Princeton Plasma Physics Laboratory

PPPL- 4967

PPPL- 4967

Annual Site Environmental Report for Calendar Year 2012

Virginia Finley

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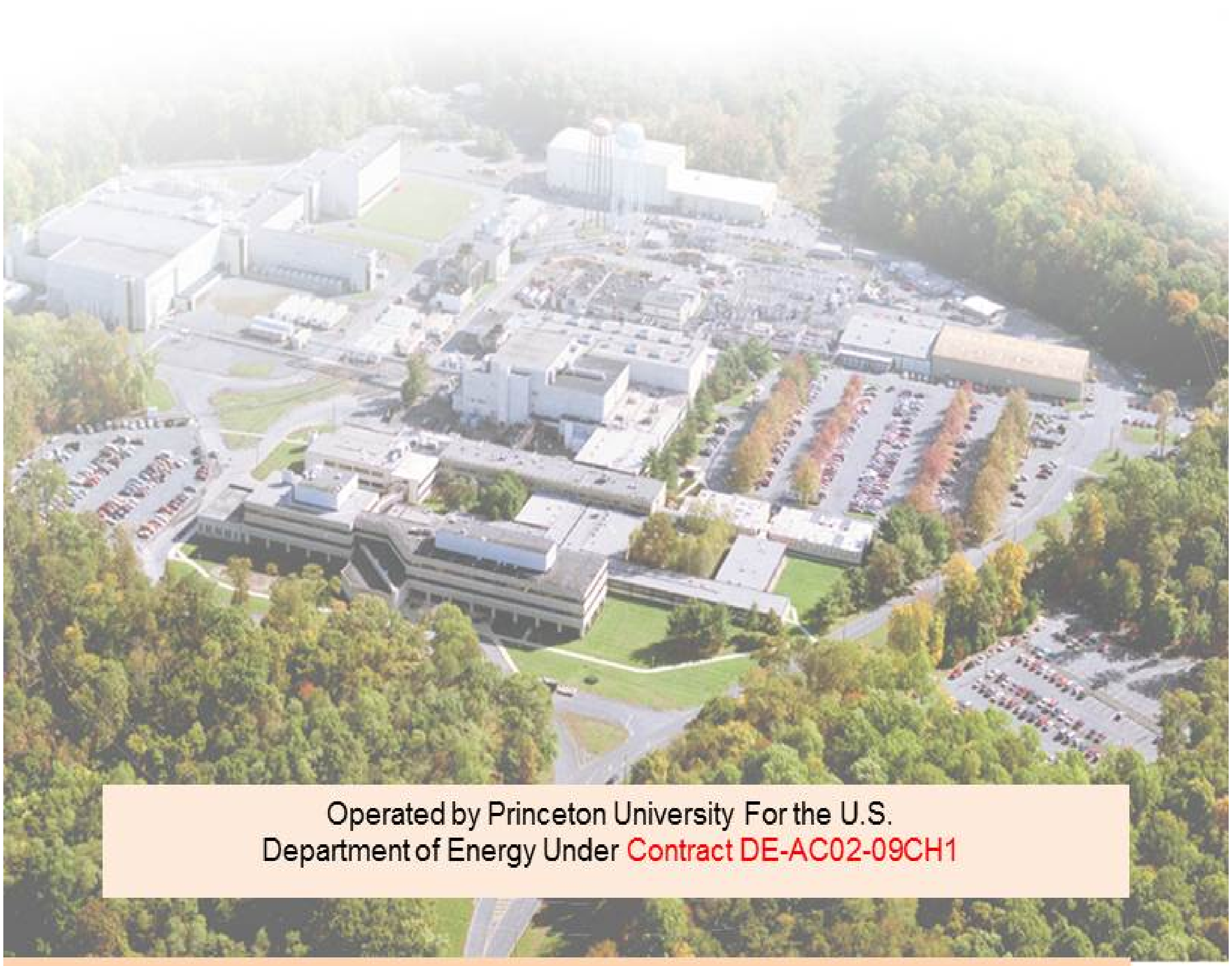
An Annual Site Environmental Report for

Princeton Plasma Physics Laboratory

ANNUAL SITE ENVIRONMENTAL REPORT

For Calendar Year 2012



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NOTE: ***Data tables are located in Appendix A - 2012 Tables beginning on page 67. All tables as noted in the report are located in Appendix A***.

List of Acronyms

AEA	Atomic Energy Act of 1954
AFV	alternative fuel vehicles
ALARA	as low as reasonably achievable
ARD	America Recycles Day (November 15th)
B1, B2	Bee Brook 1 (upstream of DSN001) and 2 (downstream of DSN001) (surface water stations)
B-20/100	biofuel (20%/100%)
BAS	building automation system
BOD	Biochemical oxygen demand
BPX	Burning Plasma Experiment
Bq	Becquerel
BTU/gsf	British Thermal Unit per gross square feet
^{o}C	Degrees Celsius
C	C-site of James Forrestal Campus, part of PPPL site
C1	Canal - surface water monitoring location (Delaware & Raritan Canal)
c-1,2-DCE	cis-1,2-dichloroethylene
C&D	Construction and demolition (waste)
CAA	Clean Air Act
CAS	Coil Assembly and Storage building
CDX-U	Current Drive Experiment – Upgrade (at PPPL)
CEA	classified exception area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Ci	Curie (3.7 ^{E10} Becquerel)
CIT	Compact Ignition Tokamak
cm	centimeter
CNG	compressed natural gas
CO_2	carbon dioxide (GHG)
CO_{2e}	carbon dioxide equivalent
COD	chemical oxygen demand
CPO	chlorine-produced oxidants known as total residual chlorine
CWA	Clean Water Act
CXs	categorical exclusions
CY	calendar year
DCE	dichloroethylene
D&D	deconstruction and decontamination
D-D	deuterium-deuterium
DART	days away, restricted transferred (case rate - Safety statistic)
DATS	differential atmospheric tritium sampler
DESC	Defense Energy Supply Center
DMR	discharge monitoring report
DOE	Department of Energy
DOE-HQ	Department of Energy - Headquarters
DOE-PSO	Department of Energy - Princeton Site Office
DOT	Department of Transportation
DPCC	Discharge Prevention Control and Containment
dpm	disintegrations per minute
D&R	Delaware & Raritan (Canal)

List of Acronyms

DSN	discharge serial number
E1	Elizabethtown Water (formerly- NJ American Water Co.potable water supplier – surface water station)
E-85	ethanol (85%) fuel
EEB	Energy-efficient building
EDE	effective dose equivalent
EHS	Environment, Health & Safety
EML	Environmental Monitoring Laboratory (DOE)
EMS	Environmental Management System
EO	Executive Order
EPA	Environmental Protection Agency (US)
EPCRA	Emergency Planning and Community Right to Know Act
EPEAT	Electronic Product Environmental Assessment Tool
EPP	Environmentally Preferred Products
ESD	Environmental Services Division (PPPL)
ES&H	Environment, Safety, and Health
ESHD	Environment, Safety, &Health Directives
ESPC	Energy Savings Performance Contract
^{o}F	Degrees Fahrenheit
FABA	Former Annex Building Area
FEWG	Fugitive Emission Working Group
FFCA	Federal Facility Compliance Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FY	fiscal year (October 1 to September 30)
GGE	Gasoline gallon equivalent
GHGs	greenhouse gases
GP	Guiding principles
GPIC	Greater Philadelphia Information Center
GSA	General Services Administration
HQ	Headquarters
HT	tritium (elemental)
HTO	tritiated water or tritium oxide
IC25	Inhibition concentraion
ILA	Industrial landscaping and agriculture
SO14001	International Standards Organization 14001 (Environmental Management System – EMS)
ITER	International Thermonuclear Experimental Reactor (France)
JFC	James Forrestal Campus
JET	Joint European Torus facility (United Kingdom)
km	kilometer
kWh	kilowatt hour
LEC	liquid effluent collection (tanks)
LED	Light emitting diode
LEED	Leadership in Energy and Environmental Design
LEED-EB	Leadership in Energy and Environmental Design - Existing Buildings
LLD	Lower limit of detection
LLW	Low level waste
LSB	Lyman Spitzer Building (Formerly Laboratory Office Building)
LSRP	Licensed Site Remediation Professional

List of Acronyms

LOI	Letter of Interpretation (Wetlands)
LOTO	lock-out, tag-out (electrical safety)
LSI	lined surface impoundment
LTX	Lithium Tokamak Experiment
Ma	Million years ago
M1	Millstone River (surface water station)
MC&A	Material Control & Accountability (nuclear materials)
MG	Motor Generator (Building)
MGD	Million gallons per day
mg/L	milligram per liter
M&O	Maintenance &Operations
mrem	milli roentgen equivalent man (per year)
MRX	Magnetic Reconnection Experiment
MSDS	Material Safety Data Sheet
msl	mean sea level (in feet)
mSv	milliSievert
MT	metric ton (equivalent to 2,204.6 pounds or 1.10 tons)
MW	monitoring well
Mwh	Megawatt hour
MSW	Municipal solid waste
n	neutron
N or N-	nitrogen
NCSX	National Compact Stellarator Experiment
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic and Preservation Act
NIST	National Institute of Standards and Technology
NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection (prior to 1991 and after July 1994)
NJPDES	New Jersey Pollutant Discharge Elimination System
NNSS	Nevada National Security Site(DOE site)
NOEC	no observable effect concentration
NOVs	Notice of violations
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NSTX-U	National Spherical Torus Experiment Upgrade
NSTXCC	National Spherical Torus Experiment Computer Center
NVLAP	National Voluntary Laboratory Accreditation Program (NIST)
ODS	ozone-depleting substances (Class I and II)
ORPS	occurrence reporting and processing system ((DOE accident/incident reporting system)
OSHA	Occupational Safety and Health Agency
P1, P2	Plainsboro 1 (Cranbury Brook) and 2 (Devil's Brook) (surface water stations)
PCBs	polychlorinated biphenyls
PCE	perchloroethylene, tetrachloroethene, or tetrachloroethylene
pCi/L	picoCuries per liter
PE	Professional engineer
PEARL	Princeton Environmental, Analytical, and Radiological Laboratory
PFC	Plasma facing component

List of Acronyms

PJM	Pennsylvania, Jersey, Maryland (Electric-power grid controllers/operators)
POTW	publicly-owned treatment works
PPA	Power Purchase Agreement
PPPL	Princeton Plasma Physics Laboratory
PPPLCC	Princeton Plasma Physics Laboratory Computer Center
PPTRS	Pollution Prevention Tracking System Report
PT	proficiency test (Laboratory certification)
PTE	potential to emit (air emissions)
PUE	Power utilization effectiveness
QA	Quality assurance
QC	Quality control
RAA	Remedial Alternative Assessment
RASR	Remedial Action Selection Report
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
REC	renewable energy credits
Redox	Oxidation-reduction (potential)
rem	roentgen equivalent man
RESA	Research Equipment Storage and Assembly Building
RI	Remedial Investigation
RWHF	Radiological Waste Handling Facility
SF_6	sulfur hexafluoride (GHG)
SARA	Superfund Amendments and Reauthorization Act of 1986
SBRSA	Stony Brook Regional Sewerage Authority
SDWA	Safe Drinking Water Act
SESC	Soil erosion and sediment control
SO_2	sulfur dioxide
SPCC	Spill Prevention Control and Countermeasure
T	tritium
TCE	trichloroethene or trichloroethylene
TDS	Total dissolved solids
TFTR	Tokamak Fusion Test Reactor
TPHC	total petroleum hydrocarbons
TRI	Toxic Reduction Inventory (CERCLA)
TSCA	Toxic Substance Control Act
TSS	total suspended solids
TW	test wells
USGBC	US Green Building Council
USGS	US Geological Survey
VOCs	volatile organic compounds
WCR	Waste Characterization Report (NJPDES permit requirement)
χ/Q	atmospheric dilution factor (NOAA)
$\mu g/L$	micrograms per liter
μSv	microSievert

Princeton Plasma Physics Laboratory (PPPL)
Certification of Monitoring Data for
Annual Site Environmental Report for 2012

Contained in the following report are data for radioactivity in the environment collected and analyzed by Princeton Plasma Physics Laboratory's Princeton Environmental, Analytical, and Radiological Laboratory (PEARL). The PEARL is located on-site and is certified for analyzing radiological and non-radiological parameters through the New Jersey Department of Environmental Protection's Laboratory Certification Program, Certification Number 12471. Non-radiological surface and ground water samples are analyzed by NJDEP certified subcontractor laboratories – QC, Inc. and Accutest Laboratory. To the best of our knowledge, these data, as contained in the "Annual Site Environmental Report for 2012," are documented and certified to be correct.

Signed:

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Virginia L. Finley,
Head, Environmental Compliance
Environmental Services Division

____
Robert S. Sheneman,
Deputy Head
Environment, Safety,& Health and Security Department

Approved: ______________________________
Jerry D. Levine,
Head
Environment, Safety,& Health and Security Department

Executive Summary

Princeton Plasma Physics Laboratory
Annual Site Environmental Report for
Calendar Year 2012

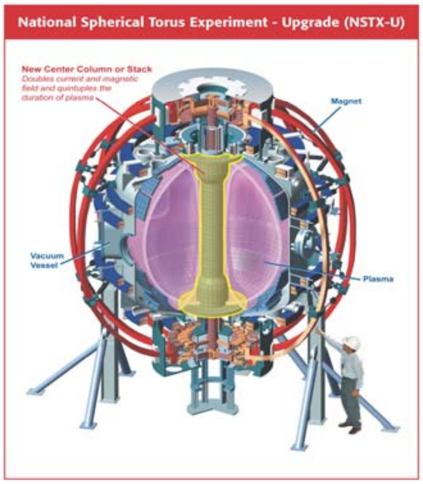
This report presents the results of environmental activities and monitoring programs at the Princeton Plasma Physics Laboratory (PPPL) for Calendar Year 2012. The report provides the U.S. Department of Energy (DOE) and the public with information on the level of radioactive and non-radioactive pollutants, if any, that are released into the environment as a result of PPPL operations. The report also summarizes environmental initiatives, assessments, and programs that were undertaken in 2012. The objective of the Site Environmental Report is to document PPPL's efforts to protect the public's health and the environment through its environmental protection, safety, and health programs.

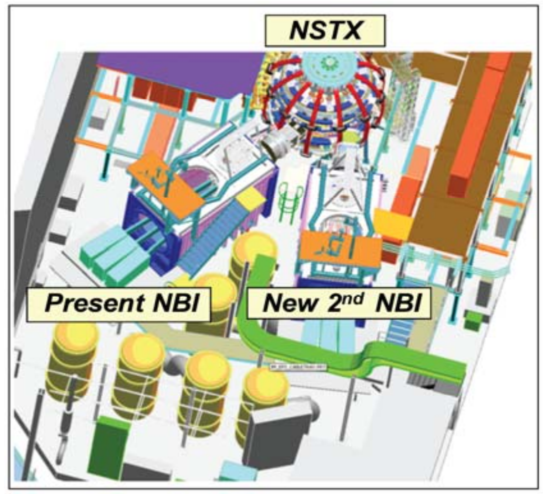
Since 1951, the Princeton Plasma Physics Laboratory has engaged in fusion energy research. Fusion is the reaction that occurs in our sun as well as in other stars. During fusion reactions, the nuclei of hydrogen atoms in a plasma state, *i.e.* as a hot, ionized gas, fuse or join forming helium atoms and releasing of neutrons and energy. Unlike the sun, PPPL's fusion reactions are magnetically confined within a vessel or reactor under vacuum conditions. The long-range goal of the U.S. Fusion Energy Science program is to develop and demonstrate the practical application of fusion power as a safe, alternative energy source replacing power plants that burn fossil fuels. Energy from fusion power plants would boil water for steam that drives electric-generating turbines without the production of greenhouse gases and other air pollutants.

National Spherical Torus Experiment - Upgrade

Though 2012 marked the fourteenth year of the National Spherical Torus Experiment (NSTX), NSTX did not conduct experimental operations. After a thorough review in 2010, PPPL and DOE jointly decided to commence the planned upgrade (NSTX-U) project, in lieu of making repairs to the magnetic coils that confine the plasma and continuing operations in 2012. The upgrade plan for NSTX-U includes the redesign of the center stack magnets and the addition of a second neutral beam from the former Tokamak Fusion Test Reactor (TFTR). In NSTX-U, the plasma is heated by radio-frequency waves and deuterium (hydrogen isotope with one neutron) neutral beam injection. With two neutral beams, NSTX-U will have greater heating capacity and hotter plasmas. The new center stack design will increase the magnetic field strength to one tesla - or 20,000 times the strength of Earth's magnetic field. The magnetic field generated by the polodial field coils is used to control the plasma shape with in the vacuum vessel. NSTX-U includes research collaborators from 30 U.S. institutions and 11 other countries.

The National Spherical Torus Experiment Heated by Neutral Beam Injection (NBI)





The new center column or stack is shown in a yellow outline; the vacuum vessel is spherical in shape and produces a "round" plasma, and the person standing next to the right-hand base illustrates the scale of this device. In the drawing on the right, the two neutral beam injectors (NBI) are shown.

ITER - Cadarache, France

ITER in Latin means "the way" and is the name of the large international fusion experiment located in the Provence-Alpes-Côte-d'Azur region in southeastern France. Construction began in 2007 with a completion date of 2018. When operational, ITER will generate 10 times the external power delivered to heat the plasma. PPPL, partnering with Oak Ridge National Laboratory, hosts the U.S. ITER Project office that coordinates U.S. ITER activities - lending to the project design, construction, and technical expertise.

PPPL Achievements and Activities in 2012

PPPL encourages its employees to practice being good environmental stewards in their daily lives through such actions as purchasing sustainable products and reducing, reusing and recycling . Each year, PPPL hosts events such as Earth Week and America Recycles Day when information on green products and recycling opportunites are provided. PPPL's "Green Team" designs programs and activities to help green PPPL and the whole community.

From left to right: Associate Deputy Secretary of Energy Melvin G. Wiliams Jr., Mark Hughes, Rob Sheneman and Jennifer McDonald, Director of the DOE's Sustainability Performance Office

When the total maximum off-site dose for 2012 was calculated, PPPL's radiological contribution was a small fraction of the 10-mrem/year PPPL objective and the 100-mrem/year DOE limit. Based on the radiological monitoring program data, the dose results for 2012 were:

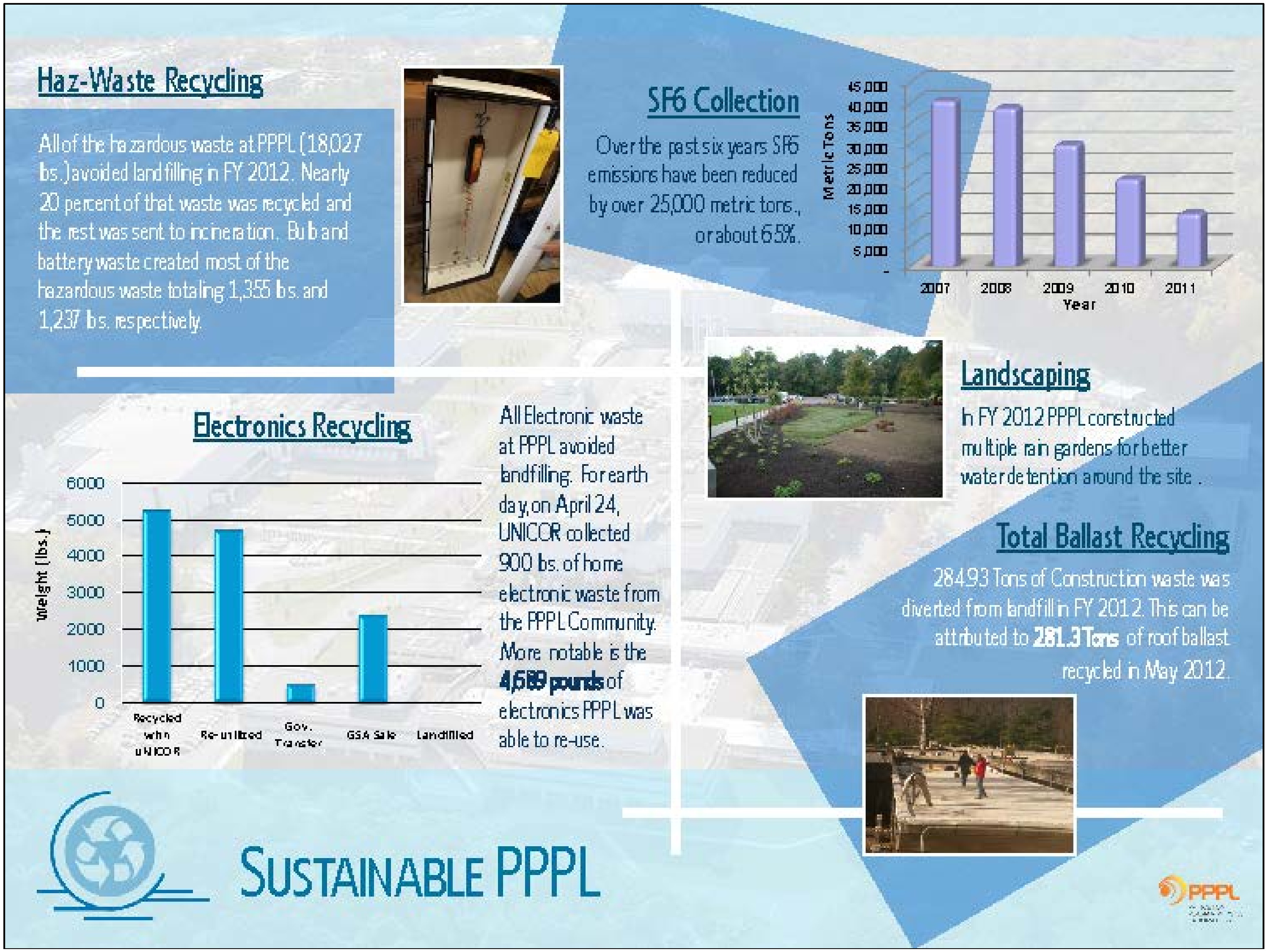
1. Total maximum off-site dose from all sources—airborne and liquid releases—was **1.22 x 10^{-2}mrem per year (1.22 x10^{-4} mSv per year)**.
2. Dose at the nearest business (at the site boundary) due to airborne releases was **1.15 x 10^{-2} mrem per year (1.15 x 10^{-4} mSv per year).**
3. The collective effective dose equivalent for the population living within 80 kilometers was **0.573 person-rem (5.73 x 10^{-3} person-Sv).**

The Laboratory expects to continue a high level of performance in all aspects of ES&H as it has demonstrated in its fusion research program. Efforts are geared not only to full compliance with applicable local, state, and federal regulations, but also to achieve a level of excellence in ES&H performance. PPPL is an institution that serves other research facilities and the nation by providing valuable information gathered from its fusion research program.

In 2012, Princeton Plasma Physics Laboratory accepted the following awards:

- U.S. Department of Energy (DOE) Sustainability Award for reducing greenhouse gas emissions by 72 percent from 2008 to 2011, exceeding the goal of 28 percent reduction from the 2008 baseline year.
- One of nine DOE sites to be given the 2012 Sustainability Award from the U.S. Department of Energy (DOE) award for the new DOE-sponsored GreenBuy ® program; this program promotes the purchase of environmentally preferable products in categories DOE targets.
- US Environmental Protection Agency's (EPA) PPPL presented with the Silver Award in Federal Electronic Challenge for its purchasing and managing energy-efficient electronic equipment and recycling of inefficient equipment. The previous year, PPPL had won the bronze award.
- The second EPA award for PPPL's lifecycle management of its electronics including the waste reduction efforts was the WasteWise® Gold Achievement Award.

(See next page for Sustainable PPPL Poster)


Haz-Waste Recycling
All of the hazardous waste at PPPL (18,027 lbs.) avoided landfilling in FY 2012. Nearly 20 percent of that waste was recycled and the rest was sent to incineration. Bulb and battery waste created most of the hazardous waste totaling 1,355 lbs. and 1,237 lbs. respectively.
SF6 Collection
Over the past six years SF6 emissions have been reduced by over 25,000 metric tons., or about 65%.
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
-
Metric Tons
2007
2008
2009
2010
2011
Year
Electronics Recycling
All Electronic waste at PPPL avoided landfilling. For earth day, on April 24, UNICOR collected 900 lbs. of home electronic waste from the PPPL Community. More notable is the 4,689 pounds of electronics PPPL was able to re-use.
6000
5000
4000
3000
2000
1000
0
Weight (lbs.)
Recycled with UNICOR
Re-utilized
Gov. Transfer
GSA Sale
Landfilled
Landscaping
In FY 2012 PPPL constructed multiple rain gardens for better water detention around the site.
Total Ballast Recycling
284.93 Tons of Construction waste was diverted from landfill in FY 2012. This can be attributed to 281.3 Tons of roof ballast recycled in May 2012.
SUSTAINABLE PPPL
PPPL

Chapter

1

Introduction

1.1 Site Mission

The U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL) is a Collaborative National Center for plasma and fusion science. Its primary mission is to develop scientific understandings and key innovations leading to an attractive fusion energy source [PPPL08a]. Related missions include conducting world-class research along the broad frontier of plasma science, providing the highest quality of scientific education and experimentation, and participating in technology transfer and science education projects/programs within the local community and nation-wide.

The National Spherical Torus Experiment (NSTX) is a collaborative project among 30 U.S. laboratories, including Department of Energy National Laboratories, universities, and institutions, and 28 international institutes from 11 countries. Also located at PPPL are smaller experimental devices, the Magnetic Reconnection Experiment (MRX), the Lithium Tokamak Experiment (LTX) and Hall Thruster, which investigate plasma physics phenomena.

