Docket No: 50-461

CLINTON POWER STATION

Annual Radiological Groundwater Protection Program Report -ARGPP

January 1 through December 31, 2016

Prepared By
Teledyne Brown Engineering
Environmental Services

Exelon Generation

Clinton Power Station
Clinton, IL 61727

April 2017

Intentionally Left Blank

Table Of Contents

Appendices

I. Summary and Conclusions

In 2006, Exelon instituted a comprehensive program to evaluate the impact of station operations on groundwater and surface water in the vicinity of Clinton Power Station (CPS). This evaluation involved numerous station personnel and contractor support personnel. This report covers groundwater and surface water samples, collected outside of the Licensee required Off-Site Dose Calculation Manual (ODCM) requirements, both on and off station property in 2016. During that time period, 257 analyses were performed on 97 samples from 24 locations. The monitoring was conducted in four phases.

In assessing all the data gathered for this report, it was concluded that the operation of CPS had no adverse radiological impact on the environment, and there are no known active releases into the groundwater or surface water at CPS. No program changes occurred during the sampling year of 2016.

Gamma-emitting radionuclides associated with licensed plant operations were not detected at concentrations greater than their respective Lower Limits of Detection (LLDs) as specified in NUREG-1302 in any of the groundwater or surface water samples. In the case of tritium, Exelon specified that the independent laboratory achieve a lower limit of detection 10 times lower than that required by the United States Environmental Protection Agency (USEPA) regulation.

Strontium-89 (Sr-89) was not detected in any samples. Strontium-90 (Sr-90) was not detected in any samples.

Tritium was not detected in any of the groundwater or surface water samples at concentrations greater than the United States Environmental Protection Agency (USEPA) drinking water standard (and the Nuclear Regulatory Commission Reporting Limit) of 20,000 pCi/L. Background levels of tritium were detected at concentrations greater than the self-imposed LLD of 200 pCi/L in four of 17 groundwater monitoring locations. The tritium concentrations ranged from 196 ± 121 pCi/L to 309 ± 131 pCi/L. Tritium was not detected in any surface water or precipitation water samples.

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on groundwater samples during the third quarter of sampling in 2016. Gross Alpha (dissolved and suspended) was not detected at any of the groundwater locations. Gross Beta (dissolved) was detected in 11 of 17 groundwater locations. The concentrations ranged from 2.0 to 13.8 pCi/L. Gross Beta (suspended) was not detected at any of the groundwater locations.

Hard-To-Detect analyses were performed on two groundwater locations. The analyses included Iron-55 (Fe-55), Nickel-63 (Ni-63), Americium-241 (Am-241),

Cerium-242 (Cm-242), Cerium-243/244 (Cm-243/244), Plutonium-238 (Pu-238), Plutonium-239/240 (Pu-239/240), Uranium-234 (U-234), Uranium-235 (U-235) and Uranium-238 (U-238). All hard-to-detect nuclides analyzed were not found at concentrations greater than their respective MDCs.

II. Introduction

The Clinton Power Station (CPS), consisting of one approximately 1,140 MW gross electrical power output boiling water reactor is located in Harp Township, DeWitt County, Illinois. CPS is owned and operated by Exelon and became operational in 1987. Unit No. 1 went critical on 15 February 1987. The site encloses approximately 13,730 acres. This includes the 4,895 acre, man-made cooling lake and about 452 acres of property not owned by Exelon. The plant is situated on approximately 150 acres. The cooling water discharge flume, which discharges to the eastern arm of the lake, occupies an additional 130 acres. Although the nuclear reactor, supporting equipment and associated electrical generation and distribution equipment lie in Harp Township, portions of the aforementioned 13,730 acre plot reside within Wilson, Rutledge, DeWitt, Creek, Nixon and Santa Anna Townships.

This report covers those analyses performed by Teledyne Brown Engineering (TBE) on samples collected in 2016.

A. Objectives of the Radiological Groundwater Protection Program (RGPP)

The long-term objectives of the RGPP are as follows:

1. Identify suitable locations to monitor and evaluate potential impacts from station operations before significant radiological impact to the environment and potential drinking water sources.

2. Understand the local hydrogeologic regime in the vicinity of the station and maintain knowledge of flow patterns on the surface and shallow subsurface.

3. Perform routine water sampling and radiological analysis of water from selected locations.

4. Report new leaks, spills, or other detections with potential radiological significance to stakeholders in a timely manner.

5. Regularly assess analytical results to identify adverse trends.

6. Take necessary corrective actions to protect groundwater resources.

B. Implementation of the Objectives

The objectives identified have been implemented at Clinton Power Station as discussed below:

1. Exelon and its consultant identified locations as described in the Phase 1 study. Phase 1 studies were conducted by Connestoga Rovers and Associates (CRA) and the results and conclusions were made available to state and federal regulators as well as the public in station specific reports.

2. The Clinton Power Station reports describe the local hydrogeologic regime. Periodically, the flow patterns on the surface and shallow subsurface are updated based on ongoing measurements.

3. Clinton Power Station will continue to perform routine sampling and radiological analysis of water from selected locations.

4. Clinton Power Station has implemented new procedures to identify and report new leaks, spills, or other detections with potential radiological significance in a timely manner.

5. Clinton Power Station staff and consulting hydrogeologist assess analytical results on an ongoing basis to identify adverse trends.

C. Program Description

1. Sample Collection

Sample locations can be found in Table A–1 and Figures A–1, A–2, A–3, and A–4 Appendix A.

