ENVIRONMENTAL REPORT

CHAPTER 6

ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

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6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

6.1 THERMAL MONITORING

{This section presents the pre-application, construction and pre-operational, and operational thermal monitoring programs for the proposed new unit near the existing site of the Susquehanna Steam Electric Station (SSES) Units 1 and 2. The new unit is referred to as Bell Bend Nuclear Power Plant (BBNPP). The objective of thermal monitoring during each phase is to comply with State and Federal water quality criteria and regulations and to protect aquatic life within the area of influence of the BBNPP.

Pertinent BBNPP site and plant features, including boundaries and bathymetry of all water bodies adjacent to the site, are described in Section 2.3.1. The thermal monitoring stations are shown in Figure 6.1-1. Additional information related to field water temperature measurement and data analysis is described in Section 2.3.3. Hydrological and ecological monitoring are described in Section 6.3 and Section 6.5. The extent of the predicted thermal plume is described in Section 5.3.2.1.

Temperature monitoring is described in each subsection below, corresponding with the pre-application, construction and pre-operational, and operational phases of the project. Existing and planned monitoring equipment is similarly described below.

Thermal program acceptance criteria are based on relevant Federal, State, and local requirements. Consultation with the Pennsylvania Department of Environmental Protection (PADEP) has been initiated and will continue throughout pre-application, construction and pre-operational, and operational phases of the project. PADEP will issue the facility a NPDES discharge permit prior to operation.}

6.1.1 PREAPPLICATION MONITORING

{Preapplication thermal monitoring for BBNPP consists of past and present thermal monitoring activities conducted for SSES (PP&L, 1972). SSES Unit 1 began commercial operations in June 1983 and Unit 2 in February 1985. More than 24 years of monitoring activities associated with the existing plant establishes the basis for the thermal description and baseline water temperature conditions for BBNPP.

Data collected prior to the construction of SSES Units 1 and 2 were used to design the cooling water systems to achieve rapid dispersion of effluents and to minimize water temperature variations in the area of plant influence.

Temperature measurements continue to be taken as part of an ongoing water quality monitoring program for the Susquehanna River. Ecology III, Inc. on behalf of SSES Environmental Laboratory records river temperatures on a daily basis at the SSES Environmental Laboratory, and also monitors the cooling water discharge and the river upstream and downstream of the SSES discharge for temperature, among other water quality parameters, on a quarterly basis. Results from the monitoring program are reported in Ecology III, 1987; Ecology III, 1995; Ecology III, 2005; Ecology III, 2007a; Ecology III, 2007b. The locations of the existing temperature monitoring stations are shown on Figure 6.1-1. Bathymetry characteristics adjacent to the existing SSES and proposed BBNPP intake structures and discharge outfalls are described in Section 2.3.1.

The existing SSES plume was determined to have limited downstream temperature impact (Ecology III, 1987). Spring, fall, and winter studies were completed that measured the temperature and downstream extent of the thermal increase. During these studies the maximum increase above ambient temperatures within the plume ranged from 0.5 to 1.0 °F (0.3 to 0.6 °C) and the plume extent varied from 25 to 130 ft (7.6 to 40 m) downstream from the diffuser pipe. The study indicated that river flow, not discharge temperature increase above ambient, was the most important determinant of the temperature and areal extent of the plume (Ecology III, 1987). SSES is not currently required as a condition of its NPDES permit to monitor the plant's cooling water discharge for temperature.

As discussed in Section 5.3.2.1, modeling of the BBNPP discharge was performed to predict the temperature gradient and downstream extent of the plume. The modeling effort evaluated the maximum possible size of the plume during winter and summer flow scenarios. To accomplish this, summer and winter low and average flow conditions and extreme water temperatures were inputs to the model. The model indicated that within the near-field plume, the discharge temperature decreased quickly to very small values above ambient river temperature due to rapid mixing.}

6.1.2 PREOPERATIONAL MONITORING

{Pre-operational thermal monitoring will be a continuation of the pre-application monitoring program. Thermal monitoring data collected during the pre-operational monitoring program will supplement pre-application monitoring data and further serve to establish baseline river water temperature conditions for comparative purposes in assessing potential environmental impact from new plant operations. Preoperational monitoring will be conducted during BBNPP site preparation and construction.

Construction related discharges will consist mainly of drainage that collects in sumps at the bottom of excavations, which will be pumped to a storm water discharge point, storm water associated with construction activities, and hydrostatic test waters. Therefore, no thermal discharges associated with the BBNPP are expected during the preoperational monitoring program.

The PADEP will be notified of pending construction activities and approval of storm water management and erosion/sediment control plans will be obtained in accordance with the NPDES Construction General Permit as described in Section 1.3.

Refer to Section 4.2.1 for anticipated bathymetric characteristics of the Susquehanna River adjacent to the BBNPP site following construction activities.}

6.1.3 OPERATIONAL MONITORING

{Thermal monitoring will continue during operation of BBNPP to assess water temperature changes associated with effluents from the new plant.

BBNPP requires water for cooling and operational uses. Cooling water for the turbine condenser and closed cooling heat exchanger for normal plant operating conditions is provided by the Circulating Water System (CWS). The excess heat from the CWS is dissipated to the environment through a closed loop cooling system. A closed loop cooling system recirculates water through the plant components and cools this water for reuse by transferring excess heat to the atmosphere with a cooling tower. The cooling system for BBNPP will be a closed-cycle, wet

cooling system, consisting of two natural draft cooling towers for heat dissipation. The existing SSES Units 1 and 2 also use a closed loop cooling system, each with a natural draft cooling tower.

BBNPP will also have four smaller Essential Service Water System (ESWS) cooling towers to dissipate heat from safety-related systems. The ESWS provides cooling water to the Component Cooling Water System heat exchangers and the cooling jackets of the Emergency Diesel Generators. Makeup water is normally provided to the ESWS cooling towers from the plant Raw Water Supply System (RWSS), but can also be supplied on an emergency basis from the Essential Service Water Emergency Makeup System (ESWEMS) Retention Pond via the ESWEMS makeup water pumps.

Blowdown from the CWS cooling tower and the ESWS cooling towers will collect in a retention basin where some of the water's heat will be released to the atmosphere and surrounding media prior to entering the final discharge pipe. Additional heat will also be transferred to piping and the surrounding environs during its passage to the discharge outfall.

Pennsylvania provides temperature criteria that designate water use and set temperature guidelines for water bodies within the Commonwealth (PA, 2007). The guidelines provide maximum allowable temperatures for critical periods during the year and state that a discharge may not change the temperature of the receiving water body by more than 2 °F (1.1 °C) during a one-hour period.

Based on modeling results of the location of the diffuser discharge, the BBNPP thermal plume is predicted to be similar to the existing SSES thermal plume. Based on its location, the BBNPP plume will likely have limited interaction with the SSES plume. The BBNPP discharge system and the associated characteristics of the associated thermal plume configuration, size, and interaction with SSES are described in greater detail in Section 5.3.2.1. The thermal effects of the BBNPP cooling water discharge will be minimized by the installation of a closed cooling system for BBNPP, as detailed in Section 3.4, due to the reduced output temperature and reduced outfall volume inherent in a closed-cycle system versus a once-through system which will reduce the size and persistence of the thermal plume. Discharge effects have been studied at SSES and provide a basis for assessing the potential ecological impacts of the BBNPP discharge (Ecology III, 1995, 2005, 2007a, 2007b). As discussed in Section 5.3.2.2, the effects of the BBNPP discharge are anticipated to be similar to the SSES discharge. The existing SSES discharge will be used to gauge and evaluate the potential for impacts to result from the BBNPP discharge.

The extent and duration of the operational monitoring program will conform to the requirements of the NPDES permit issued for the new plant, and are expected to be similar to the existing program for SSES. Water temperatures from new plant discharges will meet applicable federal and state environmental regulatory requirements.}

6.1.4 REFERENCES

{**Ecology III, 1987**. Thermal plume studies in the Susquehanna River at the discharge diffuser of the Susquehanna Steam Electric Station, 1986-1987. Prepared for PP&L.

Ecology III, 1995. Environmental Studies in the vicinity of the Susquehanna Steam Electric Station, 1994 Annual Report. Prepared for PPL Susquehanna, LLC.

Ecology III, 2005. Environmental Studies in the vicinity of the Susquehanna Steam Electric Station, 2004 water quality and fishes. Prepared for PPL Susquehanna, LLC.

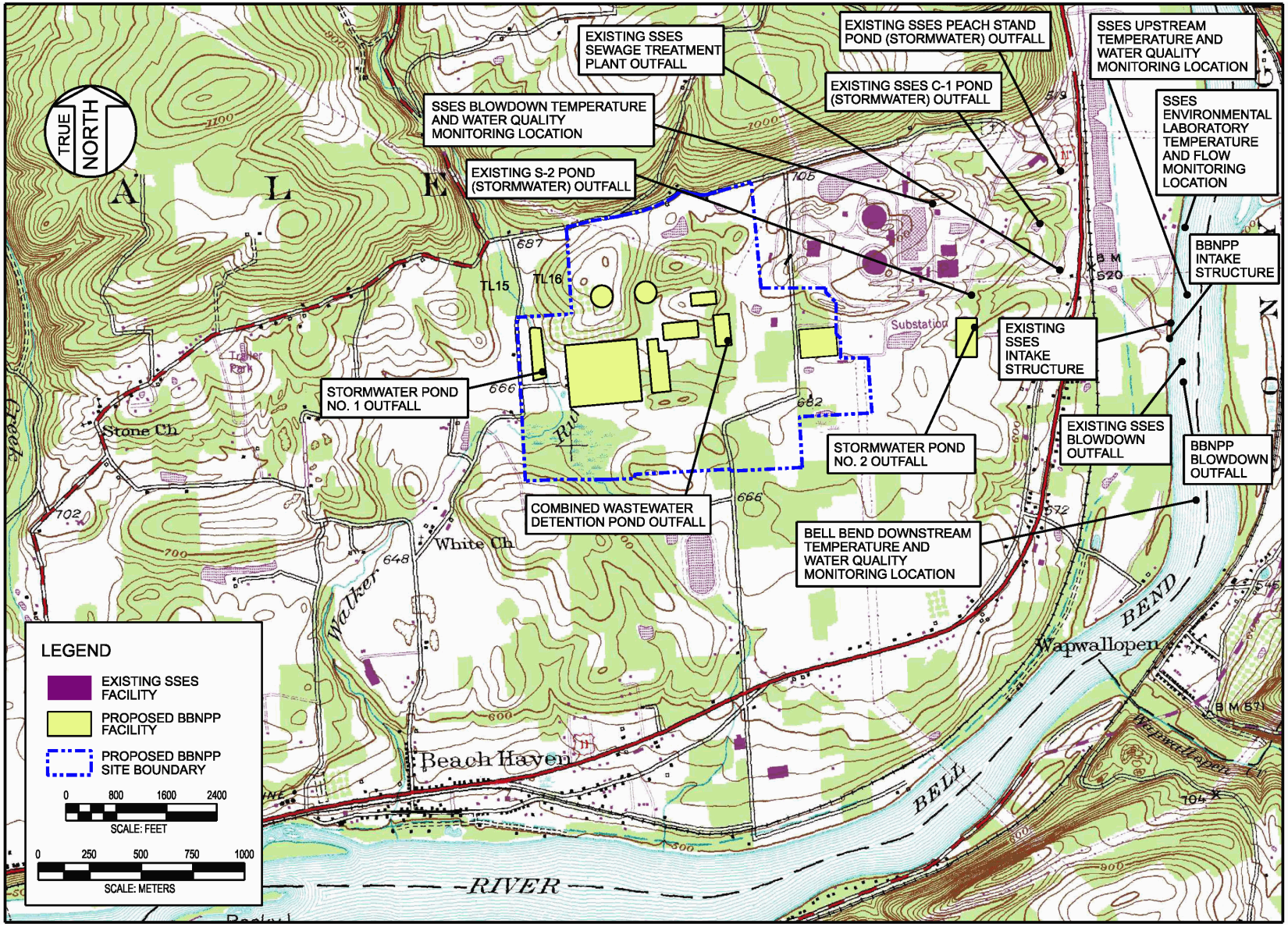
Ecology III, 2007a. Environmental Studies in the vicinity of the Susquehanna Steam Electric Station, 2005 water quality and fishes. Prepared for PPL Susquehanna, LLC.,

Ecology III, 2007b. Environmental Studies in the vicinity of the Susquehanna Steam Electric Station, 2006 water quality and fishes. Prepared for PPL Susquehanna, LLC., July 2007.

PA, 2007. Pa Code § 93.7, Specific Water Quality Criteria, Amended January 5, 2007, Website: http://www.pacode.com/secure/data/025/chapter93/s93.7.html, Date accessed: May 15, 2008.

PP&L, 1972. Pennsylvania Power and Light Company. Susquehanna Steam Electric Station, Applicant's Environmental Report, Revised, July 1972.}

Figure 6.1-1 {Existing SSES and Proposed BBNPP Discharge and Temperature Monitoring Stations}



6.2 RADIOLOGICAL MONITORING

{This section describes the objectives, basis, content, reporting and quality assurance aspects of the site area Radiological Environmental Monitoring Program (REMP) which includes the Susquehanna Steam Electric Station (SSES) Units 1 and 2 and the new Bell Bend Nuclear Power Plant (BBNPP). The BBNPP REMP will build upon the existing SSES program where sample types, locations, collection frequencies, and analysis requirements are consistent with satisfying the program requirements (such as objectives, basis, and reporting) that are identified for BBNPP. The BBNPP REMP is considered a separate program from that administered by the SSES, even though many of the program elements are shared between operating entities on the SSES units and the BBNPP. The existing REMP for the SSES site covers the entire Susquehanna and BBNPP site and environs surrounding the site and will be used to provide baseline information in support of the pre-operational phase of BBNPP (SSES, 2005)(SSES, 2007).

The pre-operational monitoring program for SSES Units 1 and 2 was implemented in April, 1972 (SSES, 2007). SSES Unit 1 achieved criticality on September 10, 1982. SSES Unit 2 achieved criticality on May 4, 1984 (SSES, 1984). Results of the existing monitoring program for both the pre-operational and operational periods to date have been reported to the Nuclear Regulatory Commission (NRC) in a series of annual reports. Annual reporting of REMP activities, detected radioactivity, trends, and plant related impacts will continue through the construction and operation of BBNPP and will cover the influence of all three units in a series of annual reports entitled "Annual Radiological Environmental Operating Report (AREOR)". The BBNPP REMP will be initiated at least two years prior to the plant's first criticality.

The objectives of the REMP for the existing SSES Units 1 & 2 are (SSES, 2007):

a. To implement the REMP in accordance with Technical Specifications, Technical Requirements Manual, and the Offsite Dose Calculation Manual, which are based on the design objectives in 10 CFR Part 50 Appendix I, Sections IV.B.2, IV.B.3, and IV.C (CFR, 2008). The REMP supplements the results of the radioactive effluent-monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation in the environment are not higher than expected on the basis of the effluent measurements and modeling of the environment in the vicinity of the site.
b. Document compliance with REMP requirements.
c. Verify proper implementation of station radiological effluent controls.
d. Identify, measure, and evaluate trends of radionuciide concentrations in environmental pathways near the station.
e. Assess the impact of station effluents on the environment and the public.

These same objectives are applied to the design and operation of the BBNPP Radiological Environmental Monitoring program which provides for a site area wide compatibility between the existing SSES program and the addition of the BBNPP.

The SSES monitoring program was originally developed based on the guidance from the NRC's Radiological Assessment Branch Technical Position on radiological environmental monitoring, as described in Revision 1, November 1979 (NRC, 1979b). The current environmental monitoring sampling program is consistent with the guidance provided in standard radiological effluent

technical specifications as described in NUREG-1301 (NRC, 1991) and Regulatory Guide 4.1 (NRC, 1975). The Radiological Environmental Monitoring Program (REMP) for BBNPP was designed following the same guidance criteria in NUREG-1301, Table 3.12-1, including, when consistent with the guidance criteria, the current REMP sampling conducted by SSES Units 1 and 2. The justification for the selection of sample media, locations and collection frequencies that make up the REMP is based on the need to provide representative measurements of radiation and radioactive materials in those exposure pathways and for those radionuclides that could lead to radiation exposure of Members of the Public resulting from plant operations. The REMP implements Section IV.B.2 of Appendix I to 10 CFR Part 50 (CFR, 2008) and thereby supplements the Radiological Effluent Monitoring Program by verifying that measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of effluent measurements and modeling of the environmental exposure pathways. Table 6.2-1 identifies the exposure pathways to be sampled and the types of radiological monitoring and sample media that are included in the REMP. The exposure pathways to be sampled along with the sampling frequency or collection duration and a description of the sampling location requirements are provided in Table 6.2-2 for the existing SSES Units 1 and 2 REMP and Table 6.2-4 for BBNPP. Table 6.2-3 and Table 6.2-5 give specific sampling locations for both the existing REMP (i.e., SSES Units 1 and 2) and for BBNPP. On-site ground water monitoring locations near BBNPP are provided for early detection of liquid leaks from the plant. Sample sizes for the different types of environmental media are based on commercial counting laboratory standard collection protocols which insure that Lower Limits of Detection (LLD) requirements as shown on Table 6.2-7 can be routinely achieved. Table 6.2-6 indicates the detection levels for different environmental media which if reached will result in a report to the NRC of high radioactivity detected in the environs near the facility. Table 6.2-8 provides typical sample sizes for various environmental media.

Expected changes to the existing SSES Unit 1 and 2 REMP to reflect the addition of BBNPP and changing monitoring requirements are noted in Sections 6.2.7 and 6.2.8.}

6.2.1 PATHWAYS MONITORED

{Environmental exposure pathways to man resulting from BBNPP radiological effluents are described in Section 5.4.1. These are the same environmental pathways that apply to effluents from SSES Units 1 and 2. Radioactive liquid pathways include internal exposure due to the ingestion of aquatic foods (fish) and external exposure due to recreational activities on the shoreline and in the water (boating, and swimming if it occurs). Radioactive gaseous pathways include external exposure due to immersion in airborne effluents and exposure to a deposited material on the ground plane. Internal exposures result from the ingestion of food products grown in areas under the influence of atmospheric releases, and inhalation from airborne effluents. In addition, direct radiation exposure from the facility structures is also considered a potential pathway. The REMP for all three units will be designed to evaluate detectable levels of radioactive materials in environmental media associated with these exposure pathways.

The relationship between exposure pathways and environmental media included in the existing SSES Units sampling program are shown in Table 6.2-1 and are applicable to BBNPP.

The exposure pathways being monitored are listed in Table 6.2-2 and Table 6.2-3 for the existing REMP. These same pathways and monitoring locations will be applied to the BBNPP REMP for sample locations identified in Table 6.2-5. Changes to the program from the existing site REMP are noted in Section 6.2.7.}

6.2.2 LAND USE CENSUS

{A Land Use Census for the BBNPP site area is conducted during the growing season at least once every 12 months as committed to in the Offsite Dose Calculation Manual (ODCM)}. The Land Use Census is conducted to identify the following within five (5) miles of the plant in each of the sixteen (16) meteorological sectors:

- The nearest milk animal,
- The nearest residence, and
- The nearest garden of greater than 500 ft^2 (50 m^2) producing broad leaf vegetation.

The purpose of the Land Use Census is to identify needed changes in the Radiological Environmental Monitoring Program. This ensures that sampling locations associated with media that have the highest dose potential are included in the REMP as changes in land use patterns occur over time. The implementation of the land use census satisfies the requirement of 10 CFR Part 50, Appendix I (CFR, 2008).

6.2.3 ENVIRONMENTAL MONITORING PROGRAM SAMPLE TYPES

6.2.3.1 Direct Radiation Monitoring

{Radiation exposure occurs by immersion in radionuclides present in the atmosphere, deposited on the ground, or via direct shine from fixed sources such as an Independent Spent Fuel Storage Installation (ISFSI). Thermoluminescent dosimeters (TLDs) are used to measure ambient gamma radiation levels at many locations surrounding the existing units and will be extended to include locations near the BBNPP site boundary for each of the 16 compass sectors. Current locations for SSES Units 1 and 2 are shown in Table 6.2-3 and Figure 6.2-1 through Figure 6.2-3. Table 6.2-4 describes the direct radiation measurement criteria applied to both the pre-operational and operational REMP specific to BBNPP. BBNPP TLD Monitoring locations are identified in Table 6.2-5 and Figure 6.2-7 through Figure 6.2-9. Data collected as part of the existing SSES environmental TLD program will be included as part of the Bell Bend REMP as indicated in Table 6.2-4 and Table 6.2-5.}

TLDs are crystalline devices that store energy when they are exposed to radiation. They are processed after their exposure periods, with minimal loss of information, to read the amount of stored energy, or radiation, that they had accumulated during their exposure period in the field. This makes them well suited for quarterly environmental radiation measurements.

During TLD processing, stored energy is released as light, and is measured by a TLD reader. The light intensity is proportional to the radiation dose to which the TLD was exposed.

6.2.3.2 Airborne Activity Monitoring

{Radioiodine and particulate samples are currently collected with continuously operating air pumps, particulate filters, and iodine collection charcoal cartridges at six sample collection points (12S1, 12E1, 3S2, 13S6, 6G1, 8G1). Sampling frequencies are shown in Table 6.2-2 for the existing SSES REMP. Filter elements and iodine cartridges are changed out on a weekly basis. Airborne activity monitoring data collected as part of the existing SSES REMP will be included in the assessment of the BBNPP REMP. Additions to the airborne monitoring program that are related directly to the BBNPP REMP are identified Section 6.2.7. These include three new air

samplers near the BBNPP site boundary with highest ranked D/Q values, as well as one new air sampler near Nescopeck, PA as a nearby community with high D/Q estimate. Table 6.2-4 describes the air sampling criteria applied to both the pre-operational and operational REMP specific to BBNPP. Table 6.2-5 and Figure 6.2-10 through Figure 6.2-12 provides the locations of air particulate and radioiodine sampling locations for the BBNPP REMP.}

6.2.3.3 Waterborne Monitoring

{Waterborne and sediment samples for the SSES program are currently collected at 18 locations (6 surface waters, 1 drinking water, and 11 ground waters) as shown in Table 6.2-3 and Figure 6.2-4 through Figure 6.2-6. Sampling frequencies are shown in Table 6.2-2 for the existing SSES REMP. Waterborne activity monitoring data collected as part of SSES Units 1 and 2 REMP will be included as appropriate in the assessment the BBNPP REMP. Additions to the waterborne monitoring program that are related directly to the BBNPP REMP are identified in Section 6.2.7. These include new surface water sampling locations in the Susquehanna River near the BBNPP liquid effluent discharge point, its cooling water intake location, and at an upstream control site. Eight ground water well sampling locations specific to the Bell Bend plant facilities are also added to BBNPP REMP to monitor for potential liquid leaks to ground water as a result of BBNPP operations. Table 6.2-4 describes the surface and ground water sampling criteria applied to both the pre-operational and operational REMP specific to BBNPP. Table 6.2-4, Table 6.2-5 and Figure 6.2-10 and Figure 6.2-13 provide the locations of additional waterborne sampling locations for the BBNPP REMP.}

6.2.3.4 Ingestion Pathway Monitoring

{For liquid effluent pathways, fish have been collected as part of the SSES program at off-site locations IND and 2H and from an on-site (SSES) surface water body, Lake Took-A-While (LTAW) as shown in Table 6.2-2 and Table 6.2-3, Figure 6.2-4 through Figure 6.2-6.

Food products (fruits / vegetables) are sampled from as many as six locations (11D1, 11D2, 11F2, 12F7, 5S10, 5S11) also shown in Table 6.2-2 andTable 6.2-3, Figure 6.2-4 through Figure 6.2-6. Milk samples have been collected in the recent past, as needed to meet the minimum sample requirements of the SSES program listed in Table 6.2-2, from as many as seven different locations (5E2, 6E3, 10D2, 10D3, 13E3, 10G1, 12B2) depending on dose potential ranking and availability of milk from locations in business at the time.

Drinking water is currently collected from one municipal water supply which draws water from the Susquehanna River (location 12H2, Danville Water company, 26 mi (42 km) downstream.

Environmental ingestion pathway data collected as part of SSES Units 1 and 2 REMP as shown on Table 6.2-2 and Table 6.2-3 will be included in the assessment the BBNPP REMP. The same ingestion pathway sample sites will be utilized to satisfy the BBNPP ingestion pathway requirements as listed in Table 6.2-4. Table 6.2-5 provides the locations of ingestion sampling locations for the BBNPP REMP.}

6.2.4 SAMPLE SIZE

Table 6.2-8 is an estimate of typical sample sizes for radiological analyses. These are approximations and may vary depending on such things as laboratory procedures and methods, available media obtained during sampling, lower limits of detection (LLDs), and split sampling, if applicable.

6.2.5 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM REPORTS

Routine REMP reports are submitted annually to the NRC. The annual REMP reports for {BBNPP} include summaries, interpretations, and an analysis of trends of the results of the radiological environmental surveillance activities for the report period. The reports also include comparisons with preoperational studies and with operational controls, as appropriate, and with previous environmental surveillance reports, and an assessment of any observed impacts of the plant operation on the environment. The reports also include the results of the land use census for {BBNPP. SSES Units 1 and 2 and one for BBNPP, will be submitted annually. The BBNPP Report will include all data collected and shared between operating companies.}

6.2.6 QUALITY ASSURANCE PROGRAM

The REMP quality assurance program for {BBNPP} will be conducted in accordance with Regulatory Guide 4.15, Revision 2 (NRC, 2007).

{The REMP quality assurance program for SSES Units 1 and 2, prior to BBNPP has been conducted in accordance with Regulatory Guide 4.15, Revision 1 (NRC, 1979a). For site area environmental samples results that are to be shared between all three units, the most limiting QA requirements of either revision of Regulatory Guide 4.15 will be applied, or independent sampling and analyses for SSES Units 1 and 2 and BBNPP will be performed in accordance with their respective versions of the Regulatory Guide 4.15 guidance document.

The QA program also involves the use of "Inter-laboratory Comparison Program" samples as discussed in the ODCM and split samples for all parameters listed in Table 6.2-7 to verify the accuracy of laboratory techniques. The performance of these samples is reported in each AREOR. Because there are no NRC approved laboratory that supply TLDs as part of a comparison program, no TLDs are analyzed as part of the "Inter-laboratory Comparison Program". The nature of TLDs precludes their use in the split sample program.}

6.2.7 REMP MODIFICATIONS FOR {BBNPP}

{Table 6.2-4 lists the location of the operational BBNPP radiological environmental sampling locations. The BBNPP operational program shares many of the same sampling locations with those used for SSES Units 1 and 2, along with several additional locations specific to BBNPP.

Changes to the existing SSES Unit 1 and 2 REMP may result from the location of BBNPP near the SSES units and the inner ring of on-site sample locations. BBNPP is centered approximately 1 mi (1.6 km) west-southwest from the centerline between SSES Units 1 and 2. The BBNPP creates the potential need to re-locate existing SSES sample sites if interferences during plant construction of BBNPP are identified. As an example, existing TLD sample site 12S7, 1.1 mi (1.8 km) WSW of the SSES units, will need to be moved since it falls within the footprint of the BBNPP main facility structures.

