Princeton Plasma Physics Laboratory

PPPL- 4839

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PPPL Annual Site Environmental Report
Calendar Year 2011

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December, 2012

PRINCETON PLASMA PHYSICS LABORATORY

Prepared for the U.S. Department of Energy under Contract DE-AC02-09CH11466.

Annual Site Environmental Report




For Calendar year 2011

An Annual Site Environmental Report for

Princeton Plasma Physics Laboratory

Operated by Princeton University For the U.S. Department of Energy Under Contract DE-AC02-09CH11466

PPPL-xxx

ANNUAL SITE ENVIRONMENTAL REPORT

FOR

CALENDAR YEAR 2011

Princeton Plasma Physics Laboratory
P.O. Box 451
Princeton, New Jersey 08543

Operated by Princeton University
For the U.S. Department of Energy
Under Contract DE-AC02-09CH11466
See http://www.pppl.gov

Table of Contents

Table of Contents

Table of Contents

Table of Contents

List of Exhibits Contained in the Text (continued)

NOTE: Data tables are located in Appendix A - 2011 Tables beginning on page 65.

List of Acronyms

AEA	Atomic Energy Act of 1954
AFV	alternative fuel vehicles
ALARA	as low as reasonably achievable
B1, B2	Bee Brook 1 (upstream of DSN001) and 2 (downstream of DSN001) (surface water stations)
B-20/100	biolfuel (20%/100%)
BAS	building automation system
BPX	Burning Plasma Experiment
Bq	Becquerel
BTU/gsf	British Thermal Unit per gross square feet
C	C-site of James Forrestal Campus, part of PPPL site
c-1,2-DCE	cis-1,2-dichloroethylene
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
DPCC	Discharge Prevention Control and Containment
dpm	disintegrations per minute
D&R	Delaware & Raritan (Canal)
DSN	discharge serial number
E1	Elizabethtown Water (formerly- NJ American Water Co.potable water supplier – surface water station)
E-85	ethanol (85%) fuel
EDE	effective dose equivalent
EHS	Environment, Health & Safety

List of Acronyms

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
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)
GHGs	greenhouse gases
GSA	General Services Administration
HQ	Headquarters
HT	tritium (elemental)
HTO	tritiated water
ISO14001	International Standards Organization 14001 (Environmental Management System – EMS)
ITER	International Thermonuclear Experimental Reactor (France)
JET	Joint European Torus facility (United Kingdom)
km	kilometer
kWh	kilowatt hour
LEC	liquid effluent collection (tanks)
LEED	Leadership in Energy and Environmental Design
LEED-EB	Leadership in Energy and Environmental Design - Existing Buildings
LSB	Lyman Spitzer Building (Formerly Laboratory Office Building)
LOI	Letter of Interpretation (Wetlands)
LOTO	lock-out, tag-out (electrical safety)
LSI	lined surface impoundment
LTX	Lithium Tokamak Experiment
M1	Millstone River (surface water station)
MC&A	Material Control & Accountability (nuclear materials)
MG	Motor Generator (Building)
mg/L	milligram per liter
M&O	Maintenance &Operations
mrem	milli radiation equivalent man (per year)
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
n	neutron
N or N-	nitrogen
NCSX	National Compact Stellarator Experiment

List of Acronyms

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
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NSTX	National Spherical Torus Experiment
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
PEARL	Princeton Environmental, Analytical, and Radiological Laboratory
PFC	Princeton Forrestal Center
PJM	Pennsylvania, Jersey, Maryland (Electric-power grid controllers/operators)
POTW	publicly-owned treatment works
PPA	Power Purchase Agreement
PPPL	Princeton Plasma Physics Laboratory
PT	proficiency test (Laboratory certification)
PTE	potential to emit (air emissions)
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
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
SO_2	sulfur dioxide
SPCC	Spill Prevention Control and Countermeasure
T	tritium
TCE	trichloroethene or trichloroethylene
TFTR	Tokamak Fusion Test Reactor

List of Acronyms

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)
μg/L	micrograms per liter
μSv	microSievert

Princeton Plasma Physics Laboratory (PPPL)
Certification of Monitoring Data for
Annual Site Environmental Report for 2011

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 2011," are documented and certified to be correct.

Signed:

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

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Robert S. Sheneman,
Head, Environmental Services Division

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

Executive Summary

Princeton Plasma Physics Laboratory
Annual Site Environmental Report for
Calendar Year 2011

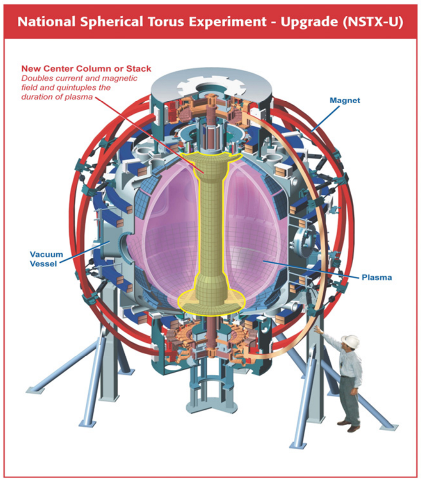
This report presents the results of environmental activities and monitoring programs at the Princeton Plasma Physics Laboratory (PPPL) for Calendar Year 2011. The report provides the U.S. Department of Energy (DOE) and the public with information on the level of radioactive and non-radioactive pollutants, 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 2011. 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.

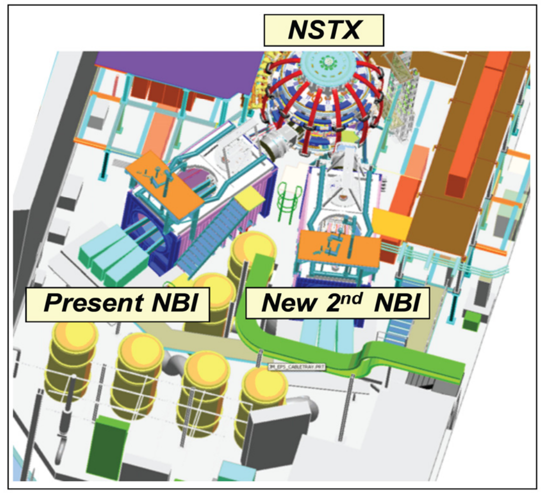
Since 1951,the Princeton Plasma Physics Laboratory has engaged in fusion energy research. Fusion is the reaction that occurs in our sun as well as in other stars. During fusion reactions, the nuclei of hydrogen atoms in a plasma state, *i.e*. as an ionized gas, fuse or join forming helium atoms and releasing 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. Magnetic 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

Though 2011 marked the thirteenth year of the National Spherical Torus Experiment (NSTX), NSTX did not operate nor conduct experiments. After a thorough review in 2010, PPPL and DOE jointly decided to commence the planned NSTX upgrade project, in lieu of making repairs to the magnetic coils that confine the plasma and continuing operations in 2011. The upgrade plan for NSTX includes the redesign of the center stack magnets and the addition of a second neutral beam box from the former Tokamak Fusion Test Reactor (TFTR). In NSTX, the plasma is heated by radio-frequency waves and deuterium (hydrogen isotope with one neutron) neutral beam injection, which with two neutral beams will allow for greater heat capacity and a hotter plasma. The new center stack design will increase the 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. For the NSTX research collaborators from 30 U.S. institutions and 11 other countries, the project was a major effort to produce a smaller, more economical fusion reactor.

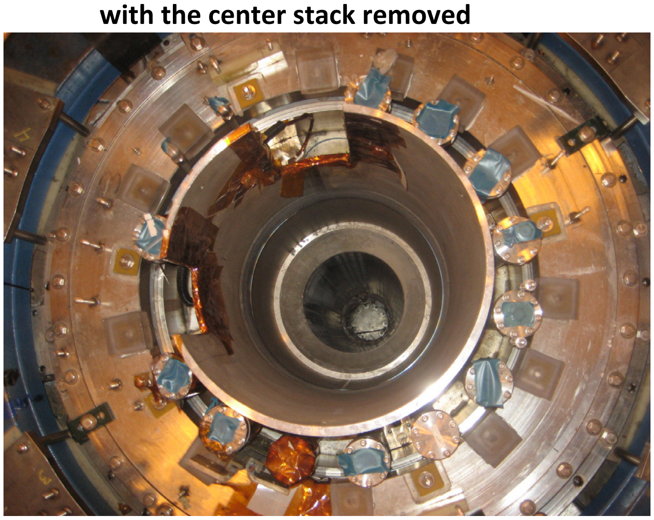
The National Spherical Torus Experiment Heated by Neutral Beam Injection (NBI)





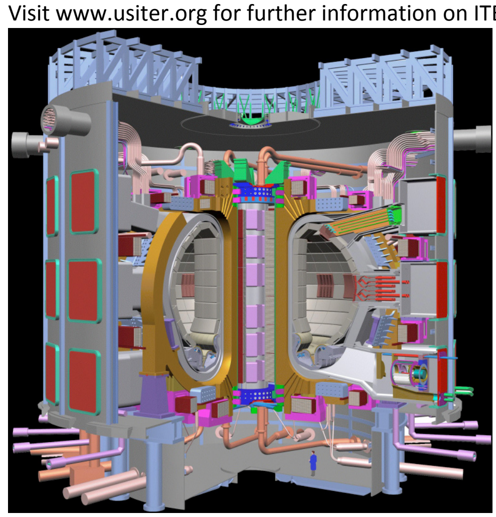
The new center column or stack is shown in a yellow outline, the vacuum vessel is spherical in shape and produces a "round" plasma, and the person standing next to the right-hand base illustrates the scale of this device. In the drawing on the right, the two neutral beam injectors (NBI) are shown.

Interior of NSTX vacuum vessel with the center stack removed



Drawing of ITER

Visit www.usiter.org for further information on ITER



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's Senior Scientist, Richard Hawryluk, was appointed the Deputy Director-General of the ITER Organization and director of its Administration Department in March 2011.

PPPL Achievements and Activities in 2011

In 2011, the Federal Electronics Challenge (FEC) presented PPPL with the Bronze award of its achievements for End-of-Life Management of equipment. PPPL participates in the FEC, which is a federal facilities partnership program that encourages the management of electronic assets through the lifecycle approach. Lifecycle management begins with purchasing green technology, using and maintaining the equipment properly, and returning the technology back into the market place through recycle or reuse.

PPPL encourages its employees to practice these principles in their daily lives through their personal purchases and recycling activities. 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.

When the total maximum off-site dose for 2011 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 2011 were:

1. Total maximum off-site dose from all sources—airborne and liquid releases—was **6.36 x10^{-3}mrem per year (6.36x10^{-5}** mSv per year).
2. Dose at the nearest business (at the site boundary) due to airborne releases was **6.0 x 10^{-4} mrem per year (6.0x10^{-6} mSv per year).**
3. The collective effective dose equivalent for the population living within 80 kilometers was **0.0236 person-rem (2.36x 10^{-4} person-Sv).**

In 2011, Princeton Plasma Physics Laboratory was awarded US Green Building Council's Leadership in Energy and Environmental Design (LEED) Gold for Existing Buildings. The Lyman Spitzer Building qualified for this award based on reduction of its energy and environmental footprint.
PPPL's infra-structure projects as well as improvements in green purchases and recycling efforts are a tribute to the employees' commitment to sustainability.

The Laboratory expects to continue excelling in all aspects of ES&H as it has 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.

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 2011, PPPL collaborated with other fusion research laboratories across the globe on the Joint European Torus (JET) facility located in the United Kingdom, and International Consortium's International Thermonuclear Experimental Reactor or ITER, which in Latin means "The Way," located in Cadarache, France. PPPL's main fusion experiment, the National Stellarator Tokamak Experiment (NSTX), began its upgrade in 2011.

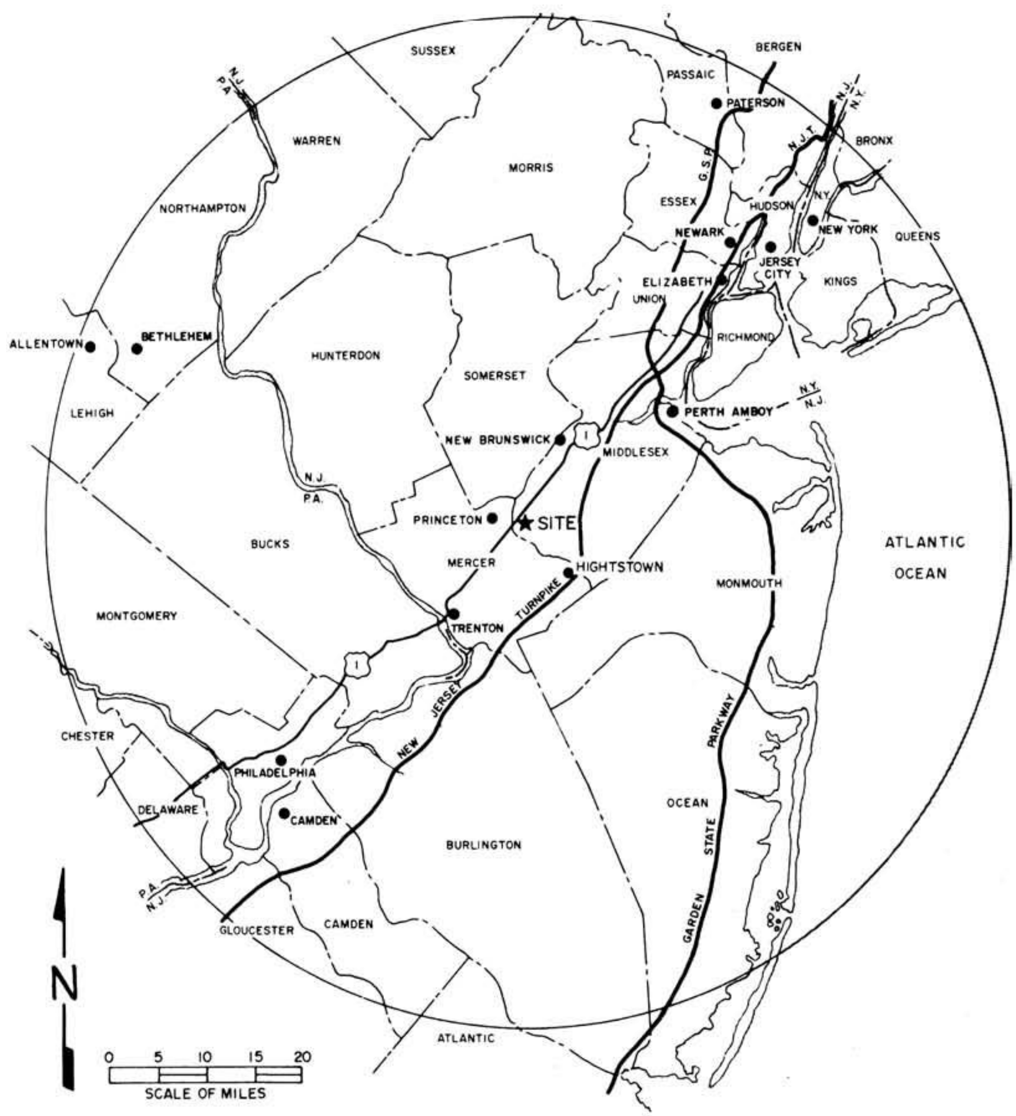
1.2 Site Location

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

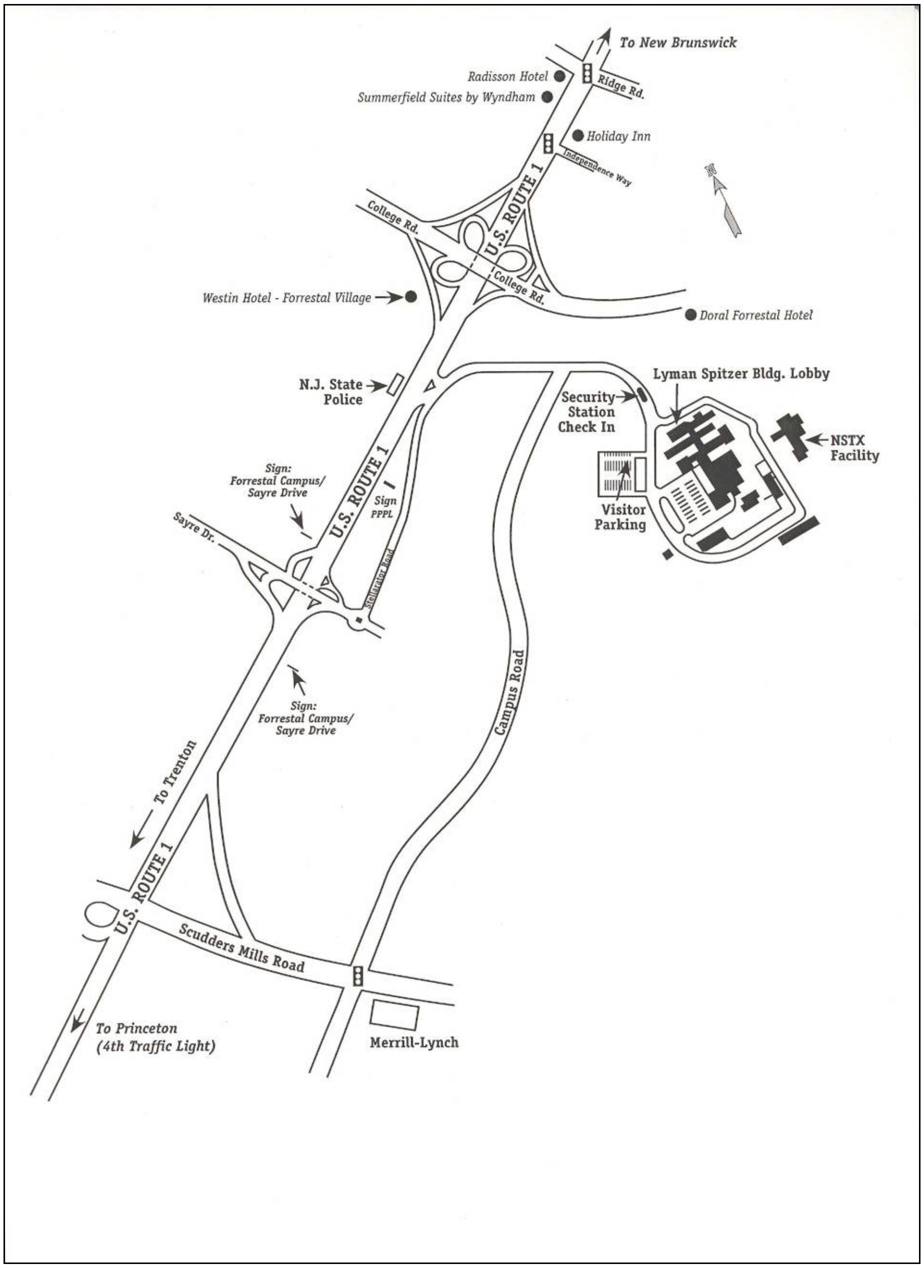
Cranbury, NJ. The Princeton area continues to experience a sustained growth of new businesses locating along the Route 1 corridor near the site. In 2011, construction of the new hospital, University Medical Center of Princeton at Plainsboro, continued. It is located within 2 miles of the site and is scheduled to be finished in 2012. Princeton University's main campus is approximately three miles west of the site, primarily located within the Borough of Princeton.

