



Report to the Director on the  
**Fermilab Environment**  
Calendar Year 2015



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science



## TABLE OF CONTENTS

|  |                                     |
|--|-------------------------------------|
| <b>1.0 Introduction</b>  | <b>3</b>                            |
| <b>2.0 Summary of Significant Environmental Issues</b>   | <b>3</b>                            |
| <b>3.0 Ecological Stewardship</b>  | <b>4</b>                            |
| <b>4.0 Sustainability</b>  | <b>4</b>                            |
| <b>5.0 Environmental Management System (EMS)</b>   | <b>9</b>                            |
| <b>6.0 Environmental Monitoring and Surveillance</b>   | <b>9</b>                            |
| 6.1 Air Quality  | 9                                   |
| 6.1.1 Radioactive Air Emissions  | 10                                  |
| 6.1.2 Non-Radioactive Air Emissions  | 10                                  |
| 6.2 Penetrating Radiation  | 11                                  |
| 6.3 Surface Water Quality  | 11                                  |
| 6.3.1 Cooling Water System   | 11                                  |
| 6.3.2 Non-Radioactive Releases to Surface Water  | 12                                  |
| 6.3.3 Radioactive Releases to Surface Water  | 12                                  |
| 6.3.4 Releases to Sanitary Sewers  | 12                                  |
| 6.4 Groundwater Quality  | 13                                  |
| 6.4.1 Radionuclides in Groundwater   | 15                                  |
| 6.4.2 Chemicals in Groundwater   | 16                                  |
| <b>7.0 Compliance with Specific Environmental Requirements</b>   | <b>16</b>                           |
| 7.1 Clean Air Act  | 16                                  |
| 7.2 Greenhouse Gas Emissions Reporting per Executive Order 13514   | 16                                  |
| 7.3 Underground Storage Tanks and Fuels  | 17                                  |
| 7.4 The Endangered Species Act of 1973   | 17                                  |
| 7.5 Executive Order 11988, "Floodplain Management"   | 17                                  |
| 7.6 Clean Water Act (CWA) Section 404 (and Executive Order 11990, "Protection of Wetlands")  | 18                                  |
| 7.7 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)  | 18                                  |
| 7.8 Illinois Department of Natural Resources "Rules for Construction and Maintenance of Dams"  | 18                                  |
| 7.9 The Migratory Bird Treaty Act  | 18                                  |
| 7.10 National Environmental Policy Act (NEPA)  | 19                                  |
| 7.11 National Historic Preservation Act (NHPA), Archaeological Resources Protection Act, Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 | 19                                  |
| 7.12 National Pollutant Discharge Elimination System (NPDES)   | 19                                  |
| 7.13 Resource Conservation and Recovery Act of 1976 (RCRA)   | <b>Error! Bookmark not defined.</b> |
| 7.13.1 Regulated Waste Disposal and Reclamation  | 20                                  |
| 7.13.2 RCRA Facility Investigation (RFI) Activities  | 21                                  |
| 7.14 Safe Drinking Water Act   | 22                                  |

|  |           |
|--|-----------|
| 7.15 Superfund Amendments and Reauthorization Act (SARA) TITLE III or Emergency Planning and Community Right-To-Know Act of 1986 (EPCRA) | 22        |
| 7.16 Oil Spill Prevention  | 23        |
| 7.17 Toxic Substance Control Act (TSCA)  | 23        |
| <b>8.0 Pollution Prevention and Waste Minimization</b>   | <b>23</b> |
| <b>9.0 Radiological Clearance of Property and Metals Release Suspension</b>  | <b>24</b> |
| <b>10.0 Conclusion</b>   | <b>24</b> |

---

Cover: Winter scene at Site 39, photo and design by Reidar Hann, Fermilab Visual Media Services.

## 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

### *Federal Sustainability Goals*

In December 2015 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.

### *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. This group works 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.

### 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 2015, 36 reports of nuisance wildlife were received, resulting in the transfer and release of one animal on site. No animals were euthanized. 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 no removals were necessary, so the activity was not required in 2015. Therefore, no whitetail deer were removed.

