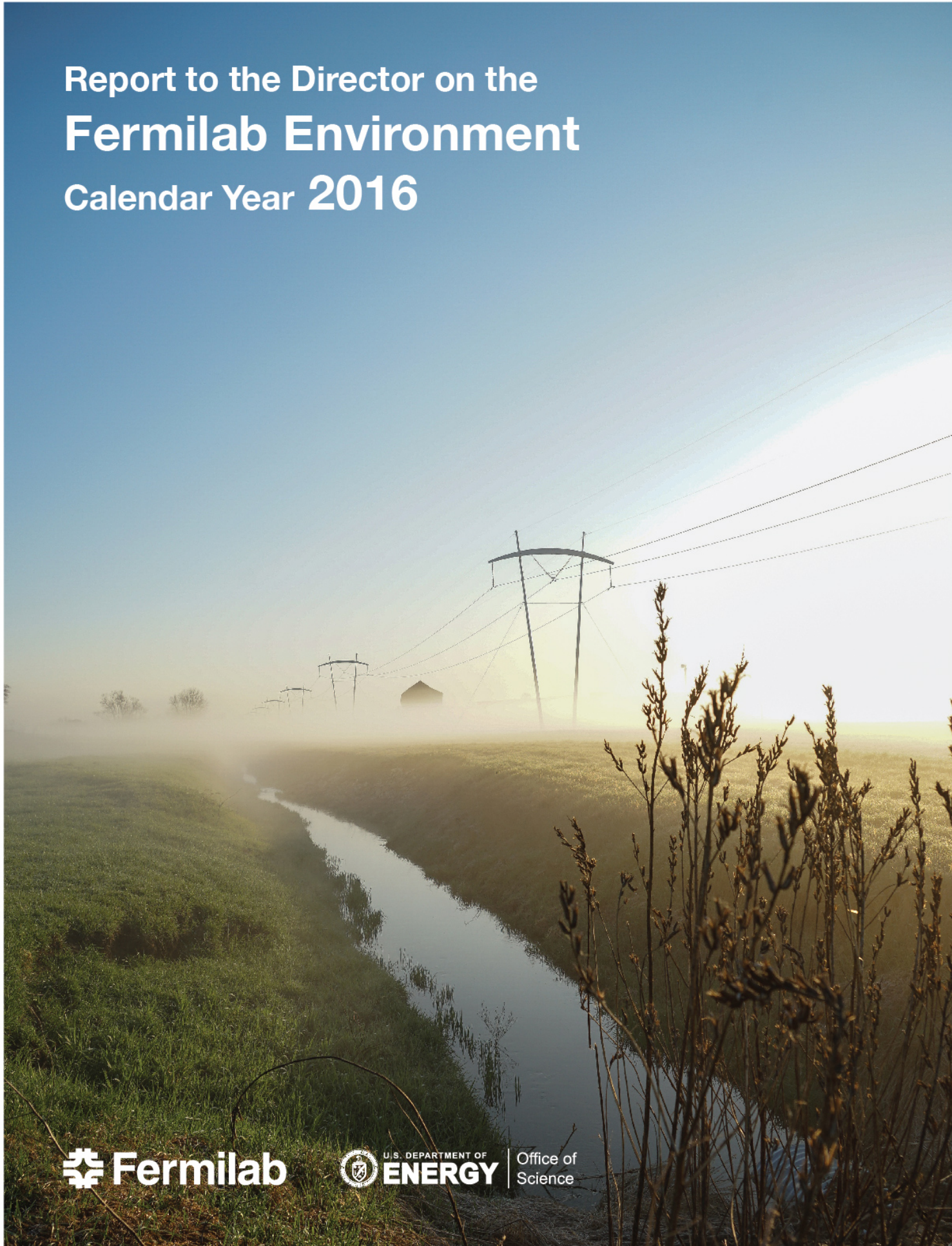


Report to the Director on the Fermilab Environment Calendar Year 2016



Office of
Science

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Cover: Foggy April Morning, photo by Leticia Shaddix and design by Reidar Hann.

1.0 Introduction

This Report to the Director on the Fermilab Environment documents the performance of Fermilab's environmental protection program. The report presents the status of environmental objectives for the laboratory and documents the compliance status of environmental requirements under the scope of Fermilab's Environmental Management System (EMS). Our EMS conforms to the core set of standards described in ISO 14001 (International Organization for Standardization). The EMS structure provides Fermilab a practical framework from which to assess and manage the environmental impacts of site operations.

The Fermilab site consists of 6,800 acres of mixed use land. The primary features on the site include the accelerator complex and associated building infrastructure, an interconnected industrial cooling water system, a housing complex for visiting researchers (the Village), row crop agriculture, and natural areas in various states of restoration. These consist primarily of tall grass prairie, forest, and wetlands. Fermilab is America's premier particle physics laboratory with a mission to drive discovery in particle physics, encouraging pioneering research by operating world-class accelerators and detector facilities. Founded in 1967, Fermilab has been operated by Fermi Research Alliance LLC (FRA) since 2007.

A core component of our EMS is the environmental monitoring and surveillance program which provides for the measurement and interpretation of the impact of Fermilab operations on the environment. Surveillance and monitoring tasks are conducted to confirm compliance with established standards and specific permit limits, as well as ensure early detection of an unplanned pollutant release. The location and frequency of sampling are based on established routines, operational considerations and process assessments as well as historic levels of pollutants found at a particular location. Sampling points are selected based on the potential for adverse impacts. Additionally, samples of effluents and environmental media such as soil and groundwater are collected on the site and at the site boundary. These samples are analyzed and results are compared to applicable guidelines and standards. Discussed in this report are the results of Fermilab's environmental monitoring and surveillance activities, compliance with all specific environmental regulations, and our progress on environmental restoration, waste management and corrective action activities. The report is arranged by environmental topic and specific environmental compliance requirement.

2.0 Summary of Significant Environmental Issues

Tritium Discharges

The generation of tritium is an expected outcome of operating the accelerator complex and it has been monitored throughout the history of the laboratory. Detectable amounts of tritium have been observed in surface water discharges from the site since 2005 and Fermilab maintains permits to release tritium from regulated points. Additionally, Fermilab monitors the sanitary effluent discharged from the site to the municipal waste water treatment plants of Batavia and Warrenville/Naperville. Low concentrations of tritium are regularly recorded in the discharge to Batavia.

In response to the persistence of observable tritium and the expectation that future operations will generate additional tritium, the Fermilab Director formed a Tritium Working Group beginning in 2012. In June of 2016 the director convened an over-all review of tritium management, bringing together both internal and external expertise to assist in the evaluation of current and future practices. As a result of the review the working group has evolved into a Tritium Task Force, and is chaired by the Chief Safety Officer. The task force continues the work to identify, manage and mitigate to the extent possible tritium generated as a result of laboratory operations. Additional details concerning the management of tritium can be found in various sections of this report.

Federal Sustainability Goals

In December 2016 Fermilab issued the annual Site Sustainability Plan. This plan outlines the laboratory's progress towards achieving goals the Department of Energy (DOE) has committed to in its Strategic Sustainability Performance Plan, as required by Executive Order (E.O.) 13693. This Order commits the federal government to measure, manage and develop a strategy to reduce its own greenhouse gas (GHG) emissions. In addition, agencies must increase energy efficiencies, reduce fleet petroleum consumption, conserve water and reduce waste. The GHG emission reduction goals have long term targets that mature in 2025, with other related goals having shorter time frames. Fermilab's sustainability progress is summarized in additional sections in this report.

3.0 Ecological Stewardship

The Director of Fermilab established the Ecological Land Management (ELM) Committee to recommend management practices based on sound ecological principles that enhance the natural resources of the laboratory. The ELM committee, in conjunction with FESS Site Services and Roads & Grounds, oversees the management of nearly 2,500 acres of natural areas, which include 1,000 acres of tall grass prairie plantings, oak savannas, open-water marshes, wetlands, and forests. The primary goal is to increase biodiversity of native flora and fauna while enhancing functional services of these ecological systems. This type of site stewardship includes prescribed burning, controlling invasive species, monitoring threatened & endangered species, surveying plants and wildlife and collecting seed from over 250 native species to spread into recently restored areas. Some of this work is carried out by trained natural areas volunteers that are provided by Fermilab Natural Areas, a 501(c)(3) not-for-profit corporation.

Fermilab manages wildlife resources to preserve the Fermilab ecosystem while still conducting the primary mission of the laboratory. The Lab has a Nuisance Animal permit issued by the Illinois Department of Natural Resources (IDNR) that allows for the trapping and elimination of nuisance animals. During 2016, 25 reports of nuisance wildlife were received, resulting in the transfer of two animals to a rehabilitation center. One animal was euthanized on site.

