State of Illinois
Illinois Emergency Management Agency

2019 Radiological Environmental Monitoring Report of the Honeywell Metropolis Works Facility

IEMA

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Introduction

The Illinois Emergency Management Agency (IEMA) is charged with protecting the citizens of Illinois from the potentially harmful effects of radioactive materials. In support of that mission, IEMA's Division of Nuclear Safety monitors the environment in Illinois for the presence of radionuclides through its radiological environmental monitoring program. This program has three primary functions: 1) collection of diverse samples from carefully chosen locations on a routine basis; 2) analyzing samples for radionuclides; and 3) evaluation of test results on both an annual and historical basis.

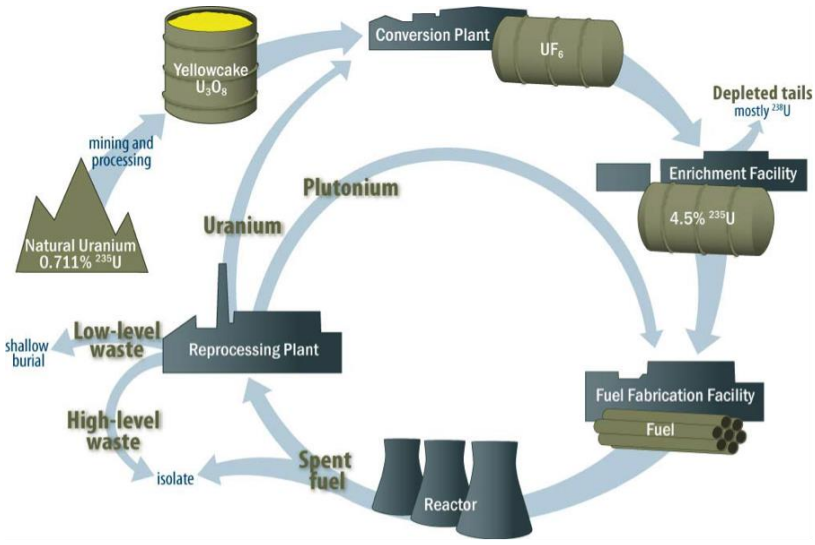
One of the locations monitored by IEMA is the environs of the Honeywell Metropolis Works (HMW) Facility near Metropolis, Illinois. The purpose of this report is to provide updated results of monitoring conducted during calendar year 2019.

Site Description

Located on approximately 1,100 acres of land within Massac County and on the peripheries of Metropolis, Illinois, the Honeywell Metropolis Works (HMW) facility perimeter is formed by U.S. Highway 45 to the north, the Ohio River to the south, a coal terminal to the west, and the city of Metropolis to the east. The facility footprint and the land immediately surrounding the facility form a 60-acre restricted area as required by HMW's United States Nuclear Regulatory Commission's (US NRC) Radioactive Materials License, number SUB-526. This restricted area is intended for the protection of the public from exposure to radiation and radioactive materials.

Opened in 1958, the HMW, a subsidiary company of Honeywell International Inc., plays a crucial role in the nuclear fuel cycle by converting uranium ore (U_3O_8) into uranium hexafluoride (UF_6). HMW is unique in that it is the only facility in the United States that produces UF_6. As depicted in Figure 1, conversion is the second step in the nuclear fuel cycle immediately following mining and processing and preceding enrichment.

Figure 1. Nuclear Fuel Cycle



HMW uses a dry conversion process to convert U_3O_8 to UF_6. The process first strips the U_3O_8 of impurities such as sodium and potassium. The material is then treated with nitrogen to form UO_2 and then hydrofluorinated with hydrofluoric acid to form uranium tetrafluoride (UF_4). The UF_4 is treated with fluorine gas to form UF_6. After HMW converts U_3O_8 into UF_6, the UF_6 is then processed, packaged and transported to enrichment plants, both domestic and foreign, where the UF_6 is enriched either by gaseous diffusion or gas centrifugation. The enriched UF_6 is then sent to fuel fabrication facilities and processed into fuel pellets for nuclear power plants.

In 2017, Honeywell announced plans to idle the HMW plant. Preparation for the idle state began late in the year, with the plant reaching a ready idle state in March of 2018. Full uranium hexafluoride cylinders continued to be shipped through March 2018. During the ready-idle state, the plant is conducting minimal operations and the amount of hazardous materials on-site has been greatly reduced. Uranium ore will continue to be received, sampled, assayed, and stored throughout the idle period. Security is being maintained, and emergency response capabilities remain commensurate with the hazards on-site. Honeywell's current plans are for the plant to remain idle until the market conditions improve. In March of 2020, the NRC renewed Honeywell's operating license through March of 2060.

Although the HMW facility is licensed by the US NRC, the Illinois Emergency Management Agency (IEMA) maintains a presence in the surrounding communities through our radiological environmental monitoring program. The overall purpose of IEMA's radiological environmental monitoring program, in relation to the HMW facility, is to determine if a radiological environmental impact is detected in the environs of the facility due to its operation, as well as determine long-term trends in environmental radiation levels.

IEMA Radiological Environmental Monitoring Program

The IEMA radiological environmental monitoring program consists of sample collection and laboratory analysis, as well as review and analysis of the resulting data. As part of the 2019 HMW radiological environmental monitoring program, samples were collected from various locations around the HMW facility and the greater Metropolis area. Appendix A contains maps of the area around the HMW plant that indicate IEMA's sampling locations.

Sampling included water, vegetation, air, direct radiation, soil, and sediment. Analyses vary from media to media but focus primarily on natural uranium. A general description of sample collection, analysis, and results follows. Sample result tables are located in Appendix B and C.

Sampling and Monitoring Activities

Air Sampling

Air particulate samples are collected from a network of five strategically positioned environmental monitoring stations (EMS) within the environs of HMW. Each EMS is comprised of a continuous low-volume vacuum pump and air filter assembly. Particulate filter samples are exchanged and analyzed weekly.

Soil Sampling

Soil samples are collected from four sampling locations during the second and third quarters of the year and analyzed for radionuclides that may have been transported from the environment and incorporated into the soil. Soil is sampled at a depth of six inches to monitor the migration of radionuclides away from the soil surface and at one inch to monitor for deposition of radionuclides on the soil surface.

Sediment Sampling

Sediment samples are collected from two sampling locations during the second and third quarters of the year to determine whether contaminants previously in solution or suspension have settled out of a body of water and, therefore, cannot be identified through water sampling.

Vegetation Sampling

Vegetation samples are collected from four sampling locations during the second and third quarters of the year and analyzed for radionuclides that may have been transported from the environment and incorporated into or on plant tissue.

Water Sampling

Water samples are collected and analyzed to ensure that radionuclides attributable to the HMW facility have not migrated into off-site water sources.

Direct Radiation Monitoring

Unlike the environmental samples described above, dosimeters do not provide information on what radionuclides are found in the environment. Instead, dosimeters provide a direct measurement of the total dose produced by all sources of gamma radiation, including naturally occurring radionuclides and cosmic rays. A network of nineteen optically-stimulated luminescent dosimeters (OSLs) is arrayed around the HMW facility; dosimeters are exchanged and analyzed quarterly.

Background Reference Areas

IEMA has established the environs of Sangchris Lake State Park, a cooling lake for a coal-fired power station near Kincaid, Illinois, as the background sampling and monitoring location for water, soil, sediment, and vegetation samples, as well as for direct radiation monitoring. Air monitoring stations in Springfield, Marion, and West Chicago, Illinois are used for background reference locations for air samples. To establish "background" radiation levels, samples are collected and analyzed utilizing the same procedures and methodologies used for the HMW samples.

In October of 2018, IEMA collected deposition and migration soil samples from ten southern Illinois locations in order to establish a background soil concentration that better represents the area. Results from these samples are used to determine analytical thresholds and for data comparison purposes.

Results for background samples can be found in Appendix C.

