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Long-Term Surveillance and Maintenance Plan Site A and Plot M Palos Forest Preserve, Cook County, Illinois

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U.S. DEPARTMENT OF ENERGY | Legacy Management

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Abbreviations

ANL	Argonne National Laboratory
CFR	*Code of Federal Regulations*
CP	Chicago pile
CY	calendar year
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
GWQS	Ground Water Quality Standard
IAC	*Illinois Administrative Code*
IDPH	Illinois Department of Public Health
IEMA	Illinois Emergency Management Agency
Illinois EPA	Illinois Environmental Protection Agency
LM	Office of Legacy Management
nCi/L	nanocuries per liter
pCi/L	picocuries per liter
USC	*United States Code*
USGS	U.S. Geological Survey

1.0 Introduction

1.1 Purpose

This Long-Term Surveillance and Maintenance Plan explains how the U.S. Department of Energy (DOE) Office of Legacy Management (LM) will fulfill its responsibility for custody and long-term care of the Site A/Plot M, Illinois, Former Decommissioned Reactor Site in the Palos Division of the Forest Preserve District of Cook County (Palos Forest Preserve). Site A was the former reactor site, and Plot M was a radioactive waste disposal site. The plan describes actions necessary for the continued protection of human health and the environment, including inspections, monitoring, and stakeholder relations.

1.2 Legal and Regulatory Requirements

LM is responsible for the radiological and other hazardous substances that remain at Site A and Plot M under the authority of the Atomic Energy Act (Title 42 *United States Code* Section 2011 et seq. [42 USC 2011 et seq.]). The primary guidance governing the surveillance of Site A and Plot M is DOE Order 458.1 Chg 4 (LtdChg), *Radiation Protection of the Public and the Environment* (2020), which establishes a dose limit of 100 millirem per year. The U.S. Environmental Protection Agency (EPA) drinking water standards in Title 40 *Code of Federal Regulations* Section 141 (40 CFR 141) do not apply because the affected water supply (picnic water wells) does not meet the definition of a public water system (Golchert 1997). However, the Illinois Environmental Protection Agency (Illinois EPA) Class I Ground Water Quality Standards (GWQSs) (Title 35 *Illinois Administrative Code* Part 620 [35 IAC 620], "Groundwater Quality") for tritium and strontium-90 of 20,000 picocuries per liter (pCi/L) (equivalent to 20 nanocuries per liter [nCi/L]) and 8 pCi/L, respectively, are useful contamination benchmarks. Neither tritium nor strontium-90 concentrations at the picnic water wells have exceeded these standards.

The Illinois Emergency Management Agency (IEMA) Division of Nuclear Safety acts as an interested but unaffiliated third party and is available for consultation on site issues to LM.

1.3 Role of DOE

DOE's Long-Term Surveillance and Maintenance Program, the predecessor to LM, has had responsibility for Site A and Plot M since 1998. The LM program was created in December 2003 to conduct long-term management activities for DOE sites that no longer support DOE's ongoing missions, including Site A and Plot M.

LM is responsible for preparing, revising, and implementing this Long-Term Surveillance and Maintenance Plan. LM is also responsible for reporting the results of site inspections and monitoring and for maintaining records pertaining to the site.

1.4 Role of Stakeholders

Stakeholders that have been involved with Site A and Plot M include Argonne National Laboratory (ANL), IEMA, EPA Region 5, Illinois EPA, the U.S. Geological Survey (USGS), the Illinois Department of Public Health (IDPH), the Illinois Department of Nuclear Safety, the Forest Preserve District of Cook County, and the general public. Any changes made to the LM program requirements, as specified in this document, will be made in consultation with stakeholders.

2.0 Site Background Information

2.1 Site Location and Description

Site A and Plot M are within the Palos Forest Preserve in Cook County, Illinois, approximately 20 miles southwest of downtown Chicago and about 3 miles east of the current site of ANL (Figure 1). The federal government leased the site from the owner, the Forest Preserve District of Cook County, from 1942 until 1956.

Approximately 9 million people reside within 50 miles of the site; the population within a 5-mile radius is about 150,000. The only portion of the Palos Forest Preserve in the immediate area of Site A and Plot M that is developed for public recreation is the Red Gate Woods picnic area, about 1200 feet north of Plot M (Figure 1) (Golchert 1997). The area is not accessible by vehicle; however, several trails used for hiking, cross-country skiing, and horseback riding provide public access to Site A and Plot M (Biang et al. 1993). Directions to Site A/Plot M from the ANL main gate on 9700 Cass Avenue are provided in Table 1 below.

Table 1. Routes and Mileage to Site A and Plot M from the Main Gate at ANL

Mileage	Route To Site A/Plot M
0.0	From the ANL main gate (northeast side of facility, 9700 South Cass Avenue), drive south on Cass Avenue until it dead ends at Bluff Avenue. Turn left onto Bluff Avenue.
2.0	Turn right onto Highway 83, Kingery Avenue.
3.0	Cross the bridge, then turn left onto Highway 171, Archer Avenue.
	Route to Site A
4.0	Turn right at the entrance road to Site A.
4.5	Pass through the locked gate and follow the gravel road for about 0.5 mile to Site A.
	Route to Plot M
4.0	Turn right at Red Gate Woods picnic area parking lot (200 yards east of the entrance road to Site A off of Archer Avenue).
	From Red Gate Woods parking lot, walk south from the southeast corner of the lot to find a trail leading to Plot M, or drive up the Site A road to the top of the hill and take the first left, then turn left again after about 100 yards.

