Bettis Atomic Power Laboratory

Environmental Summary Report

Calendar Year 2017

Prepared for the U. S. Department of Energy
by Bechtel Marine Propulsion Corporation

ENVIRONMENTAL SUMMARY REPORT

for the

BETTIS ATOMIC POWER LABORATORY

January 2017

PREPARED FOR THE U.S. DEPARTMENT OF ENERGY BY
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LIST OF ACRONYMS

ACHD	Allegheny County Health Department
AEC	Atomic Energy Commission
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CAP	Corrective Action Permit
CMIO	Corrective Measures Implementation Order
CMS	Corrective Measures Study
CRA	Cultural Resource Assessment
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
HTTF	High Temperature Test Facility
IWIP	Inactive Waste Isolation Pit
IWS	Inactive Waste Site
LWBR	Light Water Breeder Reactor
MEL	Materials Evaluation Laboratory
MOA	Memorandum of Agreement
MWSF	Mixed Waste Storage Facility
NNPP	Naval Nuclear Propulsion Program
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NRLFO	Naval Reactors Laboratory Field Office
PADEP	Pennsylvania Department of Environmental Protection
PAH	Polynuclear Aromatic Hydrocarbon
PBHP	Pennsylvania Bureau of Historic Preservation
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethylene (Also known as Perchloroethylene)
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SARA	Superfund Amendments and Reauthorization Act
SHPO	State Historic Preservation Office
SIS	Springwater Intercept System
VOC	Volatile Organic Compound
VNG	Valley National Gases (currently named Matheson Valley)

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1.0 OVERVIEW AND CONCLUSIONS

The Bettis Atomic Power Laboratory (Bettis Laboratory) is owned by the U.S. Department of Energy (DOE) and was operated under Government contract by the Westinghouse Electric Company from 1949 to 1999 and by Bechtel Bettis, Inc. from 1999 to 2009. In February 2009, Bechtel Marine Propulsion Corporation assumed operations of the facility. The Bettis Laboratory site in West Mifflin, Pennsylvania conducts research and development work on improved nuclear propulsion plants for U.S. Navy warships.

1.1 Background

For many years, environmental monitoring has been performed to demonstrate that the Bettis Laboratory site is being operated in accordance with environmental standards. The results of this monitoring have been published in annual reports provided to Federal, State, and local officials. These reports document that the Bettis Laboratory operational practices meet and are often stricter than the requirements of applicable laws and regulations. The monitoring results confirm that the Bettis Laboratory has complied with environmental standards and guidelines and in most cases has exceeded compliance with significant margin.

1.2 Purpose

The purpose of this report is to describe the nature and environmental aspects of work and facilities at the Bettis Laboratory site and provide a historical perspective of the Bettis Laboratory operations that is not provided by the annual reports. This report also provides background information, such as the geologic and hydrologic nature of the Bettis Laboratory site, pertinent to understanding the environmental aspects of Bettis Laboratory operations.

1.3 Conclusions

The following conclusions may be drawn from this report and the annual environmental monitoring results:

- The Bettis Laboratory has in place effective environmental control programs which meet or exceed the requirements of applicable laws and regulations. The Bettis Laboratory performance in radioactivity control is well established and the laboratory maintains levels of control that are stricter than Federal requirements (Sections 5.0, 6.0 and 7.0). The following examples illustrate this point:

    - Radiation exposure to any member of the public due to Bettis Laboratory site operations is too small to be measurable. The maximum possible annual radiation dose to any member of the public resulting from current operations can only be calculated using conservative assumptions of release and human uptake. The calculations show that the maximum dose is less than 0.002 Rem per year. This is less radiation than received from cosmic radiation during a cross-country airline flight between the east and the west coast of the United States (0.003 Rem). The calculations also show that the annual radiation exposures to people living adjacent to the Bettis Laboratory in all previous years were well below the annual regulatory limits established by the U.S. Environmental Protection Agency (EPA) and the DOE.

- There are no radioactive waste burial grounds at the Bettis Laboratory site. There are minimal areas on the Bettis Laboratory site where some radioactivity was released in the early days of site operations. At the present time, the estimated total quantity of manmade radioactivity in the soil at the Bettis Laboratory site is less than 72 curies, which is no more than the amount of naturally occurring radioactivity in the top 2 feet of soil in a local area the size of the Bettis Laboratory site (Sections 5.2 and 7.0). Most of this radioactivity is located under structures where it is inaccessible and poses no significant risk to the environment.

- In 1991, the Pennsylvania Department of Environmental Protection (PADEP) concluded that the levels of residual radioactivity on and immediately adjacent to the site were far below action levels and no further remedial action would be required.

The Bettis Laboratory site practices for handling chemical materials and waste conform to established regulatory requirements. In the early decades of operation, chemical waste disposal was carried out in accordance with common industrial practices at the time. In addition, some chemicals may have been disposed of or spilled on the ground when the Bettis Laboratory site was an airport. These practices resulted in small amounts of chemicals, such as degreasing solvents, being present in the soil in various locations around the site. Chemical residues have been found in the landfill on a steep hillside on the northwestern portion of the site where some waste chemicals were disposed of prior to 1964. Chemical residues have also been found at a separate landfill area on the northeast side and at a few other locations adjacent to buildings. Ground water monitoring at the site has shown that several chemical compounds are detectable in the ground water. However, since neither the Bettis Laboratory nor the public use this ground water that contains the chemical residues, and geologic conditions are likely to prohibit exposure of offsite receptors to ground water, the chemicals do not pose any health hazard to the public (Sections 5.2.4 and 7.0).

- An evaluation of the areas containing radioactivity and chemical residues at the Bettis Laboratory site was conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (See Reference (1)). This evaluation determined that there was no significant risk presented by the site to the public health and environment. In addition, the evaluation indicated that the Bettis Laboratory site did not qualify for the National Priority List under the National "Superfund" law. This evaluation has been reviewed by Region III of the EPA who assigned a hazard ranking score of zero. The EPA concluded that no further regulatory action was required under CERCLA. The Bettis Laboratory has continued actions to reduce any impact on the environment from residual chemical or radioactive materials by working within the bounds of Federal, State, and DOE regulations (Sections 5.1 and 7.0).

- The Bettis Laboratory operates a hazardous waste storage facility under a Hazardous Waste Storage Permit initially issued in February 1995 and renewed in February 2006 by the PADEP. A permit renewal application was submitted to the PADEP in August 2015. During the period between June 1985 and February 1995, the Bettis Laboratory operated the hazardous waste storage facility under interim status. The Resource Conservation and Recovery Act (RCRA) requires that sites having interim status and/or a final permit for hazardous waste treatment, storage or disposal address releases of hazardous waste to the environment. This matter was formalized in an Administrative Order on Consent (Consent Order) in August 1990. As part of the Consent Order, the EPA agreed that the conditions onsite did not require implementation of interim measures or immediate corrective actions since the Bettis Laboratory site conditions do not present an imminent substantial endangerment to human health or the environment. The Consent Order required that a RCRA Facility Investigation (RFI) and Corrective Measures Study (CMS) be performed to address the residual chemicals in the soil and ground water at the site. The Bettis Laboratory has completed the required studies, receiving EPA approval of the Final RFI Report, Reference (2), in August 1994 and the Final CMS Report, Reference (3), in March 1995. The EPA issued its final decision and response to public comments and terminated the Consent Order in 1997; the Bettis Laboratory proactively implemented or completed most of the final recommended corrective measures. The remaining measures were negotiated with the EPA to establish a Corrective Measures Implementation Order (CMIO) that became effective on April 16, 2001. The CMIO required in-situ soil vapor extraction at the Bettis Landfill, collection and treatment of specified springs and seeps, collection and treatment of groundwater seepage below the Inactive Waste Site (IWS), monitoring, institutional controls and several focused removals of on-site contamination. Bettis completed the final corrective action of the CMIO, the Enhanced Soil Vapor Extraction at the Bettis Landfill, in September 2012. A Corrective Measures Completion Report was submitted to the EPA in January 2013 and approval was received from the EPA in February 2013, Reference (4). Some corrective actions within the CMIO require the continuation of environmental monitoring and maintaining administrative controls. On August 21, 2013, the EPA issued a Permit for Corrective Action under RCRA for the Laboratory that maintains these requirements. All other CMIO required actions have been completed. On September 11, 2013, the EPA concluded that all the terms of the 2001 CMIO had been satisfied and issued a letter terminating the agreement between the EPA and the Laboratory, Reference (5). The Bettis Laboratory also operates a Mixed Waste Storage Facility (MWSF) under the site Hazardous Waste Storage Permit. The storage facility is used to store mixed waste (waste classified as both radioactive and hazardous) prior to shipment offsite for treatment or disposal.

- A risk assessment was approved by the EPA as part of the Final RFI Report. The objective of the assessment was to determine the "reasonable maximum exposure" of onsite and offsite populations to environmental contamination at the site. The risk assessment concluded that chemical residues in the environment at the site do not pose significant health risks to potentially exposed populations using "reasonable maximum exposure" assumptions. Environmental monitoring data collected since the risk assessment was completed demonstrate that these conclusions have not changed. The only study area where the carcinogenic risk estimate exceeded the EPA screening criterion of 1.0 $x10^{-6}$ (one chance in a million) was a small area of soil in a drainage ditch below the IWS, with a maximum carcinogenic risk of about 2.0×10^{-5}. However, an individual must be exposed (skin contact, ingestion, and inhalation) for 250 days/year for 25 years to achieve this risk. This risk is highly conservative because the area is rarely accessed. In reality, the risk of personnel exposure to the chemical residues in the drainage ditch area is far less than 1.0 $x10^{-6}$ (Section 7.2).

- The Bettis Laboratory operations and environmental performance have always been subject to continuous oversight by the Naval Reactors Laboratory Field Office (NRLFO) {the resident representatives of the Naval Nuclear Propulsion Program (NNPP) of the DOE (previously the Atomic Energy Commission (AEC) and the Energy Research and Development Agency)} and by periodic in-depth reviews and inspections by NNPP headquarters personnel (Section 8.0).

- The Bettis Laboratory has been recognized for efforts in pollution prevention, waste reduction, and recycling as a recipient of a year 2000 Pennsylvania Governor's Award for Environmental Excellence and as a contributor to a team that received the White House Closing the Circle Award (Section 8.0).

- In addition to the Bettis Laboratory and NNPP reviews and inspections, various aspects of the Bettis Laboratory environmental programs have been inspected by Federal, State, and local agencies (Section 8.0).

In conclusion, in over sixty years of operation, there has been no significant impact from Bettis Laboratory operations on the environment, the community, public, or employees. The Bettis Laboratory site has a well-defined environmental program in place to monitor current operations and address past activities.

2.0 THE BETTIS LABORATORY SITE

The Bettis Laboratory is owned by the U.S. Department of Energy (DOE) and was operated under Government contract by the Westinghouse Electric Company from 1949 to 1999 and by Bechtel Bettis, Inc. from 1999 to 2009. In February 2009, Bechtel Marine Propulsion Corporation assumed operations of the facility.

2.1 Bettis Laboratory Site History

The Bettis Laboratory site was originally used as Pittsburgh's first airfield. The Pittsburgh-McKeesport Airdrome opened in 1925 but was later renamed Bettis Airfield in honor of Lieutenant Cyrus Bettis, a famous aviator. The Allegheny County Airport opened in 1932. By 1940, most commercial traffic moved to this nearby airport because the Bettis airfield could not handle the increasingly larger, modern aircraft. Private aviators used the field until 1948.

The newly formed Westinghouse Atomic Power Division bought the Bettis airfield tract in early 1949 and purchased adjacent properties in 1952. The land was acquired according to a contract between Westinghouse and the Atomic Energy Commission (AEC) whereby Westinghouse was assigned certain responsibilities for engineering, design, procurement, and construction work for the prototype of the first naval nuclear reactor plant. Later, in 1957, the AEC (now DOE) exercised its contractual option to purchase the site, located on approximately 202 acres of land, and has held title since then. In 2002, the DOE acquired a 5.7 acre parcel of land adjacent to the Bettis Laboratory site. In 2008, DOE acquired a former auto service property, approximately 0.5 acres, also adjacent to the Bettis Laboratory site.

The Bettis Laboratory site has evolved into a development, support engineering, and design facility for naval nuclear propulsion work. All naval nuclear propulsion work has been and remains under the sole technical direction of the NNPP. The NNPP operated initially as an element of both the Department of the Navy and the AEC, and now operates as a joint Navy and DOE organization.

2.2 Significant Accomplishments

Bettis Laboratory has contributed to the technology developed for use in the U.S. Navy's nuclear-powered warships. Key achievements of Bettis Laboratory include the development of the power plants for the first nuclear-powered submarine, USS NAUTILUS (SSN 571); the first nuclear-powered surface ship, the cruiser USS LONG BEACH (CGN 9); the first nuclear-powered aircraft carrier, USS ENTERPRISE (CVN 65); as well as the technologically advanced submarine, the USS SEAWOLF (SSN 21).

Under the NNPP DOE authority, Bettis Laboratory designed and developed the first full-scale nuclear power plant for civilian use, the Shippingport Atomic Power Station. Later, Shippingport was also the site of the first Light Water Breeder Reactor, an advanced reactor system developed to significantly improve the utilization of fuel in nuclear reactors. Bettis Laboratory has also developed advanced nuclear propulsion plants and long-lived reactor cores for modern nuclear-powered ships including aircraft carriers, attack submarines and ballistic missile submarines. Work continues today on further advances in naval nuclear propulsion technology.

3.0 DESCRIPTION OF SITE

3.1 Site Location

The Bettis Laboratory site is located in the Borough of West Mifflin, Allegheny County, Pennsylvania approximately 8 miles southeast of central Pittsburgh. The site, shown in Figure 1, consists of approximately 208 acres of land.

The developed portion of the Bettis Laboratory site consists of laboratories, offices, warehouses, workshops, and a boiler house for centralized heating of several buildings. This developed section covers approximately 60 acres and includes 24 acres of parking area. Water for domestic, fire protection, and cooling purposes is supplied by the Pennsylvania-American Water Company. Electrical power is furnished by Constellation NewEnergy, Inc. and delivered by Duquesne Light Company. Domestic sewage from the site is discharged into the local publicly owned sewage treatment plant.

3.2 Land Use and Demography

The land use of the region surrounding the site is largely industrial and residential. The section of West Mifflin Borough in which the site is located is zoned as Heavy Industrial. The total population within a 50 mile radius of the site is approximately 3,000,000.

A heavily wooded area borders the site on the east. Most of this property is owned by the Borough of West Mifflin. Some of this West Mifflin owned property has been developed into the West Mifflin Community Park. A fence has been erected to prevent inadvertent access to the site property from the park area. An industrial district is located along the northern boundary of the site. Commercial and residential developments border the site on the south and west. Two public roadways run along the length of the southern perimeter of the property and a railroad runs along the northern end.

3.3 Topography, Geology, and Seismology

Allegheny County, Pennsylvania is situated within the Allegheny Plateau physiographic province of North America. Physiography refers to the natural physical landforms of an area. Stream erosion of a formerly raised plateau produced the present rugged land surface at the Bettis Laboratory site. The geologic formations are generally flat-lying or gently folded and inclined. The number of streams and the percentage of the land found in slopes decrease with distance from the major waterways, such as the Monongahela River.

The site is located approximately 6000 feet west of the Monongahela River. The maximum elevation at the site is approximately 1200 feet above mean sea level. The minimum elevation, approximately 975 feet above mean sea level, occurs on the northern site boundary. The normal pool elevation of the Monongahela River near the site is approximately 720 feet above mean sea level. The developed portions of the site are approximately 480 feet above the surface of the Monongahela River.