Fermilab manages the population of whitetail deer on site to preserve the ecosystem by contracting annually with the U.S. Department of Agriculture Wildlife Services Group to reduce the herd to an optimum number. Vegetation studies, accident reports and aerial surveillance indicated that reducing the herd in 2016 was not required.

4.0 Sustainability

Fermilab is committed to minimizing the environmental impact of site operations. In response to goals established by the Department of Energy to improve its environmental footprint, Fermilab has developed a Site Sustainability Plan that documents the laboratory's contribution towards meeting the goals. The primary emphasis of the plan is on the reduction of GHG emissions. The plan also addresses more broad ranging goals that include operating buildings more efficiently, reducing water consumption, reduced fossil fuel consumption for vehicle fleets and improved energy consumption of computer data centers. An outline of the primary goals and Fermilab's status in 2016 is provided below. A summary of GHG emissions is further described in section 7.2

<i>SSPP Goal No.</i>	<i>DOE Goal</i>	<i>Performance Status through FY2016</i>	<i>Planned Actions and Contribution</i>
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Goal 1: Greenhouse Gas Reduction

1.1	50% Scope 1 & 2 GHG reduction by FY 2025 from a FY2008 baseline (2016 target: 22%)	57% reduction in FY2016.	Continue to improve efficiency of conventional facilities, use RECs to meet goal
1.2	25% Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline (2016 target 7%)	Met goal for T&D losses using Renewable Energy Certificates (RECs)	Continue to maximize commuter programs, use RECs to reduce T&D losses

Goal 2: Sustainable Buildings

2.1	25% energy intensity (Btu per gross square foot) reduction in goal-subject buildings, achieving 2.5% reductions annually, by FY2025 from a FY 2015 baseline.	2.3% reduction from 2015 Baseline. Current intensity is 88,625 BTU/GSF	Continue to improve efficiency of conventional facilities.
2.2	EISA Section 432 energy and water evaluations.	Goal met. Entire building complex evaluated three years ago.	Develop plan to implement next 4-year audit cycle.
2.3	Meter all individual buildings for electricity, natural gas, steam and water, where cost-effective and appropriate.	Goal is met.	Continue to use metering data to evaluate building performance.
2.4	At least 17% (by building count or gross square feet) of existing buildings greater than 5,000 GSF to be compliant with the <i>revised</i> Guiding Principles for HPSB by FY 2025, with progress to 100% thereafter.	4% of GSF is compliant.	Specify HPSB construction for new facilities and continue to evaluate opportunities for HPSB compliance in existing building stock.
2.5	Efforts to increase regional and local planning coordination and involvement.	Goal is met.	See Site Sustainably Plan.
2.6a	Net Zero Buildings: 1% of the site's existing buildings above 5,000 gross square feet intended to be energy, waste, or water net-zero buildings by FY2025.	New DOE Goal.	See Site Sustainably Plan.

<i>SSPP Goal No.</i>	<i>DOE Goal</i>	<i>Performance Status through FY2016</i>	<i>Planned Actions and Contribution</i>
2.6b	Net Zero Buildings: All new buildings (>5,000 GSF) entering into the planning process designed to achieve energy net-zero beginning in FY 2020.	New DOE Goal.	See Site Sustainably Plan.

Goal 3: Clean and Renewable Energy

3.1	“Clean Energy” requires that the percentage of an agency’s total electric and thermal energy accounted for by renewable and alternative energy shall be not less than: 10% in FY 2016-2017, working towards 25% by FY2025.	Goal met. 16% of energy sources are Clean Energy.	REC purchases will continue to be used to supplement small onsite clean energy installations.
3.2	“Renewable Electric Energy” requires that renewable electric energy account for not less than 10% of a total agency <u>electric</u> consumption in FY16-17, working towards 30% of total agency electric consumption by FY 2025.	Onsite renewable electricity generation is negligible. Used RECs equivalent to 17% total energy consumption in lieu of onsite generation.	Continue to investigate potential for onsite renewable electricity generation.

Goal 4: Water Use Efficiency and Management

4.1	36% potable water intensity (Gallons per gross square foot) reduction by FY 2025 from a FY 2007 baseline. (2016 target: 18%)	Exceeded goal.	Continue to seek opportunities to reduce potable water consumption.
4.2	30% water consumption (Gal) reduction of industrial, landscaping, and agricultural (ILA) water by FY 2025 from a FY 2010 baseline. (2016 target:12%)	Exceeded goal.	Continue to implement ILA water conservation measures.

Goal 5: Fleet Management

5.1	30% reduction in fleet-wide per-mile greenhouse gas emissions reduction by FY 2025 from a FY2014 baseline. (2016 target: 3%; 2017 target: 4%)	10% reduction.	Install electric vehicle charging infrastructure, investigate renewable diesel and electric vehicles.
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<i>SSPP Goal No.</i>	<i>DOE Goal</i>	<i>Performance Status through FY2016</i>	<i>Planned Actions and Contribution</i>
5.2	20% reduction in annual petroleum consumption by FY 2015 relative to a FY 2005 baseline; maintain 20% reduction thereafter. (2016 target: 20%)	58% reduction.	Continue to maintain petroleum consumption below baseline.
5.3	10% increase in annual alternative fuel consumption by FY 2015 relative to a FY 2005 baseline; maintain 10% increase thereafter. (2016 target: 10%)	100% increase.	Continue to seek measures to increase use of alternative fuels.
5.4	75% of light duty vehicle acquisitions must consist of alternative fuel vehicles (AFV). (2015 target: 75%)	Greater than 75%.	Investigate purchase of diesel hybrid bus and other technologies.
5.5	50% of passenger vehicle acquisitions consist of zero emission or plug-in hybrid electric vehicles by FY 2025. (2016 target 4%)	First plug-in hybrid purchased.	Purchase vehicles as appropriate.

Goal 6: Sustainable Acquisition

6.1	Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring BioPreferred and biobased provisions and clauses are included in 95% of applicable contracts.	Goal is met.	Continue current practices.
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Goal 7: Pollution Prevention and Waste Reduction

7.1	Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris.	68% diverted from the landfill.	Continue to investigate means to increase waste diversion.
7.2	Divert at least 50% of construction and demolition materials and debris.	91% diverted from the landfill.	Continues current strategies.

<i>SSPP Goal No.</i>	<i>DOE Goal</i>	<i>Performance Status through FY2016</i>	<i>Planned Actions and Contribution</i>
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Goal 8: Energy Performance Contracts

8.1	Annual targets for performance contracting to be implemented in FY 2017 and annually thereafter as part of the planning of section 14 of E.O. 13693.	Investment grade audit conducted in 2014, ESPC not viable but energy saving opportunities identified.	Continue to investigate future opportunities for ESPC or UESC.
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Goal 9: Electronic Stewardship

9.1	Purchases – 95% of eligible acquisitions each year are EPEAT-registered products.	Goal is met.	Continue current purchasing practices.
9.2	Power management – 100% of eligible PCs, laptops, and monitors have power management enabled.	Goal is met.	Continue current computer management strategies.
9.3	Automatic duplexing – 100% of eligible computers and imaging equipment have automatic duplexing enabled.	Goal is met.	Continue current computer management strategies.
9.4	End of Life – 100% of used electronics are reused or recycled using environmentally sound disposition options each year.	Goal is met.	Continue current electronics disposition practices.
9.5	Data Center Efficiency. Establish a power usage effectiveness target in the range of 1.2-1.4 for new data centers and less than 1.5 for existing data centers.	Existing data center efficiency range 1.5 to 1.7	See Site Sustainability Plan.

Goal 10: Climate Change Resilience

10.1	Update policies to incentivize planning for, and addressing the impacts of climate change.	See Site Sustainability Plan for Goal 10 contributions.
10.2	Update emergency response procedures and protocols to account for projected climate change, including extreme weather events.	See Site Sustainability Plan for Goal 10 contributions.

<i>SSPP Goal No.</i>	<i>DOE Goal</i>	<i>Performance Status through FY2016</i>	<i>Planned Actions and Contribution</i>
10.3	Ensure workforce protocols and policies reflect projected human health and safety impacts of climate change.	See Site Sustainability Plan for Goal 10 contributions.	
10.4	Ensure site/lab management demonstrate commitment to adaptation efforts through internal communications and policies.	See Site Sustainability Plan for Goal 10 contributions.	
10.5	Ensure that site/lab climate adaptation and resilience policies and programs reflect best available current climate change science, updated as necessary.	See Site Sustainability Plan for Goal 10 contributions.	