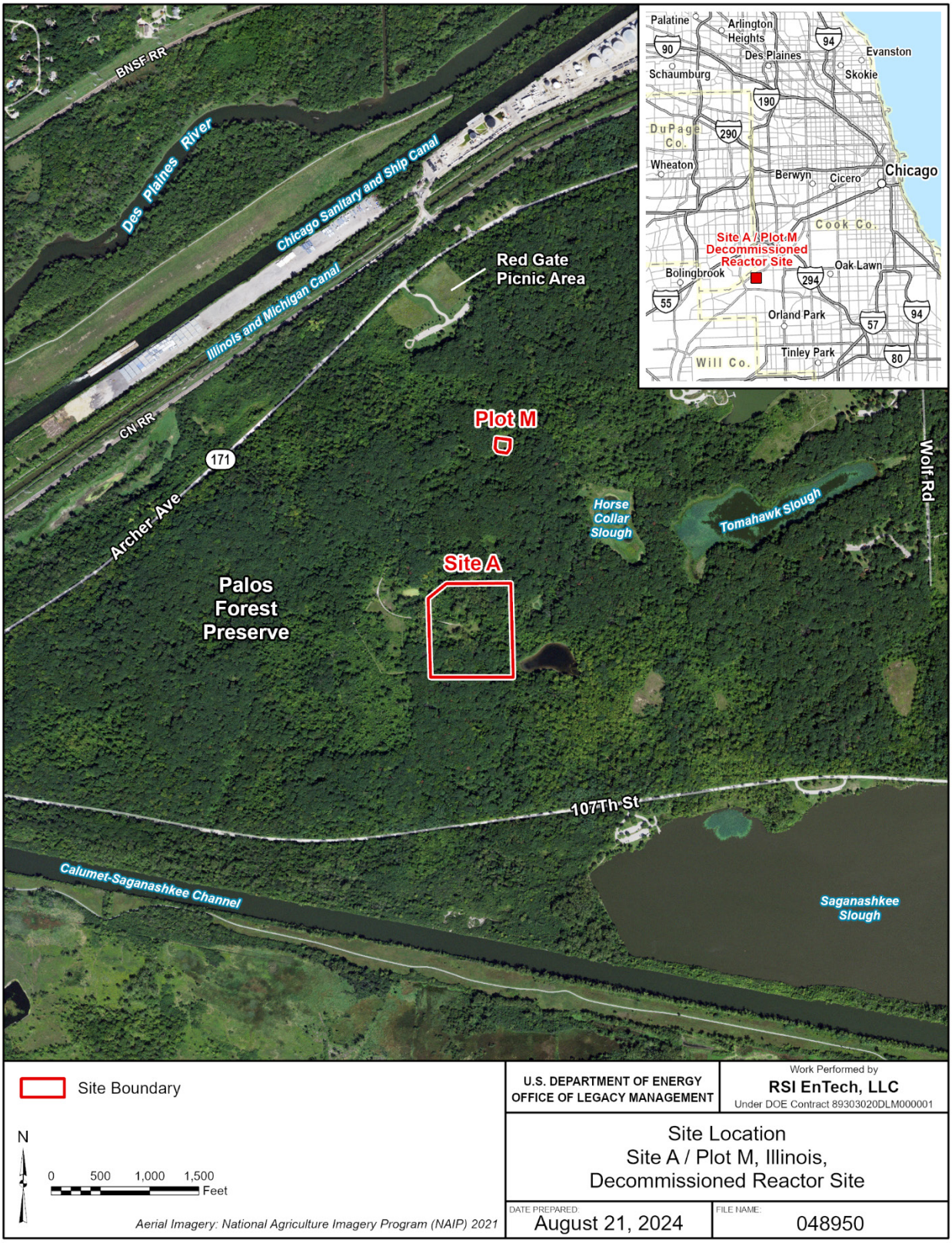

Figure 1. Site A and Plot M Vicinity Map

2.2 Topography, Geology, and Hydrology

The Site A and Plot M locations are within the 67,000-acre Palos Forest Preserve. Site A encompasses an area of 19 acres of forested, relatively flat terrain (IT 1996). Plot M, approximately 1600 feet north of Site A, encompasses an area of less than 1 acre (Figure 1).

Site A and Plot M sit on a recessional moraine upland dissected by two valleys, the Des Plaines River Valley to the north and the Calumet Sag Valley to the south. The upland is characterized by rolling terrain with poorly developed drainage. Streams are intermittent and drain internally or flow to one of the valleys. Because the soil in the upland is rather impermeable, swamps and lakes are common in the area (Biang et al. 1993). The area is underlain by glacial till or drift, dolomite, and other sedimentary rocks. The uppermost bedrock is Silurian dolomite that is about 200 feet thick. The overlying glacial till has a thickness that ranges from 165 feet at Site A to zero at the Des Plaines River and Calumet Sag Canal. The depth to bedrock at Plot M is 130 feet (Golchert 1997).

Surface water in the site area consists of ponds and intermittent streams. When there is sufficient water, the intermittent stream that drains Plot M flows from the highest point near Site A, past Plot M, then near the Red Gate Woods well, eventually discharging into the Illinois and Michigan Canal (Golchert 1997).

Groundwater in the glacial till and dolomite form two distinct flow systems. The shallow system consists of a fairly continuous perched water regime. The high clay content in the soils makes this possible. The flow in the glacial till is controlled principally by topography. The flow in the second system, the dolomite aquifer, which is recharged by groundwater from the glacial till, is controlled by two discharge areas, the Des Plaines River to the north and the Calumet Sag Canal to the south (Golchert 1997).

The dolomite bedrock forms an unconfined aquifer and is a major bedrock aquifer in this area. The dolomite aquifer was previously a source of drinking water (withdrawn using hand-pumped wells) in the adjacent Red Gate Woods picnic area of the forest preserve. Water is no longer available for public use because of high fecal coliform levels.

2.3 Climate and Vegetation

The climate is that of the Upper Mississippi Valley, as moderated by Lake Michigan, and is characterized by cold winters and hot summers. Precipitation averages about 37 inches annually. The largest rainfalls occur between April and September. The average monthly temperature ranges from 21 °F in January to 73 °F in July (Golchert 1997).

The site lies within the Prairie Peninsula of the oak-hickory forest region. The Prairie Peninsula is a mosaic of oak forest, oak openings, and tallgrass prairie occurring in glaciated portions of Illinois, northwestern Indiana, southern Wisconsin, and sections of other states. Much of the natural vegetation of this area has been modified by clearing and tillage. Forests in the region are somewhat limited to slopes of shallow, ill-defined ravines or low morainal ridges.