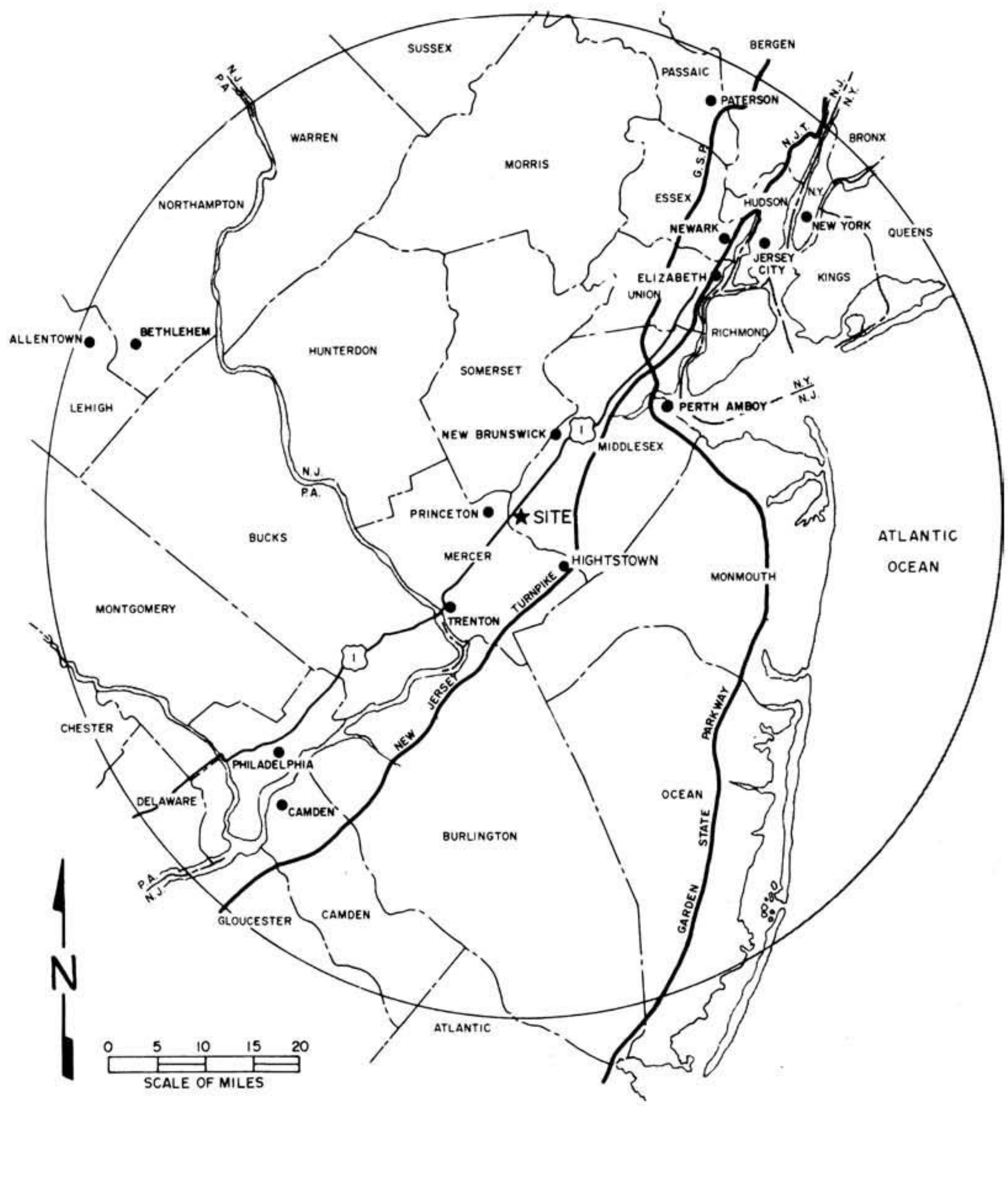
As a part of both off and on-site collaborative projects, PPPL scientists assist fusion programs within the United States and in Europe and Asia. To further fusion science in 2012, PPPL collaborated with other fusion research laboratories across the globe on the Joint European Torus (JET) facility located in the United Kingdom, and the International Thermonuclear Experimental Reactor or ITER, which in Latin means "The Way," located in Cadarache, France. PPPL's main fusion experiment, the National Spherical Torus Experiment Upgrade (NSTX-U), began its upgrade in 2011. The upgrade is scheduled to be fully operational in 2014.

1.2 Site Location

The Princeton Plasma Physics Laboratory site is in the center of a highly urbanized Northeast region. The closest urban centers are New Brunswick, 14 miles (22.5 km) to the northeast, and Trenton, 12 miles (19 km) to the southwest. Within a 50-mile (80 km) radius are the major urban centers of New York City, Philadelphia, and Newark (Exhibit 1-1).

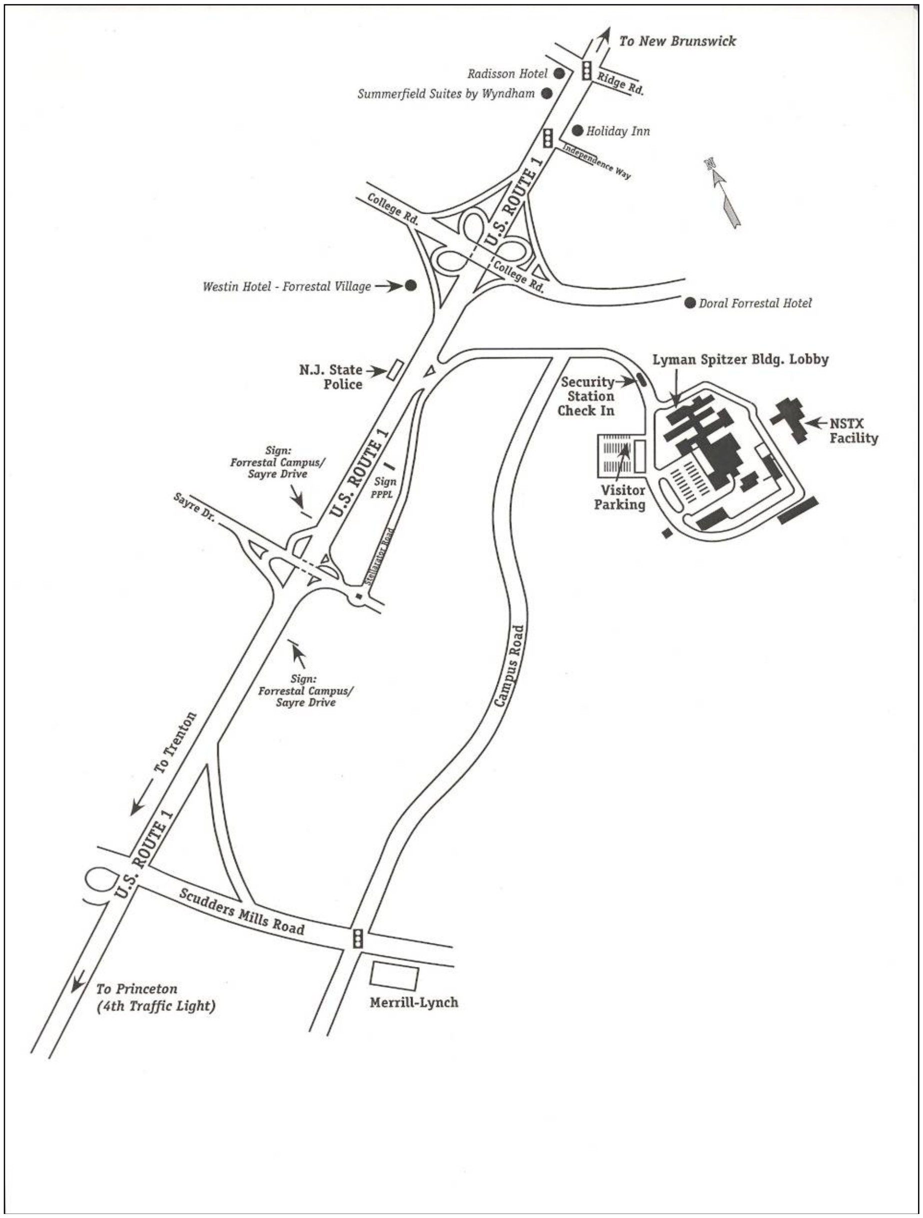
The site is located in Plainsboro Township in Middlesex County (central New Jersey), adjacent to the municipalities of Princeton, Kingston, East and West Windsor, and Cranbury, NJ. The Princeton area continues to experience a sustained growth of new businesses locating along the Route 1 corridor near the site. In 2012, construction was completed on the new University Medical Center of Princeton at Plainsboro, which is located less than 2 miles south of PPPL. Princeton University's main campus is approximately three miles west of the site, primarily located within the municipality of Princeton, New Jersey.

Exhibit 1-1. Region Surrounding PPPL (50-mile radius shown)



PPPL, then known as "Project Matterhorn", was first established on A- and B- sites of the James Forrestal Campus (JFC), Princeton University's research center named for Princeton graduate (Class of 1915) and the first Secretary of Defense, James Vincent Forrestal. Located east of U.S. Route 1, PPPL has occupied the C- and D-site location since 1959 (Exhibit 1-2). The alphabet designation was derived from the names given to the Stellarator models, those early plasma fusion devices.

Exhibit 1-2. PPPL James Forrestal Campus (JFC), Plainsboro, NJ



Surrounding the site are preserved and undisturbed lands including upland forest, wetlands, open grassy areas, and a minor stream, Bee Brook, which flows along PPPL's eastern boundary. These areas are designated as open space in the James Forrestal Campus (JFC) site development plan.

D-site is fully surrounded by a barbed-wire, chain-linked fence for security purposes. Access to D-site is limited to authorized personnel through the use of card readers. PPPL's Site Protection Division controls access to C-site allowing the public and visitor access following an identification check. Vehicle inspections may occur prior to entrance.

Exhibit 1-3. Aerial View of PPPL

The aerial photo above (Exhibit 1-3) shows the general layout of the facilities at the C- and D-sites of JFC as viewed from the north; the former TFTR and current NSTX Test Cells are located at D-site (on the left side of photo)

1.3 General Environmental Setting

The climate of central New Jersey is classified as mid-latitude, rainy climate with mild winters, hot summers, and no dry season. Temperatures may range from below zero to above 100 degrees Fahrenheit (°F) (17.8° Celsius (°C) to 37.8° C); extreme temperatures typically occur once every five years. Approximately half the year, from late April until mid-October, the days are freeze-free.

The typical regional climate is moderately humid with a total average precipitation about 46 inches (116 cm) evenly distributed throughout the year. Droughts typically occur about once every 15 years [PSAR78]. In 2012, the annual rainfall total was 38.88 inches (98.76 cm), well below the average rainfall in New Jersey. Precipitation was below average from January through March, totaling just 4.79 inches. In October 2012, Superstorm Sandy destroyed beachfront homes and businesses in Monmouth and Oceans Counties and caused widespread power outages and wind damage.

The most recent archaeological survey was conducted in 1978 as part of the TFTR site environmental assessment study. From historical records, personal interviews, and field investigations one projectile point and a stone cistern were found. Apparently, the site had limited occupation during prehistoric time and has only in recent times been actively used for farming. No significant archeological resources were identified on-site. There are examples of prehistoric occupation in areas closer to the Millstone River, which are within two miles of the site [Gr77].

1.4 Primary Operations and Activities

Several magnetic fusion experiments, including NSTX, MRX, or LTX, currently operate at PPPL. NSTX is the largest operating experiment and it is located on D-site. NSTX has produced one million amperes of plasma current, setting a world record for a spherical torus device. This device is designed to test the physics principles of spherical-shaped plasmas forming a sphere with a hole through its center. Plasma shaping is an important parameter for plasma stability and performance enabling viable fusion power. In 2011, it stopped experimental operations to begin a major upgrade project which is scheduled to be finished in 2014. The upgraded experiment, known as NSTX-U, will have twice the plasma heating power and magnetic confinement and be able to extend the pulse duration by a factor of five.

The former Tokamak Fusion Test Reactor (TFTR) Test Cell was used as a coil winding facility, where the magnetic coils were wound with copper coils, taped, and cured with an epoxy for the National Compact Stellarator Experiment (NCSX). In May 2008, when the DOE Office of Science halted NCSX construction, PPPL's staff decommissioned the experiment. All the fabricated parts of the NCSX are stored in a test cell area on C-site that would have housed the experiment.

LTX continues to explore new paths for plasma energy efficiency and sustainability. The primary goal of LTX is to investigate the properties of a lithium liquid coating for plasma surfaces or plasma-facing component (PFC). The previous experiment, Current Drive Experiment-Upgrade (CDX-U) held the lithium in a circular tray at the base of the vacuum vessel. In LTX, liquid lithium is evaporated and deposited a thin layer inside the vacuum vessel and kept liquid by heater in the shell.

1.5 Relevant Demographic Information

A demographic study of the surrounding 31.1 miles (50 kilometers) was completed in 1987 as part of the environmental assessment for the proposed Burning Plasma Experiment (BPX), which was also known as Compact Ignition Tokamak (CIT) [Be87a]. From the 2012 US Census Bureau Statistics, Middlesex County has a population of 823,041; adjacent counties of Mercer, Monmouth, Somerset, and Union have populations of 368,303, 629,384, 327,707, and, 543,976 respectively [US12]. Other information gathered and updated from previous ITER studies include socioeconomic information [Be87b] and an ecological survey, which were studies describing pre-TFTR conditions [En87]. ✲

Chapter

2

2012 COMPLIANCE SUMMARY and COMMUNITY INVOLVEMENT

Princeton Plasma Physics Laboratory's (PPPL) environmental goals are to fully comply with applicable state, federal, and local environmental regulations and to conduct our scientific research and operate the Laboratory facilities in a manner that protects and preserves human health and the environment. PPPL initiates actions which enhance and document compliance with these requirements. Compliance with applicable federal, state, and local environmental statutes or regulations, and Executive or DOE Orders is an important piece of PPPL's primary mission.

2.1 Laws and Regulations

Exhibit 2.1 summarizes the environmental statutes and regulations applicable to PPPL's activities, as well as summarizing the 2012 compliance status and providing the ASER sections where further details are located. The list of "Applicable Environmental Laws and Regulations – 2012 Status" conforms to PPPL's Environmental Management System (EMS) Appendix B, "Summary of Legal and Other Requirements" [PPPL13a].

2.2 Site Compliance and Environmental Management System (EMS) Assessments

In 2012, PPPL's Quality Assurance (QA) Division performed six (6) audits of which two (2) involved environmental topics: 1) the Radiological Protection Program and 2**)** PPPL's Environmental, Management System (EMS) against the International Organization for Standards (ISO) 14001:2004 requirements. Each audit includes records examination and requirements compliance and is tracked through PPPL's internal QA Audit Database [Ya13].

In November 2012, UL-DQS, Inc. conducted an annual surveillance audit of PPPL's EMS against ISO standard 14001:2004 – "Environmental Management Systems – Requirements with guidance for use." One minor non-conformance, nine opportunities for improvement and five strengths were noted. The auditors recommended continued registration of PPPL's EMS.

Exhibit 2-1. Applicable Environmental Laws and Regulations – 2012 Status

Regulatory program description	2012 Status	ASER section(s)
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) provides the regulatory framework for identification, assessment, and if needed remediation of contaminated sites – either recent or inactive releases of hazardous waste.	The CERCLA inventory completed in 1993 [Dy93] warranted no further CERCLA actions. During 2012, PPPL had no involvement with CERCLA-mandated clean-up actions. A New Jersey-regulated ground water investigation and remediation project is discussed in ASER Chapters 4 and 6.	*4.3.1 B* *6.5*
Resource Conservation and Recovery Act (RCRA) regulates the generation, storage, treatment, and disposal of hazardous wastes. RCRA also includes underground storage tanks containing petroleum and hazardous substances, universal waste, and recyclable used oil. (NJ-delegated program)	In 2012, PPPL shipped 6.25 tons (5.67 metric tons, MT) of hazardous waste of which 2.155tons (1.96 MT) were recycled (34.5% recycling rate). The types of waste are highly variable each year; in 2012, majority of incinerated quantities came from sulfuric acid, used oil, and flammable liquids [Pue13].	*4.2.1 C* *4.2.1 D*
Federal Facility Compliance Act (FFCA) requires the Department of Energy (DOE) to prepare "Site Treatment Plans" for the treatment of mixed waste, which is waste containing both hazardous and radioactive components.	In 1995, PPPL prepared a Preliminary Site Treatment Plan (PSTP). PPPL does not generate mixed waste nor has any future plans to generate mixed waste. An agreement among the regulators was reached to treat in the accumulation container any potential mixed waste [PPPL95].	
National Environmental Policy Act (NEPA) covers how federal actions may impact the environment and an examination of alternatives to those actions	In 2012, PPPL reviewed 21 activities. All of these activities were determined to be categorical exclusions (CXs) in accordance with the NEPA regulations/guidelines of the Council on Environmental Quality (CEQ) [Stra13].	
Toxic Substance Control Act (TSCA) governs the manufacture, use, and distribution of regulated chemicals listed.	In 2012, PPPL shipped 177 pounds of PCB TSCA Substances waste. Five PCB capacitors remain on-site. PPPL disposed of 40 cubic yards of asbestos waste in 2012 [Pue13].	*4.2.1B*
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulates the user and application of insecticides, fungicides, and rodenticides. (NJ-delegated program)	PPPL used limited quantities of insecticides, herbicides, and fertilizers. A certified subcontractor performs the application under the direction of PPPL's Facilities personnel [Kin13b].	*Exhibit 4- 11* *4.5.3*

Exhibit 2-1. Applicable Environmental Laws and Regulations – 2012 Status (continued)

Regulatory program description	2012 Status	ASER section(s)
Oil Pollution Prevention provides the regulatory requirements for a Spill Prevention Control and Countermeasure (SPCC) Plan for petroleum containing storage tanks and equipment.	The SPCC plan was reviewed and updated in 2011. PPPL does not meet the threshold quantity of 200,000 gallons of petroleum (excluding transformer oil) for the requirements of a Discharge Prevention Control and Containment (DPCC) plan. PPPL experienced three minor reportable spills, which were cleaned up [PPPL11b].	*4.3.2*
National Historic Preservation Act (NHPA) and New Jersey Register of Historic Places protect the nation and New Jersey's historical resources through a comprehensive historic preservation policy.	Due to the location of the pump house next to the Delaware & Raritan Canal, the Canal and the area within 100 yards are listed on both the federal and state register of historic sites [PPPL05].	
Floodplain Management Programs covers the delineation of the 100- and 500-year floodplain and prevention of development within the floodplain zones. (NJ-delegated program).	The 100- and 500-year floodplains are located at 80 and 85 feet above mean sea level (msl), respectively. The majority of the PPPL site is located at 100 ft. above msl; only HAZMAT building is in the flood hazard zone, but is protected by dikes [NJDEP84].	
Wetlands Protection Act governs the activities that are allowable through the permitting system and mitigation requirements. (NJ-delegated program).	In 2008, PPPL and Princeton Forrestal Center received the wetlands delineation from NJDEP. Any regulated activities either in the wetlands or transition areas must receive approve prior to commencement [PPPL08c].	*4.5.1*
Clean Air Act (CAA) and New Jersey Air Pollution Control Act controls the release of air pollutants through permit and air quality limits and conditions. USEPA regulates the National Emission Standards for Hazardous Air Pollutants (NESHAPs) for tritium (an airborne radionuclide) and boilers (<10 million BTUs). Greenhouse gas (GHG) emissions inventory tracking and reporting are regulated by EPA.	PPPL-DOE maintain air certificates/permits for the regulated equipment: 4 boilers, 3 emergency/standby generators, 2 dust collectors, 2 above-ground storage tanks (< 10,000 gals. fuel oil) and a fluorescent bulb crusher. PPPL is designated as a synthetic minor and does not exceed any air contaminant thresholds requiring a Title V permit. Submitted Subpart JJJJJJ Notification to EPA - biennial boiler adjustment. Annual boiler adjustment results were submitted to NJDEP in 2012 as required by the permit. Fuel consumption and sulfur content for the generators and boilers are recorded and annual boiler emissions are calculated. The NESHAPs report for tritium emissions is submitted annually [PPPL12g]. PPPL maintains an inventory for ozone-depleting substances (ODS) and greenhouse gas (GHG) emissions [Ne12].	*4.4*

Exhibit 2-1. Applicable Environmental Laws and Regulations – 2012 Status (continued)

Regulatory program description	2012 Status	ASER section(s)
NJ Safe Drinking Water Act (SDWA) protects the public water supply by criteria standards and monitoring requirements.	PPPL conducts quarterly inspections of the potable water cross connection system as required by the NJDEP permit. Potable water is supplied by NJ American Water Company [Pin13].	*4.1.4 A* *Exhibit 4-4*
NJ Emergency Planning and Community Right-to-Know Act, also referred to as the Superfund Amendment Reauthorization Act (SARA Title III) requires for certain toxic chemicals emergency planning information, hazardous chemical inventories, and the reporting of environmental releases to federal, state, and local authorities.	PPPL-DOE submitted annual chemical inventory reports to local health and emergency services departments for 2012 [PPPL13b].	*4.3.1 C* *Exhibit 4-8* *Exhibit 4-9*
NJ Endangered Species Act prohibits activities that may harm the existence of listed threatened or endangered species.	No endangered species reported on PPPL or D&R Canal pump house sites. Cooper's hawks and Bald eagles have been sited within 1 mile [Am98, NJB97, NJDEP97, PPPL05].	
NJ Soil Erosion and Sediment Control (SESC) Plan requires an approval by the Freehold Soil Conservation District for any soil disturbance greater than 5,000 sq. feet.	PPPL submitted and received SESC plan approval for the D-site parking lot native vegetation planting and installation of rain gardens [PPPL09d]. Rain gardens were planted; native grasses/vegetation partially completed.	*4. 5.2*
NJ Comprehensive Regulated Medical Waste Management governs the proper disposal of medical wastes.	Last report submitted to NJDEP in 2004; no longer required to submit report, but continues to comply with proper disposal of all medical wastes [Pue13].	
NJ Regulations Governing Laboratory Certification and Environmental Measurements mandate that all required water analyses be performed by certified laboratories.	PPPL's Princeton Environmental, Analytical, and Radiological Laboratory (PEARL) continued analyze immediately parameters; PPPL received acceptable for all performance tests for pH, total residual chlorine (Chlorine-produced oxidants- CPO) and conductivity. PPPL subcontractor analytical laboratory is a NJDEP certified laboratory.	*7*
Clean Water Act (CWA) and NJ Pollution Discharge Elimination System (NJPDES) regulates surface and groundwater (lined surface impoundment, LSI) quality by permit requirements and monitoring point source discharges.	In 2012, PPPL-DOE received from NJDEP the draft NJPDES surface water discharge permit; comments were submitted [PPPL12d]. PPPL reported one (1) non-compliance at DSN001, the basin outfall [PPPL12e]. An elevated CPO concentration was due potable water discharged from the cooling tower due to a valve failure. LSI was compliant.	*4.1.1* *Exhibits 4-1, 4-2, 4-3 and 4-5*

Exhibit 2-1 Applicable Environmental Laws and Regulations – 2012 Status (continued)

Regulatory program description	2012 Status	ASER section(s)
NJ Technical Standards for Site Remediation governs the soil/ground water assessments, remedial investigations, and clean-up actions for sites suspected of hazardous substance contamination.	In 1990, ground water monitoring of volatile organic compounds (VOCs) began at PPPL. Over time, more than 20 monitoring wells were installed on-site to determine contamination source and extent of the plume. Quarterly sampling of 9 wells and 1 sump is collected, and annual sampling of 12 wells, 2 sumps and 1 surface water site is collected in September with the results reported annually to NJDEP [PPPL12a].	*6.5* *Exhibits 6-2 through 6-9*
DOE Order 231.1B, ***Environment, Safety, and Health Reporting,*** requires the timely collection, analysis, reporting, and distribution of information in ES&H issues.	PPPL ES&H Department monitors/reports on environmental, safety and health data and distributes the information *via* lab-wide e-mails, PPPL news articles, at weekly Laboratory Management, DOE-Site Office, and staff meetings and at periodic ES&H Executive Board/sub-committees/Lab-wide meetings [DOE12]. PPPL's Annual Site Environmental Report (ASER) is required by this order.	*2.6.*
DOE Order 435.1, Change 1, ***Radioactive Waste Management*****,** provides guidance to ensure that DOE radioactive waste is properly managed to protect workers, the public and the environment.	PPPL developed a new Low-Level Radioactive Waste Program Basis document to meet the requirements of DOE Order 435.1 and enable shipments to the Energy Solutions disposal facility in Clive, UT. Approval was granted by DOE in July 2012. [DOE01, PPPL12e].	*5.1.3* *Exhibit 5-5*
DOE Order 436.1, ***Departmental Sustainability*****,** requires all applicable DOE elements to implement an ISO14001-compliant Environmental Management System and support departmental sustainability goals.	PPPL's Environmental Management System (EMS) was prepared in 2005 and is reviewed and updated annually [DOE11a, PPPL11d,12h]. PPPL's EMS is registered to the ISO14001 standard by an independent registrar (UL-DQS) based on annual audits.	*3*
DOE Order 458.1, ***Radiation Protection*****,** provides protection of the public and the environment from exposure to radiation from any DOE facility. Operations and its contractors comply with standards and requirements in this Order.	PPPL's policy is to maintain all radiation exposures "As Low as Reasonably Achievable" (ALARA). PPPL implements its radiation protection program as discussed in the Environmental Monitoring Plan Section 6, "Radiological Monitoring Plan." PPPL's contribution to radiation exposure is well below the DOE and PPPL limits [10CFR835, DOE01, DOE11b, PPPL07, 09b, 09c ,09f,10b & 11a].	*5.1* *Exhibit 5-1*

Exhibit 2-1. Applicable Environmental Laws and Regulations – 2012 Status (continued)

Regulatory program description	2012 Status	ASER section(s)
Atomic Energy Act (AEA) governs plans for the control of radioactive materials	PPPL's "Nuclear Materials Control and Accountability (MC&A) Plan" describes the control and accountability system of nuclear material at PPPL. This plan provides a system of checks and balances to prevent/detect unauthorized use or removal of nuclear material from PPPL [PPPL08b].	*5.2*
Executive Order (EO) 13423, ***Strengthening Federal Environment, Energy, and Transportation Management,*** requires all federal agencies to improve energy efficiency, reduce vehicle petroleum use, increase use of non-petroleum fuel in vehicles, purchase energy from renewable sources, conserve water, improve waste minimization, purchase sustainable products, implement a environmental management system . **and**	PPPL prepared *the FY2013 Site Sustainable Plan* that addressed the goals, targets and status of EOs 13423 and 13514 requirements [EO09 & PPPL12h].	*3*
Executive Order 13514 , ***Federal Leadership in Environmental, Energy, and Economic Performance,*** requires the establishment of goals and targets for the reduction of greenhouse gases (GHGs), improve water use efficiency, promote pollution prevention, advance regional and local planning, implement high performance sustainable building design, construction, M&O, and deconstruction, advance sustainable acquisition, promote electronic stewardship, and sustain environmental management systems.	See above.	*3*

2.3 External Oversight and Assessments

In January 2012, NJDEP Central Region Office, Water Compliance & Enforcement, audited PPPL's New Jersey Pollution Discharge Elimination System (NJPDES) permit requirements for retention basin outfall (DSN001) and the Delaware & Raritan (D&R) Canal pump house filter backwash outfall (DSN003). PPPL monitors these outfalls each month for conventional pollutants, *e.g.*, total petroleum hydrocarbons, total residual chlorine, pH, temperature, *etc.* (Tables 17 & 18). Additional parameters are monitored and reported quarterly, semi-annually, and annually. No findings resulted from this audit. One recommendation was for PPPL to re-submit the NJ Stewardship Checklist, which is a voluntary program that documents a facility's environmental activities beyond compliance [PPPL12m].

For details on PPPL's ongoing Environmental Management System audits and assessments, see Section 2.2 of this Chapter and Chapter 3 of this report [PPPL11h].

2.4 Emergency Reporting of Spills and Releases

Under New Jersey regulations, PPPL is required to call the Action Hotline to report any permit limits that are exceeded. Three releases of hazardous substances or petroleum hydrocarbons on pervious surfaces required notification to New Jersey's Action Hotline during 2012. In August, a subcontractor's JLG man-lift leaked approximately 1 pint or less of hydraulic fluid on the ground. The man-lift was leaking fluid onto the roadway and gravel; a cleanup was conducted immediately by PPPL personnel. Impacted soil/gravel was placed in drums and the surrounding soil tested for hydrocarbons [PPPL12b].