### 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 2015 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 FY2015</i> | <i>Planned Actions and Contribution</i> | <i>Non-attainment Risk</i> |
|----------------------|-----------------|--|---|----------------------------|
|----------------------|-----------------|--|---|----------------------------|

#### *Goal 1: Greenhouse Gas Reduction*

|     |  |   |  |     |
|-----|--|---|--|-----|
| 1.1 | 50% Scope 1 & 2 GHG reduction by FY 2025 from a FY2008 baseline (2015 target: 19%) | 54.8% reduction in FY2015 due to continued gradual accelerator startup. | Use RECs to meet goal as HEMFs increase in 2016. | Low |
| 1.2 | 25% Scope 3 GHG reduction by FY 2025 from a FY 2008 baseline (2015 target: 6%)     | Met goal for T&D losses using Renewable Energy Certificates (RECs)      | Continue to use RECs to meet T&D losses          | Low |

| <i>SSPP Goal No.</i> | <i>DOE Goal</i> | <i>Performance Status through FY2015</i> | <i>Planned Actions and Contribution</i> | <i>Non-attainment Risk</i> |
|----------------------|-----------------|--|---|----------------------------|
|----------------------|-----------------|--|---|----------------------------|

## *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.   | 29.5% reduction from 2003 Baseline. Current intensity is 90,673 BTU/GSF (new baseline)                                  | Continue to modernize facilities.   | Low                             |
| 2.2  | EISA Section 432 energy and water evaluations  | Goal met. Entire building complex evaluated two years ago.  | Continue with next 4-year audit cycle.  | Low                             |
| 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.               | Low                             |
| 2.4  | At least 15% (by building count or gross square feet) of existing buildings greater than 5,000 gross square feet (GSF) to be compliant with the <i>revised</i> Guiding Principles for HPSB by FY 2025, with progress to 100% thereafter. | In FY2015, Fermilab completed an ECM to bring one additional building into compliance with the 2008 Guiding Principles. | Fermilab plans to have 3 buildings 100% compliant with the 2008 GP in FY2016. | High (based on Financial Risks) |
| 2.5  | Efforts to increase regional and local planning coordination and involvement   | See narrative 2.5.  | See narrative 2.5.  | Low                             |
| 2.6a | Net Zero Buildings: Percentage 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 Narrative 2.6   | N/A                             |
| 2.6b | Net Zero Buildings: Percentage of new buildings(>5,000 GSF) entering into the planning process designed to achieve energy net-zero beginning in FY 2020  | New DOE Goal  | See Narrative 2.6   | N/A                             |
| 2.7  | 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.   | Modified DOE Goal   | See Narrative 2.7   | N/A                             |

| <i>SSPP Goal No.</i> | <i>DOE Goal</i> | <i>Performance Status through FY2015</i> | <i>Planned Actions and Contribution</i> | <i>Non-attainment Risk</i> |
|----------------------|-----------------|--|---|----------------------------|
|----------------------|-----------------|--|---|----------------------------|

### *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. | New DOE Goal  | REC purchases will be used to meet this requirement.                           | Low             |
| 3.2 | “Renewable Electric Energy” requires that renewable electric energy account for not less than 10% of a total agency electric 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 15.7% total energy consumption in lieu of onsite generation. | Continue to investigate potential for onsite renewable electricity generation. | Low (with RECs) |

### *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. (2015 target: 16%)                         | Exceeded goal | Maintain usage less than 2025 goal                     | Low |
| 4.2 | 30% water consumption (Gal) reduction of industrial, landscaping, and agricultural (ILA) water by FY 2025 from a FY 2010 baseline. (2015 target:10%) | Exceeded goal | Continue to implement good water conservation measures | Low |

### *Goal 5: Vehicle Management*

|     |   |  |  |     |
|-----|---|--|--|-----|
| 5.1 | 20% reduction in annual petroleum consumption by FY 2015 relative to a FY 2005 baseline; maintain 20% reduction thereafter. (2015 target: 20%)      | 59% reduction since 2005.                                  | Continue to maintain petroleum consumption below baseline. | Low |
| 5.2 | 10% increase in annual alternative fuel consumption by FY 2015 relative to a FY 2005 baseline; maintain 10% increase thereafter. (2015 target: 10%) | 61% increase in alternative fuel use relative to baseline. | Continue alternative fuel use.                             | Low |

