PSEG Site

Early Site Permit Application

Part 3

Environmental Report

Revision 4

MASTER TABLE OF CONTENTS

MASTER TABLE OF CONTENTS (CONTINUED)

Section | Title | Page

CHAPTER 4
ENVIRONMENTAL IMPACTS OF CONSTRUCTION

CHAPTER 5
ENVIRONMENTAL IMPACTS OF OPERATION

CHAPTER 6
ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

MASTER TABLE OF CONTENTS (CONTINUED)

CHAPTER 1
INTRODUCTION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

Acronym	Definition
ABWR	Advanced Boiling Water Reactor
ac.	acre
AP1000	Advanced Passive 1000
CAFRA	Coastal Area Facility Review Act
CDF	confined disposal facility
CFR	Code of Federal Regulations
COL	combined license
DCR	Discharge Cleanup and Removal
DNREC	Delaware Department of Natural Resources and Environmental Control
DPCC	Discharge Prevention, Containment, and Countermeasure
DRBC	Delaware River Basin Commission
EAB	Exclusion Area Boundary
ER	Environmental Report
ESP	early site permit
FRP	Facility Response Plan
GWh	gigawatt hour(s)
HCGS	Hope Creek Generating Station

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Acronym	Definition
kV	kilovolt(s)
mi.	miles
MW	megawatt
MWe	megawatts electric
MWt	megawatts thermal
NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System
NJSA	New Jersey Statutes Annotated
NMFS	National Marine Fisheries Service
NRC	U.S. Nuclear Regulatory Commission
$PM_{2.5}$	particulate matter less than or equal to 2.5 microns in diameter
PJM	PJM Interconnection, LLC
PPE	plant parameter envelope
PSEG	PSEG Power, LLC and PSEG Nuclear, LLC
RCRA	Resource Conservation and Recovery Act
RSA	relevant service area

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Acronym	Definition
RTO	Regional Transmission Organization
SESC	Soil Erosion and Sediment Control Act
SGS	Salem Generating Station
SPCC	Spill Prevention, Control and Countermeasures
SSAR	Site Safety Analysis Report
SWPPP	Storm Water Pollution Prevention Plan
USACE	U.S. Army Corps of Engineers
US-APWR	U.S. Advanced Pressurized Water Reactor
USC	United States Code
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
U.S. EPR	U.S. Evolutionary Power Reactor
USFWS	U.S. Fish and Wildlife Service
yr	year

CHAPTER 1
INTRODUCTION

1.0 INTRODUCTION

In accordance with the provisions of 10 CFR 52, *Licenses, Certifications, and Approvals for Nuclear Power Plants*, and supporting guidance, PSEG Power, LLC and PSEG Nuclear, LLC (PSEG) have developed an application to the U.S. Nuclear Regulatory Commission (NRC) for an early site permit (ESP). The NRC issuing an ESP represents its approval of a site or sites for one or more nuclear power units. This is separate from the filing of a combined license (COL) application for such a facility. The PSEG ESP application is for a new nuclear electric generating plant located adjacent to the existing Hope Creek Generating Station (HCGS) and Salem Generating Station, Units 1 and 2 (SGS) in Lower Alloways Creek Township, Salem County, New Jersey (NJ). The site location is depicted in Figure 1.0-1. In accordance with NRC regulations, PSEG has prepared this Environmental Report (ER), as part of its ESP application analyzing the impacts to the local and regional environment from construction, operation, and decommissioning of one or two additional nuclear power units at this site (PSEG Site). The NRC uses this ER to fulfill the National Environmental Policy Act requirement to consider the environmental impacts that could result from the construction and operation of one or two new nuclear power units at the PSEG Site.

1.1 PROPOSED ACTION

The proposed federal action is issuance of an ESP to PSEG for the PSEG Site for one or two additional nuclear power units, under the provisions of 10 CFR Part 52, that would be operated as a merchant plant to supply baseload electrical power to the State of New Jersey (NJ). A specific reactor technology has not yet been selected. However, the design characteristics of four reactor technologies under consideration were used to establish a plant parameter envelope (PPE) (Site Safety Analysis Report [SSAR] Section 1.3). While issuance of the ESP does not authorize construction and operation of any new nuclear power units, this ER analyzes the environmental impacts that could result from the construction and operation of one or two new nuclear power units at the PSEG Site. These impacts are analyzed to determine if the site is suitable for the addition of the new nuclear plant, and whether there is an alternative site that is environmentally preferable to the proposed site.

1.1.1 PURPOSE AND NEED

An analysis of the need for power, based on annual PJM Interconnection, LLC (PJM) resource and load forecast data, is provided in Chapter 8. The relevant service area (RSA) for the new plant is the State of NJ which is part of the Eastern Mid Atlantic Zone of PJM, the Regional Transmission Organization (RTO) for the area. As the RTO, PJM is responsible for the reliable supply of bulk electricity within the region. Analysis of PJM data in 2009 identified that an additional 7900 MWe (Section 8.4) of baseload capacity would be required to meet the energy needs forecasted for 2021 (Reference 1.1-1). The projected 2021 need for baseload generation in NJ, based on the 2012 PJM load forecast, is projected to be in excess of 7300 MWe. This reduced need for baseload generation reflects the suppressed demand growth stemming from the 2008-2009 recession. Given that the expected need for baseload power in NJ is still substantial despite the effects of the recession, the conclusions reached by the initial 2009 need for power analysis that serve as the documented basis for the purpose and need of this project are still valid and applicable to NJ's energy landscape. Therefore, discussions regarding the results of the initial need for power analysis are maintained throughout the Environmental Report. Based on the above projected shortfall in baseload generation, PSEG is submitting this ESP application to preserve the option of constructing a new nuclear power plant at the PSEG Site for up to approximately 2200 MWe to help meet this shortfall.

The NRC established the licensing process used by PSEG in 10 CFR 52, Subpart C, *Combined Licenses*. This provision allows entities to apply for a COL that is, a combined construction permit and operating license for a nuclear power facility. A COL authorizes construction and operation of the facility. As described in 10 CFR 52, Subpart A, *Early Site Permits*, the NRC's issuance of an ESP allows an applicant to reserve a reactor site for up to 20 years (yr) prior to obtaining a COL.

The ESP process addresses and resolves site safety, environmental protection, and emergency preparedness issues. ESP licensing issues are resolved with finality during the ESP review process and are not reexamined in any subsequent licensing action involving the permitted site, absent any information meeting certain standards established by the NRC.

An application for a COL can reference an ESP issued under 10 CFR 52. In general, if the COL application references an ESP, the application need not contain certain information or analyses submitted to the NRC in connection with the ESP. Instead, the COL application must contain the following:

- Information and analyses otherwise required
- Information sufficient to demonstrate that the facility falls within the site characteristics and design parameters specified in the ESP
- Information to resolve any other significant environmental issue(s) not considered in any previous proceeding on the site or design

In accordance with NRC regulations, PSEG is submitting this ESP application to preserve the option of constructing a new nuclear power plant at the PSEG Site for up to approximately 2200 MWe.

1.1.2 REFERENCES

1.1-1 PJM Interconnection, LLC, "2009 Load Forecast Report," PJM Capacity Adequacy Planning Department, 2009.

1.1-2 PJM Interconnection, LLC, "PJM Reliability Pricing Model (RPM) Resource Model for 2008-2009," updated November 12, 2007.

1.2 THE PROPOSED PROJECT

This section provides a brief summary of project information. Subsequent chapters, particularly Chapter 3, *Plant Description*, provide more detail.

1.2.1 THE APPLICANTS AND OWNERS

The Applicants are PSEG Power, LLC and PSEG Nuclear, LLC.

PSEG Power, LLC is a Delaware (DE) limited liability company, which is wholly owned by Public Service Enterprise Group Incorporated, a corporation formed under the laws of NJ. It is anticipated that PSEG Power, LLC will be the owner of any new plant based on the ESP requested by this application.

PSEG Nuclear, LLC is a DE limited liability company formed to own and operate nuclear generating stations and is a wholly owned subsidiary of PSEG Power, LLC. PSEG Nuclear, LLC is the owner and licensed operator of the HCGS and the partial owner and licensed operator of the SGS. These existing nuclear generating stations are located on the PSEG Site, which is the subject of this ESP application. It is anticipated that PSEG Nuclear, LLC will be the licensed operator of the new plant at the PSEG Site.

1.2.2 SITE LOCATION

The proposed site is located on the southern part of Artificial Island on the east bank of the Delaware River in Lower Alloways Creek Township, Salem County, NJ. The site is 15 miles (mi.) south of the Delaware Memorial Bridge, 18 mi. south of Wilmington, DE, 30 mi. southwest of Philadelphia, Pennsylvania (PA), and 7-1/2 mi. southwest of Salem, NJ. The municipalities of Salem and Pennsville (12 mi. north of the site) are the nearest sizable municipalities in NJ with 2007 estimated populations of 5678 and 13,363, respectively. Middletown (10 mi. due west of the site) and New Castle (13 mi. north of the site) are the nearest sizable municipalities in DE with 2007 estimated populations of 11,153 and 4973, respectively (Reference 1.2-1). The proposed new plant footprint is north of the existing HCGS. Most of the new plant area lies within the current 734 acres (ac.) property boundary.

PSEG is developing an agreement in principle with the U.S. Army Corps of Engineers (USACE) to acquire an additional 85 ac. immediately to the north of the HCGS. Therefore, with the land acquisition, the entire PSEG Site will encompass 819 ac. The specific timing of land acquisition is not currently known and is subject to further PSEG and USACE actions. However, the agreement in principle with the USACE will serve to establish the basis for eventual land acquisition and Exclusion Area Boundary (EAB) control, necessary to support the issuance of a future COL. Subsequent to the agreement in principle with the USACE, PSEG will develop a lease agreement for the USACE Confined Disposal Facility (CDF) land to the north of the PSEG Site, depicted on the Site Utilization Plan (Figure 3.1-2) for the concrete batch plant and temporary construction/laydown use. At the completion of construction, the leased land will be returned to the USACE, subject to any required long-term EAB control conditions.

1.2.3 REACTOR INFORMATION

PSEG has not yet selected a specific reactor technology. Four different technologies are under consideration including:

- Advanced Passive 1000 (AP1000)
- U.S. Evolutionary Power Reactor (U.S. EPR)
- Advanced Boiling Water Reactor (ABWR)
- U.S. Advanced Pressurized Water Reactor (US-APWR)

This ESP application uses a PPE approach that encompasses all four reactor technologies (SSAR Section 1.3). The ESP analyzes the environmental impacts of the four reactor technologies using either one unit (U.S. EPR, ABWR, or US-APWR) or two units (AP1000) at the PSEG Site. Since a specific reactor technology has not been selected, the environmental impact analyses are based on reactor bounding conditions derived from detailed reactor information supplied by the vendors. The total bounding PPE value for the new plant is 6830 gross megawatts thermal (MWt) (SSAR Table 1.3-1 Item 17.3) and 2200 MWe net. Section 3.2, Reactor Power Conversion System, provides additional information on these reactor technologies.

1.2.4 COOLING SYSTEM INFORMATION

The new plant uses a recirculating (closed-cycle) cooling water system that includes natural draft, mechanical, or fan-assisted natural draft cooling towers. A new shoreline intake structure supplies makeup water from the Delaware River to the new plant. A new discharge structure conveys cooling tower blowdown to the Delaware River in conformance with New Jersey Pollutant Discharge Elimination System (NJPDES) permit requirements. Section 3.4, Cooling System, provides additional detail on the intake, discharge, and cooling tower components of the plant cooling system.

1.2.5 TRANSMISSION SYSTEM INFORMATION

The existing HCGS and SGS site is interconnected with the regional power grid via four 500 kilovolt (kV) transmission lines extending from the existing nuclear units to the Red Lion substation in DE, and to the New Freedom substation in NJ.

During the development of the ESP application, PSEG completed a conceptual evaluation of transmission requirements associated with the addition of generation at the PSEG Site. This evaluation included the PJM Regional Transmission Expansion Plan, existing operational limits at HCGS and SGS, and other PJM transmission planning inputs. PJM routinely performs analyses of the regional transmission system and forecasts appropriate upgrades to the system as part of its long term planning cycle. These evaluations are not specific to the addition of new generation at the PSEG Site.

PSEG's conceptual evaluation indicates that a new off-site transmission line may be needed to accommodate new generation at the PSEG Site to ensure transient stability of the transmission system. The need for a new transmission line is dependent upon a range of factors including the specific reactor technology selected and the progress of regional transmission upgrade projects as part of PJM's regional planning efforts. Since the completion of this conceptual evaluation,

PJM, as an example of their continuing assessment of system reliability, recently determined that additional grid improvements are necessary to address voltage and stability constraints in the region of Artificial Island. In response, PJM has solicited proposals from both regulated and non-regulated (merchant) transmission providers for system enhancements to address these constraints. PJM's determination of the need for this transmission system upgrade is independent of PSEG's interest in new nuclear generation and is not predicated on the construction of a new nuclear facility at the PSEG Site. Therefore, any transmission project mandated by PJM, including a new off-site transmission line, is considered to be reasonably foreseeable and is considered to be an action that is independent from the potential development of the PSEG Site. Similarly, since these PJM-sponsored grid improvements serve to enhance power delivery throughout the region, they inherently possess independent utility. Although JPM has not formally assessed the scope and structure of this future transmission upgrade, PSEG has accordingly identified the potential impacts of a new off-site transmission line whose technical attributes best meet PJM's goal of resolving these regional constraints.

Section 3.7, *Power Transmission System*, provides additional details on the existing PJM transmission system. Information pertaining to alternative off-site transmission system corridors considered by PSEG is presented in Subsection 9.4.3. Of the two potential transmission corridors presented in Subsection 9.4.3, the West Macro-Corridor to the Peach Bottom substation is considered to be the most effective route to address the regional voltage and stability constraints that PJM is attempting to resolve. Therefore, PSEG has used the characteristics of the West Macro-Corridor to evaluate the potential impacts of a new transmission line as representative of the regional transmission upgrade project currently being pursued by PJM. These potential impacts are addressed as part of the cumulative effects assessment provided in Section 10.5.

1.2.6 PREAPPLICATION PUBLIC INVOLVEMENT

The NRC held a public outreach meeting on May 6, 2010 in Salem County, NJ. The purpose of the meeting was to provide information to the public on the ESP review process for the proposed site and opportunities for public involvement in that process. The meeting included a discussion of NRC perspectives, roles, and responsibilities with regard to the proposed site. An informal open house format was used, allowing the public the opportunity to speak directly with the NRC staff. The meeting included staff presentations on the regulatory framework for the ESP review process and a question-and-answer session. NRC staff also discussed upcoming opportunities for further public involvement during the application review process.

At PSEG’s request, the NRC conducted two Category 1 public meetings during the preapplication period to discuss with PSEG staff approaches to address various regulatory requirements applicable to this application. Both meetings were held at the NRC headquarters in Rockville, Maryland.

1.2.7 CONSTRUCTION START DATE

The ESP does not constitute a decision or approval to build new units. However, the projected construction start date is 2016. NRC regulations 10 CFR 50.10, *License Required; Limited Work Authorization,* and 10 CFR 52.25, *Extent of Activities Permitted*, allow site preparation preconstruction activities. If PSEG decides to initiate site preparation activities, it is estimated that such site preparation activities would take 12 to 36 months to complete, prior to the start of NRC regulated construction activities. PSEG does not plan to request a limited work authorization as part of this submittal. Furthermore, if PSEG decides to submit a COL application and the NRC grants a COL, it is estimated that new plant construction would occur over an additional 5-yr to 7-yr period.

