideline values do not represent cleanup criteria. Cleanup criteria will be developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. The preferred remedy will be presented in the Proposed Plan, which the public will be able to comment on, and final Applicable or Relevant and Appropriate Requirements (ARARs) will be determined during the Proposed Plan and presented in the Record of Decision (ROD). Results from the 2006 surveillance program at NFSS indicate that no measured parameter exceeded USDOE guidelines and no dose calculated for potentially exposed members of the general public exceeded USDOE or USEPA limits.

Prior to transfer of the FUSRAP to USACE in 1997, reports were generated based on USDOE Orders and guidance. USDOE Orders are not applicable to the activities of the USACE as the USACE is not under the authority or direction of the USDOE. However, the surveillance data continues to follow a format similar to that of the previous USDOE reports to provide the reader with consistent presentation of data and to facilitate historical comparison between reports.

1.0 INTRODUCTION

The Niagara Falls Storage Site (NFSS) is located in the Town of Lewiston in northwestern New York State, northeast of Niagara Falls and south of Lake Ontario (Figure 1, Appendix A). NFSS is approximately 77 hectare (191 acre) site which includes: one former process building (Building 401), one office building (Building 429), an equipment shed, and a 4 hectare (9.9 acre) interim waste containment structure (IWCS). The property is fenced, and public access is restricted.

Land use in the region is primarily rural residential; however, the site is bordered by a state and federally regulated chemical waste disposal facility to the north, a solid waste disposal facility to the east and south, and a National Grid Power Corporation right-of-way to the west. The nearest residential areas are approximately 1-km southwest of the site; the residences are primarily single-family dwellings.

Beginning in 1944, the NFSS was used as a storage facility for radioactive residues and wastes. The residues and wastes are the process by-products of uranium extraction from pitchblende (uranium ore). The residues originated at other sites and were transferred to the NFSS for storage in buildings, onsite pits, and surface piles.

Since 1971, activities at NFSS have been confined to residue and waste storage and remediation. Onsite and offsite areas with residual radioactivity exceeding USDOE guidelines, were remediated by the USDOE between 1955 and 1992; materials generated during remedial actions (approximately 195,000 m³) are encapsulated in the IWCS, which is specifically designed to provide interim storage of the material.

1.1 Measured Parameters

The key elements of the 2006 environmental surveillance program at NFSS were:

- measurement of external gamma radiation;
- measurement of radon gas concentrations in air (combined contributions from radon-220 and radon-222);
- monitoring of radon-222 flux (rate of radon-222 emission from the IWCS);
- sampling and analysis of surface water for isotopic uranium (U-234, U-235, U-238) & total uranium (sum of these three isotopes), isotopic thorium (Th- 230, Th-232) and isotopic radium (Ra-226, Ra-228) (referred to collectively as radioactive constituents);
- sampling and analysis of streambed sediments for radioactive constituents; and
- sampling and analysis of groundwater for radioactive constituents, metals, and water quality parameters.

1.2 Unit Conversions

The tables in Appendix A (Table A.1& A.2, Page T-1) list the units of measurement and appropriate abbreviations used in this document. Conventional units for radioactivity are used because the regulatory guidelines are generally provided in these terms.

2.0 REGULATORY GUIDELINES

The primary regulatory guidelines that affect activities at Formerly Utilized Sites Remedial Action Program (FUSRAP) sites are found in Federal statutes and in Federal, State, and Local regulations. Regulatory criteria that were used to evaluate the results of the 2006 environmental surveillance program at NFSS are summarized below, categorized by media and parameters. In several cases USDOE guidelines continue to be identified in the technical memorandum for comparison purposes of historical data collected by USDOE or their contractors. USACE is not under the authority of the USDOE orders or directives and must rely on other applicable Federal or State regulations in relation to surveillance of the IWCS. The values are for comparison only.

2.1 External Gamma Radiation and Air (Radon Gas and Airborne Particulate)

The regulatory guideline criteria used in evaluation of the calculated maximum doses from external gamma radiation and inhalation of radioactive particulate and the measured concentrations of radon gas include USDOE guidelines, United States Environmental Protection Agency (USEPA) standards, and USEPA guidance.

2.1.1 USDOE Order 5400.5

Dose limits for members of the public from USDOE operations at USDOE-owned and USDOE-operated facilities are presented in this USDOE Order. The primary dose limit is expressed as an effective dose equivalent. The limit of 100-mrem effective dose equivalent above background in a year from all sources (excluding radon) is specified in this Order; external gamma radiation dose and the calculated doses from airborne particulate releases are included in the calculation of the effective dose equivalent total. Also, this calculation includes contributions from other pathways, such as ingestion.

USDOE limits for radon concentrations in air from USDOE operations at USDOE-owned and USDOE-operated facilities are also presented in Order 5400.5. Based on the radioactive constituents in the wastes contained in the IWCS, it is unlikely that radon-220 would be emitted from the IWCS since the radon-220 half-life is approximately 55.6 seconds and this isotope would decay prior to permeating through the IWCS cap. It is, however, possible that radon-222 with a half-life of 3.8 days could be emitted. The USDOE limits for radon-222 concentrations in the atmosphere above facility surfaces or openings in addition to background levels are: 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 3.0 pCi/L at or above any location outside the facility site. To provide a conservative basis for comparison, on-site radon concentrations are evaluated against the off-site limit of 3.0 pCi/L above background.

2.1.2 USEPA Standards and USEPA Guidance

Radon

The USEPA also has a guidance action level of 4.0 pCi/L for radon concentrations for indoor air (homes and buildings), providing another conservative basis for comparison. Although these limits are specific to indoor air, they provide a conservative basis for comparison to the outdoor air results obtained during environmental surveillance activities, for details see Appendix C. For further comparison, the average radon level in US homes is about 1.25 pCi/L and the average outdoor value is 0.4 pCi/L (USEPA 1993).

Clean Air Act

Section 112 of the Clean Air Act authorized the USEPA to promulgate the National Emission Standards for Hazardous Air Pollutants (NESHAPs) which are given in 40 CFR 61. Compliance with Subpart H (for non-radon, radioactive constituents) is verified by applying the USEPA-approved CAP88-PC model. Compliance with Subpart Q is verified by annual monitoring of the IWCS for radon-222 flux (See Appendix A, Table B, Page T-1).

2.2 Sediment, Surface Water, and Groundwater - Radioactive Constituents

Regulatory criteria for evaluating the measured concentrations of radionuclides in sediment, surface water, and groundwater at NFSS are as follows.

2.2.1 USDOE Order 5400.5

This Order provides guideline limits for radioactive contaminants in water and soil at US DOE-owned and US DOE-operated facilities. US DOE historically applied the residual soil cleanup guideline criteria specified in USDOE Order 5400.5 to sediments. However, those values are provided for comparative purposes only. ARARs and specific cleanup goals will be evaluated independently and presented in the proposed plan for public comment. The standards and cleanup goals will be documented in the record of decision (ROD).

Section 5.5 presents the data for this years technical memorandum and describes the basis for comparisons with US DOE Order 5400.5 limits in detail.

2.2.2 Safe Drinking Water Act (SDWA)

Shallow groundwater resources at NFSS demonstrate uniformly poor groundwater quality and availability in the general region. Regional studies and studies conducted near the site

(La Sala 1968; Wehran 1977; Acres American 1981) conclude that groundwater quality is poor near the site because of high mineralization (see section 5.6.2.2 Water Quality Parameters). Additionally, local studies (Wehran 1977 and Acres American 1981) indicate that the permeabilities of the shallow groundwater systems are sufficiently low that it is not practicable to obtain groundwater from these systems for water supply. Onsite permeability testing at NFSS confirms the low permeabilities.

The USDOE conducted a well survey in 1988 and inventoried eight wells within 4.8 km of the site, none of which were reported as drinking water but mainly irrigation (USDOE 1994b). In 2006, the Niagara County Department of Health (DOH) updated its well inventory to include 9 potable wells (two of which were sole source), 8 non-potable wells, 20 abandoned wells and 77 idle wells within the survey area. Based on the USDOE report and recent DOH survey the NYSDEC Class GA groundwater standards represent a conservative basis for comparing analytical results. Groundwater at NFSS consistently exceeds sodium and sulfate Class GA standards. Both the shallow and deep groundwater units at the NFSS exhibit over 1000 mg/L Total Dissolved Solids (TDS) and the deep groundwater commonly over 100 mg/L Chloride, which indicates that the site groundwater can be classified as saline or Class GSA (NYCRR 701.16). However, to establish a basis for comparison of analytical results, Class GA (groundwater) water quality standards for some constituents were obtained from the NYSDEC document.

SDWA is the primary Federal law applicable to the operation of a public water system and the development of drinking water quality standards [*USEPA Drinking Water Regulations and Health Advisories* (USEPA 1996)]. The regulations in 40 CFR Part 141 (National Primary Drinking Water Regulations) set maximum permissible levels of organic, inorganic, radionuclides (including uranium and combined radium) and microbial contaminants in drinking water by specifying the maximum contaminant level (MCL) for each. The established (promulgated) MCL for combined concentrations of radium-226 and radium-228 is 5 pCi/L. The USEPA National Primary Drinking Water Regulation for Radionuclides (Final Rule – effective 2003) states a MCL of 30 µg/L for total uranium. Although groundwater at NFSS is not a public drinking water supply, MCLs for drinking water are used as a conservative basis for evaluation of analytical results, maintaining consistency with previous reports and facilitating trend analysis (See Table C in Appendix A, TABLES section, page T-2).

2.3 Groundwater - Chemical Parameters

Although groundwater at NFSS is not a public drinking water supply, State and Federal standards (Table D, Appendix A) are used as a basis for evaluation of chemical analytical results.

2.3.1 Safe Drinking Water Act

As indicated previously, SDWA is the primary Federal law applicable to the operation of a public water system and the development of drinking water quality standards (USEPA 1996). The regulations set MCLs for organic, inorganic, radiological and microbial contaminants in drinking water. In some cases, secondary maximum contaminant levels (SMCLs), which are not federally enforceable (40 CFR 143.1), are provided as guidelines for the states. SMCLs are provided for a conservative comparison of analytical results and to provide consistency with previous reports and facilitate trend analysis.

2.3.2 New York State Department of Environmental Conservation (NYSDEC) Water Quality Criteria for Groundwater

NYSDEC has adopted the Federal SDWA standards into its own regulations in Title 6 New York Codes of Rules and Regulations (NYCRR) Parts 700-705, "Water Quality Regulations for Surface and Groundwater" (NYSDEC 1996). In addition, NYSDEC has independently established standards for some constituents. To apply established standards, the State of New York categorizes groundwater resources by groundwater quality and use.

The Division of Water Technical and Operational Guidance Series (TOGS) specifically address source drinking water standards (NYSDEC –6 NYCRR Part 703 Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations (August 1999)). These standards have been used to establish additional Class GA (related, conservative case) state water quality standards for comparison of analytical results.

3.0 SAMPLING LOCATIONS AND RATIONALE

Radioactive materials that exceed USDOE cleanup guidelines at NFSS are stored in the IWCS. Exposure of members of the public to this radioactively contaminated material at NFSS is unlikely because of site access restrictions (e.g., fences) and engineering controls (e.g., pile covers). However, potential pathways include direct exposure to external gamma radiation and inhalation of air containing radon or radioactively contaminated particulates from site soils; and contact with, or ingestion of, contaminated surface water, streambed sediments, or groundwater. The environmental surveillance program at NFSS has been developed to provide surveillance of these exposure routes through periodic sampling and analysis for radioactive and chemical constituents. Figure 2 (Appendix A, page F-2) presents sampling locations and media associated with the environmental surveillance program at NFSS. A summarization of the environmental surveillance program at NFSS for external gamma radiation, radon gas, surface water, sediment, and groundwater can be found in Appendix A, Table 1, page T-1.

External gamma radiation monitoring and radon gas measurements occur at fence line locations surrounding the NFSS as well as interior portions of the site, including the perimeter of the IWCS, to assess potential exposures to the public and site workers. Measurement of radon-222 flux is conducted annually at discrete grid intersections on the IWCS (Appendix A, Figure 2, page F-2).

Groundwater monitoring wells have been selected to assess background, down gradient, and source-area (near the IWCS) groundwater quality conditions in the upper groundwater system (Appendix A, Figure 2, page F-2). Groundwater monitoring includes analysis for radioactive constituents, water quality parameters, and metals. The upper groundwater system (Appendix A, Figure 7, page F-7) would provide the earliest indication in the unlikely event of a breach of the IWCS. The lower groundwater system is not monitored because past analytical results and recent Remedial Investigation results indicate there are no groundwater contaminant plumes, or constituents in excess of MCLs, in the lower water-bearing zone.

Surface water and streambed sediment sampling of radioactive constituents is conducted along the drainage ditch system in upstream, onsite, and downstream locations (Appendix A, Figure 2, page F-2) to assess the migration of constituents in these media should any occur.

4.0 SURVEILLANCE METHODOLOGY

Under the NFSS environmental surveillance program, standard analytical methods approved and published by USEPA and the American Society for Testing and Materials (ASTM) are used for chemical (i.e., all non-radiological) analyses. The laboratories conducting the radiological analyses adhere to USEPA-approved methods and to procedures developed by the Environmental Measurements Laboratory (EML) and ASTM.

A detailed listing of the specific procedures and the data quality objectives for the surveillance program is provided in the *Environmental Surveillance Plan* (BNI 1996a).

All 2006 environmental surveillance activities at NFSS were conducted in accordance with the *Environmental Surveillance Plan* (BNI 1996a) and the instruction guides (IGs) listed in Table E in Appendix A (page T-3). The IGs are based on guidelines provided in *RCRA Ground Water Monitoring: Draft Technical Guidance* (USEPA 1992b); *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846; USEPA 1992c); and *A Compendium of Superfund Field Operations Methods* (USEPA 1987).

5.0 ANALYTICAL DATA AND INTERPRETATION OF RESULTS

This section presents the data and interpretation of results for the environmental surveillance program at NFSS. Data for 2006 are presented in Tables 2 through 10 (Appendix A). Trend graphs, summarizing analytical results for air, streambed sediment, surface water and groundwater for 2006 and the preceding four years, are presented in Figures 9 through 26 (Appendix A).

In data tables containing analyses for radioactive constituents, some results may be expressed as negative numbers. This phenomenon occurs when the average background activity of the laboratory counting instrument exceeds the measured sample activity. A negative result is generated when the instrument background activity is subtracted from the sample activity. For the purposes of interpretation, all values below the minimum detectable activity (MDA) are interpreted as having an unknown value between zero and the MDA. Therefore, a result below the MDA is referred to as a non-detected result in the text discussion.

Gross data results for surface water, sediment, and groundwater are compared to the USDOE soil guideline limits (for sediment) and DCGs (for surface water and groundwater), and are used in the assessment of potential impact. The analytical results including site background results are provided in the data tables. However, for simplicity of presentation, only the gross analytical results (without the background subtracted) are discussed in the text of this document.

Historical ranges in background concentrations for each radioactive analyte are determined from background sampling results from 1992 to 2006, unless otherwise noted. For gamma dose rates subtracting the calculated background from the sampling results for 2006 then gives an estimate of the above-background dose rate at each location; see Table 2 External Gamma Radiation Dose Rates (Appendix A, page T-7). When background is subtracted from the sampling result, it is possible that a negative number will be obtained much the same as a negative value may be obtained when the laboratory subtracts instrument background from a sample measurement.

Some of the historical data from NFSS used a method for analysis of total uranium, which yields results in $\mu\text{g/L}$, and $\mu\text{g/g}$ for water and sediment samples, respectively. To allow direct comparison of results to the DCGs and soil guidelines, the data was converted to pCi/L and pCi/g, as appropriate. The specific activity for total uranium in drinking water sources has been estimated to be about 0.9 pCi/ μg (USEPA 2000), which is the factor used to convert groundwater data from $\mu\text{g/L}$ to pCi/L in this report. The specific activity for total uranium in soil sources is estimated to be 0.67 pCi/ μg (USEPA 2000).

5.1 External Gamma Radiation

External gamma radiation dose rates are measured using thermoluminescent dosimeters (TLDs) continuously for the year. TLD results for the 2006 external gamma radiation dose (both raw and corrected data) are presented in Table 2 (Appendix A, Tables, External Gamma Radiation at NFSS).

The data are used to calculate the external gamma radiation dose rate at both the nearest residence and the nearest commercial/industrial facility to determine the hypothetical maximally exposed off-site individual (MEI). The dose rate is a function of the site fence line dose, the distance of the individual from the fence line, and the amount of time the individual spends at that location. Results of this calculation are expressed as a dose to the individual in mrem for the year.

Distances to off-site receptors are based on the findings of a year 2005 canvas of areas nearby the site. Based on external gamma radiation results, the hypothetical MEI is a resident located 500 feet from the western perimeter fence, southwest of the site that received a dose of 0.014 mrem for calendar 2006. The hypothetical dose to the nearest off-site worker located 1020 feet east of the site is 0.00055 mrem for calendar year 2006. Appendix B, CY2006 CALCULATION OF EXTERNAL GAMMA RADIATION DOSE RATES FOR NIAGARA FALLS STORAGE SITE (NFSS), section 4.1 contains all pertinent calculations. External gamma dose rates from the NFSS and IWCS perimeters from 2001 thru 2006 are presented in Figures 9 and 10 of Appendix A. Both doses are well below the USDOE guideline of 100 mrem/year (for all pathways, excluding radon).

5.2 Radon Gas

Based on the radioactive constituents in the wastes contained in the IWCS, it is unlikely that radon-220 would be emitted from the IWCS; however, it is possible that radon-222 would be emitted. Air surveillance is conducted to determine the concentration of radon gas at NFSS using Radtrak® detectors that are designed to measure alpha particle emissions from both isotopes of radon (radon-220 and radon-222) and to collect passive, integrated data throughout the period of exposure. Because radon-220 is not a contaminant of concern at NFSS (due to the relatively low concentrations of radium-228 and the short half-life of radon-220), all concentrations are conservatively assumed to be radon-222. Results of semiannual monitoring for 2006 are presented in Table 3 (Appendix A, page 8); the corresponding surveillance locations are shown in Figure 2, Appendix A.

Consistent with results from previous years, most of the site radon-222 results from the 2006 environmental surveillance program were at or below the detection limit of 0.20 pCi/L. Two background locations reported 0.7 and 0.8 pCi/L for the first half of the year. Radon concentrations at the NFSS perimeter for the 1st and 2nd half of the year are presented in Figures 11 and 12 respectively. Radon concentrations at the IWCS perimeter

for the 1st and 2nd half of the year are presented by Figures 13 and 14 respectively. All of the on-site results were less than the USDOE off-site limit of 3.0 pCi/L above background (background ranges from less than 0.2 to 0.8 pCi/L).

Radon monitoring at NFSS is performed at a level that is representative of the human breathing zone (1.7 meters above ground level). Radon concentration diminishes significantly as distance from the ground increases and mixing with ambient air takes place.

5.3 Radon-222 Flux

Measurement of radon-222 flux provides an indication of the rate of radon-222 emission from a surface. Radon-222 flux is measured with activated charcoal canisters placed at 15-m grid across the surface of the IWCS for a 24-hour exposure period. Measurements for 2006 are presented in Table 4; measurement locations are shown in Figure 2, Appendix A.

Measured results for 2006 ranged from -0.1155 to 0.2115 pCi/m²/s, with an average result of 0.00717 pCi/m²/s. Background ranged from -0.062 to .004488 with a average of -0.01848 . As in previous years, these results are well below the 20.0 pCi/m²/s 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.

5.4 Airborne Particulate Dose

To determine the dose from airborne particulates potentially released from NFSS during 2006, airborne particulate release rates were calculated using Remedial Investigation soil data (collected between 1999 and 2004), and weather data for the year 2006 from the National Weather Service. Data from meteorological stations in the immediate vicinity of the site were not available for CY 2006. Contributions from radon gas, which is not a particulate, are not considered in this calculation. The total airborne particulate release rate is input into the USEPA's CAP88-PC (Version 3.0) computer model to perform two calculations:

1. The first calculation estimates resultant doses from airborne particulates to hypothetical individuals at the distances to the nearest residences and to the nearest commercial/industrial facilities as measured from a central location onsite. Hypothetical doses are then corrected for commercial/industrial facility occupancy at assumed rate of 40 hours/week for 50 weeks/year. Residential occupancy is assumed to be full-time (i.e., 24 hours/day and 365 days/year (366 days for a leap year)). The hypothetical individual receiving the higher of these calculated doses is then identified as the hypothetical MEI for airborne particulate dose.

2. The second calculation estimates the hypothetical airborne particulate collective dose to the population within 80 km of the site using a population file (2000 census data for New York State and 2001 census data for the Province of Ontario) to determine the number of people in circular grid sections radiating to 80 km from the center of site.

The first calculation (Appendix C) indicates that the 2006 airborne particulate dose to the hypothetical MEI, a home resident, 914 meters south-southwest of the site, was 0.0008 mrem. These values are well below the 10 mrem per year standard, individual dose, specified in 40 CFR, Part 61, Subpart H, and the USDOE Order 5400.5. The second calculation indicates that the hypothetical airborne particulate collective dose to the population within 80 km of the site was 0.024 person-rem. This compares to a yearly background dose to the same population of 3,150,000 person-rem, (see Figure 8, Appendix A). Details of the calculations, including methodology are presented in Appendix C (FUSRAP CY2006 NESHAP ANNUAL REPORT FOR NIAGARA FALLS STORAGE SITE (NFSS)).

5.5 Surface Water and Sediment

In 2006, annual surface water and sediment samples were collected at five locations: SWSD009 and SWSD021 at the upstream fence line; SWSD010 and SWSD022 onsite along the central drainage ditch; and SWSD011, downstream along the central drainage ditch. Surface water and sediment sampling location SWSD009 was selected as a background location because it is at the upstream boundary of the South 31 drainage ditch, which eventually joins the central drainage ditch. Surface water and sediment sampling location SWSD021 was selected as a background location because it is located upstream, along the NFSS fence line, where the central drainage ditch first enters the property. Sampling locations are presented in Figure 2, Appendix A.

Surface water and sediment samples were analyzed for radium-226, radium-228, thorium-230, thorium-232, uranium-234, uranium-235, and uranium-238. The 2006 environmental surveillance analytical results for surface water and sediment samples are presented in Appendix A, Tables 5 and 6, respectively. Analytical results for surface water in 2006 are compared with the USDOE DCGs for radium-226, radium-228, thorium-230, thorium-232, and total uranium (sum of the uranium-234, -235, and -238 isotopes). Because there are no established limits for sediments, USDOE historically used the surface soil criterion of 5 pCi/g as a basis of comparison of radium-226, radium-228, thorium-230 and thorium-232 analytical results, and the derived site-specific criterion of 90 pCi/g for total uranium in surface soil.

Background concentrations were determined by averaging historical analytical results for the appropriate constituents at surface water/sediment sampling locations SWSD009 and SWSD021. For total uranium and radium-226, background concentrations include data

from 1992 through 2006 for surface water and sediment. Because analysis for thorium-232 first began in 1995 in sediment and 1996 in surface water, background concentrations for thorium-232 were determined from analytical results from 1995 and/or 1996 through 2006, as appropriate. Similarly, background concentrations for radium-228 and thorium-230 were determined from analytical results beginning in 1997.

5.5.1 Surface Water

In 2006 as in previous years surface water analytical results were consistently less than the USDOE DCGs, and generally indistinguishable from the historical background (upstream) concentrations. In 2006, surface water analytical results were less than the SDWA MCLs. The 2006 radiological results for the surface water were generally slightly lower or comparable to past results except for the 2004 results for sampling location SWSD010 which were elevated due to the turbidity of the sample. Measured results (with background not subtracted) are provided in Table 5, Appendix A and discussed below:

- The 2006 on-site analytical results for radium-226 concentrations in surface water are consistent with historical results and are indistinguishable from background. Radium-226 results from upstream (background) locations SWSD009 and SWSD021 were 0.290 and non-detect, respectively, falling within the historical (1997 to present) background range of non-detect to 0.37 pCi/L. The 2006 results of analysis for radium-226 in samples collected at downstream locations (SWSD010, SWSD011, and SWSD022) ranged from non-detect to 0.165 pCi/L. The radium-226 USDOE DCG is 100 pCi/L. Total radium (Ra-226 and Ra-228) concentrations in surface water are below the SDWA limit (5 pCi/L) and the USDOE DCG (100 pCi/L), as shown in Figure 15 from 2001 to 2006.
- The 2006 on-site analytical results for radium-228 concentrations in surface water are consistent with historical results and are indistinguishable from background. Radium-228 results from upstream (background) locations SWSD009 and SWSD021 were non-detect and 0.580 pCi/L, respectively comparing favorably with the historical (1997 to present) background range of non-detect to 1.02 pCi/L. The 2006 results for radium-228 in samples collected at downstream locations (SWSD010, SWSD011, and SWSD022) ranged from non-detect to 0.240 pCi/L. The radium-228 USDOE DCG is 100 pCi/L. Total radium (Ra-226 and Ra-228) concentrations in surface water are below the SDWA limit (5 pCi/L) and the USDOE DCG (100 pCi/L), as shown in Figure 15 from 2001 to 2006.
- The 2006 results for thorium-230 in samples collected at downstream locations (SWSD010, SWSD011, and SWSD022) ranged from non-detect to 0.240 pCi/L. Thorium-230 results from upstream (background) locations SWSD009 and SWSD021 were both non-detect, comparing favorably with the historical (1997 to present) background range of non-detect to 1.20 pCi/L from both background locations.

Historical values for surface water SWSD009 are non-detect to 0.75 pCi/L which is considered to be more representative of background. The thorium-230 USDOE DCG is 300 pCi/L. Thorium-230 concentrations in surface water are below the adjusted gross alpha MCL SDWA limit of 15 pCi/L and the USDOE DCG of 300 pCi/L, as shown in Figure 16 from 2001 to 2006.

- The 2006 on-site analytical results for thorium-232 concentrations in surface water were non-detect and -0.014 pCi/L, compared to background (0.00 and non-detect). The historical (1997 to present) background concentration for thorium-232 ranges from non-detect to 0.613 pCi/L. The USDOE DCG for thorium-232 is 50 pCi/L. Thorium-232 concentrations in surface water are below the adjusted gross alpha MCL SDWA limit (15 pCi/L) and the USDOE DCG (50 pCi/L), as shown in Figure 17 from 2001 to 2006.
- The 2006 on-site analytical results for total uranium in surface water, ranged from 4.46 to 7.09 pCi/L, which compares favorably against the background range of 4.53 and 8.84 pCi/L. The historical (1997 to present) background concentration for total uranium ranges from 1.8 to 25.56 pCi/L from both background locations or 1.8 to 8.67 pCi/L from surface water location SWSD009, which is considered to be more representative of background. Concentrations of total uranium in surface water, Figure 18, demonstrates a six year trend that is below the SDWA limit of 30 µg/L (27pCi/L), with the exception of SWSD010 in April 2004. That single anomalously elevated sample was attributed to greater turbidity.

5.5.2 Sediment

Concentrations of radium-226, radium-228, thorium-230, thorium-232, and total uranium in shallow sediment were less than the USDOE surface soil guidelines and were generally indistinguishable from upstream (background) conditions. At all sampled locations, results were less than the USDOE guideline for mixtures of radionuclides (using the sum-of-the-ratios method). Measured results (with background not subtracted) are presented in Table 6, Appendix A, page T-13, and discussed below:

- The 2006 analytical results for radium-226 in sediment are consistent with historical analytical results. Radium-226 results from upstream (background) locations SWSD009 and SWSD021 were 0.98 and 0.91 pCi/g, respectively, comparing favorably with the historical background range (from 1997 to present) of non-detect to 1.51 pCi/g. The 2006 results of analysis for radium-226 in samples collected at downstream locations (SWSD010, SWSD011, and SWSD022) ranged from 0.63 to 1.70 pCi/g. Historically, the concentration of radium-226 has ranged from non-detect to 2.90 pCi/g. All radium-226 concentrations in sediment were less than the USDOE guideline limit for residual radioactivity in surface soil criterion of 5 pCi/g above background. In addition, the historic concentrations of total radium (radium-226 and

radium-228) in sediment from 2001 to 2006 were below this criterion as shown in Figure 19.

- The 2006 analytical results for radium-228 in sediment are consistent with historical analytical results. Radium-228 results from upstream (background) locations SWSD009 and SWSD021 were 0.80 and 1.15 pCi/g, respectively. The 2006 results for radium-228 in samples collected at downstream locations (SWSD010, SWSD011, and SWSD022) ranged from 0.85 to 1.19 pCi/g. Historically (from 1997 to present), the background concentration of radium-228 has ranged from non-detect to 2.28 pCi/g from both background locations or non-detect to 1.15 pCi/g from sediment location SWSD009, which is considered to be more representative of background. All radium-228 concentrations in sediment were less than the USDOE surface soil cleanup criterion of 5 pCi/g above background. In addition, the historic concentrations of total radium (radium-226 and radium-228) in sediment from 2001 to 2006 were below this criterion as shown in Figure 19.
- The 2006 analytical results for thorium-230 in sediment are consistent with historical analytical results. Thorium-230 results from upstream (background) locations SWSD009 and SWSD021 were 1.32 and 1.25 pCi/g, respectively. The 2006 results for thorium-230 in samples collected at downstream locations (SWSD010, SWSD011, and SWSD022) ranged from 1.03 to 1.26 pCi/g. Historically (from 1997 to present) the background concentration of thorium-230 has ranged from 0.1 to 3.34 pCi/g. All thorium-230 concentrations in sediment were less than the USDOE Guideline Limit for Residual Radioactivity in Surface Soil. Thorium-230 concentrations in sediment are below the USDOE DCG (5 pCi/g), as shown in Figure 20 from 2001 to 2006. In addition, the historic concentrations of total thorium (thorium-230 and thorium-232) in sediment from 2001 to 2006 were below this criterion as shown in Figure 20.
- The 2006 analytical results for thorium-232 in sediment are consistent with historical analytical results. Thorium-232 results from upstream (background) locations SWSD009 and SWSD021 were 0.99 and 1.12 pCi/g, respectively. The 2006 results for thorium-232 in samples collected at downstream locations (SWSD010, SWSD011, and SWSD022) ranged from 0.86 to 1.05 pCi/g. Historically (from 1997 to present), the background concentration of thorium-232 has ranged from non-detect to 1.78 pCi/g. All thorium-232 concentrations in sediment were less than the USDOE surface soil cleanup criterion of 5 pCi/g above background. In addition, the historic concentrations of total thorium (thorium-230 and thorium-232) in sediment from 2001 to 2006 were below this criterion as shown in Figure 21.
- The 2006 analytical results for total uranium in sediment are consistent with historical analytical results. Total uranium results from upstream (background) locations SWSD009 and SWSD021 were 2.72 and 2.53 pCi/g, respectively. The 2006 results for total uranium in samples collected at downstream locations (SWSD010, SWSD011,

and SWSD022) ranged from 2.74 to 3.37 pCi/g . Historically (from 1997 to present) the background concentration of total uranium has ranged from 1.8 to 10.10 pCi/g from both background locations or 1.8 to 5.97 pCi/g from sediment location SWSD009, which is considered to be more representative of background. All uranium concentrations in sediment were less than the USDOE derived surface soil cleanup criterion of 90 pCi/g above background. In addition, the historic concentrations of total uranium (uranium-234, uranium-235 and uranium-238) in sediment from 2001 to 2006 were below this criterion as shown in Figure 22.

5.6 Groundwater

The locations of environmental surveillance groundwater monitoring wells at NFSS are shown in Figure 2. Background information, descriptions of activities performed under the groundwater surveillance program, and surveillance results are discussed below.

5.6.1 Groundwater Flow System

5.6.1.1 Natural System

Four unconsolidated geologic units and one bedrock unit are identified in the subsurface at the site. The principle hydrostratigraphic zones include the following, from top to bottom: the Upper Water Bearing Zone (fill, sand lenses, and Upper Brown Clay Till Unit), the aquitard or confining unit (Glacio-Lacustrine Clay and Middle Silt Till Units), and the Lower Water Bearing Zone (Alluvial Sand and Gravel, Basal Red Till, and Upper Queenston Formation). *See Figure-7: Schematic of Conceptualized Hydrostratigraphy in Appendix A, page F-7.* Groundwater at the NFSS primarily flows in two deposits: the upper water bearing zone in the surficial brown clay till unit and the lower water bearing zone in the combined sand and gravel unit, red till unit, and weathered portion of the Queenston Shale bedrock. Regional groundwater flow in both the upper and lower groundwater systems is to the northwest towards Lake Ontario.

Surface drainage from the site originally entered Fourmile, Sixmile, and Twelvemile Creeks, which all flow northward to Lake Ontario. However during the 1940s, drainage modifications routed surface water to a central drainage ditch that seasonally influences groundwater flow in the upper groundwater system near the IWCS. The current discharge from the central drainage ditch is to Fourmile Creek.

Monitoring wells screened in the upper groundwater system provide an early detection network to monitor the performance of the IWCS, which precludes the lower groundwater system as a monitored zone for the environmental surveillance program. Groundwater wells completed in the lower system were sampled during the recent CERCLA Remedial Investigation (RI), which produced results supporting the programmatic premise that

annual monitoring of this lower groundwater system is not necessary (i.e., RI results indicate a lack of contamination).

Background concentrations for the upper groundwater system were determined by averaging analytical results from 1992 through 1997 for the appropriate constituents at monitoring well B02W20S. This well was selected to represent background because it is distal from and not downgradient of the IWCS. Additional background groundwater was sampled in 2003 from wells hydraulically upgradient from operations at the adjacent property of Modern Landfill. Since this data, compiled for the RI, was comparable to historic groundwater concentrations from B02W20, this well was verified to be representative of background conditions.

5.6.1.2 Water Level Measurements

Groundwater levels were measured in ninety-one (91) NFSS wells with an electronic depth-to-water meter. Potentiometric data were recorded from forty-nine (49) wells in the upper ground water system and forty-two (42) wells in the lower groundwater system (including 6 bedrock wells).

The screened intervals for wells completed in the upper groundwater zone range from 1.4 to 8.4 m (4.7 to 27.6 ft) below ground surface, while screened intervals for wells completed in the lower groundwater zone range from 6.8 to 31.9 m (22.4 to 104.5 ft) below ground surface. The ninety-one groundwater monitoring wells are located throughout the NFSS and provide significant areal coverage for groundwater flow characterization. The monitored (sampled) subset of eight (8) wells provide adequate data to assess the IWCS performance and monitor specific areas of concern (Appendix A, Figure 2).

Vertical gradients derived from heads in monitoring well pairs vary with seasonality. Flow from the upper zone to the lower zone was dominant during the first quarterly measurements. However, during the second, third, and fourth quarters, the majority of elevations in the lower system were greater than those measured in the upper system, albeit very slight in some cases. This seasonal variation in the direction and magnitude of vertical gradients will affect vertical flow between water bearing zones and thus affect the long-term transport of potential contaminants by maintaining the upper zone as the primary transport pathway at the NFSS. While groundwater flow is primarily horizontal in these upper and lower zones, the upward vertical gradients help impede the potential for downward migration of contaminants into the lower zone from possible contaminant sources in the upper zone.

In the upper groundwater system, the depth to water ranged from -0.01 to 4.98 m (-0.04 to 16.34 ft) below ground surface during 2006; the above-ground (negative) level was observed during October, when standing water occupied the ground surface near well 201A due to a significant precipitation event in October. The quarterly water level fluctuations in the upper groundwater system averaged 0.62 m (2.05 ft) and showed high

and low elevations during the February and August measurements, respectively.

In the lower groundwater system, the depth to water ranged from 0.43 to 2.98 m (1.41 to 9.79 ft) below ground surface during 2006. Quarterly water-level fluctuations in the lower groundwater system averaged 0.27 m (0.87 ft) and showed high and low elevations during May and October measurements respectively.

Head fluctuations in both the upper and lower water-bearing zones were lower in 2006 than 2005 due to greater precipitation in 2006, which lessened summer-season soil-moisture stresses on the upper zone groundwater. Precipitation data recorded at the Niagara Falls International Airport total 91.4 cm (35.99 inches) in 2005 and approximately 98.2 cm (38.66 inches) in 2006.

Water-level data indicate that the upper groundwater system responds more rapidly to the recharge and discharge seasons (wet and dry periods) than the lower confined groundwater system due to the aquitard created by the intervening Glacio-Lacustrine Clay and Middle Silt Till Units. The two water-bearing zones demonstrate hydraulic separation through independent water-level responses, as exemplified by the temporally different seasonal high and low conditions. This two to three month time lag between head extremes indicates that the Glacio-Lacustrine Clay and Middle Silt Till Units form a competent aquitard that governs vertical flow at the NFSS, even where thin (e.g., a 2.5-foot thickness at wells OW10A and OW10B still produces up to 0.6 m (2 ft) of head differential between the wells).

Figures 3 through 6 in Appendix A show the piezometric surfaces and groundwater flow directions in the upper and lower units during seasonally high and low groundwater conditions. Groundwater contours initially are hand-drawn to account for site features (e.g., the IWCS and drainage ditches) and then digitized using ArcGIS® to present the groundwater flow directions and gradients in report-quality graphics.

5.6.1.3 Groundwater Flow

Water-bearing hydrostratigraphic zones in the layered glacial sediments underlying the NFSS include the upper surficial clay till unit, the lower alluvial sand and gravel, and the weathered bedrock unit (i.e., approximated as the upper 10 feet of bedrock). Groundwater-level data indicate that the intervening glaciolacustrine clay unit hydraulically separates the upper clay till unit from the lower sand and gravel unit; this glaciolacustrine clay is present across the entire site. The average horizontal gradients in the upper system range between 0.01 and 0.002 ft/ft and are dependent on local to regional flow conditions (i.e., flow along the IWCS to the central drainage ditch or more regional gradients across the whole site).

Localized on-site flow towards the central drainage ditch east of the IWCS is consistently apparent due to the unique flow boundary conditions in this area (i.e., IWCS cut-off wall,

low recharge due to a sloped [well drained] land surface, and proximate ditch). The drainage ditches at the NFSS have accumulated sediment and organic matter since their original installation (up to 10-feet deep); consequently they do not fully penetrate the upper water-bearing zone and some groundwater is assumed to pass beneath the ditches during high-water periods. Water-level contours may be drawn through the ditches to reflect some groundwater flow beneath them. During the summer, vegetation within the ditches will evapotranspire groundwater and further lower local heads near site ditches.

The lower groundwater system generally shows a northerly to northwesterly flow under gradients of 0.003 to 0.004 ft/ft. This flow vector has been affected by the excavation of a clay borrow operation west of the site (mining the Glaciolacustrine Clay), where local surface-water recharges the lower water-bearing zone, which has caused the normally northwestern gradients to have a northerly component during the high-water period (May 2006). The local groundwater low underlying the IWCS is likely a combined artifact of impressed heads to the west, variations in the thickness of the gray clay aquitard and underlying hydrostratigraphic layers, and topography of the Queenston Shale. The long-term impacts from the clay mining will be assessed in future Technical Memorandums.

Dewatering activities in the upper zone to support a waste-cell expansion at Modern Landfill southeast of the NFSS did not affect NFSS wells (i.e., no significant drawdown was evident in 2006).

A groundwater flow velocity of 38 cm/yr (15 in/yr) was estimated at NFSS in 1994 (USDOE 1994b). This velocity does not represent a contaminant migration rate since contaminant-soil partitioning retards (or slows) the rate of contaminant flow (transport) with respect to groundwater flow. This partitioning causes contaminants to adsorb, or bind, to local fine-grained soils in the upper water-bearing zone and aquitard.

Groundwater elevations measured quarterly during 2006 in the upper water-bearing zone show a high condition occurred on February 21, 2006 and a low condition on August 16, 2006. The high-water elevations in the upper system ranged from 94.99 to 97.22 m (311.67 to 318.96 ft) above mean sea level, whereas the low-water condition ranged from 92.46 to 96.81 m (303.35 to 317.63 ft). Groundwater elevations in the lower water bearing zone indicate a seasonal high occurred on May 16, 2006 and a seasonal low occurred on October 17, 2006. The high-water elevation in the lower system ranged from 94.62 to 96.85 m (310.43 to 317.74 ft) above mean sea level, whereas the low-water condition ranged from 93.86 to 96.07 m (307.95 to 315.18 ft). See Figures 3 through 6 in Appendix A for a graphical representation of these data, interpreted groundwater flow directions, and conditions evident from local clay mining west of the NFSS.

5.6.2 Groundwater Analytical Results

5.6.2.1 Field Parameters

Table 7, Appendix A summarizes field measurements (temperature, pH, specific conductance, oxidation-reduction potential, and turbidity) for 2006 environmental surveillance sampling. These measurements represent water conditions at the time of sampling.

5.6.2.2 Water Quality Parameters

At NFSS, water quality in the upper water-bearing zone is indicative of low recharge to a hydraulically slow flow system, which produces poor-quality (near-saline) groundwater containing high total dissolved solids and calcium/magnesium sulfates. Water quality in the lower water-bearing zone is poor due to high total dissolved solids produced by long residence times associated with long (possibly tortuous) flow paths from aerial recharge zones. It is likely that the lower groundwater system receives recharge along the base of the Niagara Escarpment, situated approximately 3.2 km south of the site (USDOE 1994b) and, to a lesser extent, via downward flow from the upper unit during spring recharge. Water quality parameter data for 2006 are provided in Table 8, Appendix A.

Analytical results for sodium, sulfate, and total dissolved solids were consistently above the drinking water standards in both the upgradient (background) and downgradient samples. These values indicate that groundwater in the area is naturally saline and confirm the findings of regional to local studies that state groundwater quality is poor near the site because of high mineralization (La Sala 1968; Wehran 1977; Acres American 1981). Groundwater at NFSS is not used as a public water supply, although the comparison to the drinking water standard will continue to be used to provide a conservative evaluation of groundwater analytical results.

For comparative purposes, the NYSDEC Class GA water quality standards shall be utilized when primary Federal standards are not available. Total dissolved solids (TDS), sulfate, and sodium were present onsite and upgradient (background) in concentrations exceeding NYSDEC Class GA groundwater quality standards. TDS results in all wells including the background well exceed the NYSDEC Class GA and Secondary National Drinking Water Quality standard of 500 mg/L; for example, 2006 TDS data for monitoring wells show OW13B at 2,270 mg/L (highest annual value) and OW17B at 982 mg/L (lowest annual value). The on-site background well, B02W20S, produced a TDS value of 905 mg/L in 2006. Sodium was detected in all wells, including the background well, at concentrations ranging from 38.0 mg/L to 80.8 mg/L, which are consistently greater than the NYSDEC Class GA groundwater quality standard of 20 mg/L for sodium. Sulfate was detected in all wells at concentrations ranging from 50.0 mg/L to 785 mg/L, indicating all but one well had sulfate concentrations greater than the NYSDEC Class GA groundwater quality standard of 250 mg/L.

5.6.2.3 Groundwater - Radioactive Constituents

In 2006, unfiltered groundwater samples collected from seven groundwater monitoring wells completed in the upper groundwater system were analyzed for radium-226, radium-228, thorium-230, thorium-232, uranium-234, uranium-235, and uranium-238.

Environmental surveillance analytical results for radioactive constituents in groundwater are presented in Appendix A, Table 9 and Figures 23 through 26. Only results for detected analytes are discussed and used in constituent average values.

Radium-226 concentrations in groundwater at NFSS have been consistently low, with all measured concentrations (background not subtracted) less than 0.3 pCi/L. Combined concentrations of radium-226 and radium-228 at NFSS are below the SDWA MCL of 5 pCi/L. Thorium-230 and thorium-232 concentrations are below USDOE DCGs (300 pCi/L and 50 pCi/L) and the SDWA MCL of 15 pCi/L, adjusted gross alpha MCL, for combined thorium-230 and thorium-232 in drinking water. The 2006 total uranium analytical results are consistent with the historical results. Total uranium concentrations are below the SDWA MCL 30 µg/L or 27 pCi/L, with the exception of OW04B and A45. Since 1992, total uranium concentrations in all sampled wells have been less than 60 pCi/L (background not subtracted), which falls below the USDOE DCG of 600 pCi/L for water.

All analytical results for radium-226, radium-228, thorium-230, thorium-232, and total uranium in groundwater were well below the USDOE DCGs. At all sampled locations, results were less than the USDOE guideline for mixtures of radionuclides (using the sum-of-the-ratios method). Current analytical results (background not subtracted) are summarized below.

Note: Groundwater at NFSS is not a drinking water source. Samples from all seven wells have unfiltered results for comparison purposes.