| <i>SSPP Goal No.</i> | <i>DOE Goal</i>  | <i>Performance Status through FY2015</i>      | <i>Planned Actions and Contribution</i>                           | <i>Non-attainment Risk</i> |
|----------------------|--|---|---|----------------------------|
| 5.3                  | 30% reduction in fleet-wide per-mile greenhouse gas emissions reduction by FY 2025 from a FY2014 baseline. (2015 target: N/A; 2017 target: 4%) | New DOE Goal                                  | Evaluate new fleet purchases                                      | Low                        |
| 5.4                  | 75% of light duty vehicle acquisitions must consist of alternative fuel vehicles (AFV). (2015 target: 75%)                                     | Greater than 75% light duty vehicles are AFV. | Investigate purchase of diesel hybrid bus and other technologies. | Low                        |
| 5.5                  | 50% of passenger vehicle acquisitions consist of zero emission or plug-in hybrid electric vehicles by FY 2025. (2015 target: N/A)              | New DOE Goal                                  | Purchase vehicles as appropriate.                                 | Low                        |

### ***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. | Low |
|-----|---|--------------|-----------------------------|-----|

### ***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 landfills. | Continue current waste diversion strategies. | Low |
| 7.2 | Divert at least 50% of construction and demolition materials and debris.                        | 91% diverted from landfills. | Continue current strategies.                 | Low |

### ***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. | Most recent ESPC unsuccessful. | Continue to investigate future opportunities. | Medium |
|-----|--|--------------------------------|---|--------|



| <i>SSPP<br/>Goal<br/>No.</i> | <i>DOE Goal</i> | <i>Performance Status<br/>through FY2015</i> | <i>Planned Actions<br/>and Contribution</i> | <i>Non-<br/>attainment<br/>Risk</i> |
|------------------------------|-----------------|--|---|-------------------------------------|
|------------------------------|-----------------|--|---|-------------------------------------|

***Goal 9: Electronic Stewardship***

|     |  |              |   |     |
|-----|--|--------------|---|-----|
| 9.1 | Purchases – 95% of eligible acquisitions each year are EPEAT-registered products.  | Goal is met. | Continue current purchasing practices.              | Low |
| 9.2 | Power management – 100% of eligible PCs, laptops, and monitors have power management enabled.                            | Goal is met. | Continue current computer management strategies.    | Low |
| 9.3 | Automatic duplexing – 100% of eligible computers and imaging equipment have automatic duplexing enabled.                 | Goal is met. | Continue current computer management strategies.    | Low |
| 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. | Low |

***Goal 10: Climate Change Resilience***

|      |   |                                      |  |  |
|------|---|--------------------------------------|--|--|
| 10.1 | Update policies to incentivize planning for, and addressing the impacts of climate change.  | Site Sustainability Plan Section 10. |  |  |
| 10.2 | Update emergency response procedures and protocols to account for projected climate change, including extreme weather events.                             | As above.                            |  |  |
| 10.3 | Ensure workforce protocols and policies reflect projected human health and safety impacts of climate change.  | As above.                            |  |  |
| 10.4 | Ensure site/lab management demonstrate commitment to adaptation efforts through internal communications and policies.                                     | As above.                            |  |  |
| 10.5 | Ensure that site/lab climate adaptation and resilience policies and programs reflect best available current climate change science, updated as necessary. | As above.                            |  |  |

## 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's EMS was formally established in 2005 in accordance with DOE and Executive Order requirements. The EMS became certified to the ISO 14001 standard in 2007 and remained in effect throughout 2015. As part of this management system Fermilab routinely evaluates operations and seeks to improve environmental performance. The laboratory's significant environmental aspects have been identified and were reviewed in 2015. In areas where change is desired or required, goals are established with measurable targets that seek to improve a particular aspect of operations. In particular, the goals outlined in our Site Sustainably 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 in the vicinity of 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 2015, the accelerator and the experiments operated throughout the calendar year, except for the standard annual maintenance shutdown that lasted anywhere from six 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 2015, the debonding oven burned one Class-1 radioactive magnet. The Muon-Ring, 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 108.9 Curies in 2015. These radioactive air emissions were approximately 5.4% 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 2015 continued to be well below the USEPA standard of 10 mrem in a year and also 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 0.0278 mrem.

Fermilab's 2015 Radionuclide Air Emissions Annual Report will be submitted to the DOE Fermi Site Office (FSO) in May 2016. The report is distributed by the DOE FSO to the USEPA and IEPA.

### 6.1.2 Non-Radioactive Air Emissions

In 2015, 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).