In September, PPPL's air conditioner unit on D-site leaked 4 oz. of refrigerant onto the gravel while the unit was being removed. A cleanup was conducted immediately by PPPL personnel. Impacted soil/gravel was placed in drums and the surrounding soil tested for hydrocarbons [PPPL12c].

In December 2012, an unknown quantity of an unknown petroleum product was found spilled on unpaved roadway. A cleanup was conducted immediately by PPPL personnel. Soil/gravel was placed in drums which were removed and the surrounding soil tested for hydrocarbons [PPPL12d].

2.5 Notice of Violations and Penalties

There were no notices of violations or penalties for environmental occurrences at PPPL during 2012.

2.6 Community Involvement

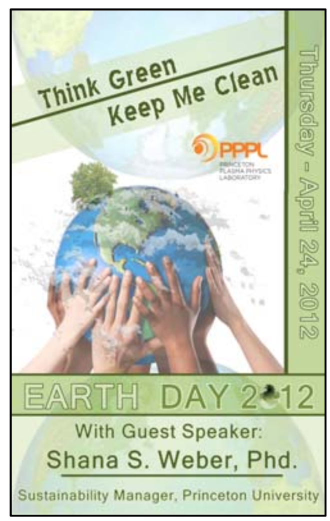
2.6.1 Earth Week and American Recycles Day at PPPL – 2012

"Think Green, Keep Me Clean" was the theme of PPPL's 2012 Earth Week celebration (Exhibit 2-2). On April 24th, PPPL employees and members of the public were invited to participate in viewing displays on sustainable renovations and projects: Princeton University's Sustainability Group, Stony Brook-Millstone Watershed Association, Mercer County Improvement Authority, Stony Brook-Millstone Watershed Association, and PPPL's subcontractor office supply, janitorial supply, cafeteria, sustainable furniture supply, and waste removal companies. PPPL's electronic recycling vendor provided recycling for employees' personal e-waste.

The colloquium speaker, Dr. Shana Weber, Sustainability Manager at Princeton University, presented "Sustainable Princeton."

Each year, employees are asked to nominate their co-workers for their exceptional efforts to minimize waste, improve energy efficiency, and promote sustainable practices at PPPL. There were twenty-nine employees who received the 2011 PPPL Green Machine Awards for the following projects:

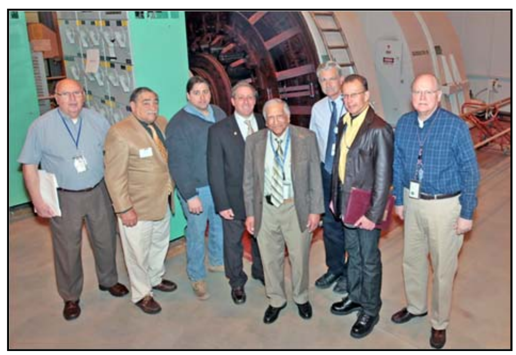
Exhibit 2-2. PPPL's Earth Week Poster



- Recycled metals from C-site motor generator removal, netting over $1 million.
- Educating staff about recycling and how to keep recyclables out of the trash – 57% office waste was recycled.
- Installed a new phone system saving $2K in energy costs.
- Conversion of emergency vehicles to biofuels.
- Acquired a used diesel generator and tank from GSA at a cost-saving to PPPL.
- Developed Bicycle Safety training for on-site Security rounds, reducing the use of powered-vehicles.

On November 15, 2012, PPPL's Green Team, volunteers who promote recycling within their Departments, hosted the America Recycles Day (ARD) program that highlighted the food waste composting efforts. Employees were able to recycle old personal electronics through PPPL's subcontractor, Unicor, who collected those items on ARD. PPPL employees received non-PBA water bottles to promote the use of reusable bottles instead of purchasing bottled water.

Exhibit 2-3. PPPL's Earth Week Green Machine Recipients and America Recycles Day Theme



The photos above are PPPL's 2012 Earth Week Green Machine Recipients: from upper left corner- Bicycle Safety trainers, biofuel emergency vehicles, new telephone system, 'new" reused diesel generator, American Recycles Day poster (center), PPPL's janitorial staff, motor generator (MG) recycling project participants (2 large group photos).

2.6.2 PPPL Participates in the Energy-Efficient Building (EEB) Hub Program, Mentoring Students and Outreach Programs

In 2011, The Department of Energy established the Greater Philadelphia Innovation Cluster Hub (GPIC HUB), now known as the Energy Efficient Buildings Hub (EEB Hub). Organized as an aggregation of building professionals, the hub's mission is to promote deep energy retrofits of commercial buildings in the Greater Philadelphia region, in order to reduce energy consumption from commercial buildings by 20%. In 2012, PPPL participated in multiple EEB Hub projects.

In conjunction with Princeton University's Environmental Engineering Department, PPPL was tasked with studying the potential of roof retrofits (Exhibit 2-4). Using the lab as a test site, analysis of commercial white and black flat roofs at various insulation values was conducted to select which roof characteristic provides the best energy efficiency option for the climatic region. This research, began in the summer of 2012, addressed the thermal conductivity of the various roofing material on cooling degree days. Knowledge of the thermal conductivity will help to recognize which roofing option will decrease the cooling load of commercial buildings for the Greater Philadelphia area resulting in a decrease in energy consumption. Further analysis followed in the colder months that address heating degree days in the climatic region and the best roofing characteristic combination. This year-long study at PPPL will provide sufficient data for analysis.

PPPL hosted a series of occupant behavior studies on site that explore the correlation between occupant behavior, energy efficiency, human health and well-being, and the indoor environment. Organized by Penn State University, Carnegie Melon University, and Rutgers University, the projects include office energy load reduction dashboard and game, load shedding study, automated lighting control study, and automated window blind study. The goal of this sub task is to implement strategies to reduce occupant's energy use without negatively impacting occupant's behavior mood, health, and productivity. Further analysis will prove, or disprove, the usefulness of the implemented technology.

In 2012 PPPL mentored two Monmouth University students and one local high school student with assisting in EEB Hub Activities. Throughout their summer they assisted with "Energy Chickens" study conducted by Penn State researchers and data collection to support the roofing retrofit study. Along with helping with light field work and shadowing Environmental Services employees, the students each presented their own projects in a lab wide intern poster session. Outreach to a local middle school involved sharing composting experience and helping the "Outdoor Learning Center" construct their school compost bin for future use for experiments and their on-site cafeteria scraps.

Exhibit 2-4. Meteorological Station on LSB Roof

Chapter

3

ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

PPPL has been successful in meeting the sustainability goals established by Executive Orders (EO) 13423 and 13514 and DOE Order 436.1 by integrating these goals into its site-wide Environmental Management System (EMS). Since 2005, PPPL has focused on improving the sustainability of Laboratory operations and improving environmental performance. "Sustainable PPPL" is a program that capitalizes on PPPL's existing EMS to move the Laboratory toward more sustainable operations. The EMS includes energy management, water conservation, renewable energy, greenhouse gas management, waste minimization, environmentally preferable purchasing, and facility operation programs to reduce environmental impacts and improve performance [PPPL12i]. PPPL continues to proactively implement sustainability practices aimed at meeting, or exceeding, the sustainability goals in its EMS, DOE Orders and Executive Orders [EO08, 09].

In 2012, PPPL's Environmental Management System was formally registered having met the International Standard Organization ISO-14001:2004 requirements. The first annual surveillance audit, required to maintain ISO 14001:2004 certification, was completed in November 2012.

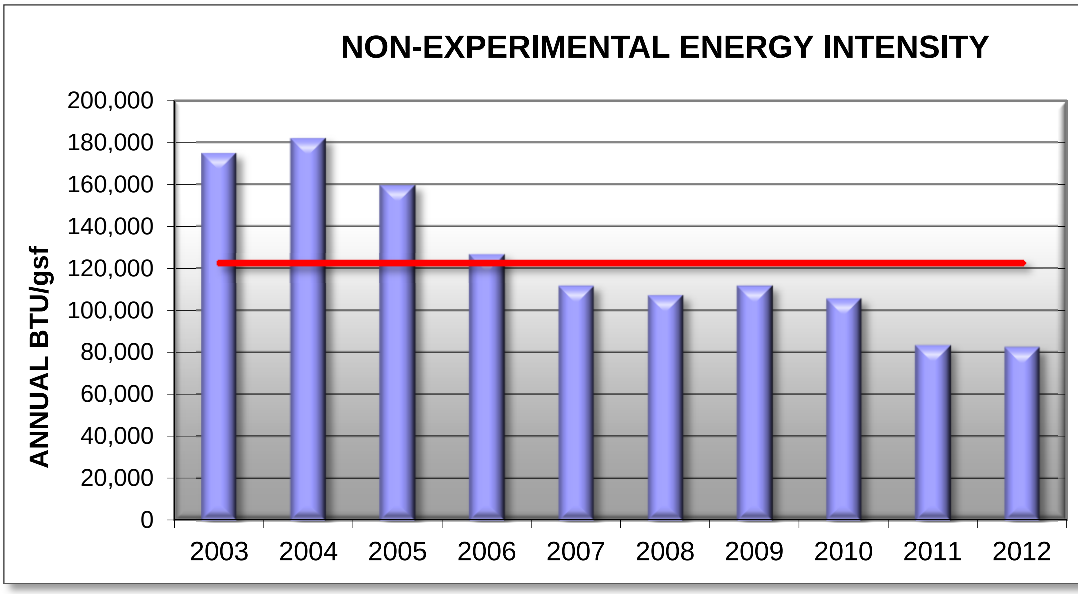
3.1 DOE Sustainability Goals

In 2012, PPPL continued to address the aggressive new sustainability and greenhouse gas management goals of EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*. PPPL completed its third annual *Site Sustainability Plan,* which summarized progress and outlined future plans for meeting the departmental sustainability goals under EOs 13423 and 13514, and submitted the Pollution Prevention Tracking System Report (PPTRS) that contained the following data [PPPL12f & 12h].

3.1.1 Energy Efficiency

In 2012, PPPL achieved a reduction of 52.8% in energy intensity (British Thermal Unit per gross square feet, BTU/gsf) for non-experimental energy use compared to the 2003 baseline year (see Exhibit 3-1). This means that PPPL's non-experimental buildings currently use less than half of the energy used in 2003. This was achieved through building automation, energy conservation measures, and equipment upgrades.

Exhibit 3-1. Annual Non-Experimental Energy Intensity in BTU/gsf
(Red line indicates the Federal energy efficiency goal set for 2015)



PPPL continues to emphasize energy management as part of its facility operations and continues to leverage the success in non-experimental energy management to improve experimental efficiency. For example, PPPL continues to carefully manage its central steam and chilled water plant to maximize efficiency and minimize greenhouse gas emissions. PPPL has standardized on high-efficiency light-emitting diode (LED) lighting for all office renovations and continues to evaluate and implement other energy efficiency projects.

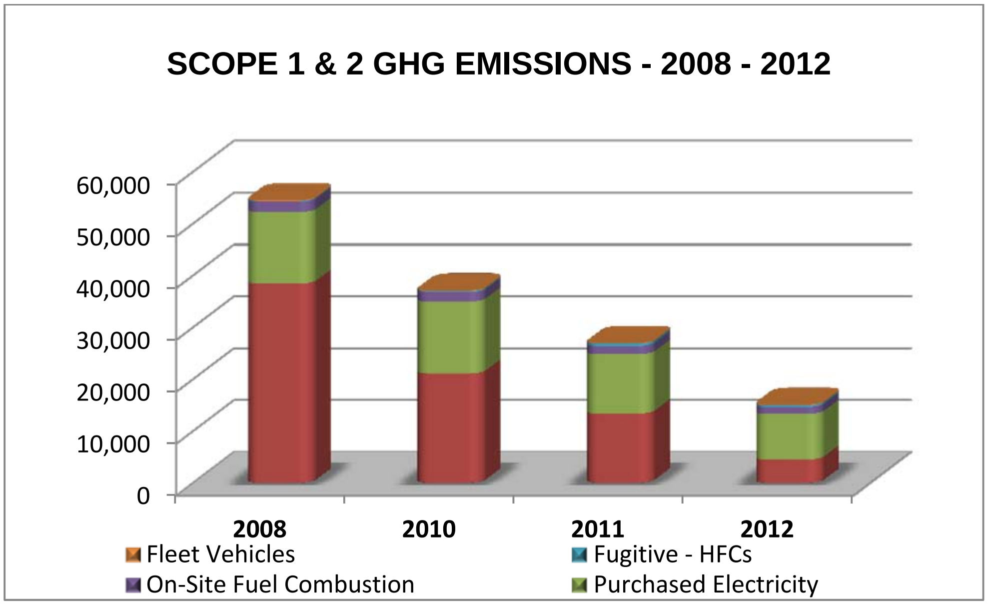
3.1.2 Renewable Energy

PPPL and DOE-PSO pursued an on-site solar renewable energy generation project for as much as 40% of non-experimental energy use over the course of three years. The Energy Savings Performance Contract (ESPC) proposal received in FY08 was not successful due to the need for significant up-front investment by DOE. PSO and PPPL then pursued a long-term Power Purchase Agreement (PPA) through the Defense Energy Supply Center (DESC). After more than a year of bidding and negotiations, DESC, PSO, PPPL and the vendor were unable to develop a financially viable project. The ESPC and PPA processes at PPPL identified several significant statutory and management barriers to the cost-effective development of renewable power projects at DOE sites. PPPL will continue to pursue cost-effective renewable energy project opportunities within the context of the DOE Office of Science's portfolio approach to the EO13514 sustainability goals.

3.1.3 Greenhouse Gas Emissions

Between 2008 and 2012, PPPL reduced its Scope 1 and 2 greenhouse gas (GHG) emissions by 72%. This significant reduction in GHG emissions, achieved in only three years, is largely due to the focused efforts to control fugitive losses of sulfur hexafluoride (SF_6) and reduced emissions from on-site combustion of fuel through improved boiler operations, boiler control upgrade projects and the use of natural gas as the primary fuel over fuel oil. Sulfur hexafluoride is a potent GHG that is a highly effective high voltage insulator (see Exhibit 3-2).

Exhibit 3-2. Summary of PPPL Scope 1 & 2 GHG Emissions between 2008 and 2012



3.1.4 Fleet Management

In 2012, PPPL's fleet petroleum fuel use was 67% below 2005 levels (see Exhibit 3-3). In addition, alternative fleet fuel consumption in 2012 was nearly 13 times higher than the levels in 2005, representing approximately 38% of PPPL's total covered fleet fuel use (see Exhibit 3-4).

Exhibit 3-3. Annual Non-Exempt Fleet Petroleum Fuel Use between 2005 and 2012

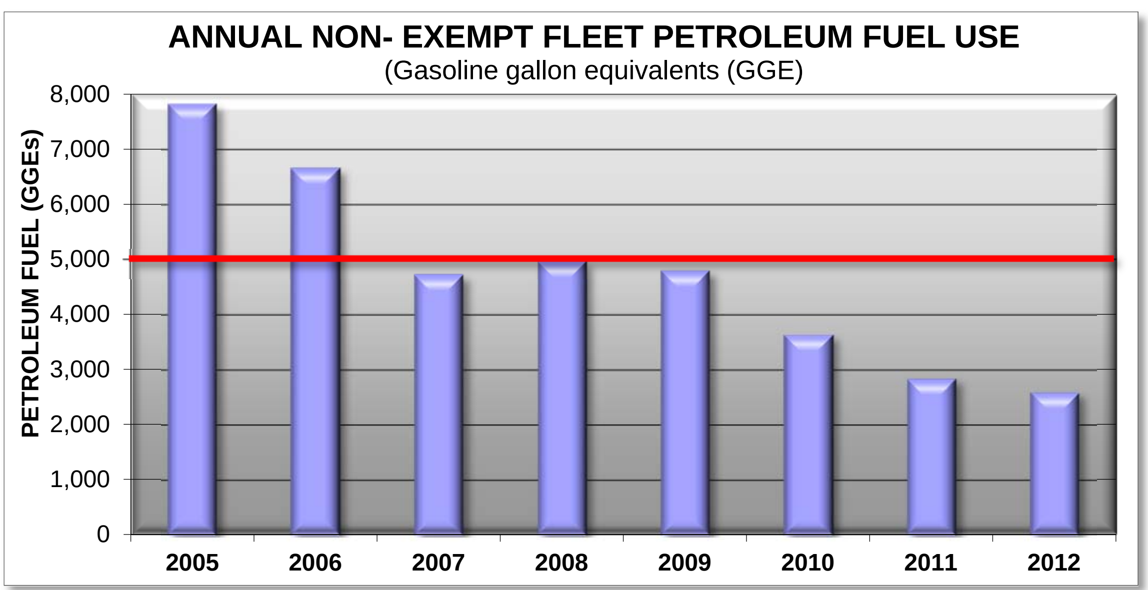
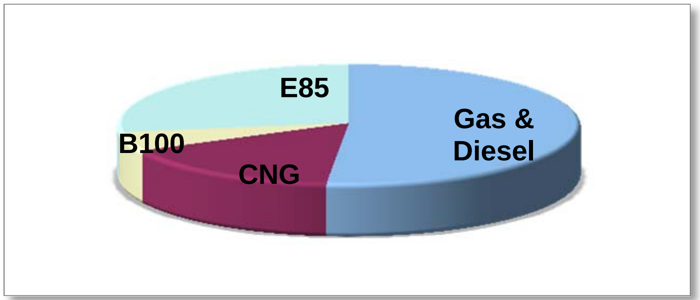


Exhibit 3-4. FY2012 Non-Exempt Fleet Fuel Use by Type

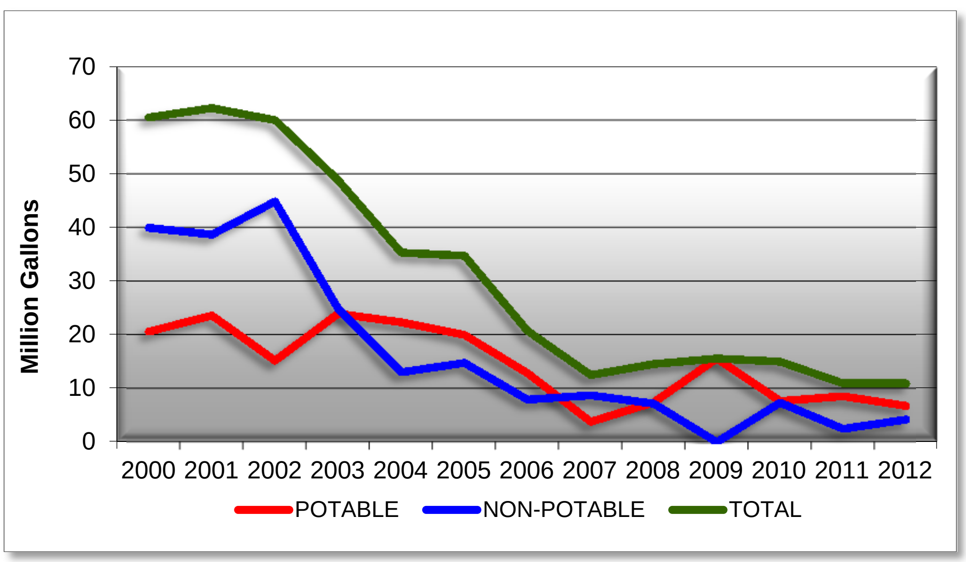


PPPL continues to exceed the goal for 75% acquisition of alternative fuel vehicle (AFV) for light duty vehicles by FY2015. PPPL specifies only AFVs as replacement lease vehicles through the GSA whenever a suitable AFV is available. PPPL's fleet includes gasoline-electric hybrid vehicles, alternative fuel vehicles - Ethanol 85% (E85) or biodiesel 20% (B20) - and petroleum-fueled (gasoline & diesel) vehicles. In addition to the use of alternative fuels in its covered fleet vehicles, PPPL uses B20 in several pieces of heavy-mobile equipment, including a 15-ton forklift, backhoe, and skid steer loader. PPPL's fleet of John Deere Gator® vehicles run exclusively on B20. Following B20 pilot testing in FY2007 and 2008, PPPL expanded its on-site fleet refueling station to support the storage and dispensing of E85 and B20 fuels in addition to the existing compressed natural gas (CNG) vehicle fueling system.

3.1.5 Water Efficiency

PPPL has made significant progress in reducing its use of both potable and non-potable water in recent years achieving an overall water use reduction of approximately 82% between 2000 and 2012 (see Exhibit 3-5). PPPL continues to pursue water conservation pilot projects and to identify new opportunities for water conservation. Given the reductions already achieved additional savings may be incremental over a number of years, as the largest water efficiency opportunities have likely already been addressed.

Exhibit 3-5. PPPL Annual Water Use from 2000 to 2012



3.2 Energy Efficient "Green" Buildings

The Lyman Spitzer Building (LSB), PPPL's main office building was awarded LEED®-Gold certification by the U.S. Green Building Council in April 2011 for meeting the rigorous Leadership in Energy and Environmental Design – Existing Buildings Operations & Maintenance (LEED®-EBOM) standard. The LSB represents approximately 16% of the current building space and certification of this building to the LEED®-EBOM standard is a major step toward the goal of having at least 15% of buildings meeting the Guiding Principles for High Performance and Sustainable Buildings.

In 2012, PPPL installed over 40,000 square feet of energy efficient (R-30) light-colored "cool roofs." Over 17% of PPPL' total roof area is now energy-efficient "cool" roofing. Light-colored roofs absorb much less energy than traditional black roofing materials. In conjunction with this facilities improvement project, PPPL is collaborating with Princeton University and other researchers on a large-scale study of the thermal performance of various roofing systems in a mid-latitude climate region. This study is expected to yield important "real-world" data that will enable more energy efficient roofing designs.

A tabular summary of PPPL's performance against the comprehensive sustainability goals of EO 13514 and the applicable DOE Orders is presented in Exhibit 3-6.

3.3 Sustainability Awards

Over the years PPPL has demonstrated its commitment to sustainability through its environmental stewardship programs. PPPL is frequently consulted by DOE Laboratories and other organizations for advice and experience in sustainable environmental performance. In 2012, PPPL received a DOE Sustainability Award for its comprehensive greenhouse gas management strategy. PPPL also received a Silver Award from the Federal Electronics Challenge – up from a Bronze award in 2011. PPPL was also recognized by EPA's WasteWise program for its lifecycle electronics management and electronic waste reduction efforts with a WasteWise Gold Achievement Award. Finally, PPPL was one of nine DOE sites to be recognized in the new DOE GreenBuy program with a Gold Award – the program's highest award level. The GreenBuy program promotes the purchase of environmentally preferable products targeted by DOE.

Exhibit 3-6. 2012 DOE Sustainability Goal Summary Table for PPPL

Goal Number		DOE Goal	Performance Status	Planned Actions & Contribution
Goal #1		**28% Scope 1 & 2 GHG Reduction by FY 2010 from a FY 2008 baseline**	**EXCEEDED** 72% reduction from FY2008 baseline.	Continue to focus on SF_6 emissions, purchased electricity, and on-site fuel use.
	1.1	Energy Intensity Reduction 30% by FY 2015 from FY 2003 baseline	**EXCEEDED** 53.2% reduction from FY2003 baseline.	Continue to emphasize energy efficiency; improve building energy performance.
	1.2	7.5% of annual electricity consumption from renewable sources by FY 2013 and thereafter (5% FY 2010 – 2012)	**MET** FY2012 REC purchases: 1,700 MWh	ESPC and PPA were not financially viable. Continue to explore other renewable energy options and integration of renewable energy into new building construction project.
	1.3	SF_6 Reduction	**EXCEEDED** SF6 emissions down by 88.4% from FY2008.	Continue to focus on fugitive SF_6 emissions in plans for NSTX-U operations.
	1.4	Individual buildings metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (recommended) (by October 1, 2015.)	**MET** 6 buildings are separately metered.	Additional sub-metering as cost-effective and programmatically appropriate.
	1.5	Cool roofs, unless uneconomical, for roof replacements unless project already has CD-2 approval. New roofs must have thermal resistance of at least R-30.	**MET** 17% of roofing is cool roofs. 3 new cool roofs installed in FY2012.	R-30 is standard for roof installation and replacement.
	1.6	Training	**MET** Certified Energy Manager.	Continue sustainability education efforts include energy efficiency .
	1.7	Net Zero energy in new or major renovation facilities	**AT RISK**	Current plans do not include net zero buildings due to funding limitations .
	1.8	Evaluate 25% of 75% of Facility Energy Use over 4-Year Cycle	**MET**	All buildings evaluated in FY09. Every building is evaluated at least once every 4 years. PPPL's new cycle starts FY13.
	1.9	13% Scope 3 GHG energy intensity reduction by FY 2020 from a FY 2008 baseline	**ON TARGET**	Renewed emphasis on business travel and employee commuting

Goal Number		DOE Goal	Performance Status	Planned Actions & Contribution
Goal #2	**Buildings HPSB, ESPC Initiative, Regional and Local Planning**			
	2.1.a	15% of existing buildings greater than 5,000 gross square feet (gsf) are compliant with Guiding Principles (GPs) for HPSB by FY 2015	**ON TARGET** LSB is LEED-Gold certified. Other buildings in progress.	Four additional buildings are currently being assessed against the Guiding Principles for Sustainable Existing Buildings.
	2.1.b	All new construction, major renovations, and alterations of buildings greater than 5,000 gsf must comply with GPs	**ON TARGET**	Planned new Science and Technology Center will comply with GPs.
	2.2	ESPC Initiative	**MET**	Previous ESPC proposals were not viable. No new ESPCs planned.
	2.3	Regional & Local Planning	**MET**	PPPL site development included in James Forrestal Center Master Plan.
Goal #3	**Fleet Management**			
	3.1	10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline	**EXCEEDED** Alternative fuel use of 84 times higher than FY2005.	Continue acquiring AFVs and supporting E85, and B20 vehicles. Goal 3.4 may impact future performance.
	3.2	2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline	**EXCEEDED** Petroleum fuel use down by 67% from FY2005.	Continue acquiring AFVs and supporting E85, and B20 vehicles. Goal 3.4 may impact future performance.
	3.3	75% of light duty vehicle purchases must consist of alternative fuel vehicles (AFV) by FY 2000 and thereafter	**EXCEEDED** 100% for FY2012.	Continue acquiring AFVs.
	3.4	Reduce fleet inventory by 35% by FY 2013 relative to a FY 2005 baseline	**MET**	Mission-critical vehicle needs are being re-evaluated.
Goal #4	**Water Use Efficiency and Management**			
	4.1	26% water intensity reduction by FY 2020 from a FY 2007 baseline	**ON TARGET** Total water used down by 21.6%. Significant water savings prior to FY2007.	Water conservation measures targeted for new building construction. Operational needs require flexible water use goals.
	4.2	20% water consumption reduction of industrial, landscaping, and agricultural (ILA) water by FY 2020 from a FY 2010 baseline	**MET** FY12 water use down by 35%. Significant water savings prior to FY2007.	Water conservation measures targeted new building construction. Operational needs require flexible water use goals.