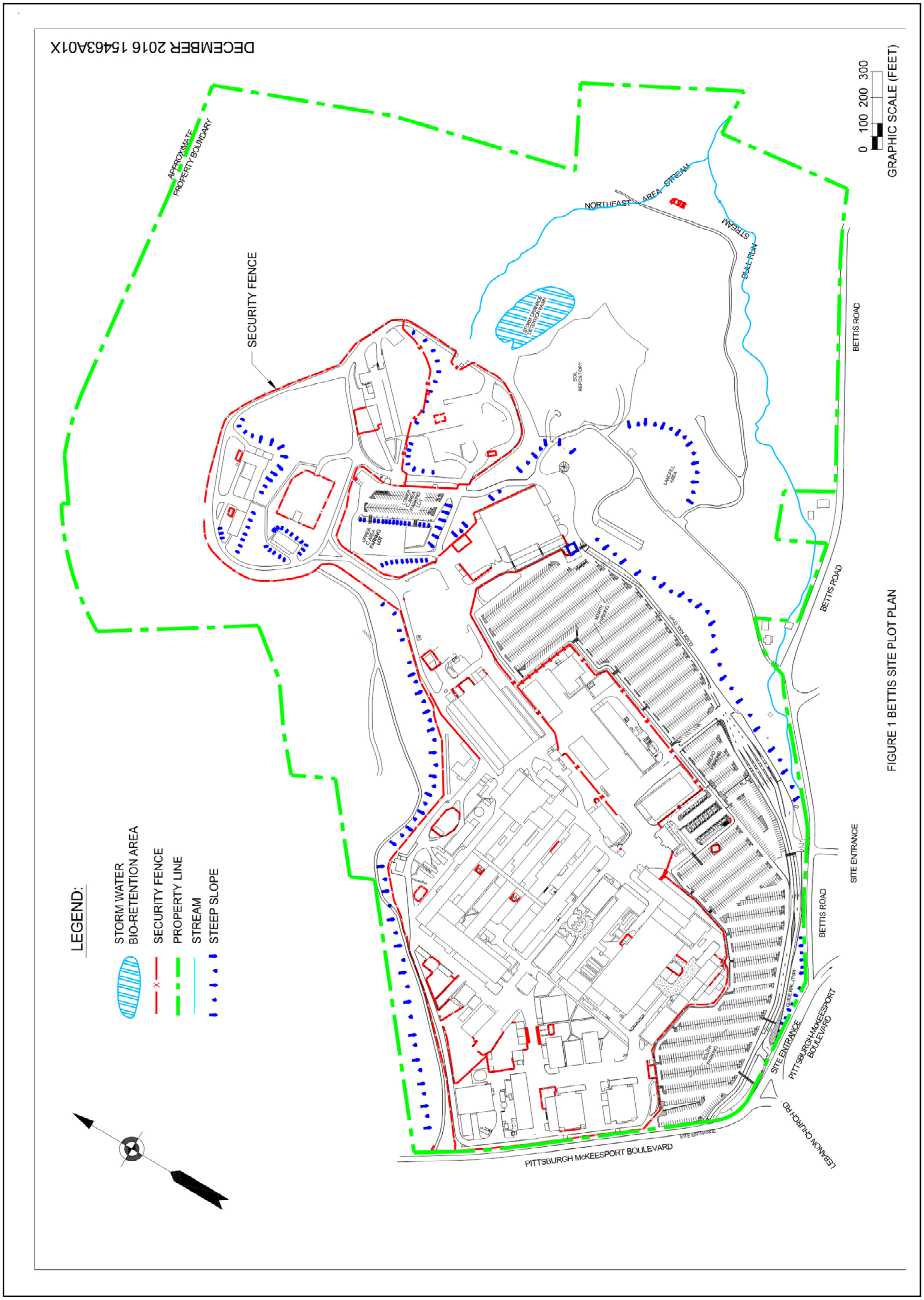

FIGURE 1 BETTIS SITE PLOT PLAN

Surface drainage at the site is primarily toward the east, discharging into Bull Run Stream and its tributaries. A narrow, mostly sloped area that includes a small developed portion of the site drains northwest into Thompson Run Stream.

The soils at the site are residual in origin, having been formed by weathering of the underlying Monongahela Group bedrock or are the result of filling operations. None of the site land is utilized for agrarian purposes. The soils onsite are classified as the Culleoka and Urban Land-Guernsey soils. The Culleoka soils are characterized as moderately deep, well drained soils formed from shale and fine grained sandstone bedrock. They generally occur on upland slopes, have moderate permeability, and normally have a water table below four feet throughout the year. The surface soil can be described as dark brown, granular silt loam, while the subsoil is yellowish-brown, blocky silt loam to channery clay loam. The substrata consist of yellowish-brown, massive, very channery clay loam.

The Urban Land-Guernsey soils are described as variable consisting of disturbed land resulting from cut and fill operation and subsequent coverage with urban works. These soils occur in a complex pattern with Culleoka soils which are described above. The Urban Land-Guernsey soils are characterized as deep, well drained soils with a low permeability and a winter water table within 1 or 2 feet of the surface. This soil type is formed from interbedded clay shale, shale, and limestone bedrock.

The geologic formations that underlie the portion of Allegheny County in which the site is located are part of the Pennsylvania System. The Monongahela, Conemaugh, and Allegheny Groups are all part of the Pennsylvania System and underlie the site. The Monongahela Group, the uppermost group, includes beds of limestone, variable shales, discontinuous layers of sandstone and coal beds. Several of these coal beds had significant economic importance. The base of the Pittsburgh Coal marks the base of the Monongahela Group.

Some of the important beds in the Monongahela Group are the Uniontown Limestone, Benwood Limestone, Sewickley Sandstone, Fishpot Limestone, Pittsburgh Sandstone, and the Redstone and Pittsburgh Coal. Core borings taken onsite confirm that the bedrock consists of layers of limestone, shale, and sandstone.

Extensive mining of the Pittsburgh Coal seam has occurred to the west and south as well as under the site. The Pittsburgh Coal seam lies about 200 feet below the active portion of the site. Most of the Pittsburgh Coal that can be mined has been removed. There are no current coal mining activities in this area.

The Bettis Laboratory is located in a landslide and mine subsidence prone area of western Pennsylvania. The developed area of the site is considered free of landslide hazards. While the steep slopes on the eastern and northern edge could be affected by landslides, these areas are stabilized with vegetative growth. The probability of mine subsidence on the developed portion of the site is considered very low because the mines are located approximately 200-250 feet below the site. Two openings to the old mines near the property boundary, discovered following a period of heavy rainfall, were filled and graded in December 2000 as a safety precaution.

The seismic risks for the region in which the Bettis Laboratory site is located are judged to be minimal. This conclusion is supported by the U.S. Coast and Geodetic Survey of 1947 which placed the site within a zone where earthquake damage has been minor and where intensities are normally below the threshold of structural damage.

3.4 Hydrology

3.4.1 Surface Water Description and Uses

Surface water flow at the Laboratory, including stormwater management, is primarily toward the east, discharging into the Bull Run Stream and its tributaries. A narrow, mostly sloped area that includes a small portion of the developed area of the site drains northwest into Thompson Run Stream.

The waters in the Bull Run Stream, which originates on the site, include once-through non-contact cooling water, stormwater runoff, and some dilute process waste water. Springs and seeps also discharge to the stream from various locations onsite including the discharge of treated ground water from the Springwater Intercept System. Approximately 27 million gallons of water were discharged into the Bull Run Stream through the Bull Run outfall monitoring station in 2016; this outfall is National Pollutant Discharge Elimination System (NPDES) permitted outfall #001. A significant portion of this discharge was precipitation runoff collected by the site storm drain system. In addition, there are several outfalls (#003, #005, #006, and #008) that are included in the NPDES permit that discharge stormwater only. In 2004, a sedimentation pond was constructed to control stormwater runoff during the upgrade of the site parking lot and other construction projects. The discharge from the pond flows to the Northeast Area Stream through outfall #008. In 2013, outfall #002 was eliminated with the stormwater runoff from this outfall directed to stormwater outfall #008. The Bull Run Stream flows about 1.4 miles before joining Thompson Run Stream which empties into the Monongahela River in Duquesne. There are no known uses of the Bull Run and Thompson Run Streams. Thompson Run is known to contain mine drainage and occasionally some raw sewage, neither of which comes from the Bettis Laboratory site.

An aquatic biology survey of Bull Run Stream by representatives of the Pennsylvania Department of Environmental Protection (PADEP) in 1995 indicated the stream maintains a diverse, sustainable population of macro-invertebrates. This condition indicates good water quality in Bull Run Stream.

Because of the location and elevation of the site, flooding from local streams or rivers is not possible. Some bank overflowing from Bull Run Stream may occur downstream from the site during heavy rainfall.

Some water from offsite enters the site storm drain system. This offsite flow consists mainly of precipitation runoff from an offsite road and has been shown, on occasion, to have an elevated pH and/or to contain high levels of suspended solids. The constituents of this water can influence the water quality of the Bull Run Outfall (#001) effluent and have resulted in one documented case of an NPDES non-compliant situation. The Bettis Laboratory has informed the PADEP of this condition.

3.4.2 Ground Water Description and Use

Bettis Laboratory has performed an extensive assessment of the hydrogeologic (ground water flow) conditions at the site. The results of this assessment are provided in Reference (2).

There are no wells or springs onsite or in the local, hydraulically downgradient area that are used for drinking water, industrial, or irrigation purposes.

The site is underlain by the geologic units of the Pennsylvanian Monongahela Group. The Monongahela Group is not an important local aquifer. Well yields from the Monongahela Group range from less than 1 to 30 gallons per minute.

The topographic features of the area, such as high hills cut by major stream valleys, greatly affect the direction and depth of water tables. There may be subregional ground water regimes where the discharge of the ground water is to local streams. In cases where the stream channels lie below the water table, some aquifers may discharge on valley slopes. Based on data obtained through rock coring, monitoring well drilling, geophysical logging, and ground water elevation monitoring, the ground water under the site was determined to be in five different water-bearing zones. These water-bearing zones, in descending order, are the Perched zone, Benwood Limestone zone, Sewickley Sandstone zone, Pittsburgh Sandstone zone, and Pittsburgh Coal zone. The Pittsburgh Coal water-bearing zone represents the bottom-most ground water flow studied at the site.

Several springs, which are surface manifestations of ground water, discharge on the site property. The largest springs were on the eastern, undeveloped portion of the site. These were permanent springs with varying flows that were reflective of the seasons. A few of these springs contained trace levels of degreasing solvents from historical operations. In 1997, the Springwater Intercept System was installed to collect and treat the ground water discharging from these springs. The Springwater Intercept System discharges to the Northeast Area Stream which is a tributary of Bull Run Stream via a NPDES-permitted area outfall (#007) and is operated in accordance with a Consent Order and Agreement established with the PADEP in 1999. Due to the aging components of the current system, a new Springwater Intercept System was designed. Construction began in September 2016 and is estimated to be completed and operational in 2017.

3.4.3 River Water Use

Along with its role as a navigable waterway, the Monongahela River is a significant recreational source and it supplies water for domestic and industrial purposes. There is a public water supply intake (Becks Run) located downstream of the confluence of Thompson Run Stream with the Monongahela River. The Becks Run intake is operated by the Pennsylvania-American Water Company and services residential and industrial customers, including Bettis Laboratory, in the Pittsburgh metropolitan area.

3.5 Cultural Resources Management

An evaluation of cultural resources in 1990 indicated that there were no historic or archaeological properties eligible to be listed in the National Register of Historic Places at the Bettis Laboratory site. This evaluation was required as part of the Bettis Laboratory Resource Conservation and Recovery Act Part B Permit application for the storage of hazardous waste. The evaluation was documented in a Commonwealth of Pennsylvania, Department of Environmental Protection document entitled General Environmental, Social and Economic Information, Module No. 9. This module was also provided as an Appendix in Reference (1).

Subsequently, a cultural historian was contracted to prepare a Cultural Resource Assessment (CRA) report for the Bettis Laboratory site in accordance with the National Historic Preservation Act. The CRA was issued to the Pennsylvania State Historic Preservation Office (SHPO) in May 2002. The CRA identified the Bettis Laboratory as significant in the Cold War era, noted specific areas with a high probability for archaeological significance, and described the historic importance of the Bettis airport. Based on this report, the state found the Bettis Laboratory to be eligible for the National Register of Historic Places.

The CRA recognized four areas as potentially archaeologically significant. The completion of a Phase I Archaeological Survey Report removed two of the four areas. Completion of the Phase II report additionally removed the “Rhodes Farm House” area as it is no longer a viable archaeological site due to past demolition of the area. The “Rhodes Mine Shack” area was deemed archaeologically significant in the Phase II report.

With the acquisition of approximately 5.7 acres of property in 2002, an addendum to the CRA was needed. The addendum, issued in June 2003, concluded that the property acquired by the Bettis Laboratory has no historic significance. An Archeological Field Survey performed by the qualified historian concluded that there were no significant archeological finds.

In July 2006, Pittsburgh Naval Reactors Office (now known as Naval Reactors Laboratory Field Office – NRLFO) and the Pennsylvania SHPO entered into a Memorandum of Agreement (MOA) which governs future construction efforts on the Bettis Laboratory site. The MOA defines actions needed to mitigate any adverse effects on areas of historic importance. Mitigative actions are in place for future work or have been completed, as appropriate, to ensure the continuing protection of the site’s cultural resources.

In support of plans to purchase an additional small (0.5 acre) parcel, information was provided to the Pennsylvania Bureau of Historic Preservation (PBHP) to further supplement the CRA. In March 2007, the PBHP concurred with the findings that the parcel is a non-contributing property and that no archeological investigations were necessary. Acquisition of the parcel was completed in 2008.

4.0 DESCRIPTION OF OPERATIONS

4.1 Past Operations

In 1951, the Navy awarded the Bettis Laboratory a contract to build the power plant for the world's first nuclear-powered submarine, NAUTILUS. Much of the assembly work on NAUTILUS nuclear reactor core was done at the Bettis Laboratory site.

Since NAUTILUS, advanced technology for submarine and surface ship nuclear reactor plants has constituted a major portion of the work program. Bettis Laboratory's work on the prototype nuclear propulsion plant for a surface ship, and successful operation of the prototype at the Naval Reactors Facility in Idaho Falls, Idaho, led to the development of the first nuclear-powered surface ship, the cruiser LONG BEACH, and the first nuclear-powered aircraft carrier, ENTERPRISE. ENTERPRISE was launched in September 1960.

Under the Atomic Energy Commission (AEC) Division of Naval Reactors, Bettis Laboratory also worked on the design and development of the first full-scale nuclear power plant for civilian use. This was the Shippingport Atomic Power Station located in Shippingport, Pennsylvania. Subsequently, Bettis Laboratory designed and developed the first Light Water Breeder Reactor (LWBR) core which was placed in the Shippingport reactor vessel in 1977 and was operated until October 1982. The LWBR reactor core was assembled at the Bettis Laboratory. This advanced reactor system was developed to significantly improve the utilization of fuel in nuclear reactors. The technology developed for the Shippingport program has been made available to industry for commercial application.

4.2 Present Operations

Much of the work at the Bettis Laboratory does not involve chemicals or radioactivity but is conducted in office and computer spaces employing scientists and engineers in propulsion plant design, operator training development, and procedure preparation activities. Physical work involving the development of improved materials and components for naval nuclear propulsion plants is conducted in several Bettis Laboratory facilities which are described below.

<u>Chemical Laboratories</u>

The chemical laboratories consist of several individual laboratories for mass spectrometry, corrosion testing, chemical analysis, radiochemistry, and other related analytical and developmental functions. Most of the chemistry laboratory work involves non-radioactive materials and work with concentrated chemicals is confined to appropriate containment areas such as fume hoods. For radioactive work, the containment areas are provided with high efficiency filtered and monitored ventilation exhaust systems. Liquids that are generated are collected for processing.