- The 2006 total (unfiltered) and filtered (0.45 micrometer filter) analytical results for radium-226 ranged from non-detect to 0.25 pCi/L. The USDOE DCG for radium-226 is 100 pCi/L above background and the SDWA MCL for combined radium-226 and radium-228 is 5 pCi/L (2006 background level was non-detect). Total radium (Ra-226 and Ra-228) concentrations in groundwater are below the SDWA limit of 5 pCi/L and the USDOE DCG of 100 pCi/L, as shown in Figure 23 from 2001 to 2006.
- The 2006 total (unfiltered) and filtered (0.45 micrometer filter) analytical results for radium-228 ranged from non-detect to 0.650 pCi/L. The USDOE DCG for radium-228 is 100 pCi/L above background and the SDWA MCL for combined radium-226 and radium-228 is 5 pCi/L (2006 background levels was non-detect). Total radium (Ra-226 and Ra-228) concentrations in groundwater are below the SDWA limit (5 pCi/L) and the USDOE DCG (100 pCi/L), as shown in Figure 23 from 2001 to 2006.

- The 2006 total (unfiltered) and filtered (0.45 micrometer filter) analytical results for thorium-230 ranged from non-detect to 0.084 pCi/L. The USDOE DCG for thorium-230 is 300 pCi/L above background and the SDWA MCL for thorium-230 and thorium-232 is 15 pCi/L, adjusted gross alpha MCL (2006 background levels was nondetect). Thorium-230 concentrations in groundwater are below the SDWA limit of 15 pCi/L and the USDOE DCG of 100 pCi/L, as shown in Figure 24 from 2001 to 2006.
- The 2006 total (unfiltered) and filtered (0.45 micrometer filter) analytical results for thorium-232 are non-detect and accordingly U-flagged (see Table 9). The USDOE DCG for thorium-232 is 50 pCi/L above background and the SDWA MCL for thorium-230 and thorium-232 is 15 pCi/L, adjusted gross alpha MCL, (2006 background level for thorium -232 was non-detect). Thorium-232 concentrations in groundwater are below the SDWA limit of 15 pCi/L and the USDOE DCG of 50 pCi/L, as shown in Figure 25 from 2001 to 2006.
- The 2006 total (unfiltered) and filtered (0.45 micrometer filter) analytical results for total uranium ranged from 4.42 to 40.42 pCi/L. The USDOE DCG for total uranium is 600 pCi/L above background (2006 background level was 9.34 pCi/L). The USEPA National Primary Drinking Water Regulation for Radionuclides (Final Rule – effective 2003) states the SDWA MCL for total uranium is 30 µg/L or 27 pCi/L. Two wells exceeded this limit for both the filtered and unfiltered groundwater samples, OW04B filtered sample at 40.42 pCi/L, or 44.90 µg/L, and A45, unfiltered, duplicate sample at 38.12 pCi/L, or 42.36 µg/L. Total uranium concentrations in groundwater are below the USDOE DCG of 600 pCi/L, as shown in Figure 26. Historic total uranium concentrations in groundwater, as shown in Figure 26, are also below the SDWA limit of 27 pCi/L, with the exception of well A45 between 2001 to 2003 and 2006, and well OW04B between 2001 and 2006. However, total uranium concentrations in groundwater in wells A45 and OW04B do not exhibit consistently increasing trends throughout the six year period. *Note: The total uranium MCL of 30 µg/L is for comparative purposes only and includes background*

5.6.2.4 Groundwater - Chemical Constituents/Metals

The 2006 environmental surveillance analytical results for metals in groundwater are presented in Table 10, Appendix A, and discussed below.

Groundwater at NFSS is not used as a public drinking water supply, although sampling results are compared to the SDWA MCLs and New York State Water Quality Regulation Class GA standards as a conservative baseline. Copper was present in six groundwater-monitoring wells sampled at NFSS, but the 2006 analytical results indicate that neither the SDWA MCLs nor the New York State Water Quality Regulation Class GA standards for

these metals were exceeded at any well. Vanadium and lead were not detected in the eight wells sampled in 2006.

- Copper 2006 total (unfiltered) and filtered (0.45 micron filter) analytical results ranged from 1.9 µg/L to 5.8 µg/L . The SDWA action level is 1,300 µg/L and the New York State Water Quality Regulation Class GA standard of 200 µg/L. Historically the concentration of copper has ranged from nondetect to 62.4 µg/L.
- Lead 2006 total (unfiltered) and filtered (0.45 micron filter) analytical results were non-detect (less than 0.49 µg/L) . The SDWA action level is 15 µg/L and the New York State Water Quality Regulation Class GA standard is 25 µg/L. Historically the concentration of lead has ranged from nondetect to 6.8 µg/L.
- Vanadium 2006 total (unfiltered) and filtered (0.45 micron filter) analytical results were non-detect (less than 1.6 µg/L). Historically the concentration of vanadium has ranged from nondetect to 53.4 µg/L. Neither an SDWA MCL nor a New York State Water Quality Regulation Class GA standard has been established for vanadium.

6.0 CONCLUSIONS

6.1 External Gamma Radiation

For 2006 the calculated hypothetical doses from external gamma radiation are 0.014 mrem for the nearest resident and 0.00055 mrem for the nearest off-site worker.

6.2 Radon Gas

Results of the 2006 radon gas surveillance program indicate radon gas emissions are comparable to background. The radon gas concentrations at the site were consistently low (non-detect to 0.8 pCi/L, including background (Appendix A, Table 3)), and in many cases were at or below the detection limit. All radon gas concentration analytical results at NFSS were well below the USDOE limit for radon-222 of 3.0 pCi/L above background (Appendix A, Table 3).

6.3 Radon-222 Flux

The 2006 radon-222 flux measurements were indistinguishable from background. Results ranged from non-detect to 0.1162 pCi/m²/s, with an average (of detects and non-detects) result of 0.00717 pCi/m²/s (Appendix A, Table 4). The average value is less than one percent of the standard of 20 pCi/m²/s specified in 40 CFR Part 61, Subpart Q of the National Emission Standards for Hazardous Air Pollutants (NESHAPs), demonstrating the effectiveness of the containment cell design and construction in mitigating radon-222 migration.

6.4 Airborne Particulate Dose

The 2006 airborne particulate annual dose from the wind erosion of soil to a hypothetical maximally exposed individual is calculated at 0.0008 mrem (Appendix C, FUSRAP CY2006 NESHAP ANNUAL REPORT FOR NIAGARA FALLS STORAGE SITE (NFSS), section 4.3). The hypothetical annual dose to the individual can be compared to the 10 mrem/year dose standard in 40 CFR Part 61, Subpart H of NESHAPs. The 2006 hypothetical airborne particulate annual collective dose to the population within an 80 km radius of the site is calculated at 0.024 person-rem (Appendix C, FUSRAP CY2006 NESHAP ANNUAL REPORT FOR NIAGARA FALLS STORAGE SITE (NFSS), section 5.1).

6.5 Cumulative Dose from External Gamma Radiation and Airborne Particulates

The CY 2006 maximum annual total external gamma radiation and airborne particulate dose to a hypothetical individual is 0.015 mrem [0.014 + 0.0008 (assumes same individual

receives both maximum doses from external and airborne dose pathways)], Appendix B, CY2006 CALCULATION OF EXTERNAL GAMMA RADIATION DOSE RATES FOR NIAGARA FALLS STORAGE SITE (NFSS), Section 4.2 and Appendix C, FUSRAP CY2006 NESHAP ANNUAL REPORT FOR NIAGARA FALLS STORAGE SITE (NFSS), Section 4.3, respectively. This value can be compared to the USDOE limit of 100 mrem/year and the US average per capita background dose of approximately 360 mrem/year.

6.6 Surface Water

In 2006, onsite radionuclide concentrations in surface water samples were consistent with historical results that indicate no evidence of a release.

6.7 Sediment

In 2006, onsite radionuclide concentrations in sediment samples were consistent with historical results that are comparable to background and indicate no evidence of a release.

6.8 Groundwater

Current and past onsite radionuclide concentrations in groundwater samples from the upper water bearing zone indicate total uranium levels in excess of background and in some wells the SDWA MCL. The uranium levels are indicative of uranium groundwater contamination caused by past radioactive waste storage practices identified during the remedial investigation and are limited in extent, i.e., generally coincident with historical use areas. Uranium levels in groundwater will continue to be monitored as part of the environmental surveillance program and the on-going CERCLA process will evaluate the extent of uranium in groundwater in excess of background levels and applicable regulatory limits throughout NFSS.

7.0 REFERENCES

- Acres American, Inc., 1981. *Hydrologic and Geologic Characterization of the USDOE-Niagara Falls Storage Site*, Buffalo, New York (September).
- Bechtel National, Inc. (BNI), 1993a. *Instruction Guide for Surface Water and Sediment Sampling Activities*, 191-IG-028, Rev. 0 (August 23).
- BNI, 1993b. *Instruction Guide for Radon/Thoron and TETLD Exchange*, 191-IG-028, Rev. 0 (August 27).
- BNI, 1996a. *Environmental Surveillance Plan*, Appendix C2 (Niagara Falls Storage Site), 158-ESP, Rev. 1, Oak Ridge, Tenn. (December).
- BNI, 1996b. *Instruction Guide for Groundwater Level and Meteorological Measurements*, 191-IG-007, Rev. 4 (March 28).
- BNI, 1996c. *Instruction Guide for Decontamination of Field Sampling Equipment at FUSRAP Sites*, 191-IG-011, Rev. 6 (March 29).
- BNI, 1996d. *Instruction Guide for Groundwater Sampling Activities*, 191-IG-033, Rev. 1 (August 1996).
- Department of Energy (USDOE), 1994a. Letter from Letter from L. K. Price (Director, FSRD) to P. A. Giardina (Radiation Branch, USEPA Region II), □Niagara Falls Storage Site - NESHAPs Subpart H - Nonapplicability, CCN 123928 (December 8).
- USDOE, 1994b. *Niagara Falls Storage Site Failure Analysis Report* (unnumbered), Oak Ridge, Tenn. (December).
- USDOE, 1996a. *Standards/Requirements Identification Document, Formerly Utilized Sites Remedial Action Program*, (April).
- USDOE, 1996b. Letter from L. K. Price (Director, FSRD) to P. A. Giardina (Radiation Branch, USEPA Region II), □Status of Radon Flux Monitoring (NESHAPs Subpart Q) at Three Department of Energy Sites in USEPA Region II, CCN 143772 (July 1).
- Environmental Protection Agency (USEPA), 1985. *Rapid Assessment Exposure to Particulate Emissions from Surface Contamination Sites*, USEPA/600/8-85/002 (February).
- USEPA, 1987. *A Compendium of Superfund Field Operations Methods*, USEPA/540/P-87/001 (August).
- USEPA, 2006. *Users Guide for Version 3.0, CAP88-PC*, (March).
- USEPA, 1992b. *RCRA Groundwater Monitoring: Draft Technical Guidance*, USEPA/530/R-93/001, Office of Solid Waste (November).
- USEPA, Revision 1, 1996. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846 (September).

USEPA, 1993. *Radon - A Physician's Guide: The Health Threat With A Simple Solution*, 402-K-93-008 (September).

USEPA, 1995. Letter from Tara O'Toole (Assistant Secretary, Environment, Safety and Health) to Distribution, □Memorandum of Understanding with the Environmental Protection Agency Concerning the Radionuclide National Emission Standards for Hazardous Air Pollutants, CCN 130813 (April 5).

USEPA, 1996. *Drinking Water Regulations and Health Advisories*, USEPA-822-R-96-001, Office of Water (February).

USEPA, 2000. *National Primary Drinking Water Regulations; Radionuclides; Final Rule*, Federal Register Vol.65, No. 236 (December)

La Sala, A.M. Jr., 1968. *Ground-Water Resources of the Erie-Niagara Basin*, New York, State of New York Conservation Department, Water Resources Commission, Basin Planning Report ENB-3.

New York State Department of Environmental Conservation (NYSDEC), 1994. Memorandum from Michael J. O'Toole to the Regional Hazardous Waste Remediation Engineers, Bureau Directors and Section Chiefs, Division of Technical and Administrative Guidance, □Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels (January 24).

NYSDEC, 1996. *Codes of Rules and Regulations of the State of New York (NYCRR); Title 6, Department of Environmental Conservation; Chapter X, Division of Water Resources; Subchapter A, General; Part 703, Surface Water and Groundwater Quality Standards and Groundwater Effluent Standards*. NYSDEC Water-Quality Regulations (August 1999).

Wehran Engineering Corporation, 1977. *Hydrogeologic Investigation: Chem-trol Pollution Services, Inc., Townships of Porter and Lewiston, Niagara County, New York*.

HydroGeologic, Inc., August 2001, *Draft Conceptual Model and Calibration Technical Memorandum Niagara Falls Storage Site Lewiston, New York*.

APPENDIX A

NFSS 2006 Environmental Surveillance Technical

Memorandum

Environmental Monitoring at NFSS

This appendix documents the results of environmental monitoring activities conducted in 2006 and supplements the environmental surveillance information included in the body of this technical memorandum. These activities are described to present a more complete picture of the site activities during the year and to provide technical reviewers with sufficient information to determine how much these activities influenced site conditions and ultimately the environmental surveillance program.

Two distinct activities compose the FUSRAP monitoring program at NFSS: environmental monitoring and environmental surveillance. Environmental monitoring consists of measuring the quantities and concentrations of pollutants in solid wastes, liquid effluents, and air that are discharged directly to the environment from onsite activities. Environmental surveillance documents the effects, if any, of USACE activities on onsite and offsite environmental and natural resources. At FUSRAP sites, because there are typically no onsite waste treatment facilities with routine point discharges, the monitoring program consists primarily of environmental surveillance (BNI 1996). The Environmental Surveillance Technical Memorandum specifically reports the results of routine environmental surveillance sampling and, at applicable sites, includes information about routine environmental monitoring (storm water discharges and radon flux measurement).

From November 1999 to October 2003, surface water, sediment, soil, groundwater, and other media was sampled to support a three-phased Remedial Investigation (RI) at NFSS.

References

Bechtel National, Inc. (BNI), 1996. *Environmental Surveillance Plan, Appendix C2, 191-ESP, Rev. 0* (March 7).

FUSRAP NIAGARA FALLS STORAGE SITE

2006

TABLES

ENVIRONMENTAL SURVEILLANCE TECHNICAL MEMORANDUM



**US Army Corps
of Engineers ®**
Buffalo District

Table A.1

(Section 1.2 Unit Conversions)

Units of Measurement and Conversion Factors – Dose and Radioactivity

Parameter	Conventional Units	SI Units	Conversion Factor
Dose	millirem (mrem)	milliSievert (mSv)	1 mrem = 0.01 mSv
Activity	picoCurie (pCi)	becquerel (Bq)	1 pCi = 0.037 Bq

Table A.2**Units of Measurement and Conversion Factors - Mass, Length, Area, and Volume**

Parameter	SI Units	English Units	Conversion Factor
Mass	gram (g)	Ounce (oz)	1 g = 0.035 oz
	Kilogram (kg)	Pound (lb)	1 kg = 2.2046 lb
Length	centimeter (cm)	Inch (in.)	1 cm = 0.394 in.
	meter (m)	foot (ft)	1 m = 3.281 ft
	kilometer (km)	mile (mi.)	1 km = 0.621 mi.
Area	hectare (ha)	Acre	1 ha = 2.47 acres
Volume	Milliliter (mL)	Fluid ounce (fl. oz.)	1 mL = 0.0338 fl. oz.
	liter (L)	gallon (gal)	1 L = 0.264 gal
	cubic meter (m ³)	Cubic yard (yd ³)	1 m ³ = 1.307 yd ³

Table B

(Section: 2.1 External Gamma Radiation and Air (Radon Gas and Airborne Particulates))

Summary of Radiological Standards and Guidelines for External Gamma Radiation and Air

Parameter	USDOE Order 5400.5 ^a	Other Federal Standard or Guidelines
Radon-222 flux	20 pCi/m ² /s	20 pCi/m ² /s ^b
Radon-222	3.0 pCi/L ^c	-
Radionuclide emissions (airborne particulates and radioactive gases excluding radon-220 and radon-222)	10 mrem/y	10 mrem/y ^b
Effective dose equivalent (total contribution from all sources ^c)	100 mrem/y	100 mrem/y ^d

a. Guidelines provided in the USDOE Order are above background concentrations or exposure rates.

b. Federal (USEPA) Standard from 40 CFR, Part 61, subparts H (radionuclide emissions) and Q (radon-222 flux).

c. Contributing sources at NFSS consist of external gamma radiation exposure, radionuclide emissions listed above, and ingested radionuclides in water and soil/sediment (listed in the following table).

d. Federal (USNRC) Standard 10 CFR 20

e. The guideline of 3.0 pCi/L is based on an annual average value at or above any location outside of the facility site.

Table C**(Section: 2.2.2 Safe Drinking Water Act (SDWA))****Summary of Radiological Standards and Guidelines for Water and Sediment**

Parameter	USDOE DCG ^a for Water ^b	Other Federal Standards	USDOE Guideline Limit for Residual Radioactivity in Surface Soil ^{c,d}
Total uranium	600 pCi/L	30 µg/L ^e	90 pCi/g
Thorium-232	50 pCi/L	15 pCi/L ^f	5 pCi/g
Thorium-230	300 pCi/L	15 pCi/L ^f	5 pCi/g
Combined Radium-226&228	100 pCi/L	5 pCi/L ^e	5 pCi/g

a. USDOE derived concentration guide USDOE Order 5400.5) for drinking water. Groundwater at NFSS is not a drinking water source. The above concentration is for comparative purposes only.

b. Surface water and groundwater (non-drinking water values); criteria represent concentrations above background. If a mixture of radionuclides is present, the sum of the ratios of each isotope to its respective DCG must be less than one.

c. Above-background concentrations in soil, averaged over the topmost 15-cm of soil.

d. There are no standards for sediment; therefore, the USDOE residual (radium and thorium) and site-specific (uranium) surface soil cleanup guideline criteria are used as a basis for evaluating analytical results for sediment. If a mixture of the radionuclides is present in soil, then the sum of the ratios of the concentration of each isotope to the allowable limit must be less than one. This guideline applies for total uranium in natural isotopic abundance.

e. This regulation for uranium of 30 µg/L became effective December 8, 2003 –National Primary Drinking Water Regulations; Radionuclides; Final Rule (Federal Register- December 7, 2000. Current SDWA MCL for the combined concentration of radium-226 and radium-228 in drinking water is 5pCi/L (40CFR141.1) Groundwater at NFSS is not a drinking water source. The above concentration is for comparative purposes only.

f. “Adjusted” gross alpha MCL of 15 pCi/L, including Th-230, excluding radon and uranium –National Primary Drinking Water Regulations; Radionuclide; Final Rule (Federal Register- December 7,2000)

Table D**(Section: 2.3 Groundwater - Chemical Parameters)****Groundwater - Chemical Parameters**

Analyte	Related Regulations^a	
	Federal (mg/L)	State^c (mg/L)
Alkalinity, Total as CaCO ₃	NE	NE
Bicarbonate (HCO ₃)	NE	NE
Calcium (Ca)	NE	NE
Carbonate (CO ₃)	NE	NE
Chloride	250 ^d	250
Copper	1.3 ^e	0.2 ^e
Lead	0.015 ^e	0.025 ^e
Magnesium (Mg)	NE	NE
Nitrogen, Nitrate	10 ^b	10
Nitrogen, Nitrite	1 ^b	1
Phosphorous, Total	NE	NE
Potassium (K)	NE	NE
Sodium (Na)	NE	20
Solids, Total Dissolved (TDS)	500 ^d	500
Sulfate (SO ₄)	250 ^d	250
Vanadium	NE	NE

a. **Regulations presented pertain to drinking water quality and are listed for comparison only.**

No drinking water supply is obtained from groundwater at NFSS. NE - Not established.

b. Federal Safe Drinking Water Act maximum contaminant levels from USEPA Drinking Water Regulations (40CFR141.62)

c. Water Quality Criteria (class GA) per 6 NYCRR, Part 703.

d. National Secondary Drinking Water Regulations (40CFR143.3). These regulations primarily control and affect the aesthetic qualities of drinking water

e. Action Level

Table E**(Section: 4.0 SURVEILLANCE METHODOLOGY)****FUSRAP Instruction Guides Used for Environmental Surveillance Activities**

Document Number	Document Title
191-IG-007	Groundwater Level and Meteorological Measurements (BNI 1996b)
191-IG-011	Decontamination of Field Sampling Equipment at FUSRAP Sites (BNI 1996c)
191-IG-028	Surface Water and Sediment Sampling Activities (BNI 1993a)
191-IG-029	Radon/Thoron and TETLD Exchange (BNI 1993b)
191-IG-033	Groundwater Sampling Activities (BNI 1996d)

Table 1a
Environmental Surveillance Summary
External Gamma Radiation, Radon Gas, and Radon-222 Flux
Niagara Falls Storage Site

Measured Parameter	Station Identification	Number of Analyses or Measurements																Total Analyses per Year	
		No. of Sample Locations				Sample Duplicate				Ship Blank				Contingency Sample					
		CY Quarter				CY Quarter				CY Quarter				CY Quarter					
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4		
LABORATORY MEASUREMENTS																			
External gamma radiation (TLDs) ^a	1, 7, 8, 10, 11, 12, 13, 15 18, 21, 23, 24, 28, 29, 36 105, 116, 120 122, 123	20		20		1		1		1		1		20		20		84	
Radon gas		20		20		1		1										42	
Radon-222 flux	WCS ^b			183														183	

a. TLD = Thermoluminescent Dosimeter.

b. Waste Containment Structure

Table 1b
Environmental Surveillance Summary
Groundwater
Niagara Falls Storage Site

Measured Parameter	Station Identification	Number of Analyses or Measurements																												Total Analyses per Year	
		No. of Sample Locations				Rinsate Blank				Trip Blank				Sample Duplicate				Matrix Spike				Matrix Spike Duplicate									
		CY Quarter				CY Quarter				CY Quarter				CY Quarter				CY Quarter				CY Quarter									
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4						
FIELD MEASUREMENTS																															
Dissolved oxygen	A45, A50, OW04B, OW06B, OW13B, OW15B, OW17B, B02W20S		8																										8		
ORP ^a			8																										8		
Turbidity			8																										8		
Temperature			8																										8		
Specific conductivity			8																										8		
pH			8																										8		
LABORATORY MEASUREMENTS																															
Radiological	A45, A50, OW04B, OW06B, OW13B, OW15B, OW17B, B02W20S		8				1							1				1				1							12		
Uranium-234/235/238			8				1							1				1				1							12		
Radium-226/228			8				1							1				1				1							12		
Thorium-230/232																															
Metals																															
Copper			8				1								1				1				1						12		
Lead			8				1								1				1				1						12		
Vanadium			8				1								1				1				1						12		
Water Quality ^b		8				1								1				1				1						12			

a. ORP = Oxidation-Reduction Potential
b. Table 8 lists water quality parameters.

T-5

Table 1c
Environmental Surveillance Summary
Surface Water and Sediment
Niagara Falls Storage Site

Measured Parameter	Station Identification	Number of Analyses or Measurements																				Total Analyses per Year				
		No. of Sample Locations				Rinsate Blank				Trip Blank				Sample Duplicate				Matrix Spike					Matrix Spike Duplicate			
		CY Quarter				CY Quarter				CY Quarter				CY Quarter				CY Quarter					CY Quarter			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4		1	2	3	4
FIELD MEASUREMENTS																										
Chemical																										
Dissolved oxygen	SWSD009		5																						5	
Eh	SWSD010		5																						5	
Turbidity	SWSD011		5																						5	
Temperature	SWSD021		5																						5	
Specific conductivity	SWSD022		5																						5	
pH			5																						5	
LABORATORY MEASUREMENTS																										
Radiological																										
Surface Water																										
Uranium-234/235/238	SWSD009		5											1				1				1			8	
Radium-226/228	SWSD010		5											1				1				1			8	
Thorium-230/232	SWSD011		5											1				1				1			8	
Sediment																										
Uranium-234/235/238	SWSD021																									
Uranium-234/235/238	SWSD022		5				1							1				1				1			9	
Radium-226/228			5				1							1				1				1			9	
Thorium-230/232			5				1							1				1				1			9	

T-6

Table 2
2006 External Gamma Dose Rates
Niagara Falls Storage Site

Monitoring Location	Monitoring Station	Gross TLD Data ^a (mrem) (First period)	Gross TLD Data ^a (mrem) (Second period)	Normalized Gross TLD Data ^b (mrem/yr)	CY2006 Net TLD Data ^c (mrem/yr)
NFSS Perimeter	1	13.4	14.4	27.5	1.0
	1	12.6	23.2	35.4	8.9
	7	10.6	11.3	21.7	-4.9
	7	8.1	7.7	15.6	-10.9
	11	14.4	22.3	36.3	9.8
	11	12.9	21.6	34.1	7.6
	12 ^d	13.9	20.4	33.9	7.4
	12	13.9	12.6	26.2	-0.3
	13	5.9	13	18.7	-7.8
	13	2.1	21.5	23.3	-3.2
	15 ^d	12.9	28.5	41.0	14.4
	15	12.9	23.9	36.4	9.9
	28 ^d	15.4	4.7	19.9	-6.6
	28	15.4	4.7	19.9	-6.6
	29	8.4	20	28.1	1.6
	29	7.1	19	25.8	-0.7
	36	16.4	18.6	34.6	8.1
	36	19.7	22.2	41.4	14.9
	122	4.6	20	24.3	-2.2
	122	15.8	25.2	40.6	14.0
IWCS Perimeter	123	18.2	20.2	38.0	11.5
	123	9.5	17.7	26.9	0.4
	8	5.5	19.1	24.3	-2.2
	8	6.1	11.9	17.8	-8.7
	10 ^d	6.3	16.1	22.2	-4.4
	10	6.3	23	29.0	2.5
	18	13.8	4.1	17.7	-8.8
	18	21.2	9.5	30.4	3.8
	21 ^d	19.5	25.1	44.1	17.6
	21	19.5	20.5	39.6	13.0
	23 ^d	10.2	12.7	22.7	-3.9
	23	10.2	15.3	25.2	-1.3
Background	24	15.8	25.3	40.7	14.1
	24	11.4	24.4	35.4	8.9
	105	12.2	12.9	24.8	---
	105	11.3	14.9	25.9	---
	116	6.6	20.1	26.4	---
	116	10.4	21.9	31.9	---
Average Background	120	11.7	19.6	31.0	---
	120	-1.8	21.1	19.1	---
Average Background		8.4	18.4	26.5	

Exposure Period 05JAN - 27JUN2006 and 27JUN - 09JAN2007 (Total 369 days)

^a All data reported from the vendor were gross results in mrem per monitoring period. Negative values are replaced by the co-located badge value with the exception of the background values.

^b Gross data for each period are normalized to a daily dose rate, averaged, and then normalized for the length of the year (365 days)

^c Net data are corrected by subtracting the average normalized background value.

^d TLD value rejected. Replaced with value from co-located badge.

Table 3
2006 Radon Gas ^a Concentrations
Niagara Falls Storage Site

Average Daily Concentration (pCi/L) ^b				
Monitoring Location ^c	Monitoring Station	Start Dates ^d :	1/5/2006	6/27/2006
		End Dates ^d :	6/27/2006	1/9/2007
NFSS Perimeter	1		<0.2	0.3
	7		<0.2	0.2
	11		<0.2	<0.2
	12		<0.2	0.2
	12 (dup ^e)		<0.2	0.2
	13		<0.2	0.3
	15		<0.2	<0.2
	28		<0.2	<0.2
	29		<0.2	0.2
	36		<0.2	0.2
	122		<0.2	0.2
	123		<0.2	<0.2
WCS ^f Perimeter	8		<0.2	<0.2
	10		<0.2	0.2
	18		<0.2	0.2
	21		<0.2	0.2
	23		<0.2	0.2
	24		<0.2	0.2
Background	105		<0.2	0.2
	116		0.7	0.2
	120		0.8	<0.2

a. Radon gas concentrations in 2006 were measured with RadTrak® detectors.

These detectors measure the combined concentration of radon-220 and radon-222 in air.

b. pCi/L - picocuries per liter.

c. Monitoring locations are shown in Figure 2.

d. Detectors were installed and removed on the dates listed.

e. A quality control duplicate is collected at the same time and location and is analyzed by the same method for evaluating precision in sampling and analysis.

f. Monitoring locations are at the perimeter of the waste containment structure (WCS).

Note: The DOE limit for radon-222 is 3.00 pCi/L above background.

(<0.2) Indicates detection limit is reported. Actual result is less than this value.

1 pCi = 0.037 becquerel

Table 4

2006 Radon Flux Monitoring Results^a
Niagara Falls Storage Site

NFSS Sample ID	Radon-222 Flux (pCi/m ² /s)	NFSS Sample ID	Radon-222 Flux (pCi/m ² /s)	NFSS Sample ID	Radon-222 Flux (pCi/m ² /s)
1	0.1004 ± 0.0575	41	0.06887 ± 0.03506	81	0.05626 ± 0.03792
2	0.2115 ± 0.0874	42	-0.04654 ± 0.0813	82	-0.04468 ± 0.08826
3	0.04609 ± 0.0525	43	0.03195 ± 0.03348	83	0.0424 ± 0.03887
4	0.01575 ± 0.0352	44	-0.08967 ± 0.07601	84	-0.05051 ± 0.08376
5	0.02894 ± 0.034	45	0.03897 ± 0.03821	85	0.05792 ± 0.03293
6	0.03592 ± 0.0437	46	-0.05741 ± 0.08817	86	-0.08366 ± 0.08484
7	-0.002563 ± 0.052	47	0.0749 ± 0.03773	87	0.0144 ± 0.03298
8	0.1142 ± 0.0627	48	-0.06635 ± 0.08333	88	-0.06944 ± 0.08459
9	0.07715 ± 0.0526	49	0.04983 ± 0.03641	89	0.0806 ± 0.0495
10	0.1002 ± 0.073	50	-0.07058 ± 0.07191	90	0.01199 ± 0.09468
10 DUP ^b	0.07885 ± 0.0503	50 DUP	0.02162 ± 0.08967	90 DUP	-0.09408 ± 0.09794
11	0.1008 ± 0.0556	51	0.033 ± 0.03854	91	0.08533 ± 0.04526
12	0.08386 ± 0.0545	52	0.05951 ± 0.03949	92	-0.07265 ± 0.08706
13	0.07059 ± 0.0455	53	-0.0293 ± 0.0846	93	0.005416 ± 0.02965
14	0.03602 ± 0.0376	54	0.07843 ± 0.05277	94	-0.05974 ± 0.08612
15	0.06558 ± 0.0344	55	0.03173 ± 0.09427	95	0.04392 ± 0.0385
16	0.08385 ± 0.07112	56	0.003904 ± 0.03006	96	-0.07735 ± 0.09351
17	0.1051 ± 0.0506	57	0.00555 ± 0.0849	97	0.05727 ± 0.0430
18	0.09803 ± 0.0722	58	0.06663 ± 0.04561	98	-0.06698 ± 0.08856
19	0.09535 ± 0.0524	59	-0.03852 ± 0.08007	99	0.05651 ± 0.04344
20	0.02762 ± 0.0336	60	0.07273 ± 0.0434	100	-0.07638 ± 0.09005
20 DUP	0.01153 ± 0.0407	60 DUP	0.06913 ± 0.04697	100 DUP	-0.07278 ± 0.08721
21	0.07043 ± 0.0358	61	-0.07558 ± 0.08611	101	0.07784 ± 0.04924
22	0.05829 ± 0.0568	62	0.01391 ± 0.03861	102	-0.04496 ± 0.09319
23	0.06193 ± 0.0422	63	-0.05107 ± 0.07766	103	0.02672 ± 0.03961
24	0.03319 ± 0.0489	64	0.01975 ± 0.03781	104	-0.1036 ± 0.09231
25	0.03018 ± 0.035	65	0.01264 ± 0.0894	105	0.05501 ± 0.03134
26	0.03618 ± 0.0378	66	0.03802 ± 0.03273	106	-0.1155 ± 0.08642
27	0.04057 ± 0.0334	67	-0.05345 ± 0.08779	107	0.07873 ± 0.04836
28	0.06947 ± 0.0448	68	0.05564 ± 0.04251	108	-0.01782 ± 0.09222
29	0.05961 ± 0.0347	69	-0.03886 ± 0.08078	109	0.01431 ± 0.03276
30	0.1137 ± 0.0564	70	0.00397 ± 0.03056	110	-0.05281 ± 0.09119
30 DUP	0.1162 ± 0.0371	70 DUP	0.07246 ± 0.04261	110 DUP	-0.07871 ± 0.07787
31	0.02163 ± 0.0353	71	-0.08872 ± 0.07706	111	0.02514 ± 0.03313
32	0.02821 ± 0.0322	72	0.01977 ± 0.09831	112	0.02132 ± 0.03183
33	0.09714 ± 0.0679	73	-0.02557 ± 0.0952	113	-0.06864 ± 0.08362
34	0.06022 ± 0.0497	74	-0.06825 ± 0.08314	114	0.02669 ± 0.03031
35	0.03771 ± 0.0514	75	-0.09954 ± 0.09366	115	-0.05794 ± 0.08214
36	0.03369 ± 0.0341	76	0.07258 ± 0.04654	116	0.0171 ± 0.03033
37	0.08793 ± 0.0662	77	-0.05971 ± 0.08609	117	-0.06326 ± 0.08888
38	0.006512 ± 0.0305	78	0.06492 ± 0.03655	118	0.07356 ± 0.04478
39	-0.08936 ± 0.0813	79	-0.07431 ± 0.09101	119	-0.07685 ± 0.08719
40	0.0003804 ± 0.0286	80	0.07281 ± 0.04146	120	0.009541 ± 0.01859
40 DUP	0.01573 ± 0.0279	80 DUP	0.06184 ± 0.03933	120 DUP	0.01103 ± 0.03199

Table 4

2006 Radon Flux Monitoring Results^a
Niagara Falls Storage Site

NFSS Sample ID		Radon-222 Flux (pCi/m ² /s)	NFSS Sample ID		Radon-222 Flux (pCi/m ² /s)	NFSS Sample ID		Radon-222 Flux (pCi/m ² /s)
121		0.001704 ± 0.0321	161		0.075 ± 0.04439			
122		-0.02322 ± 0.0914	162		-0.04125 ± 0.09028			
123		0.01181 ± 0.0287	163		0.05755 ± 0.04491			
124		-0.04562 ± 0.0901	164		-0.1037 ± 0.09042			
125		-0.002854 ± 0.0368	165		0.008675 ± 0.02703			
126		-0.09338 ± 0.0831	166		-0.1096 ± 0.08962			
127		0.0454 ± 0.0474	167		0.03174 ± 0.03211			
128		-0.05888 ± 0.0891	168		-0.0599 ± 0.0819			
129		0.01542 ± 0.0297	169		-0.009301 ± 0.02769			
130		-0.09562 ± 0.0894	170		-0.1044 ± 0.07586			
130 DUP		-0.06929 ± 0.0799	170 DUP		-0.0505 ± 0.0882			
131		0.05174 ± 0.0312	171		0.01171 ± 0.02847			
132		-0.04843 ± 0.0926	172		-0.03292 ± 0.0902			
133		0.04468 ± 0.0431	173		0.07549 ± 0.03879			
134		-0.07913 ± 0.0829	174		0.009266 ± 0.1027	Average:	0.00717 (pCi/m ² /s)	
135		-0.001065 ± 0.018	175		0.0533 ± 0.03155	High	0.21150 (pCi/m ² /s)	
136		-0.0674 ± 0.0945	176		-0.05731 ± 0.08784	Low	-0.11550 (pCi/m ² /s)	
137		-0.01583 ± 0.0286	177		0.01734 ± 0.03076			
138		-0.0761 ± 0.0856	178		0.0009766 ± 0.09087			
139		0.04318 ± 0.0289	179		0.07102 ± 0.04684			
140		0.003642 ± 0.0956	180		-0.03157 ± 0.09575			
140 DUP		0.01109 ± 0.0952	180 DUP		-0.06251 ± 0.08199			
141		0.08849 ± 0.056	181 ^c		0.002078 ± 0.03323			
142		0.0003442 ± 0.0916	182 ^c		-0.062 ± 0.08057			
143		0.01923 ± 0.0311	183 ^c		0.004488 ± 0.03404			
144		-0.07693 ± 0.093	Average		-0.01848			
145		0.09737 ± 0.0528	background					
146		-0.05811 ± 0.0838						
147		0.01883 ± 0.0304						
148		-0.04078 ± 0.0841						
149		0.006998 ± 0.0328						
150		-0.02608 ± 0.0913						
150 DUP		-0.05869 ± 0.0846						
151		0.01821 ± 0.0336						
152		0.01196 ± 0.0315						
153		-0.06788 ± 0.0827						
154		0.01727 ± 0.0393						
155		-0.0631 ± 0.0887						
156		0.005688 ± 0.0215						
157		-0.07597 ± 0.0862						
158		0.07195 ± 0.044						
159		-0.03926 ± 0.0904						
160		-0.01381 ± 0.033						
160 DUP		0.0632 ± 0.0441						

NOTE: The EPA Standard for Radon-222 Flux is 20 pCi/m²/sec

a. Radon-222 flux was performed on August 08-09, 2006

b. Every 10th canister is counted twice as a quality control (QC) duplicate to evaluate analytical precision

c. Background: 181-Lewiston-Porter Central School
182-Balmer Rd. (CWM Secondary Gate)
183-Lewiston Water Pollution Control Center

Table 5
2006 Surface Water Analytical Results - Radioactive Constituents
Niagara Falls Storage Site

Sampling Location	Date Collected	Analyte	Qualifier ^f	Result (pCi/L) ^a		MDA ^b (pCi/L) ^a	DCG ^c (pCi/L) ^a
SWSD009 Background	5/18/2006	Radium-226	J	0.290 ±	0.140	0.180	100
	5/18/2006	Radium-228	U	0.330 ±	0.320	0.520	100
	5/18/2006	Thorium-230	U	0.150 ±	0.160	0.180	300
	5/18/2006	Thorium-232	J	0.000 ±	0.000	0.000	50
	5/18/2006	Uranium-234		2.460 ±	0.440	0.060	500
	5/18/2006	Uranium-235	J	0.097 ±	0.071	0.058	600
	5/18/2006	Uranium-238		1.970 ±	0.370	0.020	600
		<i>Total uranium^d</i>		<i>4.527</i>			<i>600</i>
SWSD021 Background	5/18/2006	Radium-226	U	0.074 ±	0.070	0.100	100
	5/18/2006	Radium-228		0.580 ±	0.330	0.510	100
	5/18/2006	Thorium-230	UJ	0.039 ±	0.078	0.130	300
	5/18/2006	Thorium-232	UJ	0.038 ±	0.077	0.130	50
	5/18/2006	Uranium-234		4.770 ±	0.810	0.030	500
	5/18/2006	Uranium-235	J	0.190 ±	0.110	0.040	600
	5/18/2006	Uranium-238		3.880 ±	0.680	0.050	600
		<i>Total uranium^d</i>		<i>8.840</i>			<i>600</i>
SWSD010	5/18/2006	Radium-226	J	0.160 ±	0.110	0.150	100
	5/18/2006	Radium-228	U	-0.500 ±	0.470	0.820	100
	5/18/2006	Thorium-230	UJ	0.032 ±	0.079	0.140	300
	5/18/2006	Thorium-232	UJ	0.019 ±	0.053	0.110	50
	5/18/2006	Uranium-234		2.660 ±	0.500	0.060	500
	5/18/2006	Uranium-235	J	0.091 ±	0.077	0.071	600
	5/18/2006	Uranium-238		1.880 ±	0.390	0.060	600
		<i>Total uranium^d</i>		<i>4.631</i>			<i>600</i>
SWSD011	5/18/2006	Radium-226	J	0.165 ±	0.084	0.095	100
	5/18/2006	Radium-228	U	0.004 ±	0.220	0.380	100
	5/18/2006	Thorium-230	J	0.240 ±	0.140	0.100	300
	5/18/2006	Thorium-232	UJ	0.018 ±	0.050	0.048	50
	5/18/2006	Uranium-234		3.310 ±	0.570	0.050	500
	5/18/2006	Uranium-235	J	0.146 ±	0.089	0.055	600
	5/18/2006	Uranium-238		2.910 ±	0.520	0.060	600
		<i>Total uranium^d</i>		<i>6.366</i>			<i>600</i>

Table 5
2006 Surface Water Analytical Results - Radioactive Constituents
Niagara Falls Storage Site

Sampling Location	Date Collected	Analyte	Qualifier ^f	Result (pCi/L) ^a		MDA ^b (pCi/L) ^a	DCG ^c (pCi/L) ^a
Duplicate ^e SWSD011-D SWSD011	5/18/2006	Radium-226	U	0.080 ±	0.081	0.130	100
	5/18/2006	Radium-228	U	0.240 ±	0.240	0.400	100
	5/18/2006	Thorium-230	UJ	0.045 ±	0.084	0.130	300
	5/18/2006	Thorium-232	UJ	-0.014 ±	0.054	0.120	50
	5/18/2006	Uranium-234		3.830 ±	0.710	0.080	500
	5/18/2006	Uranium-235	J	0.270 ±	0.140	0.040	600
	5/18/2006	Uranium-238		2.990 ±	0.580	0.080	600
		<i>Total uranium^d</i>		<i>7.090</i>			<i>600</i>
SWSD022	5/18/2006	Radium-226	J	0.145 ±	0.081	0.130	100
	5/18/2006	Radium-228	U	0.170 ±	0.240	0.400	100
	5/18/2006	Thorium-230	UJ	0.049 ±	0.084	0.130	300
	5/18/2006	Thorium-232	UJ	0.000 ±	0.054	0.120	50
	5/18/2006	Uranium-234		2.330 ±	0.440	0.050	500
	5/18/2006	Uranium-235	J	0.166 ±	0.098	0.035	600
	5/18/2006	Uranium-238		1.960 ±	0.390	0.050	600
		<i>Total uranium^d</i>		<i>4.456</i>			<i>600</i>

a. pCi/L - picocuries per liter.

b. MDA - Minimum detectable activity.

c. DOE Derived Concentration Guide (DCG) for water.

d. Sum of uranium isotope concentrations.

e. A quality control duplicate is collected at the same time and location and is analyzed by the same method for evaluating precision in sampling and analysis (SWSD011).

f. Validated Qualifier: **J** - indicates an estimated value.

Validated Qualifier: **U** - indicates that no analyte was detected (Non-Detect).