Groundwater, Surface Water and Precipitation Water

Samples of water are collected, managed, transported and analyzed in accordance with approved procedures following regulatory methods. Groundwater, surface water, and precipitation water are collected. Sample locations, sample collection frequencies and analytical frequencies are controlled in accordance with approved station procedures. Contractor and/or station personnel are trained in the collection, preservation management, and shipment of samples, as well as in documentation of sampling events. Analytical laboratories are subject to internal quality assurance programs and inter-laboratory cross-check programs, as well as nuclear industry audits. Station personnel review and evaluate all analytical data deliverables after initial review by the contractor.

Analytical data results are reviewed by both station personnel and an independent hydrogeologist for adverse trends or changes to

hydrogeologic conditions.

D. Characteristics of Tritium (H-3)

Tritium (chemical symbol H-3) is a radioactive isotope of hydrogen. The most common form of tritium is tritium oxide, which is also called "tritiated water." The chemical properties of tritium are essentially those of ordinary hydrogen.

Tritiated water behaves the same as ordinary water in both the environment and the body. Tritium can be taken into the body by drinking water, breathing air, eating food, or absorption through skin. Once tritium enters the body, it disperses quickly and is uniformly distributed throughout the body. Tritium is excreted primarily through urine with a clearance rate characterized by an effective biological half-life of about 14 days. Within one month or so after ingestion, essentially all tritium is cleared. Organically bound tritium (tritium that is incorporated in organic compounds) can remain in the body for a longer period.

Tritium is produced naturally in the upper atmosphere when cosmic rays strike air molecules. Tritium is also produced during nuclear weapons explosions, as a by-product in reactors producing electricity, and in special production reactors, where the isotopes Lithium-7 (Li-7) and/or Boron-10 (B-10) are activated to produce tritium. Like normal water, tritiated water is colorless and odorless. Tritiated water behaves chemically and physically like non-tritiated water in the subsurface, and therefore tritiated water will travel at the same velocity as the average groundwater velocity.

Tritium has a half-life of approximately 12.3 years. It decays spontaneously to Helium-3 (3He). This radioactive decay releases a beta particle (low-energy electron). The radioactive decay of tritium is the source of the health risk from exposure to tritium. Tritium is one of the least dangerous radionuclides because it emits very weak beta radiation and leaves the body relatively quickly. Since tritium is almost always found as water, it goes directly into soft tissues and organs. The associated dose to these tissues is generally uniform and is dependent on the water content of the specific tissue.

III. Program Description

A. Sample Analysis

This section describes the general analytical methodologies used by TBE to analyze the environmental samples for radioactivity for the Clinton

Power Station RGPP in 2016. In order to achieve the stated objectives, the current program includes the following analyses:

1. Concentrations of gamma emitters in groundwater and surface water
2. Concentrations of strontium in groundwater
3. Concentrations of tritium in groundwater and surface water
4. Concentrations of gross alpha and gross beta in groundwater
5. Concentrations of Am-241 in groundwater
6. Concentrations of Cm-242 and Cm-243/244 in groundwater
7. Concentrations of Pu-238 and Pu-239/240 in groundwater
8. Concentrations of U-234, U-235 and U-238 in groundwater
9. Concentrations of Fe-55 in groundwater
10. Concentrations of Ni-63 in groundwater

B. Data Interpretation

The radiological data collected prior to Clinton Power Station becoming operational were used as a baseline with which these operational data were compared. For the purpose of this report, Clinton Power Station was considered operational at initial criticality. Several factors were important in the interpretation of the data:

1. Lower Limit of Detection and Minimum Detectable Concentration

The lower limit of detection (LLD) is defined as the smallest concentration of radioactive material in a sample that would yield a net count (above background) that would be detected with only a 5% probability of falsely concluding that a blank observation represents a "real" signal. The LLD is intended as an *a priori* (a before the fact) estimate of a system (including instrumentation, procedure and sample type) and not as an *a posteriori* (after the fact) criteria for the presence of activity. All analyses were designed to achieve the required CPS detection capabilities for environmental sample analysis.

The minimum detectable concentration (MDC) is defined above with the exception that the measurement is an *a posteriori* (after the fact) estimate of the presence of activity.

2. Laboratory Measurements Uncertainty

The estimated uncertainty in measurement of tritium in environmental samples is frequently on the order of 50% of the measurement value. Statistically, the exact value of a measurement is expressed as a range with a stated level of confidence. The convention is to report results with a 95% level of confidence. The uncertainty comes from calibration standards, sample volume or weight measurements, sampling uncertainty and other factors. Exelon reports the uncertainty of a measurement created by statistical process (counting error) as well as all sources of error (Total Propagated Uncertainty or TPU). Each result has two values calculated. Exelon reports the TPU by following the result with plus or minus ± the estimated sample standard deviation, as TPU, that is obtained by propagating all sources of analytical uncertainty in measurements.

Analytical uncertainties are reported at the 95% confidence level in this report for reporting consistency with the AREOR.

C. Background Analysis

Pre-operational Radiological Environmental Monitoring Program (pre-operational REMP) was conducted to establish background radioactivity levels prior to operation of the Station. The environmental media sampled and analyzed during the pre-operational REMP were atmospheric radiation, fall-out, domestic water, surface water, marine life, milk, and vegetation. The results of the monitoring were detailed in the report entitled, Environmental Radiological Monitoring for Clinton Power Nuclear Power Station, Illinois Power Company, Annual Report 1987, May 1988.

The pre-operational REMP contained analytical results from samples collected from the surface water and groundwater.