Sampling and Monitoring Adjustments

The following adjustments were made to the HMW sampling plan in 2019:

- The EMS located at Dorothy Miller Park was shut down in February due to flood waters damaging the air sampling equipment. The EMS remained off-line until August, when the likelihood of further flood damage had passed. Discussions with the City of Metropolis to relocate the EMS to a less flood prone area is underway.

- Direct radiation monitoring locations METR-31 and METR-32, which were located near the two entrances to the HWM plant were repositioned in 2019. Results seen at the previous locations were artificially elevated due to their proximity to transport vehicles moving materials in and out of the facility and, therefore, were not a true representation of the exposure attributable to the HMW facility. Instead, the exposures seen at those locations were elevated due to material that was in commerce. Furthermore, the previous monitoring locations did not provide a good indication of the possible exposure to the public due to their positioning in areas closely monitored and controlled by HMW security and staff.

General Sampling and Monitoring Information

Every effort is made to collect all scheduled environmental samples; however, occasionally samples are unobtainable due to weather conditions, water levels, or obstructed access.

Laboratory Analysis

Soil, sediment, vegetation, water, and air samples were analyzed by the IEMA Radiochemistry Laboratory located in Springfield, Illinois. The laboratory participates in semi-annual proficiency testing programs through Environmental Resource Associates, an accredited proficiency testing provider, and the Department of Energy (DOE) Radiological and Environmental Science Laboratory's Mixed Analyte Performance Evaluation Program (MAPEP). A general description of each analysis performed is provided below.

Gross Alpha/Beta Analysis

Air particulate filters are exchanged and analyzed weekly for airborne radioactivity through gross alpha and beta analysis using a gas proportional counter. Since radionuclides associated with natural uranium emit either alpha or beta particles, analysis of air particulate samples for gross alpha/beta activity provides a good method of screening for the presence of radioactive materials.

Two "trigger" levels are used to determine if additional analysis is required for air particulate samples. These levels represent approximately 25% and 100% of the total uranium effluent concentration limit of 90 fCi/m^3 established in 10CFR20, Appendix B.

Gross Alpha/Beta Trigger Levels:

- Gross alpha results at or above 25.0 fCi/m^3 are evaluated to determine if Kinetic Phosphorescence Analyzer (KPA) analysis will need to be performed.

- Samples with gross alpha results at or above 90 fCi/m^3 require KPA analysis.

Isotopic Uranium Analysis

Isotopic uranium analysis via alpha spectroscopy is used to determine specific uranium-234 (U-234), uranium-235 (U-235), and uranium-238 (U-238) concentrations. Although more labor intensive, isotopic uranium analysis provides a more accurate representation of the concentration of uranium present within a sample compared to the past practice of using Pa-234m as a surrogate for U-238 and is capable of detecting much smaller concentrations. All soil, vegetation, and sediment samples are analyzed using this method. Isotopic uranium results can be found in in Appendix B-Tables B.6 and B.7 for soil, Table B.10 for sediment samples, and Table B.11 for vegetation.

Ingrowth Analysis

Soil and sediment samples that exceed the Isotopic Uranium Action Level set by the Agency (See below) are sealed and stored for at least 28 days to allow for the ingrowth of daughter products and then reanalyzed to identify and quantify Ra-26 and Th-230. Ingrowth analysis is conducted using a high-purity germanium detector in a process called gamma spectroscopy. Ingrowth, gamma spectroscopy results are displayed in Appendix B-Tables B.8 and B.9.

Due to an issue with the sealing of vegetation samples, they do not currently receive ingrowth analysis. IEMA's Radiochemistry Laboratory is currently researching solutions to remedy this issue.

Isotopic Uranium Action Level:

The isotopic uranium action level is based on the results obtained from background samples collected in 2018 from several southern Illinois locations. The trigger limit has been set at 5pCi/g for combined (total) uranium (U-234 + U-235 + U-238) which is approximately twice the average isotopic uranium background level found in that area of the state.

Kinetic Phosphorescence Analyzer (KPA) Analysis

Water samples are analyzed for the presence of uranium using Kinetic Phosphorescence Analyzer (KPA) analysis. Air particulate samples with results above the established gross alpha/beta triggering levels may also be analyzed using KPA.

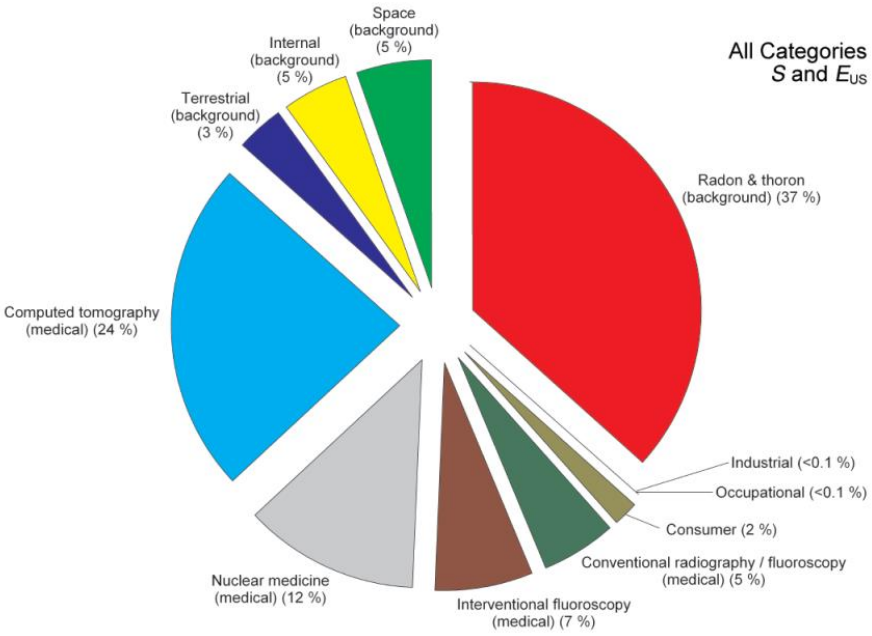
Optically Stimulated Luminescence Analysis

Optically Stimulated Luminescence (OSL) dosimeters provide a direct measurement of the total dose received from all sources of gamma radiation, including naturally occurring radionuclides and cosmic rays. The dosimeters are used to monitor for small changes in ambient background levels of gamma radiation that could result from releases of radioactive material or exposure to large quantities of stored material on-site.

OSLs are analyzed by IEMA staff using a Landauer In Light System Auto Reader. Results are expressed as the average milliroentgen (mR) per quarter and are also calculated to the approximate mR per year that would have been accrued by an individual at that location for an entire year.

The ambient gamma results can be compared to the average annual radiation exposure to an individual of 620mR/year from various sources (according to the 2009 National Council on Radiation Protection's (NCRP) Report 160, see Figure 2). Approximately 8% (49.6 mR/year) of that exposure is from Terrestrial and Cosmic radiation (background radiation).

Figure 2. Sources of Radiation Exposure to Man



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Minimum Detectable Concentration (MDC)

All analytical methods have limitations: amounts that are too small to be detected. The Minimum Detectable Concentration (MDC) is an "a priori" measure of that limitation – an estimate of the lower limit of detection. It is defined as the smallest quantity that an analytical method has 95% likelihood of detecting. For example, the MDC for IEMA's method for tritium in water is 200 picocuries per liter (pCi/L). Given a sample with a tritium concentration of 200 pCi/L, our laboratory would detect that tritium approximately 95 times out of 100. Samples with less than 200 pCi/L could be detected, but with less certainty. Conversely, samples with more than 200 pCi/L would be more likely to be detected, approaching 100% as concentrations increase. Analytical methods are chosen, in part, on their MDC. As a general rule, methods are chosen such that their MDC is less than 10% of any applicable regulatory limit.