Intervening areas between ridges and ravines, which are gently rolling to flat, were predominantly occupied by prairie before their use for agriculture. The prevailing successional

trend in these areas, in the absence of cultivation, is toward oak-hickory forest. Forests dominated by sugar maple, red oak, and basswood may occupy more pronounced slopes. Poorly drained areas, streamside communities, and flood plains may support forests dominated by silver maple, elm, and cottonwood (Golchert and Kolzow 2004).

2.4 Site History

The Site A and Plot M area is the former site of ANL and its predecessor, the University of Chicago Metallurgical Laboratory, which was part of the World War II Manhattan Project, in the Palos Forest Preserve southwest of Chicago. The laboratory used two locations in the Palos Forest Preserve: Site A, a 19-acre area that contained experimental laboratories and nuclear reactor research facilities, and Plot M, a 150-foot by 140-foot area used for the burial of radioactive waste (Golchert 1997). These locations are shown in Figure 2.

Site A was the operational facility for two of the nation's first nuclear reactors, referred to as Chicago Pile-2 and Chicago Pile-3 (CP-2 and CP-3, respectively [DOE 1999]). Besides the two reactors, an estimated 35 support buildings were also constructed at the site and included laboratory buildings, dormitories, a cafeteria, dog kennels, and a lead foundry, among others. No operations were conducted at Plot M. That site was used only for disposal of radioactive materials and other materials generated by Site A operations.

Operations at Site A began in 1943 and ceased in 1954. The first reactor to achieve a self-sustaining chain reaction, CP-1, was moved from the University of Chicago to Site A in 1943 and renamed CP-2. A second reactor, CP-3, was constructed on the site in 1943. Among the research programs carried out at Site A were reactor physics studies, fission product separations, tritium recovery from irradiated lithium, and studies of the metabolism of radionuclides in laboratory animals. In 1954, essentially all work was moved about 3 miles northwest to the current location of ANL.

At the termination of the programs, the reactor fuel and heavy water, used for neutron moderation and reactor cooling, were removed and shipped to Oak Ridge National Laboratory. The biological shield for the CP-3 reactor, together with various pipes, valves, and building debris, was buried in place at Site A in 1956 (Golchert 1997). The CP-2 (formerly CP-1) reactor shield is also buried at Site A (Biang et al. 1993). By 1956, all buildings and equipment at Site A had been decontaminated and demolished (see Section 2.5.1 for details).

During operations, radioactive waste and radioactively contaminated laboratory articles generated from Site A research activities were buried in Plot M. Burial of radioactive waste at Plot M began in May 1944 (Biang et al. 1993); it is not clear how wastes were disposed of before that time, but it appears some may have been burned at locations at Site A (Biang et al. 1993). Disposal of wastes at Plot M was discontinued in 1949. Apparently, both solid and liquid waste was buried from 1944 through 1946. Liquid wastes were disposed of in intact containers, which may have subsequently been breached (Biang et al. 1993). Through 1948, waste was buried in 6-foot-deep trenches and covered with soil to minimize radiation release; beginning in May 1948 burial took place in steel bins. The steel bins were removed in 1949 in a search for some missing uranium-235, which was subsequently found (Biang et al. 1993). Instead of being reburied, the bins were shipped offsite for disposal; the waste buried in trenches was allowed to remain in place. Records of items placed in Plot M are incomplete, but known items include animal carcasses, building debris, clothing, contaminated equipment, air filters, paper, and other

radioactive and hazardous materials (Biang et al. 1993). Both the Site A and Plot M areas were decommissioned in 1956.

In 1973, elevated levels of tritium were detected in two nearby hand-pumped picnic wells. The tritium was found to be migrating from the Plot M burial area into the surrounding soil and groundwater. A subsequent investigation of soils, groundwater, sediment, and surface water in the vicinity of Plot M confirmed the presence of tritium in the subsurface. Tritium was also detected in surface water and sediment samples (Biang et al. 1993). As a result, a groundwater, sediment, and surface water monitoring program was instituted at the site and continues to the present. These studies focused primarily on determining the nature and extent of near-surface radioactive contamination. Studies conducted in the 1960s identified a small area (30 × 60 meters [98 × 197 feet]) of surface soil northwest of Plot M that had somewhat elevated (compared to background) concentrations of uranium and plutonium (Sedlet and Golchert 1980), which were attributed to spillage during burial and removal operations. It is not clear if these soils were removed or if they were determined to pose no unacceptable risk and left in place.

In May 1990, the Illinois Department of Nuclear Safety, while conducting routine oversight monitoring at Site A, discovered a piece of uranium metal beneath leaves and underbrush on the forest floor (DOE 1999). Further inspection uncovered additional debris, and it was eventually concluded that this area was a forgotten sanitary landfill. As a result, a number of studies were undertaken to characterize Site A. Historical knowledge was used to identify different "investigation groupings" and "suspect areas," which were systematically sampled and analyzed for both radiological and chemical constituents. Geophysical surveys were conducted to investigate suspected burial areas, and subsurface anomalies were evaluated. The investigations determined that surface soils in several areas at Site A contained radiological contamination at levels above background. A number of physical hazards were also identified (e.g., pipes protruding from the ground, concrete rubble).

A risk assessment conducted in association with these characterization efforts indicated that residual contamination at Site A posed only minimal risk. However, in consultation with various stakeholder groups, DOE determined that it was in the best interest of the general public to conduct a voluntary cleanup action. The U.S. Army Corps of Engineers removed physical hazards in 1995. A limited removal action to address chemical and radioactive wastes was conducted in 1997. Subsequent verification surveys confirmed that radiological cleanup criteria had been met (see Appendix A), and control of Site A was returned to the Forest Preserve District of Cook County (DOE 1999).

2.5 Stabilization and Isolation Technique

2.5.1 Decommissioning

Site A research activities ceased in May 1954 when the reactors were shut down. The CP-2 and CP-3 reactor shells were demolished and buried, and the support facilities and buildings were decontaminated and torn down (DOE 1997). Uncontaminated materials were removed from the site, and arrangements were made to return the site to the Forest Preserve District of Cook County.