1. Background Concentrations of Tritium

The purpose of the following discussion is to summarize background measurements of tritium in various media performed by others:

a. Tritium Production

Tritium is created in the environment from naturally-occurring processes both cosmic and subterranean, as well as from anthropogenic (i.e., man-made) sources. In the upper atmosphere, "Cosmogenic" tritium is produced from the bombardment of stable nuclides and combines with oxygen to form tritiated water, which will then enter the hydrologic cycle. Below ground, "lithogenic" tritium is produced by the bombardment of natural lithium present in crystalline rocks by neutrons produced by the radioactive decay of naturally abundant uranium and thorium. Lithogenic production of tritium is usually negligible compared to other sources due to the limited abundance of lithium in rock. The lithogenic tritium is introduced directly to groundwater.

A major anthropogenic source of tritium and Sr-90 comes from the former atmospheric testing of thermonuclear weapons. Levels of tritium in precipitation increased significantly during the 1950s and early 1960s, and later with additional testing, resulting in the release of significant amounts of tritium to the atmosphere. The Canadian heavy water nuclear power reactors, other commercial power reactors, nuclear research and weapons production continue to influence tritium concentrations in the environment.

b. Precipitation Data

Precipitation samples are routinely collected at stations around the world for the analysis of tritium and other radionuclides. Two publicly available databases that provide tritium concentrations in precipitation are Global Network of Isotopes in Precipitation (GNIP) and USEPA's RadNet database. GNIP provides tritium precipitation concentration data for samples collected world wide from 1960 to 2006. RadNet provides tritium precipitation concentration data for samples collected at stations through out the U.S. from 1960 up to and including 2006. Based on GNIP data for sample stations located in the U.S. Midwest, tritium concentrations peaked around 1963. This peak, which approached 10,000 pCi/L for some stations, coincided with the atmospheric testing of thermonuclear weapons. Tritium concentrations in surface water showed a sharp decline up until 1975, followed by a gradual decline since that time. Tritium

concentrations in Midwest precipitation have typically been below 100 pCi/L since around 1980. Tritium concentrations in wells may still be above the 200 pCi/L detection limit from the external causes described above.

c. Surface Water Data

Tritium concentrations are routinely measured in Clinton Lake.

According to the USEPA, surface water data typically has an uncertainty ± 70 to 100 pCi/L 95% confidence bound on each given measurement. Therefore, the typical background data provided may be subject to measurement uncertainty of approximately ± 70 to 100 pCi/L.

The radio-analytical laboratory is counting tritium results to an Exelon specified LLD of 200 pCi/L. Typically, the lowest positive measurement will be reported within a range of 40 – 240 pCi/L or 140 ± 100 pCi/L. Clearly, these sample results cannot be distinguished as different from background at this concentration.

IV. Results and Discussion

A. Program Exceptions

1. Sample Anomalies

January 20, 2016, IR 03964938

The LLD for dissolved gross alpha analysis is 3 pCi/L per Table 1 of Attachment 5 of EN-AA-408-4000. This analysis is performed by Teledyne Brown Engineering (TBE). The lab notified the station that that could not reach EN-AA-408-4000's MDC in Monitoring Wells WM-CL-17S and MS-CL-19S due to high sold content in the samples. The vendor extended the count time to 200 minutes to achieve the lowest possible MDC, but were only capable of obtaining MDC's of 4.88E+00 pCi/L for MS-CL-17S and 3.65E+00 pCi/L for MS-CL-19S (results found on Report #L69299). This is not a procedural discrepancy – there is no regulatory requirement for perform gross alpha analysis on these samples and no plant/RGPP impacts either.

2. Missed Samples

There were no missed samples in 2016.

B. Program Changes

Changes were made to the annual precipitation/recapture study sample locations. Locations RG-NE, RG-26, and MPT-1 were removed from the program, which RG-WNW, RG-NNW, RG-NW, and RG-ENE sample locations were added due to the 2016 wind rose data.

C. Groundwater Results

Groundwater

Baseline samples were collected from off-site wells during four (4) phases at the station. Analytical results are discussed below:

Tritium

Samples from 17 locations were analyzed for tritium activity (Table B–I.1 Appendix B). Tritium values ranged from below the Exelon imposed LLD of 200 pCi/l to 309 pCi/l.

Strontium

Sr-89 was not detected in any of the 17 samples analyzed and the required LLD of 10 pCi/L was met. Sr-90 was also not detected in any of the 17 samples analyzed and the required LLD of 1 pCi/L was met. (Table B-I.1 Appendix B).

Gross Alpha and Gross Beta (dissolved and suspended)

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on groundwater samples during the third quarter of sampling in 2016. Gross Alpha (dissolved and suspended) was not detected at any of the groundwater locations. Gross Beta (dissolved) was detected in 11 of 17 groundwater locations. The concentrations ranged from 2.0 to 13.8 pCi/L. Gross Beta (suspended) was not detected at any of the groundwater locations (Table B–I.1 Appendix B).

Gamma Emitters

No plant-produced radionuclides were detected (Table B–I.2,

Appendix B).

Hard-To-Detect

Hard-To-Detect analyses were performed on two groundwater locations to establish background levels. The analyses included Fe-55, Ni-63, Am-241, Cm-242, Cm-243/244, Pu-238, Pu-239/240, U-234, U-235, and U-238. One sample detected U-234 and U-238. Occasionally, the isotopes of U-234 and U-238 are detected at low levels and indistinguishable from background. All other hard-to-detect nuclides were not detected at concentrations greater than their respective MDCs (Table B–I.3 Appendix B).

D. Surface Water Results

Surface Water

Baseline samples were collected from on-site surface waters during four (4) phases at the station. Analytical results are discussed below. No anomalies were noted during the year.

Tritium

Samples from seven locations were analyzed for tritium activity (Table B–II.1 Appendix B). Tritium was not detected at concentrations greater than the LLD.

Strontium

Strontium was not analyzed in 2016 (Table B–II.1 Appendix B).