Analysis Adjustments

The following adjustments were made to the HMW laboratory analysis in 2019:

- Routine gamma analysis for HMW was discontinued and has been replaced with isotopic uranium analysis and ingrowth analysis when necessary.

- Due to the soil sample results from the nearest residence sampling location consistently being above the established isotopic uranium trigger level, routine ingrowth analysis is now being conducted on all soil samples collected from that location.

Radiological Environmental Sampling and Monitoring Results

Air Sampling Results

Air particulate sample results are compared to historical data collected from the environs of the HMW facility, and to sample data collected from the background reference locations. Results from each of the five air monitoring stations are displayed in Appendix B -Tables B.1 – B.5.

Results are comparable to those obtained from background EMSs located in Marion and Springfield, and West Chicago, Illinois, and are consistent with data previously collected by IEMA as part of its HMW radiological environmental monitoring program. All air particulate sample results for 2019 remain below the trigger levels established by IEMA.

Soil Sampling Results

Soil sample results are compared to historical data collected from the environs of the HMW facility, sample data collected from the background reference location, and to sample data collected from soil sampling performed in October 2018 to establish an area wide background concentration level. The area wide average background concentration determined through isotopic uranium analysis is 1.00 pCi/g of U-234, 0.05 pCi/g of U-235, and 1.02 pCi/g of U-238. The average area wide concentration determined via ingrowth analysis is 1.09 pCi/g of Ra-226 and below the established MDC for Th-230. Analytical results are shown in Table B.6-B.9.

Isotopic uranium results for samples collected from the Metropolis Airport and from the intersection of Gurley and Devers are comparable to results obtained from the background sampling locations and consistent with historical data. Results from samples taken from the Massac Creek at Country Club Road location are significantly lower than background sample results, likely due to the sand content of the soil at that location. Results from samples collected from the Nearest Residence, although consistent with historical data, are higher than results found at the background reference location in Kincaid, Illinois, as well as results obtained from samples collected in and around the Massac County area in October of 2018.

Gamma spectroscopy results for soil deposition samples after ingrowth of radioactive progeny are comparable to results obtained from the background sampling locations and are consistent with data previously collected by IEMA as part of its HMW radiological environmental monitoring program. Ra-226 analytical results for soil migration samples after ingrowth of radioactive progeny are comparable to results obtained from the background sampling locations and are consistent with data previously collected. Ingrowth results for Th-230 were slightly above the established MDC.

Sediment Sampling Results

Sediment sample results are compared to historical data collected from the environs of the HMW facility, and to sample data collected from the background reference location. Analytical results are shown in Table B.10.

Results for isotopic uranium analysis of sediment samples collected from the Ohio River at Joppa on July 31, 2019 and the public boat launch near Harrah's Casino on May 14, 2019 were consistent with data previously collected from these locations, but indicated a slight elevation in uranium concentrations when compared to sediment samples collected from the background reference locations. All other sediment samples are comparable to results obtained from the background sampling locations, and all results were below the isotopic uranium action level for ingrowth analysis.

Vegetation Sampling Results

Vegetation sample results are compared to historical data collected from the environs of the HMW facility, and to sample data collected from the background reference location. Analytical results are shown in Table B.11 for isotopic uranium analysis.

The May 14, 2019 vegetation sampling of Massac Creek at Country Club Road indicated isotopic uranium at a higher concentration than results seen in background samples and in data previously collected from that location. Results from the sample collected in the subsequent quarter were consistent with background data. All other vegetation sample results are comparable to those obtained from the background sampling locations.

Water Sampling Results

Water sample results are compared to historical data collected from the environs of the HMW facility, and to sample data collected from the background reference location. Analytical results for water samples are displayed in Table B.12.

Results are consistent with results obtained from the background sampling locations and to historical data collected.

Direct Radiation Monitoring Results

OSL results are compared to historical data collected from the environs of the HMW facility, and to sample data collected from the background reference location. Results are displayed in Table B.13.

The annual exposure for the METR-32 location was slightly higher than the annual exposure seen at background locations. However, there was a significant reduction in the annual exposure at that location when compared to the previous year's data. This reduction is likely due to the repositioning of this OSL in 2019. All other direct radiation monitoring results were comparable to those obtained from the background sampling locations and were consistent with historical data.

Results Interpretation or Limit Adjustments

The following adjustments were made to how the HMW sample results were interpreted in 2019:

- Action levels were established in 2019 to determine the need for ingrowth analysis.
- A West Chicago air particulate sampling is location is now being used for background comparison purposes. West Chicago air samples, although collected and analyzed for many years, were not suitable for background comparisons due to the samplers' proximity to the Kerr-McGee Rare Earths site. After an extensive decommissioning and decontamination process at the Kerr-McGee site, samples collected from the West Chicago location are no longer potentially impacted from site operations and can be included for background comparison purposes.

Summary

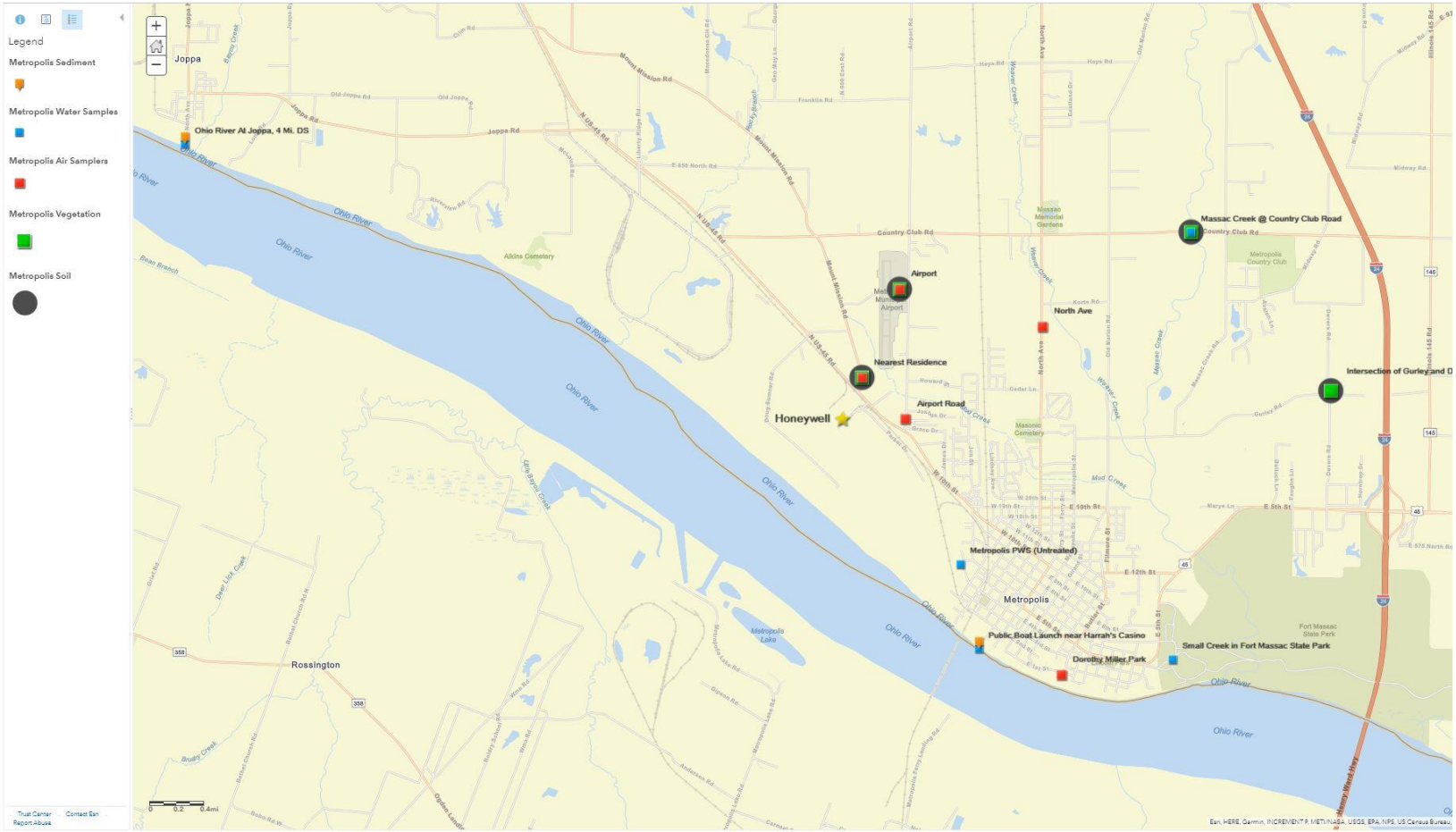
With the exception of a vegetation sample collected from the Massac Creek location in the second quarter of 2019, sampling and monitoring results collected as part of IEMA's HMW radiological environmental monitoring program indicate that radioactivity levels remain consistent with data collected in previous years. Laboratory analysis of the Massac Creek sample indicated isotopic uranium at a higher concentration than results seen in background samples and in data previously collected from that location. Results from the third quarter sampling were consistent with background and historical data.