5.0 Environmental Management System (EMS)

Fermilab recognizes the importance of maintaining an EMS. The EMS is the organizational framework that enables the laboratory to minimize environmental impacts due to operations. The system functions via an ongoing cycle that focuses on planning, implementing, evaluating and improving environmental performance. This process is used as means to continuously focus on the environmental aspects of laboratory operations to ensure compliance with regulations, and to demonstrate that the facility is operating in an environmentally responsible manner. In addition, the elements of the EMS have been aligned with the principles of Fermilab's ESH&Q management system to form a combined management system that address facility operational liabilities that have the potential to impact individuals and/or the environment.

Fermilab routinely evaluates operations and seeks to improve environmental performance. The laboratory's significant environmental aspects have been identified and were reviewed in 2016. In areas where change is desired or required, goals are established with measurable targets that seek to improve a particular aspect of operations. The goals outlined in the laboratory's Site Sustainability Plan document areas of significant emphasis where the laboratory is pursuing change.

6.0 Environmental Monitoring and Surveillance

The goal of Fermilab's Environmental Monitoring Program is to assist laboratory management in decision-making by providing data relevant to impacts that facility operations have on the surrounding environment. This program includes effluent monitoring which is used to confirm compliance with permits at particular discharge points. Environmental surveillance is conducted at various locations to intercept the pathway of potential pollutants to receptors such as plants, animals or members of the public. Fermilab collects environmental data for reporting purposes or whenever it is necessary or useful in conducting the business of the laboratory. Line organizations have the responsibility to recognize and understand the environmental aspects of their operations and to conduct their work in an environmentally sound manner.

The pathways for the most likely movement of chemical and radioactive materials resulting from Fermilab operations to the environment include the atmosphere, surface water (including sewer systems), groundwater, and via the roadways (transportation of materials to and from the site). Environmental surveillance consists of collecting and analyzing samples of various media and by measuring penetrating radiation (e.g. muons) within and at the site boundaries.

Ground and surface waters are sampled at locations near operating areas, potential contamination sources and along potential transport pathways. In addition to air and water surveillance, samples of soil are collected and analyzed for radioactivity to ascertain whether there is build-up of radioactive materials in the environment due to long-term operations.

Surface water, air, groundwater, soil, sediment samples are analyzed for radionuclide concentrations. Surface waters are also monitored for potential chemical constituents. While levels of penetrating radiation are in some places measurable near operational areas on the site, the levels decrease rapidly with distance from the sources. External penetrating radiation and airborne emissions are commonly below instrument detection levels at the site boundary and must be estimated to provide information about the maximum potential radiation doses to offsite populations. The results of the environmental surveillance program are interpreted and compared with environmental standards where applicable. The Fermilab Environmental Monitoring Plan, which is maintained by the ESH&Q Section, provides more details.

6.1 Air Quality

Fermilab is not a significant source of chemical air pollution and is registered with the Illinois Environmental Protection Agency (IEPA) Registration of Smaller Sources (ROSS) program. This is a relatively new program administered by IEPA and is available to facilities that emit only minor amounts of air pollution.

6.1.1 Radioactive Air Emissions

Airborne radionuclides are normally released to the atmosphere from operating target stations and beamlines. Measures to keep these releases as low as reasonably achievable (ALARA) are incorporated into the operating processes and procedures at these facilities and in design efforts for new projects. Monitoring is conducted at targeting areas where air emissions are considered a significant contributor to the overall transport of radioactive materials offsite. In addition, a small quantity of airborne radionuclides is contributed by the operation of the Magnet Debonding Oven when operating. Fermilab has declared in its air permit application to the IEPA that total activity released from the lab would average no greater than 2000 Curies in a year with a maximum of 9000 Curies in a year; current and planned operations are far below these levels.

The radiation doses potentially received by the offsite public due to Fermilab operations are calculated from data gathered through environmental surveillance of the onsite sources. Selected vent stacks are monitored directly with stack monitors and indirectly by taking soil samples near the stacks. The dose for the air pathway is calculated using a Gaussian plume computer simulation model called Clean Air Act Assessment Package-1988 (CAP88PC Version 4.0). This model was created by the U.S. Environmental Protection Agency (USEPA) to predict the movement of airborne radionuclides and its use is dictated by regulations governing hazardous air pollutants (40 CFR 61). Maximum calculated concentrations off-site are predicted to be below the level that could be detected by direct monitoring.

In 2016, the accelerator and the experiments operated throughout the calendar year, except for the standard annual maintenance shutdown that lasted anywhere from ten to twelve weeks for the different machines. Operation of the debonding oven, when radioactive components are being burned, is a potential source of tritium. In 2016, the debonding oven burned three Class-1 radioactive magnet. The Muon Campus, did not use any proton beam for muon production. The Main Injector, SeaQuest experiment (E-906), the BNB (Booster Neutrino Beamline) and NuMI stacks are estimated to have released a total of 193.2 Curies in 2016. These radioactive air emissions were approximately 9.7% of the annual average (2000 Curies) expected from operations as acknowledged in the air pollution permit application on file with the IEPA. Doses to the public from emissions in 2016 continued to be well below the USEPA standard of 10 mrem in a year and less than the USEPA's continuous

monitoring threshold of 0.1 mrem in a year. Using the CAP-88PC Version 4.0, Gaussian dispersion model, the highest dose equivalent to any member of the public was estimated to be 0.0411 mrem.

Fermilab's 2016 Radionuclide Air Emissions Annual Report will be submitted to the DOE Fermi Site Office (FSO) in May 2017. The report is distributed by the DOE FSO to the USEPA and IEPA.

6.1.2 Non-Radioactive Air Emissions

In 2016, Fermilab continued to operate under the ROSS program. Registration for ROSS is required for facilities such as Fermilab that emit air pollution in very minor amounts. Even though Fermilab no longer operates under a Lifetime Operating Permit it continues to monitor the sources named in this permit. Managing the sources according to the former permit allows Fermilab to demonstrate compliance with the conditions under the ROSS program. This also allows for continuity in the event that Fermilab returns to being a permitted source. The sources Fermilab continues to monitor include the following:

1. Magnet de-bonding oven;
2. One 15 mmBTU and one 11.55 mmBTU natural gas-fired boilers at the Central Utility Building (CUB);
3. One 12,000-gallon gasoline storage tank with a stage 1 vapor balance system
4. Various radionuclide emission stacks;
5. 2,200 horsepower standby diesel generator;
6. Cavity Processing Lab (CPL).

6.2 Penetrating Radiation

Operation of the Fermilab accelerator and associated beamlines produces ionizing radiation such as neutrons and muons. Beamlines and experiments are designed so that most of the radiation is absorbed before reaching the ground surface and outdoor areas. The neutrons are absorbed by shielding. The remaining radiation that emerges above the surface presents a very small potential for radiation dose. Small muon fields have been measured in conjunction with the operation of the Fixed Target beamlines in the past. Only the Meson Test (MTest), Meson Center (MCenter) and Neutrino Muon beamlines (E906) operated in 2016. The maximum muon dose offsite due to the operation of MTest, MCenter and E-906 was 0.103 mrem. Both the BNB and NuMI experiments have the potential to produce measurable muon flux; however, the 8 GeV energy protons used in BNB are too low in energy to produce muons that can escape the bulk shielding surrounding the experiment. The NuMI beamline bends the beam down so that the muons produced are absorbed deep underground as part of the beamline design.

Another potential source of exposure to ionizing radiation is the centralized radioactive materials storage area referred to as the Railhead. This source of penetrating radiation was monitored continuously in 2016 by a large ionization chamber located in the Railhead colloquially called a 'Hippo.' The Hippo measurements are supplemented by several of environmental dosimeters placed around the storage area and by periodic onsite surveys. Based on measurements made, it is estimated that radioactive materials stored at the Railhead contributed no directly measurable equivalent dose at the site boundary in 2016. The maximum total penetrating radiation equivalent dose in 2016 to an individual at the nearest offsite house was thus estimated to be less than 0.103 mrem, and not directly measurable.

6.3 Surface Water Quality

Fermilab releases minor amounts of contaminants to surface water bodies. As part of the management of these discharges the laboratory holds National Pollutant Discharge Elimination System (NPDES) permits that govern releases to surface water from storm water runoff, cooling water, effluents from various onsite construction projects, and pesticide applications. In addition to monitoring for the physical and chemical parameters required by NPDES permits, samples of surface water are taken monthly from selected water bodies and analyzed for radionuclides. These surface waters are sampled for radionuclides based upon their potential for contamination. Fermilab Environment, Safety, and Health Manual (FESHM) Chapter 8026 Surface Water Protection describes regulatory aspects and responsibilities of the surface water program.