Table 6
2006 Sediment Analytical Results - Radioactive Constituents
Niagara Falls Storage Site

Sampling Location	Date Collected	Analyte	Qualifier ^g	Result (pCi/g) ^a	MDA ^b (pCi/g) ^a	Cleanup Criteria ^c (pCi/g) ^a
SWSD009 Background	5/18/2006	Radium-226		0.980 ± 0.190	0.150	5
	5/18/2006	Radium-228		0.800 ± 0.350	0.260	5
	5/18/2006	Thorium-230		1.320 ± 0.280	0.040	5
	5/18/2006	Thorium-232		0.990 ± 0.230	0.040	5
	5/18/2006	Uranium-234		1.370 ± 0.260	0.030	--
	5/18/2006	Uranium-235	J	0.058 ± 0.042	0.033	--
	5/18/2006	Uranium-238		1.290 ± 0.240	0.030	--
		<i>Total uranium^e</i>		2.718		90 ^d
SWSD021 Background	5/18/2006	Radium-226		0.910 ± 0.160	0.130	5
	5/18/2006	Radium-228		1.150 ± 0.310	0.240	5
	5/18/2006	Thorium-230		1.250 ± 0.270	0.040	5
	5/18/2006	Thorium-232		1.120 ± 0.250	0.030	5
	5/18/2006	Uranium-234		1.250 ± 0.240	0.030	--
	5/18/2006	Uranium-235	J	0.053 ± 0.039	0.029	--
	5/18/2006	Uranium-238		1.230 ± 0.230	0.030	--
		<i>Total uranium^e</i>		2.533		90 ^d
SWSD010	5/18/2006	Radium-226		0.630 ± 0.250	0.220	5
	5/18/2006	Radium-228		0.980 ± 0.370	0.440	5
	5/18/2006	Thorium-230		1.110 ± 0.240	0.020	5
	5/18/2006	Thorium-232		0.980 ± 0.220	0.030	5
	5/18/2006	Uranium-234		1.680 ± 0.300	0.030	--
	5/18/2006	Uranium-235	J	0.097 ± 0.053	0.028	--
	5/18/2006	Uranium-238		1.430 ± 0.260	0.020	--
		<i>Total uranium^e</i>		3.207		90 ^d
SWSD022	5/18/2006	Radium-226		1.700 ± 0.250	0.160	5
	5/18/2006	Radium-228		1.190 ± 0.370	0.280	5
	5/18/2006	Thorium-230		1.260 ± 0.260	0.030	5
	5/18/2006	Thorium-232		1.050 ± 0.230	0.030	5
	5/18/2006	Uranium-234		1.820 ± 0.330	0.020	--
	5/18/2006	Uranium-235	J	0.083 ± 0.053	0.039	--
	5/18/2006	Uranium-238		1.550 ± 0.290	0.030	--
		<i>Total uranium^e</i>		3.370		90 ^d

Table 6
2006 Sediment Analytical Results - Radioactive Constituents
Niagara Falls Storage Site

Sampling Location	Date Collected	Analyte	Qualifier ^g	Result (pCi/g) ^a	MDA ^b (pCi/g) ^a	Cleanup Criteria ^c (pCi/g) ^a
SWSD011	5/18/2006	Radium-226		1.020 ± 0.190	0.130	5
	5/18/2006	Radium-228		1.170 ± 0.330	0.250	5
	5/18/2006	Thorium-230		1.220 ± 0.250	0.030	5
	5/18/2006	Thorium-232		0.870 ± 0.190	0.030	5
	5/18/2006	Uranium-234		1.460 ± 0.270	0.030	--
	5/18/2006	Uranium-235	J	0.091 ± 0.053	0.030	--
	5/18/2006	Uranium-238		1.470 ± 0.280	0.020	--
		<i>Total uranium^e</i>		<i>3.021</i>		<i>90^d</i>
Duplicate ^f SWSD011-D SWSD011	5/18/2006	Radium-226		1.080 ± 0.200	0.150	5
	5/18/2006	Radium-228		0.850 ± 0.380	0.320	5
	5/18/2006	Thorium-230		1.030 ± 0.250	0.050	5
	5/18/2006	Thorium-232		0.860 ± 0.220	0.030	5
	5/18/2006	Uranium-234		1.330 ± 0.260	0.040	--
	5/18/2006	Uranium-235	J	0.089 ± 0.055	0.020	--
	5/18/2006	Uranium-238		1.320 ± 0.260	0.040	--
		<i>Total uranium^e</i>		<i>2.739</i>		<i>90^d</i>

a. pCi/g - picocuries per gram.

b. MDA - Minimum detectable activity.

c. DOE surface soil cleanup criteria, averaged over topmost 6 in. (15 cm) of soil. Because there are no standards for radioactive constituents in sediment, these soil values are used as a basis for comparison of sediment results.

d. NFSS DOE site-specific cleanup criterion for total uranium.

e. Sum of uranium isotope concentrations.

f. A quality control duplicate is collected at the same time and location and is analyzed by the same method for evaluating precision in sampling and analysis.

g. Validated Qualifier: **J** - indicates an estimated value.

Validated Qualifier: **U** - indicates that no analyte was detected (Non-Detect).

Table 7
2006 Field Parameter Summary
Niagara Falls Storage Site

Sampling Location	Date	Temperature (°F ^a)	pH	Spec. Cond. ^b (uS/cm ^c)	DO ^d (mg/L ^e)	ORP ^f (mV ^g)	Turbidity (NTU ^h)	Volume Purged (Liters ⁱ)	Discharge milliter PM ^j
GROUNDWATER									
A45	5/18/2006	59.6	6.91	1171	1.83	146	8.3	5.45	101
A50	5/18/2006	54.1	7.28	1831	2.98	196	8.5	6.49	110
OW04B	5/18/2006	52.7	7.13	1695	0.17	167	4.5	3.08	88
OW06B	5/17/2006	60.2	7.11	1943	0.16	-9	4.4	3.36	80
OW13B	5/17/2006	59.1	7.1	2430	0.24	185	5.1	4.37	97
OW15B	5/17/2006	59.8	7.52	1227	1.07	191	4.7	3.97	81
OW17B	5/18/2006	53.5	7.49	1475	0.31	83	3.7	3.15	85
B02W20S	5/17/2006	57.8	7.25	1337	0.12	74	4.2	4.16	80
SURFACE WATER									
SWSD009	5/18/2006	62.8	7.46	2460	3.67	165	23	NA	NA
SWSD010	5/18/2006	60.5	7.82	1693	6.23	229	11	NA	NA
SWSD011	5/18/2006	57.1	7.54	1536	5.82	164	13	NA	NA
SWSD021	5/18/2006	61.0	7.64	911	4.43	243	70	NA	NA
SWSD022	5/18/2006	58.1	7.51	1702	4.17	247	12	NA	NA

a. °F - Degrees Fahrenheit.

b. Spec. Cond. - Specific conductance.

c. uS/cm - microSiemens/centimeter.

d. DO - Dissolved oxygen.

e. mg/L - milligrams per liter.

f. ORP - Oxidation-Reduction potential.

g. mV - milliVolts.

h. NTU - Nephelometric turbidity units.

i. 1-Liter = 0.26 gallons

j. Milliter PM = milliter per minute (1000ml = 1.0 liter)

Table 8
2006 Groundwater Quality Results for Niagara Falls Storage Site

Sampling Location	Date Collected	Analyte	Qualifier ^f	Result (mg/L) ^a	Reporting Limit (mg/L) ^a	Related Regulations ^b	
						Federal ^c (mg/L) ^a	State ^d (mg/L) ^a
B02W20S Background	5/17/2006	Total Dissolved Solids		905.0	5.0	500	500
	5/17/2006	Chloride	J	7.9	4.0	250	250
	5/17/2006	Nitrogen, Nitrate		0.1	0.02	10	10
	5/17/2006	Nitrogen, Nitrite	U	0.02	0.02	1	1
	5/17/2006	Phosphate as P, Ortho	U	0.50	0.50	NE	NE
	5/17/2006	Sulfate		356.0	25.0	250	250
	5/17/2006	Bicarbonate alkalinity (CaCO ₃)		440.0	25.0	NE	NE
	5/17/2006	Carbonate alkalinity (CaCO ₃)	U	5.0	5.0	NE	NE
	5/17/2006	Alkalinity, Total as CaCO ₃		440.0	25.0	NE	NE
	5/17/2006	Calcium		75.9	5.0	NE	NE
	5/17/2006	Magnesium		116.0	5.0	NE	NE
	5/17/2006	Potassium	J	1.66	0.5	NE	NE
	5/17/2006	Sodium		59.1	5.0	NE	20
	5/17/2006	Calcium		78.9	5.0	NE	NE
B02W20S-Filtered Background	5/17/2006	Magnesium		122.0	5.0	NE	NE
	5/17/2006	Potassium	J	1.60	0.5	NE	NE
	5/17/2006	Sodium		60.2	5.0	NE	20
	5/17/2006	Sodium		60.2	5.0	NE	20
A45	5/22/2006	Total Dissolved Solids		1810.0	5.0	500	500
	5/22/2006	Chloride	J	0.25	4.0	250	250
	5/22/2006	Nitrogen, Nitrate		0.23	0.02	10	10
	5/22/2006	Nitrogen, Nitrite		0.64	0.02	1	1
	5/22/2006	Phosphate as P, Ortho	U	0.02	0.50	NE	NE
	5/22/2006	Sulfate	J	0.36	50.0	250	250
	5/22/2006	Bicarbonate alkalinity (CaCO ₃)		782.0	25.0	NE	NE
	5/22/2006	Carbonate alkalinity (CaCO ₃)		460.0	5.0	NE	NE
	5/22/2006	Alkalinity, Total as CaCO ₃	U	5.0	25.0	NE	NE
	5/18/2006	Calcium	J	27.3	5.0	NE	NE
	5/18/2006	Magnesium		146.0	5.0	NE	NE
	5/18/2006	Potassium		4.23	0.5	NE	NE
	5/18/2006	Sodium		45.5	5.0	NE	20
	5/18/2006	Calcium	J	289.0	5.0	NE	NE
45-Filtered	5/18/2006	Magnesium		156.0	5.0	NE	NE
	5/18/2006	Potassium		4.3	0.5	NE	NE
	5/18/2006	Sodium		48.4	5.0	NE	20
	5/18/2006	Sodium		48.4	5.0	NE	20
Duplicate ^e (D1) A45	5/18/2006	Total Dissolved Solids		1730.0	5.0	500	500
	5/18/2006	Chloride	J	51.5	4.0	250	250
	5/18/2006	Nitrogen, Nitrate		0.36	0.02	10	10
	5/18/2006	Nitrogen, Nitrite	U	0.02	0.02	1	1
	5/18/2006	Phosphate as P, Ortho	U	0.50	0.50	NE	NE
	5/18/2006	Sulfate	J	785.0	50.0	250	250
	5/18/2006	Bicarbonate alkalinity (CaCO ₃)		480.0	25.0	NE	NE
	5/18/2006	Carbonate alkalinity (CaCO ₃)	U	5.0	5.0	NE	NE
	5/18/2006	Alkalinity, Total as CaCO ₃		480.0	25.0	NE	NE
	5/18/2006	Calcium	J	301.0	5.0	NE	NE
	5/18/2006	Magnesium		161.0	5.0	NE	NE
	5/18/2006	Potassium		4.35	0.5	NE	NE
	5/18/2006	Sodium		49.9	5.0	NE	20
	5/18/2006	Sodium		49.9	5.0	NE	20

Table 8
2006 Groundwater Quality Results for Niagara Falls Storage Site

Sampling Location	Date Collected	Analyte	Qualifier ^f	Result (mg/L) ^a	Reporting	Related Regulations ^b	
					Limit (mg/L) ^a	Federal ^c (mg/L) ^a	State ^d (mg/L) ^a
A50	5/18/2006	Total Dissolved Solids		1320.0	5.0	500	500
	5/18/2006	Chloride	J	19.6	2.0	250	250
	5/18/2006	Nitrogen, Nitrate		0.36	0.02	10	10
	5/18/2006	Nitrogen, Nitrite	U	0.02	0.02	1	1
	5/18/2006	Phosphate as P, Ortho	U	0.50	0.50	NE	NE
	5/18/2006	Sulfate	J	618.0	50.0	250	250
	5/18/2006	Bicarbonate alkalinity (CaCO ₃)		420.0	25.0	NE	NE
	5/18/2006	Carbonate alkalinity (CaCO ₃)	U	5.0	5.0	NE	NE
	5/18/2006	Alkalinity, Total as CaCO ₃		420.0	25.0	NE	NE
	5/18/2006	Calcium	J	125.0	5.0	NE	NE
	5/18/2006	Magnesium		170.0	5.0	NE	NE
	5/18/2006	Potassium		2.12	0.5	NE	NE
	5/18/2006	Sodium		80.8	5.0	NE	20
50-Filtered	5/18/2006	Calcium	J	129.0	5.0	NE	NE
	5/18/2006	Magnesium		163.0	5.0	NE	NE
	5/18/2006	Potassium		1.67	0.5	NE	NE
	5/18/2006	Sodium		78.5	5.0	NE	20
OW04B	5/18/2006	Total Dissolved Solids		1350.0	5.0	500	500
	5/18/2006	Chloride	J	81.6	10.0	250	250
	5/18/2006	Nitrogen, Nitrate		0.053	0.02	10	10
	5/18/2006	Nitrogen, Nitrite	U	0.02	0.02	1	1
	5/18/2006	Phosphate as P, Ortho	U	0.50	0.50	NE	NE
	5/18/2006	Sulfate	J	621.0	25.0	250	250
	5/18/2006	Bicarbonate alkalinity (CaCO ₃)		480.0	25.0	NE	NE
	5/18/2006	Carbonate alkalinity (CaCO ₃)	U	5.0	5.0	NE	NE
	5/18/2006	Alkalinity, Total as CaCO ₃		480.0	25.0	NE	NE
	5/18/2006	Calcium	J	181.0	5.0	NE	NE
	5/18/2006	Magnesium		138.0	5.0	NE	NE
	5/18/2006	Potassium		2.05	0.5	NE	NE
	5/18/2006	Sodium		61.6	0.5	NE	20
OW04B-Filtered	5/18/2006	Calcium	J	183.0	5.0	NE	NE
	5/18/2006	Magnesium		129.0	5.0	NE	NE
	5/18/2006	Potassium		1.86	0.5	NE	NE
	5/18/2006	Sodium		58.8	5.0	NE	20
OW06B	5/17/2006	Total Dissolved Solids		1440.0	5.0	500	500
	5/17/2006	Chloride	J	32.1	2.0	250	250
	5/17/2006	Nitrogen, Nitrate		0.07	0.02	10	10
	5/17/2006	Nitrogen, Nitrite	U	0.02	0.02	1	1
	5/17/2006	Phosphate as P, Ortho	U	0.50	0.50	NE	NE
	5/17/2006	Sulfate		493.0	50.0	250	250
	5/17/2006	Bicarbonate alkalinity (CaCO ₃)		610.0	25.0	NE	NE
	5/17/2006	Carbonate alkalinity (CaCO ₃)	U	5.0	5.0	NE	NE
	5/17/2006	Alkalinity, Total as CaCO ₃		610.0	25.0	NE	NE
	5/17/2006	Calcium		118.0	5.0	NE	NE
	5/17/2006	Magnesium		172.0	5.0	NE	NE
	5/17/2006	Potassium	J	2.4	0.5	NE	NE
	5/17/2006	Sodium		72.1	5.0	NE	20
OW06B -Filtered	5/17/2006	Calcium		127.0	5.0	NE	NE
	5/17/2006	Magnesium		185.0	5.0	NE	NE
	5/17/2006	Potassium	J	2.7	0.5	NE	NE
	5/17/2006	Sodium		72.1	5.0	NE	20

Table 8
2006 Groundwater Quality Results for Niagara Falls Storage Site

Sampling Location	Date Collected	Analyte	Qualifier ^f	Result (mg/L) ^a	Reporting Limit (mg/L) ^a	Related Regulations ^b	
						Federal ^c (mg/L) ^a	State ^d (mg/L) ^a
OW13B	5/17/2006	Total Dissolved Solids		2270.0	5.0	500	500
	5/17/2006	Chloride	J	42.2	2.0	250	250
	5/17/2006	Nitrogen, Nitrate		0.09	0.02	10	10
	5/17/2006	Nitrogen, Nitrite	U	0.02	0.02	1	1
	5/17/2006	Phosphate as P, Ortho	U	0.50	0.50	NE	NE
	5/17/2006	Sulfate		50.0	50.0	250	250
	5/17/2006	Bicarbonate alkalinity (CaCO ₃)		530.0	25.0	NE	NE
	5/17/2006	Carbonate alkalinity (CaCO ₃)	U	5.0	5.0	NE	NE
	5/17/2006	Alkalinity, Total as CaCO ₃		530.0	25.0	NE	NE
	5/17/2006	Calcium		159.0	5.0	NE	NE
	5/17/2006	Magnesium		246.0	5.0	NE	NE
	5/17/2006	Potassium		1.67	0.5	NE	NE
	5/17/2006	Sodium		74.7	5.0	NE	20
OW13B -Filtered	5/17/2006	Calcium		193.0	5.0	NE	NE
	5/17/2006	Magnesium		273.0	5.0	NE	NE
	5/17/2006	Potassium	J	1.7	0.5	NE	NE
	5/17/2006	Sodium		83.6	5.0	NE	20
OW15B	5/17/2006	Total Dissolved Solids		798.0	5.00	500	500
	5/17/2006	Chloride	J	4.6	2.00	250	250
	5/17/2006	Nitrogen, Nitrate		0.59	0.02	10	10
	5/17/2006	Nitrogen, Nitrite	U	0.02	0.02	1	1
	5/17/2006	Phosphate as P, Ortho	U	0.50	0.50	NE	NE
	5/17/2006	Sulfate		301.0	50.0	250	250
	5/17/2006	Bicarbonate alkalinity (CaCO ₃)		310.0	25.0	NE	NE
	5/17/2006	Carbonate alkalinity (CaCO ₃)	U	5.0	5.0	NE	NE
	5/17/2006	Alkalinity, Total as CaCO ₃		310.0	25.0	NE	NE
	5/17/2006	Calcium		88.6	5.0	NE	NE
	5/17/2006	Magnesium		87.0	5.0	NE	NE
	5/17/2006	Potassium		1.13	0.5	NE	NE
	5/17/2006	Sodium		38.0	5.0	NE	20
OW15B -Filtered	5/17/2006	Calcium		98.5	5.0	NE	NE
	5/17/2006	Magnesium		109.0	5.0	NE	NE
	5/17/2006	Potassium	J	1.2	0.5	NE	NE
	5/17/2006	Sodium		50.4	5.0	NE	20
OW17B	5/18/2006	Total Dissolved Solids		982.0	5.0	500	500
	5/18/2006	Chloride	J	10.4	2.0	250	250
	5/18/2006	Nitrate		0.09	0.02	10	10
	5/18/2006	Nitrite	U	0.02	0.02	1	1
	5/18/2006	Phosphate as P, Ortho	U	0.50	0.50	NE	NE
	5/18/2006	Sulfate	J	425.0	25.0	250	250
	5/18/2006	Bicarbonate Alkalinity		440.0	25.0	NE	NE
	5/18/2006	Carbonate Alkalinity	U	5.0	5.0	NE	NE
	5/18/2006	Total Alkalinity		440.0	10.0	NE	NE
	5/18/2006	Calcium	J	71.5	5.0	NE	NE
	5/18/2006	Magnesium		144.0	5.0	NE	NE
	5/18/2006	Potassium		2.10	0.5	NE	NE
	5/18/2006	Sodium		72.7	5.0	NE	20
OW17B -Filtered	5/18/2006	Calcium	J	70.8	5.0	NE	NE
	5/18/2006	Magnesium		138.0	5.0	NE	NE
	5/18/2006	Potassium		2.0	0.5	NE	NE
	5/18/2006	Sodium		67.1	5.0	NE	20

a. mg/L - milligrams per liter.

b. Regulations presented pertain to drinking water quality and are listed for comparison only.

No drinking water supply is obtained from groundwater at NFSS. NE - Not established.

c. Federal Safe Drinking Water Act maximum contaminant levels from EPA Drinking Water Regulations and Health Advisories (October 1996).

d. Water Quality Criteria (class GA) per 6 NYCRR, Part 703.

e. A quality control (QC) duplicate is collected at the same time and location and is analyzed by the same method for evaluating precision in sampling and analysis.

f. Validated Qualifier: U - indicates that no analyte was detected above reporting limit (Non-Detect).

Validated Qualifier: J - indicates an estimated value.

Table 9
2006 Groundwater Analytical Results - Radioactive Constituents
Niagara Falls Storage Site

Sampling Location	Date Collected	Analyte	Qualifier ^f	Result ^a (pCi/L) ^b	MDA (pCi/L) ^b	DCG ^d (pCi/L) ^b
B02W20S	5/17/2006	Radium-226	U	0.089 ± 0.082	0.120	100 ^h
Background	5/17/2006	Radium-228	U	0.110 ± 0.280	0.470	100 ^h
		<i>Total Radium^{g,h}</i>		Non-Detect		100 ^h
	5/17/2006	Thorium-230	U	0.025 ± 0.045	0.065	300
	5/17/2006	Thorium-232	U	0.009 ± 0.043	0.047	50
	5/17/2006	Uranium-234		4.510 ± 0.770	0.050	500
	5/17/2006	Uranium-235	J	0.180 ± 0.110	0.060	600
	5/17/2006	Uranium-238		3.510 ± 0.630	0.050	600
		<i>Total Uranium^e</i>		8.200		600
B02W20S Filtered	5/17/2006	Radium-226	U	0.050 ± 0.084	0.140	100 ^h
Background	5/17/2006	Radium-228	U	0.320 ± 0.310	0.500	100 ^h
		<i>Total Radium^{g,h}</i>		Non-Detect		100 ^h
	5/17/2006	Thorium-230	U	0.014 ± 0.032	0.054	300
	5/17/2006	Thorium-232	U	0.018 ± 0.030	0.042	50
	5/17/2006	Uranium-234		5.260 ± 0.900	0.070	500
	5/17/2006	Uranium-235	J	0.180 ± 0.110	0.070	600
	5/17/2006	Uranium-238		3.900 ± 0.700	0.030	600
		<i>Total Uranium^e</i>		9.340		600
A50	5/18/2006	Radium-226	U	0.101 ± 0.090	0.140	100 ^h
	5/18/2006	Radium-228	U	0.140 ± 0.300	0.490	100 ^h
		<i>Total Radium^{g,h}</i>		Non-Detect		100 ^h
	5/18/2006	Thorium-230	U	0.030 ± 0.046	0.066	300
	5/18/2006	Thorium-232	U	-0.002 ± 0.026	0.052	50
	5/18/2006	Uranium-234		7.200 ± 1.200	0.070	500
	5/18/2006	Uranium-235	J	0.470 ± 0.200	0.080	600
	5/18/2006	Uranium-238		5.620 ± 0.998	0.070	600
		<i>Total Uranium^e</i>		13.290		600
A50-Filtered	5/18/2006	Radium-226	J	0.100 ± 0.090	0.110	100 ^h
	5/18/2006	Radium-228	U	0.380 ± 0.300	0.640	100 ^h
		<i>Total Radium^{g,h}</i>		0.100		100 ^h
	5/18/2006	Thorium-230	J	0.061 ± 0.053	0.045	300
	5/18/2006	Thorium-232	U	-0.002 ± 0.023	0.045	50
	5/18/2006	Uranium-234		6.900 ± 1.200	0.090	500
	5/18/2006	Uranium-235	J	0.360 ± 0.160	0.070	600
	5/18/2006	Uranium-238		5.900 ± 1.000	0.060	600
		<i>Total Uranium^e</i>		13.160		600
OW04B	5/18/2006	Radium-226	U	0.088 ± 0.080	0.120	100 ^h
	5/18/2006	Radium-228	U	0.110 ± 0.350	0.580	100 ^h
		<i>Total Radium^{g,h}</i>		Non-Detect		100 ^h
	5/18/2006	Thorium-230		0.052 ± 0.053	0.055	300
	5/18/2006	Thorium-232		-0.004 ± 0.026	0.055	50
	5/18/2006	Uranium-234		19.000 ± 2.800	0.070	500
	5/18/2006	Uranium-235		1.020 ± 0.280	0.040	600
	5/18/2006	Uranium-238		17.000 ± 2.500	0.050	600
		<i>Total Uranium^e</i>		37.020		600
OW04B-Filtered	5/18/2006	Radium-226	U	0.069 ± 0.068	0.100	100 ^h
	5/18/2006	Radium-228	U	0.230 ± 0.360	0.590	100 ^h
		<i>Total Radium^{g,h}</i>		Non-Detect		100 ^h
	5/18/2006	Thorium-230	UJ	0.021 ± 0.034	0.050	300
	5/18/2006	Thorium-232	UJ	0.014 ± 0.028	0.045	50
	5/18/2006	Uranium-234		20.400 ± 2.900	0.050	500
	5/18/2006	Uranium-235		0.820 ± 0.240	0.060	600
	5/18/2006	Uranium-238		19.200 ± 2.800	0.050	600
		<i>Total Uranium^e</i>		40.420		600

Table 9
2006 Groundwater Analytical Results - Radioactive Constituents
Niagara Falls Storage Site

Sampling Location	Date Collected	Analyte	Qualifier ^f	Result ^a (pCi/L) ^b	MDA (pCi/L) ^b	DCG ^d (pCi/L) ^b
OW13B	5/17/2006	Radium-226	U	0.056 ± 0.060	0.092	100 ^h
	5/17/2006	Radium-228	U	0.160 ± 0.300	0.500	100 ^h
		<i>Total Radium^{g,h}</i>		Non-Detect		100 ^h
	5/17/2006	Thorium-230	U	0.031 ± 0.039	0.046	300
	5/17/2006	Thorium-232	U	0.000 ± 0.000	0.030	50
	5/17/2006	Uranium-234		12.600 ± 2.000	0.080	500
	5/17/2006	Uranium-235	J	0.490 ± 0.190	0.070	600
	5/17/2006	Uranium-238		9.900 ± 1.600	0.040	600
		<i>Total Uranium^e</i>		22.990		600
OW13B-Filtered	5/17/2006	Radium-226	U	0.105 ± 0.078	0.110	100 ^h
	5/17/2006	Radium-228	U	0.240 ± 0.320	0.520	100 ^h
		<i>Total Radium^{g,h}</i>		Non-Detect		100 ^h
	5/17/2006	Thorium-230	U	0.037 ± 0.050	0.067	300
	5/17/2006	Thorium-232	U	-0.006 ± 0.029	0.062	50
	5/17/2006	Uranium-234		14.100 ± 2.300	0.090	500
	5/17/2006	Uranium-235		0.600 ± 0.230	0.090	600
	5/17/2006	Uranium-238		11.000 ± 1.800	0.040	600
		<i>Total Uranium^e</i>		25.700		600
OW06B	5/17/2006	Radium-226	J	0.168 ± 0.092	0.100	100 ^h
	5/17/2006	Radium-228	U	0.250 ± 0.320	0.520	100 ^h
		<i>Total Radium^{g,h}</i>		0.168		100 ^h
	5/17/2006	Thorium-230	J	0.084 ± 0.065	0.054	300
	5/17/2006	Thorium-232	U	-0.006 ± 0.027	0.059	50
	5/17/2006	Uranium-234		9.400 ± 1.500	0.060	500
	5/17/2006	Uranium-235	J	0.390 ± 0.170	0.070	600
	5/17/2006	Uranium-238		6.700 ± 1.100	0.060	600
		<i>Total Uranium^e</i>		16.490		600
OW06B-Filtered	5/17/2006	Radium-226	J	0.147 ± 0.087	0.110	100 ^h
	5/17/2006	Radium-228	U	-0.130 ± 0.360	0.610	100 ^h
		<i>Total Radium^{g,h}</i>		0.147		100 ^h
	5/17/2006	Thorium-230	U	0.016 ± 0.036	0.061	300
	5/17/2006	Thorium-232	U	-0.002 ± 0.024	0.048	50
	5/17/2006	Uranium-234		9.400 ± 1.500	0.060	500
	5/17/2006	Uranium-235	J	0.250 ± 0.130	0.080	600
	5/17/2006	Uranium-238		6.900 ± 1.200	0.060	600
		<i>Total Uranium^e</i>		16.550		600
OW15B	5/17/2006	Radium-226	U	0.180 ± 0.180	0.280	100 ^h
	5/17/2006	Radium-228	U	0.250 ± 0.260	0.430	100 ^h
		<i>Total Radium^{g,h}</i>		Non-Detect		100 ^h
	5/17/2006	Thorium-230	U	0.040 ± 0.054	0.072	300
	5/17/2006	Thorium-232	U	-0.002 ± 0.027	0.052	50
	5/17/2006	Uranium-234		5.560 ± 0.960	0.080	500
	5/17/2006	Uranium-235	J	0.250 ± 0.130	0.070	600
	5/17/2006	Uranium-238		3.400 ± 0.640	0.050	600
		<i>Total Uranium^e</i>		9.210		600
OW15B-Filtered	5/17/2006	Radium-226	J	0.178 ± 0.093	0.110	100 ^h
	5/17/2006	Radium-228	U	0.110 ± 0.300	0.510	100 ^h
		<i>Total Radium^{g,h}</i>		0.178		100 ^h
	5/17/2006	Thorium-230	U	0.059 ± 0.060	0.063	300
	5/17/2006	Thorium-232	U	0.008 ± 0.030	0.063	50
	5/17/2006	Uranium-234		5.180 ± 0.870	0.070	500
	5/17/2006	Uranium-235	J	0.240 ± 0.120	0.040	600
	5/17/2006	Uranium-238		3.430 ± 0.620	0.050	600
		<i>Total Uranium^e</i>		8.850		600

Table 9
2006 Groundwater Analytical Results - Radioactive Constituents
Niagara Falls Storage Site

Sampling Location	Date Collected	Analyte	Qualifier ^f	Result ^a (pCi/L) ^b	MDA (pCi/L) ^b	DCG ^d (pCi/L) ^b
OW17B	5/18/2006	Radium-226	U	0.040 ± 0.100	0.180	100 ^h
	5/18/2006	Radium-228	U	-0.180 ± 0.290	0.500	100 ^h
		<i>Total Radium^{g,h}</i>		Non-Detect		100 ^h
	5/18/2006	Thorium-230	J	0.048 ± 0.047	0.026	300
	5/18/2006	Thorium-232	UJ	-0.006 ± 0.024	0.054	50
	5/18/2006	Uranium-234		2.400 ± 0.460	0.030	500
	5/18/2006	Uranium-235	J	0.109 ± 0.083	0.037	600
	5/18/2006	Uranium-238		1.940 ± 0.390	0.060	600
		<i>Total Uranium^e</i>		4.449		600
OW17B-Filtered	5/18/2006	Radium-226	U	0.097 ± 0.078	0.110	100 ^h
	5/18/2006	Radium-228	U	0.130 ± 0.320	0.530	100 ^h
		<i>Total Radium^{g,h}</i>		Non-Detect		100 ^h
	5/18/2006	Thorium-230	J	0.049 ± 0.043	0.038	300
	5/18/2006	Thorium-232	UJ	-0.002 ± 0.019	0.037	50
	5/18/2006	Uranium-234		2.400 ± 0.450	0.050	500
	5/18/2006	Uranium-235	J	0.112 ± 0.079	0.056	600
	5/18/2006	Uranium-238		1.910 ± 0.380	0.050	600
		<i>Total Uranium^e</i>		4.422		600
A45	5/18/2006	Radium-226	J	0.250 ± 0.110	0.100	100 ^h
	5/18/2006	Radium-228		0.650 ± 0.390	0.610	100 ^h
		<i>Total Radium^{g,h}</i>		0.900		100 ^h
	5/18/2006	Thorium-230	U	0.047 ± 0.050	0.057	300
	5/18/2006	Thorium-232	U	0.000 ± 0.000	0.030	50
	5/18/2006	Uranium-234		19.400 ± 3.000	0.040	500
	5/18/2006	Uranium-235		0.720 ± 0.250	0.080	600
	5/18/2006	Uranium-238		14.300 ± 2.300	0.040	600
		<i>Total Uranium^e</i>		34.420		600
A45-Filtered	5/18/2006	Radium-226	J	0.180 ± 0.096	0.120	100 ^h
	5/18/2006	Radium-228	U	0.410 ± 0.310	0.500	100 ^h
		<i>Total Radium^{g,h}</i>		0.590		100 ^h
	5/18/2006	Thorium-230	U	0.021 ± 0.035	0.050	300
	5/18/2006	Thorium-232	U	0.000 ± 0.000	0.030	50
	5/18/2006	Uranium-234		20.000 ± 3.100	0.070	500
	5/18/2006	Uranium-235		0.830 ± 0.270	0.080	600
	5/18/2006	Uranium-238		14.600 ± 2.300	0.070	600
		<i>Total Uranium^e</i>		35.430		600
Duplicate (A45-D) ^f A45	5/18/2006	Radium-226	J	0.177 ± 0.098	0.120	100 ^h
	5/18/2006	Radium-228	U	0.080 ± 0.340	0.570	100 ^h
		<i>Total Radium^{g,h}</i>		0.257		100 ^h
	5/18/2006	Thorium-230	U	0.038 ± 0.048	0.060	300
	5/18/2006	Thorium-232	U	0.018 ± 0.034	0.054	50
	5/18/2006	Uranium-234		21.300 ± 3.200	0.060	500
	5/18/2006	Uranium-235		0.620 ± 0.220	0.070	600
	5/18/2006	Uranium-238		16.200 ± 2.500	0.050	600
		<i>Total Uranium^e</i>		38.120		600

- a. Results reported with (±) radiological error quoted at 2-sigma (95 percent confidence level).
b. pCi/L - picocuries per liter.
c. Validated Qualifier: **U** - indicates that no analyte was detected (Non-Detect)
Validated Qualifier: **J** - indicates an estimated value.
d. DOE derived concentration guide for water.
e. Sum of uranium isotope concentrations.
f. A quality control duplicate is collected at the same time and location and is analyzed by the same method for evaluating precision of sampling and analysis.
g. Sum of radium isotope concentrations.
h. Not included in averages for Section 5.6.2.3

Table 10
2006 Groundwater Analytical Results - Metals
Niagara Falls Storage Site

Sampling Location	Date Collected	Detected Analyte	Qualifier ^f	Detection		Related Regulations ^c	
				Result (µg/L) ^a	Limit (µg/L) ^a	Federal ^d (µg/L) ^a	State ^e (µg/L) ^a
B02W20S Background	5/17/06	Copper	J	1.80	0.25	1300	200
	5/17/06	Lead	U	0.49	0.49	15	25
	5/17/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
B02W20S-Filtered Background	5/17/06	Copper	J	1.80	0.25	1300	200
	5/17/06	Lead	U	0.49	0.49	15	25
	5/17/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
A45	5/18/06	Copper	J	4.60	0.25	1300	200
	5/18/06	Lead	U	0.49	0.49	15	25
	5/18/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
A45-Filtered	5/18/06	Copper	J	3.90	0.25	1300	200
	5/18/06	Lead	U	0.49	0.49	15	25
	5/18/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
Duplicate A45	5/18/06	Copper	J	4.20	0.25	1300	200
	5/18/06	Lead	U	0.49	0.49	15	25
	5/18/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
OW04B	5/18/06	Copper	J	5.30	0.25	1300	200
	5/18/06	Lead	U	0.49	0.49	15	25
	5/18/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
OW04B-Filtered	5/18/06	Copper	J	4.00	0.25	1300	200
	5/18/06	Lead	U	0.49	0.49	15	25
	5/18/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
OW06B	5/17/06	Copper	J	2.10	0.25	1300	200
	5/17/06	Lead	U	0.49	0.49	15	25
	5/17/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
OW06B-Filtered	5/17/06	Copper	J	1.90	0.25	1300	200
	5/17/06	Lead	U	0.49	0.49	15	25
	5/17/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
OW13B	5/17/06	Copper	J	5.80	0.25	1300	200
	5/17/06	Lead	U	0.49	0.49	15	25
	5/17/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
OW13B-Filtered	5/17/06	Copper	J	5.80	0.25	1300	200
	5/17/06	Lead	U	0.49	0.49	15	25
	5/17/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
OW15B	5/17/06	Copper	J	4.70	0.25	1300	200
	5/17/06	Lead	U	0.49	0.49	15	25
	5/17/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
OW15B-Filtered	5/17/06	Copper	J	5.60	0.25	1300	200
	5/17/06	Lead	U	0.49	0.49	15	25
	5/17/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
OW17B	5/18/06	Copper	J	3.50	0.25	1300	200
	5/18/06	Lead	U	0.49	0.49	15	25
	5/18/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
OW17B-Filtered	5/18/06	Copper	J	4.70	0.25	1300	200
	5/18/06	Lead	U	0.49	0.49	15	25
	5/18/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
A50	5/18/06	Copper	J	3.90	0.25	1300	200
	5/18/06	Lead	U	0.49	0.49	15	25
	5/18/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b
A50-Filtered	5/18/06	Copper	J	4.20	0.25	1300	200
	5/18/06	Lead	U	0.49	0.49	15	25
	5/18/06	Vanadium	U	1.60	1.60	NE ^b	NE ^b

a. µg/L - micrograms per liter.

b. NE - Not Established

c. Regulations presented pertain to drinking water quality and are listed for comparison only.

No drinking water supply is obtained from groundwater at NFSS.

d. Federal Safe Drinking Water Act maximum contaminant levels from EPA Drinking Water Regulations and Health Advisories (October 1996).

e. Water Quality Criteria (Class GA) per 6 NYCRR, Chapter X, Subchapter A.

f. A quality control duplicate is collected at the same time and location and is analyzed by the same method for evaluating precision in sampling and analysis.

g. Validated Qualifier: **U** - indicates that no analyte was detected above detection limit (Non-Detect).

Validated Qualifier: **J** - indicates qan estimated value below the detection limit.

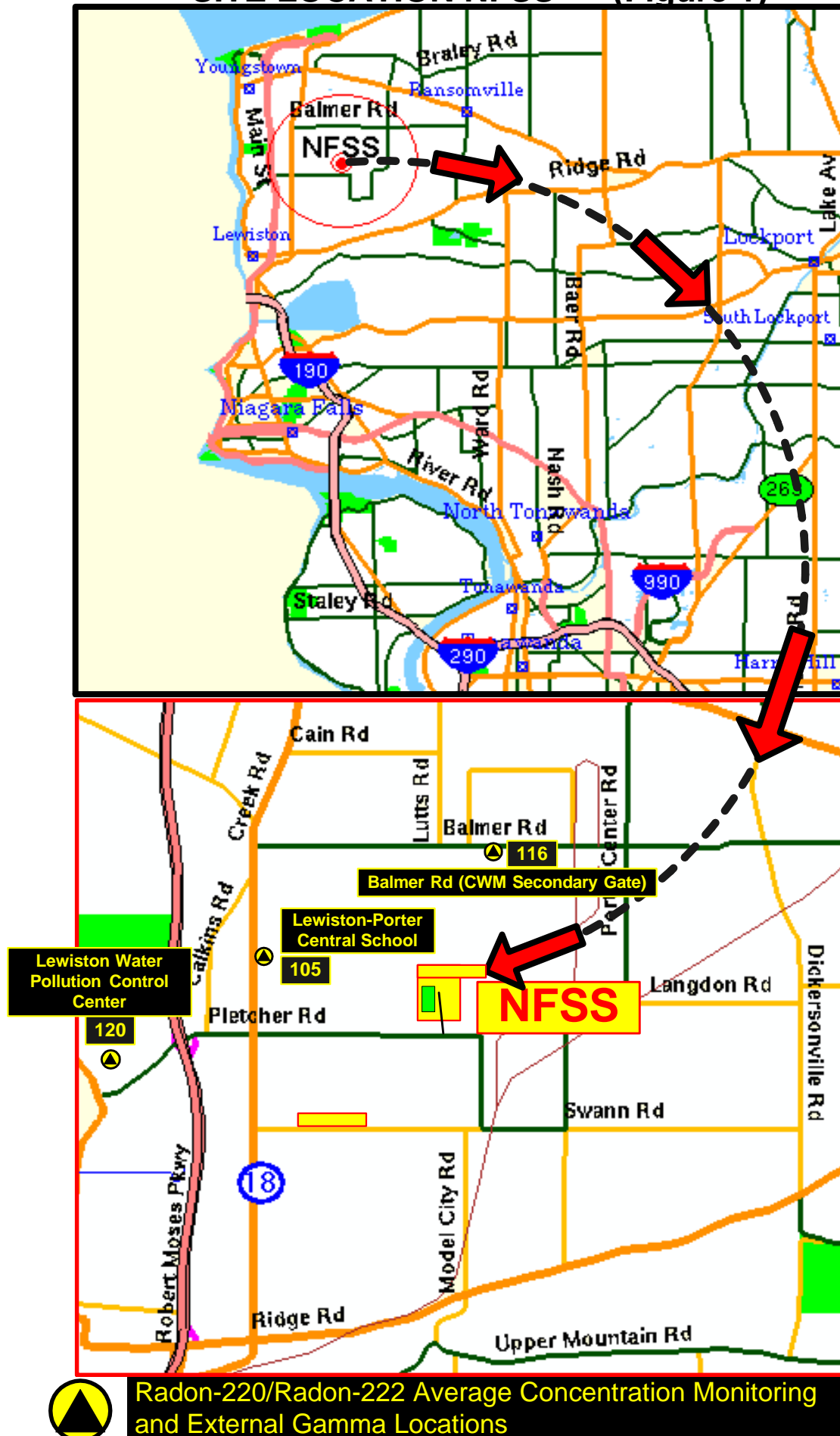
FUSRAP NIAGARA FALLS STORAGE SITE

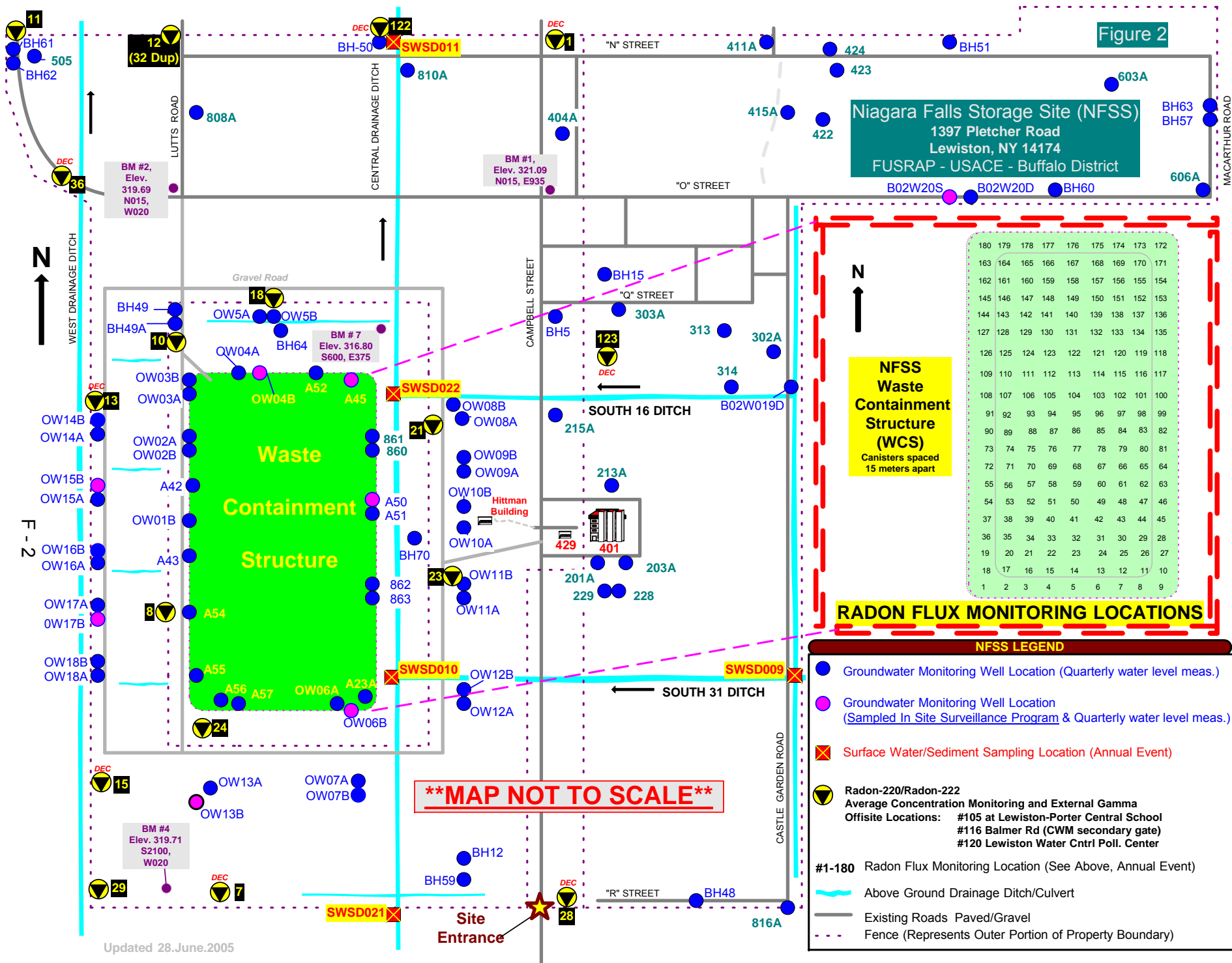
2006

FIGURES

ENVIRONMENTAL SURVEILLANCE TECHNICAL MEMORANDUM

SITE LOCATION NFSS (Figure 1)