In addition to the relocation of some existing SSES sample sites, the BBNPP REMP includes the addition of several new sampling locations in order to meet the sampling criteria of Table 6.2-4 as related to the specific location of the BBNPP facilities and its effluent release points (the main vent stack located directly next to the BBNPP Containment, and the BBNPP liquid effluent discharge line to the Susquehanna River located down stream from the SSES liquid discharge to the river. The following items identify specific sample additions to the BBNPP REMP:

- The addition of three new air particulate / charcoal filter samplers (AP's) close to the BBNPP site boundary in three sectors with the highest ranked annual average D/Q values. These samplers are designated AP1, AP2 and AP3, with there locations listed on Table 6.2-5.
- The addition of one new air particulate / charcoal filter sampler (AP) close to a community with high ranked annual average D/Q. This sampler is designated AP4 and is situated near Nescopeck, PA, approximately 3 mi (4.8 km) SW of BBNPP. This supplements the existing SSES community sampler at location 12E1 in Berwick, PA, 3.6 mi (5.8 km) WSW of BBNPP.
- The addition of 16 new TLD locations, one in each of the 16 compass directions near the BBNPP site boundary designated as TL1 through TL16. This provides indications of radiation field near the plant boundary perimeter, including those sectors which border the SSES site and their ISFSI located approximately 0.5 mi (0.8 km) NE of BBNPP Containment Building.
- The addition of 12 new TLD locations, designated TL17 through TL28, each in a different compass sector. These, along with 4 additional existing SSES TLD locations constitue the outer ring of TLD locations between 4 and 5 miles from the plant, as required by Table 6.2-4.
- The addition of three new surface water (Susquehanna River) sample locations designated WS1, WS2 and WS3 and cover the BBNPP liquid effluent discharge point to the river, the BBNPP cooling water intake, and an upstream control location beyond the influence of both SSES and BBNPP.
- The addition of eight new on-site well water sampling locations to monitor for potential leaks from plant facilities which could impact ground water. Six of these wells (designated WG1 through WG6) are to be located near those plant building containing significant radioactive liquid inventory, as well as sampling two locations (WG7 and WG8) down gradient from the ESWEMS Retention Pond and the Wastewater Retention Pond.}

6.2.8 REFERENCES

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Table 6.2-1 {Effluent Exposure Pathways and Environmental Sampling Media}

Effluent Exposure Pathways	REMP Sampling Media
Liquid Effluents:	
Ingestion Fish	Recreational fish species
Ingestion of water	Potable water from the Susquehanna River
Shoreline Exposure (external direct)	Sediments from River shoreline / bottom
Swimming & boating (external direct)	Susquehanna River surface waters
Gaseous Effluents	
Cloud Immersion (external direct)	TLDs
Ground Plane (external direct)	TLDs
Inhalation	Continuous operation air samplers (particulate filter and charcoal cartridge for Iodine)
Ingestion of agricultural products	Broadleaf vegetation and/or food crops
Ingestion of dairy products	Milk

Table 6.2-2 {The Existing Radiological Environmental Monitoring Program for SSES Units 1 and 2}

Exposure Pathway and\or Sample	Number of Representative Samples[(a)] and Sample Locations	Sampling and Collection Frequency[(a)]	Type and Frequency of Analysis
Direct Radiation[(e)]	40 routine monitoring stations with two or more dosimeters or with one instrument for measuring and recording dose rate continuously placed as follows: • an inner ring of at least one station in each of the 16 meteorological sectors, in the general area of the site boundary • an outer ring of at least one station in each of the 16 meteorological sectors, in the 3 to 9 mi (4.8 to 14.4 km) range from the site. • the balance of the stations placed in special interest areas such as population centers, nearby residences, schools, and in one or two areas to serve as control stations.	Once per 3 months	Gamma dose once per 3 months
Airborne Radioiodine & Particulates [(j)]	Samples from at least 5 locations: • 1 sample from close to each of the three site boundary locations (in difference sectors) with the highest calculated annual average ground level X/Q. • One sample from the vicinity of the community having one of the highest calculated annual ground level X/Q. • One sample from a control location between 9.4 mi and 18.8 mi (15 and 30 km) and in the least prevalent wind direction of wind blowing from the plant.	Continuous sampler operation with sample collection weekly or as required by dust loading, whichever is more frequent	• Radioiodine canisters: analyze once/week for I-131 • Particulate Samplers: Gross beta radioactivity following filter change,[(i)] composite (by location) for gamma-isotopic analysis[(c)] once per 3 months (as a minimum)
Waterborne	Surface[(f)] • 1 sample upstream • 1 sample downstream	Composite sample over one-month period[(g)]	Gamma isotopic analysis[(c)] once per bi-weekly period or monthly. Composite for H-3 analysis at least quarterly.
	Ground Water • Samples from one or two sources only if likely to be affected	Quarterly	Gamma isotopic analysis and tritium analysis quarterly

Table 6.2-2 {The Existing Radiological Environmental Monitoring Program for SSES Units 1 and 2}

Exposure Pathway and\or Sample	Number of Representative Samples[(a)] and Sample Locations	Sampling and Collection Frequency[(a)]	Type and Frequency of Analysis
Waterborne	Drinking Water • One sample from each of one to three of the nearest water supplies that could be affected by its discharge • Once sample from a control location	Composite samples over a two week period when I-131 analysis is performed. Monthly composite otherwise.	I-131 analysis on each composite when the dose calculated for the consumption of water is greater than 1 mrem per year. Composite for gross beta and gamma-isotopic analyses monthly. Composite for tritium analysis quarterly.
Sediment from Shoreline	1 sample from a downstream area with existing or potential recreational value	Semi-annually	Gamma isotopic analysis semi-annually[(c)]
Soil	2 Samples each from one of the air sampling locations	Annually	Gamma isotopic analysis semi-annually[(c)]
Ingestion - Milk	• Samples from milking animals in three locations within 5km from the plant having the highest dose potential. If there are none, then one sample from milking animals in each of three areas 3.2 to 5 mi (5 to 8 km) distance where doses are calculated to be greater than 1 mrem per year. • One sample from milking animals at a control location (between 9.4 and 18.8 mi) (15 and 30 km) from the plant preferably in the least prevalent wind direction from the plant)[(d)]	Semi-monthly when animals are on pasture, monthly otherwise	Gamma isotopic[(c)] and I-131 analysis of each sample.
Ingestion - Fish and Invertebrates	• One sample of each of two recreational important species in the vicinity of the plant discharge area • One sample of the same species in areas not influenced by plant discharge	Sample in season, or semi-annually if they are not seasonal.	Gamma isotopic analysis[(c)] on edible portions.
Ingestion - Food Products	• One sample of each principal class of food products from any area which is irrigated by water in which liquid plant wastes have been discharged. • Samples of three different kinds of broad leaf vegetation grown nearest to each of two different off-site locations of highest predicted annual average ground level D/Q if milking sampling is not performed. • One sample of each of the similar broad leaf vegetation grown between 9.4 and 18.8 mi (15 to 30 km) from the plant, preferably in the least prevalent wind direction from the plant if milk sampling is not performed.	At harvest time	Gamma isotopic analysis[(c)] of edible portions

Table 6.2-2 {The Existing Radiological Environmental Monitoring Program for SSES Units 1 and 2}

Exposure Pathway and\or Sample	Number of Representative Samples[(a)] and Sample Locations	Sampling and Collection Frequency[(a)]	Type and Frequency of Analysis

Notes:

(a) It is recognized that, at times, it may not be possible or practical to obtain samples of the media of choice at the most desired location or time. In these instances, suitable alternative media and locations may be chosen for the particular pathway in question and may be substituted. Actual locations (distance and directions) from the site shall be provided in the Annual Radiological Environmental Operating Report. Highest D/Q locations are based on historical meteorological data for all site licensed reactors.

(b) Particulate sample filters should be analyzed for gross beta 24 hours or more after sampling to allow for radon and thoron daughter decay. If the gross beta activity in air is greater than 10 times a historical yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.

(c) Gamma isotopic analysis means the identification and quantification of gamma emitting radionuclides that may be attributable to the effluents from the facitlity.

(d) The purpose of these samples is to obtain background information. If it is not practical to establish control locations in accordance with the distance and wind direction criteria, other sites, such as historical control locations which provide valid background data may be substituted.

(e) One or more instruments, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. For the purpose of this table, a thermoluminesecent dosimeter may be considered to be one phosphor and two or more phosphors in a packet may be considered as two or more dosimeters. Film badges shall not be used to measure direct radiation.

(f) The "upstream sample" should be taken at a distance beyond significant influence of the discharge. The "downstream sample" should taken in an area beyond but near the mixing zone, if possible.

(g) Composite samples should be collected with equipment (or equivalent) which is capable of collecting an aliquot at time intervals which are very short (e.g., hourly) relative to the compositing period (e.g., monthly) in order to assure obtaining a representative samples.

(h) In the event commercial or recreational important species are not available as result of three attempts, then other species may be utilized as available.

(i) Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate samples is greater than ten times the yearly mean of control samples, gamma-isotopic analysis shall be performed in the individual samples.

(j) In 2007, SSES actually collected air particulate and charcoal cartridge from four indicator locations and two control locations.

Table 6.2-3 {Existing Environmental Monitoring Sites for SSES Units 1 and 2}

(Page 1 of 5)

SampleSite*	SSESSector*	Distance*		Location
		miles	km	
Airborne (Radioiodine[a] & Air Particulates[b])				
12S1	WSW	0.4	0.6	SSES West Building Laboratory
12E1	WSW	4.7	7.6	Berwick Hospital
3S2	NE	0.5	0.8	SSES Backup Met Tower
13S6	W	0.4	0.6	Former Laydown Area, West of Confer's Lane
6G1	ESE	13.5	21.7	Freeland Substation [c]
8G1	SSE	12.2	19.3	PPL System Facilities Central, Humboldt Industrial Park [c]
Direct Radiation (TLD)				
1D5	N	4	6.4	Shickshinny/Mocanaqua Sewage Treatment Plant [e]
1S2	N	0.2	0.3	Perimeter Fence [e]
2S2	NNE	0.9	1.4	Thomas Road
2S3	NNE	0.2	0.3	Perimeter Fence [e]
2F1	NNE	5.9	9.5	St. Adalberts Cemetery [e]
3E1	NE	4.7	7.6	Residence - Lilly Lakee
3G4	NE	17	27.4	Wilkes Barre Service Center [ce]
3S2	NE	0.5	0.8	SSES Backup Met Tower
3S3	NE	0.9	1.4	ANSP Riverlands Garden
4S3	ENE	0.2	0.3	Post, West of SSES APF [e]
4E2	ENE	4.7	7.6	Ruckles Hill/Pond Hill Roads Intersection [e]
4G1	ENE	14	22.5	Mountaintop - Crestwood Industrial Park [ce]
4S6	ENE	0.7	1.1	Riverlands
5E2	E	4.5	7.2	Farm [e]
5S7	E	0.3	0.5	Perimeter Fence [e]
5S4	E	0.8	1.3	West of Environmental Laboratory
6S4	ESE	0.2	0.3	Perimeter Fence (north) [e]
6A4	ESE	0.6	1.0	Restaurant (U. S. Route 11) [s]
6E1	ESE	4.7	7.6	St. James Church [e]
6S9	ESE	0.2	0.3	Perimeter Fence (south) [e]

Table 6.2-3 {Existing Environmental Monitoring Sites for SSES Units 1 and 2}

SampleSite*	SSESSector*	Distance*		Location
		miles	km	
7S6	SE	0.2	0.3	Perimeter Fence [e]
7E1	SE	4.2	6.8	Harwood Transmission Line Pole #2 [e]
7G1	SE	14	22.5	Hazleton PP&L Complex [ce]
7S7	SE	0.4	0.6	End of Kline's Road
8A3	SSE	0.9	1.4	PPL Wetlands Sign (U. S. Route 11)
8S2	SSE	0.2	0.3	Perimeter Fence [e]
8B2	SSE	1.4	2.3	Residence [s]
8D3	SSE	4	6.4	Residence [e]
9B1	S	1.3	2.1	Transmission Line - east of Route 11
9S2	S	0.2	0.3	Security Fence [e]
9D4	S	3.6	5.8	Country Folk Store [e]
10B3	SSW	1.7	2.7	Castek Inc.[s]
10S1	SSW	0.4	0.6	Post - south of switching station
10S2	SSW	0.2	0.3	Security Fence [e]
10D1	SSW	3	4.8	Farm [e]
11E1	SW	4.7	7.6	Residence [e]
11S7	SW	0.4	0.6	SSES Access Road Gate #50
12D2	WSW	3.7	6.0	Residence
12S3	WSW	0.5	0.8	Confers Lane (east side) at "12 WSW" white sign [e]
12E1	WSW	4.7	7.6	Berwick Hospital [s e]
12G1	WSW	15	24.1	PPL Service Center, Bloomsburg [c e]
12G4	WSW	10	16.1	Residence [e]
12S1	WSW	0.4	0.6	SSES West Building
12S7	WSW	1.1	1.8	Former Kisner Property
13S2	W	0.4	0.6	Perimeter Fence [e]
13S5	W	0.4	0.6	Perimeter Fence
13S6	W	0.4	0.6	Former Laydown Area - West of Confer's Lane
13E4	W	4.1	6.6	Farm [e]
14D1	WNW	3.6	5.8	Moore's Hill/Mingle Inn Roads Intersection
14S5	WNW	0.5	0.8	Beach Grove Rd./Confer's Lane Intersection [e]
15A3	NW	0.9	1.4	Residence [s]

Table 6.2-3 {Existing Environmental Monitoring Sites for SSES Units 1 and 2}

(Page 3 of 5)

SampleSite*	SSESSector*	Distance*		Location
		miles	km	
15F1	NW	5.4	8.7	Farm [e]
15S5	NW	0.4	0.6	Perimeter Fence [e]
16A2	NNW	0.8	1.3	Residence [s]
16S1	NNW	0.3	0.5	Perimeter Fence (east)
16S2	NNW	0.3	0.5	Perimeter Fence (west) [e]
16F1	NNW	7.8	12.6	Residence [e]
Surface Water				
2S7	NNE	0.1	0.2	Cooling Tower Blowdown Line
5S9	E	0.8	1.3	Environmental Lab Boat Ramp [c g]
6S6	ESE	0.8	1.3	River Water Intake Line [c]
6S5	ESE	0.9	1.4	SSES Susquehanna River below discharge line
LTAW	NE	0.7	1.1	Lake Took-A-While (on site)
4S7	ENE	0.4	0.6	Peach Stand Pond
Drinking Water				
12H2	WSW	26	41.8	Danville Water Co. (treated) [d]
Ground Water				
1S3	N	0.1	0.2	MW-1, N of RW Bldg.
2S2	NNE	0.9	1.4	SSES Energy Information Center
4S4	ENE	0.5	0.8	SSES Learning Center
4S8	ENE	0.1	0.2	MW-2, SE of E. Diesel Bldg.
4S9	ENE	0.3	0.5	MW-3, NW corner of APF parking lot
6S10	ESE	0.4	0.6	SSES Sewage Treatment Plant
7S10	SE	0.3	0.5	MW-5, N of S-2 Pond
8S4	SSE	0.1	0.2	MW-4, E of U-2 CST
11S2	SW	0.4	0.6	Tower's Club

Table 6.2-3 {Existing Environmental Monitoring Sites for SSES Units 1 and 2}

SampleSite*	SSESSector*	Distance*		Location
		miles	km	
12F3	WSW	5.2	8.4	Berwick Water Company [c]
13S7	W	0.2	0.3	MW-6, Laydown Area W of cooling towers
Sediment from Shoreline				
2B	NNE	1.6	2.6	Gould Island [c h]
7B	SE	1.2	1.9	Bell Bend [h]
12F	WSW	6.9	11.1	Old Berwick Test Track
Milk**				
5E2	E	4.5	7.2	Farm
6E3	ESE	4.2	6.8	Farm
10D2	SSW	3.1	5.0	Farm
10D3	SSW	3.5	5.6	Farm
13E3	W	5	8.0	Farm
10G1	SSW	14	22.5	Farm [c]
12B2	WSW	1.7	2.7	Farm
Fish				
IND	ESE	0.9-1.4	1.4-2.3	Outfall Area [f]
2H	NNE	30	48.3	Near Falls, PA [c f]
LTAW	NE-ESE	0.7	1.1	On-site lake
Food Products				
11D1	SW	3.3	5.3	Farm (vegetable)
11D2	SW	3.5	5.6	Farm - Route 93 Field (vegetable)
11F2	SW	5.5	8.9	Field (vegetable)
12F7	WSW	8.3	13.4	Farm (vegetable)
5S10	E	0.7	1.1	PPL Riverlands Parcel 30 (vegetable) [c]
5S11	E	1.1	1.8	PPL East Side Parcel 25 (vegetable) [c]

Table 6.2-3 {Existing Environmental Monitoring Sites for SSES Units 1 and 2}

SampleSite*	SSESSector*	Distance*		Location
		miles	km	

Notes:

* The location of samples and equipment were designed using the guidance in the Branch Technical Position to NRC Reg. Guide 4.8, Rev. 1, Nov, 1979, Reg. Guide 4.8 1975, and ORP/SID 72-2 Environmental Radioactivity Surveillance Guide. Therefore, the airborne sampler locations were based upon χ/Q and/or D/Q.

** All potential dairy farms are listed. Samples from 3 indicator locations (dairy farms within 5 miles) are collected based on highest dose potential. If a milk sample is unavailable for more than two sampling periods from one or more of the locations, a vegetation sample shall be substituted until a suitable milk location is evaluated. Such an occurrence will be documented in the REMP annual report.

a The charcoal sampler cartridges used in the airborne radioiodine-sampling program are designed and tested by the manufacturer to assure a high quality of radioiodine capture. A certificate from the manufacturer is supplied and retained with each batch of cartridges certifying the percent reduction of radioiodine versus air flow rate through the cartridge.

b Gross beta activity calculations will be performed in accordance with the procedures of the designated REMP analysis laboratory.

c Control sample location.

d Two-week composite if calculated doses due to consumption of water exceed one millirem per year. In these cases, I-131 analyses will be performed.

e Emergency Plan TLD located at this location in addition to REMP TLD.

f The sample collector will determine the species based upon availability, which may vary seasonally and yearly.

g Alternate sample location for 6S6 to be collected and analyzed according to the required frequencies.

h Station code is omitted because no permanent location exist; sample are taken based on availability.

s Special Interest Area sample location

SSES Sample Sites Naming Convention:

All distances from the SSES to monitoring locations are measured from the standby gas treatment vent. The location codes are based on both distance and direction from the SSES. The letters in the location codes indicate if the monitoring locations are on site (within the site boundary) or, if they are not on site, the approximate distances of the locations from the SSES as described below:

S - on site
A - <1 mile
B - 1-2 miles
C - 2-3 miles
D - 3-4 miles
E - 4-5 miles
F - 5-10 miles
G - 10-20 miles
H - >20 miles

The numbers preceding the letters in the location codes provide the directions of the monitoring locations from the SSES by indicating the sectors in which they are located. A total of 16 sectors (numbered 1 through 16) equally divide an imaginary circle on a map of the SSES and its vicinity, with the SSES at the center of the circle. The middle of sector 1 is directed due north (N). Moving clockwise from sector 1, the sector immediately adjacent to sector 1 is sector 2, the middle of which is directed due north , northeast (NNE). Continuing to move clockwise, the sector numbers increase to 16, which is the north, northwest sector. The numbers following the letters in the location codes are used to differentiate sampling locations found in the same sectors at approximately the same distances from the SSES.

Table 6.2-4 {BBNPP Radiological Environmental Monitoring Program}

(Page 1 of 3)

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations[a]	Sampling and Collection Frequency	Type and Frequency of Analysis
1. Direct Radiation(b)	40 routine monitoring stations either with two or more dosimeters or with one instrument for measuring and recording dose rate continuously, placed as follows: An inner ring of stations, one in each meteorological sector in the general area of the Site Boundary. An outer ring of stations, one in each meteorological sector in the 4 to 5 mi (6 to 8 km) range from the site.	Quarterly	Gamma Dose Quarterly
2. Airborne Radioiodine and Particulates	Samples from 5 locations[c]: 3 samples from close to the 3 Site Boundary locations, in different sectors, of high calculated annual average ground-level D/Q. 1 sample from the vicinity of a community having a high calculated annual average ground-level D/Q. 1 sample from a control location, as for example 9 to 19 mi (15 to 30 km) distance and in a non-prevalent wind direction.	Continuous sampler operation with sample collection weekly - or more frequently if required by dust loading.	Radioiodine Canister: I-131 analysis weekly Particulate Sampler: Gross beta radioactivity analysis following filter change[d] Gamma isotopic analysis([e]) of composite (by location) quarterly.
3. Waterborne a. Surface	1 sample at intake area 1 sample at discharge area	Composite Sample[f] over 1month period	Gamma Isotopic Analysis(e) monthly. Composite for tritium analysis quarterly
b. Sediment from shoreline	1 sample from downstream area with existing or potential recreational value	Semiannually	Gamma Isotopic Analysis[e] semiannually

Table 6.2-4 {BBNPP Radiological Environmental Monitoring Program}

(Page 2 of 3)

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations[a]	Sampling and Collection Frequency	Type and Frequency of Analysis
c. Ground Water	1 sample from 8 on-site locations near plant facilities with liquid radioactive inventory that could influence ground water.	Quarterly	Gamma Isotopic and tritium analysis quarterly
4. Ingestion a. Milk(i)	Samples from milking animals in three locations within 3 mi (5 km) distance having the highest dose potential. If there are none, then one sample from milking animals in each of three areas between 3 to 8 mi (5 to 8 km) distances where doses are calculated to be greater than 1 mrem/yr.[j] One sample from milking animals at a control location 9 to 19 mi (15 to 30 km) distance and in a non-prevalent wind direction.	Semimonthly when animals are on pasture; monthly at other times	Gamma Isotopic Analysis [e] and I-131 analysis semimonthly when animals are on pasture; monthly at other times.
b. Fish	One sample from each of two recreationally important species in vicinity of plant discharge area. 3 samples of same species in areas not influenced by plant discharge.	Sample in season, or semiannually if they are not seasonal	Gamma Isotopic Analysis(e) on edible portions.
c. Food Products	Samples of 3 different kinds of broad leaf vegetation(g) grown near the Site Boundary at 2 different locations of high predicted annual average ground level D/Q[(h)(i)]. 1 sample of each of the similar-broad leaf vegetation grown 9 to 19 mi (15-30 km) distant in a non-prevalent wind direction.	Monthly during growing season	Gamma Isotopic[e] and 1-131 analysis .

Table 6.2-4 {BBNPP Radiological Environmental Monitoring Program}

(Page 3 of 3)

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations[a]	Sampling and Collection Frequency	Type and Frequency of Analysis

(a) Deviations are permitted from the required sampling schedule if specimens are unobtainable due to circumstances such as hazardous conditions, seasonal unavailability and malfunction of automatic sampling equipment. If specimens are unobtainable due to sampling equipment malfunction, effort shall be made to complete corrective action prior to the end of the next sampling period.

(b) One or more instruments, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. For the purposes of this table, a thermoluminescent dosimeter (TLD) is considered to be one phosphor; two or more phosphors in a packet are considered as two or more dosimeters. Film badges shall not be used as dosimeters for measuring direct radiation. The frequency of analysis or readout for TLD systems will depend upon the characteristics of the specific system used and should be selected to obtain optimum dose information with minimal fading.)

(c) Optimal air sampling locations are based not only on D/Q but on factors such as population in the area, year round access to the site, and availability of power.

(d) Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate samples is greater than ten times the yearly mean of control samples, Gamma Isotopic Analysis shall be performed on the individual samples.

(e) Gamma Isotopic Analysis is an analytical method of measurement used for the identification and quantification of gamma emitting radionuclides which may be attributable to the effluents from the facility.

(f) A composite sample is one in which the quantity (aliquot) of liquid is proportional to the quantity of flowing liquid and in which the method of sampling employed results in a specimen that is representative of the liquid flow. In this program, COMPOSITE SAMPLE aliquots shall be collected at time intervals that are very short (e.g., hourly) relative to the compositing period (e.g., monthly) in order to assure a representative sample is obtained.

(g) If broad leaf vegetation is unavailable, other vegetation will be sampled. Attention shall be paid to including samples of tuberous and root food products.

(h) Broad leaf vegetation sampling of at least three different kinds of vegetation may be performed at the site boundary in each of two different direction sectors with high predicted D/Qs in lieu of the garden census.

(i) Broad leaf vegetation sampling is performed in lieu of milk sampling if the required minimum number of milk locations is not available in the site area. Milk samples need be collected and analyzed if the milk is commercially available in quantities greater than 130 liters (34.3.gal) per year.

(j) The dose shall be calculated for the maximum organ and age group, using the methodology and parameters in the ODCM.

Table 6.2-5 {Operational BBNPP Radiological Environmental Monitoring Program Locations[(d)]}

(Page 1 of 5)

SampleSite	Required for Minimum REMP[i]	BBNPP Sector	BBNPP Distance[a]		Location
			miles	km	
Airborne (Radioiodine & Air Particulates)					
12S1	No	ENE	0.6	0.9	SSES West Building Laboratory
12E1	No	WSW	3.6	5.8	Berwick Hospital
3S2	No	ENE	1.4	2.3	SSES Backup Met Tower
13S6	Yes	ENE	0.7	1.1	Former Laydown Area, West of Confer's Lane
6G1	Yes	ESE	14.3	22.9	Freeland Substation
8G1	No	SSE	12.3	19.8	PPL System Facilities Central, Humboldt Industrial Park
AP1	Yes	N	0.2	0.3	BBNPP Site Boundary
AP2	No	NNE	0.6	0.8	BBNPP Site Boundary
AP3	Yes	SSW	0.3	0.5	BBNPP Site Boundary
AP4	Yes	SW	3.0	4.8	Noscopack, PA
Direct Radiation (TLD)[c]					
TL1	Yes	N	0.5	0.7	BBNPP Site Boundary [e]
TL2	Yes	NNE	0.5	0.8	BBNPP Site Boundary [e]
TL3	Yes	NE	0.7	1.1	BBNPP Site Boundary [e]
TL4	Yes	ENE	0.6	1.0	BBNPP Site Boundary [e]
TL5	Yes	E	0.7	1.2	BBNPP Site Boundary [e]
TL6	Yes	ESE	0.6	1.0	BBNPP Site Boundary [e]
TL7	Yes	SE	0.4	0.6	BBNPP Site Boundary [e]
TL8	Yes	SSE	0.3	0.5	BBNPP Site Boundary [e]
TL9	Yes	S	0.3	0.5	BBNPP Site Boundary [e]
TL10	Yes	SSW	0.3	0.5	BBNPP Site Boundary [e]
TL11	Yes	SW	0.3	0.4	BBNPP Site Boundary [e]
TL12	Yes	WSW	0.2	0.3	BBNPP Site Boundary [e]
TL13	Yes	W	0.2	0.3	BBNPP Site Boundary [e]
TL14	Yes	WNW	0.2	0.4	BBNPP Site Boundary [e]
TL15	Yes	NW	0.2	0.3	BBNPP Site Boundary [e]
TL16	Yes	NNW	0.2	0.3	BBNPP Site Boundary [e]
TL17	Yes	N	4.2	6.8	Shickshinny Valley Road [f]
TL18	Yes	NE	4.7	7.6	Pond Hill Mountain Road [f]
TL19	Yes	ENE	4.9	7.9	Ruckle Hill Road and Cemetary Road [f]
TL20	Yes	E	4.7	7.6	St. Mary's Road and Church Road [f]
TL21	Yes	SSE	4.3	6.9	Berwick Hazleton Highway [f]
TL22	Yes	S	4.4	7.1	Overlook Road [f]
TL23	Yes	SSW	4.9	7.9	Black Creek Road at bridge [f]
TL24	Yes	WSW	4.9	7.9	Intersection Orange Street and West Fron Street [f]
TL25	Yes	W	4.5	7.2	Dairy Road and Valley Road [f]

Table 6.2-5 {Operational BBNPP Radiological Environmental Monitoring Program Locations[(d)]}

(Page 2 of 5)

SampleSite	Required for Minimum REMP[i]	BBNPP Sector	BBNPP Distance[a]		Location
			miles	km	
TL26	Yes	WNW	4.7	7.6	Shickshinny Valley Road at power line right-of-way [f]
TL27	Yes	NW	4.1	6.6	Intersection S. Mountain Rd and Shickshinny Valley Rd [f]
TL28	Yes	NNW	4.2	6.8	Shickshinny Valley Road [f]
1D5	Yes	NNE	4.6	7.4	Shickshinny/Mocanaqua Sewage Treatment Plant
2S2	No	NE	1.8	2.9	Thomas Road
2F1	No	NE	6.8	10.9	St. Adalberts Cemetery
3E1	Yes	NE	5.6	9.1	Residence - Lilly Lake f
3G4	Yes	NE	18.5	29.8	Wilkes Barre Service Center (control) [g]
3S3	No	ENE	2.0	3.2	ANSP Riverlands Garden (Abandoned)
4E2	Yes	ENE	5.8	9.3	Ruckles Hill/Pond Hill Roads Intersection
4G1	Yes	ENE	15.0	24.2	Mountaintop - Crestwood Industrial Park (control)[g]
4S6	Yes	ENE	1.8	2.9	Riverlands[g]
5E2	Yes	E	5.4	8.8	Farm[f]
5S4	No	ENE	1.8	2.9	West of Environmental Laboratory
6A4	No	E	1.5	2.4	Restaurant
6E1	Yes	E	5.6	9.0	St. James Church [g]
7E1	No	SE	4.7	7.5	Harwood Transmission Line Pole #2 [f]
7G1	Yes	SE	13.9	22.3	Hazleton PP&L Complex (control) [g]
8A3	No	ESE	1.1	2.3	PPL Wetlands Sign (U. S. Route 11)
8B2	Yes	E	1.9	3.1	Residence [g]
8D3	Yes	SE	4.0	6.5	Residence [f]
9B1	Yes	ESE	1.4	2.3	Transmission Line - east of Route 11 [g]
9S2	No	E	1.0	1.6	SSES Security Fence [h]
9D4	Yes	ESE	3.4	5.4	Country Folk Store [f]
10B3	Yes	S	1.3	2.1	Castek Inc.[g]
10S1	No	E	0.8	1.3	Post - south of switching station
10S2	No	E	0.9	1.4	SSES Security Fence
10D1	Yes	SSW	2.1	3.4	Farm[g]
11E1	Yes	SW	3.8	6.1	Residence [f]
11S7	No	E	0.6	1.0	SSES Access Road Gate #50 [h]
12D2	Yes	WSW	2.6	4.2	Residence [g]
12S3	No	ENE	0.7	1.1	Confers Lane (east side) at -12 WSW-white sign
12E1	Yes	WSW	3.6	5.7	Berwick Hospital
12G1	No	WSW	14.0	22.5	PPL Service Center, Bloomsburg
12G4	Yes	WSW	9.4	15.1	Residence [g]
12S1	Yes	ENE	0.6	0.9	SSES West Building [h]
13S2	No	ENE	0.7	1.2	SSES Perimeter Fence [h]
13S5	Yes	ENE	0.8	1.1	SSES Perimeter Fence [h]
13S6	Yes	NE	0.7	1.1	Former Laydown Area - West of Confer's Lane [h]