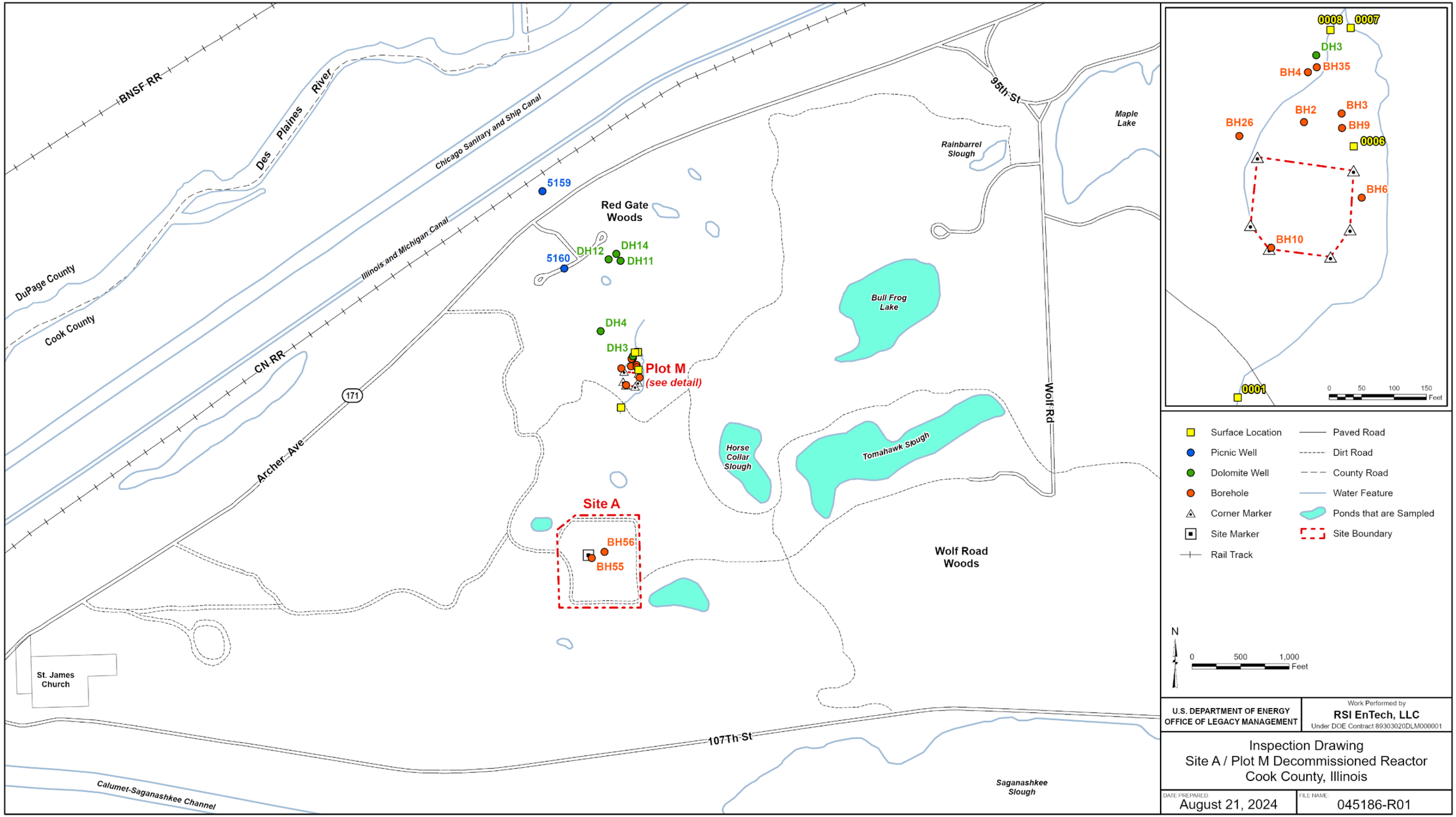

Figure 2. Annual Inspection Drawing

An excavation approximately 100 feet across and 40 feet deep was prepared between the two reactors. The reactors themselves were approximately 180 feet apart. The 800-ton, concrete-filled shell of the CP-3 reactor was buried by excavating around it on three sides and detonating strategically placed explosives in the earthen "pedestal" supporting it. The reactor shell rolled and came to rest upside down in the excavation (Biang et al. 1993). The concrete shield of CP-2 was demolished and pushed into the same excavation. The buildings that housed the reactors were demolished and placed in the excavation. The excavation was then backfilled, leveled, and landscaped (Biang et al. 1993). The top of the CP-3 reactor shield is approximately 23 feet below ground surface; rubble and building debris fill the excavation both laterally and vertically to within a few feet of the surface (Bechtel 1995). A large, engraved stone marker briefly describes the history of the site and indicates the approximate burial location.

In 1956, Plot M was stabilized and isolated by backfilling after the waste was buried, and the sides and top of the burial zone were encased with concrete. The disposal area was surrounded by concrete walls 8 feet deep and 1.5 feet thick. A 1-foot-thick concrete slab was placed over the top of the entire disposal area. The walls and slab are reinforced with wire mesh (Biang et al. 1993). The concrete was covered with 2 feet of soil and seeded with grass, and an inscribed granite marker was placed in the center of Plot M (Golchert 1997). The purpose of the concrete barrier was to prevent people from digging into the waste and to impede the flow of water through the buried radioactive materials (Biang et al. 1993).

2.5.2 Voluntary Removal Action

In 1995, the U.S. Army Corps of Engineers conducted a physical hazard removal action. Concrete rubble from foundations of the former support buildings, various pieces of pipe that were protruding from the soil surface, manholes, and other construction rubble were removed from Site A. In addition, holes resulting from subsidence of the former sewage system were backfilled. This action was completed in fall 1995 (DOE 1997).