1.2.8 REFERENCES

1.2-1 U.S. Census Bureau, 2008, American FactFinder, 2007 Population Estimates. http://factfinder.census.gov/servlet/SAFFPopulation?_event=ChangeGeoContext&geo_id=1, accessed May 8, 2009.

1.3 STATUS OF REVIEWS, APPROVALS, AND CONSULTATIONS

PSEG informed regulatory stakeholders of their intention to submit this ESP application for the new plant, to prepare the required ER, and to coordinate and consult with these agencies as appropriate. Agencies contacted include, but are not limited to:

- State of New Jersey Department of Environmental Protection (NJDEP)
- State of Delaware Department of Natural Resources and Environmental Control (DNREC)
- U.S. Army Corps of Engineers (USACE)
- U.S. Fish and Wildlife Service (USFWS)
- National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS)
- U.S. Coast Guard (USCG)
- U.S. Environmental Protection Agency (USEPA)
- Delaware River Basin Commission (DRBC)

Tables 1.3-1 and 1.3-2 identify the following information related to consultations for the ESP and authorizations related to support of construction and operation activities:

- Jurisdictional agency
- Authority, law, or regulation that dictates the requirement
- Name of the required authorization
- Description of the activities covered by authorization

License and permit numbers, as well as expiration dates of existing licenses and permits are not included in Table 1.3-2 as they are not applicable at the ESP licensing phase.

The authorizations from federal, state, and local authorities for construction and operation are not yet necessary because an ESP is limited to establishing the acceptability of the PSEG Site for future development. PSEG is filing an application for a coastal consistency determination from the State of New Jersey concurrent with this ESP application. PSEG does not anticipate securing any other authorizations for construction of the new plant during the ESP stage. PSEG will apply for and receive any required authorizations prior to initiating preconstruction, construction, and operational activities. The following subsections describe the activities to be authorized.

1.3.1 ESP ISSUANCE

The following statutes summarize the agency consultations necessary for the ESP. Table 1.3-1 lists these required consultations.

<u>Endangered Species Act</u>

The Endangered Species Act requires federal agencies to ensure that agency action is not likely to jeopardize any species listed or proposed for listing as endangered or threatened. Depending on the action involved, the Act requires consultation with the USFWS regarding the effects on non-marine species, the NMFS for marine species, or both. There are both freshwater and

marine species at the proposed site, therefore, the NRC consults with both USFWS and NMFS. As a matter of policy, the NRC consults with the NJDEP Division of Fish and Wildlife and DNREC regarding protected species.

<u>Bald and Golden Eagle Protection Act</u>

The Bald and Golden Eagle Protection Act provides for the protection of the bald eagle and golden eagle from harassment, taking, and possession. The 1972 amendments increased penalties for violating provisions of the Act. Bald eagles have been observed foraging near the proposed site, therefore, the NRC consults with USFWS on this issue to ensure that no adverse impacts to bald eagles occur as a result of the proposed project. As a matter of policy, the NRC consults with the NJDEP Division of Fish and Wildlife and DNREC regarding protected species.

<u>National Historic Preservation Act</u>

The National Historic Preservation Act requires federal agencies, which have the authority to issue licenses, to take into account the effect on historic properties. The Advisory Committee on Historic Preservation has an opportunity to comment, prior to license issuance. The Advisory Committee regulations allow an agreement with any State Historic Preservation Officer to substitute state review for committee review (35 CFR 800.7). Accordingly, the NRC consults with the New Jersey Historic Preservation Office and the Delaware State Historic Preservation Office.

<u>Coastal Zone Management Act</u>

The Coastal Zone Management Act requires an applicant for a federal license or permit to certify to the licensing agency that the proposed activity is consistent with the state's federally approved coastal zone management program. Portions of the proposed site are located within NJ's coastal zone, and consultation with NJDEP's Division of Land Use Management is necessary.

<u>Clean Air Act</u>

The Clean Air Act imposes regulatory requirements on federally licensed projects where construction and operation may have an impact on state and regional air quality. The proposed site lies within an ozone non-attainment area (Salem County, NJ) and is adjacent to a particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$) non-attainment area (New Castle County, DE). The NRC consults with the NJDEP Division of Air Quality and potentially DNREC Division of Air and Waste Management on these non-attainment issues.

<u>Clean Water Act / Rivers and Harbors Act</u>

The Clean Water Act requires that federal agencies consider the potential impacts to jurisdictional "waters of the United States." Section 401 of this Act regulates the issuance of a Water Quality Certification, Section 402 regulates point source and non-point source discharges under the National Pollutant Discharge Elimination System, and Section 404 regulates the placement of fill in waters of the United States. The USACE regulates dredge and fill activities in navigable waters pursuant to Section 10 of the Rivers and Harbors Act. As a matter of policy,

the NRC consults with the USACE and NJDEP regarding potential impacts to waters of the United States.

1.3.2 PRECONSTRUCTION, CONSTRUCTION, AND OPERATION ACTIVITIES

Permits and authorizations for future construction and operation of a new plant will be obtained in accordance with applicable statutes and regulations. Applications for these authorizations will be developed after a reactor technology has been selected and detailed design is initiated. Table 1.3-2 lists authorizations that are anticipated for preconstruction, construction, and plant operation.

Table 1.3-1
Consultations Required for Early Site Permit

Agency	Authority	Requirement	Activity Covered
U.S. Fish and Wildlife Service	Endangered Species Act , 16 USC 1536	Consultation regarding potential to adversely impact protected non-marine species	Concurrence with no adverse impact or consultation on appropriate mitigation measures
	Bald and Golden Eagle Protection Act, 16 USC 668-668c	Consultation regarding potential to adversely impact bald eagles	Concurrence with no adverse impact or consultation on appropriate mitigation measures
National Marine Fisheries Service	Endangered Species Act, 16 USC 1536	Consultation regarding potential to adversely impact protected marine species	Concurrence with no adverse impact or consultation on appropriate mitigation measures
NJDEP – Fish and Wildlife	New Jersey Endangered Species Conservation Act, New Jersey Statutes Annotated (NJSA) 23:2A et seq.	Consultation regarding potential to adversely impact protected species	Concurrence with no adverse impact or consultation on appropriate mitigation measures
New Jersey Historic Preservation Office	National Historic Preservation Act, 16 USC 470 et seq.	Consultation regarding potential to adversely impact historic resources	Confirm that site construction and operation activities would not affect protected historic resources or would be mitigated if unavoidable
NJDEP – Division of Land Use Regulation	Coastal Zone Management Act, 16 USC 1451-1464	Certificate of consistency with established coastal zone management plan	Concurrence with certification that site construction and operation activities are consistent with established coastal zone management plan
NJDEP – Division of Air Quality	Clean Air Act, USC 42 et seq.	Consultation regarding potential adverse impacts to ozone standards	Concurrence with no adverse impact or consultation on appropriate mitigation measures
Delaware Office of Historic Preservation	National Historic Preservation Act, 16 USC 470 et seq.	Consultation regarding potential to adverse impacts to historic resources	Confirm that site construction and operation activities would not affect protected historic resources or would be mitigated if unavoidable
U.S. Army Corps of Engineers	Federal Clean Water Act, 33 CFR 330 Rivers and Harbors Act, 33 USC 403	Consultation regarding potential to adverse impacts to waters of the United States	Concurrence with no adverse impact or consultation on appropriate mitigation measures

Table 1.3-2 (Sheet 1 of 5)
Authorizations Required for Preconstruction, Construction, and Operation Activities[a]

Agency	Authority	Requirement	Activity Covered
U.S. Nuclear Regulatory Commission	Atomic Energy and Energy Reorganization Acts 10 CFR 52 Subpart C or 10 CFR 50.10(e)(1)	ESP and COL or Limited Work Authorization, in addition to applicable By-Product License, Source Material License, and Special Nuclear Material License	Site Licensing, including safety-related construction activities and operation of a nuclear power facility
Federal Aviation Administration	Federal Aviation Act 49 USC 1501; 14 CFR 77	Construction Notice	Notice of erection of structures greater than 200 feet high that potentially may impact air navigation
U.S. Department of Transportation	Hazardous Material Transportation Act 40 CFR 107 Subpart G	Certificate of Registration	Transportation of hazardous materials
U.S. Army Corps of Engineers	Federal Clean Water Act 33 CFR 330	Section 404 Permit	Disturbance, crossing or filling-in of wetland areas or navigable waters from site (barge slip modification, maintenance dredging, intake/discharge structures, and proposed causeway construction)
	Rivers and Harbors Act 33 USC 403	Section 10 Permit	Construction and maintenance of intake, discharge and barge structures in navigable waters of Delaware River
U.S. Coast Guard	Ports and Waterways Safety Act 33 USC 1221, et seq.	Private Aids to Navigation Permit	Construction of discharge pipeline in navigable waters of the Delaware River
	Rivers and Harbors Act 33 USC 401	Section 9 Permit	Construction of bridge over navigable waterway (Alloway Creek)
U.S. Environmental Protection Agency	Resource Conservation and Recovery Act (RCRA), Section 3010	Acknowledgement of Notification of Hazardous Waste Activity	Hazardous Waste Generation
	USEPA Facility Response Plan (FRP) (40 CFR 9 and 112), and the USEPA Hazardous Waste Contingency Plan	Facility Response Plan Approval	Spill/Discharge Response Program
	Spill Prevention, Control and Countermeasures (SPCC) rule (40 CFR 112), Appendix F, Sections1.2.1 and 1.2.2	SPCC Plan	Spill/Discharge Prevention Plan

Table 1.3-2 (Sheet 2 of 5)
Authorizations Required for Preconstruction, Construction, and Operation Activities[(a)]

Agency	Authority	Requirement	Activity Covered
U.S. Fish and Wildlife Service	Migratory Bird Treaty Act 16 USC 703 et seq.	Federal Depredation Permit	Potential impacts to protected species or their nests for construction of the proposed causeway and potential off-site transmission line
	Endangered Species Act Section 7 (16 USC 1536)	Incidental Take Permit	Possession and disposition of potential impinged or stranded species (turtles, shortnose sturgeon)
Delaware River Basin Commission	Delaware River Basin Compact, Section 3.8; Resolution No. 71-4	Water Withdrawal Docket	Additional Delaware River water required for cooling purposes
		Water Withdrawal Docket	Additional groundwater required for a new plant and existing permit modifications
		Water Use Contract	A water use contract may be required for the new plant
		Approval of Wells	New wells required for the new plant
		Oxygen Demand Wasteload Allocations	Allocation for First Stage Oxygen Demand discharge to Delaware Estuary
	Delaware River Basin Compact, Section 3.8	Industrial Waste Treatment Facility	Waste treatment required for a new plant
Salem County Soil Conservation District	Soil Erosion and Sediment Control (SESC) Act SESC Act, Chapter 251 NJAC 2:90	Soil Erosion and Sediment Control Plan Approval	Soil Erosion and Sediment Control Plan approval required for earth disturbance greater than 5000 square feet
Lower Alloways Creek Township	Code of Lower Alloways Creek Township, Chapter 156 (Land Development), Section 5.07B2	Site Plan Approval	Planning Board and/or Zoning Board of Adjustment approval of the development of the site in compliance with township ordinances
		Construction Permits	Construction of the new plant facilities in compliance with township ordinances
Salem County	Salem County Planning Board	Site Plan Approval	Construction of the new plant facilities in compliance with county ordinances if county facilities or drainage are impacted

Table 1.3-2 (Sheet 3 of 5)
Authorizations Required for Preconstruction, Construction, and Operation Activities[(a)]

Agency	Authority	Requirement	Activity Covered
New Jersey Department of Community Affairs	New Jersey State Uniform Construction Code Act, NJAC 5:23	Construction Permits	Construction of the new plant facilities in compliance with State of New Jersey construction codes
New Jersey Department of Environmental Protection	Federal Clean Water Act (33 USC 1251 et seq.), NJSA Water Pollution Control Act 58:10A et seq. and NJAC 7:14A et seq.	NJPDES Permit for storm water discharges associated with construction activities greater than 5 ac.	Construction/operation of storm water control measures (detention basins, etc.)
		NJPDES Permit for Dewatering Activities	Construction dewatering
		Section 401 Certification, NJPDES Permit	Compliance with federal and state water quality standards, discharges to waters of the state due to construction of the new plant, proposed causeway, switchyards, and on-site and potential off-site transmission lines
	Sewage Infrastructure Improvement Act NJAC 7:14A-22	Treatment Works Approval	Construction and operation of a treatment system for construction dewatering
		Treatment Works Approval	Modification and operation of an existing permanent treatment system for plant wastewater
	Water Quality Management Planning, NJAC 7:15	Water Quality Management Plan Amendment	New discharges or expansion of existing discharges require an amendment
	Federal Clean Water Act (33 USC 1251 et seq.), NJSA Water Pollution Control Act 58:10A et seq. and NJAC 7:14A et seq.	NJPDES Permit for plant operation activities	Cooling water, service water, and runoff discharge from plant operations

Table 1.3-2 (Sheet 4 of 5)
Authorizations Required for Preconstruction, Construction, and Operation Activities[a]

Agency	Authority	Requirement	Activity Covered
New Jersey Department of Environmental Protection, cont.	Water Supply Management Act, NJSA 58:1A-1 et seq.	Temporary Dewatering Permit	Required for construction dewatering where dewatering rate exceeds 100,000 gallons per day for 31 consecutive days in a year
		Well Drilling Permit	For construction dewatering wells, permanent water supply wells and closure of abandoned wells
		Water Allocation Permit	Current permit requires modification to allow additional groundwater use for new plant
	Coastal Area Facility Review Act (CAFRA), NJSA 13:19-1, 13:9B-1 and 13:1D-1	CAFRA Permit[b]	Property required for construction of the new plant is in NJ coastal zone Portions of the new plant site, proposed causeway, switchyards, and on-site and potential off-site transmission lines may be located in freshwater wetlands and transitional areas
	Flood Hazard Area Control Act, NJSA 58:16A-50 et seq.	Flood Hazard Control Permit	Construction within a flood hazard area (100-yr floodplain)
	New Jersey Freshwater Wetlands Protection Act, NJAC 7:7A	Freshwater Wetland Permit	Portions of the new plant site, proposed causeway, switchyards, and on-site and potential off-site transmission lines may be located in freshwater wetlands and transitional areas
	New Jersey Wetlands Act, NJSA 13:9A	Coastal Wetlands Permit	Portions of new plant site, proposed causeway, and on-site and potential off-site transmission lines constructed in areas designated as coastal wetlands
	Waterfront Development Act, NJSA 12:5-1, 13:19-1, 13:9B-1 and 13:1D-1	Waterfront Development Permit	Required for any activity occurring below mean high water line (dredging/construction)
	Tidelands Act NJSA 12:3	Grant, Lease or License	Portions of new plant site, proposed causeway, or on-site and potential off-site transmission lines may be constructed in lands subject to tidelands claims
	Solid Waste Management Act, NJSA 13:1 E-1	Beneficial Use Certificate of Authority	Re-use of excavated materials

Table 1.3-2 (Sheet 5 of 5)
Authorizations Required for Preconstruction, Construction, and Operation Activities[a]

Agency	Authority	Requirement	Activity Covered
New Jersey Department of Environmental Protection, cont.	Federal Clean Air Act, 42 USC 7401	Title V Operating Permit; Prevention of Significant Deterioration Preconstruction Permit	Discharge of air pollutants from cooling tower(s), emergency generators, auxiliary boiler(s), and ancillary equipment
	NJAC, Title 7, Chapter 1E (NJAC 7:1E-1 et seq.)	Discharge Prevention, Containment, and Countermeasure (DPCC) Plan and Discharge Cleanup and Removal (DCR) Plan	DPCC/DCR Program: DPCC Plan, DCR Plan, SPCC Plan, Hazardous Waste Contingency Plan, and Storm Water Pollution Prevention Plan (SWPPP)
South Carolina Department of Health and Environmental Control – Division of Waste Management	South Carolina Radioactive Waste Transportation and Disposal Act, (Act No. 429)	South Carolina Radioactive Waste Transport Permit	Transportation of radioactive waste into the State of South Carolina
State of Tennessee Department of Environment and Conservation Division of Radiological Health	Tennessee Department of Environment and Conservation, Rule 1200-2-10.32	Tennessee Radioactive Waste License-for-Delivery	Transportation of radioactive waste into the State of Tennessee

a) None of the authorizations will be applied for at the time of the ESP application, except the New Jersey Coastal Consistency Determination, which was filed concurrently with the submittal of the ESP.
b) Includes State Planning Commission action to modify State Plan to modify the Heavy Industry-Transportation-Utility Node based on revised PSEG Site boundary.