Table 6.2-5 {Operational BBNPP Radiological Environmental Monitoring Program Locations[(d)]}

(Page 3 of 5)

SampleSite	Required for Minimum REMP[i]	BBNPP Sector	BBNPP Distance[a]		Location
			miles	km	
13E4	Yes	W	3.0	5.8	Farm
14D1	Yes	WNW	2.9	4.5	Moore's Hill/Mingle Inn Roads Intersection
14S5	Yes	NE	0.8	1.3	Beach Grove Rd./Confer's Lane Intersection [h]
15A3	Yes	NNE	1.0	1.6	Residence [g]
15F1	Yes	NNW	5.1	8.2	Farm [f]
15S5	Yes	NE	1.0	1.5	SSES Perimeter Fence [h]
16A2	Yes	NNE	1.4	2.3	Residence [g]
16S1	Yes	NE	1.2	1.9	SSES Perimeter Fence (east) [h]
16S2	Yes	NE	1.1	1.8	SSES Perimeter Fence (west) [h]
16F1	No	NNW	8.4	13.5	Residence
Surface Water					
5S9	No	ENE	1.8	2.9	Environmental Lab Boat Ramp (alternate for 6S6)
6S6	No	E	1.7	2.7	SSES River Water Intake Line
6S5	No	E	1.7	2.9	SSES Susquehanna River below discharge line
WS1	Yes	E	1.7	2.9	Surface Water Below BBNPP Discharge
WS2	Yes	E	1.7	2.7	BBNPP River Water Intake Line
WS3	No	NE	2.5	4.0	Gould Island Surface Water (Control)
Drinking Water					
12H2	Yes	WSW	25	40.9	Danville Water Co. (treated)
Ground Water					
WG1	Yes	NE	0.07	0.11	Ground Water Sampling Well N of Demin Water Tanks
WG2	Yes	SE	0.06	0.10	Ground Water Sampling Well NW of 3URB
WG3	Yes	S	0.09	0.14	Ground Water Sampling Well S of Radwaste Processing Bldg
WG4	Yes	SW	0.08	0.13	Ground Water Sampling Well SW of Radwaste Processing Bldg
WG5	Yes	W	0.06	0.10	Ground Water Sampling Well WSW of SFP Bldg
WG6	Yes	N	0.06	0.10	Ground Water Sampling Well E of 1URB & 2URB
WG7	Yes	E	0.23	0.37	Ground Water Sampling Well S of ESWEMS Retention Pond
WG8	Yes	E	0.42	0.68	Ground Water Sampling Well S of Wastewater Retention Pond
Sediment from Shoreline					
2B	No	NE	2.4	3.8	Gould Island
7B	No	ESE	1.8	2.9	Bell Bend
12F	Yes	WSW	6	9.1	Old Berwick Test Track

Table 6.2-5 {Operational BBNPP Radiological Environmental Monitoring Program Locations[(d)]}

(Page 4 of 5)

SampleSite	Required for Minimum REMP[i]	BBNPP Sector	BBNPP Distance[a]		Location
			miles	km	
Milk					
5E2	Note b	E	5.5	8.8	Farm
6E3	Note b	ESE	5.0	8.0	Farm
10D2	Note b	S	2.5	4.0	Farm
10D3	Note b	S	2.9	4.6	Farm
13E3	Note b	WNW	4.1	6.6	Farm
10G1	Note b	SSW	12.2	19.9	Farm
12B2	Note b	SW	0.8	1.3	Farm
Fish					
IND	Yes	E	1.8	2.9	Outfall Area
2H	Yes	NNE	30.5	49.0	Near Falls, PA
Food Products					
11D1	No	SW	2.5	4.0	Farm (vegetable)
11D2	No	SW	3.0	4.9	Farm - Route 93 Field (vegetable)
11F2	No	SW	4.9	7.9	Farm (vegetable)
12F7	Yes	WSW	7.2	11.6	Farm (vegetable)
5S10	Yes	ENE	1.8	2.9	PPL Riverlands Parcel 30 (vegetable)
5S11	Yes	E	2.0	3.3	PPL East Side Parcel 25 (vegetable)

Table 6.2-5 {Operational BBNPP Radiological Environmental Monitoring Program Locations[(d)]}

(Page 5 of 5)

SampleSite	Required for Minimum REMP[i]	BBNPP Sector	BBNPP Distance[a]		Location
			miles	km	

Notes:

a Distance and direction are from the BBNPP Rx vent

b All available dairy farms are listed. Samples from 3 indicator locations (dairy farms within 5 miles) are collected based on highest dose potential. If a milk sample is unavailable for more than two sampling periods from one or more of the locations, a vegetation sample shall be substituted until a suitable milk location is evaluated. Such an occurrence will be documented in the REMP annual report.

c For the SSES TLD program locations which are not included as a formal part of the BBNPP REMP, will be included in the BBNPP REMP reporting when data from these locations is available.

Key: # The sequential number of the sampling station for BBNPP.
TL# Direct Radiation, TLD Station specific to BBNPP
AP# Airborne Sampling Station specific to BBNPP
WS#Surface Water Sampling Station specific to BBNPP
Wg#Ground Water Sampling Station specific to BBNPP

All other sampling stations are SSES stations used by the BBNPP program (See Table 6.2-3).

d. The same requirements as indicated for the operational program also apply to the BBNPP pre-operational period for 2 years prior to plant first criticality.

e. TLD placements per Table 6.2-4 for "inner ring" near to site boundary.

f. TLD placements per Table 6.2-4 for "outer ring".

g. TLD placements per Table 6.2-4 for special interest locations and controls.

h. Additional TLDs in areas potentially impacted by SSES ISFSI.

i. Minimum BBNPP program requirements indicated as "Yes" refer to the requirements of Table 6.2-4. Other locations indicated as "No" are also included in the BBNPP REMP as non-required locations

Table 6.2-6 {The Reporting Levels for Radioactivity Concentrations in Environmental Samples[a]}

Analysis	Water (pCi/L)	Airborne Particulate of Gases (pCi/m^3)	Fish (pCi/kg, wet)	Milk (pCi/L)	Food Products (pCi/kg, wet)
H-3[b]	2×10^4				
Mn-54	1×10^3		3×10^4		
Fe-59	4×10^2		1×10^4		
Co-58	1×10^3		3×10^4		
Co-60	3×10^2		1×10^4		
Zn-65	3×10^2		2×10^4		
Zr-Nb-95	4×10^2				
I-131	2 [c]	0.9		3	1×10^2
Cs-134	30	10	1×10^3	60	1×10^3
Cs-137	50	20	2×10^3	70	2×10^3
Ba-La-140	2×10^2			3×10^2	

(a) The limits are for samples that have only one radionuclide detected. When a sample contains more than one radionuclide, the total level of radioactivity limit is:

$$\frac{\text{Concentration (1)}}{\text{Reporting Level (1)}} + \frac{\text{Concentration (2)}}{\text{Reporting Level (2)}} + \ldots \leq 1.0$$

(b) For drinking water samples. The value given is the 40 CFR Part 141 value. If no drinking water pathway exists, a value of 30,000 pCi/L may be used.

(c) If no drinking water pathway exists, a value of 20 pCi/L may be used.

Table 6.2-7 {Lower Limits of Detection (LLD) for Environmental Media}

Measurement Type	Analysis Parameter	Required LLD	Measurement Units
Direct Radiation	Gamma Dose	Note: (a)	mR
Airborne Activity-Radioiodine Cannister	I-131	0.07	pCi/m^3
Airborne Radioactivity - Particulate Filter	Gross Beta	0.01	pCi/m^3
	Cs-134	0.05	pCi/m^3
	Cs-137	0.06	
Waterborne Activity - Surface Water- Drinking Water- Ground Water	Gross Beta	4	pCi/L
	H-3	2000	
	Mn-54	15	
	Fe-59	30	
	Co-58	15	
	Co-60	15	
	Zn-65	30	
	Zr-95	30	
	Nb-95	15	
	I-131	1[(b)]	
	Cs-134	15	
	Cs-137	18	
	Ba-140	60	
	La-140	15	
Shoreline Sediment	Cs-134	150	pCi/kg-dry
	Cs-137	180	
Ingestible Activity-Fish and Invertebrates[(c)]	Mn-54	130	pCi/kg-wet
	Fe-59	260	
	Co-58	130	
	Co-60	130	
	Zn-65	260	
	Cs-134	130	
	Cs-137	150	
Ingestible Activity-Milk[(d)]	I-131	1	pCi/L
	Cs-134	15	
	Cs-137	18	
	Ba-140	60	
	La-140	15	
Food Products	I-131	60	pCi/kg-wet
	Cs-134	60	
	Cs-137	80	

Notes:

(a) LLD for TLDs used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13.

(b) If no drinking water pathway exists, a value of 3000 pCi/L may be used.

(c) If no drinking water pathway exists, a value of 15 pCi/L may be used.

Table 6.2-8 {Typical Sample Sizes for Environmental Media}

Media	Approximate Weight/Volume [Note: (c)]
Air Particulate	100 m^3 (3,531 ft^3)
Algae	2 kg (4.4 lb)
Aquatic (Special)	2 kg (4.4 lb)
Aquatic Vegetation	2 kg (4.4 lb)
Benthic Organisms	2 kg (4.4 lb)
Biological Organisms	2 kg (4.4 lb)
Cattle Feed	1 - 2 kg (2.2-4.4 lb)
Charcoal Filter	100 m^3 (3,531 ft^3)
Fish	2 kg (4.4 lb)
Food Crop	0.5 - 1 kg (1.1-2.2 lb)
Fresh Water	1 quart (0.95 liters) [Note: (a)]
Green Leafy Vegetation	0.5 - 1 kg (1.1-2.2 lb)
Ground Water	1 gallon (3.8 liters) [Note: (a)]
Mixed Vegetation	0.5 - 1 kg (1.1-2.2 lb)
Sediment	Cores as Required [Note: (b)]

Notes:

(a) One gallon (3.8 liters) is needed for gamma spectrometry/tritium analysis ONLY. An additional gallon (3.8 liters) is required for a gross beta analysis.

(b) Six core sections having a minimum depth of 6 in (15.2 cm) by means of a 2 in (5.1 cm) ID coring device.

(c) The sample sizes in this table should only be used as representative of approximate sizes needed. These may vary significantly depending on the LLD of the isotopes being measured.

Table 6.2-9 {Background Radiation and Radioactivity Concentrations Measured Pre-Operationally* at SSES}

(Page 1 of 3)

Sample Type	Nuclide or Analysis Type	Average Concentration***	Concentration Range***
TLDs (Indicators)	Exposure	18.9 mR/std qtr	18.5 - 19.2 mR/std qtr
TLDs (Controls)	Exposure	16.3 mR/std qtr	15.0 - 17.9 mR/std qtr
Air Iodine	I-131	0.004 ± 0.0048 pCi/m^3	<.0013 - 0.015 pCi/m^3
Air Particulates	Alpha	0.0014 ± 0.0013 pCi/m^3	<0.0001 - 0.0052 pCi/m^3
	Beta	0.074 ± 0.180 pCi/m^3	0.0045 - 0.535 pCi/m^3
	Be-7**	0.151 ± 0.133 pCi/m^3	0.089 - 0.360 pCi/m^3
	Co-58**	-	0.0002 pCi/m^3
	Zr-95**	0.012 ± 0.032 pCi/m^3	0.0005 - 0.068 pCi/m^3
	Nb-95**	0.043 ± 0.155 pCi/m^3	0.0005 - 0.340 pCi/m^3
	Ru-103**	0.0042 ± 0.0072 pCi/m^3	0.0011 - 0.017 pCi/m^3
	Ru-106**	0.021 ± 0.042 pCi/m^3	0.0023 - 0.071 pCi/m^3
	Sb-125**	0.0066 ± 0.016 pCi/m^3	0.0006 - 0.027 pCi/m^3
	Cs-137**	0.0028 ± 0.0068 pCi/m^3	0.0003 - 0.016 pCi/m^3
	Ce-141**	0.0042 ± 0.0044 pCi/m^3	0.0015 - 0.0089 pCi/m^3
	Ce-144**	0.041 ± 0.110 pCi/m^3	0.0014 - 0.220 pCi/m^3
	Ra-226**	0.013 ± 0.050 pCi/m^3	0.0021 - 0.079 pCi/m^3
	Th-232**	0.0037 ± 0.0030 pCi/m^3	0.0015 - 0.0069 pCi/m^3
Precipitation	H-3	-	212 pCi/l
	Sr-89	-	48 pCi/l
	Sr-90	-	<7.5 pCi/l
Well Water	H-3	370 ± 310 pCi/l	<80 - 1100 pCi/l
	Alpha-Total	1.6 ± 0.5 pCi/l	<1.5 - 3.2 pCi/l
	Beta-Total	3.3 ± 3.2 pCi/l	<3.0 - 20 pCi/l
	Sr-90	0.6 ± 0.4 pCi/l	<0.1 - <1.0 pCi/l
	K-40	0.9 ± 0.5 pCi/l	0.5 - 1.6 pCi/l
	K-40**	-	24 pCi/l
Milk	Sr-89	33 ± 68 pCi/l	<6.1 - 83 pCi/l
	Sr-90	4.9 ± 4.2 pCi/l	<0.5 - 9.0 pCi/l
	I-131	210 ± 368 pCi/l	1.0 - 370 pCi/l
	I-131**	61 ± 32 pCi/l	49 - 79 pCi/l
	K-40**	1490 ± 631 pCi/l	1100 - 2600 pCi/l
	Cs-137**	3.8 ± 5.4 pCi/l	2.0 - 11 pCi/l
	Ba/La-140**	31 ± 29 pCi/l	22 - 48 pCi/l
Food Products	Sr-90	-	<10 - <100 pCi/kg
	K-40**	2900 ± 4200 pCi/kg	920 - 7600 pCi/kg
	Cs-137**	-	240 pCi/kg
	Ra-226**	9.7 ± 15 pCi/kg	4.4 - 15 pCi/kg
Squirrels	K-40**	3029 ± 2477 pCi/kg(wet)	420 - 4500 pCi/kg(wet)
	Cs-137**	4994 ± 10,959 pCi/kg(wet)	830 - 20,000 pCi/kg(wet)

Table 6.2-9 {Background Radiation and Radioactivity Concentrations Measured Pre-Operationally* at SSES}

Sample Type	Nuclide or Analysis Type	Average Concentration***	Concentration Range***
Other Game	Sr-90	-	8.0 pCi/kg
	K-40**	3250 ± 1291 pCi/kg(wet)	2300 - 4800 pCi/kg(wet)
	Cs-137**	141 ± 305 pCi/kg(wet)	8.0 - 480 pCi/kg(wet)
	Be-7**	136 pCi/kg(wet)	136 - 136 pCi/kg(wet)
Vegetation	Sr-89	1125 ± 710 pCi/kg	715 - 1340 pCi/kg
	Sr-90	-	136 pCi/kg
Vegetation (wet weight)	K-40**	5.4 ± 5.5 pCi/g(wet)	3.5 - 7.4 pCi/g(wet)
	Cs-137**	0.4 ± 0.4 pCi/g(wet)	0.3 - 0.6 pCi/g(wet)
Vegetation (dry weight)	K-40**	25 ± 101 pCi/g(dry)	2.0 - 230 pCi/g(dry)
	Be-7**	2.1 ± 3.9 pCi/g(dry)	0.08 - 7.2 pCi/g(dry)
	Cs-137**	1.7 ± 8.2 pCi/g(dry)	0.06 - 17 pCi/g(dry)
	ZrNb-95**	0.26 ± 0.56 pCi/g(dry)	0.07 - 1.0 pCi/g(dry)
	Ra-226**	0.8 ± 0.1 pCi/g(dry)	0.8 - 0.9 pCi/g(dry)
	Th-232**	0.8 ± 0.3 pCi/g(dry)	0.7 - 1.0 pCi/g(dry)
Vegetation (Chinese fallout samples)	Be-7**	2.3 ± 3.3 pCi/g(dry)	0.8 - 4.6 pCi/g(dry)
	K-40**	6.1 ± 1.3 pCi/g(dry)	5.5 - 7.0 pCi/g(dry)
	Nb-95**	4.4 ± 8.3 pCi/g(dry)	0.3 - 10 pCi/g(dry)
	Zr-95**	7.0 ± 7.2 pCi/g(dry)	1.0 - 10 pCi/g(dry)
	Mo-99**	5.3 ± 11 pCi/g(dry)	0.2 - 11 pCi/g(dry)
	Ru-103**	1.9 ± 2.6 pCi/g(dry)	0.6 - 3.4 pCi/g(dry)
	I-131**	8.4 ± 1.1 pCi/g(dry)	8.0 - 9.0 pCi/g(dry)
	I-132**	2.6 ± 4.3 pCi/g(dry)	0.2 - 4.2 pCi/g(dry)
	I-133**	0.9 ± 1.1 pCi/g(dry)	0.3 - 1.3 pCi/g(dry)
	Te-132**	4.5 ± 3.7 pCi/g(dry)	2.4 - 5.8 pCi/g(dry)
	Ba-140**	9.8 ± 13 pCi/g(dry)	2.2 - 14 pCi/g(dry)
	La-140**	11 ± 16 pCi/g(dry)	2.2 - 16 pCi/g(dry)
	BaLa-140**	1.7 pCi/g(dry)	1.7 - 1.7 pCi/g(dry)
	Ce-141**	5.0 ± 6.0 pCi/g(dry)	1.1 - 7.7 pCi/g(dry)
	Ce-144**	1.7 pCi/g(dry)	1.7 - 1.7 pCi/g(dry)
	Np-239**	6.9 pCi/g(dry)	6.9 - 6.9 pCi/g(dry)
Surface Water	H-3	300 ± 317 pCi/l	<80 - 1200 pCi/l
	Alpha-soluble	1.9 ± 1.5 pCi/l	<1.5 - 3.4 pCi/l
	Alpha-insoluble	1.5 ± 0.2 pCi/l	<1.5 - 2.5 pCi/l
	Beta-soluble	3.2 ± 1.2 pCi/l	<3.0 - 7.3 pCi/l
	Beta-insoluble	3.1 ± 1.4 pCi/l	<3.0 - 9.0 pCi/l
	Beta-total	3.8 ± 3.8 pCi/l	<3.0 - 18 pCi/l
	Sr-90	0.7 ± 0.4 pCi/l	<0.5 - <1.0 pCi/l
	K-40	1.2 ± 0.8 pCi/l	0.3 - 1.8 pCi/l
	K-40**	18 ± 35 pCi/l	3 - 42 pCi/l
	Ra-226**	-	1.5 pCi/l

Table 6.2-9 {Background Radiation and Radioactivity Concentrations Measured Pre-Operationally* at SSES}

Sample Type	Nuclide or Analysis Type	Average Concentration***	Concentration Range***
Sediment	Alpha	30 ± 38 pCi/g(dry)	7.0 - 48 pCi/g(dry)
	Be-7**	0.89 ± 0.88 pCi/g(dry)	0.58 - 1.2 pCi/g(dry)
	K-40**	11 ± 9 pCi/g(dry)	0.88 - 18 pCi/g(dry)
	Zr-95**	0.18 ± 0.35 pCi/g(dry)	0.05 - 0.3 pCi/g(dry)
	Nb-95**	0.22 ± 0.76 pCi/g(dry)	0.03 - 0.9 pCi/g(dry)
	Ru-106**	-	0.6 pCi/g(dry)
	Sb-125**	0.05 ± 0.09 pCi/g(dry)	0.07 - 0.1 pCi/g(dry)
	Cs-137**	0.23 ± 0.22 pCi/g(dry)	0.03 - 0.38 pCi/g(dry)
	Ce-141**	-	0.2 pCi/g(dry)
	Ce-144**	0.5 ± 0.8 pCi/g(dry)	0.2 - 0.8 pCi/g(dry)
	Ra-226**	0.78 ± 0.56 pCi/g(dry)	0.08 - 1.1 pCi/g(dry)
	Th-232**	0.83 ± 0.68 pCi/g(dry)	0.08 - 1.3 pCi/g(dry)
Fish	Sr-90	7.8 ± 10.9 pCi/kg(wet)	3.0 - 13 pCi/kg(wet)
	K-40**	2.4 ± 4.4 pCi/g(wet)	0.02 - 5.9 pCi/g(wet)
	Cs-137**	0.004 ± 0.189 pCi/g(wet)	0.001 - 0.61 pCi/g(wet)
Aquatic Invertebrates	K-40**	-	5.3 pCi/g(dry)
	Cs-137**	-	0.25 pCi/g(dry)

* TLD exposure rates are based on a pre-operational period of 1978 to 1981. All other radionuclide concentration data are based on a pre-operational period of 1972 to 1976.

** Indicates concentration was determined by gamma spectrometry.

*** The minimum detectable level (MDL) was used as the detection limit during this period, and is defined as the level at which the result exceeds background by three times the standard deviation of that background. For gamma spectrometry results, only the results exceeding the MDL are included in the "Average Concentration" and "Concentration Range" of the table. For all other results, "less than MDL" values were reported in the table as being equal to the MDL value. Where MDL values are used in the table they are preceded by a "less than" symbol. For all non-gamma spectrometry results, the MDL value was used in the calculation of average values, which are reported with the associated error of two standard deviations . Each such average is reported with an associated error of two standard deviations. When only a single analysis was performed, the result of that analysis appears as the "Concentration Range" value.