A voluntary removal action of contaminated soil and debris was completed at Site A in 1997 (DOE 1997). This removal action consisted of the excavation of approximately 360 cubic yards of contaminated soil and the removal of an additional 140 cubic yards of debris, consisting primarily of graphite blocks. The soil and debris were mixed with Portland cement and shipped to the Hanford Site near Richland, Washington, for disposal. Following completion of excavation, approximately 2000 cubic yards of clean clay were spread across the excavated areas to minimize groundwater percolation. Topsoil was brought in, placed over the clay, and reseeded to Forest Preserve District specifications. Additionally, three mounds of sludge from a chemical or water treatment facility (referred to as "Milorganite"), previously brought to the area for use as fill and fertilizer, were leveled, covered with topsoil, and also reseeded to Forest Preserve District specifications.

The *Record of Decision for Site A* (DOE 1999) documents cleanup activities that were completed there. The Record of Decision also includes the radiological verification report that was completed by the Illinois Department of Nuclear Safety. It is assumed that decommissioning activities at Plot M adequately addressed any concerns over surficial contamination.

2.6 Current Site Conditions

The surface at both Site A and Plot M is considered to be clean and suitable for recreational use (IDPH 2002a; IDPH 2002b). Hiking trails and bike paths are in use in the area. A picnic area is adjacent to Plot M in the Red Gate Woods. The Forest Preserve District of Cook County has control over surface use. DOE is responsible for the wastes buried at both Site A and Plot M. Consistent with the Forest Preserve District's goal of "preserving nature," Forest Preserve District regulations do not allow any digging. Consequently, it is assumed that this land-use restriction remains in effect at Site A and Plot M and that buried wastes will not become exposed through intentional human intrusion (DOE 1997). The concrete cap and vegetation on Plot M will prevent exposures of buried waste there through surface erosion. Vegetation at Site A will inhibit erosion that could expose buried wastes, though it does not ensure the prevention of erosion. However, the most radioactive wastes were placed at depth and covered with largely uncontaminated building rubble and debris, which in turn was covered with clean fill.

The primary constituents of concern in groundwater and surface water in the vicinity of Site A and Plot M are tritium (hydrogen-3) and strontium-90. Radiological characterization of Site A and Plot M showed that very low levels of tritium migrated from the burial area at Plot M and were detected in two nearby hand-pumped picnic wells in the Red Gate Woods area approximately 1500 feet to the north. (Pump handles have subsequently been removed to prevent exposure to fecal coliform contamination detected in the picnic wells. The fecal coliform contamination is not related to Site A or Plot M.) Tritium activity is still detected in the picnic wells, but average and maximum activities are significantly less than were indicated by previous observations and well below the Illinois EPA Class I GWQS of 20,000 pCi/L (equivalent to 20 nCi/L). Tritium concentrations continue to exceed the Illinois EPA Class I GWQS in a number of monitoring wells at the site in the vicinity of Plot M. Low levels of strontium-90 have been detected in groundwater from several monitoring wells near Site A and Plot M since 1984. Strontium-90 (13.14 pCi/L) exceeded the Illinois EPA Class I GWQS of 8 pCi/L at one location in the glacial till at Site A in 2003. With a few exceptions, the amount of strontium-90 in the wells is decreasing over time. All results in 2023 were below the Illinois EPA Class I GWQS of 8 pCi/L for strontium-90.

Table 2 presents the analytical results of the groundwater and surface water monitoring program for Site A and Plot M for 2023. Sampling locations are shown in Figure 2.

USGS conducted a detailed investigation of the hydrogeologic and geochemical properties of the glacial drift to determine the extent of tritium in the drift material and the rate and direction of movement in bedrock groundwater (Olimpio 1984). These studies showed that anisotropic hydrogeologic properties of the drift significantly affected groundwater flow and contaminant migration. The size, shape, and configuration indicate that the plume is a single slug and that the site no longer releases tritium into the glacial drift. The leading edge of the plume probably left the burial area in the late 1940s or early 1950s and intersected the underlying bedrock surface before 1973. The key factors that control both the activity level and the extent of migration of tritium in groundwater in the glacial drift at Plot M are (1) the limited amount of tritiated waste buried at Plot M, (2) the long period of time that has elapsed since the waste was buried relative to the radioactive half-life of tritium (approximately 12.3 years), and (3) the great thickness and low permeability of the glacial drift at the site. It is therefore expected that groundwater contaminant concentrations at the site will continue to decrease over time.

Table 2. Summary of 2023 Analytical Results for Site A and Plot M Constituents of Concern

Area	Location	Tritium[a] (nCi/L)	Strontium-90[a] (pCi/L)
Illinois EPA Class I GWQS		20	8
Groundwater from Monitoring Wells Screened in Glacial Drift			
Plot M	BH2	1.4–4.5	0.42 ±0.091
	BH3	4.5–75	<0.25
	BH4	249–268	<0.25
	BH6	282–1231	1.11 ±0.114
	BH9[b]	288[c]	Dry[d]
	BH10[b]	5.8–25.4	<0.25
	BH11s	43–53	1.39 ±0.135
	BH26	0.6–44	0.28 ±0.075
	BH35	631–914	<0.25
Site A	BH55	0.82	1.49 ±0.180
	BH56	0.76	0.96 ±0.225
Groundwater from Monitoring Wells Screened in Dolomite			
Plot M	DH3	0.63	NSR
	DH4	0.75	NSR
	DH11	0.43	NSR
	DH12	0.36	NSR
	DH14	0.40	NSR
	DH15	1.86	NSR
Groundwater from Picnic Wells Screened in Dolomite			
	5159	0.37	NSR
	5160	0.73	NSR
Surface Water			
Plot M	1	<0.1	NSR
	6	1.0–7.6	NSR
	7	0.7–1.0	NSR
	8	<0.1–0.2	NSR
Regional	Ponds (5)[e]	<0.1	NSR

Notes:
[a] A range is provided if a location was sampled more than once in 2023 and the results differed.
[b] Slant hole drilled at 45°.
[c] BH9 was dry for three quarters of the year. Only one sample was collected.
[d] Not enough water to sample.
[e] The ponds are Horse Collar Slough, Bull Frog Lake, Tomahawk Slough, and two unnamed ponds northwest and southeast of Site A.