1.4 METHODOLOGY

NRC regulation 10 CFR 52.17(a)(2), *Contents of Applications; Technical Information*, specifies the ER contents for an ESP application. Regulatory Guide 4.2, *Preparation of Environmental Reports for Nuclear Power Stations*, Revision 2, July 1976, provides guidance to applicants preparing ERs for nuclear power stations. NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan*, Revision 0, 1999, provides guidance to the NRC staff when conducting environmental reviews of applications related to nuclear power plants.

In preparing this ER, PSEG chose to use NUREG-1555 for guidance in establishing the format and content of its ER and Regulatory Guide 4.2 for guidance on the preparation of the ER. PSEG provides additional information, as appropriate, based on lessons learned, and NRC requests for additional information for the Clinton, Grand Gulf, North Anna and Vogtle ESP applications and recent COL applications. Table 1.4-1 lists regulatory requirements and where in the ER each requirement is addressed.

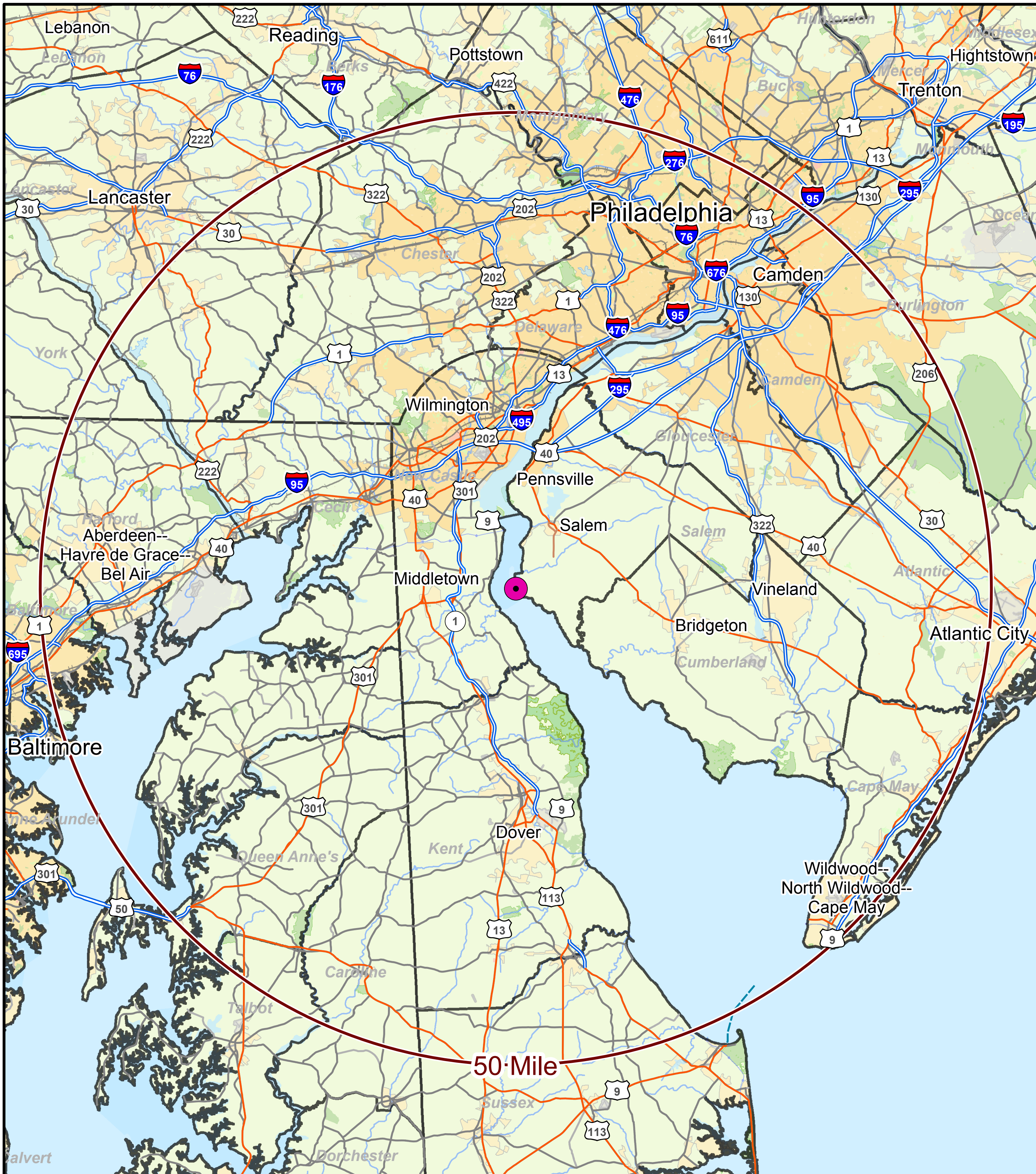
Table 1.4-1 (Sheet 1 of 2)
Environmental Report Responses to Early Site Permit Regulatory Requirements

No.	Regulatory Requirement (10 CFR)[a]	Responsive Environmental Report Section
1	51.45(a), Signed original	Transmittal letter
2	51.45(b), Description of proposed action	Chapter 3, Plant Description
3	51.45(b), Statement of purpose of proposed action	Subsection 1.1.1, Purpose and Need
4	51.45(b), Description of environment affected by proposed action	Chapter 2, Environmental Description
5	51.45(b)(1) and 51.50(b), Environmental impact of proposed action	Chapter 4, Environmental Impacts of Construction; Chapter 5, Environmental Impacts of Station Operation; Chapter 7, Environmental Impact of Postulated Accidents Involving Radioactive Materials; and Chapter 10, Environmental Consequences of the Proposed Action
6	51.45(b)(2), Unavoidable adverse impacts	Section 10.1, Unavoidable Adverse Environmental Impacts
7	51.45(b)(3), Alternatives to proposed action	Chapter 9, Alternatives to the Proposed Action
8	51.45(b)(4), Relationship between short-term use and long-term productivity	Section 10.3, Relationship Between Short-Term Uses and Long-Term Productivity of the Human Environment
9	51.45(b)(5), Irreversible and irretrievable commitments of resources	Section 10.2, Irreversible and Irretrievable Commitments of Resources
10	51.45(c) and 51.50(b), Comparison of environmental effects of proposed action and alternatives	Chapter 4, Environmental Impacts of Construction; Chapter 5, Environmental Impacts of Station Operation; Chapter 7, Environmental Impact of Postulated Accidents Involving Radioactive Materials; Chapter 10, Environmental Consequences of the Proposed Action; and Chapter 9, Alternatives to the Proposed Action
11	51.45(c), Description of impacts of the preconstruction activities	Chapter 4, Environmental Impacts of Construction
12	51.45(c), Alternatives for reducing or avoiding adverse environmental impacts	Section 4.6, Measures and Controls to Limit Adverse Impacts During Construction; and Section 5.10, Measures and Controls to Limit Adverse Impacts During Operation
13	51.45(c), Economic, technical, and other benefits and costs of proposed action and alternatives	Section 10.4, Benefit-Cost Balance
14	51.45(d), Federal permits and other entitlements and status of compliance	Section 1.3, Status of Reviews, Approvals, and Consultations
15	51.45(d), Compliance with federal and other environmental quality standards and requirements	Section 1.3, Status of Reviews, Approvals, and Consultations
16	51.45(d) and 51.50(b), Compliance for alternatives	Section 9.2, Energy Alternatives; and Section 9.3, Alternative Sites
17	51.45(e), Adverse information	Section 10.1, Unavoidable Adverse Environmental Impacts
18	51.50(a), 51.50(b) and 51.51(a), Uranium fuel cycle	Section 5.7, Uranium Fuel Cycle Impacts

Table 1.4-1 (Sheet 2 of 2)
Environmental Report Responses to Early Site Permit Regulatory Requirements

No.	Regulatory Requirement (10 CFR)[(a)]	Responsive Environmental Report Section
19	51.50(a) and 51.52, Fuel and waste transportation	Section 3.8, Transportation of Radioactive Materials; Transportation of Radioactive Materials; and Section 7.4, Transportation Accidents
20	51.50(a) and 51.50(b), Reporting and record keeping procedures	Chapter 6, Environmental Measurements and Monitoring Programs
21	51.50(a) and 51.50(b), Conditions and monitoring	Chapter 6, Environmental Measurements and Monitoring Programs

a) 10 CFR 51.45, 10 CFR 51.50, 10 CFR 51.51, and 10 CFR 51.52



LEGEND

Site Location

50-mile (80 km) Ring

N W E S

0 10 20
Kilometers

0 10 20
Miles

PSEG Power, LLC

PSEG Site ESPA
Part 3, Environmental Report

Site Location

FIGURE 1.0-1

Rev 0

CHAPTER 2

ENVIRONMENTAL DESCRIPTION

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF FIGURES

LIST OF FIGURES (CONTINUED)

LIST OF FIGURES (CONTINUED)

LIST OF FIGURES (CONTINUED)

ACRONYMS AND ABBREVIATIONS

Acronym	Definition
AADT	Annual Average Daily Traffic
ac.	acre
ac-ft	acre-feet
ACS	American Communities Survey
AFB	Air Force Base
AP1000	Advanced Passive 1000
BBS	Breeding Bird Survey
BEA	Bureau of Economic Analysis
BP	before present
Btu/hr	British thermal units per hour
bu.	bushel
BWR	boiling water reactor
C&D	Chesapeake and Delaware
χ/Q	atmospheric dispersion factor
$CaCO_3$	calcium carbonate
CAFRA	Coastal Area Facility Review Act
CDF	confined disposal facilities
cfs	cubic feet per second
CFU	colony forming units
Ci	curie
Ci/yr	curies per year
cm	centimeter
CMP	Coastal Management Program
COL	combined license
CORMIX	Cornell Mixing Zone Expert System
CR	County Road
CWA	Clean Water Act
CWS	circulating water system
CZMA	Coastal Zone Management Act
D/Q	ground deposition factor

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Acronym	Definition
dBA	A-weighted decibels
DBT	design basis tornado
DDT	dichlorodiphenyltrichloroethane
°C	degrees Centigrade
°F	degrees Fahrenheit
delta-T	temperature difference
DEMA	Delaware Emergency Management Agency
DNREC	Delaware Department of Natural Resources and Environmental Control
DOE	U.S. Department of Energy
DRBC	Delaware River Basin Commission
DTM	Digital Terrain Model
DVRPC	Delaware Valley Regional Planning Commission
dynes/cm^3	dynes per cubic centimeter
EA	environmental assessment
EAB	exclusion area boundary
EEP	Estuary Enhancement Program
EERC	Energy and Environmental Resource Center
EFH	essential fish habitat
EIF	equivalent impact factor
EIS	environmental impact statement
EMF	electromagnetic fields
EPC	Engineering, Procurement and Construction
EPZ	Emergency Planning Zone
ER	Environmental Report
ESA	Endangered Species Act
ESP	early site permit
ESPA	early site permit application
ETE	evacuation time estimate
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
ft.	foot

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Acronym	Definition
ft/day	feet per day
ft/ft	feet per foot
ft/mi	feet per mile
ft/yr	feet per year
ft^3	cubic feet
ft^3/yr	cubic feet per year
gal.	gallon
GEIS	Generic Environmental Impact Statement
GIS	geographical information system
gpd	gallons per day
gpm	gallons per minute
GWh	gigawatthour(s)
ha	hectare
HCGS	Hope Creek Generating Station
HPO	New Jersey Historic Preservation Office
hr.	hour
in.	inch
JFD	joint frequency distributions
kg/m^3	kilograms per cubic meter
kV	kilovolt
lb.	pound
lb/ft^2	pounds per square foot
L_{eq}	Equivalent Sound Levels
LMDCT	linear mechanical draft cooling towers
LOI	letter of interpretation
LOS	level of service
LPZ	low population zone
LULC	land use and land cover
m	meter
m^3	cubic meter
MAPP	Mid-Atlantic Power Pathway

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Acronym	Definition
Mg	million gallons
mg/L	milligrams per liter
Mgd	million gallons per day
Mgm	million gallons per month
Mgy	million gallons per year
mi.	mile
$\mu g/m^3$	micrograms per cubic meter
mm	millimeters
mph	miles per hour
MPO	Metropolitan Planning Organization
msl	mean sea level
MT	metric tonne
MUA	Municipal Utilities Authority
MW	megawatt
MWe	megawatt electric
MWt	megawatt thermal
NAVD	North American Vertical Datum of 1988
NDCT	natural draft cooling towers
NGVD	National Geodetic Vertical Datum of 1929
NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NJOEM	New Jersey Office of Emergency Management
NJPDES	New Jersey Pollutant Discharge Elimination System
NMFS	National Marine Fisheries Service
nmi	nautical miles
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOx	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resource Conservation Service

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Acronym	Definition
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated biphenyls
pCi/L	picoCurie per liter
PHI	Pepco Holdings, Inc.
PJM	PJM Interconnection, LLC
PM_{10}	particulate matter smaller than 10 microns in diameter
$PM_{2.5}$	particulate matter smaller than 2.5 microns in diameter
PMF	probable maximum flood
PMH	probable maximum hurricane
PPE	plant parameter envelope
ppm	parts per million
ppt	parts per thousand
PRM	Potomac-Raritan-Magothy
PRPA	Philadelphia Regional Port Authority
PSE&G	Public Service Electric & Gas Company Inc.
PSEG	PSEG Power, LLC and PSEG Nuclear, LLC
PWR	pressurized water reactor
RERP	Radiological Emergency Response Plans
RFMC	regional fisheries management councils
RG	Regulatory Guide
RM	river mile
SACTI	Seasonal/Annual Cooling Tower Impact
SAV	submerged aquatic vegetation
SGS	Salem Generating Station
SHPO	State Historic Preservation Office
SJPC	South Jersey Port Corporation
SJTPO	South Jersey Transportation Planning Organization
SO_2	sulfur dioxide

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Acronym	Definition
SO_x	sulfur oxides
sq. mi.	square mile
SSAR	Site Safety Analysis Report
SSC	structures, systems, and components
Sv	Sievert
SWS	service water system
TMDL	total maximum daily load
TNRES	Total Non-Filterable Residue
TNTC	too numerous to count
TSS	total suspended solids
U.S. EPR	U.S. Evolutionary Power Reactor
USACE	U.S. Army Corps of Engineers
US-APWR	U.S. Advanced Pressurized Water Reactor
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWB	Upper Wetland Boundary
VOC	volatile organic compounds
vpd	vehicles per day
WILMAPCO	Wilmington Planning Council
WMA	Wildlife Management Area
WRS	wetland restoration site
yr	year

CHAPTER 2

ENVIRONMENTAL DESCRIPTION

2.1 SITE LOCATION

2.1.1 DESCRIPTION OF THE EXISTING PSEG GENERATING STATIONS

The existing 734-acre (ac.) Salem Generating Station (SGS) and Hope Creek Generating Station (HCGS) site is located on the southern part of Artificial Island on the east bank of the Delaware River in Lower Alloways Creek Township, Salem County, NJ. Currently, 373 ac. of this property is used by the HCGS and SGS (153 and 220 ac., respectively). The remaining 361 ac. of the property are comprised of developed upland areas in industrial use, a variety of wetland types, and maintained stormwater management facilities such as swales and detention basins. Much of this land has previously been developed and disturbed for various power plant uses. PSEG Power, LLC and PSEG Nuclear, LLC (PSEG) are developing an agreement in principle with the U.S. Army Corps of Engineers (USACE) to acquire an additional 85 ac. immediately to the north of HCGS as shown on Figure 3.1-2. Therefore, with the land acquisition, the entire PSEG Site will be 819 ac. The specific timing of land acquisition is not currently known and is subject to further PSEG and USACE actions. However, the agreement in principle with the USACE will serve to establish the basis for eventual land acquisition and exclusion area boundary (EAB) control, necessary to support the issuance of a future combined license (COL).