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



In 1951, known as "Project Matterhorn", PPPL 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 North, 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 (JCF), Plainsboro, NJ



Surrounding the site are lands of preserved and undisturbed areas 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. The Site Protection Division of PPPL controls C-site access allowing the public and visitors' access following an identification check and/or the Security Access Form that is completed by the PPPL host. 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.

Normally, the 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 2011, the annual rainfall total, 65.12 inches (173.02 cm), was well above the average rainfall in New Jersey. In the last week of August alone, precipitation totals reached 8.94 inches, roughly one-fifth of the average of 46 inches.

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 fusion experiments, including NSTX, MRX, or LTX, currently operate at PPPL. NSTX is the largest operating experiment and it is located on D-site. In 2011, it stopped operations and is being prepared for future upgrades scheduled to be finished in 2014. The upgrade is expected to more efficiently use resources to run the experiment and be able sustain energy production. NSTX has produced one million amperes of plasma current, setting a new 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.

The former TFTR Test Cell was renamed the National Compact Stellarator Experiment (NCSX) Coil Winding Facility during the fabrication of the magnetic coils that were wound with copper coils, taped, and baked with an epoxy. In May 2008, when the DOE Office of Science halted the NCSX's construction, PPPL's staff began decommissioning the experiment. All the fabricated parts of the NCSX were moved into the Test Cell 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. The LTX liquid lithium was 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 2010 US Census Bureau Statistics, Middlesex County has a population of 809,858: adjacent counties of Mercer - 366,513, Monmouth - 630,380, Somerset - 323,444, and Union - 536,499 [US10]. 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

2011 COMPLIANCE SUMMARY and COMMUNITY INVOLVEMENT

Princeton Plasma Physics Laboratory's (PPPL) environmental goal is to fully comply with applicable state, federal, and local environmental regulations and to operate the facility in a manner that minimizes environmental impacts. 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 2011 compliance status and providing the ASER sections where further details are located. The list of "Applicable Environmental Laws and Regulations – 2011 Status" conforms to PPPL's Environmental Management System (EMS) Appendix B, "Summary of Legal and Other Requirements" [PPPL12a].

2.2 Site Compliance and Environmental Management System (EMS) Assessments

In 2011, PPPL's Quality Assurance (QA) Division performed seven (7) audits of which five (5) involved environmental topics: 1) Audit of Corrective Actions taken to improve receipt of chemicals at PPPL, 2**)** PPPL's Environmental, Analytical, and Radiological Laboratory (PEARL), 3) PPPL's Radioactive Waste Handling Program, 4) PPPL's September 2011 Radioactive Waste Shipment, and 5) American Testing Laboratory (supplier used by PPPL's Waste Management group to conduct vibration testing of shipping containers used for waste shipments). Each audit includes records examination and requirements compliance and is tracked through PPPL's internal QA Audit Database [Ya12].

In November 2011, the PPPL QA conducted an Internal EMS Audit. The findings are discussed in detail in Chapter 3 of this report. In December 2011, UL-DQS, Inc. conducted the Stage 2 Registration Assessment of PPPL's International Organization for Standards (ISO) 14001:2004 – "Environmental Management System." Six minor non-conformances were reported, and 18 opportunities for improvement and 2 strengths were cited. The auditors recommended registration to the ISO-registration review committee, and PPPL received its ISO 14001- registration in March 2012.

Exhibit 2-1 Applicable Environmental Laws and Regulations – 2011 Status

Regulatory program description	2011 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 2011, 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 2011, PPPL shipped 8.24 tons (7.5 metric tons, MT) of hazardous waste of which 2.43 tons (2.2 MT) were recycled (29.5% recycling rate). The types of waste are highly variable each year; in 2011, majority of incinerated quantities came from oily debris, used oil, and flammable liquids [Pue12].	*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 2011, PPPL reviewed 25 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) [Lev10&11].	
Toxic Substance Control Act (TSCA) governs the manufacture, use, and distribution of regulated chemicals listed.	PPPL shipped in 2011 – 1,027 pounds of PCB TSCA Hazardous Substances. Five PCB capacitors remain on-site. Asbestos removals in 2011 were 40 cubic yards[Pue12].	*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 [Kin12b].	*Exhibit 4- 6* *4.2.1 A*

Exhibit 2-1 Applicable Environmental Laws and Regulations – 2011 Status (continued)

Regulatory program description	2011 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 one reportable spill 2011 [PPPL11e].	*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. Boiler 2 was modified with low NOx burners. Submitted Subpart JJJJJJ Notification to EPA - biennial boiler adjustment and energy audit requirements. Annual boiler adjustment results were submitted to NJDEP in 2011 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. PPPL maintains an inventory for ozone-depleting substances (ODS) and greenhouse gas (GHG) emissions [Ne11, 12e].	*4.4*

Exhibit 2-1 Applicable Environmental Laws and Regulations – 2011 Status (continued)

Regulatory program description	2011 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 [Pin12].	*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 2011 [PPPL12b].	*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 [Pue12].	
NJ Regulations Governing Laboratory Certification and Environmental Measurements mandates that all required water analyses be performed by certified laboratories.	PPPL's Princeton Environmental, Analytical, and Radiological Laboratory (PEARL) continued analyze immediately parameters; NJDEP Office of Quality Assurance audited PEARL in May 2011; audit deficiencies closed in November [PPPL11c & 11f]. 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.	PPPL-DOE awaiting the draft NJPDES surface water discharge permit; renewal application submitted to NJDEP in 2010 [PPPL10d]. In 2011, PPPL reported one (1) non-compliance at DSN003, D&R Canal pump house outfall. pH was 5.81 due to high rainfall that lowered the pH in the Canal. LSI was compliant [PPPL11h].	*4.1.1* *Exhibits 4-1, 4-2, 4-3 and 4-5*

Exhibit 2-1 Applicable Environmental Laws and Regulations – 2011 Status (continued)

Regulatory program description	2011 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 [PPPL12c].	*6.5*
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 [DOE11a].	*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 provides rad-waste requirements in the Environment, Safety, & Health directive (ESHD) 5008, Section 7, "Waste Management," and Environmental Services Division (ESD) procedure, EM-CP-21, "Certification of Low-level Radioactive Waste for Disposal at Nevada Test Site " [DOE01, PPPL11d].	*5.1.3*
DOE Order 450.1A, ***Environmental Protection Program*****,** requires all DOE facilities to implement an "Environmental Management System" for the protection of air, water, land, and other natural/cultural resources and establish sustainable-stewardship practices.	PPPL's Environmental Management System (EMS) was prepared in 2005 and is reviewed and updated annually [PPPL11i]. EM-OP-46, "Environmental Aspects and Impacts Evaluation," requires the site's activities are evaluated biennially to ensure the protection of environmental resources and to implement sustainable practices [PPPL09a & 11j].	*3*
DOE Order 5400.5, ***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 [DOE01, 11c, PPPL07, 09c, 09d & 10g].	*5.1* *Exhibit 5-1*

Exhibit 2-1 Applicable Environmental Laws and Regulations – 2011 Status (continued)

Regulatory program description	2011 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 .	PPPL completed the *Executable Plan* in 2009, which outlined the goals and status of compliance with EO 13423 [EO08, PPPL10a].	*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.	PPPL prepared *the 2012 Site Sustainable Plan* that addressed the goals, targets and status of EO 13514 requirements [EO09 & PPPL11b].	*3*

2.3 External Oversight and Assessments

In March 2011, U.S. Environmental Protection Agency (EPA) Region 2 inspector conducted a Multi-media Inspection at PPPL. Eight actions were noted for two programs: Spill Control and Countermeasure (SPCC) Plan and Resource Conservation and Recovery Act (RCRA). The SPCC actions were to clarify 1) the roles and personnel responsibilities of the Emergency Plan, SPCC, and Hazardous Materials Storage Facility (HMSF) Contingency Plan, 2) SPCC implementation procedures and records management, 3) SPCC training, and 4 & 5) guidance for inspection, operation, and maintenance of alarms for the above-ground tanks (AGT). RCRA actions included 1) training for general employees and hazardous waste workers, 2) remove miscellaneous waste identified during inspection, and 3) new location of Facilities site accumulation area (SAA) or replacement of HazStor locker. All the actions were addressed and the inspection was satisfactorily closed [PPPL11l].

In May 2011, NJDEP Office of Quality Assurance (OQA) audited PPPL's Princeton Environmental, Analytical and Radiological Laboratory, PEARL. PEARL is certified by NJDEP to conduct analyses for Analyze-Immediately parameters supporting the New Jersey Pollutant Discharge Elimination System (NJPDES) permit requirements and radiological parameters for internal samples. NJDEP OQA issued the PEARL audit report in July that contained 9 deficiencies, which are discussed in Chapter 7 – Quality Assurance of this report. In October 2011, PPPL completed its response to nine deficiencies and received NJDEP's closeout in November [NJDEP11].

DOE-PSO and DOE-Brookhaven conducted a Transportation and Packaging Program Audit in August 2011, which included PPPL's hazardous materials transportation program. Of the six findings and one recommendation, one finding cited that PPPL did not have a PSO-approved treatment, storage, and disposal (TSD) facility on file. In early 2012, this finding was resolved with a letter from DOE-PSO approving PPPL's TSD facility that handles hazardous waste in accordance with DOE guidance and federal/state regulations. The second finding cited the limited number of key individuals who have training and experience in handling waste shipments. PPPL recognizes the risk of limited back-ups, however, is unable to add personnel. This audit's findings and recommendation were completed in 2012 [Ya12b].

In November 2011, NJDEP RCRA Inspection resulted in no findings or recommendations for PPPL.

Nevada National Security Site (NNSS) Radioactive Waste Acceptance Program (RWAP) Surveillance of PPPL's Waste Certification Program (WCP) was conducted in December 2011. Three observations were identified in the Surveillance Report Number RWAP-S-12-04 [NNSS11]. The WCP was determined to be generally in compliance, because PPPL's radioactive waste management program continued to be effective. PPPL was approved to continue the shipment of radioactive waste to NNSS.

For details on the External Stage 2 Environmental Management System Registration Audit of December 2011, see Section 2.2 of this Chapter and Chapter 3 of this report.

2.4 Emergency Reporting of Spills and Releases

There was one release of hazardous substances or petroleum hydrocarbons on pervious surfaces that exceeded the reportable quantities or required notification to New Jersey's Action Hotline during 2011. In July, PPPL's backhoe leaked approximately 1-2 gallons of hydraulic fluid on the ground. A hose ruptured and a cleanup was conducted immediately by PPPL personnel. Soil/gravel was placed in drums and the soil tested for hydrocarbons [PPPL11g].

Under New Jersey regulations, PPPL is required to call the Action Hotline to report any permit limits that are exceeded. One such call was made in 2011.

In March 2011, pH level at the Delaware & Raritan (D&R) Canal pump house filter backwash, DSN003, was measured at 5.81 S.U. The permit limits are 6.0 and 9.0. The water level in the Canal was high due to record rainfall and snow melt during the previous week; the pH upper stream in the Canal was found to be only slightly above the permit limit (6.01). PPPL reported this occurrence to the Action Hotline and prepared the follow-up compliance report, NJDEP Case No. 11-03-02-1520-22. The investigation into the cause of the low pH at the pump house outfall determined that the heavy rainfall and large amount of storm-water runoff was the cause [PPPL11h].

2.5 Notice of Violations and Penalties

There were no notices of violations or penalties for environmental occurrences at PPPL during 2011.

2.6 Community Involvement

2.6.1 Earth Week and American Recycles Day at PPPL – 2011

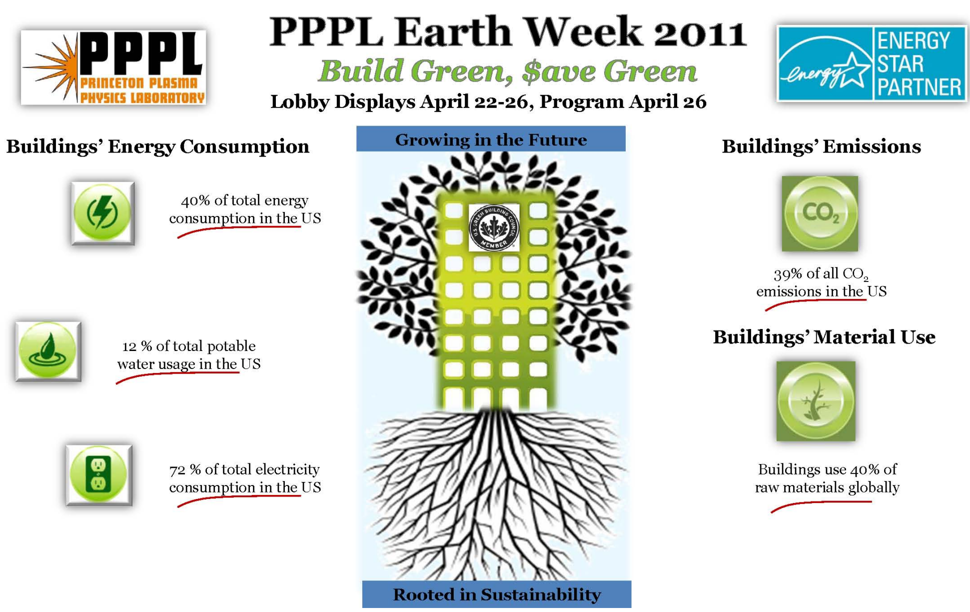
"Build Green, $ave Green" was the theme of PPPL's 2011 Earth Week celebration (See box). On April 26th, PPPL employees and members of the public were invited to participate in viewing displays on sustainable renovations and projects, PPPL's outstanding recycling program, Beneficial landscaping, Mercer County Improvement Authority, Stony Brook-Millstone Watershed Association, and PPPL's subcontractor office supply and waste removal companies. PPPL's electronic recycling vendor provided recycling for employees' personal e-waste.

The colloquium speaker, Mr. J. Freihaut, Director for Technology and Operations – Energy Efficient Buildings Hub @ Greater Philadelphia Innovation Cluster (GPIC), presented "High-Efficiency Sustainable Buildings."

Each year, employees are asked to nominate their fellow workers for their exceptional efforts to minimize waste, improve energy efficiency, and promote sustainable practices at PPPL. There were twenty-eight employees who received the 2010 PPPL Green Machine Awards for the following projects:

- Reducing sulfur hexafluoride (SF_6) losses to the atmosphere by preventing leaks of the modulator regulators on PPPL's main experimental fusion device. SF_6 is a potent greenhouse gas.
- Diverting scrap materials from the waste stream to reused or remade products at PPPL
- Recycling over 32 tons of magnetic data tapes; plastic and iron oxide were recovered and remade into new plastic and recycled steel.
- Reusing asphalt for road base at PPPL (296 tons) and a total of 630 tons for replacement/repair of roadways
- Championing food waste composting in PPPL's cafeteria

Exhibit 2-2 PPPL's Earth Week Poster



On November 15, 2011, 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. The speaker was Nelson Wydell from Penisula Composting, who presented information about PPPL's composting and a new facility in Nantucket, Massachusetts.

2.6.2 PPPL's Environmental Mentoring Program 2011

Begun in 2009, PPPL's hosted several science teachers from across the country who participated in the DOE-sponsored ACTs 3-year program. Due to budget restrictions, the ACTs program was not funded in 2011. During the 2011-2012 school year, the Environmental Services Division continued to mentor two teachers who started with this program- a high school biology teacher from Lawrenceville, NJ and a middle school chemistry/general science teacher from Ewing, NJ. In addition to mentoring, PPPL donated 3-ring binders to the schools, which provides them to students and helps to keep PPPL "greener."

These teachers and their mentors continued to meet and exchange ideas that they use at their respective schools. In return, PPPL receives valuable feedback from these teachers that is helpful in improving communication and participation within the community as a whole.

Exhibit 2-3 PPPL's Earth Week Green Machine Recipients And America Recycles Day Green Team

The photos above were taken during PPPL's 2011 Earth Week and America Recycles Day events: from upper left corner Earth Day at Princeton University, Staff member who promoted food composting, Team who reduced Sulfur hexafluoride-a potent greenhouse gas, Team who recycled computer magnetic tapes, Green Team members who promote recycling at PPPL, Staff members who found innovative means to minimize waste or use recycled products. ✵

Chapter

3

ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

PPPL has been very 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, environmentally preferable purchasing, and facility operation programs to reduce environmental impacts and improve performance. PPPL will continue to proactively implement sustainability practices aimed at meeting, or exceeding, the sustainability goals in its EMS, DOE Orders and Executive Orders [EO08, 09].