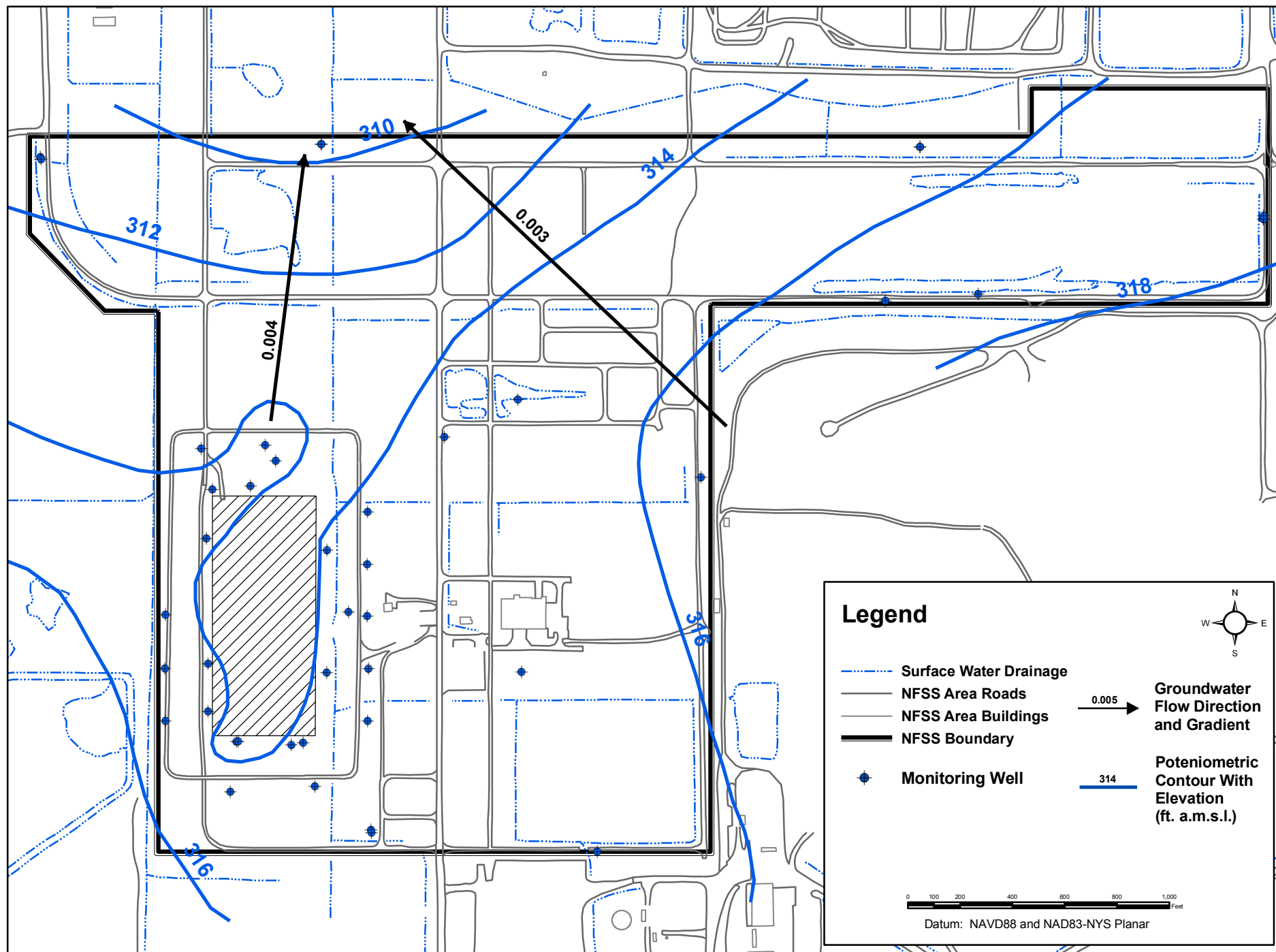


Figure 3
 Seasonal High Potentiometric Surface Map (May 17, 2006)
 Lower Groundwater System

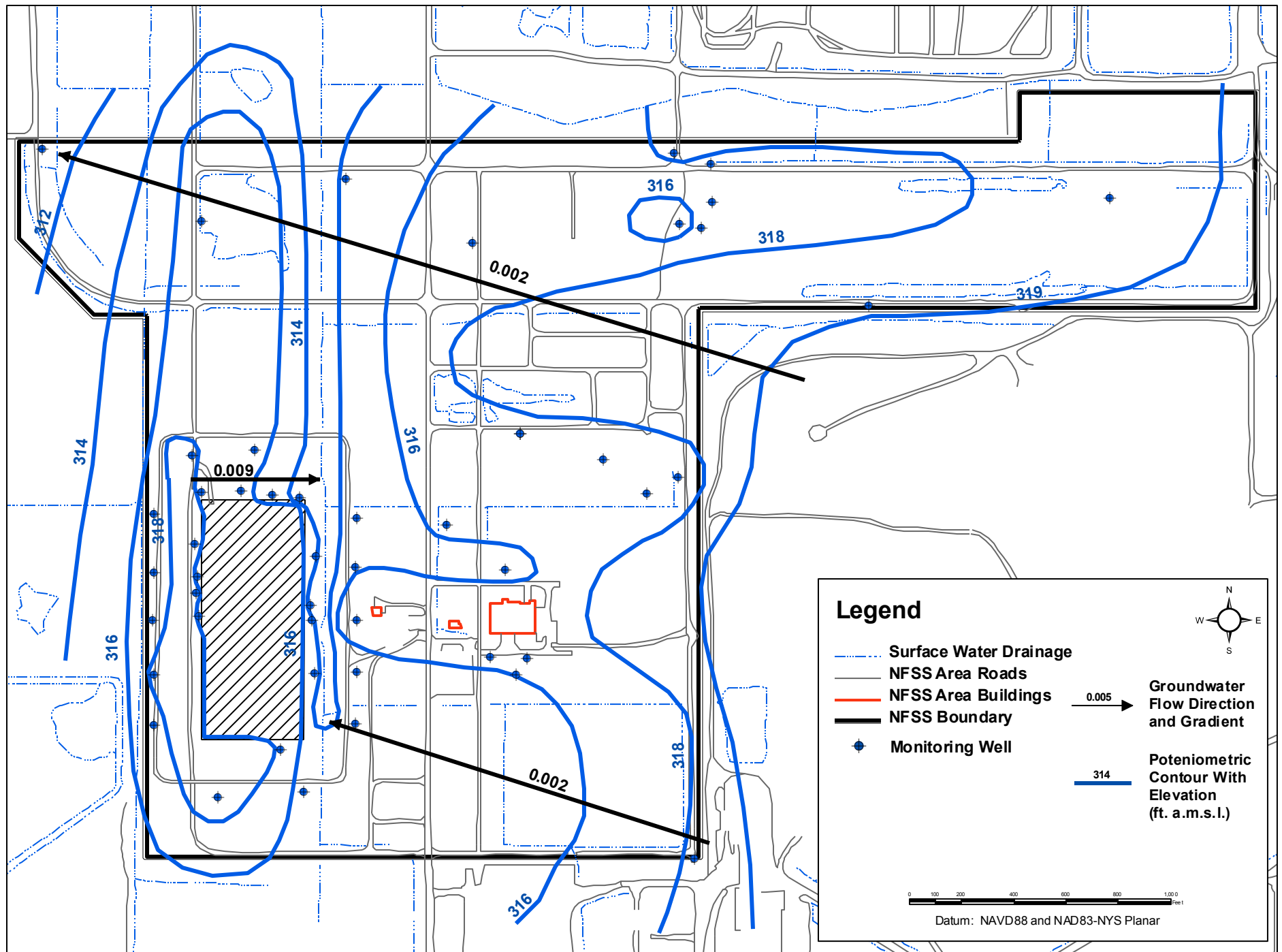


Figure 4
 Seasonal High Potentiometric Surface Map (February 21, 2006)
 Upper Groundwater System

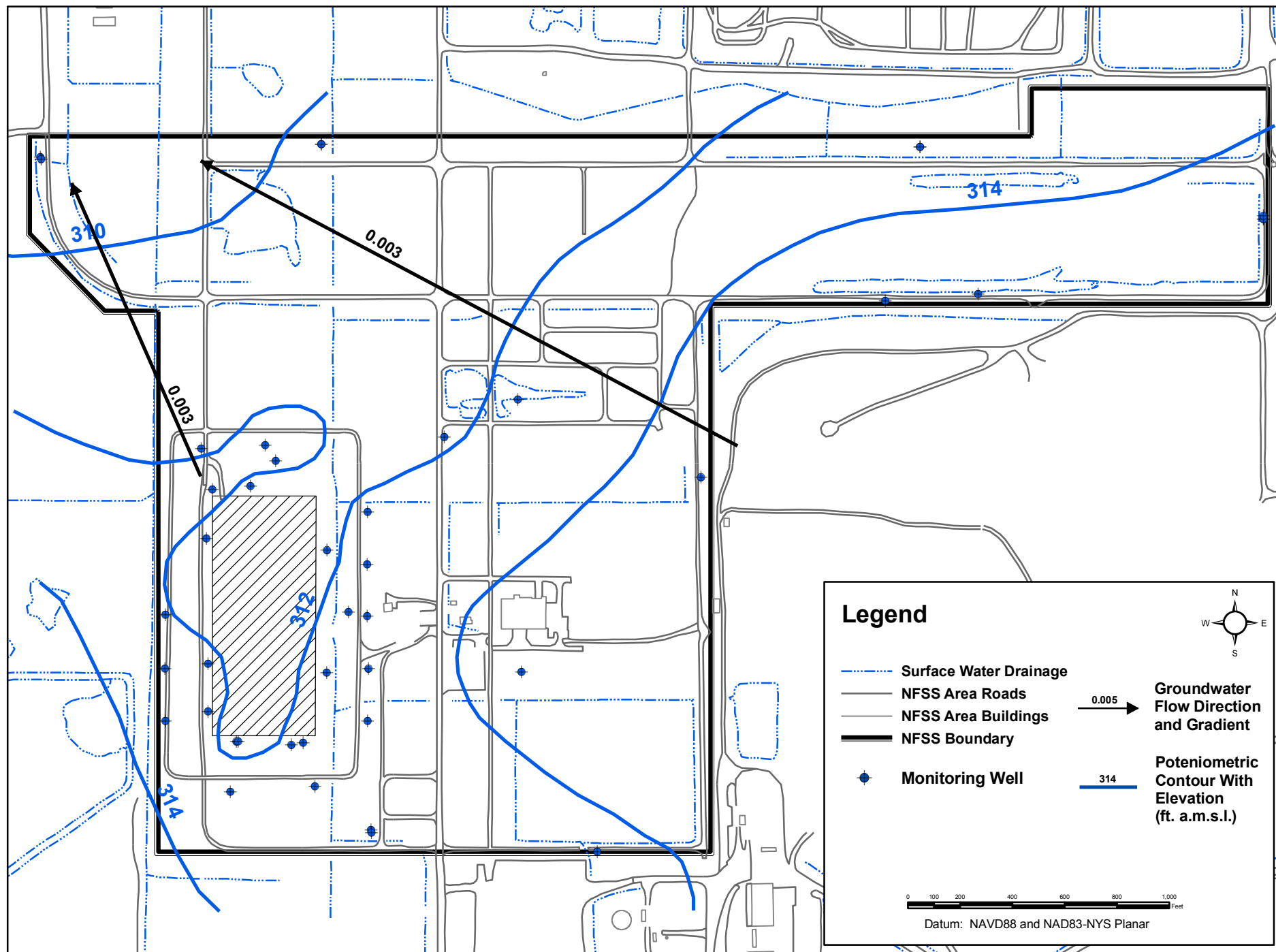


Figure 5
Seasonal Low Potentiometric Surface Map (October 18, 2006)
Lower Groundwater System

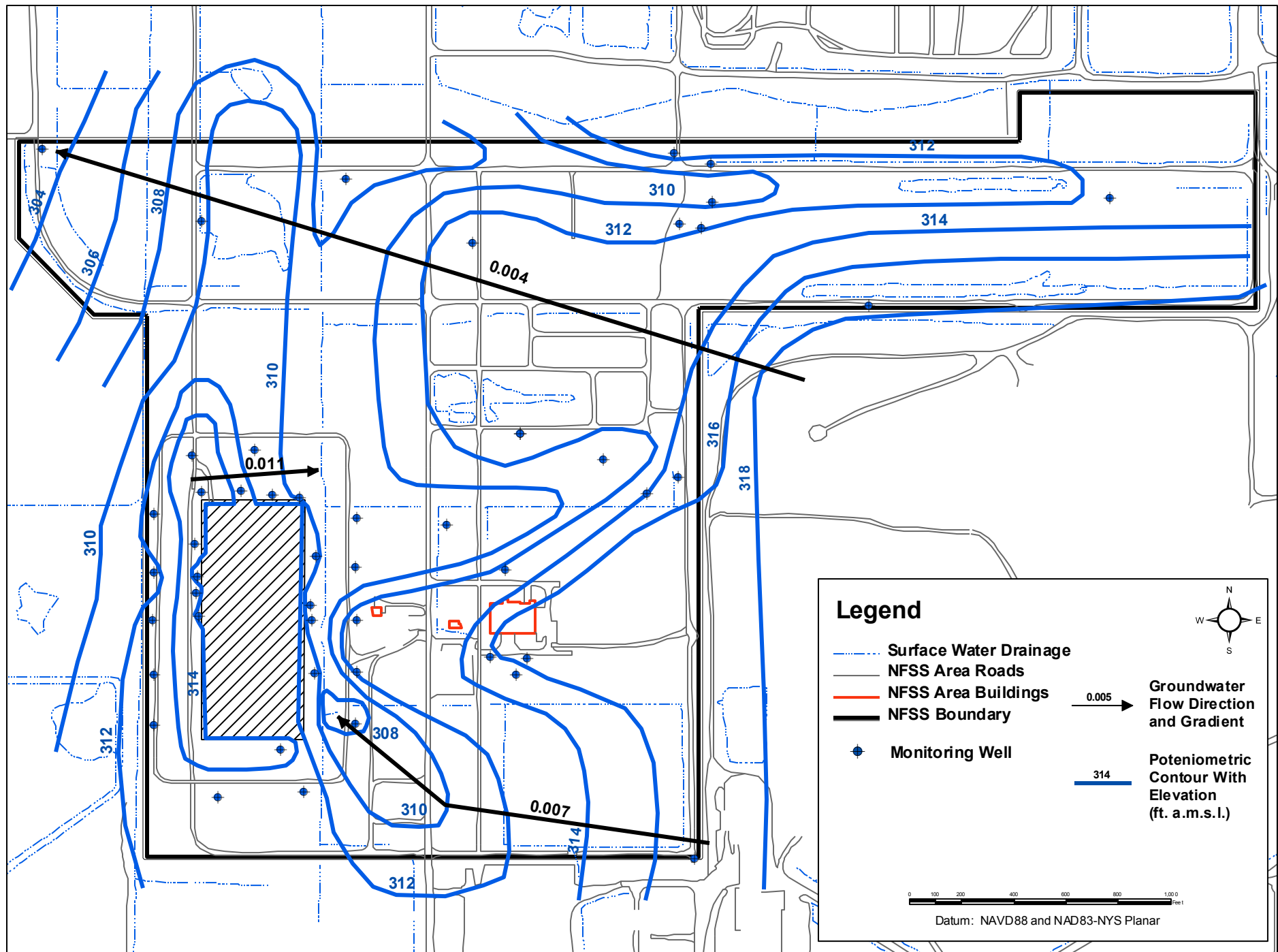


Figure 6
Seasonal Low Potentiometric Surface Map (August 16, 2006)
Upper Groundwater System

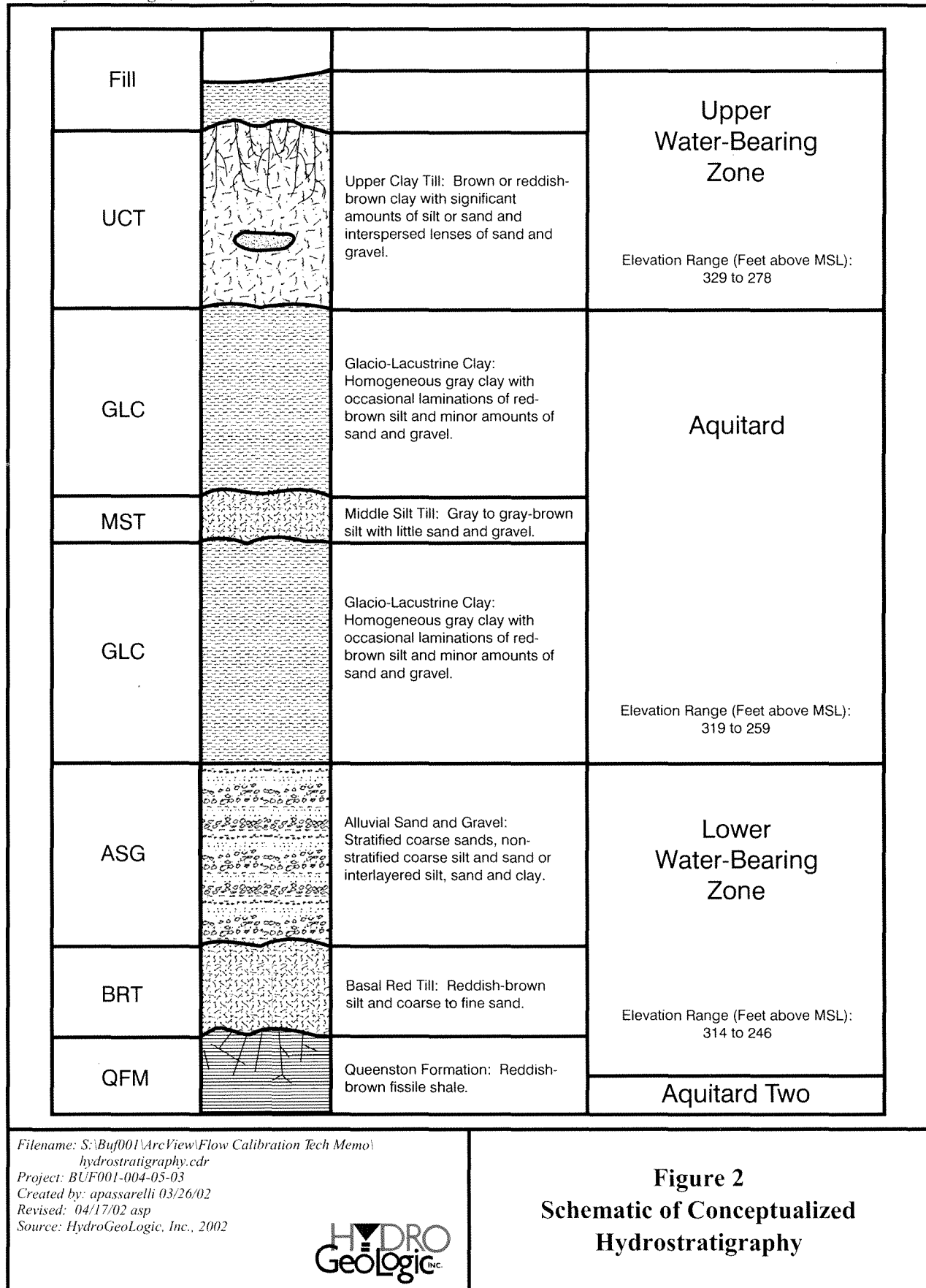


Figure 8: Census Data

F-8

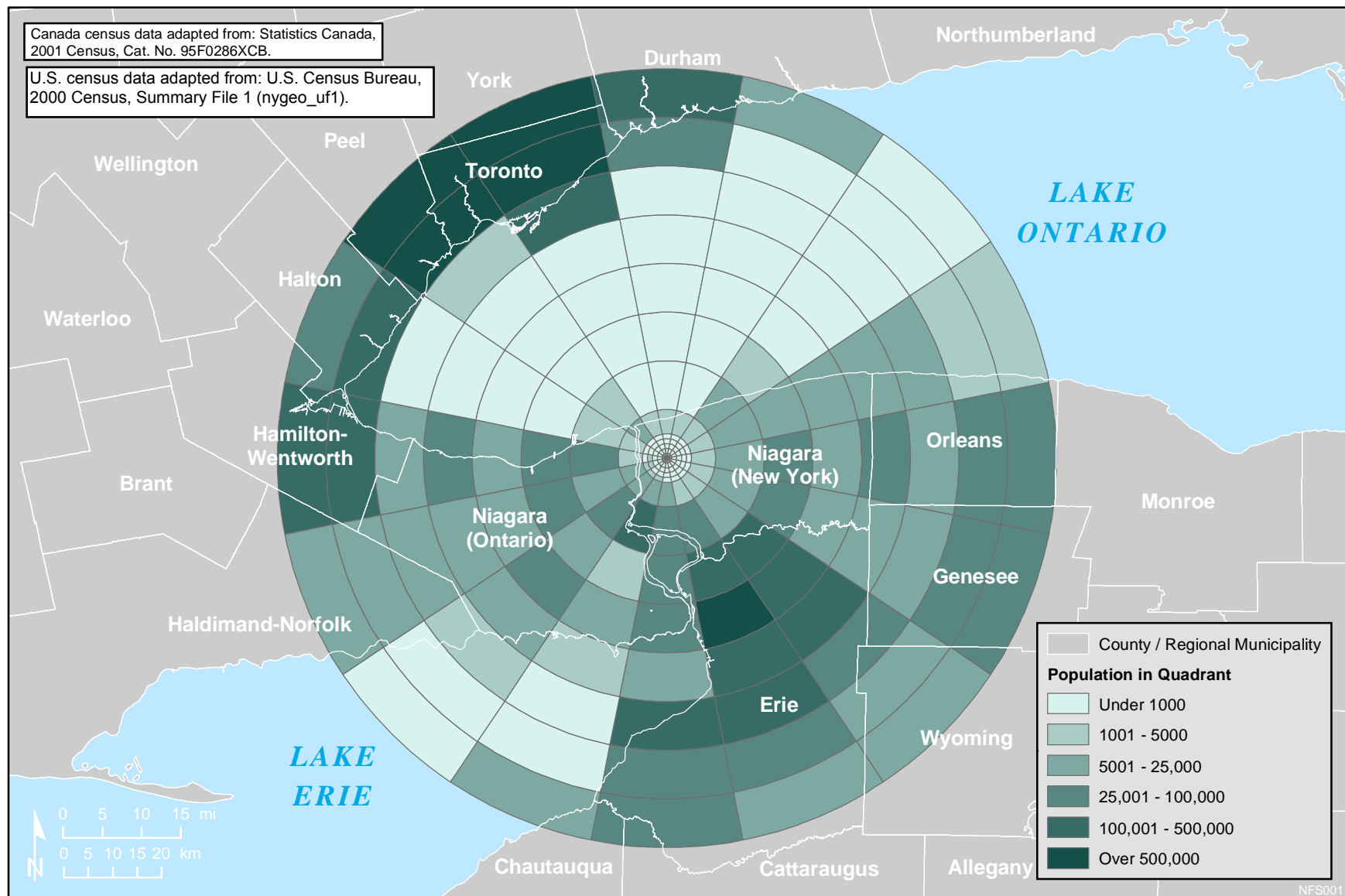
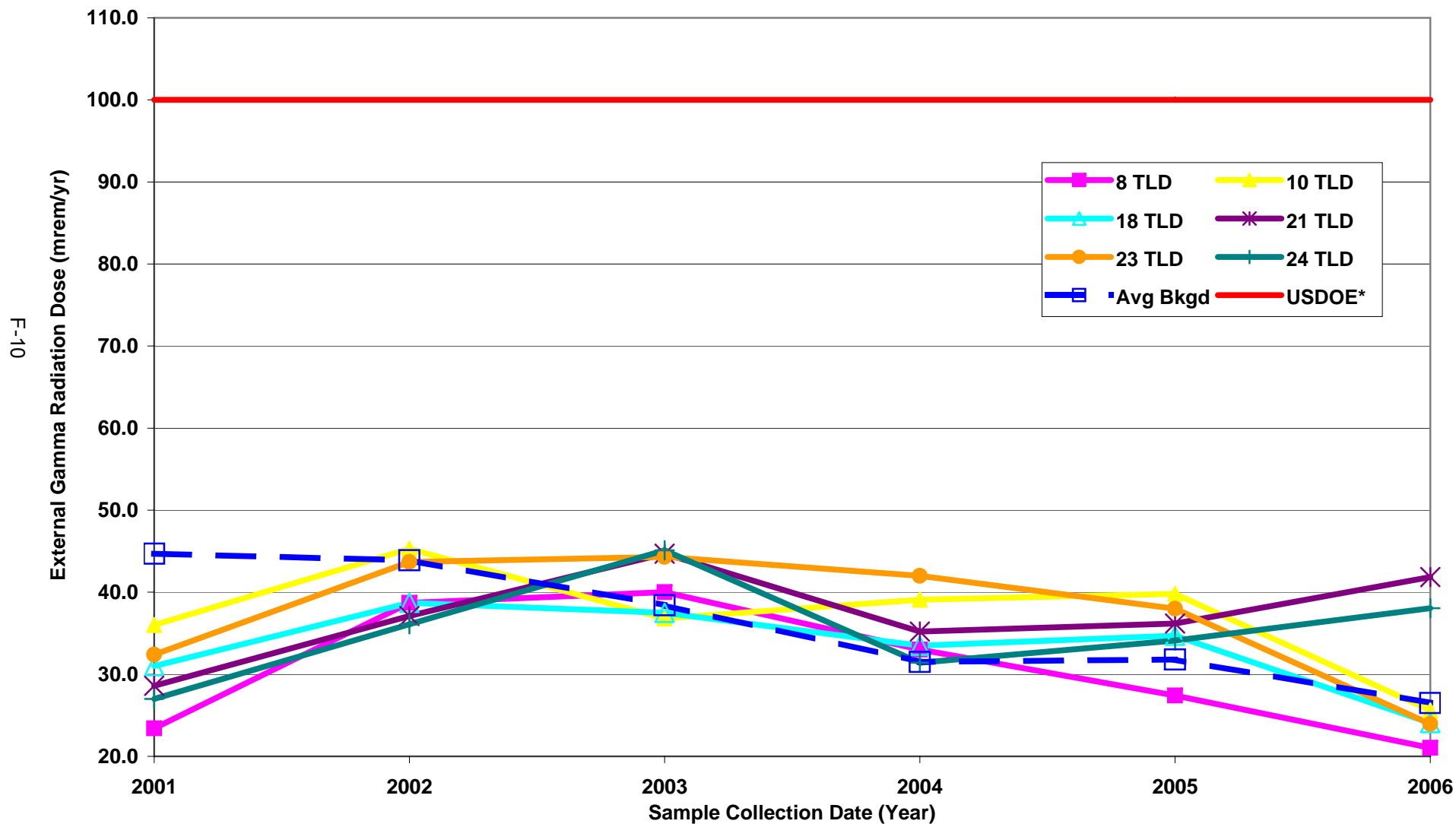


FIGURE 9: EXTERNAL GAMMA RADIATION DOSE RATES AT NFSS PERIMETER



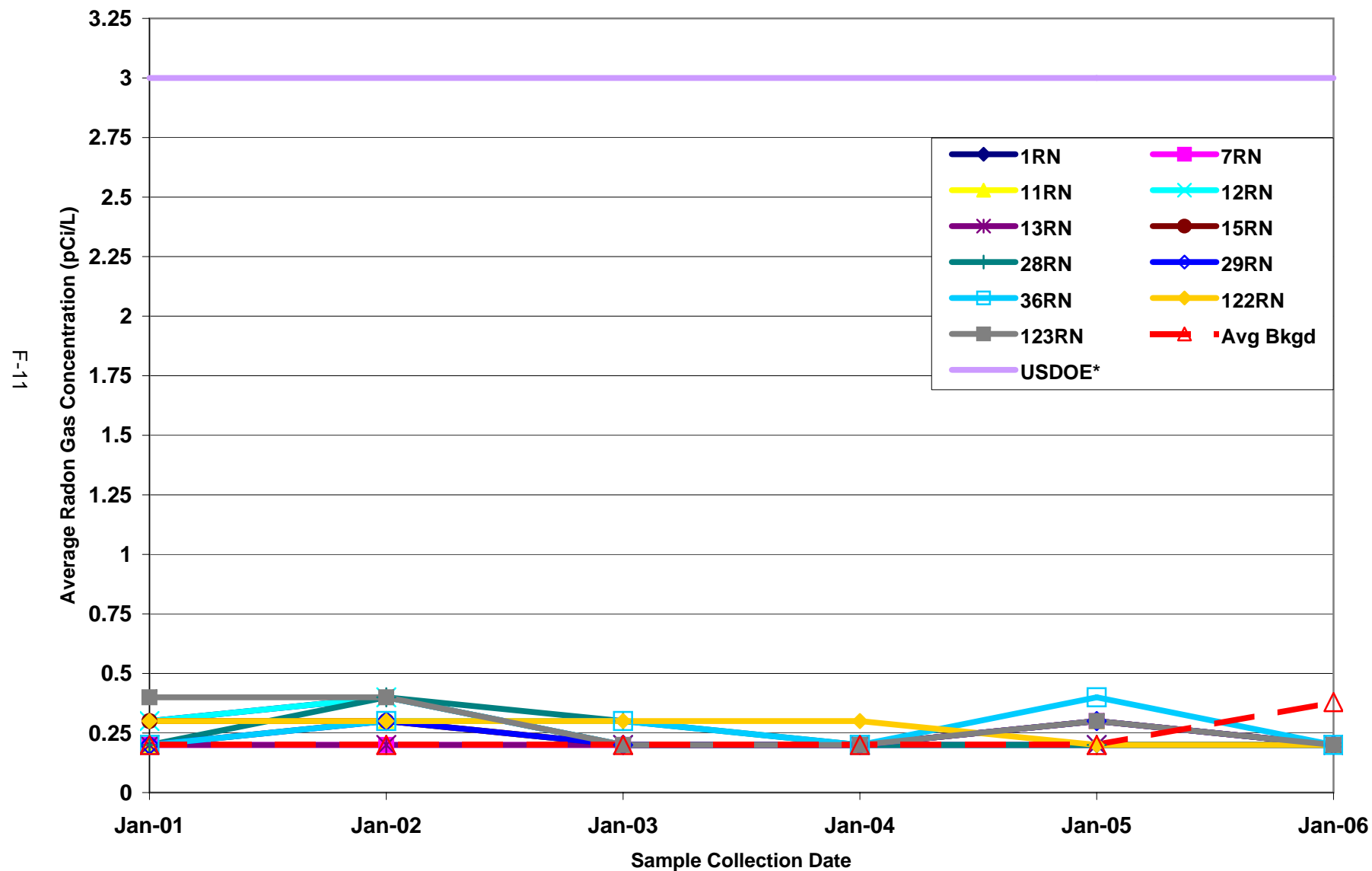
*The United States Department of Energy (USDOE) limit for external gamma radiation is 100 mrem/year above background.

FIGURE 10: EXTERNAL GAMMA RADIATION DOSE RATES AT IWCS



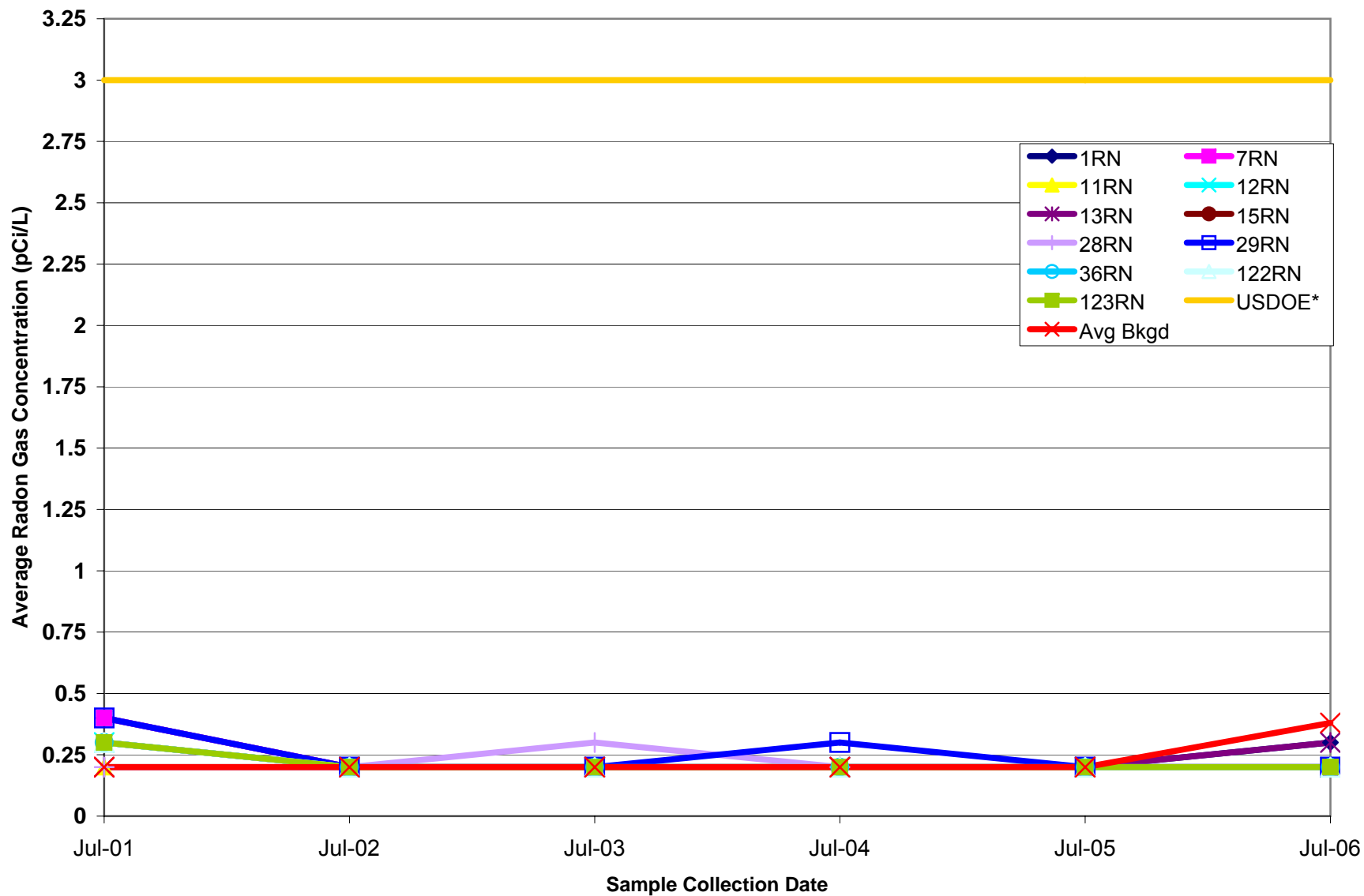
*The United States Department of Energy (USDOE) limit for external gamma radiation is 100 mrem/year above background.

**FIGURE 11: RADON GAS CONCENTRATIONS AT NFSS PERIMETER
(JANUARY - JULY INTERVAL)**



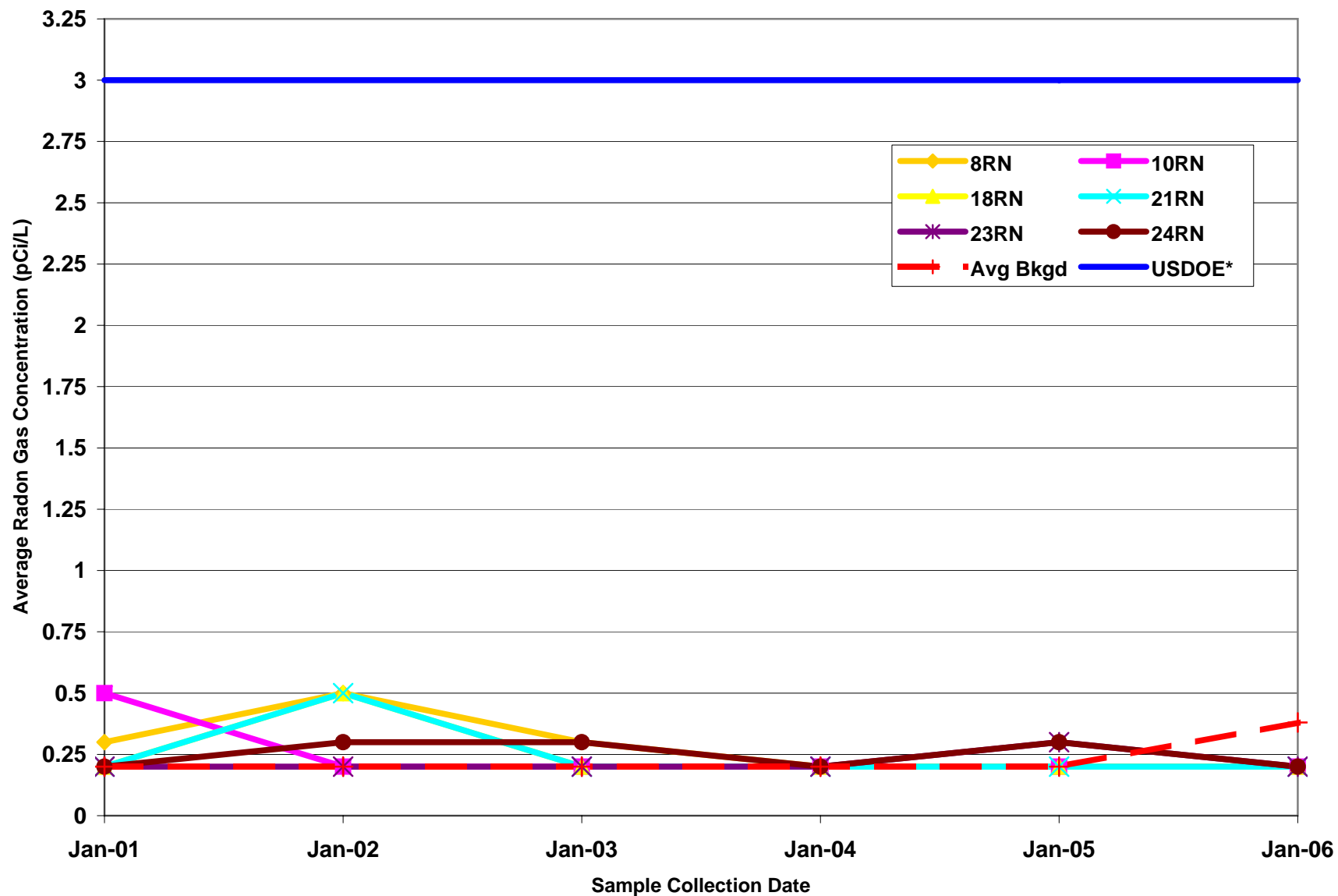
*The United States Department of Energy (USDOE) off-site limit for radon gas is 3.0 pCi/L above background.

**FIGURE 12: RADON GAS CONCENTRATIONS AT NFSS PERIMETER
(JULY - JANUARY INTERVAL)**



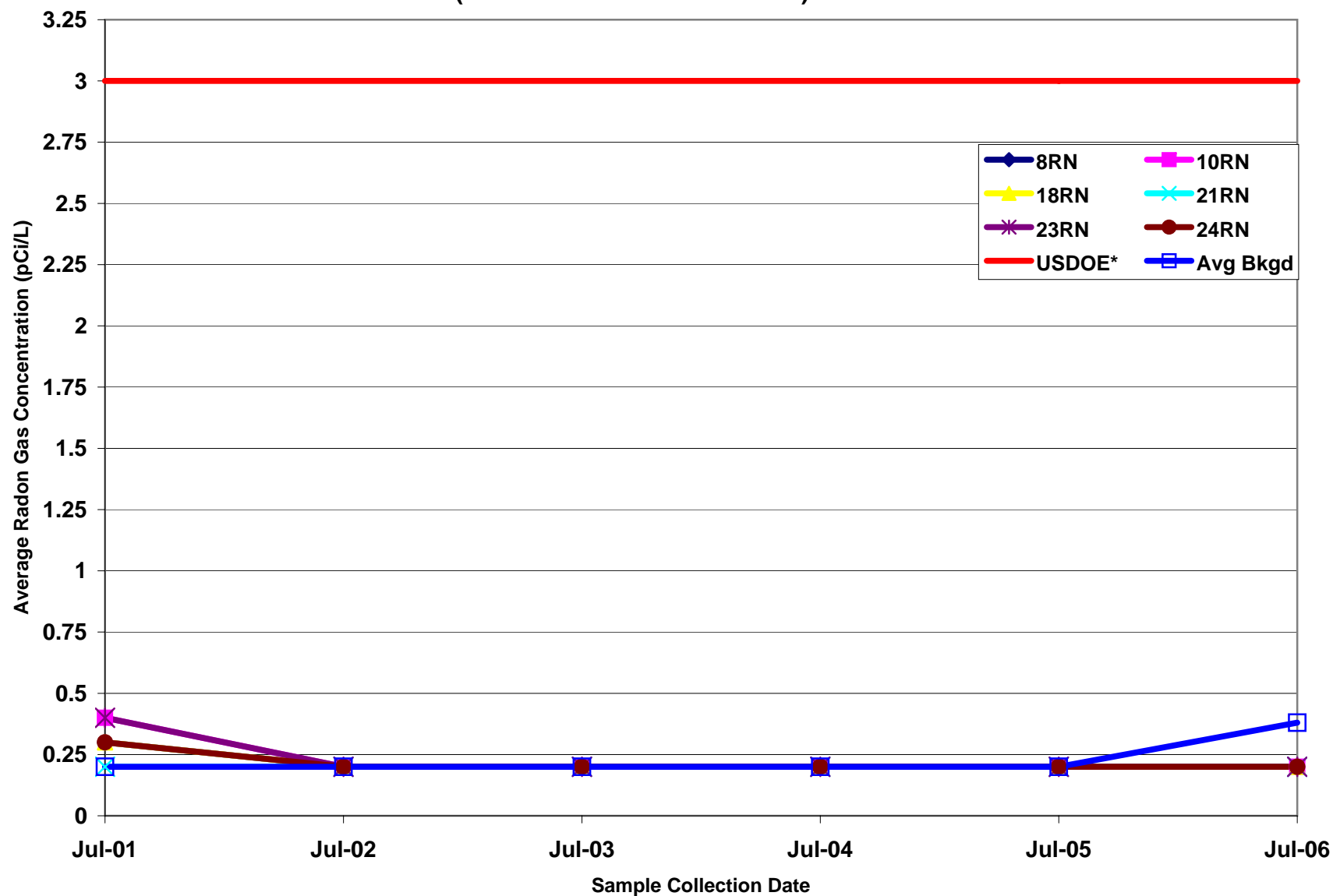
*The United States Department of Energy (USDOE) off-site limit for radon gas is 3.0 pCi/L above background.

**FIGURE 13: RADON GAS CONCENTRATION AT IWCS PERIMETER
(JANUARY - JULY INTERVAL)**



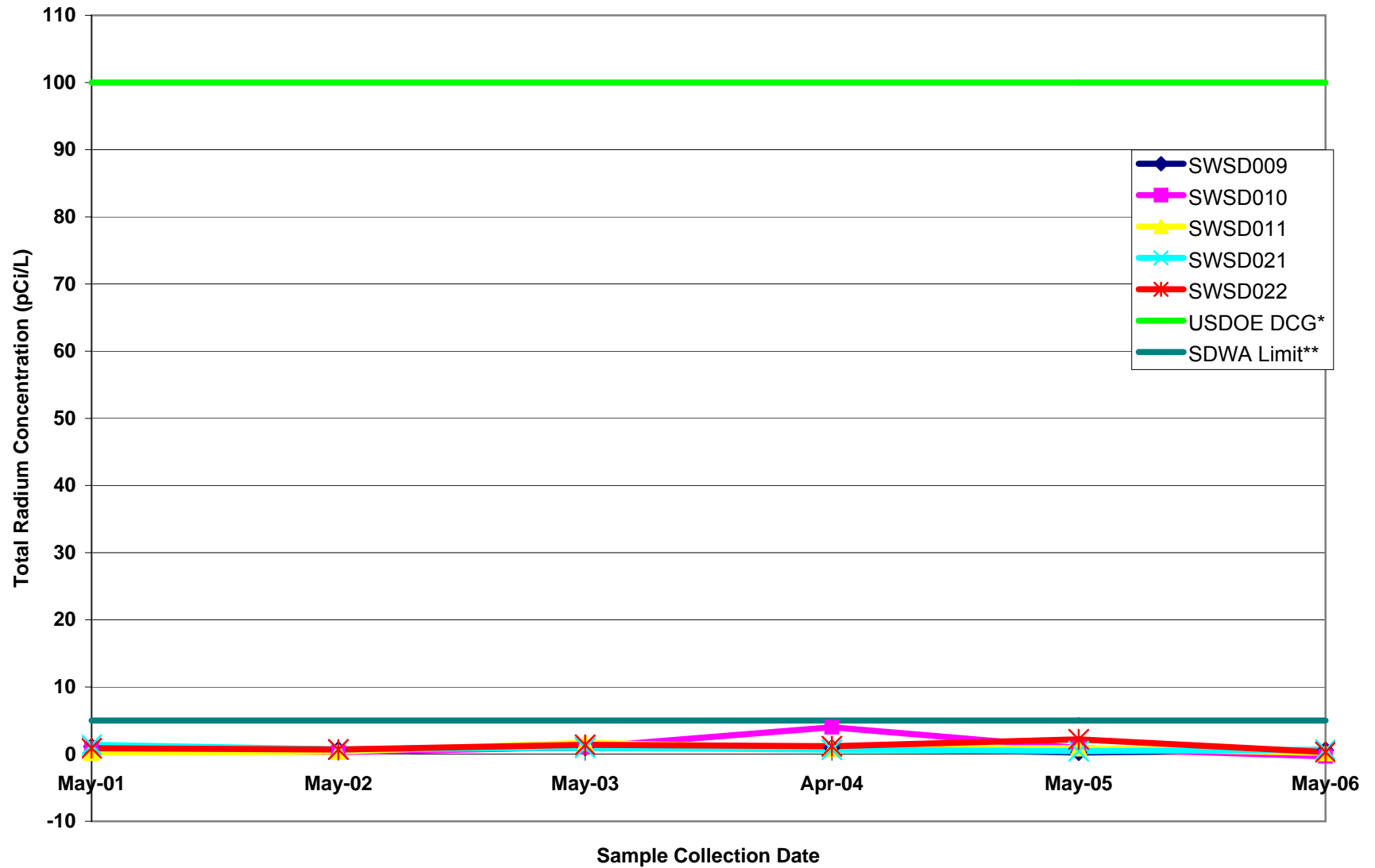
*The United States Department of Energy (USDOE) off-site limit for radon gas is 3.0 pCi/L above background.