Goal Number		DOE Goal	Performance Status	Planned Actions & Contribution
Goal #5	**Pollution Prevention and Waste Reduction**			
	5.1	Divert at least 50% of non-hazardous solid waste, excluding construction and demolition (C&D) debris, by FY 2015	**EXCEEDED** 69% of municipal solid waste (MSW) was recycled in FY12.	Continue to maximize waste diversion. Five year average MSW recycling rate is 56%.
	5.2	Divert at least 50% of construction and demolition materials and debris by FY 2015	**EXCEEDED** 80% of C&D was recycled in FY11.	Continue to maximize waste diversion. Five year average C&D recycling rate is 87.6%.
Goal #6	**Sustainable Acquisition**			
	6.1	Procurements meet sustainability requirements and include sustainable acquisition clause (95% each year)	**MET** 100% for FY2012.	Statement of Work procedure revised to include sustainable acquisition guidance.
Goal #7	**Electronic Stewardship and Data Centers**			
	7.1	All data centers are metered to measure a monthly Power Utilization Effectiveness (PUE) (100% by FY 2015)	**ON TARGET** PPLCC meters installed in FY2011.	PPL Computing Center (PPLCC) metering completed in FY2011. NSTX Computer Center (NSTXCC) meters to be installed by FY2015.
	7.2	Maximum annual weighted average (PUE) of 1.4 by FY 2015	**AT RISK** PPLCC current PUE is 4.5.	Additional energy efficiency opportunities for PPLCC are being evaluated. PUE baseline for NSTXCC will be established.
	7.3	Electronic Stewardship - 100% of eligible PCs, laptops, and monitors with power management actively implemented and in use by FY 2012	**ON TARGET**	Traditional power management has limited impact. Alternative power saving options being developed and implemented.
Goal #8	8.1	**Agency Innovation & Government-Wide Support**	**MET** Energy efficient buildings (EEB) Hub roofing, lighting and window projects.	Current projects will be ramping down in FY13.

Chapter

4

ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM INFORMATION

The following sections briefly describe PPPL's environmental programs required by federal, state, or local agencies. These programs were developed to comply with regulations governing air, water, waste water, soil, land use, and hazardous materials, as well as with DOE orders or programs.

4.1 Non-Radiological Water Programs

4.1.1 New Jersey Pollutant Discharge Elimination System (NJPDES) Program

A. Monthly Discharge Monitoring Reports (DMR)
In compliance with permit requirements of the New Jersey Pollutant Discharge Elimination System (NJPDES) permit, NJ0023922, PPPL and DOE-PSO submitted to NJDEP monthly discharge monitoring reports (DMRs) for Discharge Serial Number (DSN)—DSN001, retention basin outfall, and DSN003, Delaware & Raritan (D&R) Canal pump house filter backwash discharge (Tables 12, 17 & 18).

In 2006, PPPL received the final NJPDES permit with the effective date of February 1, 2006. In February of 2008 NJDEP issued a *Final Surface Water Minor Modification Permit Action* report [NJDEP08].

In July 2010, DOE and PPPL submitted to the NJDEP the renewal application for the NJPDES Surface Water Discharge permit, which was required 180 days prior to the permit expiration (February 1, 2011) [PPPL10c]. With the permit expiration in 2011, all permit requirements remain in effect until a new approved NJPDES permit is issued. During 2012, PPPL's discharges were within allowable limits for all tested parameters (Exhibit 4-1), with the exception of the following. All permit exceedance were reported to NJDEP within the allowable time frame.

- July 2, 2012 Chlorine-Produced Oxidants (CPO) 0.1 mg/L limit was exceeded at DSN001. Probable cause found was the potable water supply to the cooling tower was stuck in the open position thereby, overfilling the tower basin and discharging potable to the retention basin, which discharges at DSN001 [PPPL12e].

In September 2012, DOE-PSO and PPPL received the draft NJPDES permit from NJDEP. Comments were submitted addressing the use of 0.0 cubic feet per second (cfs) flow to calculate maximum daily loading limits for tetrachloroethylene and the addition of monitoring for metals at DSN001 and 003 and the chronic toxicity testing using *Ceriodaphnia dubia,* water flea [NJDEP12].

Exhibit 4-1. NJPDES Monthly Discharge Monitoring Report (DMR)

Parameter (1)	Location	Permit Limit	Loading	Frequency/ Type
Temperature º C	DSN001	30		Monthly / Grab
pH, S. U.	DSN001, DSN003	Min.: 6.0, Max.: 9.0		Monthly / Grab
Chemical Oxygen Demand (COD), mg/l	DSN001	50		Monthly / Grab
Total Suspended Solids (TSS), mg/l	DSN001 DSN003, C1	50 50		Monthly / Grab Monthly / Grab
Petroleum Hydrocarbons (TPHC), mg/l	DSN001 DSN003	Daily max: 10 Monthly avg: 10 Daily max: 15		Monthly / Grab
Flow, MGD	DSN001 DSN003	NA NA	✓	Monthly/ Flow Meter
Chlorine Produced Oxidants (CPO),mg/l	DSN001, DSN003	<0.1	✓	Monthly / Grab
Phosphorus, total mg/L (2)	DSN001	NA	✓	Monthly / Grab
Tetrachloroethylene (PCE), µg/L (3)	DSN001	0.703 µg/L	✓	Monthly / Grab
Total Organic Carbon, mg/L	DSN001, DSN003	NA		Monthly / Grab
Nitrogen, total, mg/L	DSN001	NA	✓	Quarterly
Biochemical Oxygen Demand (BOD), mg/L	DSN001	NA		Biannual
Total Suspended Solids (TDS), mg/L	DSN001	NA		Biannual

NA = Not applicable

Note: All samples reported in quality or concentration on monthly DMR

(1) *Methods for Chemical Analysis of Water and Wastes*, Environmental Monitoring and Support Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, March 1983, EPA-600 4-79-020 [EPA83].

(2) Phosphorus Evaluation Study will be included in the Raritan Watershed Study..

(3) Tetrachloroethylene (PCE) found in the retention basin outfall results from ground water from the building foundation drainage system. Additional basin aeration is expected to keep the discharge concentration of PCE at or below 0.7 µg/L.

Exhibit 4-2. NJPDES Reporting Requirements

Parameter	Location	Completed	Frequency/ Type
Acute Whole Effluent Toxicity	DSN003	March 20, 2010	4 – 4.5 Years
Chronic Toxicity (% Effluent)	DSN001	December 7, 2012	Annual
Waste Characterization Report (WCR)	DSN001	December 4, 2012	Annual
Waste Characterization Report (WCR)	DSN003	March 17, 2010	4 – 4.5 Years

B. Acute Toxicity Study

The Acute Biomonitoring Report for the water flea (*Ceriodaphnia dubia*) was completed on March 20, 2010 for DSN003. Samples were collected for the 48-hour acute toxicity survival test, required to be performed between 4 to 4.5 years after the effective date of the permit (Exhibit 4-

2). The toxicity test with *Ceriodaphnia dubia* resulted in an inhibition concentration (IC25) of >100 percent (statistically possible) no observable effect concentration (NOEC) [PPPL10a].

C. Chronic Whole Effluent Toxicity Study

Annual Chronic Whole Effluent toxicity testing for DSN001 was completed on December 7, 2012 (Exhibit 4-2). In all chronic toxicity tests, *Pimephales promelas* (fathead minnow) survival rate inhibition concentration (IC25), as defined by the NJ Surface Water Quality Standards, was IC25 >100 percent (statistically possible) no observable effect concentration (NOEC) [NJDEP08, PPPL12j].

D. Waste Characterization Report (WCR)

Waste Characterization Reports (WCR) are required by NJPDES Permit for monitoring effluent conditions. For DSN001 WCR reports are required annually, while DSN003 WCR reports are required once per permit cycle between 4 to 4.5 years after the effective date of the permit (EDP) [NJDEP08]. PPPL completed DSN001 Annual WCR on December 4, 2012 (Table 24) with only four metals found above the detection level: barium, copper, manganese and zinc [PPPL12k]. DSN003 was completed once per permit cycle on March 17, 2010 [PPPL10d].

4.1.2 Lined Surface Impoundment Permit (LSI)

PPPL complies with NJDEP Ground Water General Permit No. NJ0142051 and is permitted to operate Lined Surface Impoundment (LSI) Program Interest (P.I.) ID#:47029 dated February 26, 2009. LSI Permit operates on a 5-year permit cycle, expiring on February 28, 2014. The LSI Permit also authorizes PPPL to discharge from our lined retention basin outlet to surface water, Bee Brook in Plainsboro, NJ [NJDEP09]. An estimated total of 68.58 million gallons of water was discharged from the retention basin in 2012 [Fin12a].

Exhibit 4-3. PPPL Retention Basin, Flow Sensor, Discharge Gate

LSI permit requires inspection and maintenance of liner every three years. In April 2012, PPPL completed its annual basin cleaning and inspected and certified the liner by Professional Engineer (P.E.) for repairs and maintenance. Liner inspection was reported to the state during May 2012.

Water flowing through the retention basin includes site storm water, groundwater from building foundation drains, non-contact cooling water, and cooling tower and boiler blow down. PPPL operates and maintains all equipment associated with the retention basin including aerators, sonic algae control, oil sensors, oil boom, sump pump and flow meter (Exhibit 4-3). If oil is detected within the basin, an alarm signals the PPPL Emergency Communication Center and automatically closes the discharge valve. The ultrasonic flow meter measures flow from the basin is downloaded monthly for NJPDES Discharge Monitoring Report (DMR). The following maintenance activities were conducted in 2012:

- Basin cleaning, liner inspected & certified by PE in April
- Sump pump maintained and oil sensors replaced and calibrated

4.1.3 Ground Water

A. *NJPDES Ground Water Program*

No ground water monitoring is required by the LSI NJPDES Groundwater permit.

B. Regional Ground Water Monitoring Program

PPPL's Remedial Investigation and Remedial Action Selection Report (RI & RASR) was approved by NJDEP in 2000 [PPPL99b]. The Remedial Action Work Plan (RAWP) was approved NJDEP in June 2000 [PPPL00]. The process of natural attenuation by the indigenous bacteria and other *in-situ* processes are slowly degrading tetrachloroethylene or perchloroethylene (PCE) to its natural degradation products. The de-watering sumps located in the D-site MG and air shaft (formerly TFTR) basements draw ground water radially from the shallow aquifer, controlling ground water flow and preventing off-site contaminant migration. For details, see Chapter 6 "Site Hydrology, Ground Water, and Drinking Water Protection."

4.1.4 Metered Water

A. Drinking (Potable) Water

Potable water is supplied by the public utility, New Jersey American Water Company. PPPL used approximately 6.753 million gallons in 2012 (Exhibit 4-4) [Pin12]. PPPL uses potable water as a backup resource for fire protection.

Exhibit 4-4. PPPL Potable Water Use from NJ American Water Co. [Pin13]

CY	In million gallons
2003	23.97
2004	22.33
2005	20.01
2006	12.85
2007	3.78
2008	7.41
2009	15.57
2010	7.65
2011	8.54
2012	6.75

Exhibit 4-5. PPPL Non-Potable Water Use from Delaware & Raritan Canal[Pin13]

CY	In million gallons
2003	24.87
2004	13.02
2005	14.77
2006	7.90
2007	8.71
2008	7.15
2009	0.00
2010	7.35
2011	2.47
2012	4.19

B. Process (Non-potable) Water

Delaware & Raritan (D&R) Canal non-potable water is used for fire protection and process cooling *via* Physical Cross-Connection Permit 0826-WPC110001. Non-potable water is pumped from the D&R Canal as authorized through a contract with the New Jersey Water Supply Authority that allows for the withdrawal of up to 150,000 gpd and an annual limit of 54.75 million gallons [NJWSA07]. PPPL used 4.189 million gallons of non-potable water from the D&R Canal in 2012 (Exhibit 4-5) [Pin13].

Filtration to remove solids and the addition of chlorine and a corrosion inhibitor are the primary water treatment at the canal pump house. Discharge serial number DSN003, located at the canal pump house filter-backwash, is a separate discharge point in the NJPDES surface-water permit and is monitored monthly (Table 18). A sampling point (C1) was established to provide baseline data for surface water that is pumped from the D&R Canal for non-potable uses. Table 12 summarizes the results of water quality analysis at the D&R Canal.

C. Surface Water

Surface water is monitored for potential non-radioactive pollutants both on-site and at surface water discharge pathways upstream and downstream off-site. Other sampling locations—Bee Brook (B1 & B2), New Jersey American Water Company (potable water supplier-E1), Delaware & Raritan Canal (C1), Millstone River (M1), and Cranbury and Devil's Brooks in Plainsboro (P1 & P2) sampling points (Tables 10 -16)—are not required by regulation, but are a part of PPPL's environmental surveillance program.

D. Sanitary Sewage

Sanitary sewage is discharged to the Publicly-Owned Treatment Works (POTW) operated by South Brunswick Township, which is part of the Stony Brook Regional Sewerage Authority (SBRSA). SBRSA requires quarterly reporting of total volume discharged from the Liquid Effluent Collection (LEC) tanks on D-Site. PPPL continued to collect radioactive tritium samples and non-radioactive data (pH and temperature) during 2012 (Table 8). Detailed radiological and discharge quantities for LEC tanks can be found in Chapter 5 "Environmental Radiological Program Information".

For 2012, PPPL estimated a total annual sanitary sewage discharge of 6.86 million gallons to the South Brunswick sewerage treatment plant [Pin13**].**

4.2 Non-Radiological Waste Programs

4.2.1 Hazardous Waste Programs

A. Toxic Substance Control Act (TSCA) - Polychlorinated Biphenyls (PCBs)

In 2012, PPPL shipped 177 pounds of PCB TSCA waste. All contents were recycled or incinerated as TSCA waste [Pue13].

B. Hazardous Waste

PPPL did not submit a Hazardous Waste Generator Annual Report to the NJDEP for 2012. Hazardous waste generation did not exceed the reporting quantity threshold during that time period. A description of Resource Conservation and Recovery Act (RCRA) compliance is found in Exhibit 2-1 of this report.

PPPL continues to evaluate opportunities to remove hazardous materials from the workplace that have the potential to become hazardous wastes by substituting them with non-hazardous materials that has the added benefit of reducing employee exposure.

C. Recycled Hazardous/Universal Waste

The types and quantities of waste that are recycled each year changes due to the activities varying greatly from year to year as shown in Exhibit 4-6. Recycled universal and hazardous waste included fluorescent bulbs that are crushed prior to recycling; ballasts and batteries are a more typical waste, which are recycled each year [Pue13].

Exhibit 4-6. CY 2012 Hazardous Recycled Material [Pue13]

Recycled Hazardous Waste	CY 2012 (lbs)
Batteries	2197
Fluorescent Bulbs-Mercury	1423
Ballasts	513
Misc.	177
Total Recycled	**4310 lbs**

4.3 Environmental Protection Programs

4.3.1 Release Programs

A. Spill Prevention Control and Countermeasure (SPCC)

PPPL maintains a Spill Prevention Control and Countermeasure Plan (SPCC), which was updated in 2011. No revisions were made to SPCC in 2012. The SPCC Plan is incorporated as a supplement to the PPPL Emergency Preparedness Plan. In addition to the 5-year major revision as required by the USEPA, PPPL's Environmental Services Division (ESD) completes a review every year to make any minor changes required to the SPCC [PPPL11b].

B. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) - Continuous Release Reporting

Under Comprehensive Environmental Recovery, Compensation, and Liability Act (CERCLA) reporting requirements, the release of the listed hazardous substances in quantities equal to or greater than its reportable quantity must be reported to the National Response Center, and the facility is then required to submit a report annually to EPA. Because PPPL has released no CERCLA-regulated hazardous substances, a "Continuous Release Reports" have not been filed with EPA.

C. Superfund Amendments and Reauthorization Act (SARA) Title III Reporting Requirements

NJDEP administers the Superfund Amendments and Reauthorization Act (SARA) Title III, also known as the Emergency Reporting and Community Right-to-Know Act (EPCRA), and submits reports to USEPA Region II. The modified Tier I form includes SARA Title III and NJDEP-specific reporting requirements. PPPL submitted the SARA Title III Report to NJDEP by March 1, 2013 [PPPL13b].

Changes for 2012 EPCRA/SARA report include:

1. Sulfur hexafluoride (SF_6) content was shifted from modular regulators to storage tanks and cylinders.
2. Ozone Depleting Substance (ODS) Halon 1301 inventory was slightly reduced from previous year and moved to Materiel Control for disposal.
3. Bulk sulfuric acid storage in the D-Site Cooling Tower was removed during the 2012 summer. It is still shown on last year's inventory for half the year and will be removed completely for the 2013 survey.

SARA Title III reports included information about twelve compounds used at PPPL as listed in Exhibits 4-7and 4-8.

Exhibit 4-7. 2012 Summary of PPPL EPCRA Reporting Requirements

SARA	YES	NO	NOT REQUIRED
EPCRA 302-303: Planning Notification	✓		
EPCRA 304: EHS Release Notification		✓	
EPCRA 311-312: MSDS/Chemical Inventory	✓		
EPCRA 313: TRI Report			[✓]

EHS – Extremely hazardous substances (No EHS are on-site at PPPL)
MSDS – Material Safety Data Sheets
TRI – Toxic Release Inventory

Exhibit 4-8. 2012 Hazard Class of Chemicals at PPPL

Compound	Category	Compound	Category
Bromochlorodifluoro-methane (Halon 1211)	Sudden release of pressure & Acute health effects	**Lead**	Chronic health effects
Bromotrifluoromethane (Halon 1301)	Sudden release of pressure & Acute health effects	**Nitrogen**	Sudden release of pressure
Carbon dioxide	Sudden release of pressure & Reactive	**Propane**	Sudden release of pressure
Diesel Fuel Oil	Fire	**Petroleum Oil**	Fire
Gasoline	Fire & Chronic Health Hazard	**Sulfur Hexafluoride**	Sudden release of pressure
Helium	Sudden release of pressure	**Sulfuric acid**	Acute Health Hazard & Reactive

Though PPPL does not exceed threshold amounts for chemicals listed on the Toxic Release Inventory (TRI), PPPL completed the TRI cover page and laboratory exemptions report for 1996, and submitted these documents to DOE. Since PPPL did not exceed the threshold amounts, no TRI submittal was completed for 2012.

4.3.2 Environmental Releases

PPPL reported a small hydraulic fluid spill in August 3, 2012 [PPPL12b]. Due to New Jersey's no *de minimus* thresholds, all oil released to unpaved surfaces must be reported. Dirt was removed, and the soil was tested to ensure adequate cleanup of petroluem hydrocarbons. Two small oil spills were reported in September and December and were cleaned up by PPPL personel [PPPL12c and d].

4.3.3 Pollution Prevention Program

In 2012, PPPL continued to pursue waste minimization and pollution prevention opportunities through active recycling efforts and through the purchasing of recycled-content and other environmentally-preferable products (EPP).

PPPL employs a number of "green building practices" that include purchasing "green-sustainable" products when renovating offices and other laboratory spaces. From Electronic Product Environmental Assessment Tool (EPEAT), Energy Star® equipment and products/lighting fixtures, recycled flooring tiles and carpet squares, low volatile organic compound (VOC)-paints to other types of recycled wall coverings, PPPL actively pursues the use of these types of green products and practices, wherever possible.

In FY 2012, PPPL's office recycling rate was ~70%; this rate reflects 74.12 tons of municipal solid waste (MSW) that were diverted from landfills. The DOE EO 13514 goal of 50% recycle *versus* disposal rate was met and accomplished by active participation of Laboratory employees. PPPL's FY 2012 rate for recycling of construction materials - wood, concrete, roofing stone ballast - was an impressive 80% by weight [Kin13a].

In September 2010, PPPL initiated the collection and recycling of food waste from the cafeteria kitchen and the trash bins located in the cafeteria and select locations around the laboratory. In FY12, PPPL composted 15.8 tons of food waste, which was a greater than 50% increase of compostable materials from 10.2 tons in FY11.

In 2012, improvements to the food composting program included replacing non-compostable products (cups, forks, knives, spoons, food containers) with compostable products, posting new color-coded signs, and increasing the number of composting locations across the laboratory [Kin13a].,

4.4 Non-Radiological Emissions Monitoring Programs

Air Permits

PPPL maintains New Jersey Department of Environmental Protection (NJDEP) air permits/certificates for the equipment as listed in Exhibit 4-9. PPPL is classified as a synthetic- minor facility and does not exceed the Potential to Emit (PTE) limits for any of the Criteria Air Pollutants.

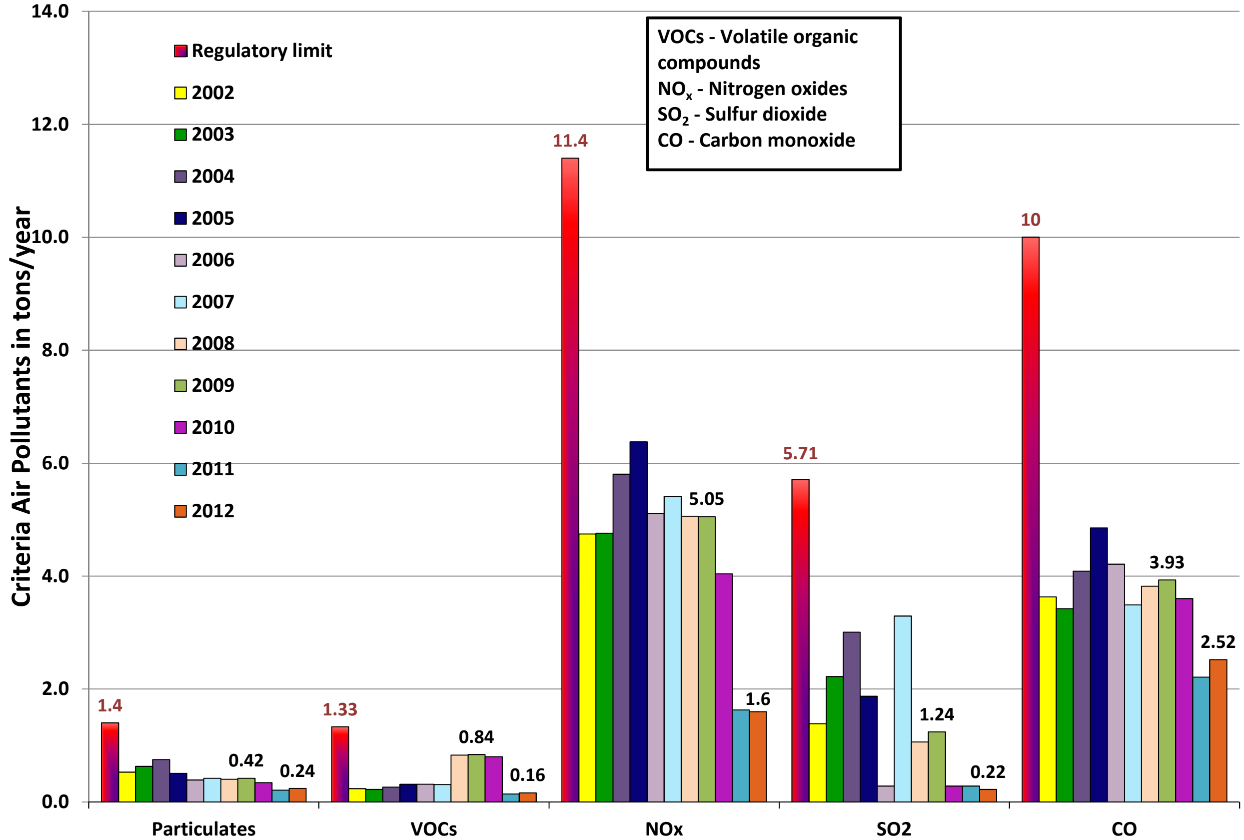
PPPL tracks NJDEP Air Quality Conditions Alerts. Unhealthy conditions are noted and all generator repairs and maintenance are postponed until normal air quality is reinstated. During those times, the standby (emergency) generators may be used only in an emergency (power outage) or when a voltage reduction issued by Pennsylvania, Jersey, Maryland Interconnect (PJM – electric-power grid controllers) and posted on the PJM internet website under the "emergency procedures" menu.

In 2008, NJDEP reduced the Criteria Air Pollutants permit limits for operating the boilers; PPPL's operated these four boilers were well below those limits in 2012 (Exhibit 4-10 & Table 9). With the installation of digital controls and high-efficiency, lower nitrogen oxide (NO_x) burners, the NO_x, volatile organic compounds (VOCs), particulates, sulfur dioxide (SO_2), and carbon monoxide (CO) emissions are being further reduced [Ne12].

Exhibit 4-9. PPPL's Air-Permitted Equipment

Type of Air Permit	Qty	Location	Requirements
Dust collectors	2	Maintenance & Operations (M&O) Woodworking shop C-Site MG Annex	Operate at 99% efficiency General Permit July 2011; reused from C-site Assembly and Storage/Research Equipment Storage and Assembly (CAS/RESA) buildings
Storage tanks vents	2	25,000 gal. No. 2 & 4 oil 15,000 gal. No.1 oil	TANKS – EPA annual emissions based on amount of fuel through-put
Diesel generators	2	D-site generator C-site generator	Annual Limit of 200 hours for D-site & 100 hours for C-site of operation excluding emergencies; no testing on NJDEP Air Action Days
Utility boilers	4	Units 2,3,4, & 5 in M&O	Annual emission testing same quarter each year; annual emission calculations based on hours of operations (Ex.4-12); rolling 12-month calendar total fuel consumed by boiler and fuel type (Tables 9A & 9B). Visual stack checked weekly when operating.
Fluorescent bulb crusher	1	Hazardous Materials Storage Facility	Hours of operations and number of bulbs crushed; air monitoring for mercury during filter changes.

Exhibit 4-10. PPPL's Boiler Emissions from 2002- 2012 vs. Regulatory Limits (Fin12b)



4.5 Land Resources and Conservation

4.5.1 Wetlands Letter of Interpretation (LOI)

PPPL operates under NJDEP Land Use Wetlands LOI. In permit No. 1218-06-0002.2FWW070001, NJDEP re-verified PPPL's freshwater wetland boundaries in 2008. No construction or alterations to existing vegetation can commence without state notification. Freshwater line verifications must be present on all future site development drawings [PPPL08c].

4.5.2. Soil Erosion and Landscaping

In 2009, PPPL applied for Soil Erosion Permit through Freehold Soil Conservation District. Permit No. 2009-0343 for PPPL's D-Site Parking Lot rain garden conversion was issued on August 28, 2009 and is valid for 3.5 years after issued date. PPPL continued to reduce the grassed acreage that required mowing and other maintenance by planting native meadow grasses that are allowed to grow tall [PPPL09d].

4.5.3 Herbicides and Fertilizers

During 2012, PPPL's Facilities Division used herbicides, insecticide and fertilizer on campus grounds (Exhibit 4-11). The insecticide was used by arborist contractors to help kill bag worms on infected trees in 2012. These materials are applied in accordance with state and federal regulations. Chemicals are applied by certified applicators. No herbicides or fertilizers are stored on site; therefore, no disposal of these types of regulated chemicals is required by PPPL [Kin13b].