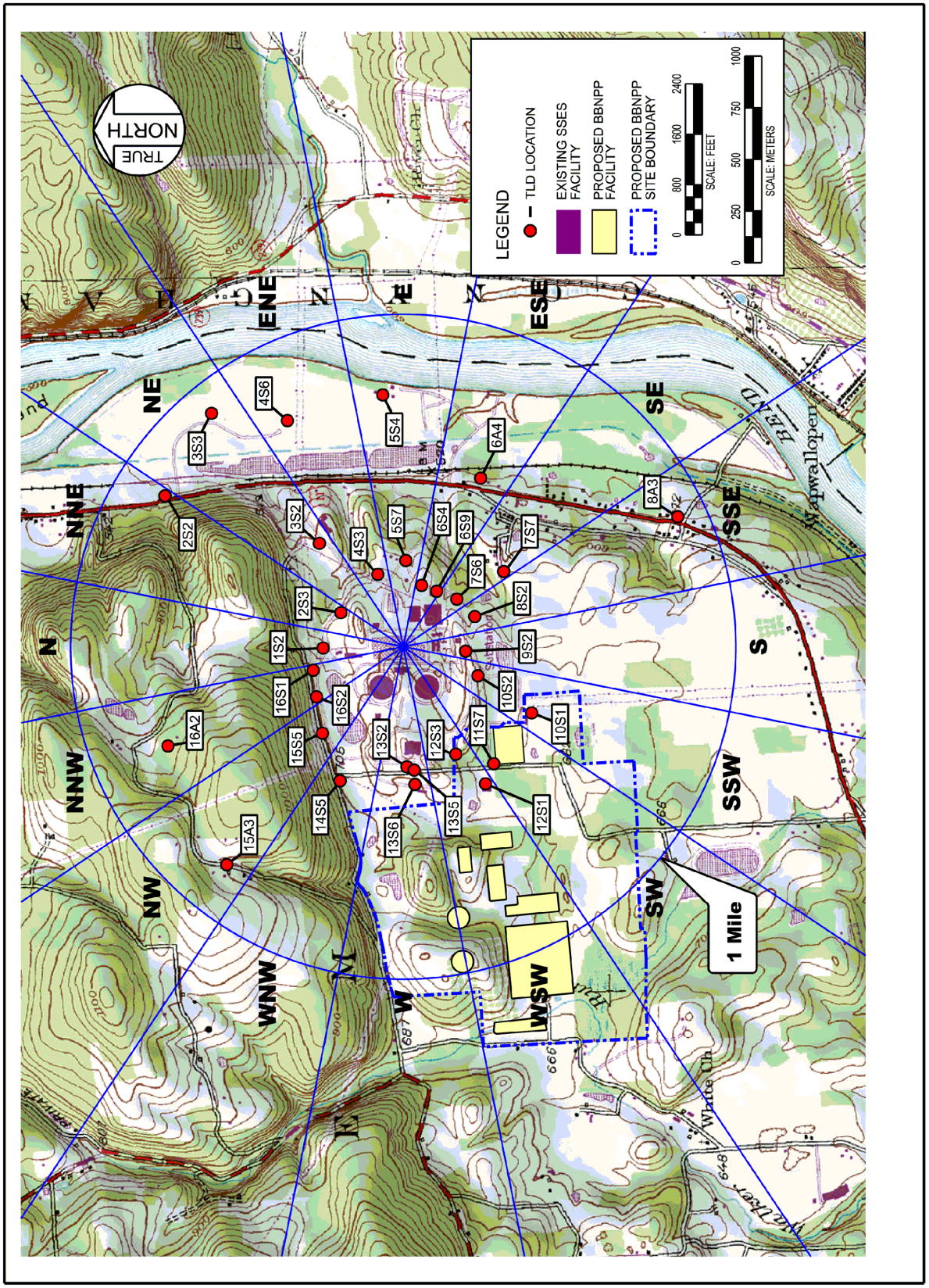


Figure 6.2-1 {Existing SSES TLD Monitoring Locations within One Mile of Plant}

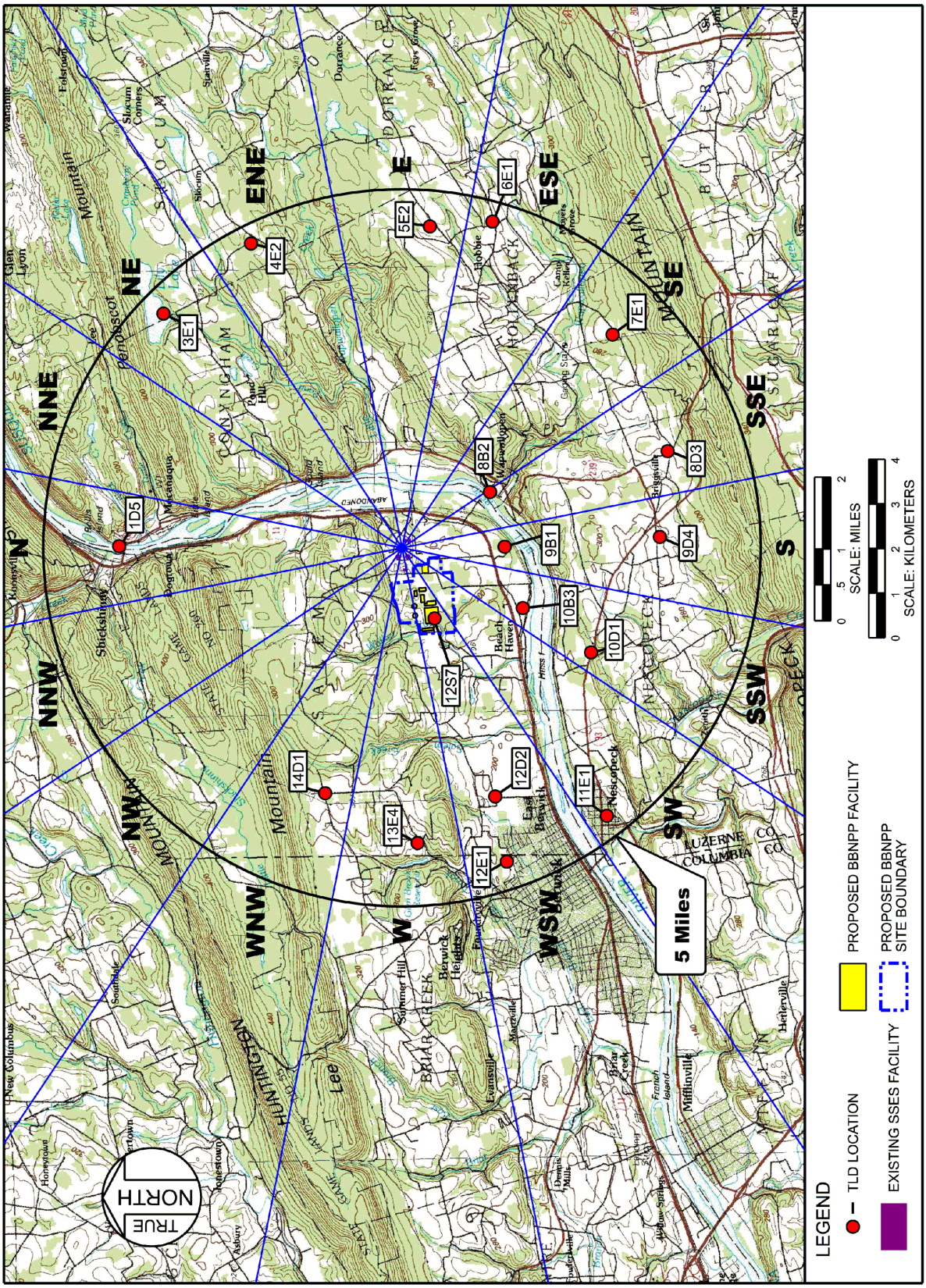
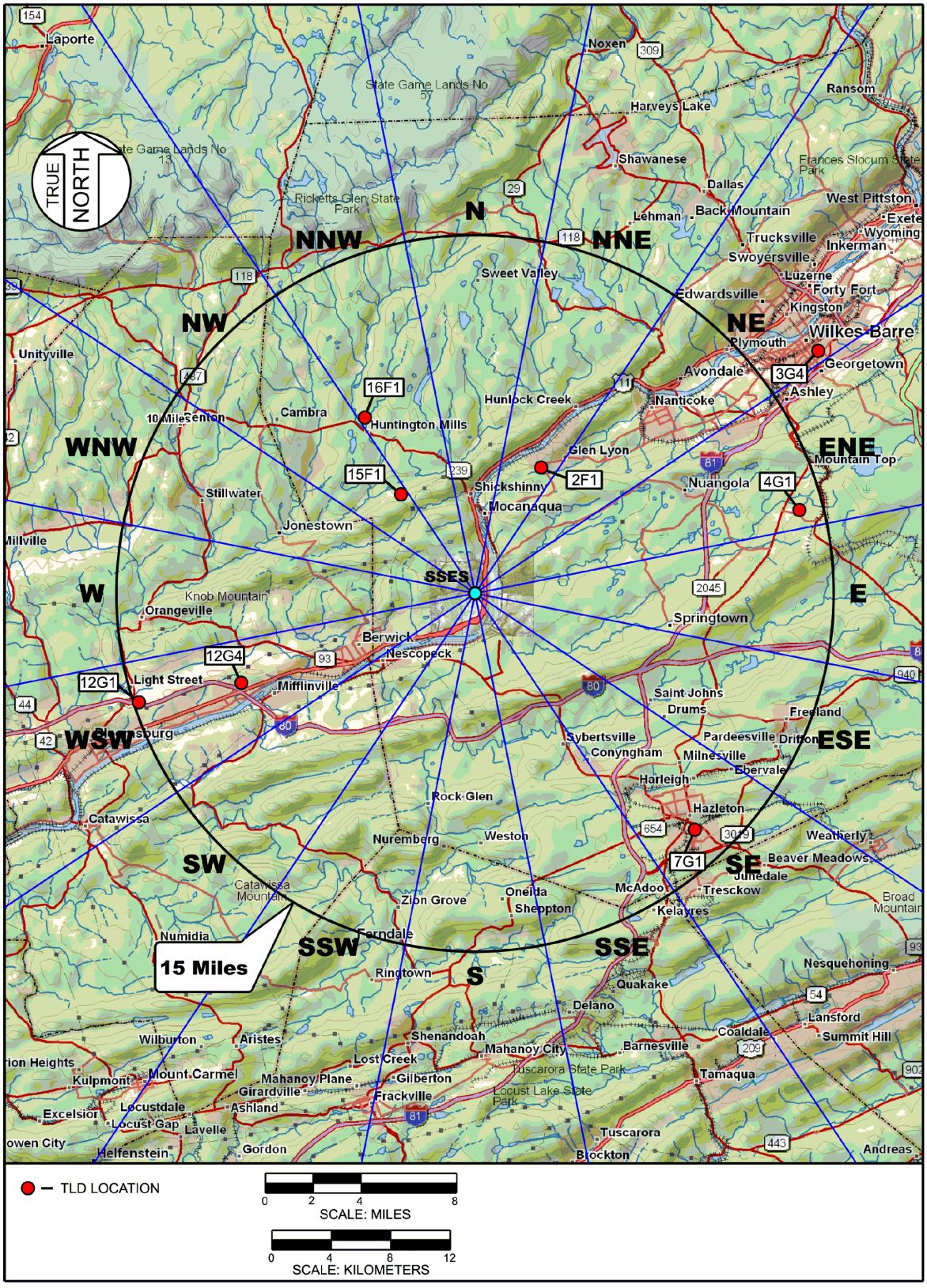


Figure 6.2-2 {Existing SSES TLD Monitoring Locations that are One to Five Miles from the Plant}

Figure 6.2-3 {Existing SSES TLD Monitoring Locations that are Greater than Five Miles from the Plant}



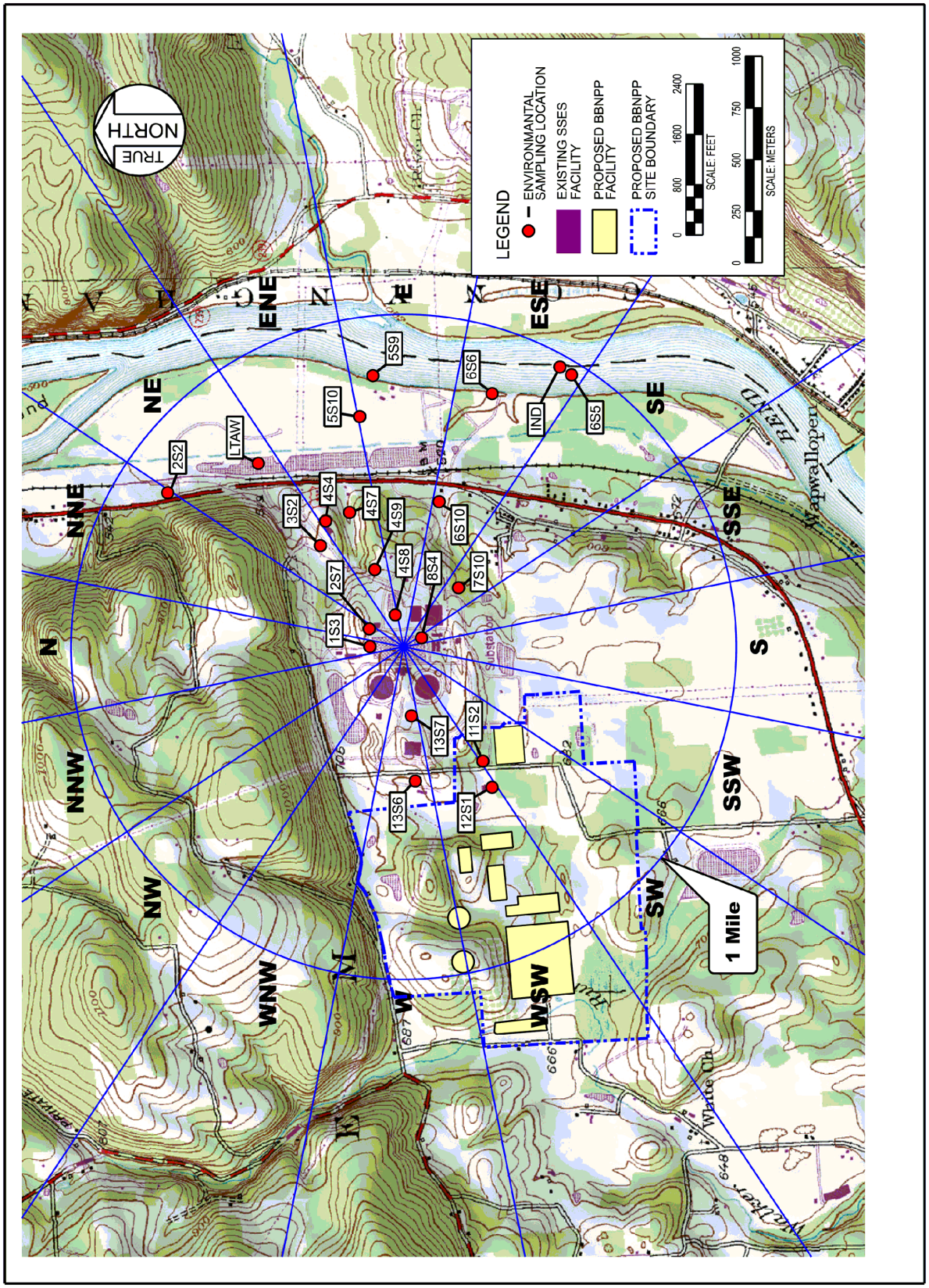


Figure 6.2-4 {Existing SSES Environmental Sampling Locations that are within One Mile of the Plant}

Figure 6.2-5 {Existing SSES Environmental Sampling Locations from One to Five Miles of the Plant}

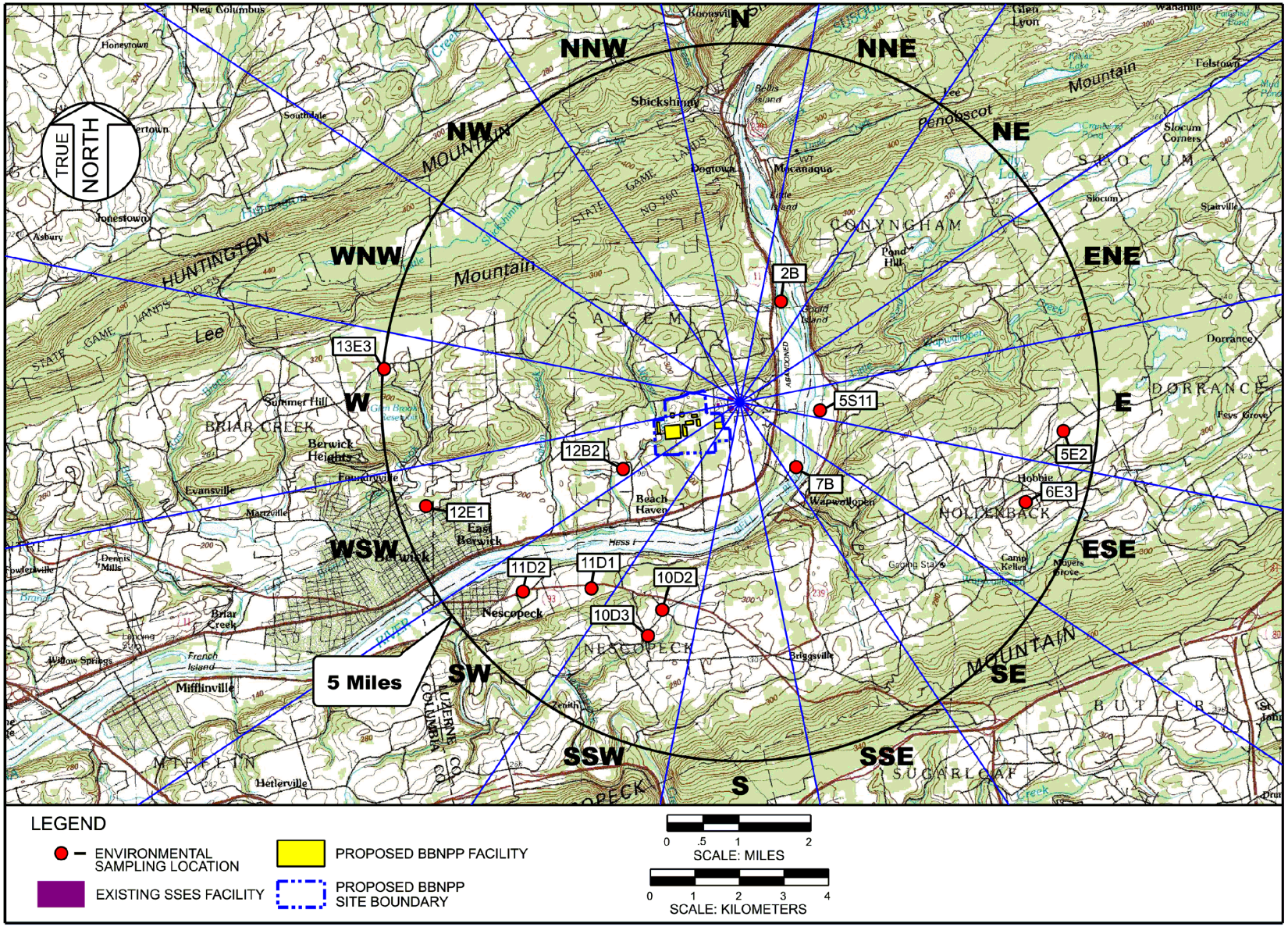
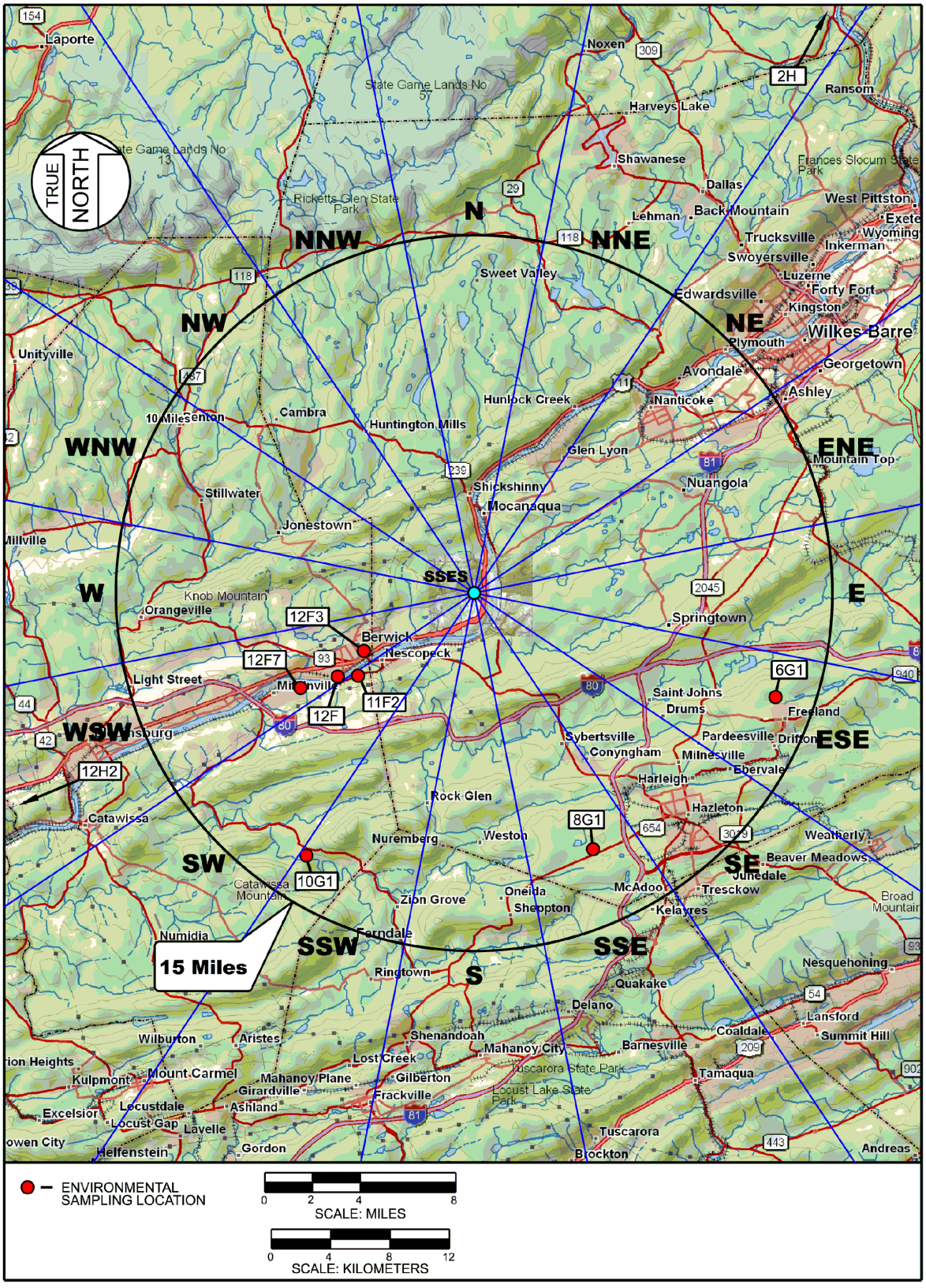


Figure 6.2-6 {Existing SSES Environmental Sampling Locations Greater than Five Miles}



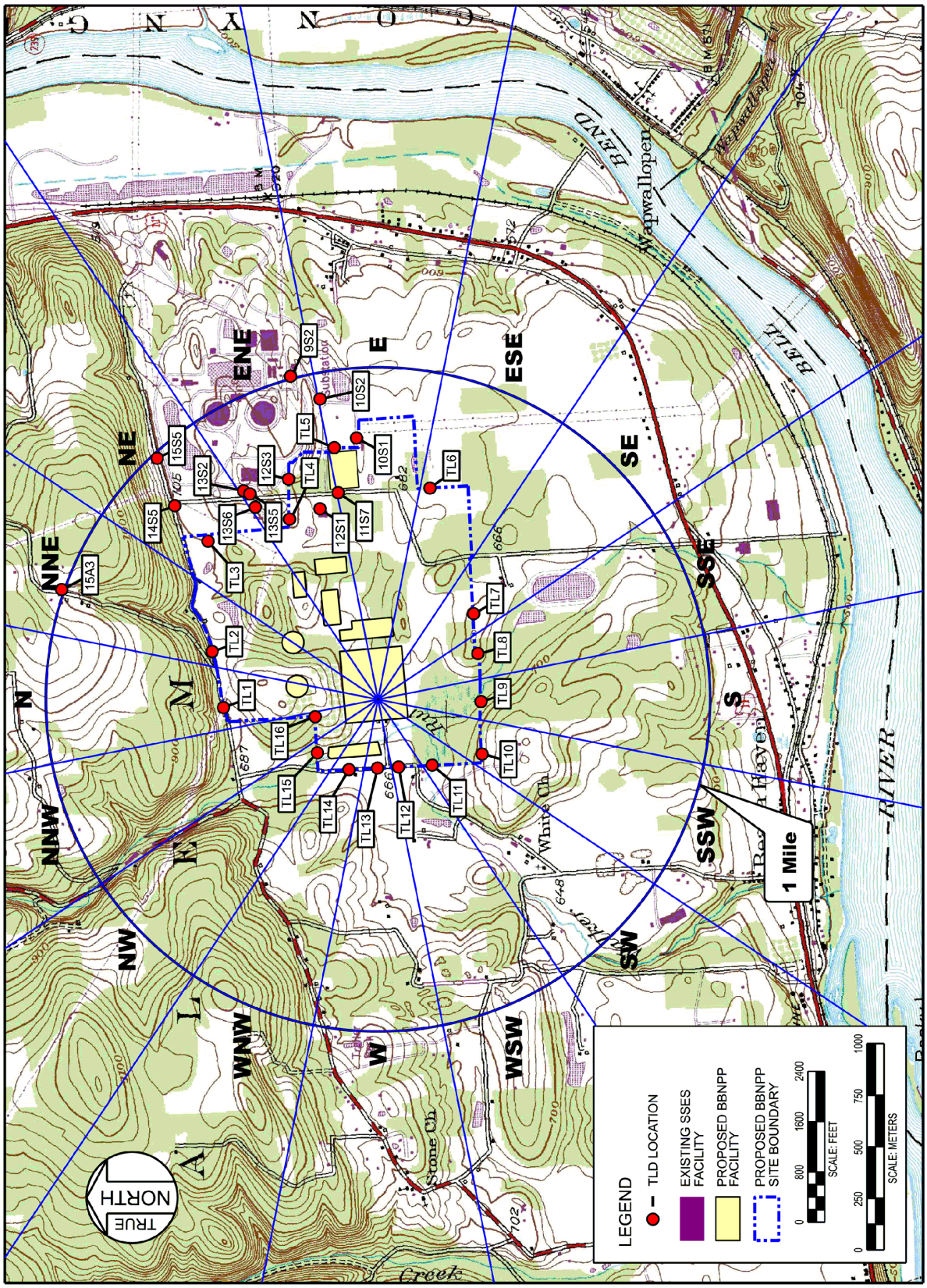


Figure 6.2-7 {BBNPP TLD Monitoring Locations Within One Mile of Plant}

Figure 6.2-8 {BBNPP TLD Monitoring Locations from One to Five Miles from Plant}}

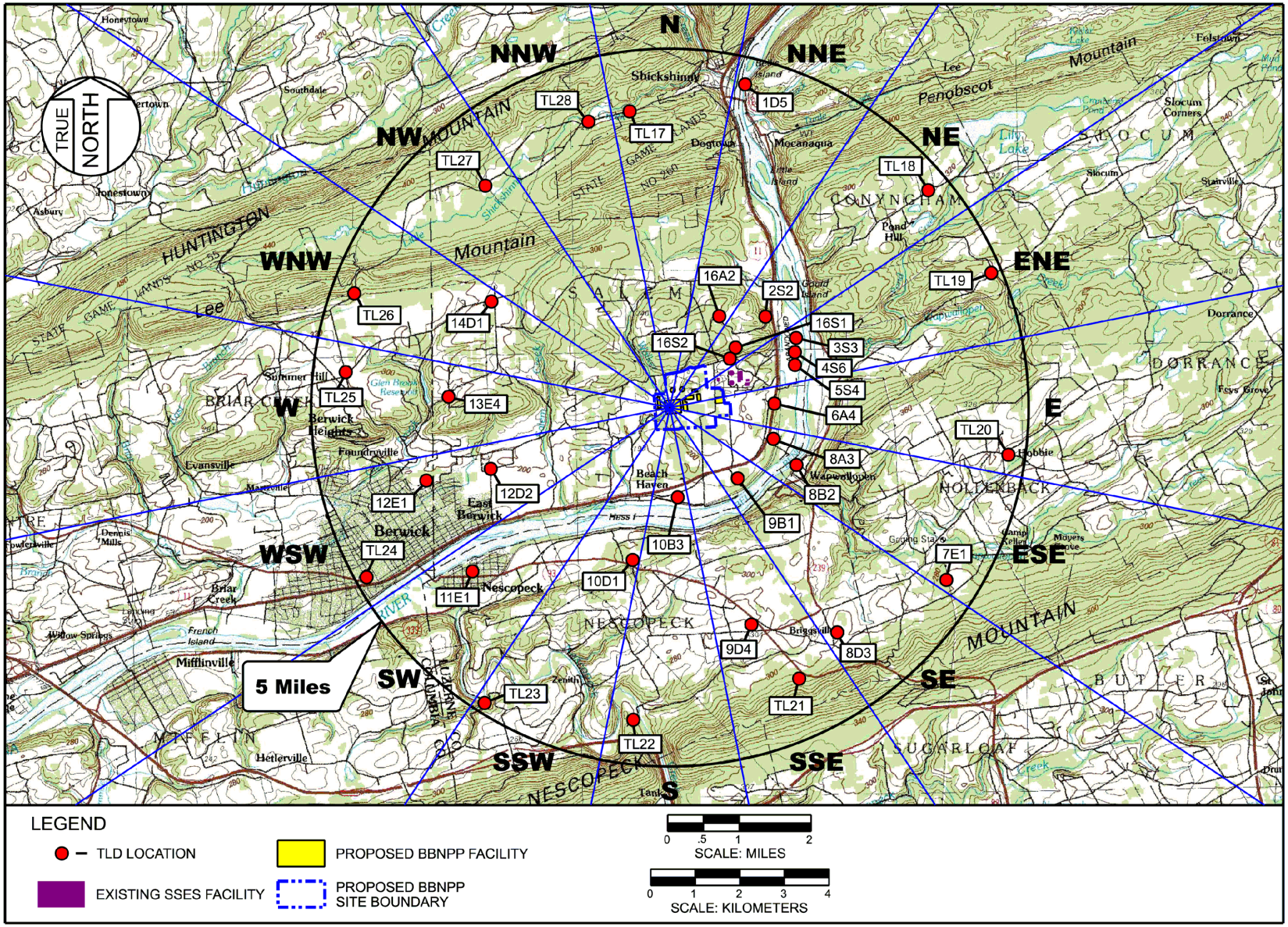
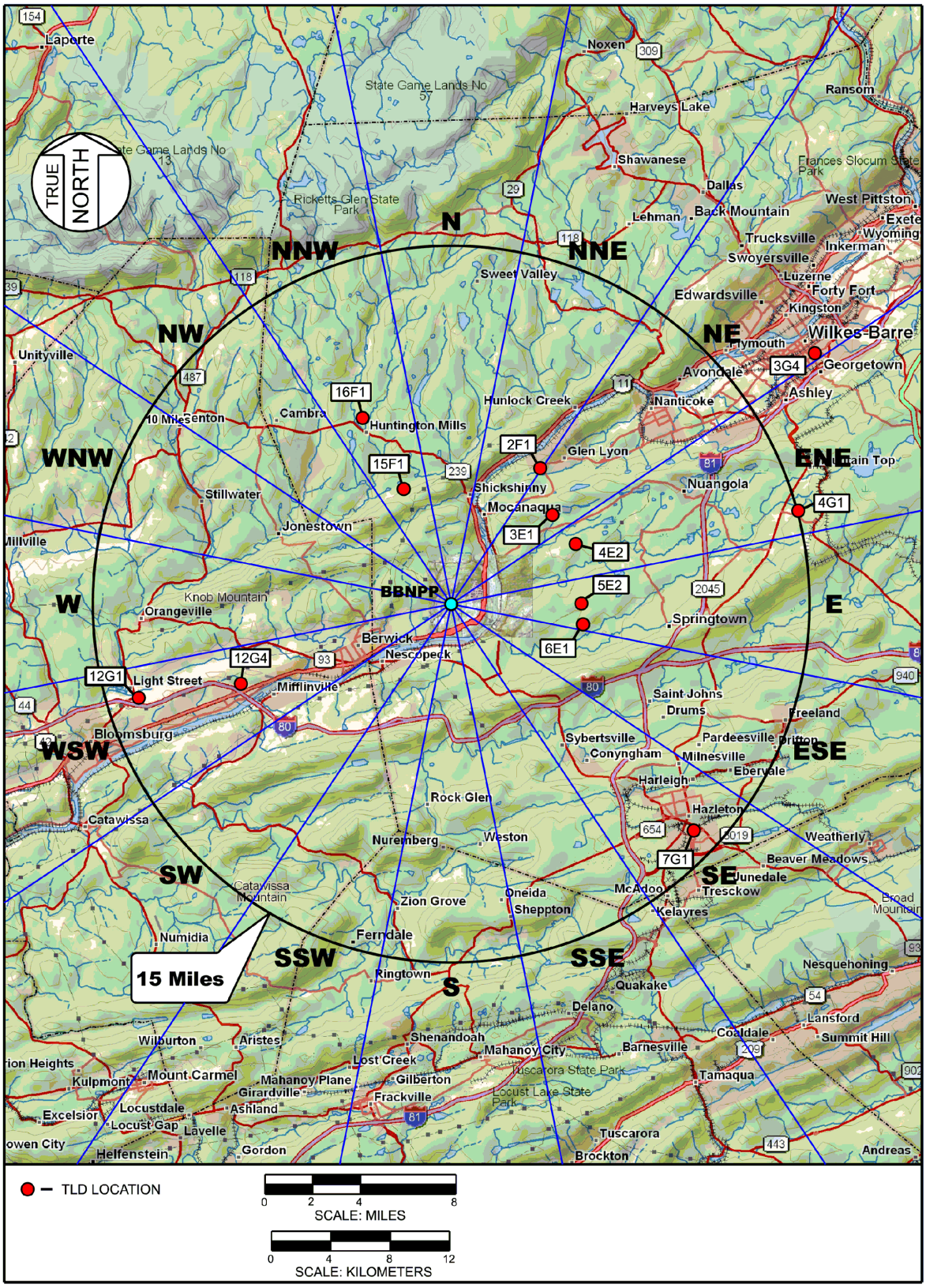