In 2011, PPPL successfully completed independent third-party audits of its EMS against the requirements of the ISO-14001:2004 international standard. An independent ISO-14001 registrar conducted two comprehensive system audits in 2011 – a pre-registration audit (October) and the formal ISO registration audit (December). These audits reviewed PPPL's EMS program documents, implementing processes, training, and performance status. Several minor non-conformances were identified during the registration audit, which were addressed through PPPL's corrective action process [UL11]. Formal registration of PPPL's Environmental Management System to the ISO-14001:2004 standard was granted on February 7, 2012. On-going annual audits and a triennial registration audit are required to maintain ISO 14001:2004 certification.

3.1 DOE Sustainability Goals

In 2011, PPPL continued to address the aggressive new sustainability and greenhouse gas management goals of EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance,* which was signed by President Obama in October 2009. PPPL completed its second 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 [PPPL11b & 11k].

3.1.1 Energy Efficiency

In 2011, PPPL achieved a reduction of 52% 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.

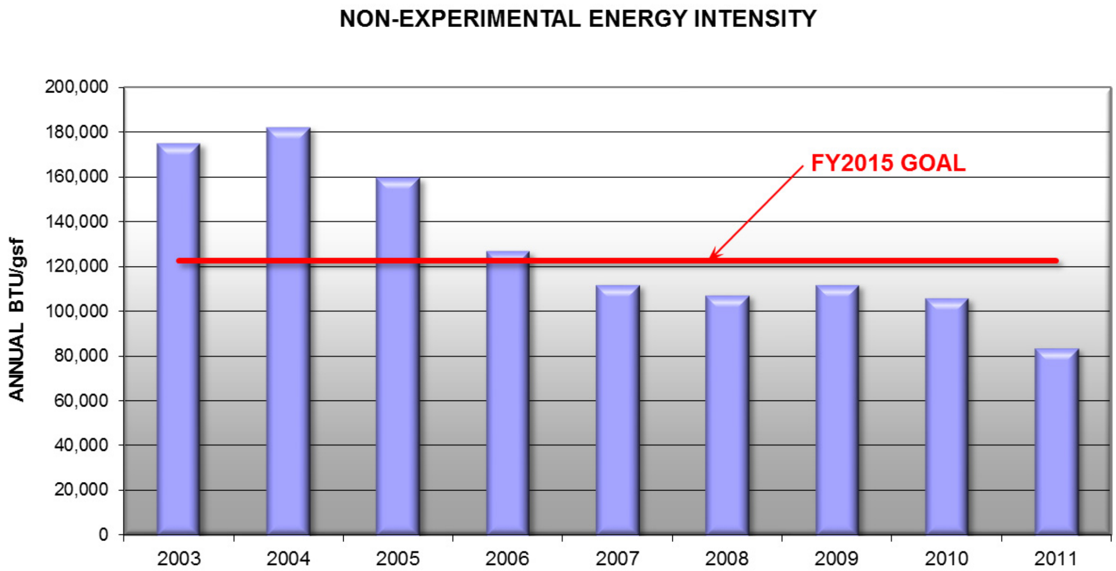


Exhibit 3-1. Annual Non-Experimental Energy Intensity in BTU/gsf
(Red line indicates the Federal energy efficiency goal set for 2015)

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 LED lighting for all office renovations and continues to evaluate and implement other lighting retrofit 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 fiscal 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 2011, PPPL reduced its Scope 1 and 2 greenhouse gas (GHG) emissions by 52%. 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 and boiler control upgrade projects. Sulfur hexafluoride is a potent GHG that is a highly effective high voltage insulator.

PPPL is an active member of the DOE Fugitive Emissions Working Group (FEWG) coordinated by DOE's Health & Safety Office (HS-22). The FEWG has already reduced DOE's overall fugitive GHG emissions by half and was recognized with a 2011 Secretarial Achievement Award for its efforts.

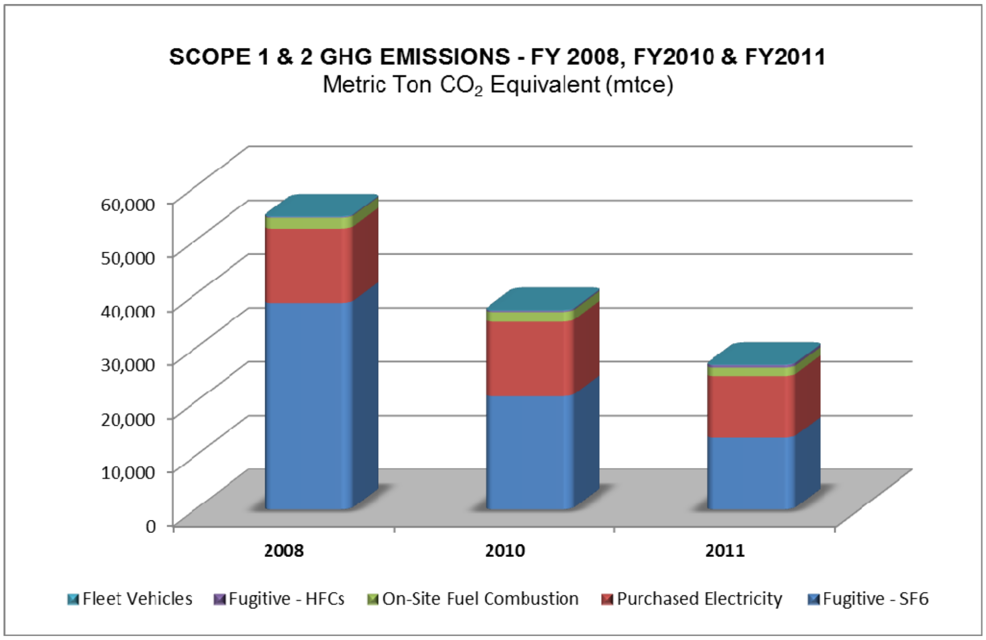


Exhibit 3-2. Summary of PPPL Scope 1 & 2 GHG Emissions for 2008, 2010 and 2011

3.1.4 Fleet Management

In 2011, PPPL's fleet petroleum fuel use was 64% below 2005 levels (see Exhibit 3-3). In addition, alternative fleet fuel consumption in 2011 was 19 times higher than the levels in 2005, representing over 62% of PPPL's total covered fleet fuel use (see Exhibit 3-4).

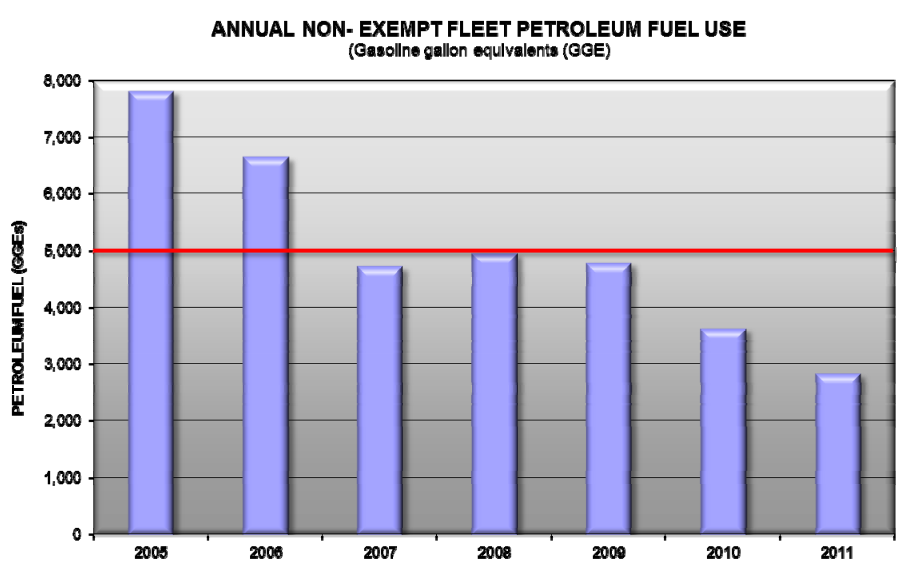


Exhibit 3-3. Annual Non-Exempt Fleet Petroleum Fuel Use between 2005 and 2011

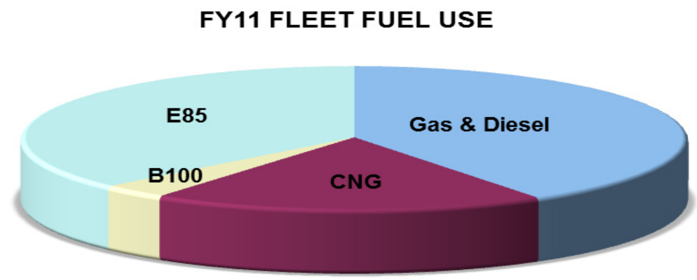


Exhibit 3-4. FY2011 Non-Exempt Fleet Fuel Use by Type

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 fuels (E85 or 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 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 77% between 2000 and 2011 (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 already been addressed.

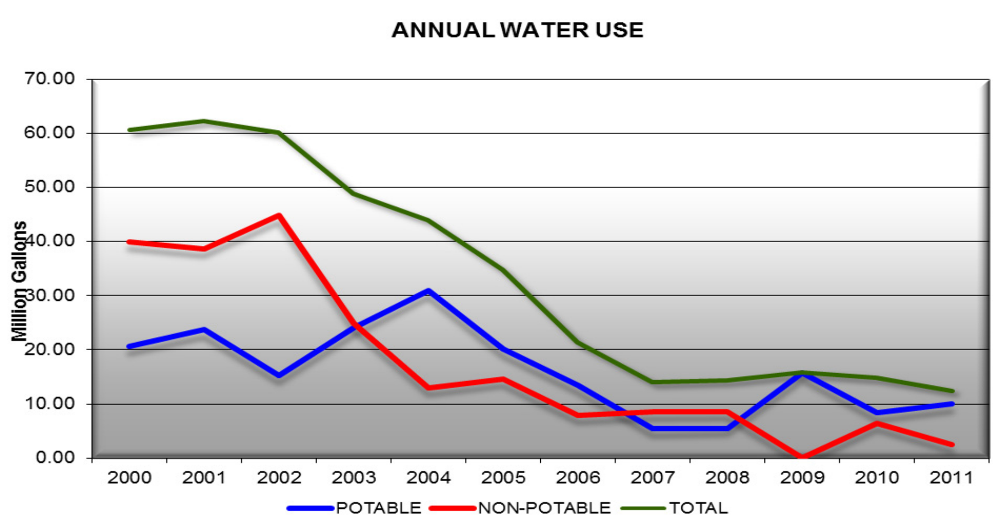


Exhibit 3-5. PPPL Annual Water Use from 2000 to 2011

3.2 U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED®) Program

In April 2011, the Lyman Spitzer Building (LSB), PPPL's main office buildings was granted LEED®-Gold certification by the U.S. Green Building Council 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.

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 2011, PPPL received a DOE Sustainability Award for its use of bio-based products and a DOE Management Award for its fleet management program. PPPL also received a Bronze Award from the Federal Electronics Challenge. Finally, PPPL was one of 10 organizations to receive the prestigious DOE Secretarial Achievement Award for its contributions to the DOE Fugitive Emissions Working Group (FEWG).

Exhibit 3-6. 2011 DOE Sustainability Goal Summary Table for PPPL

DOE Goal #	DOE/ SC Goal	Performance Status	Planned Actions & Contribution
1.1	28% Scope 1 & 2 GHG reduction by FY 2020 from a FY 2008 baseline	**EXCEEDED** 50.22% reduction in FY11 v. FY08	Continue to focus on SF_6 emissions, purchased electricity, and on-site fuel use.
1.2	30% energy intensity reduction by FY 2015 from a FY 2003 baseline	**EXCEEDED** 52.2% reduction through FY11	Continue to emphasize energy efficiency; improve building energy performance.
1.3	Individual buildings or processes metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015) where life cycle cost effective. The site *may* also report on potable water and chilled water as applicable.	**ON TARGET** 9 meters installed	Continue installing advanced meters for electricity and natural gas as practicable. Standard meters for water with use of BAS.
1.4	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** 1 building with cool roof. 1 project roof insulation to R-30	R-30 is new standard for roof installation. Additional cool roof installations planned for FY2012.
1.5	7.5% of annual electricity consumption from renewable sources by FY 2013 and thereafter (5% FY 2010 – 2012)	**MET** FY11 REC Purchases = 1.042 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.
1.6	10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline	**EXCEEDED** 22 times higher than FY05	Continue acquiring AFVS and supporting CNG, E85, and B20 vehicles. Goal 1.9 may impact future performance.
1.7	2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline	**EXCEEDED** 60% reduction from FY05	Continue supporting CNG, E85, and B20 vehicles. Goal 1.9 may impact future performance.
1.8	75% of light duty vehicle purchases must consist of alternative fuel vehicles (AFV) by FY 2000 and thereafter. Starting in FY 2015 100%	**EXCEEDED** 100%	Continue acquiring AFVs.
1.9	Reduce fleet inventory by 35% within the next 3 years relative to a FY 2005 baseline	**ON TARGET** 5 vehicles returned in FY11	Additional fleet reductions scheduled for FY12 and FY13 to meet goal. Note: this goal may impact 1.6 and 1.7 performance.
2.1	13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline	**ON TARGET** 7.7% reduction in FY11 from FY08	Increasing international collaborations may impact performance on this goal
3.1	15% of existing buildings greater than 5,000 gross square feet (GSF) are compliant with the Guiding Principles (GPs) of HPSB by FY 2015	**ON TARGET** LEED®-EBOM Gold certification for LSB in FY11	Additional assessments planned in FY2011; energy efficiency may enable three additional buildings to meet HPSB goal.

DOE Goal #	DOE/ SC Goal	Performance Status	Planned Actions & Contribution
3.2	All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs and where the work exceeds $5 million, each are LEED ® – NC Gold certification or equivalent	**ON TARGET** All new buildings will be LEED®-Gold	Science and Technology Center targeted for LEED® Gold certification.
4.1	26% water intensity reduction by FY 2020 from a FY 2007 baseline	**AT RISK** 88.7% reduction achieved prior to baseline year	Additional water reductions projects are limited. 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	**AT RISK** FY10 baseline established	Additional water reductions projects are limited. Water conservation measures targeted for new building construction. Operational needs require flexible water use goals.
5.1	Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris, by FY 2015	**EXCEEDED** 58.2% of MSW was recycled in FY11	Continue to maximize recycling. Five year average recycling rate is 55%.
5.2	Divert at least 50% of construction and demolition materials and debris by FY 2015	**EXCEEDED** 97.2% C&D of waste recycled in FY11	Continue to maximize recycling. Five year average recycling rate is 55.5%.
6.1	Procurements meet sustainability requirements and include sustainable acquisition clause (95% each year)	**MET**	Continue to identify opportunities to implement sustainable acquisition requirements.
7.1	All data centers are metered to measure a monthly PUE (100% by FY 2015)	**MET** PPLCC meters installed in FY11	PPLCC metering completed in FY2011
7.2	Maximum annual weighted average Power Utilization Effectiveness (PUE) of 1.4 by FY 2015	**AT RISK** Baseline PUE established.	Additional energy efficiency opportunities for PPLCC being evaluated
7.3	Electronic Stewardship - 100% of eligible PCs, laptops, and monitors with power management actively implemented and in use by FY 2012	**ON TARGET**	ENERGY STAR® power management function enabled. Significant barriers to full implementation still exist.

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 and DSN003 (Tables 17 , 18, & 21).

During 2011, 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.

- March 2, 2011 pH exceeded the minimum permit limit at DSN003
- March 14, 2011 PCE loading concentrations exceeded at DSN001
- August 24, 2011 Total Phosphorus exceeded above monthly average and daily maximum at DSN001

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) [PPPL10d]. With the permit expiration in 2011, all permit requirements remain in effect until a new approved NJPDES permit is issued.

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 NA		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	NA	✓	Monthly / Grab
Total Organic Carbon, mg/L	DSN001, DSN003	NA		Monthly / Grab
Nitrogen, total, mg/L	DSN001	NA	✓	Quarterly

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	August 30, 2011	Annual
Waste Characterization Report (WCR)	DSN001	August 24, 2011	Annual
Waste Characterization Report (WCR)	DSN003	March 17, 2010	4 – 4.5 Years

B. Acute Toxicity Study

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 [PPPL10b].

C. Chronic Whole Effluent Toxicity Study

Annual Chronic Whole Effluent toxicity testing for DSN001 was completed on August 30, 2011 (Exhibit 4-2). In all chronic toxicity tests, *Pimephales promelas* (fathead minnow) survival rate, as defined by the NJ Surface Water Quality Standards, was >100 percent (statistically possible) no observable effect concentration (NOEC) [NJDEP08, PPPL11m].

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 once per permit cycle every 4 to 4.5 years [NJDEP08]. PPPL completed DSN001 Annual WCR on August 24, 2011 [PPPL11n]. DSN003 was completed once per permit cycle on March 17, 2010 [PPPL10e].

4.1.2 LSI- Lined Surface Impoundment Permit

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 114.64 million gallons of water was discharged from the retention basin in 2011 [Fin12a].

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

Water flowing through the retention basin includes site storm water, groundwater sump pumps, rainwater, non-contact cooling water, 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 Site Protection Office 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 2011:

- Basin Cleaning May 2011
- Additional aerator installed
- Lightning protection and grounding wires installed

4.1.3 Ground Water

A. NJPDES Ground Water Program

As discussed in Chapter 6, "Site Hydrology, Ground Water and Public Drinking Water Protection," the volatile organic compounds (VOCs) detected in the ground water monitoring wells adjacent to the basin are not believed to originate from the detention basin, but rather are the result of historical contamination in the Former Annex Building Area (FABA).