HCGS is a one-unit boiling water reactor (BWR) with a current licensed thermal power of 3840 megawatts-thermal (MWt). HCGS has a closed-cycle cooling system consisting of a natural draft cooling tower and associated withdrawal, circulation, and discharge facilities. The closed-cycle cooling system withdraws water from the Delaware River for the circulating water system (CWS) and service water system (SWS) through a single intake structure. Cooling tower blowdown and other station effluents are discharged to the Delaware River through an underwater pipe located near the shoreline approximately 1500 feet (ft.) north of the intake. The HCGS intake withdraws an average of 67 million gallons per day (Mgd) from the Delaware River. PSEG is authorized by the Delaware River Basin Commission (DRBC) and New Jersey Department of Environmental Protection (NJDEP) for withdrawal and consumptive use by HCGS of groundwater and brackish water from the Delaware River.

SGS consists of two pressurized water reactors (PWR). Each unit has a current licensed thermal power of 3459 MWt. SGS has a once-through CWS for condenser cooling that withdraws water from, and discharges water to, the Delaware River. The intake structure for the CWS is located at the southwest corner of the PSEG property. The SWS has an independent intake structure located north of the CWS intake. The discharge of the SGS is through a submerged pipe that extends approximately 500 ft. into the river. PSEG has a New Jersey Pollutant Discharge Elimination System (NJPDES) permit for the SGS that limits intake flow from the Delaware River to a 30-day average of 3024 Mgd of circulating water. PSEG is authorized by the DRBC and NJDEP for withdrawal and consumptive use by SGS of groundwater and water from the Delaware River (Reference 2.1-1).

2.1.2 SITE LOCATION AND GENERAL SETTING

The location for the construction and operation of the new plant is north of HCGS on the northwestern portion of the PSEG Site in Lower Alloways Creek Township, New Jersey (NJ). Figures 2.1-1 and 2.1-2 depict the location of the new plant site within the context of the 50-mile (mi.) region and the 6-mi. vicinity, respectively. Figure 2.1-3 presents an oblique aerial photograph of the PSEG Site. Location of the centerpoint of the new plant has been calculated based upon a composite drawing of the four reactor technologies considered in this early site permit application (ESPA):

Latitude: 39°28’23.744” North
Longitude: 75°32’24.332” West

The Delaware River borders the western and southern sides of the property currently owned by PSEG. Lands developed by the USACE as confined disposal facilities (CDF) for the placement of material dredged from the Delaware River are located immediately north of the PSEG property along the east bank of the river. Lands consisting of tidal marsh are located to the north and east of the property. The proposed site is located 15 mi. south of the Delaware Memorial Bridge near river mile (RM) 52 on the east side of the Delaware River. The portion of the river flowing adjacent to the site is 2.5 mi. wide. The site is 18 mi. south of Wilmington, Delaware (DE) and 30 mi. southwest of Philadelphia, Pennsylvania (PA). Other nearby communities in NJ include the city of Salem, located 7-1/2 mi. to the northeast and town of Pennsville located 9 mi. to the north. Middletown, DE is located 7 mi. to the west. The river area adjacent to the proposed site is a Transition Zone between the Delaware Bay (to the south of the site) and the Delaware River (to the north of the site). This Transition Zone extends from Marcus Hook, PA downriver to Artificial Island (Reference 2.1-22).

The creation of Artificial Island began around 1900 by the USACE with the disposal of hydraulic dredge spoils within a diked area established around a naturally occurring sandbar that projected into the river (Reference 2.1-3). Over the years, the diked area was enlarged to accommodate additional spoils materials produced as a result of maintenance dredging of the Delaware River navigation channel. As this area was filled in and enlarged, it became known as Artificial Island. The elevation of the terrain across the PSEG Site generally ranges from 5 to 15 ft. North American Vertical Datum 1988 (NAVD). Developed areas of the site are nominally 10 to 12 ft. NAVD.

The nearest residences to the new plant site are located 2.8 mi. west in DE, and 3.4 mi. east-northeast of the PSEG Site near Hancocks Bridge, NJ. The nearest population center distance (defined in 10 CFR 100, *Reactor Site Criteria*, as the distance from the reactor to the nearest boundary of a densely populated center with 25,000 residents or more) is Wilmington, DE, which is located 18 mi. to the north of the new plant. The area within 15 mi. of the site primarily consists of coastal and freshwater wetland systems, or is used for agriculture. The nearest heavy industries are an oil refinery 8.9 mi. to the northwest, and three manufacturing facilities between 7.6 mi. and 8.7 mi. to the northeast.

There are no major airports, accessible highways, or railroads within 7.5 mi. of the new plant site, and the only current land access to the site is a road constructed by PSEG. Philadelphia International Airport is the closest major airport and is located 30 mi. to the northeast. New Castle County Airport in DE is also a small regional airport located south of Wilmington that

offers a small number of commercial operations. The closest railroad is a Southern Railroad Company of New Jersey rail line located 8 mi. to the northeast. Route 49 is the closest highway in NJ, and is located 7.5 mi. to the northeast. An access road connects the PSEG Site to an existing secondary road 3.6 mi. to the east. The PSEG Site can also be accessed from the Delaware River. Barge access to SGS is located at the southern end of Artificial Island, whereas barge access to HCGS is provided by a barge slip on the western side of Artificial Island.

Chapter 3.0 provides a description of the proposed plant including the reactor and containment systems, site general arrangements, cooling water system, waste management systems, and transmission system. Site Safety Analysis Report (SSAR) Chapter 1 provides a description of the plant parameter envelope for the new plant.

2.1.3 REFERENCES

2.1-1 Delaware River Basin Commission, Approval to Revise Delaware River Basin Compact, Docket No. D-68-20 (Revision 20), West Trenton, New Jersey, September 26, 2001.

2.1-2 Santoro, E.D., Delaware Estuary Monitoring Report, Covering Monitoring Developments and Data Collected or Reported during 1999 – 2003, Prepared for the DRBC and Delaware Estuary Program, Trenton, New Jersey, 2004.

2.1-3 U.S. Army Corps of Engineers, *Early Days, 1877-1915,* Philadelphia District website at http://www.nap.usace.army.mil/sb/Time_1877-1915.pdf, accessed March 8, 2009.

2.2 LAND

This section describes the terrestrial characteristics of the site, the vicinity, the region, the existing transmission line corridors and other off-site areas. The land use for the site and proposed causeway is analyzed using the New Jersey Land Use/Land Cover (LULC) database. In contrast, the U.S. Geological Survey (USGS) LULC database is used to analyze land use for the vicinity and region as this provides for a more unified database for the multiple jurisdictions within the larger region (DE, NJ, PA, and Maryland [MD]).

2.2.1 THE SITE AND VICINITY

2.2.1.1 The Site

The PSEG Site is defined as the land area owned by PSEG at the time of licensing. PSEG is developing an agreement in principle with the USACE to acquire an additional 85 ac. immediately to the north of HCGS. Therefore, with the land acquisition, the entire PSEG Site will be 819 ac. The specific timing of land acquisition is not currently known and is subject to further PSEG and USACE actions. However the agreement in principle with the USACE will serve to establish the basis for eventual land acquisition and EAB control, necessary to support the issuance of a future COL.

Subsequent to the agreement in principle with the USACE, PSEG will develop a lease agreement for the USACE CDF land to the north of the PSEG Site, depicted on the Site Utilization Plan for the concrete batch plant and temporary construction/laydown use. At the completion of construction, the leased land will be returned to the USACE, subject to any required long-term EAB control conditions.

The lands to be acquired are currently part of the 305 ac. of lands that comprise the Artificial Island CDF owned by the USACE (Reference 2.2-11). This CDF area has been used since around 1900 as a disposal area for materials derived from maintenance dredging of the navigation channel in the Delaware River (Reference 2.2-12).

HCGS and SGS occupy 373 ac. of the 734-ac. site currently owned by PSEG. The land use within the property boundary is industrial. The elevation of the terrain across the PSEG Site generally ranges from 5 to 15 ft. NAVD (Reference 2.2-3). The habitat surrounding the PSEG Site has been characterized as tidal marsh and grassland with some upland woodland vegetation. The Delaware River is located adjacent to the western and southern boundaries of the PSEG Site and barge slips located along the southern and western boundaries of the site provide access from the river to the SGS and HCGS, respectively.

Based on analysis of NJ LULC data, major land uses within the property boundary include industrial, herbaceous and coastal wetlands, old field, built-up, and undeveloped rights-of-way. Figure 2.2-1 presents the types and distribution of land use on the PSEG Site, and Table 2.2-1 provides the area for each of the land use categories. Dominant land uses on the PSEG Site are disturbed lands that were either previously used to support the construction of SGS and HCGS or wetlands that are dominated by monotypic populations of common reed (*Phragmites australis*). These dominant land uses include industrial (29 percent), *Phragmites*-dominated coastal wetlands (19 percent), and *Phragmites*-dominated interior wetlands (15 percent). Old field and urban or built-up land account for 9 and 7 percent of the site, respectively. The

remaining area of the property includes altered lands, artificial ponds, deciduous brush/shrubland, deciduous scrub/shrub and herbaceous wetlands, disturbed wetlands, recreation land, tidal-related lands, transportation/communication/utilities and upland rights-of-way. No railroads, roads, or transmission corridors (other than those that serve SGS and HCGS) traverse or are located near the PSEG Site. Additionally, no prime farmland soils occur within the boundaries of the site (Reference 2.2-9). Large portions of the PSEG Site were disturbed previously for construction of SGS and HCGS, or were used for dredge material disposal by the USACE.

As indicated in the *Salem County Farmland Preservation Plan* (Reference 2.2-4), the county lies within the Atlantic Coastal Plain, which is composed of a sequence of unconsolidated highly permeable to relatively impermeable quartzose gravel, sand, silt, glauconitic sand (greensand), and clay strata. Therefore, the principal mineral sources within Salem County are sand and gravel. No gravel and sand mining operations occur on-site.

Coastal Zones

The federal Coastal Zone Management Act (CZMA) was promulgated to encourage and assist states and territories in developing management programs that preserve, protect, develop, and, where possible, restore the resources of the coastal zone. A coastal zone is generally described as the coastal waters and the adjacent shore lands strongly influenced by each other. This includes islands, transitional and intertidal areas, salt marshes, wetlands, beaches, and Great Lakes waters. Activities of federal agencies affecting coastal zones shall be consistent with the approved coastal management program (CMP) of the state or territory to the maximum extent practical. The CZMA provisions apply to all actions requiring federal approval (e.g. new plant licenses, license renewals) that affect the coastal zone in a state or territory with a federally approved CMP. The proposed early site permit (ESP) for a new plant at the PSEG Site is subject to the CZMA, and as such, a NJ coastal zone consistency determination has been requested.

The New Jersey State Planning Commission has approved a State Plan Policy Map to delineate a “Heavy Industry-Transportation-Utility Node” on Artificial Island. The State Planning Commission adopted the New Jersey Department of Environmental Protection’s (NJDEP) recommendation that the boundary of the Node include 501 ac. of the 734-ac. SGS and HCGS site. On December 2, 2002, NJDEP amended the Coastal Area Facility Review Act (CAFRA) Planning Map to include the Energy Facility Node, recognizing among other things that this designation enables the PSEG nuclear facilities to be maintained and upgraded. The Node designation allows for increased impervious cover and intensity use as provided in New Jersey Administrative Code (NJAC) 7:7E-5.3, Section VI.C.2, *Impervious cover requirements that apply to sites in the upland waterfront development and CAFRA areas*, and NJAC 7:7E-5.4, Section VI.C.3, *Vegetative cover requirements that apply to sites in the upland waterfront development and CAFRA areas*.

2.2.1.2 The Vicinity

The vicinity of the PSEG Site is defined as the area within a 6-mi. radius of the new plant centerpoint. New Castle, DE and Salem, NJ are the only two counties located within the 6-mi. vicinity (Figure 2.2-2). Most of the land surrounding the site is owned by the federal government (under control of the USACE) and the State of New Jersey. Of the USACE land to the north of

the site, 305 ac. is developed for use as a CDF facility. Vehicle access to the PSEG Site is via a road constructed by PSEG, which connects to an existing secondary road 3.6 mi. to the east. The land in the Coastal Lowlands subregion of the Atlantic Coastal Plain is characterized by low elevation lands and low topographical relief. This subregion is characterized by poor drainage, shallow water tables, abundant wetlands, and tidal streams and rivers. Land uses within this subregion included agriculture (27 percent), barren land (1 percent), forest (20 percent), urban (6 percent), and wetlands (46 percent) (Reference 2.2-1).

According to the USGS *2006 Minerals Yearbooks* (for DE and NJ) (References 2.2-15 and 2.2-16), the principal mineral resources in New Castle and Salem Counties are sand and gravel. No sand and gravel mining operations were identified within the vicinity.

Based on geographical information system (GIS) analysis of USGS LULC, three major land uses (agriculture, open water and wetlands) account for 94 percent of the total 72,382 ac. within the vicinity. Table 2.2-2 presents the acreage for each of 13 land uses within the vicinity. Open water (primarily the Delaware River) represents 37 percent of the total vicinity area, while wetlands (emergent herbaceous and woody wetlands) and agriculture represent 35 percent and 23 percent, respectively. Developed land, forests, and barren land account for the remaining land use. Figure 2.2-2 defines the areas within DE and NJ that are included within the vicinity area and depicts the distribution of the land cover and land use within this area.

Figure 2.2-2 identifies four wildlife management areas (WMAs) that are located within the vicinity. Two are located in New Castle County (Augustine and Cedar Swamp WMAs), and two in Salem County (Abbotts Meadow and Mad Horse Creek WMAs). Augustine and Cedar Swamp WMAs represent a total of 8182 ac. devoted to wildlife management and protection (Reference 2.2-2); and Abbotts Meadow and Mad Horse Creek WMAs total 10,509 ac. (Reference 2.2-6).

As shown in Figure 2.2-2, there are no accessible highways or railroads within 7.5 mi. of the PSEG Site. In relation to the new plant centerpoint, DE Route 9 is located 3 mi. to the west at its nearest point. DE Routes 1 and 13 are located just over 5 mi. to the west. New Jersey Route 49 is located 7.5 mi. to the northeast, and Interstate 295 and the Delaware Memorial Bridge are 15 mi. to the north (Figure 2.2-5). The nearest railroad is located in Salem, 8 mi. to the northeast.