The Illinois Pollution Control Board adopted rule amendments to the Stage 2 vapor recovery equipment program in December, 2013 (35 IAC 218.586). The amendments required existing gasoline dispensing facilities (such as Fermilab's Fuel Service Center) to decommission such equipment by December 31, 2016. Fermilab's stage 2 vapor balance system for the gasoline storage tank dispensing system was decommissioned in August, 2014. Notifications were sent to the IEPA Bureau of Air as required.

## 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 2015. The maximum muon dose offsite due to the operation of MTest, MCenter and E-906 was 0.094 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 2015 by a large ionization chamber located in the Railhead colloquially called a 'Hippo.' The Hippo measurements are supplemented by a number 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 measureable equivalent dose at the site boundary in 2015. The maximum total penetrating radiation equivalent dose in 2015 to an individual at the nearest offsite house was thus estimated to be less than 0.094 mrem, and not directly measureable.

## 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 2015, 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.

In 2015, there were no exceedances of the NPDES permit. In 2014, there were two exceedances of the NPDES permit for chlorine discharges to Kress Creek. To further reduce the possibility of exceeding our discharge limits a plan is being developed for a dechlorination 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,  $^3\text{H}$ ) 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 measureable 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 2014 for the first time, measurable tritium (above 1 pCi/ml) was discharged to Kress Creek at the outfall. In 2015, the months of March and April showed detectable levels of tritium discharged to Kress Creek (1.9 pCi/ml, 3.4 pCi/ml). Indian Creek had tritium discharges ten months of the year (highest concentration was 8.5 pCi/ml). Monthly data from measurements taken at 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 2015 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 2015. 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 2015 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.

|                              |                     |
|------------------------------|---------------------|
| <b>Total Tritium</b>         | <b>0.277 Curies</b> |
| <b>Average Concentration</b> | 2.32 pCi/ml         |
| <b>Highest Concentration</b> | 6.00 pCi/ml         |
| <b>Total Sanitary Volume</b> | 27,450 kGal         |

Fermilab's Tritium 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 was undertaken 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 2014 ten glacial and Silurian dolostone (Joliet Formation) monitoring wells at the CUB Pipe and Clay Tile Field and eight glacial wells at Meson Hill 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-1426-1 and S-1426-2, replacing S-1273 from previous years). 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.