Figure 6.2-9 {BBNPP TLD Monitoring Locations Greater than 5 miles from Plant}



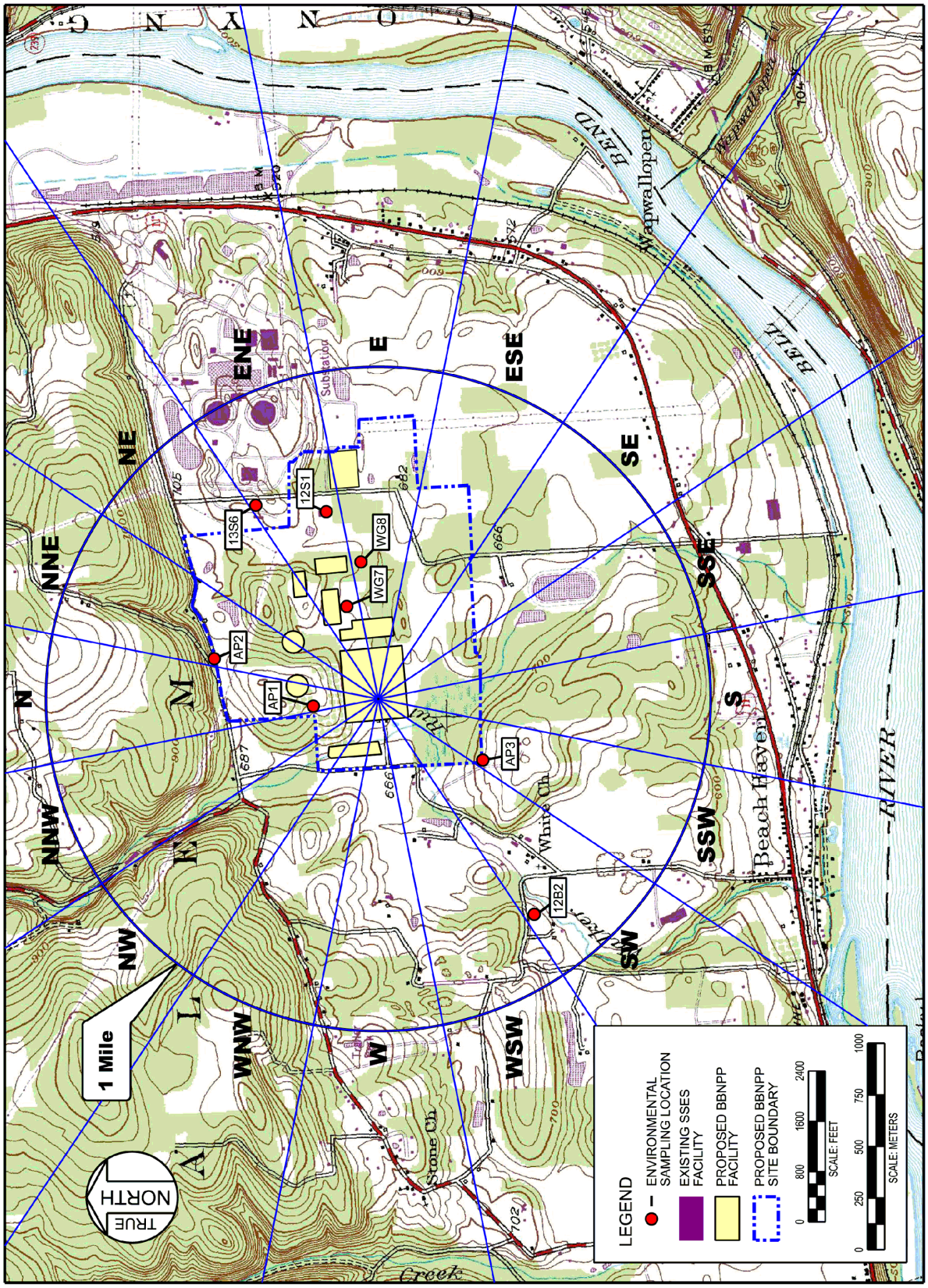


Figure 6.2-10 {BBNPP Environmental Sampling Locations Within One Mile of Plant}

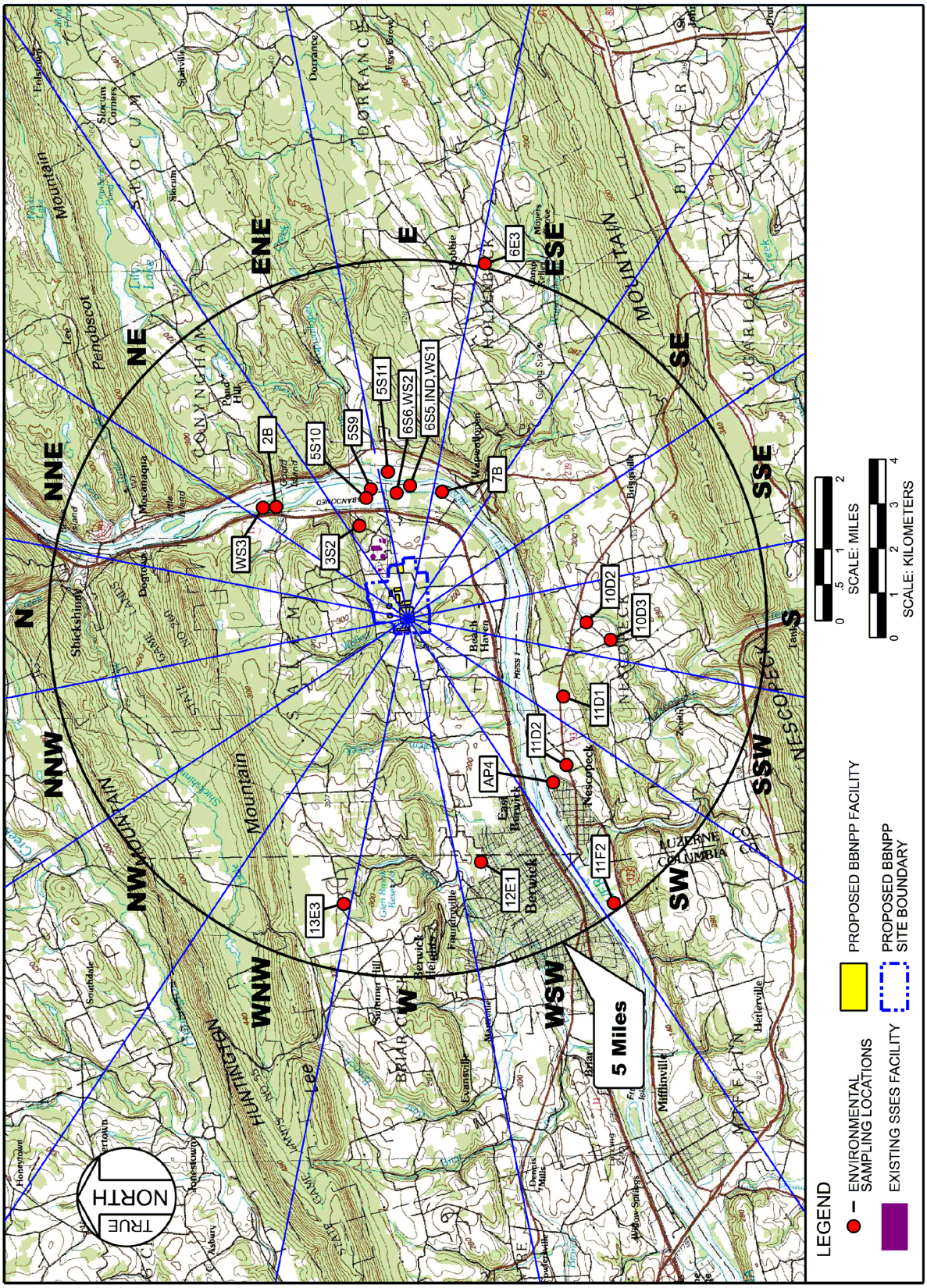


Figure 6.2-11 {BBNPP Environmental Sampling Locations from One to Five from Plant}

Figure 6.2-12 {BBNPP Environmental Sampling Locations that are Greater than 5 Miles from the Plant}

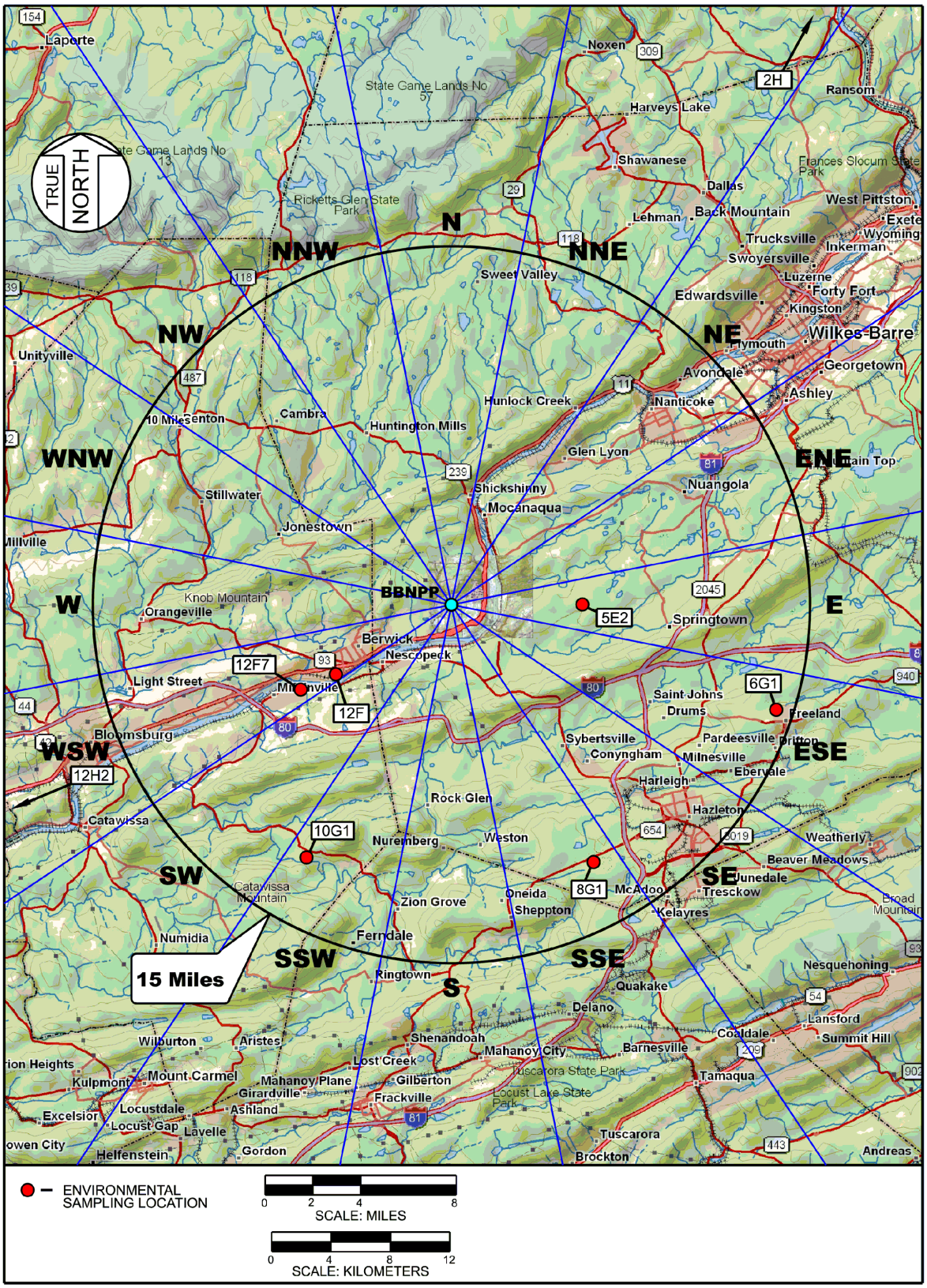
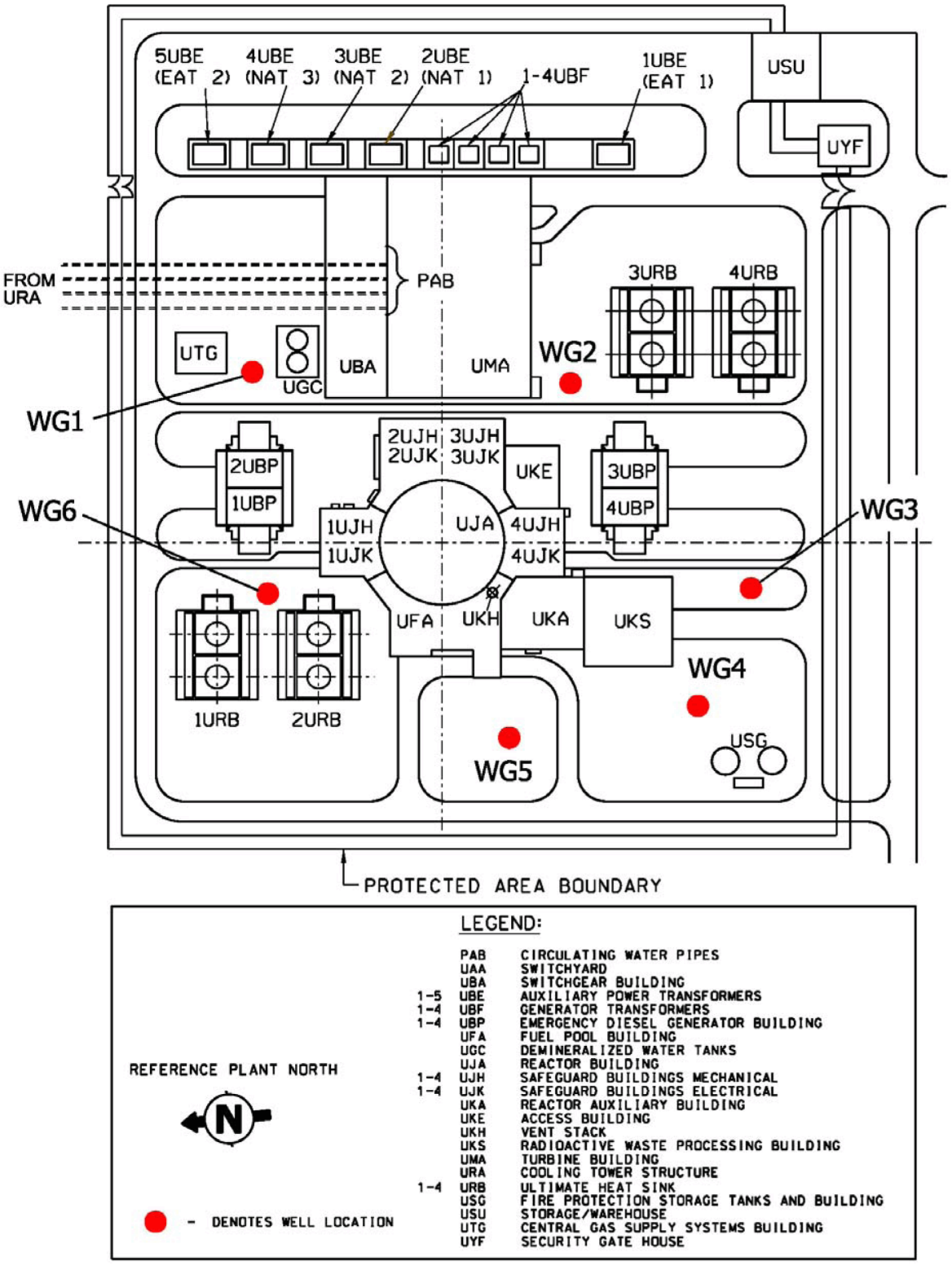


Figure 6.2-13 {BBNPP Ground Water Sampling Locations that are within the Protected Area Boundary}



6.3 HYDROLOGICAL MONITORING

This section describes the hydrological monitoring program that will be implemented to monitor the effects of the {BBNPP}. Elements of the hydrological program relating to thermal, radiological, and chemical monitoring are described separately in Section 6.1, Section 6.2, and Section 6.6, respectively.

This section includes the pre-application monitoring program that discusses the {existing hydrological monitoring program at the SSES site as well as the BBNPP site, and the} programs to monitor {BBNPP} during the construction/pre-operational and operational phases.

{Section 2.3.1 describes the vicinity watershed and stream flow data collected by the U.S. Geological Survey and the Pennsylvania Geological Survey. Groundwater velocities are discussed in Section 2.3.1.2. Flow rates are discussed in Section 2.3.1.1 and Table 2.3-2 and Table 2.3-7. Stream bank erosion is discussed in Sections 2.4.2, 4.2.1, 4.2.2, 4.3.1, and 4.3.2. Section 2.3.2 describes surface and groundwater uses. Features of the BBNPP site, including boundaries and bathymetry of all surface water bodies adjacent to the site are provided in Section 2.3.1. The location of groundwater monitoring wells are provided in Figure 2.3-32. The surface water monitoring locations are shown on Figure 2.3-33. The existing thermal and ecological monitoring stations are discussed in Section 6.1 and Section 6.5 for surface water. No thermal or ecological monitoring stations exist for groundwater and none are planned. Figures showing major geomorphic features and regional geology are shown in Section 2.3.1 and Section 2.6.}

6.3.1 PREAPPLICATION MONITORING

{Hydrological monitoring at the BBNPP site includes both surface water and groundwater. Both monitoring programs comply with and are controlled by regulatory permit requirements and conditions. Additional information on bathymetric characteristics of surface water, soil and groundwater characteristics, and transient hydrological parameters in the site vicinity are discussed in Section 2.3.1.}

6.3.1.1 Surface Water

{SSES conducts hydrological monitoring of surface water in accordance with the National Pollutant Discharge Elimination System (NPDES) program. Flows from storm water, plant-associated activities such as equipment blowdown, and various system effluents are measured at different monitoring locations. Table 6.3-1 lists the monitoring locations and the permit flow requirements. Refer to Section 6.6 for a description of the monitoring locations as well as the NPDES monitoring program data analysis and quality control procedures. Flow is monitored as described in Table 6.3-1 and reported to the Pennsylvania Department of Environmental Protection (PADEP) monthly.

In addition, water withdrawn from the Susquehanna River that is used for SSES plant system cooling is monitored as part of the Susquehanna River Basin Commission (SRBC) Regulation 806.30. Withdrawal is monitored daily and reported to SRBC quarterly and to PADEP annually.

Susquehanna River water flow and quality is monitored by Ecology III, Inc. on behalf of the SSES Environmental Laboratory. Water flow is measured daily upstream of the SSES intake structure. Water quality samples are taken on a quarterly basis upstream and downstream of the SSES

discharge. Results from the monitoring program are reported on a yearly basis (Ecology III, 2007).

Additional preapplication monitoring is described in Section 2.3.3.}

6.3.1.2 Groundwater

{As described in Section 2.3.2.2, the SSES site has nine groundwater wells that supply water for domestic and miscellaneous process water uses on either a regular or emergency basis. Section 2.3.2.2 describes the well locations, permit limits, and withdrawal volumes.

Groundwater observation wells were installed across the BBNPP site as discussed in Section 2.3.1. The wells were located in order to provide adequate distribution with which to determine site groundwater levels, subsurface flow directions, hydraulic gradients, and vertical gradients beneath the site. To evaluate vertical hydraulic gradients, several observation wells were installed as well clusters as discussed in Section 2.3.1. Well clusters are a series of wells placed at the same location, with each well monitoring a distinct water bearing unit.

Water levels in the observation wells were measured to characterize seasonal trends in groundwater levels and flow directions for the BBNPP site. Results are discussed and shown in Section 2.3.1.}

6.3.2 CONSTRUCTION AND PRE-OPERATIONAL MONITORING

{Hydrological monitoring at the BBNPP site during construction will include both surface water and groundwater. Both monitoring programs will comply with regulatory permit requirements and conditions described below. The objective of each program will be to establish a baseline for evaluating potential hydrologic changes, monitor anticipated impacts from site preparation and construction, and detect unexpected impacts}

6.3.2.1 Surface Water

Surface water onsite will be monitored as part of the NPDES Construction General Permit as described in Section 1.3. Conditions of the permit will include compliance with erosion/sediment control and storm water management plans, which will be detailed in a required Storm Water Pollution Prevention Plan (SWPPP). The SWPPP also requires inspections as well as monitoring and record keeping.

In addition, {Susquehanna River} surface water will be monitored during construction of {both the BBNPP intake and discharge structures.} Monitoring will be part of the U.S. Corps of Engineers, Clean Water Act 404 permit and PADEP 401 Water Quality Certification as described in Section 1.3 to ensure compliance with applicable water quality (e.g., turbidity) and sediment transport requirements.

6.3.2.2 Groundwater

Groundwater monitoring during {BBNPP} construction will include, as needed, data from groundwater observation wells installed across the {BBNPP} site as part of COL preapplication studies described in Section 2.3.1.2. The purpose will be to monitor the potential effects of dewatering on perched water levels.

{Some of the existing BBNPP area observation wells may be taken out of service prior to construction activities due to earth moving and construction requirements. Prior to construction activities, the observation well monitoring network will be evaluated in order to determine groundwater data gaps and needs created by the abandonment of existing wells. These data needs will be met by the installation of additional observation wells, if required. Additionally, the hydrologic properties and groundwater flow regimes of the shallow water bearing units will be impacted by the proposed earthmoving, regrading, and construction of infrastructure (buildings, parking lots, etc.). Revisions to the observation well network will be implemented to ensure that the resulting changes in the local groundwater regime from construction activities will be identified.

No groundwater wells are anticipated for consumptive use during construction.}

Disturbances to existing drainage systems will be avoided, if possible. {Environmental controls (i.e., silt screens, dams, settling basins, and spill containment measures), will be implemented to reduce potential pollutants in storm water runoff and to minimize construction impacts to aquatic habitats. Prior to the start of construction, approval of storm water management and erosion/ sediment control plans will be obtained in accordance with the NPDES Construction General Permit as described in Section 1.3. These controls will be incorporated into a Storm Water Pollution Prevention Plan (SWPPP).}

6.3.3 OPERATIONAL MONITORING

Hydrological monitoring during {BBNPP} operation will be designed, as needed, to monitor the potential impacts from plant operation as well as detect unanticipated operational impacts.

During {BBNPP} operation, plant water supply will be from the {Susquehanna River} at a {BBNPP intake structure to be located on the Susquehanna River downstream of the existing SSES intake}. The principle potable (fresh water) source will be from {the Pennsylvania American Water Company. Operation of the BBNPP intake structure will require surface water monitoring and reporting as part of the SRBC Regulation 806.30 and the PA Water Resources Planning Act. In addition, discharge effluents to the Susquehanna River from BBNPP during} operation will require monitoring as discussed in Section 6.6.

{As discussed in more detail in Section 3.6.2, sanitary sewage effluent will be directed to a sewer main for off-site treatment at a Publicly Owned Treatment Works (POTW) and monitored as required in accordance with any local sewer use ordinances.

Non-radioactive liquid effluents that could potentially drain to the Susquehanna River will be limited under a NPDES permit with the PADEP. An anticipated list of permitted outfalls is included in Section 3.6.3.2. Non-radioactive liquid waste effluents from various sources are listed in Table 3.6-2 and Table 3.6-4. Table 3.6-1 provides information on the various chemicals anticipated to be used for the various plant water treatment systems. Chemical additives will have limiting discharge concentrations specified in the NPDES permit.}

Chemical monitoring will be performed at the {BBNPP} to assess the effectiveness of retention methods and effluent treatment systems, as well as to detect changes in water quality associated with plant operations. {BBNPP} chemical monitoring will also be performed at {stormwater runoff} outfalls and at internal monitoring points (i.e., sanitary waste effluents, wastewater

retention basin influent and/or effluent). Effluent water chemistry will meet applicable Federal and State environmental regulatory requirements.

Finally, NRC regulations do not explicitly require routine, onsite groundwater monitoring during plant operation. However, a recent nuclear industry initiative by the Nuclear Energy Institute (NEI) and Electric Power Research Institute (EPRI) and NRC assessment (NRC, 2006) of existing nuclear reactors indicates that regulations relating to groundwater monitoring during plant operation for present and future nuclear reactors may change.

6.3.4 REFERENCES

{**Ecology III, 2007**. Environmental Studies in the vicinity of the Susquehanna Steam Electric Station, 2006 water quality and fishes. Prepared for PPL Susquehanna, LLC.

NRC, 2006. Liquid Radioactive Release Lessons Learned Task Force, Final Report, Nuclear Regulatory Commission, September 1, 2006.}

Table 6.3-1 SSES Units 1 and 2 NPDES Hydrological Monitoring Program

Monitoring Station	Description	Parameter	Frequency	Sample Type
Outfall 070	Stormwater From S-2 Pond	Note (a)	NA	NA
Outfall 071	Cooling Tower Blowdown	Flow	Daily	Recorded
Outfall 072	Service and Admin. Building Low Volume Waste Sump	Flow	Daily When Discharging	Estimate
Outfall 073	Unit #1 Turbine Bldg Low Volume Waste Sump	Flow	Daily When Discharging	Estimate
Outfall 074	Unit #2 Turbine Bldg Low Volume Waste Sump	Flow	Daily When Discharging	Estimate
Outfall 075	Stormwater From Peach Stand Pond	Note (a)	NA	NA
Outfall 079	Sewage Treatment Plant	Flow	Daily	Pump rate or Weir
Outfall 080	Stormwater From C-1 Pond	Note (a)	NA	NA
Outfall 171	Radwaste Treatment Bldg	Flow	Daily When Discharging	Estimate
Outfall 371	Neutralization Basin	Flow	Daily When Discharging	Estimate

Note:
(a) No flow requirement

6.4 METEOROLOGICAL MONITORING

This section describes the meteorological monitoring program that will be implemented for the {BBNPP}. It includes the pre-application and pre-operational meteorological monitoring program consisting of {the existing meteorological monitoring program for SSES Units 1 and 2} and the operational meteorological monitoring program utilizing the BBNPP meteorological tower. There are no unusual circumstances anticipated during site preparation and construction that require additional meteorological monitoring.

The other source of meteorological data used was from the U.S. National Weather Service (NWS). This data is certified by the National Climate Data Center (NCDC, 2007).

6.4.1 PRE-APPLICATION AND PRE-OPERATIONAL METEOROLOGICAL MEASUREMENT PROGRAM

{The pre-application and pre-operational meteorological monitoring program for BBNPP is the operational program for SSES Units 1 and 2. This program complies with the second proposed Revision 1 of Regulatory Guide 1.23 (NRC, 1986). Delta temperature accuracy criteria is provided in Safety Guide 23, Onsite Meteorological Programs (NRC, 1972). There are currently three monitoring locations at SSES: a primary meteorological tower, a backup tower and a supplemental (downriver) tower (described below in greater detail). The pre-applicatoin and pre-operational meteorological monitoring program for BBNPP only includes data from the primary SSES meteorological tower.}

6.4.1.1 Tower Location

{The site is about 5 mi (8 km) NE of Berwick, Pennsylvania. The primary meteorological tower for the SSES is located on-site (650 ft (198 m) msl) approximately 1115 ft (340 m) to the southeast of the cooling towers. The area is generally level, increasing slightly in elevation to the north and west. South and east of the tower the topography slopes down towards the Susquehanna River. Vegetation in the immediate vicinity consists of low weeds with some deciduous trees in a gully to the south. The deciduous trees are approximately 40 ft (12 m) in height and are approximately 100 ft (30 m) from the tower. An ash facility exists approximately 185 ft (56 m) north of the tower. The maximum height of this structure is approximately 30 ft (9 m).

Figure 6.4-1, Site Map with Meteorological Tower Location, presents the location of the meteorological towers as well as the topography within a 1 mi (1.6 km) radius of the BBNPP site. Figure 6.4-2, Detailed Topography Within 5 mi (8 km), also presents the general topographic features of the region.}

6.4.1.2 Tower Design

{The SSES meteorological tower is a 200 ft (61 m) open-lattice steel framed tower.

The primary data recording system used for the SSES meteorological tower is a digital data acquisition system. All telemetry transmitters, translators and a data logger are housed in a weatherproof cinderblock building. This building has thermostatically controlled heating and air conditioning. The secondary recording system is the SSES Control Room recorders.}

6.4.1.3 Instrumentation

{Instruments at the SSES meteorological tower monitor temperature, delta temperatures, wind speed and direction, sigma theta, dew point and precipitation.