Figure 2.2-3 identifies prime farmland and farmland of unique or statewide importance within the vicinity of the PSEG Site. These areas that may be affected by access road development are identified using soil information (types and slopes) specified as prime by the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS). Prime farmland of statewide importance is located in uplands east of the PSEG Site. In contrast, farmlands of “unique” importance correspond to lands within the coastal wetlands and may relate to the historical use of some of these areas for salt hay farming. As illustrated in Figure 2.2-3, upland areas east of the PSEG Site have also been designated by Salem County as “Farm Project Area #3.” However, no specific tracts having restrictions as preserved farmlands have been identified within 7 mi. of the site.

2.2.2 REGION

The region within which the PSEG Site is located is defined as the area within a 50-mi. radius of the new plant centerpoint. All or parts of 25 counties in four states (three in DE, seven in MD, seven in NJ, and eight in PA) are within this region (Figure 2.2-4). The land in the region lies within the Coastal Lowlands, Middle Coastal Plain and Inner Coastal Plain subregions of the Mid-Atlantic Coastal Plain. Characteristics of the Coastal Lowlands are given in Subsection 2.2.1.2 for the vicinity and are typical for the region. The Middle Coastal Plain is the other major subregion near the plant site. It is characterized by variable drainage, abundant forests, low topographic elevations and low to moderate relief. Land uses for the Middle Coastal Plain are variable and include agriculture (27 to 39 percent), barren land (1 to 2 percent), forest (38 to 60 percent), urban (3 to 7 percent), and wetlands (9 to 21 percent). Similarly, the land use distribution for the Inner Coast Plain is composed of agriculture (23 to 28 percent), barren land (2 to 3 percent), forest (46 to 59 percent), urban (10 to 16 percent), and wetlands (6 to 7 percent) (Reference 2.2-1).

Figure 2.2-4 delineates the areas within DE, MD, NJ and PA that are included within the region and depicts the distribution of the land cover and land use. Based on analysis of USGS land cover and land use classifications, four major land uses (agriculture, forests, open water, and developed lands) account for 89 percent of the total area (5,026,539 ac.) within the region. Table 2.2-2 presents the acreage for each of 13 land uses within the region. Agricultural uses represent 37 percent of the total region area, while forests (deciduous, evergreen and mixed) account for approximately 24 percent. Open water (principally the Delaware Bay, Delaware River and Chesapeake Bay), accounts for 16 percent of the regional area and developed lands (open space and low to high intensity) represent 13 percent. Wetlands (10 percent) and barren land (1 percent) account for the remaining land use.

As indicated in the preceding paragraph, agriculture is one of the major land uses in the region. Within the region, four counties are likely to be the most affected due to their proximity to the PSEG Site. These counties are New Castle in DE, and Cumberland, Gloucester, and Salem in NJ. Data from the USDA, *2007 Census of Agriculture,* (Reference 2.2-13) for these four counties indicate that the principal agricultural crops are corn, wheat, barley, soybeans, forage, vegetables and fruits. The breakdown of crops, acreages, and yields for each of the counties is shown in Table 2.2-5. New Castle County produced a total of 3,340,399 bushels (bu.) of corn, wheat, barley, and soybeans in 2007 on a total of 51,789 ac, while Salem County had the second highest yield for these four crops at 3,294,991 bu. on a total of 75,160 ac. These two counties also had the highest yields of forage, 12,551 dry tons for New Castle County and 27,112 dry tons for Salem County. Cumberland and Gloucester had much lower yields for corn, wheat, barley, soybeans, and forage, but had 1424 and 4497 ac. in fruit crops. Data on fruit yields in New Castle and Salem Counties were not available. Vegetable yields were minimal in New Castle County (769 ac.) and ranged from 9847 to 11,786 ac. in Cumberland, Gloucester, and Salem Counties.

As shown in Figure 2.2-5, several major highways are located within the region and include Interstates 76, 95, 276, 295, 476, 495 and 676. Other principal roadways include NJ Route 55, the NJ Turnpike, the Garden State Parkway, and the Atlantic City Expressway. The Delaware Bay, Delaware River, Chesapeake and Delaware Canal, and the Chesapeake Bay represent the major waterways within the region. Major rail lines or rail systems include

those owned by Conrail, Southeastern Pennsylvania Transportation Authority, Port Authority Transit Corporation, and Southern Railroad of New Jersey (References 2.2-8 and 2.2-10).

There are no Native American tribal land use plans in the region.

2.2.3 TRANSMISSION LINE AND OFF-SITE AREAS

2.2.3.1 Existing Transmission Corridors

As described in Subsection 3.7.2, presently, there are two 500 kilovolt (kV) transmission lines to the HCGS switchyard from off-site, and one 500 kV tie line from HCGS to the SGS switchyard. One off-site line is a tie to the Red Lion Switching Station, located northwest in New Castle County, DE, and the other line is a tie to the New Freedom Switching Station, located northeast in Camden County, NJ. Red Lion and New Freedom are 500/230-kV switching stations approximately 40 mi. apart. All three lines are physically independent sources of off-site power to HCGS.

In addition, there are two 500 kV transmission lines to the SGS switchyard from off-site, and one 500 kV tie line from SGS to the HCGS switchyard. Both off-site lines are ties to the New Freedom Switching Station, described above. All three lines are physically independent sources of off-site power to SGS and are available for either or both units (Subsection 3.7.2).

The transmission corridor rights-of-way range from 200 ft. to 350 ft. wide. The three corridors cross Camden, Gloucester and Salem counties in NJ, and New Castle County in DE, and are approximately 102 mi. in total length. One of these corridors is shared by two transmission lines. Land uses along these existing corridors are dominated by marshland, agricultural lands, forested lands, and water. The transmission line to New Castle County crosses the Delaware River to the north of the PSEG Site. The three transmission line corridors are shown on Figure 2.2-6 and contain the following lines:

- Hope Creek-New Freedom – This 500 kV line, which is operated by Public Service Electric and Gas (PSE&G), extends northeast from HCGS for 43 mi. in a 350-ft. wide corridor to the New Freedom switching station north of Williamstown, NJ. This line generally shares the corridor with the 500 kV Salem-New Freedom line. During 2008, a new substation (Orchard) was installed along this line, dividing it into two segments.

- Salem-New Freedom – This 500 kV line, which is operated by PSE&G, runs northeast from SGS for 50 mi. in a 350-ft. wide corridor to the New Freedom Switching Station north of Williamstown, NJ. This line generally shares the corridor with the 500 kV HCGS-New Freedom line.

- Hope Creek-Red Lion – This 500 kV line extends north from HCGS for 13 mi. It then continues west over the Delaware River approximately 4 mi. to the Red Lion substation in Delaware. In NJ the line is operated by PSE&G, and in DE it is operated by Pepco Holdings, Inc. (PHI). Two-thirds of the 17-mi. corridor is 200 ft. wide, and the remainder is 350 ft. wide.

- Salem-New Freedom South - This 500 kV line operated by PSE&G extends northeast from SGS for 42 mi. in a variable width but generally 350-ft. wide corridor from Salem to the New Freedom substation north of Williamstown, NJ.

Existing land uses along these transmission lines are assessed based on analysis of USGS LULC data. A 500-ft. wide corridor centered on the existing rights-of-way is used to characterize baseline land uses along the existing corridors. Three major land uses are identified (agriculture, forests, and wetlands) that collectively account for the majority of the 6920 ac. within the three transmission line corridor rights-of-way. Table 2.2-3 presents the acreage for each of 13 land uses along the transmission line corridors. Agriculture (pasture hay and cultivated crops) represents 39 percent of the total transmission line corridor right-of-way areas, while forests (deciduous, evergreen and mixed), and wetlands (woody and emergent herbaceous) represent 30 percent and 23 percent, respectively. Developed land (2 percent), open water (3 percent), and barren land (2 percent) account for the remaining land use.

2.2.3.2 Existing Access Road

The only other off-site corridor is the existing plant access road (Figure 2.2-2). This road extends through coastal wetlands from the PSEG Site in an easterly and east-northeasterly direction for 3.6 mi., where it connects to Alloway Creek Neck Road (an existing secondary road). Alloway Creek Neck Road continues through uplands to the town of Hancock's Bridge. The existing right-of-way for the access road is variable, ranging from 350 ft. to 450 ft. wide through state-owned lands.

Based on analysis of USGS LULC, within a 500-ft. corridor along the access road, two major land uses (agriculture and wetlands) account for 74 percent of the 379 ac. within this access road right-of-way. Table 2.2-3 presents the area for each of 13 land uses within the access road right-of-way. Agriculture represents 35 percent of the total right-of-way and wetlands 39 percent. Barren land (10 percent), developed land (13 percent), forests (2 percent), and open water (1 percent) account for the remaining land uses.

Alloway Creek Neck Road extends through an area that has been designated as Farm Project Area # 3 - Maskells Mill – Hagerville-Mannington Meadows, in Salem County's *Open Space and Farmland Preservation Plan*. This area is characterized by prime farmland soils and is not heavily forested. Twenty percent of the land in this project area is in farmland preservation with an additional 8 percent targeted for preservation. Several tracts of land in the vicinity have been dedicated as farmland preservation areas in Elsinboro Township, whereas none of the lands immediately adjacent to Alloway Creek Neck Road are in farmland preservation status. Fifty-two percent of the target farms' soils in this project area are prime soils, while another 35 percent are soils of statewide importance (Reference 2.2-4). A soils map indicates that Alloway Creek Neck Road passes through several areas designated as prime farmland soils (Reference 2.2-9).

2.2.3.3 Proposed Transmission Macro-Corridors

As summarized in Subsection 1.2.5, PSEG completed a conceptual evaluation during development of the ESP application to identify potential transmission requirements associated with the addition of generation at the PSEG Site. This evaluation included the PJM Interconnection, LLC (PJM) Regional Transmission Expansion Plan, existing operational limits

at HCGS and SGS, and other PJM transmission planning inputs. PJM routinely performs analyses of the regional transmission system and forecasts appropriate upgrades to the system as part of its long-term planning cycle. These evaluations are not specific to the addition of new generation at the PSEG Site.

In order to capture the potential effects of developing off-site transmission, PSEG analyzed the potential effects of two new off-site macro-corridors during development of the ESP application. Information pertaining to alternative off-site transmission system corridors considered by PSEG is presented in Subsection 9.4.3. The two 5-mi. wide macro-corridors analyzed are the South and West Macro-Corridors. The West Macro-Corridor (55 mi. long) generally follows existing transmission line corridors, extending from the PSEG Site to Peach Bottom Substation. The South Macro-Corridor (94 mi. long) also follows existing transmission line corridors and is generally consistent with the original Mid-Atlantic Power Pathway project (MAPP) line that had been preliminarily planned by PJM to extend from Indian River Substation to the PSEG Site. Each of these macro-corridors is developed with a common segment. From the PSEG Site, the hypothetical macro-corridor extends north and then west across the Delaware River to the Red Lion Substation. From this location, each of the potential macro-corridors diverge extending to the west (Peach Bottom) or south (Indian River).

The characteristics of land use within each hypothetical macro-corridor are presented in Table 2.2-4. Based on overall differences in macro-corridor length, the total land area within the South Macro-Corridor (316,429 ac.) is notably greater than the area contained within the West Macro-Corridor (191,523 ac.) (Subsection 9.4.3). Cultivated cropland (121,895 ac., 39 percent) is the largest land use type within the South Macro-Corridor. Other major land uses within the South Macro-Corridor include wetlands (20 percent), deciduous forest (13 percent), pasture hay (11 percent), and open water (8 percent). Comparatively, pasture hay (46,055 ac., 24 percent) is the largest land use type within the West Macro-Corridor. Other major land uses within the West Macro-Corridor include cultivated cropland (19 percent), deciduous forest (18 percent), wetlands (14 percent combined), and open water (11 percent).

Additional discussion regarding potential off-site transmission and its potential impact is provided in Chapter 4 (Impacts of Construction), Chapter 5 (Impacts of Station Operation) and Chapter 9 (Alternatives).

2.2.3.4 Proposed Access Road

Additional access road capacity is necessary to address future transportation needs for the PSEG Site. This access road is conceptually designed as a three-lane causeway to be constructed on elevated structures for its entire length through the coastal wetlands. The proposed causeway extends northeast from the PSEG Site along or adjacent to the existing transmission corridor right-of-way to the intersection of Money Island Road and Mason Point Road (Figure 2.2-2). The alignment runs roughly 200 ft. east of, and parallel to, the existing Red Lion transmission line for most of its length. Through the coastal wetlands, the causeway is constructed on elevated structures, thereby reducing environmental impacts. Existing land uses along the alignment of the proposed causeway are illustrated in Figure 2.2-1 and summarized as part of the vicinity in Table 2.2-2. Additional discussion regarding the proposed access road and its potential impact is provided in Chapter 4 (Impacts of Construction) and Chapter 5 (Impacts of Station Operation).

2.2.3.5 Other Proposed Off-Site Areas

Most of the area for the new plant lies within the current property boundary. PSEG is developing an agreement in principle with the USACE to acquire an additional 85 ac. immediately to the north of HCGS. The specific timing of land acquisition is not currently known and is subject to further PSEG and USACE actions. The additional acreage is north of the SGS and HCGS site and facilitates locating permanent plant equipment and to provide areas for construction support facilities. 50 ac. of the southern USACE CDF and 35 ac. of adjoining coastal marsh will be used for permanent plant facilities. The balance of the CDF cell (45 ac.) will be leased to support the construction of the new plant. These lands (excluding the 35 ac. of coastal marsh) are contained within the existing 305 ac. USACE CDF. Land uses within this area are summarized in Table 2.2-1. An analysis of NJDEP LULC classifications for the 45 ac. off-site area indicates that disturbed and *Phragmites*-dominated coastal and interior wetlands comprise 91 percent; altered lands and other urban or built-up lands account for 7 percent. The area is highly disturbed and of low quality, consisting of unvegetated sand and *Phragmites*-dominated vegetation. Additional discussion regarding the potential impact to other proposed off-site areas is provided in Chapter 4 (Impacts of Construction) and Chapter 5 (Impacts of Station Operation).

2.2.4 REFERENCES

2.2-1 Ator Scott W., Judith M. Denver, David E. Krantz, Wayne L. Newell, and Sarah K. Martucci, A Surficial Hydrogeologic Framework for the Mid-Atlantic Coastal Plain. Professional Paper 1680, U.S. Geological Survey, Reston, Virginia, 2005.

2.2-2 Delaware Department of Natural Resources and Environmental Control, Website, http://www.fw.delaware.gov/Hunting/Documents/WMA%20maps%202008/Augustine%20Green%20Tract%20Deer-Upland.pdf, and http://www.fw.delaware.gov/Hunting/Documents/WMA%20maps%202008/Cedar%20Swamp%20Bell%20Tract%20Waterfowl.pdf, accessed April 26, 2009.

2.2-3 NOT USED

2.2-4 Morris Land Conservancy and Salem County Open Space Advisory Committee, County of Salem Open Space and Farmland Preservation Plan. Volume 2: Farmland Preservation Plan. Boonton, New Jersey, August 2008.

2.2-5 NOT USED

2.2-6 New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Mad Horse Creek Wildlife Management Area and Abbotts Meadow Wildlife Management Area, Website, http://www.nj.gov/dep/fgw/pdf/wmamaps/mad_horse_crk_no.pdf and http://www.nj.gov/dep/fgw/pdf/wmamaps/abbotts_meadow.pdf, respectively, accessed on April 24, 2009.

2.2-7 New Jersey Department of Environmental Protection, Geographic Information Systems, 2002 Land Use/Land Cover by Watershed Management Area, http://www.state.nj.us/dep/gis/lulc02cshp.html#top, Trenton, New Jersey, 2004, accessed October 5, 2009.