Gamma Emitters

No plant-produced radionuclides were detected (Table B–II.2, Appendix B)

E. Precipitation Water Results

Precipitation Water

Precipitation water samples were collected at 10 locations during 2016 and analyzed for tritium activity (Table B–III.1 Appendix B). Tritium was not detected at concentrations greater than the LLD.

F. Recapture

Clinton Power Station conducted recapture precipitation sampling and analysis per the Radiological Groundwater Protection Program. No consistent indication of recapture was identified.

G. Summary of Results – Inter-Laboratory Comparison Program

Inter-Laboratory Comparison Program results for TBE are presented in the Annual Radiological Environmental Operating Report.

H. Errata Data

There was no errata data for 2016.

I. Leaks, Spills, and Releases

No leaks, spills or releases were identified during the year.

J. Trends

No trends have been identified in 2016.

K. Investigations

Currently no investigations are on-going.

L. Actions Taken

1. Compensatory Actions

   There have been no station events requiring compensatory actions at the Clinton Power Station in 2016.

2. Installation of Monitoring Wells

   No new wells were installed during the 2016.

3. Actions to Recover/Reverse Plumes

   No actions were required to recover or reverse groundwater plumes.

APPENDIX A

LOCATION DESIGNATION OF THE ANNUAL RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM REPORT (ARGPPR)

Intentionally Left Blank

TABLE A-1: Radiological Groundwater Protection Program - Sampling Locations, Clinton PowerStation, 2016

Site	Site Type
B-3	Monitoring Well
MW-CL-1	Monitoring Well
MW-CL-2	Monitoring Well
MW-CL-12I	Monitoring Well
MW-CL-13I	Monitoring Well
MW-CL-13S	Monitoring Well
MW-CL-14S	Monitoring Well
MW-CL-15I	Monitoring Well
MW-CL-15S	Monitoring Well
MW-CL-16S	Monitoring Well
MW-CL-17S	Monitoring Well
MW-CL-18I	Monitoring Well
MW-CL-18S	Monitoring Well
MW-CL-19S	Monitoring Well
MW-CL-20S	Monitoring Well
MW-CL-21S	Monitoring Well
MW-CL-22S	Monitoring Well
Sewage Treatment Plant	Surface Water
SW-CL-1	Surface Water
SW-CL-2	Surface Water
SW-CL-4	Surface Water
SW-CL-5	Surface Water
SW-CL-6	Surface Water
SW-CL-7	Surface Water
RG-2	Precipitation Water
RG-3	Precipitation Water
RG-15	Precipitation Water
RG-ENE	Precipitation Water
RG-N	Precipitation Water
RG-NNE	Precipitation Water
RG-NNW	Precipitation Water
RG-NW	Precipitation Water
RG-S	Precipitation Water
RG-WNW	Precipitation Water