The temperature measuring system consists of multiple thermistor composite sensors. Two sensors are mounted in motor aspirated shields at each of the 33 ft (10 m) and 197 ft (60 m) levels (above ground level). Vertical dispersion coefficients are computed from the vertical temperature differences.

Wind speed and direction are monitored at the 33 ft (10 m) and 197 ft (60 m) levels using a 3-cup anemometer and a counterbalanced lightweight vane. The standard deviation of the wind direction (sigma theta) is measured at 33 ft (10 m) and 197 ft (60 m) and is used to compute horizontal dispersion coefficients. Sigma theta calculations based on wind direction measurements are used as a backup to temperature difference readings to monitor atmospheric stability.

The dew point temperature is measured at the 33 ft (10 m) level using a sensor consisting of bifilar gold electrodes wound on a lithium chloride impregnated wick.

Precipitation is measured at the base of the tower using a heated tipping bucket rain gauge. This is a remote reading rain gauge which produces a signal proportional to total rainfall.

Table 6.4-1 provides the current meteorological instrument accuracies and ranges and compares them with the guidance provided in Regulatory Guide 1.23, Revision 1 (NRC, 2007).}

6.4.1.4 Instrument Maintenance and Surveillance Schedules

{All calibration and maintenance is performed at least semi-annually in accordance with the frequencies and procedures prescribed in the manufacturer's operating and maintenance manual.}

6.4.1.5 Data Reduction and Compilation

{The primary data recording system is a digital data acquisition system. The analog recording system provides a backup in case of digital system failure, so that a high data recovery rate can be maintained. Data recovery rates for the SSES meteorological monitoring program have consistently been greater than 95%. Recovery rates for each year from 1999 through 2003 were above 95% for all instruments, except the recovery rate for dew point in 2000 which was 87.2%. The five year average recovery rates for all instruments was greater than 95% for this period.

Section 2.3.3.6 of the SSES FSAR, Rev. 60 (SSES, 2005) describes the analytical data reduction procedures used to produce hourly averages and other specified meteorological compilations. In summary, Section 2.3.3.6 of the SSES Units 1 and 2 FSAR provides procedures for the following:

- For temperature and dew point, computing hourly averages from one-minute observations
- Treatment of calm wind conditions
- Computing hourly averages for wind speed and wind direction

- Replacement of invalid or missing digital data with analog data
- Substituting data from the secondary (197 ft (60 m)) tower level for unavailable data from the primary (33 ft (10 m)) tower level
- Reducing the 197 ft (60 m) wind speed to the equivalent 10-meter value utilizing the wind power law.

The hourly values of the meteorological parameters are then processed to obtain the following compilations:

- Joint frequency distributions of wind speed and stability for lower and upper levels
- Wind direction persistence summaries by stability class
- Maximum, minimum and diurnal variation of temperature and humidity
- Annual average values of relative concentration with direction and distance
- Frequency distribution of concentrations for the 0-2 hour, 0-8 hour, 8-24 hour, 1-4 day and 4-30 day time periods.}

6.4.1.6 Nearby Obstructions to Air Flow

{Downwind distances from the SSES meteorological tower to nearby (within 0.5 mi (0.8 km)) obstructions to air flow were determined using U.S. Geological Survey topographical maps. Highest terrain is to the west and north. Lowest terrrain is to the northeast through southeast (river valley). Table 6.4-2 presents the distances to nearby obstructions to air flow in each downwind sector.

A study performed to determine the effect of the SSES Unit 1 and 2 cooling towers on meteorological measurements at SSES concluded that the impact of the cooling towers on wind speed measurements is minimal and the effect on wind direction measurements is nearly non-existent.}

6.4.1.7 Deviations to Guidance from Regulatory Guide 1.23

{The pre-operational meteorological monitoring program for BBNPP deviates from the guidance provided in Regulatory Guide 1.23, Revision 1 (NRC, 2007) The SSES meteorological tower is not at a distance at least 10 times the height of any nearby obstruction that exceeds one-half the height of the wind measurement. Further discussion is provided in Section 6.4.1.1. The SSES meteorological tower is not at the same elevation as the finished BBNPP grade. The SSES tower location was selected to assure the meteorological tower was located on level, open terrain at a suitable distance from any nearby obstructions and complies with the guidance of the second proposed revision to Reguatory Guide 1.23, Revision 1 (NRC, 1986). Also, the resolution of the existing sensors does not meet the measurement resolution recommended in Regulatory Guide 1.23, Revision 1.

The tower, guyed wire, and anchor inspections are performed once every 5 years instead of an annual inspection for tower and guyed wire and an anchor inspection of once every 3 years as provided in Regulatory Guide 1.23, Revision 1.}

6.4.2 OPERATIONAL METEOROLOGICAL MEASUREMENT PROGRAM

{The operational meteorological monitoring program for BBNPP utilizes the BBNPP meteorological tower and its instrumentation, telemetry and data recording system. This program is designed according to the guidance provided in Regulatory Guide 1.23, Revision 1 (NRC, 2007).

Information relating to the BBNPP meteorological tower location and support facilities for the operational meteorological monitoring program is contained in Section 6.4.2.1 and Section 6.4.2.2. Likewise, Section 6.4.2.3 contains general instrument information.

Table 6.4-3 presents detailed information on the BBNPP meteorological tower instrument types and specifications and compares them with regulatory requirements from Regulatory Guide 1.23, Revision 1 (NRC, 2007). Information relating to operational instrument maintenance and service schedules contained in Section 6.4.2.4. Data reduction and compilation is contained in Section 6.4.2.5.}

6.4.2.1 Tower Location

{The BBNPP meteorological tower is located approximately 3577 ft (1090 m) ESE of the BBNPP Reactor Building. Grade at the tower is approximately 670 ft (204 m) msl. Figure 6.4-1, Site Map with Meteorological Tower Location, presents the location of the meteorological towers as well as the topography within a 1 mi (1.6 km) radius of the BBNPP site. Figure 6.4-2, Detailed Topography Within 5 mi (8 km), presents the general topographic features of the region.}

6.4.2.2 Tower Design

{The BBNPP meteorological tower is a 200 ft (61 m) open-lattice steel framed tower.

The primary data recording system used for the BBNPP meteorological tower is a digital data acquisition system. All telemetry transmitters, translators and a data logger are housed in a weatherproof cinderblock building. This building has thermostatically controlled heating and air conditioning. The secondary recording system is the Process Information and Control System (PICS) described in Section 7.1.1.3.2 of the U.S. EPR FSAR.}

6.4.2.3 Instrumentation

{The instrumentation for the meteorological tower is outlined in Table 6.4-3.}

6.4.2.4 Instrument Maintenance and Surveillance Schedules

{The BBNPP meteorological tower instrument maintenance and surveillance includes channel checks performed daily, and channel calibrations performed semiannually. System calibrations encompass entire data channels, including all recorders and displays (e.g., those local at the meteorological tower and in the emergency response facilities, as well as those used to compile the historical data.}

6.4.2.5 Data Reduction and Compilation

{The BBNPP meteorological tower data collection uses electronic digital data acquistion systems as the primary data recording system and conforms to the guidance in Regulatory Guide 1.23, Revision 1 (NRC, 2007).}

6.4.2.6 Nearby Obstructions to Air Flow

{Downwind distances from the BBNPP meteorological tower to nearby (within 0.5 mile or 0.8 km) obstructions to air flow were determined using U.S. Geological Survey topographical maps. Highest terrain is to the west and north. Lowest terrain is to the northeast through southeast (river valley). Table 6.4-5 presents the distances to nearby obstructions to air flow in each downwind sector.

Table 6.4-4 presents building heights and distances from various structures to the BBNPP meteorological tower. The BBNPP cooling towers are 475 ft (145 m) tall and the SSES cooling towers are 540 ft (165 m) tall. The two tallest EPR buildings are the Reactor Building 204 ft (62 m) and the Turbine Building 180 ft (55 m). The Turbine Building is also the closest major building to the meteorological tower. Both buildings will be a finished grade of approximately 674 ft (205 m) msl. Grade at the BBNPP meteorological tower is approximately 670 ft (204 m) msl. This small difference in grade between finished site grade and the meteorological tower grade is acceptable per Regulatory Guide 1.23, Revision 1.

All EPR buildings are greater than a factor of ten times their respective heights away from the meteorological tower, and as such are not expected to impact the meteorological measurements. The BBNPP and SSES cooling towers are closer than a factor of ten times their respective heights away from the BBNPP meteorological tower. This deviation from Regulatory Guide 1.23, Revision 1 has a minimal influence on the BBNPP meteorological tower instruments as discussed in the study described below.

A study performed to determine the effect of the SSES Unit 1 and 2 cooling towers on meteorological measurements at SSES (refer to Section 6.4.1.6) concluded that the impact of the cooling towers on wind speed measurements is minimal and the effect on wind direction measurements is nearly non-existent. Since the BBNPP meteorological tower is further away from the SSES cooling towers than the SSES meteorological tower, it is concluded that there will be little to no impact on wind measurements made at the BBNPP meteorological tower due to the SSES cooling towers. Similarly, since the BBNPP meteorological tower is further away from the BBNPP cooling towers than the SSES meteorological tower is to the SSES cooling towers, it is concluded that there will be little to no impact on wind measurements made at the BBNPP meteorological tower due to the BBNPP cooling towers. In addition, the predominant wind direction for the site has been from the east-northeast at the 10 m level and from the north-northeast at the 60 m level with secondary peaks at both levels from the southwest. Due to the orientation of the BBNPP meteorological tower with respect to the BBNPP and SSES cooling towers, the influence of the local meteorology will act also to minimize the impact of the cooling towers on meteorological measurements.}

6.4.2.7 Deviations to Guidance from Regulatory Guide 1.23

{The only deviation to the guidance from Regulatory Guide 1.23, Revision 1 (NRC, 2007) is the criterion that the distance of any nearby obstructions are at least 10 times the height of the structure that exceeds one-half of the height of the wind measurement away from the meteorological tower. The BBNPP and SSES cooling towers do not meet this distance criterion for the BBNPP meteorological tower.}

6.4.3 REFERENCES

{**NRC, 1972**. Onsite Meteorological Programs, Safety Guide 23 (Regulatory Guide 1.23 Revision 0), U.S. Nuclear Regulatory Commission, February 1972.

NRC, 1986. Meteorological Measurement Program For Nuclear Power Plants, Regulatory Guide 1.23, Second Proposed Revision 1, U.S. Nuclear Regulatory Commission, April 1986.

NRC, 2007. Meteorological Monitoring Programs for Nuclear Power Plants, Regulatory Guide 1.23, Revision 1, U.S. Nuclear Regulatory Commission, March 2007.

SSES, 2005. Susquehanna Steam Electric Station, Final Safety Analysis Report, Rev. 60, pp. 2.3-12 through 2.3-18, June 2005.}

Table 6.4-1 {SSES Meteorological Tower Instrument Types, Specifications and Accuracies for Pre-Application and Pre-Operational Programs}

Characteristics	Requirements*	Specifications
Wind Speed Sensor		
Make		Climatronics
Model		100075
Starting Threshold	< 1 mph (0.45 m/s)	0.5 mph
Range		0-50 mph
Accuracy	+/- 0.2 m/s (+/- 0.45 mph) or 5% of observed wind speed	+/- 1.0% or +/- 0.15 mph, whichever is greater
Wind Direction Sensor		
Make		Climatronics
Model		100076
Starting Threshold	< 1 mph (0.45 m/s)	0.5 mph
Range		0-540 degrees
Accuracy	+/- 5 degrees	+/- 2 degrees
Temperature Sensors		
Make		Climatronics
Model		100093
Range (ambient)		-20°F to +100°F
Range (vertical temperature diference)		-5°F to +5°F
Accuracy (ambient)	+/- 0.5°C (+/- 0.9°F)	+/- 0.15°C
Accuracy (vertical temperature difference)	+/- 0.1°C (+/- 0.18°F)	+/- 0.1°C
Dew Point Sensor		
Make		Climatronics
Model		101197
Range		-40°F to +100°F
Accuracy	+/- 1.5°C (+/- 2.7°F)	+/- 0.5°C
Precipitation Sensor		
Make		Climatronics
Model		100097-1
Accuracy	+/- 10% for a volume equivalent to 2.54 mm (0.1 in.) of precipitation at a rate of 50 mm/h (< 2 in./h)	+/- 1.0% at 3 inches per hour

* Accuracy requirements from Regulatory Guide 1.23, Revision 1, March 2007

Table 6.4-2 {Distances from the SSES Meteorological Tower to Nearby Obstructions to Air Flow}

Downwind Sector*	Approximate Distance miles (meters)
N	0.5 (805)
NNE	N/A**
NE	N/A**
ENE	N/A**
E	N/A**
ESE	N/A**
SE	N/A**
SSE	N/A**
S	N/A**
SSW	0.5 (805)
SW	0.5 (805)
WSW	N/A**
W	0.35 (563)
WNW	0.36 (579)
NW	0.5 (805)
NNW	0.5 (805)

* With respect to True North

** Lower than base elevation and therefore no possible obstructions

Table 6.4-3 {BBNPP Meteorological Tower Instrument Types, Specifications and Accuracies for Operation Program}

Measurement	System Accuracy*	Measurement Resolution*
Wind Speed	+/- 0.2 m/s (+/-0.45 mph) or 5% of observed wind speed starting threshold <0.45 m/s (1 mph)	0.1 m/s or 0.1 mph
Wind Direction	+/- 5 degree starting threshold <0.45 m/s (1 mph)	1.0 degree
Ambient Temperature	+/-0.5°C (+/-0.9°F)	0.1°C or 0.1°F
Vertical Temperature Difference	+/-0.1°C (+/-0.18°F)	0.01°C or 0.01°F
Dew Point Temperature	+/-°1.5°C (+/-2.7°F)	0.1°C or 0.1°F
Wet-Buld Temperature	+/-0.5°C (+/-0.9°F)	0.1°C or 0.1°F
Relative Hum	+/-4%	0.1%
Precipitation (water equivalent	+/-10% for a volume equivalent to 2.54 mm (0.1 in) of precipitation at a rate <50 mm/h (<2 in/h)	0.25 mm or 0.01 in
Time	+/- 5 min	1 min
*Resolution and Accuracy requirements consistent with Regulatory Guide 1.23, Revision 1 March 2007		

Table 6.4-4 {Distances from the U.S. EPR Major Buildings to the BBNPP Meteorological Tower}

Building	Height	Distance to Meteorological Tower
BBNPP Reactor Building	62 m (203 ft) above grade	1090 m (3577 ft) (estimated)
BBNPP Turbine Building	55 m (180 ft) (estimated)	950 m (3115 ft) (estimated)
BBNPP Cooling Tower (closest)	145 m (475 ft)	1048 m (3438 ft)
SSES Cooling Tower (closest)	165 m (540 ft)	844 m (2769 ft)

Table 6.4-5 {Distances from BBNPP Met Tower to Nearby Obstructions to Air Flow}

Downwind Sector*	Approximate Distance miles (meters)
N	0.45 (724)
NNE	0.45 (724)
NE	N/A**
ENE	N/A**
E	N/A**
ESE	N/A**
SE	N/A**
SSE	N/A**
S	N/A**
SSW	N/A**
SW	0.25 (402)
WSW	0.40 (644)
W	0.30 (483)
WNW	0.45 (724)
NW	0.5 (805)
NNW	0.5 (805)

* With respect to True North

** Lower than base elevation and therefore no possible obstructions

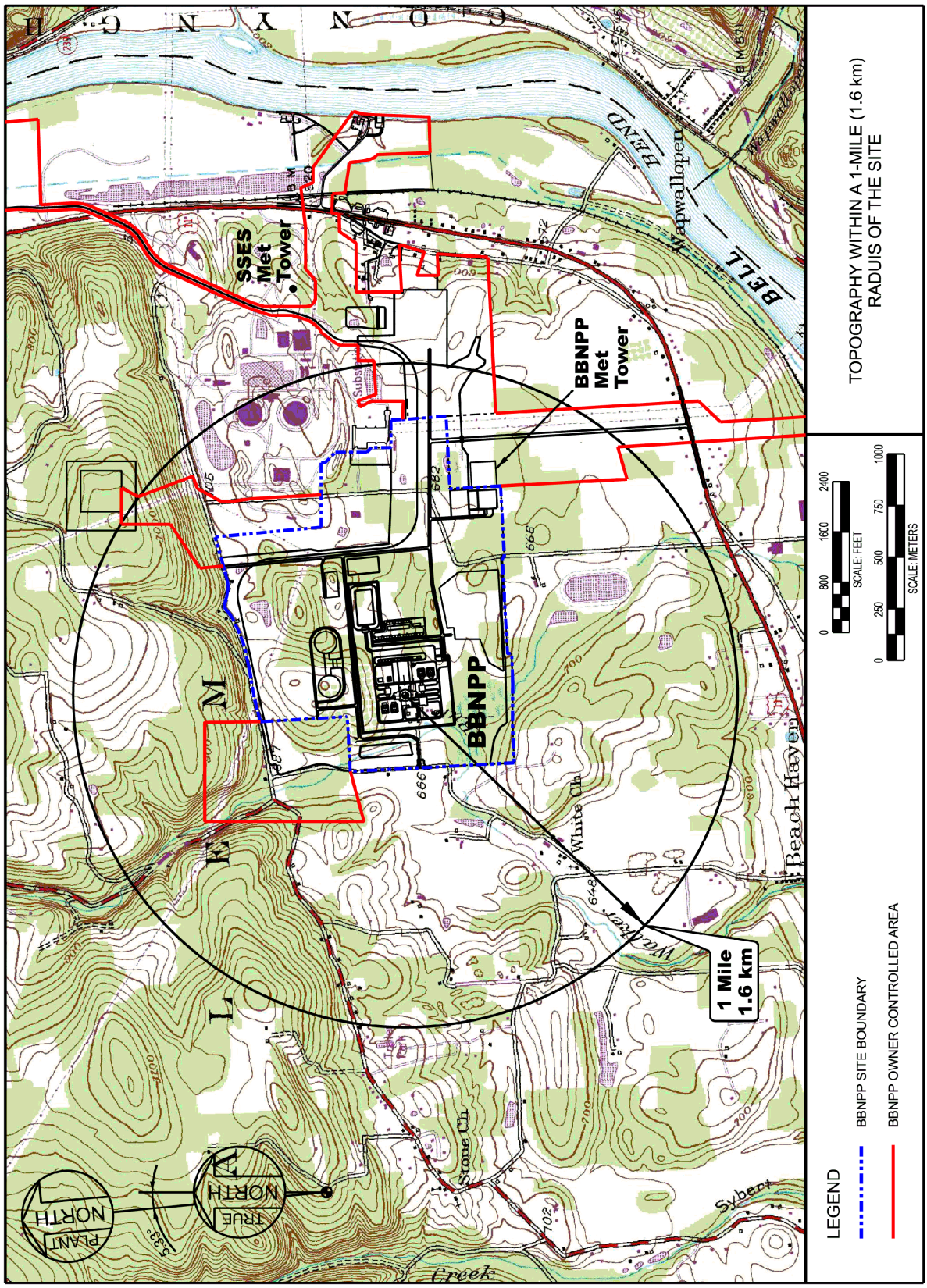


Figure 6.4-1 {Topography within a 1-Mile (1.6 km) Radius of the Site}

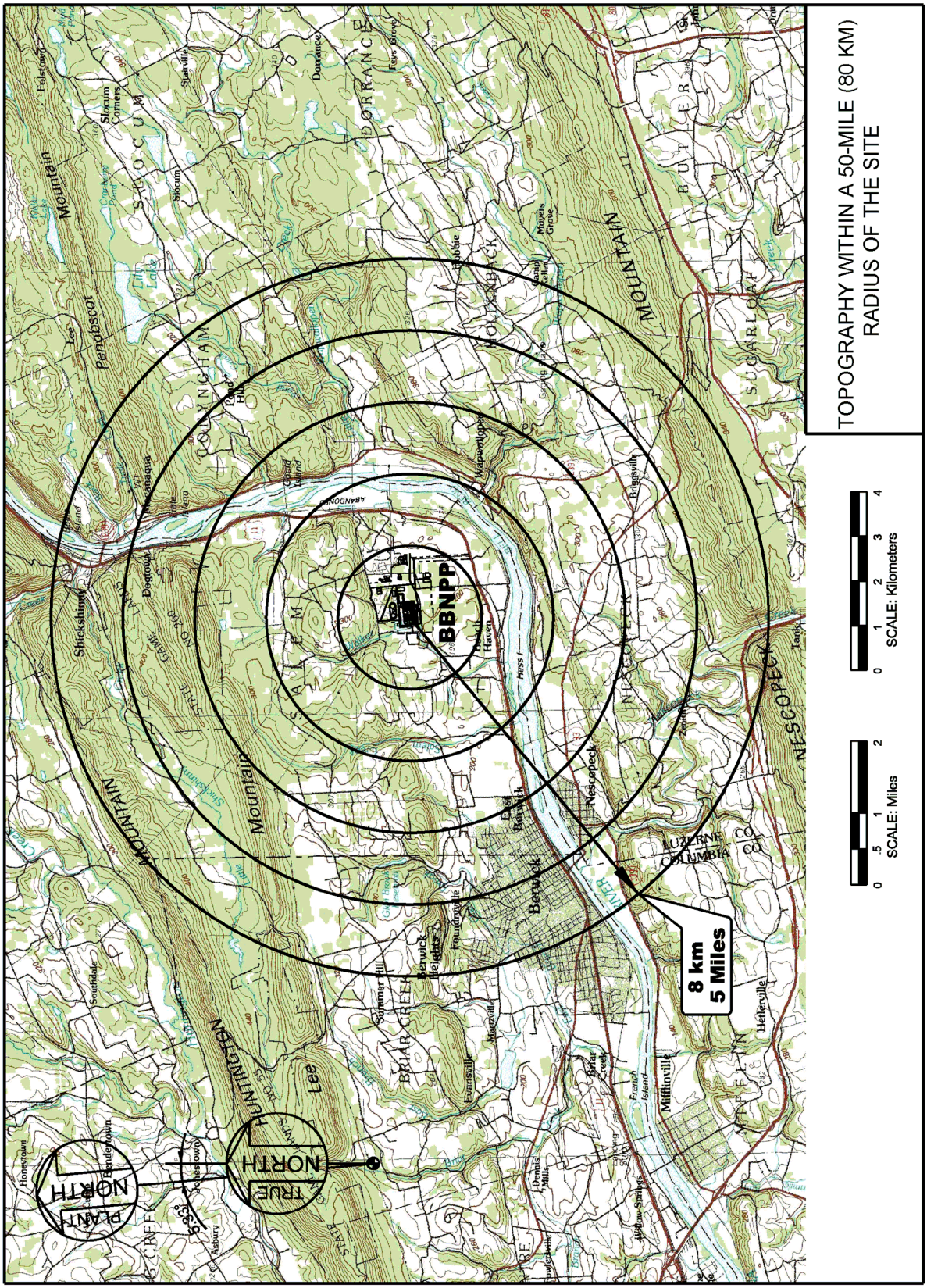


Figure 6.4-2 {Topography within a 5-Mile (8 km) Radius of the Site}

6.5 ECOLOGICAL MONITORING

The following sections present information regarding ecological monitoring for terrestrial ecology, land use, and aquatic ecology of the {Bell Bend Nuclear Power Plant (BBNPP) site} areas likely to be affected by site preparation, construction, and operation and maintenance of {BBNPP}. The monitoring programs are designed based on anticipated environmental impacts through the various stages of {BBNPP} project implementation. This section complies with NRC Regulatory Guide Sections 4.7 and 4.11 regarding general site suitability studies and terrestrial environmental studies to allow reasonably certain predictions that there are no significant impacts to the terrestrial ecology associated with the construction or operation of {BBNPP}.

Monitoring programs to detect changes in the ecology begin before application submittal and continue during site preparation and construction and throughout station operation and maintenance. The monitoring programs cover elements of the ecosystem where a causal relationship between station construction and operation and adverse changes are established or strongly suspected. An evaluation of the standardization, adequacy and accuracy of data collection and analytical methods used in the monitoring programs is included.

6.5.1 TERRESTRIAL ECOLOGY AND LAND USE

The following sections present information on monitoring programs for terrestrial ecology and land use likely to be affected by site preparation, construction, or operation and maintenance of the facility. The monitoring programs are designed based on anticipated environmental impacts through the various stages of project implementation.

6.5.1.1 Preapplication Monitoring

Section 2.2.1 describes the site features and land use including a map showing these features. Section 2.2.2 describes the existing and proposed transmission line corridors and Section 2.4.1 describes the field studies performed to determine the major plant communities and important species and habitats. Note that the details of the type, frequency and duration of observations or samples taken at each location are contained in the individual reports for the field studies discussed in Section 2.4.1. The field studies and Section 2.4.1 discuss the distribution and abundance of important species and habitats. Critical life history information including parameters such as feeding areas, wintering areas and migration routes are also discussed in Section 2.4.1. Descriptions of modifications that may affect existing patterns of plant and animal communities including the development of cooling ponds and reservoirs, cooling towers, transmission line corridors and access routes is discussed in Section 4.3.1.

{Mitigation requirements for unavoidable impacts to wetlands will be guided by conditions established in permits issued by the U.S. Army Corps of Engineers (USACE) under Section 404 of the Federal Water Pollution Control Act (EPA, 1977) and by the Pennsylvania Department of Environmental Protection (PADEP) under its Chapter 105 Dam Safety and Waterway Management Regulations (PA, 1991). Section 1.3 contains a list of the permits required for this project as well as the applicable Federal and State regulations. Monitoring of mitigation success will be defined and executed with reference to these regulations. Additional guidance will be provided by "Design Criteria for Wetland Replacement" (PADEP, 1997), and "Mitigation and Monitoring Guidelines" (USACE, 2004).

As part of the mitigation design process, all wetlands likely to be affected by BBNPP site preparation and construction will be evaluated to determine their functions and values by a

methodology accepted by USACE and PADEP. Functions identified will be used as the basis of mitigating loss of wetlands during site development.}

As an essential record of overall project area baseline conditions, field surveys and aerial photography of the proposed site and transmission line system were obtained prior to construction. The resulting map of vegetation types by structure (e.g., herbaceous, shrub-scrub, sapling/small trees) and moisture regime (e.g., emergent wetland, droughty outcrops) serve as a guide to identify suitable habitats of Federal and State-listed species of plants and animals. {Following the results of a listed-species field survey, access roads and staging areas within the proposed site were located so as to avoid such habitats to the extent possible. Management plans will be prepared that aim to enhance or at least perpetuate the habitat for target species. Repeated aerial photography every five years including some field observations to verify the information gathered from photo interpretation will serve as a record of forest regrowth in restored areas after completion of construction as proposed in Section 4.3.1.4.} It would also provide evidence of any erosion around construction and other work areas, and indicate changes in vegetation that may call for corrective action (e.g., wind throws) or aid in the scheduling of routine transmission corridor right-of-way management.

{Wildlife surveys of mammals, birds, reptiles, amphibians, and terrestrial invertebrates were conducted at the BBNPP site during 2007 and 2008. In addition, plant species were inventoried as part of the wetlands delineation and plant community mapping field studies conducted during the same time period. Table 2.4-1 identifies the important terrestrial specials at the BBNPP OCA. The Northern myotis, peregrine falcon, long dash butterfly, and black dash butterfly have been observed on the site. In addition, recreationally important fauna (white-tailed deer, black bear, wild turkey) and ecologically important fauna (meadow vole, deer mouse, white-footed mouse, scarlet tanager) were observed but are also known to commonly occur in surrounding areas. Plants that are commercially important (black cherry) and ecologically important (red maple, river birch, spicebush, skunk cabbage, Canada goldenrod) were also observed onsite. Similarly, these plant species are very common both locally and regionally.

There are no continuous monitoring programs required for terrestrial ecology and land use in this phase of the project.}

6.5.1.2 Site Preparation, Construction and Pre-Operational Monitoring

{A description of site preparation and construction impacts on terrestrial resources, including wetlands, is discussed in Section 4.1.

Mitigating wetlands lost to BBNPP site development will commence according to mitigation plans developed for USACE and PADEP approval. Any monitoring required during site preparation, construction and pre-operation will follow guidelines developed by the USACE and the Commonwealth of Pennsylvania in accordance with conditions specified in required permits listed in Table 1.3-1. Additional monitoring including program elements, actions and reporting levels will be specified as required by the PA Department of Environmental Protection; Pennsylvania Stormwater Best Management Practices Manual (PADEP, 2008); Best Management Practices (BMPs) for erosion and sediment control as provided in Title 25 PA Code, Chapter 102 (PA, 2000); the NPDES permit; and other applicable permits obtained for construction. This plan and program will be implemented during this phase in order to minimize impacts to wetlands, groundwater and aquatic ecology.