2.2-8 New Jersey Department of Transportation, Website, http://www.state.nj.us/transportation/gis/maps/rail.pdf, 2007, accessed April 27, 2009.

2.2-9 Rukenstein and Associates, Salem County Farmland Soils: Smart Growth Development Plan for Northern Salem County, New Jersey, Website, http://www.salemcountynj.gov/cmssite/downloads/departments/Planning_Board/Salem_Farmland_Soils.pdf, Glen Ridge, NJ, 2001, accessed April 26, 2009.

2.2-10 Southeastern Pennsylvania Transportation Authority, http://www.septa.com/maps/click_map.html, 2009, accessed April 27, 2009.

2.2-11 U.S. Army Corps of Engineers, Delaware River Main Stem and Channel Deepening Project – Environmental Assessment, Philadelphia District, Philadelphia, Pennsylvania, 2009.

2.2-12 U.S. Army Corps of Engineers, Early History, 1877 – 1915, Website, http://www.nap.usace.army.mil/sb/Time_1877-1915.pdf, accessed April 13, 2009.

2.2-13 U.S. Department of Agriculture, *2007 Census of Agriculture- County Data for Delaware and New Jersey,* Website; http://www.agcensus.usda.gov, accessed on February 4, 2010.

2.2-14 U. S. Geological Survey, National Land Cover Database 2001, Use/Land Cover, http://www.mrlc.gov/nlcd.php, 2001, accessed October 5, 2009.

2.2-15 U.S. Geological Survey, *2006 Minerals Yearbook: Delaware,* Washington DC, March 2009, 4 pages.

2.2-16 U.S. Geological Survey, *2006 Minerals Yearbook: New Jersey,* Washington DC, July 2009, 7 pages.

Table 2.2-1
Land Use within the PSEG Plant Site Property Boundary and Construction Support Facilities

	PSEG Site		Construction Support Facilities[(a)]	
New Jersey Land Use Category	**Area (ac.)**	**Percent**	**Area (ac.)**	**Percent**
Wetland and Aquatic Habitat				
Artificial Lakes	40.3	4.9	0.0	0.0
Deciduous Scrub/Shrub Wetlands	4.6	0.6	0.0	0.0
Disturbed Wetlands (Modified)	4.3	0.5	11.8	26.1
Herbaceous Wetlands	5.8	0.7	0.0	0.0
Managed Wetland in Maintained Lawn Greenspace	3.8	0.5	0.0	0.0
Phragmites-Dominated Coastal Wetlands	155.6	19.0	2.1	4.6
Phragmites-Dominated Interior Wetlands	118.7	14.5	27.3	60.4
Saline Marsh	0.2	0.0	0.8	1.8
Tidal Rivers, Inland Bays, and Other Tidal Waters	5.6	0.7	0.1	0.2
Wetland Rights-of-Way	23.8	2.9	0.0	0.0
Subtotal	**362.7**	**44.3**	**42.1**	**93.1**
Old Field Habitat				
Deciduous Brush/Shrubland	6.0	0.7	0.0	0.0
Old Field (<25 percent Brush Covered)	69.4	8.5	0.0	0.0
Phragmites-Dominated Old Field	31.9	3.9	0.0	0.0
Upland Rights-of-Way Undeveloped	29.5	3.6	0.0	0.0
Subtotal	**136.8**	**16.7**	**0.0**	**0.0**
Developed Land Uses				
Altered Lands	14.8	1.8	0.7	1.6
Industrial	234.5	28.6	0.0	0.0
Other Urban or Built-up Land	55.8	6.8	2.4	5.3
Phragmites-Dominated Urban Area	0.5	0.1	0.0	0.0
Recreation Land	4.9	0.6	0.0	0.0
Transportation/Communication/Utilities	8.5	1.0	0.0	0.0
Upland Rights-of-Way Developed	0.5	0.1	0.0	0.0
Subtotal	**319.5**	**39.0**	**3.1**	**6.9**
Totals	**819.0**	**100.0**	**45.2**	**100.0**

a) Adjacent off-site areas in USACE CDF

Reference 2.2-7

Table 2.2-2
Land Use in the Vicinity (6-Mile Radius)
and Region (50-Mile Radius) of the PSEG Site

USGS Land Use Designation	Vicinity		Region	
	Area (ac.)	**Percent**	**Area (ac.)**	**Percent**
Open Water	26,732.5	36.9%	792,255	15.7%
Developed - Open Space	345.5	0.5%	239,295	4.8%
Developed - Low Intensity	257.4	0.4%	212,119	4.2%
Developed - Medium Intensity	100.4	0.1%	119,736	2.4%
Developed - High Intensity	190.3	0.2%	60,039	1.2%
Barren Land	632.9	0.9%	54,164	1.1%
Deciduous Forest	2455.2	3.4%	1,029,000	20.5%
Evergreen Forest	64.3	0.1%	156,566	3.1%
Mixed Forest	12.9	0.0%	33,841	0.7%
Pasture Hay	3533.0	4.9%	774,826	15.4%
Cultivated Crops	12,808.1	17.7%	1,075,642	21.4%
Woody Wetlands	8869.9	12.3%	279,358	5.5%
Emergent Herbaceous Wetlands	16,379.2	22.6%	199,698	4.0%
Totals	**72,381.6**	**100.0%**	**5,026,539**	**100.0%**

Reference 2.2-14

Table 2.2-3
Land Use in the Existing PSEG Transmission Line Corridors and Existing Access Road Rights-of-Way

	Existing Transmission Corridors		Access Road	
USGS Land Use Designation	**Area (ac.)**	**Percent**	**Area (ac.)**	**Percent**
Open Water	206	3.0%	4	1.0%
Developed - Open Space	99	1.4%	18	4.7%
Developed - Low Intensity	91	1.3%	25	6.6%
Developed - Medium Intensity	34	0.5%	6	1.6%
Developed - High Intensity	20	0.3%	1	0.3%
Barren Land	124	1.8%	39	10.3%
Deciduous Forest	1843	26.6%	6	1.6%
Evergreen Forest	233	3.4%		
Mixed Forest	24	0.4%		
Pasture Hay	591	8.5%	17	4.5%
Cultivated Crops	2091	30.2%	117	30.9%
Woody Wetlands	1029	14.9%	15	3.9%
Emergent Herbaceous Wetlands	535	7.7%	131	34.6%
Totals	**6920**	**100.0%**	**379**	**100.0%**

Transmission Line and Access Road Corridor area of analysis is 500 ft. The specific corridors and rights-of-way are less than this width.

Reference 2.2-14

Table 2.2-4
Land Use/Land Cover (LULC) (Acres) within Each Off-Site Transmission Macro-Corridor

	6-Mile Vicinity	6 to 50+ Mile Region	Total	Percent
South Corridor[(a)]				
Open Water	4468	21,686	26,154	8%
Developed - Open Space	282	6360	6642	2%
Developed - Low Intensity	199	5696	5895	2%
Developed - Medium Intensity	90	2684	2774	1%
Developed - High Intensity	192	1394	1586	1%
Barren Land	493	3110	3603	1%
Deciduous Forest	2243	39,052	41,295	13%
Evergreen Forest	58	4106	4165	1%
Mixed Forest	11	1807	1817	1%
Pasture Hay	3416	32,175	35,591	11%
Cultivated Crops	11,704	110,191	121,895	39%
Woody Wetlands	7742	18,707	26,448	8%
Emergent Herbaceous Wetlands	11,648	26,915	38,563	12%
Total	**42,545**	**273,884**	**316,429**	**100%**
West Corridor[(b)]				
Open Water	1976	18,744	20,721	11%
Developed - Open Space	98	7609	7706	4%
Developed - Low Intensity	97	8769	8867	5%
Developed - Medium Intensity	64	3726	3789	2%
Developed - High Intensity	191	1420	1610	1%
Barren Land	351	2570	2921	1%
Deciduous Forest	1086	33,969	35,055	18%
Evergreen Forest	13	1064	1077	1%
Mixed Forest	9	32	42	0%
Pasture Hay	934	45,122	46,055	24%
Cultivated Crops	4310	31,396	35,706	19%
Woody Wetlands	4276	11,534	15,810	8%
Emergent Herbaceous Wetlands	7675	4490	12,164	6%
Total	**21,077**	**170,446**	**191,523**	**100%**

a) Total length = 94 mi.
b) Total length = 55 mi.

Reference: 2.2-14

Table 2.2-5
Principal Agricultural Crops within the New Castle (DE), Cumberland (NJ), Gloucester (NJ), and Salem (NJ) Counties as of 2007

Crops	New Castle	Cumberland	Gloucester	Salem	Totals
Corn					
Number of Acres	16,812	7069	3067	20,483	47,431
Yield in Bushels	1,964,809	603,375	228,950	2,253,406	5,050,540
Wheat					
Number of Acres	7934	7811	2433	8119	26,297
Yield in Bushels	592,953	375,866	117,245	414,253	1,500,317
Barley					
Number of Acres	1175	95	456	1150	2,876
Yield in Bushels	119,038	6305	28,732	86,294	240,369
Soybeans					
Number of Acres	19,930	10,561	5476	20,545	56,512
Yield in Bushels	663,599	193,609	140,662	541,038	1,538,908
Vegetables					
Number of Acres	769	9847	9907	11,786	32,309
Fruits					
Number of Acres	NA	1424	4497	NA	5,921
Forage					
Number of Acres	5169	5001	4349	13,077	27,596
Dry tons	12,551	8786	9225	27,112	57,674
Total Acres	51,789	41,808	30,185	75,160	198,942
Total Bushels/year	3,340,399	1,179,155	515,589	3,294,991	8,330,134

Reference 2.2-13

NA-Not Available

2.3 WATER

This section describes the physical and hydrological characteristics of the PSEG Site and vicinity and provides a baseline for the assessment of potential effects from the construction and operation of the new plant. The site location and general plant description is provided in Subsection 1.2.2.

The new plant is located along the east bank of the Delaware River at approximate RM 52. The new plant location occupies the southern portion of the 1500-ac. Artificial Island, located in southwestern NJ in Lower Alloways Creek Township, Salem County (Figure 2.3-1). Artificial Island is largely a man-made land form created by the deposition of dredge spoils behind a naturally occurring sandbar and bulkhead. The developed portions of the site occupy 373 ac. of the 734-ac. parcel owned by PSEG. The remaining 361 ac. of the property and the additional 85 ac. to be acquired are comprised of developed upland areas in industrial use, a variety of wetland types, desilting basins, and stormwater management facilities.

2.3.1 HYDROLOGY

This subsection presents descriptions of the surface water and groundwater resources that could be affected by the construction and operation of the new plant. The physical and hydrologic water resource characteristics of the site and region are summarized below.

2.3.1.1 Surface Water Resources

The new plant is located on the NJ shoreline of the Delaware River. The land surrounding the new plant location to the north and east is low-lying tidal marsh that is interlaced with a network of tidally influenced marsh creeks. The new plant is in an area of low topographic relief composed of relatively flat upland areas, coastal marsh, shallow open water areas, and several dredge spoil containment berms. Artificial ponds within these containment berms are shallow systems that are perched and isolated from groundwater (Subsection 2.3.1.2.4). These artificial ponds are contained within the PSEG desilt basin, a permitted facility that is used to dispose of material removed from the intake structures or during maintenance dredging for the existing plants. Similarly, the shallow pond within the USACE CDF is also used to dispose of material dredged from the Delaware River.

The tidal Delaware River, also known as the Delaware Estuary, extends from the Atlantic coast 133 mi. inland to Trenton, NJ. This subsection describes the Estuary and includes a characterization of the freshwater inflows and tides controlling the hydrologic conditions at the PSEG Site. Water temperatures, salinity, sediment, and bathymetry are also discussed.

2.3.1.1.1 Watershed Description

The Delaware River watershed encompasses an area that extends into NJ, DE, PA, New York (NY), and the extreme northeastern corner of MD. The northern extent of the watershed is near the town of Stamford in Delaware County, NY. The watershed is 330 mi. north to south and 150 mi. east to west at its widest points. The Delaware River Basin encompasses approximately 13,600 square miles (sq. mi.) including 12,800 sq. mi. of land area and 800 sq. mi. of open water (Reference 2.3-14). Elevations within the watershed range from sea level to 4000 ft. above sea level in the Catskill Mountains.

The Delaware River Basin and its subbasins, delineated as 8-digit hydrologic unit code subbasins by the USGS, are shown in Figure 2.3-2. Table 2.3-1 lists the drainage area of each basin upstream and downstream of the PSEG Site. The total estimated drainage area upstream of the PSEG Site is approximately 11,500 sq. mi.

The average surface water runoff from the watershed is 20,240 cubic feet per second (cfs) (Reference 2.3-52), which is equivalent to 20.2 inches (in.) of annual watershed runoff. Subsection 2.3.1.1.3 describes streamflow in greater detail.

The Delaware River is an open river with no dams on the main channel. However, numerous dams and reservoirs exist on tributaries and serve various purposes, including water supply, flood control, recreation, power generation, and flow augmentation (Reference 2.3-14). There are 24 reservoirs in the watershed with a combined permanent storage capacity totaling over 410 billion gallons (gal.) (Reference 2.3-14), or 1.257 million acre-feet (ac-ft). This volume is equivalent to 1.8 in. of runoff from the entire land area of the watershed. Subsection 2.3.1.1.1.2 describes reservoirs in the watershed in more detail. Nearly 15 million people within the region and as far away as New York City rely on water from the Delaware River Basin (Reference 2.3-14). This dependency on the Delaware River Basin as a water supply has resulted in extensive study of the Delaware River and its tributaries.

The Delaware Estuary connects to the upper end of Chesapeake Bay via the Chesapeake and Delaware (C&D) Canal. Initially constructed with a lock and dam system, the C&D Canal has been modified over the years to be a sea level canal connection with a width of 450 ft. and depth of 35 ft. (Reference 2.3-63).

The Delaware Estuary is a flooded river valley created by a rise in ocean water levels which flooded the prior riverine system believed to have formed 30 – 50 million yr ago (Reference 2.3-14). The limit of tidal influence on the Delaware River is located at RM 134 in Trenton, NJ. The drainage area upstream of Trenton is 6780 sq. mi. (Reference 2.3-87). Major tributaries discharging to the Delaware Estuary downstream of Trenton include the Schuylkill River at Philadelphia, PA (RM 92), the Christina River at Wilmington, DE (RM 71, Brandywine-Christina subbasin), and Rancocas Creek, NJ (RM 111, Lower Delaware subbasin) (Table 2.3-1). The Delaware River is not saline until south of Philadelphia, with the most upstream extent of the salt line being RM 90. However, the maximum saltwater intrusion was recorded to RM 102 during the drought of record in the early 1960s (Reference 2.3-14). More extensive reservoir storage and water management strategies have been developed since that period to maintain minimum low flows to control the upstream intrusion of saltwater.

2.3.1.1.1.1 Climate

Average annual precipitation in the Delaware River Basin ranges from 42 in. for southern NJ to 50 in. for the Catskill Mountains of southern NY. Annual snowfall ranges from 13 in. for southern NJ to 80 in. for the Catskill Mountains. In general, precipitation is evenly distributed in the basin throughout the year. Annual average temperatures throughout the basin range from 56 degrees Fahrenheit (°F) in southern NJ to 45°F in southern NY (Reference 2.3-68).

The National Oceanic and Atmospheric Administration (NOAA) has analyzed historic point precipitation (precipitation depths observed at a single location) in terms of depths, duration,

and return period (Reference 2.3-37). Table 2.3-2 summarizes selected point precipitation values for the vicinity of the PSEG Site.