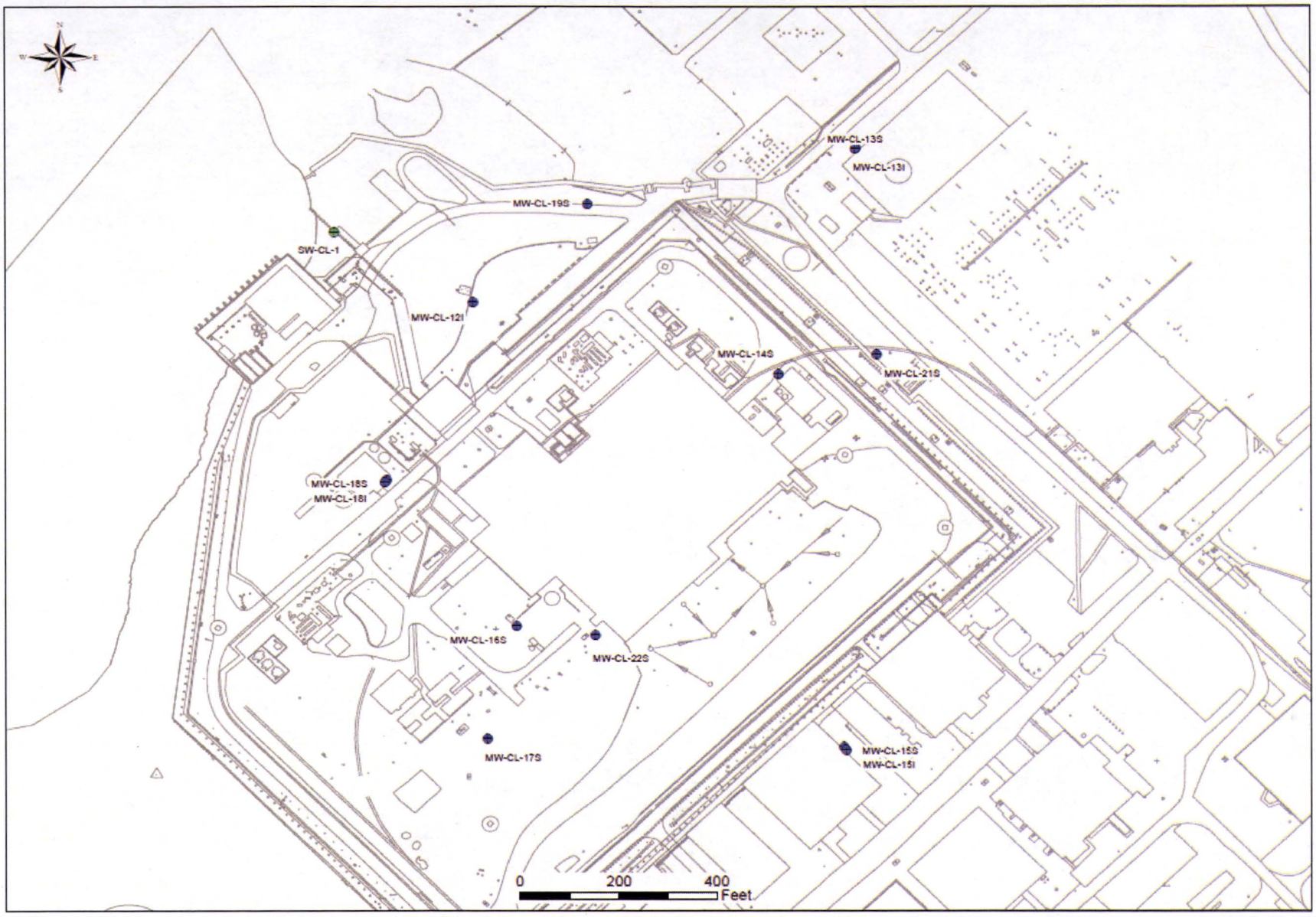

Figure A – 1
Onsite Sampling Locations at Clinton Power Station

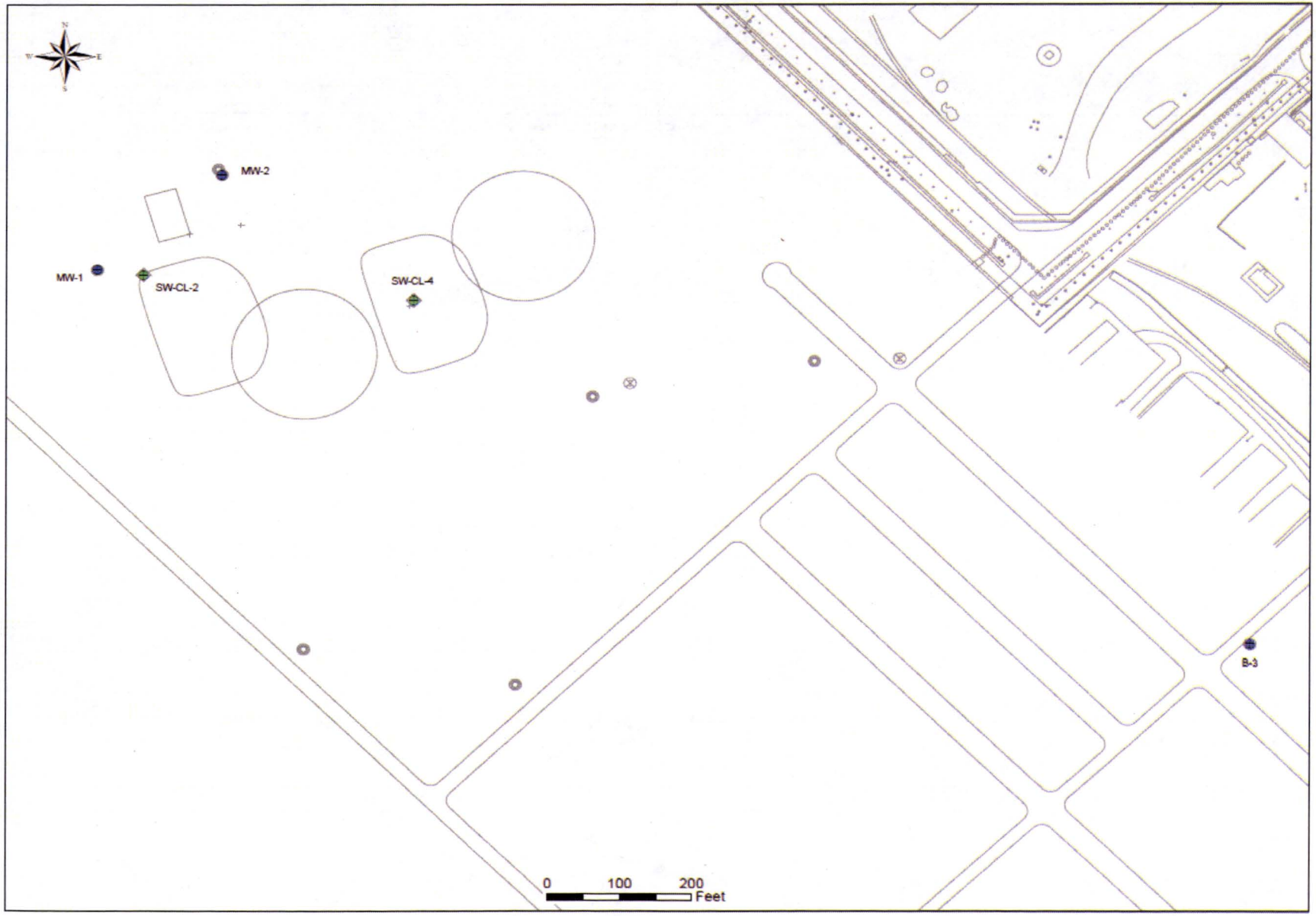

Figure A – 2
Sampling Locations South of Clinton Power Station

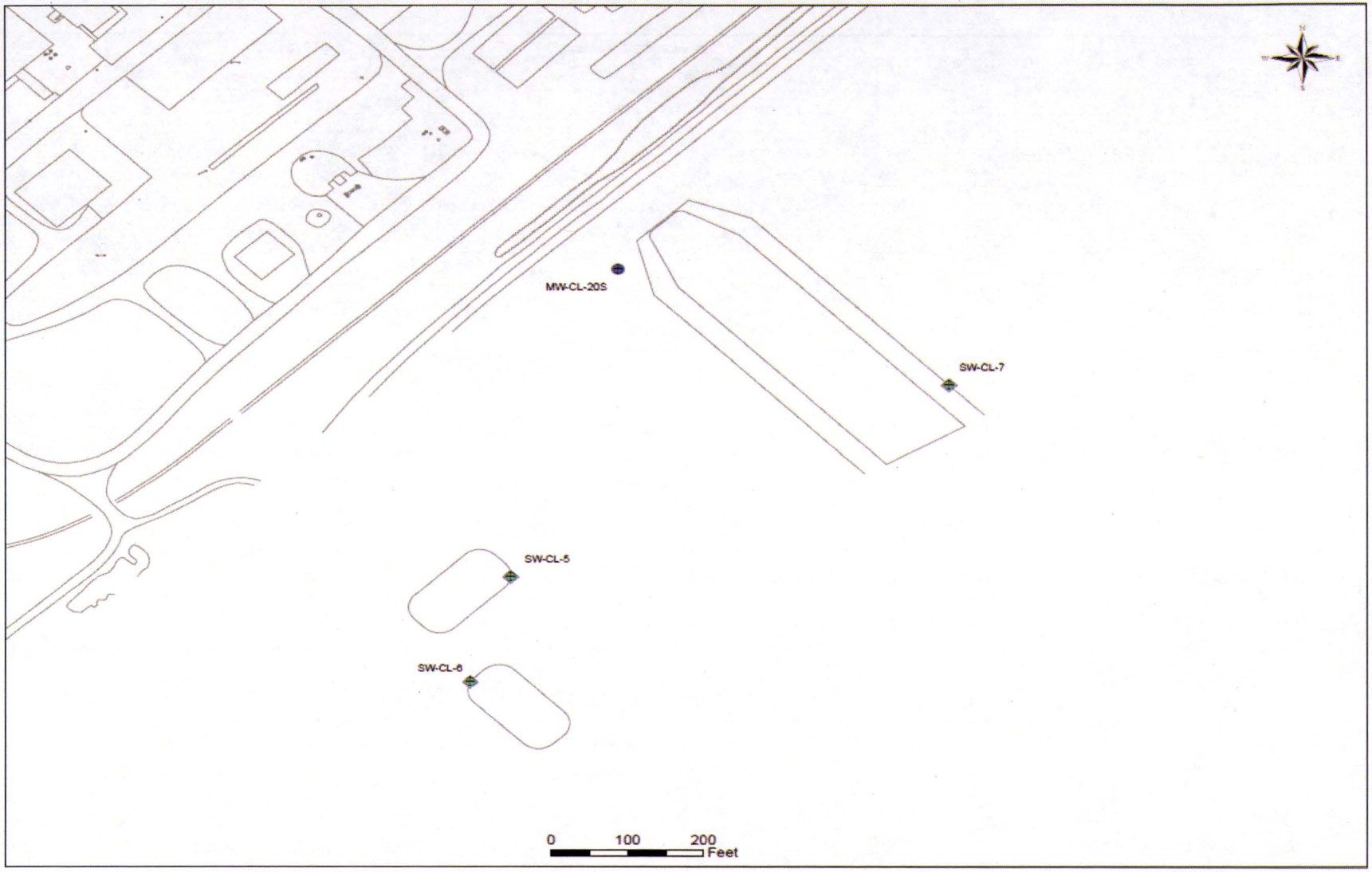

Figure A – 3
Sampling Locations East of Clinton Power Station

Figure A – 4
Recapture Sampling Locations of Clinton Power Station

Intentionally Left Blank

APPENDIX B

DATA TABLES OF THE ANNUAL RADIOLOGICAL GROUNDWATER PROTECTION PROGRAM REPORT (ARGPPR)

Intentionally left blank

TABLE B-I.1 CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA AND GROSS BETA IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2016

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	H-3	Sr-89	Sr-90	Gr-A (Dis)	Gr-A (Sus)	Gr-B (Dis)	Gr-B (Sus)
B-3	02/01/16	< 192						
B-3	05/02/16	< 183						
B-3	08/08/16	< 176	< 2.5	< 0.7	< 2.0	< 0.7	2.4 ± 0.9	< 1.4
B-3	10/31/16	< 189						
MW-CL-1	02/01/16	< 187						
MW-CL-1	05/02/16	< 183						
MW-CL-1	08/08/16	< 175	< 4.0	< 0.8	< 1.8	< 0.7	2.2 ± 0.9	< 1.4
MW-CL-1	10/31/16	< 194						
MW-CL-2	02/01/16	< 186						
MW-CL-2	05/02/16	< 183						
MW-CL-2	08/08/16	< 176	< 4.1	< 0.8	< 2.2	< 0.7	3.1 ± 1.1	< 1.4
MW-CL-2	10/31/16	< 193						
MW-CL-12I	02/01/16	< 187						
MW-CL-12I	05/02/16	< 177						
MW-CL-12I	08/08/16	< 175	< 3.8	< 0.7	< 1.9	< 0.7	3.9 ± 1.0	< 1.4