**FIGURE 14: RADON GAS CONCENTRATION AT IWCS PERIMETER
(JULY - JANUARY INTERVAL)**



*The United States Department of Energy (USDOE) off-site limit for radon gas is 3.0 pCi/L above background.

FIGURE 15: TOTAL RADIUM (RADIUM-226 AND RADIUM-228) CONCENTRATION IN SURFACE WATER

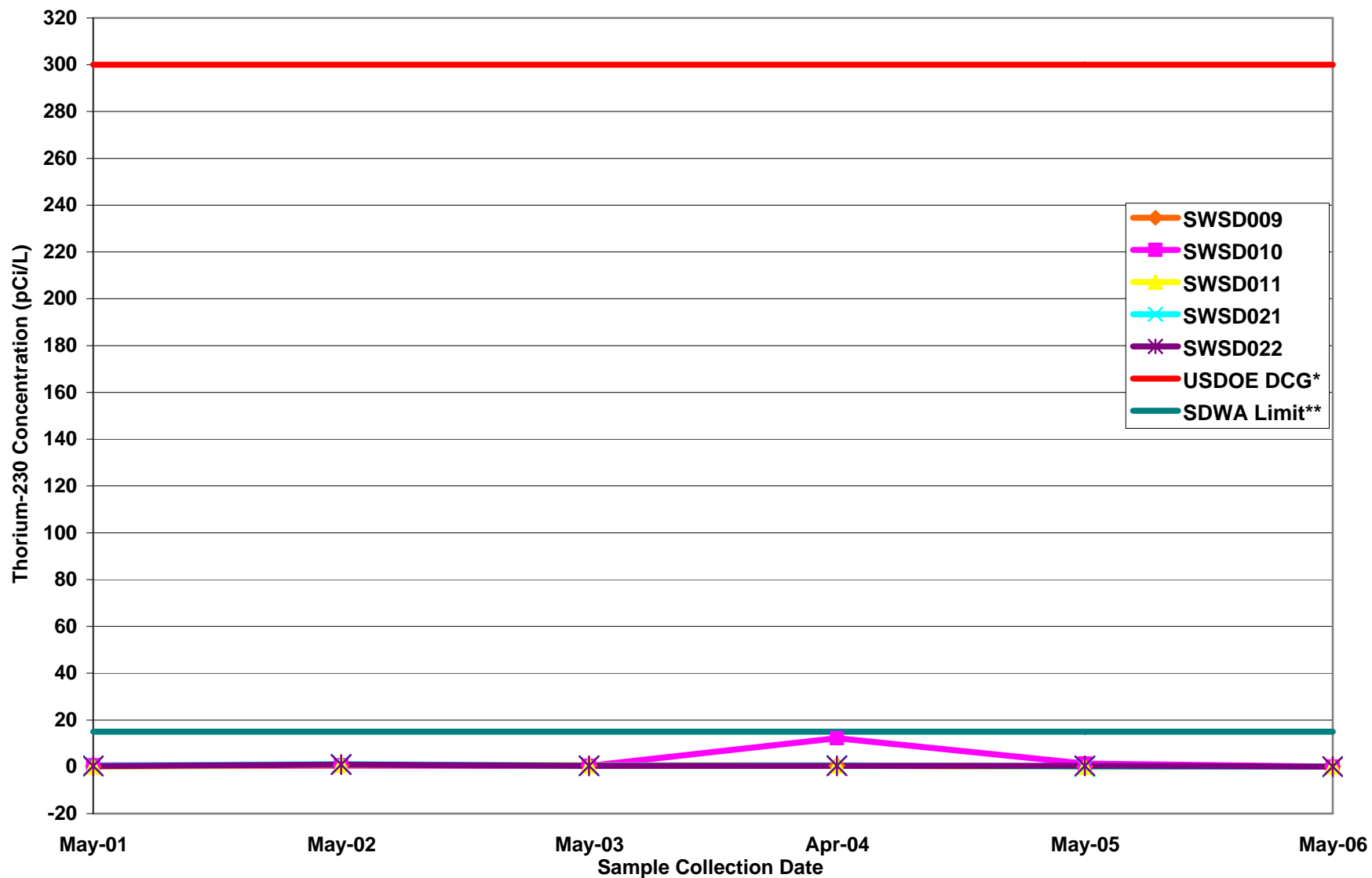


* The United States Department of Energy Derived Concentration Guide (USDOE DCG) for combined Radium-226 & 228 is 100 pCi/L.

**The Safe Drinking Water Act Maximum Containment Level (SDWA MCL) for Total Radium is 5 pCi/L. Groundwater at NFSS is not a drinking water source. The above concentrations are for comparative purposes only.

Note: 2004 findings for sample SWSD010 was attributed to excess turbidity of the sample.

FIGURE 16: THORIUM-230 CONCENTRATION IN SURFACE WATER

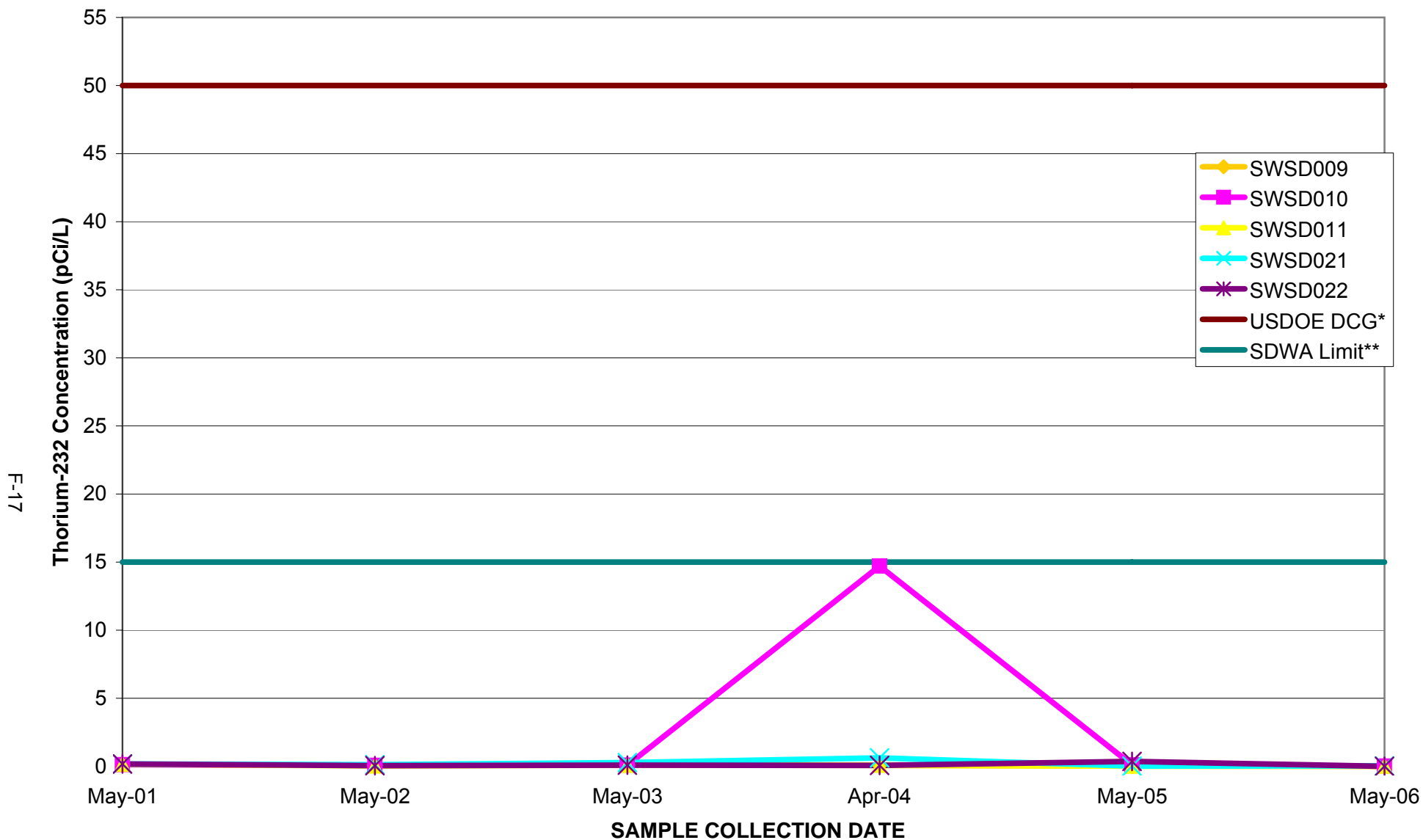


* The United States Department of Energy Derived Concentration Guide (USDOE DCG) for Thorium-230 is 300 pCi/L.

** "Adjusted" gross alpha MCL of 15 pCi/L, including Th-230, excluding radon and uranium –National Primary Drinking Water Regulations; Radionuclide; Final Rule (Federal Register- December 7,2000)

Note: 2004 findings for sample SWSD010 was attributed to excess turbidity of the sample.

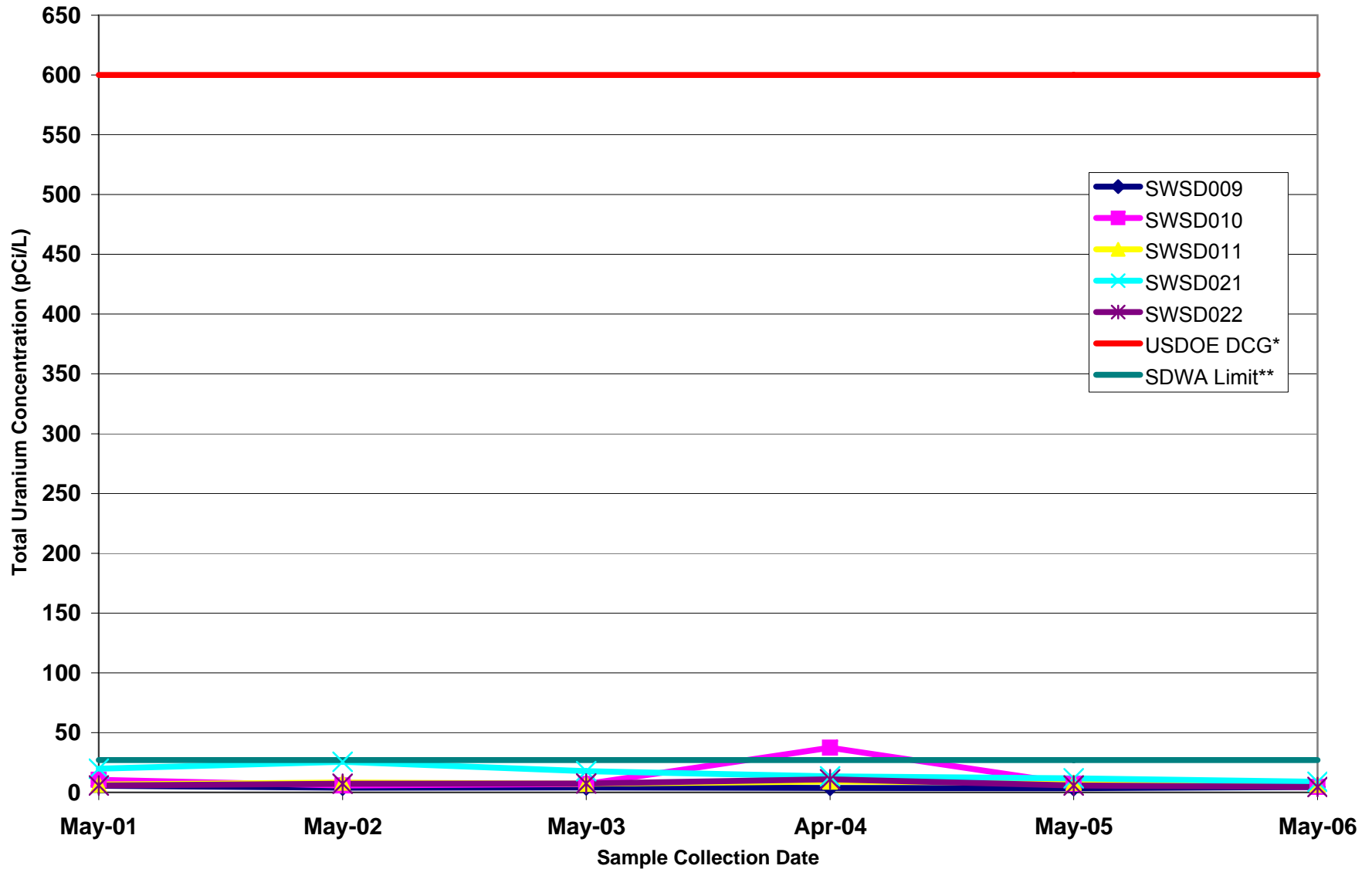
FIGURE 17: THORIUM-232 CONCENTRATION IN SURFACE WATER



* The United States Department of Energy Derived Concentration Guide (USDOE DCG) for Thorium-232 is 50 pCi/L.

** "Adjusted" gross alpha MCL of 15 pCi/L, including Th-230, excluding radon and uranium –National Primary Drinking Water Regulations; Radionuclide; Final Rule (Federal Register- December 7,2000)

FIGURE 18: TOTAL URANIUM CONCENTRATION IN SURFACE WATER

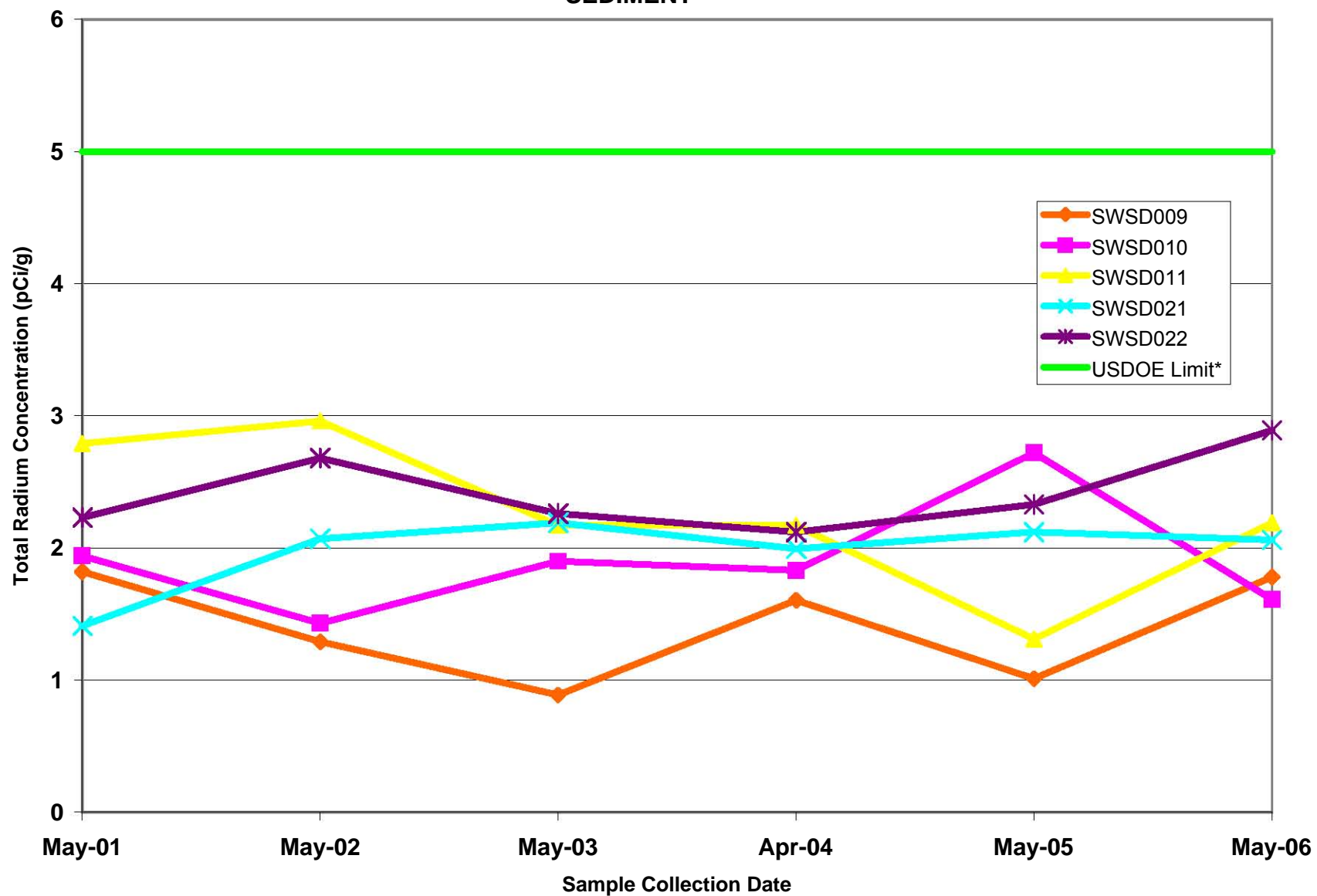


* The United States Department of Energy Derived Concentration Guide (USDOE DCG) for Total Uranium is 600 pCi/L.

**The Safe Drinking Water Act Maximum Containment Level (SDWA MCL) for Total Uranium is 27 pCi/L. Ground water at NFSS is not a drinking water source. The above concentrations are for comparative purposes only.

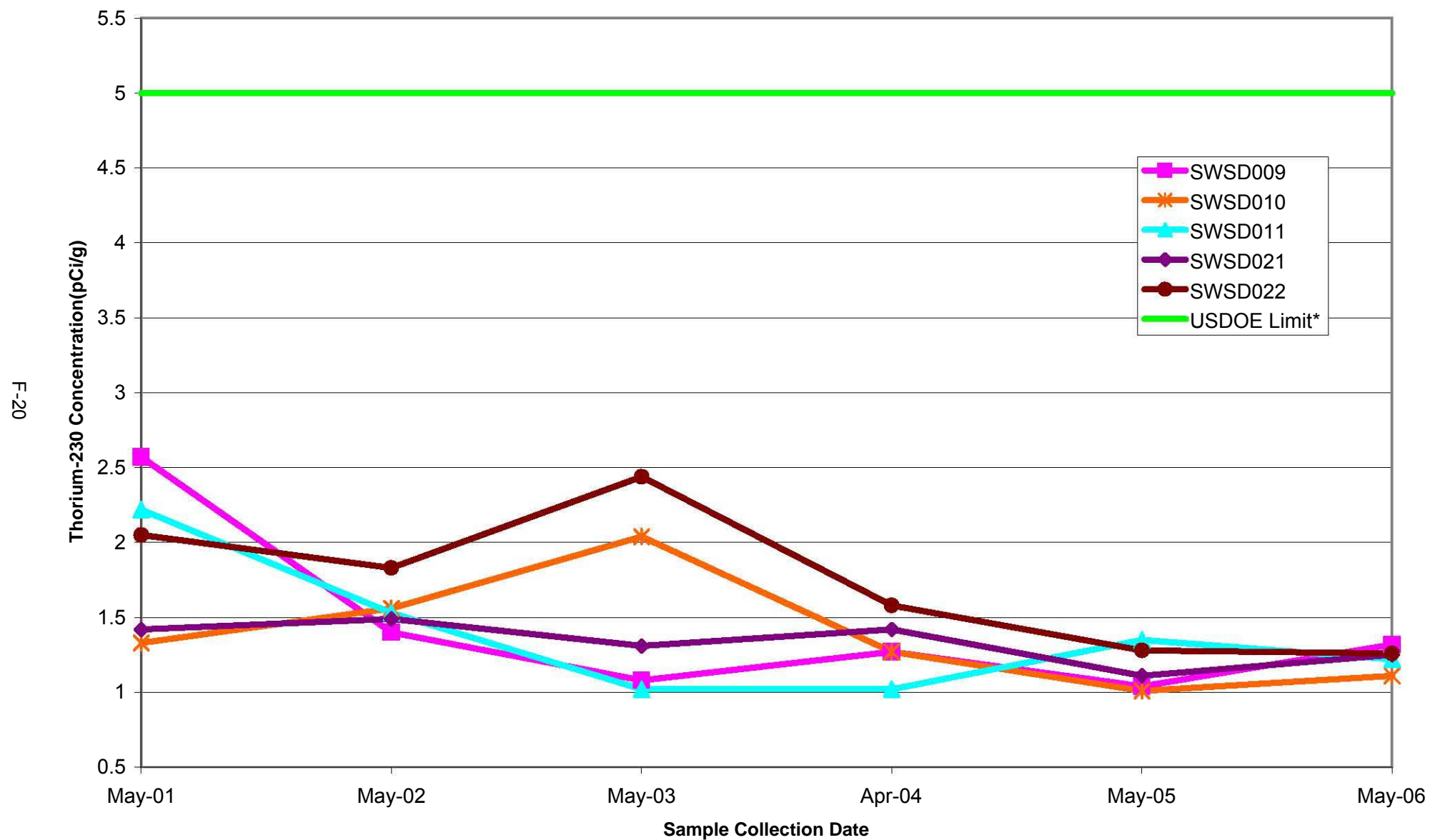
Note: 2004 findings for sample SWSD010 was attributed to excess turbidity of the sample.

FIGURE 19: TOTAL RADIUM (RADIUM-226 AND RADIUM-228) CONCENTRATION IN SEDIMENT



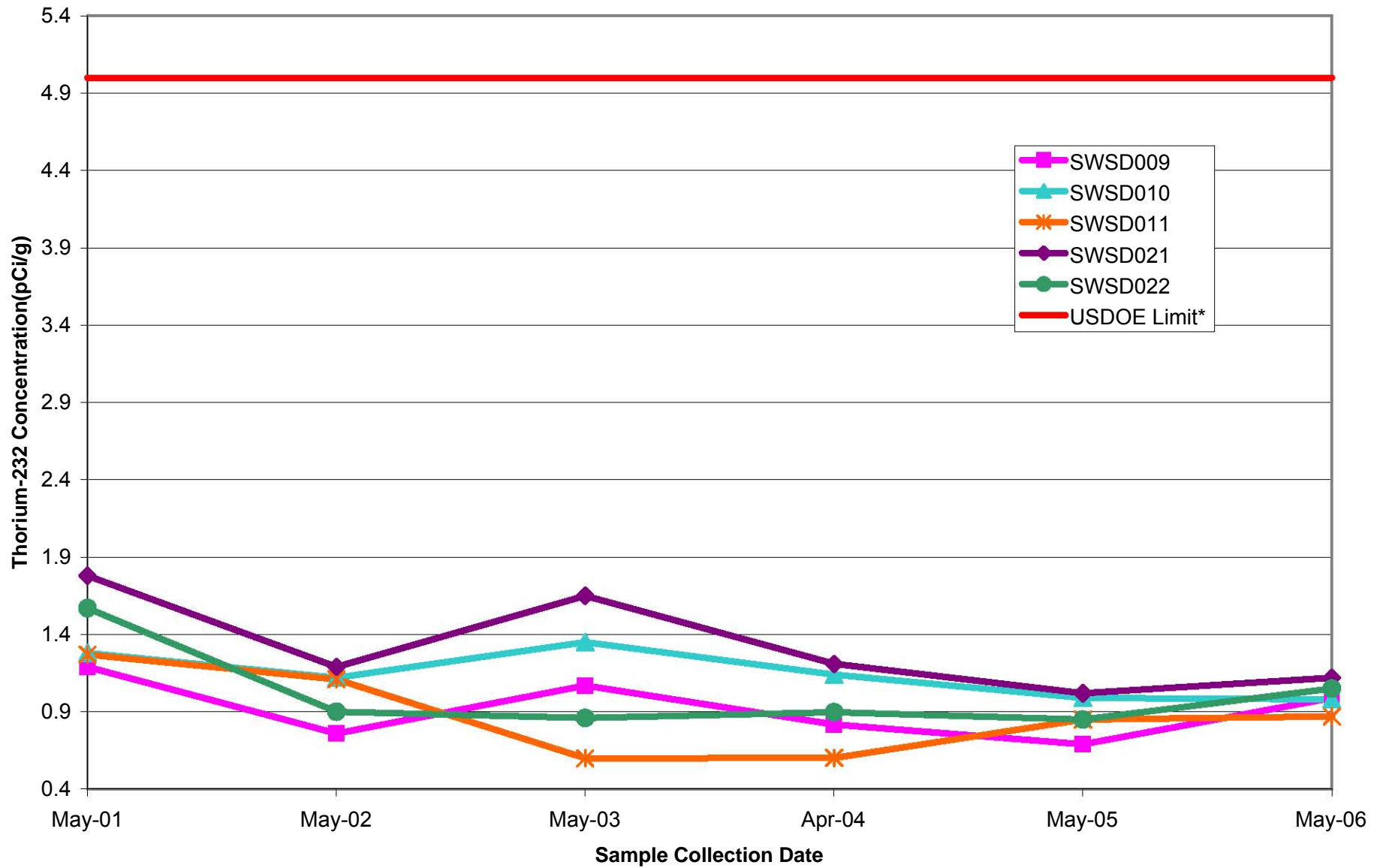
*The United States Department of Energy (USDOE) surface soil cleanup criterion for total radium is 5pCi/g above background.

FIGURE 20: THORIUM-230 CONCENTRATION IN SEDIMENT



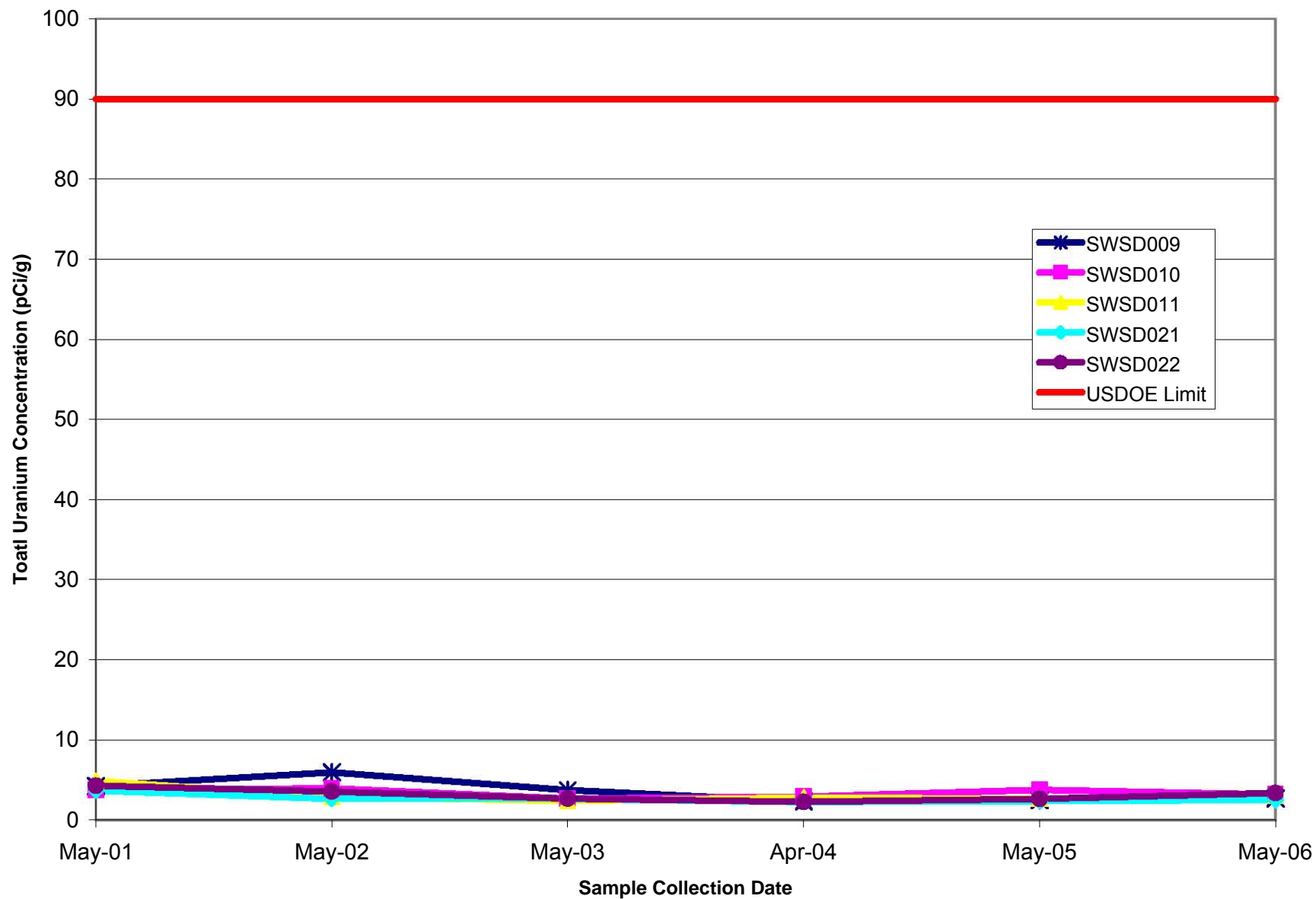
*The United States Department of Energy (USDOE) surface soil cleanup criterion for total thorium is 5pCi/g above background.

FIGURE 21: THORIUM-232 CONCENTRATION IN SEDIMENT



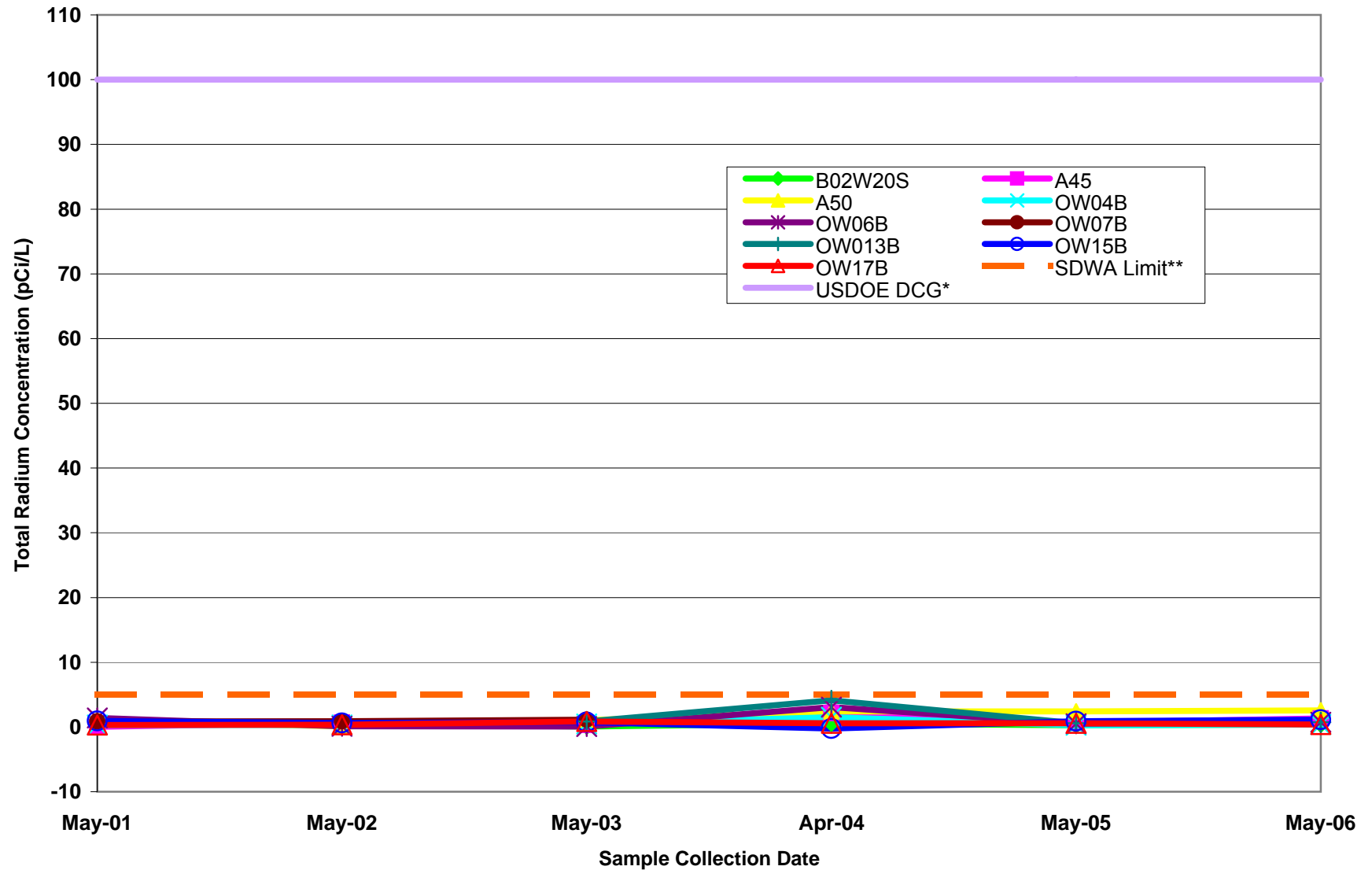
*The United States Department of Energy (USDOE) surface soil cleanup criterion for total thorium is 5pCi/g above background.

FIGURE 22: TOTAL URANIUM CONCENTRATION IN SEDIMENT



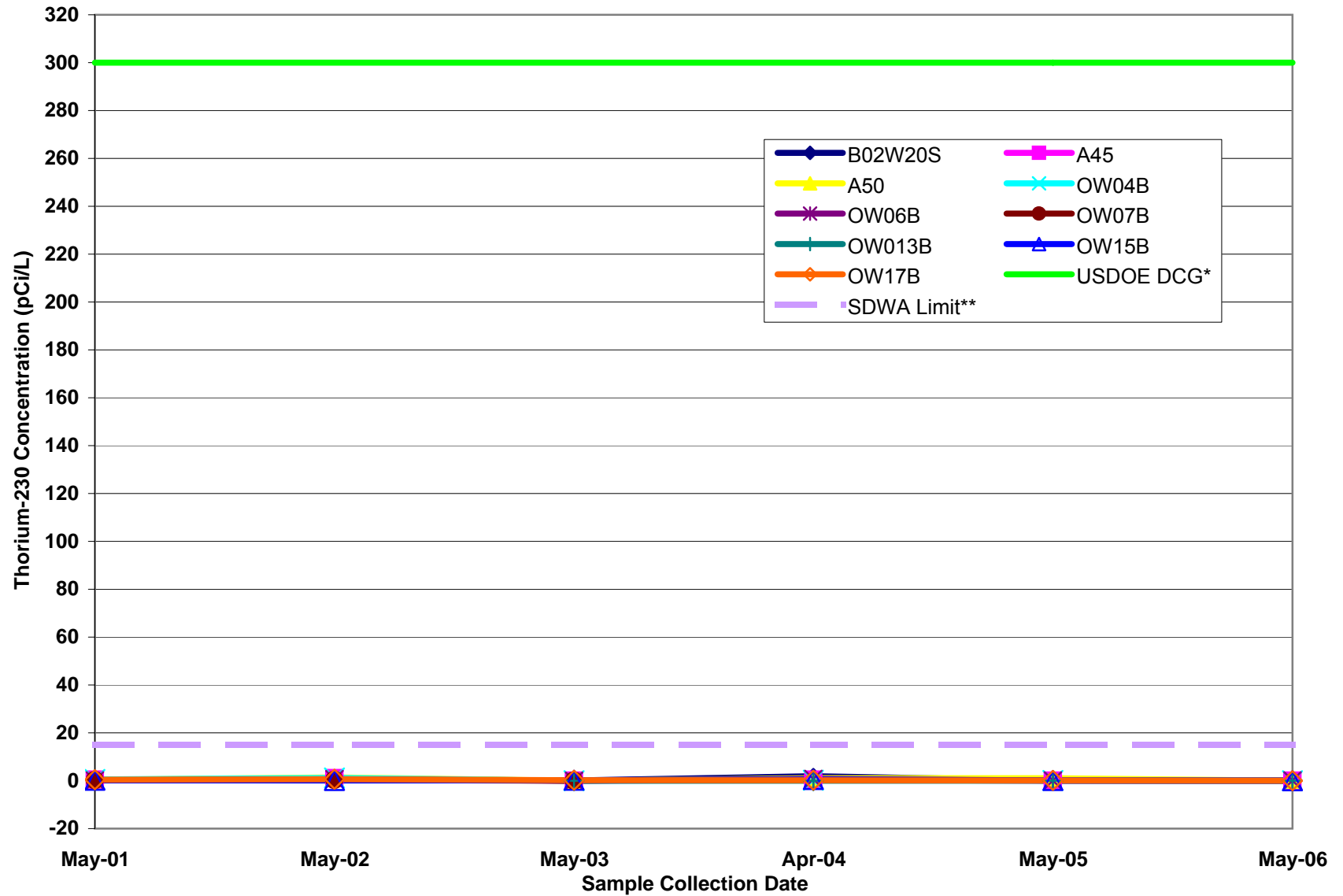
*The United States Department of Energy (USDOE) surface soil cleanup criterion for total uranium is 90pCi/g above background.

FIGURE 23: TOTAL RADIUM (RADIUM-226 AND RADIUM-228) CONCENTRATION IN GROUNDWATER AT NFSS



* The United States Department of Energy Derived Concentration Guide (USDOE DCG) for combined Radium-226 & 228 is 100 pCi/L.

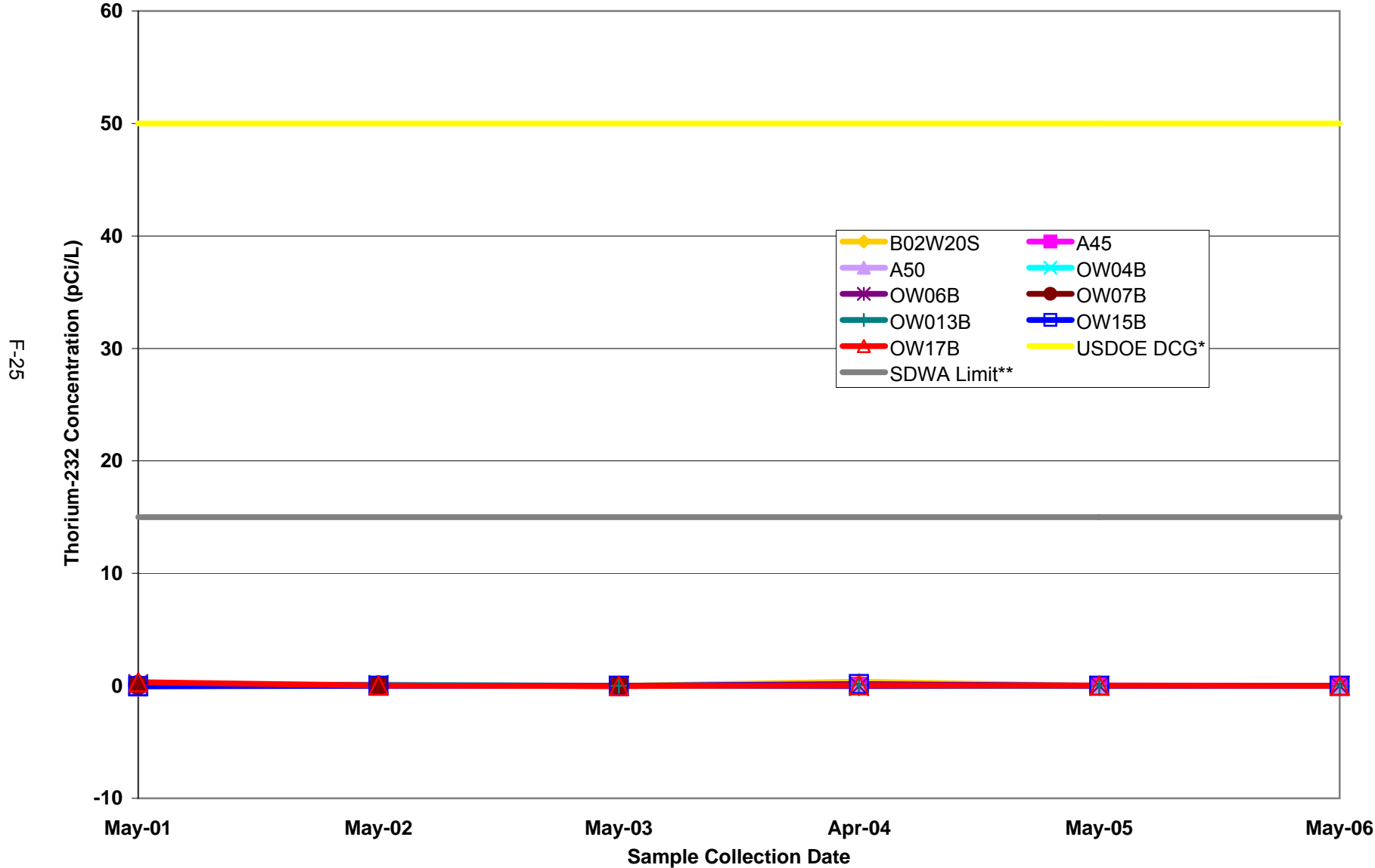
**The Safe Drinking Water Act Maximum Containment Level (SDWA MCL) for Total Radium is 5 pCi/L. Groundwater at NFSS is not a drinking water source. The above concentrations are for comparative purposes only.

FIGURE 24: THORIUM-230 CONCENTRATION IN GROUNDWATER AT NFSS

* The United States Department of Energy Derived Concentration Guide (USDOE DCG) for Thorium-230 is 300 pCi/L.

**The Safe Drinking Water Act Maximum Containment Level (SDWA MCL) for Thorium-230 is 15 pCi/L. Groundwater at NFSS is not a drinking water source. The above concentrations are for comparative purposes only.

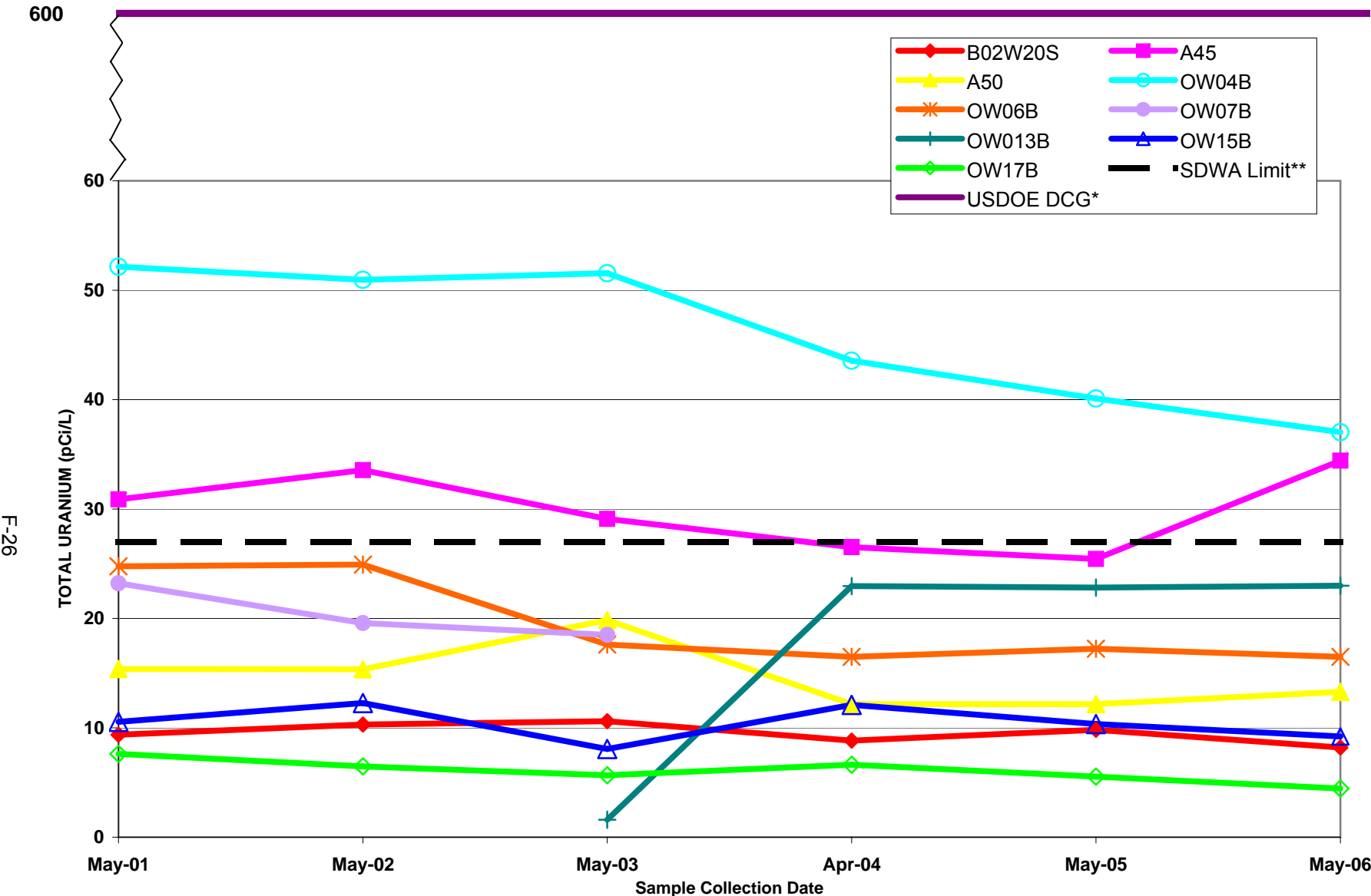
FIGURE 25: THORIUM-232 CONCENTRATION IN GROUNDWATER AT NFSS



* The United States Department of Energy Derived Concentration Guide (USDOE DCG) for Thorium-232 is 50 pCi/L.

**The Safe Drinking Water Act Maximum Containment Level (SDWA MCL) for Thorium-232 is 15 pCi/L. Groundwater at NFSS is not a drinking water source. The above concentrations are for comparative purposes only.

FIGURE 26: TOTAL URANIUM CONCENTRATION IN GROUNDWATER AT NFSS

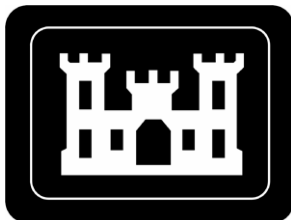


APPENDIX B: NFSS CY2006 ENVIRONMENTAL SURVEILLANCE TECHNICAL MEMORANDUM

CY2006 CALCULATION OF EXTERNAL GAMMA RADIATION DOSE RATES FOR NIAGARA FALLS STORAGE SITE (NFSS)

LEWISTON, NEW YORK

AUGUST 2006



**U.S. Army Corps of Engineers
Buffalo District Office
Formerly Utilized Sites Remedial Action Program**

TABLE OF CONTENTS

1.0 PURPOSE.....	1
2.0 ASSUMPTIONS.....	1
3.0 TLD DATA.....	1
4.0 ASSESSMENT METHODOLOGY AND RESULTS.....	2
4.1 Nearest Resident	2
4.2 Nearest Off-Site Worker	3
5.0 REFERENCES	4

1.0 PURPOSE

This calculation estimates the external gamma radiation dose from the Niagara Falls Storage Site (NFSS), Lewiston, New York (see Figure 1, Appendix A), during calendar year 2006 (CY2006). Hypothetical doses from external gamma radiation to members of the public are calculated from dose measurements using thermoluminescent dosimeters (TLDs) located at the perimeters of the NFSS and the Interim Waste Containment Structure (IWCS) (see Figure 2, Appendix A).

2.0 ASSUMPTIONS

Doses were calculated for off-site receptors based on these locations for off-site receptors based on the canvas of receptors in CY2006. The hypothetical doses for the nearest resident and off-site worker are reported. The modeling approach described below is considered to be protective of human health (conservative) in calculating hypothetical dose to receptors. The shielding effect of the air has not been included in the calculations. Calculations for the hypothetical annual external gamma radiation doses to the nearest resident and nearest off-site worker used the following assumptions:

- Distance from each TLD above the source (the ground) is 3 feet (ft),
- Distance from the TLDs to the nearest resident is 500 ft (perpendicular to the western TLD line),
- Distance from the TLDs to the nearest off-site worker is 1,020 ft (perpendicular to the eastern TLD line),
- Length of the western TLD monitoring line (western perimeter fence) is 2,766 ft,
- Length of the eastern TLD monitoring line (east of Campbell Street) is 2,700 ft.

3.0 TLD DATA

At NFSS, TLDs are used to measure gamma radiation from the site and from sources of background radiation. Natural sources of background radiation include cosmic radiation and terrestrial radiation sources. In the United States, the annual average (per capita) cosmic and terrestrial radiation doses are 27 millirem per year (mrem/yr) and 28 mrem/yr, respectively (NCRP Report 93). Annual doses due to background at NFSS are measured at background locations using TLDs. Background dose for the same period of exposure is subtracted from site dose values to estimate the net dose from NFSS. TLDs are located at the facility perimeter and at the perimeter of the IWCS. The TLDs are placed at approximately 3 ft [1.6 meters (m)] above the ground surface. The TLDs measure approximately six-month intervals and are analyzed at an off-site vendor.

Eleven locations around the perimeter of the site and six locations around the IWCS were monitored in CY2006 (see Figure 2, Appendix A). In addition to these locations, there were three background locations (Figure 1, Appendix A). Two environmental TLDs were placed at each monitoring location. The environmental program utilizes two TLDs at each monitoring location for each monitoring period as a quality control check. In addition, if a measurement result is rejected or a TLD is lost, the duplicate reading is assumed for that monitoring period.

TLD monitoring data for CY2006 are presented in Table 2 in the Tables section. A time-weighted or normalized annual dose is calculated that accounts for exposure periods having different integration times (a different number of measurement days). Negative net values are retained for calculation purposes.

4.0 ASSESSMENT METHODOLOGY AND RESULTS

Gamma radiation measured at the perimeter fence line represents the dose for full-time occupancy i.e. 24 hours/day and 365 days/year (366 days for a leap year). Dose to an off-site receptor is significantly affected by proximity to the source and the amount of time spent at the receptor location. The estimate of dose to an off-site worker therefore uses a correction factor for occupancy assuming 2000 hours worked per year. The estimate of dose to an off-site resident assumes a full-time occupancy at home. The average net dose rate for CY 2006 at the site perimeter by direction is calculated to be:

Direction	TLD Locations	Calculated Average Net Dose Rate (mrem/year)
North Perimeter	1, 11, 12, and 122	4.91
East Perimeter	1,28,123	4.30
South Perimeter	7, 28, and 29	6.40
West Perimeter	11,13,15,29,36,8,10	2.47

4.1 NEAREST RESIDENT

The dose calculation for the nearest resident, uses the line of TLDs along the western perimeter fence. The TLDs along this side of the facility include NFSS perimeter fence monitoring locations 11, 13, 15, 29, and 36, and WCS perimeter fence monitoring locations 8 and 10. The two WCS locations are located close to the western NFSS perimeter fence. These TLD locations are shown in Appendix A, Figure 2. Net dose rates (corrected for background) for these TLDs are summed and divided by the total number of observations (14 for CY2006). This average value represents the annual dose at the site perimeter ($D_1 = 2.98$ mrem for CY2006). The dose contribution to this resident from the southern exposure is insignificant compared to the exposure from the western line source. The western site perimeter dose is then used in the following equation for a line source:

$$D_2 = D_1 * h_1/h_2 * (\text{ArcTan}(L/h_2)/\text{ArcTan}(L/h_1))$$

where:

- D_2 = dose calculated at the receptor location from the line source
- D_1 = dose at the site perimeter as described above
- h_1 = the distance of the TLDs from the source (3 ft)
- h_2 = the distance of the resident from the fence line (500 ft)
- L = half the length of line of TLDs measuring the line source (1,383 ft)

Nearest Resident Dose Calculation (Resident southwest of NFSS)

NFSS Perimeter Monitoring Locations 11, 13, 15, 29, and 36 and IWCS Perimeter Monitoring Locations 8 and 10

h_1 = 3 feet distance of TLD from the source

h_2 = 500 feet distance of resident from the TLDs

L = 1,383 feet half the length of the western line source

D_1 = 2.98 mrem average annual dose at the TLD monitoring locations

D_2 = 0.014 mrem resident annual dose at 500 feet from the TLD

The hypothetical dose to the nearest resident is 1.4×10^{-2} (or 0.014) mrem for calendar year 2006.

4.2 NEAREST OFF-SITE WORKER

The dose to the nearest off-site worker uses, the line of TLDs, closest to the eastern perimeter fence (Castle Garden Road). The TLDs used include monitoring locations 1, 28, and 123. These TLDs are located along an interior fence east of Campbell Street. Their locations are shown in Figure 2, Appendix A. There are no WCS perimeter fence monitoring locations in close to those along the line east of Campbell Street; therefore, none are included in the dose calculations. Net dose rates (corrected for background) for TLD monitoring locations 1, 28, and 123 are summed and divided by the total number observations (6 for CY2006). This average represents the annual dose at the site perimeter ($D_1 = 1.4$ mrem for CY2006).

Nearest Off-Site Worker Dose Calculations (Worker east of NFSS)

NFSS Perimeter Monitoring Locations 1, 28, 123

$h_1 = 3$ feet distance of TLD from the source

$h_2 = 1,020$ feet distance of off-site worker from the TLDs

$L = 1,350$ feet half the length of the eastern line source

$D_1 = 1.4$ mrem average annual dose at the TLD monitoring locations

$D_2 = 0.00055$ mrem off-site worker annual dose at 1,020 feet from the TLD location

Using the equation above) and a correction factor for off-site worker occupancy of 2000/8760 hours the hypothetical dose to the nearest off-site worker is $5.5 \text{ E-}04$ (or 0.00055) mrem for calendar year 2006.

5.0 REFERENCES

Bechtel National, Inc. (BNI), 1997. "1996 Public External Gamma Dose," 14501-158-CV-031, Rev. 0, Oak Ridge, TN.

APPENDIX C: NFSS CY2006 ENVIRONMENTAL SURVEILLANCE TECHNICAL MEMORANDUM

FUSRAP CY2006 NESHAP ANNUAL REPORT FOR NIAGARA FALLS STORAGE SITE (NFSS)

LEWISTON, NEW YORK

JUNE 2006



**U.S. Army Corps of Engineers
Buffalo District Office
Formerly Utilized Sites Remedial Action Program**

TABLE OF CONTENTS

1.0	INTRODUCTION	1
1.1	SITE DESCRIPTION	1
1.2	SOURCE DESCRIPTION	1
2.0	REGULATORY STANDARDS	2
2.1	40 CFR 61, SUBPART H	2
2.2	40 CFR 61, SUBPART Q	2
3.0	AIR EMISSION DATA	2
4.0	DOSE ASSESSMENTS.....	3
4.1	MODEL SOURCE DESCRIPTION	3
4.2	DESCRIPTION OF DOSE MODEL	3
4.3	COMPLIANCE ASSESSMENT	4
5.0	SUPPLEMENTAL INFORMATION.....	5
5.1	POPULATION DOSE	5
5.2	RADON-222 FLUX	5
5.3	NON-APPLICABILITY	6
6.0	REFERENCES	7

LIST OF APPENDICES

Attachment A: Annual Wind Erosion Emission Calculation
Attachment B: Source Term Calculations and Annual Air Releases
Attachment C: CAP88-PC Reports – Individual
Attachment D: CAP88-PC Reports – Population
Attachment E: National Climatic Data Center, Niagara Falls, New York

ACRONYMS AND ABBREVIATIONS

BNI	Bechtel National, Inc.
CAP88-PC Ver 3	Clean Air Act Assessment Package-1988, Version 3.0
CFR	Code of Federal Regulations
E _w	annual wind erosion emission
FUSRAP	Formerly Utilized Sites Remedial Action Program
ICRP	International Commission on Radiological Protection
IWCS	Interim Waste Containment Structure
m ²	square meter(s)
MEI	maximally exposed individual
ML	Modern Landfill
mph	miles per hour
NOAA	National Oceanic and Atmospheric Administration
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFIA	Niagara Falls International Airport
NFSS	Niagara Falls Storage Site
USAEC	United States Atomic Energy Commission
USACE	United States Army Corps of Engineers
UCL	upper confidence limit
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency

1.0 INTRODUCTION

In 1974, the United States Atomic Energy Commission (USAEC), a predecessor to the United States Department of Energy (USDOE), instituted the Formerly Utilized Sites Remedial Action Program (FUSRAP). This program is now managed by United States Army Corps of Engineers (USACE) to identify and clean up, or otherwise control sites where residual radioactivity remains from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized USACE to remedy under FUSRAP. The Niagara Falls Storage Site (NFSS) is a federally-owned storage site managed under FUSRAP. In October 1997, Congress transferred the responsibility for FUSRAP from USDOE to USACE.

1.1 SITE DESCRIPTION

The Niagara Falls Storage Site (NFSS) is located in the Town of Lewiston in northwestern New York State, northeast of Niagara Falls and south of Lake Ontario (Figure 1-Appendix A). NFSS is approximately 77 hectare (~191 acre) site which includes: one former process building (Building 401), one office building (Building 429), an equipment shed, and a 4 hectare (9.9 acre) interim waste containment structure (IWCS). The property is fenced, and public access is restricted.

Land use in the region is primarily rural; however, the site is bordered by a chemical waste disposal facility on the north, a solid waste disposal facility on the east and south, and a Niagara Mohawk Power Corporation right-of-way on the west. The nearest residential areas are approximately 1.1-km southwest of the site; the residences are primarily single-family dwellings.

1.2 SOURCE DESCRIPTION

Beginning in 1944, NFSS was used as a storage facility for radioactive residues and wastes. The residues and wastes are the process by-products of uranium extraction from pitchblende (uranium ore). Waste was also generated from remediation of buildings and process equipment used in the uranium extraction process. The residues originated at other sites and were transferred to NFSS for storage in buildings, on-site pits, and surface piles. Table 1 includes a brief history and description of the major radioactive residues and wastes transferred to NFSS. From 1953 to 1959 and 1965 to 1971, Building 401 was used as a boron-10 isotope separation plant.

Table 1. History and Description of Wastes Transferred to NFSS

Material	Description	Transferred to NFSS
L-50	Low-activity radioactive residues from the processing of low-grade uranium ores at Linde Air Products, Tonawanda, New York.	1944
R-10	Low-activity radioactive residues from the processing of low-grade uranium ores at Linde Air Products, Tonawanda, New York.	1944
F-32	Low-activity radioactive residues from the processing of high-grade uranium ores at Middlesex, New Jersey.	1944 to early 1950
L-30	Low-activity radioactive residues from the processing of low-grade uranium ores at Linde Air Products, Tonawanda, New York.	1945
K-65	High-activity radioactive residues from the processing of high-grade uranium ores at Mallinckrodt Chemical Works, St. Louis, Missouri.	1949
Middlesex Sands	Sand and abraded material from the sandblasting of buildings and process equipment where the F-32 residue was generated at Middlesex Metal Refinement Plant, Middlesex, New Jersey.	1950

Since 1971, activities at NFSS have been confined to residue and waste storage and remediation. All on-site and off-site areas with residual radioactivity exceeding USDOE guidelines were remediated between 1981 and 1992. The materials generated during remedial actions (approximately 195,000 m³) are encapsulated in the IWCS (See Appendix A, Figure 2), which is specifically designed to provide interim storage of the materials. Remedial investigation began at the end of 1999 to determine if any areas of the site contained radioactive or chemical contaminants at levels that could pose an unacceptable risk to human health and the environment. Initial results show that isolated areas of elevated activity do exist.

2.0 REGULATORY STANDARDS

The United States Environmental Protection Agency's (USEPA) National Emission Standards for Hazardous Air Pollutants (NESHAP) are compliance standards that require annual reporting of emissions of radionuclides and radon gas from operations at nuclear facilities.

2.1 40 CFR 61, SUBPART H

40 CFR 61, Subpart H provides standards for reporting emissions of radionuclides (excluding radon-222 and radon-220) into the air from USDOE facilities. Although control and maintenance of the site currently rests with USACE, responsibility for NFSS will return to USDOE following completion of remedial actions. This regulation therefore provides an appropriate standard for NFSS. Compliance with Subpart H is verified by applying the USEPA approved code, CAP88-PC. CAP88-PC Version 3.0 (USEPA 2006)] was used for this years calculation. The applicable regulation, 40 CFR 61.92 limits exposure of the public to effective dose equivalent of 10 mrem/yr from radioactive emissions.

2.2 40 CFR 61, SUBPART Q

40 CFR 61, Subpart Q applies to storage and disposal facilities for radium-containing material that emits radon-222 into air. NFSS is specifically identified as one such facility in this subpart (in 40 CFR 61.190). Compliance with Subpart Q is verified by annual monitoring of the IWCS for radon-222 flux. Subpart Q limits radon-222 emission to 20 pCi/m²/s.

3.0 AIR EMISSION DATA

Table 2 summarizes the sources of air emissions. Attachment A contains the annual wind erosion emission (E_w) calculation. Attachment B contains the source term calculations and annual air releases.

These calculations use the USEPA air pollution emission factor methodology (AP-42) to estimate the radioactive release from wind erosion, which is then used as the source term in the Clean Air Act Assessment Package (CAP88-PC) model to estimate airborne doses to hypothetically exposed individuals. The annual wind erosion emission estimate uses the most current soil data from the NFSS RI sampling Phases I, II, and III. A 95% upper confidence limit (UCL) without the subtraction of background radioactivity, was calculated for each soil nuclide of concern and used for the 2006 year source term estimate. The area of the entire NFSS was assumed to be uniformly contaminated and to contribute to the source term.

Table 2. Air Emission Data - NFSS

Point Sources	Type Control	Efficiency	Distance to Hypothetical Exposed Individual
none	not applicable	not applicable	not applicable
Non-Point Sources	Type Control	Efficiency	Distance and Direction from Center of Site to Hypothetical Exposed Individual
<i>in situ</i> soil –area source	vegetative cover	90 percent ^a	533 m SE Modern Scale-house Worker 783 m S Greenhouse Worker 914 m SSW Resident 1105 m S Resident (farm) 1250 m WSW Resident 1486 m ESE Resident 2499 m W School 2629 m WNW School
Group Sources	Type Control	Efficiency	Distance to Hypothetical Exposed Individual
none	not applicable	not applicable	not applicable

^a This is the fraction of vegetative cover used to correct emissions (Attachments A,B).

4.0 DOSE ASSESSMENTS

4.1 MODEL SOURCE DESCRIPTION

To determine the dose from airborne particulates potentially released from NFSS during CY2006, the annual wind erosion emission, E_w (Attachment A) is calculated using local climatological data (Attachment F) from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center for the Niagara Falls International Airport (NFIA) in Niagara Falls, NY. Data from an on-site meteorological station at Modern Landfill (ML) in Lewiston, NY was not available for this year. E_w is calculated using the USEPA AP-42 methodology for “fugitive emissions” from an “area source” that uses the “fastest mile” wind speed data from local climatological data reports. E_w , in grams emitted, is then applied to the soil nuclide concentration to estimate the source term or annual emissions for each radionuclide. The soil concentration was developed from sample data compiled during Phases I, II, and III of the Remedial Investigation for soil contamination (Attachment B). Contributions from radon gas, in accordance with regulatory guidance, are not considered in this calculation. Annual estimated emissions for each radionuclide were input into the USEPA’s CAP88-PC, Version 3.0 code to calculate hypothetical receptor doses. The model estimates resultant doses from airborne particulates to hypothetical individuals at the distances to the nearest residence, commercial/industrial facility, school, and farm as measured from a central location on-site. Hypothetical doses are then corrected for occupancy. Commercial/industrial facility and school occupancy is assumed to be 40 hr/week for 50 weeks/yr. Residential and farm occupancy is assumed to be full-time for 24 hr/day for 365 days/yr. The hypothetical individual receiving the higher of these calculated doses is then identified as the maximally exposed individual (MEI) for airborne particulate dose.

4.2 DESCRIPTION OF DOSE MODEL

4.2.1 CAP88-PC Computer Program

The CAP88-PC model is a set of computer programs, databases, and associated utility programs that estimate the dose and risk from airborne radioactivity emissions. The USEPA NESHAP compliance procedures for airborne radioactivity emissions at USDOE facilities (40 CFR 61.93(a)) require the use of the CAP88-PC model, or other approved procedures to calculate effective dose equivalents to members of the public.

CAP88-PC uses a modified Gaussian plume equation to estimate the average dispersion of radionuclides released from a site. Assessments are performed for a circular grid of distances and directions for a radius of 80 km (50 miles) around the facility. Agricultural arrays of milk cattle, beef cattle and agricultural crop area are generated automatically, requiring the user to supply only the State name or agricultural productivity values. Dose and risk factors for CAP88-PC, Version 3.0 are from Federal Guidance Report 13 and are based on the methods detailed in International Commission on Radiological Protection (ICRP) 72 (ICRP72). The dose calculations presented in this document used the default values for nuclide lung clearance type. These defaults correspond to the recommended values from FGR 13. Deposition velocity and scavenging coefficient are calculated by the code in accordance with USEPA policy. In the CAP88 model nuclides are depleted from the plume by precipitation scavenging, dry deposition and radioactive decay. The default scavenging coefficient is calculated as a function of annual precipitation. The program calculates the effective dose equivalents received by receptors by combining the inhalation and ingestion intake rates and the air and ground surface concentrations using the appropriate dose conversion factors.

4.2.2 CAP88-PC Input

Input parameters for CAP88 include:

Radionuclide emissions (Attachment B),
Weather data (average annual temperature, total annual precipitation) (Attachment F),
Emission source height and area (Section 4.3), and
Distance to nearest resident, off-site worker, school, and farm (Section 4.3).

4.2.3 CAP88-PC Output

The "Dose and Risk Equivalent Summaries" from CAP88-PC contains the resulting effective dose equivalents for each modeled scenario. The effective dose equivalent summary contains results for 16 compass directions around the facility for the nearest resident, off-site worker, school, and farm. CY2006 CAP88-PC individual receptor and population output summaries are located in Attachment C and D, respectively.

4.3 COMPLIANCE ASSESSMENT

The released activity data from Attachment B is entered into the CAP88-PC modeling program to derive the hypothetical dose to the defined receptors. To derive the dose to the MEI, the CAP88-PC model must have weather data for the appropriate year, information on the emission source, and the distances and directions to the nearest residence, off-site worker, school, and farm. The following CY2006 meteorological data were entered into CAP88-PC (see Attachment E):

Average temperature	10.1 °C (50.14 °F) NFIA,
Precipitation,	98.2 cm (38.66 inches) ML, and
Mixing height	1,000 m.

The following emission source and nearest receptor distances and direction information were also entered into the program:

Source height	0 m,
Source area	780,000 m ² ,
Resident	914 m SSW
Resident (farm)	1105 m S
Resident	1250 m WSW
Resident	1486 m ESE,
Off-site worker	533 m SE,
Off-site worker	783 m S
School (building)	2499 m W
School(building)	2629 m WNW

The CAP88-PC annual hypothetical dose to the nearest resident, off-site worker, school, and farm at the corresponding directions and distances taken from page six of the "Dose and Risk Equivalent Summaries" document for individual modeling (Attachment C) are:

Resident	8.0 E-04 mrem, SSW @ 914 m,
Off-site worker	3.4 E-03 mrem, SE @ 533 m
School	3.1 E-04 mrem, W @ 2499m and
Farm	6.1 E-04 mrem, S @ 1105m.

The hypothetical doses to the nearest off-site worker and school corrected for 2,000 hr of exposure per year are:

Off-site worker	7.8 E-04 mrem and
School	7.1 E-05 mrem.

5.0 SUPPLEMENTAL INFORMATION

5.1 POPULATION DOSE

The CAP88-PC model was also used to estimate the hypothetical airborne particulate dose to the population within 80 km of the site. Population data taken from year 2000 census data for New York State and 2001 census data for Ontario, Canada was used to create a population file for CAP88-PC. The effective dose equivalent for the collective population in person-rem/yr is from the CAP88-PC "Dose and Risk Equivalent Summaries" report.

The CAP88-PC annual effective dose for the population within 80 km of the facility (Attachment D) is:

Population:	2.4 E-02 person-rem
-------------	---------------------

5.2 RADON-222 FLUX

Measurement of radon-222 flux provides an indication of the rate of radon-222 emission from a surface. Radon-222 flux is measured with activated charcoal canisters placed at 15-m intervals across the surface of the IWCS for a 24-hr exposure period. Measurements for CY2006 are presented in Table 4; measurement locations are shown in Appendix A, Figure 2.

Measured results for CY2006 ranged from non-detect to 0.126 pCi/m²/s, with an average value of 0.029 pCi/m²/s. As in previous years, these results are well below the 20 pCi/m²/s standard specified in 40 CFR Part 61, Subpart Q, and demonstrate the effectiveness of the containment cell design and construction in mitigating radon-222 migration.

5.3 NON-APPLICABILITY

Requirements from section 61.93(b) of 40 CFR for continuous monitoring from point sources (stacks or vents) are not applicable to NFSS.

6.0 REFERENCES

ANL 2003. CAP88-PC Population Files for NFSS, Argonne National Laboratory, Chicago, Illinois.

Bechtel National, Inc. (BNI), 1997. "1996 Public Inhalation Dose" 14501-158-CV-030, Rev. 0, Oak Ridge, TN.

Environmental Protection Agency (EPA), 1995. *Compilation of Air Pollutant Emission Factors, Fifth Edition*, AP-42, Office of Air Quality Planning and Standards, Research Triangle Park, NC (January).

Environmental Protection Agency (EPA), 2006. CAP88-PC Version 3.0 Computer Code, U.S. Environmental Protection Agency.

Environmental Protection Agency (EPA), 1999. *Federal Guidance Report 13, Cancer Risk Coefficients for Environmental Exposure to Radionuclides*, EPA99 EPA 402-R-99_001, USEPA Office of Radiation and Indoor Air, Washington, DC.

International Commission on Radiological Protection (ICRP72), 1996. *Age Dependent Doses to Members of the Public from Intake of Radionuclides, Part 5, Compilation of Ingestion and Inhalation Dose Coefficients*," ICRP 72, Pergamon Press, Oxford.

40 CFR 61, Subpart H. *National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities.*

40 CFR 61, Subpart Q. *National Emission Standards for Radon Emissions from Department of Energy Facilities.*

ATTACHMENT A

ANNUAL WIND EROSION EMISSION CALCULATION

A.1 ANNUAL WIND EROSION

In 2006, the potential source of airborne emissions from NFSS is assumed to be from wind erosion of in-situ soil from the entire NFSS. The AP-42 model for industrial wind erosion for limited flat sources is used. In this model the potential airborne emissions are a function of the number of disturbances of contaminated soil. The following assumptions and calculations are made:

The air release source is wind erosion of in-situ soil from an area (A) of 780,000 m² of vegetation covered soil.

$$A = 780,000 \text{ m}^2$$

The calculation assumes that 90% of this area is covered by grass or vegetation (V).

$$V = 0.90$$

For CY 2006 there is assumed to have been weekly grass cutting for half the year, occurring May through October and an April spring thaw. The number of estimated disturbances (N) is therefore:

$$N = 27$$

The threshold velocity (U_t) for overburden (USEPA 1995 Table 13.2.5-2) is:

$$U_t = 1.02 \text{ m/s}$$

Anemometer height adjustment is not necessary.

$$Z_r = \text{reference anemometer height} = 10 \text{ m}$$

$$Z_a = \text{actual anemometer height} = 10 \text{ m}$$

The roughness height for overburden is 0.3 cm (USEPA 1995 Table 13.2.5-2).

$$Z_o = 0.3 \text{ cm}$$

The corrected wind speed (U_{rN}) for each period (N) between disturbances (USEPA 1995 Equation 5) is:

$$U_{rN} = U_{aN} [\ln(Z_r/Z_o) / \ln(Z_a/Z_o)], \text{ therefore } U_{rN} = U_{aN}$$

The equivalent friction velocity (U_N) for each period between disturbances (USEPA 1995 Equation 4) is:

$$U_N = 0.053 U_{rN}$$

The fastest mile speeds (maximum 2-minute wind speeds^a) from Local Climatological Data reports from NOAA for Niagara Falls International Airport (NFIA) in mph for the period between each disturbance are:

U _{a1} = 39	U _{a2} = 22	U _{a3} = 26	U _{a4} = 32	U _{a5} = 22	U _{a6} = 20
U _{a7} = 28	U _{a8} = 26	U _{a9} = 24	U _{a10} = 32	U _{a11} = 24	U _{a12} = 26
U _{a13} = 35	U _{a14} = 39	U _{a15} = 29	U _{a16} = 23	U _{a17} = 29	U _{a18} = 17
U _{a19} = 30	U _{a20} = 21	U _{a21} = 21	U _{a22} = 31	U _{a23} = 29	U _{a24} = 26
U _{a25} = 36	U _{a26} = 25	U _{a27} = 38			

^aMaximum 2-minute wind speeds can be used to approximate fastest mile wind speeds (USEPA 2004 Table 7-4), however, this calculation applies an uncertainty correction factor, protective of human health, of 1.3 in order to approximate the fastest mile wind speeds.

The equivalent friction velocity in m/s for each period is:

U ₁ = 1.20 E00	U ₂ = 6.78 E-01	U ₃ = 8.01 E-01	U ₄ = 9.86 E-01	U ₅ = 6.78 E-01	U ₆ = 6.16 E-01
U ₇ = 8.62 E-01	U ₈ = 8.01 E-01	U ₉ = 7.39 E-01	U ₁₀ = 9.86 E-01	U ₁₁ = 7.39 E-01	U ₁₂ = 8.01E-01
U ₁₃ = 1.08 E00	U ₁₄ = 1.20 E+00	U ₁₅ = 8.93 E-01	U ₁₆ = 7.08 E-01	U ₁₇ = 8.93 E-01	U ₁₈ = 5.24 E-01
U ₁₉ = 9.24 E-01	U ₂₀ = 6.47 E-01	U ₂₁ = 6.47 E-01	U ₂₂ = 9.55 E-01	U ₂₃ = 8.93 E-01	U ₂₄ = 8.01E-01
U ₂₅ = 1.11 E00	U ₂₆ = 7.70 E-01	U ₂₇ = 1.17 E00			

The erosion potential (P_N) for a dry exposed surface (USEPA 1985 Figure 4-2) is:

$$P_N = 58 (U^* - U_t)^2 + 25(U^* - U_t) = 22.27 \text{ g/m}^2$$

The erosion potentials (P_N) for each period between disturbances in CY 2006 are all less than or equal to the threshold friction velocity except for U₁, U₁₃, U₁₄, U₂₅ and U₂₇.

The particle size multiplier (k) for 10 μ particles (USEPA 1995 Equation 2) is:

$$k = 0.5$$

The emission factor (P) for dry bare soil for 10 μ particles (USEPA 1995 Equation 2) is:

$$P = k \sum P_N = 6.66 \text{ g/m}^2$$

Thornthwaite's Precipitation Evaporation Index (PE), used as a measure of average soil moisture, is:

$$PE = 110$$

The corrected emission factor (PM₁₀) for 10 μ particles (USEPA 1985 Equation 4-1) is:

$$PM_{10} = P(1-V) / (PE/50)^2 = 0.23 \text{ g/m}^2/\text{yr}$$

The annual wind erosion emission (E) is calculated to be:

$$E = A (PM_{10}) = 179,457 \text{ g soil}$$

A.2 REFERENCES

EPA 2004. *Methods for Estimating Fugitive Air Emissions of Radionuclides from Diffuse Sources at USDOE Facilities*, Final Report, September 3, 2004.

EPA 1995. *AP 42 Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources*, Fifth Edition, 1995.

M. J. Changery, *National Wind Data Index Final Report*, HCO/T1041-01 UC-60, National Climatic Center, Asheville, NC, December 1978.

EPA 1985. *Rapid Assessment of Exposure to Particulate Emissions from Surface Contaminated Sites*, EPA/600/8-85/002, Office of Health and Environmental Assessment, Washington, DC (February).

EPA 1985. *AP 42 Compilation of Air Pollution Emission Factors*, Third Edition (including supplements 1-7), August 1977.

ATTACHMENT B

SOURCE TERM DEVELOPMENT AND ANNUAL AIR EMISSIONS

B.1 SOURCE TERM DEVELOPMENT

The source term for NFSS NESHAPS calculations was developed considering the radionuclides in the uranium, thorium, and actinium decay series as shown in Table B-1. Concentration data for these radioisotopes were taken from Phases I, II, and III of the Remedial Investigation and are listed in Table B-2. The Phase I sampling was performed from November 1999 through January 2000. The Phase II was performed from August 2000 through October 2000. The Phase III sampling was performed from May 2001 through October 2003. The dataset has been verified to ensure data quality and includes the analysis of soils from biased high locations (i.e., locations that had elevated gamma survey readings). The dataset used for CY 2006 uses higher soil concentrations than in years before CY2004 and more conservatively estimates (biased high) the site concentration values.

The IWCS, completed in 1986 and added to in 1991, is surrounded by sufficient topsoil and compacted clay to consider radionuclide emissions negligible. In 1986, the entire IWCS was covered with 0.9 meters (3 feet) of low-permeability, compacted clay, a 0.3 meter (12 inch)-thick layer of loosely compacted soil, 0.15 meter (6 inches) of topsoil and covered with shallow-rooted grass. A clay cutoff wall and dike measuring 3.35 to 8.84 meters (11 to 29 feet) in thickness formed the perimeter. In 1991 additional soil with residual radioactivity from a vicinity property, along with 60 drums containing radioactive material, were placed over the existing IWCS. Six inches of clay was placed over the waste material and two feet of compacted clay was added on top along with 0.46 meter (1.5 feet) of topsoil material. However, the area of the cap was included in the site area estimate.

Radium-226 was detected at an elevated concentration of 1,140 pCi/g in one area during the Phase I remedial investigation. This was analyzed and determined to come from a stone in the sample. Although release rates are based on dust erosion and not buried stones, this detection was used in the source term calculation.

Soil concentration data, listed in Table B-3, are not available for all the radionuclides in Table B-1. If explicit results for a radionuclide were not available, it was assumed that the radionuclide was present in equilibrium with (i.e., at the same concentration as) the nearest long-lived parent. Branching ratios were used to estimate source term concentrations. Table B-3 lists the source term values used in the CAP-88 modeled scenarios.

Table B-1. Radionuclides Considered in NESHAPS Evaluation

Uranium Series	Thorium Series	Actinium Series
U-238	Th-232	U-235
Th-234	Ra-228	Th-231
Pa-234m	Ac-228	Pa-231
Pa-234 (0.13%)	Th-228	Ac-227
U-234	Ra-224	Th-227 (98.62%)
Th-230	*Rn-220 (thoron)	Fr-223 (1.38%)
Ra-226	Po-216	Ra-223
*Rn-222 (radon)	Pb-212	*Rn-219 (actinon)
Po-218	Bi-212	Po-215
Pb-214 (99.98%)	Po-212 (64.07%)	Pb-211 ($\approx 100\%$)
At-218 (0.02%)	Tl-208 (35.93%)	At-215 (0.00023%)
Bi-214	*Pb-208 (stable)	Bi-211
Po-214 (99.979%)		Po-211 (0.273%)
Tl-210 (0.021%)		Tl-207 (99.73%)
Pb-210		*Pb-207 (stable)
Bi-210		
Po-210 ($\approx 100\%$)		
Tl-206 (0.00013%)		
*Pb-206 (stable)		
Nuclides with asterisks (*) were excluded from dose calculations for the following reasons: 1) Radon isotopes including thoron and actinon are specifically excluded per the regulation or 2) nuclides of low abundance and stable nuclides do not contribute significantly to radiological dose.		
Nuclides are presented from top to bottom in order of decay starting from the parent radionuclides. Branching fractions are shown, as appropriate, for consideration in source term development. Fractions taken from Shleien, 1992.		

Table B-2. Summary of Phases I, II, and III Characterization Data Used in NESHAP Dose Calculations

Analyte	Units	Results	Minimum Detect	Maximum Detect	Average Result	95% UCL of the Mean	Input Exposure Concentration
Radium-226 ^a	(pCi/g)	552	0.0607	1140	10.23	26.09	26.09
Thorium-228	(pCi/g)	552	0.0481	2.38	1.06	1.08	1.08
Thorium-230	(pCi/g)	552	0.0906	978	8.68	22.74	22.74
Thorium-232	(pCi/g)	551	0.0149	2.07	0.88	0.89	0.89
Uranium-234	(pCi/g)	552	0.0416	8340	20.57	87.4	87.4
Uranium-235	(pCi/g)	553	-0.16	886	1.94	8.97	8.97
Uranium-238	(pCi/g)	551	0.049	8830	21.59	92.38	92.38

^a Includes previous outlier 1,140 pCi/g (NiagAir1 on 25JUL00 at 15:36 using dataset allradnq)

Table B-3. Soil Concentration and Estimated Emission of Radionuclides from NFSS for CY 2006

Soil Concentration and CAPP88 Input Source Term								
Uranium Series			Thorium Series			Actinium Series		
Nuclide	pCi/g	Ci/y	Nuclide	pCi/g	Ci/y	Nuclide	pCi/g	Ci/y
U-238	92.38	1.66E-05	Th-232	0.89	1.60E-07	U-235	8.97	1.61E-06
Th-234	92.38	1.66E-05	Ra-228	0.89	1.60E-07	Th-231	8.97	1.61E-06
Pa-234m	92.38	1.66E-05	Ac-228	0.89	1.60E-07	Pa-231	8.97	1.61E-06
Pa-234	92.38	2.16E-08	Th-228	1.08	1.94E-07	Ac-227	8.97	1.61E-06
U-234	87.4	1.57E-05	Ra-224	1.08	1.94E-07	Th-227	8.97	1.58E-06
Th-230	22.74	4.08E-06	Rn-220	1.08	0.00E-00	Fr-223	8.97	2.22E-08
Ra-226	26.09	4.68E-06	Po-216	1.08	1.94E-07	Ra-223	8.97	1.61E-06
Rn-222	26.09	0.00E-00	Pb-212	1.08	1.94E-07	Rn-219	8.97	0.00E-00
Po-218	26.09	4.68E-06	Bi-212	1.08	1.94E-07	Po-215	8.97	1.61E-06
Pb-214	26.09	4.68E-06	Po-212	1.08	1.24E-07	Pb-211	8.97	1.61E-06
At-218	26.09	9.36E-10	Tl-208	1.08	6.96E-08	At-215	8.97	3.70E-12
Bi-214	26.09	4.68E-06	Pb-208 (stable)	1.08	0.00E-00	Bi-211	8.97	1.61E-06
Po-214	26.09	4.68E-06				Po-211	8.97	4.39E-09
Tl-210	26.09	9.83E-10				Tl-207	8.97	1.61E-06
Pb-210	26.09	4.68E-06				Pb-207 (stable)	8.97	0.00E-00
Bi-210	26.09	4.68E-06						
Po-210	26.09	4.68E-06						
Tl-206	26.09	6.09E-12						
Pb-206 (stable)	26.09	0.00E-00						

B.2 REFERENCES

Shleien, 1992. *The Health Physics and Radiological Health Handbook*, Scinta, Inc., Silver Spring, MD.

ATTACHMENT C

CAPP88-PC REPORTS – INDIVIDUAL

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

D O S E A N D R I S K E Q U I V A L E N T S U M M A R I E S

Non-Radon Individual Assessment

Apr 11, 2007 11:15 am

Facility: Niagara Falls Storage Site
Address: 1397 Pletcher Road
City: Lewiston
State: NY Zip: 14174

Source Category: Area Source
Source Type: Area
Emission Year: 2006

Comments: Tech Memo 2006
Cap88V3

Dataset Name: NFSS 2006 Ind
Dataset Date: 4/11/2007 10:40:00 AM
Wind File: . C:\Program Files\CAP88-
PC30\WindLib\IAG0905.WND

Apr 11, 2007 11:15 am

SUMMARY
Page 1

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)
INGESTION	9.29E-05
INHALATION	4.14E-03
AIR IMMERSION	1.51E-08
GROUND SURFACE	1.59E-04
INTERNAL	4.24E-03
EXTERNAL	1.59E-04
TOTAL	4.39E-03

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem/y)
U-238	3.91E-04
Th-234	3.08E-06
Pa-234m	2.66E-05
Pa-234	1.28E-10
U-234	4.50E-04
Th-230	4.69E-04
Ra-226	1.57E-04
Rn-222	2.97E-15
Po-218	5.78E-10
Pb-214	1.65E-05
Bi-214	9.68E-05
Po-214	5.29E-09
Pb-210	6.96E-05
Bi-210	6.00E-06
Po-210	1.34E-04
At-218	0.00E+00
Th-232	3.22E-05
Ra-228	3.43E-06
Ac-228	1.57E-08
Th-228	6.25E-05
Ra-224	4.68E-06
Rn-220	1.13E-13
Po-216	4.78E-15
Pb-212	2.70E-07
Bi-212	4.86E-08
Po-212	0.00E+00
Tl-208	3.75E-10
U-235	4.43E-05
Th-231	3.78E-07
Pa-231	1.23E-03
Ac-227	9.56E-04
Th-227	1.36E-04
Ra-223	1.01E-04
Rn-219	1.35E-10
Po-215	3.97E-09
Pb-211	2.39E-06
Bi-211	1.04E-06
Tl-207	1.31E-06
Po-211	5.10E-14
Fr-223	1.88E-09
TOTAL	4.39E-03

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
Esophagu	3.49E-12
Stomach	1.01E-11
Colon	2.96E-11
Liver	8.56E-11
LUNG	1.67E-09
Bone	5.67E-11
Skin	3.59E-12
Breast	9.36E-12
Ovary	1.16E-11
Bladder	8.31E-12
Kidneys	1.03E-11
Thyroid	8.24E-13
Leukemia	1.74E-11
Residual	3.87E-11
Total	1.95E-09
TOTAL	3.90E-09

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	2.84E-11
INHALATION	1.85E-09
AIR IMMERSION	8.09E-15
GROUND SURFACE	7.23E-11
INTERNAL	1.88E-09
EXTERNAL	7.23E-11
TOTAL	1.95E-09

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual
	Total Lifetime Fatal Cancer Risk
U-238	3.23E-10
Th-234	2.20E-12
Pa-234m	4.27E-12
Pa-234	8.19E-17
U-234	3.72E-10
Th-230	2.40E-10
Ra-226	1.20E-10
Rn-222	1.61E-21
Po-218	3.17E-16
Pb-214	8.87E-12
Bi-214	5.14E-11
Po-214	2.90E-15
Pb-210	3.52E-11
Bi-210	3.39E-12
Po-210	1.08E-10
At-218	0.00E+00
Th-232	1.43E-11
Ra-228	1.64E-12
Ac-228	1.00E-14
Th-228	5.35E-11
Ra-224	4.03E-12
Rn-220	6.19E-20
Po-216	2.61E-21
Pb-212	2.33E-13
Bi-212	3.14E-14
Po-212	0.00E+00
Tl-208	2.07E-16
U-235	3.56E-11
Th-231	1.73E-13
Pa-231	1.17E-10
Ac-227	2.52E-10
Th-227	1.17E-10
Ra-223	8.60E-11
Rn-219	7.28E-17
Po-215	2.18E-15
Pb-211	8.68E-13
Bi-211	5.70E-13
Tl-207	1.67E-13
Po-211	2.79E-20
Fr-223	1.59E-15
TOTAL	1.95E-09

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)
(All Radionuclides and Pathways)

Distance (m)							
Direction	533	783	914	1105	1250	1486	2499
N	3.1E-03	1.3E-03	9.9E-04	7.4E-04	6.2E-04	4.9E-04	2.6E-04
NNW	2.5E-03	1.0E-03	7.3E-04	5.0E-04	4.0E-04	2.9E-04	1.3E-04
NW	2.5E-03	8.7E-04	6.6E-04	4.9E-04	4.1E-04	3.2E-04	1.8E-04
WNW	2.7E-03	1.4E-03	1.0E-03	7.1E-04	5.8E-04	4.4E-04	2.1E-04
W	2.9E-03	1.5E-03	1.1E-03	8.4E-04	7.2E-04	5.8E-04	3.1E-04
WSW	2.9E-03	1.4E-03	1.1E-03	7.5E-04	6.1E-04	4.6E-04	2.1E-04
SW	2.7E-03	1.1E-03	8.1E-04	6.0E-04	5.0E-04	4.0E-04	2.1E-04
SSW	2.4E-03	1.1E-03	8.0E-04	5.6E-04	4.5E-04	3.4E-04	1.6E-04
S	2.6E-03	1.1E-03	8.2E-04	6.1E-04	5.2E-04	4.1E-04	2.2E-04
SSE	2.9E-03	1.4E-03	1.0E-03	7.2E-04	5.8E-04	4.4E-04	2.0E-04
SE	3.4E-03	1.5E-03	1.1E-03	8.4E-04	7.0E-04	5.5E-04	2.8E-04
ESE	3.7E-03	1.8E-03	1.3E-03	9.2E-04	7.5E-04	5.7E-04	2.6E-04
E	4.2E-03	1.8E-03	1.3E-03	9.7E-04	8.0E-04	6.2E-04	3.0E-04
ENE	4.4E-03	2.1E-03	1.5E-03	1.1E-03	8.8E-04	6.6E-04	2.9E-04
NE	4.4E-03	2.1E-03	1.6E-03	1.2E-03	9.8E-04	7.7E-04	4.0E-04
NNE	3.9E-03	2.0E-03	1.5E-03	1.0E-03	8.4E-04	6.3E-04	2.8E-04

Distance (m)	
Direction	2629
N	2.5E-04
NNW	1.2E-04
NW	1.7E-04
WNW	1.9E-04
W	2.9E-04
WSW	2.0E-04
SW	2.0E-04
SSW	1.5E-04
S	2.1E-04
SSE	1.9E-04
SE	2.7E-04
ESE	2.5E-04
E	2.8E-04
ENE	2.7E-04
NE	3.7E-04
NNE	2.6E-04

INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

Distance (m)							
<hr/>							
Direction	533	783	914	1105	1250	1486	2499
<hr/>							
N	1.4E-09	5.7E-10	4.3E-10	3.2E-10	2.7E-10	2.1E-10	1.1E-10
NNW	1.1E-09	4.4E-10	3.1E-10	2.1E-10	1.7E-10	1.2E-10	4.8E-11
NW	1.1E-09	3.8E-10	2.9E-10	2.1E-10	1.7E-10	1.3E-10	6.9E-11
WNW	1.2E-09	5.9E-10	4.4E-10	3.1E-10	2.5E-10	1.8E-10	8.2E-11
W	1.3E-09	6.4E-10	4.9E-10	3.7E-10	3.1E-10	2.5E-10	1.3E-10
WSW	1.3E-09	6.4E-10	4.7E-10	3.3E-10	2.6E-10	1.9E-10	8.4E-11
SW	1.2E-09	4.6E-10	3.5E-10	2.6E-10	2.1E-10	1.7E-10	8.4E-11
SSW	1.1E-09	4.7E-10	3.5E-10	2.4E-10	1.9E-10	1.4E-10	6.3E-11
S	1.2E-09	4.7E-10	3.6E-10	2.6E-10	2.2E-10	1.7E-10	8.9E-11
SSE	1.3E-09	6.1E-10	4.5E-10	3.1E-10	2.5E-10	1.9E-10	8.1E-11
SE	1.5E-09	6.6E-10	5.0E-10	3.7E-10	3.0E-10	2.4E-10	1.2E-10
ESE	1.6E-09	7.7E-10	5.7E-10	4.0E-10	3.3E-10	2.4E-10	1.1E-10
E	1.9E-09	7.8E-10	5.8E-10	4.2E-10	3.5E-10	2.7E-10	1.3E-10
ENE	2.0E-09	9.3E-10	6.8E-10	4.8E-10	3.8E-10	2.8E-10	1.2E-10
NE	1.9E-09	9.1E-10	6.9E-10	5.1E-10	4.3E-10	3.4E-10	1.7E-10
NNE	1.7E-09	8.7E-10	6.4E-10	4.5E-10	3.6E-10	2.7E-10	1.2E-10

Distance (m)	
<hr/>	
Direction	2629
<hr/>	
N	1.0E-10
NNW	4.6E-11
NW	6.5E-11
WNW	7.7E-11
W	1.2E-10
WSW	7.9E-11
SW	7.9E-11
SSW	5.9E-11
S	8.3E-11
SSE	7.6E-11
SE	1.1E-10
ESE	1.0E-10
E	1.2E-10
ENE	1.1E-10
NE	1.5E-10
NNE	1.1E-10

ATTACHMENT D

CAP88-PC REPORTS – POPULATION

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

D O S E A N D R I S K E Q U I V A L E N T S U M M A R I E S

Non-Radon Population Assessment

Apr 11, 2007 09:40 am

Facility: Niagara Falls Storage Site
Address: 1397 Pletcher Road
City: Lewiston
State: NY Zip: 14174

Source Category: Area Source
Source Type: Area
Emission Year: 2006

Comments: Tech Memo 2006
Cap88V3

Dataset Name: NFSS 2006 Pop
Dataset Date: 4/11/2007 9:05:00 AM
Wind File: . C:\Program Files\CAP88-
PC30\WindLib\IAG0905.WND
Population File: C:\Program Files\CAP88-
PC30\Poplib\NFSS2003.POP

Apr 11, 2007 09:40 am

SUMMARY
Page 1

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)	Collective Population (person-rem/y)
INGESTION	1.38E-05	6.06E-04
INHALATION	1.65E-02	2.21E-02
AIR IMMERSION	6.03E-08	8.10E-08
GROUND SURFACE	5.95E-04	1.47E-03
INTERNAL	1.65E-02	2.27E-02
EXTERNAL	5.95E-04	1.47E-03
TOTAL	1.71E-02	2.41E-02

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclides	Selected Individual (mrem/y)	Collective Population (person-rem/y)
U-238	1.54E-03	2.09E-03
Th-234	1.11E-05	2.38E-05
Pa-234m	1.00E-04	2.46E-04
Pa-234	5.12E-10	6.84E-10
U-234	1.77E-03	2.41E-03
Th-230	1.85E-03	2.50E-03
Ra-226	5.29E-04	8.82E-04
Rn-222	1.16E-14	2.55E-14
Po-218	2.17E-09	5.35E-09
Pb-214	6.21E-05	1.51E-04
Bi-214	3.64E-04	8.93E-04
Po-214	1.99E-08	4.89E-08
Pb-210	1.72E-04	4.04E-04
Bi-210	2.33E-05	4.16E-05
Po-210	4.96E-04	7.16E-04
At-218	0.00E+00	0.00E+00
Th-232	1.28E-04	1.72E-04
Ra-228	1.37E-05	1.83E-05
Ac-228	6.25E-08	8.36E-08
Th-228	2.49E-04	3.33E-04
Ra-224	1.87E-05	2.49E-05
Rn-220	4.44E-13	9.72E-13
Po-216	1.90E-14	2.54E-14
Pb-212	1.08E-06	1.44E-06
Bi-212	1.94E-07	2.59E-07
Po-212	0.00E+00	0.00E+00
Tl-208	1.49E-09	2.00E-09
U-235	1.73E-04	2.50E-04
Th-231	1.42E-06	3.48E-06
Pa-231	4.87E-03	6.56E-03
Ac-227	3.79E-03	5.09E-03
Th-227	5.43E-04	7.36E-04
Ra-223	3.98E-04	5.51E-04
Rn-219	5.28E-10	1.16E-09
Po-215	1.49E-08	3.67E-08
Pb-211	9.00E-06	2.15E-05
Bi-211	3.90E-06	9.62E-06
Tl-207	4.92E-06	1.21E-05
Po-211	2.03E-13	2.72E-13
Fr-223	7.48E-09	1.00E-08
TOTAL	1.71E-02	2.41E-02

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk	Total Collective Population Fatal Cancer Risk (Deaths/y)
Esophagu	1.27E-11	3.06E-10
Stomach	3.59E-11	9.56E-10
Colon	9.23E-11	2.77E-09
Liver	3.23E-10	6.06E-09
LUNG	6.63E-09	1.16E-07
Bone	2.10E-10	3.99E-09
Skin	1.34E-11	4.23E-10
Breast	3.39E-11	9.76E-10
Ovary	4.46E-11	8.88E-10
Bladder	3.04E-11	7.31E-10
Kidneys	3.08E-11	7.74E-10
Thyroid	2.93E-12	7.78E-11
Leukemia	6.31E-11	1.58E-09
Residual	1.29E-10	3.66E-09
Total	7.65E-09	1.39E-07

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk	Total Collective Population Fatal Cancer Risk (Deaths/y)
INGESTION	4.15E-12	2.42E-09
INHALATION	7.37E-09	1.28E-07
AIR IMMERSION	3.22E-14	5.61E-13
GROUND SURFACE	2.72E-10	8.67E-09
INTERNAL	7.38E-09	1.30E-07
EXTERNAL	2.72E-10	8.67E-09
TOTAL	7.65E-09	1.39E-07

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk	Total Collective Population Fatal Cancer Risk (Deaths/y)
U-238	1.28E-09	2.23E-08
Th-234	7.45E-12	2.03E-10
Pa-234m	1.60E-11	5.11E-10
Pa-234	3.26E-16	5.65E-15
U-234	1.47E-09	2.57E-08
Th-230	9.55E-10	1.66E-08
Ra-226	4.46E-10	8.49E-09
Rn-222	6.33E-21	1.79E-19
Po-218	1.19E-15	3.80E-14
Pb-214	3.34E-11	1.05E-09
Bi-214	1.93E-10	6.15E-09
Po-214	1.09E-14	3.48E-13
Pb-210	1.05E-10	2.57E-09
Bi-210	1.33E-11	2.48E-10
Po-210	4.18E-10	7.51E-09
At-218	0.00E+00	0.00E+00
Th-232	5.69E-11	9.86E-10
Ra-228	6.52E-12	1.13E-10
Ac-228	3.98E-14	6.90E-13
Th-228	2.13E-10	3.70E-09
Ra-224	1.61E-11	2.78E-10
Rn-220	2.43E-19	6.88E-18
Po-216	1.04E-20	1.80E-19
Pb-212	9.28E-13	1.61E-11
Bi-212	1.25E-13	2.16E-12
Po-212	0.00E+00	0.00E+00
Tl-208	8.25E-16	1.43E-14
U-235	1.41E-10	2.56E-09
Th-231	6.52E-13	2.05E-11
Pa-231	4.62E-10	8.07E-09
Ac-227	1.00E-09	1.74E-08
Th-227	4.68E-10	8.17E-09
Ra-223	3.40E-10	6.02E-09
Rn-219	2.86E-16	8.10E-15
Po-215	8.17E-15	2.61E-13
Pb-211	3.29E-12	9.77E-11
Bi-211	2.14E-12	6.82E-11
Tl-207	6.28E-13	2.00E-11
Po-211	1.11E-19	1.93E-18
Fr-223	6.33E-15	1.10E-13
TOTAL	7.65E-09	1.39E-07

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)
(All Radionuclides and Pathways)

Distance (m)							
Direction	250	750	1500	2500	3500	4500	7500
N	1.7E-02	1.3E-03	4.1E-04	1.9E-04	1.1E-04	7.5E-05	3.4E-05
NNW	1.7E-02	1.0E-03	2.1E-04	5.9E-05	3.4E-05	2.3E-05	1.0E-05
NW	1.7E-02	8.7E-04	2.5E-04	1.1E-04	6.1E-05	4.1E-05	1.8E-05
WNW	1.7E-02	1.4E-03	3.6E-04	1.4E-04	7.8E-05	5.3E-05	2.4E-05
W	1.7E-02	1.5E-03	5.0E-04	2.4E-04	1.4E-04	9.4E-05	4.2E-05
WSW	1.7E-02	1.5E-03	3.8E-04	1.4E-04	8.1E-05	5.5E-05	2.5E-05
SW	1.7E-02	1.1E-03	3.2E-04	1.4E-04	8.1E-05	5.5E-05	2.5E-05
SSW	1.7E-02	1.1E-03	2.6E-04	9.2E-05	5.3E-05	3.6E-05	1.6E-05
S	1.7E-02	1.1E-03	3.3E-04	1.5E-04	8.7E-05	5.9E-05	2.6E-05
SSE	1.7E-02	1.4E-03	3.6E-04	1.3E-04	7.7E-05	5.2E-05	2.4E-05
SE	1.7E-02	1.5E-03	4.7E-04	2.1E-04	1.2E-04	8.3E-05	3.8E-05
ESE	1.7E-02	1.8E-03	4.9E-04	1.9E-04	1.1E-04	7.6E-05	3.4E-05
E	1.7E-02	1.8E-03	5.4E-04	2.3E-04	1.3E-04	9.2E-05	4.2E-05
ENE	1.7E-02	2.2E-03	5.7E-04	2.2E-04	1.3E-04	8.7E-05	4.0E-05
NE	1.7E-02	2.1E-03	6.9E-04	3.2E-04	1.9E-04	1.3E-04	5.8E-05
NNE	1.7E-02	2.1E-03	5.4E-04	2.1E-04	1.2E-04	8.4E-05	3.8E-05

Distance (m)							
Direction	15000	25000	35000	45000	55000	65000	75000
N	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E-06	8.5E-07
NNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.1E-07	3.7E-07	3.0E-07
NW	6.6E-06	0.0E+00	0.0E+00	0.0E+00	8.1E-07	5.6E-07	4.4E-07
WNW	8.5E-06	0.0E+00	0.0E+00	0.0E+00	9.9E-07	6.6E-07	5.1E-07
W	1.5E-05	6.8E-06	4.1E-06	2.7E-06	1.8E-06	1.2E-06	9.2E-07
WSW	9.1E-06	4.1E-06	2.5E-06	1.7E-06	1.1E-06	7.9E-07	6.2E-07
SW	9.0E-06	4.1E-06	2.5E-06	1.7E-06	1.1E-06	7.9E-07	0.0E+00
SSW	5.8E-06	2.6E-06	1.6E-06	1.1E-06	0.0E+00	5.4E-07	4.3E-07
S	9.6E-06	4.3E-06	2.6E-06	1.8E-06	1.2E-06	8.4E-07	6.5E-07
SSE	8.5E-06	3.9E-06	2.4E-06	1.6E-06	1.1E-06	7.9E-07	6.2E-07
SE	1.4E-05	6.1E-06	3.7E-06	2.5E-06	1.7E-06	1.2E-06	9.4E-07
ESE	1.2E-05	5.7E-06	3.5E-06	2.3E-06	1.6E-06	1.1E-06	8.9E-07
E	1.5E-05	6.9E-06	4.2E-06	2.8E-06	2.0E-06	1.4E-06	1.1E-06
ENE	1.4E-05	6.6E-06	4.1E-06	2.8E-06	1.9E-06	1.4E-06	1.1E-06
NE	2.1E-05	9.8E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	1.4E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E-06

COLLECTIVE EFFECTIVE DOSE EQUIVALENT (person rem/y)
(All Radionuclides and Pathways)

Distance (m)							
Direction	250	750	1500	2500	3500	4500	7500
N	1.5E-04	3.7E-05	3.9E-05	2.6E-05	2.1E-05	1.8E-05	4.6E-05
NNW	1.5E-04	2.9E-05	2.2E-05	7.9E-06	6.4E-06	5.1E-06	1.6E-05
NW	1.5E-04	2.4E-05	2.8E-05	1.6E-05	1.1E-05	1.1E-05	1.5E-04
WNW	1.5E-04	3.9E-05	4.0E-05	2.5E-05	1.9E-05	3.0E-05	9.0E-05
W	1.5E-04	4.2E-05	5.5E-05	4.4E-05	2.2E-04	3.1E-05	4.8E-05
WSW	1.5E-04	4.2E-05	4.2E-05	2.6E-05	1.2E-04	1.1E-04	1.7E-04
SW	1.5E-04	3.0E-05	3.5E-05	2.6E-05	2.6E-05	1.2E-04	3.0E-04
SSW	1.5E-04	3.1E-05	2.9E-05	1.7E-05	1.5E-05	5.5E-05	1.8E-04
S	1.5E-04	3.0E-05	3.7E-05	2.8E-05	1.9E-05	1.7E-05	2.7E-04
SSE	1.5E-04	4.0E-05	4.0E-05	2.5E-05	1.7E-05	1.5E-05	1.1E-04
SE	1.5E-04	4.3E-05	5.2E-05	3.9E-05	2.9E-05	2.4E-05	1.2E-04
ESE	1.5E-04	5.1E-05	5.4E-05	3.6E-05	2.9E-05	2.5E-05	8.7E-05
E	1.5E-04	5.2E-05	6.0E-05	4.3E-05	3.5E-05	3.0E-05	1.0E-04
ENE	1.5E-04	6.2E-05	6.4E-05	3.9E-05	2.5E-05	1.8E-05	1.3E-04
NE	1.5E-04	6.0E-05	7.5E-05	4.0E-05	2.2E-05	1.8E-05	1.6E-04
NNE	1.5E-04	5.8E-05	5.3E-05	2.8E-05	2.2E-05	1.7E-05	5.7E-05

Distance (m)							
Direction	15000	25000	35000	45000	55000	65000	75000
N	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.3E-05	2.4E-04
NNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E-04	3.9E-04	2.1E-04
NW	6.7E-06	0.0E+00	0.0E+00	0.0E+00	4.0E-06	4.5E-04	2.3E-04
WNW	3.0E-05	0.0E+00	0.0E+00	0.0E+00	9.9E-10	1.7E-04	4.5E-05
W	4.0E-04	4.3E-04	3.9E-05	7.5E-05	3.8E-05	2.0E-04	2.3E-04
WSW	1.3E-04	1.9E-04	2.0E-05	1.1E-05	6.2E-06	7.7E-06	3.5E-06
SW	6.3E-04	2.3E-05	1.4E-04	2.3E-05	2.2E-06	5.4E-07	0.0E+00
SSW	6.7E-04	6.1E-06	1.2E-05	4.7E-06	0.0E+00	7.7E-08	6.4E-06
S	8.6E-04	2.3E-04	2.5E-04	1.0E-05	1.3E-04	5.2E-05	2.4E-05
SSE	6.6E-04	1.8E-03	2.1E-03	7.5E-04	1.8E-04	3.4E-05	1.5E-05
SE	2.4E-04	7.3E-04	6.9E-04	2.7E-04	8.1E-05	2.9E-05	2.1E-05
ESE	1.4E-04	4.6E-04	5.4E-05	5.7E-05	3.6E-05	7.8E-05	2.9E-05
E	1.5E-04	3.6E-04	6.7E-05	1.1E-04	3.0E-05	5.3E-05	4.2E-05
ENE	8.3E-05	1.4E-04	3.9E-05	1.9E-05	1.1E-05	4.6E-06	2.1E-06
NE	1.8E-04	1.1E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	7.3E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E-05

INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

Distance (m)							
Direction	250	750	1500	2500	3500	4500	7500
N	7.6E-09	5.9E-10	1.9E-10	8.5E-11	4.9E-11	3.4E-11	1.5E-11
NNW	7.6E-09	4.6E-10	9.5E-11	2.6E-11	1.5E-11	1.0E-11	4.6E-12
NW	7.6E-09	3.9E-10	1.1E-10	4.7E-11	2.7E-11	1.8E-11	8.2E-12
WNW	7.6E-09	6.2E-10	1.6E-10	6.1E-11	3.5E-11	2.4E-11	1.1E-11
W	7.6E-09	6.7E-10	2.2E-10	1.1E-10	6.2E-11	4.2E-11	1.9E-11
WSW	7.6E-09	6.7E-10	1.7E-10	6.3E-11	3.6E-11	2.5E-11	1.1E-11
SW	7.6E-09	4.8E-10	1.4E-10	6.3E-11	3.6E-11	2.5E-11	1.1E-11
SSW	7.6E-09	4.9E-10	1.2E-10	4.1E-11	2.4E-11	1.6E-11	7.2E-12
S	7.6E-09	4.9E-10	1.5E-10	6.7E-11	3.9E-11	2.6E-11	1.2E-11
SSE	7.7E-09	6.4E-10	1.6E-10	5.9E-11	3.4E-11	2.3E-11	1.1E-11
SE	7.6E-09	6.9E-10	2.1E-10	9.5E-11	5.5E-11	3.7E-11	1.7E-11
ESE	7.6E-09	8.2E-10	2.2E-10	8.6E-11	5.0E-11	3.4E-11	1.5E-11
E	7.6E-09	8.2E-10	2.4E-10	1.0E-10	6.0E-11	4.1E-11	1.9E-11
ENE	7.6E-09	9.9E-10	2.6E-10	9.8E-11	5.7E-11	3.9E-11	1.8E-11
NE	7.6E-09	9.6E-10	3.1E-10	1.4E-10	8.4E-11	5.7E-11	2.6E-11
NNE	7.6E-09	9.3E-10	2.4E-10	9.4E-11	5.5E-11	3.7E-11	1.7E-11

Distance (m)							
Direction	15000	25000	35000	45000	55000	65000	75000
N	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.8E-13	3.7E-13
NNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E-13	1.6E-13	1.2E-13
NW	2.9E-12	0.0E+00	0.0E+00	0.0E+00	3.5E-13	2.4E-13	1.9E-13
WNW	3.8E-12	0.0E+00	0.0E+00	0.0E+00	4.3E-13	2.8E-13	2.2E-13
W	6.8E-12	3.0E-12	1.8E-12	1.2E-12	8.0E-13	5.3E-13	4.0E-13
WSW	4.0E-12	1.8E-12	1.1E-12	7.4E-13	5.0E-13	3.4E-13	2.7E-13
SW	4.0E-12	1.8E-12	1.1E-12	7.3E-13	5.0E-13	3.5E-13	0.0E+00
SSW	2.6E-12	1.2E-12	7.1E-13	4.8E-13	0.0E+00	2.3E-13	1.8E-13
S	4.3E-12	1.9E-12	1.2E-12	7.8E-13	5.3E-13	3.6E-13	2.8E-13
SSE	3.8E-12	1.7E-12	1.0E-12	7.0E-13	4.9E-13	3.4E-13	2.7E-13
SE	6.1E-12	2.7E-12	1.7E-12	1.1E-12	7.6E-13	5.3E-13	4.1E-13
ESE	5.6E-12	2.5E-12	1.5E-12	1.0E-12	7.2E-13	5.0E-13	3.9E-13
E	6.8E-12	3.1E-12	1.9E-12	1.3E-12	8.7E-13	6.1E-13	4.7E-13
ENE	6.4E-12	3.0E-12	1.8E-12	1.2E-12	8.6E-13	6.1E-13	4.8E-13
NE	9.5E-12	4.4E-12	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	6.2E-12	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.5E-13

COLLECTIVE FATAL CANCER RATE (deaths/y)
(All Radionuclides and Pathways)

Distance (m)							
Direction	250	750	1500	2500	3500	4500	7500
N	8.9E-10	2.1E-10	2.3E-10	1.5E-10	1.2E-10	1.0E-10	2.7E-10
NNW	8.9E-10	1.7E-10	1.2E-10	4.6E-11	3.7E-11	3.0E-11	9.3E-11
NW	8.9E-10	1.4E-10	1.6E-10	9.2E-11	6.6E-11	6.1E-11	8.8E-10
WNW	8.9E-10	2.3E-10	2.3E-10	1.5E-10	1.1E-10	1.8E-10	5.2E-10
W	8.9E-10	2.4E-10	3.2E-10	2.6E-10	1.3E-09	1.8E-10	2.8E-10
WSW	8.9E-10	2.4E-10	2.4E-10	1.5E-10	7.2E-10	6.2E-10	9.6E-10
SW	8.8E-10	1.7E-10	2.0E-10	1.5E-10	1.5E-10	6.7E-10	1.7E-09
SSW	8.9E-10	1.8E-10	1.7E-10	9.8E-11	8.8E-11	3.2E-10	1.0E-09
S	8.9E-10	1.8E-10	2.1E-10	1.6E-10	1.1E-10	1.0E-10	1.6E-09
SSE	8.9E-10	2.3E-10	2.3E-10	1.4E-10	9.9E-11	8.5E-11	6.3E-10
SE	8.9E-10	2.5E-10	3.0E-10	2.3E-10	1.7E-10	1.4E-10	6.7E-10
ESE	8.9E-10	3.0E-10	3.1E-10	2.1E-10	1.7E-10	1.4E-10	5.0E-10
E	8.9E-10	3.0E-10	3.5E-10	2.5E-10	2.0E-10	1.8E-10	5.8E-10
ENE	8.9E-10	3.6E-10	3.7E-10	2.3E-10	1.4E-10	1.0E-10	7.3E-10
NE	8.9E-10	3.5E-10	4.4E-10	2.3E-10	1.2E-10	1.1E-10	9.1E-10
NNE	8.9E-10	3.4E-10	3.1E-10	1.6E-10	1.3E-10	1.0E-10	3.3E-10

Distance (m)							
Direction	15000	25000	35000	45000	55000	65000	75000
N	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.7E-10	1.4E-09
NNW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.0E-10	2.2E-09	1.1E-09
NW	3.8E-11	0.0E+00	0.0E+00	0.0E+00	2.3E-11	2.5E-09	1.3E-09
WNW	1.7E-10	0.0E+00	0.0E+00	0.0E+00	5.6E-15	9.3E-10	2.5E-10
W	2.3E-09	2.5E-09	2.2E-10	4.3E-10	2.2E-10	1.1E-09	1.3E-09
WSW	7.7E-10	1.1E-09	1.1E-10	6.5E-11	3.5E-11	4.3E-11	2.0E-11
SW	3.7E-09	1.3E-10	8.1E-10	1.3E-10	1.2E-11	3.1E-12	0.0E+00
SSW	3.9E-09	3.5E-11	7.1E-11	2.7E-11	0.0E+00	4.3E-13	3.5E-11
S	5.0E-09	1.3E-09	1.4E-09	5.8E-11	7.3E-10	2.9E-10	1.3E-10
SSE	3.8E-09	1.0E-08	1.2E-08	4.3E-09	1.0E-09	1.9E-10	8.4E-11
SE	1.4E-09	4.2E-09	4.0E-09	1.5E-09	4.6E-10	1.6E-10	1.2E-10
ESE	8.1E-10	2.7E-09	3.1E-10	3.3E-10	2.1E-10	4.4E-10	1.6E-10
E	8.4E-10	2.1E-09	3.8E-10	6.1E-10	1.7E-10	3.0E-10	2.4E-10
ENE	4.8E-10	8.3E-10	2.2E-10	1.1E-10	6.5E-11	2.6E-11	1.2E-11
NE	1.0E-09	6.5E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NNE	4.2E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-10

ATTACHMENT E

NATIONAL CLIMATIC DATA CENTER, NIAGARA FALLS, NEW YORK

QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA (final) NOAA, National Climatic Data Center Month: 01/2006										Station Location: NIAGARA FALLS INTL AIRPORT (04724) NIAGARA FALLS , NY Lat. 43.107 Lon. -78.945 Elevation(Ground): 585 ft. above sea level															
Date	Temperature (Fahrenheit)						Degree Days Base 65 Degrees		Significant Weather	Snow/Ice on Ground(In)		Precipitation (In)		Pressure(inches of Hg)		Wind: Speed=mph Dir=tens of degrees								Date	
	Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Heating	Cooling		1200 UTC	1200 LST	2400 LST	2400 LST	Avg. Station	Avg. Sea Level	Resultant Speed	Res Dir	Avg. Speed	max 5-second		max 2-minute				
																			Speed	Dir	Speed	Dir			
1	36	31	34	M	31	33	31	0	RA DZ SN BR	M	M	M	0.01	29.32	30.02	4.9	22	5.9	15	230	13	240	1		
2	37	33	35	M	33	35	30	0	RA DZ BR	M	M	M	0.10	29.31	30.00	10.1	08	10.3	20	060	17	060	2		
3	41	36	39	M	34	36	26	0	RA BR	M	M	M	0.01	29.30	29.97	10.3	08	11.1	26	080	20	090	3		
4	44	36	40	M	37	40	25	0	RA DZ BR	M	M	M	0.12	29.11	29.78	6.9	18	7.9	17	210	14	230	4		
5	42	31	37	M	31	34	28	0	RA DZ SN BR UP	M	M	M	0.25	29.01	29.69	10.0	28	12.8	29	250	21	240	5		
6	31	21	26	M	15	21	39	0	SN	M	M	M	T	29.26	29.93	13.7	30	14.5	24	320	22	310	6		
7	32	21	27	M	23	26	38	0	SN BR	M	M	M	0.17	29.14	29.82	10.0	19	10.7	23	180	18	190	7		
8	36	25	31	M	26	29	34	0	BR	M	M	M	T	29.21	29.90	2.6	18	8.5	15	090	13	090	8		
9	40	32	36	M	30	33	29	0	RA DZ SN BR HZ	2	M	T	T	29.24	29.98	8.5	25	10.1	22	240	18	260	9		
10	37	29	33	M	26	31	32	0	RA	T	M	0.0	T	29.70	30.38	5.4	23	8.4	22	240	17	220	10		
11	56	34	45	M	37	41	20	0	RA BR	0	M	0.0	0.15	29.29	29.93	10.0	21	11.9	38	240	29	220	11		
12	48	37	43	M	33	38	22	0	-	0	M	0.0	0.00	29.23	29.88	14.4	22	14.9	37	230	30	220	12		
13	58*	39	49*	M	36	43	16	0	RA	0	M	0.0	0.03	29.03	29.64	6.8	19	7.9	18	250	16	190	13		
14	48	20	34	M	25	29	31	0	RA SN FG+ FZFG BR	0	M	1.1	0.43	28.94	29.65	17.4	33	18.6	39	330	32	330	14		
15	20	12	16*	M	6	13	49	0	SN	T	M	T	T	29.36	30.07	9.4	33	9.6	26	330	23	330	15		
16	24	11*	18	M	9	15	47	0	-	T	M	0.0	0.00	29.34	30.03	7.9	07	8.1	20	090	15	060	16		
17	45	18	32	M	23	29	33	0	RA	T	M	0.0	0.43	29.14	29.77	11.5	12	13.9	33	160	26	160	17		
18	47	28	38	M	30	34	27	0	RA SN BR UP	0	M	0.1	0.13	28.84	29.56	19.7	23	21.8	45	240	35	240	18		
19	47	28	38	M	26	31	27	0	-	T	M	0.0	0.00	29.39	30.06	7.3	22	10.0	37	230	31	250	19		
20	54	39	47	M	37	43	18	0	RA BR HZ	0	M	0.0	0.03	29.33	29.99	11.2	22	14.4	33	240	28	240	20		
21	42	25	34	M	30	33	31	0	RA SN BR	0	M	0.3	0.27	29.39	30.13	9.0	30	10.5	35	310	26	300	21		
22	39	23	31	M	23	28	34	0	-	0	M	0.0	0.00	29.88	30.55	3.1	13	4.2	9	120	8	110	22		
23	40	28	34	M	25	30	31	0	-	0	M	0.0	0.00	29.41	30.06	4.7	26	7.4	23	240	20	250	23		
24	42	26	34	M	27	31	31	0	RA DZ SN BR	0	M	0.2	0.07	29.05	29.67	15.5	21	16.4	46	210	39	220	24		
25	36	23	30	M	23	27	35	0	SN BR	T	M	0.9	0.09	29.09	29.83	18.2	28	19.7	36	290	29	280	25		
26	36s	15	M	M	10	17	M	M	SN	T	M	0.1	0.01	29.71	30.46	9.9	30	11.4	25	310	22	310	26		
27	39	16	28	M	21	27	37	0	-	0	M	0.0	0.00	29.81	30.47	11.6	20	11.7	26	220	23	210	27		
28	48	34	41	M	30	36	24	0	-	0	M	0.0	T	29.54	30.19	11.0	21	11.7	26	220	22	230	28		
29	48	37	43	M	37	40	22	0	RA BR	0	M	0.0	0.60	29.05	29.67	5.9	17	12.4	36	220	29	220	29		
30	50	36	43	M	37	40	22	0	RA BR	0	M	0.0	T	29.00	29.67	11.5	22	12.0	32	240	25	230	30		
31	38	31	35	M	28	32	30	0	SN BR	M	M	M	0.05	29.16	29.84	10.8	26	11.7	22	260	18	260	31		
41.3 27.6 34.5 ----- 27.1 31.5 30.0 0.0										<Monthly Averages		Totals>		3.00s		29.28	29.95	5.1	23	11.6	<Monthly Average				
M M M -----										<-----Departure From Normal----->		M													
Degree Days Monthly Season to Date									Greatest 24-hr Precipitation: 0.60 Date: 29									Sea Level Pressure Date Time							
Total Departure Total Departure									Greatest 24-hr Snowfall: 0.4 Date: 07									Maximum 30.66 22 1029							
Heating: 899 M M M									Greatest Snow Depth: 3s Date: 08									Minimum 29.27 18 0510							
Cooling: 0 M																									

Month: 02/2006

Elevation(Ground): 585 ft. above sea level

D a t e	Temperature (Fahrenheit)						Degree Days Base 65 Degrees		Significant Weather	Snow/Ice on Ground(In)		Precipitation (In)		Pressure(inches of Hg)		Wind: Speed=mph Dir=tens of degrees								D a t e													
	Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Heating	Cooling		1200 UTC	1200 LST	2400 LST	2400 LST	Avg. Station	Avg. Sea Level	Resultant Speed	Res Dir	Avg. Speed	max 5-second		max 2-minute																
																			Speed	Dir	Speed	Dir	Speed		Dir												
1	38	29	34	M	25	31	31	0	-	M	M	M	0.00	29.26	M	9.0	21	10.6	21	240	17	210	1														
2	48*	34	41*	M	31	37	24	0	RA BR	M	M	M	0.04	29.13	M	4.5	19	7.4	17	190	14	200	2														
3	42	35	39	M	36	38	26	0	RA BR	M	M	M	0.19	28.92	M	8.1	22	10.7	31	220	25	220	3														
4	42	29	36	M	36	37	29	0	RA BR	M	M	M	0.39	28.94	M	11.1	08	11.5	32	090	28	070	4														
5	41	26	34	M	24	29	31	0	SN UP HZ	M	M	M	0.04	28.61	M	24.2	23	26.1	55	210	44	200	5														
6	30	23	27*	M	17	24	38	0	SN	M	M	M	T	29.00	M	25.9	24	26.0	47	250	36	250	6														
7	35s	24	M	M	22	25	M	M	SN BR	M	M	M	0.16	29.32	M	9.5	29	9.9	29	240	23	250	7														
8	25	7s	M	M	13	17	M	M	SN FZFG BR HZ	M	M	M	0.02	29.44	M	4.0	34	4.4	15	350	13	350	8														
9	24s	6s	M	M	11	16	M	M	SN FZFG BR	M	M	M	T	29.41	M	9.2	26	10.4	26	280	24	270	9														
10	28s	15s	M	M	18	21	M	M	SN FG+ FZFG BR	M	M	M	0.05	29.41	M	2.7	08	3.5	12	090	9	110	10														
11	30s	13s	M	M	19	23	M	M	SN BR HZ	M	M	M	0.01	29.42	M	6.1	05	6.8	17	020	15	020	11														
12	24s	15s	M	M	11	18	M	M	SN	M	M	M	T	29.21	M	6.0	32	9.3	17	030	14	310	12														
13	29s	22s	M	M	18	24	M	M	SN BR	M	M	M	T	29.15	M	17.3	25	17.8	37	240	31	230	13														
14	39s	27	M	M	25	30	M	M	SN FZFG BR	M	M	M	T	29.24	M	13.7	22	14.4	35	230	28	220	14														
15	44	31	38	M	29	36	27	0	-	M	M	M	0.00	29.40	M	10.7	22	12.7	33	220	28	230	15														
16	55s	33	M	M	35	37	M	M	RA DZ SN BR	M	M	M	0.49	29.36	M	7.9	09	10.8	30	170	24	180	16														
17	58s	22	M	M	21	29	M	M	RA SN BLSN	M	M	M	0.08	29.36	M	22.0	25	24.2	52	260	43	260	17														
18	25s	11	M	M	1	12	M	M	SN BR BLSN	M	M	M	T	29.66	M	17.4	28	19.0	44	270	36	270	18														
19	22s	8*	M	M	4	12	M	M	SN	M	M	M	T	29.65	M	16.5	24	16.8	32	230	26	230	19														
20	29s	16s	M	M	11	19	M	M	SN	M	M	M	T	29.39	M	17.1	24	17.4	36	240	29	230	20														
21	36s	21s	M	M	19	26	M	M	SN	M	M	M	T	29.24	M	13.5	24	14.1	38	230	29	230	21														
22	44s	18s	M	M	22	29	M	M	-	M	M	M	Ts	29.25	M	8.0	20	9.1	25	200	21	220	22														
23	42s	26s	M	M	25	31	M	M	SN FG+ BR HZ	M	M	M	T	29.20	M	10.3	25	11.8	35	280	29	290	23														
24	32s	21	M	M	13	22	M	M	SN	M	M	M	T	29.60	M	10.3	29	14.2	32	280	26	320	24														
25	42s	22s	M	M	20	27	M	M	SN BR	M	M	M	0.02	29.43	M	7.6	28	16.5	45	270	37	270	25														
26	23s	12	M	M	5	15	M	M	SN	M	M	M	0.01	29.62	M	11.7	31	13.1	28	280	23	290	26														
27	27	9s	M	M	12	17	M	M	SN BR	M	M	M	0.02	29.37	M	5.1	26	8.4	26	280	20	280	27														
28	26	8s	M	M	9	16	M	M	SN	M	M	M	T	29.29	M	13.1	26	13.7	32	270	26	260	28														
35.0										20.1	27.6	-----	19.0	24.9	M	M	<Monthly Averages								Totals>			1.90s	29.29	29.98	8.3	25	13.2	<Monthly Average			
M										M	M	-----	<-----Departure From Normal----->												M												
Degree Days										Monthly		Season to Date		Greatest 24-hr Precipitation: 0.55s Date: 16-17										Sea Level Pressure Date Time													
										Total Departure		Total Departure		Greatest 24-hr Snowfall: 0.7 Date: 07										Maximum 30.46 19 0908													
										Heating: M		M M M M		Greatest Snow Depth: 6 Date: 08										Minimum 29.09 05 0448													
										Cooling: M		M M M M																									

Month: 03/2006

NIAGARA FALLS, NY

Lat. 43.107 Lon. -78.945

Elevation(Ground): 585 ft. above sea level

Date	Temperature (Fahrenheit)						Degree Days Base 65 Degrees		Significant Weather	Snow/Ice on Ground(In)		Precipitation (In)		Pressure(inches of Hg)		Wind: Speed=mph Dir=tens of degrees								Date												
	Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Heating	Cooling		1200 UTC	1200 LST	2400 LST	2400 LST	Avg. Station	Avg. Sea Level	Resultant Speed	Res Dir	Avg. Speed	max 5-second		max 2-minute															
																			Speed	Dir	Speed	Dir	Speed		Dir											
1	33	20	27	M	14	22	38	0	SN	M	M	M	T	29.30	29.98	9.8	27	12.0	23	250	20	300	1													
2	28	18	23	M	18	22	42	0	SN FZFG	M	M	M	0.04	29.09	29.82	4.4	31	6.1	17	350	14	350	2													
3	27	13*	20*	M	11	18	45	0	SN	M	M	M	T	29.49	30.19	13.9	31	14.9	33	310	29	320	3													
4	37	23	30	M	17	25	35	0	SN	M	M	M	T	29.54	30.24	13.9	29	14.6	25	280	22	280	4													
5	40	16	28	M	16	25	37	0	-	M	M	M	0.00	29.58	30.26	9.1	27	10.0	24	280	18	280	5													
6	35	20	28	M	16	24	37	0	-	M	M	M	0.00	29.48	30.16	5.4	35	6.2	18	010	15	350	6													
7	36	21	29	M	13	24	36	0	-	M	M	M	0.02s	29.62	30.31	5.2	33	8.4	20	320	17	360	7													
8	44	22	33	M	19	29	32	0	-	M	M	M	0.00	29.36	30.04	5.3	16	5.9	14	210	10	210	8													
9	53	37	45	M	41	44	20	0	RA BR	M	M	M	0.44	28.95	29.59	10.3	17	11.3	28	180	23	180	9													
10	57	36	47	M	38	42	18	0	RA BR	M	M	M	0.08	28.93	29.64	14.3	22	17.0	47	230	37	230	10													
11	57	30	44	M	34	38	21	0	BR	M	M	M	0.00	29.57	30.21	2.1	12	4.3	9s	100	9s	100	11													
12	59	39	49	M	45	47	16	0	TSRA RA DZ BR HZ	M	M	M	0.08	29.33	29.99	2.2	21	5.4	14	190	12	200	12													
13	61	45	53	M	49	52	12	0	TSRA RA BR	M	M	M	0.75	28.97	29.58	10.9	19	14.4	35	230	29	220	13													
14	48	31	40	M	25	31	25	0	SN BLSN	M	M	M	T	28.95	29.61	24.4	25	25.0	52	250	40	250	14													
15	39	29	34	M	19	28	31	0	-	M	M	M	T	29.21	29.91	23.6	27	24.4	46	270	38	280	15													
16	40	27	34	M	19	28	31	0	-	0	M	0.0	0.00	29.44	30.13	11.1	30	12.2	26	290	21	310	16													
17	34	21	28	M	11	23	37	0	-	0	M	0.0	0.00	29.54	30.23	10.6	33	11.8	23	280	20	320	17													
18	33	19	26	M	13	23	39	0	SN	0	M	T	T	29.47	30.15	14.6	28	15.5	35	290	28	280	18													
19	34	27	31	M	20	27	34	0	SN BR UP	T	M	0.9	0.04	29.39	30.08	14.1	28	14.7	30	280	25	270	19													
20	31	23	27	M	14	23	38	0	SN	T	M	0.1s	T	29.53	30.22	11.0	34	11.5	24	310	20	340	20													
21	33	20	27	M	14	23	38	0	SN	0	M	0.1s	T	29.36	30.01	8.9	33	9.9	23	310	17	310	21													
22	34	23	29	M	23	28	36	0	SN BR	1	M	0.5	0.05	29.34	30.04	10.4	28	10.8	22	300	18	300	22													
23	37	31	34	M	23	30	31	0	SN	0	M	0.2	0.01	29.55	30.23	4.4	28	5.2	14	270	12	290	23													
24	39	31	35	M	27	31	30	0	SN BR	0	M	T	T	29.47	30.12	3.9	20	4.4	10	190	9	200	24													
25	40	30	35	M	29	32	30	0	SN BR HZ	T	M	0.1s	T	29.38	30.05	4.0	22	4.9	13	190	9	310	25													
26	45	28	37	M	26	33	28	0	RA BR	0	M	0.0	T	29.46	30.15	7.3	31	8.3	22	310	17	340	26													
27	50	25	38	M	21	32	27	0	-	0	M	0.0	0.00	29.60	30.28	8.1	21	8.3	23	200	20	200	27													
28	53	28	41	M	24	34	24	0	-	M	M	M	0.00	29.55	30.21	2.9	01	4.5	18	360	15	350	28													
29	58	29	44	M	25	36	21	0	-	0	M	0.0	0.00	29.61	30.28	1.7	30	4.9	17	310	14	300	29													
30	65	34	50	M	31	41	15	0	-	M	M	M	0.00	29.59	30.24	3.2	19	5.4	18	220	15	200	30													
31	76*	38	57*	M	42	49	8	0	RA BR HZ	0	M	0.0	0.12	29.27	29.92	10.2	20	10.7	44	210	31	230	31													
43.7										26.9	35.3	-----	23.8	31.1	29.4	0.0	<Monthly Averages								Totals>		1.64s	29.39	30.06	6.0	27	10.4	<Monthly Average			
M										M	M	-----	<-----Departure From Normal----->												M											
Degree Days									Monthly		Season to Date		Greatest 24-hr Precipitation: 0.75 Date: 13										Sea Level Pressure Date Time													
									Total Departure		Total Departure		Greatest 24-hr Snowfall: 0.2 Date: 02										Maximum 30.37 07 1054													
									Heating: 912		M M M		Greatest Snow Depth: 2s Date: 03										Minimum 29.26 10 0624													
									Cooling: 0		M																									

Month: 05/2006

NIAGARA FALLS, NY

Elevation(Ground): 585 ft. above sea level

D a t e	Temperature (Fahrenheit)						Degree Days Base 65 Degrees		Significant Weather	Snow/Ice on Ground(In)		Precipitation (In)		Pressure(inches of Hg)		Wind: Speed-mph Dir=tens of degrees								D a t e		
	Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Heating	Cooling		1200 UTC	1200 LST	2400 LST	2400 LST	Avg. Station	Avg. Sea Level	Resultant Speed	Res Dir	Avg. Speed	max		max					
																			5-second		2-minute					
																			Speed	Dir	Speed	Dir				
1	74	42	58	M	31	46	7	0	-	M	M	M	0.00	29.64	30.28	5.0	08	7.9	24	040	21	040	1			
2	71	42	57	M	35	47	8	0	-	0	M	0.0	0.00	29.39	30.01	6.4	07	6.9	23	090	18	050	2			
3	76	42	59	M	41	49	6	0	BR	M	M	M	0.00	29.30	29.93	3.4	23	7.7	22	220	20	220	3			
4	73	46	60	M	47	53	5	0	BR	M	M	M	0.01	29.20	29.84	8.5	23	10.4	28	230	22	230	4			
5	65	41	53	M	40	47	12	0	-	0	M	0.0	0.00	29.23	29.87	2.4	30	4.7	21	240	15	020	5			
6	53	36	45	M	32	40	20	0	RA	0	M	0.0	0.09	29.30	29.98	8.9	32	10.1	25	310	22	290	6			
7	64	29*	47	M	31	41	18	0	-	0	M	0.0	0.00	29.46	30.11	1.4	11	3.5	14	030	13	030	7			
8	73	41	57	M	35	47	8	0	-	0	M	0.0	0.00	29.41	30.06	3.0	06	5.7	16	050	14	040	8			
9	73	47	60	M	39	50	5	0	-	0	M	0.0	0.00	29.36	29.99	1.4	13	8.0	18	020	15	010	9			
10	79	47	63	M	41	52	2	0	-	0	M	0.0	0.00	29.19	29.80	4.9	07	7.0	22	040	18	040	10			
11	74	54	64	M	52	56	1	0	RA BR	0	M	0.0	0.54	28.92	29.52	9.2	14	11.4	36	140	26	140	11			
12	66	48	57	M	46	51	8	0	RA BR	0	M	0.0	0.17	28.99	29.66	7.2	20	8.6	23	200	18	210	12			
13	67	46	57	M	48	52	8	0	RA BR HZ	0	M	0.0	0.15	29.19	29.84	3.3	07	5.5	22	050	18	050	13			
14	66	50	58	M	50	53	7	0	RA	0	M	0.0	0.01	29.27	29.92	11.5	07	12.0	26	040	23	050	14			
15	66	49	58	M	50	52	7	0	RA BR	0	M	0.0	0.35	29.24	29.86	6.2	07	8.7	23	050	17	090	15			
16	61	50	56	M	48	50	9	0	RA BR	0	M	0.0	0.06	29.01	29.63	5.5	21	6.8	16	230	14	210	16			
17	66	50	58	M	51	53	7	0	RA BR HZ	0	M	0.0	0.02	28.89	29.50	10.5	21	10.9	24	190	21	220	17			
18	59	45	52	M	47	50	13	0	RA BR	0	M	0.0	0.11	28.77	29.42	8.6	21	9.5	30	240	25	240	18			
19	59	39	49	M	43	47	16	0	RA FG+ FG BR	0	M	0.0	0.04	28.93	29.58	10.7	23	11.2	29	220	21	260	19			
20	60	46	53	M	40	47	12	0	RA	0	M	0.0	T	29.03	29.67	14.9	26	16.1	30	290	25	290	20			
21	55	41	48	M	37	42	17	0	RA	0	M	0.0	0.11	29.07	29.74	17.0	27	18.1	40	280	32	290	21			
22	53	37	45*	M	33	40	20	0	-	0	M	0.0	0.01	29.38	30.06	11.8	31	12.4	25	300	22	310	22			
23	63	35	49	M	37	44	16	0	-	0	M	0.0	0.00	29.46	30.11	7.0	27	9.2	22	300	20	300	23			
24	70	38	54	M	40	48	11	0	-	0	M	0.0	0.00	29.39	30.02	8.4	21	8.6	22	200	18	240	24			
25	71	50	61	M	48	55	4	0	-	0	M	0.0	T	29.13	29.74	6.6	19	6.9	23	200	16	190	25			
26	69	57	63	M	58	60	2	0	RA DZ FG+ FG BR	0	M	0.0	0.10	28.97	29.59	1.8	24	4.4	14	230	13	210	26			
27	76	56	66	M	57	60	0	1	BR HZ	0	M	0.0	0.00	29.25	29.92	4.3	30	6.7	16	310	14	360	27			
28	82	53	68	M	57	62	0	3	BR HZ	0	M	0.0	0.00	29.47	30.10	4.7	20	5.3	17	200	14	200	28			
29	88	63	76	M	63	67	0	11	HZ	0	M	0.0	0.00	29.44	30.06	8.0	21	8.1	18	220	16	210	29			
30	91*	58s	M	M	65	69	M	M	BR HZ	0	M	0.0	0.00	29.44	30.06	5.8	21	6.0	18	210	14	240	30			
31	88	67	78*	M	64	68	0	13	BR HZ	0	M	0.0	0.00	29.42	30.03	7.8	22	8.6	21	230	17	220	31			
69.4 46.6 58.0 ----- 45.4 51.5 8.3 0.9										<Monthly Averages				Totals>		1.77s	29.23	29.87	2.9	23	8.6	<Monthly Average				
M M M -----										<-----Departure From Normal----->				M												
Degree Days Monthly Season to Date									Greatest 24-hr Precipitation: 0.71s Date: 11-12									Sea Level Pressure Date Time								
Total Departure Total Departure									Greatest 24-hr Snowfall: M Date: M									Maximum 30.39 01 0815								
Heating: 249 M M M									Greatest Snow Depth: M Date: M									Minimum 29.33 18 1017								
Cooling: 28 M																										

QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA

(final)
NOAA, National Climatic Data Center
Month: 06/2006
Station Location: NIAGARA FALLS INTL AIRPORT (04724)
NIAGARA FALLS , NY
Lat. 43.107 Lon. -78.945
Elevation(Ground): 585 ft. above sea level

D a t e	Temperature (Fahrenheit)						Degree Days Base 65 Degrees		Significant Weather	Snow/Ice on Ground(In)		Precipitation (In)		Pressure(inches of Hg)		Wind: Speed=mph Dir=tens of degrees								D a t e
	Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Heating	Cooling		1200 UTC	1200 LST	2400 LST	2400 LST	Avg. Station	Avg. Sea Level	Resultant Speed	Res Dir	Avg. Speed	max		max			
																			5-second	2-minute	Speed	Dir	Speed	
1	73	62	68	M	64	65	0	3	RA DZ BR HZ VCTS	0	M	0.0	0.02	29.36	29.98	3.0	33	6.0	17	360	15	010	1	
2	74	59	67	M	58	61	0	2	RA BR	0	M	0.0	0.02	29.31	29.93	3.6	36	4.3	15	010	13	010	2	
3	62	54	58	M	56	57	7	0	RA BR	0	M	0.0	0.24	29.24	29.88	5.6	01	6.5	15	010	13	020	3	
4	71	55	63	M	51	55	2	0	RA BR	0	M	0.0	0.13	29.26	29.90	9.3	03	10.1	23	020	20	030	4	
5	81	52	67	M	50	57	0	2	RA BR	0	M	0.0	T	29.27	29.90	2.4	30	5.8	20	360	15	360	5	
6	82	55	69	M	53	60	0	4	BR	0	M	0.0	0.00	29.31	29.94	2.0	02	4.3	15	360	13	360	6	
7	81	51	66	M	52	59	0	1	-	0	M	0.0	0.00	29.24	29.86	4.8	03	6.1	21	030	18	020	7	
8	75	57	66	M	53	59	0	1	RA	0	M	0.0	Ts	29.21	29.83	4.5	05	6.5	18	030	14	060	8	
9	69	54	62	M	52	56	3	0	RA BR	0	M	0.0	0.11	29.18	29.81	13.4	32	15.1	35	330	28	320	9	
10	62	49	56	M	36	46	9	0	-	0	M	0.0	0.00	29.22	29.86	16.4	33	16.8	32	310	25	300	10	
11	66	42*	54*	M	42	49	11	0	-	0	M	0.0	0.00	29.26	29.91	8.8	31	10.1	22	280	17	320	11	
12	69	52	61	M	49	54	4	0	-	0	M	0.0	0.00	29.38	30.03	6.6	34	7.0	18	330	15	340	12	
13	74	50	62	M	51	56	3	0	-	0	M	0.0	0.00	29.44	30.07	4.3	29	6.5	18	290	15	330	13	
14	76	55	66	M	50	57	0	1	-	0	M	0.0	0.00	29.39	30.02	5.2	35	6.2	20	020	15	020	14	
15	78	53	66	M	44	55	0	1	-	0	M	0.0	0.00	29.43	30.08	5.8	31	8.1	21	330	16	330	15	
16	81	52	67	M	49	58	0	2	-	0	M	0.0	0.00	29.50	30.13	9.3	21	9.6	22	220	20	210	16	
17	88	67	78	M	55	64	0	13	-	0	M	0.0	0.00	29.41	30.02	13.1	22	13.3	28	230	23	220	17	
18	90*	66	78	M	62	68	0	13	HZ	0	M	0.0	0.00	29.33	29.91	12.3	21	12.7	33	230	26	220	18	
19	79	65	72	M	63	66	0	7	RA BR	0	M	0.0	0.31	29.21	29.83	12.5	22	12.8	28	240	22	240	19	
20	77	56	67	M	53	59	0	2	-	0	M	0.0	0.00	29.28	29.93	6.6	30	9.6	24	300	20	310	20	
21	75	49	62	M	53	58	3	0	RA	0	M	0.0	T	29.41	30.02	6.7	20	7.4	25	200	20	200	21	
22	86	69	78*	M	65	68	0	13	RA DZ	0	M	0.0	T	29.33	29.95	13.3	22	13.6	29	230	24	230	22	
23	80	65	73	M	60	64	0	8	BR	0	M	0.0	0.00	29.42	30.05	1.9	36	5.4	17	360	14	360	23	
24	78	60	69	M	60	63	0	4	FG+ BR HZ	0	M	0.0	0.00	29.47	30.09	2.1	01	3.6	14	020	12	020	24	
25	84	59	72	M	60	63	0	7	TSRA RA BR	0	M	0.0	0.20	29.44	30.05	6.5	06	7.3	30	160	20	150	25	
26	80	64	72	M	65	67	0	7	RA BR HZ	0	M	0.0	T	29.34	29.96	7.6	08	7.8	18s	090	16	090	26	
27	76	68	72	M	67	68	0	7	RA BR	0	M	0.0	0.30	29.31	29.94	5.9	19	6.9	18	200	15	200	27	
28	82	65	74	M	63	66	0	9	BR HZ	0	M	0.0	0.01s	29.35	29.98	8.9	20	9.3	22	210	20	200	28	
29	76	58	67	M	58	62	0	2	TS TSRA BR	0	M	0.0	0.19	29.36	29.98	9.6	23	10.6	38	290	32	300	29	
30	80	56	68	M	56	60	0	3	TS TSRA BR	0	M	T	0.04	29.37	30.00	7.7	24	9.7	30	320	25	320	30	

76.8	57.3	67.1	-----	55.0	60.0	1.4	3.7	<Monthly Averages				Totals>		1.61s	29.34	29.96	2.5	28	8.6	<Monthly Average		
M	M	M	-----	<-----Departure From Normal----->											M							

Degree Days	Monthly		Season to Date		Greatest 24-hr Precipitation: 0.33s Date: 03-04						Sea Level	Pressure	Date	Time				
	Total		Departure		Total		Departure		Greatest 24-hr Snowfall: M Date: M						Maximum	30.21	16	0850
	Heating:		42	M	M	M		Greatest Snow Depth: M Date: M						Minimum	29.77	09	1223	
	Cooling:		112	M														

Month: 07/2006**NIAGARA FALLS, NY**

Elevation(Ground): 585 ft. above sea level

D a t e	Temperature (Fahrenheit)						Degree Days Base 65 Degrees		Significant Weather	Snow/Ice on Ground(In)		Precipitation (In)		Pressure(inches of Hg)		Wind: Speed=mph Dir=tens of degrees								D a t e	
	Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Heating	Cooling		1200 UTC	1200 LST	2400 LST	2400 LST	Avg. Station	Avg. Sea Level	Resultant Speed	Res Dir	Avg. Speed	max		max				
																			5-second		2-minute				
																			Speed	Dir	Speed	Dir			
1	83	63	73	M	59	65	0	8	-	0	M	0.0	T	29.39	29.99	13.8	21	14.0	29	200	24	210	1		
2	87	68	78	M	65	69	0	13	TS BR	0	M	0.0	0.19	29.26	29.89	15.3	22	15.7	38	240	30	230	2		
3	83	65	74	M	65	68	0	9	RA BR HZ	0	M	0.0	0.01	29.36	29.98	11.1	21	11.3	25	240	22	210	3		
4	82	65	74	M	63	67	0	9	RA BR	0	M	0.0	0.02	29.25	29.87	8.8	24	12.0	29	220	24	200	4		
5	73	53	63*	M	51	57	2	0	-	0	M	0.0	0.00	29.36	29.99	4.2	28	8.0	18	330	15	210	5		
6	75	52*	64	M	51	57	1	0	-	0	M	0.0	0.00	29.50	30.16	5.8	31	7.0	20	310	17	320	6		
7	82	55	69	M	51	59	0	4	-	0	M	0.0	0.00	29.64	30.27	4.3	24	5.7	14s	220	13	220	7		
8	83	58	71	M	54	61	0	6	-	0	M	0.0	0.00	29.57	30.17	7.2	21	7.6	23	220	15	210	8		
9	84	62	73	M	58	64	0	8	-	0	M	0.0	0.00	29.34	29.95	11.2	21	11.4	28	220	23	220	9		
10	77	63	70	M	62	65	0	5	TS TSRA RA BR HZ	0	M	0.0	0.43	29.26	29.90	9.1	22	11.1	32	220	26	230	10		
11	83	60	72	M	62	65	0	7	BR	0	M	0.0	0.00	29.41	30.04	1.5	20	6.3	15	040	13	180	11		
12	77	67	72	M	68	69	0	7	RA DZ BR	0	M	0.0	1.41	29.29	29.91	0.8	20	9.8	24	220	20	240	12		
13	85	61	73	M	63	67	0	8	FG+ FG BR HZ	0	M	0.0	0.00	29.36	29.99	1.2	02	3.1	13	020	10	340	13		
14	88	64	76	M	66	70	0	11	RA FG+ BR VCTS	0	M	0.0	0.00	29.34	29.94	2.6	18	4.1	16	200	13	200	14		
15	88	69	79	M	65	69	0	14	RA BR HZ	0	M	0.0	0.44	29.28	29.91	7.4	29	8.4	23	300	20	290	15		
16	92*	67	80	M	66	71	0	15	-	0	M	0.0	0.00	29.37	29.99	9.3	21	10.0	23	210	21	220	16		
17	88	73	81*	M	68	72	0	16	-	0	M	0.0	0.00	29.31	29.92	13.6	23	14.5	31	290	26	230	17		
18	84	69	77	M	58	65	0	12	-	0	M	0.0	0.00	29.36	30.00	5.8	28	8.2	20	340	17	340	18		
19	86	62	74	M	63	67	0	9	-	0	M	0.0	0.00	29.49	30.12	3.0	04	4.3	17	360	15	360	19		
20	88	63	76	M	66	69	0	11	RA BR HZ	M	M	M	0.09	29.39	29.99	6.2	21	8.1	32	290	28	290	20		
21	82	68	75	M	66	69	0	10	BR HZ	M	M	M	0.00	29.29	29.90	5.2	35	6.5	16	340	12	010	21		
22	71	62	67	M	63	65	0	2	RA	0	M	0.0	0.11	29.20	29.82	7.0	03	7.6	20	010	16	030	22		
23	79	57	68	M	57	60	0	3	TS TSRA GR RA BR	0	M	T	1.81	29.28	29.93	1.2	21	2.8	51	150	35	170	23		
24	82	55	69	M	59	64	0	4	BR	0	M	0.0	0.00	29.31	29.94	9.8	21	9.7	30	210	23	230	24		
25	84	72	78	M	65	69	0	13	RA	0	M	0.0	T	29.28	29.90	13.8	22	14.2	32	220	28	220	25		
26	87	71	79	M	65	70	0	14	TS RA BR HZ	0	M	0.0	0.01	29.26	29.85	11.0	21	11.8	31	240	24	210	26		
27	84	72	78	M	70	71	0	13	TSRA BR HZ	0	M	0.0	0.05	29.22	29.84	12.2	22	12.7	24	230	21	220	27		
28	83	70	77	M	69	71	0	12	TS TSRA RA BR VCTS	0	M	0.0	1.42	29.25	29.87	7.8	24	9.6	29	220	23	220	28		
29	85	70	78	M	71	73	0	13	TS BR HZ	0	M	T	0.51	29.28	29.88	9.8	22	10.4	53	070	39	070	29		
30	84	70	77	M	68	70	0	12	BR HZ	0	M	0.0	0.00	29.26	29.86	2.1	22	4.6	9s	200	8s	200	30		
31	87	73	80	M	72	74	0	15	BR HZ	0	M	0.0	0.00	29.23	29.84	10.1	22	10.7	14s	210	12s	210	31		
83.1 64.5 73.8 ----- 62.9 66.8 0.1 9.1										<Monthly Averages				Totals>		6.50s	29.34	29.95	5.9	23	9.1	<Monthly Average			
M M M -----										<-----Departure From Normal----->				M											
Degree Days Monthly Season to Date									Greatest 24-hr Precipitation: 1.81 Date: 23-24										Sea Level Pressure Date Time						
Total Departure Total Departure									Greatest 24-hr Snowfall: M Date: M										Maximum 30.31 07 1124						
Heating: 3 M M M									Greatest Snow Depth: M Date: M										Minimum 29.77 22 0623						
Cooling: 283 M																									

Month: 08/2006

NIAGARA FALLS, NY

Elevation(Ground): 585 ft. above sea level

D a t e	Temperature (Fahrenheit)						Degree Days Base 65 Degrees		Significant Weather	Snow/Ice on Ground(In)		Precipitation (In)		Pressure(inches of Hg)		Wind: Speed-mph Dir=tens of degrees								D a t e																				
	Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Heating	Cooling		1200 UTC	1200 LST	2400 LST	2400 LST	Avg. Station	Avg. Sea Level	Resultant Speed	Res Dir	Avg. Speed	max		max																							
																			5-second		2-minute																							
																			Speed	Dir	Speed	Dir																						
1	92s	78	M	M	74	77	M	M	BR HZ	0	M	0.0	0.00	29.25	29.86	13.8	22	13.9	31	230	24	230	1																					
2	90*	73	82*	M	73	76	0	17	TS RA BR HZ VCTS	0	M	0.0	0.33	29.20	29.79	14.6	23	15.6	36	240	29	230	2																					
3	83s	68	M	M	67	69	M	M	TSRA RA BR	0	M	0.0	0.66	29.18	29.79	3.4	30	7.3	28	270	21	270	3																					
4	84	64	74	M	60	66	0	9	-	0	M	0.0	0.00	29.31	29.96	9.6	30	10.1	21	270	17	290	4																					
5	81	61	71	M	58	63	0	6	-	0	M	0.0	0.00	29.50	30.13	1.8	03	4.7	15	040	10	040	5																					
6	86	62	74	M	62	66	0	9	-	0	M	0.0	0.00	29.47	30.08	5.6	20	7.2	16	220	12	210	6																					
7	84	65	75	M	64	68	0	10	TS HZ	0	M	0.0	0.00	29.36	29.98	10.3	26	11.7	26	300	23	300	7																					
8	76	58	67	M	51	59	0	2	-	0	M	0.0	0.00	29.52	30.15	5.5	36	6.8	18	010	15	010	8																					
9	79	53	66	M	50	58	0	1	-	0	M	0.0	0.00	29.48	30.09	2.9	22	3.8	15	240	12	240	9																					
10	82	62	72	M	58	63	0	7	-	0	M	0.0	0.00	29.28	29.91	3.3	34	6.3	20	020	17	360	10																					
11	70	54	62	M	49	56	3	0	-	0	M	0.0	0.00	29.41	30.05	6.5	02	7.6	20	010	15	360	11																					
12	74	50	62	M	47	55	3	0	-	0	M	0.0	0.00	29.47	30.12	2.4	04	3.4	17	010	13	360	12																					
13	77	50	64	M	52	58	1	0	-	0	M	0.0	0.00	29.46	30.08	3.3	22	4.2	17	210	13	200	13																					
14	81	55	68	M	61	64	0	3	RA BR	0	M	0.0	0.42	29.23	29.82	8.7	22	9.4	35	240	29	240	14																					
15	79	58	69	M	55	60	0	4	-	0	M	0.0	0.00	29.26	29.91	9.8	27	10.5	25	290	22	280	15																					
16	78	56	67	M	56	61	0	2	-	0	M	0.0	0.00	29.52	30.17	2.5	31	4.0	16	320	10	300	16																					
17	82	56	69	M	57	62	0	4	-	0	M	0.0	0.00	29.57	30.20	2.8	10	5.0	16	130	12	050	17																					
18	85	66	76	M	64	68	0	11	HZ	0	M	0.0	0.00	29.44	30.06	6.8	20	8.0	22	210	17	190	18																					
19	75	70	73	M	68	69	0	8	RA BR HZ	0	M	0.0	0.33	29.28	29.88	1.2	14	4.6	14	160	10	280	19																					
20	70	63	67	M	61	63	0	2	BR HZ	0	M	0.0	0.00	29.24	29.90	10.6	29	11.6	23	310	21	290	20																					
21	78	55	67	M	56	61	0	2	-	0	M	0.0	0.00	29.45	30.09	6.6	24	7.3	20	210	15	210	21																					
22	81	59	70	M	59	63	0	5	TS RA	0	M	0.0	0.34	29.43	30.05	6.1	24	7.9	29	280	17	210	22																					
23	77	54	66	M	52	58	0	1	-	0	M	0.0	0.00	29.41	30.03	2.4	33	4.6	20	010	16	360	23																					
24	74	59	67	M	57	61	0	2	RA	0	M	0.0	0.00	29.35	29.97	5.7	07	6.6	16	020	13	040	24																					
25	71	61	66	M	60	62	0	1	RA FG+ BR	0	M	0.0	0.15	29.35	30.00	7.5	06	8.1	21	060	17	070	25																					
26	75	60	68	M	62	64	0	3	BR HZ	0	M	0.0	0.00	29.42	30.05	8.4	09	9.0	18	090	15	110	26																					
27	79	70	75	M	67	69	0	10	RA DZ BR HZ	0	M	0.0	0.14	29.31	29.92	7.3	20	9.1	21	170	17	190	27																					
28	73	63	68	M	64	65	0	3	RA BR	0	M	0.0	0.17	29.31	29.92	6.4	05	7.4	20	020	14	050	28																					
29	70	59	65	M	58	60	0	0	RA BR	0	M	0.0	0.40	29.23	29.87	8.1	06	8.7	21	060	17	050	29																					
30	70	54	62	M	54	57	3	0	BR	0	M	0.0	0.00	29.40	30.06	8.4	05	8.6	22	040	18	040	30																					
31	71	50*	61*	M	49	54	4	0	-	0	M	0.0	0.00	29.59	30.24	8.8	07	9.1	23	080	18	090	31																					
78.3 60.2 69.3 ----- 58.9 63.1 0.5 4.2										<Monthly Averages		Totals>				2.99s	29.38	30.00	1.2	26	7.8	<Monthly Average																						
M M M -----										<-----Departure From Normal----->										M																								
Degree Days									Monthly									Season to Date									Greatest 24-hr Precipitation: 0.97s Date: 02-03									Sea Level Pressure Date Time								
									Total Departure Total Departure									Greatest 24-hr Snowfall: M Date: M									Maximum 30.28 31 2359																	
Heating: 14 M M M																		Greatest Snow Depth: M Date: M									Minimum 29.66 03 0224																	
Cooling: 122 M																																												

Month: 09/2006

Elevation(Ground): 585 ft. above sea level

D a t e	Temperature (Fahrenheit)						Degree Days Base 65 Degrees		Significant Weather	Snow/Ice on Ground(In)		Precipitation (In)		Pressure(inches of Hg)		Wind: Speed-mph Dir-tens of degrees						D a t e		
	Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Heating	Cooling		1200 UTC	1200 LST	2400 LST	2400 LST	Avg. Station	Avg. Sea Level	Resultant Speed	Res Dir	Avg. Speed	max		max			
																			5-second		2-minute			
																			Speed	Dir	Speed		Dir	
1	72	53	63		M	53	57	2	0	-	0	M	0.0	0.00	29.62	30.26	7.7	06	7.9	23	040	20	050	1
2	63	55	59		M	53	55	6	0	RA BR	M	M	M	1.69	29.52	30.16	13.6	06	13.9	36	070	30	060	2
3	64	55	60		M	55	56	5	0	RA DZ BR	0	M	0.0	0.14	29.38	30.02	2.7	28	7.1	20	330	16	060	3
4	69	54	62		M	54	57	3	0	BR	0	M	0.0	T	29.45	M	5.9	27	6.9	17	320	15	300	4
5	67	57	62		M	56	59	3	0	HZ	0	M	0.0	T	29.42	30.04	1.9	32	2.5	14	310	12	320	5
6	74	57	66		M	57	61	0	1	BR	0	M	0.0	0.00	29.36	30.00	1.7	34	3.9	15	340	13	350	6
7	74	59	67		M	57	61	0	2	BR HZ	0	M	0.0	0.00	29.42	30.05	5.5	21	6.8	16	220	14	230	7
8	79	60	70		M	59	63	0	5	TS BR HZ	0	M	0.0	0.00	29.38	30.00	9.7	21	10.4	25	210	21	220	8
9	69	56	63		M	57	59	2	0	TSRA RA DZ BR	0	M	0.0	0.05	29.40	30.06	4.0	35	7.8	21	280	17	290	9
10	64	48	56		M	44	50	9	0	-	0	M	0.0	0.00	29.62	30.28	7.6	05	8.2	20	050	16	010	10
11	68	45	57		M	46	51	8	0	-	0	M	0.0	0.00	29.67	30.31	9.6	07	10.0	24	090	20	090	11
12	64	53	59		M	53	55	6	0	RA BR	0	M	0.0	0.35	29.49	30.11	7.8	11	8.1	14	130	12	120	12
13	72	58	65		M	59	61	0	0	TS RA DZ BR	0	M	0.0	0.29	29.21	29.83	11.4	19	11.6	24	190	21	190	13
14	65	62	64		M	59	61	1	0	RA DZ BR	0	M	0.0	0.12	29.28	29.93	2.5	32	6.3	15	190	14	190	14
15	66	59	63		M	59	60	2	0	BR	0	M	0.0	0.00	29.48	30.13	5.7	02	6.3	16	020	14	010	15
16	69	55	62		M	58	60	3	0	FG+ BR	0	M	0.0	0.00	29.52	30.15	0.9	07	2.4	10	010	7	360	16
17	76	52	64		M	58	60	1	0	FG+ BR HZ	0	M	0.0	0.00	29.33	29.93	7.1	20	7.4	21	190	17	220	17
18	82*	59	71*		M	61	64	0	6	RA BR	0	M	0.0	0.82	29.12	29.72	10.5	20	11.4	29	220	22	200	18
19	68	57	63		M	51	56	2	0	RA BR	0	M	0.0	0.25	29.09	29.73	11.2	25	11.7	30	240	23	250	19
20	61	45	53		M	44	49	12	0	RA	0	M	0.0	0.14	29.17	29.83	11.3	27	12.6	31	300	25	310	20
21	62	43	53		M	42	48	12	0	BR	0	M	0.0	0.00	29.41	30.07	5.3	25	6.2	21	300	14	210	21
22	68	41	55		M	48	52	10	0	RA	0	M	0.0	0.02	29.39	30.01	4.8	14	5.8	23	190	20	190	22
23	75	61	68		M	62	64	0	3	RA BR	0	M	0.0	0.22	29.10	29.70	11.1	21	11.8	23	230	20	220	23
24	70	55	63		M	55	59	2	0	DZ	0	M	0.0	0.01	28.95	29.61	15.7	24	18.6	40	220	31	220	24
25	63	47	55		M	46	51	10	0	RA	0	M	0.0	0.06	29.19	29.84	12.9	24	13.7	37	300	29	300	25
26	64	46	55		M	45	49	10	0	-	0	M	0.0	0.00	29.33	29.98	5.1	23	7.2	18	190	16	190	26
27	75	47	61		M	50	56	4	0	RA	0	M	0.0	0.11	29.18	29.79	13.3	19	13.8	37	210	29	210	27
28	62	48	55		M	49	51	10	0	RA BR	0	M	0.0	0.85	29.10	29.74	4.4	31	8.7	20	220	16	270	28
29	56	40	48*		M	40	44	17	0	RA	0	M	0.0	0.01	29.24	29.91	6.0	28	6.9	22	320	20	320	29
30	58	40*	49		M	43	47	16	0	RA DZ	0	M	0.0	0.01	29.31	29.94	9.6	15	10.1	30	170	24	180	30

M	M	M	-----	52.4	55.9	5.2	0.6	<Monthly Averages				Totals>		M	M	M	2.7	22	8.9	<Monthly Average		
M	M	M	-----	<-----Departure From Normal----->											M							

Degree Days	Monthly	Season to Date		Greatest 24-hr Precipitation: M Date: M				Sea Level Pressure Date Time				
	Total	Departure	Total	Departure	Greatest 24-hr Snowfall: M Date: M				Maximum M M M			
	Heating:	156	M	M	M	Greatest Snow Depth: M Date: M				Minimum M M M		
	Cooling:	17	M									

Month: 10/2006**NIAGARA FALLS, NY**

Lat. 43.107 Lon. -78.945

Elevation(Ground): 585 ft. above sea level

D a t e	Temperature (Fahrenheit)						Degree Days Base 65 Degrees		Significant Weather	Snow/Ice on Ground(In)		Precipitation (In)		Pressure(inches of Hg)		Wind: Speed-mph Dir=tens of degrees								D a t e					
	Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Heating	Cooling		1200 UTC	1200 LST	2400 LST	2400 LST	Avg. Station	Avg. Sea Level	Resultant Speed	Res Dir	Avg. Speed	max		max								
																			5-second	2-minute	Speed	Dir	Speed		Dir				
1	65	44	55	M	47	51	10	0	RA BR HZ	0	M	0.0	0.13	29.31	29.99	7.6	26	9.3	23	300	20	310	1						
2	M	M	M	M			M	M	-	M	M	M	M	M	M	M	M	M	M	M	M	2							
3	68	58	63*	M	58		2	0	RA FG+ BR	0	M	0.0	0.44	29.47	M	9.6	21	10.2	26	230	20	240	3						
4	68	50	59	M	54	56	6	0	TSRA RA FG+ BR	0	M	0.0	0.70	29.37	30.01	2.3	29	12.9	32	320	26	320	4						
5	55	41	48	M	35	42	17	0	-	0	M	0.0	0.00	29.65	30.32	7.5	03	7.9	21	060	16	010	5						
6	58	38	48	M	39	43	17	0	-	0	M	0.0	0.00	29.78	30.46	7.6	04	7.8	21	030	16	040	6						
7	64	35	50	M	38	43	15	0	-	0	M	0.0	0.00	29.77	30.42	2.1	05	3.5	15	010	13	010	7						
8	70	38	54	M	48	51	11	0	BR	0	M	0.0	0.00	29.62	30.26	4.4	21	4.8	16	220	14	220	8						
9	72*	51	62	M	52	55	3	0	FG+ BR	0	M	0.0	0.00	29.49	30.14	3.3	25	5.2	17	220	14	230	9						
10	64	42s	M	M	46	50	M	M	RA	0	M	0.0	T	29.42	30.04	5.5	06	6.4	16	050	13	080	10						
11	66	51	59	M	56	57	6	0	TSRA RA BR VCTS	0	M	0.0	1.24	29.00	29.58	11.0	17	11.9	35	180	25	170	11						
12	62	33	48	M	36	39	17	0	TSSN RA SN BR	0	M	0.6	0.37	28.89	29.58	12.3	23	13.6	29	250	23	240	12						
13	47	33	40	M	32	36	25	0	TSSN RA SN FG BR	T	M	2.5	0.60	29.05	29.70	15.4	21	16.1	46	220	36	220	13						
14	49	37	43	M	32	39	22	0	RA PL	0	M	T	0.03	29.10	29.77	11.9	25	12.8	35	270	26	300	14						
15	51	34	43	M	31	38	22	0	-	0	M	0.0	0.00	29.36	30.05	11.0	24	11.4	22	240	20	210	15						
16	59	33	46	M	35	42	19	0	-	0	M	0.0	0.00	29.52	30.17	3.4	17	5.8	10s	120	9s	120	16						
17	58	48	53	M	48	51	12	0	RA DZ BR	0	M	0.0	0.69	29.13	29.74	11.2	18	14.5	33	220	24	230	17						
18	61	53	57	M	50	53	8	0	-	0	M	0.0	0.00	29.18	29.84	11.2	23	11.6	22	230	18	220	18						
19	61	47	54	M	50	52	11	0	RA DZ BR	0	M	0.0	0.36	29.09	29.73	4.0	24	9.2	24	220	18	220	19						
20	48	42	45	M	38	42	20	0	RA BR	0	M	0.0	0.49	29.09	29.76	7.4	30	8.9	20	290	16	290	20						
21	49	38	44	M	38	42	21	0	RA BR HZ	0	M	0.0	T	29.32	29.99	2.1	21	5.4	14	180	10	200	21						
22	52	45	49	M	44	46	16	0	RA BR	0	M	0.0	0.58	29.12	29.73	8.2	20	11.8	32	220	25	220	22						
23	45	36	41	M	32	37	24	0	RA	0	M	0.0	0.11	29.11	29.79	17.6	25	17.7	35	270	30	260	23						
24	44	35	40	M	33	37	25	0	RA	0	M	T	0.03	29.20	29.88	15.1	29	15.9	25	310	21	290	24						
25	47	39	43	M	33	38	22	0	RA	0	M	T	T	29.42	30.11	13.0	31	13.2	23	310	18	310	25						
26	45	30	38	M	28	34	27	0	-	0	M	0.0	0.00	29.57	30.24	5.3	31	6.4	26	300	20	310	26						
27	44	29*	37*	M	33	36	28	0	RA BR	0	M	0.0	0.52	29.34	29.94	7.0	08	7.1	16	090	14	090	27						
28	45	40	43	M	37	40	22	0	RA BR	0	M	0.0	0.37	28.61	29.24	12.9	26	15.4	45	250	38	250	28						
29	45	36	41	M	28	36	24	0	RA	0	M	T	T	28.90	29.62	21.3	26	21.5	45	280	38	280	29						
30	59	37	48	M	32	41	17	0	-	0	M	0.0	0.00	29.30	29.95	7.7	22	9.1	24	260	20	250	30						
31	64	44	54	M	44	49	11	0	RA BR	0	M	0.0	0.01	29.17	29.83	14.7	23	16.5	39	230	31	230	31						
55.9 40.4 48.2 ----- 40.2 44.0 16.6 0.0										<Monthly Averages				Totals>		6.67s	29.28	29.92	5.6	24	10.8	<Monthly Average							
M M M -----										<-----Departure From Normal----->										M									
Degree Days Monthly Season to Date									Greatest 24-hr Precipitation: 1.24 Date: 11										Sea Level Pressure Date Time										
Total Departure Total Departure									Greatest 24-hr Snowfall: 0.2 Date: 13										Maximum 30.52 06 1026										
Heating: 480 M M M									Greatest Snow Depth: Ts Date: 13										Minimum 29.16 28 1425										
Cooling: 0 M																													

QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA (final)															Station Location: NIAGARA FALLS INTL AIRPORT (04724) NOAA, National Climatic Data Center Month: 12/2006 Lat. 43.107 Lon. -78.945 Elevation(Ground): 585 ft. above sea level														
D a t e	Temperature (Fahrenheit)			Degree Days Base 65 Degrees			Significant Weather	Snow/Ice on Ground(In)		Precipitation (In)		Pressure(inches of Hg)		Wind: Speed=mph Dir=tens of degrees			max		D										
	Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb		Heating	Cooling	1200 UTC	1200 LST	2400 LST	2400 LST	Avg. Station	Avg. Sea Level	Resultant Speed	Res Dir	Avg. Speed		5-second Speed	2-minute Speed								
																						Depth	Water Equiv	Water Equiv	Snow Fall	Water Equiv			
1	44	34	39	M	35	38	0	TSRA RA BR	0	M	0.0	1.68	29.01	29.66	2.5	25	19.8	58	240	44	230	1							
2	35	28	32	M	22	30	0	SN	0	M	T	T	29.49	30.22	17.3	25	17.6	44	250	35	250	2							
3	37	27	32	M	22	29	0	SN	0	M	T	T	29.62	30.30	12.7	26	14.6	30	300	24	290	3							
4	60s	21	M	M	17	23	M	SN	0	M	2.8	0.10	29.53	30.20	13.1	25	14.4	28	260	24	260	4							
5	30	16	23	M	15	20	0	SN	3	M	0.8	0.04	29.52	30.24	9.6	25	10.4	29	210	23	200	5							
6	41	28	35	M	26	33	0	RA BR	1	M	0.0	0.03	29.30	29.93	16.8	21	18.1	39	200	33	200	6							
7	37	14	26	M	14	21	0	SN BR	T	M	1.1	0.06	29.37	30.10	14.2	29	15.7	31	310	28	300	7							
8	31	11*	21*	M	13	19	0	SN	T	M	0.6	0.03	29.64	30.33	13.5	25	15.0	45	230	35	230	8							
9	39	31	35	M	22	30	0	-	T	M	0.0	0.00	29.54	30.22	24.3	23	24.7	44	220	37	220	9							
10	46	38	42	M	28	37	23	0	RA	M	0.0	0.00	29.53	30.22	22.1	22	22.2	44	220	33	220	10							
11	45	16s	M	M	36	39	M	RA BR	0	M	0.0	0.18	29.73	30.43	5.6	22	7.4	22	220	17	220	11							
12	54	36	45	M	36	42	20	0	BR	0	M	0.0	T	29.69	30.32	6.2	15	7.7	25	190	20	180	12						
13	51	37	44	M	36	41	21	0	RA BR HZ	0	M	0.0	0.13	29.35	30.00	15.0	21	15.9	33	210	28	210	13						
14	54*	41	48	M	37	43	17	0	BR	0	M	0.0	0.01s	29.20	29.82	13.3	21	13.6	37	200	26	210	14						
15	53	39	46	M	36	41	19	0	RA	0	M	0.0	0.02	29.00	29.67	19.6	24	20.4	39	240	31	230	15						
16	43	34	39	M	29	35	26	0	-	0	M	0.0	0.00	29.41	30.09	7.4	23	9.9	21	280	18	260	16						
17	53	43	48*	M	42	46	17	0	RA DZ BR HZ	0	M	0.0	0.01	29.33	30.00	11.1	23	11.6	23s	240	18	240	17						
18	45	35	40	M	30	36	25	0	-	0	M	0.0	T	29.51	30.21	9.1	29	9.9	23	310	20	310	18						
19	38	27	33	M	23	30	32	0	-	0	M	T	T	29.67	30.35	11.2	25	11.4	23	260	18	250	19						
20	44	27	36	M	28	34	29	0	-	0	M	0.0	0.00	29.64	30.30	14.1	22	14.3	30	230	25	220	20						
21	44	31	38	M	28	35	27	0	-	0	M	0.0	0.00	29.62	30.31	4.3	25	7.3	25	230	20	230	21						
22	51	34	43	M	38	41	22	0	RA DZ BR	0	M	0.0	0.39	29.46	30.06	8.0	12	10.2	25	180	18	180	22						
23	51	38	45	M	37	40	20	0	RA BR	0	M	0.0	0.03	29.14	29.81	20.0	23	20.3	41	250	33	240	23						
24	42	35	39	M	32	36	26	0	RA	0	M	0.0	0.01	29.41	30.12	15.8	24	16.1	33	250	26	250	24						
25	49	30	40	M	32	36	25	0	RA BR	0	M	0.0	0.26	29.35	29.97	3.7	15	6.0	20	210	17	190	25						
26	50s	33	M	M	32	34	M	M	RA DZ SN BR	0	M	T	0.28	28.92	29.61	9.5	34	10.7	24	320	20	320	26						
27	37	31	34	M	25	30	31	0	SN BR	T	M	T	T	29.26	29.97	11.9	25	13.0	26	250	22	240	27						
28	41	36	39	M	33	36	26	0	BR	0	M	0.0	T	29.62	30.34	6.4	24	9.5	24	220	20	220	28						
29	37	29	33	M	26	29	32	0	-	0	M	0.0	0.00	29.92	30.62	10.9	07	11.0	23	090	17	060	29						
30	34	26	30	M	27	30	35	0	SN BR	0	M	T	0.01	29.79	30.48	2.0	32	3.6	13	320	12	330	30						
31	48	29	39	M	30	34	26	0	RA BR	0	M	0.0	0.14	29.62	30.21	8.1	10	9.0	24	170	18	180	31						
Totals>							<Monthly Averages							3.41s		29.46		30.13		8.7		23		13.3		<Monthly Average			
M	44.0	30.2	37.1	-----	28.6	33.8	27.7		0.0		<-----Departure From Normal----->		M																
Degree Days			Monthly		Season to Date																								
Total Departure			Total Departure																										
Heating: 776			M		M																								
Cooling: 0			M																										

ANNUAL CLIMATOLOGICAL SUMMARY (2006)

Station: 305840/99999, NIAGARA FALLS INT'L AP, New York

Elev. 519 ft. above sea level

Lat. 43°06'N, Lon. 78°57'W

Date		Temperature (° F)														Precipitation (inches)													
Elem->	MMXT	MMNT	MNTM	DPNT	HTDD	CLDD	EMXT	EMNP	DT90			DX32	DT32	DT00	TPCP	DPNP	EMXP	Greatest Observed		TSNW	MXSD	Snow, Sleet		DP01	DP05	DP10			
2006 Month	Mean Max.	Mean Min.	Mean	Depart. from Normal	Heating Degree Days	Cooling Degree Days	Highest	High Date	Lowest	Low Date	Max >=90°	Max <=32°	Min <=32°	Min <=0°	Total	Depart. from Normal	Day	Date	Total	Max Depth	Max Date	Number of Days							
1	41.2	27.6	34.4	10.2	940	0	58	13	11	16	0	5	21	0	3.00	0.45	0.60	29	6.4	3	8	10	1	1	0				
2	35.1	20.1	27.6	2.3	1040	0	58	17	6	9	0	14	25	0	1.90	-0.42	0.49	16	17.9	6	8	4	0	0	0				
3	43.6	27.1	35.4	1.6	910	0	76	31	13	3	0	3	25	0	1.64X	M	0.75	13	3.8X	2	3	3	1	0	0				
4	58.0	36.3	47.2	2.1	524	0	78	21	25	9	0	0	9	0	1.97	-0.49	0.55	23	0.3	0T	5	5	1	0	0				
5	69.4	46.6	58.0	0.9	249	38	91	30	29	7	1	0	1	0	1.68	-1.26	0.54	11	0.0	0	6	1	0	0	0				
6	76.8	57.3	67.1	1.3	42	112	90	18	42	11	1	0	0	0	1.57	-1.69	0.31	19	0.0	0	7	0	0	0	0				
7	83.1	64.5	73.8	2.4	3	283	92	16	52	6	1	0	0	0	6.51	3.82	1.81	23	0.0	0	8	4	3	0	0				
8	78.3	60.2	69.3	-0.3	14	153	92	1	50	31	2	0	0	0	2.99	-0.04	0.66	3	0.0	0	9	1	0	0	0				
9	68.0	52.8	60.4	-1.3	151	19	82	18	40	30	0	0	0	0	5.14	1.62	1.69	2	0.0	0	11	3	1	0	0				
10	56.5	40.5	48.5	-1.6	503	0	72	9	29	27	0	0	2	0	6.13	3.46	1.24	11	3.1	0T	13	12	5	1	1				
11	50.2	35.2	42.7	2.8	662	0	65	29	24	22	0	0	9	0	2.72	-0.26	0.99	30	0.4	0T	4	6	2	0	0				
12	44.9	30.2	37.6	7.9	842	0	63	1	11	8	0	2	17	0	3.41	0.53	1.68	1	4.8	3	5	8	1	1	1				
Annual	58.8	41.5	50.2	2.4	5880	605	92	Aug	6	Feb	5	24	109	0	38.66X	M	1.81	Jul	36.7X	6	Feb	89	20	6	6				

Notes

(blank) Not reported.

+ Occurred on one or more previous dates during the month. The date in the Date field is the last day of occurrence. Used through December 1983 only.

A Accumulated amount. This value is a total that may include data from a previous month or months or year (for annual value).

B Adjusted Total. Monthly value totals based on proportional available data across the entire month.

E An estimated monthly or annual total.

X Monthly means or totals based on incomplete time series. 1 to 9 days are missing. Annual means or totals include one or more months which had 1 to 9 days that were missing.

M Used to indicate data element missing.

T Trace of precipitation, snowfall, or snowdepth. The precipitation data value will = zero.

Elem- Element Types are included to provide cross-reference for users of the > NCDC CDO System.

Station Station is identified by: CoopID/WBAN, Station Name, State.

S Precipitation amount is continuing to be accumulated. Total will be included in a subsequent monthly or yearly value.
Example: Days 1-20 had 1.35 inches of precipitation, then a period of accumulation began. The element TPCP would then be 00135S and the total accumulated amount value appears in a subsequent monthly value. If TPCP = "M" there was no precipitation measured during the month. Flag is set to "S" and the total accumulated amount appears in a subsequent monthly value.

Dynamically generated Wed Jun 06 08:45:55 EDT 2007 via <http://hurricane.ncdc.noaa.gov/ancsum/ACS>

Data provided from the NCDC CDO System

Additional documentation can be found at <http://www5.ncdc.noaa.gov/cdo/3220doc.txt>