2.3.1.1.1.2 Dams and Reservoirs

The Delaware River is the longest undammed river east of the Mississippi River (Reference 2.3-14). Tributaries of the Delaware River are dammed to create reservoirs used for water supply, flood protection, hydropower generation, river flow augmentation during droughts, and recreation. Table 2.3-3 provides a summary of the purpose, and size of the 24 reservoirs in the Delaware River Basin (Reference 2.3-73).

The largest reservoirs in terms of water volume are located in the upper Delaware River Basin. Reservoir storage volumes tend to decrease in the Piedmont and Coastal Plain physiographic regions. The four largest reservoirs in the Delaware River Basin are:

- Pepacton Reservoir
- Cannonsville Reservoir
- Neversink Reservoir
- Lake Wallenpaupack

Pepacton Reservoir (460,000 acre-feet [ac-ft]), Cannonsville Reservoir (303,000 ac-ft), and Neversink Reservoir (142,000 ac-ft) all serve dual purposes. They are used as water supplies and for flow augmentation in the event of a drought to maintain the minimum mandated flow level of 1750 cfs at Montague, NJ (References 2.3-14 and 2.3-82). Pepacton Reservoir is located on the East Branch Delaware River in NY, and it has been in service since 1954. Cannonsville Reservoir is located on the West Branch Delaware River in NY, and has been in service since 1963. Neversink Reservoir is located on the Neversink River in NY, and has been in service since 1953 (Reference 2.3-62). Approximately half of the water stored in the reservoirs in the Delaware River Basin is held in these three reservoirs in the upper watershed (Reference 2.3-14). Lake Wallenpaupack (209,000 ac-ft) is used to generate hydroelectric power. It is located on the Wallenpaupack Creek in northeastern PA and has been in service since 1925 (Reference 2.3-62).

Reservoirs used for flood control maintain storage capacity to capture and slowly release flood waters to mitigate downstream flooding. The three reservoirs dedicated for flood control are located in the upper and central portions of the Delaware River Basin. Listed below, these three reservoirs are operated by the USACE, Philadelphia District.

- General Edgar Jadwin Reservoir
- Prompton Reservoir
- F.E. Walter Reservoir

Jadwin Reservoir is located on Dyberry Creek in northeast PA, and has been in operation since 1960. Prompton Reservoir is located on the Lackawaxen River in PA, and has been in operation since 1961. F.E. Walter Reservoir is located on the Lehigh River in PA, and it has been in operation since 1961 (Reference 2.3-62). These reservoirs were constructed following a devastating flood on the Delaware River in 1955. The 1955 flood is the worst flood recorded since USGS started measuring floods through their gage system network in the Delaware River Basin.

Merrill Creek Reservoir, located on Merrill Creek in the central portion of the basin, is dedicated to flow augmentation. This reservoir has been in operation since 1988. PSEG is a co-owner of this reservoir. This ensures minimum flows downstream during a drought so that the Merrill Creek co-owners may continue to withdraw water from the Delaware River to maintain power generation operations.

The reservoirs nearest the PSEG Site are small in terms of storage volume and are used for water supply. These reservoirs are:

- Springton Reservoir (Geist Dam) (10,700 ac-ft)
- Hoopes Reservoir (11,000 ac-ft)
- Newark Reservoir (920 ac-ft)

These small storage volumes have minimal impact on flows at the PSEG Site. Springton Reservoir is located on Crum Creek in southeastern PA and it has been in operation since 1931. Hoopes Reservoir is located on Red Clay Creek and it has been in operation since 1931 (Reference 2.3-62). Newark Reservoir is located adjacent to White Clay Creek and it has been in operation since 2006. These two small water supply reservoirs are located in northern DE.

2.3.1.1.2 Local Drainage

Local drainage, shown in Figure 2.3-1, is developed from the Taylor’s Bridge, Canton, Salem, and Delaware City USGS quadrangle sheets. There are 13 significant streams or channels to the Delaware River within the vicinity of the PSEG Site. Table 2.3-4 lists these tributaries and their locations. Alloway Creek has a drainage area of 60 sq. mi. (Reference 2.3-27). The creek discharges to the river from the eastern bank at the northern (upstream) end of Artificial Island; less than 2 mi. upstream from the new plant location. Hope Creek, Mad Horse Creek, and Mill Creek are other interconnected local surface water systems providing tidal connections to the coastal marsh immediately adjacent to the PSEG Site. Hope Creek is also crossed by the existing access road immediately east of the PSEG Site.

The C&D Canal is another significant tributary/hydrologic feature in terms of hydrologic influence on the PSEG Site. It connects the Chesapeake Bay with the Delaware River at RM 59, which is 7 mi. upstream from the new plant location. Both the Delaware River and Chesapeake Bay are tidal. Flow through the C&D Canal can be in either direction due to differences in tidal phases and other factors affecting water levels. The net discharge is from the Chesapeake Bay to the Delaware River.

Drainage within developed portions of the PSEG Site is conveyed through a network of ditches and pipes to outfalls on the Delaware River (Reference 2.3-53). In contrast, much of the undeveloped area of the new plant location drains to the east, northerly through tidal marshland and numerous small marsh creeks that merge in a dendritic pattern. The area ultimately discharges in a northerly direction to the Delaware River through an unnamed channel into a small bay. Alloway Creek also discharges into the northern end of this small bay area at the opening to the Delaware River.

A USGS crest stage gage is located at Hancocks Bridge Road (Reference 2.3-86) northeast of the PSEG Site and 5.2 mi. upstream of the mouth of Alloway Creek. This USGS gage

records only high water levels and has been in operation since 1980. Alloway Creek is tidal at this location, so the high water levels recorded at this station are likely the result of the combination of tidal stage and freshwater flow in the creek. Station records provide only the high water mark between gage readings and not time of occurrence. Consequently, it is not possible to relate the time of the high water to the tidal phase and elevation from tidal measurements in the Delaware River. From 1980 through 1991, annual maximum water level data are available for both this station and for the Delaware River at Reedy Point. During this period, the calendar day difference between high water and the high tide varied from -0.4 to +0.7 ft. Therefore, at least as far inland as this point on lower Alloway Creek, (5.2 mi. from the mouth), high runoff rates from watershed storm events do not contribute significantly to flood levels along the creek.

Much of the land for more than 2 mi. to the north and east of the PSEG Site is low-lying tidal marsh. Marsh habitats north of Alloway Creek have been the subject of intensive restoration as part of PSEG's Estuary Enhancement Program and reflect a plant species composition of a natural and highly functional brackish/salt marsh community. Disturbed lands having a degraded hydroperiod are often dominated by *Phragmites* (common reed). A significant portion of the tidal marsh habitats in the vicinity of the PSEG Site and extending to the south side of Alloway Creek are degraded and dominated by *Phragmites*. Within the dense monocultures of *Phragmites,* thick rootmats resist flow and inhibit water exchange within the marsh. Subsection 2.4.1.1.1.1 provides a more detailed discussion of wetlands in the area.

2.3.1.1.3 Delaware River Flow

Beginning at RM 133 at Trenton, the Delaware River is tidally influenced. At that location, average discharge is 11,880 cfs, or nearly 60 percent of the total freshwater surface inflow of 20,240 cfs. This freshwater flow normally maintains freshwater conditions in the river as far downstream as RM 90. The continuous mean daily discharge record at the USGS station at Trenton begins February 1, 1913, and provides over 96 yr of data (Reference 2.3-87).

The Delaware River discharge is affected by both consumptive and nonconsumptive water diversions, and operations of numerous reservoirs on tributaries for various purposes. These diversions and reservoir operations have changed over the 96-yr period of discharge record. The freshwater inflow has little impact on the volume of water in the Delaware River at the PSEG Site, but it affects salinity and other water quality characteristics.

Tables 2.3-5 and 2.3-6 summarize selected long-term monthly and annual streamflow statistics for the Delaware River at Trenton.

Three methodologies are commonly used to describe the characteristics of streams. Each of these is described in the following narrative which includes flow duration analysis, runoff (mass curve) analysis, and the minimum 7-day average.

2.3.1.1.3.1 Flow Duration Analysis

A common method of characterizing the range of flows within a streamflow record is flow duration analysis. Flow duration relationships present the fraction of time within a given time period that various flow rates are exceeded, without consideration of the sequence of the flows. Mean daily flows from the period of record of Trenton, NJ, are used to produce the flow

duration curves depicted in Figure 2.3-3. To assess variations over different time periods, the record was divided into three nearly equal segments of approximately 32 yr. The flow duration data for the period 1979 to 2008 indicate, for example, that 3000 cfs was exceeded 95 percent of the days during that time period, 4000 cfs was exceeded 83 percent of the time, and 5000 cfs was exceeded 74 percent of the time.

The most recent of the three periods, 1979 to 2008, is characterized by higher low flows (flow rates exceeded between 70 and 100 percent of the days) as compared to either of the earlier two periods. This higher low flow condition is believed to be at least, in part, the result of the development of large reservoirs that provide both flood storage and low flow augmentation and development in floodplains upriver. Further discussion is provided below in regard to low flows.

2.3.1.1.3.2 Mass Curve Analysis

An additional method of assessing flow variation and long-term changes in runoff is to calculate and plot cumulative runoff over time, sometimes referred to as a mass curve. Figure 2.3-4 presents a mass curve based on the monthly mean discharges from the 96-yr record for the Delaware River at the USGS gage station at Trenton. The average cumulative flow curve is also plotted, based on accumulation of long-term monthly averages. The accumulated observed flows vary over short and longer time periods of more than 10 yr. However, a bend in the curve, suggesting a significant change in runoff volume, is not apparent.

Figure 2.3-4 also presents a plot of the cumulative departure from the long-term mean, converted to inches of runoff from the watershed above the Trenton gage. This curve is based on the difference between the cumulative average and observed monthly runoff data, and is plotted at a scale more clearly illustrating the short and longer term variability in monthly streamflow. The mass curves (observed and average) and the departure from long-term mean line are two methods of presenting the same data. The departure from long-term mean line demonstrates that variations, or runs, from the long-term average for as many as 10 yr have been measured. Most notable is the period from 1961 to 1971 when a negative departure from normal grew to approximately 60 in. Nearly decade-long runs of above average flow are also apparent from 1971 to 1980 and from 2002 to present; flows are above average when a large negative departure from long-term mean is reduced.

Numerous variables are integrated into this streamflow result, and a long-term precipitation increase could offset a long-term water loss, such as that due to consumptive withdrawals. Average rainfall for NJ has increased by 3.3 in. since 1970 (Reference 2.3-14). The annual rainfall above Trenton for 2003 to 2007 was 52.3 in., compared to 43.7 in. for 1991 to 2002. The mass curve reflects the higher streamflows during that period, although as stated above, there are many factors that influence runoff in this watershed. Overall, the assessment indicates that while short and long-term fluctuations in streamflow have occurred, there does not appear to have been a significant change in runoff, or trend, at Trenton over the period of record.

2.3.1.1.3.3 Low Flow Analysis

Low freshwater flows into the head of the Delaware Estuary at Trenton are managed to maintain the historic ecological character of the Delaware Estuary and prevent saltwater intrusion. Consumptive withdrawal of water from the river upstream of the salt line, and altered hydrology due to traditional development practices, tend to decrease river flows during dry periods. Flow storage and management measures have been taken to mitigate these impacts while continuing use of the river as a water supply.

Historically, the most upstream encroachment of the salt line was during the record drought conditions of the early 1960s when the salt line (the location where the 7-day average chloride concentration equals 250 parts per million [ppm]) extended to RM 102, just upstream of the Ben Franklin Bridge at Philadelphia (Reference 2.3-14). During the period from 1988 through 2006, the salt line annual maximum intrusion was between RM 73 (just upstream of the Delaware Memorial Bridge) and RM 90 (just downstream of the mouth of the Schuylkill River).

The USGS streamflow gage at Trenton (Site No. 01463500, Delaware River at Trenton, NJ) represents a long-term streamflow record on the Delaware River. Continuous mean daily flow data is available at Trenton from 1913 to the present. Significant freshwater discharges to the Delaware Estuary downstream of that location include the Schuylkill River (RM 92.47). During most of the year, the salt line is reported to be between RM 54 and RM 82 (Reference 2.3-14).

An analysis of normal and low flows recorded for the Delaware River at the Trenton gage was conducted to evaluate the annual minimum 7-day average streamflow series. For this analysis, the calendar year was used as the annual period because low flows typically occur at a time other than the end of the calendar year.

The 7-day low flow events on the Delaware River are typically season-dependent (Figure 2.3-5). For example, no 7-day annual minimum low flow events have occurred in April to June, whereas approximately 80 percent occur during the 4-month period from August through November.

Low flows at the Trenton gage are affected by releases from reservoirs in the watershed that are intended to maintain minimum flows at Trenton and upstream at Montague, NY. Since 1954, maintenance of low flows has been required, and currently a minimum flow of 3000 cfs at Trenton is targeted (Reference 2.3-14). Consequently, use of a basic flow frequency analysis to characterize low flows is not appropriate. However, by comparing the ranked annual minimum low flows for the two approximately equal periods of duration (1914 to 1962 and 1963 to 2008), minimum flows during the latter period are observed to be approximately 50 percent larger than the low flows of equivalent rank during the earlier period. The lowest low flows since 1962 occurred in the 1960s. Since 1982, all annual minimum 7-day average low flows at Trenton have exceeded 2500 cfs.

Historically, most attempts to quantify freshwater flow through the Delaware Estuary have been based on measured surface water discharges extrapolated by drainage area estimates. However, recent literature indicates that some submarine groundwater discharges into the Delaware Estuary can be estimated. Schwartz (Reference 2.3-56) presents information suggesting that a significant submarine groundwater discharge zone in the Delaware Estuary can be identified in the vicinity of RM 51.25. This zone is located across from the PSEG Site

and is identified as more than 7 mi. in length along the Delaware Estuary. The calculated submarine groundwater discharge flux of 494 to 1024 cfs in that zone is similar in magnitude to the surface water discharge of the second and third largest tributary rivers of the Delaware Estuary. These preliminary findings suggest that estimates of freshwater discharge at various locations along the Delaware Estuary, based solely on upland drainage area and measured streamflows, may be underestimated, particularly during lower flow periods when groundwater discharges tend to be more sustained than surface flows.

2.3.1.1.4 Historic Flooding and Annual Peak Flood Frequencies

Riverine flood conditions are not a primary flooding concern at the PSEG Site because the flow conveyance capacity of the Delaware River at this location is large compared to riverine generated flow rates. Tidal storm surges generate higher water levels in the reach than do rainfall runoff events from the watershed. The Federal Emergency Management Agency (FEMA) has determined that for the 1 percent annual risk high water event, tidal storm surge water levels are higher than storm runoff generated water levels throughout the area surrounding the PSEG Site (Reference 2.3-27). Current FEMA floodplain information indicates that the 10-, 50-, 100-, and 500-yr return period flood elevations at RM 52 are 7.0, 8.2, 8.9, and 13.2 ft. National Geodetic Vertical Datum of 1929 (NGVD), respectively. FEMA refers to these as “stillwater” elevations. The area inundated by the 1 percent annual risk flood (100-yr flood), as indicated on FEMA’s Flood Insurance Rate Map for the area, is as shown on Figure 2.3-6. For context, the elevation of the terrain across the PSEG Site generally ranges from 5 to 15 ft. NAVD. Developed areas of the site are nominally 10 to 12 ft. NAVD. The site grade associated with the power block area of the new plant is set at an elevation of 36.9 ft. NAVD.