Aqueous process wastewaters are directed to sanitary sewers and ultimately discharged to publicly owned treatment works (POTWs) in Batavia and Warrenville/Naperville. Wastewater discharges are controlled by criteria described in FESHM 8025 Wastewater Discharge to Sanitary Sewers.

6.3.1 Cooling Water System

Fermilab requires large amounts of non-contact cooling water that is circulated through various surface water bodies to dissipate heat. Fermilab's site-specific NPDES permit authorizes the treatment of the Industrial Cooling Water system (ICW) and the discharge of commingled cooling water and storm water runoff to surface waters through outfalls to Kress, Indian and Ferry Creeks. The outfalls are points that designate the location at which cooling water becomes Waters of the State. A Storm Water Pollution Prevention Plan required by this NPDES permit covers storm water discharges into cooling waters from designated Solid Waste Management Units (SWMUs), industrial activity areas, and services support areas. (Also see Section 7.12 National Pollutant Discharge Elimination System.)

In 2016, Fermilab contracted a state-licensed applicator to treat a limited number of ponds for algae and pond weeds by applying herbicide. An ongoing zebra mussel infestation of the ICW system pipes and pumping infrastructure was managed by using a continuous feed of NaClO (sodium hypochlorite) solution at the Casey's Pond intake to the ICW system.

6.3.2 Non-Radioactive Releases to Surface Water

Monitoring for non-radiological chemical constituents in surface water was limited to NPDES permit parameters (temperature, flow, pH, and chlorine) this year. Discharge Monitoring Reports for six different outfalls were submitted monthly to the IEPA.

During the summer of 2016, pH levels in the A.E Sea briefly rose above the permitted discharge limit of 9. In August, an exceedance of 10.7 during discharge at the outfall was reported to IEPA on the monthly Discharge Monitoring Report. An investigation for a potential cause of the elevated pH indicated that it was not related to operational activities and was likely the result of natural causes.

In 2014, there were two exceedances for chlorine discharged to Kress Creek. To reduce the possibility of future chlorine exceedances construction has been underway for a de-chlorination system in proximity to the Kress Creek outfall.

6.3.3 Radioactive Releases to Surface Water

Numerous sumps collect and drain water from building footings and from under beamline tunnels in the Tevatron, Main Injector, and the Experimental Areas. Water collected by these sumps often contains detectable concentrations of radionuclides (primarily tritium, ^3H) that have been leached by rainwater from radioactive soil

near beam targets and absorbers or released accidentally to sumps due to losses from beamline cooling water systems. These sumps discharge to ditches and ponds onsite.

In addition, water is also collected from the NuMI tunnel system. NuMI tunnel water contains measurable concentrations of tritium and the primary source of the tritium comes from water contact with components within the tunnel. The water that is collected consists primarily of groundwater that has infiltrated into the tunnel. This high-quality water is pumped from the tunnel and directed into the ICW system where it is used primarily for make-up water for the Central Utilities Building (CUB) cooling towers. Excess NuMI water and effluent from the towers is directed to the ICW pond system.

Fermilab continued to discharge measurable concentrations of tritium to surface waters off site. The concentrations measured were well below the DOE Order 458.1 Derived Concentration Standard of 1,900 pCi/ml. Releases depend on pond levels and the operational mode of the accelerator complex. Fermilab's site-specific NPDES permit includes monitoring requirements for tritium at all six outfalls. In 2016, the month of November showed a detectable level of tritium discharged to Kress Creek (1.3 pCi/ml). Indian Creek had tritium discharges eleven months of the year (highest concentration was 10.8 pCi/ml in June). In 2016, the Ferry Creek outfall (from A. E. Sea to Sea of Evanescence) had the first detectable level of tritium in December (1.3 pCi/ml). Monthly data from measurements taken at outfall and site boundary locations are made publicly available through the *Tritium at Fermilab* website. Monitoring for radioactivity in surface water continues to be a primary component of Fermilab's routine environmental surveillance program.

6.3.4 Releases to Sanitary Sewers

Fermilab maintains an onsite piping system for the conveyance of sanitary effluent. This effluent is directed to the cities of Batavia and Warrenville/Naperville for treatment. In addition, Fermilab operated two systems in 2016 that require pretreatment prior to release to the sewers. These operations require wastewater pretreatment permits issued by IEPA. The permits are as follows:

1. Individual industrial wastewater pre-treatment permit that allows Fermilab to discharge wastewater effluent from deionized water regeneration operations occurring at the CUB to the City of Batavia sanitary sewer treatment works.
2. Individual industrial wastewater pretreatment permit that allows for metal finishing wastewater from the Technical Division's Cavity Processing Laboratory (CPL) at Industrial Building 4 (IB4) to be discharged to the city of Batavia sanitary sewage treatment works.

Monitoring stations, located at the site boundary, sample sewer discharges to the municipalities of Batavia and Warrenville. The discharge at these locations is a mixture of all effluents contributing to that sanitary sewer system. Analytical results for metals are compared to municipal discharge limits to track compliance. Fermilab occasionally exceeds the limits for iron released to Warrenville. This did not occur in 2016. Aging pipes are suspected to be the source of the exceedances and their cause has been discussed with the municipalities.

Low levels of tritium have been detected in effluent discharged to the Batavia treatment works since August 2005. All discharges in 2016 were well below DOE Order 458.1 Derived Concentration Standards (total tritium 5 curies, concentration less than 9,500 pCi/ml) and are summarized below. No other isotopes were detected.

Total Tritium	0.54 Curies
Average Concentration	4.42 pCi/ml
Highest Concentration	10.56 pCi/ml
Total Sanitary Volume	32,669 kGal

Fermilab's Tritium Task Force Working Group continued to investigate sources of tritium into both the sanitary sewer system and the Industrial Cooling Water system. As part of this effort a concerted effort is being undertaken to investigate sources of tritium in the sanitary system in the southern sections of the system.

6.4 Groundwater Quality

The IEPA publishes groundwater quality standards (35 IAC 620) and defines Class I groundwater as a non-degradable resource, which is to be highly protected. Water residing in or near the Silurian dolostone bedrock aquifer, the upper surface of which is 50 to 80 feet below the ground surface in the Joliet Formation at Fermilab (Figure 6.4-1), as well as water in the overlying Batestown Member or Henry Formation, is classified as the top of Class I groundwater. Water in the glacial deposits overlying the Batestown or lowermost Henry has been demonstrated to be Class II water requiring less-stringent standards.

The locations of groundwater monitoring wells are shown in Figure 6.4-2, with approximate screen depth intervals for wells related to sampling programs illustrated in Figure 6.4-1. In 2016 ten glacial and Silurian dolostone (Joliet Formation) monitoring wells at the CUB Pipe and Clay Tile Field were sampled as part of ongoing RCRA Facility Investigation (RFI) corrective actions at these locations. During 2006, the Meson and Neutrino Soil Activation Areas were removed from the RFI as a SWMU; however, under the Lab's environmental surveillance program, sampling continues in the five Joliet Formation wells in this region. For informational purposes, and as a courtesy, the results are reported to the IEPA annually. Four background wells (Joliet Formation) were sampled to assess tritium levels at the up gradient (north) edge of the laboratory property (BMW-1 through BMW-4) and one Elwood Formation well was sampled to assess tritium levels near the NuMI Target Hall (S-1426-2). An additional 124 wells with various screen depth intervals (Figure 6.4-2) are used as piezometers (pore-water pressure measuring apparatus) to gather information on groundwater flow directions site-wide. These data are used in conceptualizing the horizontal and vertical transport of potential contaminants from past and present operational areas of concern.