In accordance with the baseline studies performed during the preapplication timeframe and existing plant experience at the nearby SSES site, no additional monitoring programs are proposed for:

- Bird collisions with plant structures, transmission lines and towers, and cooling towers; and
- Impacts to important species and habitats.

These parameters have all been determined to have a small impact on terrestrial ecology as discussed in Section 4.3.1, and Section 4.3.2. In addition, there is a commitment to place flashing lights or reduce lighting on the large cooling towers to minimize bird collisions once these structures are built.

There are no continuous monitoring programs required for terrestrial ecology and land use in this phase of the project.}

6.5.1.3 Operational Monitoring

{Operation and maintenance impacts of the proposed transmission system are addressed in Section 5.6.1. There are no continuous monitoring programs required for terrestrial ecology and land use in this phase of the project}

6.5.2 AQUATIC ECOLOGY

The following sections present information regarding ecological monitoring for aquatic ecosystems likely to be affected by site preparation, construction, or operation and maintenance of the facility. The monitoring programs are designed based on anticipated environmental impacts through the various stages of project implementation.

Section 2.3.3 documents the pre-existing water quality characteristics of the {freshwater bodies in the vicinity of the plant and the Susquehanna River}. The principal aquatic ecological features of the {BBNPP} site and vicinity are described in Section 2.4.2, including freshwater systems on the {BBNPP} site and the intake and discharge areas of the {Susquehanna River}. Impacts to aquatic systems from construction of the facilities are described in Section 4.3.2. Impacts to aquatic systems from operation of the cooling system are described in Section 5.3.1.2. Impacts from waste discharges are described in Section 5.5.

6.5.2.1 Preapplication Monitoring

{Long-term monitoring of the Susquehanna River has occurred in relation to operation of SSES. This long-term monitoring program included water quality, algae, periphyton, benthic macroinvertebrates, and fish. Currently, the program samples river water quality on a quarterly basis, and the fish assemblage is sampled from spring to fall. In addition to the ongoing water quality and fish data collections, benthic macroinvertebrates were collected in the summer of 2007 and 2008. A mussel survey was completed during October 2007 in the vicinity of the proposed BBNPP intake/discharge structures. Other preapplication monitoring has been conducted on the BBNPP site, including sampling for fish in the ponds and Walker Run, and benthic macroinvertebrate collections in Walker Run and Unnamed Tributary 2. This recent data collection effort is reported in Section 2.4.2. An impingement and entrainment study was initiated in April 2008 at the SSES intake structure to provide data on potential impingement and entrainment at the proposed BBNPP water intake structure. A macroinvertebrate collection was

completed during the summer of 2008. The aforementioned data collection efforts provide a sufficient basis for describing the ecological resources existing on and in the vicinity of the BBNPP site. Sampling locations, sampling methods and quality control are discussed in Section 2.4.2.

No rare or unique aquatic species were identified in the on-site ponds or Walker Run. The aquatic species that occur on site are ubiquitous, common, and easily located in nearby waters. Typical fish species found in the ponds included bluegill, largemouth bass, and brown bullhead. The Walker Run fish community was predominantly comprised of creek chub, white sucker, and blacknose dace. The composition of the fish assemblage is assumed to be similar to the fish assemblage in Lake Took-A-While, a Lake that is hydrologically connected to the North Branch Canal. The fish assemblage in the lake is dominated by bluegill, other common species include carp and largemouth bass. The most important aquatic macroinvertebrate species in the on-site water bodies are the juvenile stages of aquatic insects. No mussels were observed in the ponds, Canal or Walker Run. Figure 2.4-3 through Figure 2.4-6 show the collection locations in the river and on site in the ponds, Walker Run, and the Canal.

No rare fish species were collected in the Susquehanna River. All of the collected species are common inhabitants of large rivers in Pennsylvania and include several game fishes including smallmouth bass, walleye, and muskellunge.

Two important species of mussels, green floater and yellow lampmussel, were collected from the river. The yellow lampmussel was collected during the mussel survey completed in October 2007. This survey was performed both upstream and downstream of the proposed BBNPP intake/discharge structures. The green floater was collected in the benthic macroinvertebrate samples taken during August 2007. Both species are listed as species of special concern by the Pennsylvania Fish and Boat Commission (PFBC). Construction activities will likely have minimal impact to mussels in the Susquehanna River. However, surveys may be required prior to intake/discharge structure construction to determine if mussels are present in the vicinity of these areas and, if so, these mussels may need to be relocated. This determination is coordinated with the Pennslyvania Fish and Boat Commission as construction plans for BBNPP become more definite. A description of both species is included in Section 2.4.2.

Descriptions of modifications that may affect existing patterns of plant and animal communities such as dams, impoundments, dredging, filling of wetlands, and clearing of stream banks are discussed in Section 4.3.2.

There are no continuous monitoring programs required for aquatic ecology in this phase of the project. The surveys performed to establish baseline conditions were sufficient to document the composition and abundance of aquatic organisms on site and in the river.}

6.5.2.2 Construction and Pre-Operational Monitoring

{Construction and preoperational monitoring programs are proposed for resources that may affect aquatic ecology, including thermal monitoring (as discussed in Section 6.1), hydrological monitoring (as discussed in Section 6.3) and chemical monitoring (as discussed in Section 6.6). Aquatic ecology monitoring is proposed during BBNPP site preparation and plant construction for Walker Run.

Walker Run will be monitored after re-construction of two sections of the stream on the BBNPP site. Monitoring will be undertaken for fish and benthic macroinvertebrates once new channel construction is completed. Monitoring will start a minimum of 30 days after watering the new channel. This will allow for sufficient time for colonization by fish and benthic macroinvertebrates. Sampling should be completed upstream of the new channel, within the new channel, and downstream of the new channel. Monitoring stations will be similar to those during pre-application monitoring (Figure 2.4-1). Fish and benthic macroinvertebrate sampling will be completed at each location. Both fish and benthic macroinvertebrate collections should be completed during the spring and fall. Additionally, habitat assessments of the constructed channel should also be completed at the time the biological samples are collected.

Construction monitoring mainly consists of drainage from excavations which are pumped to a storm water discharge point. Approval of storm water management and erosion/sediment control plans will be obtained in accordance with the National Pollution Discharge Elimination System (NPDES) permit (PA, 2000). The Pennsylvania Department of Environmental Protection will issue a permit to include pollutants typically found at a construction site such as sediments and petroleum hydrocarbons.

Storm water discharges from impervious surfaces at the new facility will be controlled and minimized by following guidelines established in Pennsylvania's Stormwater Best Management Practices Manual. This plan calls for periodic monitoring and record keeping of the engineered controls to ensure they are effective in minimizing silt runoff and evaluating the need to repair or replace the installed controls such as silt fences, hay bales, berms and settling ponds (PADEP, 2008). The U.S. Army Corps of Engineers 404 Permit may contain requirements for aquatic monitoring as it relates to chemical spills or control of silt discharging into water bodies. Implementation of the Preparedness, Prevention, and Contingency Plan requires periodic monitoring and record keeping ensuring spill controls are established and maintained to minimize impacts to the aquatic environment.

Details as to monitoring program elements, sampling procedures and equipment, data analysis, quality control and reporting will be contained in the various permits and approvals required for construction.

BBNPP will be designed to meet the Phase I, New Facility requirements published at 40 CFR 125.80 to 89, under Track I (CFR, 2008). The cited EPA requirements meet the Clean Water Act 316(b) rules to verify there will be minimal adverse environmental impact to fish and other aquatic organisms due to impingement and entrainment for the new intake structure.}

6.5.2.3 Operational Monitoring

{Operational aquatic ecology monitoring may be required as a condition of a new NPDES permit and for compliance with the Clean Water Act 316(b) Rule (CFR 2008). The permit will require flow and water quality monitoring, such as monitoring of certain chemical constituents in the discharge and temperature.

Aquatic biological monitoring may be required in the river, Walker Run, and in several unnamed tributaries after completion of construction and after initiation of plant operation. This monitoring would most likely entail additional aquatic collections at the same locations as the preapplication monitoring.

The River biota monitoring program should consist of summer benthic macroinvertebrate collections, monthly fish collections from spring through fall, and quarterly water quality monitoring. The sample locations would be upstream and downstream of the BBNPP diffuser bar, similar to the monitoring program currently in place for SSES. Data has been collected in the Susquehanna River for over 24 years in support of SSES operations. The monitoring originally included sampling of macroinvertebrates, fish, algae, periphyton, and water quality in the river. The current program samples water quality on a quarterly basis and fish on a monthly basis from spring through fall. Some historical impingement data has also been collected but is limited to the fall outmigration period in years when American shad were stocked up-river from SSES. Currently a year-long Impingement Mortality and Entrainment study is being completed at the existing SSES intake structure. The study includes weekly 24-hour duration year-round impingement sampling and entrainment sampling, that is focused around the primary fish spawning period, approximately April-August.

Monitoring within Walker Run may also be necessary. This monitoring should include both benthic macroinvertebrate and fish surveys at the same locations as those completed in the pre-application monitoring (Figure 2.4-1). Spring and fall collections for both groups should be sufficient to document changes in the community associated with operation of BBNPP. Additionally, water quality and habitat monitoring may also be necessary.

Several unnamed tributaries (Unnamed Tributaries 1, 2, and 3) may be impacted by construction and operation of BBNPP (Figure 2.4-1). Monitoring of these tributaries may include benthic macroinvertebrate collections during the spring and fall. Benthic macroinvertebrate surveys were completed in Unnamed Tributaries 2 and 3 during pre-application monitoring. Unnamed Tributary 3 was dry during the sampling effort. In all three streams operational monitoring should include benthic macroinvertebrate collections at the same locations as pre-application monitoring and possibly habitat assessments to document changes in the stream channel associated with runoff from the BBNPP site.

The Clean Water Act Section 316(b) (CFR 2008) requires that the location, design, construction and capacity of a cooling water intake structure reflect the best technology available (BTA) for minimizing adverse environmental impacts. The Phase I Rule, 40 CFR 125 (CFR 2008), addresses new sources of cooling water intake at steam electric plants. The BBNPP cooling water intake structure is designed to meet the Clean Water Act Section 316(b) (CFR 2008) Phase I requirements for new facilities under Track 1 (closed cycle cooling and intake screen velocity less than or equal to 0.5 fps (0.15 mps)).

As noted in Section 5.5.1.1, the discharges to surface waters from plant operations will include cooling water blowdown and storm water runoff. Concentrations of chemicals in the cooling water discharge will be controlled by the NPDES permit. Sanitary wastewater lines will be tied into a publicly owned treatment works operated by the Berwick Area Joint Sewer Authority.

Storm water discharges from impervious surfaces at the BBNPP will be controlled and minimized by provisions of Pennsylvania's Stormwater Best Management Practices Manual. An Erosion and Sediment Control Plan is required to be implemented at a construction site in which best management practices are utilized to control erosion and sediment. The plan provides detailed descriptions of various best management practices that can be implemented on site to reduce stream channel erosion, pollution, siltation and sedimentation and local flooding. A Preparedness, Prevention, and Contingency Plan is required by Pennsylvania (Pa Code Section 91.33 and 91.34). The plan shall identify areas in which toxic or hazardous substances are stored

or handled that may have the potential to cause non-compliance. BMP's shall be developed for each identified area. A Post-Construction Stormwater Management Plan must be prepared and implemented to identify the BMP's to be installed to manage and treat the stormwater discharge so that water quality is protected after construction activities are terminated.

In addition, water withdrawn from the Susquehanna River is regulated as part of the Susquehanna River Basin Commission (SRBC, 2008). The Susquehanna River Basin Commission oversees the consumptive use permitting process under Article 3, Section 3.10.2(ii) of the Commission. The withdrawn water will be used for makeup water in the plant cooling system.

Operation of the BBNPP will not require use of groundwater.

A recent nuclear industry initiative by the Nuclear Energy Institute and NRC assessment (NRC, 2006) of existing nuclear reactors indicates that requirements related to groundwater monitoring during plant operation may change for present and future nuclear reactors. Therefore, this developing issue will continued to be followed and future requirements will be addressed, as applicable.}

6.5.3 REFERENCES

{**CFR, 2008**. Title 40, Code of Federal Regulations, Sections 125.80-89, Track 1, Requirements Applicable to Cooling Water Intake Structures for New Facilities Under Section 316(b) of the Act, 2008.

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USACE, 2004. Mitigation and Monitoring Guidelines, Baltimore District Regulatory Program, U. S. Army Corps of Engineers, November 2004.}

6.6 CHEMICAL MONITORING

Chemical monitoring of surface water is performed to control and minimize adverse impacts to the {Susquehanna River} and will be implemented in three phases: preapplication, construction and preoperational, and operational monitoring. The scope for each monitoring phase will be predicated by the findings for the preceding phase.

Section 6.1 discusses discharged wastewater temperature requirements and Section 6.3 discusses flow sampling requirements.

6.6.1 PREAPPLICATION MONITORING

{Pre-application monitoring provides a baseline for assessment of effects from pre-operation and operation of the BBNPP on the aquatic environment in the vicinity of the site. Information on past studies performed to determine the characteristics of surface water are discussed in ER Section 2.3.3.

Surface Water

{The most significant surface water body in the BBNPP area is the North Branch of the Susquehanna River (NBSR). The NBSR is the source of cooling water for the SSES and the BBNPP. All surface water and groundwater discharging from the BBNPP will ultimately reach the NBSR.

The SSES has been collecting water samples from the Susquehanna River from two sites since 1968. The SSES sampling site is located 750 ft (230 m) upstream of the SSES intake structure (Figure 2.3-33) and serves as the upstream control sampling site. The Bell Bend sampling site (also referred to as SSES Indicator Site) is located approximately 2,260 ft (690 m) downstream of the SSES blowdown discharge line (Figure 2.3-33). This site was located in order to evaluate the impacts to the river due to the SSES blowdown discharge (Ecology III, 2003 - 2007). River samples are collected quarterly. The SSES river data for 1968 through 1977 are summarized in Table 2.3-41.

The SSES river data for 2002 through 2006 have been averaged for each year and are presented in Table 2.3-42. In addition to the data collected by the SSES, the BBNPP site-specific water quality sampling program included two sampling sites on the Susquehanna River. Site SR01 is co-located with the "SSES Control" sampling site, upstream of the SSES blowdown discharge line (Figure 2.3-33). Site SR02 is located downstream of the "Bell Bend SSES indicator site" identified in Table 2.3-42, downstream of the location of the BBNPP blowdown discharge line, and downstream of the NBSR confluence with Unnamed Tributary No. 2 and Walker Run (Figure 2.3-33). Thus, SR02 is downstream of all potential surface water and groundwater discharges from the SSES and the BBNPP sites. This sampling site was chosen as a reference point to evaluate potential future impacts to the river due to construction and operation of the BBNPP. Analytical data for samples collected from SR01 and SR02 are presented in Table 2.3-38. SR01 and SR02 field parameters measured in the Susquehanna River at the time of sampling are listed in Table 2.3-43.

A baseline sampling program that covered the four seasons of 2008: winter (February); spring (April); summer (July); and autumn (October) was also conducted. Data from this study was developed to serve as a baseline reference so that potential water quality impacts due to the construction and operation of the BBNPP can be assessed.

pH and Alkalinity

According to Table 2.3-38, Table 2.3-42, and Table 2.3-43, the Susquehanna River water has been alkaline (total alkalinity range: 43 - 64 mg/L, as CaCO3), with a pH range of 7.2 to 7.8, between 2002 and 2008. Between 1968 and 1977, the average total alkalinity (43.0 mg/L) and pH (7.18) values were somewhat lower respectively (Table 2.3-41). These data suggest that the pH and the alkalinity of the river have increased over the past 30 years. The anthracite mining industry has declined greatly since the 1970s, and the acidity, iron, and sulfate contained in the abandoned mines and mine refuse piles have gradually leached away, resulting in improved river water quality over time.

Specific Conductance (SC), Total Mineral Solids (TMS), Total Dissolved Solids (TDS), and Total Hardness

Between 2002 and 2006, the annual average SC has ranged from 0.226 to 0.301 mS/cm, and averaged 0.234 mS/cm (Table 2.3-42). In 2008, the average SC of river water was only 0.216 mS/cm (Table 2.3-43). In 1968 through 1977, SC ranged from 0.098 to 0.635 mS/cm, and averaged 0.297 mS/cm (Table 2.3-41). Thus, the SC of the river water has declined by approximately 21 percent since the 1970s. Again, this long-term improvement in general water quality is primarily due to the decline of anthracite mining upstream of the SSES and BBNPP.

The TMS, TDS, and total hardness are water quality parameters that are related. Like SC, they reflect the total amount of inorganic constituents that are dissolved in the water. Between 2002 and 2008, the average values of these three parameters were 134, 125, and 92 mg/L, respectively (Table 2.3-42 and Table 2.3-43). In 1968 through 1977, the average values of these three parameters were 190, 192, and 116 mg/L, respectively (Table 2.3-41). Thus, these three water quality parameters have paralleled the decrease in SC since the 1970s.

The values of SC, TMS, TDS, and total hardness are also related to flow rate in the river. As the flow rate increases during storm events and large snowmelt events, more surface runoff and direct precipitation enter the river, thereby diluting groundwater inputs into the river. This causes chemical concentrations to decline due to dilution during large storm and snowmelt events and high river flow (Figure 2.3-78). Conversely, surface water runoff and direct precipitation into the river decreases to zero during drought and low-flow conditions. During these times, values of SC, TMS, TDS, and total hardness increase (Figure 2.3-78).

Dissolved Oxygen

Between 2002 and 2008, the average dissolved oxygen (DO) in the Susquehanna River ranged from 8.9 to 11.0 mg/L, suggesting that the river is well aerated and near oxygen saturation. Between 1968 and 1977, the average DO was similar (10.1 mg/L), but decreased on at least one occasion to a low of 5.8 mg/L (Table 2.3-41). The low value of DO was likely due to a flush of mineral acidity into the river in the 1970s, which consumes DO and could have caused such a short-term decline.

Dissolved oxygen goes through annual cycles. The solubility of DO is higher in cold water, so DO concentrations can be much higher in winter. As shown on Table 2.3-43, the DO at station SR01 was 21.3 mg/L on February 28, 2008.

Inorganic Nitrogen and Phosphorus Compounds (Nutrients)

Between 2002 and 2008, annual average nitrate (as N), ammonia (as N), and total phosphorus (as PO4) concentrations have been less than 2.3, 0.20, and 0.30 mg/L, respectively (Table 2.3-39 and Table 2.3-42). These levels of nutrients are typical of a river that is slightly affected by agriculture and discharges from sewage treatment plants.

Metals

There are no minor or trace metals that appear to be elevated in the Susquehanna River, except for total iron concentrations, which ranged from 0.37 to 1.43 mg/L (annual averages) between 2002 and 2008 (Table 2.3-38 and Table 2.3-42). However, total and dissolved iron concentrations (average value: 3.2 and 0.42 mg/L, respectively) were much greater between 1968 and 1977 (Table 2.3-41), when the anthracite mining industry was still active and the number, flow rates, and iron concentrations of the AMD discharges were much greater.

Biological Parameters

Fecal coliform bacteria, total coliform bacteria, and fecal streptococci were detected in each river sample (Table 2.3-38). Farm animals, septic tanks, and discharges from sewage treatment plants upstream of the SSES account for the majority of the microbes detected in the river water.

Groundwater

A total of 41 observation wells with depths extending to 400 ft (120 m) below ground surface (bgs) were installed across the BBNPP site in September and October 2007 (except MW301C, which was installed in May 2008. The wells were located in order to provide adequate distribution with which to determine site groundwater levels, subsurface flow directions, and hydraulic gradients beneath the BBNPP site. Observation wells were installed in three different groundwater-bearing intervals:

14 wells were screened in the Glacial Overburden aquifer at depths of 9.2 to 76.0 ft (2.8 to 23.2 m) bgs,

19 wells were screened in shallow shale bedrock 50 to 181 ft (15 to 55 m) bgs, and

8 wells were screened in the Deep Shale Bedrock aquifer at 170 to 400 ft (52 to 122 m) bgs.

The Glacial Overburden aquifer is distinctly different than the shale bedrock aquifer. The shale bedrock aquifer has been divided into "shallow" and "deep" bedrock aquifer, as a means to determine if the hydraulic properties, the hydraulic potentials, or the ground water flow directions are different between the shallow and deeper shale bedrock. In other words, the division of "shallow" versus "deep" provides a means to evaluate groundwater flow characteristics in the bedrock in three dimensions, rather than two dimensions. A depth of 175 ft (53 m) bgs has been selected as a divider between the "Shallow" and "Deep" Bedrock aquifers. Field hydraulic conductivity tests (slug tests) were conducted in 14 of the glacial overburden observation wells and in 11 of the bedrock observation wells. Monthly water level measurements from the groundwater observation wells began in October 2007 and continued until August 2008.

To evaluate vertical hydraulic gradients, a total of 31 monitoring wells were installed at the first 10 drilling locations (MW301-MW310), thereby creating 10 well clusters. Well clusters are a series of wells placed at the same location, with each well installed in a different water-bearing interval. Each cluster consists of two or more wells. This was done in order to measure vertical differences in hydraulic head, and vertical hydraulic gradients and vertical differences in hydraulic conductivity within the shale bedrock.}

Well water quality data are described in Section 2.3.3.2.

6.6.2 CONSTRUCTION AND PREOPERATIONAL MONITORING

{Chemical monitoring during construction will aid in controlling adverse impacts to the Susquehanna River and Walker Run and will provide additional water quality data that can be used to measure water-quality changes from operation of the new unit. Accordingly, chemical monitoring of surface water during construction related activities for the new unit will be an extension of more than 30 years of pre-application monitoring. Construction and pre-operational chemical monitoring will be performed during the planned two year and four year periods for site preparation and plant construction, respectively. In accordance with the existing NPDES permit, the Pennsylvania Department of Environmental Protection (DEP) will be notified regarding the new proposed BBNPP. Sample collection, laboratory analyses, data evaluation and reporting practices will comply with permit modifications.

Although storm water discharges will increase during construction, primarily due to water pumped from excavation sumps, disturbance to existing drainage systems will be avoided, if possible. Environmental controls (i.e., silt screens, dams, settling basins, and spill containment measures), will be implemented to reduce potential pollutants in storm water runoff and to minimize construction impacts to aquatic habitats. Prior to the start of construction, approval of storm water management and erosion/sediment control plans will be obtained in accordance with the NPDES Construction General Permit and an Erosion and Sediment Control Plan (ER Section 1.3). These controls will be incorporated into a Storm Water Pollution Prevention Plan (SWPPP). Similar to the existing plant's SWPPP, storm water system manholes and handholds will continue to be periodically inspected and cleaned. Stormwater from the facilities and peripheral areas including the construction parking and laydown areas will be collected through a network of storm sewers, ditches and culverts and will be drained to two stormwater ponds.

Groundwater monitoring (water level observation) of the BBNPP area is currently being implemented through the use of the groundwater observation wells installed in for the BBNPP area subsurface investigation and through periodic review of water levels from selected wells within the groundwater level monitoring network. Some of the existing BBNPP area observation wells will be taken out-of-service prior to construction activities due to anticipated earth moving and construction requirements. Prior to construction activities, the observation well monitoring network will be evaluated in order to determine groundwater data gaps and needs created by the abandonment of existing wells. These data needs will be met by the installation of additional observation wells, if required. Additionally, the hydrologic properties and groundwater flow regimes of the shallow water bearing units (Surficial aquifer, and to lesser extent, the units will be impacted by the proposed earthmoving, regrading, and construction of infrastructure (buildings, parking lots, etc.). Revisions to the observation well network will be implemented to ensure that the resulting changes in the local groundwater regime from construction activities will be identified. No chemical monitoring is planned at this time for groundwater.}

6.6.3 OPERATIONAL MONITORING

{Operational monitoring will commence from the date of the first appropriation and use of Susquehanna River water and continue as long as required by the NPDES permit applicable for BBNPP. Although operational monitoring elements will be developed in consultation with the Pennsylvania DEP, it is anticipated that sampling locations, frequency and analyses will be similar to those for the existing plant; with the exception that sanitary wastewater from BBNPP will not be treated in an on-site wastewater treatment plant, but will be collected in a sanitary wastewater collection system that will direct sanitary wastes to the municipal sewer system and local POTW operated by the Berwick Area Joint Sewer Authority. No effluent discharge to the river or associated chemical monitoring for treated sanitary wastewater streams is envisioned for BBNPP. However, chemical monitoring of sewage from BBNPP into the municipal sanitary system will be done in accordance with local ordinances and permit requirements. The anticipated discharge limits for sanitary wastewater into the municipal sewer system is provided on Table 3.6-4.

Similar to SSES, the BBNPP Intake Structure will house debris screens, screen wash pumps, make-up water pumps and related equipment so that a new outfall for intake screen backwash will be likely. However, similar to SSES, chemical monitoring at the new outfall will be limited by the new NPDES permit to certain chemical parameters to ensure that the differences between the intake water and discharge water are within the limits specified in the permit.

BBNPP will utilize a closed-loop cooling water system consisting of two, natural draft cooling towers for the circulating water cooling system. Prior to discharge into the river, CWS cooling tower blowdown will be directed into a retention basin, provided as an intermediate discharge reservoir, and held for a period of time to reduce the concentration of solids and chlorine in the water. Essential Service Water System (ESWS) cooling tower blowdown, and other wastewater will also collect in the retention basin. Piping will transfer retention basin wastewater by gravity to the new Discharge Structure, which will provide a flow path for the discharge of water into the river via a submerged outfall.

Chemical monitoring will be performed at the new outfall to assess the effectiveness of retention methods and effluent treatment systems, as well as to detect changes in water quality associated with new plant operations. Similar to the existing plant, chemical monitoring will also be performed at storm water runoff outfalls and at internal monitoring points (i.e., wastewater retention basin influent and/or effluent). Effluent water chemistry will meet all applicable federal and state environmental regulatory requirements.

Test procedures for the analysis of effluent samples will be those approved under 40 CFR 136. In an effort to ensure accurate laboratory results, laboratories used for sample analysis will participate in periodic scheduled quality assurance inspections conducted by the Pennsylvania DEP and the United States Environmental Protection Agency (EPA), and will develop and implement a quality assurance program.

The following discussion provides a basis for the type of data and information that is expected to be required by the NPDES permit for BBNPP. The SSES NPDES permit specifies the monitoring conditions that the existing plant must meet to protect water quality. It is expected that the NPDES permit requirements for BBNPP will be similar.

Pursuant to the SSES NPDES permit PA-0047325, effective as of September 1, 2005, discharges to the Susquehanna River are allowed at Outfalls 070 and 075. Outfalls 071, 072, 073, 074, 075, 079 and 080 discharge to Lake Took-a-While, located adjacent to Susquehanna Riverlands. Outfall 070 monitors discharged stormwater from S-2 Pond (a sedimentation pond). Outfall 071 monitors discharged cooling tower blowdown and includes discharged treated radioactive wastewater and wastewater from the neutralization basin from the demineralizer and drains located in the raw water treatment building. Outfall 072 monitors discharged wastewater from the low volume waste sump in the Service and Administrative Building. Outfall 073 monitors discharged wastewater from the low volume waste sump in the Unit 1 Turbine Building. Outfall 074 monitors discharged wastewater from the low volume waste sump in the Unit 2 Turbine Building. Outfall 075 monitors discharged stormwater from sedimentation pond, Peach Stand Pond. Outfall 079 Monitors discharged sewage from the sanitary wastewater treatment plant. Outfall 080 monitors discharged stormwater from sedimentation pond, C-1 Pond. Oufalls 171 and 371 are internal monitoring points for discharges that are included in Outfall 071, which discharges to the Susquehanna River through the diffuser.

The NPDES permit specifies the monitoring conditions that the existing plant must meet to protect water quality. Table 6.6-1 summarizes the required water sampling protocol for the existing monitoring stations. A map showing the monitoring station locations is provided in ER Section 6.1 (Thermal Monitoring).

Sampling for NPDES permit requirements will be performed in accordance with the quality standards outlined in a Chemical Quality Assurance (QA) and Quality Control (QC) Program. This Chemical QA and QC Program will provide performance instructions for chemical/reagent control, instrumentation control, program control (e.g., sampling methodologies, analysis), minimum quantifiable concentration control, use and evaluation of charts, and data reporting.