Exhibit 4-11. 2012 Fertilizer and Herbicide

Type of Material	Name of Material	Registered EPA No.	2012 Applied
Herbicide	Lesco Surge Broadleaf	**2217-887**	6.13 Gallons
Herbicide	Roundup	**524-475**	6.89 Gallons
Herbicide	Kleep Up Pro	**34704-890**	22.5 Oz.
Insecticide	Bag Worm Spray	**-**	150 Gallons
Fertilizer	Lesco Surge Fertilizer	**-**	20090.9 Lbs.

4.5.4 Stormwater Pollution Prevention

The 2009 Stormwater Pollution Prevention Plan (SWPPP) was developed to provide guidance for reducing PPPL's impact on stormwater quality [PPPL09e]. Furthermore, PPPL reduces stormwater quantity by utilizing best management practices, such as limiting the amount of impervious cover, reducing the areas requiring mowing, installing rain gardens and plantings of native grass meadows.

4.6 Safety

PPPL's 2012 performance with respect to worker safety is noted in Exhibit 4-13 [Lev13a].

Exhibit 4-13. PPPL's Safety Performance 2012

	Total OSHA recordable case rate[1]	**Days away, restricted transferred (DART) case rate[1]**
2012	0.93	0.47
	Number of radioactive contaminations (external)	**Number of Safety report OSHA (ORPS) Occurrence confined space, chemical exposure and (LOTO) incidents**
2012	0	0

OSHA – Occupational Safety and Health Administration

[1] Per 200,000 hours worked

Chapter

5

ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

5.1 Radiological Emissions and Doses

For 2012, the releases of tritium in air and water and the total effective dose equivalent (EDE) contribution at the site boundary and for the population within 80 kilometers of PPPL are summarized in Exhibit 5-1 below. The calculated EDEs at the site boundary are less than 0.012 milli radiation equivalent man (mrem) per year, far below the annual limit of 10 mrem per year [Lev13b, Rul13].

Exhibit 5-1. Summary of 2012 Emissions and Doses from D-Site Operations

Radionuclide & Pathway	Source	Source Term Curies (Ci) (Bequerel, Bq)	EDE in mrem/yr (mSv/yr) at Site Boundary	Percent of Total	Collective EDE w/in 80 km in person-rem (person-Sv)
Tritium (air)	D-site stack	HTO - 4.19 (1.55×10^{11}) HT - 24.11 (8.9×10^{11})	1.15×10^{-2} (1.15×10^{-4})	94.1	0.572 (5.7×10^{-3})
Tritium (water)	LEC tank	HTO - 0.0176 (6.51×10^{8})	3.52×10^{-4} (3.52×10^{-6})	2.9	4.8×10^{-4} (4.8×10^{-6})
Tritium (water)	Surface Ground	188 pCi/L (DSN001) 130 pCi/L(D-site MG sump)	3.90×10^{-4} (3.90×10^{-6})	3.0	$3.97\ 10^{-4}$ (3.97×10^{-6})
Direct/Scattered neutron & Gamma Radiation	NSTX	0 DD neutrons	N/A	0	N/A
Argon-41 (Air)	NSTX	N/A	N/A	0	N/A
Total			**1.22×10^{-2}** **(1.22×10^{-4})**		0.573 (5.73×10^{-3})

[Lev13b& Rul13]

Bq = Bequerel mSv = milli Sievert EDE = effective dose equivalent HT = elemental tritium HTO = tritium oxide
DD=deuterium-deuterium mrem = milli radiation equivalent man NSTX = National Spherical Torus Experiment

Estimated dose equivalent (EDE)at the nearest business 3.23×10^{-3} mrem (3.23×10^{-5} mSv) due to tritium air emissions from the D-site stack.

Airborne doses assume maximum exposed individual is in continuous residence at the site boundary; waterborne doses assume that maximum exposed individual uses the ultimate destination of liquid discharges (Millstone River) as sole source of drinking water.

Annual limit is 10 mrem/year; background is about 360 mrem/year. Half life of tritium (HTO & HT) is 12.3 years.

Laboratory policy states that when occupational exposures have the potential to exceed 1,000 mrem (1 rem) per year (10 milli Sievert per year (mSv/y), the PPPL Environment, Safety, and Health (ES&H) Executive Board must approve an exemption. This value (1,000 mrem per year limit) is 20 percent of the DOE legal limit for occupational exposure. In addition, the Laboratory applies the "ALARA" (As Low As Reasonably Achievable) policy to all its operations. This philosophy for control of occupational exposure means that environmental radiation levels for device operation are also very low. From all operational sources of radiation, the ALARA goal for maximum individual occupational exposure was less than 100 mrem per year (1.0 mSv/year) above natural background at PPPL. The average annual dose to a member of the general population is considered to be about 360 mrem/year:

- Cosmic radiation - 28 mrem/yr
- Terrestrial sources /earth's crust - 28 mrem/yr
- Food – 40 mrem/yr
- Radon - ~200 mrem/yr
- Medical sources: x-rays-40 mrem/yr other medical sources -14 mrem/yr

5.1.1 Penetrating Radiation

Due to the upgrade project, the NSTX reactor did not conduct experiments during 2012, and therefore did not generate neutrons. The upgrade project includes installation of a new center stack, additional diagnostic instruments etc.

5.1.2 Sanitary Sewage

Drainage from D-site sumps in radiological areas is collected in the one of the three liquid effluent collection (LEC) tanks; each tank has a capacity of 15,000 gallons. Prior to release of these tanks to the sanitary sewer system, *i.e.*, Stony Brook Regional Sewerage Authority (SBRSA), a sample is collected and analyzed for tritium concentration and gross beta. All samples for 2012 showed effluent quantity and concentrations of radionuclides (tritium) to be within allowable limits established in New Jersey regulations (1 Curie per year (Ci/y)) for all radionuclides), the National Safe Drinking Water regulations (40 CFR 141.16 limit of 20,000 pico Curies per Liter (pCi/L)) and DOE Order 5400.5 (2×10^6 pCi/liter for tritium).

As shown in Exhibits 5-2 and 5-3, the 2012 total amount of tritium released to the sanitary sewer was 0.0176 Curies, 0.982 Curies less than the allowable 1Ci/y limit. In Table 8, the gross beta activity is reported; the gross beta activity was <the lower limit of detectability (about 280 pCi/l).

Exhibit 5-2.
Annual Releases to Sanitary System from Liquid Effluent Collection Tanks 1994-2012

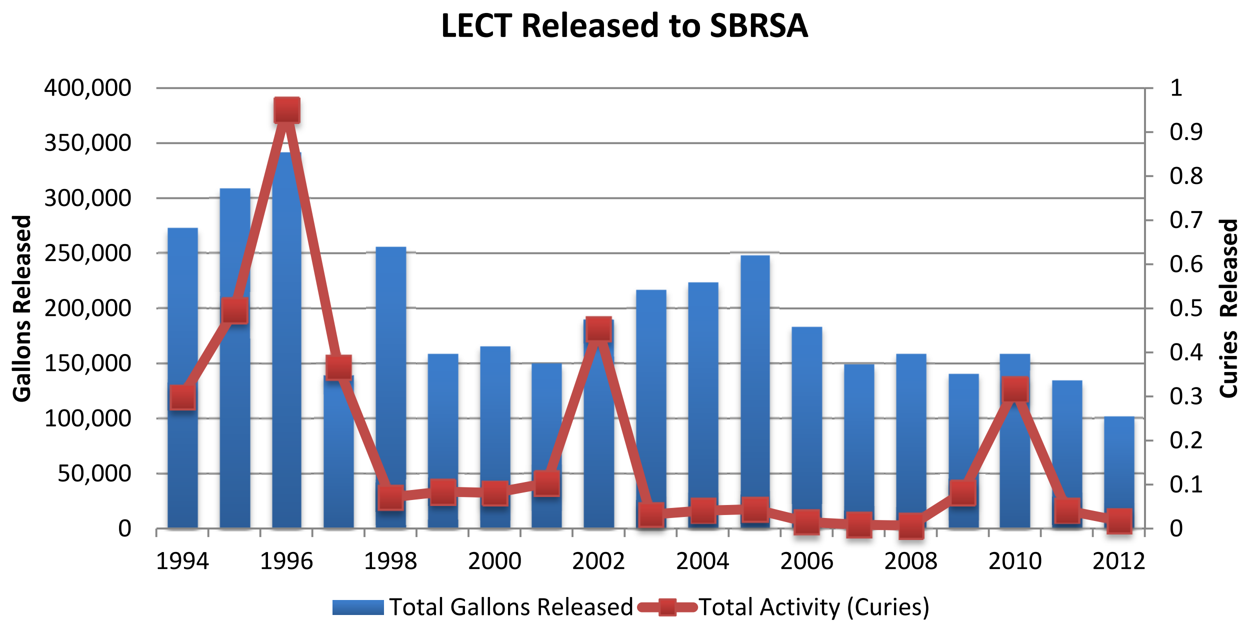


Exhibit 5-3.
Total Annual Releases (LEC tanks) to Sanitary System from 1994 to 2012

Calendar Year	Total Gallons Released	Total Activity (Curies)
1994	273,250	0.299
1995	308,930	0.496
1996	341,625	0.951
1997	139,650	0.366
1998	255,450	0.071
1999	158,760	0.084
2000	165,900	0.081
2001	150,150	0.103
2002	190,200	0.453
2003	217,320	0.032
2004	223,650	0.041
2005	247,950	0.044
2006	183,657	0.015
2007	149,100	0.009
2008	159,450	0.007
2009	140,850	0.082
2010	158,900	0.317
2011	134,450	0.041
2012	102,000	0.018

Exhibit 5-4.
Total Low-Level Radioactive Waste from 1997-2012

Year	Cubic meters (m^3) or Kilograms (kg)	Total Activity in Curies (Bq)
1997	56.6 m^3	31,903.0 (1.18×10^{15})
1998	15.1 m^3	204.80 (7.58×10^{12})
1999	33.6 m^3	213.76 (7.91×10^{12})
2000	120 m^3	50.0 (1.85×10^{12})
2001	565 m^3	1,288.43 (4.77×10^{13})
2002	858,568 kgs	4,950.14 (1.83×10^{14})
2003	8,208 kgs	0.03 (1.11×10^{9})
2004	4,467 kgs	0.0202 (7.48×10^{8})
2005	30.29m^3	0.01997 (7.389×10^{8})
2006	11.12m^3	2.3543 (8.711×10^{10})
2007	8.6 m^3	0.09285 (3.435×10^{9})
2008	3.63 m^3	0.08341 (3.086×10^{9})
2009	No Shipment	No Shipment
2010	13.3	6.30270 (2.332×10^{11})
2011	15.6 m^3	0.0351 (1.297×10^{10})
2012	No shipment	No shipment

5.1.3 Radioactive Waste

Exhibit 5-5. B-box with Liner in RWHF for Shipping Radioactive Waste

In 2012, low-level radioactive wastes (LLW) were stored on-site in the Radioactive Waste Handling Facility (RWHF) prior to off-site disposal (Exhibit 5-5).

PPPL did not ship LLW for burial in 2012 (Exhibit 5-4). The wastes are packaged for shipment and disposal in metal containers, refered to as "B-boxes" (Exhibit 5-5). PPPL maintains detailed waste profiles for LLW that is shipped off-site for burial. PPPL has changed its LLW burial facility from the Nevada National Security Site to the Energy Soluions facility in Clive, Utah. PPPL's radioactive waste program is audited every three years to ensure compliance with burial facility and U. S. Department of Transportation (DOT) requirements. The audit includes employee training, waste characterization, waste packaging, quality control, and records retention.

5.1.4 Airborne Emission - Differential Atmospheric Tritium Samplers (DATS)

PPPL uses differential atmospheric tritium sampler (DATS) to measure elemental (HT) and oxide tritium (HTO) at the D-site stack. DATS are similarly used at four environmental sampling stations located on D-site facility boundary trailers (T1 to T4), All of the aforementioned monitoring is performed on a continuous basis.

Tritium (HTO and HT) was released and monitored at the D-site stack (Table 3). Projected dose equivalent at the nearest off-site business from airborne emissions of tritium was 0.0003 mrem/year (0.003 μSv/year) in 2012 [Rul13].

The EDE at the site boundary was calculated based on annual tritium totals as measured at the stack (DATS air) and water samples at the LEC tanks and highest measurements from well and surface water during 2012 (Exhibit 5-1).

5.2 Release of Property Containing Residual Radioactive Material

Release of property containing residual radioactivity material is performed in accordance with PPPL ES&H Directives (ESHD) 5008, Section 10, Subpart L.

Such property cannot be released for unrestricted use unless it is demonstrated that contamination levels on accessible surfaces are less than the values in Appendix D of ES&HD 5008, Section 10, and that prior use does not suggest that contamination levels on inaccessible surfaces exceed Appendix D values. For tritium and tritiated compounds, the removable surface contamination value used for this purpose is 1,000 disintegrations per minute(dpm)/100 cubic meter (cm$^{2)}$ [PPPL09f].

5.3 Protection of Biota

The highest measured concentrations of tritium in ground water in 2012, was 130 pCi/L (D-site MG sump in April in Table 5) and for 188 pCi/L surface water (DSN 001 on Table 5). This concentration is a small fraction of the water biota concentration guide (BCG) (for HTO) of 3 x 10^8 pCi/L for aquatic system evaluations, and the water BCG (for HTO) of 2 x 10^8 pCi/L for terrestrial system evaluations, per DOE Standard STD-1153-2002, "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" [Lev13b]. Because of these low doses, PPPL does not conduct direct biota monitoring.

5.4 Unplanned Releases

There were no unplanned radiological releases in 2012.

5.5 Environmental Radiological Monitoring

5.5.1 Waterborne Radioactivity

A. Surface Water

Surface-water samples at eleven locations (two building foundation sumps: D-Site Airshaft, and D-Site MG; two on-site locations: DSN001, and E1; and seven off-site locations: B1, B2, C1, DSN003, M1, P1, and P2) have been analyzed for tritium (Table 5).

In January 2012, at on-site location, DNS-001, the tritium concentration was detected at 188 pCi/L, which was the highest for surface water sample (Table 5).

Rain water samples, much of which eventually reaches the surface water, were collected and analyzed and the results ranged from below detection to 182 pCi/L in 2012 ((Table 6). With the end of TFTR D&D project in September 2002, tritium concentrations in rain, surface, and ground water samples have decreased, reflecting the decreased atmospheric tritium releases measured at the D-site stack.

In April 1988, PPPL began on-site precipitation measurements as part of its environmental surveillance program. On a weekly basis, precipitation is measured by an on-site rain gauge. The 2012 weekly precipitation amounts are shown on Table 2A. Based on the average rainfall, a comparison of dry or wet years shows that 2012 was significantly drier, 38.9 inches (98.8 cm), when compared with 46.5 average inches (118.1 cm) (Table 7).

B. Ground Water

The highest concentration of tritium in ground water was found in D-site MG Sump at 165 pCi/L in January 2012 (Table 4). These tritium concentrations are well below the Drinking

Water Standard of 20,000 pCi/L. The three on-site wells used to monitoring for tritium in the ground water (TW-1, TW-5, TW-8) were tested for tritium in 2012. In 2012, all wells had levels below the lowest limit of detection (LLD). Ground water monitoring continued in 2012 based on increased stack releases do to ongoing neutral beam cleaning in preparation for the NSTX upgrade project.

Based on PPPL's environmental monitoring data and the available scientific literature [Jo74, Mu77, Mu82, Mu90], the most likely source of the tritium detected in the on-site ground water samples is from the atmospheric releases of tritium from the D-site stack and the resulting "wash-out" during precipitation. Monitoring of ground water from wells and the building foundation sump (dewatering sump for D-site buildings) will continue as on-going atmospheric releases necessitate.

C. Drinking (Potable) Water

Potable water is supplied by the public utility, New Jersey American Water Company, formerly Elizabethtown Water Company. In April 1984, a sampling point at the input to PPPL (E1 location) was established to provide baseline data for water coming onto the site. Radiological analysis has included gamma spectroscopy and tritium-concentration determination. In 2012, tritium concentrations at this location were less than the lower limit of detection (Tables 5).

5.5.2 Foodstuffs, Soil, and Vegetation

There were no foodstuffs, soil, or vegetation samples gathered for analysis in 2012. In 1996, the Health Physics (HP) Manager reviewed the requirement for soil/biota sampling. At that time, a decision was made to discontinue the sampling program. Tritium was not detected in almost all samples and these data were not adding to the understanding of tritium transport in the environment. Greater emphasis was placed on water sampling and monitoring, which produced more relevant results.

Chapter

6

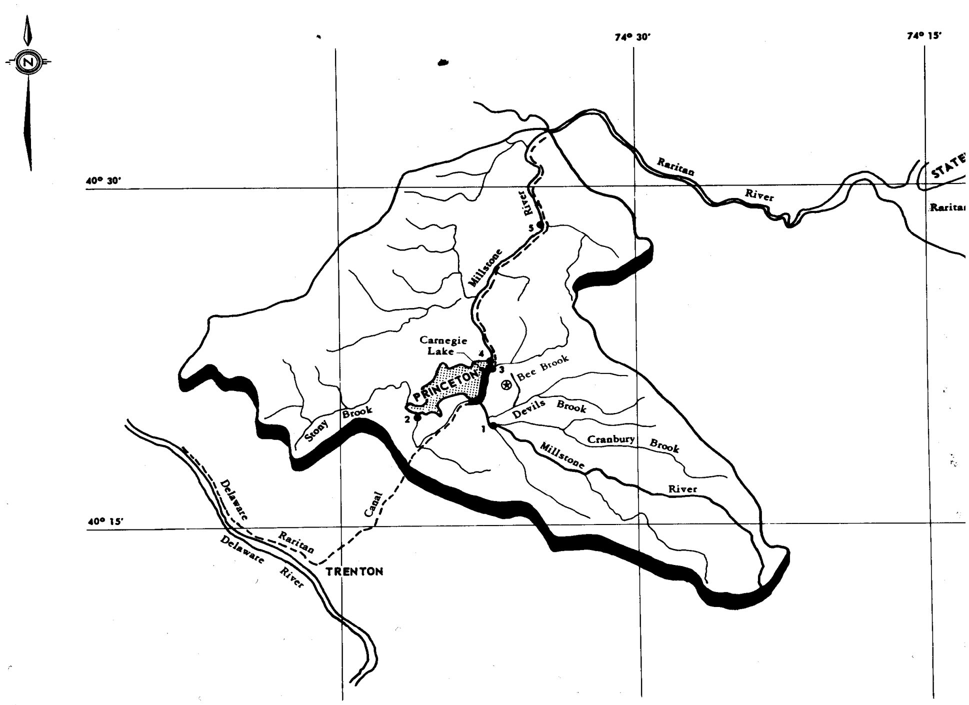
SITE HYDROLOGY, GROUND WATER, AND DRINKING WATER PROTECTION

6.1 Lower Raritan River Watershed

PPPL is located within the Bee Brook Watershed. Bee Brook is a tributary to the Millstone River, which is part of the Raritan River Watershed (Exhibit 6-1). The New Jersey Department of Environmental Protection (NJDEP) has developed a watershed-based management program for prospective environmental planning and has divided the State of New Jersey into twenty watershed basins.

Locally, the Bee Brook Watershed encompasses approximately 700 acres within the Princeton Forrestal Center and James Forrestal Campus tracts. It begins at College Road East (approximately 1600 feet east of US Route 1), flows south in a wide flood plain, and then discharges into Devil's Brook at the entrance to Mill Pond [Sa80].

Exhibit 6-1. Millstone River Watershed Basin



6.2 Geology & Topography

PPPL is situated on the eastern edge of the Piedmont Physiographic Province, approximately one-half mile from the western edge of the Atlantic Coastal Plain Province. The site is underlain largely by gently dipping and faulted sedimentary rock of the Newark Basin. The Newark Basin is one of several rift basins that were filled with sedimentary material during the Triassic Period, about 250-200 Ma (million years ago). At PPPL, bedrock is part of the Stockton Formation, which is reportedly more than 500 feet thick and consists of fractured red siltstone and sandstone [Lew87]. Regionally, the formation strikes approximately north 65 degrees east, and dips approximately 8 degrees to the northwest. The occurrence of limited amounts of clean sand near the surface indicates the presence of the Pennsauken Formation. This alluvial material was probably deposited during the Aftonian Interglacial period of the Pleistocene Epoch (approximately 2.6 million to 12,000 years ago).

Within 25 miles, there are a number of documented faults; the closest of which is the Hopewell fault located about 8 miles from the site. The Flemington Fault and Ramapo Faults are located within 20 miles. None of these faults are determined to be “active” by the U.S. Geological Survey. This area of the country (eastern central US) is not considered earthquake-prone despite the frequent occurrence of minor earthquakes that generally have cause little or no damage.

The Millstone River and its supporting tributaries geographically dominate the region. The well-watered soils of the area have provided a wealth of natural resources including good agricultural lands from prehistoric times to the present. Land use was characterized by several small early centers of historic settlement and dispersed farmland. It has now been developed into industrial parks, housing developments, apartment complexes and shopping centers [Gr 77].

The topography of the site is relatively flat and open with elevations ranging from 110 feet in the northwestern corner to 80 feet above mean sea level (msl) along the southern boundary. The low-lying topography of the Millstone River drainage reflects the glacial origins of the surface soils; sandy loams with varying percentages of clay predominate.

Two soil series are recognized in the immediate vicinity of the site. Each reflects differences in drainage and subsurface water tables. Along the low-lying banks of stream tributaries, Bee Brook, the soils are classified Nixon-Nixon Variant and Fallsington Variant Association and Urban Land [Lew87]. This series is characterized by nearly level to gently sloping upland soils, deep, moderate to well drained, with a loamy subsoil and substratum. The yellowish-white sands contain patches of mottled coloring caused by prolonged wetness. On a regional scale, the water table fluctuates between 1.5 and 2.5 feet below the surface in wet periods and drops below 5 feet during drier months.

In the slightly higher elevations (above 70 feet msl), the sandy loams are better drained and belong to the Sassafras series. Extensive historic farmlands and nurseries in the area indicate this soil provides a good environment for agricultural purposes, both today and in the past.

6.3 Biota

An upland forest type with dominant Oak forest characterizes vegetation of the site. Associated with the various oaks are Red Maple, Hickories, Sweetgums, Beech, Scarlet Oak, and Ash. Red, White, and Black Oaks are isolated in the lower poorly drained areas. Along the damp borders of Bee Brook, a bank of Sweetgum, Hickory, Beech, and Red Maple define the watercourse. The forest throughout most of the site has been removed either for farmland during the last century or recently for the construction of new facilities. Cultivated turf has replaced much of the open areas, although PPPL's beneficial landscaping program has introduced rain gardens, trees, and wildflower meadows around the site.

The woodland under-story is partially open with isolated patches of shrubs, vines, and saplings occurring mostly in the uplands area. The poorly drained areas have a low ground cover of ferns, grasses, and leaf litter.

6.4 Flood Plain

All of PPPL's storm water runoff flows to Bee Brook, either directly *via* the on-site retention basin (DSN001) or along the western swale to the wetlands south of the site. Approximately 70% of the site's total area is covered by pervious surfaces – grass, unmoved meadows, rain gardens, unpaved roadways and forested uplands and wetlands [PPPL09e, SE96].

PPPL's Stormwater Management Plan allows for a maximum impervious coverage of 60% of the developable land. Eighteen acres of PPPL's 88.5-acre site are wetlands, 13.21 acres grass, and 18.4 acres upland forest. Gravel, which is semi-impervious, covers approximately 8.02 acres, resulting in an impervious cover (buildings, roadways, sidewalks, etc.) of approximately 26.5 acres. PPPL's current site impervious cover equals about 30 percent. [PPPL09e, Hu13].

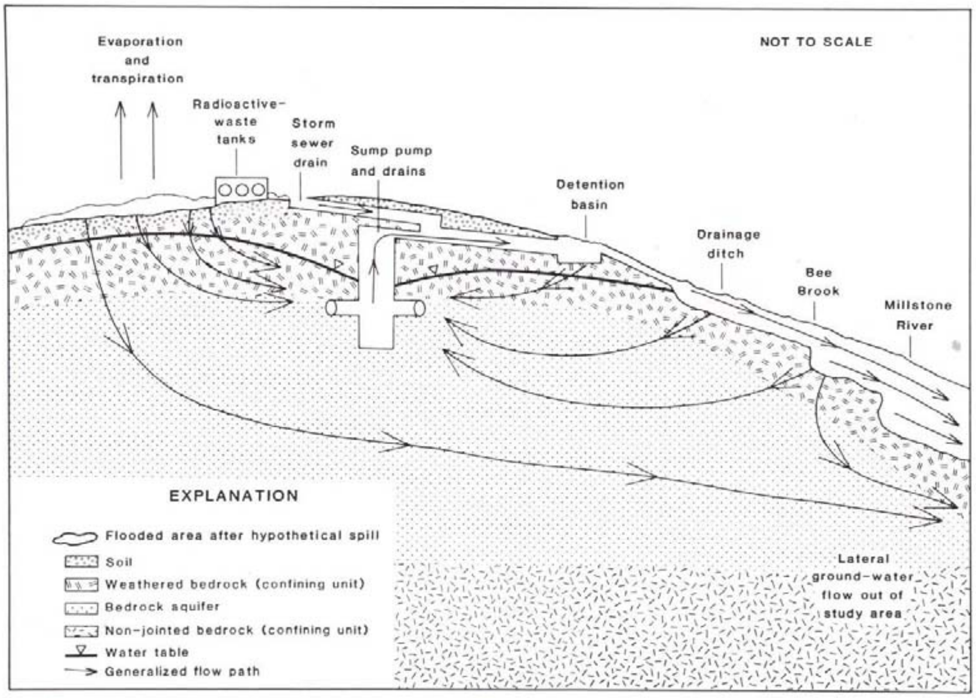
The 500-year flood plain elevation (85 ft above msl) delineates the storm protection corridor, which is vital to the flood and water quality control program for PPPL as well as the Princeton Forrestal Center site. This "corridor" is preserved and protected from development by Princeton Forrestal Center in the Site Development Plan [PFC80].

6.5 Groundwater Monitoring

The general direction of ground-water flow on the site is from the northwest of PPPL toward the southeast in the direction of Bee and Devil's Brooks. The operation of several building foundation drain sump pumps creates a local significant cone of depression which directs on-site ground water to flow radially toward the sumps (Exhibit 6-2).

Ground water is pumped from the sumps into the retention basin, which flows into Bee Brook. Bee Brook is hydraulically connected with ground water; during flooding stages, the brook recharges ground water and during low-flow periods, ground water discharges to the brook.