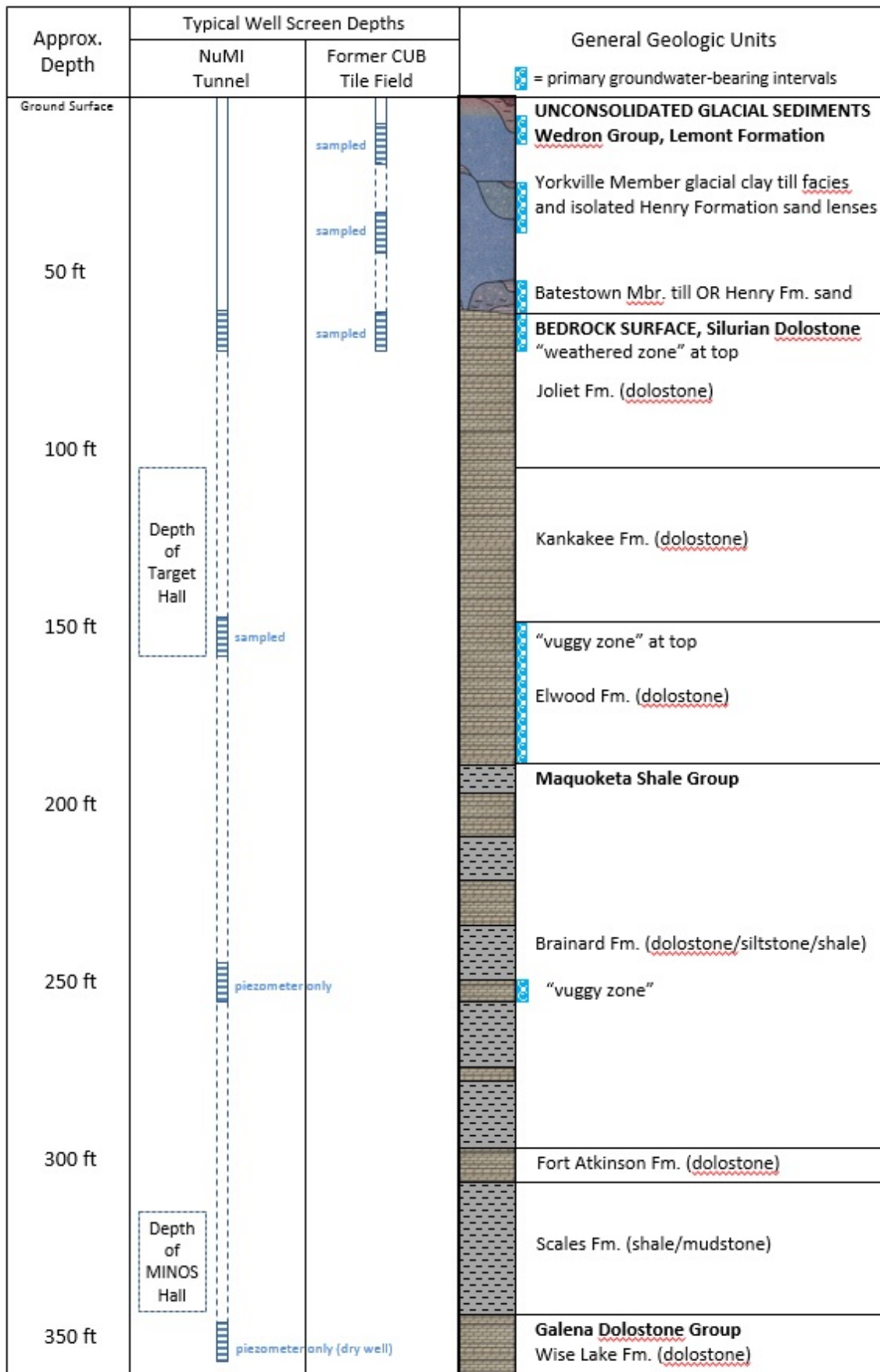


Figure 6.4-1. General Fermilab geologic section (based on NuMI Tunnel), with groundwater monitoring well screen depths and groundwater-bearing intervals. Sampling/piezometer status is for 2015.

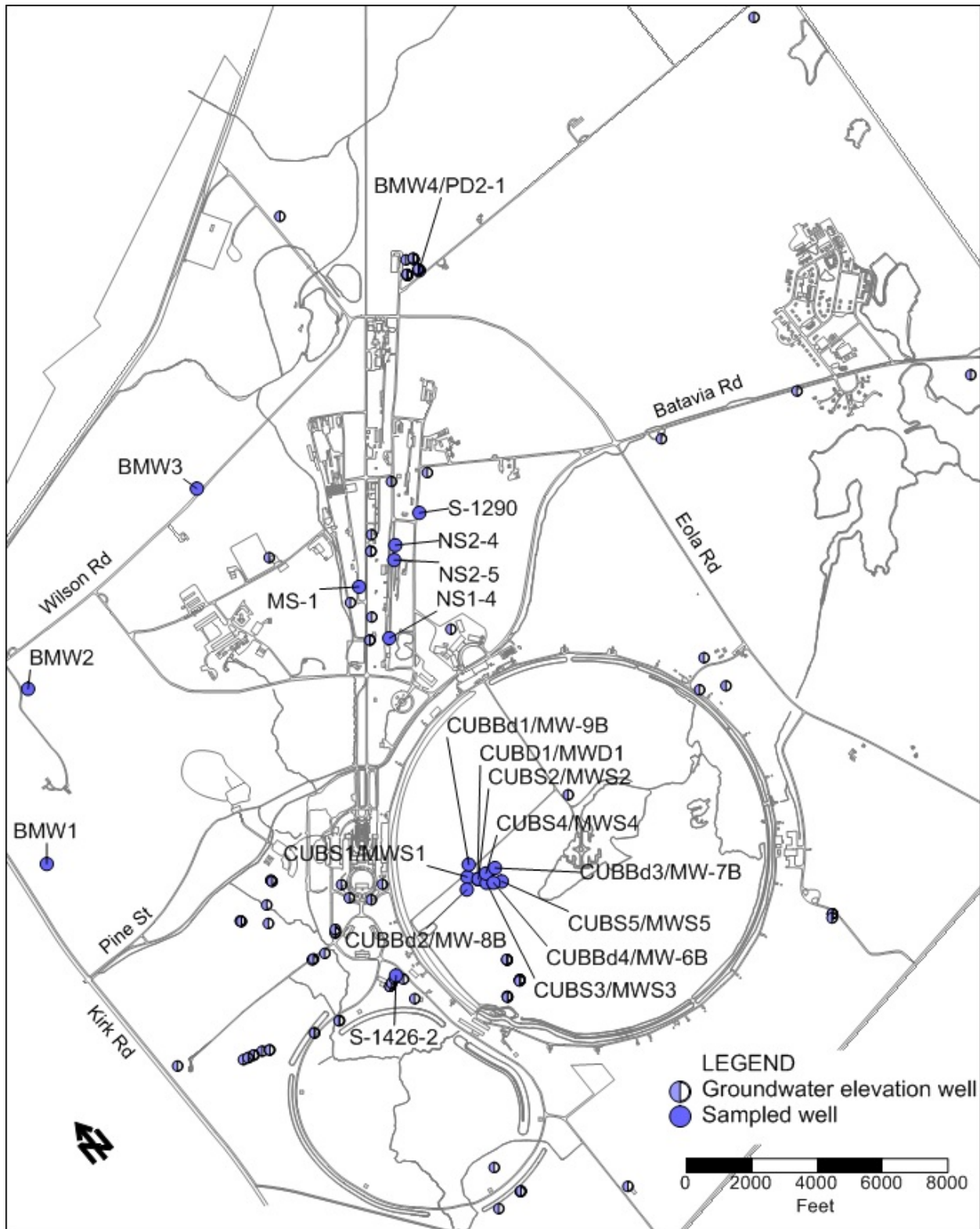


Figure 6.4-2 - Groundwater monitoring well locations in 2015. Sampled wells represented by labeled, filled circles. Wells used only for groundwater elevations represented by half-open circles. (Original DUSAF projection.)

6.4.1 Radionuclides in Groundwater

U.S. Department of Energy policy on groundwater protection as expressed in DOE O458.1 is consistent with the Illinois Class I groundwater standard of 20 pCi/ml. Fifteen samples were collected from ten locations for radionuclide analysis. Tritium and accelerator-produced radionuclides were not detected in any Class I groundwater samples during 2016.

There are six “sump” wells at the Booster Neutrino Berm (BNB) that are routinely sampled for tritium. They are not true groundwater wells, but rather drain the interior, interstitial space and exterior of the dual-liner system around the decay pipe via lateral pipes. Water in these sump wells originates from surface infiltration that makes its way through the damaged liner system near the north end, adjacent to MI-13A. In 2014 a permanent surface cover and drain system was installed over the north end of the berm to reduce the volume of infiltrating water into the decay pipe liner system. Tritium results in these wells in 2016 fluctuated between 7.4 and 24,100 pCi/ml and was routed to Pond F, or it was drummed for disposal if the holding tank concentration exceeded 1,900 pCi/ml. Further measures to redirect water away from the MI-12/BNB area are being planned for 2017-2018. Tritium concentrations and infiltrating water volumes in the BNB sump wells will continue to be monitored to evaluate the potential impact to groundwater.

6.4.2 Chemicals in Groundwater

In 2016, semi-annual groundwater sampling events were conducted at one Solid Waste Management Units (SWMUs). Chemical analyses were performed on these samples as required by the Resource Conservation and Recovery Act Facility Investigation (RFI). (See Section 7.13.2 RFI Activities.)