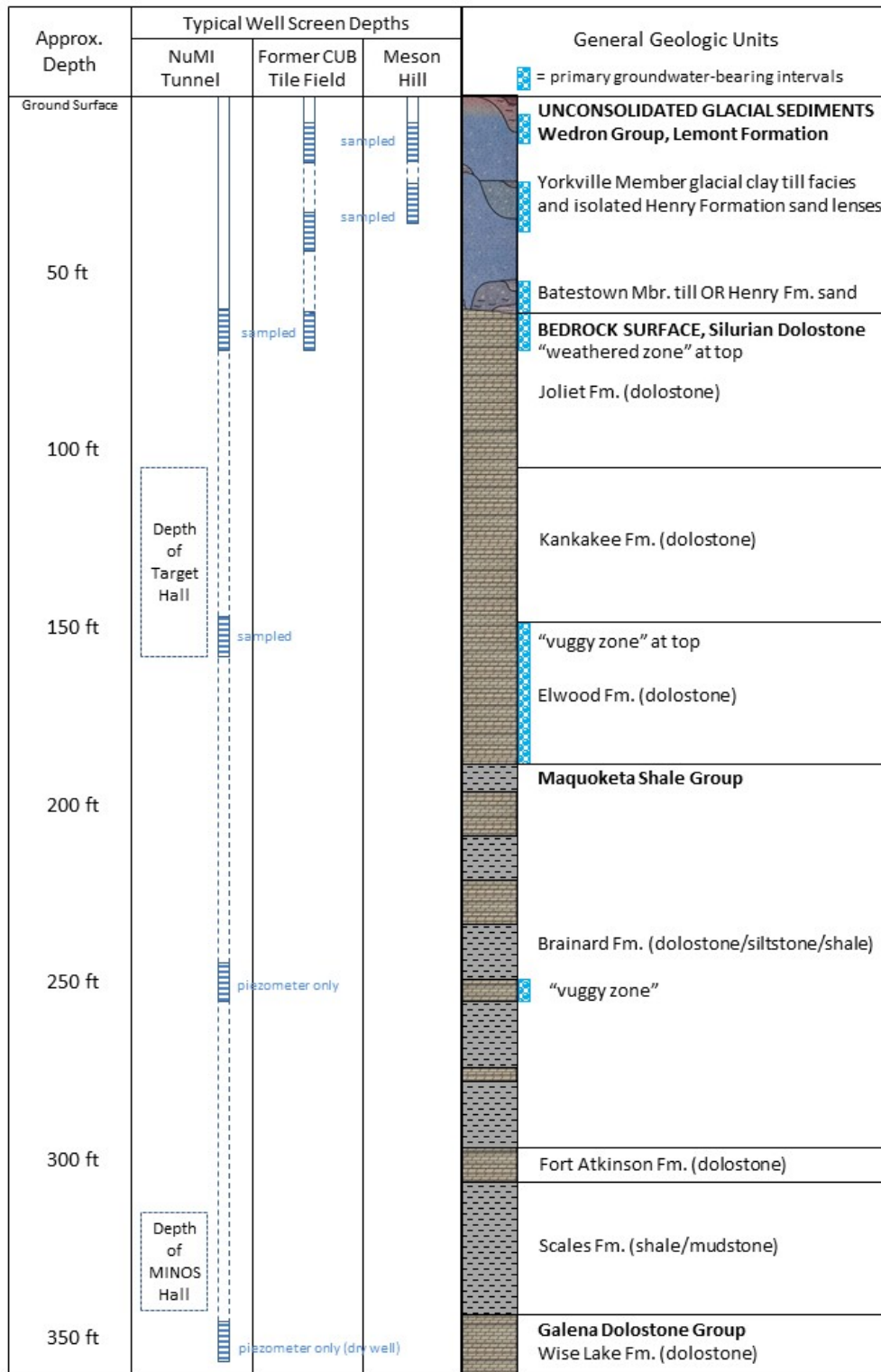


Figure 6.4-1. General Fermilab geologic section (based on NuMI Tunnel), with groundwater monitoring well screen depths and groundwater-bearing intervals. Sample/piezometer status is for 2014.