<u>Fluids and Corrosion Testing Facilities</u>

Fluids testing facilities are used to conduct power plant component testing. Both high and low pressure and temperature facilities are operated to support materials and equipment development work. Except for once-through non-contact cooling water, waste liquids from these test facilities are collected, processed, and tested prior to disposal. Radioactive materials are not used in any of this test work.

Metallurgical Laboratories

These laboratories are operated to provide services related to the development, fabrication, testing, and inspection of materials for use in naval reactors. Similar to the other laboratories, most of the work is on non-radioactive materials. Radioactive work involving easily divisible materials is confined to containments serviced by high efficiency filtered and monitored ventilation systems. Radioactive liquids are collected for processing.

L Building

The L Building consisted of a deactivated process area that was used to fabricate the LWBR. The process area was deactivated in 1982 and placed in a “cold standby” condition. The facility was designed to ensure complete containment of the radioactivity with high efficiency exhaust air filters that filter airborne radioactivity.

In September 2012, Bettis began demolition of the L Building. The radiological building structures were packaged in waste containers and shipped offsite for disposal at an authorized disposal facility. The remaining concrete floor slab and building foundation was released for unrestricted use and the demolished portions were disposed of at an approved offsite landfill in 2013.

C-CA-CAM Complex

The C-CA-CAM Complex was an integral part in the historical development of nuclear reactor technology that was the forerunner to today’s modern Navy fleet. During the 1950’s through the 1970’s, a variety of testing programs were conducted in this complex. Equipment used to support critical program work was removed in the early 1970’s. The facility continued to support other program testing until its inactivation in the late 1990’s. Demolition of the complex was initiated in March 2014. Removal of all above ground structures was completed in September 2014. Additionally, removal of underground drain lines and some building floor slabs, including the majority of the foundation and retaining walls, was completed in 2015 and 2016. Based on site priorities, Bettis will remove remaining non-radioactive structures and perform final site grading. Ninety-five percent of the demolition waste generated from the building removal has been shipped to an authorized disposal facility.

Materials Evaluation Laboratory

The Materials Evaluation Laboratory (MEL) was a metallurgical laboratory that was previously used to determine physical, chemical, and metallurgical properties of radioactive specimens. The MEL contains several shielded cell banks that allowed for remote handling of radioactive specimens. The shielded cell banks are equipped with several high efficiency exhaust air filters. The filtered air is discharged through a single exhaust stack that is continuously monitored for airborne radioactivity.

Testing operations in the MEL shielded cell banks were discontinued in 1993. The MEL and support facilities are undergoing remediation to remove remaining legacy materials and equipment. The MEL work spaces are monitored for airborne activity, radiation, and radioactive contamination to verify the integrity of remaining radiological systems.

Machine Shops

Machine shop facilities are used to perform machining operations such as turning, milling, and drilling on a variety of metal products including non-radioactive metals, fuel specimens, and other radioactive materials. The facilities for work on radioactive metals are segregated from the other work areas and are provided with special containments and high efficiency filtered ventilation exhaust systems when the possibility for radioactive contamination resulting from the process exists.

Fuel Storage Vault

Fissile materials for use in reactor development are stored in a fuel storage vault with special safety and security provisions. Personnel involved in the handling of these materials are specially trained in nuclear and radiological safety and security.

Support Facilities

In addition to the technical facilities described above, there are a number of support facilities necessary to sustain Bettis Laboratory operations. These facilities include office buildings which house the scientists and engineers, a library, a computing center, administrative centers, and the following service facilities.

Boiler House (BH) Building

The BH Building provides steam heat, compressed air, and hot water for the majority of the onsite buildings. The BH Building also contains the circulating water pumps which supply recirculating cooling water for building equipment needs. Auxiliary support facilities in the building include feedwater treatment components, such as water softeners, and a water holding tank for treatment of boiler blowdown water. Boiler blowdown water is treated prior to discharge to the sanitary sewer system. Combustion gases from onsite boilers, including boilers and water heaters discussed below, are discharged through six stacks.

The BH Building has four large boilers, each with approximately 21 million BTU/hr maximum input. The boilers are operated in accordance with an Allegheny County Health Department (ACHD) operating permit. Two of the boilers operate on natural gas and the other two boilers operate on either natural gas or No. 2 fuel oil. A diked, 10,000 gallon aboveground fuel oil storage tank is located adjacent to the BH Building. This storage tank is part of the site Spill Prevention Control and Countermeasure Plan prepared in accordance with Federal regulations. The BH storage tank is currently inactive, but is not permanently closed. It is capable of fuel storage; however, there is no fuel currently stored in the tank for operational use.

Satellite Boilers

There are 18 smaller boilers that provide steam heat or make hot water for space heating or domestic water heating. These boilers, located throughout the site, are operated in accordance with applicable ACHD air pollution control requirements. All of these boilers operate on natural gas. Boiler blowdown water from each of the steam boilers is collected and treated in the same manner as the BH Building. Water heating boilers do not require water conditioning and are discharged annually or as part of maintenance activities.

Demineralized Water Production Facilities

Demineralized water or pure water is produced at several locations throughout the Bettis Laboratory site. Pure water is generated by pumping city water through a series of anion and cation resin beds to remove impurities. The resin beds are sent offsite for regeneration.

Cooling Towers

There are 12 forced-draft cooling towers at the Bettis Laboratory site that are used to dissipate the heat generated by computer, air conditioning, and other operations. In addition, there is one cooling tower that has been placed in long term lay-up.

During operation, blowdown of the recirculating water occurs automatically to control the concentration of solids that accumulate in the water through the cooling operation. The National Pollutant Discharge Elimination System permit limits daily chemical usage for discharges to the storm drain system.

Petroleum Storage Tanks

Petroleum storage tanks are present at Bettis Laboratory to service onsite facilities and equipment. The two largest storage tanks are: an inactive 10,000-gallon aboveground fuel oil tank at the BH Building and a 4,000-gallon underground gasoline tank. Petroleum storage tanks are managed in accordance with applicable Federal and State regulations governing such tanks.

Photographic and Printing Facilities

Photographic and printing services to facilitate the preparation of documents are provided onsite. Offsite vendors handle most photographic processing. The majority of processing performed at Bettis is now digital, which decreases the previous environmental impact. Only minor amounts of photographic processing are performed onsite to support other operations and the wastes are shipped offsite to permitted treatment and disposal facilities. Printing operations generate waste materials that are either recycled or disposed of as municipal or residual waste.

Clean Soil Storage

An area near the Bettis Landfill is designated for the temporary storage of clean excavation material from onsite projects for use as fill in future onsite projects. All excavation material to be placed into storage is evaluated prior to excavation to ensure that it is acceptable for use as backfill. Access to the storage location is controlled to ensure that all materials deposited or removed from the area have been properly evaluated and approved.

Radioactive Waste Management

Radioactive waste processing facilities collect and process water containing small amounts of radioactivity and collect, process, package, and ship solid radioactive waste. The processing facilities for liquid and solid wastes are monitored for radiation and contamination and are serviced by filtered and monitored exhaust systems. Since 1998, radioactive waste materials generated at various onsite locations are staged in a centralized facility pending shipment offsite for disposal. See Section 5.1 for a more complete description of current waste management programs.

Chemical/Hazardous Waste Management

The Chemical/Hazardous Waste Storage Building is operated under a Pennsylvania Department of Environmental Protection (PADEP) Hazardous Waste Storage Permit. The facility structure and operation are maintained in compliance with applicable Federal and State regulations. This facility is used for temporary storage of chemical waste prior to shipment offsite to permitted treatment and disposal facilities. The facility is divided into five revetted areas to accommodate storage of waste based on chemical compatibility and prevent release of wastes to the environment. The storage facility has the capacity to store up to ninety 55-gallon drums and 225 gallons of waste in smaller containers.

Mixed Waste Management

The Mixed Waste Storage Facility (MWSF) is operated under a PADEP Hazardous Waste Storage Permit. Wastes that are both chemically hazardous and radioactive are stored in the MWSF in accordance with the applicable Federal and State hazardous waste regulations and the Hazardous Waste Storage Permit. The MWSF is used for temporary storage of mixed waste prior to shipment offsite to permitted treatment and disposal facilities. The MWSF contains revetments to prevent the release of wastes to the environment. Incompatible chemicals are stored in separate containments.

5.0 WASTE GENERATION AND CONTROLS

The Bettis Laboratory site is not a manufacturing facility. Previous production efforts were limited to pilot projects such as building the NAUTILUS and Light Water Breeder Reactor (LWBR) cores. As a consequence, the total quantities of chemical and radioactive materials handled at the Bettis Laboratory site have been small.

For example, during the period 2014-2016, the quantity of chemically hazardous wastes generated by site operations and shipped for offsite treatment was approximately 21 tons. At the Bettis Laboratory, this waste consists mainly of process wastes, chemistry analysis wastes, and expired reagent chemicals. In this same time period, an additional 19 tons of hazardous wastes were generated as a result of environmental remediation projects and facility demolition projects.

When sufficient quantities are accumulated, mercury, excess metallic lead, lead-acid batteries, and leaded glass are shipped offsite for reclamation.

Several of the current site buildings were formerly used as airport hangars and probably served as airport maintenance areas. It is likely that degreasers and solvents common to aircraft maintenance were used in these early operations. There are no available records that show whether or how much of such materials were used or where or how they were discarded. However, it is possible that spent solvents and degreasers may have been discarded on the site by airfield personnel and may have contributed chemical residues which are currently detectable in site soil and ground water.

The amount of radioactive materials managed at the site is also small and consists of irradiated test specimen residues, limited quantities of special nuclear materials, and a number of components with small amounts of radioactivity on their surfaces. Consequently, the amount of radioactive waste material generated by current operations is small.

A discussion of current and past waste management operations follows.

5.1 Current Waste Management Programs

5.1.1 Current Radioactive Waste Management

Liquid and solid radioactive wastes are generated and controlled in site operations. The Laboratory has maintained a vigorous radioactive waste control and minimization program for many years. The generation processes and the minimization program are described below.

Radioactive Liquid Waste

Regulations applicable to commercial nuclear industries in the United States permit discharge of low-level radioactive liquids if they meet concentration standards established by the Nuclear Regulatory Commission (NRC). Department of Energy (DOE) regulations also permit similar discharges of low-level radioactive liquids. Bettis Laboratory has operated to a more conservative standard for three decades. Water containing low levels of radioactivity is collected and processed to remove the radioactivity. When the water has no remaining detectable radioactivity, it is normally discharged to the West Mifflin Borough, Thompson Run Sewage Treatment Plant. The processing system includes collection tanks, particulate filters, and mixed-bed ion exchange columns to remove inorganics. On occasion, small amounts of radioactive liquids containing higher levels of radioactivity are solidified. The filters, ion exchange media, and solidified liquids are disposed offsite in approved radioactive solid waste disposal sites.

Radioactive Solid Waste

Solid radioactive wastes are generated at the Bettis Laboratory site as a result of research and development and decontamination/decommissioning operations. Included in this waste are such radioactive items as process system filters, expended resin, metal scrap, glass, cloth, wood, concrete, insulation, plastics, paper, ceramic or brick materials, roofing debris, sludges, asbestos, sampling planchettes, filter papers, swipes, ventilation filters, and solidified liquid wastes. The majority of this waste is from the decontamination of facilities no longer needed at the site.

Solid radioactive wastes are packaged and shipped in accordance with the requirements of the U.S. Department of Transportation. These wastes are disposed in land disposal sites outside of Pennsylvania. The annual solid radioactive waste volume dispositioned during 2014, 2015, and 2016 totaled 2618, 257, and 629 cubic meters, respectively, from routine and decontamination/decommissioning operations. The large increase in the amount of waste dispositioned in 2014 was due to the demolition of the C-CA-CAM Complex.

Radioactive Recyclable Metal

From 2014 through 2016, no radioactive scrap metal was shipped to a commercial radioactive material processing facility for radioactive metal recycling. No shipments of radioactive scrap metal are estimated until 2023.

Radioactive Airborne Effluents

Exhaust systems that service radiological facilities are designed and operated to prevent the discharge of potentially contaminated air to the environment. These systems include high efficiency filters for the removal of particulate radioactivity from the exhaust air. The exhaust systems are evaluated periodically to ensure that design flow rates are maintained and that the filtration media provide the proper collection efficiency. All high efficiency particulate air filters that discharge to the environment are tested in-place after installation and periodically thereafter using 0.7 µm diameter smoke particles. The installation must exhibit an overall collection efficiency of 99.95 percent or higher to be accepted.

In addition, all radiological, forced-air exhaust systems are continuously monitored for particulate radioactivity. Systems servicing major radiological facilities are provided with continuous monitoring equipment that will alarm if the exhaust air contains levels of radioactivity that are greater than normal but still much less than the allowable Federal environmental standards at the site boundary. Samples from the Materials Evaluation Laboratory (MEL) nuclear air cleaning are also evaluated annually for radon-220 gaseous radioactivity. Monitoring results are reported annually to Federal and State agencies.

Radioactive Waste Minimization

Bettis Laboratory has maintained a radioactive waste minimization program for many years. The program includes work to identify and eliminate sources of radioactive waste generation and identify means to compact or concentrate wastes to the minimum practicable volumes.

5.1.2 Current Non-Radioactive Waste Management

Bettis Laboratory operations produce a variety of industrial waste products including once-through non-contact cooling water, process rinse water, waste oils, chemical wastes, boiler exhaust gases, and other such products typical of a large laboratory. All such waste products are controlled in accordance with various Federal, State, and local laws and regulations. Bettis Laboratory has a hazardous waste minimization program as required by the regulations.

The following is a discussion of the non-radioactive waste management practices and the hazardous waste minimization program.

Non-Radioactive Liquid Wastes

Industrial waste liquids from site operations are controlled by several methods depending on the volume and nature of the waste. Methods used to ensure the safe control and disposal include: (1) local collection and storage; (2) transfer of wastes that contain hazardous materials or recyclable oils and liquids to licensed subcontractors for reclamation, incineration, or treatment at a licensed facility; (3) careful monitoring and control of chemical constituents to ensure that concentrations in effluent water comply with applicable standards and guidelines; and (4) extensive employee training in waste management requirements. Chemical wastes defined as hazardous are managed in accordance with a Pennsylvania Department of Environmental Protection (PADEP) Hazardous Waste Storage Permit initially issued to the Laboratory in February 1995 and renewed in February 2006. A permit renewal application was submitted to the PADEP in August 2015.

Liquid effluents discharged into the site storm drain system are controlled and monitored in accordance with two National Pollutant Discharge Elimination System (NPDES) permits. The site NPDES Industrial Discharge Permit has been renewed several times and currently covers six outfalls. One outfall discharges storm water, process water, and once-through non-contact cooling water. Four outfalls discharge only storm water. One outfall discharges treated ground water. In addition, a separate NPDES General Permit for Stormwater Discharges Associated with Construction Activities has been obtained to allow for discharge of storm water from a sedimentation pond constructed for the upgrade of the site parking lot and other construction projects.

Some water from offsite enters the site storm drain system. This offsite flow consists mainly of precipitation run-off from an offsite road and has been shown, on occasion, to have an elevated pH and/or to contain high levels of suspended solids. The constituents of this water can influence the water quality of the Bull Run Outfall (#001) effluent and has resulted in one documented case of an NPDES non-compliant situation. The Bettis Laboratory has informed the PADEP of this condition.

Sanitary Waste Discharges

Sanitary waste from the site is discharged to the West Mifflin Borough, Thompson Run Sewage Treatment Plant. This plant uses an activated sludge process to treat the sewage. The plant is operated under a permit issued by the PADEP to the Borough of West Mifflin.