Exhibit 6-2. Generalized Potentiometric Surface of the Bedrock Aquifer at PPPL [Lew87]



6.5.1 Monitoring Wells

PPPL has installed a total of 44 wells to monitor ground-water quality under various regulatory programs (Exhibit 6-3), although some wells have since been decommissioned. PPPL has 38 active monitoring wells for environmental monitoring and surveillance purposes. Remedial Investigation and Remedial Alternatives Analysis (RI/RAA) studies were conducted to delineate shallow ground water contamination and identify a suitable remedy for ground water contamination under the New Jersey Site Remediation Program [PPPL99a & b]. A Remedial Action Work Plan (RAWP) was approved by NJDEP in which ground water monitoring continues as part of the selected remedy [PPPL00]. In 2012, PPPL completed the transition from NJDEP oversight of its environmental remediation program to the new state-mandated Licensed Site Remediation Professional (LSRP) program.

Exhibit 6-3. 2012 Monitoring Wells

	Remedial Action Monitoring Well (MW)	Environmental Surveillance (TW)
Active Wells Monitored On-Site	18	10
Active Wells Monitored Off-Site	0	0
Number of Wells Sampled	15	3
Sampling Rounds Completed	4	4

Exhibit 6-4. 2012 Groundwater Contamination

Ranges of Results for Positive Detections		
	2012 Wells	**2012 Sumps**
Tritium (pCi/L)	Below Bkg	Bkg - 165
PCE (μg/L)	ND – 124.0	ND – 32.2
TCE (μg/L)	ND – 23.9	ND – 4.05

Note: ND- Not Detected;
Bkg- Background radiation naturally present

6.5.2 Sampling Events

In support of the approved ground water remedial action, PPPL monitors the groundwater wells quarterly in March, June, September and December. The type of equipment used by PPPL to sample the ground water is shown in Exhibits 6-5 [PPPL12a]. Gas from either a compressed gas (carbon dioxide) cylinders or from a gasoline–powered air compressor is pumped down into the well via a Teflon-lined polyethylene tube into the dedicated bladder pump. The air pushes the water up through the exit tube and water flows through a chamber containing instruments to measure pH, conductivity, dissolved oxygen, temperature, and turbidity. Discharged water flows into a bucket that measures the volume discharged. A water level gauge is used to determine the rate of water recharging back into the well to ensure the sample will be representative of the ground water. Ground water parameters sampled can be seen in Exhibit 6-6.

Exhibit 6-5.
Well Monitoring Setup –Compressed Air Pump Controller, Water Depth Meter, Discharge Collection Bucket, and Water Quality Monitor

Ground water monitoring results show that tetrachloroethylene, trichloroethylene (PCE, TCE), and their natural degradation products are present in a number of shallow and intermediate-depth wells on C-site (Exhibit 6-4). These volatile organic compounds VOCs) are commonly contained in industrial solvents or metal degreasing agents. The source of these chemicals has been identified as a former waste storage area known as the PPPL Annex Building.

Foundation de-watering sumps located on D-site influence ground water flow across the site (Exhibit 6-8). The sumps create a significant cone of depression drawing ground water toward them. Under natural conditions, ground water flow is to the south-southeast toward Bee Brook; however, because of building foundation drains on D-Site, ground water beneath the site is drawn radially toward the D site sumps.

Exhibit 6-6. Groundwater Parameters

Analytical Parameter	Analytical Method
Volatile Organic Compounds (VOC) + Library Search	EPA-624
Nitrate & Nitrite	EPA-300.0
Chloride	EPA-300.0
Sulfate	EPA-300.0
Alkalinity	SM 2320B
Manganese	EPA-200.7
Ferrous Iron (Fe^{+2})	SM20/3500FEB
Dissolved Methane, Ethane, Ethene	EPA-8015 (modified)
Ortho-phosphate	SM4500P E
Sulfide	SM 4500S D
Total Organic Carbon (TOC)	SM 5310C
Tritium	EPA 906.0

[EPA99 & PPPL12c]

6.5.3 Remedial Action Work Plan (RAWP)

Following a site-wide RI/RAA study and remedy selection process, PPPL prepared and submitted a Remedial Action Work Plan (RAWP) outlining continual operation of the ground water extraction system and a long-term monitoring program [Sh00]. The RAWP was approved to NJDEP in June 2000, and is currently being implemented [HLA97, HLA98, Sh00, Sh01, Sh03].

In January 2002, an Aquifer Classification Exception Area (CEA) Designation was submitted to NJDEP. The CEA designation identifies specific areas where state-wide Ground Water Quality Standards are not met and will not be met for some time. The CEAs was granted for a specific area of an aquifer to address specific VOCs in the shallow (<60 feet deep) aquifer. The CEA request was approved by NJDEP in August 2002. The CEA was recertified in 2011, with submittal of a Biennial Remedial Action and Ground Water Classification Exception Area Recertification Report (PPPL11c).

General RAWP activities monitored:

- Examination of analytical data and water level measurements indicates an inverse relationship between ground water level and VOC concentration.
- Natural attenuation (anaerobic biodegradation) occurs in the wetlands adjacent to CAS/RESA.
- Contaminated ground water is captured by building sumps and is not migrating off-site.

RAWP 2012 activities include:

- Quarterly sampling by PPPL in March; JM Sorge subcontractor sampled June, September, and December.
- Submittal of the *Remedial Action Progress Report* in May.
- Bladder pumps and monitoring well casings were repaired or refurbished as necessary.
- Groundwater monitoring equipment was repaired as necessary.

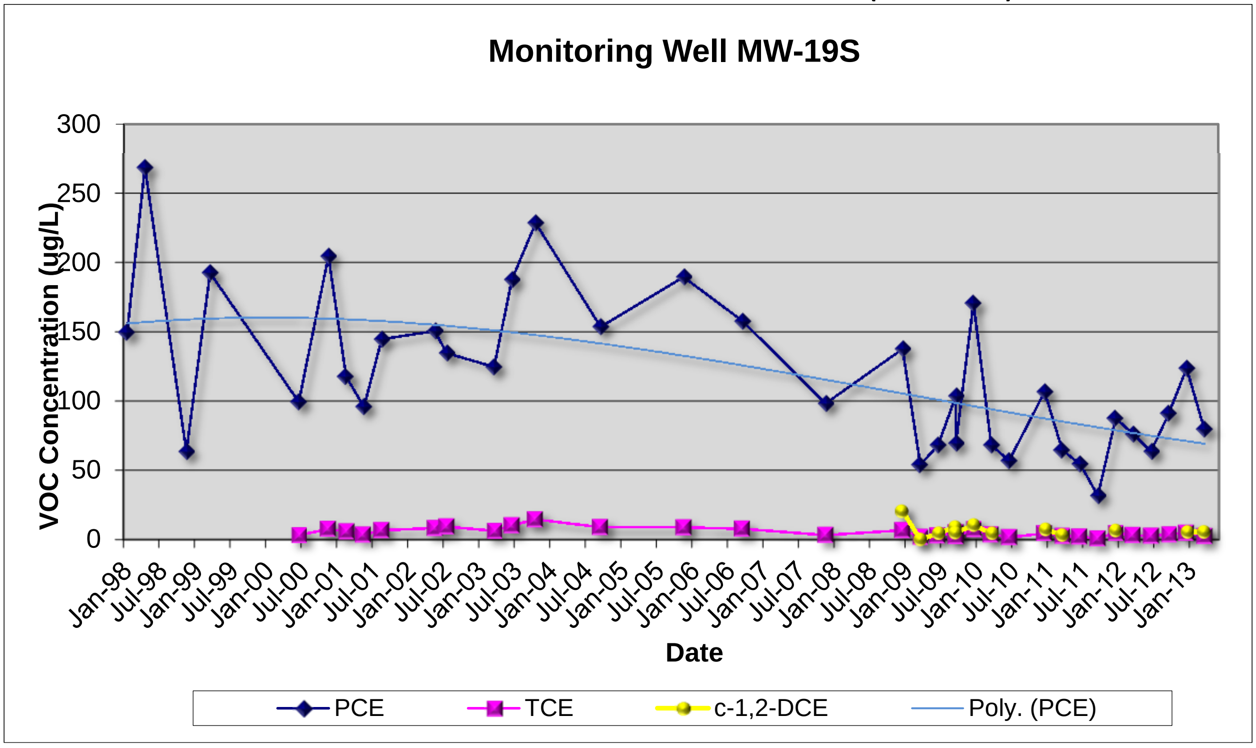
6.5.4 Monitored Natural Attenuation

Examination of analytical data and water level measurements during the Remedial Investigation and the beginning of the Remedial Action indicated an inverse relationship between ground water level and VOC concentration (particularly PCE) [PPPL12a]. Periods of higher water level generally corresponded with lower PCE results. Conversely, higher PCE results are generally coincident with period of lower ground water elevation (Tables 19-22).

Natural attenuation processes are active as evidenced by presence of degradation compounds in ground water down gradient of source area (Tables 19-22). PCE is sequentially degraded into trichloroethylene (TCE), cis-1,2-dichloroethlyene (c-1,2-DCE) and, ultimately to, vinyl chloride. The presence of c-1,2-DCE, dissolved methane, reduced dissolved oxygen levels and negative oxidation-reduction potential (redox) values provide definitive evidence of on-going biological degradation of chlorinated ethenes [PPPL12a, Sh06, Sh07, Sh08, Sh09].

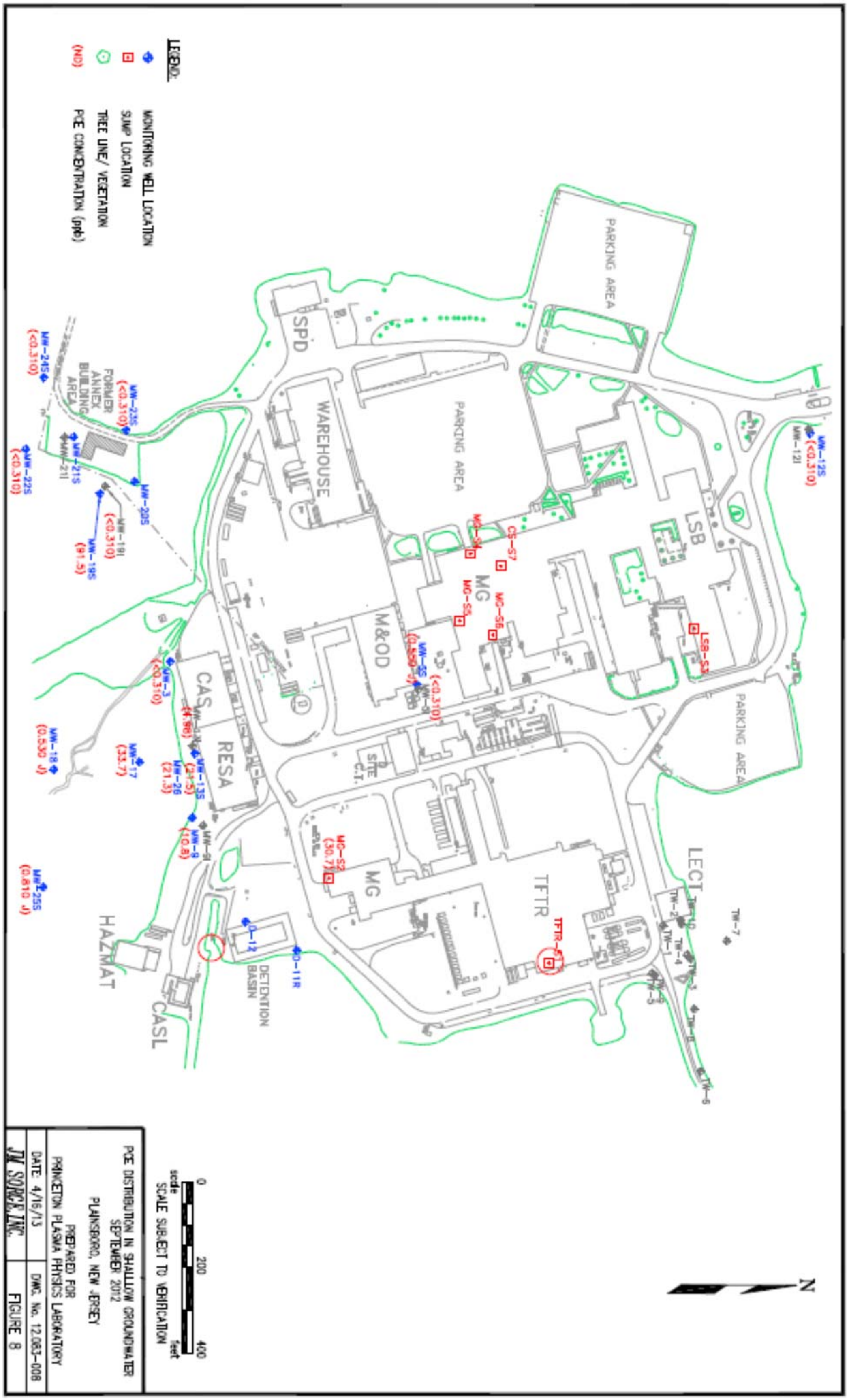
Review and examination of the analytical results indicate that contaminant concentrations, particularly PCE, are generally decreasing and are below the concentrations documented at the beginning to the Remedial Investigation. Seasonal fluctuations in VOC concentrations were seen in data collected during the RI and during periods of quarterly remedial action monitoring. These data generally showed peak VOC concentration during the late fall/winter months (Exhibits 6-7 & 6-9). The time-trend graph shown in Exhibit 6-7 also includes a second-order polynomial regression line fitted to PCE concentrations. This trend line shows an overall downward trend in contaminant concentration with a significant decrease since early 2007. Spring and summer results are generally lower [PPPL12a].

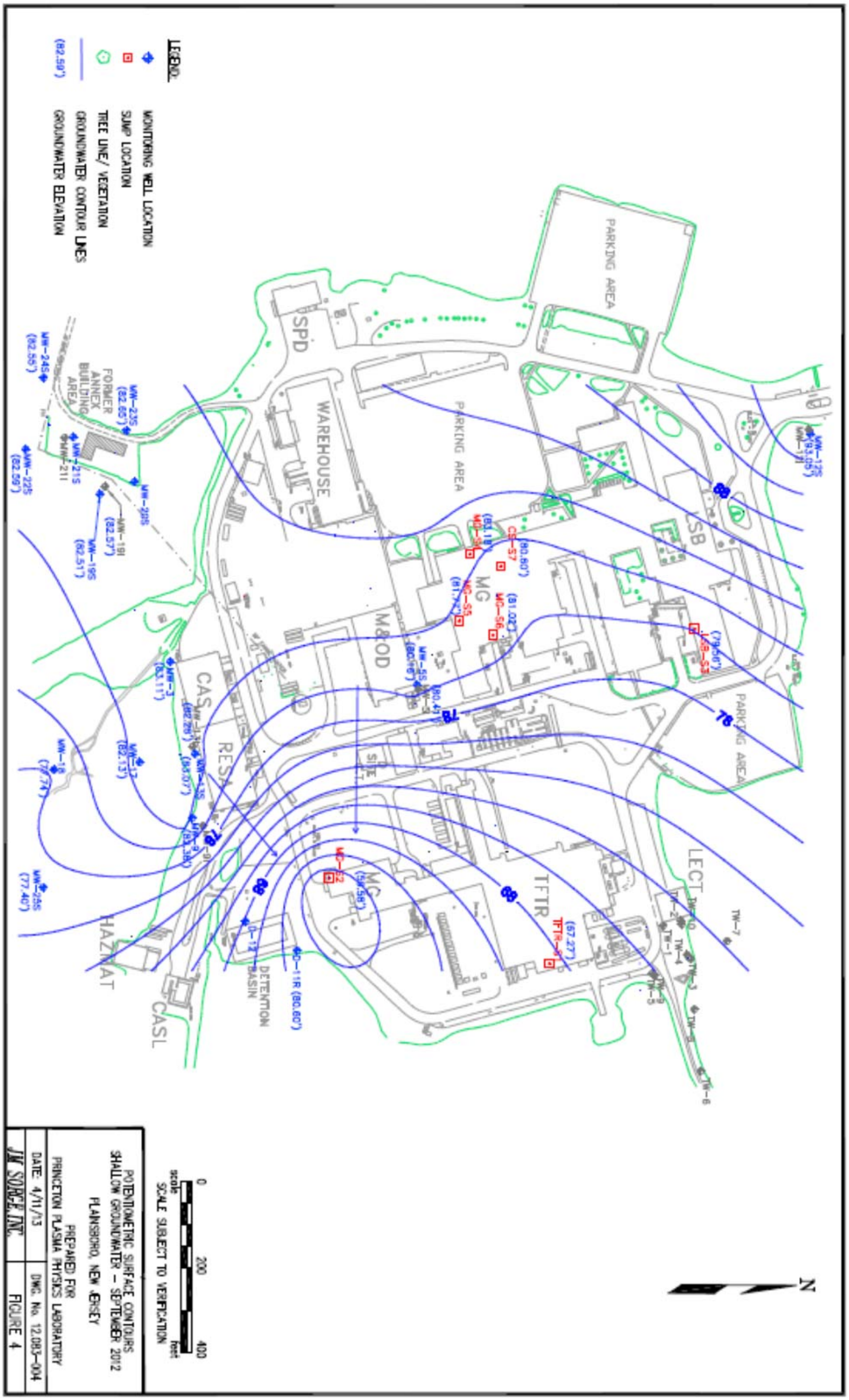
Exhibit 6-7: PCE Concentration vs. Time at MW-19S (1998-2012)



6.6 Drinking Water Protection

PPPL and the surrounding area do not rely on on-site or shallow supply wells for potable water. All potable water in the immediate area of the Laboratory is provided by New Jersey American Water Company. New Jersey American Water Company is supplied by a variety of sources, including surface water intakes and deep supply wells located throughout its service area. The nearest wells supplying water to New Jersey American are located approximately 2 miles south-southwest of the Laboratory near the Millstone River. As discussed above, ground water contaminated with PCE and other organic chemicals is captured by the building foundation drains and is not migrating offsite.


LEGEND:
MONITORING WELL LOCATION
SUMP LOCATION
TREE LINE/ VEGETATION
(ND) PCE CONCENTRATION (ppb)
PARKING AREA
SPD
WAREHOUSE
LSB
MG
M&OD
CAS
RESA
TFTR
LECT
HAZMAT
CASL
DETENTION BASIN
FORMER ANNEX BUILDING AREA
0
200
400
scale
feet
SCALE SUBJECT TO VERIFICATION
PCE DISTRIBUTION IN SHALLOW GROUNDWATER
SEPTEMBER 2012
PLAINSBORO, NEW JERSEY
PREPARED FOR
PRINCETON PLASMA PHYSICS LABORATORY
DATE: 4/16/13
DWG. No. 12.063-008
JM SORGE INC.
FIGURE 8
N


LEGEND:
MONITORING WELL LOCATION
SUMP LOCATION
TREE LINE/ VEGETATION
GROUNDWATER CONTOUR LINES
(82.59') GROUNDWATER ELEVATION
PARKING AREA
SPD
WAREHOUSE
LSB
MG
M&OD
CAS
RESA
TFTR
LECT
HAZMAT
CASL
DETENTION BASIN
FORMER ANNEX BUILDING AREA
SCALE SUBJECT TO VERIFICATION
0
200
400
feet
POTENTIOMETRIC SURFACE CONTOURS
SHALLOW GROUNDWATER – SEPTEMBER 2012
PLAINSBORO, NEW JERSEY
PREPARED FOR
PRINCETON PLASMA PHYSICS LABORATORY
DATE: 4/11/13
DWG. No. 12.083-004
JM SORGE, INC.
FIGURE 4

Chapter

7

QUALITY ASSURANCE

As required by DOE Order 450.1, Environmental Protection Program, PPPL has established a Quality Assurance/Quality Control (QA/QC) Program to ensure that the accuracy, precision, and reliability of environmental monitoring data are consistent

In 2012, analyses of environmental samples for radioactivity and other non radiological parameters were conducted by PPPL's on-site analytical laboratory (Exhibits 7-1 & 7-2).

Exhibit 7-1. PEARL Chlorine Standard Check for Accuracy

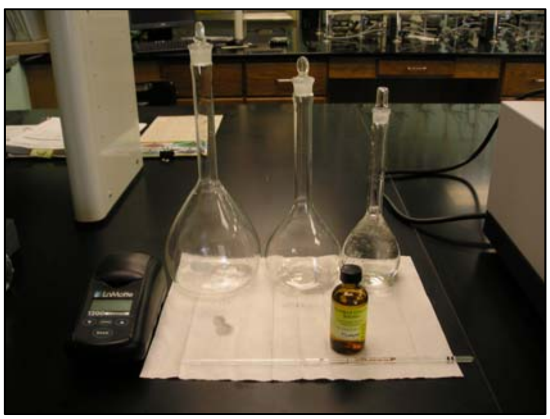


Exhibit 7-2. Distilling Samples for Tritium Analysis Performed at PEARL

The PEARL procedures follow the DOE's Environmental Measurements Laboratory's *EML HASL-300 Manual* [Vo82], EPA's *Methods and Guidance for Analysis of Water* [EPA99] *and Standard Methods of Water and Wastewater Analysis* [SM11] that are nationally recognized standards.

7.1 Lab Certification - Proficiency Testing

Beginning in 1984, PPPL participated in a NJDEP certification program initially through the USEPA QA program. In March 1986, EPA/Las Vegas and NJDEP reviewed PPPL's procedures and inspected its facilities. The laboratory became certified for tritium analysis in urine (bioassays) and water. In 2001, USEPA turned the QA program over to the states; NJDEP chose a contractor laboratory, ERA, to supply the radiological proficiency tests.

A. Radiological

To maintain its radiological certification, PPPL participates in a National Institute for Standards and Technology's (NIST) National Voluntary Laboratory Accreditation Program (NVLAP) accredited radiochemistry proficiency testing program twice annually in 2012. Cesium, cobalt and zinc use a gamma spectroscopy technique while tritium uses a distillation and liquid scintillation method (Exhibit 7-3) (Table 23) [PPPL12a].

Exhibit 7-3 NJDEP Radiological Certified Parameters 2012

Parameter	Approved Method
Cesium 134/137	SM 7120
Cobalt 60	SM 7120
Zinc 65	SM 7120
Tritium	EPA 906.0

B. Non-Radiological Parameters

For non-radiological parameters, PPPL participates in NJDEP Laboratory Certification program (NJ ID #12471) (Exhibit 7-4). A requirement of the certification program is to analyze within the acceptance range the quality control (QC) and proficiency test (PT) samples that are purchased from outside laboratory suppliers. These PT samples are provided as blind samples for analysis; the test results are submitted prior to the end of the study. Results are supplied to PPPL and NJDEP to confirm a laboratories' ability to correctly analyze those parameters being tested. In Table 23, the radiological and non-radiological proficiency testing (PT) results show that all PEARL's results were in the acceptable range

Exhibit 7-4. NJDEP Non-Radiological Certified Parameters 2012

Parameter	Approved Method
Specific Conductance	SM 2510 B
Chlorine	SM 4500-Cl G
Oxygen (dissolved, membrane)	SM 4500-O G
pH	SM 4500-H B
Temperature	SM 2550 B

7.2 Subcontractor Labs

PPPL followed its internal procedures, EM-OP-31—"Surface Water Sampling Procedure," and EM-OP-38—"Ground Water Sampling Procedures." These procedures provide detailed descriptions of all NJPDES permit-required sampling and analytical methods for collection of samples, analyses of these samples, and quality assurance/quality control requirements. Chain-of-custody forms are required for all samples; holding times are closely checked to ensure that analyses are performed within established holding times and that the data is valid; trip blanks are required for all volatile organic compound analyses.

Subcontractor laboratories used by PPPL are certified by NJDEP and participate in the state's QA program; the subcontractor laboratories must also follow their own internal quality assurance plans. QC Laboratories and Accutest Laboratories where used in 2012 for environmental laboratory analysis. Hazardous waste sample analyses were conducted by Precision Testing.

7.3 Internal QA/QC

A. Internal Audit

PPPL did not participate in any internal audits for PEARL operations in 2012 [Ya13].

B. Internal QA Check

Temperature calibrations are conducted quarterly with National Institute of Standards and Techonology (NIST) Thermometer. Temperature on all pH and dissolved oxygen meters are calibrated against NIST.

Chlorine field meters are calibrated at least annually by chlorine standard concentrations. Annual Accuracy and Precisions Reports are generated to evaulate concentration standards data. Prior use, the chlorine field meter is checked once monthly verified prior to NJPDES sampling by calibrated LaMotte Secondary Standards.

Dissolved oxygen (DO) meter is calibrated and QA checked by performting DO Titration. The Winker Titration Kit is performed against field sample of DO to check sample accuracy.

C. Calibrations

PPPL calibrates all equipment per equipment manual and following HP-LAB-03 Procedure. Calibrations are recorded in lab calibration log and reported to Head QA Officer for review.

D. Chemicals

Chemical inventories are performed quarterly to insure proper storage, expiration and quantity checks. Chemical name, stock number, lot number, date received, date opened and expiration date are all checked to ensure chemical quality for calibration.

7.4 External QA/QC

No external audits were completed in 2012. In May 2011, NJDEP Office of Quality Assurance (OQA) audited PPPL's Princeton Environmental, Analytical and Radiological Laboratory, PEARL. The next anticipated NJDEP Audit will be in 2013. PEARL conducts analyses for Analyze-Immediately parameters to support the New Jersey Pollutant Discharge Elimination System (NJPDES) permit requirements and radiological parameters for internal samples.

Chapter

8

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Chapter

9

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Appendix

A

TABLES for 2012

Table 1. PPPL Radiological Design Objectives and Regulatory Limits[(a)]

CONDITION		PUBLIC	EXPOSURE[(b)]	OCCUPA-TIONAL	EXPOSURE
		REGULATORY LIMIT	DESIGN OBJECTIVE	REGULATORY LIMIT	DESIGN OBJECTIVE
ROUTINE OPERATION Dose equivalent to an individual from routine operations (rem per year, unless otherwise indicated)	NORMAL OPERATIONS	0.1 Total, 0.01[(c)] Airborne, 0.004 Drinking Water	0.01 Total	5	1
	ANTICIPATED EVENTS ($1 > P \geq 10^{-2}$)	0.5 Total (including normal operation)	0.05 per event		
ACCIDENTS Dose equivalent to an individual from an accidental release (rem per event)	UNLIKELY EVENTS $10^{-2} > P \geq 10^{-4}$	2.5	0.5	(e)	(e)
	EXTREMELY UNLIKELY EVENTS $10^{-4} > P \geq 10^{-6}$	25	5[(d)]	(e)	(e)
	INCREDIBLE EVENTS $10^{-6} > P$	NA	NA	NA	NA

P = Probability of occurrence in a year.

(a) All operations must be planned to incorporate radiation safety guidelines, practices and procedures included in PPPL ESHD 5008, Section 10.

(b) Evaluated at PPPL site boundary.

(c) Compliance with this limit is to be determined by calculating the highest effective dose equivalent to any member of the public at any offsite point where there is a residence, school, business or office

(d) For design basis accidents (DBAs), i.e., postulated accidents or natural forces and resulting conditions for which the confinement structure, systems, components and equipment must meet their functional goals, the design objective is 0.5 rem.

(e) See PPPL ESHD-5008, Section 10, Chapter 10.1302 for emergency personnel exposure limits.