B. Regional Ground Water Monitoring Program

PPPL's Remedial Investigation and Remedial Action Selection Report (RI & RASR) was approved by NJDEP in 2000 [PPPL00a]. The Remedial Action Work Plan (RAWP) was approved NJDEP in June 2000 [PPPL00b]. The process of natural attenuation by the indigenous bacteria and other in-situ processes are slowly degrading tetrachloroethylene or perchloroethylene (PCE) to its daughter species. 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 more information please 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 8.54 million gallons in 2011(Exhibits 4-4 & 4-5) [Pin11]. The dramatic increase of potable water for 2011 is attributed to potable water being the sole source of water to the site due to the non-potable water meter was out of service from August through December 2011. PPPL uses potable water as a backup resource for fire protection.

Exhibit 4-4. PPPL Potable Water Use from NJ American Water Co. [Pin12]

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

Exhibit 4-5. PPPL Non-Potable Water Use from Delaware & Raritan Canal [Pin12]

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

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].

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.

D&R Canal pumps were out of service from August through December 2011, during which time, no non-potable water consumption occurred. Due to the pumps being inoperable for five months, there was an increase in potable water consumption. PPPL used only 2.47 million gallons of non-potable water from the D&R Canal in 2011 [Pin12].

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 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 2011 (Table 8). Detailed radiological and discharge quantities for LEC tanks can be found in Chapter 5 "Environmental Radiological Program Information".

For 2011, PPPL estimated a total annual sanitary sewage discharge of 7.6 million gallons to the South Brunswick sewerage treatment plant [Pin12**]**.

4.2 Non-Radiological Waste Programs

4.2.1 Hazardous Waste Programs

A. Herbicides and Fertilizers

During 2011, PPPL's Facilities Division used no pesticides and herbicides (Exhibit 4-6). The insecticide, Conserve SC, was used by arborist contractors to help kill bag worms on infected trees in 2011. 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 [Kin12b].

Exhibit 4-6. 2011 Fertilizer and Herbicide

Type of Material	Name of Material	Registered EPA No.	2011 Applied
Fertilizer	Signature Brand 24-5-11 SIG 40SCU	**900-031**	-
Fertilizer	19-4-6 w/ .15% Dimension	**10404-85**	-
Herbicide	Q4 Turf Herbicide	**2217-886**	-
Herbicide	Lesco 3 Way	**10404-43**	-
Herbicide	Roundup	**524-475**	-
Herbicide	Roundup	**524-536**	-
Insecticide	Conserve SC	**-**	150 Gallons

B. TSCA - Polychlorinated Biphenyls (PCBs)

PPPL shipped in 2011 1072 pounds of PCB TSCA Hazardous Substances. All contents were recycled or incinerated as TSCA Hazardous Waste [Pue12].

C. Hazardous Waste

PPPL did not submitted a Hazardous Waste Generator Annual Report to the NJDEP for 2011. Hazardous waste generation did not exceed the 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 investigated 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.

D. Recycled Hazardous Waste

Exhibit 4-7. CY 2011 Hazardous Recycled Material [Pue12]

Recycled Hazardous Waste	CY 2011 (lbs)	CY11 (gal)
Batteries	1667	
Fluorescent Bulbs-Mercury	1515	
Ballasts	375	
Oil		18,000
Misc.	1301	
Total Recycled	**4858 lbs**	**18,000 gal**

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 4-7 above. Oil recycled in 2011 included mineral oil shipped for reuse; fluorescent bulbs are replaced and crushed prior to recycling; and batteries are a more typical waste that are recycled each year.

4.3 Environmental Protection Programs

4.3.1 Release Programs

A. Spill Prevention Control and Countermeasure

PPPL maintains a Spill Prevention Control and Countermeasure Plan (SPCC), which was updated in 2011. 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 [PPPL11e].

B. CERCLA - Continuous Release Reporting

Under CERCLA's reporting requirements for the release of listed hazardous substances in quantities equal to or greater than its reportable quantity, the National Response Center is notified and the facility is required to report annually to EPA. Because PPPL has not released any CERCLA-regulated hazardous substances, no "Continuous Release Reports" have been filed with EPA.

C. 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) reporting for EPA 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, 2012 [PPPL12b]. No significant changes from the previous year were noted. The SARA Title III reports included information about twelve compounds used at PPPL as listed in Exhibits 4-8 and 4-9.

Exhibit 4-8. 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)
TRI – Toxic Release Inventory

Exhibit 4-9. 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 2011.

4.3.2 Environmental Releases

PPPL reported a small hydraulic fluid spill from backhoe equipment in July 2011. Approximately 2 gallon of hydraulic fluid was reported to NJDEP Case No. 11-07-05-1122-55 [PPPL11g]. Due to New Jerseys no *de minimus* thresholds, all oil released to unpaved surfaces must be reported. Dirt was removed and soil tested to ensure adequate cleanup of petroluem hydrocarbons.

4.3.3 Pollution Prevention Program

In 2011, 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 EPEAT Energy Star® equipment and products/lighting fixtures, flooring tiles to carpet squares, low 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 2011, PPPL's office recycling rate was 72.56%; this rate reflects 130.63 tons of municipal solid waste (MSW) that were diverted from landfills. The DOE EO13514 goal of 50% recycle *versus* disposal rate was met and accomplished by active participation of Laboratory employees. PPPL's FY 2011 rate for recycling of construction materials - wood, concrete, roofing stone ballast metals, asphalt - was an impressive 97.01% by weight [Kin12b].

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. The total quantity for September sent to the composting facility was 2,330 pounds, ~1.2 tons, instead of to a landfill. In FY11, PPPL composted 10.2 tons of food waste, changed from non-compostable products (cups, forks, knives, spoons, food containers) to compostable ones, and increased in the number of composting locations across the laboratory [Kin11b].

4.4 Non-Radiological Emissions Monitoring Programs

Air Permits

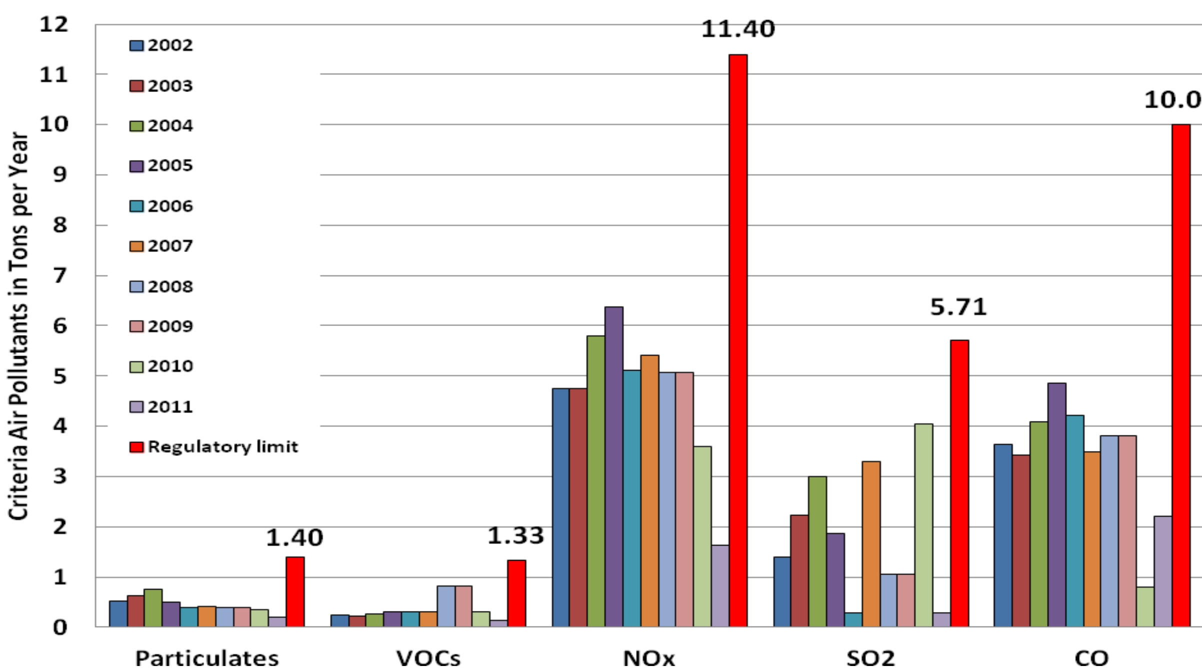
PPPL maintains New Jersey Department of Environmental Protection (NJDEP) air permits/certificates for the equipment as listed in Exhibit 4-10. PPPL is classified as a synthetic-minor facility and does not exceed the Potential to Emit (PTE) limits for any of the Criteria Air Pollutants.

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 (PJM – electric-power grid controllers) and posted on the PJM internet website under the "emergency procedures" menu.

Exhibit 4-10. PPPL's Air-Permitted Equipment

Type of Air Permit	Qty	Location	Requirements
Dust collectors	2	F&M Woodworking shop C-Site MG Annex	Operate at 99% efficiency General Permit July 2011; reused from CAS/RESA
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 4-11. PPPL's Boiler Emissions from 2002- 2011 vs. Regulatory Limits (Fin12b)



In 2008, NJDEP reduced the regulatory limits for the Criteria air pollutants for operating the boilers; PPPL's operated these four boilers were well below those limits in 2011 (Exhibit 4-11 & Table 9). With the installation of high-efficiency, lower nitrogen oxide (NO_x) burners, the NO_x emissions are being further reduced [Ne11].

4.5 Land Resources and Conservation

4.5.1 Wetlands Letter of Interpretation (LOI)

PPPL operates under NJDEP Land Use Wetlands LOI. Under permit No. 1218-06-0002.2FWW070001 NJDEP has line verified LOI PPPL's freshwater 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].

4.6 Safety

PPPL's 2011 performance with respect to worker safety is noted in Exhibit 4-13. There were two lockout/tagout (LOTO) incidents reported under the DOE ORPS System: (1) LOTO lock discovered cut on a locked-out circuit breaker, March 29, 2011; and (2) Failure to follow a prescribed hazardous energy control process prior to water removal from a transformer cabinet, September 4, 2011 [Lev12a].

Exhibit 4-13. PPPL's Safety Performance 2011

	Total OSHA recordable case rate[1]	**Days away, restricted transferred (DART) case rate[1]**
2011	1.52	0.65
	Number of radioactive contaminations (external)	**Number of Safety report OSHA (ORPS) Occurrence confined space, chemical exposure and (LOTO) incidents**
2011	0	2

[1] Per 200,000 hours worked ✵

Chapter

5

ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

5.1 Radiological Emissions and Doses

For 2011, the releases of tritium in air and water, the total effective dose equivalent (EDE) contribution at the site boundary and the EDE for population within 80 kilometers of PPPL are summarized in Exhibit 5-1 below. The calculated EDEs at the site boundary are less 2.4-hundredths of one mrem, far below the annual limit of 10 mrem per year [Lev 12b].

Exhibit 5-1. Summary of 2011 Emissions and Doses from D-Site Operations

Radionuclide & Pathway	Source	Source Term Curies (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 0.778 (2.9×10^{10}) HT 0.161 (5.9×10^{9})	$2.0\ 10^{-3}$ (2.0×10^{-5})	31.9	0.019 (1.9×10^{-4})
Tritium (water)	LEC tank	HTO 0.041 (1.52×10^{9})	$8.2\ 10^{-4}$ (8.2×10^{-6})	12.9	$1.1\ 10^{-3}$ (1.1×10^{-5})
Tritium (water)	Surface Ground	1788 pCi/L (DSN003) 210 pCi/L (Air shaft sump)	$3.54\ 10^{-3}$ (3.54×10^{-5})	**55.8**	$3.56\ 10^{-3}$ (3.56×10^{-5})
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			**$6.36\ 10^{-3}$** **(6.36×10^{-5})**		0.0236 (2.36×10^{-4})

[Lev12b & Rul12]

Bq = Bequerel
DD=deuterium-deuterium
LEC=liquid effluent collection (tank)
EDE = effective dose equivalent
mSv = milli Sievert
mrem = milli radiation equivalent man
HT = elemental tritium
HTO = tritium oxide

EDE at the nearest business 6.0 10-4 mrem (6.0×10^{-6} 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.

PPPL policy states when occupational exposures have the potential to exceed 1,000 mrem per year (10 mSv/yr), PPPL's 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/yr) above natural background at PPPL [PPPL09b, 09c, &10c].

5.1.1 Penetrating Radiation

The NSTX spherical tokamak did not conduct experiments during 2011, and therefore did not generate neutrons.

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 2011 showed effluent quantity and concentrations of radionuclides (tritium) to be within allowable limits established in New Jersey regulations (1 Ci/yr for all radionuclides), the National Safe Drinking Water regulations (40 CFR 141.16 limit of 20,000 pCi/L) and DOE Order 5400.5 (2 x 10^6pCi/liter for tritium).

As shown in Exhibits 5-3 and 5-4, the 2011 total amount of tritium released to the sanitary sewer was 0.041 Curies, less than 0.959 curies of the allowable 1.0-Curie per year limit. In Table 8, the gross beta activity is reported; the gross beta activity ranges from the lower-limit of detention (LLD) to 1680 pCi/L. A large drop off in activity from 2011 can presumably be attributed to the upgrade of NSTX that is currently in progress.

Exhibit 5-2.
Annual Releases to Sanitary System from Liquid Effluent Collection Tanks 1994-2011

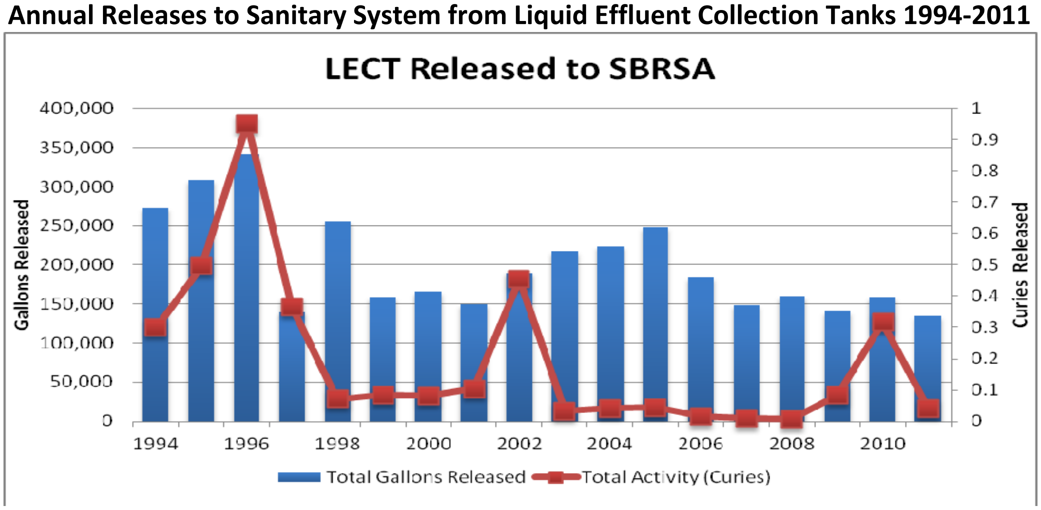


Exhibit 5-3.
Total Annual Releases (LEC tanks) to Sanitary System from 1994 to 2011

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

Exhibit 5-4.
Total Low-Level Radioactive Waste from 1997-2011

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 m^3	6.30270 (2.332×10^{11})
2011	15.6 m^3	0.0351 (1.297×10^{10})

5.1.3 Radioactive Waste

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

In 2011, low-level radioactive wastes were stored on-site in the Radioactive Waste Handling Facility (RWHF) prior to off-site disposal (Exhibit 5-5).

PPPL made one shipment of low-level radiotactive wast to Nevada National Security Site (NNSS) for burial 2011. The wastes are packaged for shipment and disposal in metal containers, refered to as "B-boxes" (Exhibit 5-6). PPPL maintains a detailed waste profile for each type of low-level waste shipped to NNSS. Periodically, NNSS audits PPPL's radioactive waste program, which includes employee training, waste characterization, waste packaging, quality control, and records retention. At a minimum, an internal QA review of the waste program is performed to ensure compliance with NNSS requirements.

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 0.0006 mrem/year (0.006 μSv/year) in 2011.

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 2011 (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 [PPPL09h].

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 10CFR835, "Occupational Radiation Protection" and that prior use does not suggest that contamination levels on inaccessible surfaces exceed Appendix D values [10CFR835]. For tritium and tritiated compounds, the removable surface contamination value used for this purpose is 1,000 dpm/100 cm^2.

5.3 Protection of Biota

In 2011,the highest measured concentrations of tritium in ground water was 210 pCi/L from the Air shaft sump (Table 4) and in surface water was 1788 pCi/L from D&R Canal pump house DSN 003 (Table 5). This concentration is a small fraction of the water biota concentration guide (BCG) (for HTO) of 3×10^8 pCi/L for aquatic system evaluations, and the water BCG for HTO of 2×10^8 pCi/L for terrestrial system evaluations, per DOE Standard STD-1153-2002, "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" [Lev12b].

5.4 Unplanned Releases

There were no unplanned radiological releases in 2011.

5.5 Environmental Radiological Monitoring

5.5.1 Waterborne Radioactivity

A. Surface Water

Surface-water samples at nine locations (two on-site: DSN001, and E1; and seven off-site: B1, B2, C1, DSN003, M1, P1, and P2) have been analyzed for tritium (Table 5).

In July 2011, at on-site location, DSN-003, the tritium concentration was detected at 1788 pCi/L, which was the highest for surface water sample (Table 5).