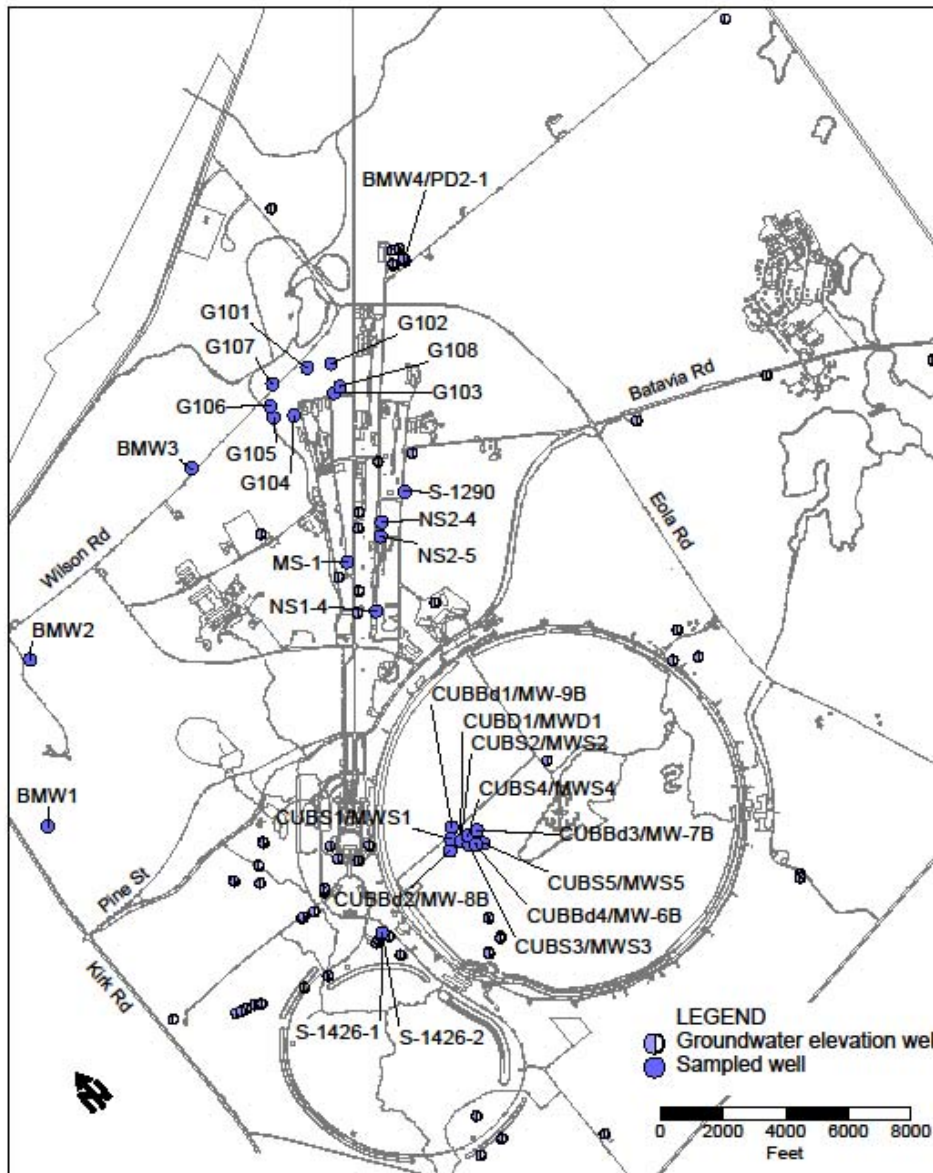


Figure 6.4-2 - Groundwater monitoring well locations in 2014. Sampled wells represented by labeled, filled circles. Wells used only for groundwater elevations represented by half-open circles. (Original DUSAF projection.)

#### 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. Twenty five samples were collected from ten locations for radionuclide analysis. Tritium and accelerator-produced radionuclides were not detected in any Class I groundwater samples during 2015.

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 a damaged portion of the liner system near the north end, adjacent to MI-13A. Tritium results in these wells has fluctuated between non-detect and 25,000 pCi/ml and is routed to Pond F, or it is drummed for disposal if the holding tank concentration exceeds 1,900 pCi/ml. In early 2014, a temporary surface cover was installed over the north end of the berm to reduce the volume of infiltrating water into the decay pipe liner system and in late 2014, a permanent surface cover and drain system was installed. 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 2015, 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 2015. The annual air emissions report for 2015 was not required due to Fermilab's registration as a ROSS source. Fermilab's 2015 Radionuclide Air Emissions Annual Report was submitted to the DOE Fermi Site Office (FSO) in May 2016. The report is distributed by the DOE FSO to the USEPA and IEPA.

In 2015, the actual annual air emissions for Criteria Air Pollutants (carbon monoxide, nitrogen oxides, particulate matter, sulfur dioxide, and volatile organic materials), were 3.3094 tons per year, much less than the maximum allowed for a ROSS site.

Doses to the public from radioactive emissions in 2015 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 2015, an estimated 108.9 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 0.0278 mrem/year in 2015.

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.

In 2015 Fermilab did not exceed reporting thresholds under the USEPA's Mandatory Greenhouse Gas Reporting Rule.

### 7.2 Greenhouse Gas Emissions Reporting per Executive Order 13693

In October 2009, E.O. 13514 took effect and directed federal agencies to account, report and reduce greenhouse gas (GHG) emissions using 2008 as the baseline year. In support of the Department of Energy's (DOE's) effort to comply, EO 13514 was added to the Fermilab contract. As a result, GHG data for fiscal year 2014 was collected and submitted to DOE via the Consolidated Energy Data Report. GHGs are divided into three categories: Scope 1, 2, and 3. Scope 1 emissions are direct emissions from activities directly controlled by Fermilab (boilers, emergency generators, fleet vehicles, and fugitive emissions). Scope 2 emissions are indirect emissions and for Fermilab include only purchased electricity. Scope 3 emissions are other indirect emissions such as employee air travel, wastewater treatment, electrical transmission and distribution losses, waste, ground travel, and employee commuting. Fermilab's baseline data is shown in Table 1 below. FY2013, FY2014 and FY2015 emissions are also shown. The performance status indicates that Fermilab has made a 54.8% reduction in

Scopes 1 and 2 emissions over the baseline year. A primary factor in the reductions over the past 3 years is due to the shutdown, upgrades and gradual restart of the accelerator complex. Scope 3 emissions were reduced by more than 39%. Electrical transmission and distribution losses associated with purchased power are Fermilab's most significant source of Scope 3 emissions.