As seen in previous years, results from sampling and monitoring locations found near the HMW facility indicate slightly elevated levels of radioactivity in the soil and air when compared to samples collected from greater distances away from the facility or from background reference areas. Similarly, direct radiation monitoring near the facility shows a slight increase in exposure in those areas when compared to other monitoring locations found away from the plant and background reference areas.

The HMW facility remained in a ready-idle state throughout 2019. While in the ready-idle state the plant has discontinued production, greatly reduced the amount of hazardous materials on-site, and is conducting only minimal operations. Honeywell's current plans are for the plant to remain idle until 2020, or until the market conditions improve.

APPENDIX A
Maps of Monitoring and Sampling Locations

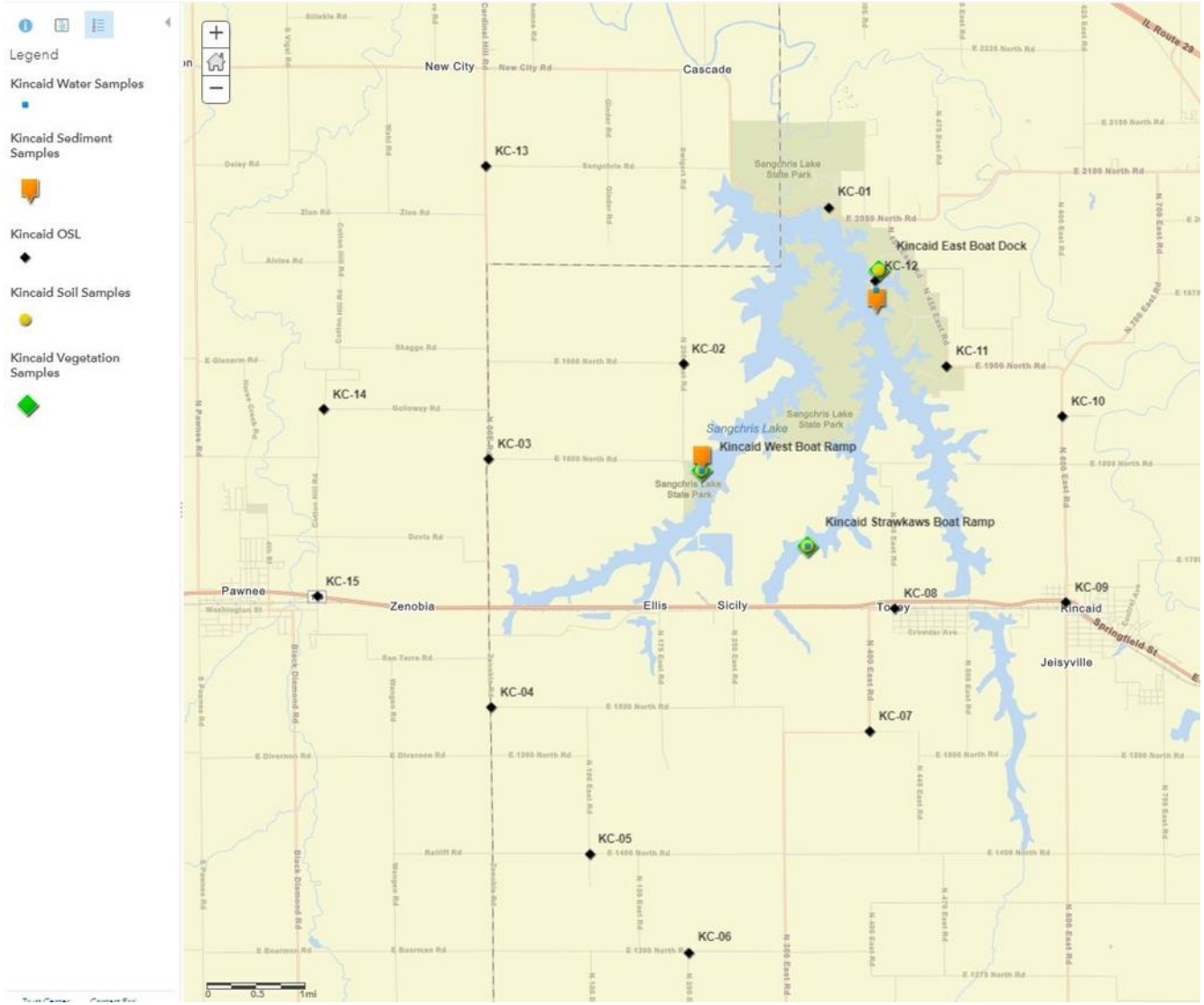
Map A.1. HMW Sampling Locations



Map A.2. HMW Optically Stimulated Luminescence (OSL) Monitoring Locations

The locations for METR-31 and METR-32 were adjusted slightly to the Northeast in 2019.

Map A.3. Background Reference Sampling Locations: Sangchris Lake State Park near Kincaid, Illinois



APPENDIX B
Sample Analysis Results for Samples Collected from the Environs of the HMW Facility

Table B.1 Sample Results for Alpha / Beta Screening of Air Particulate Filters
Nearest Residence
Results are in femtocuries per cubic meter (fCi/m^3)

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Nearest Residence				
1/2/2019	<MDC	4.5	30.1	6.1
1/9/2019	<MDC	4.5	34.4	6.1
1/15/2019	<MDC	4.5	28.9	6.1
1/28/2019	<MDC	4.5	24.0	6.1
2/5/2019	<MDC	4.5	26.9	6.1
2/11/2019	<MDC	4.5	19.5	6.1
2/20/2019	<MDC	4.5	30.3	6.1
2/27/2019	5.5	4.5	37.1	6.1
3/6/2019	5.0	4.5	28.5	6.1
3/12/2019	4.6	4.5	33.0	6.1
3/27/2019	<MDC	4.5	21.4	6.1
4/3/2019	<MDC	4.5	21.2	6.1
4/22/2019	<MDC	4.5	17.9	6.1
4/30/2019	<MDC	4.5	23.6	6.1
5/8/2019	<MDC	4.5	15.9	6.1
5/14/2019	<MDC	4.5	14.1	6.1
5/22/2019	<MDC	4.5	22.0	6.1
5/29/2019	<MDC	4.5	26.7	6.1
6/6/2019	<MDC	4.5	23.8	6.1
6/25/2019	<MDC	4.5	17.8	6.1
7/3/2019	<MDC	4.5	27.9	6.1