Abbreviation:
NSR = no sample required

2.7 Risk

Risks posed by Site A and Plot M have been evaluated since monitoring and characterization activities were undertaken in the 1970s. The only currently complete exposure pathways are associated with exposures to contaminants that may be present at the surface of the site. Groundwater is not currently being used at the site. Buried wastes at the site have adequate cover to prevent exposure. The Forest Preserve District controls land use and will impose restrictions on drilling or excavating in the area.

Limited removal actions were implemented at Site A in 1995 and 1997. The 1995 action removed potential physical hazards at the site. The 1997 action resulted in the removal of soils with contaminants that exceeded the background levels of some constituents. The need for these actions was not driven by risk; they were conducted as a best management practice. The Illinois Department of Nuclear Safety concurred that radiological cleanup criteria were met at Site A (see Appendix A).

As discussed in Section 2.6, tritium and strontium-90 have been detected in well water in the vicinity of Site A and Plot M, although concentrations in the vast majority of samples have been well below the Illinois EPA Class I GWQS of 20,000 pCi/L (20 nCi/L) and 8 pCi/L, respectively (35 IAC 620). At one time, picnic wells at the Red Gate Woods were used as a source of drinking water for visitors to the picnic grounds. These wells were removed from service due to coliform contamination unrelated to Site A or Plot M. The only complete route of exposure to groundwater is where the water surfaces at a local seep and intermittent surface stream. Because potential exposures to contaminated groundwater and surface water are of low frequency and short duration, actual risks posed by site-related contamination are negligible. Potential risks continue to decrease as concentrations of constituents of concern in the groundwater system continue to decline. Results of the surveillance program continue to indicate that, although radioactivity remains in the subsurface in the vicinity of Site A and Plot M and at the surface water at Plot M, the potential for release of hazardous amounts of contamination into groundwater and surface water is low, and the observed levels of contamination do not endanger the health or safety of the public visiting the site, using the picnic area, or living in the vicinity. Potential radiation doses are well below the applicable standards.

IDPH conducted public health assessments of Site A and Plot M (IDPH 2002a; IDPH 2002b) and concluded that cleanup at Site A has been adequate to protect the public from any risks that the site may have posed in the past. IDPH also concluded that under current conditions, exposures at Plot M are not at levels that would be expected to cause adverse health effects, and therefore, the site does not pose a public health hazard. Based on the infrequency of any exposures that would be likely to occur at the site today, and on the fact that contaminated materials are buried at depth, the site was determined to pose no unacceptable risks currently.

3.0 Long-Term Surveillance and Maintenance

3.1 Stewardship Overview

LM conducts stewardship activities at Site A and Plot M to protect human health and the environment and to comply with applicable regulations. LM is responsible for the radioactive waste material that remains at Site A and Plot M. The Palos Forest Preserve is responsible for maintenance of the land surface. IEMA and IDPH oversee LM's stewardship activities at the site.

This plan implements long-term components of remedies selected for Site A and Plot M. LM will maintain protectiveness at the site through a combination of continuing government ownership, conducting regular inspections, maintaining public awareness, and monitoring environmental media and institutional controls.

3.2 Inspections

3.2.1 Routine Inspections

Site inspections are conducted annually. Figure 2 shows the site base map used for the inspection. This figure depicts the locations of all monitoring wells, surface water locations and features, monuments, and corner markers that are physically located and observed during the inspection. In addition, attention will be given to determining if any onsite erosion is occurring. Erosion involving head cutting in the direction of the disposal sites will be documented and identified for further evaluation. The local topography and established vegetation are expected to keep erosion at a minimum. The inspectors will also assess the condition and health of site vegetation, as established vegetation is considered a primary deterrent to erosion.

During site inspections, photographs may be useful to document observations, especially evidence of vandalism, changed conditions, or maintenance needs. These photographs will be captured in the annual report.

Typically, two inspectors from ANL will perform the annual inspections. Inspectors will be experienced engineers or scientists who have the required knowledge, skills, and abilities to evaluate site conditions and recognize imminent or existing problems. In addition to the two inspectors from ANL, inspectors from other agencies and organizations may participate, including LM, IEMA, and the Forest Preserve District of Cook County.

An annual report will be issued that includes site inspection observations, recommendations, any issues or opportunities for improvement cited at the time of the inspection (followed by the appropriate corrective actions to be taken by ANL), and photographs.

3.2.2 Follow-Up Inspections

Follow-up inspections are unscheduled inspections that are conducted in response to threatening or unusual site conditions.

LM may conduct follow-up inspections if either of the following occur:

- A condition is identified during the routine site inspection, or another site visit, that requires personnel with specific expertise to return to the site to evaluate the condition
- LM is notified by a citizen, employee, or federal, state, or local agency that conditions at the site are substantially changed

Once a condition or concern is identified at the site, LM personnel will evaluate the information and decide whether to respond with a follow-up inspection.

Specific conditions that may necessitate a follow-up inspection include unauthorized intrusion, violation of institutional controls, vandalism, or the need to revisit the site to evaluate, define, or conduct maintenance tasks. Conditions that may require a more immediate follow-up inspection include extreme weather or seismic events and disclosure of human activity that threatens the integrity of waste containment. LM will evaluate risk when scheduling follow-up inspections. The urgency of the follow-up inspection will be in proportion to the seriousness of the condition.

If an incident or activity threatens or compromises institutional controls or poses a risk of exposure to or release of known contaminants, LM may, as appropriate, notify IEMA, begin the LM occurrence notification process, respond with an immediate follow-up inspection, and begin emergency measures to contain or prevent dispersion of constituents from Site A or Plot M. At any time, LM may request the assistance of local authorities to confirm the seriousness of a condition at the site before scheduling a follow-up inspection or initiating other action.

The public may use the 24-hour number monitored at the LM Field Support Center at Grand Junction, Colorado ([970] 248-6070), to request information about the site or to notify LM of site concerns.

Inspectors assigned to perform follow-up inspections will be selected on the same basis as that used for routine site inspections. Results of follow-up inspections will be included in the next annual inspection report. Separate reports will not be prepared unless LM determines it advisable to notify IEMA or another outside agency of a situation at the site that remains uncorrected. If a follow-up inspection is required for more serious or emergency reasons, LM will submit a preliminary report on the inspection within 60 days of the inspection.