| <b>Fermilab's Greenhouse Gas Emissions</b>  |                 |                |                |                |                                     |
|---|-----------------|----------------|----------------|----------------|-------------------------------------|
| <b>DOE Goal</b>   | <b>Baseline</b> | <b>FY 2013</b> | <b>FY 2014</b> | <b>FY 2015</b> | <b>Performance Status (FY 2014)</b> |
| 50% <b>Scope 1 &amp; 2</b> GHG reduction by FY 2025 from a FY 2008 baseline (metric tons equivalent CO <sub>2</sub> ) | 384,366.1       | 143,423.3      | 194,901.6      | 173,701        | -54.8%                              |
| 25% <b>Scope 3</b> GHG reduction by FY 2025 from a FY 2008 baseline (MT CO <sub>2</sub> e)                            | 29,502.5        | 14,325.7       | 19,154.7       | 17,840         | -39.5%                              |

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.

### 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. Per IEPA and USEPA rule changes, the Stage II vapor recovery function of the fuel dispensers were decommissioned in 2014. Additionally, work was completed at the same time to replace the Diesel and Gasoline spill buckets and the drop tube for the E85 UST. There were no compliance issues identified in 2015.

Fermilab continues to decrease the use of petroleum based fuels. Fermilab has reduced petroleum usage by 16.6% in the past year. 75% of Fermilab vehicles use alternate fuels (51,523 gallons of E85 and 19,582 gallons of biodiesel), with several medium and heavy-duty vehicles operating on biodiesel fuels.

### 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 2015.

### 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 2015.

## 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 Lab 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. The laboratory conducted several wetland delineation activities as part of the Surface Water Management Plan (SWaMP), managed by FESS. The CWA Section 404 permit for the Short Baseline Neutrino Project (SBN) was active and managed throughout the year.

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

In 2015, 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. 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

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 in order 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 2015, 4 nests containing 13 eggs were destroyed.

For some background, the U.S. legislature passed the Migratory Bird Treaty Act of 1918 (MBTA) to protect birds from the high demand for feather plumes for women's hats during the time period. MBTA applies to over 1,000 species of birds, including the ubiquitous American robin. Migratory species are those whose individuals migrate between countries by "normal ecological processes." Because the law prohibits a broad range of activities, the interpretation of what constitutes a violation fluctuates. Thus, inadvertently affecting migratory birds during construction or other activities could have serious repercussions. However, the courts have usually held to a narrower interpretation and in the early 2000s, guidance was passed that directed agencies to outline a plan to avoid harming migratory birds and to take proactive steps to conserve bird populations. 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.

## 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 2015, 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 5 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.

An EA was completed in 2015 for the Long Baseline Neutrino Facility (LBNF) project and subsequently resulted in a Finding of No Significant Impact. The EA analyzed potential impacts at both Fermilab and the Sanford Underground Research Facility in South Dakota. The Proposed Action and 2 Alternative Actions were considered. Impacts from the project as well as cumulative impacts resulting from other reasonably foreseeable actions were included in the Assessment.

## 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 2015 to assess any potential impacts on historic resources. No compliance issues were identified in 2015. 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 2015.

## 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 2015. 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 on a monthly basis. A new permit was issued in April 2014 from the IEPA. A Compliance Evaluation Inspection Report was 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 2015 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 pretreatment operating permits issued by IEPA (also covered under NPDES regulations and are described under Releases to Sanitary Sewers).

7.13.1 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 2015

| <b>Waste Material</b>                            | <b>Cubic Meters</b> |
|--|---------------------|
| <b>Non-Routine Hazardous Waste (RCRA + TSCA)</b> | 18.2                |
| <b>Routine Hazardous Waste (RCRA + TSCA)</b>     | 4.2                 |
| <b>Non-Routine Non-Hazardous Special Waste</b>   | 23.4                |
| <b>Routine Non-Hazardous Special Waste</b>       | 23.1                |
| <b>De-Classified Special Wastes</b>              | 8.3                 |
| <b>Dumpster/Landfill Waste</b>                   | 6,080               |
| <b>Radioactive Waste (DOE regulated)</b>         | 53.9                |

In addition, the following volumes of waste were generated by Fermilab and managed for reclamation/recycling by the HCTT 2015.