Rain water samples, which will eventually reach surface waters, were collected and analyzed and ranged from below detection to 269 pCi/L in 2011 (Table 6). With the end of TFTR D&D project in September 2002, the decrease in rain, surface, and ground water tritium concentrations have mirrored the decreased tritium emissions 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 2011 weekly precipitation amounts are shown on Table 2. Based on the average rainfall, a comparison of dry or wet years shows that 2011 was significantly wetter, 65.12 inches (165.40 cm), when compared with 46.5 average inches (118.1 cm) (Table 7).

B. Ground Water

In January 2011, the highest concentration of tritium was found in Air Shaft Sump at 210 pCi/L, (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 2011. Wells TW-1 and TW-8 had levels of 185 pCi/l and 192 pCi/l, respectively. Ground water monitoring was resumed in early 2011 based on increased stack releases due to ongoing neutral beam cleaning in preparation for the NSTX upgrade project.

From 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 venting of tritium from the D-site stack and the resulting "wash-out" during precipitation. Ground water monitoring of the wells and the foundation sump (dewatering sump for D-site buildings) will continue.

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 was established (E1 location) to provide baseline data for water coming onto the site. Radiological analysis has included gamma spectroscopy and tritium-concentration determination. In 2011, tritium concentrations at this location were less than the lower limit of detection (Table 5).

5.5.2 Foodstuffs, Soil, and Vegetation

There were no foodstuffs, soil, or vegetation samples gathered for analysis in 2011. 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

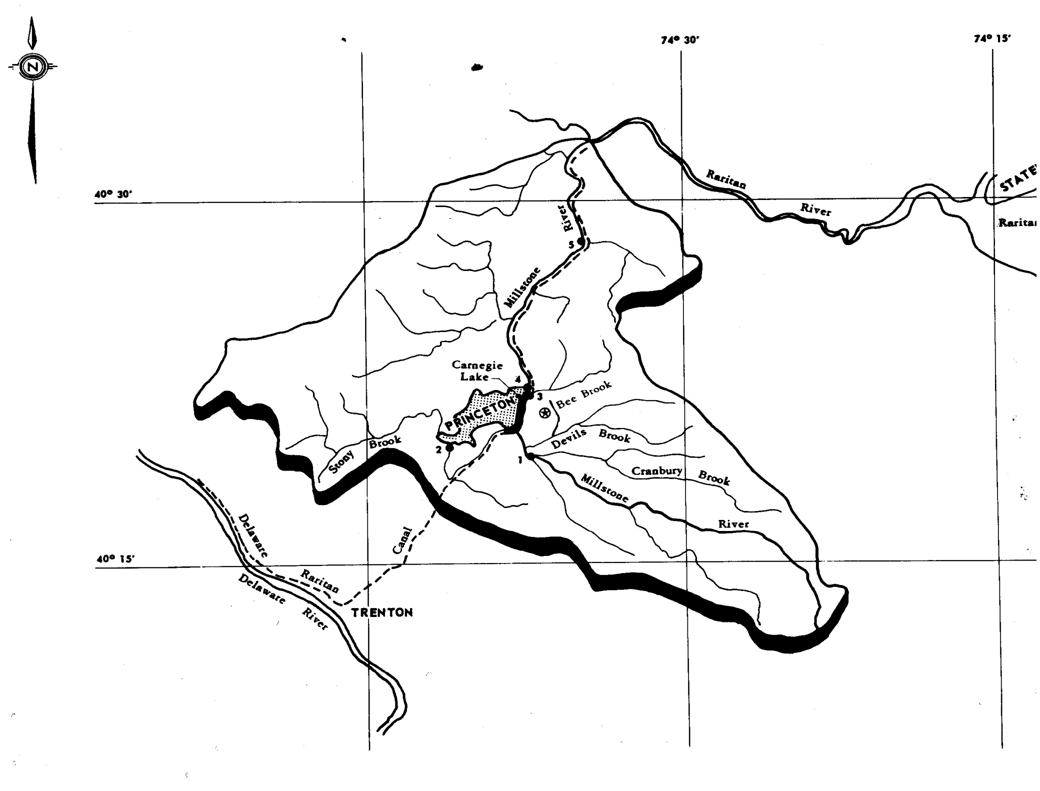
SITE HYDROLOGY, GROUND WATER, AND DRINKING WATER PROTECTION

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). 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 earthquake-prone, despite the occurrence of minor earthquakes that have caused 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 percents 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. Grass has replaced much of the open areas.

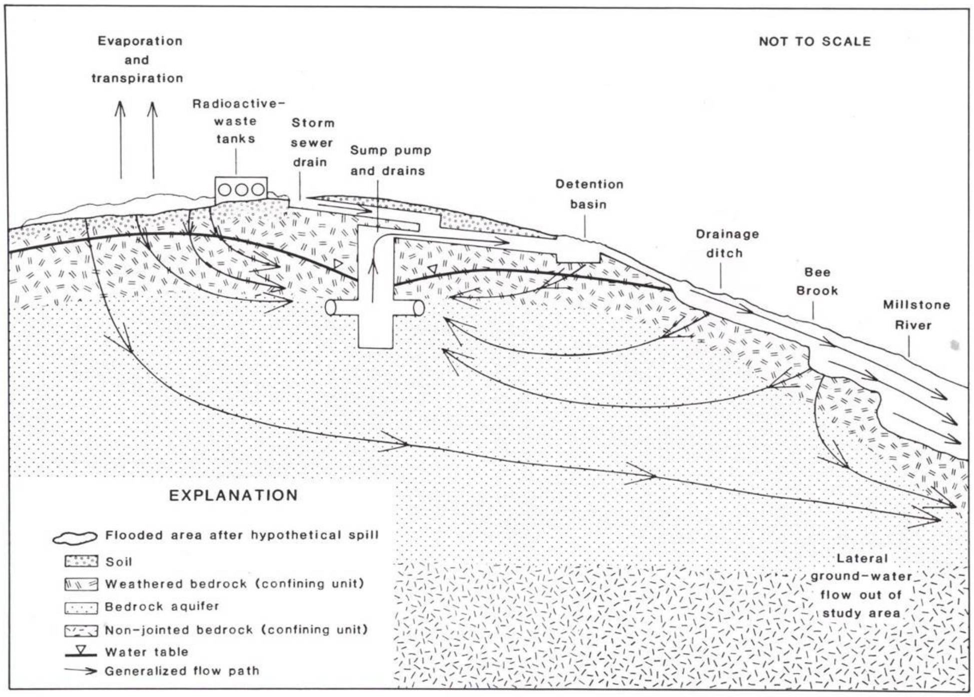
The under-story of the wooded areas is partially open with isolated patches of shrubs, vines, and saplings occurring mostly in the uplands area. The poorly drained areas have a low ground cover of ferns, grasses, and leaf litter.

6.4 Flood Plain

All of PPPL's storm water runoff flows to Bee Brook, either directly *via* the retention basin (DSN001) or along the western swale to the wetlands south of the site. Approximately 45% of the site's total area is covered by impervious surfaces – buildings, roadways and parking lots, and storage trailers.

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, 14.5 acres grass, and 18.4 acres upland forest. Gravel, which is semi-impervious, covers approximately 11.1 acres, resulting in an impervious cover (buildings, roadways, sidewalks, etc.) of 26.5 acres. PPPL's current site impervious cover equals about 30 percent. [PPPL09e & SE96].

Exhibit 6-2. Generalized Potentiometric Surface of the Bedrock Aquifer at PPPL [Le87]



Also, 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].

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 and shallow cone of depression 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.

6.5 Groundwater Monitoring

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]. PPPL has begun planning the transition from NJDEP oversight of its environmental remediation program to the new state-mandated Licensed Site Remediation Professional (LSRP) program. This transition must be completed by May 2012.

Exhibit 6-3. 2011 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. Groundwater Contamination

Ranges of Results for Positive Detections				
	2010 Wells	**2011 Wells**	**2010 Sumps**	**2011 Sumps**
Tritium (pCu/L)	Not sampled	<112 - 192	Bkg – 567.1	<112-210
PCE (µg/L)	ND – 107.0	ND – 87.9	1.67 – 34.9	ND – 29.7
TCE (µg/L)	ND – 4.92	ND – 28.2	ND – 3.88	ND – 3.31

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. 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 groundwater. Groundwater parameters sampled can be seen in Exhibit 6-6.

Exhibit 6-5.
Well Monitoring Setup –Compressed Air, Water Depth. Meter, Discharge Collection Bucket, and Probe

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 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 (Exhibits 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 submitted to NJDEP in May 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 2009, with submittal of a Biennial Remedial Action and Ground Water Classification Exception Area Recertification Report (PPPL09g).

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 2011 activities include:

- Quarterly sampling in March, June, September, and December.
- Submittal of the *Remedial Action Progress Report* and *Remedial Action Biennial Certification for Ground Water* to NJDEP in May 2011.
- Bladder pumps and monitoring well casings were refurbished as necessary.

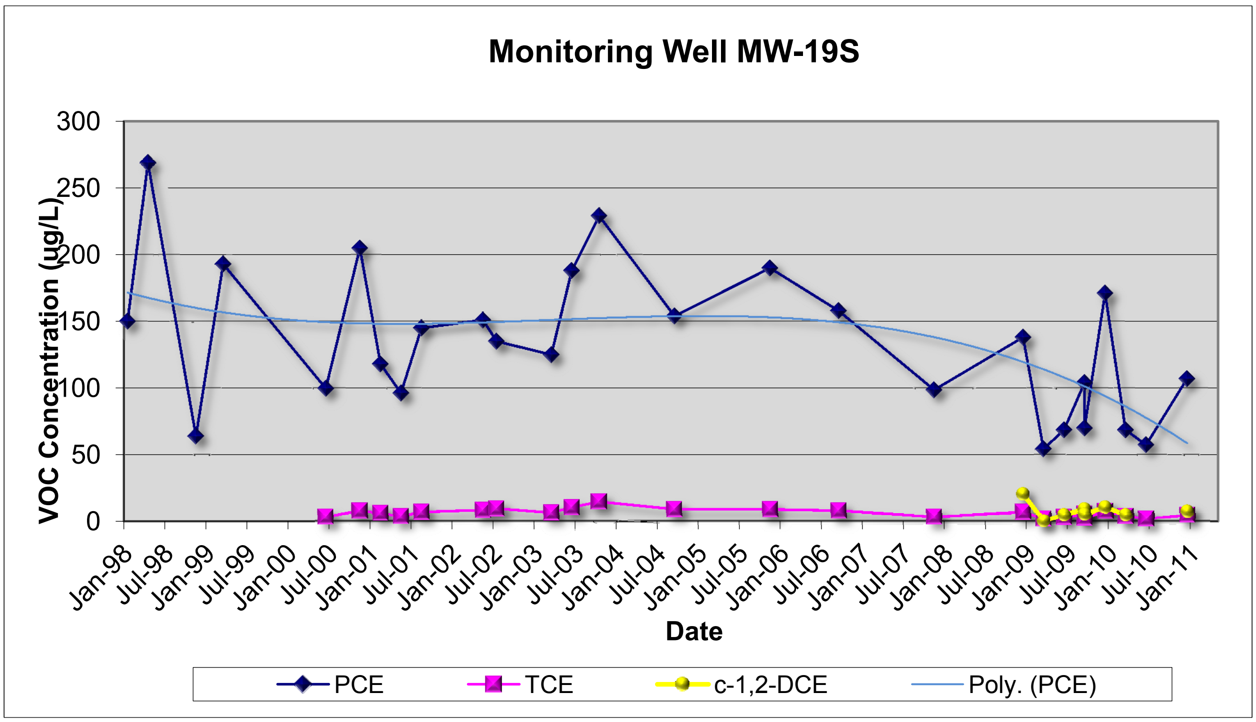
6.5.4 Monitored Natural Attenuation

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). 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) and cis-1,2-dichloroethlyene (c-1,2-DCE). 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 [PPPL12c, Sh06, Sh07, SH08, Sh09].

Review and examination of the analytical results indicate that contaminant concentrations, particularly PCE, are generally decreasing and are below the levels documented at the beginning to the Remedial Investigation. Seasonal fluctuations in VOC concentrations were seen in data collected during the RI and during the first two years of 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 [PPPL12c].

Exhibit 6-7: PCE Concentration vs. Time at MW-19S (1998-2011)



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.

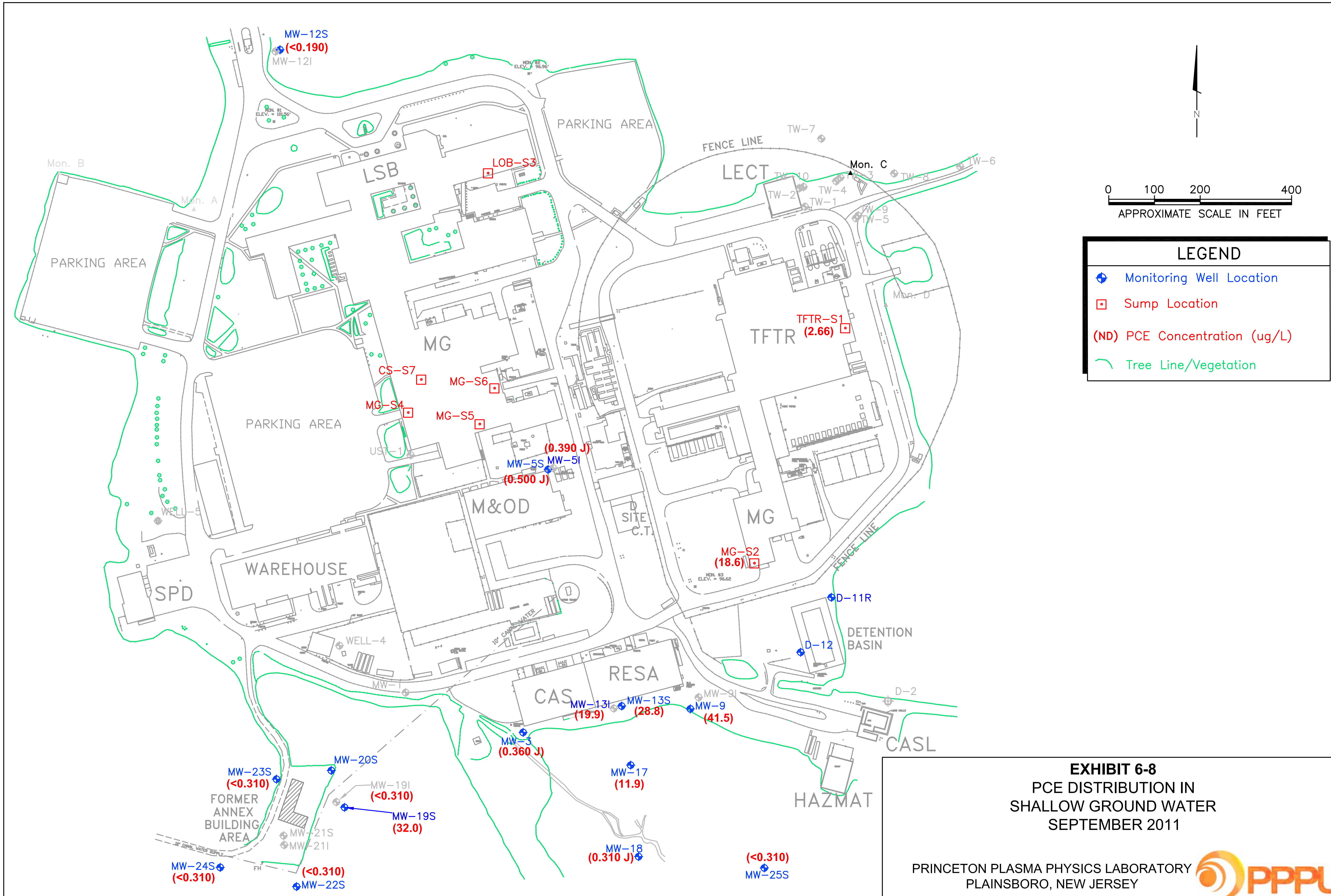


EXHIBIT 6-8
PCE DISTRIBUTION IN
SHALLOW GROUND WATER
SEPTEMBER 2011

PRINCETON PLASMA PHYSICS LABORATORY
PLAINSBORO, NEW JERSEY

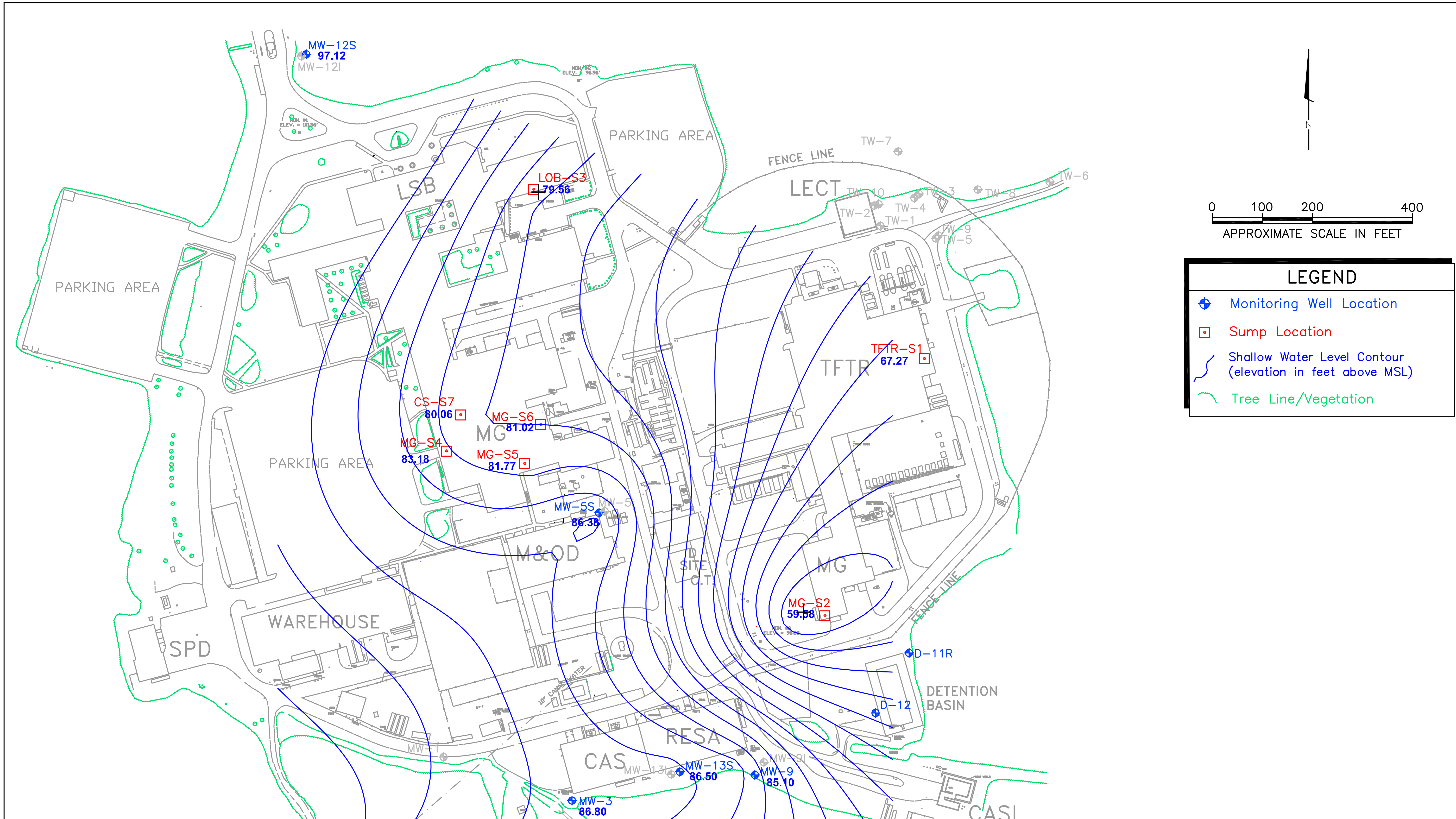


EXHIBIT 6-9
POTENTIOMETRIC SURFACE CONTOURS
SHALLOW GROUND WATER - SEPTEMBER 2011
(Contour Interval 2 feet)