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Nearest Residence				
7/9/2019	<MDC	4.5	20.8	6.1
7/15/2019	<MDC	4.5	24.1	6.1
7/22/2019	<MDC	4.5	14.8	6.1
7/31/2019	<MDC	4.5	24.8	6.1
8/7/2019	<MDC	4.5	40.5	6.1
8/12/2019	5.0	4.5	40.6	6.1
8/21/2019	<MDC	4.5	34.2	6.1
8/27/2019	<MDC	4.5	18.2	6.1
9/11/2019	5.3	4.5	43.1	6.1
9/25/2019	5.8	4.5	42.5	6.1
10/9/2019	<MDC	4.5	33.2	6.1
10/21/2019	<MDC	4.5	31.5	6.1
10/29/2019	<MDC	4.5	22.3	6.1
11/4/2019	<MDC	4.5	13.4	6.1
11/13/2019	<MDC	4.5	27.4	6.1
11/20/2019	<MDC	4.5	43.3	6.1
12/4/2019	<MDC	4.5	23.7	6.1
12/10/2019	6.0	4.5	34.5	6.1
12/18/2019	5.1	4.5	30.6	6.1
12/23/2019	<MDC	4.5	39.6	6.1
12/31/2019	<MDC	4.5	30.6	6.1

Table B.2 Sample Results for Alpha / Beta Screening of Air Particulate Filters
Metropolis Airport
Results are in femtocuries per cubic meter (fCi/m^3)

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Airport 1 Mi. NNE				
1/2/2019	<MDC	4.5	24.7	6.1
1/9/2019	<MDC	4.5	38.2	6.1
1/15/2019	<MDC	4.5	29.9	6.1
1/28/2019	<MDC	4.5	19.3	6.1
2/5/2019	<MDC	4.5	28.5	6.1
2/11/2019	<MDC	4.5	36.0	6.1
2/20/2019	<MDC	4.5	22.8	6.1
2/27/2019	5.1	4.5	34.3	6.1
3/6/2019	<MDC	4.5	26.9	6.1
3/12/2019	<MDC	4.5	28.9	6.1
3/27/2019	<MDC	4.5	18.5	6.1
4/3/2019	<MDC	4.5	18.1	6.1
4/22/2019	<MDC	4.5	12.5	6.1
4/30/2019	<MDC	4.5	24.6	6.1
5/8/2019	<MDC	4.5	18.1	6.1
5/14/2019	<MDC	4.5	12.1	6.1
5/22/2019	<MDC	4.5	19.4	6.1
5/29/2019	<MDC	4.5	11.3	6.1
6/6/2019	<MDC	4.5	21.1	6.1
6/25/2019	<MDC	4.5	8.7	6.1
7/3/2019	<MDC	4.5	31.3	6.1

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Airport 1 Mi. NNE				
7/9/2019	<MDC	4.5	24.7	6.1
7/15/2019	<MDC	4.5	24.0	6.1
7/22/2019	<MDC	4.5	15.4	6.1
7/31/2019	<MDC	4.5	13.6	6.1
8/7/2019	6.5	4.5	37.0	6.1
8/12/2019	<MDC	4.5	43.4	6.1
8/21/2019	<MDC	4.5	34.6	6.1
8/27/2019	<MDC	4.5	16.8	6.1
9/11/2019	5.5	4.5	41.9	6.1
9/25/2019	5.2	4.5	44.6	6.1
10/9/2019	<MDC	4.5	36.6	6.1
10/21/2019	<MDC	4.5	32.3	6.1
10/29/2019	<MDC	4.5	22.9	6.1
11/4/2019	<MDC	4.5	15.7	6.1
11/13/2019	<MDC	4.5	18.8	6.1
11/20/2019	<MDC	4.5	41.3	6.1
12/4/2019	<MDC	4.5	19.5	6.1
12/10/2019	6.9	4.5	40.5	6.1
12/18/2019	<MDC	4.5	31.5	6.1
12/23/2019	<MDC	4.5	39.6	6.1
12/31/2019	<MDC	4.5	28.1	6.1

Table B.3 Sample Results for Alpha / Beta Screening of Air Particulate Filters
North Avenue
Results are in femtocuries per cubic meter (fCi/m³)

Location		Alpha		Beta	
Date	Result	MDC	Result	MDC
Fire Station North Ave				
1/2/2019	<MDC	4.5	27.1	6.1
1/9/2019	<MDC	4.5	39.1	6.1
1/15/2019	<MDC	4.5	26.9	6.1
1/28/2019	<MDC	4.5	23.1	6.1
2/5/2019	<MDC	4.5	28.1	6.1
2/11/2019	<MDC	4.5	20.5	6.1
2/20/2019	<MDC	4.5	28.2	6.1
2/27/2019	<MDC	4.5	34.6	6.1
3/6/2019	<MDC	4.5	28.3	6.1
3/12/2019	<MDC	4.5	31.6	6.1
3/27/2019	<MDC	4.5	18.2	6.1
4/3/2019	<MDC	4.5	21.4	6.1
4/22/2019	<MDC	4.5	16.4	6.1
4/30/2019	<MDC	4.5	21.6	6.1
5/8/2019	<MDC	4.5	18.4	6.1
5/14/2019	<MDC	4.5	10.9	6.1
5/22/2019	<MDC	4.5	19.7	6.1
5/29/2019	<MDC	4.5	23.2	6.1
6/6/2019	<MDC	4.5	19.2	6.1
6/25/2019	<MDC	4.5	18.1	6.1
7/3/2019	<MDC	4.5	30.5	6.1

Location		Alpha		Beta	
Date	Result	MDC	Result	MDC
Fire Station North Ave				
7/9/2019	<MDC	4.5	24.3	6.1
7/15/2019	<MDC	4.5	26.2	6.1
7/22/2019	<MDC	4.5	13.7	6.1
7/31/2019	<MDC	4.5	26.1	6.1
8/7/2019	<MDC	4.5	39.7	6.1
8/12/2019	<MDC	4.5	42.4	6.1
8/21/2019	<MDC	4.5	31.2	6.1
8/27/2019	<MDC	4.5	19.2	6.1
9/11/2019	6.3	4.5	41.5	6.1
9/25/2019	<MDC	4.5	36.1	6.1
10/9/2019	<MDC	4.5	32.4	6.1
10/21/2019	<MDC	4.5	28.8	6.1
10/29/2019	<MDC	4.5	23.9	6.1
11/4/2019	<MDC	4.5	19.8	6.1
11/13/2019	<MDC	4.5	29.4	6.1
11/20/2019	4.5	4.5	43.5	6.1
12/4/2019	<MDC	4.5	22.6	6.1
12/10/2019	5.4	4.5	39.8	6.1
12/18/2019	4.7	4.5	34.4	6.1
12/23/2019	4.7	4.5	31.4	6.1
12/31/2019	<MDC	4.5	31.4	6.1

Table B.4 Sample Results for Alpha / Beta Screening of Air Particulate Filters
Dorothy Miller Park
Results are in femtocuries per cubic meter (fCi/m^3)

Location		Alpha		Beta	
Date	Result	MDC	Result	MDC
Dorothy Miller Park				
1/2/2019	<MDC	4.5	28.2	6.1
1/9/2019	<MDC	4.5	38.9	6.1
1/15/2019	<MDC	4.5	27.1	6.1
1/28/2019	<MDC	4.5	25.7	6.1
2/5/2019	<MDC	4.5	29.9	6.1
2/11/2019	<MDC	4.5	21.7	6.1
8/21/2019	4.5	4.5	35.7	6.1
8/27/2019	<MDC	4.5	15.6	6.1
9/11/2019	6.2	4.5	45.7	6.1
9/25/2019	5.2	4.5	43.9	6.1
10/9/2019	<MDC	4.5	35.8	6.1
10/21/2019	<MDC	4.5	31.5	6.1
10/29/2019	<MDC	4.5	22.2	6.1
11/4/2019	<MDC	4.5	20.9	6.1
11/13/2019	<MDC	4.5	33.2	6.1
11/20/2019	<MDC	4.5	40.9	6.1
12/4/2019	<MDC	4.5	22.1	6.1
12/10/2019	<MDC	4.5	41.9	6.1
12/18/2019	5.0	4.5	27.9	6.1
12/23/2019	<MDC	4.5	42.9	6.1
12/31/2019	<MDC	4.5	26.5	6.1