During 2016, approximately 21,500 gallons of water generated from ground or subsurface water collection and sampling efforts were discharged to the sanitary sewer for treatment at the Thompson Run Sewage Treatment Plant. The water contained traces of volatile organic compounds (VOCs) including tetrachloroethylene (also known as perchloroethylene or PCE) and trichloroethylene that were within limits acceptable to the treatment plant. The Borough of West Mifflin, the Environmental Protection Agency (EPA), and the PADEP have been notified of such discharges as required by applicable regulations.

Polychlorinated Biphenyls

All known transformers, large capacitors and other such electrical equipment containing polychlorinated biphenyls (PCBs) have been removed from service at the Bettis Laboratory site. Remaining PCB items at the site are controlled in accordance with EPA regulations issued pursuant to the Toxic Substances Control Act.

Non-Radioactive Solid Waste

Non-radioactive demolition debris and other similar materials as well as cafeteria waste are disposed in a licensed sanitary landfill. None of this waste is disposed at the Bettis Laboratory site. Hazardous wastes are controlled in accordance with Resource Conservation and Recovery Act (RCRA) requirements.

In accordance with State and local requirements, Bettis Laboratory has a program to recycle many non-radioactive solid waste materials. One trash compactor has been dedicated to compacting boxes and other corrugated paper that is taken to a local recycler. Bettis Laboratory collects commingled glass, plastic, metal, and aluminum food and beverage containers for recycling. The Bettis Laboratory has a longstanding program to collect scrap metal and sell it to a local scrap metal dealer. Bettis Laboratory also has a program to collect and recycle high quality office paper. During 2016, approximately 83% of the municipal waste generated at Bettis Laboratory was recycled. This exceeds the PADEP goal of recycling 25% of municipal wastes.

Non-Radioactive Airborne Effluents

The combustion gases from boilers are discharged through elevated stacks. In 1995, Bettis Laboratory applied to the Allegheny County Health Department (ACHD) for an Air Pollution Operating Permit. The ACHD issued a synthetic minor source Air Operating Permit in June 2006 for the main site boilers and other operations. Bettis submitted a renewal application to the ACHD in December 2010. Other sources of non-radioactive airborne effluents identified to the ACHD are included, as appropriate, in the draft renewed Air Operating Permit. These additional sources include emissions from stationary internal combustion engines, small natural gas boilers, cooling towers, and other routine sources. A final renewed Air Operating Permit is pending.

Non-Radioactive Waste Minimization

In accordance with RCRA, Bettis Laboratory has a chemical waste minimization program. The program requires specific actions to identify and minimize waste producing operations. These actions are accomplished by establishment of strict procurement procedures, substitution of non-hazardous materials where practical, and other similar measures.

Typical actions taken include:

- Careful control of type and quantity of chemical acquisitions;
- Maximizing use of unused or partially used reagents through the Bettis Laboratory Chemical Exchange Program;
- Training of employees in the hazards and proper control of the materials used in their jobs; and
- Segregation of non-hazardous and hazardous wastes at the point of generation.

Over the past several years, metals recovery, recycling, incineration, stabilization, secure landfilling, and waste water treatment have been the primary methods of offsite treatment and disposal for Bettis Laboratory-generated hazardous wastes.

In addition to recycling chemical wastes, Bettis Laboratory recycles other materials that result in benefit to the environment. Examples of other materials sent offsite for recycling from 2014 through 2016 include:

- 21 tons of batteries;
- 1565 tons of bulk scrap metal including carbon and stainless steel, copper, brass, circuit boards, wire, and non-radioactive lead;
- 109 tons of corrugated paper;
- 212 tons of high grade office paper; and
- 337 tons of miscellaneous materials including printer cartridges; commingled glass, plastic, aluminum, and metal food containers; wood; magnetic media; and cooking oil.

5.1.3 Current Mixed Waste Management

Bettis Laboratory site operations have resulted in the generation of small volumes and various types of mixed waste. These waste streams include oils, soil and related debris, chemical analysis solutions, and process wastes.

The Naval Nuclear Propulsion Program (NNPP) agreed to apply Pennsylvania hazardous waste requirements to the hazardous constituents of mixed waste prior to Pennsylvania being delegated mixed waste regulatory authority by the EPA. Bettis Laboratory managed all mixed waste in accordance with the Bettis Laboratory Mixed Waste Management Plan which was concurred with by the PADEP in September 1995. In addition, in accordance with the Federal Facility Compliance Act, the EPA and DOE signed a Consent Agreement and Consent Order, in October

1995, that bound the DOE to treat Bettis Laboratory mixed waste in accordance with the Site Treatment Plan. Pennsylvania received mixed waste regulatory authority from the EPA in November 2000. Bettis Laboratory continues to manage all mixed waste in accordance with the current Bettis Laboratory Mixed Waste Management Plan. In September 2001, the PADEP issued a revised hazardous waste storage permit to Bettis Laboratory incorporating the relevant requirements of the Federal Facility Compliance Act. This permit was renewed in February 2006. A permit renewal application was submitted to the PADEP in August 2015.

Currently, the Bettis Laboratory only performs onsite treatment of small amounts of mixed wastes as allowed by Pennsylvania permit-by-rule conditions and the Mixed Waste Management Plan.

In 2014, 2015, and 2016, respectively, 1.4, 12.8, and 3.1 cubic meters of mixed waste were shipped offsite for treatment. Bettis Laboratory will continue to ship mixed waste offsite for treatment and disposal in accordance with the site Hazardous Waste Storage Permit.

Minimization of Mixed Waste

Because of the difficulties and limited availability to treat and dispose of mixed waste, Bettis Laboratory uses every means practical to eliminate and minimize the generation of mixed waste. These methods include:

- Radioactive materials are sorted, processed or otherwise handled to segregate the radioactivity from materials or liquids which are subject to hazardous waste requirements;

- To the extent practicable, radioactive materials are not mixed or commingled with products which could cause the resulting waste to be subject to hazardous waste requirements;

- Any new process that could result in the generation of mixed waste is reviewed prior to performing the process; and

- Radiologically controlled metals containing hazardous constituents are recycled or reused whenever feasible.

5.2 Past Waste Management Practices

Radioactive waste management practices have evolved over the years consistent with advances in technology and changes in regulatory requirements. Typically, Bettis Laboratory has maintained an environmental program substantially stricter than the local, State, and Federal rules in effect at the time.

Non-radioactive waste management practices evolved in a similar manner. Land disposal of chemicals onsite was conducted until 1964. Current Bettis Laboratory practices incorporate all of the strict controls required by Federal and State regulations. Each of these areas is discussed below.

5.2.1 Past Radioactive Waste Management

Bettis Laboratory has always been involved in handling radioactive materials and has therefore always had management programs for radioactive materials and wastes. Disposal practices appropriate to each waste form (i.e., solids, liquids, gases) were developed and implemented. Requirements for the treatment and disposal of these wastes were established. For example, retention tanks and evaporators for liquid waste, facilities for storage of solid waste, and air cleaning systems (such as high efficiency particulate filters) were incorporated into the facilities.

The following is a description of the practices employed in the management of these materials.

Radioactive Liquid Waste

Operations which began at the Bettis Laboratory site in 1949 resulted in the generation of radioactive liquid wastes. These radioactive liquid wastes were a consequence of fuel research and development and the inspection and analysis of irradiated materials specimens. These operations were all performed in controlled areas within the Bettis Laboratory.

Prior to 1981, water, which potentially contained low-level radioactivity from the washing of laboratory glassware, decontamination hand sinks, and various laboratory areas which processed radioactive materials, was collected in retention tanks and analyzed for radioactivity. If the radioactivity level of the water was below the established limits, the water was released to the storm drain system. If the water failed to meet the release limits, it was processed to remove the radioactivity. The purified water was then reused in operations or released to the storm drain system after confirmation that activity levels were below the established limits at that time.

Higher radioactivity-level liquid wastes were normally evaporated to dryness. The radioactive sludges resulting from these processes were disposed offsite as solid wastes. Occasionally, some liquids were solidified and disposed offsite as radioactive solid waste.

Since operations commenced at Bettis Laboratory, less than 7 curies of Bettis Laboratory-generated radioactivity have been released in water effluents. All releases were well within the applicable release limits. Only one percent of this activity has been released in water effluents since 1969. The water effluents from these historical operations are the source of the residual low-level radioactivity that remains in a few locations along the Bull Run Stream (Section 5.2.2). In early 2014, low levels of strontium-90 (Sr-90) were detected in the site's effluent stream. The level of Sr-90 detected in a water sample was less that 0.4% of the concentration limit for water in unrestricted areas per Reference (6) and approximately one fifth of the level allowed by the EPA in drinking water (Reference (7)). An investigation determined that contaminated groundwater below the MEL had entered the storm drain system through cracks in aging pipes. Modifications to the storm drain system in the vicinity of the MEL have successfully reduced the Sr-90 levels in the outfall to near background levels detected in local surface waters several miles off-site.

Radioactive Solid Waste

The offsite disposal of solid waste materials was made in accordance with the requirements established by the Atomic Energy Commission (AEC) and the Energy Research and Development Agency, the forerunners of the DOE. The solid waste included rags, plastic bags, contaminated materials, evaporator slurry, and filters.

In the years prior to 1961, combustible solid radioactive waste was incinerated in a specially designed incinerator. The ash and noncombustible wastes were solidified in concrete and then shipped for disposal to AEC-approved areas.

In later years, the waste was packaged in the Waste Processing Building or in the MEL according to the regulations in effect at the time. No radioactive solid waste was buried on the Bettis

Laboratory site. Solid wastes were shipped to a Federally licensed or owned disposal site for disposition.

Radioactive Airborne Effluents

After passing through cleaning systems, where necessary to ensure compliance with existing radiation protection guides, ventilation air from radiological facilities was discharged to the atmosphere. The air cleaning systems included high efficiency particulate filters and wet scrubbers as appropriate for the process being served.

Monitoring of exhaust air has been accomplished through the collection and analysis of samples of the effluent. The sampling technique used was dependent on the physical and chemical nature of the radioactivity and included filter paper and carbon filter sampling.

Overall, an estimated 1000 curies of radioactivity with half-lives greater than one day have been contained in air emissions since operations commenced in 1949. Most of this radioactivity was in air emissions in the earlier years of operations. The majority of the radioactivity consisted of the inert gas krypton-85 and shorter lived iodine-131. Krypton-85 is an inert gas that does not deposit on surfaces and is readily dispersed in the atmosphere. Iodine-131 has a half-life of 8 days and decays rapidly. Smaller amounts of other beta-gamma emitting fission products and trace quantities of alpha emitting particulates comprised the remaining amount of the long-lived radioactivity in air emissions. Since 1993, radioactivity in air emissions with greater than a one day half-life has averaged less than 7×10^{-6} curies per year.

Since LWBR core development began, Bettis Laboratory air emissions have also included the radioisotope radon-220. Radon-220 is an inert gas that is readily dispersed in the atmosphere and decays very rapidly (half-life of 55 seconds). The concentration of the short-lived radon-220 at the location of the nearest offsite receptors has always been below the Federal limits for air in uncontrolled areas. For perspective, radiation doses to offsite individuals from radon-220 emissions have been too low to measure. Conservative calculations using standard EPA methods estimate the radon-220 dose to be less than 0.001 Rem per year to the maximally exposed individual.

Bettis Laboratory has employed calculational techniques that conservatively estimate potential exposures. These methods consider inhalation, ingestion, and direct radiation exposure pathways. Bettis Laboratory conservatively estimates that the maximum possible annual radiation exposure to any member of the public resulting from current operations is less than 0.002 Rem per year. This is less radiation than received from cosmic radiation during a cross-country airline flight between the east and the west coast of the United States (0.003 Rem). The calculations also show that in previous years, the annual radiation exposures to people living adjacent to Bettis Laboratory were well below the annual regulatory limits.

5.2.2 Residual Radioactivity in Soil, Ground Water, Surface Water, and Sediment

Notwithstanding the waste management operations described above, some site soil contains residual radioactivity. In the discussions which follow, levels of radioactivity in soils are discussed in terms of picocuries per gram (pCi/g) of soil. For comparison, a typical home smoke detector contains about 1,000,000 pCi of radioactivity. Additional discussion of the areas containing residual radioactivity can be found in the "Preliminary Assessment and Site Inspection Report for the Bettis Atomic Power Laboratory," - Revision 1, dated January 1990, Reference (1).

Inactive Waste Isolation Pit

Soil beneath the MEL in the vicinity of the Inactive Waste Isolation Pit (IWIP) contains some low levels of radioactivity. The IWIP consists of two small underground concrete vaults containing tanks and equipment that were used for collecting and processing radioactive liquids generated in the MEL. The radioactivity originated due to the overflow of radioactive liquid from collection tanks into the vaults and leakage to the surrounding soil. The system operated from 1956 until 1964.

In 1977, core bore soil samples were collected from inside and outside of the MEL in the area of the IWIP down to bedrock. About half of the samples contained levels of radioactivity detectable above background with the major radionuclide being strontium-90. The majority of the radioactivity was found in one core bore hole immediately adjacent to the IWIP, under the floor of the MEL.

In 1983, the soil around the IWIP with the highest levels of radioactivity was removed. The soil volume removed was approximately 420 cubic feet and extended to bedrock at a depth of about 9 feet. From 1983 through 1994, approximately 1410 cubic feet of additional soil and backfill material were removed. It was initially estimated that about 59 curies remain in the soil surrounding the IWIP. However, core bore samples taken in the soil surrounding the IWIP suggest that the amount of radioactivity that remains in the soil around the IWIP may be much lower than previously estimated.

Surface water that accumulates in an inactive section of the storm drain system adjacent to the MEL and IWIP is transferred and processed to remove radioactivity as discussed in Section 5.1.1.

N-Building Monitor Tank Room

Bedrock beneath the floor of the N-Building Monitor Tank Room (NMTR) contains low levels of radioactivity. The NMTR was installed in 1950 to process radioactive liquid waste and operated until 1975. The radioactivity originated from spills of water containing low levels of radioactivity during water processing operations and subsequent seepage of the water through cracks in the NMTR floor.

After operations of the NMTR had ceased, remediation efforts were undertaken. These efforts included removal of the floor and the fill materials that supported the floor. In 1980, Bettis Laboratory completed removal of the soil down to shale bedrock. This resulted in the removal of about 99% of the radioactivity. This material was disposed at a Federal radioactive waste disposal site. Less than 0.04 curie of radioactivity remains at the location.

Associated with the NMTR were two aboveground storage tanks that were used to store radioactive water for processing. Due to leakage of these tanks, soil beneath these tanks contained residual amounts of radioactivity. After the tanks were removed, core bore samples were collected from the vicinity of the tanks. The average cobalt-60, cesium-137, and strontium-90 results of the core bores were 0.6, 14.5, and 8.2 pCi/g, respectively.

Waste Processing Building Storage Pad

The storage pad behind the inactive Waste Processing Building had residual low-level radioactivity as a result of leaks in containers that were stored on the pad. The storage pad was a 14,900-square-foot pad located north and west of the Waste Processing Building where radioactive waste was processed prior to shipment to an approved, offsite disposal site. The triangular shaped pad is identified in Figure 2. In 1978, demolition of the pad and removal of the underlying soil was completed, and the removed material was disposed of at an approved offsite disposal facility. Samples taken throughout the pad area exhibited very low levels of radioactivity. Less than 0.02 curie of radioactivity remains at this location.

Inactive Waste Site

A portion of the hillside north of the inactive Waste Processing Building has residual low-level radioactivity due to operations conducted prior to 1969. This area is in the southwestern portion of the area referred to as the Inactive Waste Site (IWS), identified in Figure 2. The radioactivity originated primarily from leaks in containers of radioactive waste that had been stored outside on the Waste Processing Building storage pad. Runoff carried some activity to a nearby storm drain that discharged onto the hillside.