PRINCETON PLASMA PHYSICS LABORATORY
PLAINSBORO, NEW JERSEY

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 2011, 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

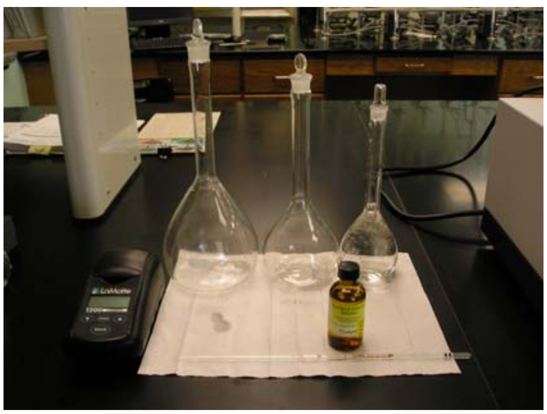


Exhibit 7-2. Distilling Samples for Tritium Analysis Performed at PEARL

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* [SM92] 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 2011 (May and November). Cesium, cobalt and zinc use a gamma spectroscopy technique while tritium uses a distillation and liquid scintillation method (Exhibit 7-3) (Table 23) [PPPL11a].

Exhibit 7-3 NJDEP Radiological Certified Parameters 2011

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 2011

Parameter	Approved Method
Specific Conductance	SM 2510 B
Chlorine	SM 4500-Cl G
Oxygen (dissolved)	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 2011 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 2011.

B. Internal QA Check

Temperature calibrations are conducted quarterly with 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 with the set of secondary standards: Blank (0mg/L), 0.2 mg/L, 1.0 mg/L, and 2.0 mg/L Total residual chlorine. Chlorine is verified prior to NJPDES sampling by calibrated LaMotte Secondary Standards.

Dissolved oxygen (DO) meter is 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

In May 2011, NJDEP Office of Quality Assurance (OQA) audited PPPL's Princeton Environmental, Analytical and Radiological Laboratory, PEARL. 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. The following issues were noted [PPPL11c, 11f]:

1) Proficiency testing (PT) should be treated in the same manner as routine samples, *i.e.*, samples in duplicate not four or five analyses,
2) PT results are to be submitted to NJDEP OQA, two previous reports had not been submitted for radiochemistry although PEARL passed both PTs,
3) pH calibration check required after 3-point calibration and recorded,
4) Primary temperature calibration (quarterly) records location needed to be verified,
5) Dissolved oxygen measurements accuracy within 0.3 mg/L (checked against titration method),
6) All chemicals, standard solutions/reagents require dates received and dates first opened,
7) Standard operating procedures (SOPs) required to be written consistent with the department standard analytical method (DSAM),
8) Spectrophotometric analysis for chlorine calibration values within ± 10%, and
9) Calibration logbook had "temporary" records of required calibrations. All the issues were satisfactorily resolved and the NJDEP closed the audit in November 2011.

Chapter

8

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Chapter

9

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Appendix

A

TABLES for 2011

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 2011

START DATE	WEEK	INCH	CUM. INCHES	TOTAL	MONTHLY TOTAL
4-Jan-11	1	0.04	0.04	2.8 in. snow	
11-Jan-11	2	0.07	0.11	4.5 in. snow	
18-Jan-11	3	0.71	0.82	3.2 in. snow	
25-Jan-11	4	0.08	0.90	15 in. snow	
1-Feb-11	5	0.52	**1.42**	**1.42**	**JANUARY**
8-Feb-11	6	0.90	2.32	13 in. snow	
15-Feb-11	7	0.00	2.32		
22-Feb-11	8	0.03	2.35		
1-Mar-11	9	1.63	**3.98**	**2.56**	**FEBRUARY**
8-Mar-11	10	2.22	6.20		
15-Mar-11	11	1.93	8.13		
22-Mar-11	12	0.92	9.05		
29-Mar-11	13	0.89	**9.94**	**5.96**	**MARCH**
5-Apr-11	14	0.61	10.55		
12-Apr-11	15	1.36	11.91		
19-Apr-11	16	3.47	15.38		
26-Apr-11	17	2.20	**17.58**	**7.64**	**APRIL**
3-May-11	18	1.06	18.64		
10-May-11	19	0.45	19.09		
17-May-11	20	1.03	20.12		
24-May-11	21	0.91	21.03		
31-May-11	22	0.33	**21.36**	**3.78**	**MAY**
7-Jun-11	23	0.10	21.46		
14-Jun-11	24	0.52	21.98		
21-Jun-11	25	1.05	23.03		
28-Jun-11	26	0.98	**24.01**	**2.65**	**JUNE**
5-Jul-11	27	2.07	26.08		
12-Jul-11	28	0.68	26.76		
19-Jul-11	29	0.00	26.76		
26-Jul-11	30	0.37	27.13		
2-Aug-11	31	0.25	**27.38**	**3.37**	**JULY**
9-Aug-11	32	1.61	28.99		
16-Aug-11	33	5.22	34.21		
23-Aug-11	34	3.30	37.51		
30-Aug-11	35	8.94	**46.45**	**19.07**	**AUGUST**
6-Sep-11	36	2.28	48.73		
13-Sep-11	37	2.04	50.77		
20-Sep-11	38	0.00	50.77		
27-Sep-11	38	1.00	**51.77**	**5.32**	**SEPTEMBER**
4-Oct-11	39	1.62	53.39		
11-Oct-11	40	0.02	53.41		
18-Oct-11	41	0.98	54.39		
25-Oct-11	42	1.09	55.48		
1-Nov-11	44	2.10	**57.58**	**5.81**	**OCTOBER**
8-Nov-11	45	0.00	57.58		
15-Nov-11	46	0.02	57.60		
22-Nov-11	47	2.29	59.89		
29-Nov-11	48	0.49	**60.38**	**2.80**	**NOVEMBER**
6-Dec-11	49	0.57	60.95		
13-Dec-11	50	1.76	62.71		
20-Dec-11	51	0.01	62.72		
27-Dec-11	52	2.34	65.06		
3-Jan-12	53	0.06	**65.12**	**4.74**	**DECEMBER**

Table 3. D–Site Tritium Stack Releases in Curies in 2011

Week Ending	HTO (Ci)	HT (Ci)	Weekly Total (Ci)	Annual Total (Ci)
1/5/11*	0.00032	0.00002	0.00034	0.00034
1/12/11	0.00024	0.00003	0.00027	0.00061
1/20/11	0.00042	0.00001	0.00043	0.00104
1/26/11	0.00018	0.00001	0.00019	0.00123
2/2/11	0.00019	0.00001	0.00020	0.00143
2/9/11	0.00017	0.00002	0.00019	0.00162
2/16/11	0.00022	0.00001	0.00023	0.00185
2/23/11	0.00017	0.00001	0.00018	0.00203
3/2/11	0.00019	0.00001	0.00020	0.00223
3/9/11	0.00026	0.00001	0.00027	0.00250
3/16/11	0.00023	0.00001	0.00024	0.00274
3/23/11	0.00017	0.00001	0.00018	0.00292
3/30/11	0.00016	0.00000	0.00016	0.00308
4/6/11	0.00022	0.00001	0.00023	0.00331
4/13/11	0.00045	0.00001	0.00046	0.00377
4/20/11	0.00023	0.00001	0.00024	0.00401
4/27/11	0.00033	0.00001	0.00034	0.00435
5/4/11	0.00027	0.00001	0.00028	0.00463
5/11/11	0.00024	0.00001	0.00025	0.00488
5/18/11	0.00024	0.00001	0.00025	0.00513
5/25/11	0.00620	0.00025	0.00645	0.01158
6/1/11	0.00027	0.00001	0.00028	0.01186
6/8/11	0.00026	0.00001	0.00027	0.01213
6/15/11	0.00039	0.00002	0.00041	0.01254
6/22/11	0.00025	0.00001	0.00026	0.01280
6/29/11	0.00023	0.00001	0.00024	0.01304
7/13/11	0.00042	0.00002	0.00044	0.01348
7/20/11	0.00022	0.00001	0.00023	0.01371
7/28/11	0.00031	0.00001	0.00032	0.01403
8/3/11	0.00019	0.00001	0.00020	0.01423
8/11/11	0.00027	0.00002	0.00029	0.01452
8/17/11	0.00017	0.00001	0.00018	0.01470
8/24/11	0.00015	0.00001	0.00016	0.01486
8/31/11	0.00042	0.00001	0.00043	0.01529
9/15/11	0.00052	0.00002	0.00054	0.01583
9/21/11	0.00022	0.00001	0.00023	0.01606
9/29/11	0.00093	0.00002	0.00095	0.01701
10/19/11	0.15410	0.00520	0.15930	0.17631
10/26/11	0.07690	0.00311	0.08001	0.25632
11/9/11	0.15100	0.00349	0.15449	0.41081
11/26/11	0.00018	0.00001	0.00019	0.41100
12/9/11	0.08450	0.00347	0.08797	0.49897
12/22/11	0.29500	0.14500	0.44000	0.93897
Total	**0.77800**	**0.16097**	**0.93897**	

Table 4. Ground Water Tritium Concentrations for 2011 (in picoCuries/Liter)

Well No. or Sump Location	Well TW-1	Well TW-5	Well TW-8	Air Shaft Sump	D-site MG Sump
January				**210**	<132
February				<127	<127
March	**162**	<122	**128**	<126	<126
April				**150**	<129
May				<113	<113
June	**124**	<112	<112	**146**	<112
July				**134**	<112
August				**139**	<122
September	**185**	***192***	<117	**191**	<117
October				<118	<118
November	<124	<124	<124	<117	<117
December				<119	<124

BOLD indicates above the level of detection. Below Bkg. = Below the Background tritium concentration.

Table 5. Surface Water Tritium Concentrations for 2011 (in picoCuries/liter)

Sample Location	Bee Brook (B1)	Bee Brook (B2)	Basin (DSN001)	D&R Canal (C1)	D&R Canal (DSN003)
January			**173**	<132	**<132**
February	Below Bkg.	<127	<127	Below Bkg.	Below Bkg.
March			<126	Below Bkg.	Below Bkg.
April			<129	<129	Below Bkg.
May	<113	<113	<113	<113	<113
June			<112	Below Bkg.	<112
July			<112	<112	**1788**
August	<122	**169**	<118	<122	<118
September			**219,** <117	<117	<117
October			<118	Below Bkg.	<118
November	<118	<117	<118	Below Bkg.	<118
December			Below Bkg	<124	Below Bkg.

Sample Location	Potable Water (E1)	Millstone River (M1)	Cranbury Brook (P1)	Devil's Brook (P2)
January				
February	Below Bkg.	Below Bkg.	Below Bkg.	Below Bkg.
March				
April				
May	<113	<113.	<113	<113
June				
July				
August	<118	<122	Below Bkg.	<122
September				
October				
November	<117	<117	<117	<117
December				

Bold indicates the highest concentrations above background levels. Blank indicates no samples collected.

Table 6. Rain Water Tritium Concentrations (in picoCuries/liter) Collected On-Site in 2011

250 feet from Stack	R1E (East)	R1W (West)	R1S (South)	R1N (North)	R1ND (Duplicate)
3/2/11	**136**		<126	<122	<126
3/17/11	<122		Below Bkg.	<122	**127**
4/13/11	**158**	<129	**232**	<129	<129
5/25/11	**122**	<113	<113	**128**	<113
6/30/11	<112	<112	<118	<112	<112
8/1/11	**169**	<115	<115	<115	<115
8/17/11	<115	<118	<115	<118	<118
9/1/11	**185**	<109	<109	**110**	<109
10/3/11	**214**	**129**	**151**	<113	<113
11/18/11	**198**		**161**	Below Bkg.	Below Bkg.
12/20/11	<118		**<118**	<118	<118

500 feet from Stack	R2E (East)	R2W (West)	R2S (South)	R2N (North)
3/2/11	<126	Below Bkg.	<126	Below Bkg.
3/17/11	<122	<122	Below Bkg.	<122
4/13/11	<129	<129	<129	<129
5/25/11	**135**	<113	<113	<113
6/30/11	**269**	<112	<112	<112
8/1/11	<115	Below Bkg.	<115	<115
8/17/11	<118	<118	<115	<115
9/1/11	**123**	<115	<109	<115
10/3/11		**133**	<113	**155**
11/18/11	<118	<118	<118	<118
12/20/11	<118	<118	<118	<119

BOLD indicates highest concentrations above background levels.
Blank indicates no sample collected.

Table 7. Annual Range of Tritium Concentration at PPPL in Precipitation from 1985 to 2011

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

Table 8. Liquid Effluent Collection Tank Release Data for 2011

Sample Date	Gallons Released	Tritium Sample LLD (pCi/L)	Tritium Sample Activity (pCi/L)	Total Tank Activity (Ci)	Annual Cumulative Activity (Ci)	Gross Beta Sample LLD (pCi/L)	Gross Beta Sample Activity (pCi/L)
3/25/2011	12,750	365	87,300	0.004210	0.004210	279	359
5/19/2011	12,450	340	259,000	0.012200	0.016410	280	1,620
6/8/2011	12,500	262	190,000	0.008980	0.025390	280	1,680
6/29/2011	12,750	304	27,200	0.001310	0.026700	279	1,600
7/8/2011	12,750	380	107,000	0.005180	0.031880	279	480
7/22/2011	12,900	272	61,300	0.003000	0.034880	293	<LLD
7/28/2011	7,350	279	28,900	0.000805	0.035685	280	<LLD
8/15/2011	12,750	355	44,400	0.002140	0.037825	279	<LLD
8/31/2011	12,750	320	32,000	0.001540	0.039365	280	<LLD
9/13/2011	12,750	282	9,520	0.000460	0.039825	281	<LLD
10/10/2011	12,750	304	26,000	0.001250	0.041075	280	<LLD
Total gallons	134,450						

Table 9. Total Fuel Consumption by Fuel Type from 2000 to 2011

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**
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 2011

Location B1 = Bee Brook upstream of PPPL basin discharge

Sample Date	2/7/11	5/5/11	8/9/11	11/1/11
Ammonia nitrogen as N, mg/L	<0.10	<0.10	0.11	<0.10
Biological Oxygen Demand, mg/L		<4.20	<2.00	<2.00
Chemical Oxygen Demand, mg/L	15.00	36.00	18.00	32.00
Oxidation-Reduction Potential, mV	52.5	11.80	13.80	7.30
pH, standard units	5.94	6.69	6.64	6.70
Phosphorus, total, mg/L	<0.050	<0.050	0.153	<0.050
Temperature, ^{o}C	1.65	13.00	23.30	7.30
Total Suspended Solids, mg/L	3.20	4.00	6.00	2.50
Total Organic Carbon, mg/L	7.09	13.40	6.80	11.20
Total Dissolved Solids, mg/L		254.00	294.00	431.00

Table 11. Surface Water Analysis for Bee Brook, B2, in 2011

Location B2 = Bee Brook downstream of PPPL basin discharge

Sample Date	2/7/11	5/5/11	8/9/11	11/1/11
Ammonia nitrogen as N, mg/L	<0.10	<0.10	0.11	<0.10
Biological Oxygen Demand, mg/L		<4.20	<2.00	<2.00
Chemical Oxygen Demand, mg/L	17.00	27.00	<10.0	32.00
Oxidation-Reduction Potential, mV	17.80	16.70		-1.70
pH, standard units	6.57	6.60	7.64	6.87
Phosphorus, total, mg/L	<0.050	<0.050	0.026	<0.050
Temperature, ^{o}C	3.85	13.80	23.80	11.05
Total Suspended Solids, mg/L	4.80	6.00	6.00	2.00
Total Organic Carbon, mg/L	5.93	9.03	3.61	6.86
Total Dissolved Solids, mg/L		337.00	454.00	409.00