MW-CL-12I	10/31/16	< 194						
MW-CL-13I	02/01/16	< 187						
MW-CL-13I	05/02/16	< 185						
MW-CL-13I	08/09/16	< 176	< 4.9	< 0.6	< 1.1	< 0.7	< 1.4	< 1.4
MW-CL-13I	11/01/16	< 193						
MW-CL-13S	02/01/16	309 ± 131						
MW-CL-13S	05/02/16	196 ± 121						
MW-CL-13S	08/09/16	< 179	< 2.8	< 0.7	< 1.2	< 0.7	< 1.5	< 1.4
MW-CL-13S	11/01/16	< 191						
MW-CL-14S	02/02/16	218 ± 125						
MW-CL-14S	05/03/16	263 ± 123						
MW-CL-14S	08/09/16	229 ± 117	< 3.0	< 0.7	< 2.8	< 0.7	13.8 ± 1.9	< 1.4
MW-CL-14S	11/01/16	< 195						
MW-CL-15I	02/01/16	< 186						
MW-CL-15I	05/02/16	< 185						
MW-CL-15I	08/08/16	< 176	< 4.4	< 0.9	< 1.0	< 0.8	< 1.3	< 1.4
MW-CL-15I	10/31/16	< 193						
MW-CL-15S	02/01/16	< 190						
MW-CL-15S	05/02/16	< 184						
MW-CL-15S	08/08/16	< 177	< 3.0	< 0.8	< 0.8	< 0.5	< 1.0	< 1.4
MW-CL-15S	10/31/16	< 190						
MW-CL-16S	02/02/16	238 ± 126						
MW-CL-16S	02/02/16	< 196						
MW-CL-16S	05/03/16	< 186						
MW-CL-16S	08/09/16	< 175	< 4.6	< 1.0	< 1.3	< 1.0	2.4 ± 0.9	< 1.6
MW-CL-16S	11/01/16	< 195						
MW-CL-17S	02/02/16	< 188						
MW-CL-17S	05/03/16	< 183						
MW-CL-17S	08/09/16	< 176	< 4.5	< 0.8	< 4.9	< 0.5	3.9 ± 1.5	< 1.5
MW-CL-17S	11/01/16	< 197						
MW-CL-18I	02/02/16	< 191						
MW-CL-18I	05/03/16	< 184						
MW-CL-18I	08/09/16	< 176	< 2.8	< 0.6	< 1.6	< 0.5	2.0 ± 1.0	< 1.4
MW-CL-18I	11/01/16	< 196						