3.3 Groundwater and Surface Water Monitoring

Various parameters of the Site A and Plot M environment have been monitored to varying degrees since the site was decommissioned in 1956. In the past, groundwater, surface water, air, and stream sediments were systematically monitored. As part of the transfer of Site A and Plot M to LM, the monitoring program was evaluated (DOE 2003). The technical evaluation consisted of a qualitative review of ANL's environmental monitoring results for the previous 10 years (e.g., Golchert 1997). The review of the program indicated that monitoring had demonstrated that the site conditions remained protective, as predicted, and presented no unacceptable risk to human health and the environment. The technical evaluation was developed with a group consisting of staff and contractors representing LM, DOE, ANL, and IEMA.

In the context of long-term surveillance and maintenance activities at other LM sites, the monitoring program was scaled back in 2004 without compromising DOE's ability to observe areas where potential problems or exposures could exist and to ensure ongoing protection of human health and the environment. Based on discussions and the consensus of the group, the revised environmental monitoring program that was implemented at Site A and Plot M, effective in February 2004, consisted of sampling at 36 locations on a quarterly basis, with 144 analyses for tritium and 60 analyses for strontium-90 (DOE 2004). Metals were no longer analyzed, since the technical evaluation group had determined that no metals were related to potential source materials. Justification for the sampling locations was based on technical and stakeholder concerns. The distribution of locations was designed to ensure that conditions would be known to remain protective.

Groundwater and surface water monitoring were evaluated in 2010 (DOE 2011) to determine if changes were needed to continue to meet two monitoring objectives: (1) ensuring that existing contaminant concentrations continue to decrease as expected due to radioactive decay and other natural processes and (2) detecting any potential future releases (though these are considered unlikely). Data collected through 2009 for the two remaining constituents of concern (tritium and strontium-90) indicated that, with the exception of tritium at Plot M, concentrations of these radionuclides were low, and trends were consistent. The low concentrations coupled with the consistent trends indicated that, with the exception of sampling for tritium at Plot M, the major monitoring objectives could be met through annual rather than quarterly sampling. However, sampling for tritium at Plot M continued to remain on a quarterly schedule.

In 2014, DOE issued a supplemental assessment that identified eight groundwater monitoring wells that could be plugged and abandoned without jeopardizing site monitoring objectives (DOE 2014).

Results of the 2022 surveillance program continue to indicate that the radioactivity remaining at Site A and Plot M remains safe for the public visiting the site, using the picnic areas, or living in the vicinity. As such, LM assessed the monitoring program again in 2023 and found that results remain similar to previous years with locations remaining below the respective Illinois EPA Class I GWQSs, showing downward trends, or fluctuating between historical results; the only two exceptions were well BH06 and well BH35. As a result of this review, LM proposed a reduction in monitoring frequencies for all groundwater locations and some surface water locations. No changes to sampling locations or analytes were proposed. IEMA gave concurrence on the proposed changes, which were implemented in calendar year (CY) 2024. LM will continue to review the groundwater monitoring program to ensure sampling frequencies are appropriate given concentrations and trends.

3.3.1 Monitoring Program

The monitoring program, effective as of 2024, is defined in Table 3 and shown in Figure 2. It consists of sampling at 28 locations (19 wells, 4 streams, and 5 ponds). Samples are analyzed only for the main constituents of concern, which are tritium and strontium-90.

- ANL personnel conduct sampling, analysis, and reporting. The sampling crew also makes observations of the site while performing sampling as part of the overall surveillance for the security and maintenance of the site.

- Analytical data are made available to stakeholders. LM maintains a database for reference and presentation to stakeholders. Reporting and distribution of information to stakeholders are performed via the method standardized under the LM long-term surveillance and maintenance program. Information is presented in annual reports and made available on the LM public website (https://energy.gov/lm/office-legacy-management).

LM will evaluate this monitoring program every 5 to 7 years. Changes should be implemented in the program, as deemed necessary and with input from the stakeholders, to maintain the LM mission of protecting human health and the environment and to reasonably reflect conditions at the site and the level of potential risk.

3.4 Inspection and Monitoring Reports

Inspection and monitoring results will be recorded in an annual status report. A copy of the report will be distributed to interested stakeholders and posted on the LM public website (https://www.energy.gov/lm/site-aplot-m-illinois-decommissioned-reactor-site).

3.5 Maintenance, Repairs, Emergency Response, and Groundwater Corrective Action

3.5.1 Maintenance and Repairs

Maintenance refers to routine activities that may be necessary to prevent long-term site degradation or deterioration from a public perception standpoint. Anticipated tasks such as grass mowing fall into this category. The Palos Forest Preserve is responsible, as landowner, for routine maintenance of the site surface (e.g., erosion, groundskeeping, public safety issues).

Repairs are actions taken to restore structures to design conditions. LM will conduct repairs of the structures DOE is responsible for (e.g., wells, markers and monuments, the Plot M waste containment system).

3.5.2 Emergency Response

LM will respond to “unusual damage or disruption” that threatens or compromises site safety, security, or integrity. LM will contain or prevent dispersal of radioactive materials in the unlikely event of an actual breach of the site containment systems.

Table 3. Summary of Environmental Monitoring Program for Site A and Plot M, Palos Forest Preserve

Effective as of CY 2024			
Area	**Location**	**Frequency—Tritium**	**Frequency—Strontium-90**
Groundwater from Monitoring Wells Screened in Glacial Drift			
Plot M	BH2	Annually	Annually
	BH3	Annually	Annually
	BH4	Annually	Annually
	BH6	Annually	Annually
	BH9	Annually	Annually
	BH10	Annually	Annually
	BH11	Annually	Annually
	BH26	Annually	Annually
	BH35	Annually	Annually
Site A	BH55	Every 2 years[a]	Every 2 years[a]
	BH56	Every 2 years[a]	Every 2 years[a]
Groundwater from Monitoring Wells Screened in Dolomite			
Plot M	DH3	Every 2 years[a]	NSR
	DH4	Every 2 years[a]	NSR
	DH11	Every 2 years[a]	NSR
	DH12	Every 2 years[a]	NSR
	DH14	Every 2 years[a]	NSR
	DH15	Every 2 years[a]	NSR
Groundwater from Picnic Wells Screened in Dolomite			
	5159	Every 2 years[a]	NSR
	5160	Every 2 years[a]	NSR
Surface Water			
Plot M	1	Annually	NSR
	6	Annually	NSR
	7	Annually	NSR
	8	Annually	NSR
Regional	Ponds (5)[b]	Annually	NSR

Notes:
This description is based on sampling recommendations made in 2011 (DOE 2011) and plugging and abandonment recommendations made in 2014 (DOE 2014).
[a] Every 2 years for the next 5 years; if results remain below Illinois EPA Class I GWQSs, sampling reduces to every 5 years starting in CY 2029.
[b] The five ponds are: (1) pond northwest of Site A, (2) pond southeast of Site A, (3) Horse Collar Slough, (4) Tomahawk Slough, and (5) Bull Frog Lake.