Table B.5 Sample Results for Alpha / Beta Screening of Air Particulate Filters
Airport Road
Results are in femtocuries per cubic meter (fCi/m³)

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Airport Road				
1/2/2019	<MDC	4.5	29.4	6.1
1/9/2019	<MDC	4.5	38.5	6.1
1/15/2019	<MDC	4.5	26.5	6.1
1/28/2019	<MDC	4.5	25.5	6.1
2/5/2019	<MDC	4.5	25.5	6.1
2/11/2019	<MDC	4.5	20.7	6.1
2/20/2019	<MDC	4.5	22.6	6.1
2/27/2019	6.6	4.5	35.8	6.1
3/6/2019	<MDC	4.5	29.4	6.1
3/12/2019	<MDC	4.5	31.8	6.1
3/27/2019	<MDC	4.5	20.0	6.1
4/3/2019	<MDC	4.5	21.1	6.1
4/22/2019	<MDC	4.5	18.0	6.1
4/30/2019	<MDC	4.5	22.8	6.1
5/8/2019	<MDC	4.5	14.6	6.1
5/14/2019	<MDC	4.5	10.4	6.1
5/22/2019	<MDC	4.5	21.2	6.1
5/29/2019	<MDC	4.5	21.4	6.1
6/6/2019	<MDC	4.5	22.3	6.1
6/25/2019	<MDC	4.5	16.1	6.1
7/3/2019	<MDC	4.5	29.7	6.1

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Airport Road				
7/9/2019	<MDC	4.5	24.7	6.1
7/15/2019	<MDC	4.5	26.5	6.1
7/22/2019	<MDC	4.5	16.3	6.1
7/31/2019	<MDC	4.5	25.6	6.1
8/7/2019	<MDC	4.5	25.7	6.1
8/12/2019	<MDC	4.5	44.8	6.1
8/21/2019	<MDC	4.5	34.3	6.1
8/27/2019	<MDC	4.5	17.6	6.1
9/11/2019	6.1	4.5	41.1	6.1
9/25/2019	5.7	4.5	42.3	6.1
10/9/2019	<MDC	4.5	32.1	6.1
10/21/2019	<MDC	4.5	30.0	6.1
10/29/2019	<MDC	4.5	24.0	6.1
11/4/2019	<MDC	4.5	20.3	6.1
11/13/2019	<MDC	4.5	29.3	6.1
11/20/2019	<MDC	4.5	47.4	6.1
12/4/2019	<MDC	4.5	21.6	6.1
12/10/2019	6.4	4.5	38.4	6.1
12/18/2019	5.3	4.5	34.1	6.1
12/23/2019	6.1	4.5	42.0	6.1
12/31/2019	<MDC	4.5	31.1	6.1

Table B.6 Isotopic Uranium Sample Results for Soil Migration Samples
Results in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
Airport 1 Mi. NNE						
5/14/2019	1.14	0.01	0.06	0.01	1.30	0.01
7/31/2019	1.21	0.01	0.06	0.01	1.37	0.01
Intersection of Gurley and Devers						
5/14/2019	0.95	0.01	0.06	0.01	0.94	0.01
7/31/2019	1.27	0.01	0.06	0.01	1.04	0.01
Massac Creek at Country Club Rd						
5/14/2019	0.39	0.01	0.03	0.01	0.36	0.01
7/31/2019	0.42	0.01	<MDC	0.01	0.49	0.01
Nearest Residence						
5/14/2019	2.67	0.01	0.16	0.01	2.51	0.01
7/31/2019	2.53	0.01	0.09	0.01	2.63	0.01

Table B.7 Isotopic Uranium Sample Results for Soil Deposition Samples
Results in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
Airport 1 Mi. NNE						
5/14/2019	1.28	0.01	0.10	0.01	1.32	0.01
7/31/2019	1.19	0.01	0.05	0.01	1.34	0.01
Intersection of Gurley and Devers						
5/14/2019	1.01	0.01	0.09	0.01	1.01	0.01
7/31/2019	0.99	0.01	0.05	0.01	1.04	0.01
Massac Creek at Country Club Rd						
5/14/2019	0.34	0.01	0.03	0.01	0.33	0.01
7/31/2019	0.44	0.01	0.02	0.01	0.41	0.01
Nearest Residence						
5/14/2019	2.78	0.01	0.15	0.01	3.14	0.01
7/31/2019	4.02	0.01	0.21	0.01	4.24	0.01

Table B.8 Ingrowth, Gamma Spectroscopy Sample Results for Soil Migration Samples
Results in picocuries per gram (pCi/g)

Location	Ra-226		Th-230	
Date	Result	MDC	Result	MDC
Nearest Residence				
5/14/2019	1.11	0.02	1.74	1.57
7/31/2019	1.24	0.02	1.85	1.57

Table B.9 Ingrowth, Gamma Spectroscopy Sample Results for Soil Deposition Samples
Results in picocuries per gram (pCi/g)

Location	Ra-226		Th-230	
Date	Result	MDC	Result	MDC
Nearest Residence				
5/14/2019	0.97	0.02	<MDC	1.64
7/31/2019	1.02	0.02	<MDC	1.64

Table B.10 Isotopic Uranium Sample Results for Sediment Samples
Results in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
Ohio River at Joppa, 4 Mi. DnS						
5/14/2019	0.79	0.01	0.04	0.01	0.71	0.01
7/31/2019	0.91	0.01	0.06	0.01	1.00	0.01
Public Boat Launch near Harrah's Casino						
5/14/2019	1.00	0.01	0.04	0.01	1.06	0.01
7/31/2019	0.62	0.01	0.03	0.01	0.63	0.01

Table B.11 Isotopic Uranium Sample Results for Vegetation Samples
Results in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
Airport 1 Mi. NNE						
5/14/2019	0.002	0.002	<MDC	0.002	0.003	0.002
7/31/2019	0.004	0.002	<MDC	0.002	0.003	0.002
Intersection of Gurley and Devers						
5/14/2019	0.004	0.002	<MDC	0.002	<MDC	0.002
7/31/2019	0.012	0.002	<MDC	0.002	0.012	0.002
Massac Creek at Country Club Rd						
5/14/2019	0.032	0.002	<MDC	0.002	0.005	0.002
7/31/2019	0.004	0.002	<MDC	0.002	0.003	0.002
Nearest Residence						
5/14/2019	0.012	0.002	<MDC	0.002	0.012	0.002
7/31/2019	0.003	0.002	<MDC	0.002	0.004	0.002

Table B.12 KPA (Total Uranium) Sample Results for Water Samples
Results in picocuries per liter (pCi/L)

Location	Uranium	
Date	Result	MDC
Massac Creek at Country Club Rd		
2/11/2019	0.2	0.1
5/14/2019	<MDC	0.1
7/31/2019	<MDC	0.1
10/21/2019	<MDC	0.1
Ohio River at Joppa, 4 Mi. DnS		
2/11/2019	0.3	0.1
5/14/2019	0.4	0.1
7/31/2019	0.3	0.1
10/21/2019	0.3	0.1
Public Boat Launch near Harrah's Casino		
2/11/2019	0.2	0.1
5/14/2019	0.5	0.1
7/31/2019	0.3	0.1
10/21/2019	0.3	0.1
PWS (Untreated)		
2/11/2019	0.4	0.1
5/14/2019	0.3	0.1
7/31/2019	0.3	0.1
10/21/2019	0.3	0.1