7.0 Compliance with Specific Environmental Requirements

The following sections are a summary of Fermilab’s compliance with key environmental requirements.

7.1 Clean Air Act

Open burn permits to allow prairie/land management burning, maintenance of Meson Hill, and fire extinguisher training were renewed by the IEPA in 2016. The annual air emissions report for 2016 was not required due to Fermilab’s registration as a ROSS source. Fermilab’s 2016 Radionuclide Air Emissions Annual Report was submitted to the DOE Fermi Site Office (FSO) in May 2017. The report is distributed by the DOE FSO to the USEPA and IEPA.

In 2016, the actual annual air emissions for Criteria Air Pollutants (carbon monoxide, nitrogen oxides, particulate matter, sulfur dioxide, and volatile organic materials), were 3.4120 tons per year, much less than the maximum allowed for a ROSS site.

Doses to the public from radioactive emissions in 2016 continued to be well below the USEPA standard of 10 mrem/year, and also much less than the EPA’s continuous monitoring threshold of 0.1 mrem/year. In 2016, an estimated 193.2 Curies were released from various sources (see section 6.1.1 Radioactive Emissions). The CAP-88PC2 dispersion model calculated the maximum dose equivalent delivered to a member of the public (at the boundary of the Lab) to be 0.0411 mrem/year in 2016.

Fermilab is registered with the Clean Fuel Fleet Program (CFFP); one of several programs the IEPA has implemented to help improve air quality in the Chicago ozone non-attainment area.

7.2 Greenhouse Gas Emissions Reporting per Executive Order 13693

Executive Order 13514 directs federal agencies to account, report and reduce greenhouse gas (GHG) emissions using 2008 as a baseline year. Fermilab supports the Department of Energy's effort to advance reduction goals and in 2016 the laboratory submitted GHG emissions data via DOE's Sustainability Dashboard.

GHGs are divided into three categories: Scope 1, 2, and 3. Scope 1 emissions are direct emissions from activities controlled by Fermilab (e.g., boilers, emergency generators, fleet vehicles, and fugitive emissions). Scope 2 emissions are indirect emissions and for Fermilab involve only purchased electricity. Scope 3 emissions are other indirect emissions such as employee air travel, electrical transmission and distribution losses, waste generation, ground travel, and employee commuting.

A three-year summary of Fermilab's emissions, including the 2008 baseline, are shown below. The performance status indicates that Fermilab has reduced Scope 1 and 2 emissions by 57.4% over the baseline year. The consumption of electricity is Fermilab's dominant source of Scope 1 and 2 emissions. Scope 3 emissions were reduced by 40.8%. Electrical transmission and distribution losses associated with purchased power are Fermilab's most significant source of Scope 3 emissions.

Fermilab is committed to assist DOE in meeting reduction goals of 50% for Scopes 1 and 2, and 25% for Scope 3 by 2025. Fermilab intends to use Renewable Energy Certificates (RECs) based on our purchased power consumption as a primary mechanism to reduce Scope 2 emissions.

Fermilab's Greenhouse Gas Emissions					
DOE Goal	Baseline	FY 2014	FY 2015	FY 2016	Performance Status (FY 2016)
50% Scope 1 & 2 GHG reduction by FY 2025 from a FY 2008 baseline (metric tons equivalent CO ₂)	384,366.1	194,901.6	173,701.0	163,818.4	-57.4%
25% Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline (MT CO ₂ e)	29,502.5	19,154.7	17,840	17,455.6	-40.8%

7.3 Underground Storage Tanks and Fuels

There are three underground storage tanks (USTs) in use at Site 38 Fuel Dispensing Facility. And these were operated and maintained per current UST standards. An Illinois State Fire Marshall compliance inspection was conducted in November, 2015 and our Underground Storage Tank Motor Fuel Dispensing Permit was approved. The UST system continues to be inspected on a semi-annual basis by a qualified subcontracted vendor, and on a daily, monthly, and quarterly basis by a Class A Certified Underground Storage Tank operator. The inspection activity ensures that the internal and external leak detection systems are functioning properly.

New directives reflect an initiative by the federal government to place an emphasis on acquiring and utilizing Low Green House Gas (LGHG) emitting vehicles. As such, we have begun adding LGHG vehicles to the fleet since the directives have been approved.

7.4 The Endangered Species Act of 1973

Impact to endangered species are considered as part of Fermilab's environmental review process for all projects, as required by the National Environmental Policy Act (NEPA). The project area and impact to protected species and critical habitat are questions explicitly asked during the environmental review process. No compliance issues were identified in 2016.

7.5 Executive Order 11988, "Floodplain Management"

Impact to floodplains is also considered as part of Fermilab's environmental review process under NEPA. Project information, such as total project area or if filling is required are questions asked during a review. No flood plain issues were encountered during 2016.

7.6 Clean Water Act (CWA) Section 404 (and Executive Order 11990, "Protection of Wetlands")

Pre-evaluation of Fermilab activities in wetlands continued to be accomplished through the NEPA and construction design review processes. The laboratory continued to use task manager/construction coordinator training to instruct participants in how to ensure that potential work areas are screened for the presence of wetlands and to be aware of all aspects of environmental compliance management. Several wetland delineation activities were conducted as part of the Surface Water Management Plan (SWaMP) and in support of facility projects, managed by FESS. The Clean Water Act Section 404 permit for the Short Baseline Neutrino Project (SBN) was active and managed throughout the year. Repairs on a Pine Street culvert required a minor regional permit as well.

7.7 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

In 2016, the use of pesticides and herbicides at Fermilab were handled in accordance with FIFRA. Fermilab adheres to the principles of Integrated Pest Management in order to minimize pollution and adverse environmental impacts.

7.8 Illinois Department of Natural Resources (IDNR) "Rules for Construction and Maintenance of Dams"

The Department of Energy holds an IDNR issued permit that classifies the Main Injector berm as a small *Class III* dam. The dam provides limited flood control to areas downstream from Fermilab in the Indian Creek watershed. Fermilab reports to IDNR annually on the condition of the dam, and on a five-year cycle Fermilab is required to perform a comprehensive inspection and file a detailed report on the condition of this structure. No non-routine action items were identified during the 2016 annual inspection. A comprehensive inspection was conducted in April of 2013 and an "Owners Maintenance Report" was transmitted to the IDNR by DOE. No non-routine action items were identified during the 2013 comprehensive inspection.

7.9 The Migratory Bird Treaty Act

A Department of Energy memorandum of understanding (MOU) with the U.S. Fish and Wildlife Service (2013) provides a number of measures designed to "protect and conserve" migratory bird habitat to the fullest extent practicable. Fermilab addresses this MOU by evaluating migratory bird impacts during the normal course of conducting environmental reviews under NEPA to avoid or minimize impacts to even the most common birds as much as reasonable. Additionally, Fermilab maintains a proactive approach to protecting the Canada goose population onsite while ensuring the safety of employees and visitors. Fermilab contracts with a firm to use dogs to harass geese to displace them from heavily populated areas on the site. The firm holds a valid permit from the IDNR to pursue this activity, which was carried out during March and April. Fermilab also possesses a Nuisance Wildlife Control Permit issued by the IDNR that allows for the destruction of Canada goose nests if they become

a safety hazard. The permit allows the laboratory to destroy up to ten nests each year. During 2016, 2 nests containing 6 eggs were destroyed.

7.10 National Environmental Policy Act (NEPA)

Compliance with this Act requires federal agencies to evaluate their proposed actions to determine the potential effects on the quality of the 'human environment,' which includes many different aspects of the natural environment, the built environment, and human health prior to carrying out those actions.

In addition, the Council on Environmental Quality and DOE NEPA regulations as well as DOE Order 451.1 prescribe an evaluation process to ensure that the proper level of review is performed before a commitment of resources is made. During 2016, Fermilab met the NEPA requirements by continuing to implement a program to review all proposed activities and evaluate their potential effects; this program is set forth in the FESHM Chapter 8060 – National Environmental Policy Review. Most of the reviewed activities were considered categorically excluded administrative actions requiring no formal documentation (found in 10 CFR 1021 Appendix A) or those fitting within the list of DOE preapproved Fermilab site wide categorically excluded routine maintenance activities or small-scale research and development projects and conventional laboratory operations. However, 5 projects/actions did need to be addressed by submitting environmental evaluation notification forms to DOE; DOE then formally determined that all 3 of the projects were 'Categorically Excluded' (see definition below) per 10 CFR 1021 Appendix B or were within the scope of a previous environmental assessment. These determinations are posted on the DOE FSO website.