Table 12. Surface Water Analysis for Delaware & Raritan Canal, C1, in 2011

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

Sample Date	1/10/11	2/7/11	3/2/11	4/6/11	5/5/11	6/2/11
Ammonia nitrogen as N, mg/L		<0.10			<0.10	
Biological Oxygen Demand, mg/L				<2.43	<2.72	
Chemical Oxygen Demand, mg/L	<10.00	20.00	14.00	39.00	<10.00	11.00
Oxidation-Reduction Potential, mV	- 40.0		52.70	- 4.10	11.00	27.05
pH, standard units	6.26		6.01	7.00	6.70	7.49
Phosphorus, total, mg/L	<0.050	0.067	<0.050	<0.050	<0.050	0.08
Temperature, ^{o}C	1.30		7.45	9.40	17.20	35.10
Total Suspended Solids, mg/L	<2.00	4.00	3.60	3.60	9.00	8.80
Total Organic Carbon, mg/L	2.22	3.89	4.42	3.08	3.45	3.79
Total Dissolved Solids, mg/L					106.00	

Sample Date	7/7/11	8/9/11	9/7/11	10/3/11	11/1/11	12/2/11
Ammonia nitrogen as N, mg/L	<0.10	<0.10	0.33		<0.10	
Biological Oxygen Demand, mg/L		<2.00			2.71	
Chemical Oxygen Demand, mg/L	19.00	10.0		27.00	29.00	17.00
Oxidation-Reduction Potential, mV	- 12.60	- 27.90	17.20	- 3.80	- 11.00	
pH, standard units	7.10	7.36	6.60	6.96	7.04	
Phosphorus, total, mg/L	0.09	0.095	0.108	0.055	0.092	<0.050
Temperature, ^{o}C	29.60	28.70	23.50	17.65	8.85	
Total Suspended Solids, mg/L	8.40	6.40	6.00	6.70	4.00	5.30
Total Organic Carbon, mg/L	3.59	2.89		9.06	7.86	3.90
Total Dissolved Solids, mg/L		137.00			166.00	

Table 13. Surface Water Analysis for Elizabethtown Water, E1, in 2011

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

Sample Date	2/7/11	5/5/11	8/9/11	11/1/11
Ammonia nitrogen as N, mg/L	0.33	<0.10	0.35	0.24
Biological Oxygen Demand, mg/L		<2.00	<2.00	<2.00
Chemical Oxygen Demand, mg/L	11.00	<10.00	<10.00	11.00
Oxidation-Reduction Potential, mV	127.60	8.20	5.00	-3.3
pH, standard units	4.71	6.75	6.80	6.90
Phosphorus, total, mg/L	0.422	0.561	0.937	1.040
Temperature, ^{o}C	12.35	15.30	24.75	16.65
Total Suspended Solids, mg/L	<2.00	<2.00	<2.00	4.60
Total Organic Carbon, mg/L	1.68	1.46	2.00	2.50
Total Dissolved Solids, mg/L		197.00	237.00	234.00

Table 14. Surface Water Analysis for Millstone River, M1, in 2011

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

Sample Date	2/7/11	5/5/11	8/9/11	11/1/11
Ammonia nitrogen as N, mg/L	0.30	<0.10	0.10	<0.10
Biological Oxygen Demand, mg/L		<4.00	3.22	3.87
Chemical Oxygen Demand, mg/L	16.00	22.00	29.00	24.00
Oxidation-Reduction Potential, mV	39.30	16.70	-6.00	-4.60
pH, standard units	6.19	6.60	6.99	6.92
Phosphorus, total, mg/L	0.062	0.071	0.124	0.076
Temperature, ^{o}C	3.67	17.80	29.75	8.70
Total Suspended Solids, mg/L	8.00	17.00	13.60	7.10
Total Organic Carbon, mg/L	3.12	5.77	4.74	6.38
Total Dissolved Solids, mg/L		186.00	183.00	174.00

Table 15. Surface Water Analysis for Cranbury Brook (Plainsboro), P1, in 2011

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

Sample Date	2/7/11	5/5/11	8/9/11	11/1/11
Ammonia nitrogen as N, mg/L	<0.10	<0.10	0.12	<0.10
Biological Oxygen Demand, mg/L		<4.00	<2.00	4.27
Chemical Oxygen Demand, mg/L	14.00	25.00	12.00	22.00
Oxidation-Reduction Potential, mV	66.00	18.10	28.20	-5.70
pH, standard units	5.72	6.58	6.40	6.94
Phosphorus, total, mg/L	<0.050	0.066	0.080	0.087
Temperature, ^{o}C	4.40	19.80	26.80	12.10
Total Suspended Solids, mg/L	11.20	18.00	7.20	15.60
Total Organic Carbon, mg/L	2.89	5.68	4.10	6.29
Total Dissolved Solids, mg/L		149.00	166.00	163.00

Table 16. Surface Water Analysis for Devil's Brook (Plainsboro), P2, in 2011

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

Sample Date	2/7/11	5/5/11	8/9/11	11/1/11
Ammonia nitrogen as N, mg/L	<0.10	<0.10	<0.10	<0.10
Biological Oxygen Demand, mg/L		<4.00	<2.00	<2.00
Chemical Oxygen Demand, mg/L	19.00	42.00	<10.0	35.00
Oxidation-Reduction Potential, mV	63.90	19.80	9.80	-10.10
pH, standard units	5.75	6.55	6.71	7.02
Phosphorus, total, mg/L	<0.050	<0.050	0.075	<0.050
Temperature, ^{o}C	3.20	16.70	24.00	11.45
Total Suspended Solids, mg/L	2.80	3.90	4.40	2.20
Total Organic Carbon, mg/L	5.36	14.10	2.86	11.70
Total Dissolved Solids, mg/L		106.00	154.00	86.00

Table 17. DSN001 - Retention Basin Outfall Surface Water Analysis (NJPDES NJ0023922) in 2011

Permit Limit	Units	Parameters	1/10/11	2/7/11	3/2/11	4/6/11	5/5/11	6/2/11
NA	mg/L	Ammonia-N		<0.10			<0.10	
NA	mg/L	Biological Oxygen Demand					7.40	
50 mg/L max.	mg/L	Chemical Oxygen Demand	<10.00	<10.00	<10.00	<10.00	12.00	<10.00
0.016	mg/L	Chlorine Produced Oxidants	0.00	0.03	0.04	0.02	0.03	0.025
NA	MGD	Flow, Avg. Monthly						
NA	mg/L	Kjeldahl Nitrogen		1.08			<1.00	
NA	mg/L	Nitrite as N		<0.025			<0.025	
NA	mg/L	Nitrate as N		1.20			1.81	
NA	mg/L	Nitrogen, Total		2.55			2.35	
NA	mV	Oxidation-Reduction Potential	-10.60	28.30	-3.8	-11.90	5.90	-58.60
10 mg/L	mg/L	Petroleum Hydrocarbons	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
6.0-9.0	S.U.	pH	7.21	6.45	7.05	7.14	6.79	7.93
NA	mg/L	Phosphorus, Total	<0.050	0.067	<0.050	<0.050	0.098	<0.050
NA	µg/L	Tetrachloroethylene	<0.30	0.410 J	0.380 J	0.510 J	0.570 J	0.420 J
30^{o} C max.	^{o} C	Temperature	0.95	8.35	12.25	11.80	15.10	20.45
NA	mg/L	Total Dissolved Solids					474.00	
NA	mg/L	Total Organic Carbon	1.28	2.23	2.09	1.81	1.70	2.14
50 mg/L	mg/L	Total Suspended Solids	<2.00	2.40	6.80	3.60	4.00	3.10

Table 17 continued. DSN001 - Retention Basin Outfall Surface Water Analysis (NJPDES NJ0023922) in 2011

Permit Limit	Units	Parameters	7/7/11	8/9/11	9/7/10	10/3/11	11/1/11	12/2/11
NA	mg/L	Ammonia-N	0.11	0.14			<0.10	
NA	mg/L	Biological Oxygen Demand		4.02			<0.20	
50 mg/L max.	mg/L	Chemical Oxygen Demand	<10.00	18.00	10.00		<10.00	<10.00
0.016	mg/L	Chlorine Produced Oxidants	0.08	0.045	0.05	0.03	0.015	
NA	MGD	Flow, Avg. Monthly						
NA	mg/L	Kjeldahl Nitrogen		1.87			<1.00	
NA	mg/L	Nitrite as N	<0.025	0.052			<0.020	
NA	mg/L	Nitrate as N	0.96	2.67			1.18	
NA	mg/L	Nitrogen, Total		4.59			1.80	
NA	mV	Oxidation-Reduction Potential	-62.40	-100.00	8.60	-67.50	-14.00	
10 mg/L	mg/L	Petroleum Hydrocarbons	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
6.0-9.0	S.U.	pH	7.96	8.60	6.73	8.09	7.09	
NA	mg/L	Phosphorus, Total	0.100	0.385	0.087	<0.050	0.050	<0.050
NA	µg/L	Tetrachloroethylene	0.410 J	<0.300	0.710 J	0.380 J	<0.190	0.28
30° C max.	°C	Temperature	22.55	24.10	19.50	17.10	13.85	
NA	mg/L	Total Dissolved Solids		446.00			426.00	
NA	mg/L	Total Organic Carbon	1.82	3.18	3.39	2.24	1.44	<1.00
50 mg/L	mg/L	Total Suspended Solids	4.40	28.40	3.30	4.70	<2.00	2.70

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

Table 18. D&R Canal Pump House - DSN003
Monthly Surface Water Analysis (NJPDES NJ0023922) in 2011

Permit Monthly Avg.	Units	Parameters	1/10/11	2/7/11	3/2/11	4/6/11	5/5/11	6/2/11
NA	mg/L	Ammonia-N		<0.10			<0.10	
NA	mg/L	Biological Oxygen Demand					<2.80	
NA	mg/L	Chemical Oxygen Demand	<10.00	12.00	16.00	11.00	10.00	17.00
0.019	mg/L	Chlorine Produced Oxidants	0.02	0.02	0.04	0.00	0.085	0.02
NA	mg/L	Kjeldahl Nitrogen		<1.00			<1.00	
NA	mg/L	Nitrite as N		<0.025			<0.025	
NA	mg/L	Nitrate as N		1.05			0.59	
NA	mg/L	Nitrogen, Total		1.56			1.10	
NA	mV	Oxidation-Reduction Potential	-41.10	19.40		8.00	13.40	-23.20
10 mg/L	mg/L	Petroleum Hydrocarbons	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
6.0 – 9.0	S.U.	pH pH 3/17/10	6.24	6.54	5.81	6.78	6.66	7.29
NA	mg/L	Phosphorus, Total	<0.050	<0.050	<0.050	<0.050	<0.050	0.075
NA	°C	Temperature	4.05	3.10		11.60	17.10	26.15
NA	mg/L	Total Dissolved Solids					117.00	
NA	mg/L	Total Organic Carbon	2.33	2.66	4.28	2.66	3.39	3.85
NA	mg/L	Total Suspended Solids	<2.00	2.00	8.40	2.80	5.00	8.80

**Note – NO discharge from DSN003 during January 2010*

Table 18. continued. D&R Canal Pump House - DSN003
Monthly Surface Water Analysis (NJPDES NJ0023922) in 2011

Permit Monthly Avg.	Units	Parameters	7/7/11	8/9/11	9/7/10	10/3/11	11/1/11	12/2/11
NA	mg/L	Ammonia-N	0.11	<0.10	0.31		<0.10 <0.10	
NA	mg/L	Biological Oxygen Demand		<2.00			2.57	
NA	mg/L	Chemical Oxygen Demand	14.00	10.00		30.00	26.00	14.00
0.019	mg/L	Chlorine Produced Oxidants	0.05	0.005	0.02	0.01	0.00	
NA	mg/L	Kjeldahl Nitrogen		<1.00			<1.00	
NA	mg/L	Nitrite as N	<0.025	<0.025	0.031		<0.20	
NA	mg/L	Nitrate as N	0.76	0.84	0.73		1.02	
NA	mg/L	Nitrogen, Total		1.35			1.53	
NA	mg/L	Ortho Phosphate as P		0.089				
NA	mV	Oxidation-Reduction Potential	-15.10	-15.50	23.00	28.50	20.00	
10 mg/L	mg/L	Petroleum Hydrocarbons	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
6.0 – 9.0	S.U.	pH	7.14	7.15	6.50	6.39	6.80	
NA	mg/L	Phosphorus, Total	0.090	0.095	0.150	0.171	0.140	<0.050
NA	^{o}C	Temperature	28.45	29.15	23.45	19.05	11.50	
	mg/L	Total Dissolved Solids		140.00			194.00	
NA	mg/L	Total Organic Carbon	3.59	2.86		8.20	5.67	4.08
NA	mg/L	Total Suspended Solids	6.00	6.80	18.00	18.00	10.00	5.30

Note: *Delaware & Raritan Canal pump house did not operate during October through December 2010.
Flow = 250 gallons per minute X 2 minutes per cycle X 10 cycles per day = 5,000 gallons per day
Permit changed from monthly to quarterly monitoring and no limit for Total suspended solids
Blank indicates no measurement
NA = not applicable
NL = no limit

Table 19. Summary of Ground Water Sampling Results –March 2011
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	D-MG Sump	MW-26 *	TB-	NJ Ground
PPPL Sample No.		11-147	11-148	11-149	11-150	11-151	11-152	11-153	11-154	11-155	11-158	11-156	11-157	Water
Lab Sample No.		L3661839-7	L3661839-8	L3661839-9	L3661839-1	L3661839-2	L3661839-3	L3661839-4	L3661839-10	L3661839-6	L3661839-11	L3661839-5	L3661839-12	Standard
Target Volatile Organic Compounds (ug/L)														
Tetrachloroethylene		<0.300	0.960 J	<0.300	0.450 J	**21.7**	**9.79**	<0.300	**64.9**	0.440 J	**17.2**	**23.6**	<0.300	1
Trichloroethylene		<0.310	<0.310	**2.60**	<0.310	**30.9**	0.600 J	<0.310	**2.90**	<0.310	**1.65**	**31.9**	<0.310	1
c-1,2-Dichloroethylene		<0.250	<0.250	3.64 JN	<0.250	14.9 JN	<0.250	<0.250	3.69 J	<0.250	<0.250	15.4 JN	<0.250	70
t-1,2-Dichloroethylene		<0.230	<0.230	<0.230	<0.230	<0.230	<0.230	<0.230	<0.230	<0.230	<0.230	<0.230	<0.230	
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	<0.260	30
1,1-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	2
Chloroform		<0.220	<0.220	<0.220	<0.220	<0.220	<0.220	<0.220	<0.220	<0.220	0.270 J	0.250 J	<0.220	6
Vinyl Chloride		<0.350	<0.350	<0.350	<0.350	<0.350	<0.350	<0.350	<0.350	<0.350	<0.350	0.460 J	<0.350	2
Tentatively Identified Compounds (ug/L)														
Unknown		ND	ND	ND	ND	3.32 J	ND	ND	ND	ND	ND	3.35 J	ND	--
1,1,2-Trichloro-1,2,2-Trifluoroethane		ND	ND	ND	ND	36.2 JN	ND	ND	ND	ND	ND	42.6 JN	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	14.5	144	425	<5.00	41.9	12.6	9.2	5.63	106	194	41.9		--
Manganese	mg/L	0.552	0.00270	0.726	0.00280	0.468	0.332	0.228	0.0259	2.74	2.07	0.656		--
Alkalinity	mg/L	94.0	17.4	149	78.1	71.0	69.5	14.3	16.9	89.1	103	69.4		--
Nitrate as N	mg/L	<0.025	1.66	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	1.3	<0.025		--
Nitrite	mg/L	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500		--
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	30.5	10.7	20.7	10.1	17.4	21.5	27.0	35.8	22.8	19.6	17.4		
Total Organic Carbon	mg/L	11.2	<0.500	<0.500	4.28	1.34	28.9	1.55	1.58	1.74	1.19	1.50		--
Ferrous Iron	mg/L	<0.20	<0.20	0.60	<0.20	0.47	<0.20	<0.20	<0.20	<0.20	0.71	0.83		--
Dissolved Methane	mg/L	0.81	<0.10	2.7	<0.10	5.0	<0.10	<0.10	<0.10	1.5	4.6	12.9	0.83	--
Dissolved Ethane	mg/L	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	--
Dissolved Ethene	mg/L	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	--
Dissolved Oxygen	mg/L	5.11	1.63	2.05	7.57	6.67	0.88	1.74	1.56	1.58				--
pH	Std. Units	5.34	6.18	7.74	5.70	5.81	6.35	5.72	5.63	6.25				--
Redox Potential	mVe	104.5	26.1	1.8	84.7	83.9	23.2	32.7	34.3	24.7				--