Samples representative of the system or stream will be collected and preserved as necessary to prevent contamination or deterioration. Sampling and analytical methods conform to procedures for the analysis of pollutants as identified in Title 40 CFR Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants". To ensure accuracy of measurements, monitoring and analytical instrumentation is maintained and periodically calibrated in accordance with manufacturer specifications or those per the Chemical QA and QC Program, whichever are more restrictive. The Chemical QA and QC Program will also provide instructions for calibration standards, prepared or purchased, used for preparing calibration curves and performing calibration checks. Statistical reliability will be achieved by calculating the mean and standard deviation of the data at a 95 percent confidence level. Data quality objectives will include producing accurate, reliable and cost effective measurements and data, adequate for their intended use.

Monthly BBNPP monitoring results will be summarized on Discharge Monitoring Reports and submitted to the Pennsylvania DEP. Sampling data collected during pre-application monitoring serve to document existing water quality conditions.

There are currently no plans to monitor groundwater for chemicals during the operational phase of BBNPP.}

6.6.4 REFERENCES

{None}

Table 6.6-1 {Required Water Sampling Protocol}

Monitoring Station[a]	Monitoring Location[b]	System(s) Sampled[b]	Parameter Sampled	Sample Type[g]	Sampling Frequency
Outfall 080[h]	S-2 pond	S-2 Sedimentation Pond Stormwater	Oil & Grease pH TSS	Grab	1/Year
Outfall 071[c,d,e]	Diffuser Pipe	Cooling Tower Blowdown	FAC[f]	Grab During Chlorination	Daily
			Total Zinc	8-Hour Composite	1/Year
			Total Chromium	8-Hour Composite	1/Year
			pH	Grab	Daily
Outfall 072[h]	Service and Admin.Building Low Volume Waste Sump	Service and Admin. Building Low Volume Waste Sump	TSS	Grab	Quarterly
			Oil & Grease	Grab	Quarterly
			pH	Grab	Daily When Discharging
Outfall 073h	Unit #1 Turbine Bldg Low Volume Waste Sump	Unit #1 Turbine Bldb Low Volume Waste Sump	TSS	Grab	Quarterly
			Oil & Grease	Grab	Quarterly
			pH	Grab	Daily When Discharging
Outfall 074[h]	Unit #2 Turbine Bldg Low Volume Waste Sump	Unit #2 Turbine Bldb Low Volume Waste Sump	TSS	Grab	Quarterly
			Oil & Grease	Grab	Quarterly
			pH	Grab	Daily When Discharging
Outfall 075[h]	Peach Stand Pond	Peach Stand Pond (Stormwater)	TSS	Grab	1/Year
			Oil & Grease	Grab	1/Year
			pH	Grab	1/Year
Outfall 079[i]	Sewage Treatment Plant	Sewage Treatment Plant	CBOD5	8-Hour Composite	1/Month
			TSS	8-Hour Composite	!/Month
			TRC	Grab	Daily
			pH	Grab	Daily
			Fecal Coliform	Grag	1/Month
			Ammonia-N	8-Hour Composite	2/Month
			Kjeldahl-H	8-Hour Composite	2/Month
			Nitrite-N	8-Hour Composite	2/month
			Nitrite-N	8-Hour Composite	2/Month
			Total Nitrogen	Calculate	2/Month
			Total Phosphorus	8-Hour Composite	2/Month
Outfall 080[h]	C-1 Pond	C-1 Pond (Stormwater)	TSS	Grab	1/Year
			Oil & Grease	Grab	1/Year
			pH	Grab	1/Year
Outfall 171	Radwaste Treatment Bldg	Radwaste Treatment	TSS	Grab	1/Month
			Oil & Grease	Grab	1/Year
Outfall 371	Neutralization Basin	Demineralizer and Raw Water Treatment Building Drain	TSS	Grab	1/Month
			Oil & Grease	Grab	1/Year

Table 6.6-1 {Required Water Sampling Protocol}

Monitoring Station[a]	Monitoring Location[b]	System(s) Sampled[b]	Parameter Sampled	Sample Type[g]	Sampling Frequency

Key:
BOD - Biochemical Oxygen Demand
TSS - Total Suspended Solids
TRC - Total Residual Chlorine

Notes:

a. Refer to ER Section 6.1 for a map showing the location of the monitoring stations.
b. Monitoring station locations and systems sampled are specified in the NPDES permit.
c. Includes discharges from internal Monitoring Points.
d. Except for Total Zinc and Total Chromium, there shall be no detectable level of the remaining priority pollutants in this discharge due to the addition of chemicals for cooling tower maintenance.
e. The monthly Discharge Monitoring Reports indicate when chlorine compounds are not in use. Discharge of residual chlorine from any unit is limited to two hours per day.
f. The term Free Available Chlorine (FAC) shall mean the value obtained using the amperometric titration or DPD method described in "Standard Methods for Examination of Water and Wastewater"
g. "Grab sample" means an individual sample of at least 100 milliliters collected in less than 15 minutes. "Composite sample" (except for GC/MS volatile organic analysis) means a combination of individual samples (at least 8 for a 24-hour period) of at least 100 milliliters each obtained at spaced time intervals during the compositing period. The must be flow-proportional; either the volume of each individual sample is proportional to the discharge flow rates or the sampling interval is proportional to the flow rates over the time period used to produce the composite. For GC/MS for volatile organic analysis, a composite sample means at least four aliquots or grab samples collected during the sampling event, not necessarily flow proportional. The samples are combined in the laboratory immediately before analysis, and then one sample is analyzed.
h. Discharge is to Lake Took-A-While.
i. BBNPP will not have a separate sewage treatment plant or discharge to the river. Sanitary wastewater will be collected at BBNPP and discharged into the municipal sanitary sewer for treatment at the local POTW.

6.7 SUMMARY OF MONITORING PROGRAMS

This section summarizes the monitoring environmental programs described in Chapter 6. The summary is divided into three sections:

- Pre-application monitoring
- Construction and Pre-Operational monitoring
- Operational monitoring

6.7.1 PREAPPLICATION MONITORING

Pre-Application monitoring for {BBNPP} will be fulfilled by the {ongoing thermal, radiological, hydrological, meteorological, ecological, and chemical monitoring programs (Section 6.1 through Section 6.6) for the existing {SSES Units 1 and 2}. This represents {over 30} years of monitoring for the site. Pre application ecological monitoring was provided through field studies. Summaries of the pre-application monitoring activities are included in Table 6.7-1 through 6.7-7.

6.7.2 CONSTRUCTION AND PREOPERATIONAL MONITORING

The current thermal, radiological, hydrological, meteorological, and chemical monitoring programs will be continued through the construction and preoperational phases of {BBNPP. Monitoring required during site preparation, construction and pre-operation will follow guidelines developed by USACE, The Commonwealth of Pennsylvania and the PA Department of Environmental Protection. This monitoring will be performed to minimize impacts to wetlands, ground water and aquatic ecology.} Summaries are included in Table 6.7-1 through 6.7-7.

6.7.3 OPERATIONAL MONITORING

While specific operational monitoring requirements and programs for {BBNPP} have not yet been fully established, they will be similar to and tiered from or added to those monitoring programs described in the previous sections which currently monitor the impacts of {SSES Units 1 and 2} on the surrounding environment. Summaries are included in Table 6.7-1 through 6.7-7.

The existing and future operational monitoring programs could be modified as a result of future consultations with state regulatory agencies. The need for modifications to established monitoring locations, parameters, collection techniques, or analytical procedures will be assessed prior to and during the course of operation, as is done now for {SSES Units 1 and 2}.

6.7.4 REFERENCES

None

Table 6.7-1 {Thermal Monitoring}

Phase	Summary	Permit
Pre-Application	The existing SSES plume was determined to have limited downstream temperature impact. Spring, fall, and winter studies were completed that measured the temperature and downstream extent of the thermal increase. During these studies the maximum increase above ambient temperatures within the plume ranged from 0.5 to 1.0 °F (0.3 to 0.6 °C) and the plume extent varied from 25 to 130 ft (7.6 to 40 m) downstream from the diffuser pipe. The study indicated that river flow, not discharge temperature increase above ambient, was the most important determinant of the temperature and areal extent of the plume. SSES is not currently required as a condition of its NPDES permit to monitor the plant's cooling water discharge for temperature. Temperature measurements continue to be taken as part of an ongoing water quality monitoring program for the Susquehanna River. Ecology III, Inc. on behalf of SSES Environmental Laboratory records river temperatures on a daily basis at the SSES Environmental Laboratory, and also monitors the cooling water discharge and the river upstream and downstream of the SSES discharge for temperature, among other water quality parameters, on a quarterly basis. Results from the monitoring program are reported on a yearly basis.	NPDES Permit issued for SSES Units 1 and 2
Construction and Pre-Operation	Construction and pre-operational thermal monitoring will be a continuation of the pre-application monitoring program. Construction related discharges will consist mainly of drainage that collects in sumps at the bottom of excavations, which will be pumped to a storm water discharge point, storm water associated with construction activities, and hydrostatic test waters. Therefore, no thermal discharges associated with the BBNPP are expected during the preoperational monitoring program. The PADEP will be notified of pending construction activities and approval of storm water management and erosion/sediment control plans will be obtained in accordance with the NPDES Construction General Permit	General NPDES Construction Permit
Operation	BBNPP will utilize a closed-cycle, wet cooling system, consisting of two natural draft cooling towers for heat dissipation. BBNPP will also have four smaller Essential Service Water System (ESWS) cooling towers to dissipate heat from safety-related systems. Thermal monitoring will continue during operation of BBNPP to assess water temperature changes associated with effluents from the new plant. The BBNPP thermal plume is predicted to be similar to the existing SSES thermal plume. Based on its location, the BBNPP plume will likely have limited interaction with the SSES plume. These effects will be minimized by the installation of a closed cooling system for BBNPP, due to the reduced output temperature and reduced outfall volume inherent in a closed-cycle system versus a once-through system which will reduce the size and persistence of the thermal plume. Discharge effects have been studied at SSES and provide a basis for assessing the potential ecological impacts of the BBNPP discharge. The effects of the BBNPP discharge are anticipated to be similar to the SSES discharge. The existing SSES discharge will be used to gauge and evaluate the potential for impacts to result from the BBNPP discharge.	NPDES Permit issued for BBNPP Operation

Table 6.7-2 {Radiological Monitoring}

Pre-application monitoring for the BBNPP site location will be provided by the existing Radiological Environmental Monitoring Program (REMP) for SSES Units 1 and 2. Annual reporting of these REMP activities, detected radioactivity, trends, and plant related impacts will continue through the construction and operation of BBNPP. Existing sampler locations, sampling frequency, and type of analysis are described further in ER Table 6.2-2 through 6.2-9.

Construction and pre-operational radiological monitoring will be a continuation of the pre-application monitoring program. Changes to the existing SSES Unit 1 and 2 REMP may result from the location of Bell Bend near the SSES units and the inner ring of on-site sample locations. Bell Bend is centered approximately one mile west-southwest from the centerline between SSES Units 1 and 2. This creates the potential need to re-locate existing SSES sample sites if interferences during plant construction of BBNPP are identified. As an example, existing TLD sample site 12S7, 1.1 mile WSW of the SSES units, will need to be moved since it falls within the footprint of the BBNPP main facility structures.

For the operational phase, the BBNPP REMP includes the addition of several new sampling locations in order to meet the sampling criteria of Table 6.2-4 as related to the specific location of the BBNPP facilities and its effluent release points (the main vent stack located directly next to the BBNPP Containment, and the BBNPP liquid effluent discharge line to the Susquehanna River located down stream from the SSES liquid discharge to the river).

Effluent Exposure Pathways	REMP Sampling Media	Frequency	Phase
Direct Radiation	TLDs	Quarterly	All Phases
Airborne Radioiodine and Particulates	a. Radioiodine Canister & b. Particulate Sampler	a. Weekly b. Quarterly	All Phases
Waterborne - Surface	Samples at intake and discharge areas.	Composite sample over one month period	All Phases
Waterborne - Sediment from shoreline	Samples from downstream area with recreational value	Semiannually	All Phases
Waterborne - Ground Water	Samples from 8 on-site locations.	Quarterly	All Phases
Ingestion - Milk	Samples from milking animals in three locations within 3mi (5 km) distance having the highest dose potential. If there are none, then one sample from milking animals in each of three areas between 3 to 8 mi (5 to 8 km) distances where doses are calculated to be greater than 1 mrem/yr. Broad leaf vegetation sampling is performed in lieu of milk sampling if the required minimum number of milk locations is not available in the site area. Milk samples need be collected and analyzed if the milk is commercially available in quantities greater than 130 liters (34.3 gal) per year.	Semimonthly when animals are on pasturel monthly at other times	All Phases
Ingestion - Fish	One sample from each of two recreationally important species in vicinity of plant discharge area.	Sample in season, or semiannually if they are not seasonal	All Phases
Ingestion - Food Products	Samples of 3 different kinds of broad leaf vegetation grown near the Site Boundary at 2 different locations of high predicted annual average ground level D/Q.	At harvest time	All Phases

Table 6.7-3 {Hydrological Monitoring}

(Page 1 of 3)

Phase	Surface Water	Potable Water
Pre-Application	SSES conducts hydrological monitoring of surface water in accordance with the National Pollutant Discharge Elimination System (NPDES) program. Flows from storm water, plant-associated activities such as equipment blowdown, and various system effluents are measured at different monitoring locations. Flow is monitored daily and reported to the Pennsylvania Department of Environmental Protection (PADEP) monthly. In addition, water withdrawn from the Susquehanna River that is used for plant system cooling is monitored as part of the Susquehanna River Basin Commission (SRBC) Regulation 806.30. Withdrawal is monitored daily and reported to SRBC quarterly and to PADEP annually. Susquehanna River water flow and quality is monitored by Ecology III, Inc. on behalf of the SSES Environmental Laboratory. Water flow is measured daily upstream of the SSES intake structure. Water quality samples are taken on a quarterly basis upstream and downstream of the SSES discharge. Results from the monitoring program are reported on a yearly basis.	As described in Section 2.3.2.2, the SSES site has nine groundwater wells that supply water for domestic and miscellaneous process water uses on either a regular or emergency basis. These existing wells require periodic monitoring. Section 2.3.2.2 describes the well locations, permit limits, and withdrawal volumes.

Table 6.7-3 {Hydrological Monitoring}

(Page 2 of 3)

Phase	Surface Water	Potable Water
Construction and Pre-Operational	Surface water on site will be monitored as part of the NPDES Construction General Permit. Conditions of the permit will include compliance with erosion/sediment control and stormwater management plans, which will be detailed in a required Stormwater Pollution Prevention Plan (SWPPP). Susquehanna River surface water will be monitored during construction of the BBNPP intake and discharge structures. Monitoring will be accordance with the U.S. Army Corps Section 404 permit and PADEP 401 Water Quality Certification to ensure compliance with applicable water quality (e.g. turbidity) requirements. Susquehanna River water flow and quality will continue to be monitored upstream and downstream of the existing SSES discharge.	Groundwater monitoring during construction of BBNPP will include, as needed, data from groundwater observation wells installed across the site as part of COL pre-application studies (ER Section 2.3.1.2, Local Hydrogeology). The purpose will be to monitor the potential effects of dewatering on perched water levels. Some of the existing BBNPP area observation wells may be taken out of service prior to construction activities due to earth moving and construction requirements. Prior to construction activities, the observation well monitoring network will be evaluated in order to determine groundwater data gaps and needs created by the abandonment of existing wells. These data needs will be met by the installation of additional observation wells, if required. Additionally, the hydrologic properties and groundwater flow regimes of the shallow water bearing units will be impacted by the proposed earthmoving, regarding, and construction of infrastructure (buildings, parking lots, etc.). Revisions to the observation well network will be implemented to ensure that the resulting changes in the local groundwater regime from construction activities will be identified. No groundwater wells are anticipated for consumptive use during construction.

Table 6.7-3 {Hydrological Monitoring}

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Phase	Surface Water	Potable Water
BBNPP Operational	Hydrological monitoring at BBNPP during operation will be designed, as needed, to monitor the potential impacts from plant operation as well as detect unanticipated operational impacts. During BBNPP operation, plant water supply will be from the Susquehanna River at a BBNPP intake structure to be located on the Susquehanna River downstream of the existing SSES intake. Operation of the BBNPP and existing intake structures will require surface water monitoring and reporting. In addition, discharge effluents to the Susquehanna River from BBNPP will require monitoring to satisfy the conditions of the facility's NPDES permit. Non-radioactive liquid effluents that could potentially drain to the Susquehanna River will be limited under a NPDES permit with the PADEP. Chemical monitoring will be performed at the BBNPP discharge outfalls to assess the effectiveness of the effluent treatment systems, as well as to detect changes in water quality associated with plant operations.	Potable water for domestic and miscellaneous process uses will be supplied by the Pennsylvania American Water Company. NRC regulations do not explicitly require routine, on-site groundwater monitoring during plant operation. However, a recent nuclear industry initiative by the Nuclear Energy Institute (NEI) and Electric Power Research Institute (EPRI) and NRC assessment of existing nuclear reactors indicates that regulations relating to groundwater monitoring during plant operation for present and future nuclear reactors may change.

Table 6.7-4 {Meteorological Monitoring}

Phase	Primary Tower	Backup Tower	Supplemental (Downriver) Tower	Detailed Descriptions
	(197 ft [60 m] and 33 ft [10 m] elevations above ground level)	(30 ft [9.1 m] elevation above ground level)	(33 ft [10 m] elevation above ground level)	
Pre-Application	Temperature Sensor, Wind Speed and Direction Sensors, Sigma Theta (standard deviation of wind direction), Dew Point Sensor (10 m level only) and Precipitation (base of tower only).	Wind Speed Sensor, Wind Direction Sensor	The meteorological data collected from the supplemental tower is used only to support assessment and restoration efforts in the event there is an accidental release of radioactive material from SSES.	Section 6.4.1.3, Table 6.4-1
Construction and Pre-Operational	Temperature Sensor, Wind Speed and Direction Sensors, Delta temperature), Dew Point Sensor (10 m level only) and Precipitation (base of tower only). The BBNPP construction and pre-operation phase will be based only on the SSES Primary Tower.	Not relied upon for the BBNPP construction and pre-operation phase.	Not relied upon for the BBNPP construction and pre-operation phase.	Section 6.4.1.3, Table 6.4-1
BBNPP Operational	Temperature Sensor, Wind Speed and Direction Sensors, Delta temperature), Dew Point Sensor (10 m level only) and Precipitation (base of tower only). The BBNPP operational phase will be based on the BBNPP primary tower.	Not relied upon for the BBNPP operation phase.	Not relied upon for the BBNPP operation phase.	Section 6.4.2.3, Table 6.4-3

Table 6.7-5 {Terrestrial Ecology Monitoring}

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Phase	Summary	Permits
Pre-application	Field surveys and aerial photography of the proposed site and transmission line system were obtained prior to construction. The resulting map of vegetation types by structure (e.g., old field, upland shrub-scrub, and upland forest) and moisture regime (e.g., emergent wetland) serve as a guide to identify habitats of Federal and State-listed species of animals. Access roads and staging areas within the proposed site were located so as to avoid such habitats to the extent possible. Management plans will be prepared that aim to enhance or at least perpetuate the habitat for target species. Wildlife surveys of mammals, birds, reptiles, amphibians, and terrestrial invertebrates were conducted at the BBNPP site during 2007 and 2008. In addition, plant species were inventoried as part of the wetlands delineation and plant community mapping field studies conducted during the same time period. Table 2.4-1 identifies the important terrestrial specials at the BBNPP OCA. The Northern myotis, peregrine falcon, long dash butterfly, and black dash butterfly have been observed on the site. In addition, recreationally important fauna (white-tailed deer, black bear, wild turkey) and ecologically important fauna (meadow vole, deer mouse, white-footed mouse, scarlet tanager) were observed but are also known to commonly occur in surrounding areas. Plants that are commercially important (black cherry) and ecologically important (red maple, river birch, spicebush, skunk cabbage, Canada goldenrod) were also observed onsite. Similarly, these plant species are very common both locally and regionally. Mitigation requirements for unavoidable impacts to wetlands will be guided by conditions established in permits issued by the U.S. Army Corps of Engineers (USACE) and by the Pennsylvania Department of Environmental Protection (PADEP). Section 1.3 contains a list of the permits required for this project as well as the applicable Federal and State regulations. Monitoring of mitigation success will be defined and executed with reference to these regulations. There are no continuous monitoring programs required for terrestrial ecology and land use in this phase of the project.	US Army Corps of Engineers Pennsylvania Department of Environmental Protection
Construction and Pre Operational	Mitigating for wetlands lost to BBNPP site development will commence concurrently with project construction with mitigation plans developed for USACE and PADEP approval. Any monitoring required during site preparation, construction and pre-operation will follow guidelines developed by the USACE and the Commonwealth of Pennsylvania in accordance with conditions specified in required permits listed in Table 1.3-1. Additional monitoring including program elements, actions and reporting levels will be specified as required by the PA Department of Environmental Protection; Pennsylvania Stormwater Best Management Practices Manual; and Best Management Practices (BMPs) for erosion and sediment control as provided in applicable permits obtained for construction. This plan and program will be implemented during this phase in order to minimize impacts to wetlands, groundwater and aquatic ecology. In accordance with the baseline studies performed during the preapplication timeframe and existing plant experience at the BBNPP site, no additional monitoring programs are proposed for: • Bird collisions with plant structures, transmission lines and towers, and cooling towers; and • Impacts to important species and habitats. These parameters have all been determined to have a small impact on terrestrial ecology. Note that there is a commitment to place flashing lights or reduce lighting on the large cooling towers to minimize bird collisions once these structures are built. There are no continuous monitoring programs required for terrestrial ecology and land use in this phase of the project.	US Army Corps of Engineers Pennsylvania Department of Environmental Protection

Table 6.7-5 {Terrestrial Ecology Monitoring}

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Phase	Summary	Permits
Operational	Operation and maintenance impacts of the proposed transmission system are addressed in Section 5.6.1. There are no continuous monitoring programs required for terrestrial ecology and land use in this phase of the project	US Army Corps of Engineers Pennsylvania Department of Environmental Protection

Table 6.7-6 {Aquatic Ecology Monitoring}

Phase	Summary	Permits
Pre-Application Monitoring	Long-term monitoring of the Susquehanna River has occurred in relation to operation of SSES. This long-term monitoring program included water quality, algae, periphyton, benthic macroinvertebrates, and fish. Currently, the program samples river water quality on a quarterly basis and the fish assemblage is sampled from spring to fall. Other preapplication monitoring has been conducted on the BBNPP site, including sampling for fish in the ponds and Walker Run, and benthic macroinvertebrate collections in Walker Run and Unnamed Tributary No. 2. An impingement and entrainment study was initiated at the SSES intake structure to provide data on potential impingement and entrainment at the proposed BBNPP water intake structure. Data collection efforts provide a sufficient basis for describing the ecological resources existing on and in the vicinity of the BBNPP site. Two important species of mussels, green floater and yellow lampmussel, were collected from the river. Both species are listed as species of special concern by the Pennsylvania Fish and Boat Commission (PFBC). Construction activities will likely have minimal impact to mussels in the river. However, surveys may be required prior to intake/discharge structure construction to determine if mussels are present in the vicinity of these areas and, if so, these mussels may need to be relocated. There are no continuous monitoring programs required for aquatic ecology in this phase of the project. The surveys performed to establish baseline conditions were sufficient to document the composition and abundance of aquatic organisms on site and in the river.	General NPDES Operations Permit for SSES Units 1 and 2
Pre-Operation and Construction Monitoring	Construction and preoperational monitoring programs are proposed for resources that may affect aquatic ecology such as thermal, hydrological and chemical monitoring. Construction monitoring mainly consists of drainage from excavations which are pumped to a storm water discharge point. Approval of storm water management and erosion/sediment control plans will be obtained in accordance with the National Pollution Discharge Elimination System (NPDES) permit. The Pennsylvania Department of Environmental Protection will issue a permit to include pollutants typically found at a construction site such as sediments and petroleum hydrocarbons. Storm water discharges from impervious surfaces at the new facility will be controlled and minimized by following guidelines established in Pennsylvania's Stormwater Best Management Practices Manual. The U.S. Army Corps of Engineers 404 Permit may contain requirements for aquatic monitoring as it relates to chemical spills or control of silt discharging into water bodies. Details as to monitoring program elements, sampling procedures and equipment, data analysis, quality control and reporting will be contained in the various permits and approvals required for construction. BBNPP will be designed to meet the requirements of the Clean Water Act to verify there will be minimal adverse environmental impact to fish and other aquatic organisms due to impingement and entrainment for the new intake structure.	General NPDES Construction Permit Army Corps of Engineers 404 Permit Spill Prevention, Control and Countermeasures Plan
Operation Monitoring	Operational aquatic ecology monitoring may be required as a condition of a new NPDES permit and for compliance with the Clean Water Act 316(b) Rule. Aquatic biological monitoring may be required in the river and Walker Run after completion of construction and after initiation of plant operation. This monitoring would most likely entail additional aquatic collections at the same locations as the preapplication monitoring. The Clean Water Act Section 316(b) requires that the location, design, construction and capacity of a cooling water intake structure reflect the best technology available (BTA) for minimizing adverse environmental impacts.	NPDES issued for BBNPP Operations

Table 6.7-7 {Chemical Monitoring}

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	Summary	Permits
Pre-Application	Information on past studies performed to determine the characteristics of surface water are discussed in ER Section 2.3.3. Water quality databases, maintained by Federal agencies, State agencies, and non-profit groups, were assessed to locate available and applicable water quality data relevant to the Susquehanna River water in the area of the BBNPP site. Groundwater observation wells were installed across the BBNPP site. The wells were established to determine site groundwater levels, subsurface flow directions, and hydraulic gradients beneath the BBNPP site. To evaluate vertical hydraulic gradients, several observation wells were installed as well clusters. Well Clusters are a series of wells placed at the same location, with each well monitoring a distinct water bearing interval. Well water quality data are described in Section 2.3.3.2.	Existing NPDES permit for SSES Units 1 and 2
Construction and Pre Operational	Chemical monitoring during construction will aid in controlling adverse impacts to the Susquehanna River and Walker Run and will provide additional water quality data that can be used to measure water-quality changes from operation of the new unit. Construction and pre-operational chemical monitoring will be performed during site preparation and plant construction. In accordance with the existing NPDES permit, the Pennsylvania Department of Environmental Protection (DEP) will be notified regarding the proposed plant expansion. Sample collection, laboratory analyses, data evaluation and reporting practices will comply with permit modifications. Groundwater monitoring (water level observation) of the BBNPP area is currently being implemented through the use of the groundwater observation wells. Some of the existing BBNPP area observation wells will be taken out-of-service prior to construction activities due to anticipated earth moving and construction requirements. Revisions to the observation well network will be implemented to ensure that the resulting changes in the local groundwater regime from construction activities will be identified. No chemical monitoring is planned at the time for groundwater.	General NPDES Construction Permit

Table 6.7-7 {Chemical Monitoring}

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	Summary	Permits
Operation	Operational monitoring will be in accordance with the NPDES permit for the new plant. Operational monitoring elements will be developed in consultation with the Pennsylvania DEP. Sanitary wastewater from BBNPP will not be treated in an on-site wastewater treatment plant, but will be collected in a sanitary wastewater collection system that will direct sanitary wastes to the municipal sewer system and local POTW operated by the Berwick Area Joint Sewer Authority. No effluent discharge to the river or associated chemical monitoring for treated sanitary wastewater streams is envisioned for BBNPP. However, chemical monitoring of sewage from BBNPP into the municipal sanitary system will be done in accordance with local ordinances and permit requirements. The anticipated discharge limits for sanitary wastewater into the municipal sewer system is provided on Table 3.6-4. The BBNPP Intake Structure will house debris screens, screen wash pumps, make-up water pumps and related equipment so that a new outfall for intake screen backwash will be likely. Chemical monitoring at the new outfall will be limited by the new NPDES permit to certain chemical parameters to ensure that the differences between the intake water and discharge water are within the limits specified in the permit. CWS cooling tower blowdown will be directed into a retention basin and held for a period of time to reduce the concentration of solids and chlorine in the water. Essential Service Water System (ESWS) cooling tower blowdown and other wastewater will also collect in the retention basin. Piping will transfer retention basin wastewater by gravity to the new Discharge Structure, which will provide a flow path for the discharge of water into the river via a submerged outfall. Chemical monitoring will be performed at the new outfall to assess the effectiveness of retention methods and effluent treatment systems, as well as to detect changes in water quality associated with new plant operations. Chemical monitoring will also be performed at storm water runoff outfalls and at internal monitoring points. Effluent water chemistry will meet all applicable federal and state environmental regulatory requirements.	NPDES issued for BBNPP Operations