Categorical exclusions (CXs) are categories of actions that do not individually or cumulatively have a significant effect on the human environment and for which, therefore, neither an Environmental Assessment (EA) nor an Environmental Impact Statement (EIS) is required.

7.11 National Historic Preservation Act (NHPA), Archaeological Resources Protection Act, Native American Graves Protection and Repatriation Act (NAGPRA) of 1990

Compliance with these Acts, as well as with DOE Order 450.1 was accomplished through the NEPA review process that included an evaluation of all proposed land-disturbing projects in 2016 to assess any potential impacts on historic resources. No compliance issues were identified in 2016. Fermilab follows a site-specific DOE required Cultural Resources Management Plan (CRMP), following guidelines outlined in DOE Publication DOE/EH-0501. The CRMP assures continued compliance with the above listed Acts by providing a comprehensive overview for the locations and status of all cultural resources within the Fermilab site boundaries thereby facilitating future NEPA reviews.

Annually, a questionnaire on Federal archaeological activities is requested by the Department of the Interior. Fermilab submitted its responses in February of 2016.

7.12 National Pollutant Discharge Elimination System (NPDES)

The IEPA has issued Fermilab three National Pollutant Discharge Elimination System (NPDES) permits that were active in 2016. These permits are as follows:

1. *Individual NPDES permit for Non-Contact Cooling Water and Storm Water*

This permit covers combined storm water and non-contact cooling water discharges associated with industrial activities. Six outfalls are associated with this permit: Outfall 001 to Ferry Creek, Outfall 002 to Kress Creek, and Outfalls 003, 004, 005, and 006 to Indian Creek. Outfalls 004, 005 and 006 were added to the permit during the last permit renewal. Outfall 004 covers potential discharges from the MINOS ICW holding tank and Outfalls 005 and 006 cover storm water overflow discharges from the Main Injector pond system. The permit dictates that water temperature, pH, flow, and tritium is to be monitored at all six outfalls; chlorine concentration is monitored at the Kress and Indian Creek outfalls. The monitoring results are reported to the IEPA monthly. A new permit was issued in April 2014 from the IEPA. A Compliance Evaluation Inspection Report was last conducted in December 2015 by the IEPA. No findings were reported.

2. *General NPDES Storm Water permit for Construction Activities*

This permit is required for all projects that disturb greater than one acre. In 2016 there were four projects.

- a. SBN Near Detector
- b. SBN Far Detector
- c. SLI UUP Project
- d. Muon Campus Project

3. *General NPDES Permit for Pesticide Application Point Source Discharge*

This permit applies to facilities that apply pesticides that may impact waters of the State.

Additionally, Fermilab holds two industrial wastewater pre-treatment operating permits issued by IEPA (also covered under NPDES regulations and are described under Releases to Sanitary Sewers).

7.13 Regulated Waste

Resource Conservation and Recovery Act (RCRA): Federal RCRA regulations govern the management of hazardous waste. Fermilab maintains a permit under RCRA to manage for disposal or reclamation hazardous waste generated at the laboratory. Fermilab does not treat, or dispose of regulated waste on site. Radioactive waste is not governed under RCRA and is managed following DOE requirements. All wastes are properly disposed through licensed waste handling, transport or disposal facilities. An annual Hazardous Waste Report is transmitted to IEPA and radioactive waste summaries are provided to DOE Fermi Site Office.

RCRA Investigation Summary: On April 20, 2016, the U.S. Environmental Protection Agency performed an unscheduled RCRA inspection on Fermilab's Hazardous Waste Storage Facility (HWSF) located at Site 55. The purpose of the inspection was to evaluate Fermilab's compliance with its Part B Permit for the storage of hazardous waste. The inspection resulted in the identification of two notice of violations (NOVs). The first violation concerned a lack of documentation demonstrating that two members of the Hazard Control Technology Team (HCTT) had not received required annual hazardous waste facility training for 2013. The second violation concerned the improper storage of waste lamps in open containers. Actions were taken immediately at the time of the inspection to establish compliance with this violation. To resolve all outstanding concerns, an internal Human Performance Improvement investigation was performed based on both NOVs. This generated five recommendations that culminated into corrective actions that have been applied.

Radioactive Waste: Fermilab's HCTT is responsible for the overall management of Low Level Radioactive Waste (LLRW). This includes all transportation related activities associated with the shipping of LLRW from Fermilab to designated DOE approved disposal facilities. In October 2016 Fermilab disposed of its first radioactive horn at the Nevada National Security Site. A horn is a beam focusing device that is under intense energy demands that becomes radioactive over time. When horns fail, they are placed in shielded storage at Fermilab for an extended period due to their radiation levels. This cool-down period allows for the attenuation of accumulated radiation prior to transport for offsite disposal.

Tritiated Water: During 2016, 19,150 gallons of tritiated water was generated for disposal. The primary source of tritiated water requiring disposal results from a below ground collection system used to capture water associated with a compromised liner surrounding the Booster Neutrino Beam Absorber at MI 12. Accumulated water is pumped to surface holding tanks where it is sampled for tritium. Water with tritium concentrations above DOE's release criteria of 1,900 picocuries per milliliter is characterized as low-level radioactive waste. It is solidified and disposed of in an approved landfill. Water below release criteria concentrations is reclaimed for use via discharge into Fermilab's Industrial Cooling Water System.

Regulated Waste Disposal and Reclamation: The following volumes of regulated waste including radioactive waste and non-radioactive waste were managed for disposal by Fermilab's Hazard Control Technology Team (HCTT) in 2016.

Waste Material	Cubic Meters
Non-Routine Hazardous Waste (RCRA + TSCA)	27.7
Routine Hazardous Waste (RCRA + TSCA)	8.3
Non-Routine Non-Hazardous Special Waste	23.8
Routine Non-Hazardous Special Waste	26.9
Radioactive Waste (DOE Regulated)	127.4

In addition, the following volumes of waste were generated by Fermilab and managed for reclamation/recycling by the HCTT 2016.

Recycled/Reclaimed	Kilograms
Non-PCB Transformers	13,245
Non-PCB Capacitors	932
Non PCB Fluorescent Light Ballasts	635
Mercury Containing Lamps	14,619
Mercury Containing Equipment	30
Alkaline Batteries	1,383
Lead Acid Batteries	2,721
Universal Waste Batteries	525
Safety Kleen Solvent	1,346
Used Oil	40,373
Oil Filters	340

7.14 RCRA Facility Investigation (RFI) Activities

CUB Pipe and Clay Tile Field (SWMU 12): At SWMU 12, the pipes and clay tiles, along with all chromate-contaminated soil and gravel, have previously been removed. Contaminated soil was disposed of properly and the surrounding soil was sampled and analyzed. On a semi-annual frequency, Fermilab continues to sample monitoring wells installed at this unit. All ten monitoring wells at SWMU 12 were sampled during the 2nd and 4th quarters of 2016.

The following table summarizes the 2016 results at SWMU 12 from wells with results above either the Class I or Class II Groundwater Quality Standards.

Glacial deposit well MWD1 produced 2nd and 4th quarter total chloride results of 1140 mg/L and 1020 mg/L, respectively. The Class II Groundwater Quality Standard is 200 mg/L.

Glacial Deposit Monitoring Wells			2Q16	4Q16
PARAMETER	Class II GW Quality Standard		Well CUBD1 MWD1	Well CUBD1 MWD1
INORGANIC (mg/L)				
Chloride, Total	200		1140	1020
Lead, Total	0.1		U	U

Grey Shading = Above the Class II GW Quality Standard

U = Undetected

Bedrock Monitoring Wells		2Q16	2Q16	4Q16
PARAMETER	Class I GW Quality Standard	Well CUBBd3 MW7B	Well CUBBd4 MW6B	Well CUBBd3 MW7B
INORGANIC (mg/L)				
Chloride, Total	200	7	19	5
Lead, Total	0.0075	0.031	0.007	0.065

Grey Shading = Above the Class I GW Quality Standard

U = Undetected

Bedrock wells MW6B and MW7B produced 2nd quarter total lead results of 0.031 mg/L and 0.007 mg/L, respectively. Bedrock well MW7B produced a 4th quarter total lead result of 0.065 mg/L. The Class I groundwater quality standard is 0.0075 mg/L.