Table 2. Annual Precipitation Data for 2012

START DATE	WEEK	INCH	CUM. INCHES	TOTAL	MONTHLY TOTAL
3-Jan-12	1	0.00	0.00		
10-Jan-12	2	0.00	0.00		
17-Jan-12	3	2.00	2.00		
24-Jan-12	4	0.42	2.42		
31-Jan-12	5	0.81	3.23	3.2300	**JANUARY**
7-Feb-12	6	0.04	3.27		
14-Feb-12	7	0.36	3.63		
21-Feb-12	8	0.13	3.76		
28-Feb-12	9	0.21	3.97	0.7400	**FEBRUARY**
6-Mar-12	10	0.42	4.39		
13-Mar-12	11	0.20	4.59		
20-Mar-12	12	0.00	4.59		
27-Mar-12	13	0.20	4.79	0.8200	**MARCH**
3-Apr-12	14	1.55	6.34		
10-Apr-12	15	0.02	6.36		
17-Apr-12	16	0.02	6.38		
24-Apr-12	17	2.12	8.50	3.7100	**APRIL**
1-May-12	18	0.01	8.51		
8-May-12	19	1.50	10.01		
15-May-12	20	1.25	11.26		
22-May-12	21	1.38	12.64		
29-May-12	22	0.82	13.46	4.9600	**MAY**
5-Jun-12	23	1.34	14.80		
12-Jun-12	24	0.98	15.78		
19-Jun-12	25	0.01	15.79		
26-Jun-12	26	0.75	16.54	3.0800	**JUNE**
3-Jul-12	27	0.02	16.56		
10-Jul-12	28	0.62	17.18		
17-Jul-12	29	0.20	17.38		
24-Jul-12	30	1.37	18.75		
31-Jul-12	31	1.18	19.93	3.3900	**JULY**
7-Aug-12	32	0.86	20.79		
14-Aug-12	33	1.50	22.29		
21-Aug-12	34	0.59	22.88		
28-Aug-12	35	0.90	23.78	3.8500	**AUGUST**
4-Sep-12	36	0.29	24.07		
11-Sep-12	37	0.28	24.35		
18-Sep-12	38	1.39	25.74		
25-Sep-12	38	0.21	25.95	2.1700	**SEPTEMBER**
2-Oct-12	39	0.57	26.52		
9-Oct-12	40	0.24	26.76		
16-Oct-12	41	0.90	27.66		
23-Oct-12	42	0.94	28.60		
30-Oct-12	44	3.20	31.80	5.8500	**OCTOBER**
6-Nov-12	45	0.51	32.31		
13-Nov-12	46	0.00	32.31		
20-Nov-12	47	0.07	32.38		
27-Nov-12	48	0.78	33.16	1.3600	**NOVEMBER**
4-Dec-12	49	0.07	33.23		
11-Dec-12	50	0.68	33.91		
18-Dec-12	51	0.53	34.44		
25-Dec-12	52	3.36	37.80		
1-Jan-13	53	1.08	38.88	5.7200	**DECEMBER**

Table 3. D–Site Tritium Stack Releases in Curies in 2012

Week Ending	HTO (Ci)	HT (Ci)	Weekly Total (Ci)	Annual Total (Ci)
1/12/2012	0.284	0.0168	0.3008	0.3008
1/19/2012	0.727	0.0458	0.7728	1.0736
2/9/2012	0.256	0.0139	0.2699	1.3435
2/22/2012	0.174	0.00829	0.18229	1.52579
2/29/2012	0.0718	1.58	1.6518	3.17759
3/7/2012	0.0736	0.0047	0.0783	3.25589
3/14/2012	0.0956	0.434	0.5296	3.78549
3/21/2012	0.0943	0.00493	0.09923	3.88472
3/28/2012	0.107	0.815	0.922	4.80672
4/4/2012	0.074	0.00209	0.07609	4.88281
4/11/2012	0.0402	0.00341	0.04361	4.92642
4/18/2012	0.0875	0.715	0.8025	5.72892
4/28/2012	0.057	0.0273	0.0843	5.81322
5/9/2012	0.0556	0.445	0.5006	6.31382
5/17/2012	0.0571	0.0112	0.0683	6.38212
5/23/2012	0.0525	0.0008	0.0533	6.43542
5/30/2012	0.0619	0.00263	0.06453	6.49995
6/6/2012	0.0441	0.00327	0.04737	6.54732
6/13/2012	0.0634	0.00383	0.06723	6.61455
6/20/2012	0.0578	1.15	1.2078	7.82235
6/27/2012	0.0656	0.00291	0.06851	7.89086
7/5/2012	0.0752	0.405	0.4802	8.37106
7/11/2012	0.0561	0.00133	0.05743	8.42849
7/18/2012	0.0663	0.00254	0.06884	8.49733
7/25/2012	0.0726	0.0029	0.0755	8.57283
8/1/2012	0.0697	0.488	0.5577	9.13053
8/15/2012	0.0572	7.06	7.1172	16.24773
8/22/2012	0.0538	0.00205	0.05585	16.30358
8/29/2012	0.0643	0.0031	0.0674	16.37098
9/5/2012	0.0471	0.002	0.0491	16.42008
9/12/2012	0.0434	0.0013	0.0447	16.46478
9/19/2012	0.0455	0.0019	0.0474	16.51218
9/26/2012	0.0436	0.0014	0.045	16.55718
10/3/2012	0.0403	0.0017	0.042	16.59918
10/10/2012	0.047	0.002	0.049	16.64818
10/17/2012	0.0493	0.0095	0.0588	16.70698
10/24/2012	0.0485	0.0014	0.0499	16.75688
10/29/2012	0.0429	0.0027	0.0456	16.80248
11/7/2012	0.0429	10	10.0429	26.84538
11/14/2012	0.0455	0.00145	0.04695	26.89233
11/21/2012	0.0438	0.00118	0.04498	26.93731
11/28/2012	0.0309	0.00226	0.03316	26.97047
12/5/2012	0.337	0.808	1.145	28.11547
12/12/2012	0.0348	0.00059	0.03539	28.15086
12/19/2012	0.0449	0.0181	0.063	28.21386
1/2/2013	0.0838	0.00242	0.08622	28.30008
Total	**4.1864**	**24.11368**	**28.30008**	

Table 4. Ground Water Tritium Concentrations for 2012 (in picoCuries/Liter)

TW wells are sampled quarterly and sumps are taken monthly

Well No. or Sump Location	Well TW-1	Well TW-5	Well TW-8	Air Shaft Sump	D-site MG Sump
January	*	*	*	*	165
April	*	*	*	130	130
August	*	*	*	*	125
December	*	*	*	*	*
Monthly Average	71.9	64.7	54.5	62.6	97.7

**All sample dates not listed or shown without a number, are below LLD*

Table 5. Surface Water Tritium Concentrations for 2012 (in picoCuries/liter)

Sample Location	Bee Brook (B1)	Bee Brook (B2)	Basin (DSN001)	D&R Canal (C1)	D&R Canal (DSN003)	E1	M1	P1	P2
January	*	*	188	*	*	*	*	*	*
February	*	*	*	*	*	*	*	*	*
March	*	*	*	*	*	*	*	*	*
April	*	*	148	*	*	*	*	*	*
May	*	*	*	*	*	*	*	*	*
June	*	*	*	*	*	*	*	*	*
July	*	*	*	*	*	*	*	*	*
August	*	*	*	*	*	*	*	*	*
September	*	*	*	*	*	*	*	*	*
October	*	*	*	*	*	*	*	*	*
November	*	*	*	*	*	*	*	*	*
December	*	*	*	*	*	*	*	*	*
Monthly Average	61.7	61.7	69.9	42.9	37.2	49.4	29.6	50.5	33.03

Sample locations B1, B2, E1, M1, P1, and P2 are taken quarterly

Sample locations DSN001, DSN003, and C1 are taken monthly

** All sample dates not listed or shown without a number, were below the LLD*

Table 6. Rain Water Tritium Concentrations (in picoCuries/liter) Collected On-Site in 2012

250 feet from Stack	R1E (East)	R1W (West)	R1S (South)	R1N (North)	R1ND (Duplicate)
January	*	177	*	*	*
February	*	*	*	*	*
March	*	169	*	*	*
April	*	*	*	*	*
May	*	*	*	*	*
June	*	*	*	*	*
July	119	*	*	*	*
August	*	*	*	*	*
October	*	*	*	*	*
November	-	148	*	*	*
December	128	*	166	*	*
Monthly Average	75.4	82.4	50.33	45.6	54.5

500 feet from Stack	R2E (East)	R2W (West)	R2S (South)	R2N (North)
January	*	*	*	-
February	*	-	*	*
March	*	*	*	*
April	*	*	*	*
May	*	*	*	*
June	*	*	*	*
July	*	*	*	*
August	*	*	*	*
October	*	*	*	*
November	*	*	*	*
December	*	*	182	*
Monthly Average	68.2	43.1	78.2	61.1

All rain water samples are taken monthly

** All sample dates not listed or shown without a number, were below the LLD*

- No sample taken for date

Table 7. Annual Range of Tritium Concentration at PPPL in Precipitation from 1985 to 2012

Year	Tritium Range picoCuries/Liter	Precipitation In Inches	Difference from Middlesex County Avg. Precipitation of 46.5 inches/yr
1985	40 to 160		
1986	40 to 140		
1987	26 to 144		
1988	34 to 105		
1989	7 to 90	55.4	+8.8
1990	14 to 94	50.3	+3.8
1991	10 to 154	45.1	-1.5
1992	10 to 838	41.9	-4.6
1993	25 to 145	42.7	-3.8
1994	32 to 1,130	51.3	+4.8
1995	<19 to 2,561	35.6	-10.9
1996	<100 to 21,140	61.0	+14.5
1997	131 to 61,660	42.0	-4.5
1998	<108 to 26,450	42.9	-3.6
1999	<58 to 7,817	47.3	+0.8
		(38.7 w/out Floyd)	(-7.8)
2000	<31 to 3,617	38.7	-7.8
2001	153 to 14,830	32.8	-13.7
2002	24 to 3,921	47.9	+1.4
2003	9 to 1,126	54.7	+8.2
2004	27 to 427	40.5	-6.0
2005	<37 to 623	48.4	+1.9
2006	9 to 3,600	48.1	+1.6
2007	<93 to 1,440	49.1	+2.6
2008	<103 to 1,212	48.2	+1.7
2009	< Bkg to 375	47.1	+1.6
2010	<105 to 469	40.8	-5.7
2011	<109 to 269	65.1	+18.6
2012	3 to 182	38.9	-7.6

Table 8. Liquid Effluent Collection Tank Release Data for 2012

Sample Date	Gallons Released	Tritium Sample LLD (pCi/L)	Tritium Sample Activity (pCi/L)	Total Tank Activity (Ci)	Annual Cumulative Activity (Ci)
3/5/2012	12,750	335	36,300	0.001750	0.001750
6/8/2012	12,750	330	63,500	0.00307	0.004820
7/2/2012	12,750	326	40,500	0.00195	0.006770
7/23/2012	12,750	335	36,300	0.00168	0.008450
8/7/2012	12,750	329	51700	0.0025	0.010950
8/20/2012	12,750	316	41900	0.00202	0.012970
9/14/2012	12,750	350	34700	0.00167	0.014640
10/16/2012	12,750	298	62200	0.003	0.017640
Total Gallons	102,000				

Table 9. Total Fuel Consumption by Fuel Type from 2000 to 2012

Year	*Natural Gas (mmcf)*	*Fuel Oil # 2 or Fuel Oil # 4 (kgals.)*
2000	0.387	42.6
2001	0.367	43
2002	0.331	33.8
2003	0.290	61.9
2004*	0.373	62.3
2005	0.427	32.7
2006	0.319	3.8
2007	0.248	49.6
2008	0.271	41
Permit limit	**0.886**	**227**
2009	0.275	33.6
2010	0.267	17.5
2011	0.230	8.0
2012		
Permit limit	**2.176**	**251**

* Note: No. 2 Fuel oil consumption first began December 2004.
No. 4 Fuel oil no longer burned after December 2004.
mmcf = millions of cubic feet
kgals. = thousands of gallons

Table 10. Surface Water Analysis for Bee Brook, B1, in 2012

Location B1 = Bee Brook upstream of PPPL basin discharge

B1									
Parameters	**Units**		**February**		**May**		**August**		**Nov.**
Ammonia nitrogen as N, NH3	mg/L	<	0.10	<	0.10	<	0.10	<	0.10
Biological Oxygen Demand, BOD	mg/L			<	2.52	<	2.56		
Chemical Oxygen Demand, COD	mg/L		16.00		43.00		25.00		54.00
Kjeldhal N, TKN	mg/L		0.79		1.15		0.90	<	0.60
Nitrogen, total	mg/L		2.58		1.41		1.43		0.86
Nitrite as N, NO2	mg/L	<	0.025	<	0.025	<	0.025	<	0.025
Nitrate as N, NO3	mg/L		1.78	<	0.50		0.52	<	0.50
Phosphorus, total	mg/L	<	0.03		0.038		0.170		0.109
Total Dissolved Solids, TDS	mg/L				163.00		223.00		
Total Organic Carbon, TOC	mg/L		5.10		13.30		1.74		19.30
Total Suspended Solids, TSS	mg/L		3.00		5.00		8.00		4.00
Field Parameters									
pH	SU		6.89		6.73		6.95		6.93
Oxidation-Reduction Potential, ORP	mV		-15.90		-5.50		-13.90		-13.9
Temperature	o C		4.55		11.65		22.90		13.7
Dissolved Oxygen, DO	mg/L		10.97		8.53		5.63		8.63

Table 11. Surface Water Analysis for Bee Brook, B2, in 2012

Location B2 = Bee Brook downstream of PPPL basin discharge

B2									
Parameters	**Units**		**February**		**May**		**August**		**Nov.**
Ammonia nitrogen as N, NH3	mg/L	<	0.10	<	0.10	<	0.10	<	0.10
Biological Oxygen Demand, BOD	mg/L			<	2.52	<	2.56		
Chemical Oxygen Demand, COD	mg/L	<	10.00		39.00		12.00		19.00
Kjeldhal N, TKN	mg/L		0.86		1.49		0.60	<	0.60
Nitrogen, total	mg/L		2.49		3.62		1.65		1.72
Nitrite as N, NO2	mg/L	<	0.025	<	0.025	<	0.025	<	0.025
Nitrate as N, NO3	mg/L		1.62		2.12		1.04		1.11
Phosphorus, total	mg/L	<	0.033		0.243		0.093	<	0.030
Total Dissolved Solids, TDS	mg/L				223.00		306.00		
Total Organic Carbon, TOC	mg/L		3.63		10.70		0.69		4.09
Total Suspended Solids, TSS	mg/L		6.00		7.00		4.00		12.00
Field Parameters									
pH	SU		6.85		7.01		7.78		7.68
Oxidation-Reduction Potential, ORP	mV		-13.70		-21.20		-61.40		-
Temperature	o C		6.40		12.65		23.10		7.45
Dissolved Oxygen, DO	mg/L		11.22		8.95		7.59		11.43

Table 12. Surface Water Analysis for Delaware & Raritan Canal, C1, in 2012

Location C1 = Delaware & Raritan Canal State Park at Mapleton Avenue, Plainsboro midway on pedestrian bridge

C1							
Parameters	**Units**	**January**	**Feb.**	**March**	**April**	**May**	**June**
Ammonia Nitrogen	mg/L		< 0.10			0.11	
BOD	mg/L					< 2.52	
COD	mg/L	< 10.00	< 10.00	10.00	15.00	21.00	31.00
Kjeldhal N, TKN	mg/L		0.83			0.99	
Nitrogen, total	mg/L		1.75			1.63	
Nitrite as N, NO2	mg/L		< 0.025			< 0.025	
Nitrate as N, NO3	mg/L		0.91			0.63	
Phosphorus, total	mg/L	< 0.050	< 0.033	0.082	0.040	0.090	0.11
Total Dissolved Solids	mg/L					117.00	
Total Organic Carbon	mg/L	2.78	2.83	2.88	4.39	4.10	9.09
Total Suspended Solids	mg/L	5.00	8.00	3.00	3.00	27.00	8.00
Field Parameters							
pH	SU	7.16	7.12	7.29	7.13	6.79	6.72
Oxidation-Reduction	mV	-22.10	-	-41.3	-	-9.00	-3.00
Potential			28.10		34.40		
Temperature	o C	1.20	4.65	6.2	13.25	15.40	20.40
Dissolved Oxygen, DO	mg/L	11.89	11.57	12.41	10.23	7.81	5.47

C1							
Parameters	**Units**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
Ammonia Nitrogen	mg/L		< 0.10			< 0.10	
BOD	mg/L		< 2.56				
COD	mg/L	< 10.00	< 10.00	15.00	< 10.00	15.00	13.00
Kjeldhal N, TKN	mg/L		0.63			0.88	
Nitrogen, total	mg/L		1.55			1.48	
Nitrite as N, NO2	mg/L		< 0.025			< 0.025	
Nitrate as N, NO3	mg/L		0.91			0.59	
Phosphorus, total	mg/L	0.07	0.101	0.085	0.065	< 0.030	0.097
Total Dissolved Solids	mg/L		134.00				
Total Organic Carbon	mg/L	3.04	3.06	3.15	3.51	4.64	2.49
Total Suspended Solids	mg/L	4.00	4.00	4.00	6.00	< 2.00	2.00
					3.00		
Field Parameters							
pH	SU	7.14	6.98	6.81	7.01	7.05	6.91
Oxidation-Reduction	mV	-28.10	-15.40	-6.10	-	-	-
Potential					17.60	20.10	11.40
Temperature	o C	27.25	27.00	25.60	19.50	8.10	10.30
Dissolved Oxygen, DO	mg/L	6.73	5.67				11.42

Table 13. Surface Water Analysis for Elizabethtown Water, E1, in 2012

Location E1 = Elizabethtown Water (potable) collected at Main Gate Security Booth

E1					
Parameters	**Units**	**February**	**May**	**August**	**Nov.**
Ammonia nitrogen as N, NH3	mg/L	0.47	0.23	0.32	0.22
Biological Oxygen Demand, BOD	mg/L		< 2.52	< 2.56	
Chemical Oxygen Demand, COD	mg/L	< 10.00	< 10.00	< 10.00	10.00
Kjeldhal N, TKN	mg/L	0.88	0.62	0.84	1.49
Nitrogen, total	mg/L	2.32	1.40	1.56	2.78
Nitrite as N, NO2	mg/L	< 0.025	< 0.025	< 0.025	< 0.025
Nitrate as N, NO3	mg/L	1.43	0.77	0.707	1.28
Phosphorus, total	mg/L	0.310	0.617	0.711	0.815
Total Dissolved Solids, TDS	mg/L		249.00	234.00	
Total Organic Carbon, TOC	mg/L	1.49	1.73	2.06	2.51
Total Suspended Solids, TSS	mg/L	3.00	< 2.00	< 2.00	< 2.00
Field Parameters					
pH	SU	6.87	6.75	6.87	6.77
Oxidation-Reduction Potential, ORP	mV	-14.20	-6.60	-9.10	-4.7
Temperature	o C	13.10	14.85	25.60	17.8
Dissolved Oxygen, DO	mg/L		10.04		

Table 14. Surface Water Analysis for Millstone River, M1, in 2012

Location M1 = Millstone River at Delaware & Raritan Canal State Park at Mapleton Road

M1					
Parameters	**Units**	**February**	**May**	**August**	**Nov.**
Ammonia nitrogen as N, NH3	mg/L	0.30	0.33	0.20	0.34
Biological Oxygen Demand, BOD	mg/L		< 2.52	4.44	
Chemical Oxygen Demand, COD	mg/L	< 10.00	25.00	34.00	22.00
Kjeldhal N, TKN	mg/L	0.87	0.91	1.86	1.75
Nitrogen, total	mg/L	3.14	2.35	2.70	3.17
Nitrite as N, NO2	mg/L	< 0.025	0.035	0.030	0.026
Nitrate as N, NO3	mg/L	2.26	1.42	0.82	1.41
Phosphorus, total	mg/L	0.054	0.095	0.193	0.084
Total Dissolved Solids, TDS	mg/L		134.00	149.00	
Total Organic Carbon, TOC	mg/L	3.76	5.60	6.20	6.72
Total Suspended Solids, TSS	mg/L	9.00	11.00	23.00	5.00
Field Parameters					
pH	SU	6.84	6.65	6.70	6.85
Oxidation-Reduction Potential, ORP	mV	-12.70	-0.10	0.50	-9.7
Temperature	o C	5.55	15.70	26.85	9.1
Dissolved Oxygen, DO	mg/L	10.57	7.48	5.69	8.44

Table 15. Surface Water Analysis for Cranbury Brook (Plainsboro), P1, in 2012

Location P1 = Cranbury Brook at George Davison Road, Plainsboro mid-span on bridge southbound

P1					
Parameters	**Units**	**February**	**May**	**August**	**Nov.**
Ammonia nitrogen as N, NH3	mg/L	0.15	0.24	0.11	0.19
Biological Oxygen Demand, BOD	mg/L		< 2.52	3.64	
Chemical Oxygen Demand, COD	mg/L	11.00	22.00	20.00	20.00
Kjeldhal N, TKN	mg/L	0.90	1.12	0.92	1.39
Nitrogen, total	mg/L	2.79	1.97	1.89	3.87
Nitrite as N, NO2	mg/L	< 0.025	< 0.025	< 0.025	< 0.025
Nitrate as N, NO3	mg/L	1.88	0.84	0.96	2.47
Phosphorus, total	mg/L	0.049	0.115	0.075	0.069
Total Dissolved Solids, TDS	mg/L		126.00	154.00	
Total Organic Carbon, TOC	mg/L	4.34	5.39	5.63	5.28
Total Suspended Solids, TSS	mg/L	21.00	20.00	11.00	7.00
Field Parameters					
pH	SU	6.84	6.58	6.65	6.73
Oxidation-Reduction Potential, ORP	mV	-12.70	2.80	3.60	-3.20
Temperature	o C	5.90	16.00	25.60	6.10
Dissolved Oxygen, DO	mg/L	10.84	8.07	6.45	

Table 16. Surface Water Analysis for Devil's Brook (Plainsboro), P2, in 2012

Location P2 = Devil's Brook at Schalks Road overpass, adjacent to Amtrak railroad tracks

P2					
Parameters	**Units**	**February**	**May**	**August**	**Nov.**
Ammonia nitrogen as N, NH3	mg/L	0.11	< 0.10	< 0.10	< 0.10
Biological Oxygen Demand, BOD	mg/L		< 2.52	< 2.56	
Chemical Oxygen Demand, COD	mg/L	15.00	45.00	< 10.00	31.00
Kjeldhal N, TKN	mg/L	0.91	0.85	0.68	1.08
Nitrogen, total	mg/L	2.16	1.36	4.08	3.37
Nitrite as N, NO2	mg/L	< 0.025	< 0.025	< 0.025	< 0.025
Nitrate as N, NO3	mg/L	1.24	< 0.50	3.39	2.28
Phosphorus, total	mg/L	< 0.033	0.049	0.022	0.033
Total Dissolved Solids, TDS	mg/L		91.00	169.00	
Total Organic Carbon, TOC	mg/L	6.33	12.40	4.41	10.50
Total Suspended Solids, TSS	mg/L	3.00	6.00	4.00	< 2.00
Field Parameters					
pH	SU	6.92	6.56	6.75	6.70
Oxidation-Reduction Potential, ORP	mV	-17.50	4.00	-2.70	-1.50
Temperature	o C	5.15	15.10	22.25	5.00
Dissolved Oxygen, DO	mg/L	10.19	7.75	7.08	

Table 17. DSN001 - Retention Basin Outfall Surface Water Analysis (NJPDES NJ0023922) in 2012

DSN001							
Parameters	**Units**	**January**	**Feb.**	**March**	**April**	**May**	**June**
Ammonia nitrogen as N, NH3	mg/L		0.10			0.13	
BOD	mg/L					< 2.52	
COD	mg/L	< 10.00	< 10.00	< 10.00	< 10.00	15.00	10.00
Kjeldhal N, TKN	mg/L		0.86			2.11	
Nitrogen, total	mg/L		2.28			8.12	
Nitrite as N, NO2	mg/L		< 0.025			< 0.025	
Nitrate as N, NO3	mg/L		1.41			6.00	
Phosphorus, total	mg/L	< 0.050	0.038	0.087	0.050	0.750	0.059
Tetrachloroethylene, PCE	ug/L	J 0.23	J 0.25	< 0.19	J 0.22	J 0.34	< 0.19
Total Petroleum Hydrocarbon	mg/L	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
Total Dissolved Solids, TDS	mg/L					383.00	
Total Organic Carbon, TOC	mg/L	< 1.00	1.04	0.818	2.23	4.47	2.43
Total Suspended Solids, TSS	mg/L	2.00	6.00	2.00	3.00	4.00	2.00
Field Parameters							
Chlorine Produced Oxidants,	mg/L	0.03	0.02	0.09	0.06	0.04	0.03
CPO Avg		0.06	0.03	0.04	0.08	0.05	0.03
pH	SU	7.24	7.14	7.43	7.41	7.90	7.62
Oxidation-Reduction Potential	mV	-26.50	-29.4	-49	-50.4	-71.50	-54.4
Temperature	o C	10.75	13.40	11.15	12.30	15.60	16.00
Dissolved Oxygen, DO	mg/L	10.65	9.50	11.35	10.45	9.70	9.50

DSN001							
Parameters	**Units**	**July**	**August**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
Ammonia nitrogen as N, NH3	mg/L		< 0.1			< 0.1	
Biological Oxygen Demand, BOD	mg/L		< 2.56				
Chemical Oxygen Demand, COD	mg/L	< 10.00	10.00	16.00	< 10.00	< 10.00	11.00
Kjeldhal N, TKN	mg/L		< 0.6			< 0.6	
Nitrogen, total	mg/L		1.365			1.6333	
Nitrite as N, NO2	mg/L		0.025			< 0.025	
Nitrate as N, NO3	mg/L		1.04			1.32	
Phosphorus, total	mg/L	0.122	0.037	0.099	0.075	0.038	0.132
Tetrachloroethylene, PCE	ug/L	J 0.27	J 0.42	J 0.19	0.28	< 0.31	< 1.00
				0.31			
Total Petroleum Hydrocarbon	mg/L	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
Total Dissolved Solids, TDS	mg/L		300.00				
Total Organic Carbon, TOC	mg/L	2.09	2.01	3.7	2.39	1.22	1.49
Total Suspended Solids, TSS	mg/L	6.00	12.00	5.00	4.00	3.00	< 2.00
Field Parameters							
Chlorine Produced Oxidants,	mg/L	0.06	0.06	0.08	0.05	0.01	0.03
CPO Avg		0.12	0.06	0.08	0.06	0.01	
pH	SU	7.75	8.62	8.08	8.20	7.50	7.82
Oxidation-Reduction Potential	mV	-62.80	-109.8	-79.0	-85.0	-45.00	-61.6
Temperature	o C	23.45	23.45	22.65	18.35	9.25	13.85
Dissolved Oxygen, DO	mg/L	14.03	11.10	8.67	9.17	10.30	11.17