Abbreviation:
NSR = no sample required

3.5.3 Groundwater Corrective Action

Currently, tritium and strontium-90 concentrations exceed Illinois EPA Class I GWQSs at some locations. Concentrations continue to decrease, and currently, complete exposure pathways present no unacceptable risk. If abrupt reversals in trends or concentrations are observed, LM would first conduct confirmatory sampling. If confirmatory sampling verifies the exceedance, LM will initiate an evaluative monitoring program. Results of the evaluative monitoring program would be used to determine if corrective action is necessary.

If corrective action is necessary, LM will develop and implement a groundwater Corrective Action Plan in consultation with IEMA.

3.6 Records

To support postremediation maintenance of Site A and Plot M, LM maintains records at the LM Business Center at Morgantown, West Virginia. These records contain critical information required to protect human health and the environment, manage land and assets, protect the legal interests of DOE and the public, and mitigate community impacts resulting from the cleanup of legacy waste. Site historical records about environmental remediation and stewardship are included in these site record holdings. All LM records will be managed in accordance with the following requirements:

- 44 USC 2901–2912, "Records Management by the Archivist of the United States and by the Administrator of General Services"
- 44 USC 3101–3107, "Records Management by Federal Agencies"
- 44 USC 3301–3324, "Disposal of Records"
- 36 CFR 1220–1249, "Records Management"
- DOE Order 243.1C, *Records Management Program*
- LM Records Management Program procedures

3.7 Quality Assurance

All activities performed by LM related to the surveillance, monitoring, and maintenance of Site A and Plot M will comply with the *Quality Assurance Manual* (DOE 2024). ANL, the Palos Forest Preserve, and others not controlled by LM will perform work to their own quality standards, as approved by DOE.

3.8 Safety and Health

Work at Site A and Plot M is performed in accordance with safety regulations promulgated by DOE and the Occupational Safety and Health Administration, including the provisions in 10 CFR 835. Before work begins, the assigned workers and the supervisor responsible for the work activity develop a job safety analysis, which is then approved by a Safety and Health representative, following the five core functions of the Integrated Safety Management System. Site-specific information relating to known hazards and emergency information can be found in the *LM/LMS All Hazards Emergency Management Plan* (DOE 2023).

All personnel assigned to a work activity or visiting the site are briefed to the approved job safety analysis and are required to have the proper personal protective equipment and communication equipment available for their immediate use.

Maintenance subcontractors are required to follow this same process, in accordance with the requirements of 10 CFR 835, which are found in their specific contract documents.

4.0 References

10 CFR 835. U.S. Department of Energy, "Occupational Radiation Protection," *Code of Federal Regulations*.

36 CFR 1220–1249. National Archives and Records Administration, "Records Management," *Code of Federal Regulations*.

40 CFR 141. U.S. Environmental Protection Agency, "National Primary Drinking Water Regulations," *Code of Federal Regulations*.

35 IAC 620. "Groundwater Quality," *Illinois Administrative Code*.

42 USC 2011 et seq. "Atomic Energy Act," *United States Code*.

44 USC 2901–2912. "Records Management by the Archivist of the United States and by the Administrator of General Services," *United States Code*.

44 USC 3101–3107. "Records Management by Federal Agencies," *United States Code*.

44 USC 3301–3324. "Disposal of Records," *United States Code*.

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DOE Order 243.1C, *Records Management Program*, U.S. Department of Energy, February 7, 2022.

DOE Order 458.1 Chg 4 (LtdChg), *Radiation Protection of the Public and the Environment*, U.S. Department of Energy, September 15, 2020.

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Golchert, N.W., and R.G. Kolzow, 2004. *Argonne National Laboratory-East Site Environmental Report for Calendar Year 2003*, ANL-04/2, Argonne National Laboratory, Argonne, Illinois, September.

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Olimpio, J.C., 1984. *Low-Level Radioactive-Waste Burial at the Palos Forest Preserve, Illinois: Geology and Hydrology of the Glacial Drift, as Related to the Migration of Tritium*, U.S. Geological Survey Water-Supply Paper 2226.

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Appendix A

Regulator Concurrence

TEC.970512.0004

STATE OF ILLINOIS
DEPARTMENT OF NUCLEAR SAFETY
1035 OUTER PARK DRIVE
SPRINGFIELD, ILLINOIS 62704
217-785-9900
217-782-6133 (TDD)

Jim Edgar
Governor

Thomas W. Ortciger
Director

May 9, 1997

Ms. Sue Nielsen
Site A Project Manager
U. S. Department of Energy
Chicago Operations Office
9800 South Cass Avenue
Argonne, Illinois 60439

Dear Ms. Nielsen:

The Illinois Department of Nuclear Safety (IDNS) has completed its report on remedial actions taken by the Department of Energy at Site A of the Palos Forest Preserve. This report describes IDNS's involvement in the cleanup of the park and documents the final radiation surveys conducted by IDNS. The report concludes that all agreed upon radiological cleanup criteria were met. Three copies are enclosed for your use.

I hope you find your report useful. If you have any questions, please call me at (217) 782-1322.

Sincerely,

Richard Allen

Rich Allen, Manager
Office of Environmental Safety

RA:tlk

Enclosures

recyclable

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