Table B.13 Summary of Ambient Gamma Results

Location	Quarter 1 mR/quarter	Quarter 2 mR/quarter	Quarter 3 mR/quarter	Quarter 4 mR/quarter	Annual Exposure mR/quarter
METR01	7.5	8.2	10.3	7.7	33.7
METR02	6.9	7.6	7.4	8.0	29.9
METR03	8.5	8.0	7.3	9.8	33.6
METR04	8.4	9.3	10.4	6.3	34.4
METR05	9.9	8.1	10.6	8.1	36.8
METR06	9.0	10.7	9.9	7.5	37.1
METR16	9.9	10.0	13.1	11.1	44.3
METR20	7.5	8.1	6.3	9.1	31.0
METR21	9.8	7.3		9.3	35.2
METR22	9.1	9.8	12.5	7.6	39.0
METR25	4.5	5.0	5.3	4.0	18.8
METR26	10.1	8.2	8.8	10.1	37.2
METR27	7.1	6.4	7.8	8.6	29.8
METR28	8.6	7.8	9.5	6.7	32.6
METR29	8.4	8.1		8.6	33.5
METR30	7.7	9.0	12.5	6.8	36.0
METR31	13.8	10.4	12.4	8.5	45.1
METR32	22.3	11.4	12.7	11.4	57.8
METR33	11.8	9.6	11.2	8.9	41.5

Blanks in the table indicate that the dosimeter was missing at the end of the quarter.
The Annual Dose column is based on averages of all available data.
Quarters estimated to be 91.25 days in length.

APPENDIX C
Sample Analysis Results for Samples Collected from Established Background Locations

Table C.1 Sample Results for Alpha / Beta Screening of Air Samples
Springfield Background Location
Results are in femtocuries per cubic meter (fCi/m^3)

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Knotts Street Air Sampler				
1/2/2019	<MDC	3.0	32.1	4.1
1/8/2019	4.3	3.0	47.5	4.1
1/15/2019	<MDC	3.0	23.0	4.1
1/22/2019	<MDC	3.0	31.6	4.1
1/29/2019	<MDC	3.0	34.4	4.1
2/4/2019	<MDC	3.0	31.4	4.1
2/11/2019	<MDC	3.0	14.8	4.1
2/20/2019	3.9	3.0	27.3	4.1
2/26/2019	4.5	3.0	40.4	4.1
3/4/2019	<MDC	3.0	29.0	4.1
3/11/2019	<MDC	3.0	23.0	4.1
3/18/2019	3.4	3.0	21.2	4.1
3/26/2019	<MDC	3.0	16.3	4.1
4/2/2019	<MDC	3.0	18.4	4.1
4/8/2019	<MDC	3.0	24.6	4.1
4/16/2019	<MDC	3.0	14.5	4.1
4/24/2019	<MDC	3.0	14.7	4.1
4/30/2019	<MDC	3.0	22.1	4.1
5/7/2019	<MDC	3.0	16.9	4.1
5/14/2019	<MDC	3.0	17.4	4.1
5/20/2019	<MDC	3.0	26.8	4.1
5/28/2019	<MDC	3.0	16.7	4.1
6/3/2019	<MDC	3.0	20.8	4.1
6/10/2019	<MDC	3.0	25.7	4.1
6/17/2019	4.2	3.0	15.3	4.1
6/25/2019	<MDC	3.0	20.8	4.1

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Knotts Street Air Sampler				
7/1/2019	<MDC	3.0	30.4	4.1
7/8/2019	<MDC	3.0	28.7	4.1
7/15/2019	<MDC	3.0	27.9	4.1
7/23/2019	<MDC	3.0	16.7	4.1
7/29/2019	3.5	3.0	24.1	4.1
8/5/2019	3.5	3.0	33.2	4.1
8/13/2019	<MDC	3.0	28.6	4.1
8/19/2019	3.1	3.0	35.8	4.1
8/27/2019	3.1	3.0	25.0	4.1
9/3/2019	3.5	3.0	30.7	4.1
9/10/2019	5.4	3.0	34.5	4.1
9/16/2019	6.6	3.0	42.5	4.1
9/23/2019	7.2	3.0	49.9	4.1
10/1/2019	3.6	3.0	28.1	4.1
10/7/2019	<MDC	3.0	20.7	4.1
10/15/2019	<MDC	3.0	27.3	4.1
10/22/2019	<MDC	3.0	27.4	4.1
10/29/2019	<MDC	3.0	25.8	4.1
11/5/2019	<MDC	3.0	20.6	4.1
11/12/2019	<MDC	3.0	31.4	4.1
11/19/2019	<MDC	3.0	39.2	4.1
11/26/2019	<MDC	3.0	33.0	4.1
12/3/2019	<MDC	3.0	11.5	4.1
12/10/2019	<MDC	3.0	29.3	4.1
12/16/2019	4.4	3.0	30.8	4.1
12/23/2019	3.1	3.0	43.3	4.1

Table C.2 Sample Results for Alpha / Beta Screening of Air Samples
Marion Background Location
Results are in femtocuries per cubic meter (fCi/m³)

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Marion Office				
1/2/2019	<MDC	3.2	30.9	4.5
1/9/2019	4.5	3.2	43.1	4.5
1/15/2019	<MDC	3.2	27.9	4.5
1/28/2019	<MDC	3.2	20.1	4.5
2/5/2019	<MDC	3.2	26.4	4.5
2/11/2019	<MDC	3.2	16.1	4.5
2/20/2019	<MDC	3.2	28.2	4.5
2/27/2019	5.2	3.2	38.2	4.5
3/6/2019	<MDC	3.2	26.9	4.5
3/12/2019	3.4	3.2	25.2	4.5
3/27/2019	<MDC	3.2	12.0	4.5
4/3/2019	3.6	3.2	17.8	4.5
4/22/2019	<MDC	3.2	17.7	4.5
4/30/2019	<MDC	3.2	19.1	4.5
5/8/2019	<MDC	3.2	18.0	4.5
5/14/2019	<MDC	3.2	15.0	4.5
5/22/2019	<MDC	3.2	15.1	4.5
5/29/2019	<MDC	3.2	19.0	4.5
6/25/2019	<MDC	3.2	19.0	4.5
7/3/2019	3.8	3.2	30.3	4.5
7/9/2019	4.6	3.2	26.3	4.5

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
Marion Office				
7/15/2019	<MDC	3.2	21.9	4.5
7/22/2019	<MDC	3.2	14.1	4.5
7/31/2019	<MDC	3.2	27.5	4.5
8/7/2019	3.4	3.2	39.7	4.5
8/12/2019	3.2	3.2	33.2	4.5
8/21/2019	3.9	3.2	29.4	4.5
8/27/2019	<MDC	3.2	17.4	4.5
9/11/2019	5.9	3.2	36.1	4.5
9/25/2019	4.6	3.2	35.3	4.5
10/9/2019	<MDC	3.2	28.6	4.5
10/21/2019	3.3	3.2	32.9	4.5
10/29/2019	<MDC	3.2	21.1	4.5
11/4/2019	<MDC	3.2	21.0	4.5
11/13/2019	<MDC	3.2	30.7	4.5
11/20/2019	<MDC	3.2	40.4	4.5
12/4/2019	<MDC	3.2	21.0	4.5
12/10/2019	6.3	3.2	37.3	4.5
12/18/2019	5.2	3.2	31.0	4.5
12/23/2019	4.7	3.2	37.6	4.5
12/31/2019	<MDC	3.2	33.4	4.5

Table C.3 Sample Results for Alpha / Beta Screening of Air Samples
West Chicago Background Location
Results are in femtocuries per cubic meter (fCi/m³)

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
IDNS Lab				
1/3/2019	<MDC	3.9	26.7	5.5
1/9/2019	<MDC	3.9	49.8	5.5
1/15/2019	<MDC	3.9	23.0	5.5
1/22/2019	<MDC	3.9	27.5	5.5
2/4/2019	<MDC	3.9	31.4	5.5
2/20/2019	<MDC	3.9	23.8	5.5
2/27/2019	4.6	3.9	39.7	5.5
3/6/2019	4.3	3.9	22.9	5.5
3/11/2019	<MDC	3.9	28.7	5.5
3/21/2019	4.4	3.9	25.1	5.5
3/28/2019	<MDC	3.9	10.9	5.5
4/2/2019	<MDC	3.9	19.0	5.5
4/11/2019	<MDC	3.9	11.2	5.5
4/17/2019	<MDC	3.9	13.2	5.5
4/25/2019	<MDC	3.9	17.4	5.5
5/1/2019	<MDC	3.9	14.5	5.5
5/7/2019	<MDC	3.9	14.0	5.5
5/15/2019	<MDC	3.9	14.9	5.5
5/22/2019	<MDC	3.9	15.6	5.5
6/4/2019	<MDC	3.9	17.7	5.5
6/18/2019	<MDC	3.9	20.0	5.5
7/3/2019	9.7	3.9	20.5	5.5
7/9/2019	<MDC	3.9	23.0	5.5

Location	Alpha		Beta	
Date	Result	MDC	Result	MDC
IDNS Lab				
7/15/2019	<MDC	3.9	21.5	5.5
7/24/2019	<MDC	3.9	16.1	5.5
7/30/2019	<MDC	3.9	26.6	5.5
8/6/2019	<MDC	3.9	23.3	5.5
8/14/2019	<MDC	3.9	35.6	5.5
8/20/2019	<MDC	3.9	19.5	5.5
8/29/2019	<MDC	3.9	21.2	5.5
9/5/2019	<MDC	3.9	24.6	5.5
9/12/2019	6.1	3.9	35.5	5.5
9/20/2019	5.2	3.9	39.0	5.5
9/27/2019	4.1	3.9	31.3	5.5
10/2/2019	<MDC	3.9	23.9	5.5
10/11/2019	<MDC	3.9	24.4	5.5
10/17/2019	<MDC	3.9	20.1	5.5
10/21/2019	<MDC	3.9	39.7	5.5
10/29/2019	<MDC	3.9	15.3	5.5
11/8/2019	<MDC	3.9	24.0	5.5
11/14/2019	<MDC	3.9	29.1	5.5
11/20/2019	<MDC	3.9	43.1	5.5
12/3/2019	<MDC	3.9	18.8	5.5
12/13/2019	4.7	3.9	30.3	5.5
12/17/2019	4.3	3.9	25.5	5.5
12/27/2019	4.2	3.9	34.0	5.5

Table C.4 Isotopic Uranium Soil Migration Samples
Kincaid, Illinois Background Locations
Results are in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
E Boat Ramp						
6/11/2019	0.96	0.03	0.05	0.02	1.03	0.03
9/9/2019	0.98	0.03	0.05	0.02	1.08	0.03
Strawkaws Boat Ramp						
6/11/2019	0.93	0.03	0.04	0.02	1.08	0.03
9/9/2019	1.02	0.03	0.04	0.02	1.07	0.03
W Boat Ramp						
6/11/2019	0.96	0.03	0.06	0.02	1.11	0.03
9/9/2019	0.93	0.03	0.06	0.02	0.99	0.03

Table C.5 Isotopic Uranium Soil Deposition Samples
Kincaid, Illinois Background Locations
Results are in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
E Boat Ramp						
6/11/2019	0.97	0.02	0.06	0.02	0.99	0.02
9/9/2019	0.90	0.02	0.04	0.02	0.99	0.02
Strawkaws Boat Ramp						
6/11/2019	0.93	0.02	0.05	0.02	0.98	0.02
9/9/2019	0.95	0.02	0.03	0.02	0.85	0.02
W Boat Ramp						
6/11/2019	0.86	0.02	0.04	0.02	0.95	0.02
9/9/2019	0.80	0.02	0.07	0.02	0.90	0.02

Table C.6 Isotopic Uranium Vegetation Samples
Kincaid, Illinois Background Locations
Results are in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
E Boat Ramp						
6/11/2019	0.007	0.001	<MDC	0.001	0.004	0.001
9/9/2019	0.002	0.001	<MDC	0.001	0.002	0.001
Strawkaws Boat Ramp						
6/11/2019	0.004	0.001	<MDC	0.001	0.003	0.001
9/9/2019	0.004	0.001	<MDC	0.001	0.004	0.001
W Boat Ramp						
6/11/2019	0.001	0.001	<MDC	0.001	0.002	0.001
9/9/2019	0.003	0.001	<MDC	0.001	0.002	0.001

Table C.7 Isotopic Uranium Sample Results for Sediment Samples
Kincaid, Illinois Background Locations
Results are in picocuries per gram (pCi/g)

Location	U-234		U-235		U-238	
Date	Result	MDC	Result	MDC	Result	MDC
Strawkaws Boat Ramp						
9/9/2019	0.16	0.01	0.02	0.01	0.21	0.01
W Boat Ramp						
6/11/2019	0.63	0.01	0.03	0.01	0.68	0.01
9/9/2019	0.70	0.01	0.02	0.01	0.63	0.01

Table C.8 Ingrowth, Gamma Spectroscopy Soil Migration Samples
Kincaid, Illinois Background Locations
Results are in picocuries per gram (pCi/g)

Location	Ra-226		Th-230	
Date	Result	MDC	Result	MDC
W Boat Ramp				
6/11/2019	1.20	0.02	<MDC	1.46
9/9/2019	1.15	0.02	<MDC	1.46

Table C.9 Ingrowth, Gamma Spectroscopy Soil Deposition Samples
Kincaid, Illinois Background Locations
Results are in picocuries per gram (pCi/g)

Location	Ra-226		Th-230	
Date	Result	MDC	Result	MDC
W Boat Ramp				
6/11/2019	1.03	0.02	<MDC	1.86
9/9/2019	1.23	0.02	<MDC	1.86

Table C.10 KPA (Total Uranium) Sample Results for Water Samples
Kincaid, Illinois Background Locations
Results are in picocuries per gram (pCi/L)

Location	Uranium	
Date	Result	MDC
E Boat Ramp		
2/20/2019	0.6	0.1
6/11/2019	0.6	0.1
9/9/2019	0.4	0.1
11/18/2019	0.5	0.1
Strawkaws Boat Ramp		
2/20/2019	0.6	0.1
6/11/2019	0.5	0.1
9/9/2019	0.4	0.1
11/18/2019	0.5	0.1
W Boat Ramp		
2/20/2019	0.6	0.1
6/11/2019	0.5	0.1
9/9/2019	0.4	0.1
11/18/2019	0.5	0.1

Table C.11 Summary of Ambient Gamma Results
Kincaid, Illinois Background Locations

Location	Quarter 1 mR/quarter	Quarter 2 mR/quarter	Quarter 3 mR/quarter	Quarter 4 mR/quarter	Annual Exposure mR/year
KC-01	11.0	11.0	10.3	10.6	42.9
KC-02	10.8	14.7	7.7	8.1	41.3
KC-03		9.3	12.7	7.8	39.7
KC-04		9.0	8.4	9.1	35.4
KC-05		13.1	8.6	9.4	41.6
KC-06	9.0	10.0	9.0	9.4	37.4
KC-07	8.5	11.5	8.8	7.6	36.4
KC-08	9.3	9.9	8.3	8.0	35.5
KC-09	11.3	11.9	9.0	6.0	38.2
KC-10	10.3	10.4	10.7	7.9	39.3
KC-11	12.0	12.5	10.6	10.7	45.8
KC-12	13.1	11.7	10.1	10.2	45.1
KC-13	10.8	12.2	8.9	10.4	42.3
KC-14		10.8	7.7	10.4	38.4
KC-15	9.9	12.9	7.5	7.4	37.7

Blanks in the table indicate that the dosimeter was missing at the end of the quarter.
The Annual Dose column is based on averages of all available data.
Quarters estimated to be 91.25 days in length.

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