Based on over 100 yr of records, the largest peak instantaneous discharge on the Delaware River at Trenton, was an estimated 329,000 cfs on August 20, 1955. The next highest peak discharge was 295,000 cfs on October 11, 1903. By contrast, Harleman (Reference 2.3-31) estimated the maximum tidal flow rate in the Delaware River at RM 52 (PSEG Site) and at RM 38 to be 800,000 cfs and 1,350,000 cfs, respectively. The design basis flood level for the PSEG Site is the probable maximum hurricane (PMH) surge. The PMH surge analysis for the SSAR concludes that the design basis flood level is 32.1 ft NAVD.

Alloway Creek is the largest stream near the PSEG Site. While the stream is tidal beyond Hancocks Bridge, FEMA indicates that 100-year riverine flood flows for Alloway Creek are 5450 cfs at the confluence with the Delaware River and 4850 cfs at Hancocks Bridge (Table 2.3-7).

2.3.1.1.5 Delaware Estuary

The Delaware Estuary is a drowned river valley of the Delaware River (Reference 2.3-91). Geometrically, it is a relatively simple estuary, with a dominant freshwater input at the head of the estuary (Delaware River) and a single, funnel-shaped bay where mixing occurs. It has been stated that when Henry Hudson sailed into the bay in 1609, he found it too shallow to navigate (Reference 2.3-91). A navigation channel has been dredged routinely and is maintained by the USACE with an authorized depth of 40 ft. The USACE is currently planning to increase the navigation channel depth to 45 ft. (Section 2.8).

Despite its apparent geometric simplicity, the Delaware Estuary is functionally complex with respect to circulation, sediment transport, salinity and other water quality characteristics and ecological processes. As a result, numerous studies of the Delaware Estuary have been completed and provide an abundant source of information with which to characterize existing conditions. This subsection provides an overview of the Delaware Estuary and a description of estuarine hydrologic dynamics related to salinity, tidal regime, circulation, temperature, and sediment transport.

Table 2.3-8 summarizes selected physical attributes and measures of the Delaware Estuary. The Delaware Estuary is 133 mi. in length from Trenton to the mouth at the Atlantic Ocean. The width varies from a maximum of 27 mi. near the mouth to 0.1 mi. at the upstream end. The total open water area is 759 sq. mi., while the adjacent marsh area is 247 sq. mi. The average depth is 19 ft. The semidiurnal tide has two nearly equal highs and lows with a period of approximately 12 hr. The mean tidal range varies from 1.3 meter (m) (4.2 ft.) at the mouth to 2.5 m (8.2 ft.) at Trenton, and is 1.6 m (5.3 ft.) at RM 52 (Figure 2.3-7) (Reference 2.3-54). The average freshwater inflow rate is 20,240 cfs. The tidal flow at the mouth is estimated to be 5,190,000 cfs. The maximum tidal flow near RM 52 is estimated to be 800,000 cfs (Reference 2.3-31) with average flows of 400,000 to 472,000 cfs.

The navigation channel is maintained by the USACE by dredging from the mouth of the Delaware Estuary to Philadelphia. Dredging occurs intermittently and as conditions require. The channel is reported to have an effect on flow conditions, salinity, and other water quality parameters. The deeper navigation channel provides less resistance to flood tide flows, allowing coastal or downstream waters to travel preferentially up the channel compared to the shallows on either side of the navigation channel. This flow condition can lead to lateral variations in salinity, water temperature, turbidity, and other water quality parameters and creates the potential for transverse currents across the Delaware Estuary.

The C&D Canal is a significant feature associated with the Delaware Estuary. It connects to the Delaware Estuary at RM 59, which is 7 mi. upstream from the PSEG Site. The C&D Canal connects Chesapeake Bay with the Delaware River. Both the Delaware Estuary and Chesapeake Bay are tidal. Flow through the C&D Canal can be in either direction due to differences in tidal phases and other factors affecting water levels. However, the net discharge is from the Chesapeake Bay to the Delaware Estuary. The enlarged size of the canal provides a significant flow conveyance feature that can interact with tidal flows. Figure 2.3-7 illustrates the tidal range along the navigation channel. The tidal range is amplified in the upstream direction, which is common for funnel-shaped estuaries, as the tidal energy is concentrated by the funnel shape. However, the general tidal amplification throughout the length of the Delaware Estuary is moderated in the vicinity of the C&D Canal between RM 60 and RM 70 where the tidal range is 5.0 ft. (1.51 m) compared to 5.7 ft. (1.75 m) downstream at RM 35 and upstream at RM 93.

The Delaware Estuary has been characterized (Reference 2.3-60) as having three ecological zones distinguished by differences in salinity, turbidity, and primary biological productivity. The upper Tidal River Zone extends from RM 133 downstream to RM 80 and is characterized as tidally influenced freshwater. The second zone extends from RM 80 to RM 50 (slightly south of the PSEG Site) and is referred to as the Transition Zone. This zone is characterized by the greatest turbidity values, low biological productivity, and varying salinity. The third zone is the Delaware Bay Zone, which encompasses the lower 50 mi. of the Delaware Estuary and

extends to the Atlantic Ocean. The Delaware Bay Zone is characterized by high salinity, large surface area, and the highest primary biological productivity.

Estuaries commonly have turbidity maxima, sometimes known as estuary turbidity maximum, where salinity gradients exist. Various theories regarding processes and conditions causing the turbidity maxima include flocculation of dissolved material in the river water, resuspension of sediments due to turbulence, and other factors. The cause(s) of the Delaware Estuary turbidity maxima are not reliably known. However, the location and extent of these high turbidity zones vary with changes in freshwater flow rate. The turbidity maxima in the Delaware Estuary occur typically at salinities of 1 – 3 parts per thousand (ppt) and 7.5 – 10 ppt and may be found between RM 35 to RM 80 (Reference 2.3-54).

PSEG completed an extensive review of the estuarine dynamics for its SGS NJPDES permit renewal applications in 1999 and 2006. R.B. Biggs and R.J. Horwitz (Reference 2.3-54) provided a comprehensive description of the Delaware Estuary flows and dynamics. Subsection 2.3.1.1.5.1 provides further descriptions of Delaware Estuary tides, circulation, and salinity.

2.3.1.1.5.1 Delaware Estuary Circulation and Freshwater Flow

2.3.1.1.5.1.1 Estuarine Dynamics

This subsection provides a background discussion of salinity and temperature patterns in the Delaware Estuary, as well as the major processes that control their distribution.

Salinity

The salinity distribution of the Delaware Estuary varies both spatially and temporally in response to various external factors, including:

- Salinity distribution of adjacent coastal waters
- Freshwater inflow variations
- Tides and tidal exchange processes
- Estuarine morphology
- Local or regional wind-induced circulation

Salinities at the seaward end of the Delaware Bay Zone vary over a limited range, from 30 to 31 ppt, with an annual standard deviation of approximately 0.8 ppt (Reference 2.3-29). Freshwater inflows vary markedly over time and enter the Delaware Estuary primarily from the north end. Also, bottom topography varies laterally throughout most of the Delaware Estuary. As a result, salinity patterns within the Delaware Estuary exhibit temporal, longitudinal, and lateral variations.

Due to the dominance of tides throughout the Delaware Estuary and associated vertical mixing processes, vertical salinity variations are often weak. This weak stratification is reflected in the high ratio (226:1) of semidiurnal tidal flows at the mouth of Delaware Bay to the mean freshwater inflow (Reference 2.3-29). That is, the potential stratifying effects of freshwater inflows are often overwhelmed by an energetic tidal exchange of saline coastal waters. Thus, under mean inflow conditions, the Delaware Estuary has been classified as a

vertically homogeneous or weakly stratified estuary. Typical vertical salinity variations range from 1 to 4 ppt (References 2.3-29 and 2.3-96). During extreme spring freshet conditions, vertical salinity variations as large as 5 – 15 ppt have been reported in Delaware Bay (Reference 2.3-57).

Salinity variability near RM 52 is characterized by relatively low salinities (averaging 4 ppt) during the spring and higher salinities (averaging 8 ppt) in the late summer (Reference 2.3-54). Long-term salinity statistics calculated from specific conductance data (from 1971 through 1997) for the DRBC monitoring stations nearest the PSEG Site at Appoquinimink River (RM 50.8) and Liston Point (RM 49) are (Reference 2.3-54): mean of 5.5 ppt, median of 5.2 ppt, minimum of 0.1 ppt, and maximum of 17.9 ppt.

Lateral salinity variability is well-documented in the broad, lower reaches of the Delaware Bay Zone. Wong and Munchow observed lateral variations as large as 6 ppt across the wide (25-mi.) area of the zone (References 2.3-93 and 2.3-95). They observed a persistent split in the lateral salinity structure characterized by two branches of low salinity water along the shore separated by high salinity water in the middle of the bay over the deep channel. This structure suggests that the high salinity inflow is concentrated in the deeper, middle parts of the bay, while low salinity outflows occur in the shallower parts along the shore. Furthermore, Wong suggests that such transverse salinity gradients and current shears may contribute to longitudinal dispersion and thereby buffer the salinity response of the system to discharge variations (Reference 2.3-95).

2.3.1.1.5.1.2 Components of Estuarine Dynamics

Astronomical Tides

Delaware Estuary tides are predominately semidiurnal (Reference 2.3-46), with two high waters and two low waters on most days. Mean tidal ranges vary from 4.2 ft. near the mouth to 8.2 ft. at Trenton, an approximate two-fold amplification of the tide over the length of the Delaware Estuary (Figure 2.3-7). Tidal amplification is less apparent in the vicinity of both the C&D Canal (near RM 59) and tidal shallows near the Salem River. Tidal amplification in the Transition and Tidal River zones has been associated with their convergent (funneling) geometry and resonant response (References 2.3-26 and 2.3-46).

Prior to the historical period of dredging (1910 – 1964), mean tidal ranges at Trenton were 4.2 ft. Historical increases in navigation channel depths (from 18 to 40 ft.) and associated reductions in bed friction likely contributed to the two-fold amplification of upper Delaware Estuary tides (Reference 2.3-26). These amplified tides enhance both vertical mixing and horizontal dispersion in the Tidal River Zone.

Delaware Estuary tidal ranges vary over fortnightly periods (14.7 days). Maximum astronomical tidal ranges occur during both full moon and new moon phases (spring tides); minimum ranges occur halfway between these periods (neap tides). The spring tidal range at the PSEG Site is 10 percent greater than the mean range.

The tidal excursion is commonly defined as the distance a drifting particle may be displaced along the open estuary during one-half tidal cycle (e.g., during an entire 6-hr. flood-tide interval). It is calculated by integrating the tidal current speed over one-half of a tidal cycle.

Delaware Estuary tidal excursions vary in accordance with the distribution of maximum tidal currents in the Delaware Estuary. Relatively large tidal excursions occur in both the main entrance channel and the narrow upstream channel of both the Transition Zone and lower Tidal River Zone. Relatively small tidal excursions (2 to 6 mi.) occur in the wider reaches of the Delaware Bay Zone. Relatively large tidal excursions occur near the PSEG Site, as represented by computed tidal excursions of 5 mi. at the entrance to the Appoquinimink River (RM 50.9) and 11.3 mi. at Reedy Island (RM 55.3).

Flushing characteristics of estuaries are related to tidal excursion through the concept of movement of a particle or tracer. The Delaware Estuary flushing times for selected high freshwater flow (40,194 cfs) and low freshwater flow (6076 cfs) are calculated to be 45.7 days and 228.2 days, respectively (Reference 2.3-54). For the Delaware Estuary segment south of the PSEG Site, the flushing times for these high and low flows are 34 days and 157 days, respectively.

Dynamics of the Triple Bend

Circulation patterns in the vicinity of RM 50 vary spatially in response to the following morphologic controls:

- Cross-estuary bathymetry
- Bends in the estuarine channel
- Lateral expansions in the shoreline configuration

Bathymetric features, such as the artificially maintained navigation channel, the shallows to either side of the navigation channel, and the multiple shoals near the PSEG Site, induce variability in circulation patterns and water flow. The characteristic cross-estuary bathymetry provides greater frictional resistance in the tidal shoals relative to the deep channels. As a result, transverse shears can develop in the tidal flow, with enhanced flows in the deep channel. Additionally, tidal phases can change at different times across the Delaware Estuary, and tidal currents may vary in magnitude. In general, the complex river bathymetry enhances mixing rates by virtue of the strong horizontal and vertical velocity differences (shear).

Channel bends are large-scale geomorphologic features that also modify estuarine flows. The Delaware Estuary changes from its roughly linear course from the bay mouth to RM 50, where it takes a relatively sharp bend of nearly 60 degrees (towards the northeast) along the Fall Zone. This bend, accentuated by Artificial Island, causes flow patterns similar to those observed in meandering rivers. That is, flow around a river bend tends to be stronger on the outside of the bend (western shore in this case), causing the natural channel thalweg (main channel flow area) to be located against the outer bank. Sometimes, shoreline erosion may occur along the outer banks of such rivers, which is a positive feedback mechanism that tends to accentuate a river bend. The ultimate result of such processes is the well-known ox-bow morphology common to many meandering rivers on a smaller gradient.

On the inside of the bend (the eastern side), flows tend to be slower and more conducive to sedimentation. This flow pattern often leads to shoaling of the inside of the bend (point bars, in the classic river situation) and formation of large bedforms (sandwaves, submarine dunes). Areas of stagnant flow inside of the bend are sometimes characterized as zones of accumulation.

The river bend morphology north of RM 50 appears to be controlled primarily by antecedent geological structures rather than by shoreline erosion associated with flow instabilities. Though the area has not been mapped in a geological sense, numerous studies have investigated different aspects of its geology. One specific geological study addressing this region was found (Reference 2.3-58). Based on an analysis of Landsat photographs, and considering published literature on the geological structure of the region, Spoljaric mapped the folds, faults and other structures in the triple bend region (as well as adjacent regions of NJ and DE).

The Spoljaric analysis shows many structures running through the region, including those having a surface expression. Though the structures are not verified by detailed mapping, their existence is consistent with past geological investigation. Based on his mapping, it appears that there are two parallel structures which may control the triple bend.

The morphology in the triple bend region of the Delaware Estuary appears to result from a structural control rather than from simple river flow instabilities as is the case for many river bends. This structural control suggests that the bends are more stable than typical river bends, and that the bends control the local hydrodynamics in this region rather than being formed as a result of the hydrodynamics. The resulting hydraulic effects of these bends (i.e., stronger flows on the outside of the bend, slower flows and sedimentation on the inside) are similar on both flooding and ebbing Delaware Estuary tides. The river bend effect is nearly continuous, except during periods of slack tide. Overall, hydraulic effects of channel bends can be profound, altering tidal characteristics, mixing, and sedimentation processes near the PSEG Site.

A third morphologic feature affecting spatial flow variability is the change in shoreline orientation in this region. South of RM 50, the Delaware Estuary broadens. This lateral expansion induces complex, eddy-like variations in the flow near the PSEG Site. On flood tide, the flow from the south will concentrate (funnel) around Artificial Island and, at times, create an eddy near the southwestern point of the PSEG Site. On the ebb tide, as the flow moves past the lateral expansion, an eddy-like feature has been measured during previous investigations (Reference 2.3-3). These eddies do not effect or concentrate detritus or organisms in the vicinity of the existing intake structures, but these general features are important as they enhance mixing rates in areas of otherwise slower flow, where turbulent mixing might otherwise be less efficient.

In summary, complex flow fields reflecting the geology, geomorphology, and sediment dynamics of the Delaware Estuary characterize the region surrounding Artificial Island.

At the PSEG Site and Artificial Island, located at the downstream end of the triple bend reach, the Artificial Island shoreline has been stabilized with stone riprap for protection from erosion by waves generated by winds and navigation. