# FUSRAP
# NIAGARA FALLS STORAGE SITE

# 2004
# ENVIRONMENTAL SURVEILLANCE TECHNICAL MEMORANDUM

US Army Corps of Engineers ®
Buffalo District

December 2005

200-1e
NFSS_01.19_0008_a

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## ACRONYMS

| | |
|---|---|
| ALARA | as low as reasonably achievable |
| ANL | Argonne National Laboratory |
| ARAR | applicable or relevant and appropriate requirement |
| ASME | American Society of Mechanical Engineers |
| 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 |
| COC | chain of custody |
| DCG | derived concentration guide |
| DQO | data quality objective |
| EA | environmental assessment |
| EDE | effective dose equivalent |
| EE/CA | engineering evaluation/cost analysis |
| EIS | environmental impact statement |
| EML | Environmental Measurements Laboratory |
| ESP | environmental surveillance plan |
| FFA | federal facility agreement |
| FIFRA | Federal Insecticide, Fungicide, and Rodenticide Act |
| FSRD | Former Sites Restoration Division |
| FUSRAP | Formerly Utilized Sites Remedial Action Program |
| GC-EC | gas chromatography/electron capture |
| GC/MS | gas chromatography/mass spectrometry |
| GFAA | graphite furnace atomic adsorption |
| HWP | hazardous work permit |
| ICPAES | inductively coupled plasma atomic emission spectrophotometry |
| ID | identification |
| IG | instruction guide |
| IWCS | interim waste containment structure |
| KPA | kinetic phosphorescence analyzer |
| LCS | laboratory control sample |
| LEL | lower explosive limit |
| LOOW | Lake Ontario Ordnance Works |
| MCL | maximum contaminant level |
| MCLG | maximum contaminant level goal |
| 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 |
| NHPA | National Historic Preservation Act |
| NIST | National Institute for Standards and Technology |
| NL | National Lead |
| NPDES | National Pollutant Discharge Elimination System |
| NPL | National Priorities List |
| NYSDEC | New York State Department of Environmental Conservation |

(Continued)

| | |
|---|---|
| PERALS | photon/electron-rejecting alpha liquid scintillation |
| PI | project instruction |
| PP | project procedure |
| PPE | personal protective equipment |
| QA | quality assurance |
| QAP | Quality Assurance Plan |
| QAT | Quality Assurance Team |
| QC | quality control |
| RCRA | Resource Conservation and Recovery Act |
| RI/FS | remedial investigation/feasibility study |
| ROD | Record of Decision |
| RPD | relative percent difference |
| SARA | Superfund Amendments and Reauthorization Act |
| SDWA | Safe Drinking Water Act |
| SRM | standard reference material |
| SSHR | site safety and health representative |
| S/RID | Standards/Requirements Identification Document |
| TCLP | toxicity characteristics leaching procedure |
| TDS | total dissolved solids |
| TETLD | tissue-equivalent thermoluminescent dosimeter |
| TLD | thermoluminescent dosimeter |
| TOC | total organic carbon |
| TOX | total organic halides |
| TPH | total petroleum hydrocarbons |
| TSCA | Toxic Substances Control Act |
| 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 |
| VOC | volatile organic compound |

## 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 2004 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 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.

USDOE and United States Environmental Protection Agency (USEPA) guidelines are presented throughout this report for comparative purposes in evaluating environmental surveillance data. The USACE continues to compare data with USDOE guidelines because even though the facility is owned by the Federal Government and is currently maintained by the USACE, USDOE has property accountability. However, those values are provided for comparative purposes only and do not represent USACE site cleanup criteria, which will be developed in the future in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. The final selected 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 presented in the Record of Decision (ROD). Results from the 2004 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 US Army Corps of Engineers 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 a 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 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.

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). The residues originated at other sites and were transferred to NFSS for storage in buildings and onsite pits and surface piles. From 1953 to 1959 and 1965 to 1971, Building 401 was used as a boron-10 isotope separation plant.

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 $m^3$) are encapsulated in the IWCS, which are specifically designed to provide interim storage of the material.

### 1.1 Measured Parameters

The key elements of the 2004 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-228, Th- 230, Th-232) and isotopic radium (Ra-224, 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 listed in the Appendix A (Table A.1&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; Système Internationale (SI) units of measurement are used in the discussion of all other parameters. Unit conversions are provided in the text for water level information only.

## 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 2004 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, likely 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

**A Physician's Guide - Radon**

The USEPA also has established sets a guidance action level of 4.0 pCi/L for radon concentrations in residential indoor air (homes), 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 about1.25 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 constituents in water and soil at USDOE-owned and USDOE-operated facilities. The environmental surveillance program does not include analysis of onsite soils; however, because there are no standards for sediment, USDOE historically used the residual soil cleanup guideline criteria specified in USDOE Order 5400.5. The USACE is continuing that process. However, those values are provided for comparative purposes only. ARARs and cleanup goals will be presented in the proposed plan, which the public will be able to comment on. These standards will then be presented in the record of decision (ROD).

USDOE Order 5400.5 states that the guideline for residual concentrations of radium-226, radium-228, thorium-230 and thorium-232 in surface soil is 5 pCi/g above background, based on an average of the first 15-cm of soil below the surface. For subsequent 15-cm depth intervals (subsurface soils), the specified limit is 15 pCi/g above background. Because surveillance sediment samples are collected from the first 15-cm of sediment only the surface soil criteria are used. If both thorium-230 and radium-226 or both thorium-232

and radium-228 are present and not in secular equilibrium, the appropriate guideline is applied as a limit for the radionuclide with the higher concentration. If other mixtures of radionuclides occur, the Order prescribes that the data be evaluated by the sum-of-the-ratios (SOR) method. By this method, the above-background concentration of each of the radionuclides is divided by its respective criterion, and the ratios are summed. If the result is greater than 1, the mixture of radionuclides fails the sum-of-the-ratios test and is considered to exceed the soil guidelines. USDOE Order 5400.5 does not give concentration limits for uranium in soils or sediment. Therefore, the analytical data will only be compared to the site-specific USDOE guideline limit of 90 pCi/g for total uranium in surface soil.

USDOE-derived concentration guides (DCGs) for radionuclides in water are used to evaluate analytical data for surface water and groundwater at NFSS and are cited in the appropriate data tables in this report. These guidelines are also presented in the Order. The DCG for each radionuclide represents the concentration that would result in a dose of 100 mrem during a year by ingestion of water, conservatively calculated for continuous exposure conditions. For mixtures of radionuclides in water, the sum of the ratios of each concentration to the DCG must not exceed 1.

### 2.2.2 Safe Drinking Water Act (SDWA)

At NFSS, because of uniformly poor groundwater quality and availability in the general region, the shallow groundwater resources are of little consequence. 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. 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 2005, 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 because the ambient groundwater at NFSS does not meet the 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 30µg/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. Following public comment on the Proposed Plan and selection of cleanup goals/ARARs, those standards will be presented in the ROD.

#### 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, presents sampling locations and media associated with the environmental surveillance program at NFSS. Table 1, Appendix A, summarizes the environmental surveillance program at NFSS for external gamma radiation, radon gas, surface water, sediment, and groundwater.

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, downgradient, 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 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 background levels and/or 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) 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 2004 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 2004 are presented in Tables 2 through 10 (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. In this case, 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 and DCGs, 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 2004, unless otherwise noted. For gamma dose rates subtracting the calculated background from the sampling results for 2004 then gives an estimate of the above-background concentration of the measured constituent 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 µg/L, and µg/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 pCi/L to µg/L in this report. The specific activity for total uranium in soil sources has been 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) in place at NFSS continuously throughout the year. Each TLD measures a cumulative dose over the period of exposure (approximately six months). When corrected

for background and normalized to exactly one year's exposure, these detectors provide a measurement of the annual external gamma radiation dose at that location. TLD results for the 2004 external gamma radiation dose (both raw and corrected data) are summarized in Table 2, External Gamma Radiation Dose Rates (Appendix A, page T-7).

The corrected 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 individual (MEI). Net monitoring results (average normalized location minus average normalized background reading) that are less than zero are retained as negative values for calculating purposes. 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. Occupancy of the nearest residence is assumed to be 24 hours/day, 365 days/year, while occupancy of the nearest commercial/industrial facility is assumed to be 40 hours/week, 50 weeks/year. Results of this calculation are expressed as a maximum dose rate to the individual (mrem/year).

Based on 2004 external gamma radiation results, the hypothetical MEI would be a commercial/industrial worker conservatively assumed to work at a location 150 feet east of the site perimeter fence for 40 hours/week, 50 weeks/year, with an annual dose of 0.0036 mrem (1,020 feet from the TLD monitoring line (Appendix B, CY2004 CALCULATION OF EXTERNAL GAMMA RADIATION DOSE RATES FOR NIAGARA FALLS STORAGE SITE (NFSS), section 4.2)). The annual dose at the nearest residence located 3,600 feet southwest of the site conservatively assumed to reside at the location for 24 hours/day, 365 days/year, would be 0.0011 mrem (Appendix B, CY2004 CALCULATION OF EXTERNAL GAMMA RADIATION DOSE RATES FOR NIAGARA FALLS STORAGE SITE (NFSS), section 4.1). Both dose values 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 2004 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 radon-222 results from the 2004 environmental surveillance program were at or below the detection limit (0.20 pCi/L),

although for some monitoring stations the reported concentrations in the second half of the year were somewhat higher than those for the first half of the year. All of the on-site results (ranges from nondetect to 0.4 pCi/L) were less than the USDOE off-site limit of 3.0 pCi/L above background (background ranges from less than 0.2 to 0.3 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-h exposure period. Measurements for 2004 are presented in Table 4; measurement locations are shown in Figure 2, Appendix A.

Measured results for 2004 ranged from below the average background (0.123) to 0.213 $pCi/m^2/s$, with an average result of 0.066 $pCi/m^2/s$. As in previous years, these results are well below the 20.0 $pCi/m^2/s$ 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 2004, airborne particulate release rates were calculated using Remedial Investigation soil data (collected between 1999 and 2003), and weather data from the National Weather Service and meteorological stations in the vicinity of the site (contributions from radon gas, which is not a particulate, are not considered in this calculation). The total airborne particulate release rate is then entered into the USEPA's CAP88-PC (Version 2.0) 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 (center of the IWCS). Hypothetical doses are then corrected for residential occupancy (conservatively assumed to be 24 hours/day, 365 days/year) and commercial/industrial facility occupancy (40 hours/week, 50 weeks/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 fanning out to 80 km from the center of site.

The first calculation (Appendix C) indicates that the 2004 airborne particulate dose to the hypothetical MEI, an occupant at the commercial/industrial facility 275 meters east of the IWCS, was 0.0046 mrem assuming 2000 hours worked per year. 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 0.032 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 CY2004 NESHAP ANNUAL REPORT FOR NIAGARA FALLS STORAGE SITE (NFSS)).

### 5.5 Surface Water and Sediment

In 2004, 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 2004 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 2004 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 2004 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 2004, 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 2004 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 2004, surface water analytical results were less than the SDWA MCLs, with the exception of thorium-230 (12.2 pCi/L) and thorium-232 (14.7 pCi/L), and total uranium (37.32 pCi/L) concentrations at surface water location SWSD010. However, elevated thorium and uranium at this surface water location were verified to be attributed to the high turbidity (see Table 7) of the sample and therefore were not considered to be representative of the actual thorium and uranium concentrations in surface water at this location. The 2004 total uranium result for surface water location SWSD010 using a Kinetic Phosphorescence Analyzer (KPA) methodology that is less susceptible to the interference of turbidity was 10.4 ug/L (or 11.6 pCi/L), which is consistent with past results. In addition, preliminary 2005 thorium and uranium results for surface water location SWSD010 are indicative of past results and 2004 thorium and uranium results for downstream surface water location SWSD011 were within background ranges. Measured results (with background not subtracted) are provided in Table 5, Appendix A and discussed below:

- The 2004 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 0.299 and 0.32 pCi/L, respectively, falling within the historical (1997 to present) background range of nondetect to 0.37 pCi/L. The 2004 results of analysis for radium-226 in samples collected at downstream locations (SWSD011, and SWSD022) ranged from 0.063 (field duplicate sample for SWSD011) to 0.493 pCi/L. The radium-226 result for downstream location SWSD010 was 3.34 pCi/L, however, was elevated due to the turbidity of the sample and therefore was not considered representative of the actual radium-226 concentration in surface water at this location. The radium-226 USDOE DCG is 100 pCi/L.

- The 2004 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 0.66 and 0.351 pCi/L, respectively, comparing favorably with the historical (1997 to present) background range of nondetect to 1.02 pCi/L. The 2004 results for radium-228 in samples collected at downstream locations (SWSD010, SWSD011, and SWSD022) ranged from 0.427 to 0.957 pCi/L. The radium-228 USDOE DCG is 100 pCi/L.

- The 2004 results for thorium-230 in samples collected at downstream locations (SWSD011, and SWSD022) ranged from 0.378 to 0.59 pCi/L. Thorium-230 results from upstream (background) locations SWSD009 and SWSD021 were 0.561 and 0.649 pCi/L, respectively, comparing favorably with the historical (1997 to present) background range of nondetect to 1.20 pCi/L from both background locations or nondetect to 0.75 pCi/L from surface water location SWSD009, which is considered to be more representative of background. The thorium-230 result for downstream location SWSD010 was 12.2 pCi/L, however, was elevated due to the turbidity of the sample and therefore was not considered representative of the actual thorium-230 concentration in surface water at this location. The thorium-230 USDOE DCG is 300 pCi/L.

- The 2004 on-site analytical results for thorium-232 concentrations in surface water were 0.068 to 0.432 pCi/L, compared to background (0.068 and 0.613 pCi/L). The historical (1997 to present) background concentration for thorium-232 ranges from nondetect to 0.613 pCi/L. The thorium-232 result for downstream location SWSD010 was 14.7 pCi/L, however, was elevated due to the turbidity of the sample and therefore was not considered representative of the actual thorium-232 concentration in surface water at this location. The USDOE DCG for thorium-232 is 50 pCi/L.

- The 2004 on-site analytical results for total uranium in surface water, ranging from 7.66 (field duplicate sample for SWSD011) to 10.51 pCi/L, compared to background (3.67 and 12.95 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. The total uranium result for downstream location SWSD010 was 37.32 pCi/L, however, was elevated due to the turbidity of the sample and therefore was not considered representative of the actual total uranium concentration in surface water at this location. The USDOE DCG for total uranium is 600 pCi/L.

### 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 2004 analytical results for radium-226 in sediment are consistent with historical analytical results. Radium-226 results from upstream (background) locations

SWSD009 and SWSD021 were 0.742 and 0.924 pCi/g, respectively, comparing favorably with the historical background range (from 1997 to present) of nondetect to 1.51 pCi/g. The 2004 results of analysis for radium-226 in samples collected at downstream locations (SWSD010, SWSD011, and SWSD022) ranged from 0.891 to 1.20 pCi/g. Historically, the concentration of radium-226 has ranged from nondetect to 2.90 pCi/g. All radium-226 concentrations in sediment were less than the USDOE surface soil cleanup criterion of 5 pCi/g above background.

- The 2004 analytical results for radium-228 in sediment are consistent with historical analytical results. Radium-228 results from upstream (background) locations SWSD009 and SWSD021 were 0.862 and 1.07 pCi/g, respectively. The 2004 results for radium-228 in samples collected at downstream locations (SWSD010, SWSD011, and SWSD022) ranged from 0.91 to 1.1 pCi/g (field duplicate for SWSD011). Historically (from 1997 to present), the background concentration of radium-228 has ranged from nondetect to 2.28 pCi/g from both background locations or nondetect 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.

- The 2004 analytical results for thorium-230 in sediment are consistent with historical analytical results. Thorium-230 results from upstream (background) locations SWSD009 and SWSD021 were 1.27 and 1.42 pCi/g, respectively. The 2004 results for thorium-230 in samples collected at downstream locations (SWSD010, SWSD011, and SWSD022) ranged from 1.02 to 1.58 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 surface soil cleanup criterion of 5 pCi/g above background.

- The 2004 analytical results for thorium-232 in sediment are consistent with historical analytical results. Thorium-232 results from upstream (background) locations SWSD009 and SWSD021 were 0.818 and 1.21 pCi/g, respectively. The 2004 results for thorium-232 in samples collected at downstream locations (SWSD010, SWSD011, and SWSD022) ranged from 0.601 to 1.14 pCi/g. Historically (from 1997 to present), the background concentration of thorium-232 has ranged from nondetect 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.

- The 2004 analytical results for total uranium in sediment are consistent with historical analytical results. Total uranium results from upstream (background) locations SWSD009 and SWSD021 were 2.33 and 2.265 pCi/g, respectively. The 2004 results for total uranium in samples collected at downstream locations (SWSD010, SWSD011, and SWSD022) ranged from 2.286 to 2.905 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.

## 5.6 Groundwater

The locations of environmental surveillance groundwater monitoring wells at NFSS are shown in Figure 2, Appendix A. 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 units and one bedrock unit are readily identified in the subsurface at the site. The principle hydrostratigraphic zones include the following, from top to bottom: the Upper Aquifer (fill and Upper Clay Till Units), the aquitard or confining unit (Glacio-Lacustrine Clay and Middle Silt Till Units), and the Lower Aquifer (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 NFSS occurs in two unconsolidated deposits and the shale bedrock. The unconsolidated deposits exhibit an upper groundwater system within the surficial brown clay till unit and a lower groundwater system within the sand and gravel unit, the underlying red till unit, and the 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 a system of drainage ditches was installed in the 1940s to drain surface water to a central drainage ditch that now influences groundwater flow in the upper groundwater system near the IWCS. Historically low concentrations of constituents in groundwater wells completed in the lower groundwater system and recent Remedial Investigation sampling of constituents in the lower groundwater system indicate that annual monitoring of the lower groundwater system is not currently necessary. Since the wells monitoring the upper groundwater system provide an early detection network by which to monitor the performance of the IWCS, the lower groundwater system is not routinely monitored as part of the environmental surveillance program. Groundwater studies, conducted in conjunction with the environmental surveillance sampling, are conducted periodically at NFSS and typically include sampling and analysis of groundwater samples from the upper groundwater system. These studies, the last of which was conducted in October 2003, help to track seasonal fluctuation of constituents detected in the upper groundwater system monitoring well network.

Background concentrations for the upper groundwater system were determined by averaging 1992 through 1997 analytical results for the appropriate constituents at the background monitoring well B02W20S. This well was selected as the background well because it is distant and is not downgradient from the IWCS. Additional background groundwater was sampled in 2003 at an adjacent property (Modern Landfill); those monitoring data indicate that groundwater from B02W20S represents local background conditions.

#### 5.6.1.2 Water Level Measurements

Water level measurements are obtained using an electronic depth-to-water meter. Ninety-one groundwater monitoring wells are used to monitor groundwater levels in both the upper and lower groundwater systems. These include 49 wells in the upper ground water system, and 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. The 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 total groundwater monitoring wells located throughout the property, as well as near the IWCS and the northern fence line, indicate that the areal coverage for groundwater is adequate to monitor all areas of concern on the NFSS (Appendix A, Figure 2).

The vertical gradients calculated at groundwater monitoring well pairs indicate that during the first and second quarters the elevations in the upper system were almost uniformly greater than the corresponding measurements in the lower unit. However, in the third and fourth quarters the majority of elevations in the lower system were greater than those measured in the upper system. These data indicate that the direction and magnitude of the vertical gradient changes seasonally. While groundwater flow is primarily horizontal, vertical hydraulic gradients change the magnitude and direction of vertical flow and thus further impede the potential migration of contaminant into the lower units.

In the upper groundwater system, the depth to water ranged from -0.88 to 6.28 m (-2.88 to 20.61 ft) below ground surface during 2004; the above-ground levels were observed during February when standing water occupied the ground surface around several wells. The quarterly water level fluctuations in the upper groundwater system averaged 0.97 m (3.19 ft) and showed high and low elevations during the February and October measurements, respectively. Shallow wells near the IWCS also are affected by the watering the IWCS to maintain the appropriate soil-moisture content in the capping material.

In the lower groundwater system, the depth to water ranged from 0.19 to 2.62 m (0.62 to

8.59 ft) below ground surface during 2004. The water-level fluctuation in the lower groundwater system averaged 0.19 m (0.61 ft), which appear similar to the upper zone. Long-term water-level data indicate that the upper groundwater system responds more rapidly to recharge than the lower confined groundwater system, because the Glacio-Lacustrine Clay Unit and intervening Middle Silt Till Unit act as an aquitard between the upper and lower groundwater zones. The upper and lower groundwater zones demonstrated an independent water level response, as exemplified by the seasonal high conditions observed in the lower groundwater zone during August and February, respectively, which further indicate the hydraulic separation of the two zones. During the fall, a higher downward gradient caused leakage from the upper to the lower groundwater zone, through the Glacio-Lacustrine Clay and intervening Middle Silt Till Units, resulting in higher (or shallower) water levels in the lower system than the upper system during this period.

Figures 3 through 6 in Appendix A show the piezometric surfaces and groundwater flow directions in the upper and lower units and their seasonally high and low groundwater conditions. The ArcGIS® software was employed to estimate all piezometric surfaces and define groundwater flow directions and gradients.

#### 5.6.1.3 Groundwater Flow

Groundwater occurs in layered glacial sediments composed of unconsolidated sand, silt, and clay. The two groundwater systems at the site are contained in the surficial clay till unit and the lower alluvial sand and gravel and bedrock unit. Hydrogeologic data indicate that the intervening glaciolacustrine clay unit hydraulically separates the upper clay till unit from the lower sand and gravel unit; the glaciolacustrine clay is present across the entire site. The average horizontal gradients in the upper system range between 0.002 and 0.003 to the northwest and appear locally erratic. On-site trends towards the central drainage ditch east of the IWCS were consistently apparent. In the lower system, groundwater flow was generally northwest with local low points underlying the IWCS. The approximate gradients range between 0.002 and 0.003. Dewatering activities at Modern Landfill are designed to minimize hydrostatic pressures on the developing cell liners, although no effects of these activities on groundwater flow at the NFSS were apparent in the 2004 measurements.

A groundwater flow velocity of 38 cm/yr (15 in/yr) has previously been estimated at NFSS (USDOE 1994b). This velocity does not necessarily represent the rate at which a contaminant could migrate because contaminant-dependent transport factors such as retardation (caused by physical interactions such as contaminants binding to clay particles) can significantly slow the rate of transport.

Groundwater elevations measured in the upper water-bearing zone during 2004 generally indicate a seasonal high condition occurred on February 17, 2004 and a seasonal low

occurred on October 19, 2004. The high-water elevations in the upper system ranged from 94.50 to 97.13 m (309.97 to 318.59 ft) above mean sea level, whereas the low-water condition ranged from 94.20 to 96.75 m (308.99 to 317.33 ft). Groundwater elevations measured in the lower water bearing zone during 2004 generally indicate a seasonal high condition occurred on August 17, 2004 and a seasonal low occurred on February 17, 2004. The high-water elevation in the lower system ranged from 95.12 to 96.84 m (311.98 to 317.64 ft) above mean sea level, whereas the low-water condition ranged from 94.36 to 96.41 m (309.58 to 316.29 ft). See Figures 3 through 6 in Appendix A for a graphical representation of these data and interpreted groundwater flow directions.

In 2004, well OW13B was sampled as part of the environmental surveillance plan (ESP) in lieu of OW7B, which was historically sampled under the ESP, due to the high turbidity of the groundwater at this location, which negatively affects sample quality. OW13B exhibits a higher hydraulic conductance and is more downgradient of the IWCS, thus making OW13B a better IWCS surveillance well than OW07B. The monitoring data from OW13B do not deviate from historical OW7B results, indicating that the substitution properly supports the surveillance program.

### 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 2004 environmental surveillance sampling. These measurements represent water conditions at the time of sampling.

#### 5.6.2.2 Water Quality Parameters

At NFSS, the upper groundwater system water quality indicates relatively recently recharged groundwater. The lower groundwater system water quality parameters indicate longer residence times or distance traveled. It is likely that the primary recharge of the lower groundwater system occurs at the base of the Niagara Escarpment, situated approximately 3.2 km south of the site (USDOE 1994b). Water quality parameter data for 2004 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 slightly saline and confirm the findings of the regional studies and studies conducted near the site 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.

Total dissolved solids (TDS), sulfate, and sodium were present onsite and upgradient (background) in concentrations exceeding NYSDEC water quality standards; there are no Federal standards for these water quality parameters. TDS results in all wells including the background well frequently exceed the NYSDEC Class GA and Secondary National Drinking Water Quality standard of 500 mg/L; for example, OW13B is highest at 1,960 mg/L of field samples and B02W20S is lowest at 891 mg/L. Six of the eight wells exceeded the NYSDEC Class GSA water quality standard of 1000 mg/L for TDS. Sodium was detected in all wells, including the background well, at concentrations ranging from 52.3 mg/L to 88.4 mg/L. The results are consistently greater than the NYSDEC groundwater quality standard for sodium (20 mg/L). Sulfate also was detected in all wells at concentrations ranging from 345 mg/L to 937 mg/L. All wells had sulfate concentrations greater than the NYSDEC groundwater quality standard for sulfate (250 mg/L).

#### 5.6.2.3 Groundwater - Radioactive Constituents

In 2004, filtered and 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. Only results for detected analytes are discussed.

Radium-226 concentrations in groundwater at NFSS have been consistently low, with all measured concentrations (background not subtracted) less than 1.2 pCi/L. Combined concentrations of radium-226 and radium-228 at NFSS are below the SDWA MCL (5 pCi/L). Thorium-230 and thorium-232 concentrations are below USDOE DCGs (300 pCi/L and 50 pCi/L) and the SDWA MCL (15 pCi/L for combined thorium-230 and thorium-232) for drinking water. The 2004 total uranium analytical results are consistent with the historical results, however, above background concentrations with the exception of OW17B. Total uranium concentrations are below the SDWA MCL, with the exception of OW04B. Since 1992, total uranium concentrations in all sampled wells have been less than 60 pCi/L (background not subtracted) this is compared to 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 both filtered and unfiltered results for comparison purposes.*

- The 2004 total analytical results for radium-226 ranged from non-detect to 1.12 pCi/L with an average value of 0.81 pCi/L. The 2004 filtered analytical results for radium-226 ranged from non-detect to 0.88 pCi/L with an average value of 0.58 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 (2004 total and filtered background levels were both non-detect).

- The 2004 total analytical results for radium-228 ranged from non-detect to 3.75 pCi/L with an average value of 2.32 pCi/L. The 2004 filtered analytical results for radium-228 ranged from non-detect to 2.94 pCi/L with an average value of 2.33 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 (2004 total and filtered background levels were both non-detect).

- The 2004 total analytical results for thorium-230 ranged from non-detect to 1.07 pCi/L with an average value of 0.69 pCi/L. The 2004 filtered analytical results for thorium-230 ranged from non-detect to 0.88 pCi/L with an average value of 0.52 pCi/L. The USDOE DCG for thorium-230 is 300 pCi/L above background and the SDWA MCL for combined thorium-230 and thorium-232 is 15 pCi/L (2004 total and filtered background levels were 1.86 pCi/L and non-detect, respectively).

- The 2004 total and filtered analytical results for thorium-232 ranged were all non-detect (all results were less than 0.369 pCi/L). The USDOE DCG for thorium-232 is 50 pCi/L above background and the SDWA MCL for combined thorium-230 and thorium-232 is 15 pCi/L (2004 total and filtered background levels were both non-detect).

- The 2004 total analytical results for total uranium ranged from 6.41 to 44.78 pCi/L with an average value of 20.14 pCi/L. The 2004 filtered analytical results for total uranium ranged from 7.08 to 41.05 pCi/L with an average value of 19.98 pCi/L. The USDOE DCG for total uranium is 600 pCi/L above background (2004 total and filtered background levels were 8.83 and 7.81 pCi/L, respectively). The USEPA National Primary Drinking Water Regulation for Radionuclides (Final Rule – effective 2003) states the SDWA MCL of 30µg/L or 27 pCi/L for total uranium. The average 2004 total uranium result of 20.14 pCi/L is equivalent to 22.38 µg/L assuming a conversion factor of 0.9 pCi/µg, which is below the drinking water standard. One well exceeded this limit, OW04B (44.78 pCi/L or 49.8 µg/L).

  *Note: The concentration (30µg/L) is for comparative purposes only and includes background.*

#### 5.6.2.4 Groundwater - Chemical Constituents/Metals

The 2004 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 and lead in one but the 2004 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 was not detected in the eight wells sampled in 2004.

- In 2004 copper results ranged from nondetect to 5.98 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.

- In 2004 lead results ranged from nondetect to 2.58 µg/L. The SDWA action level is 15 µg/L and the New York State Water Quality Regulation Class GA standard of 25 µg/L. Historically the concentration of lead has ranged from nondetect to 6.8 µg/L.

- In 2004, vanadium results were non-detect. 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

The 2004 external gamma radiation annual dose to a hypothetical maximally exposed individual is negligible having a calculated value is 0.0011 mrem for the nearest residence (Appendix B, CY2004 CALCULATION OF EXTERNAL GAMMA RADIATION DOSE RATES FOR NIAGARA FALLS STORAGE SITE (NFSS), Section 4.1). The hypothetical annual dose to the nearest off-site worker is 0.0036 mrem (Section 4.2, of the above mentioned reference).

### 6.2 Radon Gas

Results of the 2004 radon gas surveillance program indicate radon gas emissions are comparable to or below background. The radon gas concentrations at the site were consistently low (nondetect to 0.4 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 2004 radon-222 flux measurements were indistinguishable from background. Results ranged from non-detect to 0.213 $pCi/m^2/s$, with an average result of 0.066 $pCi/m^2/s$ (Appendix A, Table 4). The average value is less than one percent of the standard of 20 $pCi/m^2/s$ 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 2004 airborne particulate annual dose from the wind erosion of soil to a hypothetical maximally exposed individual is calculated at 0.0046 mrem Appendix C, FUSRAP CY2004 NESHAP ANNUAL REPORT FOR NIAGARA FALLS STORAGE SITE (NFSS), section 4.3). The hypothetical annual dose to the individual is low relative to the 10 mrem/year standard in 40 CFR Part 61, Subpart H of NESHAPs. The 2004 hypothetical airborne particulate annual collective dose to the population within an 80 km radius of the site is calculated at 0.032 person-rem (Appendix C, FUSRAP CY2004 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 2004 maximum annual total external gamma radiation and airborne particulate dose to a hypothetical individual is 0.0082 mrem (0.0036 + 0.0046, Appendix B, CY2004 CALCULATION OF EXTERNAL GAMMA RADIATION DOSE RATES FOR NIAGARA FALLS STORAGE SITE (NFSS), Section 4.2 and Appendix C, FUSRAP CY2004 NESHAP ANNUAL REPORT FOR NIAGARA FALLS STORAGE SITE (NFSS), Section 4.3, respectively). This value is low when compared to the USDOE limit of 100 mrem/year or the average national background dose of approximately 360 mrem/year to an individual.

### 6.6 Surface Water

In 2004, onsite radionuclide concentrations in surface water samples were consistent with historical results that indicate no evidence of a release.

### 6.7 Sediment

In 2004, 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 the SWDA 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. Uranium levels in groundwater will continue to be monitored as part of the environmental surveillance program and the on-going CERCLA remedial investigation of the site will define the extent of uranium in groundwater in excess of background levels and applicable regulatory limits throughout NFSS.

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# APPENDIX A

## NFSS 2004 Environmental Surveillance Technical Memorandum

Environmental Monitoring at NFSS

This appendix documents the results of environmental monitoring activities conducted in 2004 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).

The three part remedial investigation that began in 1999 continued through the year 2004 at NFSS**.**

**References**

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

FUSRAP NIAGARA FALLS STORAGE SITE

2004

# 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 [e] | - |
| 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 guideline (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 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 (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 Ra-226, 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 | 20 | | 20 | | 1 | | 1 | | 1 | | 1 | | 20 | | 20 | | 84 |
| | 18, 21, 23, 24, 28, 29, 36 | | | | | | | | | | | | | | | | | |
| Radon gas | 105, 116, 120 122, 123 | 20 | | 20 | | 1 | | 1 | | | | | | | | | | 42 |
| Radon-222 flux | IWCS [b] | | | 183 | | | | | | | | | | | | | | 183 |

a. TLD = Thermoluminescent Dosimeter

b. Interim 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 |
| Eh | | | 8 | | | | | | | | | | | | | | | | | | | | | | | 8 |
| Turbidity | | | 8 | | | | | | | | | | | | | | | | | | | | | | | 8 |
| Temperature | | | 8 | | | | | | | | | | | | | | | | | | | | | | | 8 |
| Specific conductivity | | | 8 | | | | | | | | | | | | | | | | | | | | | | | 8 |
| pH | | | 8 | | | | | | | | | | | | | | | | | | | | | | | 8 |
| LABORATORY MEASUREMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Radiological** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Uranium-234/235/238 | A45, A50, OW04B, OW06B, OW13B, OW15B, OW17B, B02W20S | | 8 | | | | | | | | | | | | 1 | | | | 1 | | | | 1 | | | 11 |
| Radium-226/228 | | | 8 | | | | | | | | | | | | 1 | | | | 1 | | | | 1 | | | 11 |
| Thorium-230/232 | | | 8 | | | | | | | | | | | | 1 | | | | 1 | | | | 1 | | | 11 |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Copper | | | 8 | | | | | | | | | | | | 1 | | | | 1 | | | | 1 | | | 11 |
| Lead | | | 8 | | | | | | | | | | | | 1 | | | | 1 | | | | 1 | | | 11 |
| Vanadium | | | 8 | | | | | | | | | | | | 1 | | | | 1 | | | | 1 | | | 11 |
| **Water Quality**[a] | | | 8 | | | | | | | | | | | | 1 | | | | 1 | | | | 1 | | | 11 |

a. Table 8 lists water quality parameters.

# 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** | SWSD021 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Uranium-234/235/238 | SWSD022 | | 5 | | | | | | | | | | | | 1 | | | | 1 | | | | 1 | | | 9 |
| Radium-226/228 | | | 5 | | | | | | | | | | | | 1 | | | | 1 | | | | 1 | | | 9 |
| Thorium-230/232 | | | 5 | | | | | | | | | | | | 1 | | | | 1 | | | | 1 | | | 9 |

**Table 2**
**2004 External Gamma Radiation Dose Rates**
**Niagara Falls Storage Site**

**NFSS - 2004 Data (TLD Exposure from: Jan.06.2004 to Jan.04.2005)**

| From 01/06/04 to 07/01/04 (177 days) | | | | From 07/01/04 to 01/04/05 (187 days) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | TLD[a] Dose Rate | | | | TLD[a] Dose Rate | | |
| Monitoring Location[b] | | Total[c] (mrem)[f] | Above Background[e] (mrem)[f] | Monitoring Location[b] | | Total[c] (mrem)[f] | Above Background[e] (mrem)[f] | Corrected Yearly Exposure[d] |
| NFSS | 1 | 18.2 | 5.3 | NFSS | 1 | 20.2 | 1.8 | **39.5** |
| Perimeter | 1 | 20.6 | 7.7 | Perimeter | 1 | 19.7 | 1.3 | |
| | 7 | 15.8 | 2.9 | | 7 | 20.2 | 1.8 | **35.2** |
| | 7 | 15.1 | 2.2 | | 7 | 19.1 | 0.7 | |
| | 11 | 16.4 | 3.5 | | 11 | 15.9 | -2.5 | **33.0** |
| | 11 | 12.5 | -0.4 | | 11 | 21.1 | 2.7 | |
| | 12 | 16.2 | 3.3 | | 12 | 18.0 | -0.4 | **37.6** |
| | 12 | 15.9 | 3.0 | | 12 | 24.9 | 6.5 | |
| | 13 | 14.2 | 1.3 | | 13 | 22.8 | 4.4 | **38.2** |
| | 13 | 15.8 | 2.9 | | 13 | 23.4 | 5.0 | |
| | 15 | 16.2 | 3.3 | | 15 | 18.4 | 0.0 | **37.0** |
| | 15 | 19.0 | 6.1 | | 15 | 20.2 | 1.8 | |
| | 28 | 25.9 | 13.0 | | 28 | 23.7 | 5.3 | **49.7** |
| | 28 | 22.2 | 9.3 | | 28 | 27.3 | 8.9 | |
| | 29 | 9.8 | -3.1 | | 29 | 25.3 | 6.9 | **40.8** |
| | 29 | 22.1 | 9.2 | | 29 | 24.2 | 5.8 | |
| | 36 | 16.6 | 3.7 | | 36 | 19.1 | 0.7 | **36.6** |
| | 36 | 17.4 | 4.5 | | 36 | 19.9 | 1.5 | |
| | 122 | 17.5 | 4.6 | | 122 | 20.7 | 2.3 | **37.3** |
| | 122 | 17.6 | 4.7 | | 122 | 18.5 | 0.1 | |
| | 123 | 14.6 | 1.7 | | 123 | 17.2 | -1.2 | **32.2** |
| | 123 | 15.9 | 3.0 | | 123 | 16.5 | -1.9 | |
| ***Average*** | | ***17.1*** | ***4.1*** | | | ***20.7*** | ***2.3*** | ***37.9*** |
| IWCS[g] | 8 | 13.1 | 0.2 | IWCS[g] | 8 | 17.0 | -1.4 | **33.0** |
| Perimeter | 8 | 14.6 | 1.7 | Perimeter | 8 | 21.2 | 2.8 | |
| | 10 | 16.5 | 3.6 | | 10 | 22.5 | 4.1 | **39.1** |
| | 10 | 18.2 | 5.3 | | 10 | 20.8 | 2.4 | |
| | 18 | 15.2 | 2.3 | | 18 | 17.0 | -1.4 | **33.5** |
| | 18 | 15.0 | 2.1 | | 18 | 19.6 | 1.2 | |
| | 21 | 16.3 | 3.4 | | 21 | 16.7 | -1.7 | **35.2** |
| | 21 | 18.2 | 5.3 | | 21 | 19.1 | 0.7 | |
| | 23 | 20.2 | 7.3 | | 23 | 20.2 | 1.8 | **42.0** |
| | 23 | 18.2 | 5.3 | | 23 | 25.1 | 6.7 | |
| | 24 | 15.1 | 2.2 | | 24 | 13.6 | -4.8 | **31.4** |
| | 24 | 16.1 | 3.2 | | 24 | 17.9 | -0.5 | |
| ***Average*** | | ***16.4*** | ***3.5*** | | | ***19.2*** | ***0.8*** | ***35.7*** |
| Background | 105 | 17.1 | | Background | 105 | 18.1 | | **33.6** |
| Locations | 105 | 10.1 | | Locations | 105 | 21.7 | | |
| | 116 | 12.7 | | | 116 | 13.3 | | **30.5** |
| | 116 | 12.6 | | | 116 | 22.2 | | |
| | 120[h] | 12.8 | | | 120[h] | 18.7 | | **30.5** |
| | 120[h] | 12.3 | | | 120[h] | 16.6 | | |
| ***Average Background*** | | ***12.9*** | | ***Average Background*** | | ***18.4*** | | ***31.5*** |

a. TLD = Thermoluminescent dosimeter. There are two TLDs per monitoring location.
b. Monitoring locations are shown in Figure 2 (Appendix A - Figures).
c. Reported values are the average reading per TLD. There are two detection units per each device.
d. TLD are normalized to a one-year exposure.
Corrected yearly exposure =Biannual TLD readings averaged * 365 days/# of days of exposure.
Example (Location 1, First TLD):
((18.2 + 20.6 mrem)/2 + ((20.2 + 19.7 mrem)/2) * 365 days per year / (177+187 days) =39.5 mrem/year.
e. Average background during exposure period is subtracted from dose during exposure period.
Above-background exposure = dose over exposure period - average background over exposure period.
*Example (Location 1, First TLD): 18.2 mrem - 12.9 mrem = 5.3 mrem.
**Numbers in the above calculation are all rounded up to one decimal place.*
f. mrem - millirem.
g. Monitoring locations along the perimeter of the interim waste containment structure (IWCS).
h. Location was moved from next to brick building to fence line location. *Note: Brick is naturally radioactive. Results for this location will exhibit lower results than in previous years.*

# Table 3
## 2004 Radon Gas [a] Concentrations
## Niagara Falls Storage Site

**NFSS - 2004 Data**

| Monitoring Location[c] | Monitoring Station | Average Daily Concentration (pCi/L)[b] Start Dates[d]: | 1/6/2004 | 7/1/2004 |
|---|---|---|---|---|
| | | End Dates[d]: | 7/1/2004 | 1/4/2005 |
| NFSS Perimeter | 1 | | <0.2 | <0.2 |
| | 7 | | <0.2 | 0.3 |
| | 11 | | <0.2 | 0.3 |
| | 12 | | <0.2 | <0.2 |
| | 12 (dup[e]) | | <0.2 | 0.3 |
| | 13 | | <0.2 | 0.2 |
| | 15 | | <0.2 | 0.3 |
| | 28 | | <0.2 | 0.2 |
| | 29 | | 0.3 | 0.3 |
| | 36 | | <0.2 | 0.4 |
| | 122 | | <0.2 | 0.2 |
| | 123 | | <0.2 | 0.3 |
| IWCS[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 | 0.3 |
| | 24 | | 0.2 | 0.3 |
| Background | 105 | | <0.2 | 0.3 |
| | 116 | | <0.2 | 0.2 |
| | 120 | | <0.2 | <0.2 |

a. Radon gas concentrations in 2004 were measured with RadTrack 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 interim waste containment structure (IWCS).

**Note:** The USDOE 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

2004 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 | 0.116 ± 0.058 | 41 | 0.046 ± 0.049 | 81 | 0.042 ± 0.040 |
| 2 | 0.015 ± 0.036 | 42 | 0.081 ± 0.068 | 82 | 0.086 ± 0.050 |
| 3 | 0.050 ± 0.062 | 43 | 0.060 ± 0.052 | 83 | 0.024 ± 0.033 |
| 4 | 0.107 ± 0.063 | 44 | 0.041 ± 0.049 | 84 | 0.122 ± 0.076 |
| 5 | 0.103 ± 0.053 | 45 | 0.077 ± 0.046 | 85 | 0.047 ± 0.042 |
| 6 [d] | NR ± 0.000 | 46 | 0.101 ± 0.067 | 86 | 0.025 ± 0.065 |
| 7 | 0.059 ± 0.032 | 47 | 0.063 ± 0.051 | 87 | -0.015 ± 0.026 |
| 8 | 0.046 ± 0.041 | 48 | 0.034 ± 0.038 | 88 | 0.119 ± 0.078 |
| 9 | 0.047 ± 0.038 | 49 | 0.036 ± 0.033 | 89 | 0.100 ± 0.060 |
| 10 | 0.106 ± 0.064 | 50 | 0.016 ± 0.038 | 90 | 0.103 ± 0.062 |
| 10 DUP [b] | 0.058 ± 0.035 | 50 DUP | 0.040 ± 0.041 | 90 DUP | 0.028 ± 0.061 |
| 11 | 0.081 ± 0.051 | 51 | 0.052 ± 0.048 | 91 | 0.034 ± 0.033 |
| 12 | 0.120 ± 0.060 | 52 | 0.100 ± 0.059 | 92 | 0.070 ± 0.044 |
| 13 | 0.093 ± 0.066 | 53 | -0.009 ± 0.042 | 93 | 0.036 ± 0.040 |
| 14 | 0.113 ± 0.055 | 54 | 0.035 ± 0.045 | 94 | 0.019 ± 0.040 |
| 15 | 0.018 ± 0.058 | 55 | 0.084 ± 0.061 | 95 | 0.028 ± 0.060 |
| 16 | 0.083 ± 0.055 | 56 | 0.072 ± 0.047 | 96 | 0.054 ± 0.046 |
| 17 | 0.078 ± 0.058 | 57 | 0.037 ± 0.062 | 97 | 0.016 ± 0.067 |
| 18 | 0.053 ± 0.043 | 58 | 0.054 ± 0.054 | 98 | 0.101 ± 0.065 |
| 19 | 0.031 ± 0.047 | 59 | 0.023 ± 0.043 | 99 | 0.082 ± 0.065 |
| 20 | 0.031 ± 0.028 | 60 | 0.069 ± 0.052 | 100 | 0.093 ± 0.054 |
| 20 DUP | 0.092 ± 0.071 | 60 DUP | 0.083 ± 0.061 | 100 DUP | 0.133 ± 0.078 |
| 21 | 0.102 ± 0.084 | 61 | 0.072 ± 0.045 | 101 | 0.084 ± 0.052 |
| 22 | 0.097 ± 0.030 | 62 | 0.053 ± 0.061 | 102 | 0.043 ± 0.044 |
| 23 | 0.031 ± 0.041 | 63 | 0.076 ± 0.046 | 103 | 0.081 ± 0.049 |
| 24 | 0.018 ± 0.033 | 64 | 0.111 ± 0.067 | 104 | -0.013 ± 0.044 |
| 25 | 0.095 ± 0.059 | 65 | 0.067 ± 0.046 | 105 | 0.103 ± 0.050 |
| 26 | 0.071 ± 0.048 | 66 | 0.103 ± 0.060 | 106 | 0.017 ± 0.040 |
| 27 | 0.067 ± 0.046 | 67 | 0.086 ± 0.044 | 107 | 0.106 ± 0.066 |
| 28 | 0.095 ± 0.054 | 68 | 0.008 ± 0.059 | 108 | 0.009 ± 0.066 |
| 29 | 0.040 ± 0.047 | 69 | 0.105 ± 0.055 | 109 | 0.090 ± 0.058 |
| 30 | 0.023 ± 0.016 | 70 | 0.026 ± 0.044 | 110 | 0.110 ± 0.060 |
| 30 DUP | 0.083 ± 0.055 | 70 DUP | 0.026 ± 0.035 | 110 DUP | 0.053 ± 0.048 |
| 31 | 0.025 ± 0.048 | 71 | 0.072 ± 0.044 | 111 | 0.064 ± 0.047 |
| 32 | 0.100 ± 0.055 | 72 | 0.096 ± 0.054 | 112 | 0.133 ± 0.064 |
| 33 | 0.111 ± 0.062 | 73 | 0.111 ± 0.083 | 113 | 0.048 ± 0.042 |
| 34 | 0.076 ± 0.045 | 74 | 0.016 ± 0.039 | 114 | 0.110 ± 0.062 |
| 35 | 0.046 ± 0.041 | 75 | 0.019 ± 0.035 | 115 | 0.078 ± 0.044 |
| 36 | 0.024 ± 0.065 | 76 | 0.077 ± 0.049 | 116 | 0.064 ± 0.053 |
| 37 | 0.000 ± 0.035 | 77 | 0.054 ± 0.044 | 117 | 0.104 ± 0.064 |
| 38 | 0.078 ± 0.046 | 78 | 0.109 ± 0.060 | 118 | 0.037 ± 0.050 |
| 39 | 0.023 ± 0.031 | 79 | 0.055 ± 0.040 | 119 | 0.074 ± 0.066 |
| 40 | 0.049 ± 0.044 | 80 | -0.004 ± 0.028 | 120 | 0.037 ± 0.050 |
| 40 DUP | 0.025 ± 0.049 | 80 DUP | -0.031 ± 0.051 | 120 DUP | 0.079 ± 0.054 |

Table 4

2004 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 | 0.025 ± 0.034 | 161 | 0.075 ± 0.054 | | |
| 122 | 0.007 ± 0.035 | 162 | 0.099 ± 0.070 | | |
| 123 | 0.079 ± 0.049 | 163 | 0.090 ± 0.059 | | |
| 124 | 0.126 ± 0.071 | 164 | 0.185 ± 0.084 | | |
| 125 | 0.047 ± 0.046 | 165 | 0.123 ± 0.039 | | |
| 126 | 0.099 ± 0.059 | 166 | 0.083 ± 0.066 | | |
| 127 | 0.158 ± 0.078 | 167 | 0.128 ± 0.039 | | |
| 128 | 0.047 ± 0.046 | 168 | 0.102 ± 0.080 | | |
| 129 | 0.033 ± 0.041 | 169 | 0.060 ± 0.039 | | |
| 130 | 0.028 ± 0.060 | 170 | 0.135 ± 0.094 | | |
| 130 DUP | 0.058 ± 0.058 | 170 DUP | 0.181 ± 0.091 | | |
| 131 | 0.002 ± 0.046 | 171 | 0.090 ± 0.054 | | |
| 132 | 0.020 ± 0.037 | 172 | 0.213 ± 0.082 | | |
| 133 | 0.008 ± 0.053 | 173 | 0.092 ± 0.066 | | |
| 134 | 0.013 ± 0.043 | 174 | 0.098 ± 0.062 | Average: | 0.066 ($pCi/m^2/s$) |
| 135 | 0.049 ± 0.061 | 175 | 0.113 ± 0.064 | High | 0.213 ($pCi/m^2/s$) |
| 136 | 0.027 ± 0.040 | 176 | 0.073 ± 0.051 | Low | -0.031 ($pCi/m^2/s$) |
| 137 | 0.017 ± 0.041 | 177 | 0.131 ± 0.073 | | |
| 138 | 0.075 ± 0.045 | 178 | 0.006 ± 0.037 | | |
| 139 | 0.013 ± 0.027 | 179 | 0.198 ± 0.090 | | |
| 140 | 0.084 ± 0.047 | 180 | 0.100 ± 0.064 | | |
| 140 DUP | 0.062 ± 0.069 | 180 DUP | 0.132 ± 0.071 | | |
| 141 | 0.071 ± 0.049 | 181[c] | 0.061 ± 0.053 | | |
| 142 | 0.133 ± 0.068 | 182[c] | 0.105 ± 0.076 | | |
| 143 | 0.096 ± 0.056 | 183[c] | 0.202 ± 0.090 | | |
| 144 | 0.005 ± 0.060 | Average background | 0.123 | | |
| 145 | 0.026 ± 0.035 | | | | |
| 146 | 0.065 ± 0.054 | | | | |
| 147 | 0.020 ± 0.041 | | | | |
| 148 | 0.060 ± 0.071 | | | | |
| 149 | 0.085 ± 0.064 | | | | |
| 150 | 0.039 ± 0.059 | | | | |
| 150 DUP | 0.048 ± 0.047 | | | | |
| 151 | 0.039 ± 0.051 | | | | |
| 152 | 0.089 ± 0.048 | | | | |
| 153 | 0.103 ± 0.051 | | | | |
| 154 | 0.018 ± 0.042 | | | | |
| 155 | 0.094 ± 0.061 | | | | |
| 156 | 0.083 ± 0.075 | | | | |
| 157 | 0.071 ± 0.060 | | | | |
| 158 | 0.049 ± 0.048 | | | | |
| 159 | 0.108 ± 0.069 | | | | |
| 160 | 0.030 ± 0.070 | | | | |
| 160 DUP | 0.009 ± 0.063 | | | | |

NOTE: The USEPA Standard for Radon-222 Flux is 20 $pCi/m^2/sec$

a. Radon-222 flux was performed on August 11-12, 2004

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

d. Due to laboratory problems (non-resolvable energy peaks), no results are available for this location.

**Table 5**
**2004 Surface Water Analytical Results - Radioactive Constituents**
**Niagara Falls Storage Site**



| Sampling Location | Date Collected | Analyte | Qualifier[f] | Result (pCi/L)[a] | Reporting Limit | MDA[b] (pCi/L)[a] | DCG[c] (pCi/L)[a] |
|---|---|---|---|---|---|---|---|
| SWSD009 | 4/27/2004 | Radium-226 | U | 0.299 ± 0.278 | 1.00 | 0.397 | 100 |
| Background | 4/27/2004 | Radium-228 | U | 0.660 ± 0.447 | 3.00 | 0.868 | 100 |
| | 4/27/2004 | Thorium-230 | | 0.561 ± 0.408 | 1.00 | 0.446 | 300 |
| | 4/27/2004 | Thorium-232 | U | 0.068 ± 0.137 | 1.00 | 0.215 | 50 |
| | 4/27/2004 | Uranium-234 | | 2.350 ± 0.735 | 1.00 | 0.553 | 500 |
| | 4/27/2004 | Uranium-235 | U | 0.144 ± 0.230 | 1.00 | 0.484 | 600 |
| | 4/27/2004 | Uranium-238 | | 1.320 ± 0.555 | 1.00 | 0.482 | 600 |
| | 4/27/2004 | *Total uranium*[d] | | *3.670* | | | *600* |
| SWSD021 | 4/27/2004 | Radium-226 | U | 0.320 ± 0.320 | 1.00 | 0.502 | 100 |
| Background | 4/27/2004 | Radium-228 | U | 0.351 ± 0.549 | 3.00 | 1.120 | 100 |
| | 4/27/2004 | Thorium-230 | | 0.649 ± 0.440 | 1.00 | 0.596 | 300 |
| | 4/27/2004 | Thorium-232 | | 0.613 ± 0.391 | 1.00 | 0.333 | 50 |
| | 4/27/2004 | Uranium-234 | | 7.780 ± 1.460 | 1.00 | 0.378 | 500 |
| | 4/27/2004 | Uranium-235 | U | 0.456 ± 0.437 | 1.00 | 0.757 | 600 |
| | 4/27/2004 | Uranium-238 | | 5.170 ± 1.200 | 1.00 | 0.497 | 600 |
| | 4/27/2004 | *Total uranium*[d] | | *12.950* | | | *600* |
| SWSD010[g] | 4/27/2004 | Radium-226 | | 3.340 ± 0.792 | 1.00 | 0.626 | 100 |
| | 4/27/2004 | Radium-228 | U | 0.668 ± 0.505 | 3.00 | 0.982 | 100 |
| | 4/27/2004 | Thorium-230 | | 12.200 ± 2.540 | 1.00 | 1.160 | 300 |
| | 4/27/2004 | Thorium-232 | | 14.700 ± 2.770 | 1.00 | 0.406 | 50 |
| | 4/27/2004 | Uranium-234 | | 19.100 ± 2.910 | 1.00 | 0.346 | 500 |
| | 4/27/2004 | Uranium-235 | U | 1.620 ± 0.848 | 1.00 | 0.347 | 600 |
| | 4/27/2004 | Uranium-238 | | 16.600 ± 2.710 | 1.00 | 0.608 | 600 |
| | 4/27/2004 | *Total uranium*[d] | | *37.320* | | | *600* |
| SWSD011 | 4/27/2004 | Radium-226 | | 0.413 ± 0.245 | 1.00 | 0.275 | 100 |
| | 4/27/2004 | Radium-228 | U | 0.427 ± 0.630 | 3.00 | 1.280 | 100 |
| | 4/27/2004 | Thorium-230 | U | 0.590 ± 0.529 | 1.00 | 0.854 | 300 |
| | 4/27/2004 | Thorium-232 | U | 0.091 ± 0.262 | 1.00 | 0.683 | 50 |
| | 4/27/2004 | Uranium-234 | | 4.050 ± 0.990 | 1.00 | 0.498 | 500 |
| | 4/27/2004 | Uranium-235 | | 0.741 ± 0.419 | 1.00 | 0.185 | 600 |
| | 4/27/2004 | Uranium-238 | | 4.360 ± 1.020 | 1.00 | 0.325 | 600 |
| | 4/27/2004 | *Total uranium*[d] | | *9.151* | | | *600* |

**Table 5**
**2004 Surface Water Analytical Results - Radioactive Constituents**
**Niagara Falls Storage Site**



| Sampling Location | Date Collected | Analyte | Qualifier[f] | Result (pCi/L)[a] | Reporting Limit | MDA[b] (pCi/L)[a] | DCG[c] (pCi/L)[a] |
|---|---|---|---|---|---|---|---|
| Duplicate[e] SWSD1-SW | 4/27/2004 | Radium-226 | U | 0.063 ± 0.228 | 1.00 | 0.495 | 100 |
| *SWSD011* | 4/27/2004 | Radium-228 | U | 0.957 ± 0.590 | 3.00 | 1.140 | 100 |
| | 4/27/2004 | Thorium-230 | | 0.840 ± 0.525 | 1.00 | 0.548 | 300 |
| | 4/27/2004 | Thorium-232 | U | 0.432 ± 0.381 | 1.00 | 0.491 | 50 |
| | 4/27/2004 | Uranium-234 | | 3.720 ± 0.933 | 1.00 | 0.574 | 500 |
| | 4/27/2004 | Uranium-235 | U | 0.091 ± 0.210 | 1.00 | 0.502 | 600 |
| | 4/27/2004 | Uranium-238 | | 3.940 ± 0.952 | 1.00 | 0.501 | 600 |
| | | *Total uranium*[d] | | *7.660* | | | *600* |
| SWSD022 | 4/27/2004 | Radium-226 | | 0.493 ± 0.340 | 1.00 | 0.416 | 100 |
| | 4/27/2004 | Radium-228 | U | 0.684 ± 0.467 | 3.00 | 1.070 | 100 |
| | 4/27/2004 | Thorium-230 | U | 0.378 ± 0.339 | 1.00 | 0.473 | 300 |
| | 4/27/2004 | Thorium-232 | U | 0.068 ± 0.197 | 1.00 | 0.515 | 50 |
| | 4/27/2004 | Uranium-234 | | 5.440 ± 1.250 | 1.00 | 0.778 | 500 |
| | 4/27/2004 | Uranium-235 | U | 0.433 ± 0.378 | 1.00 | 0.541 | 600 |
| | 4/27/2004 | Uranium-238 | | 5.070 ± 1.180 | 1.00 | 0.214 | 600 |
| | | *Total uranium*[d] | | *10.510* | | | *600* |

a. pCi/L - picocuries per liter.

b. MDA - Minimum detectable activity.

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

d. Sum of uranium isotope concentrations. Values qualified as U were not included in the total.

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

g. Elevated thorium and uranium results in surface water at this location are attributed to the high turbidity of the sample. The 2004 total uranium results, using a KPA method that is less susceptible to interference from turbidity, and preliminary 2005 total uranium results for this location are indicative of past results.

**Table 6**
**2004**
**Sediment Analytical Results - Radioactive Constituents**
**Niagara Falls Storage Site**



| Sampling Location | Date Collected | Analyte | Qualifier[g] | Result (pCi/g)[a] | Reporting Limit (pCi/g)[a] | MDA[b] (pCi/g)[a] | Cleanup Criteria[c] (pCi/g)[a] |
|---|---|---|---|---|---|---|---|
| SWSD009 | 4/27/2004 | Radium-226 | | 0.742 ± 0.107 | 1.000 | 0.054 | 5 |
| | 4/27/2004 | Radium-228 | | 0.862 ± 0.217 | 0.500 | 0.144 | 5 |
| Background | 4/27/2004 | Thorium-230 | | 1.270 ± 0.253 | 1.000 | 0.099 | 5 |
| | 4/27/2004 | Thorium-232 | | 0.818 ± 0.203 | 1.000 | 0.081 | 5 |
| | 4/27/2004 | Uranium-234 | | 1.110 ± 0.378 | 1.000 | 0.226 | - |
| | 4/27/2004 | Uranium-235 | U | 0.082 ± 0.113 | 1.000 | 0.203 | - |
| | 4/27/2004 | Uranium-238 | | 1.220 ± 0.393 | 1.000 | 0.202 | - |
| | | *Total uranium*[e] | | *2.330* | | | *90*[d] |
| SWSD021 | 4/27/2004 | Radium-226 | | 0.924 ± 0.133 | 1.000 | 0.055 | 5 |
| | 4/27/2004 | Radium-228 | | 1.070 ± 0.262 | 0.500 | 0.190 | 5 |
| Background | 4/27/2004 | Thorium-230 | | 1.420 ± 0.239 | 1.000 | 0.098 | 5 |
| | 4/27/2004 | Thorium-232 | | 1.210 ± 0.219 | 1.000 | 0.064 | 5 |
| | 4/27/2004 | Uranium-234 | | 1.120 ± 0.360 | 1.000 | 0.248 | - |
| | 4/27/2004 | Uranium-235 | | 0.276 ± 0.181 | 1.000 | 0.181 | - |
| | 4/27/2004 | Uranium-238 | | 0.869 ± 0.311 | 1.000 | 0.087 | - |
| | | *Total uranium*[e] | | *2.265* | | | *90*[d] |
| SWSD010 | 4/27/2004 | Radium-226 | | 0.891 ± 0.156 | 1.000 | 0.091 | 5 |
| | 4/27/2004 | Radium-228 | | 0.940 ± 0.234 | 0.500 | 0.163 | 5 |
| | 4/27/2004 | Thorium-230 | | 1.270 ± 0.245 | 1.000 | 0.093 | 5 |
| | 4/27/2004 | Thorium-232 | | 1.140 ± 0.233 | 1.000 | 0.093 | 5 |
| | 4/27/2004 | Uranium-234 | | 1.610 ± 0.349 | 1.000 | 0.174 | - |
| | 4/27/2004 | Uranium-235 | | 0.165 ± 0.114 | 1.000 | 0.120 | - |
| | 4/27/2004 | Uranium-238 | | 1.130 ± 0.290 | 1.000 | 0.102 | - |
| | | *Total uranium*[e] | | *2.905* | | | *90*[d] |
| SWSD022 | 4/27/2004 | Radium-226 | | 1.210 ± 0.166 | 1.000 | 0.095 | 5 |
| | 4/27/2004 | Radium-228 | | 0.910 ± 0.266 | 0.500 | 0.196 | 5 |
| | 4/27/2004 | Thorium-230 | | 1.580 ± 0.289 | 1.000 | 0.168 | 5 |
| | 4/27/2004 | Thorium-232 | | 0.897 ± 0.212 | 1.000 | 0.039 | 5 |
| | 4/27/2004 | Uranium-234 | | 1.110 ± 0.335 | 1.000 | 0.218 | - |
| | 4/27/2004 | Uranium-235 | | 0.223 ± 0.150 | 1.000 | 0.134 | - |
| | 4/27/2004 | Uranium-238 | | 0.953 ± 0.307 | 1.000 | 0.158 | - |
| | | *Total uranium*[e] | | *2.286* | | | *90*[d] |

**Table 6**
**2004**
**Sediment Analytical Results - Radioactive Constituents**
**Niagara Falls Storage Site**

| Sampling Location | Date Collected | Analyte | Qualifier[g] | Result (pCi/g)[a] | Reporting Limit (pCi/g)[a] | MDA[b] (pCi/g)[a] | Cleanup Criteria[c] (pCi/g)[a] |
|---|---|---|---|---|---|---|---|
| SWSD011 | 4/27/2004 | Radium-226 | | 1.080 ± 0.243 | 1.000 | 0.073 | 5 |
| | 4/27/2004 | Radium-228 | | 1.090 ± 0.173 | 0.500 | 0.145 | 5 |
| | 4/27/2004 | Thorium-230 | | 1.020 ± 0.326 | 1.000 | 0.184 | 5 |
| | 4/27/2004 | Thorium-232 | | 0.601 ± 0.249 | 1.000 | 0.140 | 5 |
| | 4/27/2004 | Uranium-234 | | 1.300 ± 0.371 | 1.000 | 0.187 | - |
| | 4/27/2004 | Uranium-235 | | 0.386 ± 0.206 | 1.000 | 0.188 | - |
| | 4/27/2004 | Uranium-238 | | 1.150 ± 0.347 | 1.000 | 0.168 | - |
| | | *Total uranium*[e] | | *2.836* | | | *90*[d] |
| Duplicate[f] SWSD1-SED *SWSD011* | 4/27/2004 | Radium-226 | | 0.973 ± 0.141 | 1.000 | 0.087 | 5 |
| | 4/27/2004 | Radium-228 | | 1.100 ± 0.241 | 0.500 | 0.160 | 5 |
| | 4/27/2004 | Thorium-230 | | 1.290 ± 0.236 | 1.000 | 0.085 | 5 |
| | 4/27/2004 | Thorium-232 | | 0.981 ± 0.205 | 1.000 | 0.070 | 5 |
| | 4/27/2004 | Uranium-234 | | 1.200 ± 0.349 | 1.000 | 0.387 | - |
| | 4/27/2004 | Uranium-235 | | 0.288 ± 0.182 | 1.000 | 0.240 | - |
| | 4/27/2004 | Uranium-238 | | 1.020 ± 0.318 | 1.000 | 0.239 | - |
| | | *Total uranium*[e] | | *2.508* | | | *90*[d] |

a. pCi/g - picocuries per gram.
b. MDA - Minimum detectable activity.
c. USDOE 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 camparison of sediment results.
d. USDOE-derived NFSS site-specific cleanup criterion for total uranium.
e. Sum of uranium isotope concentrations. Values qualified as U were not included in the total.
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. Lab Qualifier: **U** - indicates that no analyte was detected above reporting limit (Non-Detect).

# Table 7
## 2004 Field Parameter Summary
## Niagara Falls Storage Site



| Sampling Location | Date | Temperature (°F[a]) | pH | Spec. Cond.[b] (mS/cm[c]) | DO[d] (mg/L[e]) | Eh[f] (mV[g]) | Turbidity (NTU[h]) | Volume Purged (Liters[i]) | Discharge milliter PM[j] |
|---|---|---|---|---|---|---|---|---|---|
| **GROUNDWATER** | | | | | | | | | |
| A45 | 4/29/2004 | 59.6 | 6.75 | 2.121 | 0.24 | 87 | 6.30 | 3.28 | 82 |
| A50 | 4/29/2004 | 62.6 | 7.11 | 1.677 | 1.58 | 304 | 6.00 | 2.98 | 85 |
| OW04B | 4/30/2004 | 58.2 | 7.29 | 1.703 | 0.42 | 356 | 8.00 | 3.36 | 96 |
| OW06B | 4/29/2004 | 62.8 | 7.02 | 1.887 | 0.22 | 263 | 13.00 | 2.28 | 76 |
| OW13B | 4/28/2004 | 51.0 | 6.92 | 2.355 | 0.34 | 400 | 8.90 | 2.94 | 92 |
| OW15B | 4/27/2004 | 48.8 | 7.71 | 1.312 | 0.49 | 362 | 8.00 | 1.93 | 55 |
| OW17B | 4/28/2004 | 50.6 | 7.46 | 1.451 | 0.47 | 408 | 7.40 | 1.08 | 60 |
| B02W20S | 4/26/2004 | 53.8 | 7.36 | 1.292 | 0.42 | 319 | 5.70 | 6.05 | 93 |
| **SURFACE WATER** | | | | | | | | | |
| SWSD009 | 4/27/2004 | 53.6 | 8.22 | 0.8254 | 8.26 | 609 | 130 | NA | NA |
| SWSD010 | 4/27/2004 | 53.1 | 8.30 | 0.7836 | 10.21 | 541 | 700 | NA | NA |
| SWSD011 | 4/27/2004 | 54.5 | 8.38 | 0.7495 | 10.60 | 385 | 34 | NA | NA |
| SWSD021 | 4/27/2004 | 53.3 | 7.99 | 0.7306 | 13.02 | 393 | 75 | NA | NA |
| SWSD022 | 4/27/2004 | 49.6 | 7.80 | 0.8442 | 8.34 | 642 | 45 | NA | NA |

a. °F - Degrees Fahrenheit.
b. Spec. Cond. - Specific conductance.
c. mS/cm - milliSiemens/centimeter.
d. DO - Dissolved oxygen.
e. mg/L - milligrams per liter.
f. Eh - 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
## 2004 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] | Related Regulations[b] State[d] (mg/L)[a] |
|---|---|---|---|---|---|---|---|
| B02W20S | 04/26/04 | Alkalinity, Total as CaCO3 | | 446 | 2 | NE | NE |
| Background | 04/26/04 | Bicarbonate alkalinity (CaCO3 | | 444 | 2 | NE | NE |
| | 04/26/04 | Calcium | | 79.7 | 0.1 | NE | NE |
| | 04/26/04 | Carbonate alkalinity (CaCO3 | J | 1.91 | 2 | NE | NE |
| | 04/26/04 | Chloride | | 7.96 | 0.2 | 250 | 250 |
| | 04/26/04 | Magnesium | | 128 | 0.1 | 4 | 1.5 |
| | 04/26/04 | Nitrogen, Nitrate | | 0.117 | 0.1 | 10 | 10 |
| | 04/26/04 | Nitrogen, Nitrite | U | 0.542 | 0.1 | 1 | 1 |
| | 04/26/04 | Ortho-phosphate | U | 0.151 | 0.2 | NE | NE |
| | 04/26/04 | Potassium | | 1.81 | 0.1 | NE | NE |
| | 04/26/04 | Sodium | | 63 | 0.1 | NE | 20 |
| | 04/26/04 | Solids, Total Dissolved | | 891 | 10 | 500 | 500 |
| | 04/26/04 | Sulfate | | 345 | 40 | NE | 250 |
| A45 | 04/29/04 | Alkalinity | | 453 | 2 | NE | NE |
| | 04/29/04 | Bicarbonate | | 452 | 2 | NE | NE |
| | 04/29/04 | Calcium | | 292 | 0.1 | NE | NE |
| | 04/29/04 | Carbonate alkalinity (CaCO3 | U | 0.586 | 2 | NE | NE |
| | 04/29/04 | Chloride | | 56.1 | 0.2 | 250 | 250 |
| | 04/29/04 | Magnesium | | 151 | 0.1 | 4 | 1.5 |
| | 04/29/04 | Nitrogen, Nitrate | U | 0 | 0.1 | 10 | 10 |
| | 04/29/04 | Nitrogen, Nitrite | U | 0 | 0.1 | 1 | 1 |
| | 04/29/04 | Ortho-phosphate | U | 0 | 0.2 | NE | NE |
| | 04/29/04 | Potassium | | 6.7 | 0.1 | NE | NE |
| | 04/29/04 | Sodium | | 53.1 | 0.1 | NE | 20 |
| | 04/29/04 | Total dissolved solid | | 1790 | 10 | 500 | 500 |
| | 04/29/04 | Sulfate | | 775 | 40 | NE | 250 |
| Duplicate[e](D1-GW) | 04/30/05 | Alkalinity, Total as CaCO3 | | 308 | 2 | NE | NE |
| *OW04B* | 04/30/05 | Bicarbonate alkalinity (CaCO3 | | 307 | 2 | NE | NE |
| | 04/30/05 | Calcium | | 192 | 0.1 | NE | NE |
| | 04/30/05 | Carbonate alkalinity (CaCO3 | U | 1.18 | 2 | NE | NE |
| | 04/30/05 | Chloride | | 80.7 | 0.2 | 250 | 250 |
| | 04/30/05 | Magnesium | | 128 | 0.1 | 4 | 1.5 |
| | 04/30/05 | Nitrogen, Nitrate | U | 0 | 0.1 | 10 | 10 |
| | 04/30/05 | Nitrogen, Nitrite | U | 0 | 0.1 | 1 | 1 |
| | 04/30/05 | Ortho-phosphate | U | 0 | 0.2 | NE | NE |
| | 04/30/05 | Potassium | | 2.06 | 0.1 | NE | NE |
| | 04/30/05 | Sodium | | 62.1 | 0.1 | NE | 20 |
| | 04/30/05 | Solids, Total Dissolved | | 1460 | 10 | 500 | 500 |
| | 04/30/05 | Sulfate | | 634 | 40 | NE | 250 |

**Table 8**
**2004 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] | Related Regulations[b] State[d] (mg/L)[a] |
|---|---|---|---|---|---|---|---|
| A50 | 04/29/04 | Alkalinity, Total as CaCO3 | | 416 | 2 | NE | NE |
| | 04/29/04 | Bicarbonate alkalinity (CaCO3 | | 415 | 2 | NE | NE |
| | 04/29/04 | Calcium | | 122 | 0.1 | NE | NE |
| | 04/29/04 | Carbonate alkalinity (CaCO3 | U | 1.12 | 2 | NE | NE |
| | 04/29/04 | Chloride | | 23.1 | 0.2 | 250 | 250 |
| | 04/29/04 | Magnesium | | 155 | 0.1 | 4 | 1.5 |
| | 04/29/04 | Nitrogen, Nitrate | U | 0 | 0.1 | 10 | 10 |
| | 04/29/04 | Nitrogen, Nitrite | U | 0 | 0.1 | 1 | 1 |
| | 04/29/04 | Ortho-phosphate | U | 0 | 0.2 | NE | NE |
| | 04/29/04 | Potassium | | 1.63 | 0.1 | NE | NE |
| | 04/29/04 | Sodium | | 78.6 | 0.1 | NE | 20 |
| | 04/29/04 | Solids, Total Dissolved | | 1330 | 10 | 500 | 500 |
| | 04/29/04 | Sulfate | | 653 | 40 | NE | 250 |
| OW04B | 04/30/04 | Alkalinity, Total as CaCO3 | | 305 | 2 | NE | NE |
| | 04/30/04 | Bicarbonate alkalinity (CaCO3 | | 304 | 2 | NE | NE |
| | 04/30/04 | Calcium | | 191 | 0.1 | NE | NE |
| | 04/30/04 | Carbonate alkalinity (CaCO3 | U | 1.14 | 2 | NE | NE |
| | 04/30/04 | Chloride | | 80.5 | 0.2 | 250 | 250 |
| | 04/30/04 | Magnesium | | 128 | 0.1 | 4 | 1.5 |
| | 04/30/04 | Nitrogen, Nitrate | | 0.114 | 0.1 | 10 | 10 |
| | 04/30/04 | Nitrogen, Nitrite | U | 0 | 0.1 | 1 | 1 |
| | 04/30/04 | Ortho-phosphate | U | 0 | 0.2 | NE | NE |
| | 04/30/04 | Potassium | | 2.02 | 0.1 | NE | NE |
| | 04/30/04 | Sodium | | 61.4 | 0.1 | NE | 20 |
| | 04/30/04 | Solids, Total Dissolved | | 1440 | 10 | 500 | 500 |
| | 04/30/04 | Sulfate | | 634 | 40 | NE | 250 |
| OW06B | 04/29/04 | Alkalinity, Total as CaCO3 | | 592 | 2 | NE | NE |
| | 04/29/04 | Bicarbonate alkalinity (CaCO3 | | 591 | 2 | NE | NE |
| | 04/29/04 | Calcium | | 131 | 0.1 | NE | NE |
| | 04/29/04 | Carbonate alkalinity (CaCO3 | J | 1.53 | 2 | NE | NE |
| | 04/29/04 | Chloride | | 29.1 | 0.2 | 250 | 250 |
| | 04/29/04 | Magnesium | | 200 | 0.1 | 4 | 1.5 |
| | 04/29/04 | Nitrogen, Nitrate | U | 0 | 0.1 | 10 | 10 |
| | 04/29/04 | Nitrogen, Nitrite | U | 0 | 0.1 | 1 | 1 |
| | 04/29/04 | Ortho-phosphate | U | 0 | 0.2 | NE | NE |
| | 04/29/04 | Potassium | | 3.03 | 0.1 | NE | NE |
| | 04/29/04 | Sodium | | 69.3 | 0.1 | NE | 20 |
| | 04/29/04 | Solids, Total Dissolved | | 1450 | 10 | 500 | 500 |
| | 04/29/04 | Sulfate | | 571 | 40 | NE | 250 |

## Table 8
## 2004 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] | Related Regulations[b] State[d] (mg/L)[a] |
|---|---|---|---|---|---|---|---|
| OW13B | 04/28/04 | Alkalinity, Total as CaCO3 | | 501 | 2 | NE | NE |
| | 04/28/04 | Bicarbonate alkalinity (CaCO3 | | 499 | 2 | NE | NE |
| | 04/28/04 | Calcium | | 164 | 0.1 | NE | NE |
| | 04/28/04 | Carbonate alkalinity (CaCO3 | U | 1.38 | 2 | NE | NE |
| | 04/28/04 | Chloride | | 34 | 0.2 | 250 | 250 |
| | 04/28/04 | Magnesium | | 258 | 0.1 | 4 | 1.5 |
| | 04/28/04 | Nitrogen, Nitrate | U | 0 | 0.1 | 10 | 10 |
| | 04/28/04 | Nitrogen, Nitrite | U | 0 | 0.1 | 1 | 1 |
| | 04/28/04 | Ortho-phosphate | U | 0 | 0.2 | NE | NE |
| | 04/28/04 | Potassium | | 2.05 | 0.1 | NE | NE |
| | 04/28/04 | Sodium | | 88.4 | 0.1 | NE | 20 |
| | 04/28/04 | Solids, Total Dissolve | | 1960 | 10 | 500 | 500 |
| | 04/28/04 | Sulfate | | 937 | 40 | NE | 250 |
| OW15B | 04/27/04 | Alkalinity, Total as CaCO3 | | 387 | 2 | NE | NE |
| | 04/27/04 | Bicarbonate alkalinity (CaCO3 | | 384 | 2 | NE | NE |
| | 04/27/04 | Calcium | | 107 | 0.1 | NE | NE |
| | 04/27/04 | Carbonate alkalinity (CaCO3 | | 2.93 | 2 | NE | NE |
| | 04/27/04 | Chloride | | 7.16 | 0.2 | 250 | 250 |
| | 04/27/04 | Magnesium | | 106 | 0.1 | 4 | 1.5 |
| | 04/27/04 | Nitrogen, Nitrate | | 0.768 | 0.1 | 10 | 10 |
| | 04/27/04 | Nitrogen, Nitrite | U | 0.0542 | 0.1 | 1 | 1 |
| | 04/27/04 | Ortho-phosphate | U | 0.151 | 0.2 | NE | NE |
| | 04/27/04 | Potassium | | 1.44 | 0.1 | NE | NE |
| | 04/27/04 | Sodium | | 52.3 | 0.1 | NE | 20 |
| | 04/27/04 | Solids, Total Dissolve | | 919 | 10 | 500 | 500 |
| | 04/27/04 | Sulfate | | 375 | 40 | NE | 250 |
| OW17B | 04/28/04 | Alkalinity, Total as CaCO3 | | 415 | 2 | NE | NE |
| | 04/28/04 | Bicarbonate alkalinity (CaCO3 | | 413 | 2 | NE | NE |
| | 04/28/04 | Calcium | | 81.1 | 0.1 | NE | NE |
| | 04/28/04 | Carbonate alkalinity (CaCO3 | J | 1.77 | 2 | NE | NE |
| | 04/28/04 | Chloride | | 10.9 | 0.2 | 250 | 250 |
| | 04/28/04 | Magnesium | | 144 | 0.1 | 4 | 1.5 |
| | 04/28/04 | Nitrogen, Nitrate | U | 0.0341 | 0.1 | 10 | 10 |
| | 04/28/04 | Nitrogen, Nitrite | U | 0.0542 | 0.1 | 1 | 1 |
| | 04/28/04 | Ortho-phosphate | U | 0.151 | 0.2 | NE | NE |
| | 04/28/04 | Potassium | | 2.24 | 0.1 | NE | NE |
| | 04/28/04 | Sodium | | 73.3 | 0.1 | NE | 20 |
| | 04/28/04 | Solids, Total Dissolve | | 1020 | 10 | 500 | 500 |
| | 04/28/04 | Sulfate | | 427 | 40 | NE | 250 |

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 USEPA 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. Lab Qualifier: U - indicates that no analyte was detected above reporting limit (Non-Detect).
J - estimated value (above detection limit, but below reporting limit)

**Table 9**
**2004 Groundwater Analytical Results - Radioactive Constituents**
**Niagara Falls Storage Site**



| Sampling Location | Date Collected | Analyte | Qualifier[c] | Result[a] (pCi/L)[b] | Reporting Limit (pCi/L)[b] | DCG[d] (pCi/L)[b] |
|---|---|---|---|---|---|---|
| B02W20S | 04/26/04 | Radium-226[h] | U | 0.179 ± 0.393 | 1.000 | 100 |
| Background | 04/26/04 | Radium-228[h] | U | 0.364 ± 0.848 | 3.000 | 100 |
| | | *Total Radium*[g] | Non-Detect | | | 100 |
| | 04/26/04 | Thorium-230 | | 1.860 ± 0.601 | 1.000 | 300 |
| | 04/26/04 | Thorium-232[h] | U | 0.369 ± 0.313 | 1.000 | 50 |
| | 04/26/04 | Uranium-234 | | 4.47 ± 1.18 | 1.000 | 500 |
| | 04/26/04 | Uranium-235 | | 0.399 ± 0.349 | 1.000 | 600 |
| | 04/26/04 | Uranium-238 | | 3.96 ± 1.10 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 8.83 | | *600* |
| B02W20S Filtered | 04/26/04 | Radium-226[h] | U | 0.076 ± 0.277 | 1.000 | 100 |
| Background | 04/26/04 | Radium-228[h] | U | 1.070 ± 0.761 | 3.000 | 100 |
| | | *Total Radium*[g] | Non-Detect | | | 100 |
| | 04/26/04 | Thorium-230[h] | U | 0.585 ± 0.532 | 1.000 | 300 |
| | 04/26/04 | Thorium-232[h] | U | 0.218 ± 0.303 | 1.000 | 50 |
| | 04/26/04 | Uranium-234 | | 4.79 ± 1.25 | 1.000 | 500 |
| | 04/26/04 | Uranium-235[h] | U | 0.532 ± 0.445 | 1.000 | 600 |
| | 04/26/04 | Uranium-238 | | 3.02 ± 0.994 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 7.81 | | *600* |
| A50 | 04/29/04 | Radium-226[h] | U | 0.443 ± 0.410 | 1.000 | 100 |
| | 04/29/04 | Radium-228 | | 1.97 ± 0.682 | 3.000 | 100 |
| | | *Total Radium*[g] | | 1.97 | | 100 |
| | 04/29/04 | Thorium-230 | | 1.070 ± 0.544 | 1.000 | 300 |
| | 04/29/04 | Thorium-232[h] | U | 0.051 ± 0.140 | 1.000 | 50 |
| | 04/29/04 | Uranium-234 | | 6.18 ± 1.27 | 1.000 | 500 |
| | 04/29/04 | Uranium-235 | | 0.811 ± 0.470 | 1.000 | 600 |
| | 04/29/04 | Uranium-238 | | 5.17 ± 1.16 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 12.16 | | *600* |
| A50 Filtered | 04/29/04 | Radium-226[h] | U | 0.345 ± 0.375 | 1.000 | 100 |
| | 04/29/04 | Radium-228 | | 1.71 ± 0.687 | 3.000 | 100 |
| | | *Total Radium*[g] | | 1.71 | | 100 |
| | 04/29/04 | Thorium-230 | | 0.883 ± 0.505 | 1.000 | 300 |
| | 04/29/04 | Thorium-232[h] | U | 0.050 ± 0.138 | 1.000 | 50 |
| | 04/29/04 | Uranium-234 | | 6.69 ± 1.40 | 1.000 | 500 |
| | 04/29/04 | Uranium-235 | | 0.729 ± 0.514 | 1.000 | 600 |
| | 04/29/04 | Uranium-238 | | 5.91 ± 1.30 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 13.33 | | *600* |
| OW04B | 04/30/04 | Radium-226[h] | U | 0.280 ± 0.242 | 1.000 | 100 |
| | 04/30/04 | Radium-228 | | 1.220 ± 0.645 | 3.000 | 100 |
| | | *Total Radium*[g] | | 1.220 | | 100 |
| | 04/30/04 | Thorium-230[h] | U | 0.159 ± 0.136 | 1.000 | 300 |
| | 04/30/04 | Thorium-232[h] | U | -0.015 ± 0.057 | 1.000 | 50 |
| | 04/30/04 | Uranium-234 | | 21.60 ± 1.51 | 1.000 | 500 |
| | 04/30/04 | Uranium-235 | | 1.56 ± 0.41 | 1.000 | 600 |
| | 04/30/04 | Uranium-238 | | 20.40 ± 1.46 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 43.56 | | *600* |
| Duplicate (D1-GW)[f] | 04/30/04 | Radium-226 | | 0.342 ± 0.232 | 1.000 | 100 |
| *OW04B* | 04/30/04 | Radium-228 | | 1.460 ± 0.728 | 3.000 | 100 |
| | | *Total Radium*[g] | | 1.802 | | 100 |
| | 04/30/04 | Thorium-230 | | 0.328 ± 0.205 | 1.000 | 300 |
| | 04/30/04 | Thorium-232[h] | U | 0.031 ± 0.090 | 1.000 | 50 |
| | 04/30/04 | Uranium-234 | | 21.70 ± 1.54 | 1.000 | 500 |
| | 04/30/04 | Uranium-235 | | 2.28 ± 0.50 | 1.000 | 600 |
| | 04/30/04 | Uranium-238 | | 20.80 ± 1.50 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 44.78 | | *600* |
| OW04B Filtered | 04/30/04 | Radium-226 | | 0.287 ± 0.211 | 1.000 | 100 |
| | 04/30/04 | Radium-228[h] | U | 0.619 ± 0.539 | 3.000 | 100 |
| | | *Total Radium*[g] | | 0.287 | | 100 |
| | 04/30/04 | Thorium-230 | | 0.233 ± 0.169 | 1.000 | 300 |
| | 04/30/04 | Thorium-232[h] | U | -0.001 ± 0.058 | 1.000 | 50 |
| | 04/30/04 | Uranium-234 | | 19.40 ± 1.33 | 1.000 | 500 |
| | 04/30/04 | Uranium-235 | | 1.95 ± 0.42 | 1.000 | 600 |
| | 04/30/04 | Uranium-238 | | 19.70 ± 1.33 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 41.05 | | *600* |

**Table 9**
**2004 Groundwater Analytical Results - Radioactive Constituents**
**Niagara Falls Storage Site**



| Sampling Location | Date Collected | Analyte | Qualifier[c] | Result[a] (pCi/L)[b] | Reporting Limit (pCi/L)[b] | DCG[d] (pCi/L)[b] |
|---|---|---|---|---|---|---|
| OW13B[h] | 04/28/04 | Radium-226[h] | U | 0.359 ± 0.307 | 1.000 | 100 |
| | 04/28/04 | Radium-228 | | 3.750 ± 0.855 | 3.000 | 100 |
| | | *Total Radium*[g] | | 3.750 | | 100 |
| | 04/28/04 | Thorium-230[h] | U | -0.044 ± 0.195 | 1.000 | 300 |
| | 04/28/04 | Thorium-232[h] | U | 0.071 ± 0.142 | 1.000 | 50 |
| | 04/28/04 | Uranium-234 | | 13.20 ± 2.01 | 1.000 | 500 |
| | 04/28/04 | Uranium-235[h] | U | 0.419 ± 0.387 | 1.000 | 600 |
| | 04/28/04 | Uranium-238 | | 9.34 ± 1.69 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 22.54 | | *600* |
| OW13B Filtered | 04/28/04 | Radium-226[h] | U | 0.401 ± 0.333 | 1.000 | 100 |
| | 04/28/04 | Radium-228 | | 2.280 ± 0.709 | 3.000 | 100 |
| | | *Total Radium*[g] | | 2.280 | | 100 |
| | 04/28/04 | Thorium-230[h] | U | 0.250 ± 0.290 | 1.000 | 300 |
| | 04/28/04 | Thorium-232[h] | U | 0.156 ± 0.219 | 1.000 | 50 |
| | 04/28/04 | Uranium-234 | | 11.10 ± 1.76 | 1.000 | 500 |
| | 04/28/04 | Uranium-235 | | 0.725 ± 0.474 | 1.000 | 600 |
| | 04/28/04 | Uranium-238 | | 8.96 ± 1.58 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 20.79 | | *600* |
| OW06B | 04/29/04 | Radium-226 | | 0.971 ± 0.488 | 1.000 | 100 |
| | 04/29/04 | Radium-228 | | 2.100 ± 0.794 | 3.000 | 100 |
| | | *Total Radium*[g] | | 3.071 | | 100 |
| | 04/29/04 | Thorium-230 | | 0.786 ± 0.346 | 1.000 | 300 |
| | 04/29/04 | Thorium-232[h] | U | -0.019 ± 0.077 | 1.000 | 50 |
| | 04/29/04 | Uranium-234 | | 8.93 ± 0.982 | 1.000 | 500 |
| | 04/29/04 | Uranium-235 | | 0.584 ± 0.253 | 1.000 | 600 |
| | 04/29/04 | Uranium-238 | | 6.97 ± 0.867 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 16.48 | | *600* |
| OW06B Filtered | 04/29/04 | Radium-226[h] | U | 0.505 ± 0.436 | 1.000 | 100 |
| | 04/29/04 | Radium-228 | | 2.380 ± 0.576 | 3.000 | 100 |
| | | *Total Radium*[g] | | 2.380 | | 100 |
| | 04/29/04 | Thorium-230 | | 0.190 ± 0.149 | 1.000 | 300 |
| | 04/29/04 | Thorium-232[h] | U | 0.020 ± 0.055 | 1.000 | 50 |
| | 04/29/04 | Uranium-234 | | 10.60 ± 1.02 | 1.000 | 500 |
| | 04/29/04 | Uranium-235 | | 0.533 ± 0.254 | 1.000 | 600 |
| | 04/29/04 | Uranium-238 | | 8.55 ± 0.905 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 19.68 | | *600* |
| OW15B | 04/27/04 | Radium-226[h] | U | 0.408 ± 0.313 | 1.000 | 100 |
| | 04/27/04 | Radium-228[h] | U | -0.666 ± 1.070 | 3.000 | 100 |
| | | *Total Radium*[g] | | Non-Detect | | 100 |
| | 04/27/04 | Thorium-230 | | 0.575 ± 0.373 | 1.000 | 300 |
| | 04/27/04 | Thorium-232[h] | U | 0.146 ± 0.204 | 1.000 | 50 |
| | 04/27/04 | Uranium-234 | | 6.45 ± 1.29 | 1.000 | 500 |
| | 04/27/04 | Uranium-235 | | 0.653 ± 0.416 | 1.000 | 600 |
| | 04/27/04 | Uranium-238 | | 4.99 ± 1.13 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 12.09 | | *600* |
| OW15B Filtered | 04/27/04 | Radium-226[h] | U | 0.0495 ± 0.207 | 1.000 | 100 |
| | 04/27/04 | Radium-228 | U | -0.52 ± 0.753 | 3.000 | 100 |
| | | *Total Radium*[g] | | Non-Detect | | 100 |
| | 04/27/04 | Thorium-230[h] | U | 0.313 ± 0.333 | 1.000 | 300 |
| | 04/27/04 | Thorium-232[h] | U | 0.123 ± 0.200 | 1.000 | 50 |
| | 04/27/04 | Uranium-234 | | 7.91 ± 1.54 | 1.000 | 500 |
| | 04/27/04 | Uranium-235[h] | U | 0.573 ± 0.454 | 1.000 | 600 |
| | 04/27/04 | Uranium-238 | | 3.70 ± 1.04 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 11.61 | | *600* |

**Table 9**
**2004 Groundwater Analytical Results - Radioactive Constituents**
**Niagara Falls Storage Site**



| Sampling Location | Date Collected | Analyte | Qualifier[c] | Result[a] (pCi/L)[b] | Reporting Limit (pCi/L)[b] | DCG[d] (pCi/L)[b] |
|---|---|---|---|---|---|---|
| OW17B | 04/28/04 | Radium-226[h] | U | -0.0854 ± 0.265 | 1.000 | 100 |
| | 04/28/04 | Radium-228[h] | U | 0.670 ± 0.797 | 3.000 | 100 |
| | | *Total Radium*[g] | Non-Detect | | | 100 |
| | 04/28/04 | Thorium-230[h] | U | 0.201 ± 0.276 | 1.000 | 300 |
| | 04/28/04 | Thorium-232[h] | U | 0.065 ± 0.191 | 1.000 | 50 |
| | 04/28/04 | Uranium-234 | | 4.11 ± 1.12 | 1.000 | 500 |
| | 04/28/04 | Uranium-235[h] | U | 0.214 ± 0.266 | 1.000 | 600 |
| | 04/28/04 | Uranium-238 | | 2.30 ± 0.832 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 6.41 | | *600* |
| OW17B Filtered | 04/28/04 | Radium-226[h] | U | 0.1 ± 0.218 | 1.000 | 100 |
| | 04/28/04 | Radium-228[h] | U | 0.623 ± 0.617 | 3.000 | 100 |
| | | *Total Radium*[g] | Non-Detect | | | 100 |
| | 04/28/04 | Thorium-230[h] | U | 0.169 ± 0.222 | 1.000 | 300 |
| | 04/28/04 | Thorium-232[h] | U | -0.033 ± 0.129 | 1.000 | 50 |
| | 04/28/04 | Uranium-234 | | 4.11 ± 1.07 | 1.000 | 500 |
| | 04/28/04 | Uranium-235[h] | U | 0.020 ± 0.149 | 1.000 | 600 |
| | 04/28/04 | Uranium-238 | | 2.97 ± 0.911 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 7.08 | | *600* |
| A45 | 04/29/04 | Radium-226 | | 1.120 ± 0.535 | 1.000 | 100 |
| | 04/29/04 | Radium-228[h] | U | 1.020 ± 0.943 | 3.000 | 100 |
| | | *Total Radium*[g] | | 1.120 | | 100 |
| | 04/29/04 | Thorium-230[h] | U | 0.428 ± 0.364 | 1.000 | 300 |
| | 04/29/04 | Thorium-232[h] | U | 0.0156 ± 0.141 | 1.000 | 50 |
| | 04/29/04 | Uranium-234 | | 14.20 ± 1.82 | 1.000 | 500 |
| | 04/29/04 | Uranium-235 | | 1.51 ± 0.592 | 1.000 | 600 |
| | 04/29/04 | Uranium-238 | | 10.80 ± 1.58 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 26.51 | | *600* |
| A45 Filtered | 04/29/04 | Radium-226 | | 0.875 ± 0.424 | 1.000 | 100 |
| | 04/29/04 | Radium-228 | | 2.940 ± 0.718 | 3.000 | 100 |
| | | *Total Radium*[g] | | 3.815 | | 100 |
| | 04/29/04 | Thorium-230 | | 0.780 ± 0.457 | 1.000 | 300 |
| | 04/29/04 | Thorium-232[h] | U | -0.019 ± 0.128 | 1.000 | 50 |
| | 04/29/04 | Uranium-234 | | 14.20 ± 1.97 | 1.000 | 500 |
| | 04/29/04 | Uranium-235 | | 0.696 ± 0.44 | 1.000 | 600 |
| | 04/29/04 | Uranium-238 | | 11.40 ± 1.76 | 1.000 | 600 |
| | | *Total Uranium*[e] | | 26.30 | | *600* |

a. Results reported with (±) radiological error quoted at 2-sigma (95 percent confidence level).

b. pCi/L - picocuries per liter.

c. Lab Qualifier: **U** - indicates that no analyte was detected above reporting limit (Non-Detect).

d. USDOE derived concentration guide for water.

e. Sum of uranium isotope concentrations. Values qualified as U were not included in the total.

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**
**2004 Groundwater Analytical Results - Metals**
**Niagara Falls Storage Site**

| Sampling Location | Date Collected | Detected Analyte | Qualifier[g] | Result (µg/L)[a] | Detection Limit (µg/L)[a] | Related Regulations[c] Federal[d] (µg/L)[a] | Related Regulations[c] State[e] (µg/L)[a] |
|---|---|---|---|---|---|---|---|
| B02W20S | 04/26/04 | Copper | J | 1.39 | 1.39 | 1300 | 200 |
| Background | 04/26/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/26/04 | Vanadium | U | 0.606 | 0.606 | NE[b] | NE[b] |
| B02W20S Filtered | 04/26/04 | Copper | U | 2.15 | 1.39 | 1300 | 200 |
| Background | 04/26/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/26/04 | Vanadium | U | 0.606 | 0.606 | NE[b] | NE[b] |
| A45 | 04/29/04 | Copper | U | 1.39 | 1.39 | 1300 | 200 |
| | 04/29/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/29/04 | Vanadium | U | 0.606 | 0.606 | NE[b] | NE[b] |
| A45 Filtered | 04/29/04 | Copper | J | 1.68 | 1.39 | 1300 | 200 |
| | 04/29/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/29/04 | Vanadium | U | 0.606 | 0.606 | NE[b] | NE[b] |
| Duplicate (D1-GW) | 04/30/04 | Copper | J | 3.75 | 1.39 | 1300 | 200 |
| *OW04B* | 04/30/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/30/04 | Vanadium | U | 0.606 | 0.606 | NE[b] | NE[b] |
| OW04B | 04/30/04 | Copper | J | 3.82 | 1.39 | 1300 | 200 |
| | 04/30/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/30/04 | Vanadium | U | 0.606 | 0.606 | NE[b] | NE[b] |
| OW04B Filtered | 04/30/04 | Copper | J | 3.8 | 1.39 | 1300 | 200 |
| | 04/30/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/30/04 | Vanadium | U | 0.606 | 0.606 | NE[b] | NE[b] |
| OW06B | 04/29/04 | Copper | | 5.98 | 1.39 | 1300 | 200 |
| | 04/29/04 | Lead | J | 2.58 | 1.72 | 15 | 25 |
| | 04/29/04 | Vanadium | U | 0.606 | 0.606 | NE[b] | NE[b] |
| OW06B Filtered | 04/29/04 | Copper | U | 1.39 | 1.39 | 1300 | 200 |
| | 04/29/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/29/04 | Vanadium | U | 0.606 | 0.606 | NE[b] | NE[b] |
| OW13B | 04/28/04 | Copper | J | 3.83 | 1.39 | 1300 | 200 |
| | 04/28/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/28/04 | Vanadium | U | 0.606 | 0.606 | NE[b] | NE[b] |
| OW13B Filtered | 04/28/04 | Copper | J | 4.95 | 1.39 | 1300 | 200 |
| | 04/28/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/28/04 | Vanadium | U | 0.606 | 0.606 | NE[b] | NE[b] |
| OW15B | 04/27/04 | Copper | J | 4.76 | 1.39 | 1300 | 200 |
| | 04/27/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/27/04 | Vanadium | U | 0.606 | 0.606 | NE[b] | NE[b] |
| OW15B Filtered | 04/27/04 | Copper | J | 4.03 | 1.39 | 1300 | 200 |
| | 04/27/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/27/04 | Vanadium | U | 0.606 | 0.606 | NE[b] | NE[b] |
| OW17B | 04/28/04 | Copper | J | 3.24 | 1.39 | 1300 | 200 |
| | 04/28/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/28/04 | Vanadium | U | 0.606 | 0.606 | NE[b] | NE[b] |
| OW17B Filtered | 04/28/04 | Copper | J | 4.25 | 1.39 | 1300 | 200 |
| | 04/28/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/28/04 | Vanadium | U | 0.606 | 0.606 | NE[b] | NE[b] |
| A50 | 04/29/04 | Copper | J | 3.03 | 1.39 | 1300 | 200 |
| | 04/29/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/29/04 | Vanadium | U | 0.606 | 2.48 | NE[b] | NE[b] |
| A50 Filtered | 04/29/04 | Copper | J | 1.72 | 1.39 | 1300 | 200 |
| | 04/29/04 | Lead | U | 1.72 | 1.72 | 15 | 25 |
| | 04/29/04 | Vanadium | U | 0.606 | 0.606 | 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. Lab Qualifier: U - indicates that no analyte was detected above detection limit (Non-Detect).
J - estimated value (above detection limit, but below reporting limit)

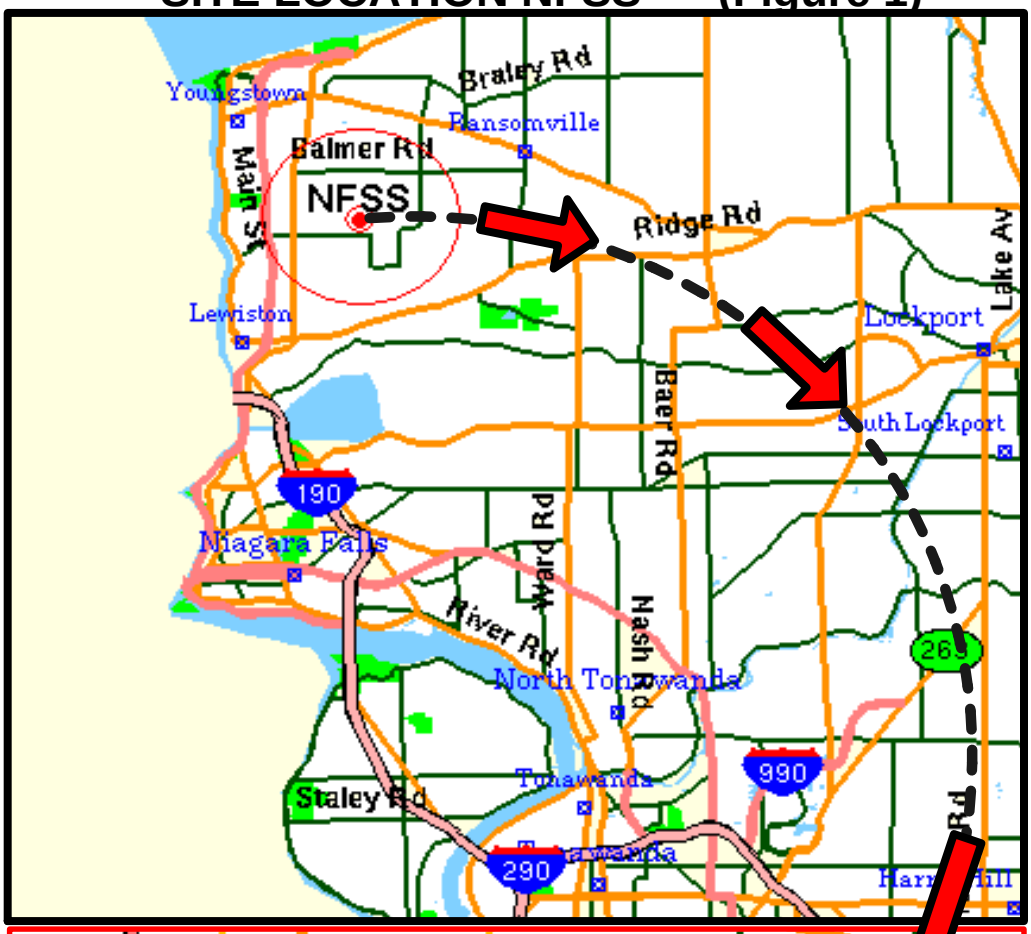
FUSRAP NIAGARA FALLS STORAGE SITE

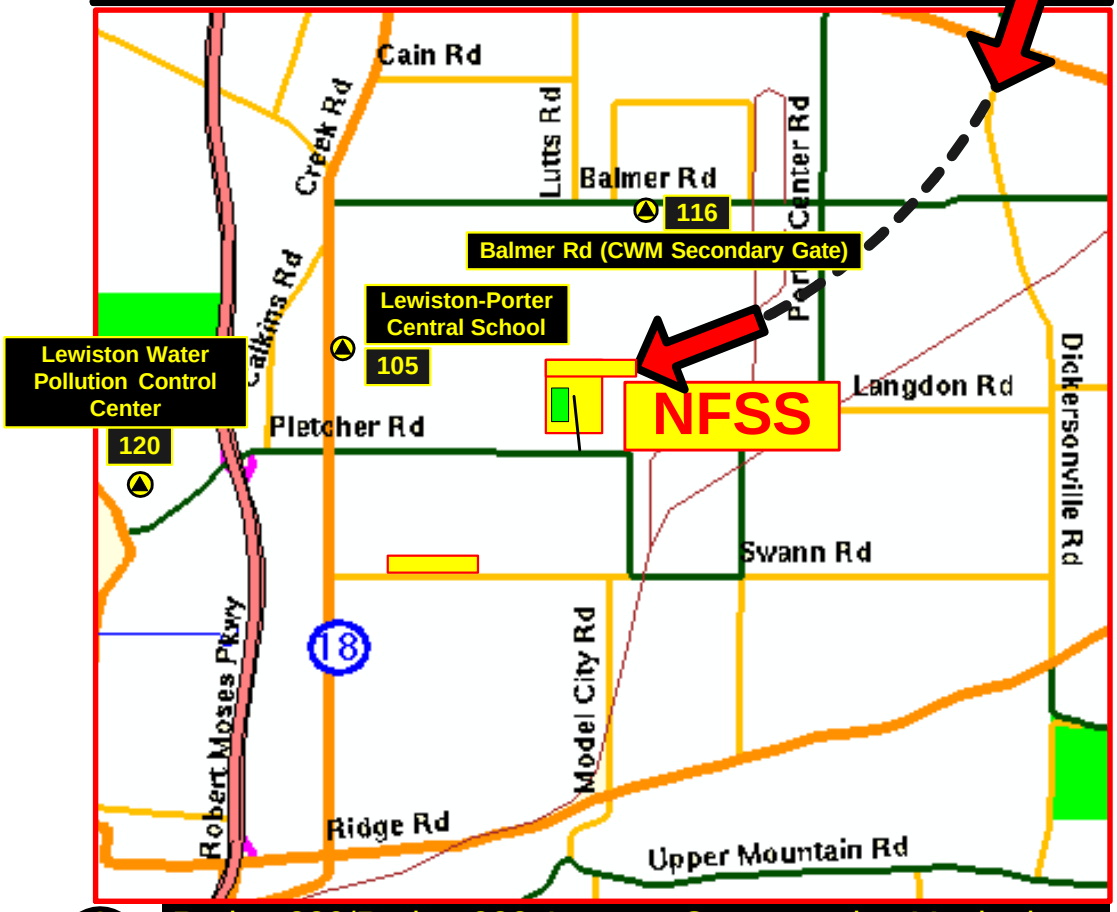
2004

# FIGURES

**ENVIRONMENTAL SURVEILLANCE TECHNICAL MEMORANDUM**

# SITE LOCATION NFSS (Figure 1)




Radon-220/Radon-222 Average Concentration Monitoring and External Gamma Locations

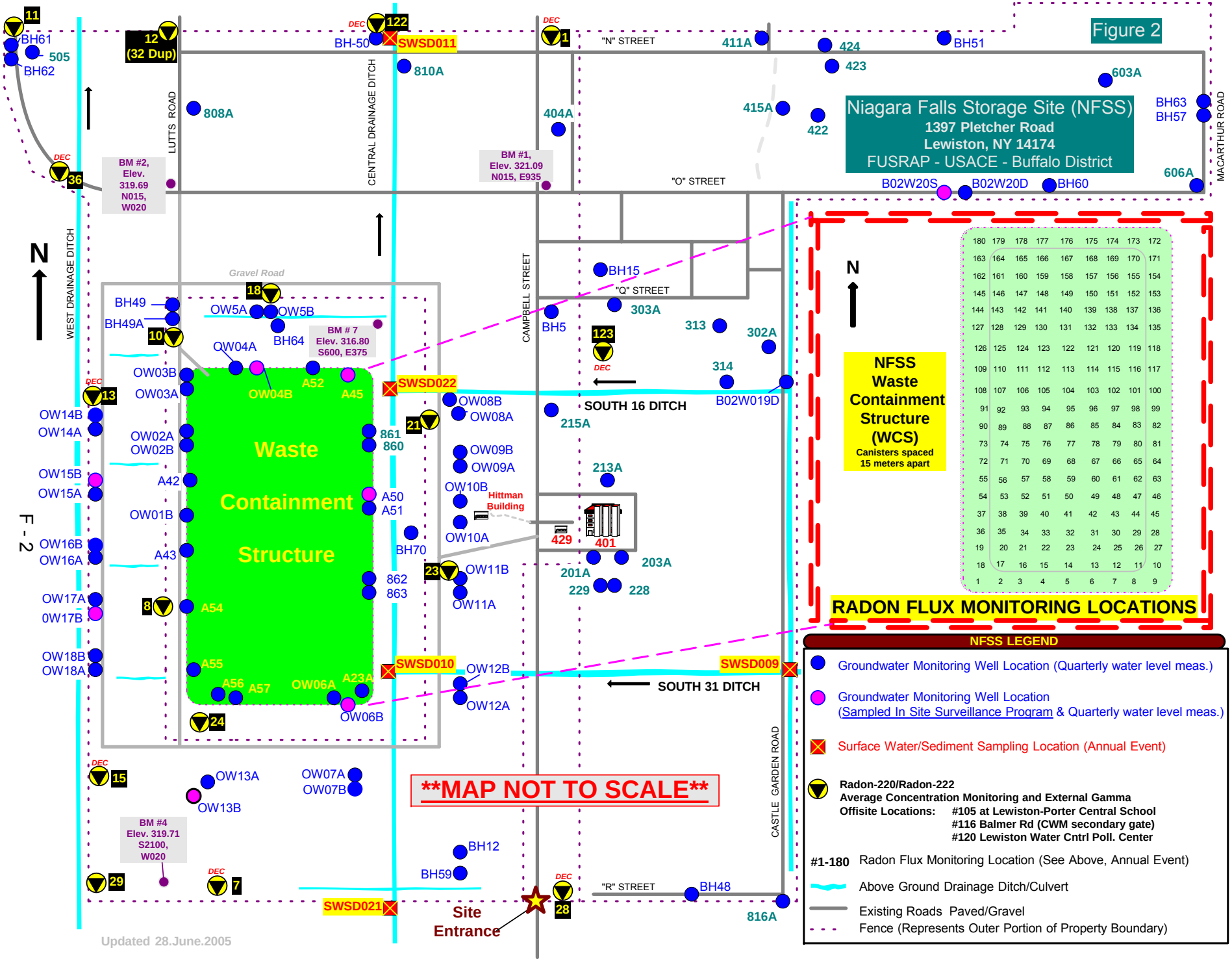


Figure 2
Niagara Falls Storage Site (NFSS)
1397 Pletcher Road
Lewiston, NY 14174
FUSRAP - USACE - Buffalo District
Waste Containment Structure
NFSS Waste Containment Structure (WCS)
Canisters spaced 15 meters apart
RADON FLUX MONITORING LOCATIONS
NFSS LEGEND
Groundwater Monitoring Well Location (Quarterly water level meas.)
Groundwater Monitoring Well Location (Sampled In Site Surveillance Program & Quarterly water level meas.)
Surface Water/Sediment Sampling Location (Annual Event)
Radon-220/Radon-222 Average Concentration Monitoring and External Gamma
Offisite Locations: #105 at Lewiston-Porter Central School
#116 Balmer Rd (CWM secondary gate)
#120 Lewiston Water Cntrl Poll. Center
#1-180 Radon Flux Monitoring Location (See Above, Annual Event)
Above Ground Drainage Ditch/Culvert
Existing Roads Paved/Gravel
Fence (Represents Outer Portion of Property Boundary)
**MAP NOT TO SCALE**
Site Entrance
SWSD011
SWSD022
SWSD010
SWSD009
SWSD021
LUTTS ROAD
CENTRAL DRAINAGE DITCH
WEST DRAINAGE DITCH
CAMPBELL STREET
CASTLE GARDEN ROAD
MACARTHUR ROAD
"N" STREET
"O" STREET
"Q" STREET
"R" STREET
SOUTH 16 DITCH
SOUTH 31 DITCH
Gravel Road
Hittman Building
BM #1, Elev. 321.09 N015, E935
BM #2, Elev. 319.69 N015, W020
BM # 7 Elev. 316.80 S600, E375
BM #4 Elev. 319.71 S2100, W020
Updated 28.June.2005
F - 2

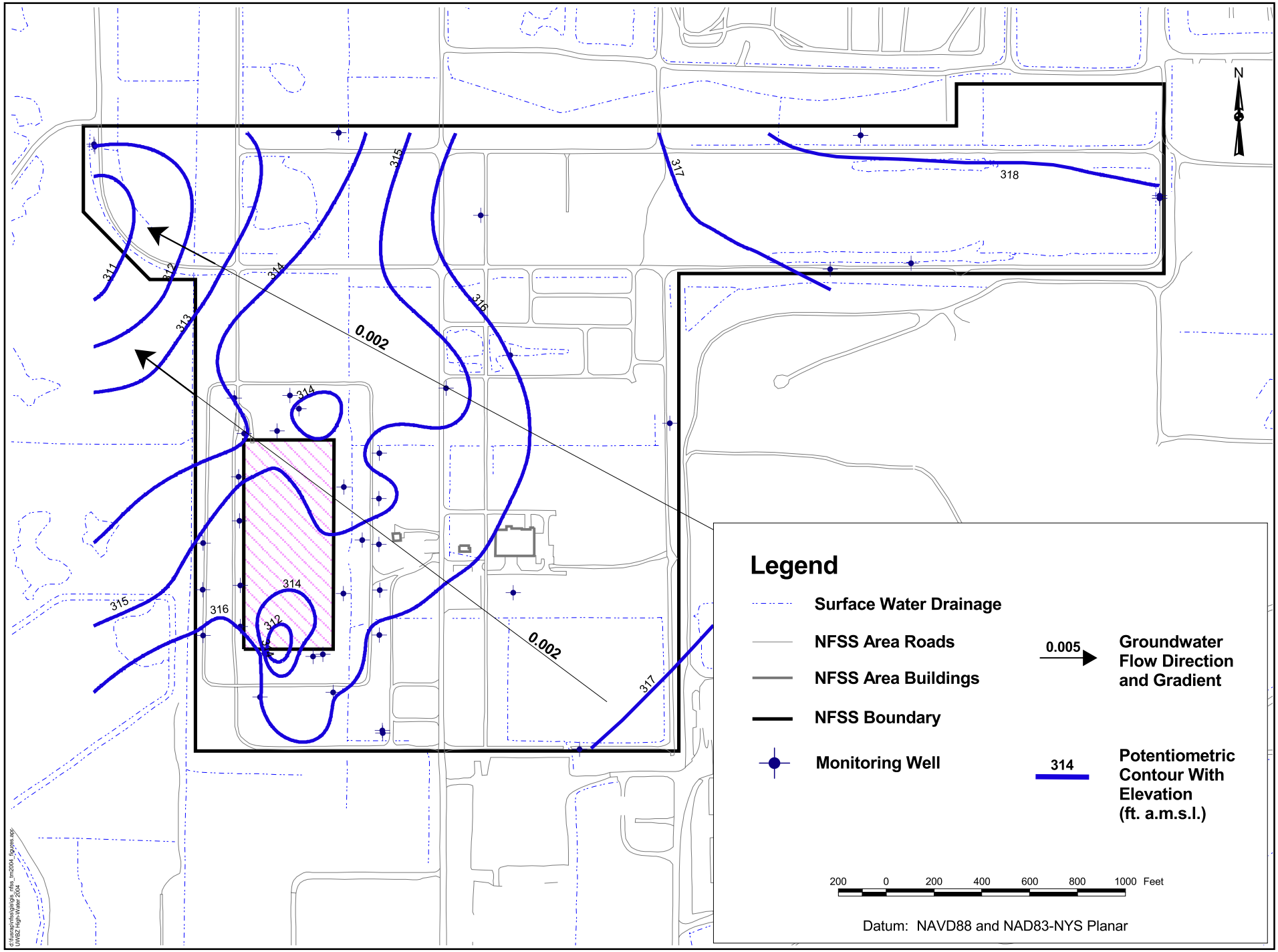



Figure 3
Seasonal High Potentiometric Surface Map (August 17, 2004)
Lower Groundwater System

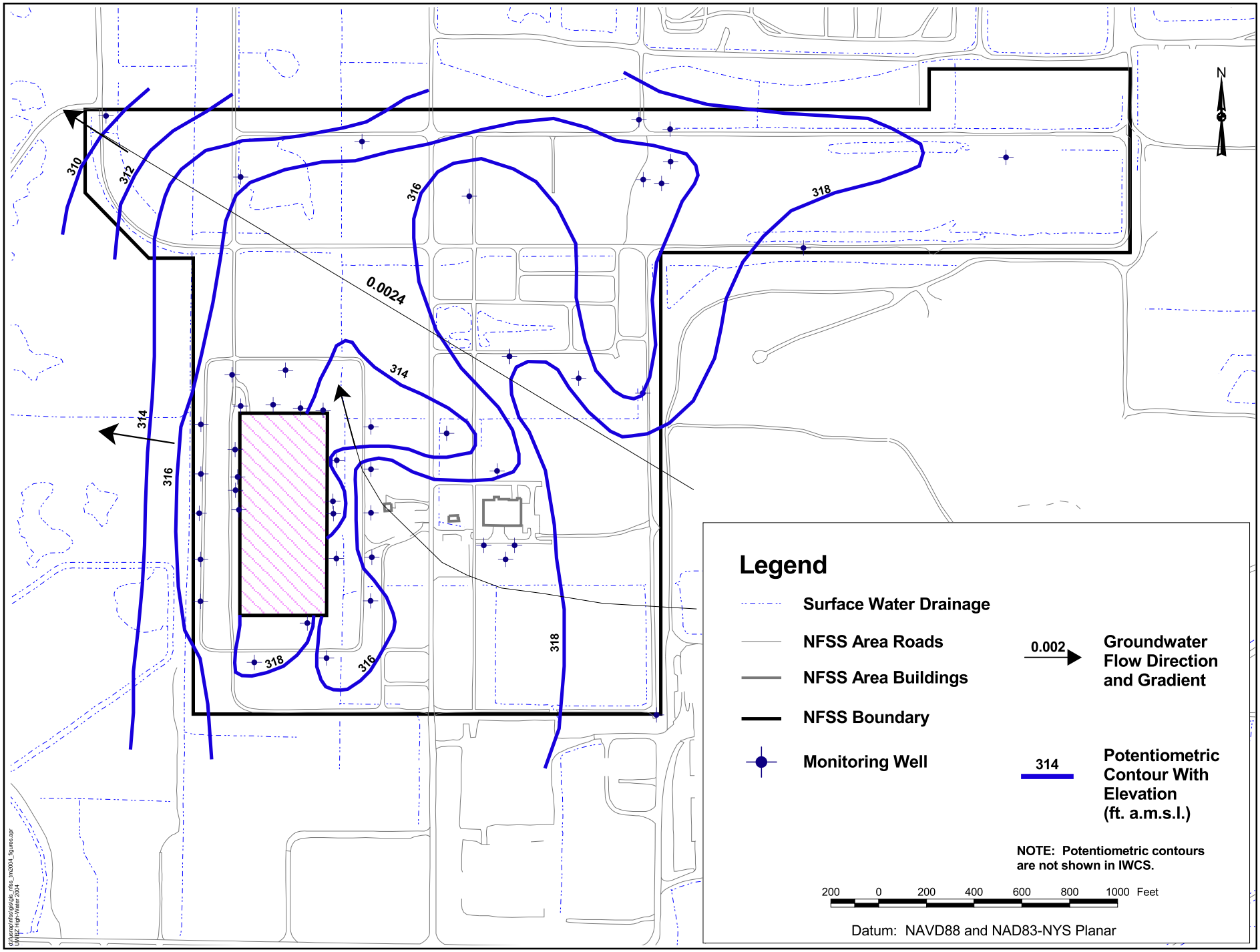



Figure 4
Seasonal High Potentiometric Surface Map (February 17, 2004)
Upper Groundwater System

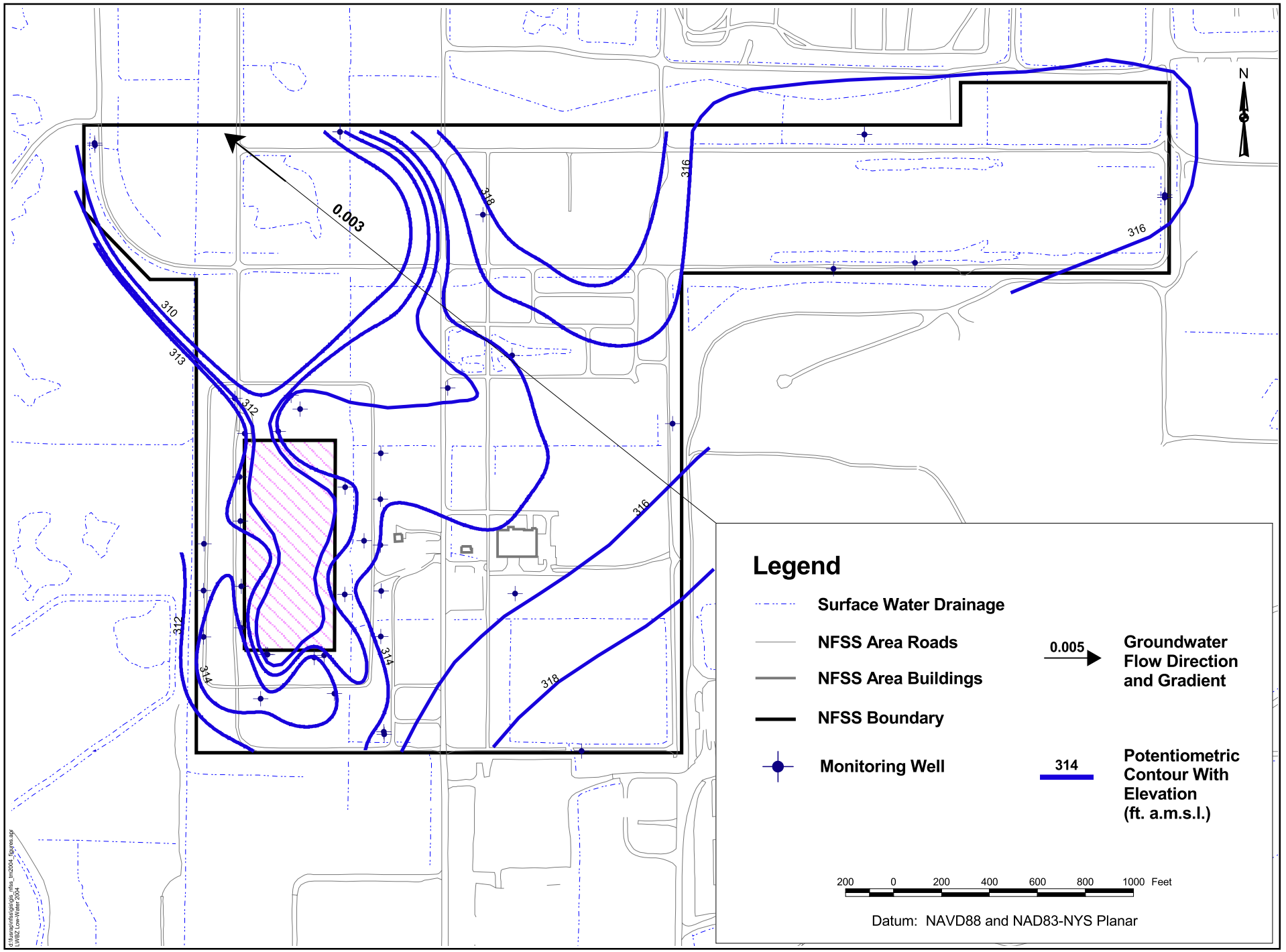



Figure 5
Seasonal Low Potentiometric Surface Map (February 17, 2004)
Lower Groundwater System

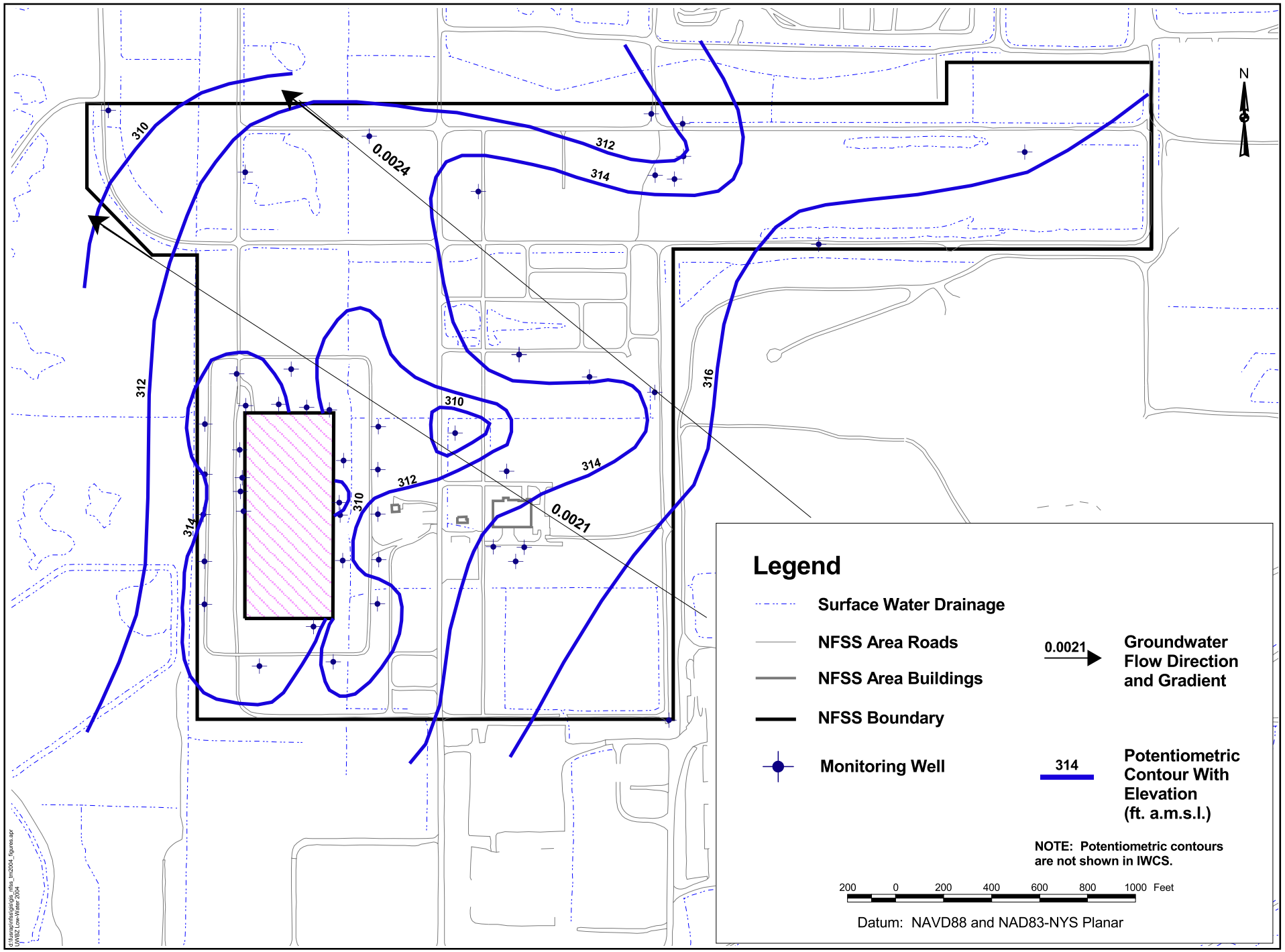
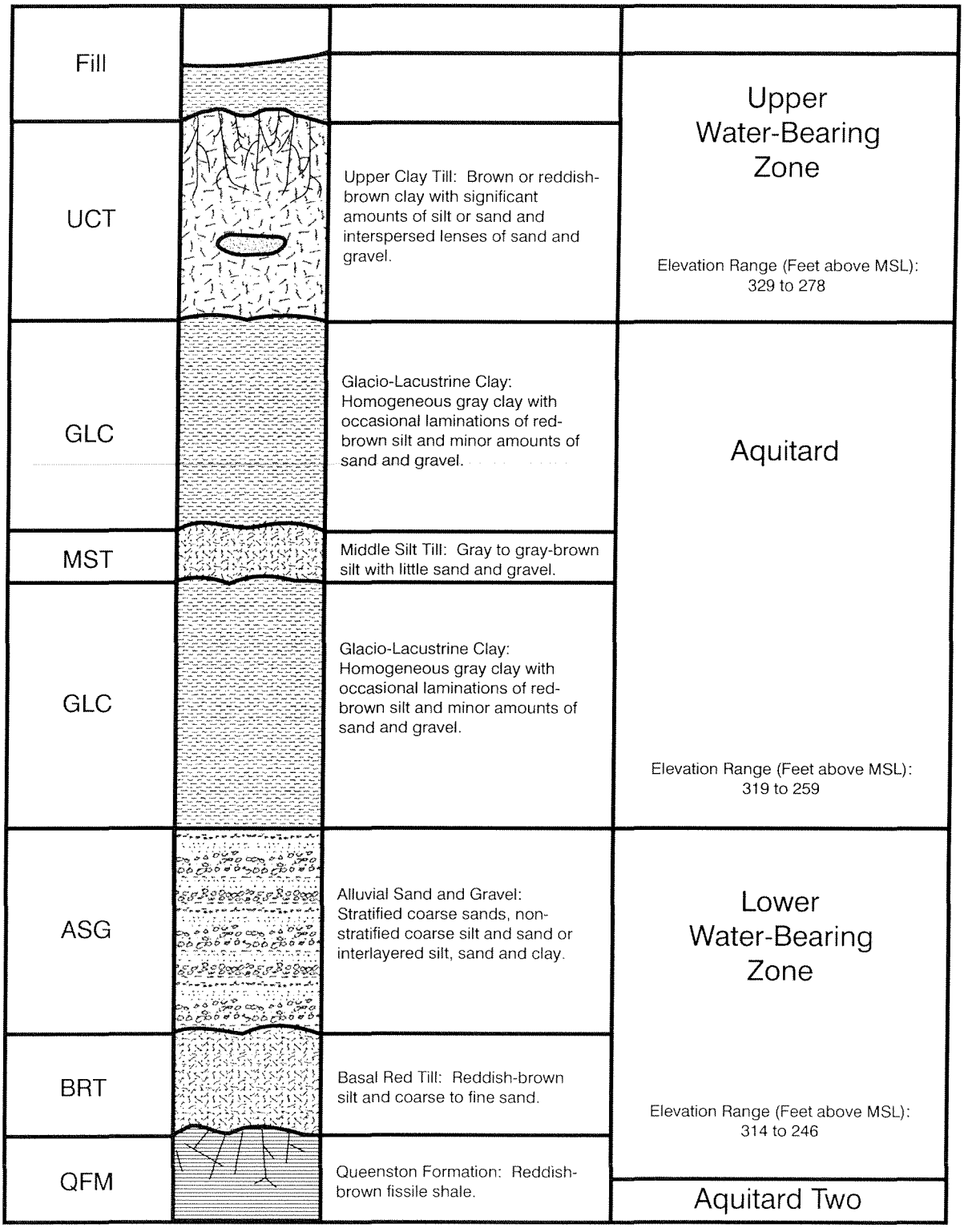



Figure 6
Seasonal Low Potentiometric Surface Map (October 19, 2004)
Upper Groundwater System

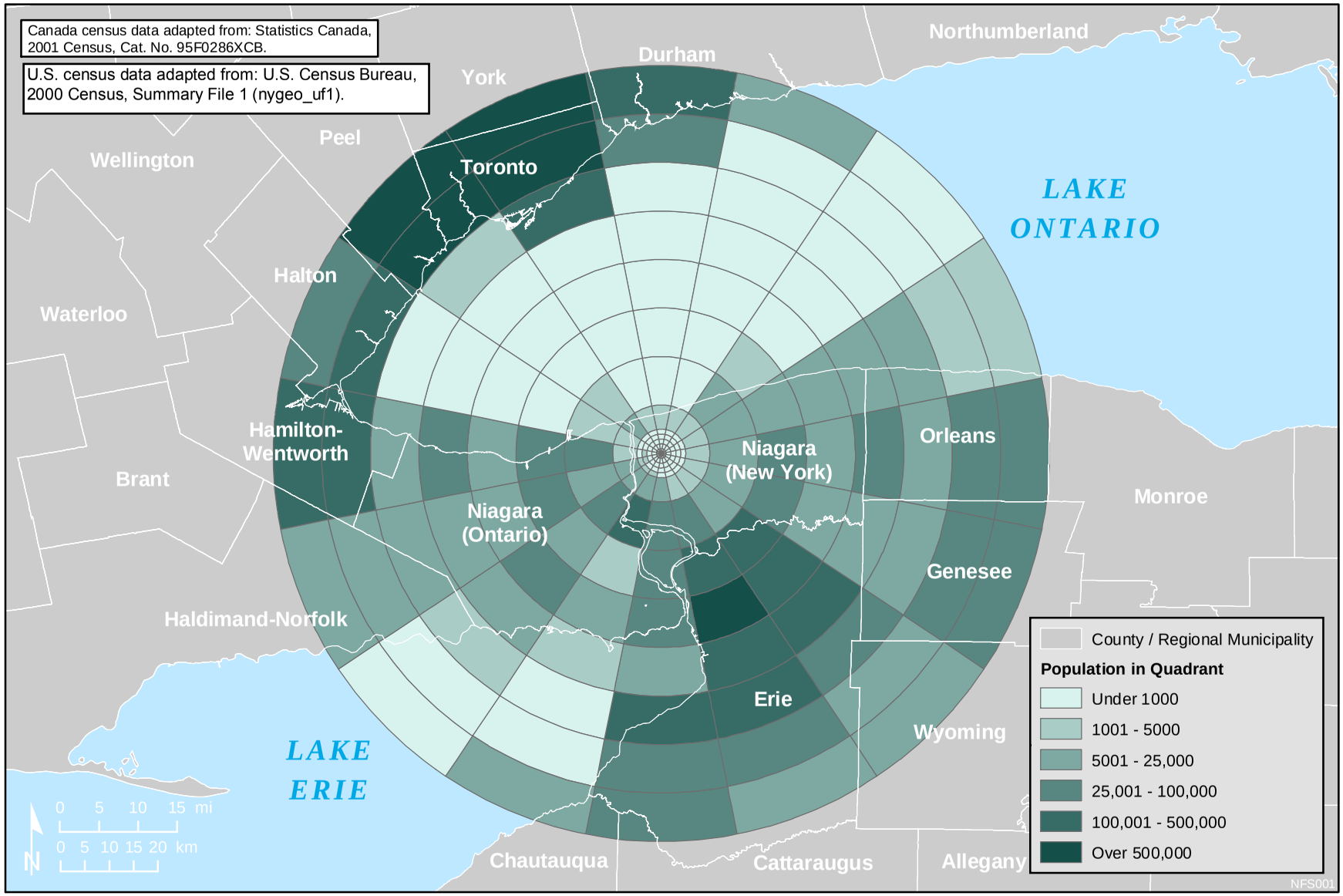



*Filename: S:\Buf001\ArcView\Flow Calibration Tech Memo\hydrostratigraphy.cdr*
*Project: BUF001-004-05-03*
*Created by: apassarelli 03/26/02*
*Revised: 04/17/02 asp*
*Source: HydroGeoLogic, Inc., 2002*

**FIGURE 7**

**Schematic of Conceptualized Hydrostratigraphy**

Figure 8: Census Data



# APPENDIX B: NFSS CY2004 ENVIRONMENTAL SURVEILLANCE TECHNICAL MEMORANDUM

# CY2004 CALCULATION OF EXTERNAL GAMMA RADIATION DOSE RATES FOR NIAGARA FALLS STORAGE SITE (NFSS)

## LEWISTON, NEW YORK

**October 2005**

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

## TABLE OF CONTENTS



## LIST OF ATTACHMENTS

## 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 2004 (CY2004). Hypothetical doses from external gamma radiation to hypothetical 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

Calculations for the annual external gamma radiation doses to residence-based and off-site worker-based receptors are incorporated using 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 3,600 ft,
Distance from the TLDs to the nearest off-site worker is 1,020 ft,
Length of the western TLD monitoring line (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

TLDs measure gamma radiation from the site and from sources of background radiation. Sources of background radiation include cosmic radiation, terrestrial radiation and, man-made sources. Average levels of cosmic and terrestrial radiation in the United States are 27 millirem per year (mrem/yr) and 28 mrem/yr, respectively (NCRP Report 93). Annual doses are measured at background locations using TLDs. Background dose for the same period of exposure is subtracted from site dose to estimate the net dose from NFSS. 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 are collected semi-annually and sent to an off-site vendor for analysis.

Eleven locations around the perimeter of the site and six locations around the IWCS were monitored in CY2004 (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) to provide additional quality control.

TLD monitoring data for CY2004 are presented in Table 1. A time-weighted dose for the year is calculated and accounts for exposure periods that have different integration times (different number of measurement days).

Net monitoring results (average normalized location reading minus average normalized background reading) that are less than zero are retained as negative values for calculation purposes. A more detailed description of CY2004 TLD results is presented in Attachment A.

## Table 1. External Gamma Radiation at NFSS

| 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) | CY2004 Net TLD Data[c] (mrem/yr) |
|---|---|---|---|---|---|
| NFSS Perimeter | 1 | 18.2 | 20.2 | 38.5 | 7.2 |
| | 1 | 20.6 | 19.7 | 40.5 | 9.2 |
| | 7 | 15.8 | 20.2 | 36.0 | 4.7 |
| | 7 | 15.1 | 19.1 | 34.2 | 2.9 |
| | 11 | 16.4 | 15.9 | 32.4 | 1.1 |
| | 11 | 12.5 | 21.1 | 33.5 | 2.2 |
| | 12 | 16.2 | 18.0 | 34.3 | 3 |
| | 12 | 15.9 | 24.9 | 40.7 | 9.4 |
| | 13 | 14.2 | 22.8 | 36.9 | 5.6 |
| | 13 | 15.8 | 23.4 | 39.1 | 7.8 |
| | 15 | 16.2 | 18.4 | 34.7 | 3.4 |
| | 15 | 19.0 | 20.2 | 39.3 | 8 |
| | 28 | 25.9 | 23.7 | 49.8 | 18.5 |
| | 28 | 22.2 | 27.3 | 49.5 | 18.2 |
| | 29 | 9.8 | 25.3 | 34.8 | 3.5 |
| | 29 | 22.1 | 24.2 | 46.4 | 15.1 |
| | 36 | 16.6 | 19.1 | 35.8 | 4.5 |
| | 36 | 17.4 | 19.9 | 37.4 | 6.1 |
| | 122 | 17.5 | 20.7 | 38.2 | 6.9 |
| | 122 | 17.6 | 18.5 | 36.2 | 4.9 |
| | 123 | 14.6 | 17.2 | 31.8 | 0.5 |
| | 123 | 15.9 | 16.5 | 32.5 | 1.2 |
| WCS Perimeter | 8 | 13.1 | 17.0 | 30.1 | -1.2 |
| | 8 | 14.6 | 21.2 | 35.7 | 4.4 |
| | 10 | 16.5 | 22.5 | 39.0 | 7.7 |
| | 10 | 18.2 | 20.8 | 39.1 | 7.8 |
| | 18 | 15.2 | 17.0 | 32.3 | 1 |
| | 18 | 15.0 | 19.6 | 34.6 | 3.3 |
| | 21 | 16.3 | 16.7 | 33.1 | 1.8 |
| | 21 | 18.2 | 19.1 | 37.4 | 6.1 |
| | 23 | 20.2 | 20.2 | 40.5 | 9.2 |
| | 23 | 18.2 | 25.1 | 43.3 | 12 |
| | 24 | 15.1 | 13.6 | 28.8 | -2.5 |
| | 24 | 16.1 | 17.9 | 34.1 | 2.8 |
| Background | 105 | 17.1 | 18.1 | 35.3 | --- |
| | 105 | 10.1 | 21.7 | 31.6 | --- |
| | 116 | 12.7 | 13.3 | 26.1 | --- |
| | 116 | 12.6 | 22.2 | 34.7 | --- |
| | 120 | 12.8 | 18.7 | 31.4 | --- |
| | 120 | 12.3 | 16.6 | 28.9 | --- |
| Average Background | --- | 12.9 | 18.8 | 31.3 | |

[a] All data reported from the vendor were gross results in mrem per monitoring period.

[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.

## 4.0 ASSESSMENT METHODOLOGY AND RESULTS

Gamma radiation exposure measured at the perimeter fence line represents dose to a hypothetical receptor that would be at the same locations 24 hours/day, 365 days/year. Off-site dose to the nearest member of the public is significantly affected by their proximity to the source and the amount of time spent at the receptor location. A more realistic approach to estimating off-site dose therefore evaluates members of the public as either residence or off-site worker-based receptors. An off-site residence exposure assumes a 100 percent occupancy rate at a given location. An off-site worker exposure assumes that a worker's occupancy rate is 23 percent, based on an 8 hours/day, 5 days/week, and 50 weeks/year work schedule.

## 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 added due to their close proximity to the western NFSS perimeter fence. These TLD locations are shown in Figure 2, Appendix A. Net dose rates (corrected for background) for these TLDs are summed and divided by the total number of observations (14 for CY2004). This value represents the annual dose at the site perimeter (D1 = 5.4 mrem for CY2004). The site perimeter dose is then used in the following equation for a line source:

$$D_2 = D_1 * h1/h2 * (\text{ArcTan}(L/h2)/\text{ArcTan}(L/h1))$$

where:

| | |
|---|---|
| D2 | = dose calculated at the receptor location from the line source |
| D1 | = dose at the site perimeter as described above |
| h1 | = the distance of the TLDs from the source (3 ft ) |
| h2 | = the distance of the resident from the fence line (3,600 ft ) |
| L | = half the length of line of TLDs measuring the line source (1,383 ft ) |

This yields a hypothetical annual dose of 1.1 E-03 (or 0.0011) mrem at the residence.

## 4.2 NEAREST OFF-SITE WORKER

The dose to the nearest off-site worker uses, the TLDs, placed linearly, 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 proximity 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 CY2004). This represents the annual dose at the site perimeter (D1 = 9.0 mrem for CY2004).

Using the equation above (with the assumptions given in Attachment A) and a correction factor for off-site worker occupancy of 2000 hours/8760 hours, i.e., 23 percent, the annual dose to the nearest off-site worker is 3.6 E-03 (or 0.0036) mrem.

## 5.0 REFERENCES

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

**ATTACHMENT A**

**CY2004 EXTERNAL GAMMA RADIATION DOSE RATES**
**NIAGARA FALLS STORAGE SITE**

## Attachment A
## CY2004 External Gamma Radiation Dose Rates – Niagara Falls Storage Site

| TLD[a] Dose Rate | | | | |
|---|---|---|---|---|
| **Monitoring Location[b]** | **Total[c] First[j] (mrem)[f]** | **Total[c] Second[k] (mrem)[f]** | **Normalized[d] (mrem/yr)[g]** | **Above Background[e] (mrem/yr)[g]** |
| NFSS Perimeter | | | | |
| 1 | 18.2 | 20.2 | 38.5 | 7.2 |
| 1 | 20.6 | 19.7 | 40.5 | 9.2 |
| 7 | 15.8 | 20.2 | 36.0 | 4.7 |
| 7 | 15.1 | 19.1 | 34.2 | 2.9 |
| 11 | 16.4 | 15.9 | 32.4 | 1.1 |
| 11 | 12.5 | 21.1 | 33.5 | 2.2 |
| 12 | 16.2 | 18.0 | 34.3 | 3 |
| 12 | 15.9 | 24.9 | 40.7 | 9.4 |
| 13 | 14.2 | 22.8 | 36.9 | 5.6 |
| 13 | 15.8 | 23.4 | 39.1 | 7.8 |
| 15 | 16.2 | 18.4 | 34.7 | 3.4 |
| 15 | 19.0 | 20.2 | 39.3 | 8 |
| 28 | 25.9 | 23.7 | 49.8 | 18.5 |
| 28 | 22.2 | 27.3 | 49.5 | 18.2 |
| 29 | 9.8 | 25.3 | 34.8 | 3.5 |
| 29 | 22.1 | 24.2 | 46.4 | 15.1 |
| 36 | 16.6 | 19.1 | 35.8 | 4.5 |
| 36 | 17.4 | 19.9 | 37.4 | 6.1 |
| 122 | 17.5 | 20.7 | 38.2 | 6.9 |
| 122 | 17.6 | 18.5 | 36.2 | 4.9 |
| 123 | 14.6 | 17.2 | 31.8 | 0.5 |
| 123 | 15.9 | 16.5 | 32.5 | 1.2 |

| TLD[a] Dose Rate | | | | |
|---|---|---|---|---|
| **Monitoring Location[b]** | **Total[c] First (mrem)[f]** | **Total[c] Second (mrem)[f]** | **Normalized[d] (mrem/yr)[g]** | **Above Background[e] (mrem/yr)[g]** |
| IWCS[h] Perimeter | | | | |
| 8 | 13.1 | 17.0 | 30.1 | -1.2 |
| 8 | 14.6 | 21.2 | 35.7 | 4.4 |
| 10 | 16.5 | 22.5 | 39.0 | 7.7 |
| 10 | 18.2 | 20.8 | 39.1 | 7.8 |
| 18 | 15.2 | 17.0 | 32.3 | 1 |
| 18 | 15.0 | 19.6 | 34.6 | 3.3 |
| 21 | 16.3 | 16.7 | 33.1 | 1.8 |
| 21 | 18.2 | 19.1 | 37.4 | 6.1 |
| 23 | 20.2 | 20.2 | 40.5 | 9.2 |
| 23 | 18.2 | 25.1 | 43.3 | 12 |
| 24 | 15.1 | 13.6 | 28.8 | -2.5 |
| 24 | 16.1 | 17.9 | 34.1 | 2.8 |

| TLD[a] Dose Rate | | | | |
|---|---|---|---|---|
| Background: | | | | |
| 105 | 17.1 | 18.1 | 35.3 | --- |
| 105 | 10.1 | 21.7 | 31.6 | --- |
| 116 | 12.7 | 13.3 | 26.1 | --- |
| 116 | 12.6 | 22.2 | 34.7 | --- |
| 120 | 12.8 | 18.7 | 31.4 | --- |
| 120 | 12.3 | 16.6 | 28.9 | --- |
| *Average Background* | 12.9 | 18.8 | 31.3 | |

a. TLD = Thermoluminescent dosimeter. There are two TLDs per monitoring location.
b. Monitoring locations are shown in Figure 2, Appendix A.
c. Reported values are the average reading per TLD. There are two detection units per each device.
d. TLD readings are normalized to a one-year exposure.
Annual exposure = (first TLD reading/exposure duration + second TLD reading/exposure duration)/2 * 365 days per year.
Example for Location 1: (18.2 mrem/177 days + 20.2 mrem/187 days )/2 * 365 days per year = 38.5 mrem/year
e. Average background (normalized) is subtracted from annual exposure. Negative values are retained for calculation purposes.
f. mrem – millirem.
g. mrem/yr – millirem per year.
h. Monitoring locations along the perimeter of the interim waste containment structure (IWCS).
i. The average dose rate was calculated by summing the TLD measurements and dividing by the total number of TLD measurements.
j. First monitoring period.
k. Second monitoring period.

Nearest Resident Dose Calculations (3,600 feet Southwest of NFSS)

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

| | | |
|---|---|---|
| h1 | 3 feet | distance of TLD from the source |
| h2 | 3,600 feet | distance of resident from the TLDs |
| L | 1,383 feet | half the length of the line source (West perimeter fence) |
| D1 | 5.4 mrem | average annual dose at the TLD monitoring locations[i] |
| D2 | 0.0011 mrem | resident annual dose at 3,600 feet from the TLD |

Nearest Off-Site Worker Dose Calculations (150 ft East of Castle Garden Road)

- NFSS Perimeter Monitoring Locations 1, 28, 123
- Off-Site Worker Receives 8-Hour Dose per Day

| | | |
|---|---|---|
| h1 | 3 feet | distance of TLD from the source |
| h2 | 1,020 feet | distance of off-site worker from the TLDs |
| L | 1,350 feet | half the length of the line source (Campbell Street) |
| D1 | 9.0 mrem | average annual dose at the TLD monitoring locations[i] |
| D2 | 0.0036 mrem | off-site worker annual dose at 1,020 feet from the TLD location (8-hour day) |

# APPENDIX C: NFSS CY2004 ENVIRONMENTAL SURVEILLANCE TECHNICAL MEMORANDUM

# FUSRAP CY2004 NESHAP ANNUAL REPORT FOR NIAGARA FALLS STORAGE SITE (NFSS)

## LEWISTON, NEW YORK

**October 2005**

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

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| BNI | Bechtel National, Inc. |
| CAP88-PC | Clean Air Act Assessment Package-1988, Version 2.0 |
| 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 a 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-level, low-activity radioactive residues from the processing of low-grade uranium ores at Linde Air Products, Tonawanda, New York. | 1944 |
| **R-10** | Low-level, low-activity radioactive residues from the processing of low-grade uranium ores at Linde Air Products, Tonawanda, New York. | 1944 |
| **F-32** | Low-level, low-activity radioactive residues from the processing of high-grade uranium ores at Middlesex, New Jersey. | 1944 to early 1950 |
| **L-30** | Low-level, low-activity radioactive residues from the processing of low-grade uranium ores at Linde Air Products, Tonawanda, New York. | 1945 |
| **K-65** | Low-level, high-activity radioactive residues from the processing of low-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 1955 and 1992. The materials generated during remedial actions (approximately 195,000 $m^3$) 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 see if any areas of elevated activity, or activity above currently applicable, relevant, and appropriate regulations, exist. Initial results show that isolated areas of elevated activity do exist. This investigation is currently ongoing.

## 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. Hence, this regulation is felt to provide the most appropriate standards for NFSS. Compliance with Subpart H is verified by applying the USEPA approved CAP88-PCversion 2.0 (CAP88-PC) model (USEPA 1997). 40 CFR 61.92 states that emissions "shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr."

### 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 states "no source shall emit more than 20 $pCi/m^2/s$ of radon-222."

## 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 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. Previous technical memoranda used soil data from Phase I only. A 95% upper confidence limit (UCL) without the subtraction of background radioactivity, was calculated for each soil nuclide and used as the 2004 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 Maximally Exposed Individual |
|---|---|---|---|
| none | not applicable | not applicable | not applicable |
| **Non-Point Sources** | **Type Control** | **Efficiency** | **Distance to Hypothetical Maximally Exposed Individual** |
| *in situ* soil –area source | vegetative cover | 90 percent[a] | 1,475 m southwest (resident)[b]<br>275 m east (off-site worker)<br>3,050 m west-northwest (school)<br>595 m south (farm) |
| **Group Sources** | **Type Control** | **Efficiency** | **Distance to Hypothetical Maximally Exposed Individual** |
| none | not applicable | not applicable | not applicable |

[a] This is the fraction of vegetative cover used to correct emissions (Attachment A,B).
[b] Distance from center of non-point source to nearest resident and worker were defined previously (BNI 1997).

# 4.0 DOSE ASSESSMENTS

## 4.1 MODEL SOURCE DESCRIPTION

To determine the dose from airborne particulates potentially released from NFSS during CY2004, the annual wind erosion emission, $E_w$ (Attachment A) is first calculated using local climatological data (Attachment F) from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center from the Niagara Falls International Airport (NFIA) in Niagara Falls, NY and an on-site meteorological station at Modern Landfill (ML) in Lewiston, NY. The $E_w$ 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, per regulatory guidance, are not considered in this calculation. CAP88-PCAnnual estimated emissions for each radionuclide were then used with the USEPA's CAP88-PC, Version 2.0 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 residential home and farm occupancy (conservatively assumed to be 24 hr/day, 365 days/yr) and commercial/industrial facility and school occupancy (40 hr/week, 50 weeks/yr). The hypothetical individual receiving the higher of these calculated doses is then identified as the hypothetical 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. Organs and weighting factors are modified to follow the International Commission on Radiological Protection (ICRP) 26/30 effective dose equivalent calculations. The calculation of deposition velocity and the default scavenging coefficient is also modified to incorporate current USEPA policy. The default scavenging coefficient is calculated as a function of annual precipitation. The program calculates the effective dose equivalents by combining the inhalation and ingestion intake rates and the air and ground surface concentrations with 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. CY2004 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 CY2004 meteorological data was entered into CAP88-PC (see Attachment F):

| | |
|---|---|
| Average temperature | 8.58 °C (47.45 °F) NFIA, |
| Precipitation, | 98 cm (38.61 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 | 1,475 m (southwest), |
| Off-site worker | 275 m (east), |
| School | 3,050 m (west-northwest), and |
| Farm | 595 m (south). |

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 | 1.0 E-03 mrem/yr, |
| Off-site worker | 2.0 E-02 mrem/yr, |
| School | 7.1 E-04 mrem/yr, and |
| Farm | 3.1 E-03 mrem/yr. |

The nearest off-site worker and school doses are corrected to 2,000 hr out of 8,760 possible hours per year. The adjusted hypothetical doses are:

| | |
|---|---|
| Off-site worker | 4.6 E-03 mrem/yr and |
| School | 1.6 E-04 mrem/yr. |

## 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.

TheCAP88-PC annual effective dose for the population within 80 km of the facility (Attachment D) is:

| | |
|---|---|
| Population: | 3.2 E-02 person-rem/yr. |

### 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 CY2004 are presented in Attachment E; measurement locations are shown in Appendix A, Figure 2.

Measured results for CY2004 ranged from non-detect to 0.213 $pCi/m^2/s$, with an average value of 0.066 $pCi/m^2/s$. As in previous years, these results are well below the 20 $pCi/m^2/s$ 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).

EPA 1997. CAP88-PC Version 2.0 Computer Code, U.S. Environmental Protection Agency.

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 2004, 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 $m^2$ of vegetation covered soil.

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

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

$V = 0.90$

For CY 2004 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:

$U_t = 1.02$ m/s

Anemometer height adjustment is not necessary.

$Z_r$ = reference anemometer height = 10 m

$Z_a$ = actual anemometer height = 10 m

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

$Z_o = 0.3$ cm

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

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

| | | | | | |
|---|---|---|---|---|---|
| $U_{a1} = 28$ | $U_{a2} = 31$ | $U_{a3} = 28$ | $U_{a4} = 33$ | $U_{a5} = 26$ | $U_{a6} = 26$ |
| $U_{a7} = 29$ | $U_{a8} = 29$ | $U_{a9} = 31$ | $U_{a10} = 29$ | $U_{a11} = 23$ | $U_{a12} = 22$ |
| $U_{a13} = 18$ | $U_{a14} = 24$ | $U_{a15} = 28$ | $U_{a16} = 23$ | $U_{a17} = 22$ | $U_{a18} = 17$ |
| $U_{a19} = 31$ | $U_{a20} = 24$ | $U_{a21} = 21$ | $U_{a22} = 20$ | $U_{a23} = 28$ | $U_{a24} = 29$ |
| $U_{a25} = 32$ | $U_{a26} = 15$ | $U_{a27} = 40$ | | | |

[a]Although max 2-minute wind speeds can be used to approximate fastest mile wind speeds (USEPA 2004 Table 7-4) 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:

| | | | | | |
|---|---|---|---|---|---|
| $U_1$ = 8.62E-01 | $U_2$ = 9.55E-01 | $U_3$ = 8.62E-01 | $U_4$ = 1.02E+00 | $U_5$ = 8.01E-01 | $U_6$ = 8.01E-01 |
| $U_7$ = 8.93E-01 | $U_8$ = 8.93E-01 | $U_9$ = 9.55E-01 | $U_{10}$ = 8.93E-01 | $U_{11}$ = 7.08E-01 | $U_{12}$ = 6.78E-01 |
| $U_{13}$ = 5.54E-01 | $U_{14}$ = 7.39E-01 | $U_{15}$ = 8.62E-01 | $U_{16}$ = 7.08E-01 | $U_{17}$ = 6.78E-01 | $U_{18}$ = 5.24E-01 |
| $U_{19}$ = 9.55E-01 | $U_{20}$ = 7.39E-01 | $U_{21}$ = 6.47E-01 | $U_{22}$ = 6.16E-01 | $U_{23}$ = 8.62E-01 | $U_{24}$ = 8.93E-01 |
| $U_{25}$ = 9.86E-01 | $U_{26}$ = 4.62E-01 | $U_{27}$ = 1.23E+00 | | | |

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

$$P_N = 58 (U^*-U_t)^2 + 25(U^*-U_t) = 7.91 \text{ g/m}^2$$

The erosion potentials ($P_N$) for each period between disturbances in CY 2004 are all less than or equal to the threshold friction velocity with a single exception for $U_{27}$.

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:

$$P = k \sum P_N = \text{is } 3.95 \text{ g/m}^2$$

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

$$PE = 110$$

The corrected emission factor ($PM_{10}$) for 10 μ particles (USEPA 1985 Equation 4-1) is:

$$PM_{10} = P(1-V) / (PE/50)^2 = 0.082 \text{ g/m}^2\text{/yr}$$

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

$$E = A (PM_{10}) = 63{,}728 \text{ g soil}$$

## 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 DEVELOPMENTAND 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. A subset of this data set was used in the technical memorandum for CY 2003. 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 2004 therefore has much higher soil concentrations than in previous years 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 also used, as appropriate, to more accurately 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 (≈ 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 (≈ 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 insignificant abundance and stable nuclides do not contribute 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 2004**

| 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 | 5.89E-06 | Th-232 | 0.89 | 5.67E-08 | U-235 | 8.97 | 5.72E-07 |
| Th-234 | 92.38 | 5.89E-06 | Ra-228 | 0.89 | 5.67E-08 | Th-231 | 8.97 | 5.72E-07 |
| Pa-234m | 92.38 | 5.89E-06 | Ac-228 | 0.89 | 5.67E-08 | Pa-231 | 8.97 | 5.72E-07 |
| Pa-234 | 92.38 | 5.89E-06 | Th-228 | 1.08 | 6.88E-08 | Ac-227 | 8.97 | 5.72E-07 |
| U-234 | 87.4 | 5.57E-06 | Ra-224 | 1.08 | 6.88E-08 | Th-227 | 8.97 | 5.72E-07 |
| Th-230 | 22.74 | 1.45E-06 | Rn-220 | 1.08 | 6.88E-08 | Fr-223 | 8.97 | 5.72E-07 |
| Ra-226 | 26.09 | 1.66E-06 | Po-216 | 1.08 | 6.88E-08 | Ra-223 | 8.97 | 5.72E-07 |
| Rn-222 | 26.09 | 1.66E-06 | Pb-212 | 1.08 | 6.88E-08 | Rn-219 | 8.97 | 5.72E-07 |
| Po-218 | 26.09 | 1.66E-06 | Bi-212 | 1.08 | 6.88E-08 | Po-215 | 8.97 | 5.72E-07 |
| Pb-214 | 26.09 | 1.66E-06 | Po-212 | 1.08 | 6.88E-08 | Pb-211 | 8.97 | 5.72E-07 |
| At-218 | 26.09 | 1.66E-06 | Tl-208 | 1.08 | 6.88E-08 | At-215 | 8.97 | 5.72E-07 |
| Bi-214 | 26.09 | 1.66E-06 | Pb-208 (stable) | 1.08 | 6.88E-08 | Bi-211 | 8.97 | 5.72E-07 |
| Po-214 | 26.09 | 1.66E-06 | | | | Po-211 | 8.97 | 5.72E-07 |
| Tl-210 | 26.09 | 1.66E-06 | | | | Tl-207 | 8.97 | 5.72E-07 |
| Pb-210 | 26.09 | 1.66E-06 | | | | Pb-207 (stable) | 8.97 | 5.72E-07 |
| Bi-210 | 26.09 | 1.66E-06 | | | | | | |
| Po-210 | 26.09 | 1.66E-06 | | | | | | |
| Tl-206 | 26.09 | 1.66E-06 | | | | | | |
| Pb-206 (stable) | 26.09 | 1.66E-06 | | | | | | |

## B.2 REFERENCES

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

**ATTACHMENT C**

**CAPP88-PC REPORTS – INDIVIDUAL**

NFSSIN04.SUM

C A P 8 8 - P C

Version 2.00

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
Sep 2, 2005 07:48 amm

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

Source Category: Area
Source Type: Area
Emission Year: 2004

Comments: NFSS 2004 Individual

Dataset Name: NFSS 2004 Ind
Dataset Date: Sep 2, 2005 07:45 am
Wind File: C:\CAP88PC2\WNDFILES\IAG0905.WND



ORGAN DOSE EQUIVALENT SUMMARY

| Organ | Selected Individual (mrem/y) |
|---|---|
| GONADS | 3.48E-04 |
| BREAST | 1.29E-04 |
| R MAR | 7.56E-03 |
| LUNGS | 1.41E-01 |
| THYROID | 1.19E-04 |
| ENDOST | 9.52E-02 |
| RMNDR | 2.17E-03 |
| EFFEC | 2.15E-02 |

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

| Pathway | Selected Individual (mrem/y) |
|---|---|
| INGESTION | 7.41E-04 |
| INHALATION | 2.07E-02 |
| AIR IMMERSION | 7.60E-08 |
| GROUND SURFACE | 1.80E-05 |
| INTERNAL | 2.14E-02 |
| EXTERNAL | 1.81E-05 |
| TOTAL | 2.15E-02 |



NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

| Nuclide | Selected Individual (mrem/y) |
|---|---|
| U-238 | 5.63E-03 |
| TH-234 | 2.51E-06 |
| PA-234M | 2.03E-10 |
| U-234 | 5.98E-03 |
| TH-230 | 2.91E-03 |
| RA-226 | 1.69E-04 |
| PO-218 | 4.63E-10 |
| PB-214 | 1.40E-08 |
| BI-214 | 1.77E-08 |
| PO-214 | 0.00E+00 |
| PB-210 | 3.93E-04 |
| BI-210 | 2.59E-06 |
| PO-210 | 1.74E-04 |
| TH-232 | 1.64E-04 |
| RA-228 | 1.98E-06 |
| AC-228 | 3.93E-08 |
| TH-228 | 1.39E-04 |
| RA-224 | 1.94E-06 |
| PO-216 | 0.00E+00 |
| PB-212 | 9.29E-08 |
| BI-212 | 1.84E-08 |
| TL-208 | 8.77E-10 |
| U-235 | 5.81E-04 |
| TH-231 | 4.62E-09 |
| PA-231 | 2.26E-03 |
| AC-227 | 2.96E-03 |
| FR-223 | 1.19E-08 |
| RA-223 | 3.99E-05 |
| PO-215 | 0.00E+00 |
| PB-211 | 4.24E-08 |
| BI-211 | 2.87E-09 |
| PO-211 | 7.16E-33 |
| TL-207 | 3.38E-11 |
| PA-234 | 1.47E-07 |
| PO-212 | 0.00E+00 |
| TH-227 | 5.38E-05 |

| | |
|---|---|
| TOTAL | 2.15E-02 |



CANCER RISK SUMMARY

| Cancer | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| LEUKEMIA | 6.50E-09 |
| BONE | 4.21E-09 |
| THYROID | 2.45E-11 |
| BREAST | 2.41E-10 |
| LUNG | 2.20E-07 |
| STOMACH | 1.53E-10 |
| BOWEL | 1.32E-10 |
| LIVER | 5.10E-09 |
| PANCREAS | 1.08E-10 |
| URINARY | 1.44E-09 |
| OTHER | 1.32E-10 |
| TOTAL | 2.38E-07 |

PATHWAY RISK SUMMARY

| Pathway | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| INGESTION | 4.12E-09 |
| INHALATION | 2.33E-07 |
| AIR IMMERSION | 1.83E-12 |
| GROUND SURFACE | 4.17E-10 |
| INTERNAL | 2.37E-07 |
| EXTERNAL | 4.19E-10 |
| TOTAL | 2.38E-07 |



NUCLIDE RISK SUMMARY

| Nuclide | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| U-238 | 7.45E-08 |
| TH-234 | 1.07E-10 |
| PA-234M | 5.18E-15 |

| | NFSSIN04.SUM |
|---|---|
| U-234 | 7.86E-08 |
| TH-230 | 2.40E-08 |
| RA-226 | 2.90E-09 |
| PO-218 | 3.28E-13 |
| PB-214 | 2.39E-12 |
| BI-214 | 2.05E-12 |
| PO-214 | 0.00E+00 |
| PB-210 | 2.81E-09 |
| BI-210 | 6.98E-11 |
| PO-210 | 2.54E-09 |
| TH-232 | 9.25E-10 |
| RA-228 | 2.47E-11 |
| AC-228 | 7.93E-13 |
| TH-228 | 2.80E-09 |
| RA-224 | 4.40E-11 |
| PO-216 | 0.00E+00 |
| PB-212 | 1.59E-12 |
| BI-212 | 2.37E-13 |
| TL-208 | 2.15E-14 |
| U-235 | 7.78E-09 |
| TH-231 | 1.35E-13 |
| PA-231 | 1.26E-08 |
| AC-227 | 2.56E-08 |
| FR-223 | 1.25E-13 |
| RA-223 | 9.56E-10 |
| PO-215 | 0.00E+00 |
| PB-211 | 8.16E-13 |
| BI-211 | 3.40E-14 |
| PO-211 | 1.72E-37 |
| TL-207 | 1.10E-15 |
| PA-234 | 3.79E-12 |
| PO-212 | 0.00E+00 |
| TH-227 | 1.48E-09 |
| TOTAL | 2.38E-07 |



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

| | Distance (m) | | | |
|---|---|---|---|---|
| Direction | 275 | 595 | 1475 | 3050 |
| N | 2.1E-02 | 3.7E-03 | 1.1E-03 | 7.6E-04 |
| NNW | 2.0E-02 | 3.0E-03 | 8.8E-04 | 6.4E-04 |
| NW | 2.0E-02 | 2.9E-03 | 9.2E-04 | 6.8E-04 |
| WNW | 1.9E-02 | 3.4E-03 | 1.1E-03 | 7.1E-04 |
| W | 1.9E-02 | 3.6E-03 | 1.3E-03 | 8.1E-04 |
| WSW | 1.8E-02 | 3.6E-03 | 1.1E-03 | 7.1E-04 |
| SW | 1.8E-02 | 3.2E-03 | 1.0E-03 | 7.1E-04 |
| SSW | 1.8E-02 | 3.0E-03 | 9.5E-04 | 6.7E-04 |
| S | 2.0E-02 | 3.1E-03 | 1.0E-03 | 7.2E-04 |
| SSE | 2.1E-02 | 3.6E-03 | 1.1E-03 | 7.1E-04 |
| SE | 2.1E-02 | 4.0E-03 | 1.2E-03 | 7.8E-04 |
| ESE | 2.0E-02 | 4.4E-03 | 1.3E-03 | 7.6E-04 |
| E | 2.0E-02 | 4.8E-03 | 1.3E-03 | 8.0E-04 |

| | | | | |
|---|---|---|---|---|
| ENE | 2.0E-02 | 5.2E-03 | 1.4E-03 | 7.9E-04 |
| NE | 2.1E-02 | 5.1E-03 | 1.5E-03 | 8.9E-04 |
| NNE | 2.1E-02 | 4.7E-03 | 1.3E-03 | 7.8E-04 |



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

| | Distance (m) | | | |
|---|---|---|---|---|
| Direction | 275 | 595 | 1475 | 3050 |
| N | 2.3E-07 | 3.8E-08 | 9.6E-09 | 5.3E-09 |
| NNW | 2.2E-07 | 3.1E-08 | 6.6E-09 | 3.9E-09 |
| NW | 2.2E-07 | 3.0E-08 | 7.1E-09 | 4.3E-09 |
| WNW | 2.1E-07 | 3.5E-08 | 8.8E-09 | 4.7E-09 |
| W | 2.1E-07 | 3.8E-08 | 1.1E-08 | 5.8E-09 |
| WSW | 2.0E-07 | 3.7E-08 | 9.1E-09 | 4.7E-09 |
| SW | 2.0E-07 | 3.3E-08 | 8.1E-09 | 4.7E-09 |
| SSW | 2.0E-07 | 3.1E-08 | 7.3E-09 | 4.2E-09 |
| S | 2.2E-07 | 3.2E-08 | 8.4E-09 | 4.8E-09 |
| SSE | 2.3E-07 | 3.7E-08 | 8.8E-09 | 4.6E-09 |
| SE | 2.4E-07 | 4.2E-08 | 1.0E-08 | 5.5E-09 |
| ESE | 2.2E-07 | 4.6E-08 | 1.1E-08 | 5.3E-09 |
| E | 2.2E-07 | 5.0E-08 | 1.2E-08 | 5.7E-09 |
| ENE | 2.2E-07 | 5.5E-08 | 1.2E-08 | 5.6E-09 |
| NE | 2.3E-07 | 5.4E-08 | 1.4E-08 | 6.7E-09 |
| NNE | 2.3E-07 | 4.9E-08 | 1.2E-08 | 5.5E-09 |

**ATTACHMENT D**

**CAP88-PC REPORTS – POPULATION**

C A P 8 8 - P C

Version 2.00

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
Sep 2, 2005 08:01 amm

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

Source Category: Area
Source Type: Area
Emission Year: 2004

Comments: NFSS 2004 Population

Dataset Name: NFSS 2004 Pop
Dataset Date: Sep 2, 2005 08:00 am
Wind File: C:\CAP88PC2\WNDFILES\IAG0905.WND
Population File: C:\CAP88PC2\POPFILES\NFSS2003.POP



ORGAN DOSE EQUIVALENT SUMMARY

| Organ | Selected Individual (mrem/y) | Collective Population (person-rem/y) |
|---|---|---|
| GONADS | 3.15E-04 | 5.51E-04 |
| BREAST | 8.57E-05 | 2.38E-04 |
| R MAR | 7.43E-03 | 1.13E-02 |
| LUNGS | 1.56E-01 | 2.08E-01 |
| THYROID | 7.50E-05 | 2.11E-04 |
| ENDOST | 9.29E-02 | 1.43E-01 |
| RMNDR | 1.44E-03 | 3.44E-03 |
| EFFEC | 2.29E-02 | 3.18E-02 |

NFSS04PO.SUM
PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

| Pathway | Selected Individual (mrem/y) | Collective Population (person-rem/y) |
|---|---|---|
| INGESTION | 2.81E-05 | 1.27E-03 |
| INHALATION | 2.28E-02 | 3.05E-02 |
| AIR IMMERSION | 8.39E-08 | 7.05E-08 |
| GROUND SURFACE | 1.98E-05 | 4.87E-05 |
| INTERNAL | 2.28E-02 | 3.18E-02 |
| EXTERNAL | 1.99E-05 | 4.88E-05 |
| TOTAL | 2.29E-02 | 3.18E-02 |



NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

| Nuclides | Selected Individual (mrem/y) | Collective Population (person-rem/y) |
|---|---|---|
| U-238 | 6.06E-03 | 8.34E-03 |
| TH-234 | 1.90E-06 | 3.73E-06 |
| PA-234M | 2.32E-10 | 3.70E-11 |
| U-234 | 6.44E-03 | 8.86E-03 |
| TH-230 | 3.19E-03 | 4.29E-03 |
| RA-226 | 1.33E-04 | 2.65E-04 |
| PO-218 | 5.22E-10 | 9.37E-11 |
| PB-214 | 1.55E-08 | 5.30E-09 |
| BI-214 | 1.96E-08 | 5.93E-09 |
| PO-214 | 0.00E+00 | 0.00E+00 |
| PB-210 | 2.10E-04 | 6.15E-04 |
| BI-210 | 2.85E-06 | 3.74E-06 |
| PO-210 | 1.29E-04 | 2.68E-04 |
| TH-232 | 1.80E-04 | 2.41E-04 |
| RA-228 | 1.25E-06 | 3.18E-06 |
| AC-228 | 4.34E-08 | 4.13E-08 |
| TH-228 | 1.53E-04 | 2.05E-04 |
| RA-224 | 2.13E-06 | 2.78E-06 |
| PO-216 | 0.00E+00 | 0.00E+00 |
| PB-212 | 1.02E-07 | 1.10E-07 |
| BI-212 | 2.04E-08 | 1.01E-08 |
| TL-208 | 9.89E-10 | 1.78E-10 |
| U-235 | 6.26E-04 | 8.76E-04 |
| TH-231 | 5.09E-09 | 6.29E-09 |
| PA-231 | 2.43E-03 | 3.34E-03 |
| AC-227 | 3.21E-03 | 4.36E-03 |
| FR-223 | 1.31E-08 | 4.11E-09 |
| RA-223 | 4.18E-05 | 5.85E-05 |
| PO-215 | 0.00E+00 | 0.00E+00 |
| PB-211 | 4.68E-08 | 1.83E-08 |
| BI-211 | 3.25E-09 | 5.55E-10 |
| PO-211 | 5.94E-31 | 8.51E-32 |
| TL-207 | 3.78E-11 | 7.37E-12 |

| | | |
|---|---|---|
| PA-234 | 1.62E-07 | 1.89E-07 |
| PO-212 | 0.00E+00 | 0.00E+00 |
| TH-227 | 5.91E-05 | 7.88E-05 |
| TOTAL | 2.29E-02 | 3.18E-02 |



CANCER RISK SUMMARY

| Cancer | Selected Individual Total Lifetime Fatal Cancer Risk | Total Collective Population Fatal Cancer Risk (Deaths/y) |
|---|---|---|
| LEUKEMIA | 6.23E-09 | 1.39E-07 |
| BONE | 4.02E-09 | 8.96E-08 |
| THYROID | 1.78E-11 | 6.90E-10 |
| BREAST | 1.90E-10 | 7.21E-09 |
| LUNG | 2.42E-07 | 4.58E-06 |
| STOMACH | 1.03E-10 | 4.11E-09 |
| BOWEL | 7.61E-11 | 3.32E-09 |
| LIVER | 4.41E-09 | 1.09E-07 |
| PANCREAS | 7.13E-11 | 2.86E-09 |
| URINARY | 3.85E-10 | 3.54E-08 |
| OTHER | 8.73E-11 | 3.49E-09 |
| TOTAL | 2.58E-07 | 4.97E-06 |

PATHWAY RISK SUMMARY

| Pathway | Selected Individual Total Lifetime Fatal Cancer Risk | Total Collective Population Fatal Cancer Risk (Deaths/y) |
|---|---|---|
| INGESTION | 1.56E-10 | 9.96E-08 |
| INHALATION | 2.57E-07 | 4.86E-06 |
| AIR IMMERSION | 2.01E-12 | 2.39E-11 |
| GROUND SURFACE | 4.58E-10 | 1.59E-08 |
| INTERNAL | 2.57E-07 | 4.95E-06 |
| EXTERNAL | 4.60E-10 | 1.59E-08 |
| TOTAL | 2.58E-07 | 4.97E-06 |



PATHWAY GENETIC RISK SUMMARY
(Collective Population)

| Pathway | Genetic Risk (person-rem/y) |
|---|---|
| INGESTION | 1.13E-05 |
| INHALATION | 2.17E-05 |
| AIR IMMERSION | 6.91E-08 |
| GROUND SURFACE | 4.29E-05 |
| INTERNAL | 3.30E-05 |
| EXTERNAL | 4.30E-05 |
| TOTAL | 7.60E-05 |



NUCLIDE RISK SUMMARY

| Nuclide | Selected Individual Total Lifetime Fatal Cancer Risk | Total Collective Population Fatal Cancer Risk (Deaths/y) |
|---|---|---|
| U-238 | 8.13E-08 | 1.56E-06 |
| TH-234 | 1.08E-10 | 2.23E-09 |
| PA-234M | 5.92E-15 | 1.33E-14 |
| U-234 | 8.59E-08 | 1.64E-06 |
| TH-230 | 2.64E-08 | 5.00E-07 |
| RA-226 | 2.93E-09 | 6.21E-08 |
| PO-218 | 3.70E-13 | 9.39E-13 |
| PB-214 | 2.64E-12 | 1.28E-11 |
| BI-214 | 2.27E-12 | 9.67E-12 |
| PO-214 | 0.00E+00 | 0.00E+00 |
| PB-210 | 1.50E-09 | 6.21E-08 |
| BI-210 | 7.68E-11 | 1.42E-09 |
| PO-210 | 2.48E-09 | 5.39E-08 |
| TH-232 | 1.02E-09 | 1.93E-08 |
| RA-228 | 2.06E-11 | 5.40E-10 |
| AC-228 | 8.75E-13 | 1.18E-11 |
| TH-228 | 3.08E-09 | 5.83E-08 |
| RA-224 | 4.84E-11 | 8.87E-10 |
| PO-216 | 0.00E+00 | 0.00E+00 |
| PB-212 | 1.75E-12 | 2.66E-11 |
| BI-212 | 2.62E-13 | 1.83E-12 |
| TL-208 | 2.42E-14 | 6.15E-14 |
| U-235 | 8.50E-09 | 1.67E-07 |
| TH-231 | 1.49E-13 | 2.58E-12 |
| PA-231 | 1.37E-08 | 2.63E-07 |
| AC-227 | 2.79E-08 | 5.34E-07 |
| FR-223 | 1.38E-13 | 6.13E-13 |
| RA-223 | 1.04E-09 | 1.97E-08 |
| PO-215 | 0.00E+00 | 0.00E+00 |
| PB-211 | 9.02E-13 | 4.98E-12 |
| BI-211 | 3.86E-14 | 9.30E-14 |
| PO-211 | 1.43E-35 | 2.89E-35 |
| TL-207 | 1.24E-15 | 3.41E-15 |
| PA-234 | 4.18E-12 | 6.79E-11 |
| PO-212 | 0.00E+00 | 0.00E+00 |
| TH-227 | 1.63E-09 | 3.06E-08 |

TOTAL 2.58E-07 4.97E-06



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

| | Distance (m) | | | | | | |
|---|---|---|---|---|---|---|---|
| Direction | 250 | 750 | 1500 | 2500 | 3500 | 4500 | 7500 |
| N | 2.3E-02 | 1.8E-03 | 5.5E-04 | 2.5E-04 | 1.5E-04 | 9.9E-05 | 4.5E-05 |
| NNW | 2.3E-02 | 1.4E-03 | 2.8E-04 | 7.8E-05 | 4.5E-05 | 3.0E-05 | 1.4E-05 |
| NW | 2.3E-02 | 1.2E-03 | 3.3E-04 | 1.4E-04 | 8.0E-05 | 5.4E-05 | 2.4E-05 |
| WNW | 2.3E-02 | 1.9E-03 | 4.7E-04 | 1.8E-04 | 1.0E-04 | 7.0E-05 | 3.1E-05 |
| W | 2.3E-02 | 2.0E-03 | 6.6E-04 | 3.2E-04 | 1.8E-04 | 1.2E-04 | 5.6E-05 |
| WSW | 2.3E-02 | 2.0E-03 | 5.0E-04 | 1.9E-04 | 1.1E-04 | 7.3E-05 | 3.3E-05 |
| SW | 2.3E-02 | 1.4E-03 | 4.2E-04 | 1.9E-04 | 1.1E-04 | 7.3E-05 | 3.3E-05 |
| SSW | 2.3E-02 | 1.5E-03 | 3.5E-04 | 1.2E-04 | 7.0E-05 | 4.7E-05 | 2.1E-05 |
| S | 2.3E-02 | 1.4E-03 | 4.4E-04 | 2.0E-04 | 1.1E-04 | 7.7E-05 | 3.5E-05 |
| SSE | 2.3E-02 | 1.9E-03 | 4.8E-04 | 1.8E-04 | 1.0E-04 | 6.9E-05 | 3.1E-05 |
| SE | 2.3E-02 | 2.1E-03 | 6.3E-04 | 2.8E-04 | 1.6E-04 | 1.1E-04 | 4.9E-05 |
| ESE | 2.3E-02 | 2.4E-03 | 6.5E-04 | 2.5E-04 | 1.5E-04 | 1.0E-04 | 4.5E-05 |
| E | 2.3E-02 | 2.5E-03 | 7.1E-04 | 3.1E-04 | 1.8E-04 | 1.2E-04 | 5.5E-05 |
| ENE | 2.3E-02 | 2.9E-03 | 7.6E-04 | 2.9E-04 | 1.7E-04 | 1.1E-04 | 5.2E-05 |
| NE | 2.3E-02 | 2.9E-03 | 9.1E-04 | 4.3E-04 | 2.5E-04 | 1.7E-04 | 7.6E-05 |
| NNE | 2.3E-02 | 2.8E-03 | 7.2E-04 | 2.8E-04 | 1.6E-04 | 1.1E-04 | 5.0E-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 | 1.4E-06 | 1.1E-06 |
| NNW | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 7.1E-07 | 5.2E-07 | 4.3E-07 |
| NW | 8.6E-06 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 1.1E-06 | 7.6E-07 | 6.1E-07 |
| WNW | 1.1E-05 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 1.3E-06 | 9.0E-07 | 7.0E-07 |
| W | 2.0E-05 | 8.8E-06 | 5.4E-06 | 3.5E-06 | 2.4E-06 | 1.6E-06 | 1.2E-06 |
| WSW | 1.2E-05 | 5.3E-06 | 3.3E-06 | 2.2E-06 | 1.5E-06 | 1.1E-06 | 8.4E-07 |
| SW | 1.2E-05 | 5.3E-06 | 3.2E-06 | 2.2E-06 | 1.5E-06 | 1.1E-06 | 0.0E+00 |
| SSW | 7.6E-06 | 3.5E-06 | 2.1E-06 | 1.4E-06 | 0.0E+00 | 7.4E-07 | 6.0E-07 |
| S | 1.2E-05 | 5.6E-06 | 3.4E-06 | 2.3E-06 | 1.6E-06 | 1.1E-06 | 8.8E-07 |
| SSE | 1.1E-05 | 5.0E-06 | 3.1E-06 | 2.1E-06 | 1.5E-06 | 1.0E-06 | 8.3E-07 |
| SE | 1.8E-05 | 7.9E-06 | 4.8E-06 | 3.3E-06 | 2.3E-06 | 1.6E-06 | 1.2E-06 |
| ESE | 1.6E-05 | 7.4E-06 | 4.5E-06 | 3.0E-06 | 2.1E-06 | 1.5E-06 | 1.2E-06 |
| E | 2.0E-05 | 9.0E-06 | 5.5E-06 | 3.7E-06 | 2.6E-06 | 1.8E-06 | 1.4E-06 |
| ENE | 1.9E-05 | 8.6E-06 | 5.3E-06 | 3.6E-06 | 2.5E-06 | 1.8E-06 | 1.4E-06 |
| NE | 2.8E-05 | 1.3E-05 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 |
| NNE | 1.8E-05 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 1.4E-06 |

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

| | Distance (m) | | | | | | |
|---|---|---|---|---|---|---|---|
| Direction | 250 | 750 | 1500 | 2500 | 3500 | 4500 | 7500 |
| N | 2.1E-04 | 4.9E-05 | 5.2E-05 | 3.4E-05 | 2.7E-05 | 2.3E-05 | 6.1E-05 |
| NNW | 2.1E-04 | 3.8E-05 | 2.9E-05 | 1.0E-05 | 8.4E-06 | 6.8E-06 | 2.1E-05 |
| NW | 2.0E-04 | 3.3E-05 | 3.7E-05 | 2.1E-05 | 1.5E-05 | 1.4E-05 | 2.0E-04 |
| WNW | 2.0E-04 | 5.2E-05 | 5.3E-05 | 3.3E-05 | 2.5E-05 | 4.0E-05 | 1.2E-04 |
| W | 2.0E-04 | 5.6E-05 | 7.3E-05 | 5.9E-05 | 2.9E-04 | 4.1E-05 | 6.3E-05 |
| WSW | 2.0E-04 | 5.6E-05 | 5.6E-05 | 3.4E-05 | 1.6E-04 | 1.4E-04 | 2.2E-04 |
| SW | 2.0E-04 | 4.0E-05 | 4.7E-05 | 3.4E-05 | 3.4E-05 | 1.5E-04 | 4.0E-04 |
| SSW | 2.0E-04 | 4.1E-05 | 3.9E-05 | 2.2E-05 | 2.0E-05 | 7.3E-05 | 2.3E-04 |
| S | 2.0E-04 | 4.0E-05 | 4.9E-05 | 3.7E-05 | 2.5E-05 | 2.3E-05 | 3.6E-04 |
| SSE | 2.1E-04 | 5.3E-05 | 5.3E-05 | 3.3E-05 | 2.3E-05 | 1.9E-05 | 1.4E-04 |
| SE | 2.1E-04 | 5.8E-05 | 6.9E-05 | 5.2E-05 | 3.9E-05 | 3.1E-05 | 1.5E-04 |
| ESE | 2.1E-04 | 6.8E-05 | 7.2E-05 | 4.7E-05 | 3.8E-05 | 3.3E-05 | 1.1E-04 |
| E | 2.0E-04 | 6.9E-05 | 7.9E-05 | 5.7E-05 | 4.6E-05 | 4.0E-05 | 1.3E-04 |
| ENE | 2.1E-04 | 8.2E-05 | 8.4E-05 | 5.2E-05 | 3.3E-05 | 2.4E-05 | 1.6E-04 |
| NE | 2.1E-04 | 8.0E-05 | 1.0E-04 | 5.3E-05 | 2.8E-05 | 2.4E-05 | 2.1E-04 |
| NNE | 2.1E-04 | 7.7E-05 | 7.1E-05 | 3.7E-05 | 2.9E-05 | 2.3E-05 | 7.5E-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-04 | 3.2E-04 |
| NNW | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 1.5E-04 | 5.6E-04 | 3.0E-04 |
| NW | 8.7E-06 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 5.4E-06 | 6.2E-04 | 3.2E-04 |
| WNW | 3.9E-05 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 1.3E-09 | 2.3E-04 | 6.2E-05 |
| W | 5.3E-04 | 5.7E-04 | 5.1E-05 | 9.8E-05 | 5.0E-05 | 2.7E-04 | 3.1E-04 |
| WSW | 1.7E-04 | 2.5E-04 | 2.6E-05 | 1.5E-05 | 8.3E-06 | 1.0E-05 | 4.8E-06 |
| SW | 8.3E-04 | 3.0E-05 | 1.9E-04 | 3.0E-05 | 2.9E-06 | 7.3E-07 | 0.0E+00 |
| SSW | 8.8E-04 | 8.0E-06 | 1.6E-05 | 6.3E-06 | 0.0E+00 | 1.0E-07 | 8.8E-06 |
| S | 1.1E-03 | 3.0E-04 | 3.2E-04 | 1.3E-05 | 1.7E-04 | 6.9E-05 | 3.2E-05 |
| SSE | 8.6E-04 | 2.3E-03 | 2.7E-03 | 9.8E-04 | 2.4E-04 | 4.5E-05 | 2.0E-05 |
| SE | 3.2E-04 | 9.5E-04 | 9.0E-04 | 3.5E-04 | 1.1E-04 | 3.8E-05 | 2.8E-05 |
| ESE | 1.8E-04 | 6.0E-04 | 7.1E-05 | 7.4E-05 | 4.8E-05 | 1.0E-04 | 3.8E-05 |
| E | 1.9E-04 | 4.7E-04 | 8.7E-05 | 1.4E-04 | 3.9E-05 | 6.9E-05 | 5.5E-05 |
| ENE | 1.1E-04 | 1.9E-04 | 5.1E-05 | 2.4E-05 | 1.5E-05 | 6.0E-06 | 2.8E-06 |
| NE | 2.3E-04 | 1.5E-05 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 |
| NNE | 9.5E-06 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 2.9E-05 |



AVERAGE COLLECTIVE GENETIC DOSE EQUIVALENT
(person rem)
(All Radionuclides and Pathways)

| Direction | Distance (m) 250 | 750 | 1500 | 2500 | 3500 | 4500 | 7500 |
|---|---|---|---|---|---|---|---|
| N | 3.8E-05 | 9.2E-06 | 9.9E-06 | 6.5E-06 | 5.3E-06 | 4.6E-06 | 1.2E-05 |
| NNW | 3.8E-05 | 7.1E-06 | 5.4E-06 | 2.0E-06 | 1.7E-06 | 1.4E-06 | 4.6E-06 |
| NW | 3.8E-05 | 6.1E-06 | 6.9E-06 | 4.1E-06 | 3.0E-06 | 2.8E-06 | 4.2E-05 |
| WNW | 3.8E-05 | 9.7E-06 | 1.0E-05 | 6.4E-06 | 4.9E-06 | 7.9E-06 | 2.4E-05 |
| W | 3.7E-05 | 1.0E-05 | 1.4E-05 | 1.1E-05 | 5.7E-05 | 8.1E-06 | 1.3E-05 |
| WSW | 3.8E-05 | 1.0E-05 | 1.1E-05 | 6.6E-06 | 3.2E-05 | 2.8E-05 | 4.4E-05 |
| SW | 3.7E-05 | 7.4E-06 | 8.9E-06 | 6.6E-06 | 6.7E-06 | 3.0E-05 | 8.1E-05 |
| SSW | 3.8E-05 | 7.7E-06 | 7.4E-06 | 4.3E-06 | 4.0E-06 | 1.5E-05 | 4.9E-05 |
| S | 3.8E-05 | 7.5E-06 | 9.3E-06 | 7.1E-06 | 5.0E-06 | 4.5E-06 | 7.4E-05 |
| SSE | 3.8E-05 | 9.9E-06 | 1.0E-05 | 6.3E-06 | 4.4E-06 | 3.9E-06 | 2.9E-05 |
| SE | 3.8E-05 | 1.1E-05 | 1.3E-05 | 1.0E-05 | 7.6E-06 | 6.1E-06 | 3.1E-05 |
| ESE | 3.8E-05 | 1.3E-05 | 1.4E-05 | 9.1E-06 | 7.4E-06 | 6.5E-06 | 2.3E-05 |
| E | 3.7E-05 | 1.3E-05 | 1.5E-05 | 1.1E-05 | 8.9E-06 | 7.9E-06 | 2.7E-05 |
| ENE | 3.8E-05 | 1.5E-05 | 1.6E-05 | 1.0E-05 | 6.4E-06 | 4.7E-06 | 3.4E-05 |
| NE | 3.8E-05 | 1.5E-05 | 1.9E-05 | 1.0E-05 | 5.5E-06 | 4.8E-06 | 4.2E-05 |
| NNE | 3.8E-05 | 1.4E-05 | 1.3E-05 | 7.2E-06 | 5.7E-06 | 4.5E-06 | 1.5E-05 |

| Direction | Distance (m) 15000 | 25000 | 35000 | 45000 | 55000 | 65000 | 75000 |
|---|---|---|---|---|---|---|---|
| N | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 4.2E-05 | 1.4E-04 |
| NNW | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 8.3E-05 | 3.8E-04 | 2.4E-04 |
| NW | 2.0E-06 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 2.4E-06 | 3.3E-04 | 2.0E-04 |
| WNW | 8.7E-06 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 5.2E-10 | 1.1E-04 | 3.5E-05 |
| W | 1.1E-04 | 1.3E-04 | 1.3E-05 | 2.7E-05 | 1.5E-05 | 9.7E-05 | 1.3E-04 |
| WSW | 3.9E-05 | 6.2E-05 | 7.3E-06 | 4.7E-06 | 3.1E-06 | 4.6E-06 | 2.4E-06 |
| SW | 1.9E-04 | 7.5E-06 | 5.3E-05 | 9.7E-06 | 1.1E-06 | 3.2E-07 | 0.0E+00 |
| SSW | 2.1E-04 | 2.2E-06 | 5.3E-06 | 2.4E-06 | 0.0E+00 | 5.7E-08 | 5.5E-06 |
| S | 2.5E-04 | 7.6E-05 | 9.1E-05 | 4.2E-06 | 6.2E-05 | 3.0E-05 | 1.6E-05 |
| SSE | 2.0E-04 | 6.1E-04 | 7.9E-04 | 3.2E-04 | 9.0E-05 | 2.0E-05 | 1.0E-05 |
| SE | 6.9E-05 | 2.3E-04 | 2.4E-04 | 1.0E-04 | 3.4E-05 | 1.4E-05 | 1.1E-05 |
| ESE | 4.0E-05 | 1.4E-04 | 1.9E-05 | 2.2E-05 | 1.6E-05 | 3.9E-05 | 1.6E-05 |
| E | 4.1E-05 | 1.1E-04 | 2.2E-05 | 3.9E-05 | 1.2E-05 | 2.4E-05 | 2.2E-05 |
| ENE | 2.3E-05 | 4.4E-05 | 1.3E-05 | 6.8E-06 | 4.6E-06 | 2.1E-06 | 1.1E-06 |
| NE | 4.9E-05 | 3.3E-06 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 |
| NNE | 2.1E-06 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 1.1E-05 |



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

| Direction | Distance (m) 250 | 750 | 1500 | 2500 | 3500 | 4500 | 7500 |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| N | 2.6E-07 | 2.0E-08 | 6.2E-09 | 2.8E-09 | 1.6E-09 | 1.1E-09 | 5.0E-10 |
| NNW | 2.6E-07 | 1.5E-08 | 3.2E-09 | 8.7E-10 | 5.0E-10 | 3.4E-10 | 1.5E-10 |
| NW | 2.6E-07 | 1.3E-08 | 3.7E-09 | 1.6E-09 | 9.0E-10 | 6.1E-10 | 2.7E-10 |
| WNW | 2.6E-07 | 2.1E-08 | 5.4E-09 | 2.0E-09 | 1.2E-09 | 7.9E-10 | 3.5E-10 |
| W | 2.6E-07 | 2.2E-08 | 7.4E-09 | 3.6E-09 | 2.1E-09 | 1.4E-09 | 6.3E-10 |
| WSW | 2.6E-07 | 2.3E-08 | 5.6E-09 | 2.1E-09 | 1.2E-09 | 8.2E-10 | 3.7E-10 |
| SW | 2.6E-07 | 1.6E-08 | 4.8E-09 | 2.1E-09 | 1.2E-09 | 8.2E-10 | 3.7E-10 |
| SSW | 2.6E-07 | 1.7E-08 | 3.9E-09 | 1.4E-09 | 7.8E-10 | 5.3E-10 | 2.4E-10 |
| S | 2.6E-07 | 1.6E-08 | 5.0E-09 | 2.2E-09 | 1.3E-09 | 8.7E-10 | 3.9E-10 |
| SSE | 2.6E-07 | 2.1E-08 | 5.4E-09 | 2.0E-09 | 1.1E-09 | 7.7E-10 | 3.5E-10 |
| SE | 2.6E-07 | 2.3E-08 | 7.0E-09 | 3.2E-09 | 1.8E-09 | 1.2E-09 | 5.5E-10 |
| ESE | 2.6E-07 | 2.7E-08 | 7.3E-09 | 2.9E-09 | 1.7E-09 | 1.1E-09 | 5.1E-10 |
| E | 2.6E-07 | 2.8E-08 | 8.0E-09 | 3.5E-09 | 2.0E-09 | 1.4E-09 | 6.2E-10 |
| ENE | 2.6E-07 | 3.3E-08 | 8.6E-09 | 3.3E-09 | 1.9E-09 | 1.3E-09 | 5.8E-10 |
| NE | 2.6E-07 | 3.2E-08 | 1.0E-08 | 4.8E-09 | 2.8E-09 | 1.9E-09 | 8.6E-10 |
| NNE | 2.6E-07 | 3.1E-08 | 8.1E-09 | 3.1E-09 | 1.8E-09 | 1.2E-09 | 5.6E-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 | 1.6E-11 | 1.2E-11 |
| NNW | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 7.2E-12 | 5.1E-12 | 4.0E-12 |
| NW | 9.6E-11 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 1.1E-11 | 7.8E-12 | 6.1E-12 |
| WNW | 1.2E-10 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 1.4E-11 | 9.3E-12 | 7.1E-12 |
| W | 2.2E-10 | 9.9E-11 | 6.0E-11 | 3.9E-11 | 2.6E-11 | 1.7E-11 | 1.3E-11 |
| WSW | 1.3E-10 | 5.9E-11 | 3.6E-11 | 2.4E-11 | 1.6E-11 | 1.1E-11 | 8.7E-12 |
| SW | 1.3E-10 | 5.9E-11 | 3.6E-11 | 2.4E-11 | 1.6E-11 | 1.1E-11 | 0.0E+00 |
| SSW | 8.5E-11 | 3.8E-11 | 2.3E-11 | 1.6E-11 | 0.0E+00 | 7.6E-12 | 6.0E-12 |
| S | 1.4E-10 | 6.2E-11 | 3.8E-11 | 2.5E-11 | 1.7E-11 | 1.2E-11 | 9.1E-12 |
| SSE | 1.2E-10 | 5.6E-11 | 3.4E-11 | 2.3E-11 | 1.6E-11 | 1.1E-11 | 8.6E-12 |
| SE | 2.0E-10 | 8.9E-11 | 5.4E-11 | 3.6E-11 | 2.5E-11 | 1.7E-11 | 1.3E-11 |
| ESE | 1.8E-10 | 8.2E-11 | 5.0E-11 | 3.3E-11 | 2.3E-11 | 1.6E-11 | 1.3E-11 |
| E | 2.2E-10 | 1.0E-10 | 6.1E-11 | 4.1E-11 | 2.8E-11 | 2.0E-11 | 1.5E-11 |
| ENE | 2.1E-10 | 9.7E-11 | 5.9E-11 | 4.0E-11 | 2.8E-11 | 2.0E-11 | 1.5E-11 |
| NE | 3.1E-10 | 1.4E-10 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 |
| NNE | 2.0E-10 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 1.5E-11 |



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

| | Distance (m) | | | | | | |
|---|---|---|---|---|---|---|---|
| Direction | 250 | 750 | 1500 | 2500 | 3500 | 4500 | 7500 |
| N | 3.3E-08 | 7.8E-09 | 8.3E-09 | 5.4E-09 | 4.4E-09 | 3.7E-09 | 9.6E-09 |
| NNW | 3.3E-08 | 6.1E-09 | 4.6E-09 | 1.7E-09 | 1.3E-09 | 1.1E-09 | 3.3E-09 |
| NW | 3.3E-08 | 5.2E-09 | 5.8E-09 | 3.3E-09 | 2.4E-09 | 2.2E-09 | 3.2E-08 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| WNW | 3.3E-08 | 8.3E-09 | 8.4E-09 | 5.3E-09 | 4.0E-09 | 6.4E-09 | 1.9E-08 |
| W | 3.3E-08 | 8.9E-09 | 1.2E-08 | 9.3E-09 | 4.7E-08 | 6.5E-09 | 1.0E-08 |
| WSW | 3.3E-08 | 8.9E-09 | 8.9E-09 | 5.5E-09 | 2.6E-08 | 2.2E-08 | 3.4E-08 |
| SW | 3.2E-08 | 6.4E-09 | 7.5E-09 | 5.5E-09 | 5.5E-09 | 2.4E-08 | 6.3E-08 |
| SSW | 3.3E-08 | 6.6E-09 | 6.2E-09 | 3.6E-09 | 3.2E-09 | 1.2E-08 | 3.7E-08 |
| S | 3.3E-08 | 6.4E-09 | 7.8E-09 | 5.9E-09 | 4.1E-09 | 3.6E-09 | 5.7E-08 |
| SSE | 3.3E-08 | 8.5E-09 | 8.4E-09 | 5.2E-09 | 3.6E-09 | 3.1E-09 | 2.2E-08 |
| SE | 3.3E-08 | 9.2E-09 | 1.1E-08 | 8.2E-09 | 6.2E-09 | 4.9E-09 | 2.4E-08 |
| ESE | 3.3E-08 | 1.1E-08 | 1.1E-08 | 7.5E-09 | 6.0E-09 | 5.2E-09 | 1.8E-08 |
| E | 3.3E-08 | 1.1E-08 | 1.3E-08 | 9.0E-09 | 7.3E-09 | 6.4E-09 | 2.1E-08 |
| ENE | 3.3E-08 | 1.3E-08 | 1.3E-08 | 8.3E-09 | 5.2E-09 | 3.8E-09 | 2.6E-08 |
| NE | 3.3E-08 | 1.3E-08 | 1.6E-08 | 8.4E-09 | 4.5E-09 | 3.9E-09 | 3.3E-08 |
| NNE | 3.3E-08 | 1.2E-08 | 1.1E-08 | 6.0E-09 | 4.7E-09 | 3.6E-09 | 1.2E-08 |

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 | 1.7E-08 | 4.9E-08 |
| NNW | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 2.1E-08 | 7.7E-08 | 4.0E-08 |
| NW | 1.4E-09 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 8.0E-10 | 9.0E-08 | 4.5E-08 |
| WNW | 6.2E-09 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 2.0E-13 | 3.3E-08 | 8.9E-09 |
| W | 8.4E-08 | 9.0E-08 | 7.9E-09 | 1.5E-08 | 7.7E-09 | 4.1E-08 | 4.6E-08 |
| WSW | 2.8E-08 | 3.9E-08 | 4.1E-09 | 2.3E-09 | 1.3E-09 | 1.5E-09 | 7.0E-10 |
| SW | 1.3E-07 | 4.7E-09 | 2.9E-08 | 4.7E-09 | 4.4E-10 | 1.1E-10 | 0.0E+00 |
| SSW | 1.4E-07 | 1.2E-09 | 2.5E-09 | 9.5E-10 | 0.0E+00 | 1.5E-11 | 1.2E-09 |
| S | 1.8E-07 | 4.7E-08 | 5.1E-08 | 2.0E-09 | 2.6E-08 | 1.0E-08 | 4.7E-09 |
| SSE | 1.4E-07 | 3.7E-07 | 4.3E-07 | 1.5E-07 | 3.6E-08 | 6.7E-09 | 3.0E-09 |
| SE | 5.0E-08 | 1.5E-07 | 1.4E-07 | 5.4E-08 | 1.6E-08 | 5.7E-09 | 4.1E-09 |
| ESE | 2.9E-08 | 9.5E-08 | 1.1E-08 | 1.2E-08 | 7.3E-09 | 1.6E-08 | 5.7E-09 |
| E | 3.0E-08 | 7.5E-08 | 1.4E-08 | 2.2E-08 | 6.1E-09 | 1.1E-08 | 8.4E-09 |
| ENE | 1.7E-08 | 2.9E-08 | 7.9E-09 | 3.8E-09 | 2.3E-09 | 9.2E-10 | 4.2E-10 |
| NE | 3.7E-08 | 2.3E-09 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 |
| NNE | 1.5E-09 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 0.0E+00 | 4.4E-09 |

# ATTACHMENT E

# CY2004 RADON-222 FLUX MEASUREMENTS

## 2004 Radon-222 Flux Monitoring Results[a]
## Niagara Falls Storage Site

| NFSS Radon Flux | | | | | |
|---|---|---|---|---|---|
| Sample ID | ($pCi/m^2/s$) | Sample ID | ($pCi/m^2/s$) | Sample ID | ($pCi/m^2/s$) |
| 1 | 0.116 ± 0.058 | 41 | 0.046 ± 0.049 | 81 | 0.042 ± 0.040 |
| 2 | 0.015 ± 0.036 | 42 | 0.081 ± 0.068 | 82 | 0.086 ± 0.050 |
| 3 | 0.050 ± 0.062 | 43 | 0.060 ± 0.052 | 83 | 0.024 ± 0.033 |
| 4 | 0.107 ± 0.063 | 44 | 0.041 ± 0.049 | 84 | 0.122 ± 0.076 |
| 5 | 0.103 ± 0.053 | 45 | 0.077 ± 0.046 | 85 | 0.047 ± 0.042 |
| 6 [d] | NR ± 0.000 | 46 | 0.101 ± 0.067 | 86 | 0.025 ± 0.065 |
| 7 | 0.059 ± 0.032 | 47 | 0.063 ± 0.051 | 87 | -0.015 ± 0.026 |
| 8 | 0.046 ± 0.041 | 48 | 0.034 ± 0.038 | 88 | 0.119 ± 0.078 |
| 9 | 0.047 ± 0.038 | 49 | 0.036 ± 0.033 | 89 | 0.100 ± 0.060 |
| 10 | 0.106 ± 0.064 | 50 | 0.016 ± 0.038 | 90 | 0.103 ± 0.062 |
| 10 DUP [b] | 0.058 ± 0.035 | 50 DUP | 0.040 ± 0.041 | 90 DUP | 0.028 ± 0.061 |
| 11 | 0.081 ± 0.051 | 51 | 0.052 ± 0.048 | 91 | 0.034 ± 0.033 |
| 12 | 0.120 ± 0.060 | 52 | 0.100 ± 0.059 | 92 | 0.070 ± 0.044 |
| 13 | 0.093 ± 0.066 | 53 | -0.009 ± 0.042 | 93 | 0.036 ± 0.040 |
| 14 | 0.113 ± 0.055 | 54 | 0.035 ± 0.045 | 94 | 0.019 ± 0.040 |
| 15 | 0.018 ± 0.058 | 55 | 0.084 ± 0.061 | 95 | 0.028 ± 0.060 |
| 16 | 0.083 ± 0.055 | 56 | 0.072 ± 0.047 | 96 | 0.054 ± 0.046 |
| 17 | 0.078 ± 0.058 | 57 | 0.037 ± 0.062 | 97 | 0.016 ± 0.067 |
| 18 | 0.053 ± 0.043 | 58 | 0.054 ± 0.054 | 98 | 0.101 ± 0.065 |
| 19 | 0.031 ± 0.047 | 59 | 0.023 ± 0.043 | 99 | 0.082 ± 0.065 |
| 20 | 0.031 ± 0.028 | 60 | 0.069 ± 0.052 | 100 | 0.093 ± 0.054 |
| 20 DUP | 0.092 ± 0.071 | 60 DUP | 0.083 ± 0.061 | 100 DUP | 0.133 ± 0.078 |
| 21 | 0.102 ± 0.084 | 61 | 0.072 ± 0.045 | 101 | 0.084 ± 0.052 |
| 22 | 0.097 ± 0.030 | 62 | 0.053 ± 0.061 | 102 | 0.043 ± 0.044 |
| 23 | 0.031 ± 0.041 | 63 | 0.076 ± 0.046 | 103 | 0.081 ± 0.049 |
| 24 | 0.018 ± 0.033 | 64 | 0.111 ± 0.067 | 104 | -0.013 ± 0.044 |
| 25 | 0.095 ± 0.059 | 65 | 0.067 ± 0.046 | 105 | 0.103 ± 0.050 |
| 26 | 0.071 ± 0.048 | 66 | 0.103 ± 0.060 | 106 | 0.017 ± 0.040 |
| 27 | 0.067 ± 0.046 | 67 | 0.086 ± 0.044 | 107 | 0.106 ± 0.066 |
| 28 | 0.095 ± 0.054 | 68 | 0.008 ± 0.059 | 108 | 0.009 ± 0.066 |
| 29 | 0.040 ± 0.047 | 69 | 0.105 ± 0.055 | 109 | 0.090 ± 0.058 |
| 30 | 0.023 ± 0.016 | 70 | 0.026 ± 0.044 | 110 | 0.110 ± 0.060 |
| 30 DUP | 0.083 ± 0.055 | 70 DUP | 0.026 ± 0.035 | 110 DUP | 0.053 ± 0.048 |
| 31 | 0.025 ± 0.048 | 71 | 0.072 ± 0.044 | 111 | 0.064 ± 0.047 |
| 32 | 0.100 ± 0.055 | 72 | 0.096 ± 0.054 | 112 | 0.133 ± 0.064 |
| 33 | 0.111 ± 0.062 | 73 | 0.111 ± 0.083 | 113 | 0.048 ± 0.042 |
| 34 | 0.076 ± 0.045 | 74 | 0.016 ± 0.039 | 114 | 0.110 ± 0.062 |
| 35 | 0.046 ± 0.041 | 75 | 0.019 ± 0.035 | 115 | 0.078 ± 0.044 |
| 36 | 0.024 ± 0.065 | 76 | 0.077 ± 0.049 | 116 | 0.064 ± 0.053 |
| 37 | 0.000 ± 0.035 | 77 | 0.054 ± 0.044 | 117 | 0.104 ± 0.064 |
| 38 | 0.078 ± 0.046 | 78 | 0.109 ± 0.060 | 118 | 0.037 ± 0.050 |
| 39 | 0.023 ± 0.031 | 79 | 0.055 ± 0.040 | 119 | 0.074 ± 0.066 |
| 40 | 0.049 ± 0.044 | 80 | -0.004 ± 0.028 | 120 | 0.037 ± 0.050 |
| 40 DUP | 0.025 ± 0.049 | 80 DUP | -0.031 ± 0.051 | 120 DUP | 0.079 ± 0.054 |

## 2004 Radon-222 Flux Monitoring Results[a]
## Niagara Falls Storage Site

| NFSS Radon Flux | | | | | | |
|---|---|---|---|---|---|---|
| **Sample ID** | **($pCi/m^2/s$)** | **Sample ID** | **($pCi/m^2/s$)** | **Sample ID** | **($pCi/m^2/s$)** | |
| 121 | 0.025 ± 0.034 | 151 | 0.039 ± 0.051 | 181[c] | 0.061 ± 0.053 | |
| 122 | 0.007 ± 0.035 | 152 | 0.089 ± 0.048 | 182[c] | 0.105 ± 0.076 | |
| 123 | 0.079 ± 0.049 | 153 | 0.103 ± 0.051 | 183[c] | 0.202 ± 0.090 | |
| 124 | 0.126 ± 0.071 | 154 | 0.018 ± 0.042 | Average background | 0.123 | |
| 125 | 0.047 ± 0.046 | 155 | 0.094 ± 0.061 | | | |
| 126 | 0.099 ± 0.059 | 156 | 0.083 ± 0.075 | | | |
| 127 | 0.158 ± 0.078 | 157 | 0.071 ± 0.060 | | | |
| 128 | 0.047 ± 0.046 | 158 | 0.049 ± 0.048 | | | |
| 129 | 0.033 ± 0.041 | 159 | 0.108 ± 0.069 | | | |
| 130 | 0.028 ± 0.060 | 160 | 0.030 ± 0.070 | | | |
| 130 DUP | 0.058 ± 0.058 | 160 DUP | 0.009 ± 0.063 | | | |
| 131 | 0.002 ± 0.046 | 161 | 0.075 ± 0.054 | Average: | 0.066 | ($pCi/m^2/s$) |
| 132 | 0.020 ± 0.037 | 162 | 0.099 ± 0.070 | High: | 0.213 | ($pCi/m^2/s$) |
| 133 | 0.008 ± 0.053 | 163 | 0.090 ± 0.059 | Low: | -0.031 | ($pCi/m^2/s$) |
| 134 | 0.013 ± 0.043 | 164 | 0.185 ± 0.084 | | | |
| 135 | 0.049 ± 0.061 | 165 | 0.123 ± 0.039 | | | |
| 136 | 0.027 ± 0.040 | 166 | 0.083 ± 0.066 | | | |
| 137 | 0.017 ± 0.041 | 167 | 0.128 ± 0.039 | | | |
| 138 | 0.075 ± 0.045 | 168 | 0.102 ± 0.080 | | | |
| 139 | 0.013 ± 0.027 | 169 | 0.060 ± 0.039 | | | |
| 140 | 0.084 ± 0.047 | 170 | 0.135 ± 0.094 | | | |
| 140 DUP | 0.062 ± 0.069 | 170 DUP | 0.181 ± 0.091 | | | |
| 141 | 0.071 ± 0.049 | 171 | 0.090 ± 0.054 | | | |
| 142 | 0.133 ± 0.068 | 172 | 0.213 ± 0.082 | | | |
| 143 | 0.096 ± 0.056 | 173 | 0.092 ± 0.066 | | | |
| 144 | 0.005 ± 0.060 | 174 | 0.098 ± 0.062 | | | |
| 145 | 0.026 ± 0.035 | 175 | 0.113 ± 0.064 | | | |
| 146 | 0.065 ± 0.054 | 176 | 0.073 ± 0.051 | | | |
| 147 | 0.020 ± 0.041 | 177 | 0.131 ± 0.073 | | | |
| 148 | 0.060 ± 0.071 | 178 | 0.006 ± 0.037 | | | |
| 149 | 0.085 ± 0.064 | 179 | 0.198 ± 0.090 | | | |
| 150 | 0.039 ± 0.059 | 180 | 0.100 ± 0.064 | | | |
| 150 DUP | 0.048 ± 0.047 | 180 DUP | 0.132 ± 0.071 | | | |

NOTE: The EPA Standard for Radon-222 Flux is 20 $pCi/m^2/sec$

a. Radon-222 flux testing was performed in August 8-9, 2004

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

d. Due to the laboratory having non-resolvable energy peaks, results are not available for this location.

**ATTACHMENT F**

**NATIONAL CLIMATIC DATA CENTER, NIAGARA FALLS, NEW YORK**

U.S. Department of Commerce
National Oceanic & Atmospheric Administration

# ANNUAL CLIMATOLOGICAL SUMMARY
## (2004)

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, North Carolina 28801

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 | | TSNW | MXSD | | DP01 | DP05 | DP10 |
| | | | | | | | | | | | Number of Days | | | | | | Greatest Observed | | Snow, Sleet | | | Number of Days | | |
| 2004 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 Fall | Max Depth | Max Date | >=.10 | >=.50 | >=1.0 |
| 1 | 26.3 | 10.1 | 18.2 | -6.0 | 1444 | 0 | 56 | 3 | -10 | 25 | 0 | 24 | 29 | 9 | 2.11 | -0.44 | 0.56 | 11 | 39.6 | 13 | 28 | 5 | 1 | 0 |
| 2 | 32.3 | 15.7 | 24.0 | -1.3 | 1181 | 0 | 45 | 29 | -3 | 15 | 0 | 12 | 29 | 2 | 1.03 | -1.29 | 0.47 | 3 | 7.0 | 12 | 1 | 4 | 0 | 0 |
| 3 | 43.6 | 29.1 | 36.4 | 2.6 | 877 | 0 | 68 | 29 | 12 | 18 | 0 | 5 | 20 | 0 | 2.66 | 0.03 | 0.62 | 26 | 10.1 | 7 | 17 | 8 | 1 | 0 |
| 4 | 53.7 | 35.7 | 44.7 | -0.4 | 601 | 0 | 77 | 30 | 21 | 6 | 0 | 0 | 11 | 0 | 3.93X | M | 0.80 | 13 | 1.9 | 1 | 6 | 10 | 3 | 0 |
| 5 | 67.8 | 46.8 | 57.3 | 0.2 | 254 | 24 | 85 | 13 | 28 | 4 | 0 | 0 | 1 | 0 | 4.38 | 1.44 | 0.72 | 24 | 0.0 | 0 | | 12 | 3 | 0 |
| 6 | 73.0 | 53.2 | 63.1 | -2.7 | 107 | 58 | 86 | 9 | 42 | 12 | 0 | 0 | 0 | 0 | 1.78 | -1.48 | 0.51 | 24 | 0.0 | 0 | | 6 | 1 | 0 |
| 7 | 76.9 | 61.2 | 69.1 | -2.3 | 3 | 137 | 88 | 4 | 52 | 3 | 0 | 0 | 0 | 0 | 6.64 | 3.95 | 2.26 | 31 | 0.0 | 0 | | 9 | 4 | 2 |
| 8 | 75.4 | 58.6 | 67.0 | -2.6 | 38 | 105 | 85 | 25 | 46 | 22 | 0 | 0 | 0 | 0 | 2.17 | -0.86 | 0.48 | 29 | 0.0 | 0 | | 7 | 0 | 0 |
| 9 | 74.6 | 55.6 | 65.1 | 3.4 | 60 | 72 | 85 | 5 | 42 | 20 | 0 | 0 | 0 | 0 | 3.57 | 0.05 | 3.00 | 9 | 0.0 | 0 | | 3 | 1 | 1 |
| 10 | 60.3 | 42.9 | 51.6 | 1.5 | 408 | 0 | 76 | 8 | 32 | 12 | 0 | 0 | 1 | 0 | 1.62 | -1.05 | 0.61 | 2 | 0.0 | 0 | | 3 | 2 | 0 |
| 11 | 50.2 | 34.7 | 42.5 | 2.6 | 667 | 0 | 63 | 7 | 23 | 14 | 0 | 0 | 16 | 0 | 2.98 | 0.00 | 0.72 | 24 | 1.0 | 0T | 26 | 6 | 3 | 0 |
| 12 | 37.7 | 23.1 | 30.4 | 0.7 | 1065 | 0 | 55 | 7 | 0 | 25 | 0 | 6 | 25 | 2 | 3.46X | M | 1.07 | 23 | 16.5X | 5 | 27 | 8 | 2 | 1 |
| Annual | 56.0 | 38.9 | 47.4 | -0.4 | 6705 | 396 | 88 | Jul | -10 | Jan | 0 | 47 | 132 | 13 | 36.33X | M | 3.00 | Sep | 76.1X | 13 | Jan | 81 | 21 | 4 |

## 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 Thu Aug 04 16:54:02 EDT 2005 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*

# UNEDITED LOCAL CLIMATOLOGICAL DATA

**NOAA, National Climatic Data Center**

**Month: 01/2004**

**Station Location: NIAGARA FALLS INTERNATIONAL AIRPORT (IAG)**
**NIAGARA FALLS , NY**
Lat. 43°07'N Lon. 78°57'W
Elevation(Ground): 585 ft. above sea level

| Date | Temperature (Fahrenheit) Max. | Min. | Avg. | Dep From Normal | Avg. Dew pt. | Avg Wet Bulb | Degree Days Base 65 Degrees Heating | Cooling | Significant Weather | Snow/Ice on Ground(In) 0600 LST Depth | 1200 LST Water Equiv | Precipitation (In) 2400 LST Snow Fall | 2400 LST Water Equiv | Pressure(inches of Hg) Avg. Station | Avg. Sea level | Wind: Speed=mph Dir=tens of degrees Resultant Speed | Res Dir | Avg. Speed | max 5-sec Speed | max 5-sec Dir | max 2-min Speed | max 2-min Dir | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 36 | 28 | 32 | 0 | 24 | 29 | 33 | 0 | - | - | - | - | 0.00 | 29.61 | 30.32 | 4.1 | 25 | 9.0 | 24 | 29 | 21 | 29 | 1 |
| 2 | 48 | 33 | 41 | 0 | 40 | 42 | 24 | 0 | RA DZ FG | - | - | - | 0.16 | 29.29 | 29.99 | 6.6 | 20 | 8.6 | 23 | 23 | 20 | 23 | 2 |
| 3 | 56* | 42 | 49* | 0 | 46 | 48 | 16 | 0 | RA FG HZ | - | - | - | 0.22 | 29.13 | 29.81 | 10.8 | 22 | 11.5 | 31 | 20 | 25 | 20 | 3 |
| 4 | 43 | 29 | 36 | 0 | 26 | 31 | 29 | 0 | SN FG | - | - | - | 0.02 | 29.35 | 30.05 | 6.6 | 1 | 11.0 | 25 | 7 | 21 | 7 | 4 |
| 5 | 30 | 25 | 28 | 0 | 23 | 26 | 37 | 0 | FZDZ SN FG UP | - | - | - | 0.07 | 29.21 | 29.93 | 6.0 | 1 | 13.6 | 30 | 4 | 24 | 5 | 5 |
| 6 | 25 | 12 | 19 | 0 | 8 | 16 | 46 | 0 | SN BLSN | - | - | - | T | 29.39 | 30.13 | 20.5 | 26 | 20.6 | 41 | 26 | 36 | 26 | 6 |
| 7 | 19 | 11 | 15 | 0 | 3 | 12 | 50 | 0 | - | - | - | - | T | 29.46 | 30.22 | 21.5 | 25 | 21.7 | 40 | 27 | 32 | 26 | 7 |
| 8 | 26 | 14 | 20 | 0 | 12 | 17 | 45 | 0 | SN FG FZFG | - | - | - | 0.02 | 29.53 | 30.29 | 7.9 | 27 | 12.4 | 24 | 26 | 21 | 23 | 8 |
| 9 | 14 | -6 | 4 | 0 | -4 | 1 | 61 | 0 | SN FG HZ | - | - | - | 0.02 | 29.76 | 30.52 | 6.8 | 7 | 7.3 | 21 | 6 | 17 | 6 | 9 |
| 10 | 13 | -9 | 2 | 0 | -6 | -1 | 63 | 0 | SN FG HZ | - | - | - | T | 29.76 | 30.53 | 1.1 | 25 | 2.3 | 13 | 18 | 12 | 18 | 10 |
| 11 | 31 | 13 | 22 | 0 | 20 | 23 | 43 | 0 | SN FG+ FG FZFG | - | - | - | 0.16 | 29.34 | 30.08 | 17.8 | 21 | 18.2 | 41 | 22 | 31 | 22 | 11 |
| 12 | 33 | 30 | 32 | 0 | 29 | 30 | 33 | 0 | DZ SN FG | - | - | - | 0.18 | 29.20 | 29.92 | 6.7 | 26 | 8.2 | 21 | 23 | 17 | 23 | 12 |
| 13 | 33 | 0 | 17 | 0 | 12 | 18 | 48 | 0 | RA FZRA SN FG UP HZ BLSN | M | - | M | 0.01 | 29.36 | 30.09 | 15.5 | 28 | 19.4 | 41 | 27 | 35 | 27 | 13 |
| 14 | 7 | 0 | 4 | 0 | -1 | 3 | 61 | 0 | SN FG HZ | - | - | - | T | 29.35 | 30.11 | 9.1 | 9 | 9.9 | 26 | 9 | 20 | 8 | 14 |
| 15 | 6 | -4 | 1* | 0 | -5 | 0 | 64 | 0 | SN FG HZ BLSN | - | - | - | T | 29.38 | 30.14 | 9.4 | 34 | 12.3 | 24 | 32 | 21 | 32 | 15 |
| 16 | 14 | -7 | 4 | 0 | -1 | 5 | 61 | 0 | SN FG HZ BLSN | - | - | - | T | 29.51 | 30.28 | 12.4 | 26 | 13.4 | 28 | 29 | 23 | 28 | 16 |
| 17 | 26 | -1 | 13 | 0 | 11 | 13 | 52 | 0 | FZDZ SN FG FZFG | - | - | - | T | 29.34 | 30.08 | 4.1 | 18 | 5.8 | 16 | 23 | 15 | 23 | 17 |
| 18 | 31 | 15 | 23 | 0 | 17 | 22 | 42 | 0 | SN FG HZ | - | - | - | T | 28.92 | 29.62 | 16.0 | 27 | 17.0 | 32 | 29 | 26 | 30 | 18 |
| 19 | 17 | 12 | 15 | 0 | 9 | 13 | 50 | 0 | SN FG FZFG | - | - | - | T | 29.15 | 29.89 | 14.3 | 29 | 14.6 | 33 | 29 | 26 | 29 | 19 |
| 20 | 16 | 10 | 13 | 0 | 8 | 12 | 52 | 0 | SN FG HZ | M | - | M | T | 29.43 | 30.19 | 9.3 | 28 | 10.3 | 21 | 31 | 17 | 31 | 20 |
| 21 | 24 | 3 | 14 | M | 10 | 14 | 51 | 0 | SN FG BLSN | 13 | - | 0.2 | T | 29.34 | 30.08 | 10.4 | 21 | 11.2 | 28 | 19 | 24 | 21 | 21 |
| 22 | 31 | 6 | 19 | M | 11 | 16 | 46 | 0 | SN FG FZFG UP HZ BLSN | 11 | - | 1.0 | 0.02 | 29.05 | 29.77 | 22.5 | 26 | 23.5 | 44 | 27 | 37 | 26 | 22 |
| 23 | 12 | 2 | 7 | M | -2 | 5 | 58 | 0 | FG HZ | M | - | M | T | 29.23 | 29.99 | 15.7 | 26 | 15.8 | 30 | 25 | 25 | 26 | 23 |
| 24 | 12 | -1 | 6 | M | 0 | 6 | 59 | 0 | SN FG HZ BLSN | M | - | M | T | 29.33 | 30.09 | 7.9 | 30 | 10.2 | 25 | 30 | 21 | 32 | 24 |
| 25 | 15 | -10 | 3 | M | -1 | 5 | 62 | 0 | FG HZ | 11 | - | T | T | 29.60 | 30.35 | 1.6 | 10 | 4.5 | 18 | 8 | 13 | 7 | 25 |
| 26 | 15 | 8 | 12 | 0 | 1 | 9 | 53 | 0 | SN FG HZ BLSN | - | - | - | T | 29.49 | 30.23 | 18.0 | 8 | 18.1 | 36 | 9 | 29 | 9 | 26 |
| 27 | 31 | 15 | 23 | 0 | 21 | 23 | 42 | 0 | FZRA FZDZ SN FG+ FG FZFG | M | - | M | T | 29.04 | 29.77 | 3.5 | 11 | 12.6 | 30 | 10 | 23 | 8 | 27 |
| 28 | 26 | 18 | 22 | 0 | 16 | 19 | 43 | 0 | SN FG BLSN | - | - | - | M | 29.06 | 29.78 | 19.7 | 25 | 20.1 | 36 | 26 | 30 | 26 | 28 |
| 29 | 20 | 6 | 13 | 0 | 3 | 9 | 52 | 0 | SN FG HZ BLSN | - | - | - | M | 29.17 | 29.93 | 20.0 | 25 | 20.1 | 36 | 25 | 29 | 24 | 29 |
| 30 | 15 | 5 | 10 | 0 | 5 | 10 | 55 | 0 | SN FG HZ BLSN | M | - | M | 0.05 | 29.02 | 29.76 | 20.4 | 24 | 20.5 | 38 | 24 | 31 | 24 | 30 |
| 31 | 21 | 13 | 17 | 0 | 11 | 15 | 48 | 0 | SN FG FZFG HZ BLSN | - | - | - | T | 29.32 | 30.05 | 16.1 | 25 | 17.0 | 30 | 24 | 25 | 24 | 31 |
| | 24.1 | 10.1 | 17.1 | ------- | 11.2 | 15.8 | 47.7 | .0 | <Monthly Averages | Totals> | | | 0.95 | 29.33 | 30.07 | 7.5 | 25.5 | 13.6 | <Monthly Average | | | | |
| | | | .0 | ------- | <----------Departure From Normal----------> | | | | | | | | -4.25 | | | | | | | | | | |

**Degree Days**

| | Monthly Total | Monthly Departure | Season to Date Total | Season to Date Departure |
|---|---|---|---|---|
| Heating: | 1479 | 1005 | 0 | 0 |
| Cooling: | 0 | 0 | 0 | 0 |

Greatest 24-hr Precipitation: 0.35 Date: 02-3
Greatest 24-hr Snowfall: Date:
Greatest Snow Depth: 0 Date: -

| Sea Level | Pressure | Date | Time |
|---|---|---|---|
| Maximum | 30.60 | 10 | 1029 |
| Minimum | 29.54 | 22 | 0549 |

Number of Days with -------->
Max Temp >=90: 0
Max Temp <=32: 25
Thunderstorms : 0
Min Temp <=32: 29
Min Temp <=0 : 9
Heavy Fog : 2
Precipitation >=.01 inch: 10
Precipitation >=.10 inch: 4
Snowfall >=1.0 inch : 1

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

# UNEDITED LOCAL CLIMATOLOGICAL DATA

**NOAA, National Climatic Data Center**

**Month: 02/2004**

**Station Location: NIAGARA FALLS INTERNATIONAL AIRPORT (IAG)**
**NIAGARA FALLS , NY**
Lat. 43°07'N Lon. 78°57'W
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 | | 0600 LST Depth | 1200 LST Water Equiv | 2400 LST Snow Fall | 2400 LST Water Equiv | Avg. Station | Avg. Sea level | Resultant Speed | Res Dir | Avg. Speed | max 5-sec Speed | max 5-sec Dir | max 2-min Speed | max 2-min Dir | |
| 1 | 22 | 4 | 13 | 0 | 12 | 15 | 52 | 0 | SN FG | - | - | - | T | 29.75 | 30.49 | 2.5 | 30 | 3.2 | 14 | 34 | 12 | 34 | 1 |
| 2 | 32 | 3 | 18 | 0 | 14 | 18 | 47 | 0 | FG HZ | - | - | - | T | 29.67 | 30.41 | 7.6 | 8 | 7.8 | 16 | 9 | 14 | 10 | 2 |
| 3 | 36 | 20 | 28 | 0 | 29 | 32 | 37 | 0 | RA DZ SN FG | - | - | - | 0.47 | 29.23 | 29.95 | 10.2 | 20 | 12.1 | 28 | 23 | 24 | 23 | 3 |
| 4 | 34 | 15 | 25 | 0 | 16 | 22 | 40 | 0 | FG | - | - | - | T | 29.63 | 30.36 | 17.0 | 26 | 17.8 | 36 | 25 | 29 | 27 | 4 |
| 5 | 25 | 11 | 18 | 0 | 14 | 18 | 47 | 0 | - | - | - | - | T | 29.84 | 30.59 | 5.2 | 9 | 8.2 | 25 | 5 | 22 | 5 | 5 |
| 6 | 40 | 25 | 33 | 0 | 30 | 32 | 32 | 0 | RA DZ FZRA FZDZ SN FG UP | - | - | - | 0.11 | 29.13 | 29.85 | 5.4 | 19 | 12.1 | 25 | 23 | 21 | 23 | 6 |
| 7 | 33 | 14 | 24 | 0 | 16 | 22 | 41 | 0 | FG | - | - | - | T | 29.17 | 29.88 | 14.7 | 30 | 15.6 | 28 | 31 | 24 | 29 | 7 |
| 8 | 26 | 6 | 16 | 0 | 9 | 16 | 49 | 0 | - | - | - | - | 0.00 | 29.64 | 30.38 | 14.4 | 23 | 15.7 | 35 | 24 | 28 | 23 | 8 |
| 9 | 36 | 23 | 30 | 0 | 21 | 28 | 35 | 0 | - | - | - | - | 0.00 | 29.38 | 30.11 | 21.6 | 22 | 22.8 | 49 | 23 | 38 | 23 | 9 |
| 10 | 33 | 26 | 30 | 0 | 23 | 27 | 35 | 0 | SN FG BLSN | - | - | - | 0.01 | 29.25 | 29.97 | 17.9 | 24 | 18.2 | 41 | 22 | 32 | 23 | 10 |
| 11 | 26 | 19 | 23 | 0 | 16 | 21 | 42 | 0 | - | - | - | - | T | 29.45 | 30.19 | 10.4 | 25 | 11.7 | 26 | 29 | 22 | 27 | 11 |
| 12 | 32 | 23 | 28 | 0 | 21 | 26 | 37 | 0 | SN FG HZ | - | - | - | T | 29.42 | 30.14 | 6.0 | 23 | 7.4 | 22 | 26 | 18 | 26 | 12 |
| 13 | 29 | 26 | 28 | 0 | 20 | 25 | 37 | 0 | HZ BLSN | - | - | - | 0.00 | 29.27 | 29.99 | 26.6 | 23 | 26.8 | 61 | 23 | 47 | 23 | 13 |
| 14 | 30 | 14 | 22 | 0 | 18 | 22 | 43 | 0 | SN FG | - | - | - | 0.01 | 29.25 | 29.97 | 13.9 | 26 | 17.8 | 48 | 23 | 39 | 23 | 14 |
| 15 | 15 | -3 | 6* | 0 | -2 | 7 | 59 | 0 | HZ | - | - | - | 0.00 | 29.65 | 30.39 | 6.0 | 35 | 7.5 | 21 | 35 | 17 | 35 | 15 |
| 16 | 20 | -1 | 10 | 0 | 4 | 10 | 55 | 0 | - | - | - | - | T | 29.86 | 30.62 | 2.7 | 19 | 5.1 | 13 | 21 | 10 | 23 | 16 |
| 17 | 28 | 8 | 18 | 0 | 7 | 17 | 47 | 0 | - | - | - | - | 0.00 | 29.74 | 30.48 | 4.0 | 19 | 6.1 | 14 | 20 | 12 | 23 | 17 |
| 18 | 33 | 9 | 21 | 0 | 15 | 20 | 44 | 0 | FG HZ | - | - | - | 0.00 | 29.54 | 30.27 | 8.0 | 21 | 8.7 | 28 | 22 | 23 | 22 | 18 |
| 19 | 37 | 27 | 32 | 0 | 26 | 30 | 33 | 0 | FG HZ | - | - | - | 0.00 | 29.27 | 29.97 | 5.4 | 23 | 7.0 | 30 | 22 | 25 | 23 | 19 |
| 20 | 42 | 27 | 35 | 0 | 29 | 33 | 30 | 0 | RA SN FG HZ | - | - | - | 0.04 | 28.96 | 30.77 | 7.9 | 10 | 9.2 | 21 | 9 | 17 | 9 | 20 |
| 21 | 41 | 29 | 35* | 0 | 28 | 31 | 30 | 0 | RA SN FG FZFG UP HZ BLSN | - | - | - | 0.05 | 28.86 | 31.16 | 22.8 | 24 | 23.9 | 47 | 22 | 36 | 22 | 21 |
| 22 | 33 | 17 | 25 | 0 | 20 | 25 | 40 | 0 | - | - | - | - | T | 29.48 | 30.20 | 9.4 | 28 | 10.0 | 24 | 26 | 21 | 27 | 22 |
| 23 | 33 | 13 | 23 | 0 | 17 | 22 | 42 | 0 | FG HZ | - | - | - | T | 29.56 | 30.29 | 4.7 | 5 | 4.8 | 15 | 5 | 14 | 6 | 23 |
| 24 | 29 | 20 | 25 | 0 | 18 | 23 | 40 | 0 | SN FG HZ | - | - | - | 0.02 | 29.49 | 30.21 | 6.3 | 2 | 9.5 | 23 | 3 | 15 | 3 | 24 |
| 25 | 34 | 12 | 23 | M | 17 | 23 | 42 | 0 | FG | 3 | - | 0.0 | 0.00 | 29.66 | 30.36 | 4.0 | 33 | 4.5 | 17 | 36 | 10 | 36 | 25 |
| 26 | 34 | 15 | 25 | 0 | 18 | 23 | 40 | 0 | FG FZFG | - | - | - | 0.00 | 29.72 | 30.47 | 5.3 | 5 | 5.6 | 16 | 2 | 14 | 3 | 26 |
| 27 | 39 | 12 | 26 | 0 | - | - | 39 | 0 | - | - | - | - | 0.00 | - | - | - | - | 2.4 | 9 | 5 | 8 | 5 | 27 |
| 28 | 40 | 14 | 27 | 0 | - | - | 38 | 0 | - | - | - | - | 0.00 | - | - | - | - | 8.1 | 18 | 23 | 16 | 22 | 28 |
| 29 | | | | | | | | | | | | | | | | | | | | | | | 29 |
| | 32.3 | 15.7 | 24.0 | ------- | | | 41.2 | .0 | <Monthly Averages | Totals> | | | 0.71 | | | | | 11.1 | <Monthly Average | | | | |
| | | | .0 | ------- | <----------Departure From Normal----------> | | | | | | | | -2.06 | | | | | | | | | |

**Degree Days**

| | Monthly Total | Monthly Departure | Season to Date Total | Season to Date Departure |
|---|---|---|---|---|
| Heating: | 1181 | 307 | 0 | 0 |
| Cooling: | 0 | 0 | 0 | 0 |

Greatest 24-hr Precipitation: 0.47 Date: 03-4
Greatest 24-hr Snowfall: Date:
Greatest Snow Depth: 0 Date: -

| Sea Level | Pressure | Date | Time |
|---|---|---|---|
| Maximum | 30.71 | 5 | 0938 |
| Minimum | 29.30 | 21 | 0028 |

Number of Days with -------->
Max Temp >=90: 0
Max Temp <=32: 12
Thunderstorms : 0
Min Temp <=32: 29
Min Temp <=0 : 2
Heavy Fog : 0
Precipitation >=.01 inch: 7
Precipitation >=.10 inch: 2
Snowfall >=1.0 inch : 0

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

# UNEDITED LOCAL CLIMATOLOGICAL DATA

**NOAA, National Climatic Data Center**

**Month: 03/2004**

**Station Location: NIAGARA FALLS INTERNATIONAL AIRPORT (IAG)**
**NIAGARA FALLS , NY**
Lat. 43°07'N Lon. 78°57'W
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 | | 0600 LST Depth | 1200 LST Water Equiv | 2400 LST Snow Fall | 2400 LST Water Equiv | Avg. Station | Avg. Sea level | Resultant Speed | Res Dir | Avg. Speed | max 5-sec Speed | max 5-sec Dir | max 2-min Speed | max 2-min Dir | |
| 1 | 54 | 27 | 41 | M | 30 | 36 | 24 | 0 | FG | T | - | 0.0 | 0.04 | 29.38 | 30.10 | 4.0 | 17 | M | 18 | 21 | 16 | 21 | 1 |
| 2 | 48 | 39 | 44 | M | 37 | 41 | 21 | 0 | RA FG | 0 | - | 0.0 | 0.02 | 29.26 | 29.97 | 14.3 | 23 | 15.3 | 37 | 22 | 25 | 23 | 2 |
| 3 | 43 | 34 | 39 | M | 34 | 36 | 26 | 0 | DZ SN FG HZ | 0 | - | T | T | 29.54 | 30.26 | 6.4 | 22 | 6.7 | 16 | 23 | 14 | 19 | 3 |
| 4 | 43 | 34 | 39 | M | - | - | 26 | 0 | RA FG HZ | 0 | - | 0.0 | 0.08 | 29.48 | 30.17 | 3.3 | 21 | 6.0 | 15 | 9 | 12 | 9 | 4 |
| 5 | 65 | 38 | 52 | M | 44 | 47 | 13 | 0 | RA FG | M | - | M | 0.28 | 29.01 | 30.43 | 9.1 | 19 | 14.3 | 37 | 26 | 29 | 25 | 5 |
| 6 | 45 | 32 | 39 | M | 30 | 34 | 26 | 0 | DZ FG | M | - | M | T | 29.06 | 29.76 | 13.3 | 27 | 14.7 | 29 | 28 | 23 | 27 | 6 |
| 7 | 43 | 28 | 36 | M | 30 | 33 | 29 | 0 | RA FG | T | - | T | 0.20 | 29.13 | 29.85 | 3.6 | 19 | 7.3 | 22 | 16 | 18 | 14 | 7 |
| 8 | 34 | 27 | 31 | M | 28 | 29 | 34 | 0 | SN FG | T | - | 0.5 | 0.05 | 29.17 | 29.88 | 7.3 | 30 | 9.0 | 22 | 33 | 17 | 31 | 8 |
| 9 | 35 | 24 | 30 | M | 25 | 28 | 35 | 0 | SN FG+ FG FZFG HZ | T | - | 0.1 | 0.01 | 29.43 | 30.15 | 1.8 | 34 | 3.4 | 10 | 34 | 9 | 35 | 9 |
| 10 | 42 | 21 | 32 | M | 25 | 29 | 33 | 0 | FG | 0 | - | 0.0 | 0.00 | 29.63 | 30.35 | 0.8 | 5 | 3.1 | 13 | 1 | 9 | 3 | 10 |
| 11 | 46 | 25 | 36 | M | 26 | 32 | 29 | 0 | FG HZ | 0 | - | 0.0 | 0.03 | 29.27 | 29.99 | 8.9 | 20 | 9.9 | 33 | 21 | 28 | 21 | 11 |
| 12 | 34 | 21 | 28 | M | 18 | 23 | 37 | 0 | SN FG FZFG BLSN | T | - | 0.3 | 0.03 | 29.26 | 29.98 | 19.2 | 26 | 19.5 | 37 | 25 | 30 | 25 | 12 |
| 13 | 32 | 21 | 27 | M | 15 | 21 | 38 | 0 | SN FG | M | - | M | T | 29.72 | 30.44 | 8.8 | 26 | 12.6 | 31 | 31 | 28 | 31 | 13 |
| 14 | 43 | 22 | 33 | M | 25 | 31 | 32 | 0 | RA FG | 0 | - | 0.0 | 0.05 | 29.39 | 30.12 | 10.8 | 21 | 14.1 | 47 | 26 | 40 | 26 | 14 |
| 15 | 37 | 26 | 32 | M | 20 | 28 | 33 | 0 | - | 0 | - | T | T | 29.51 | 30.23 | 13.8 | 27 | 16.6 | 37 | 26 | 28 | 28 | 15 |
| 16 | 27 | 21 | 24 | M | 20 | 23 | 41 | 0 | SN FG+ FG BLSN | 0 | - | 4.8 | 0.18 | 29.45 | 30.17 | 17.5 | 6 | 17.9 | 37 | 6 | 30 | 4 | 16 |
| 17 | 26 | 19 | 23 | M | 19 | 22 | 42 | 0 | SN FG+ FG FZFG | 7 | - | 2.7 | 0.16 | 29.30 | 30.03 | 8.9 | 5 | 9.6 | 24 | 5 | 21 | 6 | 17 |
| 18 | 32 | 12 | 22 | 0 | 18 | 22 | 43 | 0 | SN FG+ FG FZFG | M | - | M | 0.01 | 29.40 | 30.13 | 1.9 | 25 | 5.5 | 14 | 24 | 12 | 25 | 18 |
| 19 | 36 | 14 | 25 | 0 | 20 | 25 | 40 | 0 | FG HZ | - | - | - | T | 29.66 | 30.40 | 1.8 | 21 | 4.4 | 15 | 22 | 13 | 24 | 19 |
| 20 | 41 | 30 | 36 | 0 | 29 | 34 | 29 | 0 | RA FG HZ | M | - | M | 0.43 | 29.28 | 29.98 | 6.5 | 21 | 10.2 | 24 | 31 | 21 | 31 | 20 |
| 21 | 35 | 21 | 28 | 0 | 18 | 25 | 37 | 0 | SN FG BLSN | M | - | M | T | 29.31 | 30.03 | 18.3 | 31 | 19.6 | 32 | 32 | 30 | 32 | 21 |
| 22 | 27 | 16 | 22* | 0 | 7 | 18 | 43 | 0 | - | - | - | - | T | 29.61 | 30.34 | 8.3 | 28 | 12.9 | 24 | 20 | 20 | 21 | 22 |
| 23 | 35 | 23 | 29 | 0 | 25 | 29 | 36 | 0 | RA SN FG BLSN | - | - | - | T | 29.54 | 30.27 | 13.2 | 22 | 14.3 | 35 | 23 | 29 | 22 | 23 |
| 24 | 50 | 27 | 39 | 0 | 32 | 36 | 26 | 0 | RA DZ FG HZ | - | - | - | 0.18 | 29.60 | 30.32 | 7.9 | 18 | 9.7 | 33 | 19 | 28 | 20 | 24 |
| 25 | 57 | 45 | 51 | 0 | 44 | 48 | 14 | 0 | - | M | - | M | 0.00 | 29.61 | 30.31 | 13.6 | 21 | 13.9 | 23 | 21 | 18 | 21 | 25 |
| 26 | 60 | 51 | 56* | 0 | 49 | 52 | 9 | 0 | RA FG | M | - | M | 0.62 | 29.54 | 30.23 | 14.2 | 21 | 14.9 | 31 | 23 | 25 | 23 | 26 |
| 27 | 52 | 42 | 47 | 0 | 44 | 45 | 18 | 0 | DZ FG+ FG | M | - | M | T | 29.65 | 30.34 | 6.6 | 2 | 8.7 | 18 | 9 | 14 | 9 | 27 |
| 28 | 61 | 40 | 51 | 0 | 40 | 44 | 14 | 0 | FG | - | - | - | 0.00 | 29.65 | 30.36 | 10.8 | 9 | 11.2 | 22 | 10 | 18 | 10 | 28 |
| 29 | 68* | 38 | 53 | 0 | 38 | 46 | 12 | 0 | - | M | - | M | 0.00 | 29.46 | 30.15 | 2.8 | 17 | 7.3 | 15 | 31 | 14 | 31 | 29 |
| 30 | 51 | 41 | 46 | M | 39 | 43 | 19 | 0 | RA DZ FG HZ | 0 | - | 0.0 | 0.11 | 29.34 | 30.02 | 2.2 | 23 | 5.6 | 16 | 21 | 14 | 22 | 30 |
| 31 | 48 | 41 | 45 | M | 40 | 42 | 20 | 0 | RA FG HZ | 0 | - | 0.0 | 0.06 | 29.21 | 29.91 | 6.8 | 5 | 8.5 | 23 | 5 | 18 | 5 | 31 |
| | 43.5 | 29.0 | 36.3 | ------- | 29.0 | 33.4 | 28.4 | .0 | <Monthly Averages | Totals> | | | 0.79 | 29.42 | 30.15 | 3.8 | 23.7 | 10.9 | <Monthly Average | | | | |
| | | | .0 | ------- | <----------Departure From Normal----------> | | | | | | | | -2.76 | | | | | | | | | | |

**Degree Days**

| | Monthly Total | Monthly Departure | Season to Date Total | Season to Date Departure |
|---|---|---|---|---|
| Heating: | 879 | 209 | 0 | 0 |
| Cooling: | 0 | -4 | 0 | 0 |

Greatest 24-hr Precipitation: 0.62 Date: 26
Greatest 24-hr Snowfall: Date:
Greatest Snow Depth: 0 Date: -

| Sea Level | Pressure | Date | Time |
|---|---|---|---|
| Maximum | 30.54 | 13 | 1211 |
| Minimum | 29.46 | 5 | 1446 |

Number of Days with -------->

| | | | |
|---|---|---|---|
| Max Temp >=90: 0 | Min Temp <=32: 20 | Precipitation >=.01 inch: 2 |
| Max Temp <=32: 5 | Min Temp <=0 : 0 | Precipitation >=.10 inch: 1 |
| Thunderstorms : 0 | Heavy Fog : 5 | Snowfall >=1.0 inch : 2 |

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

# UNEDITED LOCAL CLIMATOLOGICAL DATA

**NOAA, National Climatic Data Center**

**Month: 04/2004**

**Station Location: NIAGARA FALLS INTERNATIONAL AIRPORT (IAG)**
**NIAGARA FALLS , NY**
Lat. 43°07'N Lon. 78°57'W
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 | | 0600 LST | 1200 LST | 2400 LST | 2400 LST | Avg. Station | Avg. Sea level | Resultant Speed | Res Dir | Avg. Speed | max 5-sec | | max 2-min | | |
| | | | | | | | | | | Depth | Water Equiv | Snow Fall | Water Equiv | | | | | | Speed | Dir | Speed | Dir | |
| 1 | 41 | 36 | 39 | M | 37 | 38 | 26 | 0 | RA DZ FG | 0 | - | 0.0 | 0.40 | 29.13 | 29.82 | 14.5 | 3 | 15.0 | 26 | 6 | 22 | 6 | 1 |
| 2 | 41 | 38 | 40 | M | 37 | 38 | 25 | 0 | RA DZ FG | M | - | M | 0.12 | 29.16 | 29.85 | 11.2 | 5 | 11.4 | 14 | 5 | 12 | 4 | 2 |
| 3 | 43 | 37 | 40 | M | 37 | 38 | 25 | 0 | RA DZ FG+ FG UP | M | - | M | 0.25 | 28.95 | 29.78 | 4.8 | 21 | 6.4 | 15 | 19 | 13 | 19 | 3 |
| 4 | 38 | 25 | 32 | M | 22 | 27 | 33 | 0 | RA SN FG FZFG | 1 | - | 1.9 | 0.27 | 29.05 | 30.00 | 17.4 | 33 | 17.7 | 33 | 32 | 29 | 31 | 4 |
| 5 | 35 | 21 | 28* | 0 | 12 | 23 | 37 | 0 | - | - | - | - | 0.00 | 29.32 | 30.05 | 16.9 | 31 | 17.5 | 32 | 34 | 25 | 31 | 5 |
| 6 | 44 | 21 | 33 | M | 23 | 30 | 32 | 0 | FG | 0 | - | 0.0 | 0.03 | 29.27 | 29.99 | 5.8 | 22 | 8.6 | 7 | 34 | 7 | 35 | 6 |
| 7 | 46 | 31 | 39 | M | 34 | 36 | 26 | 0 | DZ FG | 0 | - | 0.0 | T | 29.12 | 29.83 | 4.5 | 28 | 7.1 | 18 | 30 | 16 | 32 | 7 |
| 8 | 54 | 31 | 43 | M | 33 | 38 | 22 | 0 | FG+ FG FZFG HZ | M | - | M | T | 29.04 | 29.73 | 1.7 | 5 | 6.3 | 17 | 1 | 15 | 2 | 8 |
| 9 | 51 | 33 | 42 | M | 27 | 36 | 23 | 0 | - | M | - | M | 0.00 | 29.21 | 29.93 | 9.0 | 30 | 9.8 | 24 | 29 | 18 | 28 | 9 |
| 10 | 48 | 32 | 40 | M | 27 | 35 | 25 | 0 | - | M | - | M | T | 29.34 | 30.06 | 8.0 | 30 | 9.6 | 10 | 36 | 9 | 36 | 10 |
| 11 | 46 | 29 | 38 | M | 23 | 32 | 27 | 0 | - | M | - | M | 0.00 | 29.49 | 30.19 | 4.8 | 3 | 6.9 | 8 | 10 | 7 | 10 | 11 |
| 12 | 51 | 35 | 43 | 0 | 28 | 36 | 22 | 0 | RA FG | - | - | - | 0.27 | 29.49 | 30.20 | 11.9 | 6 | 12.4 | 28 | 9 | 23 | 9 | 12 |
| 13 | 43 | 34 | 39 | 0 | 37 | 37 | 26 | 0 | RA DZ SN FG | M | - | M | 0.80 | 29.16 | 29.86 | 11.4 | 4 | 12.5 | 18 | 35 | 15 | 35 | 13 |
| 14 | 53 | 33 | 43 | 0 | 29 | 37 | 22 | 0 | SN FG | M | - | M | 0.00 | 29.25 | 29.95 | 10.7 | 34 | 11.4 | 17 | 34 | 15 | 33 | 14 |
| 15 | 54 | 32 | 43 | 0 | 27 | 37 | 22 | 0 | - | - | - | - | 0.00 | 29.53 | 30.22 | 3.2 | 34 | 5.0 | 17 | 35 | 15 | 35 | 15 |
| 16 | 68 | 32 | 50 | 0 | 32 | 43 | 15 | 0 | - | M | - | M | T | 29.51 | 30.21 | 3.3 | 16 | 5.5 | 14 | 21 | 12 | 21 | 16 |
| 17 | 65 | 51 | 58 | 0 | 46 | 52 | 7 | 0 | FG HZ | - | - | - | 0.05 | 29.43 | 30.11 | 5.8 | 22 | 7.3 | 24 | 24 | 20 | 25 | 17 |
| 18 | 72 | 45 | 59 | 0 | 51 | 54 | 6 | 0 | TS TSRA TSRAGR GR RA FG+ | M | - | M | 0.60 | 29.46 | 30.14 | 3.2 | 17 | 9.2 | 31 | 20 | 23 | 20 | 18 |
| 19 | 71 | 43 | 57 | 0 | 46 | 53 | 8 | 0 | RA FG | - | - | - | 0.03 | 29.21 | 29.88 | 20.9 | 23 | 23.6 | 51 | 23 | 40 | 22 | 19 |
| 20 | 53 | 42 | 48 | 0 | 36 | 41 | 17 | 0 | - | M | - | M | 0.01 | 29.43 | 30.13 | 3.2 | 3 | 8.2 | 20 | 3 | 15 | 9 | 20 |
| 21 | 73 | 44 | 59 | 0 | 50 | 55 | 6 | 0 | TS TSRA RA FG | M | - | M | 0.53 | 29.08 | 29.75 | 11.7 | 20 | 14.1 | 37 | 26 | 29 | 25 | 21 |
| 22 | 59 | 47 | 53 | 0 | 43 | 48 | 12 | 0 | FG | M | - | M | 0.00 | 29.39 | 30.06 | 4.4 | 29 | 9.3 | 16 | 35 | 12 | 3 | 22 |
| 23 | 58 | 40 | 49 | 0 | 39 | 44 | 16 | 0 | - | - | - | - | 0.00 | 29.42 | 30.12 | 5.2 | 4 | 9.5 | 21 | 9 | 17 | 7 | 23 |
| 24 | 54 | 39 | 47 | 0 | 33 | 41 | 18 | 0 | - | - | - | - | 0.00 | 29.59 | 30.30 | 4.9 | 34 | 7.6 | 20 | 32 | 17 | 33 | 24 |
| 25 | 57 | 41 | 49 | M | 41 | 45 | 16 | 0 | TS TSRA RA FG HZ | 0 | - | 0.0 | 0.37 | 29.32 | 30.01 | 9.5 | 14 | 13.5 | 29 | 26 | 24 | 26 | 25 |
| 26 | 57 | 43 | 50 | M | 42 | 46 | 15 | 0 | FG | 0 | - | 0.0 | T | 29.15 | 29.85 | 9.2 | 23 | 11.6 | 26 | 30 | 22 | 22 | 26 |
| 27 | 47 | 31 | 39 | M | 30 | 36 | 26 | 0 | RA | 0 | - | T | T | 29.16 | 29.84 | 12.9 | 28 | 14.2 | 30 | 30 | 24 | 30 | 27 |
| 28 | 53 | 28 | 41 | M | 28 | 36 | 24 | 0 | - | 0 | - | 0.0 | T | 29.42 | 30.11 | 8.7 | 21 | 10.6 | 24 | 22 | 18 | 20 | 28 |
| 29 | 77* | 52 | 65 | 0 | 40 | 52 | 0 | 0 | - | - | - | - | 0.00 | 29.38 | 30.06 | 19.1 | 22 | 19.5 | 51 | 21 | 37 | 22 | 29 |
| 30 | 77 | 53 | 65* | 0 | 49 | 55 | 0 | 0 | RA FG | - | - | - | 0.06 | 29.39 | 30.05 | 7.9 | 21 | 9.4 | 25 | 24 | 22 | 23 | 30 |
| | 54.3 | 36.6 | 45.5 | ------- | 34.6 | 40.6 | 19.3 | .0 | <Monthly Averages | Totals> | | | 1.65 | 29.30 | 30.00 | 2.5 | 28.4 | 11.0 | <Monthly Average | | | | |
| | | | .0 | ------- | <----------Departure From Normal----------> | | | | | | | | -1.57 | | | | | | | | | | |

**Degree Days**

| | Monthly Total | Monthly Departure | Season to Date Total | Season to Date Departure |
|---|---|---|---|---|
| Heating: | 579 | 217 | 0 | 0 |
| Cooling: | 0 | -11 | 0 | 0 |

Greatest 24-hr Precipitation: 0.65 Date: 17-18
Greatest 24-hr Snowfall: Date:
Greatest Snow Depth: 0 Date: -

Sea Level Pressure Date Time
Maximum 30.40 18 0954
Minimum 29.51 4 0204

Number of Days with -------->
Max Temp >=90: 0
Max Temp <=32: 0
Thunderstorms : 3
Min Temp <=32: 11
Min Temp <=0 : 0
Heavy Fog : 3
Precipitation >=.01 inch: 5
Precipitation >=.10 inch: 1
Snowfall >=1.0 inch : 1

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

# UNEDITED LOCAL CLIMATOLOGICAL DATA

**NOAA, National Climatic Data Center**

**Month: 05/2004**

**Station Location: NIAGARA FALLS INTERNATIONAL AIRPORT (IAG)**
**NIAGARA FALLS , NY**
Lat. 43°07'N Lon. 78°57'W
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 | | 0600 LST | 1200 LST | 2400 LST | 2400 LST | Avg. Station | Avg. Sea level | Resultant Speed | Res Dir | Avg. Speed | max 5-sec | | max 2-min | | |
| | | | | | | | | | | Depth | Water Equiv | Snow Fall | Water Equiv | | | | | | Speed | Dir | Speed | Dir | |
| 1 | 72 | 46 | 59 | 0 | 54 | 57 | 6 | 0 | TS TSRA RA FG HZ | - | - | - | 0.13 | 29.24 | 29.92 | 7.1 | 22 | 12.3 | 33 | 23 | 28 | 23 | 1 |
| 2 | 48 | 38 | 43 | 0 | 42 | 44 | 22 | 0 | RA DZ FG+ FG | M | - | M | 0.45 | 29.12 | 29.81 | 8.2 | 31 | 10.8 | 24 | 30 | 20 | 28 | 2 |
| 3 | 47 | 33 | 40* | 0 | 30 | 36 | 25 | 0 | - | - | - | - | 0.07 | 29.38 | 30.08 | 8.1 | 27 | 9.9 | 22 | 27 | 17 | 28 | 3 |
| 4 | 53 | 28 | 41 | M | 29 | 37 | 24 | 0 | - | M | - | M | 0.12 | 29.33 | 30.03 | 8.1 | 22 | 9.7 | 25 | 22 | 21 | 19 | 4 |
| 5 | 57 | 40 | 49 | M | 40 | 45 | 16 | 0 | FG HZ | 0 | - | 0.0 | 0.03 | 29.23 | 29.92 | 8.5 | 27 | 11.7 | 28 | 31 | 22 | 30 | 5 |
| 6 | 71 | 38 | 55 | M | 42 | 50 | 10 | 0 | TS TSRA FG | 0 | - | 0.0 | 0.03 | 29.31 | 29.99 | 8.3 | 21 | 9.9 | 29 | 23 | 24 | 21 | 6 |
| 7 | 59 | 42 | 51 | M | 36 | 45 | 14 | 0 | TS FG HZ VCTS | 0 | - | 0.0 | 0.00 | 29.54 | 30.22 | 8.4 | 34 | 9.4 | 21 | 31 | 18 | 33 | 7 |
| 8 | 52 | 40 | 46 | M | 37 | 42 | 19 | 0 | RA FG | 0 | - | 0.0 | 0.21 | 29.53 | 30.24 | 6.1 | 8 | 8.1 | 20 | 10 | 17 | 12 | 8 |
| 9 | 62 | 43 | 53 | M | 48 | 50 | 12 | 0 | RA FG | 0 | - | 0.0 | 0.26 | 29.39 | 30.10 | 2.1 | 3 | 5.6 | 16 | 29 | 13 | 33 | 9 |
| 10 | 80 | 45 | 63 | 0 | 56 | 60 | 2 | 0 | TS TSRA RA FG VCTS | - | - | - | 0.07 | 29.31 | 29.99 | 11.7 | 22 | 13.7 | 37 | 23 | 31 | 23 | 10 |
| 11 | 75 | 58 | 67 | 0 | 49 | 57 | 0 | 2 | RA FG | - | - | - | T | 29.46 | 30.12 | 1.0 | 28 | 5.3 | 16 | 22 | 15 | 23 | 11 |
| 12 | 82 | 57 | 70 | 0 | 60 | 64 | 0 | 5 | FG HZ | - | - | - | T | 29.43 | 30.10 | 6.0 | 21 | 6.8 | 18 | 21 | 14 | 24 | 12 |
| 13 | 85* | 63 | 74* | 0 | 64 | 68 | 0 | 9 | FG HZ | - | - | - | 0.00 | 29.42 | 30.08 | 4.1 | 21 | 5.1 | 16 | 23 | 14 | 21 | 13 |
| 14 | 81 | 64 | 73 | 0 | 65 | 68 | 0 | 8 | FG HZ | - | - | - | T | 29.36 | 30.00 | 11.4 | 21 | 12.1 | 30 | 24 | 24 | 23 | 14 |
| 15 | 68 | 46 | 57 | 0 | 51 | 53 | 8 | 0 | RA FG | - | - | - | 0.19 | 29.47 | 30.15 | 7.7 | 30 | 9.7 | 29 | 31 | 23 | 31 | 15 |
| 16 | 61 | 42 | 52 | 0 | 45 | 48 | 13 | 0 | - | - | - | - | 0.00 | 29.66 | 30.34 | 5.1 | 23 | 6.6 | 17 | 20 | 13 | 21 | 16 |
| 17 | 78 | 42 | 60 | 0 | 54 | 58 | 5 | 0 | FG | - | - | - | 0.01 | 29.56 | 30.24 | 5.8 | 21 | 6.8 | 21 | 21 | 17 | 21 | 17 |
| 18 | 76 | 54 | 65 | 0 | 61 | 63 | 0 | 0 | TS RA FG VCTS | - | - | - | T | 29.34 | 30.02 | 10.5 | 25 | 15.0 | 35 | 24 | 28 | 23 | 18 |
| 19 | 70 | 49 | 60 | 0 | 48 | 53 | 5 | 0 | FG | - | - | - | 0.00 | 29.50 | 30.18 | 7.4 | 5 | 8.6 | 20 | 5 | 16 | 5 | 19 |
| 20 | 78 | 48 | 63 | 0 | 62 | 63 | 2 | 0 | TS TSRA FG HZ VCTS | M | - | M | 0.13 | 29.34 | 30.01 | 9.3 | 21 | 10.3 | 25 | 23 | 20 | 24 | 20 |
| 21 | 70 | 55 | 63 | 0 | 60 | 61 | 2 | 0 | FG+ FG | - | - | - | T | 29.36 | 30.03 | 8.1 | 6 | 9.3 | 31 | 15 | 26 | 15 | 21 |
| 22 | 73 | 51 | 62 | 0 | 58 | 59 | 3 | 0 | TS TSRA RA FG VCTS | - | - | - | 0.43 | 29.20 | 29.87 | 1.2 | 8 | 4.4 | 45 | 28 | 30 | 29 | 22 |
| 23 | 65 | 51 | 58 | 0 | 58 | 58 | 7 | 0 | TS TSRA RA FG+ FG VCTS | - | - | - | 0.68 | 29.13 | 29.80 | 4.8 | 6 | 6.6 | 23 | 10 | 20 | 10 | 23 |
| 24 | 75 | 53 | 64 | 0 | 57 | 59 | 1 | 0 | TS TSRA RA FG VCTS | - | - | - | 0.72 | 29.06 | 29.74 | 12.0 | 24 | 14.1 | 40 | 22 | 33 | 24 | 24 |
| 25 | 63 | 52 | 58 | 0 | 52 | 54 | 7 | 0 | RA DZ FG | - | - | - | 0.11 | 29.16 | 29.84 | 1.4 | 30 | 6.2 | 17 | 36 | 14 | 5 | 25 |
| 26 | 69 | 50 | 60 | 0 | 53 | 55 | 5 | 0 | DZ FG+ FG HZ | M | - | M | 0.02 | 29.08 | 29.74 | 5.0 | 24 | 7.5 | 24 | 22 | 21 | 22 | 26 |
| 27 | 74 | 48 | 61 | 0 | 53 | 56 | 4 | 0 | FG HZ | M | - | M | 0.09 | 29.00 | 29.66 | 5.0 | 20 | 6.3 | 21 | 19 | 17 | 21 | 27 |
| 28 | 62 | 45 | 54 | 0 | 46 | 51 | 11 | 0 | FG | - | - | - | 0.00 | 29.09 | 29.76 | 10.1 | 31 | 11.2 | 23 | 33 | 18 | 33 | 28 |
| 29 | 62 | 39 | 51 | 0 | 37 | 45 | 14 | 0 | - | - | - | - | 0.00 | 29.38 | 30.06 | 3.9 | 23 | 7.1 | 21 | 22 | 17 | 23 | 29 |
| 30 | 69 | 40 | 55 | 0 | 41 | 49 | 10 | 0 | FG | - | - | - | 0.00 | 29.30 | 29.98 | 5.2 | 7 | 6.6 | 18 | 10 | 14 | 4 | 30 |
| 31 | 64 | 50 | 57 | 0 | 53 | 56 | 8 | 0 | RA FG+ FG | - | - | - | 0.71 | 28.93 | 30.54 | 7.3 | 13 | 10.6 | 21 | 9 | 17 | 10 | 31 |
| | 67.8 | 46.8 | 57.3 | ------- | 49.7 | 53.7 | 8.2 | .8 | <Monthly Averages | Totals> | | | 0.82 | 29.31 | 30.02 | 3.0 | 23.9 | 9.0 | <Monthly Average | | | | |
| | | | .0 | ------- | <----------Departure From Normal----------> | | | | | | | | -3.40 | | | | | | | | | | |

**Degree Days**

| | Monthly Total | Monthly Departure | Season to Date Total | Season to Date Departure |
|---|---|---|---|---|
| Heating: | 255 | 116 | 0 | 0 |
| Cooling: | 24 | -36 | 0 | 0 |

Greatest 24-hr Precipitation: 0.71 Date: 31
Greatest 24-hr Snowfall: Date:
Greatest Snow Depth: 0 Date: -

| Sea Level Pressure | | | |
|---|---|---|---|
| | | Date | Time |
| Maximum | 30.40 | 8 | 0052 |
| Minimum | .00 | 0 | 0000 |

Number of Days with -------->

| | | | |
|---|---|---|---|
| Max Temp >=90: 0 | Min Temp <=32: 1 | Precipitation >=.01 inch: 2 |
| Max Temp <=32: 0 | Min Temp <=0 : 0 | Precipitation >=.10 inch: 1 |
| Thunderstorms : 9 | Heavy Fog : 5 | Snowfall >=1.0 inch : 0 |

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

# UNEDITED LOCAL CLIMATOLOGICAL DATA

**NOAA, National Climatic Data Center**

**Month: 06/2004**

**Station Location: NIAGARA FALLS INTERNATIONAL AIRPORT (IAG)**
**NIAGARA FALLS , NY**
Lat. 43°07'N Lon. 78°57'W
Elevation(Ground): 585 ft. above sea level

| Date | Temperature (Fahrenheit) Max. | Min. | Avg. | Dep From Normal | Avg. Dew pt. | Avg Wet Bulb | Degree Days Base 65 Degrees Heating | Cooling | Significant Weather | Snow/Ice on Ground(In) 0600 LST Depth | 1200 LST Water Equiv | Precipitation (In) 2400 LST Snow Fall | 2400 LST Water Equiv | Pressure(inches of Hg) Avg. Station | Avg. Sea level | Wind: Speed=mph Dir=tens of degrees Resultant Speed | Res Dir | Avg. Speed | max 5-sec Speed | max 5-sec Dir | max 2-min Speed | max 2-min Dir | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 70 | 50 | 60 | 0 | 54 | 57 | 5 | 0 | FG+ FG | - | - | - | 0.01 | 28.93 | 29.60 | 10.2 | 22 | 11.1 | 31 | 24 | 26 | 23 | 1 |
| 2 | 59 | 52 | 56 | M | 54 | 55 | 9 | 0 | RA FG | 0 | - | 0.0 | 0.06 | 29.15 | 29.83 | 1.0 | 29 | 3.7 | 10 | 1 | 9 | 36 | 2 |
| 3 | 69 | 45 | 57 | M | 46 | 51 | 8 | 0 | - | 0 | - | 0.0 | 0.00 | 29.43 | 30.11 | 6.4 | 31 | 8.4 | 23 | 33 | 20 | 34 | 3 |
| 4 | 67 | 44 | 56 | M | 42 | 49 | 9 | 0 | - | M | - | M | 0.00 | 29.56 | 30.23 | 5.9 | 5 | 7.2 | 21 | 3 | 17 | 2 | 4 |
| 5 | 71 | 51 | 61 | M | 51 | 55 | 4 | 0 | - | M | - | M | 0.00 | 29.41 | 30.10 | 4.0 | 14 | 5.6 | 18 | 16 | 15 | 16 | 5 |
| 6 | 71 | 53 | 62 | M | 55 | 59 | 3 | 0 | FG | M | - | M | 0.00 | 29.35 | 30.02 | 7.0 | 20 | 7.4 | 18 | 24 | 16 | 22 | 6 |
| 7 | 80 | 61 | 71 | 0 | 60 | 64 | 0 | 6 | HZ | - | - | - | T | 29.39 | 30.06 | 8.9 | 21 | 9.5 | 22 | 24 | 18 | 21 | 7 |
| 8 | 84 | 63 | 74 | M | 64 | 68 | 0 | 9 | FG HZ | 0 | - | 0.0 | 0.00 | 29.41 | 30.07 | 11.8 | 21 | 12.1 | 29 | 21 | 23 | 22 | 8 |
| 9 | 86* | 66 | 76* | M | 68 | 70 | 0 | 11 | TS TSRA RA FG HZ | 0 | - | 0.0 | 0.29 | 29.28 | 29.96 | 10.2 | 23 | 11.3 | 31 | 22 | 26 | 22 | 9 |
| 10 | 66 | 49 | 58 | M | 52 | 54 | 7 | 0 | RA FG | 0 | - | 0.0 | 0.03 | 29.33 | 30.01 | 7.7 | 6 | 8.4 | 21 | 5 | 17 | 6 | 10 |
| 11 | 67 | 47 | 57 | 0 | 42 | 50 | 8 | 0 | - | - | - | - | 0.00 | 29.36 | 30.04 | 6.9 | 6 | 7.5 | 23 | 4 | 17 | 5 | 11 |
| 12 | 74 | 42 | 58 | 0 | 42 | 51 | 7 | 0 | - | - | - | - | 0.00 | 29.43 | 30.11 | 5.2 | 8 | 6.0 | 17 | 6 | 15 | 5 | 12 |
| 13 | 78 | 54 | 66 | 0 | 59 | 63 | 0 | 1 | TS FG HZ VCTS | - | - | - | T | 29.26 | 29.93 | 6.8 | 18 | 7.8 | 24 | 18 | 20 | 18 | 13 |
| 14 | 83 | 64 | 74 | 0 | 63 | 67 | 0 | 9 | TS TSRA RA FG | - | - | - | 0.12 | 29.18 | 29.85 | 13.1 | 22 | 13.4 | 39 | 22 | 29 | 23 | 14 |
| 15 | 78 | 61 | 70 | 0 | 62 | 65 | 0 | 5 | FG HZ | - | - | - | 0.00 | 29.35 | 30.01 | 3.2 | 29 | 7.4 | 17 | 1 | 14 | 1 | 15 |
| 16 | 80 | 55 | 68 | 0 | 56 | 60 | 0 | 3 | - | - | - | - | T | 29.46 | 30.13 | 3.1 | 5 | 4.2 | 16 | 1 | 14 | 36 | 16 |
| 17 | 76 | 65 | 71 | 0 | 66 | 67 | 0 | 6 | TS TSRA RA FG HZ | - | - | - | 0.30 | 29.29 | 29.95 | 1.2 | 6 | 6.0 | 14 | 10 | 13 | 11 | 17 |
| 18 | 76 | 62 | 69 | 0 | 64 | 65 | 0 | 4 | RA FG+ FG HZ | - | - | - | 0.02 | 29.28 | 29.94 | 5.8 | 27 | 7.4 | 25 | 29 | 22 | 29 | 18 |
| 19 | 64 | 47 | 56 | 0 | 48 | 53 | 9 | 0 | RA FG | - | - | - | 0.10 | 29.36 | 30.03 | 11.6 | 30 | 12.2 | 28 | 30 | 22 | 27 | 19 |
| 20 | 68 | 43 | 56 | 0 | 45 | 51 | 9 | 0 | - | M | - | M | 0.00 | 29.37 | 30.07 | 9.7 | 22 | 10.4 | 23 | 22 | 18 | 22 | 20 |
| 21 | 75 | 53 | 64 | 0 | 53 | 58 | 1 | 0 | RA FG | - | - | - | 0.07 | 29.21 | 29.89 | 8.6 | 22 | 10.7 | 26 | 23 | 23 | 21 | 21 |
| 22 | 74 | 58 | 66 | 0 | 60 | 62 | 0 | 1 | RA FG HZ | - | - | - | 0.05 | 29.08 | 29.76 | 6.5 | 23 | 9.1 | 25 | 27 | 22 | 27 | 22 |
| 23 | 73 | 52 | 63 | 0 | 51 | 56 | 2 | 0 | - | - | - | - | 0.00 | 29.29 | 29.97 | 5.9 | 20 | 6.5 | 22 | 20 | 16 | 20 | 23 |
| 24 | 80 | 53 | 67 | 0 | 53 | 59 | 0 | 2 | TS TSRA FG | - | - | - | 0.51 | 29.27 | 29.95 | 10.1 | 24 | 14.3 | 35 | 30 | 29 | 30 | 24 |
| 25 | 65 | 49 | 57 | 0 | 47 | 52 | 8 | 0 | - | M | - | M | T | 29.42 | 30.10 | 0.5 | 30 | 2.9 | 10 | 30 | 9 | 29 | 25 |
| 26 | 70 | 49 | 60 | 0 | 47 | 53 | 5 | 0 | - | - | - | - | 0.01 | 29.31 | 29.99 | 8.2 | 28 | 10.0 | 30 | 29 | 24 | 30 | 26 |
| 27 | 72 | 53 | 63 | 0 | 49 | 55 | 2 | 0 | - | - | - | - | 0.00 | 29.38 | 30.04 | 9.9 | 25 | 11.3 | 32 | 24 | 26 | 24 | 27 |
| 28 | 63 | 49 | 56* | 0 | 54 | 56 | 9 | 0 | RA DZ FG | - | - | - | 0.06 | 29.38 | 30.05 | 1.9 | 23 | 4.6 | 14 | 22 | 12 | 23 | 28 |
| 29 | 74 | 52 | 63 | 0 | 57 | 60 | 2 | 0 | TS TSRA FG | - | - | - | 0.14 | 29.37 | 30.04 | 11.3 | 23 | 12.2 | 38 | 24 | 31 | 24 | 29 |
| 30 | 77 | 54 | 66 | 0 | 58 | 61 | 0 | 1 | FG HZ | - | - | - | 0.00 | 29.43 | 30.10 | 5.8 | 20 | 6.9 | 17 | 20 | 15 | 20 | 30 |
| | 73.0 | 53.2 | 63.1 | ------- | 54.1 | 58.2 | 3.6 | 1.9 | <Monthly Averages | Totals> | | | 1.82 | 29.32 | 30.00 | 4.0 | 22.9 | 8.5 | <Monthly Average | | | | |
| | | | .0 | ------- | <----------Departure From Normal----------> | | | | | | | | -2.25 | | | | | | | | | | |

**Degree Days**

| | Monthly Total | Monthly Departure | Season to Date Total | Season to Date Departure |
|---|---|---|---|---|
| Heating: | 107 | 86 | 0 | 0 |
| Cooling: | 58 | -145 | 0 | 0 |

Greatest 24-hr Precipitation: 0.72 Date: 01
Greatest 24-hr Snowfall: Date:
Greatest Snow Depth: 0 Date: -

| Sea Level | Pressure | Date | Time |
|---|---|---|---|
| Maximum | 30.29 | 4 | 0917 |
| Minimum | 29.55 | 1 | 0153 |

Number of Days with -------->

| | | | |
|---|---|---|---|
| Max Temp >=90: 0 | Min Temp <=32: 0 | Precipitation >=.01 inch: 14 |
| Max Temp <=32: 0 | Min Temp <=0 : 0 | Precipitation >=.10 inch: 6 |
| Thunderstorms : 6 | Heavy Fog : 2 | Snowfall >=1.0 inch : 0 |

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

# UNEDITED LOCAL CLIMATOLOGICAL DATA

**NOAA, National Climatic Data Center**

**Month: 07/2004**

**Station Location: NIAGARA FALLS INTERNATIONAL AIRPORT (IAG)**
**NIAGARA FALLS , NY**
Lat. 43°07'N Lon. 78°57'W
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 | | 0600 LST | 1200 LST | 2400 LST | 2400 LST | Avg. Station | Avg. Sea level | Resultant Speed | Res Dir | Avg. Speed | max 5-sec | | max 2-min | | |
| | | | | | | | | | | Depth | Water Equiv | Snow Fall | Water Equiv | | | | | | Speed | Dir | Speed | Dir | |
| 1 | 82 | 63 | 73 | 0 | 59 | 64 | 0 | 8 | TS TSRA | M | - | M | 0.03 | 29.38 | 30.04 | 10.2 | 22 | 12.0 | 33 | 22 | 26 | 22 | 1 |
| 2 | 76 | 58 | 67 | 0 | 53 | 59 | 0 | 2 | - | M | - | M | 0.00 | 29.40 | 30.08 | 3.0 | 35 | 4.8 | 17 | 1 | 14 | 34 | 2 |
| 3 | 84 | 52 | 68 | 0 | 55 | 61 | 0 | 3 | - | - | - | - | 0.00 | 29.34 | 30.00 | 3.8 | 10 | 4.6 | 20 | 9 | 16 | 5 | 3 |
| 4 | 88* | 62 | 75 | 0 | 67 | 69 | 0 | 10 | TS TSRA RA FG HZ | - | - | - | 0.41 | 29.09 | 29.76 | 9.7 | 18 | 10.5 | 35 | 24 | 29 | 24 | 4 |
| 5 | 78 | 58 | 68 | 0 | 62 | 64 | 0 | 3 | FG | - | - | - | 0.13 | 29.17 | 29.83 | 11.0 | 26 | 14.4 | 29 | 29 | 24 | 29 | 5 |
| 6 | 77 | 57 | 67 | 0 | 58 | 61 | 0 | 2 | - | M | - | M | 0.00 | 29.31 | 29.97 | 1.8 | 3 | 6.9 | 14 | 5 | 12 | 10 | 6 |
| 7 | 79 | 64 | 72 | 0 | 67 | 69 | 0 | 7 | TS TSRA RA FG HZ VCTS | - | - | - | 0.12 | 29.10 | 29.75 | 9.6 | 20 | 10.3 | 21 | 23 | 17 | 22 | 7 |
| 8 | 72 | 59 | 66 | 0 | 58 | 61 | 0 | 1 | FG | - | - | - | 0.03 | 29.18 | 29.84 | 8.6 | 25 | 9.3 | 23 | 30 | 20 | 29 | 8 |
| 9 | 72 | 55 | 64 | 0 | 56 | 59 | 1 | 0 | - | - | - | - | 0.00 | 29.38 | 30.05 | 8.6 | 27 | 10.3 | 21 | 26 | 16 | 33 | 9 |
| 10 | 78 | 57 | 68 | 0 | 59 | 63 | 0 | 3 | - | - | - | - | 0.00 | 29.43 | 30.11 | 3.5 | 28 | 5.0 | 16 | 31 | 13 | 33 | 10 |
| 11 | 83 | 58 | 71 | 0 | 62 | 65 | 0 | 6 | FG | - | - | - | 0.00 | 29.41 | 30.08 | 1.8 | 7 | 4.8 | 15 | 35 | 13 | 35 | 11 |
| 12 | 82 | 65 | 74 | 0 | 68 | 69 | 0 | 9 | RA FG HZ | - | - | - | 0.02 | 29.25 | 29.90 | 1.7 | 7 | 4.9 | 15 | 2 | 14 | 1 | 12 |
| 13 | 83 | 65 | 74 | M | 68 | 70 | 0 | 9 | DZ FG+ FG HZ | 0 | - | 0.0 | 0.01 | 29.15 | 29.80 | 1.7 | 23 | 4.6 | 10 | 21 | 9 | 21 | 13 |
| 14 | 72 | 62 | 67 | M | 64 | 65 | 0 | 2 | TS TSRA RA FG VCTS | 0 | - | 0.0 | 1.39 | 28.91 | 30.53 | 4.5 | 22 | 7.3 | 24 | 28 | 23 | 28 | 14 |
| 15 | 66 | 61 | 64 | M | 61 | 62 | 1 | 0 | RA DZ FG | 0 | - | 0.0 | 0.05 | 28.90 | 30.42 | 12.0 | 27 | 12.3 | 25 | 28 | 21 | 27 | 15 |
| 16 | 79 | 62 | 71 | M | 62 | 65 | 0 | 6 | RA FG | 0 | - | 0.0 | 0.28 | 29.07 | 29.72 | 7.4 | 28 | 8.9 | 22 | 29 | 18 | 29 | 16 |
| 17 | 79 | 59 | 69 | 0 | 61 | 64 | 0 | 4 | TS TSRA FG | - | - | - | 0.04 | 29.20 | 29.87 | 0.4 | 19 | 2.6 | 18 | 5 | 16 | 4 | 17 |
| 18 | 72 | 63 | 68 | 0 | 65 | 66 | 0 | 3 | TS TSRA RA DZ FG VCTS | M | - | M | 0.46 | 29.25 | 29.90 | 6.3 | 5 | 6.7 | 15 | 4 | 13 | 5 | 18 |
| 19 | 76 | 64 | 70 | 0 | 64 | 66 | 0 | 5 | TS TSRA FG HZ VCTS | - | - | - | 0.03 | 29.15 | 29.82 | 2.7 | 19 | 4.9 | 17 | 15 | 14 | 15 | 19 |
| 20 | 80 | 62 | 71 | 0 | 65 | 67 | 0 | 6 | TS TSRA FG HZ VCTS | - | - | - | 0.09 | 29.22 | 29.89 | 6.6 | 22 | 8.8 | 22 | 21 | 18 | 1 | 20 |
| 21 | 85 | 65 | 75 | 0 | 68 | 70 | 0 | 10 | FG HZ | - | - | - | 0.01 | 29.26 | 29.90 | 8.0 | 21 | 8.5 | 21 | 21 | 17 | 22 | 21 |
| 22 | 82 | 72 | 77* | 0 | 69 | 72 | 0 | 12 | RA FG HZ | - | - | - | T | 29.12 | 29.79 | 12.3 | 21 | 12.7 | 25 | 21 | 22 | 23 | 22 |
| 23 | 72 | 59 | 66 | 0 | 59 | 62 | 0 | 1 | FG | - | - | - | T | 29.32 | 29.98 | 8.7 | 33 | 9.3 | 21 | 36 | 17 | 33 | 23 |
| 24 | 71 | 56 | 64* | 0 | 50 | 56 | 1 | 0 | - | - | - | - | 0.00 | 29.64 | 30.30 | 8.0 | 4 | 9.0 | 24 | 3 | 18 | 4 | 24 |
| 25 | 74 | 56 | 65 | 0 | 57 | 60 | 0 | 0 | - | - | - | - | 0.00 | 29.61 | 30.28 | 3.5 | 4 | 5.3 | 17 | 3 | 15 | 1 | 25 |
| 26 | 68 | 61 | 65 | 0 | 61 | 63 | 0 | 0 | RA FG | - | - | - | 0.04 | 29.46 | 30.12 | 8.1 | 6 | 8.3 | 18 | 10 | 15 | 9 | 26 |
| 27 | 67 | 64 | 66 | 0 | 64 | 64 | 0 | 1 | RA DZ FG | - | - | - | 0.64 | 29.28 | 29.95 | 7.8 | 7 | 8.7 | 20 | 7 | 16 | 7 | 27 |
| 28 | 74 | 62 | 68 | 0 | 64 | 65 | 0 | 3 | FG+ FG | - | - | - | 0.01 | 29.31 | 29.98 | 6.0 | 24 | 7.1 | 16 | 29 | 14 | 30 | 28 |
| 29 | 80 | 63 | 72 | 0 | 64 | 67 | 0 | 7 | FG | - | - | - | 0.00 | 29.38 | 30.04 | 3.5 | 18 | 6.3 | 15 | 20 | 13 | 24 | 29 |
| 30 | 78 | 64 | 71 | 0 | 68 | 70 | 0 | 6 | TS TSRA RA FG HZ VCTS | - | - | - | 0.60 | 29.30 | 29.96 | 4.8 | 19 | 5.7 | 20 | 19 | 16 | 24 | 30 |
| 31 | 78 | 69 | 74 | 0 | 70 | 71 | 0 | 9 | TS TSRA RA FG VCTS | - | - | - | 2.26 | 29.22 | 29.88 | 11.2 | 21 | 12.3 | 31 | 22 | 24 | 21 | 31 |
| | 77.0 | 61.2 | 69.1 | ------- | 62.2 | 64.8 | .1 | 4.5 | <Monthly Averages | Totals> | | | 6.53 | 29.27 | 29.99 | 2.5 | 23.2 | 8.0 | <Monthly Average | | | | |
| | | | .0 | ------- | <----------Departure From Normal----------> | | | | | | | | 2.96 | | | | | | | | | | |

**Degree Days**

| | Monthly Total | Monthly Departure | Season to Date Total | Season to Date Departure |
|---|---|---|---|---|
| Heating: | 3 | 2 | 3 | 0 |
| Cooling: | 138 | -207 | 0 | 0 |

Greatest 24-hr Precipitation: 2.86 Date: 30-31
Greatest 24-hr Snowfall: Date:
Greatest Snow Depth: 0 Date: -

Sea Level Pressure Date Time
Maximum 30.35 24 1153
Minimum 29.48 15 0340

Number of Days with -------->
Max Temp >=90: 0
Max Temp <=32: 0
Thunderstorms : 10
Min Temp <=32: 0
Min Temp <=0 : 0
Heavy Fog : 2
Precipitation >=.01 inch: 18
Precipitation >=.10 inch: 7
Snowfall >=1.0 inch : 0

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

# UNEDITED LOCAL CLIMATOLOGICAL DATA

**NOAA, National Climatic Data Center**

**Month: 08/2004**

**Station Location: NIAGARA FALLS INTERNATIONAL AIRPORT (IAG)**
**NIAGARA FALLS , NY**
Lat. 43°07'N Lon. 78°57'W
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 | | 0600 LST | 1200 LST | 2400 LST | 2400 LST | Avg. Station | Avg. Sea level | Resultant Speed | Res Dir | Avg. Speed | max 5-sec | | max 2-min | | |
| | | | | | | | | | | Depth | Water Equiv | Snow Fall | Water Equiv | | | | | | Speed | Dir | Speed | Dir | |
| 1 | 79 | 65 | 72 | 0 | 61 | 65 | 0 | 7 | FG | - | - | - | 0.00 | 29.40 | 30.05 | 3.1 | 28 | 5.9 | 16 | 33 | 13 | 32 | 1 |
| 2 | 83 | 63 | 73 | 0 | 64 | 67 | 0 | 8 | FG | - | - | - | 0.01 | 29.31 | 29.96 | 5.7 | 21 | 6.7 | 21 | 23 | 15 | 28 | 2 |
| 3 | 83 | 68 | 76 | 0 | 68 | 70 | 0 | 11 | TS TSRA RA FG VCTS | - | - | - | 0.24 | 29.17 | 29.83 | 4.6 | 23 | 6.6 | 22 | 23 | 18 | 33 | 3 |
| 4 | 70 | 60 | 65 | 0 | 64 | 65 | 0 | 0 | RA FG+ FG MIFG | - | - | - | 0.22 | 29.16 | 29.82 | 2.3 | 30 | 3.9 | 15 | 29 | 13 | 31 | 4 |
| 5 | 67 | 57 | 62 | 0 | 52 | 57 | 3 | 0 | FG+ FG | - | - | - | 0.00 | 29.28 | 29.96 | 9.2 | 36 | 9.8 | 21 | 33 | 17 | 32 | 5 |
| 6 | 69 | 51 | 60 | 0 | 51 | 55 | 5 | 0 | - | - | - | - | T | 29.30 | 29.99 | 5.4 | 33 | 7.8 | 23 | 31 | 20 | 32 | 6 |
| 7 | 67 | 49 | 58* | 0 | 53 | 56 | 7 | 0 | - | - | - | - | 0.00 | 29.33 | 30.01 | 2.1 | 27 | 4.4 | 16 | 22 | 14 | 23 | 7 |
| 8 | 80 | 54 | 67 | 0 | 56 | 60 | 0 | 2 | FG | - | - | - | 0.01 | 29.39 | 30.05 | 5.7 | 26 | 7.3 | 26 | 26 | 20 | 28 | 8 |
| 9 | 79 | 56 | 68 | 0 | 59 | 63 | 0 | 3 | FG | - | - | - | 0.00 | 29.38 | 30.06 | 5.8 | 20 | 6.7 | 21 | 24 | 18 | 24 | 9 |
| 10 | 78 | 65 | 72 | 0 | 64 | 66 | 0 | 7 | TS TSRA FG HZ VCTS | M | - | M | 0.22 | 29.15 | 29.81 | 13.1 | 21 | 13.8 | 33 | 21 | 28 | 23 | 10 |
| 11 | 71 | 61 | 66 | 0 | 59 | 62 | 0 | 1 | RA FG | - | - | - | 0.11 | 29.17 | 29.84 | 9.8 | 22 | 10.0 | 26 | 23 | 22 | 23 | 11 |
| 12 | 71 | 56 | 64 | 0 | 56 | 59 | 1 | 0 | - | - | - | - | T | 29.28 | 29.96 | 2.0 | 3 | 3.2 | 14 | 3 | 12 | 3 | 12 |
| 13 | 66 | 54 | 60 | 0 | 59 | 60 | 5 | 0 | RA FG | - | - | - | 0.46 | 29.33 | 30.00 | 3.0 | 32 | 4.2 | 16 | 32 | 14 | 33 | 13 |
| 14 | 72 | 53 | 63 | 0 | 57 | 60 | 2 | 0 | FG | - | - | - | 0.01 | 29.48 | 30.17 | 1.3 | 27 | 4.2 | 13 | 32 | 12 | 31 | 14 |
| 15 | 73 | 56 | 65 | 0 | 58 | 61 | 0 | 0 | FG | - | - | - | T | 29.60 | 30.26 | 1.2 | 3 | 2.6 | 13 | 2 | 12 | 5 | 15 |
| 16 | 76 | 51 | 64 | 0 | 57 | 60 | 1 | 0 | FG BCFG HZ | - | - | - | 0.01 | 29.56 | 30.22 | 2.5 | 29 | 4.3 | 14 | 31 | 13 | 32 | 16 |
| 17 | 77 | 59 | 68 | 0 | 59 | 62 | 0 | 3 | FG HZ | - | - | - | T | 29.40 | 30.06 | 8.0 | 20 | 8.5 | 22 | 24 | 18 | 24 | 17 |
| 18 | 80 | 66 | 73 | 0 | 63 | 66 | 0 | 8 | FG HZ | - | - | - | T | 29.19 | 29.85 | 14.1 | 20 | 14.4 | 32 | 21 | 23 | 21 | 18 |
| 19 | 74 | 59 | 67 | 0 | 60 | 63 | 0 | 2 | RA FG HZ | - | - | - | T | 29.23 | 29.89 | 8.2 | 24 | 10.4 | 24 | 23 | 20 | 32 | 19 |
| 20 | 72 | 52 | 62 | 0 | 56 | 58 | 3 | 0 | - | - | - | - | 0.06 | 29.28 | 29.97 | 5.1 | 22 | 6.0 | 23 | 23 | 20 | 24 | 20 |
| 21 | 69 | 51 | 60 | 0 | 51 | 55 | 5 | 0 | RA FG | - | - | - | T | 29.28 | 29.96 | 5.3 | 33 | 5.7 | 20 | 33 | 16 | 31 | 21 |
| 22 | 72 | 46 | 59 | 0 | 51 | 55 | 6 | 0 | - | - | - | - | 0.01 | 29.36 | 30.02 | 5.8 | 21 | 6.8 | 22 | 20 | 18 | 21 | 22 |
| 23 | 78 | 61 | 70 | 0 | 61 | 64 | 0 | 5 | - | - | - | - | T | 29.29 | 29.97 | 4.5 | 24 | 10.8 | 21 | 24 | 16 | 1 | 23 |
| 24 | 77 | 56 | 67 | 0 | 56 | 60 | 0 | 2 | - | - | - | - | 0.00 | 29.50 | 30.16 | 9.9 | 7 | 10.4 | 23 | 10 | 18 | 10 | 24 |
| 25 | 85* | 59 | 72 | 0 | 64 | 67 | 0 | 7 | FG HZ | - | - | - | 0.00 | 29.41 | 30.09 | 8.2 | 18 | 9.2 | 24 | 20 | 21 | 19 | 25 |
| 26 | 81 | 71 | 76 | 0 | 64 | 68 | 0 | 11 | FG HZ | - | - | - | T | 29.40 | 30.05 | 10.9 | 19 | 11.0 | 24 | 20 | 20 | 19 | 26 |
| 27 | 84 | 70 | 77* | 0 | 70 | 72 | 0 | 12 | FG HZ | - | - | - | T | 29.33 | 29.98 | 12.0 | 21 | 12.5 | 29 | 23 | 22 | 23 | 27 |
| 28 | 79 | 69 | 74 | 0 | 69 | 70 | 0 | 9 | TS TSRA RA FG HZ VCTS | M | - | M | 0.29 | 29.26 | 29.92 | 4.1 | 22 | 6.4 | 17 | 21 | 15 | 21 | 28 |
| 29 | 80 | 64 | 72 | 0 | 67 | 68 | 0 | 7 | TS TSRA RA FG+ FG VCTS | - | - | - | 0.48 | 29.23 | 29.90 | 4.7 | 29 | 7.4 | 18 | 24 | 16 | 23 | 29 |
| 30 | 69 | 61 | 65 | 0 | 60 | 62 | 0 | 0 | DZ FG | - | - | - | 0.08 | 29.37 | 30.03 | 5.7 | 33 | 6.4 | 14 | 34 | 12 | 34 | 30 |
| 31 | 76 | 54 | 65 | 0 | 57 | 60 | 0 | 0 | FG | - | - | - | 0.00 | 29.48 | 30.14 | 6.0 | 24 | 7.7 | 21 | 21 | 17 | 21 | 31 |
| | 75.4 | 58.6 | 67.0 | ------- | 59.6 | 62.5 | 1.2 | 3.4 | <Monthly Averages | Totals> | | | 2.21 | 29.33 | 30.00 | 3.6 | 23.1 | 7.6 | <Monthly Average | | | | |
| | | | .0 | ------- | <----------Departure From Normal----------> | | | | | | | | -1.57 | | | | | | | | | | |

**Degree Days**

| | Monthly Total | Monthly Departure | Season to Date Total | Season to Date Departure |
|---|---|---|---|---|
| Heating: | 38 | 34 | 0 | 0 |
| Cooling: | 105 | -197 | 0 | 0 |

Greatest 24-hr Precipitation: 0.00 Date:
Greatest 24-hr Snowfall: Date:
Greatest Snow Depth: 0 Date: -

| Sea Level | Pressure | Date | Time |
|---|---|---|---|
| Maximum | 30.29 | 15 | 1033 |
| Minimum | 29.73 | 10 | 1645 |

Number of Days with -------->

| | | | |
|---|---|---|---|
| Max Temp >=90: 0 | Min Temp <=32: 0 | Precipitation >=.01 inch: 14 |
| Max Temp <=32: 0 | Min Temp <=0 : 0 | Precipitation >=.10 inch: 7 |
| Thunderstorms : 4 | Heavy Fog : 3 | Snowfall >=1.0 inch : 0 |

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

# UNEDITED LOCAL CLIMATOLOGICAL DATA

**NOAA, National Climatic Data Center**

**Month: 09/2004**

**Station Location: NIAGARA FALLS INTERNATIONAL AIRPORT (IAG)**
**NIAGARA FALLS , NY**
Lat. 43°07'N Lon. 78°57'W
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 | | 0600 LST Depth | 1200 LST Water Equiv | 2400 LST Snow Fall | 2400 LST Water Equiv | Avg. Station | Avg. Sea level | Resultant Speed | Res Dir | Avg. Speed | max 5-sec Speed | max 5-sec Dir | max 2-min Speed | max 2-min Dir | |
| 1 | 73 | 54 | 64 | 0 | 54 | 59 | 1 | 0 | - | - | - | - | 0.01 | 29.56 | 30.23 | 4.5 | 30 | 6.5 | 18 | 32 | 15 | 31 | 1 |
| 2 | 79 | 54 | 67 | 0 | 57 | 61 | 0 | 2 | FG | - | - | - | 0.00 | 29.57 | 30.25 | 2.1 | 5 | 3.8 | 15 | 34 | 12 | 33 | 2 |
| 3 | 81 | 60 | 71 | 0 | 61 | 65 | 0 | 6 | FG HZ | - | - | - | 0.00 | 29.48 | 30.15 | 6.7 | 21 | 7.1 | 17 | 22 | 15 | 21 | 3 |
| 4 | 83 | 59 | 71 | 0 | 64 | 67 | 0 | 6 | FG HZ | - | - | - | 0.01 | 29.50 | 30.15 | 2.7 | 7 | 3.7 | 14 | 10 | 12 | 10 | 4 |
| 5 | 85* | 61 | 73 | 0 | 62 | 66 | 0 | 8 | FG HZ | - | - | - | 0.00 | 29.51 | 30.17 | 4.7 | 16 | 6.9 | 20 | 17 | 15 | 17 | 5 |
| 6 | 82 | 65 | 74* | 0 | 60 | 65 | 0 | 9 | - | - | - | - | 0.00 | 29.41 | 30.07 | 13.2 | 19 | 13.3 | 29 | 19 | 23 | 18 | 6 |
| 7 | 74 | 64 | 69 | 0 | 64 | 66 | 0 | 4 | RA DZ FG | M | - | M | 0.03 | 29.32 | 29.99 | 6.0 | 22 | 9.3 | 14 | 1 | 13 | 1 | 7 |
| 8 | 66 | 60 | 63 | 0 | 59 | 61 | 2 | 0 | RA FG | - | - | - | 0.43 | 29.38 | 30.07 | 12.0 | 6 | 12.6 | 32 | 5 | 25 | 6 | 8 |
| 9 | 68 | 58 | 63 | 0 | 58 | 60 | 2 | 0 | RA FG | - | - | - | 3.00 | 29.17 | 29.84 | 13.7 | 35 | 16.6 | 38 | 1 | 31 | 1 | 9 |
| 10 | 72 | 57 | 65 | 0 | 42 | 52 | 0 | 0 | - | - | - | - | 0.00 | 29.52 | 30.19 | 4.2 | 30 | 6.1 | 17 | 31 | 15 | 31 | 10 |
| 11 | 75 | 53 | 64 | 0 | 48 | 56 | 1 | 0 | HZ | M | - | M | 0.01 | 29.56 | 30.22 | 1.1 | 20 | 3.4 | 13 | 22 | 12 | 19 | 11 |
| 12 | 78 | 56 | 67 | 0 | 54 | 61 | 0 | 2 | FG HZ | M | - | M | 0.01 | 29.48 | 30.14 | 7.0 | 21 | 7.2 | 20 | 21 | 16 | 21 | 12 |
| 13 | 76 | 58 | 67 | 0 | 61 | 63 | 0 | 2 | FG+ FG HZ | - | - | - | 0.01 | 29.55 | 30.23 | 4.8 | 9 | 5.9 | 15 | 9 | 12 | 10 | 13 |
| 14 | 80 | 57 | 69 | 0 | 61 | 64 | 0 | 4 | FG HZ | - | - | - | 0.00 | 29.52 | 30.19 | 6.1 | 18 | 6.8 | 18 | 19 | 16 | 19 | 14 |
| 15 | 79 | 64 | 72 | M | 62 | 66 | 0 | 7 | FG HZ | M | - | M | 0.00 | 29.45 | 30.11 | 10.1 | 19 | 10.4 | 21 | 22 | 17 | 22 | 15 |
| 16 | 79 | 63 | 71 | M | 64 | 67 | 0 | 6 | TS TSRA RA FG HZ | M | - | M | 0.11 | 29.26 | 29.93 | 8.8 | 21 | 11.0 | 30 | 24 | 24 | 23 | 16 |
| 17 | 64 | 57 | 61 | M | 53 | 56 | 4 | 0 | - | M | - | M | 0.00 | 29.32 | 30.00 | 6.7 | 2 | 7.1 | 17 | 1 | 14 | 36 | 17 |
| 18 | 64 | 51 | 58 | M | 45 | 51 | 7 | 0 | - | M | - | M | 0.00 | 29.48 | 30.17 | 9.9 | 1 | 11.1 | 25 | 3 | 21 | 3 | 18 |
| 19 | 62 | 42 | 52* | M | 43 | 48 | 13 | 0 | - | M | - | M | 0.00 | 29.70 | 30.41 | 3.2 | 3 | 5.1 | 17 | 35 | 14 | 2 | 19 |
| 20 | 71 | 42 | 57 | 0 | 46 | 51 | 8 | 0 | - | - | - | - | 0.00 | 29.67 | 30.38 | 0.5 | 20 | 1.7 | 10 | 23 | 9 | 23 | 20 |
| 21 | 76 | 51 | 64 | 0 | 57 | 59 | 1 | 0 | FG MIFG | - | - | - | 0.00 | 29.59 | 30.27 | 6.6 | 21 | 6.9 | 18 | 21 | 15 | 22 | 21 |
| 22 | 79 | 58 | 69 | 0 | 59 | 62 | 0 | 4 | FG | - | - | - | 0.01 | 29.60 | 30.25 | 6.0 | 22 | 6.7 | 18 | 22 | 15 | 22 | 22 |
| 23 | 83 | 54 | 69 | 0 | 59 | 62 | 0 | 4 | FG HZ | - | - | - | 0.00 | 29.60 | 30.26 | 2.3 | 21 | 3.5 | 13 | 31 | 9 | 17 | 23 |
| 24 | 82 | 55 | 69 | 0 | 62 | 64 | 0 | 4 | FG HZ | - | - | - | 0.01 | 29.46 | 30.15 | 5.6 | 21 | 6.0 | 17 | 22 | 15 | 21 | 24 |
| 25 | 75 | 63 | 69 | 0 | 60 | 63 | 0 | 4 | FG HZ | - | - | - | T | 29.42 | 30.07 | 6.3 | 27 | 8.5 | 18 | 31 | 16 | 32 | 25 |
| 26 | 73 | 52 | 63 | 0 | 55 | 58 | 2 | 0 | - | - | - | - | 0.00 | 29.50 | 30.16 | 1.7 | 24 | 3.3 | 13 | 22 | 10 | 23 | 26 |
| 27 | 75 | 49 | 62 | 0 | 55 | 58 | 3 | 0 | FG MIFG | - | - | - | 0.00 | 29.39 | 30.06 | 2.0 | 17 | 2.5 | 13 | 19 | 9 | 23 | 27 |
| 28 | 69 | 55 | 62 | 0 | 57 | 60 | 3 | 0 | RA FG HZ | - | - | - | T | 29.28 | 29.95 | 7.8 | 3 | 8.6 | 23 | 3 | 18 | 5 | 28 |
| 29 | 66 | 47 | 57 | 0 | 46 | 51 | 8 | 0 | - | - | - | - | 0.00 | 29.34 | 30.04 | 6.9 | 4 | 7.7 | 21 | 5 | 16 | 4 | 29 |
| 30 | 69 | 49 | 59 | 0 | 50 | 54 | 6 | 0 | - | - | - | - | T | 29.38 | 30.06 | 5.6 | 23 | 6.9 | 18 | 22 | 15 | 22 | 30 |
| | 74.6 | 55.6 | 65.1 | ------- | 55.9 | 59.9 | 2.0 | 2.4 | <Monthly Averages | Totals> | | | 3.64 | 29.47 | 30.14 | 1.0 | 21.5 | 7.2 | <Monthly Average | | | | |
| | | | .0 | ------- | <----------Departure From Normal----------> | | | | | | | | 0.20 | | | | | | | | | | |

**Degree Days**

| | Monthly Total | Monthly Departure | Season to Date Total | Season to Date Departure |
|---|---|---|---|---|
| Heating: | 61 | -271 | 0 | 0 |
| Cooling: | 72 | 69 | 0 | 0 |

Greatest 24-hr Precipitation: 3.42 Date: 08-9
Greatest 24-hr Snowfall: Date:
Greatest Snow Depth: 0 Date: -

| Sea Level | Pressure | Date | Time |
|---|---|---|---|
| Maximum | 30.47 | 19 | 0942 |
| Minimum | 29.68 | 9 | 0750 |

Number of Days with -------->
Max Temp >=90: 0
Max Temp <=32: 0
Thunderstorms : 1
Min Temp <=32: 0
Min Temp <=0 : 0
Heavy Fog : 1
Precipitation >=.01 inch: 11
Precipitation >=.10 inch: 3
Snowfall >=1.0 inch : 0

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

# UNEDITED LOCAL CLIMATOLOGICAL DATA

**NOAA, National Climatic Data Center**

**Month: 10/2004**

**Station Location: NIAGARA FALLS INTERNATIONAL AIRPORT (IAG)**
**NIAGARA FALLS , NY**
Lat. 43°07'N Lon. 78°57'W
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 | | 0600 LST | 1200 LST | 2400 LST | 2400 LST | Avg. Station | Avg. Sea level | Resultant Speed | Res Dir | Avg. Speed | max 5-sec | | max 2-min | | |
| | | | | | | | | | | Depth | Water Equiv | Snow Fall | Water Equiv | | | | | | Speed | Dir | Speed | Dir | |
| 1 | 74 | 45 | 60 | 0 | 50 | 55 | 5 | 0 | FG | - | - | - | 0.00 | 29.44 | 30.11 | 4.2 | 16 | 5.6 | 24 | 18 | 20 | 18 | 1 |
| 2 | 68 | 42 | 55 | 0 | 51 | 55 | 10 | 0 | RA FG HZ | M | - | M | 0.61 | 29.36 | 30.04 | 9.5 | 22 | 12.0 | 35 | 29 | 28 | 29 | 2 |
| 3 | 64 | 37 | 51 | 0 | 44 | 48 | 14 | 0 | - | - | - | - | 0.00 | 29.46 | 30.15 | 8.1 | 21 | 8.5 | 25 | 21 | 22 | 22 | 3 |
| 4 | 63 | 39 | 51 | 0 | 41 | 48 | 14 | 0 | - | M | - | M | 0.00 | 29.37 | 30.05 | 6.6 | 27 | 12.2 | 26 | 30 | 23 | 30 | 4 |
| 5 | 56 | 35 | 46 | 0 | 34 | 41 | 19 | 0 | HZ | - | - | - | 0.00 | 29.66 | 30.36 | 2.4 | 25 | 5.8 | 18 | 30 | 16 | 21 | 5 |
| 6 | 66 | 38 | 52 | M | 43 | 49 | 13 | 0 | - | M | - | M | 0.00 | 29.60 | 30.31 | 14.1 | 23 | 14.3 | 35 | 23 | 28 | 24 | 6 |
| 7 | 72 | 55 | 64 | M | 53 | 57 | 1 | 0 | - | M | - | M | 0.00 | 29.69 | 30.35 | 9.1 | 21 | 9.7 | 23 | 22 | 17 | 20 | 7 |
| 8 | 76* | 46 | 61 | M | 47 | 54 | 4 | 0 | FG | M | - | M | 0.00 | 29.51 | 30.19 | 7.9 | 20 | 8.2 | 26 | 21 | 22 | 21 | 8 |
| 9 | 68 | 48 | 58 | M | 47 | 54 | 7 | 0 | - | M | - | M | T | 29.32 | 29.98 | 13.4 | 24 | 15.3 | 35 | 24 | 29 | 23 | 9 |
| 10 | 59 | 42 | 51 | M | 41 | 46 | 14 | 0 | - | M | - | M | 0.00 | 29.48 | 30.18 | 6.7 | 33 | 7.9 | 26 | 34 | 21 | 34 | 10 |
| 11 | 49 | 33 | 41* | M | 37 | 41 | 24 | 0 | FG | M | - | M | 0.00 | 29.52 | 30.22 | 4.7 | 36 | 5.2 | 15 | 2 | 12 | 2 | 11 |
| 12 | 59 | 32 | 46 | 0 | 37 | 42 | 19 | 0 | FG | M | - | M | 0.00 | 29.28 | 29.97 | 2.1 | 29 | 3.3 | 13 | 30 | 12 | 31 | 12 |
| 13 | 69 | 34 | 52 | 0 | 40 | 45 | 13 | 0 | FG | - | - | - | 0.00 | 29.00 | 29.69 | 4.8 | 8 | 5.3 | 16 | 9 | 14 | 7 | 13 |
| 14 | 58 | 47 | 53 | 0 | 47 | 51 | 12 | 0 | FG HZ | - | - | - | T | 28.88 | 30.28 | 4.6 | 18 | 5.7 | 16 | 17 | 13 | 18 | 14 |
| 15 | 62 | 50 | 56 | 0 | 48 | 52 | 9 | 0 | RA FG HZ | - | - | - | 0.09 | 28.70 | 32.32 | 6.9 | 19 | 10.4 | 36 | 24 | 26 | 20 | 15 |
| 16 | 53 | 42 | 48 | 0 | 41 | 44 | 17 | 0 | RA FG | - | - | - | 0.54 | 28.72 | 32.35 | 14.3 | 23 | 14.9 | 33 | 21 | 28 | 25 | 16 |
| 17 | 49 | 42 | 46 | 0 | 34 | 40 | 19 | 0 | - | - | - | - | 0.02 | 29.02 | 29.96 | 20.0 | 25 | 20.2 | 39 | 24 | 32 | 25 | 17 |
| 18 | 50 | 34 | 42 | 0 | 37 | 41 | 23 | 0 | - | - | - | - | T | 29.38 | 30.07 | 2.4 | 2 | 8.5 | 21 | 27 | 17 | 26 | 18 |
| 19 | 50 | 45 | 48 | 0 | 42 | 45 | 17 | 0 | RA FG | - | - | - | 0.04 | 29.36 | 30.05 | 13.4 | 8 | 13.5 | 28 | 9 | 21 | 7 | 19 |
| 20 | 53 | 46 | 50 | 0 | 47 | 48 | 15 | 0 | DZ FG+ FG | M | - | M | 0.03 | 29.38 | 30.06 | 5.3 | 7 | 6.2 | 9 | 9 | 8 | 9 | 20 |
| 21 | 50 | 46 | 48 | 0 | 45 | 46 | 17 | 0 | DZ FG+ FG | - | - | - | 0.03 | 29.47 | 30.17 | 7.7 | 1 | 8.2 | 16 | 4 | 13 | 4 | 21 |
| 22 | 53 | 42 | 48 | 0 | 45 | 47 | 17 | 0 | DZ FG | - | - | - | 0.01 | 29.55 | 30.25 | 7.0 | 7 | 7.9 | 16 | 9 | 13 | 8 | 22 |
| 23 | 61 | 37 | 49 | 0 | 38 | 44 | 16 | 0 | FG | - | - | - | 0.00 | 29.38 | 30.08 | 7.7 | 12 | 8.1 | 17 | 11 | 15 | 11 | 23 |
| 24 | 57 | 48 | 53 | 0 | 47 | 49 | 12 | 0 | RA DZ FG HZ | - | - | - | 0.02 | 29.17 | 29.86 | 4.3 | 18 | 6.4 | 18 | 17 | 14 | 19 | 24 |
| 25 | 58 | 50 | 54 | 0 | 49 | 50 | 11 | 0 | RA FG+ FG HZ | M | - | M | 0.02 | 29.38 | 30.07 | 2.2 | 33 | 3.5 | 12 | 35 | 9 | 32 | 25 |
| 26 | 64 | 41 | 53 | 0 | 45 | 48 | 12 | 0 | FG+ FG HZ | M | - | M | 0.00 | 29.52 | 30.22 | 0.6 | 36 | 2.0 | 12 | 2 | 10 | 35 | 26 |
| 27 | 59 | 47 | 53 | 0 | 46 | 49 | 12 | 0 | RA FG+ FG HZ | M | - | M | T | 29.59 | 30.28 | 6.3 | 5 | 6.7 | 20 | 9 | 15 | 4 | 27 |
| 28 | 56 | 38 | 47 | 0 | 39 | 43 | 18 | 0 | - | - | - | - | 0.00 | 29.60 | 30.28 | 5.0 | 6 | 6.2 | 14 | 36 | 10 | 1 | 28 |
| 29 | 63 | 44 | 54 | 0 | 48 | 51 | 11 | 0 | RA FG | - | - | - | 0.04 | 29.25 | 29.94 | 4.1 | 15 | 5.3 | 17 | 15 | 14 | 16 | 29 |
| 30 | 71 | 57 | 64* | 0 | 56 | 60 | 1 | 0 | TS RA FG HZ VCTS | - | - | - | 0.18 | 28.90 | 30.67 | 12.4 | 22 | 13.7 | 37 | 25 | 31 | 25 | 30 |
| 31 | 57 | 48 | 53 | 0 | 42 | 48 | 12 | 0 | - | - | - | - | T | 29.12 | 29.80 | 16.6 | 25 | 18.0 | 37 | 24 | 29 | 25 | 31 |
| | 60.2 | 42.9 | 51.6 | ------- | 43.9 | 48.1 | 13.2 | .0 | <Monthly Averages | Totals> | | | 1.63 | 29.33 | 30.27 | 2.8 | 22.1 | 9.0 | <Monthly Average | | | | |
| | | | .0 | ------- | <----------Departure From Normal----------> | | | | | | | | -1.74 | | | | | | | | | | |

**Degree Days**

| | Monthly Total | Monthly Departure | Season to Date Total | Season to Date Departure |
|---|---|---|---|---|
| Heating: | 408 | 85 | 0 | 0 |
| Cooling: | 0 | -15 | 0 | 0 |

Greatest 24-hr Precipitation: 0.61 Date: 02
Greatest 24-hr Snowfall: Date:
Greatest Snow Depth: 0 Date: -

Sea Level Pressure Date Time
Maximum 30.42 5 1134
Minimum 29.26 15 1146

Number of Days with -------->
Max Temp >=90: 0
Max Temp <=32: 0
Thunderstorms : 1
Min Temp <=32: 1
Min Temp <=0 : 0
Heavy Fog : 5
Precipitation >=.01 inch: 11
Precipitation >=.10 inch: 2
Snowfall >=1.0 inch : 0

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

# UNEDITED LOCAL CLIMATOLOGICAL DATA

**NOAA, National Climatic Data Center**

**Month: 11/2004**

**Station Location: NIAGARA FALLS INTERNATIONAL AIRPORT (IAG)**
**NIAGARA FALLS , NY**
Lat. 43°07'N Lon. 78°57'W
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 | | 0600 LST Depth | 1200 LST Water Equiv | 2400 LST Snow Fall | 2400 LST Water Equiv | Avg. Station | Avg. Sea level | Resultant Speed | Res Dir | Avg. Speed | max 5-sec Speed | max 5-sec Dir | max 2-min Speed | max 2-min Dir | |
| 1 | 50 | 45 | 48 | 0 | 38 | 43 | 17 | 0 | - | - | - | - | 0.00 | 29.47 | 30.16 | 2.7 | 34 | 7.2 | 18 | 29 | 16 | 30 | 1 |
| 2 | 52 | 45 | 49 | 0 | 44 | 46 | 16 | 0 | RA FG | - | - | - | 0.67 | 29.26 | 29.94 | 3.7 | 36 | 7.8 | 21 | 33 | 18 | 33 | 2 |
| 3 | 47 | 31 | 39 | 0 | 32 | 37 | 26 | 0 | - | M | - | M | T | 29.56 | 30.27 | 5.8 | 33 | 8.0 | 28 | 32 | 22 | 31 | 3 |
| 4 | 54 | 29 | 42 | 0 | 36 | 39 | 23 | 0 | RA FG | - | - | - | 0.57 | 29.01 | 30.94 | 6.2 | 21 | 12.9 | 43 | 26 | 36 | 24 | 4 |
| 5 | 50 | 40 | 45 | 0 | 31 | 38 | 20 | 0 | - | - | - | - | 0.01 | 29.06 | 29.76 | 19.7 | 27 | 20.5 | 46 | 27 | 36 | 28 | 5 |
| 6 | 55 | 47 | 51 | 0 | 39 | 45 | 14 | 0 | - | - | - | - | 0.00 | 29.04 | 29.72 | 17.6 | 23 | 17.8 | 38 | 23 | 31 | 23 | 6 |
| 7 | 63* | 35 | 49 | 0 | 40 | 45 | 16 | 0 | - | - | - | - | 0.00 | 29.11 | 29.79 | 11.5 | 26 | 15.1 | 32 | 29 | 26 | 30 | 7 |
| 8 | 44 | 30 | 37 | 0 | 25 | 32 | 28 | 0 | GR SN FG HZ | - | - | - | 0.06 | 29.56 | 30.25 | 13.1 | 29 | 13.8 | 31 | 33 | 25 | 29 | 8 |
| 9 | 37 | 27 | 32 | M | 22 | 28 | 33 | 0 | - | M | - | M | T | 29.78 | 30.52 | 1.4 | 9 | 5.3 | 14 | 36 | 10 | 1 | 9 |
| 10 | 57 | 32 | 45 | M | 29 | 40 | 20 | 0 | - | M | - | M | 0.00 | 29.56 | 30.27 | 14.6 | 20 | 15.8 | 33 | 20 | 25 | 22 | 10 |
| 11 | 58 | 32 | 45 | M | 30 | 38 | 20 | 0 | - | M | - | M | T | 29.58 | 30.27 | 6.1 | 30 | 12.4 | 35 | 23 | 26 | 23 | 11 |
| 12 | 44 | 25 | 35 | M | 22 | 29 | 30 | 0 | - | M | - | M | 0.00 | 29.73 | 30.44 | 6.6 | 6 | 7.2 | 21 | 1 | 18 | 1 | 12 |
| 13 | 40 | 24 | 32* | M | 20 | 28 | 33 | 0 | - | M | - | M | T | 29.95 | 30.68 | 4.0 | 1 | 4.6 | 21 | 34 | 15 | 36 | 13 |
| 14 | 50 | 23 | 37 | M | 24 | 31 | 28 | 0 | - | M | - | M | 0.00 | 30.05 | 30.77 | 6.3 | 25 | 6.5 | 20 | 24 | 16 | 24 | 14 |
| 15 | 55 | 30 | 43 | 0 | 31 | 37 | 22 | 0 | - | M | - | M | 0.00 | 29.88 | 30.60 | 8.8 | 23 | 9.0 | 14 | 23 | 12 | 25 | 15 |
| 16 | 55 | 30 | 43 | M | 38 | 43 | 22 | 0 | FG+ FG MIFG HZ | M | - | M | 0.00 | 29.68 | 30.39 | 6.6 | 23 | 7.2 | 20 | 23 | 16 | 23 | 16 |
| 17 | 55 | 50 | 53* | M | 47 | 49 | 12 | 0 | RA DZ FG | M | - | M | 0.06 | 29.56 | 30.25 | 10.6 | 22 | 10.8 | 22 | 22 | 18 | 22 | 17 |
| 18 | 56 | 45 | 51 | M | 50 | 51 | 14 | 0 | RA DZ FG+ FG HZ | M | - | M | 0.00 | 29.46 | 30.14 | 7.6 | 23 | 7.7 | 16 | 21 | 14 | 24 | 18 |
| 19 | 52 | 42 | 47 | M | 42 | 45 | 18 | 0 | FG+ FG HZ | M | - | M | T | 29.49 | 30.18 | 6.1 | 6 | 7.8 | 21 | 10 | 16 | 10 | 19 |
| 20 | 54 | 43 | 49 | M | 46 | 47 | 16 | 0 | RA FG | M | - | M | 0.25 | 29.33 | 30.03 | 3.1 | 15 | 8.4 | 21 | 23 | 16 | 22 | 20 |
| 21 | 54 | 39 | 47 | M | 40 | 45 | 18 | 0 | FG | M | - | M | T | 29.53 | 30.21 | 9.0 | 27 | 9.9 | 21 | 28 | 16 | 31 | 21 |
| 22 | 49 | 31 | 40 | 0 | 32 | 37 | 25 | 0 | - | - | - | - | 0.00 | 29.45 | 30.15 | 4.1 | 26 | 5.3 | 16 | 27 | 14 | 24 | 22 |
| 23 | 51 | 30 | 41 | 0 | 38 | 41 | 24 | 0 | FG | - | - | - | T | 29.27 | 29.98 | 8.4 | 19 | 9.0 | 25 | 22 | 21 | 21 | 23 |
| 24 | 50 | 39 | 45 | 0 | 41 | 42 | 20 | 0 | RA DZ FG+ FG | - | - | - | 0.72 | 29.00 | 30.56 | 10.7 | 3 | 11.5 | 35 | 3 | 28 | 5 | 24 |
| 25 | 39 | 28 | 34 | 0 | 26 | 30 | 31 | 0 | RA SN FG | - | - | - | 0.19 | 28.91 | 30.73 | 13.7 | 31 | 15.2 | 32 | 30 | 28 | 31 | 25 |
| 26 | 40 | 31 | 36 | 0 | 26 | 32 | 29 | 0 | - | - | - | - | 0.00 | 29.34 | 30.05 | 8.9 | 24 | 10.4 | 29 | 26 | 23 | 25 | 26 |
| 27 | 55 | 36 | 46 | 0 | 30 | 39 | 19 | 0 | - | - | - | - | 0.01 | 29.27 | 29.97 | 11.6 | 16 | 12.1 | 32 | 15 | 24 | 18 | 27 |
| 28 | 52 | 35 | 44 | 0 | 35 | 40 | 21 | 0 | RA FG | M | - | M | 0.36 | 29.18 | 29.86 | 15.6 | 23 | 17.9 | 45 | 24 | 35 | 24 | 28 |
| 29 | 42 | 32 | 37 | 0 | 27 | 33 | 28 | 0 | - | - | - | - | 0.00 | 29.61 | 30.31 | 3.7 | 23 | 5.3 | 17 | 31 | 14 | 30 | 29 |
| 30 | 44 | 33 | 39 | 0 | 33 | 37 | 26 | 0 | FG | - | - | - | 0.05 | 29.40 | 30.12 | 3.1 | 8 | 4.6 | 14 | 10 | 12 | 10 | 30 |
| | 50.1 | 34.6 | 42.4 | ------- | 33.8 | 38.9 | 22.3 | .0 | <Monthly Averages | Totals> | | | 2.96 | 29.44 | 30.24 | 4.5 | 24.7 | 10.2 | <Monthly Average | | | | |
| | | | .0 | ------- | <----------Departure From Normal----------> | | | | | | | | -.35 | | | | | | | | | | |

**Degree Days**

| | Monthly Total | Monthly Departure | Season to Date Total | Season to Date Departure |
|---|---|---|---|---|
| Heating: | 669 | 80 | 0 | 0 |
| Cooling: | 0 | -3 | 0 | 0 |

Greatest 24-hr Precipitation: 0.89 Date: 24-25
Greatest 24-hr Snowfall: Date:
Greatest Snow Depth: 0 Date: -

Sea Level Pressure Date Time
Maximum 30.84 14 0859
Minimum 29.26 25 0154

Number of Days with -------->
Max Temp >=90: 0
Max Temp <=32: 0
Thunderstorms : 0
Min Temp <=32: 16
Min Temp <=0 : 0
Heavy Fog : 4
Precipitation >=.01 inch: 12
Precipitation >=.10 inch: 6
Snowfall >=1.0 inch : 0

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**

# UNEDITED LOCAL CLIMATOLOGICAL DATA

**NOAA, National Climatic Data Center**

**Month: 12/2004**

**Station Location: NIAGARA FALLS INTERNATIONAL AIRPORT (IAG)**
**NIAGARA FALLS , NY**
Lat. 43°07'N Lon. 78°57'W
Elevation(Ground): 585 ft. above sea level

| Date | Temperature (Fahrenheit) Max. | Min. | Avg. | Dep From Normal | Avg. Dew pt. | Avg Wet Bulb | Degree Days Base 65 Degrees Heating | Cooling | Significant Weather | Snow/Ice on Ground(In) 0600 LST Depth | 1200 LST Water Equiv | Precipitation (In) 2400 LST Snow Fall | 2400 LST Water Equiv | Pressure(inches of Hg) Avg. Station | Avg. Sea level | Wind: Speed=mph Dir=tens of degrees Resultant Speed | Res Dir | Avg. Speed | max 5-sec Speed | max 5-sec Dir | max 2-min Speed | max 2-min Dir | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 50 | 36 | 43 | 0 | 34 | 38 | 22 | 0 | RA FG | - | - | - | 0.53 | 28.98 | 30.66 | 11.3 | 26 | 17.5 | 51 | 23 | 39 | 23 | 1 |
| 2 | 41 | 33 | 37 | 0 | 28 | 33 | 28 | 0 | SN FG | - | - | - | 0.02 | 29.28 | 29.99 | 10.9 | 25 | 11.5 | 25 | 25 | 22 | 24 | 2 |
| 3 | 35 | 22 | 29 | 0 | 22 | 28 | 36 | 0 | SN FG+ FG HZ | - | - | - | 0.18 | 29.19 | 29.91 | 12.2 | 27 | 13.3 | 38 | 29 | 31 | 28 | 3 |
| 4 | 46 | 21 | 34 | 0 | 28 | 33 | 31 | 0 | - | - | - | - | 0.01 | 29.13 | 29.84 | 16.1 | 22 | 18.0 | 46 | 23 | 38 | 22 | 4 |
| 5 | 43 | 25 | 34 | 0 | 24 | 30 | 31 | 0 | - | - | - | - | 0.00 | 29.48 | 30.21 | 5.5 | 32 | 9.7 | 25 | 29 | 22 | 30 | 5 |
| 6 | 32 | 26 | 29 | 0 | 23 | 27 | 36 | 0 | FZDZ SN FG | - | - | - | T | 29.46 | 30.16 | 13.1 | 8 | 13.1 | 26 | 9 | 21 | 9 | 6 |
| 7 | 55* | 32 | 44 | 0 | 38 | 41 | 21 | 0 | RA FG | M | - | M | 0.30 | 28.96 | 30.94 | 7.9 | 17 | 16.8 | 66 | 24 | 52 | 23 | 7 |
| 8 | 47 | 39 | 43 | 0 | 34 | 39 | 22 | 0 | - | - | - | - | 0.00 | 29.31 | 30.01 | 14.8 | 26 | 15.5 | 41 | 26 | 35 | 25 | 8 |
| 9 | 45 | 35 | 40 | 0 | 34 | 38 | 25 | 0 | FG | - | - | - | 0.02 | 29.28 | 29.98 | 5.4 | 9 | 6.2 | 15 | 10 | 13 | 9 | 9 |
| 10 | 42 | 40 | 41 | 0 | 39 | 41 | 24 | 0 | RA FG | - | - | - | 0.05 | 28.91 | 30.95 | 11.0 | 7 | 11.1 | 23 | 9 | 16 | 6 | 10 |
| 11 | 40 | 32 | 36 | 0 | 32 | 34 | 29 | 0 | RA FZRA SN FG | - | - | - | 0.15 | 28.78 | 31.57 | 7.8 | 33 | 10.3 | 23 | 29 | 18 | 30 | 11 |
| 12 | 40 | 31 | 36 | 0 | 30 | 33 | 29 | 0 | RA SN FG | - | - | - | 0.14 | 28.87 | 30.79 | 11.5 | 23 | 13.3 | 29 | 19 | 23 | 23 | 12 |
| 13 | 40 | 24 | 32 | 0 | 26 | 30 | 33 | 0 | FZDZ FG | - | - | - | T | 28.92 | 30.61 | 10.8 | 28 | 13.5 | 162 | 25 | 22 | 33 | 13 |
| 14 | 24 | 18 | 21 | 0 | 14 | 19 | 44 | 0 | SN FG FZFG HZ | - | - | - | T | 29.55 | 30.28 | 8.6 | 31 | 10.5 | 26 | 32 | 23 | 32 | 14 |
| 15 | 33 | 22 | 28 | 0 | 21 | 26 | 37 | 0 | - | - | - | - | T | 29.66 | 30.39 | 14.2 | 24 | 15.0 | 37 | 21 | 26 | 23 | 15 |
| 16 | 41 | 31 | 36 | 0 | 24 | 31 | 29 | 0 | RA SN FG HZ | - | - | - | 0.04 | 29.40 | 30.11 | 21.4 | 22 | 21.9 | 43 | 24 | 33 | 23 | 16 |
| 17 | 35 | 20 | 28 | 0 | 16 | 23 | 37 | 0 | SN FG HZ | - | - | - | T | 29.53 | 30.25 | 9.3 | 28 | 11.4 | 36 | 29 | 29 | 29 | 17 |
| 18 | 41 | 24 | 33 | 0 | 25 | 31 | 32 | 0 | RA FG | - | - | - | 0.03 | 29.21 | 29.93 | 10.9 | 20 | 12.8 | 32 | 22 | 28 | 22 | 18 |
| 19 | 38 | 2 | 20 | 0 | 8 | 13 | 45 | 0 | RA SN FG FZFG BLSN | - | - | - | 0.03 | 29.22 | 29.95 | 16.3 | 32 | 18.1 | 35 | 33 | 29 | 31 | 19 |
| 20 | 14 | 0 | 7* | 0 | -3 | 4 | 58 | 0 | SN BLSN | - | - | - | T | 29.41 | 30.17 | 3.4 | 34 | 9.6 | 24 | 33 | 21 | 33 | 20 |
| 21 | 41 | 13 | 27 | 0 | 19 | 25 | 38 | 0 | HZ | - | - | - | T | 29.17 | 29.90 | 9.1 | 20 | 11.9 | 28 | 24 | 23 | 23 | 21 |
| 22 | 41 | 28 | 35 | 0 | 29 | 32 | 30 | 0 | SN FG | M | - | M | 0.19 | 29.41 | 30.13 | 8.2 | 25 | 9.3 | 23 | 24 | 18 | 24 | 22 |
| 23 | 48 | 18 | 33 | 0 | 24 | 27 | 32 | 0 | RA FZRA SN FG | M | - | M | 1.07 | 29.13 | 30.22 | 6.1 | 28 | 16.2 | 36 | 26 | 30 | 27 | 23 |
| 24 | 21 | 9 | 15 | 0 | 7 | 13 | 50 | 0 | SN FG FZFG | - | - | - | T | 29.50 | 30.23 | 12.5 | 26 | 12.8 | 24 | 27 | 21 | 28 | 24 |
| 25 | 17 | 0 | 9 | 0 | 2 | 10 | 56 | 0 | - | - | - | - | 0.00 | 29.60 | 30.34 | 2.2 | 18 | 7.9 | 23 | 28 | 20 | 28 | 25 |
| 26 | 23 | 16 | 20 | M | 12 | 17 | 45 | 0 | SN FG | 5 | - | 2.0 | 0.06 | 29.61 | 30.33 | 7.4 | 5 | 9.0 | 25 | 4 | 22 | 3 | 26 |
| 27 | 18 | 6 | 12 | M | 4 | 11 | 53 | 0 | FG HZ | 5 | - | T | T | 29.87 | 30.63 | 5.8 | 30 | 7.8 | 14 | 27 | 13 | 27 | 27 |
| 28 | 38 | 5 | 22 | M | 16 | 22 | 43 | 0 | SN FG HZ BLSN | 4 | - | 0.3 | 0.01 | 29.56 | 30.30 | 12.8 | 21 | 13.9 | 38 | 23 | 31 | 22 | 28 |
| 29 | 37 | 32 | 35 | M | 30 | 33 | 30 | 0 | DZ FG HZ | 3 | - | 0.0 | T | 29.48 | 30.19 | 8.9 | 25 | 9.8 | 31 | 23 | 24 | 25 | 29 |
| 30 | 44 | 32 | 38 | M | 32 | 35 | 27 | 0 | FG HZ | 2 | - | 0.0 | T | 29.61 | 30.32 | 4.7 | 12 | 5.4 | 16 | 17 | 13 | 15 | 30 |
| 31 | 53 | 43 | 48* | M | 45 | 47 | 17 | 0 | RA DZ FG | T | - | 0.0 | 0.46 | 29.32 | 30.01 | 20.3 | 21 | 22.1 | 46 | 26 | 37 | 24 | 31 |
| | 37.5 | 23.1 | 30.3 | ------- | 23.1 | 27.9 | 34.5 | .0 | <Monthly Averages | Totals> | | | 3.23 | 29.32 | 30.30 | 5.7 | 24.5 | 12.8 | <Monthly Average | | | | |
| | | | .0 | ------- | <----------Departure From Normal----------> | | | | | | | | 0.16 | | | | | | | | | | |

**Degree Days**

| | Monthly Total | Monthly Departure | Season to Date Total | Season to Date Departure |
|---|---|---|---|---|
| Heating: | 1070 | 186 | 0 | 0 |
| Cooling: | 0 | 0 | 0 | 0 |

Greatest 24-hr Precipitation: 1.26 Date: 22-23
Greatest 24-hr Snowfall: Date:
Greatest Snow Depth: 0 Date: -

Sea Level Pressure Date Time
Maximum 30.69 27 1804
Minimum 29.31 1 0757

Number of Days with -------->
Max Temp >=90: 0
Max Temp <=32: 7
Thunderstorms : 0
Min Temp <=32: 25
Min Temp <=0 : 2
Heavy Fog : 1
Precipitation >=.01 inch: 16
Precipitation >=.10 inch: 8
Snowfall >=1.0 inch : 1

*** EXTREME FOR THE MONTH - LAST OCCURRENCE IF MORE THAN ONE.**