Meson Hill (SWMU 13): Illinois EPA determined in March 2016 that post-closure care activities for Meson Hill were complete and 2016 was the first year with no groundwater-related activities at Meson Hill. In November 2014, the Affidavit for Certification of Post-Closure Care for Non-Hazardous Waste Facilities was submitted to Illinois EPA. In April 2015 IEPA stated that all eight wells could be sealed and abandoned and a subsequent final inspection of the final cover over the landfill would be performed to ensure that it has been properly maintained and is intact. All eight monitoring wells were sealed and abandoned in August 2015 and the final cover inspection was successfully performed in November 2015. Periodic inspections of the cover will be made to ensure that it remains intact.

7.15 Safe Drinking Water Act

Fermilab's domestic water is purchased from the City of Warrenville. In addition, Fermilab retains four private wells at three sites (Site 29 [two wells], Site 53 [Buffalo Barn], and Site 56 [Horse Barn]). Private wells do not require any water treatment or sampling. Estimates of water withdrawn from these wells are reported annually to the Illinois State Water Survey.

7.16 Superfund Amendments and Reauthorization Act (SARA) TITLE III or Emergency Planning and Community Right-To-Know Act of 1986 (EPCRA)

Under these regulations Fermilab is required to provide the USEPA, State, and local officials with an annual accounting of hazardous, toxic, and extremely hazardous chemicals used or stored onsite in quantities greater than their respective reporting thresholds as defined in SARA Title III Section 313. Fermilab had no chemicals that exceeded the reporting threshold in calendar year 2016.

As required by Section 312 of SARA Title III, Fermilab will submit a Tier II Emergency and Hazardous Chemical Inventory for 2016 to state and local emergency services and disaster agencies in February 2017.

7.17 Oil Spill Prevention

Fermilab's Spill Prevention Control and Countermeasures (SPCC) Plan is in compliance with 40 CFR 112 – Oil Pollution Prevention. This US EPA-enforced regulation states that any facility that has the capacity to use or store more than 1,320 gallons of oil (petroleum, plant or animal oils and fats) must write and implement a SPCC Plan that encompasses every oil source with the capacity of 55 gallons or more. A FESHM chapter and SPCC training for oil handling employees describe the Fermilab SPCC Plan. Training must be repeated annually according to the regulation.

Fermilab has more than 700,000 gallons of oil on site including more than 350 oil-filled transformers. In 2015 Fermilab developed a new SPCC database to improve the management of the inventory. The database has helped to ensure the oil sources owned by each division/section were in compliance with 40 CFR 112 by storing all monthly inspections and the locations of oil sources. In 2016 Fermilab began to plan the demolition of the NOvA Surface Detector, to take place in early 2017.

7.18 Toxic Substance Control Act (TSCA)

In June 2016, Fermilab shipped 2116 gallons of non-regulated PCB oil (<50 ppm) to a licensed treatment and disposal facility in Hannibal, Missouri for incineration. The oil was drained from four transformers at Fermilab, three of which were decommissioned and sent to a licensed disposal facility in Port Washington, Wisconsin. Engineers are re-evaluating the fourth transformer to determine its fate at the lab. Fermilab does not own any PCB-regulated equipment, all of the remaining transformers at Fermilab were retro-filled to concentrations < 50 ppm several years ago.

The Accelerator Division (AD) tracked the removal of PCB-containing equipment, such as transformers, capacitors, and other items into a database for more than 20 years. Since the reorganization of the ESH&Q Section, the database is currently being managed by the ESH&Q Section's Environmental Group. AD continues to successfully phase-out their PCB inventory, eliminating PCB capacitors used in equipment located in Booster Gallery East, Booster Gallery West and Fixed Target Service buildings, replacing capacitors with non-PCB capacitors. In 2015, the remaining PCB capacitors once used in the ACME Power Supplies located in Linac Gallery were replaced with non-PCB capacitors.

There are no changes to the status of the Groundwater at Main Ring service buildings B1 and B4 since it was determined in 2002 to be PCB-contaminated as a result of seepage of groundwater into the excavations after the completion of the phased cleanup in 2002. These locations could not be declared "clean" so Fermilab requested approval from EPA to classify the residual PCB contamination as "disposed in place." USEPA approved the request with some conditions that included Fermilab placing a notice to the deed that identified the location of the

contaminated groundwater and indicate that its use is restricted. This was accomplished in June of 2010. The laboratory was also required to notify the Agency in writing, at least 10 days prior to conducting any excavation activities that involve the removal of soil or other material in the area where the contaminated groundwater exists. If groundwater is encountered, it must be sampled, and all results must be reported to EPA. Several internal mechanisms were created to ensure that these requirements were met, including placing signs at the affected locations, adding the locations to the Geographic Information System (GIS), and modifying ESH&Q review procedures.

8.0 Pollution Prevention and Waste Minimization

Fermilab continues to make progress minimizing waste and reducing pollution. In FY2016, Fermilab generated 957 metric tons of municipal type waste. Fermilab recycled 683 tons (71%) of material through a combination of office/ residential type recycling, and the recycling of scrap metals, wood, tires and other materials. Only 254 tons (27%) were sent to a landfill. This amount does not include electronics.

Fermilab recycles or donates for reuse 100% of eligible used computer equipment. This includes computing and electronic equipment including servers, printers, laptops, monitors, cellphones, PDAs, TVs etc. Donations for reuse go through DOE's Computers for Learning program.

Permanent dumpsters dedicated to recycling construction and demolition debris were staged on site. Fermilab has these dumpsters to encourage recycling of materials from small-scale construction projects. Fermilab Time and Materials (T&M) contractors have been directed to use these dumpsters for waste generated from projects. In 2016, these dumpsters and construction dumpsters from large scale fixed price projects collected 1469 tons of construction waste; 1307 tons (89% of the total) was recycled.

Other notable pollution prevention measures include:

- In May 2014, the cafeteria food service provider started composting their kitchen scraps, coffee grounds and paper towels. In 2016, 6 metric tons of food and compostable waste was diverted from the landfill and hauled to a compost facility.
- The kitchen's grease traps are cleaned out every two months and the "sludge" is taken to an anaerobic digester at either Fair Oaks Dairy Farm in Indiana or the Downers Grove sanitation district. It is mixed with other organic waste as fuel to create electricity. In 2016, 6.8 metric tons of sludge was converted to energy.
- Several surrounding municipalities dispose of their residential fall leaf refuse on Fermilab's agricultural fields. In 2016, 17,500 cubic yards (roughly 793 tons) were incorporated into the fields as a soil amendment after composting.
- It is common practice at Fermilab for project engineers, technicians, and physicists to reuse or reconfigure old equipment for new experiments.
- In 2016, 100% of eligible PCs, laptops, and monitors had power management enabled and are centrally managed. A comprehensive managed print services is in place throughout the site. Printers are defaulted to double-sided printing and black/white ink.
- Grid Computing Center received the USEPA Energy Star Award for the sixth consecutive year in 2016 and is in compliance with 100 percent of the Guiding Principles for High Performance and Sustainable Buildings, a federal mandate to dramatically increase the efficiency and sustainability of federally owned buildings. The Illinois Accelerator Research Center OTE building at Fermilab was certified as a LEED-NC Gold building in March 2015. The Roads and Grounds building at Site 37 is also compliant with the Guiding Principles for Sustainable Federal Buildings.

9.0 Radiological Clearance of Property and Metals Release Suspension

Fermilab has operated an active scrap metal recycling program for many years. The program includes policies and procedures to ensure that the DOE secretarial mandates regarding the moratorium and suspension on the release of scrap metals from departmental sites is not violated. Historically, as a general operating principle, Fermilab has not released radioactive metals as scrap. Beginning in 2000, to comply with the suspension directive, the laboratory began holding non-radioactive scrap metals originating from radiological areas (as defined 10CFR 835). This material has been accumulating since the suspension became effective. Direct impacts as a result of the suspension include the loss of scrap revenue, the costs associated with the management and storage of this material and the potential future cost of disposal if it cannot be scrapped.

In 2016, Fermilab continued to operate a metals recycling program that has a rigorous material screening process and has incorporated numerous ongoing improvements that have been made since 2000. An enhanced Material Move Request form (MMR) is used to clearly identify and document which metals are eligible for recycling. These metals are then subjected to multiple hand held radiation surveys and must pass successfully through the vehicle scrap monitor before leaving the site.

“Recycling Packages” are created for metals being disposed from posted Radioactive Material Areas. Recycling packages will include a precise description of the metals to be released, with photo documentation, and area surveys of the building where the metals were removed. Additionally, a summary of the timeline tracks the location of the materials for the duration that they were on site. In 2016, 211 metric tons of various metals met Fermilab's release requirements and were recycled.

10.0 Conclusion

The operations at Fermilab during 2016 had no significant adverse impact on the environment or on public safety. An emphasis on compliance with regulations and requirements and environmental stewardship remains a high priority for the laboratory.