Over 95% of the radioactivity on the IWS that originated from the Waste Processing Building storage pad was removed by excavation of soil and removal of the storm drain. The contaminated soil was shipped to a licensed radioactive waste disposal site and the area restored. Currently, the hillside in this area still contains some residual, low-level contamination, with less than 1.9 curies of activity remaining in the area contaminated by runoff from the Waste Processing Building Storage Pad. The 2012 survey of the runoff area below the IWS identified readings between 6 and 8 μR/hr which are indistinguishable from background, typically 10 μR/hr (0.00001 Rem/hr).

Bull Run Stream Basin

As shown in Figure 2, the Bull Run Stream originates on the Bettis Laboratory site as a wet-weather drainage ditch. When there is no precipitation runoff, the primary source of flow in the stream is from the Bettis Laboratory storm drain system outfalls and consists of city water that was used for cooling purposes and some dilute process waste water. The stream runs approximately one-third of a mile on the Bettis Laboratory site, roughly parallel to the southern site boundary. The stream passes through two small private properties indented along the boundary. After the Bull Run Stream leaves the Bettis Laboratory property, it passes through several properties and the West Mifflin Park and joins the Thompson Run Stream which flows into the Monongahela River. Neither Bull Run Stream nor Thompson Run Stream is known to be used as a source of water for human consumption.

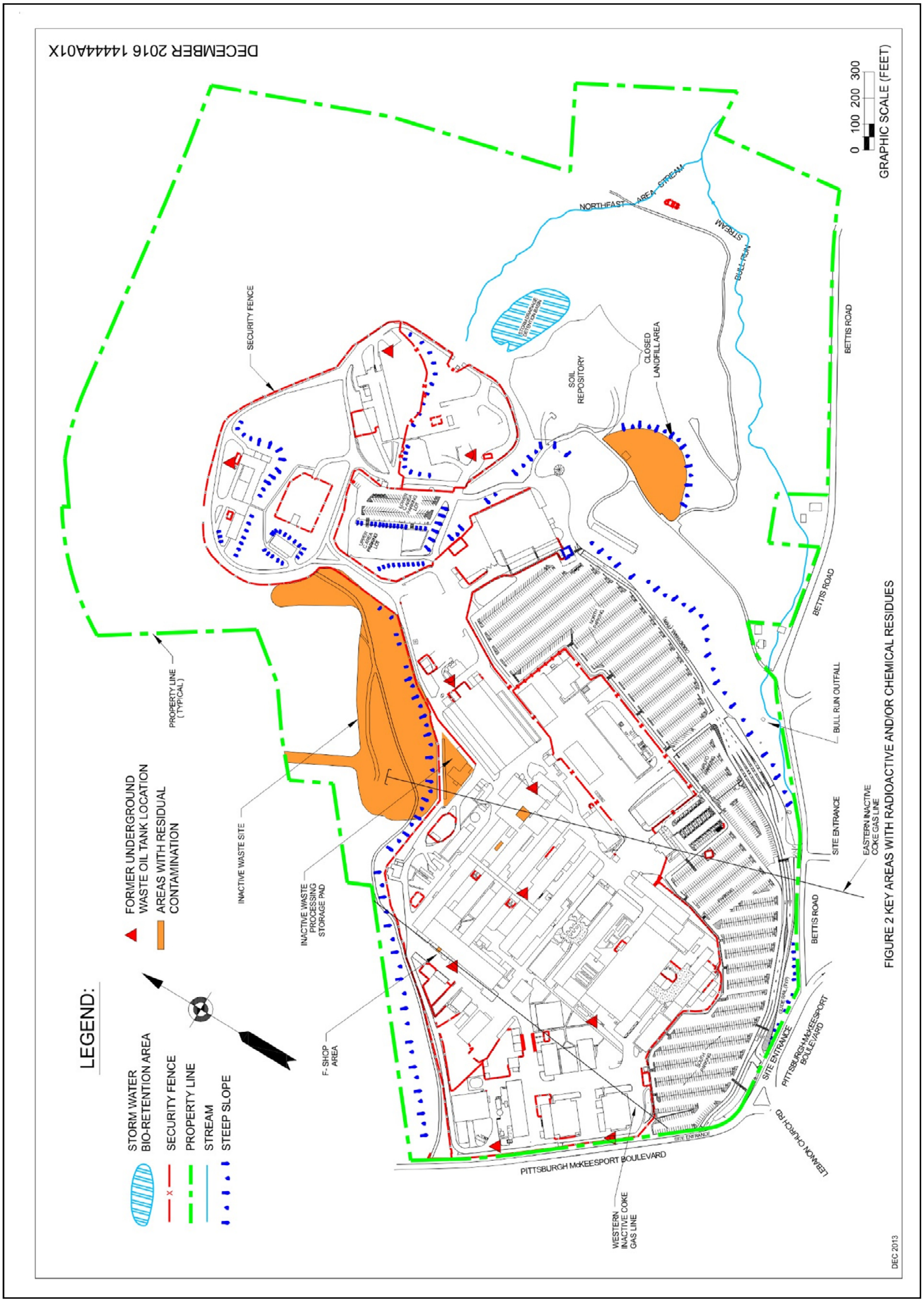

FIGURE 2 KEY AREAS WITH RADIOACTIVE AND/OR CHEMICAL RESIDUES

In the first decades of site operation, water effluents from the Bettis Laboratory to the Bull Run Stream contained small amounts of radioactivity at concentrations below applicable Federal limits. Over 99 percent of the radioactivity contained in the effluent water was released prior to 1969.

Although not required by Federal or State regulation, Bettis Laboratory began monitoring the Bull Run Stream basin in 1959. The results of this monitoring were initially reported to and published by the U.S. Public Health Service in their journal "Radiological Health Data and Reports." Subsequently, the results have been provided in annual environmental monitoring reports to the EPA and PADEP. These documents indicate that, in addition to the presence of naturally occurring radioactivity in Bull Run Stream, very low levels of residual radioactivity from the earlier Bettis Laboratory releases are detectable. A detailed presentation of residual radioactivity in the Bull Run Stream basin was provided to the PADEP; a summary of this information was provided in the Preliminary Assessment Report (Reference (1)) of the Bettis Laboratory site, developed pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

During the winter of 1976-77, most of the residual radioactivity along the Bettis Laboratory portion of the stream basin was removed and disposed of at a licensed offsite disposal facility (392 cubic meters of soil and approximately 90% of the radioactivity was removed). Soil samples taken after the removal effort indicated that only a small fraction of the residual radioactivity remained, with low, but still detectable levels observed. Most of this residual material is located along the lower two-thirds of the onsite Bull Run Stream basin in small, localized areas.

Radiation levels measured in surveys prior to the 1976-77 soil removal varied from natural background levels (approximately 10 μR/hr) to approximately 100 μR/hr at waist level in isolated onsite locations. The offsite portion of the survey included an area about 1,400 feet downstream of the site boundary where radiation levels were measured from approximately 10 to 22 μR/hr. Detailed surveys of the onsite Bull Run basin performed since 1976-77 show that the waist-level radiation readings are generally less than 20 μR/hr. The average radiation level in this area is about 13 μR/hr at waist level, which is only slightly above background.

As part of its detailed survey efforts, Bettis Laboratory has also taken samples of the soil along the stream basin and measured the concentration of residual radioactivity with sensitive laboratory instruments. In addition to the naturally occurring radioactivity found in the soil, low levels of cesium-137 are detectable. The typical cesium-137 concentration along the stream basin is much less than 20 pCi/g, although a few, small spots contain cesium-137 to about 200 pCi/g. The maximum cesium-137 concentration measured to date was found in 1982 in a small, isolated spot at a level of 460 pCi/g; a subsequent sample in the immediate area contained 9.6 pCi/g of cesium-137.

During April 1993, Bettis personnel and a representative of the PADEP performed an environmental radiation survey of a portion of the Bull Run Stream basin in the West Mifflin Community Park. This portion of the basin was selected because it represents the only known segment of Bull Run Stream in the West Mifflin Park area that contains low levels of Bettis-generated radioactivity above natural background levels in the soil. The area surveyed was selected since it is a relatively flat section of the stream where there would be the greatest potential for accumulating low-level radioactivity that could have settled out of the stream waters. The survey area is undeveloped and individuals have not been routinely observed there. Radiation measurements were taken and recorded on a 10 foot by 10 foot grid system at approximately three feet above the ground surface. The area within each 100 square foot grid section was scanned. The measured radiation levels varied from background, about 10 μR/hr, to a maximum of 27 µR/hr. These slightly enhanced, yet still very low, radiation levels are due to the presence of low levels of radioactivity, primarily cesium-137, from early site operations. The levels and locations measured in the 1993 survey were consistent with previously measured and reported values and indicated there had been no migration from or buildup of radioactivity in the area since circa 1976.

Soil samples were also collected from the surface down to rock at ten locations to determine the radioactivity profile in the soil. The sample results confirm that the primary radionuclide present is cesium-137. Cesium-137 radioactivity ranged from background of about 1.4 pCi/g to 120 pCi/g. As a measure of the significance of soil containing 120 pCi/g of cesium-137, an individual would have to consume 27 pounds of soil to receive a dose of 100 millirem which is the NRC dose limit for an individual member of the public per year. The data show low levels of natural uranium in the soil. The data indicate the majority of the low level radioactivity is found in the top one foot or less of the soil. This profile is consistent with deposition from flooding of the area and the propensity of cesium-137 to become attached to soil particles as it is carried into the ground by the water.

In 2014, Bettis Laboratory personnel performed an environmental radiation survey of a portion of the Bull Run Stream basin located in the West Mifflin Community Park. The survey area was essentially the same area as surveyed in 1993 and 2004 by representatives of Bettis. The PADEP participated in the 1993 and 2004 survey/sampling evolutions. Results of the survey were provided to PADEP and the West Mifflin Borough.

During the 2014 survey, the radiation levels ranged from approximately 6 µR/hr (e.g. background) to 19 µR/hr at three feet above the ground surface. By comparison, the maximum radiation level at three feet above the ground surface in 1993 was 27 µR/hr, and 20 µR/hr in 2004. The average radiation level in the floodplain portion of the survey area was 9.5 µR/hr in 2014, compared to approximately 13 µR/hr in 1993 and 12 µR/hr in 2004.

Since individuals are not routinely observed in either the onsite Bull Run Stream area or the undeveloped park area containing residual radioactivity, the most probable radiation dose received by any person from these residues is zero. However, in the unlikely event that a person would spend one hour each day in the area where the radiation level is the highest, the yearly dose received would be far below that allowed for members of the general public by the NRC regulations and less than $1/100^{th}$ of the average annual dose received from natural background sources by a member of the general public in the United States. Therefore, the radioactivity and the resultant radiation do not present a hazard to the public.

Soil samples were also collected to a depth of 30 inches at nine locations to determine the radioactivity profile in the soil. Low levels of cesium-137 and uranium were confirmed to be present primarily in the region below six inches deep at levels consistent with those detected in 1993.

The most recent radiation survey of the on-site portion of Bull Run Stream was performed in 2016. The results of this survey showed evident decline in the detected levels of historical radioactivity in the stream bed and adjacent floodplain areas when compared to results of previous surveys conducted in this area. The decline is predominantly due to decay of the residual radioactivity.

Inactive Systems

The Bettis Laboratory has inactive systems such as tanks, sumps, and underground lines associated with the processing of low level radioactive liquids. These underground radioactive liquid waste drain systems were installed in the 1950s. After more than 10 years of operation, the underground systems were deactivated. Since then, much of the accessible piping and adjacent soil have been removed and disposed of as solid radioactive waste. Where possible, the inaccessible sections of pipe were hydrostatically tested and capped to maintain system integrity. The remaining sections of pipe total approximately 12,000 feet. Radioactivity still exists in the remaining systems. In addition, some of the systems contain small quantities of residues and some systems contain ground water. These systems are being removed during the decontamination and decommissioning of the radiological facilities with which they are associated.

There are a few additional locations at the Bettis Laboratory where soil potentially contains low levels of radioactivity due to past minor breaches in containers or spills. Bettis Laboratory has excavated soil from many of these areas to remove the radioactivity, but some very small amounts of radioactivity still remain in the soil.

Ground Water Radiological Monitoring Results

The ground water radiological monitoring program results show that Bettis Laboratory operations have not had a significant effect on the radiological quality of the ground water at the site.

This program has been maintained since the mid-1980s and includes ground water samples from seeps, springs, and monitoring wells. Samples are collected regularly and analyzed for gross alpha, gross beta, and specific radionuclides associated with past or current Bettis Laboratory operations, such as cobalt-60, cesium-137, and strontium-90. In addition, samples are also taken at remote sites for comparison of the levels of radioactivity naturally occurring in the environment in southwestern Pennsylvania with the Bettis Laboratory site results. While the specific results from both onsite and offsite sampling vary from sample to sample and year to year, the results of the monitoring indicate that the gross alpha and beta radioactivity levels in the ground water at the Bettis Laboratory site are consistent with the naturally occurring radioactivity levels found at remote locations.

Ground water monitoring well data in the IWS area indicates that, for the most part, gross alpha and beta radioactivity levels in the ground water are equal to background levels found in ground water remote from the Bettis Laboratory site. However, a few ground water samples collected from monitoring wells near the middle of the hillside area have contained limited amounts of non-naturally occurring radioactivity.

Low levels of radioactivity have been identified in the surface soil and surface water downgrade and west of the IWS hillside. The gross alpha and beta radioactivity levels in the water and soil are consistent with naturally occurring levels. Specific radionuclide analysis revealed the presence of radioactivity in the soil and water. The radiation dose that could be incurred from this residual radioactivity in the soil is less than the exposure a person would receive from cosmic radiation during a round trip flight between the east and the west coast. The levels in the water are well below the Federal guideline concentrations for water in unrestricted areas, Reference (6). This water is not used for any purpose and is not a source of drinking water.

Ground water monitoring wells have been installed around the MEL to monitor the migration of residual radioactivity from under the MEL. Low levels of strontium-90 have been detected in these wells. The data has not shown an increase in the radioactivity levels since the monitoring began. The levels of strontium-90 found in the wells are much less than the guideline concentration for water in unrestricted areas, Reference (6).

The radioactivity data for the Pittsburgh Coal water-bearing zone wells are consistent with natural background levels with two possible exceptions. There are two Pittsburgh Coal water-bearing zone monitoring wells located within a few feet of each other downgrade of the IWS. The results from these two wells have, at times, indicated the presence of low levels of strontium-90. The levels of strontium-90 detected are similar to those detected in ground water around the country and attributed to past atmospheric nuclear weapons testing. Strontium-90 is present in the soil in the IWS from past site operations and higher than background levels of strontium-90 have previously been detected in surface drainage from the IWS.

5.2.3 Past Non-Radioactive Waste Management

Over the years, Bettis Laboratory has generated a variety of chemical wastes. In the first few decades of laboratory operation, disposal methods included common industrial practices such as discharge to sanitary sewers and storm drain systems, placement in municipal landfills, evaporation, and onsite land disposal. In 1983, Bettis Laboratory initiated efforts to identify and define areas onsite that may have been used to dispose of chemicals.

5.2.4 Chemical Residues in Soil, Ground Water, Surface Water, and Sediment

The past waste management methods described above resulted in some chemical residues in soil. A detailed discussion of the areas containing chemical residues can be found in the Final RCRA Facility Investigation (RFI) Report, Reference (2), and the Final Corrective Measures Study (CMS) Report, Reference (3).

<u>Inactive Waste Site</u>

The IWS, identified in Figure 2, was used from the late 1950s to approximately 1964 to dispose of mainly plant rubbish and excavation materials. The area was also used to dispose of some waste chemicals, such as solvents, oils, and various metal-containing sludges. Asbestos-containing materials were also deposited in the area. The site was covered with dirt from onsite excavation and construction jobs, with the last use occurring in 1972. The IWS is approximately 3.5 acres in size and is located on the hillside on the northwest portion of the site away from areas frequented by the public. The maximum depth of the fill materials is estimated to be 28 feet.