TABLE B-I.1 CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA AND GROSS BETA IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2016

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	H-3	Sr-89	Sr-90	Gr-A (Dis)	Gr-A (Sus)	Gr-B (Dis)	Gr-B (Sus)
MW-CL-18S	02/02/16	< 191						
MW-CL-18S	05/03/16	< 181						
MW-CL-18S	08/09/16	< 175	< 8.4	< 0.7	< 2.0	< 0.5	4.9 ± 1.5	< 1.4
MW-CL-18S	11/01/16	< 191						
MW-CL-19S	02/01/16	< 186						
MW-CL-19S	05/02/16	< 184						
MW-CL-19S	08/08/16	< 176	< 4.8	< 1.0	**< 3.7**	< 0.6	5.4 ± 1.7	< 1.5
MW-CL-19S	10/31/16	< 194						
MW-CL-20S	02/01/16	< 186						
MW-CL-20S	05/02/16	< 183						
MW-CL-20S	08/08/16	< 175	< 8.5	< 0.8	< 1.3	< 0.5	< 1.8	< 1.4
MW-CL-20S	10/31/16	< 195						
MW-CL-21S	02/01/16	< 191						
MW-CL-21S	05/02/16	211 ± 122						
MW-CL-21S	08/08/16	< 177	< 3.9	< 0.8	< 1.1	< 0.5	< 1.5	< 1.4
MW-CL-21S	10/31/16	< 190						
MW-CL-22S	02/02/16	< 190						
MW-CL-22S	05/03/16	< 180						
MW-CL-22S	08/09/16	< 178	< 6.2	< 0.6	< 1.3	< 0.5	10.8 ± 1.5	< 1.4
MW-CL-22S	11/01/16	< 195						

Bolded values indicate LLD was not met due to high solids content in the sample

Table B-I.2

CONCENTRATIONS OF GAMMA EMITTERS IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2016

RESULTS IN UNITS OF PCI/LITER + SIGMA

SITE	COLLECTION DATE	Be-7	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
B-3	08/08/16	< 50	< 48	< 4	< 5	< 9	< 5	< 11	< 7	< 8	< 5	< 6	< 29	< 8
MW-CL-1	08/08/16	< 59	< 147	< 7	< 6	< 14	< 8	< 13	< 7	< 11	< 5	< 8	< 31	< 13
MW-CL-2	08/08/16	< 45	< 55	< 5	< 4	< 10	< 6	< 11	< 5	< 9	< 4	< 6	< 23	< 9
MW-CL-12I	08/08/16	< 48	< 99	< 5	< 5	< 11	< 6	< 11	< 5	< 10	< 5	< 6	< 28	< 9
MW-CL-13I	08/09/16	< 57	< 107	< 7	< 7	< 10	< 5	< 13	< 7	< 12	< 7	< 6	< 30	< 8
MW-CL-13S	08/09/16	< 64	< 37	< 8	< 8	< 21	< 11	< 17	< 9	< 12	< 9	< 9	< 43	< 12
MW-CL-14S	02/02/16	< 41	< 94	< 5	< 6	< 10	< 5	< 11	< 6	< 11	< 5	< 5	< 28	< 12
MW-CL-14S	05/03/16	< 64	< 63	< 7	< 7	< 12	< 5	< 14	< 6	< 12	< 6	< 6	< 34	< 10
MW-CL-14S	08/09/16	< 45	< 41	< 5	< 4	< 11	< 4	< 10	< 5	< 7	< 4	< 5	< 22	< 7
MW-CL-15I	08/08/16	< 40	< 66	< 4	< 4	< 9	< 4	< 7	< 4	< 8	< 4	< 4	< 23	< 6
MW-CL-15S	08/08/16	< 33	< 37	< 4	< 3	< 7	< 4	< 6	< 4	< 6	< 3	< 4	< 20	< 6
MW-CL-16S	08/09/16	< 56	< 114	< 5	< 3	< 10	< 7	< 7	< 6	< 8	< 5	< 5	< 26	< 4
MW-CL-17S	08/09/16	< 45	< 99	< 5	< 5	< 9	< 5	< 9	< 5	< 8	< 4	< 5	< 25	< 9
MW-CL-18I	08/09/16	< 62	< 66	< 7	< 6	< 14	< 5	< 13	< 7	< 10	< 7	< 7	< 29	< 8
MW-CL-18S	08/09/16	< 45	< 102	< 6	< 5	< 12	< 5	< 10	< 5	< 8	< 5	< 6	< 28	< 9
MW-CL-19S	08/08/16	< 42	< 82	< 4	< 4	< 8	< 4	< 8	< 4	< 7	< 4	< 5	< 23	< 8
MW-CL-20S	08/08/16	< 49	< 60	< 6	< 6	< 13	< 6	< 13	< 7	< 10	< 6	< 6	< 32	< 11
MW-CL-21S	02/01/16	< 51	< 139	< 5	< 6	< 14	< 8	< 11	< 6	< 10	< 5	< 7	< 33	< 9
MW-CL-21S	05/02/16	< 50	< 87	< 5	< 4	< 9	< 5	< 8	< 5	< 10	< 5	< 6	< 29	< 10
MW-CL-21S	08/08/16	< 57	< 131	< 6	< 5	< 12	< 7	< 10	< 6	< 11	< 5	< 6	< 33	< 8
MW-CL-22S	08/09/16	< 43	< 38	< 4	< 5	< 10	< 5	< 10	< 5	< 8	< 5	< 6	< 26	< 5