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 20. Summary of Ground Water Sampling Results –June 2011
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	D-MG Sump	MW-26 *	TB-3/6/12	NJ Ground
PPPL Sample No.		11-248	11-249	11-250	11-251	11-252	11-253	11-254	11-255	11-256	11-258	11-257	11-259	Water
Lab Sample No.		L3759741-5	L3759741-6	L3759741-7	L3759741-8	L3759741-1	L3759741-2	L3759741-9	L3759741-3	L3759741-4	L3759741-11	L3759741-10	L3759741-12	Standard
Target Volatile Organic Compounds (ug/L)														
Tetrachloroethylene		<0.190	**1.95**	<0.190	**36.7**	**28.4**	**23.5**	0.280 J	**54.9**	0.48 J	**29.7**	**30.8**	<0.190	1
Trichloroethylene		<0.120	<0.120	**2.76**	**7.83**	**20.7**	**1.03**	<0.120	**2.44**	0.26 J	**3.31**	**21.3**	<0.120	1
c-1,2-Dichloroethylene		ND	ND	4.38 JN	ND	18.4 JN	ND	ND	ND	ND	ND	18.7 JN	ND	70
t-1,2-Dichloroethylene		<0.190	<0.190	<0.190	<0.190	0.37 J	<0.190	<0.190	<0.190	<0.190	<0.190	0.34 J	<0.190	100
1,1,1-Trichloroethane		<0.190	<0.190	<0.190	0.77 J	0.26 J	0.30 J	<0.190	<0.190	<0.190	<0.190	0.30 J	<0.190	30
1,1-Dichloroethylene		<0.190	<0.190	<0.190	0.33 J	0.53 J	<0.190	<0.190	<0.190	<0.190	0.47 J	0.86 J	<0.190	1
Chloroform		<0.120	<0.120	<0.120	1.63	0.56 J	0.94 J	<0.120	<0.120	<0.120	0.28 J	0.51 J	<0.120	70
Vinyl Chloride		<0.220	<0.220	<0.220	<0.220	**1.48**	<0.220	<0.220	<0.220	<0.220	<0.220	**1.66**	<0.220	1
Tentatively Identified Compounds (ug/L)														
Unknown		27.9 J	ND	8.36 J	7.09 JN	12.5 J	5.85 J	5.87 J	16.3 J	6.77 J	ND	11.4 J	ND	--
1,1,2-Trichloro-1,2,2-Trifluoroethane		ND	ND	ND	ND	53.6 JN	ND	ND	ND	ND	ND	97.1 JN	ND	--
1,2-Dichloro-1,1,2-Trifluoroethane		ND	ND	ND	ND	8.07 JN	ND	ND	ND	ND	ND	11.1 JN	ND	--
Natural Attenuation Indicators														
Chloride	mg/L	14.2	142.00	**368.00**	15.60	77.00	12.80	10.50	5.74	121.00	207.00	75.90		250
Manganese	mg/L	**0.811**	0.0018 B	**0.6280**	0.0043	**4.9900**	**0.0905**	**0.2030**	0.0417	**7.1600**	**1.4800**	**4.7600**		0.05
Alkalinity	mg/L	115	12.30	146.00	39.70	58.40	45.80	17.00	17.00	89.10	95.80	60.00		--
Nitrate as N	mg/L	<0.500	1.61	<0.500	<0.500	<0.50	<0.50	<0.500	<0.500	<0.500	0.83	<0.500		10
Nitrite	mg/L	<0.025	0.03	0.04	<0.025	<0.025	0.0899	<0.025	<0.025	<0.025	<0.025	<0.025		1
Sulfide	mg/L	<0.100	<0.100	<1.00	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100		--
Sulfate	mg/L	30.3	11.90	18.40	23.40	16.20	22.40	25.50	40.50	22.20	17.90	16.10		250
Total Organic Carbon	mg/L	12.2	<1.00	<1.00	1.10	1.47	18.50	1.59	1.95	1.40	1.00	1.51		--
Ferrous Iron	mg/L	<0.20	<0.20	0.50	<0.20	4.2	<0.20	<0.20	<0.20	<0.20	3.4	5.2		--
Dissolved Methane	ug/L	5.5	<0.10	1.2	<0.10	62.6	0.26	<0.10	<0.10	5.3	12.7	69	1.2	--
Dissolved Ethane	ug/L	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	--
Dissolved Ethene	ug/L	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	--
Dissolved Oxygen	mg/L	2.52	10.14	1.71	4.94	3.65	9.5	4.07	6.83	2.97		3.65		--
pH	Std. Units	5.81	5.5	6.6	5.38	5.5	5.50	5.02	5.15	5.9		5.5		--
Redox Potential	mVe	-28.9	-49.4	-74.3	-19.6	-21.7	-35.8	-38	-14.3	-77.2		-21.7		--

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 2011
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-3S	MW-5S	MW-5I	MW-9S	MW-12S	MW-13S	MW-13I	MW-17	MW-18	MW-19I	NJ Ground
PPPL Sample No.		11-343	11-344	11-345	11-346	11-347	11-348	11-349	11-350	11-351	11-352	Water
Lab Sample No.		L3877991-1	L3877991-2	L3877991-3	L3877991-4	L3759740-1	L3877991-5	L3877991-6	L3877991-7	L3877991-8	L3877991-9	Standard
Target Volatile Organic Compounds (ug/L)												
Tetrachloroethylene		0.360 J	0.500 J	0.390 J	**41.5**	<0.190	**28.8**	**19.9**	**11.9**	0.310 J	<0.310	1
Trichloroethylene		<0.340	<0.340	**3.54**	**28.2**	<0.120	**18**	0.460 J	0.67 J	<0.340	<0.340	1
c-1,2-Dichloroethylene		ND	ND	4.20 JN	4.02 JN	ND	15.2 JN	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	100
1,1,1-Trichloroethane		<0.260	<0.260	<0.260	0.590 J	<0.260	<0.260	0.760 J	<0.260	<0.260	<0.260	30
1,1-Dichloroethylene		<0.320	<0.320	<0.320	<0.320	<0.320	0.480 J	0.460 J	<0.320	<0.320	<0.320	1
Chloroform		<0.290	<0.290	<0.290	0.970 J	<0.120	0.380 J	0.870 J	<0.290	0.460 J	<0.290	70
Vinyl Chloride		<0.380	<0.380	<0.380	<0.380	<0.380	**1.22**	<0.380	<0.380	<0.380	<0.380	1
Tentatively Identified Compounds (ug/L)												
Unknown		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--
1,1,2-Trichloro-1,2,2-Trifluoroethane		ND	ND	ND	11.0 JN	ND	50.6 JN	18.0 JN	ND	ND	ND	--
1,2-Dichloro-1,1,2-Trifluoroethane		ND	ND	ND	ND	ND	5.85 JN	ND	ND	ND	ND	--
Natural Attenuation Indicators												
Chloride	mg/L	23.50	68.50	**340.00**	14.40	51.00	77.60	12.50	10.70	16.30	99.20	250
Manganese	mg/L	**1.1900**	0.0016 B	**0.5390**	**0.1170**	0.0018 B	**3.5800**	**0.1020**	**0.0975**	**0.0942**	0.0071	0.05
Alkalinity	mg/L	137.00	21.30	141.00	69.50	128.00	62.20	122.00	64.00	22.90	24.30	--
Nitrate as N	mg/L	<0.500	2.30	<0.500	<0.500	2.61	<0.50	<0.500	<0.500	<0.500	1.23	10
Nitrite	mg/L	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	1
Sulfate	mg/L	28.30	9.11	18.10	23.20	11.70	16.80	18.40	17.60	30.40	8.07	--
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	250
Total Organic Carbon	mg/L	11.90	<1.00	<1.00	1.45	<1.00	1.54	<1.00	1.36	1.65	<1.00	--
Ferrous Iron	mg/L	0.22	0.52	<0.20	<0.20	<0.20	13.20	<0.20	<0.20	<0.20	<0.20	--
Dissolved Methane	ug/L	34.50	<0.11	2.30	1.20	<0.11	118.00	<0.11	<0.11	<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	--
Dissolved Ethene	ug/L	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	--
Dissolved Oxygen	mg/L	0.45	8.15	0.86	1.15	3.78	1.94	1.50	0.10	2.34	6.80	--
pH	Std. Units	5.50	6.38	6.92	5.94	7.33	5.60	6.60	6.20	5.62	5.30	--
Redox Potential	mVe	150.80	225.10	8.10	149.00	90.40	79.50	123.20	177.90	230.80	203.50	--

NOTES: See explanatory notes on page 2.

Table 21 Continued. Summary of Ground Water Sampling Results – Annual September 2011
Target Chlorinated Volatile Organic Compounds (VOC), Monitored Natural Attenuation (MNA)

Well No.		MW-19S	MW-22S	MW-23S	MW-24	MW-25	D-MG Sump	TFTR Sump	MW-26 *	DSN-001	TB-9/14	TB-9/14	NJ Ground
PPPL Sample No.		11-353	11-354	11-355	11-356	11-357	11-360	11-361	11-358	11-359	11-363	11-362	Water
Lab Sample No.		L3877991-10	L3877991-11	L3877991-12	L3877991-13	L3877991-14	L3877991-17	L3877991-18	L3877991-15	L3877991-16	L3877991-19	L3759740-4	Standard
Target Volatile Organic Compounds (ug/L)													
Tetrachloroethylene		**32**	<0.310	<0.310	<0.310	<0.310	**18.6**	**2.66**	**30.6**	0.570 J	<0.310	<0.190	1
Trichloroethylene		**1.13**	<0.340	<0.340	<0.340	<0.340	**1.68**	0.380 J	**19.3**	<0.340	<0.340	<0.120	1
c-1,2-Dichloroethylene		ND	ND	ND	ND	ND	ND	ND	15.6 JN	ND	ND	ND	70
t-1,2-Dichloroethylene		<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	<0.290	0.300 J	<0.290	<0.290	<0.190	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	<0.190	30
1,1-Dichloroethylene		<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	<0.320	0.560 J	<0.320	<0.320	<0.190	1
Chloroform		<0.290	0.290 J	<0.290	0.370 J	<0.290	<0.290	0.420 J	0.470 J	2.83	<0.290	<0.120	70
Vinyl Chloride		<0.380	<0.380	<0.380	<0.380	<0.380	<0.380	<0.380	**1.43**	<0.380	<0.380	<0.220	1
Tentatively Identified Compounds (ug/L)													
Unknown		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--
1,1,2-Trichloro-1,2,2-Trifluoroethane		ND	ND	ND	ND	ND	ND	ND	56.3 JN	ND	ND	ND	--
1,2-Dichloro-1,1,2-Trifluoroethane		ND	ND	ND	ND	ND	ND	ND	6.60 JN	ND	ND	ND	--
Natural Attenuation Indicators													
Chloride	mg/L	8.73	44.30	<5.00	<5.00	119.00	147.00	114.00	77.60	142.00			250
Manganese	mg/L	0.0267	0.0192	0.0491	0.0101	**5.2700**	**0.6900**	**0.0537**	**3.5300**	**0.0675**			0.05
Alkalinity	mg/L	16.90	61.60	2.25	22.00	92.50	106.00	110.00	62.00	75.60			--
Nitrate as N	mg/L	<0.500	<0.500	<0.500	<0.500	<0.500	1.14	1.23	<0.500	1.59			10
Nitrite	mg/L	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200			1
Sulfate	mg/L	23.70	20.50	41.00	16.20	17.30	19.40	18.30	16.60	23.20			--
Sulfide	mg/L	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100			250
Total Organic Carbon	mg/L	2.69	<1.00	1.83	<1.00	2.10	1.05	<1.00	1.60	1.38			--
Ferrous Iron	mg/L	<0.20	<0.20	<0.20	<0.20	<0.20	0.84	<0.20	10.70	<0.20			--
Dissolved Methane	ug/L	<0.11	<0.11	<0.11	<0.11	8.80	2.90	<0.11	112.00	1.30		0.22	--
Dissolved Ethane	ug/L	<0.23	<0.23	<0.23	<0.23	0.17	<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	--
Dissolved Oxygen	mg/L	4.02	8.26	3.92	8.57	0.05			1.94				--
pH	Std. Units	5.18	5.93	4.41	5.67	6.46			5.60				--
Redox Potential	mVe	234.10	272.00	270.30	264.70	76.50			79.50				--

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.
N/A - Not available, well had to be sampled by bailer due to bladder pump malfunction.
** - pH measurement recoded at these locations are far above historical values. Equipment malfunction is suspected.

Table 22. Summary of Ground Water Sampling Results –December 2011
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	D-MG Sump	MW-26 *	TB-3/6/12	NJ Ground
PPPL Sample No.		12-030	12-031	12-032	12-033	12-034	12-035	12-036	12-037	12-038	12-040	12-039	12-041	Water
Lab Sample No.		L3970362-1	L3970362-2	L3970362-3	L3970362-5	L3970362-6	L3970362-7	L3970362-8	L3970362-9	L3970362-10	L3970362-12	L3970362-11	L3970362-4	Standard
Target Volatile Organic Compounds (ug/L)														
Tetrachloroethylene		0.750 J	<0.190	<0.190	**1.74**	**39.5**	**10.6**	0.240 J	**87.9**	0.340 J	**10.4**	**36.8**	<0.190	1
Trichloroethylene		<0.120	<0.121	**2.87**	0.150 J	**18.4**	0.740 J	<0.121	**5.04**	<0.121	**1.11**	**17.1**	<0.121	1
c-1,2-Dichloroethylene		ND	ND	4.69 JN	ND	16.9 JN	ND	ND	6.94 JN	ND	ND	15.5 JN	ND	70
t-1,2-Dichloroethylene		<0.190	<0.190	<0.190	<0.190	0.380 J	<0.190	<0.190	<0.190	<0.190	<0.190	0.340 J	<0.190	100
1,1,1-Trichloroethane		<0.190	<0.190	<0.190	<0.190	0.300 J	<0.190	<0.190	<0.190	<0.190	<0.190	0.270 J	<0.190	30
1,1-Dichloroethylene		<0.190	<0.190	<0.190	<0.190	0.740 J	<0.190	<0.190	<0.190	<0.190	<0.190	0.660 J	<0.190	1
Chloroform		<0.120	<0.120	<0.120	<0.120	0.610 J	<0.120	0.850 J	<0.120	<0.120	0.210 J	0.600 J	<0.120	70
Vinyl Chloride		<0.220	<0.220	<0.220	<0.220	**1.56**	<0.220	<0.220	<0.220	<0.220	<0.220	**1.36**	<0.220	1
Tentatively Identified Compounds (ug/L)														
Unknown		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--
1,1,2-Trichloro-1,2,2-Trifluoroethane		ND	ND	ND	ND	74.7 JN	ND	ND	ND	ND	ND	64.6 JN	ND	--
1,2-Dichloro-1,1,2-Trifluoroethane		ND	ND	ND	ND	7.86 JN	ND	ND	ND	ND	ND	6.85 JN	ND	--
Natural Attenuation Indicators														
Chloride	mg/L	27.70	7.64	**301.00**	<5.00	64.00	14.60	13.70	5.28	128.00	119.00	63.00		250
Manganese	mg/L	**0.9100**	0.0108	**0.5020**	0.0080	**3.1200**	**0.0887**	**0.1350**	0.0306	**5.5700**	**4.2700**	**3.1400**		0.05
Alkalinity	mg/L	119.00	22.20	145.00	60.60	64.50	66.90	26.80	31.10	102.00	128.00	64.40		--
Nitrate as N	mg/L	<0.500	0.83	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	1.10	<0.500		10
Nitrite	mg/L	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025		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	27.60	<5.00	17.20	5.12	15.70	15.60	29.70	24.60	16.70	17.10	15.70		250
Total Organic Carbon	mg/L	11.60	1.43	1.20	8.42	1.98	3.86	2.53	1.66	1.01	1.03	1.16		--
Ferrous Iron	mg/L	0.45	<0.20	0.20	<0.20	7.60	<0.20	<0.20	<0.20	<0.20	0.76	7.50		--
Dissolved Methane	ug/L	16.10	<0.11	1.70	<0.11	80.70	<0.11	<0.11	2.20	2.70	2.80	73.90	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	2.07	10.20	0.62	3.72	2.01	0.13	1.55	4.63	0.19		2.01		--
pH	Std. Units	5.54	6.87	6.78	6.35	5.69	6.64	5.96	5.01	6.73		5.69		--
Redox Potential	mVe	356.20	242.10	27.20	230.40	78.10	178.60	238.70	115.20	112.30		78.10		--

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 23. Quality Assurance Data for Radiological and Non-Radiological Samples for 2011

Laboratory, Program, and Parameter	Reported Value	Actual Value	Acceptance Range	Acceptable Not acceptable
ERA *(picoCuries/Liter)*				
May 2011 RAD 85				
Barium-133	73.79	75.3	63.0-82.8	Acceptable
Cesium-134	65.92	72.9	59.5-80.2	Acceptable
Cesium-137	75.62	77.0	69.3-87.4	Acceptable
Cobalt-60	91.50	88.8	79.9-100.0	Acceptable
Zinc-65	105.29	98.9	89.0-118.0	Acceptable
Tritium	10517.87	10200	8870-11200	Acceptable
November 2011 RAD 87				
Barium-133	95.54	96.9	81.8-106.0	Acceptable
Cesium-134	31.42	33.4	26.3-36.7	Acceptable
Cesium-137	47.86	44.3	39.4-51.7	Acceptable
Cobalt-60	125.95	119.0	107.0-133.0	Acceptable
Zinc-65	73.29	76.8	68.9-92.5	Acceptable
Tritium	17594.99	17400	15200-19100	Acceptable
May 2011 WP-194				
Specific conductance (µmhos/cm)	499	492	442-541	Acceptable
pH (S.U.)	5.50	5.50	5.30-5.70	Acceptable
Total residual chlorine (mg/L)	0.77	0.810	0.586-1.01	Acceptable

Table 24. Waste Characterization Report (WCR) for DSN001 Surface Water Sampling August 24, 2011

Laboratory Parameter	Reported Value (µg/L)
Barium	207.0
Beryllium	0.075 B
Bis(2-ethylhexyl) phthalate	1.90 J
Chloroform	0.420 J
Copper	6.20
Di-n-butyl phthalate	3.05 JB
Manganese	59.5
Nickel	2.10 B
Selenium	4.30 B
Tetrachloroethylene	0.250 J
Thallium	10.20
Zinc	32.9

Appendix

B

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