In 1985, Bettis Laboratory drilled a series of borings in the IWS. The principal chemical in soil samples collected from the borings was tetrachloroethylene, (also known as perchloroethylene or PCE) a commonly used dry cleaning agent which was used at the Bettis Laboratory for degreasing metal parts.

There are no odors or visual evidence of environmental damage or stress, such as dead vegetation, in the area of the IWS. The vegetative growth, which consists of grasses, crown vetch, and small trees and bushes, limits direct contact with the materials and airborne releases. Asbestos air sampling and organic vapor sampling indicated levels consistent with ambient conditions. Sampling for PCBs using a standard Occupational Safety and Health Administration method indicated levels less than 1% of worker limits. The results of the soil, water, and air samples collected in 1992 and 1993 during the RFI confirmed the types and levels of chemical residues previously detected at the IWS.

In 1989, surface soil and water samples collected downgrade from the IWS on adjacent industrial properties formerly owned by Duquesne Light Company and Valley National Gases ((VNG) currently Matheson Valley) showed the presence of very low levels of PCBs and VOCs in the soil and VOCs and asbestos in the water. These samples were collected in a wet-weather ditch located in an undeveloped, limited access area. Subsequently, additional soil and surface water samples have been collected from this area during the RFI and as part of annual monitoring. The PCB levels found in the ditch soil, with one exception (13 parts per million (ppm)), have been less than 10 ppm. The levels of VOCs in the surface water and soil are the result of migration from the IWS and pose no health risk to the public since the water is not used for human consumption. VOCs in the soil exceeded the EPA screening level in less than 1% of the soil samples. The fiber sizes of the traces of asbestos found in the water were smaller than those considered to be a health risk from ingestion. The results were provided to the Duquesne Light Company and VNG. The results of soil and water sampling performed in 1992 and 1993 during the RFI generally confirmed the types and levels of chemical residues previously detected on Duquesne Light Company and VNG properties. During the 1992 and 1993 sampling, additional constituents were analyzed for and some low levels of polynuclear aromatic hydrocarbons (PAHs) were detected. These levels of detected PAHs are consistent with background levels for the area surrounding Bettis Laboratory and, as such do not pose any risk unique to Bettis operations. The Bettis Laboratory sampling program to monitor for migration of residues from the IWS continued through 2010 but then terminated as discussed in Section 5.3.2.

During 2002, the DOE purchased approximately 5.5 acres of adjacent VNG and Duquesne Light Company properties to provide additional alternatives to mitigate trace contaminants from past Bettis operations, to control areas of contaminated ground water seepage flow except during periods of high surface water runoff, and to control future ground water access by members of the public. Bettis Laboratory conducted a study of the ground water in this area as part of the Corrective Measures Implementation Order (CMIO) negotiated with the EPA; this study is discussed further in Section 5.3.2.

<u>Soil Surrounding Underground Waste Oil Tanks</u>

In about 1960, Bettis Laboratory installed 10 steel underground storage tanks for the collection of waste oil. The tank volumes ranged from 65 to 550 gallons. Their function was to serve as collection points for used oil from which a vendor could pump the oil for offsite disposition. In 1979, use of the tanks was terminated and the tanks emptied except for minor amounts of residual material. In 1986, Bettis Laboratory reopened the tanks and sampled the residuals remaining in the tanks and the soil around the tanks. Several of the soil analyses showed the presence of residues of the same products found inside the tanks.

Each of the tanks has been removed, cleaned, and reclaimed as scrap metal. The boundary of the affected soil around the tanks was not established in 1986 but was during 1992 and 1993. Samples of soil collected from the underground storage tank excavation areas in 1992 and 1993 during the RFI revealed that, for the most part, only trace levels of residues remain in these areas. The source of the oil and solvents is thought to be from spillage when oil was added to the tanks rather than tank leakage. This is supported by the fact that all but one of the removed tanks appeared to be intact. The quantity of affected soil is estimated to be less than 30 cubic meters.

All tank areas are inside the Bettis security fence, limiting contact by outside persons, with the exception of one tank area, which has been determined to exhibit no contaminants of concern in the soil. The excavated holes have been lined with plastic and filled with clean sand. The sites are not being used for any purpose by Bettis personnel. In October 2016, an agreement between Bettis and the EPA was finalized to reflect that only five of the ten previous underground storage tank excavation areas include trace levels of oil and solvent residues. The areas are monitored annually to validate that no soil disturbances have occurred.

<u>Petroleum Storage Tanks</u>

In addition to the waste oil tanks, two underground gasoline tanks, an underground airport fuel tank, and an underground diesel fuel tank have been removed. These removal actions were conducted in accordance with applicable Federal and State regulations.

<u>F-Shop Area</u>

This area (identified in Figure 2) is located immediately outside a building, the F-Shop, that at one time contained two tanks used for vapor degreasing of metals. A soil sample collected in the area from a two-foot layer of soil above bedrock contained 1.15 parts per million of PCE. The source of the solvent was thought to be from the historical disposal of small quantities of solvents used in the F-Shop degreasing units. The total quantity of solvent deposited in this approximate 1600-square-foot area is estimated to be a few gallons. There were no physical signs of the solvents, such as odors, nor any visual evidence of environmental damage. Samples collected during the RFI confirmed the previously detected levels of VOCs.

Approximately 8.5 tons of affected soil and rock were removed and remaining soil sampled in 2000. The removal operation and analytical results were described in a closure report submitted to the EPA in December 2000 and that the EPA approved in January 2001 (Section 5.3.2). No further work is required in this area.

<u>Bettis Landfill Area</u>

There are currently no active waste disposal landfills at the Bettis Laboratory site. From approximately 1960 until 1987, Bettis Laboratory operated a landfill area, identified in Figure 2, to dispose of soil and concrete removed from site excavation and construction activities. The landfill was not used for disposal of radioactive waste.

In the fall of 1987, auger borings were drilled into the fill and soil samples were collected for analysis. The soil analysis revealed the presence of PCE, trichloroethylene, trans-1, 2-dichloroethylene, and PCBs. The areas of the highest chemical concentrations appeared to be centered around two of the borings located in an older portion of the fill. The chemicals were found at depths of 5 feet or greater. The exact quantity of these chemicals in the landfill is unknown but is likely to be a few hundred gallons.

The total surface area of the Bettis Landfill is approximately 1.5 acres with a maximum fill depth of approximately 25 feet. There are no odors at the landfill surface or in the area surrounding the fill nor are there any visual indications of environmental stress at the landfill. Air sampling for asbestos and organic vapor indicated levels consistent with ambient. PCB sampling indicated trace amounts are detectable, but at levels less than 1% of worker limits. The results of soil and air samples collected during the RFI confirmed the types and levels of previously detected chemical residues at the Bettis Landfill.

Bettis Laboratory operated a soil vapor extraction system in this area from 2004 to 2011, as part of the CMIO negotiated with the EPA, to reduce the VOC levels in the soils. In April 2011, the soil vapor extraction system was shut down upon achieving the cleanup criteria established for the system. This system is discussed further in Section 5.3.2.

Coke Gas Lines

Bettis Laboratory investigated two 40-inch diameter abandoned gas lines dating from the early 1900s that transect the Bettis Laboratory site. The gas lines were used to transport coke oven gas between steel mills in the valleys of western Pennsylvania. The lines have been inactive for many years, but the investigations have found that some sections of the lines contain residual sludge and water. This sludge and water contains coal tar derivatives and other hazardous constituents such as benzene. The levels of sludge and water are routinely monitored and approximately 150 feet of a breached section of one line was removed in 2000 (Section 5.3.2). The operations were described in a closure report submitted to the EPA in December 2000 and that the EPA approved in January 2001. In 2004, water and sludge were removed from two portions of the lines and the endcap was replaced to improve integrity on one of the lines. In 2006, approximately 60 feet of one line was removed to facilitate infrastructure construction. Further work on the coke gas lines will be pursued as necessary to support other operations.

Storm Drain System

The developed portion of the site is serviced by a storm drain system that discharges primarily to the Bull Run and Northeast Area Streams. Historically, some chemicals were disposed of by discharging to the storm drain system. Sampling of manholes in certain sections of the storm drain system has resulted in the detection of chemical residues, including VOCs and PCBs in the sediment. These chemical residues have leaked into the soil/fill surrounding the storm drain system in some locations. The VOCs in these areas have leached into the upper water-bearing zones. In 1992 and 1993 during the RFI, extensive sampling of the storm drain system was performed. This sampling confirmed the presence of low-level residues in certain portions of the storm drain system. These residues pose an insignificant risk to human health. In 1997, a program was completed to remove the sediment that had accumulated in select manholes around the site.

Other Onsite Areas

Other areas onsite were investigated in 1992 and 1993 during the RFI for the presence of chemical residues. The investigations included the collection of soil and soil gas samples. Only trace quantities of chemical residues were identified in a few areas and they pose an insignificant risk to human health and the environment.

In 1996, following completion of the RFI, small bead-like polyethylene particles, that contained approximately 7% lead by weight, were discovered in an outdoor area on Bettis Laboratory property. An investigation of the area was conducted and a report of the results submitted to the EPA. The report concluded that lead contamination was restricted to the top few inches of soil in the area where the beads were observed on the surface. An evaluation of the impact of the lead-contaminated soil on ground water concluded that, although the lead contamination was not a threat to ground water, removal of the beads and entrained soil for proper disposal offsite was a viable and prudent corrective measure. The beads and entrained soil have been removed and disposed of offsite.

Old Airfield Operations at the Bettis Laboratory Site

It is possible that small quantities of spent solvents and degreasers common to aircraft maintenance may have been discarded in some areas during the time period when the Bettis Laboratory site was a privately owned airfield. Bettis Laboratory investigations have not identified any specific disposal areas from airfield operations.

Surface Water and Sediment

The results of analyses for VOCs in surface water samples collected during 1992 and 1993 from onsite and offsite streams confirm the data previously obtained through historical sampling and analysis. The only surface water samples that contained site-related VOCs were collected from Bull Run Stream downstream of the confluence with the discharges from Buono and other springs within the property boundary. VOCs associated with site operations were not detected in water samples collected from the Bull Run and Northeast Stream outfalls, the Northeast Stream, or the inactive High Temperature Test Facility (HTTF) drainage channel located in the northwest portion of the Bettis Laboratory site. VOCs were not detected in surface water samples collected offsite from Thompson Run Stream. Sampling and analysis of surface water demonstrated that no other chemicals were present at measurable levels.

The discharge of low levels of VOCs occurred primarily between Buono Spring and the confluence of the Bull Run Stream and Northeast Stream. The presence of VOCs in Bull Run Stream water was attributed to the continuous discharge of water to the stream from various springs and seeps discharging from a VOC impacted water-bearing zone. The springs and seeps represented a continuous source of VOC discharge to Bull Run Stream. Surface water sampling and analysis at onsite locations downstream of the Bull Run Stream/Northeast Stream confluence and offsite locations were normally near or below the analytical method quantitation level of 0.005 parts per million. These results indicated that VOCs in Bull Run Stream surface water were not migrating offsite to a measurable degree. However, based on the findings of the RFI and CMS, Bettis Laboratory proactively undertook measures to further reduce the potential for VOCs to migrate offsite. In late 1997, the Springwater Intercept System was installed to collect and remove the VOCs prior to discharge to Bull Run Stream through a newly established NPDES outfall. Monitoring results for treated ground water discharged from the Springwater Intercept System indicate that the system is effective in removing the VOCs. This system is operated in accordance with a 1999 Consent Order and Agreement established with the PADEP. Construction of a replacement SIS commenced in 2016 and is expected to be completed and operational in 2017.

VOCs associated with site operations were not detected in sediment samples collected from Thompson Run Stream, the Northeast Stream, or the inactive HTTF drainage channel. Sediment samples collected from Bull Run Stream and the Buono Spring discharge flow path contained VOCs. PCE was the only VOC detected in Bull Run Stream sediment. The primary source of PCE in the sediment was the discharge of water from springs and seeps that contained low levels of PCE. The Buono Spring and several other springs and seeps are now tied into the Springwater Intercept System. Therefore, PCE concentrations in the Bull Run Stream sediment are expected to decline. The results of sediment sampling and analyses at onsite locations downstream of the Bull Run Stream/Northeast Stream confluence and offsite locations during the RFI were well below screening concentrations identified by EPA Region III for risk assessment thresholds. These levels indicated that PCE in Bull Run Stream sediment was not migrating offsite to a measurable degree.

The presence of PCBs in onsite stream sediment and the inactive HTTF drainage channel is likely associated with historic disposal of wastes containing small quantities of PCBs to the storm drain system and subsequent discharge to the various streams and the drainage channel. PAHs detected in onsite stream and spring sediments are comparable to those present in local stream sediments unaffected by site discharges and are not associated with any site-specific operations, past or present. Sampling conducted during the RFI detected only trace amounts of one pesticide in comparable concentrations in both Thompson Run and Bull Run sediments that was not associated with site activities.

In November 2015, chemical analysis of the residue found in the bottom of an on-site historical electrical distribution system manhole indicated the presence of PCBs in excess of 50 ppm. The maximum PCB concentration found in the residue was 2,060 ppm. A courtesy notification was made to EPA Region III regarding the event. All contaminated residue has been removed from the manhole.

<u>Ground Water and Well Water Monitoring Results</u>

Extensive ground water monitoring has been conducted at the Bettis Laboratory site. This ground water monitoring program includes sampling wells, springs, and seeps. The chemicals in the ground water include the solvent PCE and its degradation products trichloroethylene and dichloroethylene. The results for PCB, PAH, and pesticide monitoring did not reveal the presence of these materials in ground water. The results of the well water analyses also revealed the presence of certain inorganic species such as iron, manganese, sulfates, and chlorides that were slightly above primary and secondary drinking water maximum permissible levels in a few cases. There are no uses for the ground water at Bettis Laboratory. The iron, manganese, and sulfates are inorganic species that are commonly found in the ground water in western Pennsylvania and are typically considered to be either naturally occurring or from man-made activities such as mining. The elevated chloride levels in the well samples may reflect winter deicing activities onsite.

The results of the site ground water investigations indicate that ground water quality has been impacted by the release of chemical constituents at the site. Ground water quality impacts are evident in the Perched, Benwood, and Sewickley water-bearing zones and, to a much smaller degree, in the Pittsburgh Sandstone water-bearing zone. Ground water data from wells in the Pittsburgh Coal do not show evidence of chemical constituents associated with operations at the site. The ground water quality impacts in the Perched water-bearing zone are primarily related to the past practice of discharging effluents containing chemicals into the onsite storm and sanitary sewer systems and the resultant discharge of these materials into the ground water through leaks in these systems. Ground water quality impacts in the Benwood Limestone and Sewickley and Pittsburgh Sandstones are related to the release of contaminants from the IWS, Bettis Landfill, and other areas that contain chemical residues and, to a limited extent, the migrations of the chemical residues from the overlying water-bearing zones. In general, other areas of soil contamination do not appear to have had a significant effect on ground water quality. The water quality of springs that discharged from the water-bearing zones reflected the water quality obtained from the wells within those zones.

The investigation of the ground water flow path at the site, Reference (2), concludes that there is no risk to the general public from Bettis ground water migration.