TABLE B-I.3

CONCENTRATIONS OF HARD TO DETECTS IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2016

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	Am-241	Cm-242	Cm-243/244	Pu-238	Pu-239/240	U-234	U-235	U-238	Fe-55	Ni-63
MW-CL-14S	08/09/16	< 0.67	< 0.03	< 0.04	< 0.02	< 0.06	0.65	< 0.05	0.42	< 149	< 3.7
MW-CL-21S	08/08/16	< 0.09	< 0.06	< 0.08	< 0.14	< 0.12	< 0.15	< 0.05	< 0.10	< 165	< 3.6

TABLE B-II.1 CONCENTRATIONS OF TRITIUM IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2016

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	H-3
SEWAGE TRMT PLANT	02/01/16	< 186
SEWAGE TRMT PLANT	05/02/16	< 178
SEWAGE TRMT PLANT	08/08/16	< 174
SEWAGE TRMT PLANT	10/31/16	< 193
SW-CL-1	02/01/16	< 184
SW-CL-1	05/02/16	< 179
SW-CL-1	08/08/16	< 179
SW-CL-1	10/31/16	< 194
SW-CL-2	02/01/16	< 183
SW-CL-2	05/02/16	< 179
SW-CL-2	08/08/16	< 178
SW-CL-2	10/31/16	< 194
SW-CL-4	02/01/16	< 187
SW-CL-4	05/02/16	< 177
SW-CL-4	08/08/16	< 174
SW-CL-4	10/31/16	< 192
SW-CL-5	02/01/16	< 186
SW-CL-5	05/02/16	< 176
SW-CL-5	08/08/16	< 174
SW-CL-5	10/31/16	< 194
SW-CL-6	02/01/16	< 184
SW-CL-6	05/02/16	< 178
SW-CL-6	08/08/16	< 175
SW-CL-6	10/31/16	< 195
SW-CL-7	02/01/16	< 188
SW-CL-7	05/02/16	< 179
SW-CL-7	08/08/16	< 177
SW-CL-7	10/31/16	< 193

Table B-II.2

CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2016

RESULTS IN UNITS OF PCI/LITER + SIGMA

SITE	COLLECTION DATE	Be-7	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
SEWAGE TRMT PLANT	08/08/16	< 61	< 132	< 6	< 7	< 14	< 7	< 12	< 8	< 11	< 6	< 7	< 37	< 12
SW-CL-1	08/08/16	< 41	< 97	< 4	< 4	< 10	< 5	< 9	< 5	< 6	< 4	< 4	< 21	< 7
SW-CL-2	08/08/16	< 50	< 100	< 6	< 6	< 14	< 6	< 10	< 6	< 10	< 5	< 6	< 32	< 11
SW-CL-4	08/08/16	< 57	< 54	< 6	< 6	< 11	< 5	< 13	< 6	< 12	< 7	< 6	< 34	< 9
SW-CL-5	08/08/16	< 65	< 109	< 7	< 6	< 15	< 8	< 16	< 7	< 11	< 5	< 7	< 36	< 9
SW-CL-6	08/08/16	< 46	< 116	< 6	< 6	< 13	< 6	< 12	< 6	< 8	< 5	< 6	< 33	< 11
SW-CL-7	08/08/16	< 75	< 87	< 8	< 7	< 18	< 8	< 19	< 9	< 13	< 8	< 8	< 45	< 13

TABLE B-III.1 CONCENTRATIONS OF TRITIUM IN PRECIPITATION WATER SAMPLES COLLECTED IN THE VICINITY OF CLINTON POWER STATION, 2016

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	H-3
RG-15	12/05/16	< 195
RG-2	12/05/16	< 190
RG-3	12/05/16	< 191
RG-ENE	12/05/16	< 193
RG-N	12/05/16	< 194
RG-NNE	12/05/16	< 192
RG-NNW	12/05/16	< 191
RG-NW	12/05/16	< 191
RG-S	12/05/16	< 193
RG-WNW	12/05/16	< 195