| <b>Waste Material</b>                     | <b>Kilograms</b> |
|---|------------------|
| <b>Ethylene Glycol</b>                    | 2,643            |
| <b>Lead Acid Batteries</b>                | 6,804            |
| <b>Non PCB Fluorescent Light Ballasts</b> | 982              |
| <b>Mercury Containing Lamps</b>           | 21,215           |
| <b>Mercury Containing Equipment</b>       | 49               |
| <b>Non PCB Capacitors</b>                 | 52               |
| <b>Oil Filters</b>                        | 272              |
| <b>Safety Kleen Solvent</b>               | 866              |
| <b>Used Oil</b>                           | 16,852           |
| <b>Universal Waste Batteries</b>          | 111              |

### 7.13.2 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 2015.

The following table summarizes the 2015 results at SWMU 12 from wells with results above either the Class I or Class II Groundwater Quality Standards.

Glacial deposit well MWD1 produced 2<sup>nd</sup> and 4<sup>th</sup> quarter total chloride results of 1010 mg/L and 1060 mg/L, respectively. The Class II Groundwater Quality Standard is 200 mg/L.

| <b>Glacial Deposit Monitoring Wells</b> |                                       |  |                       |                       |
|---|---------------------------------------|--|-----------------------|-----------------------|
|   |                                       |  | 2Q15                  | 4Q15                  |
| PARAMETER                               | Class II<br>GW<br>Quality<br>Standard |  | Well<br>CUBD1<br>MWD1 | Well<br>CUBD1<br>MWD1 |
| INORGANIC (mg/L)                        |                                       |  |                       |                       |
| Chloride, Total                         | 200                                   |  | 1010                  | 1060                  |
| Lead, Total                             | 0.1                                   |  | 0.004                 | U                     |

Grey Shading = Above the Class II GW Quality Standard

U = Undetected

| <b>Bedrock Monitoring Wells</b> |                                      |                        |                        |      |
|---------------------------------|--------------------------------------|------------------------|------------------------|------|
|                                 |                                      | 2Q15                   | 2Q15                   | 4Q15 |
| PARAMETER                       | Class I<br>GW<br>Quality<br>Standard | Well<br>CUBBd3<br>MW7B | Well<br>CUBBd4<br>MW6B | None |
| INORGANIC (mg/L)                |                                      |                        |                        |      |
| Chloride, Total                 | 200                                  | 7                      | 19                     |      |
| Lead, Total                     | 0.0075                               | 0.076                  | 0.019                  |      |

Grey Shading = Above the Class I GW Quality Standard

U = Undetected

Bedrock wells MW6B and MW7B produced 2<sup>nd</sup> quarter total lead results of 0.019 mg/L and 0.076 mg/L, respectively. The Class I groundwater quality standard is 0.0075 mg/L. There were no lead results above the Class I groundwater quality standard in 4<sup>th</sup> quarter.

#### 7.14 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.

#### 7.15 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 2015.

As required by Section 312 of SARA Title III, Fermilab will submit a Tier II Emergency and Hazardous Chemical Inventory (2014) to state and local emergency services and disaster agencies each February.

## 7.16 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 will help to ensure the oil sources owned by each division/section are in compliance (provided with secondary containment, inspected as required, etc.) by storing all monthly inspections and the locations of oil sources.

## 7.17 Toxic Substance Control Act (TSCA)

In 2015, the Accelerator Division continued its program to phase out the use of PCBs, when opportunities occurred. This involved removing the remaining PCB capacitors from Linac quadrupole power supplies, and replacing them with non-PCB capacitors. Additional PCB capacitors were removed from power supplies that were located in PS5 service building. All capacitors were disposed of properly. This has reduced the PCB inventory by 792 pounds. Further reductions are being planned.

Groundwater at Main Ring service buildings B1 and B4 was determined 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 FY2015, Fermilab recycled 532 tons of material through a combination of office/ residential type recycling, and the recycling of scrap metals, wood, tires and other materials. Sixty-eight percent of waste material generated was diverted by recycling. 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. Including large scale fixed price projects, approximately 675 tons of construction waste (91% of the total waste generated) was recycled in 2015.

Other notable pollution prevention measures include:

- In May 2014, the cafeteria food service provider started composting their kitchen scraps, coffee grounds and paper towels. During the latter half of 2015, 5.4 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 2015, 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 2015, 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 2015, 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 fifth consecutive year in 2015 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 2015, 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 2015, 396 metric tons of various metals met Fermilab's release requirements and were recycled.

## 10.0 Conclusion

The operations at Fermilab during 2015 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.