5.3 Decontamination and Decommissioning Programs

5.3.1 Decontamination and Decommissioning Programs for Radioactivity

In September 1977, a long-term program was initiated by Bettis Laboratory to decontaminate and reduce the number of facilities and areas requiring radiological controls and to provide efficient use of space to support current operations. The Decontamination and Decommissioning program tracks the amount of radiological, non-radiological, and mixed waste shipped; the total curies shipped; and total building area eliminated from radiological controls. During 2014, 2015, and 2016 the program has accomplished the following at the Bettis Laboratory:

- Shipped 2,416 tons of radiological waste, mostly generated in 2014 due to the demolition of the C-CA-CAM Complex;
- Shipped 11.8 tons of mixed waste;
- Shipped 4,642 tons of non-radiological waste;
- Shipped 3.5 curies; and
- Eliminated approximately 26,000 square feet of building area due to the demolition of the C-CA-CAM Complex, of which the majority was subject to radiological controls.

Bettis Laboratory maintains an active decontamination program that concentrates on decontaminating and decommissioning facilities. Small quantities of soil containing residual radioactivity are removed in conjunction with decontamination, construction, and renovation activities.

The areas with residual soil radioactivity, discussed in Section 5.2.2, are monitored to ensure that there is no potential for significant radiation exposure to workers or the public. Removal of soil with low concentrations of residual radioactivity is evaluated on a case by case basis.

During 1991, the PADEP completed a review of radiological environmental data for the site. The PADEP concluded that the levels of residual radioactivity on and immediately adjacent to the site were far below NRC action levels and that no additional regulatory action was required. The Bettis Laboratory will take actions to release the footprint of facilities for unrestricted use in accordance with all applicable requirements as the facilities are decommissioned and removed.

5.3.2 Remedial Programs for Chemical Residues

The CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires Federal facilities at which hazardous substances are located to be evaluated for potential risks to public health and the environment. This evaluation is completed by the facility or agency using an EPA-generated ranking system used to identify facilities requiring prompt remedial action. The EPA, in consultation with states, has the responsibility to review the evaluation and officially establish the ranking. Facilities with high rankings are considered for placement on the National Priority List. Otherwise, sites are addressed in accordance with individual state requirements or the requirements of other Federal laws such as RCRA. Bettis Laboratory completed an evaluation for potential risks to public health and the environment and submitted the results to the EPA and the Commonwealth of Pennsylvania in Reference (1). Bettis Laboratory concluded that the site has a ranking value which is well below the cutoff for listing on the National Priority List. The EPA reviewed the evaluation and assigned a hazard ranking score of zero, concluding that no regulatory or remedial actions were required under CERCLA.

However, under the requirements of RCRA, sites having interim status or a final permit for hazardous waste storage must address releases of hazardous constituents to the environment from past operations. This matter was formalized in a Consent Order issued under Section 3008(h) of RCRA, and signed by the Pittsburgh Naval Reactors Office (now known as the Naval Reactors Laboratory Field Office – NRLFO) and the EPA in August 1990. As part of the Consent Order, the EPA agreed that the conditions onsite do not require implementation of interim measures or immediate corrective actions.

The Consent Order required a RFI and CMS to be conducted. The RFI was conducted to characterize the site and the CMS was conducted to determine site-specific remediation alternatives. The RFI work plans were approved by the EPA in 1991. Ground water monitoring well installation and the ground water, surface water, soil, sediment and air sampling specified in the RFI work plans were completed in 1993. The Final RFI Report, Reference (2), was approved by the EPA in August 1994.

The purpose of the CMS was to evaluate and recommend, where needed, corrective measures that would protect human health and the environment. The need for corrective measures was based on the carcinogenic risks and the noncarcinogenic hazards to human health potentially posed by the chemical contaminants of concern. A risk assessment, which was included in the Final RFI Report, demonstrated that the chemical residues in the environment at the site do not realistically present a significant risk or hazard to human health. Therefore, extensive corrective measures are not considered necessary now or in the foreseeable future.

The Final CMS Report, Reference (3), proposed to the EPA several actions to ensure the conclusions of the Final RFI Report remain accurate in the future, to limit potential migration of chemical residues, and to reduce the chemical residues in the environment to as-low-as-reasonably-achievable. These actions included the collection and treatment of select spring and seep water, removal of some coke gas line residues, continued environmental monitoring, and maintenance of existing health and safety requirements for accessing areas that contain residual chemicals. The Final CMS Report was approved by the EPA in March 1995.

The EPA issued its preliminary recommendations for corrective measures in November 1995 and requested public comment on the recommendations. The EPA responded to public comments and issued final recommendations for corrective measures in October 1997. The EPA terminated the Consent Order in November 1997 and stated that all requirements of the Consent Order had been met. Bettis Laboratory has proactively implemented and completed the majority of the recommended corrective measures to the EPA's satisfaction. Upon completion of the Consent Order, Bettis Laboratory entered into negotiations with the EPA on the CMIO as discussed later in this report.

Voluntary Chemical Remedial Programs

Bettis Laboratory has actively addressed areas shown or suspected to contain chemical residues. Some examples of major voluntary efforts include the following. In the mid-1980s, Bettis Laboratory removed ten underground waste oil storage tanks. Leaking gasoline storage tanks have been removed and replaced with a new tank with automated leak detection systems. An old airport fuel tank and a site underground fuel oil tank for an emergency generator have been removed. Soil in the immediate vicinity of the tanks that contained chemical residues due to small spills or overfilling was removed and properly disposed. Also, approximately 200 tons of soil that contained lead from a closed outdoor firing range was removed and disposed at an offsite licensed landfill. Polyethylene beads, containing a small amount of lead, and entrained soil have been removed from an outdoor area onsite and disposed.

Other source control activities implemented include: removal of chemically contaminated sediment and/or liquid from portions of the site storm drain system; removal of liquids from underground coke gas lines (remaining from historical non-Bettis usage); removal of a localized area of chemically contaminated soil; and removal of a breached section of an abandoned coke gas line. Institutional controls are in place to ensure personnel safety and health for activities that could involve contact with environmental media containing chemical residues. Monitoring programs for ground water, surface water and sediment, storm drains, and the coke gas lines are also in place to confirm that the conclusions of the Final RFI Report remain accurate. In March 2001, EPA formally approved the corrective measures identified above that had been implemented at Bettis.

During negotiation of the 1990 Consent Order, the PADEP issued Bettis Laboratory a Notice of Violation concerning the presence of residual chemicals in the ground water at the Bettis Laboratory due to past practices. One of the voluntary corrective measures implemented onsite was the installation of the Springwater Intercept System. During 1999, a Consent Order and Agreement for operation of the Springwater Intercept System was established with the PADEP; this order closed the Notice of Violation. In addition, the EPA formally approved, in March 2001, the installation and operation of the Springwater Intercept System. Construction of a replacement SIS commenced in 2016 and is expected to be completed and operational in 2017.

Although not required by law, Bettis Laboratory has been actively engaged in the removal of friable asbestos containing materials from the Laboratory. In the past, this effort was directed to the removal of small quantities associated with repairs or renovation activities. In June 1991, a planned program to remove friable asbestos containing materials was initiated. This program resulted in the removal of approximately 66,000 linear feet and 31,000 square feet of friable asbestos containing material. This program removed most of the non-radiologically contaminated friable asbestos containing material at the Bettis Laboratory. Radiological asbestos work performed since 1989 has focused on the removal of approximately 12,900 linear feet of radiologically contaminated friable asbestos pipe insulation. Approximately 6,700 linear feet of radiologically contaminated asbestos remain and will be removed during future facility decontamination and decommissioning or renovation activities.

Non-friable asbestos-containing building materials such as floor tiles and roofing materials are removed during normal operations and maintenance work or as part of construction and prior to demolition activities. Although not required by law, Bettis Laboratory has stopped using asbestos-containing building materials.

Corrective Measures Implementation Order

In 2000, efforts were initiated with the EPA to negotiate a CMIO. The CMIO became effective on April 16, 2001. The CMIO addressed the implementation of corrective measures selected by the EPA in the Final Decision and Response to Comments (FDRTC) for the Bettis Laboratory (Reference (8)). The corrective measures to be implemented included in-situ soil vapor extraction at the Bettis Landfill, collection and treatment of specified springs and seeps, collection and treatment of groundwater seepage below the IWS, monitoring, institutional controls and several focused removals of on-site contamination.

Soil vapor extraction is an in-situ process that physically removes volatile contaminants from soils by inducing airflow through the soil. The air is then passed through activated carbon filter units to capture the volatile contaminants prior to discharge to the atmosphere. The purpose of the vapor extraction corrective measure is to reduce the VOC levels in the soils and reduce a potential source of ground water contamination to as low as reasonably achievable.

Construction of the system was interrupted in 2002 by the discovery of ground water in many of the soil vapor extraction wells. Ground water pumping tests and additional field investigations were conducted in order to redesign the system to lower ground water levels and improve the efficiency of soil vapor extraction. The redesigned, enhanced soil vapor extraction system began operation in September 2004, treating both ground water and soil vapor removed from the Landfill.

On April 6, 2011, the enhanced soil vapor extraction system was shut down after reaching the as-low-as-reasonably-achievable criteria established for the system. In March 2012, both the EPA and the PADEP confirmed that the enhanced soil vapor extraction system operations could be permanently terminated and the system could be removed. System removal activities were completed on September 11, 2012. These activities included carbon removal, equipment removal, well abandonment, and site restoration.

A Corrective Measures Completion Report was submitted to the EPA in January 2013 and approved by the EPA in February 2013 (Reference (4)). Soil vapor extraction efforts removed approximately 7,000 pounds of VOCs from the Bettis Landfill prior to reaching the effective limit of the in-situ soil vapor extraction technology.

Upon receipt of EPA approval of the Bettis Groundwater Regime Study for the IWS, a ground water study on the northern hillside of the area was performed to determine the sources and quantities of ground water that occasionally surface on adjacent properties and to determine if a subsurface drainage system is an appropriate remedy for this area. The study was completed in 2003 and the study results issued to the EPA. The study concluded that seepage originates from two separate water-bearing zones and typically reabsorbs back into the ground on what is now DOE property.

Based on the ground water study results and as an alternative to collection and treatment, the Bettis Laboratory recommended installation of a flow separator in the wet-weather ditch to preclude the mixing of seepage containing trace levels of contaminants with surface water that could potentially carry contaminants offsite. The EPA subsequently determined that, based on additional investigations, ground water impacted by the IWS does not present an unacceptable risk and that further action is limited to monitoring VNG (currently Matheson Valley) property annually to confirm the absence or presence of water supply wells or plans to install such wells. Any use or planned use of ground water will be reported to the EPA. However, to be further protective of the environment, Bettis Laboratory developed plans and, in October 2010, constructed the flow separator after obtaining PADEP concurrence that this action is an acceptable alternative measure to collection and treatment that also precludes the offsite migration of sediment.

In November 2011, the EPA issued a revision to the 1997 FDRTC (Reference (9)). The purpose of the revision to the FDRTC was to codify the new remedy for the IWS that included contacting Matheson Valley annually to confirm the absence or presence of water supply wells and/or plans for installation of such wells. The revised FDRTC also included deleting two remedy components identified in the 1997 FDRTC. Specifically, these components included deleting the construction of a groundwater treatment system and terminating periodic monitoring of water and sediments in the runoff area below the IWS. These remedy components were deleted following the installation of the flow separator that was completed in October 2010.

Bettis completed the final corrective action of the CMIO, the enhanced soil vapor extraction at the Bettis Landfill, in September 2012. Some corrective actions within the CMIO require the continuation of environmental monitoring and maintaining administrative controls.

On August 21, 2013, the EPA issued a Permit for Corrective Action under RCRA for the Bettis Laboratory that maintains these requirements. All other CMIO required actions have been completed.

On September 11, 2013, the EPA concluded that that all the terms of the 2001 CMIO had been satisfied and issued a letter terminating the agreement between the EPA and the Bettis Laboratory (Reference (5)).

6.0 MONITORING PROGRAMS

Bettis Laboratory maintains a comprehensive environmental monitoring program covering all aspects of Bettis Laboratory operations. This program includes routine environmental monitoring of outfalls and of the Bull Run and Northeast Area streams, including sediment and vegetation, gaseous and particulate airborne effluents, sanitary effluents, ground water, and environmental radiation levels. Evaluation of the environmental data indicates that the operation of the Bettis Laboratory site continues to have no significant effect on the environment. The program is described in detail in the annual environmental monitoring reports. In addition to the routine monitoring, Bettis Laboratory has conducted extensive special monitoring of areas of the site potentially affected by chemical and radiological residues. Examples of special monitoring efforts are described in the following sections.

6.1 Aerial Radiation Survey

Convincing evidence that Bettis Laboratory does not represent a significant radiological problem comes from the results of an aerial radiation survey of the site and the surrounding areas, conducted in July 1983. The aerial radiation survey over the Bettis Laboratory site covered a 100 square mile area. The survey area included West Mifflin, McKeesport, and other nearby communities. The results of the survey for the Bettis Laboratory site indicated radiation readings of background with the exception of minor elevations of the readings in the immediate vicinity of the buildings where radiological work is undertaken. No changes in radiological conditions have occurred at the site that would affect the conclusion of the 1983 aerial survey.

6.2 Ground Water Monitoring

There are no wells or springs onsite or in the local, hydraulically downgradient area which are known to be used for drinking water, industrial, or irrigation purposes. Nonetheless, Bettis Laboratory monitors the ground water under the site to determine what, if any, effects the operations at the site have had on the quality of the ground water. Although this program has involved the installation of over 100 ground water monitoring wells, wells that are no longer needed for monitoring have been removed. As of 2016, 36 wells remain to support ongoing monitoring. Selected wells and various springs onsite are monitored for both chemical and radiological parameters. A portion of the chemical monitoring program has been incorporated in the Corrective Measures Implementation Order (CMIO) Environmental Protection Agency Permit for Corrective Action which requires routine environmental monitoring. These analyses are used to evaluate the impacts on the ground water. The results of the ground water monitoring are discussed in Section 5.2.4.

7.0 ASSESSMENT OF HUMAN HEALTH IMPACTS

The impact of Bettis Laboratory operations on the environment can be assessed separately in terms of radioactive and non-radioactive effects. The annual environmental monitoring reports show that Bettis Laboratory operations have no adverse effect on the environment around the site or the general public.

7.1 Radiological Assessment

Bettis Laboratory monitors discharges of radioactivity to the environment from the site in liquid and airborne effluents. Effluent discharges of radioactivity have been at levels below limits prescribed by applicable Federal, State, and local authorities.

The Bettis Laboratory has never maintained a radioactive waste burial ground. However, activities in the past have resulted in small amounts of radioactive material deposited in localized areas of soil onsite. There are five primary locations onsite where such releases occurred: Inactive Waste Isolation Pit, N-Building Monitor Tank Room, Waste Processing Storage Pad, Inactive Waste Site, and the headwaters of the Bull Run Stream Basin. Bettis Laboratory is continuing with a program to monitor and, where appropriate, clean up and remove those structures and adjacent soil where the radioactivity exists. At the present time, the estimated total quantity of manmade radioactivity in the soil at the Bettis Laboratory site is less than 72 curies, which is no more than the amount of naturally occurring radioactivity in the top 2 feet of soil in a local area the size of the Bettis Laboratory site. Most of this radioactivity is located under structures where it is inaccessible.

The comprehensive site radiation monitoring program, which is described in the annual environmental monitoring report, shows that the radiation dose to persons offsite is too small to be measured. Bettis Laboratory has employed calculational techniques that conservatively estimate potential exposures. These calculational techniques consider inhalation, ingestion, and direct radiation exposure pathways. The most recent assessment for 2016 shows that the maximum potential radiation exposure to a member of the public was less than 0.002 Rem for the entire year. The calculations also show that in previous years, the annual radiation exposures to people living adjacent to the Bettis Laboratory were well below the annual regulatory limits.

7.2 Non-Radiological Assessment

Regarding non-radiological environmental effects, Bettis Laboratory monitors effluent water, ground water, sanitary discharges, sediment, and surface water to ensure that they meet the requirements of applicable Federal and State environmental standards.