Table 18. D&R Canal Pump House - DSN003 Monthly Surface Water Analysis (NJPDES NJ0023922) in 2012

DSN003							
Parameters	**Units**	**January**	**Feb.**	**March**	**April**	**May**	**June**
Ammonia nitrogen as N, NH3	mg/L		< 0.10			0.12	
Biological Oxygen Demand	mg/L					< 2.52	
Chemical Oxygen Demand	mg/L	< 10.00	13.00	< 10.00	11.00	21.00	18.00
Kjeldhal N, TKN	mg/L		0.91			0.89	
Nitrogen, total	mg/L		1.76			1.53	
Nitrite as N, NO2	mg/L		< 0.025			< 0.025	
Nitrate as N, NO3	mg/L		0.84			0.63	
Phosphorus, total	mg/L	< 0.05	0.096	0.155	0.129	0.059	0.141
Total Petroleum Hydrocarbon	mg/L	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
Total Dissolved Solids, TDS	mg/L					117.00	
Total Organic Carbon, TOC	mg/L	2.96	3.86	3.1	3.91	4.09	5.70
Total Suspended Solids, TSS	mg/L	3.00	12.00	5.00	7.00	9.00	7.00
Field Parameters							
Chlorine Produced Oxidants	mg/L	0.04	0.01	0.00	0.08	0.050	0.00
pH	SU	6.89	6.94	6.94	7.05	6.71	6.72
Oxidation-Reduction Potential	mV	-7.80	-18.5	-22.1	-30.2	-4.30	-2.6
Temperature	o C	3.05	4.95	5.7	14.25	15.30	21.70
Dissolved Oxygen, DO	mg/L	10.56	8.95	10.24	7.53	7.31	5.64

DSN003							
Parameters	**Units**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
Ammonia nitrogen as N, NH3	mg/L		< 0.10			< 0.10	
Biological Oxygen Demand	mg/L		< 2.56				
Chemical Oxygen Demand	mg/L	12.00	11.00	10.00	< 10.00	17.00	< 10.00
Kjeldhal N, TKN	mg/L		1.04			< 0.60	
Nitrogen, total	mg/L		1.90			1.23	
Nitrite as N, NO2	mg/L		< 0.025			< 0.03	
Nitrate as N, NO3	mg/L		0.85			0.62	
Phosphorus, total	mg/L	0.106	0.116	0.104	0.212	0.099	0.167
Total Petroleum Hydrocarbon	mg/L	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
Total Dissolved Solids, TDS	mg/L		120.00				
Total Organic Carbon, TOC	mg/L	3.08	3.19	3.18	3.61	4.77	2.56
Total Suspended Solids, TSS	mg/L	4.00	5.00	5.00	91.00 4.00	4.00	3.00
Field Parameters							
Chlorine Produced Oxidants	mg/L	0.02	0.020	0.01	0.00	0.01	0.02,0.02
pH	SU	6.90	6.99	6.84	6.89	6.75	6.84
Oxidation-Reduction Potential	mV	-19.60	-17.90	-7.80	-12.7	-3.90	-7.20
Temperature	o C	26.45	26.60	25.50	20.50	11.35	13.45
Dissolved Oxygen, DO	mg/L	4.69	4.17	4.48	5.35	6.70	6.23

Blank indicates no measurement   *NA = not applicable*   *NL = no limit*

Table 19. Summary of Ground Water Sampling Results –March 2012
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-3S	MW-5S	MW-5I	MW-9S	MW-13S	MW-17	MW-18	MW-19S	MW-25	MW-26 *	D-MG Sump	TB-3/6/12	TB-3/7/12	NJ Ground
PPPL Sample No.		12-088	12-089	12-090	12-091	12-092	12-093	12-094	12-095	12-096	12-097	12-098	12-085	12-099	Water
Target Volatile Organic Compounds (µg/L)															
Tetrachloroethylene		<0.19	0.52	<0.31	**17.2**	**26.8**	**5.52**	0.19 J	**76.5**	0.35 J	**27.1**	**18.8**	<0.19	<0.31	1
Trichloroethylene		<0.12	<0.34	**2.24**	**5.36**	**10.5**	0.50 J	<0.12	**3.51**	0.22 J	**10.9**	**2.12**	<0.12	<0.34	1
c-1,2-Dichloroethylene		ND	ND	3.52 JN	ND	8.38 JN	ND	ND	ND	ND	8.21 JN	ND	ND	ND	70
t-1,2-Dichloroethylene		<0.19	<0.29	<0.29	<0.19	<0.19	<0.19	<0.19	<0.29	<0.19	<0.19	<0.19	<0.19	<0.29	100
1,1,1-Trichloroethane		<0.19	<0.26	<0.26	0.28 J	0.22 J	<0.19	<0.19	<0.26	<0.19	0.21 J	<0.19	<0.19	<0.26	30
1,1-Dichloroethylene		<0.19	<0.32	<0.32	<0.19	0.37 J	<0.19	<0.19	<0.32	<0.19	0.35 J	0.32 J	<0.19	<0.32	1
Chloroform		<0.12	<0.29	<0.29	0.64 J	0.5 J	<0.12	0.23 J	<0.29	<0.12	0.53 J	0.24 J	<0.12	<0.29	70
Vinyl Chloride		<0.22	<0.38	<0.38	<0.22	<0.22	<0.22	<0.22	<0.38	<0.22	<0.22	<0.22	<0.22	<0.38	1
Tentatively Identified Compounds (µg/L)															
Unknown		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--
1,1,2-Trichloro-1,2,2-Trifluoroethane		ND	ND	ND	4.30 JN	37.00 JN	ND	ND	ND	ND	36.50 JN	ND	ND	ND	--
1,2-Dichloro-1,1,2-Trifluoroethane		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--
Natural Attenuation Indicators															
Chloride	mg/L	14.1	160	**287**	11.9	63	9.06	13.1	6.27	120	62.9	171			250
Manganese	mg/L	**1.29**	0.0021	**0.491**	0.0027	**1.75**	**0.135**	**0.162**	0.0481	**2.52**	**1.77**	**1.06**			0.05
Alkalinity	mg/L	171	22.2	142	60.3	49.7	86.2	26.4	25	86.8	50.7	106			--
Nitrate as N	mg/L	<0.500	1.41	<0.500	<0.500	<0.500	<0.500	<0.500	0.26	<0.500	<0.500	0.953			10
Nitrite	mg/L	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200			1
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100			--
Sulfate	mg/L	27.5	12.5	17.4	19.8	16.9	13.9	28	33.8	21.7	16.7	18.7			250
Total Organic Carbon	mg/L	16.9	0.517	0.522	<2.50	1.25	0.762	1.47	1.85	2.3	1.16	0.962			--
Ferrous Iron	mg/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.32			--
Dissolved Methane	ug/L	8.2	<0.11	1.1	<0.11	6.3	<0.11	<0.11	0.82	2.4	10.7	5.7	0.51	0.59	--
Dissolved Ethane	ug/L	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	--
Dissolved Ethene	ug/L	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	--
Dissolved Oxygen	mg/L	0.53	4.97	4.11	1.65	2.48	6.04	5.62	5.39	13.48	2.48				--
pH	Std. Units	5.95	6.03	7.05	6.01	5.78	6.42	5.63	5.34	6.38	5.78				--
Redox Potential	mVe	142.2	148	20.7	191.6	145.1	-187	36.8	283.5	258.9	145.1				--

NOTES: J - Estimated, concentration listed greater than the MDL but lower than the lowest standard.
N - Indicates presumptive evidence of the compound's presence.
Ground water quality standards as published in N.J.A.C. 7:9-6.9.

* MW-26 is duplicate sample from well MW-13S
-- Compound-specific Ground Water Quality Standard not published

Table 20. Summary of Ground Water Sampling Results –June 2012
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-3S	MW-5I	MW-5S	MW-9S	MW-13S	MW-17	MW-18	MW-19S	MW-25	D-MG Sump	MW-26 *	TB-6/26	TB-6/27	NJ Ground
PPPL Sample No.		12-154	12-156	12-155	12-157	12-158	12-159	12-160	12-161	12-162	12-164	12-163	12-165	12-165	Water Std
Target Volatile Organic Compounds (µg/L)															
Tetrachloroethylene		0.150 J	0.210 J	**1.11**	**28.2**	**30.5**	**31**	0.300 J	**64**	0.700 J	**29.1**	**27.8**	<0.110	<0.110	1
Trichloroethylene		<0.0800	**1.83**	0.110 J	**6.71**	**12.4**	**1.45**	<0.0800	**3.04**	0.440 J	**3.54**	**11.8**	<0.0800	<0.0800	1
c-1,2-Dichloroethylene		ND	3.73 JN	ND	ND	13.6 JN	ND	ND	ND	ND	ND	13.2 JN	ND	ND	70
t-1,2-Dichloroethylene		<0.160	<0.160	<0.160	<0.160	0.200 J	<0.160	<0.160	<0.160	<0.160	<0.160	0.220 J	<0.160	<0.160	100
1,1,1-Trichloroethane		<0.130	<0.130	<0.130	0.480 J	0.240 J	0.220 J	<0.130	<0.130	<0.130	<0.130	0.220 J	<0.130	<0.130	30
1,1-Dichloroethylene		<0.150	<0.150	<0.150	<0.150	0.430 J	<0.150	<0.150	<0.150	<0.150	0.380 J	0.440 J	<0.150	<0.150	2
Chloroform		<0.120	<0.120	<0.120	0.960 J	0.530 J	0.800 J	<0.120	<0.120	<0.120	0.160 J	0.570 J	<0.120	<0.120	6
Vinyl Chloride		<0.140	<0.140	<0.140	<0.140	0.740 J	<0.140	<0.140	<0.140	<0.140	<0.140	0.670 J	<0.140	<0.140	2
Tentatively Identified Compounds (µg/L)															
Unknown		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--
1,1,2-Trichloro-1,2,2-Trifluoroethan		ND	ND	ND	3.61 JN	29.9 JN	ND	ND	ND	ND	ND	28.2 JN	ND	ND	--
1,2-Dichloro-1,1,2-Trifluoroethane		ND	ND	ND	ND	3.31 JN	ND	ND	ND	ND	ND	3.21 JN	ND	ND	--
Natural Attenuation Indicators															
Chloride	mg/L	11	**261**	74.1	16.6	59.2	11.7	14.2	6.35	111	182	59.2	-	-	250
Manganese	mg/L	**1.72**	**0.465**	0.0067	0.0219	**2.76**	0.028	**0.212**	0.0427	**5.8**	**1.63**	**2.64**	-	-	0.05
Alkalinity	mg/L	198	130	20.5	40.5	56.6	20.9	17.3	15.5	81.8	97.2	56	-	-	--
Nitrate as N	mg/L	<0.500	<0.500	1.41	<0.100	<0.500	<0.100	<0.100	<0.500	<0.500	0.954	<0.500	-	-	10
Nitrite	mg/L	<0.200	<0.200	<0.200	<0.100	<0.200	<0.100	<0.100	<0.200	<0.200	<0.200	<0.200	-	-	1
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	-	-	--
Sulfate	mg/L	24.9	13.6	10.3	23.5	17.3	23.3	29.9	32.9	27.1	17.5	17	-	-	250
Total Organic Carbon	mg/L	18.7	0.96	1.05	1.32	1.73	1.15	2.07	2.23	2.02	1.6	1.73	-	-	--
Ferrous Iron	mg/L	3.8	<0.20	<0.20	<0.20	5.0	<0.20	<0.20	<0.20	0.36	1.8	5.2	-	-	--
Dissolved Methane	ug/L	67.4	2.1	<0.11	<0.11	27.3	0.21	<0.11	<0.11	3.2	9	26	<0.11	<0.11	--
Dissolved Ethane	ug/L	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	--
Dissolved Ethene	ug/L	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	--
Dissolved Oxygen	mg/L	25.63	6	4.89	1.86	22.15	5.18	8.07	8.03	7.87	-	22.15	-	-	--
pH	Std. Units	5.8	7.12	6.07	5.62	5.72	5.45	5.45	5.15	6.42	-	5.72	-	-	--
Redox Potential	mVe	70.7	-41.2	1576	1596	82	1881	196	241.3	58	-	82	-	-	--

NOTES: J - Estimated, concentration listed greater than the MDL but lower than the lowest standard N - Indicates presumptive evidence of the compound's presence.

* MW-26 is duplicate sample from well MW-13S. Ground water quality standards as published in N.J.A.C. 7:9-6.9-- Compound-specific Ground Water Quality Standard not published

Table 21 Summary of Ground Water Sampling Results – Annual September 2012
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-3S	MW-5I	MW-5S	MW-9S	MW-12S	MW-13S	MW-13I	MW-17	MW-18	MW-19S	MW-19I	NJ GW
PPPL Sample No.		12-216	12-218	12-217	12-219	12-220	12-221	12-222	12-223	12-224	12-225	12-226	Std
Target Volatile Organic Compounds (µg/L)													
Tetrachloroethylene		<0.310	<0.310	0.550 J	**10.8**	<0.310	**21.5**	**4.98**	**33.7**	0.530 J	**91.5**	<0.310	1
Trichloroethylene		<0.340	**1.66**	<0.340	**23.9**	<0.340	**11.1**	<0.340	**1.55**	0.340 J	**3.96**	<0.340	1
c-1,2-Dichloroethylene		N	ND	ND	3.12 JN	ND	10.1 JN	ND	ND	ND	ND	ND	7
t-1,2-Dichloroethylene		<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	1
1,1,1-Trichloroethane		<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	0.280 J	<0.260	<0.260	<0.260	3
1,1-Dichloroethylene		<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	2
Chloroform		<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	0.680 J	0.940 J	<0.290	<0.290	<0.290	6
Vinyl Chloride		<0.380	<0.380	<0.380	<0.380	<0.380	1.3	<0.380	<0.380	<0.380	<0.380	<0.380	2
Tentatively Identified Compounds (µg/L)													
Unknown		ND	ND	ND	ND	ND	4.34 J	ND	ND	ND	ND	ND	-
1,1,2-Trichloro-1,2,2-Trifluoroethane		N	ND	ND	ND	ND	36.8 JN	ND			ND	ND	-
1,2-Dichloro-1,1,2-Trifluoroethane		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
													-
Natural Attenuation Indicators													
Chloride	mg/L	22.5	234	121	16.4	64.4	73.7	16.5	13.1	10.2	6.7	11	2
Manganese	mg/L	**0.569**	**0.429**	**0.726**	**0.0857**	0.00150 B	**3.21**	**0.0741**	0.0356	**0.507**	0.0211	0.0213	0.05
Alkalinity	mg/L	112	103	39.5	102	111	62.3	102	20.9	23.3	23.2	22.1	-
Nitrate as N	mg/L	<0.500	<0.500	1.68	<0.500	3.04	<0.100	<0.500	<0.500	<0.500	<0.500	1.29	1
Nitrite	mg/L	<0.200	<0.0250	<0.0250	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.0250	1
Sulfide	mg/L	<0.100	<0.100	0.108	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	-
Sulfate	mg/L	34.5	8.19	10.5	22.7	12	17.9	20.7	24.9	24.9	32.1	7.74	2
Total Organic Carbon	mg/L	15	1.47	1.73	1.75	1.2	2.35	1.2	1.53	1.49	2.68	1.25	-
Ferrous Iron	mg/L	<0.20	<0.20	<0.20	<0.20	<0.20	8.3	<0.20	<0.20	<0.20	<0.20	<0.20	-
Dissolved Methane	ug/L	1.1	40	<0.11	0.65	<0.11	47.1	<0.11	0.6	1.5	0.25	<0.11	-
Dissolved Ethane	ug/L	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-
Dissolved Ethene	ug/L	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	-
Dissolved Oxygen	mg/L	2.63	2.75	NA	2.95	2.91	2.92	2.75	1.41	5.27	3.49	3.36	-
pH	Std.	5.58	7.27	NA	5.97	7.17	5.63	6.47	5.46	5.72	4.74	5.33	-
Redox Potential	mVe	189.1	-60.5	NA	119.4	226.4	51.2	92.1	180.7	190.5	328.8	242.8	-

NOTES: J - Estimated, concentration listed greater than the MDL but lower than the lowest standard. * MW-26 is duplicate sample from well MW-13S.
Ground water quality standards as published in N.J.A.C. 7:9-6.9 - - Compound-specific Ground Water Quality Standard not published.

Table 21 continued Summary of Ground Water Sampling Results – September 2012
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well Number		MW-22S 12-227	MW-23 12-228	MW-24 12-229	MW-25S 12-230	MW-26 12-231	DSN001 12-232	Dsite MG 12-233	Dsite Air 12-234	TB 9/17 12-235	TB 9/19 12-235	TB 9/20 12-235	TB 9/20 12-235	NJ Ground Water Std.
Target Volatile Organic Compounds (µg/L)														
Tetrachloroethylene		<0.310	<0.310	<0.310	0.810 J	**21.3**	<0.310	**30.7**	**1.5**	<0.310	<0.310	<0.310	<0.310	1
Trichloroethylene		<0.340	<0.340	<0.340	0.420 J	**10**	<0.340	**4.05**	0.390 J	<0.340	<0.340	<0.340	<0.340	1
c-1,2-Dichloroethylene		ND	ND	ND	ND	10.6 JN	ND	ND	ND	ND	ND	ND	ND	70
t-1,2-Dichloroethylene		<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	100
1,1,1-Trichloroethane		<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	<0.260	0.330 J	30
1,1-Dichloroethylene		<0.320	<0.320	<0.320	<0.320	0.380 J	<0.320	0.540 J	<0.320	<0.320	<0.320	<0.320	<0.320	2
Chloroform		<0.290	<0.290	0.540 J	<0.290	<0.290	<0.290	<0.290	0.400 J	<0.290	<0.290	<0.290	<0.290	6
Vinyl Chloride		<0.380	<0.380	<0.380	<0.380	1.34	<0.380	<0.380	<0.380	<0.380	<0.380	<0.380	<0.380	2
Tentatively Identified Compounds)		**(µg/L)**												
Unknown		ND	ND	ND	ND	4.17 J	ND	ND	ND	ND	ND	ND	ND	--
1,1,2-Trichloro-1,2,2-Trifluoroethane		ND	ND	ND	ND	38.7 JN	ND	ND	ND	ND	ND	ND	ND	--
1,2-Dichloro-1,1,2-Trifluoroethane		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--
Natural Attenuation Indicators														
Chloride	mg/L	66.2	6.29	5.44	96.1	75.3	46.9	195	86.5	-	-	-	-	250
Manganese	mg/L	0.0232	0.0479	0.0416	**5.18**	**3.2**	**0.0927**	**1.75**	**0.0702**	-	-	-	-	0.05
Alkalinity	mg/L	5.53	9.26	14	85.9	63.3	64.2	101	128	-	-	-	-	--
Nitrate as N	mg/L	0.979	<0.500	<0.500	<0.500	<0.500	0.648	0.99	1.19	-	-	-	-	10
Nitrite	mg/L	<0.200	<0.0250	<0.0250	<0.200	<0.200	<0.200	<0.0250	<0.0250	-	-	-	-	1
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	-	-	-	-	--
Sulfate	mg/L	20.5	49.5	14.3	29.8	19.3	11	17.6	18.5	-	-	-	-	250
Total Organic Carbon	mg/L	1.59	2.3	1.73	2.16	2.31	4.45	1.9	1.23	-	-	-	-	--
Ferrous Iron	mg/L	<0.20	<0.20	<0.20	0.35	8.2	<0.20	2.4	<0.20	-	-	-	-	--
Dissolved Methane	ug/L	<0.11	<0.11	<0.11	4.1	44.9	0.8	10.5	<0.11	1.1	0.88	0.81	<0.11	--
Dissolved Ethane	ug/L	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	--
Dissolved Ethene	ug/L	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	--
Dissolved Oxygen	mg/L	2.02	NA	NA	3.13	2.92	-	-	-	-	-	-	-	--
pH	Std. Units	5.15	NA	NA	6.44	5.63	-	-	-	-	-	-	-	--
Redox Potential	mVe	289.7	NA	NA	67.9	51.2								--

NOTES: J - Estimated, concentration listed greater than the MDL but lower than the lowest standard. * MW-26 is duplicate sample from well MW-13S.
Ground water quality standards as published in N.J.A.C. 7:9-6.9 -- Compound-specific Ground Water Quality Standard not published.

Table 22 Summary of Ground Water Sampling Results – December 2012
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No. / PPPL Sample No.		MW-3S 13-050	MW-5I 13-052	MW-5S 13-051	MW-9S 13-053	MW-13S 13-054	MW-17 13-055	MW-18 13-056	MW-19S 13-057	MW-25 13-058	D-MG Sump 13-060	MW-26 * 13-059	TB-12/17 13-061	TB-12/18 13-061	TB-12/19 13-061	NJ GW Std
Target Volatile Organic Compounds (ug/L)																
Tetrachloroethylene		<1.00	0.380 J	NS	**4.29**	**21.1**	**24.6**	0.290 J	**124**	0.530 J	**32.2**	**19.9**	<0.110	<0.110	<1.00	1
Trichloroethylene		<1.00	**2.13**	NS	**1.05**	**17.5**	**1.61**	0.160 J	**5.16**	0.130 J	**3.61**	**16.8**	<0.0800	<0.0800	<1.00	1
c-1,2-Dichloroethylene		ND	4.99 JN	NS	ND	21.1 JN	ND	ND	5.89 JN	ND	ND	ND	ND	ND	ND	70
t-1,2-Dichloroethylene		<1.00	<0.160	NS	<0.160	<0.160	<0.160	<0.160	<0.160	<0.160	<0.160	20.7 JN	<0.160	<0.160	<1.00	100
1,1,1-Trichloroethane		<1.00	<0.130	NS	<0.130	0.150 J	0.310 J	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	<0.130	<1.00	30
1,1-Dichloroethylene		<1.00	<0.150	NS	<0.150	<0.150	<0.150	<0.150	<0.150	<0.150	0.500 J	<0.150	<0.150	<0.150	<1.00	2
Chloroform		<1.00	<0.120	NS	<0.120	0.390 J	0.780 J	<0.120	<0.120	0.280 J	<0.120	0.380 J	<0.120	<0.120	<1.00	6
Vinyl Chloride		<1.00	<0.140	NS	<0.140	**2.45**	<0.140	<0.140	<0.140	<0.140	<0.140	**2.22**	<0.140	<0.140	<1.00	2
Tentatively Identified Compounds (ug/L)																
Unknown		ND	ND	NS	ND	ND	ND	ND	ND	ND	ND	5.08 J	ND	ND	ND	--
1,1,2-Trichloro-1,2,2-Trifluoroetha		ND	ND	NS	ND	44.0 JN	ND	ND	ND	ND	ND	41.2 JN	ND	ND	ND	--
1,2-Dichloro-1,1,2-Trifluoroethane		ND	ND	NS	ND	4.79 JN	ND	ND	ND	ND	ND	ND	ND	ND	ND	--
Natural Attenuation Indicators																
Chloride	mg/L	14.3	**459**	NS	9.46	61.1	12.4	10.8	6.29	34.4	184	60.7	-	-	-	250
Manganese	mg/L	NA	**0.661**	NS	0.0058	**2.81**	**0.0914**	**0.441**	0.0181	**1.52**	**2.02**	**2.72**	-	-	-	0.05
Alkalinity	mg/L	NA	146	NS	71.6	66.7	20.5	20.7	29.5	42.5	108	67.3	-	-	-	--
Nitrate as N	mg/L	<0.500	<0.500	NS	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	0.958	<0.500	-	-	-	10
Nitrite	mg/L	<0.0250	<0.0250	NS	<0.0250	<0.0250	0.041	<0.0250	<0.0250	<0.0250	<0.0250	<0.0250	-	-	-	1
Sulfide	mg/L	<0.100	<0.100	NS	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	-	-	-	--
Sulfate	mg/L	23.2	20.9	NS	17.4	17.9	27.3	23.1	29.6	26.2	17.4	17.9	-	-	-	250
Total Organic Carbon	mg/L	NA	0.971	NS	3.92	2.05	3.34	1.66	1.76	34	1.26	1.96	-	-	-	--
Ferrous Iron	mg/L	<0.20	<0.20	NS	<0.20	10.3	<0.20	<0.20	<0.20	0.36	0.36	10.6	-	-	-	--
Dissolved Methane	ug/L	<0.11	3.2	NS	<0.11	51.8	0.65	<0.11	1.4	0.81	8.5	50.3	0.11	<0.11	<0.11	--
Dissolved Ethane	ug/L	<0.23	<0.23	NS	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	--
Dissolved Ethene	ug/L	<0.31	<0.31	NS	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	--
Dissolved Oxygen	mg/L	3.81	3.02	NS	3.65	3.18	3.53	3.48	3.62	3.7	-	3.18	-	-	-	--
pH	Std. Units	5.91	6.82	NS	6.03	5.66	5.52	5.55	5.01	6.58	-	5.66	-	-	-	--
Redox Potential	mVe	91.8	-23.6	NS	116.4	48.2	131.2	158.2	25.33	93.8	-	48.2	-	-	-	--

NOTES: J - Estimated, concentration listed greater than the MDL but lower than the lowest standard. * MW-26 is duplicate sample from well MW-13S.
Ground water quality standards as published in N.J.A.C. 7:9-6.9 -- Compound-specific Ground Water Quality Standard not published

Table 23. Quality Assurance Data for Radiological and Non-Radiological Samples for 2012

Laboratory, Program, and Parameter	Reported Value	Actual Value	Acceptance Range	Acceptable Not acceptable
ERA *(picoCuries/Liter)*				
May 2012 RAD 89				
Barium-133	82.76	82.3	69.1 – 90.5	Acceptable
Cesium-134	70.62	74.2	60.6 – 81.6	Acceptable
Cesium-137	156.08	155	140 - 172	Acceptable
Cobalt-60	81.14	72.9	65.6 – 82.6	Acceptable
Zinc-65	116.07	105	94.5 - 125	Acceptable
Tritium	16375.62	15800	13800 - 17400	Acceptable
November 2012 RAD 91				
Barium-133	83.45	84.8	71.93 – 93.3	Acceptable
Cesium-134	70.67	76.6	62.6 – 84.3	Acceptable
Cesium-137	176.63	183.0	165 - 203	Acceptable
Cobalt-60	80.41	78.3	70.5 – 88.5	Acceptable
Zinc-65	218.68	204	184 - 240	Acceptable
Tritium	4992.74	4890	4190 - 5380	Acceptable
May 2012 WP-206				
Specific conductance (µmhos/cm)	389	384	343 - 425	Acceptable
pH (S.U.)	5.32	5.36	5.16 – 5.56	Acceptable
Total residual chlorine (mg/L)	1.048	1.15	0.827 – 1.43	Acceptable

Table 24. Waste Characterization Report (WCR) for DSN001 Surface Water Sampled December 4th, 2012

Laboratory Parameter	Reported Value (µg/L)
Barium	193
Copper	6.70
Manganese	64.8
Zinc	36.6

Appendix B

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Phone: 609-243-2245
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