Hazard ranking calculations done in accordance with guidelines for judging the significance of waste areas containing chemical and radioactive residues have been conducted in accordance with Federal law (see Reference (1)). The calculation concludes that the Bettis Laboratory site scores well below the values which would make the site a candidate for placement on the National Priority List. The calculations and supporting documentation have been reviewed by the Environmental Protection Agency (EPA) who assigned a hazard ranking score of zero. The EPA concluded that no action was required under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

A site-specific risk assessment was prepared as part of the Final RCRA Facility Investigation (RFI) Report. This assessment was prepared using the Superfund related methodology outlined in Reference (10). The detailed assessment, presented in the Final RFI Report (Reference (2)), is summarized below.

The objective of the assessment was to determine the reasonable maximum exposure of onsite and offsite populations to environmental contamination at the site. The media containing chemical residues are soil, ground water, surface water (springs and streams), and sediment. Residues whose concentrations exceeded the EPA Region III risk-based screening levels were evaluated. The main residues evaluated were certain volatile organic compounds, polychlorinated biphenyls, and polynuclear aromatic hydrocarbons.

Risks were evaluated for present and future realistic industrial land-use scenarios. EPA exposure default parameters were used for offsite commercial/industrial workers. Site-specific exposure parameters were used for pathways where standard EPA values were not available or were not appropriate. All exposure pathways judged to be complete now and in the future were quantified. Ground water exposure was not quantified because the onsite and offsite populations that are hydrologically downgradient receive municipal water and this is unlikely to change for the foreseeable future because the municipal water supply is convenient, reliable, and safe.

The risk assessment quantified carcinogenic risk and noncarcinogenic hazard for four potentially exposed populations:

- Onsite construction workers exposed to chemical residues in soil;
- Offsite commercial/industrial workers exposed to chemical residues in soil;
- Trespassing children exposed to chemical residues in water and sediments in springs and streams; and
- Offsite children exposed to chemical residues in water in a spring and sediment in a stream.

Based on EPA criteria, the calculated carcinogenic risk and non-carcinogenic hazard values were compared with the values of 1.0×10^{-6} and 1.0, respectively, which represent acceptable screening risk levels. The non-carcinogenic hazard value of 1.0 indicates that overall non-carcinogenic hazards are not of concern. Remedial actions are generally not required until the hazard value exceeds 10.0.

In summary, the risk assessment concluded chemical residues in the environment at the site do not pose significant health risks to potentially exposed populations using reasonable maximum exposure assumptions. The assessment concluded that chemical residues in the environment at the site did not pose significant health risks to potentially exposed populations using “reasonable maximum exposure” assumptions. The only study area where the carcinogenic risk estimate exceeded the EPA screening criterion of 1.0×10^{-6} (one chance in a million) was a small area of soil in a drainage ditch below the IWS, with a maximum carcinogenic risk of about 2.0×10^{-5}. However, an individual must be exposed (skin contact, ingestion, and inhalation) for 250 days/year for 25 years to achieve this risk. This risk is highly conservative because the area is rarely accessed. In reality, the risk of personnel exposure to the chemical residues in the drainage ditch area is far less than 1.0×10^{-6}. Non-carcinogenic risks were all significantly less than the comparison criteria of 1.0. The ongoing routine monitoring program continues to confirm that these conditions and conclusions have not changed.

The Bettis Laboratory will continue actions to preclude any impact on the environment from the remaining residual chemical and radioactive materials at the site in accordance with Federal, State, and Department of Energy requirements.

8.0 AUDITS AND REVIEWS

The Bettis Laboratory uses training, surveillances, controls, checks and cross-checks, audits, and inspections of numerous kinds to maintain high standards of environmental control. Examples include:

- Each worker is specially trained in the appropriate controls as they relate to their job.
- Written procedures must be followed in many cases.
- Supervisors oversee environmental monitoring and related work.
- Engineering and environmental staff are available to assist area personnel.
- Bettis Laboratory maintains an independent audit program that covers environmental requirements and includes in-depth audits of specific areas.
- The Naval Nuclear Propulsion Program (NNPP) maintains an onsite resident office with a technical staff that reports directly to the Director, NNPP in Washington, D.C. Several personnel in this office are assigned full time to audit and review environmental controls. NNPP headquarters personnel also conduct periodic in-depth inspections of these areas.

In addition to the above controls, various aspects of the Bettis Laboratory environmental program are reviewed by other Government agencies. For example, both the Pennsylvania Department of Environmental Protection (PADEP) and the Environmental Protection Agency (EPA) have conducted onsite inspections of Resource Conservation and Recovery Act (RCRA) programs as illustrated by Table 1. None of these EPA, State, or local inspections has ever detected a significant item of non-compliance in operations; minor shortcomings have been noted and have been corrected.

In December 2000, the Bettis Laboratory was selected to receive a year 2000 Pennsylvania Governor's Award for Environmental Excellence. The Bettis Laboratory was recognized for its achievements in the areas of pollution prevention and environmental protection. The Bettis Laboratory implemented an integrated pollution prevention program that reduces the sources of waste, encourages conservation, and promotes recycling to achieve significant reductions in solid waste, and air and water emissions. Examples of the environmental benefits of the pollution prevention program are the recycling of 491 tons of waste material in one year and the annual reduction of 89 million gallons of water usage.

The Bettis Laboratory was a contributing member to an Oak Ridge team that received a White House Closing the Circle Award in the Recycling Category for Oak Ridge's Electronic Recycle Program. The Bettis Laboratory, along with other Department of Energy (DOE) facilities, participated in an Oak Ridge program that accepted computer equipment for recycling. The Oak Ridge National Recycling Center refurbishes electronics for resale or recycles the basic components, such as precious metals, copper, steel, aluminum, plastic, and glass for profit.

TABLE 1
ENVIRONMENTAL INSPECTIONS OF THE BETTIS LABORATORY SITE (2007-2016)

TOPIC	DATE	AGENCY	DATE	AGENCY
RCRA	June 15, 2007 March 26, 2008 August 21, 2008 June 18, 2009 June 17, 2010 September 23, 2011	PADEP EPA/PADEP PADEP PADEP PADEP PADEP	August 23, 2012 August 28, 2013 August 21, 2014 August 27, 2015 September 27, 2016	PADEP PADEP PADEP PADEP PADEP
Asbestos	May 29, 2007 August 9, 2007 January 30, 2008 April 30, 2008 November 6, 2008 December 2, 2008 December 23 2008 February 5, 2009 May 27, 2009 (2) June 29, 2009 September 29, 2009 December 15, 2009 (2) October 27, 2010 (2) February 18, 2011 April 1, 2011 April 26, 2011 (2) August 22, 2011 September 12, 2011 October 19, 2011 November 23, 2011 (2) April 2, 2012	ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD	August 17, 2012 August 23, 2012 (2) September 4, 2012 December 4, 2012 May 15, 2013 June 11, 2013 June 21, 2013 June 28, 2013 July 10, 2013 July 17, 2013 August 23, 2013 February 13, 2014 January 15, 2015 February 23, 2015 April 9, 2015 June 4, 2015 June 29, 2015 (2) July 23, 2015 August 12, 2015 May 2, 2016 December 27, 2016	ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD ACHD
NPDES	June 6, 2007 February 6, 2008 March 12, 2008 March 26, 2008 December 19, 2012	PADEP PADEP PADEP PADEP ACCD	June 20, 2013 October 21, 2013 August 20, 2014 October 12, 2016	PADEP ACCD PADEP ACCD
Air	December 17, 2007 December 19, 2008	ACHD ACHD	April 15, 2009 May 21, 2009	ACHD ACHD
Underground Storage Tank	July 20, 2009	PADEP*	June 29, 2012 May 28, 2015	PADEP* PADEP*
EPA Region III Federal Facility Coordinator Site Inspection	December 14, 2016	EPA		

NOTES: When more than one inspection was performed, the number of inspections is shown in ( ).

EPA - U.S. Environmental Protection Agency
PADEP - Pennsylvania Department of Environmental Protection
ACHD - Allegheny County Health Department
ACCD – Allegheny County Conservation District

* Inspection was performed by a PADEP certified inspector and the results were submitted to the PADEP.

9.0 REGULATORY MATTERS

The Bettis Laboratory always responds promptly and effectively to meet new Federal, State, and local requirements. Bettis Laboratory maintains a program to review changes in regulatory requirements to ensure operations remain in compliance with applicable laws and regulations.

National Environmental Policy Act

This Act establishes policies and procedures for evaluating the impact of human activities on the environment. These evaluations are intended to help public officials and citizens make decisions that are based on an understanding of the environmental consequences of a proposed project and to take actions that protect, restore, and enhance the environment. All Federal agencies are required to give appropriate consideration to the environmental effects of their proposed project. At Bettis Laboratory, all major construction projects are evaluated to determine their effects on the environment. In addition, any physical construction project or capital equipment that has the potential for creating new emissions to the environment receives a National Environmental Policy Act evaluation.

Resource Conservation and Recovery Act (RCRA)

This Act establishes requirements for the proper treatment, storage, and disposal of chemically hazardous wastes. Currently, the Bettis Laboratory operates in accordance with its Hazardous Waste Storage Permit which was initially issued by the Pennsylvania Department of Environmental Protection (PADEP) in February 1995 and renewed in February 2006. A permit renewal application was submitted to the PADEP in August 2015. The Hazardous Waste Storage Permit includes specific details regarding operations and management practices for safe control and storage of hazardous and mixed wastes.

During 1990, a Consent Order issued under Section 3008(h) of RCRA was signed by the Pittsburgh Naval Reactors Office (now known as the Naval Reactors Laboratory Field Office – NRLFO) and the Environmental Protection Agency (EPA). Following approval of the RCRA Facility Investigation and Corrective Measures Study Reports, the EPA terminated the Consent Order in 1997. Corrective measures negotiations began in 2000 and a Corrective Measures Implementation Order (CMIO) was established in April 2001. Bettis completed the final corrective action of the CMIO in September 2012. Some corrective actions within the CMIO require the continuation of environmental monitoring and maintaining administrative controls. On August 21, 2013, the EPA issued a Permit for Corrective Action under RCRA for the Bettis Laboratory that maintains these requirements. All other CMIO required actions have been completed. On September 11, 2013, the EPA concluded that that all the terms of the 2001 CMIO had been satisfied and issued a letter terminating the agreement between the EPA and the Bettis Laboratory (Reference (5)). Details of the requirements and compliance status of the Consent Order and CMIO are provided in Section 5.3.2.

Federal Facility Compliance Act

This Act requires the Department of Energy (DOE) to prepare Site Treatment Plans to address treatment of mixed radioactive and hazardous waste for each DOE site which generates and stores mixed waste. These plans were approved by the states (or the EPA in cases where the State has not been delegated authority to regulate mixed waste). The Bettis Laboratory Site

Treatment Plan was provided to EPA Region III and was approved by the EPA in October 1995. In November 2000, the EPA granted Pennsylvania authority to regulate mixed waste. In September 2001, the PADEP issued a revised hazardous waste storage permit to the Bettis Laboratory incorporating the relevant requirements of the Federal Facility Compliance Act. This permit was renewed in February 2006. A permit renewal application was submitted to the PADEP in August 2015.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

This Act, commonly known as Superfund, establishes requirements for the identification of areas where hazardous materials may be present in the environment and for the evaluation of possible risks from these contaminants to the public health and the environment. Bettis Laboratory has prepared and submitted to the EPA and the Commonwealth of Pennsylvania the documentation concerning such areas at the site (discussed in Section 5.3.2) as required by CERCLA (Reference (1)). The submittal included hazard ranking calculations conducted in accordance with EPA methods. The ranking calculation concluded that the Bettis Laboratory site scored well below the value that could place the site on the National Priority List. The EPA reviewed the submittal and assigned a hazard ranking score of zero and concluded that no further action was required under CERCLA.

Superfund Amendments and Reauthorization Act (SARA)

This Act, more commonly known as SARA, is a five-year extension of the programs established under Superfund (CERCLA) to clean up hazardous releases at past hazardous waste sites. In addition, SARA created a separate fund for the cleanup of leaking underground petroleum storage tanks and defined a new regulatory program known as the Emergency Planning and Community Right-to-Know Act. As part of the requirements of Emergency Planning and Community Right-to-Know Act, the Bettis Laboratory submits details on the amounts, locations, and potential health hazards associated with onsite hazardous materials to State and local emergency planning groups.

Clean Air Act

This Act, as amended in 1990, established requirements for the control of air emissions. The regulations promulgated pursuant to the Clean Air Act also govern use of ozone depleting substances, the use and removal of asbestos containing materials, and the emission of radionuclides to the environment. For the Bettis Laboratory site, most of the non-radiological air programs are administered by the Allegheny County Health Department (ACHD) through its Article XXI regulations. In 1995, the Bettis Laboratory submitted an Air Pollution Operating Permit application in accordance with updated Clean Air Act and ACHD requirements. A permit renewal application was submitted to the ACHD in December 2010. Required installation permits have been obtained from the ACHD and notifications of facility upgrades and equipment changes provided to the ACHD, as appropriate. Radiological air emissions at the Bettis Laboratory are monitored and reported annually to the EPA in accordance with the requirements of the National Emission Standards for Hazardous Air Pollutants.

Clean Water Act

The Clean Water Act requires facilities that discharge pollutants to navigable waters to obtain authorization for their discharges by acquiring a National Pollutant Discharge Elimination System (NPDES) permit. NPDES permits specify the discharge limitations and monitoring requirements for selected parameters in a facility's effluents. The Bettis Laboratory site received its first NPDES permit, which was issued by the Commonwealth of Pennsylvania, in 1977. The site NPDES permit has been renewed several times and currently covers six outfalls. One outfall discharges storm water, process water, and once-through non-contact cooling water. Four outfalls discharge only storm water. Another outfall discharges treated ground water from the Springwater Intercept System that is operated in accordance with a 1999 Consent Order and Agreement established with the PADEP. In addition, a separate NPDES general permit has been obtained to discharge stormwater from a sedimentation pond constructed for the upgrade of the site parking lot and other construction projects.

Other Laws and Regulations

Bettis Laboratory also operates in compliance with other Federal, State, and local environmental regulations. Bettis complies with the National Historic Preservation Act. The polychlorinated biphenyl program onsite is managed in accordance with the Toxic Substances Control Act. Compliance with Commonwealth of Pennsylvania laws and regulations that regulate waste, water, and tanks is also maintained. Discharges of domestic wastes to the sanitary sewer system are regulated by the West Mifflin Sewer Municipal Authority under West Mifflin Borough Resolution 69-02 and compliance is demonstrated by periodic sampling.

REFERENCES

(1) Preliminary Assessment and Site Inspection Report for the Bettis Atomic Power Laboratory, Revision 1, January 1990.

(2) Final Resource Conservation and Recovery Act Facility Investigation (RFI) Report for the Bettis Laboratory, West Mifflin, Pennsylvania, June 1994.

(3) Final Corrective Measures Study (CMS) Report for the Bettis Laboratory, West Mifflin, PA, January 1995.

(4) Approval of Certification of Completion/Corrective Measures Completion Report Letter dated February 19, 2013

(5) *Termination of 2001 Corrective Measures Implementation Order,* Armstead, J. A., U. S. Environmental Protection Agency, September 11, 2013

(6) Nuclear Regulatory Commission. “Standards for Protection Against Radiation.” *Code of Federal Regulation.* Title 10, Part 20.

(7) Title 40, Code of Federal Regulations, Part 141, *National Primary Drinking Water Regulations.*

(8) EPA Letter ZMaldonado to U.S. Department of Energy, dated October 3, 1997

(9) Decision and Response to Comments dated November 10, 2011

(10) Risk Assessment Guidance for Superfund (RAGS) Volume I (Part A), Human Health Evaluation Manual, USEPA, 1989.

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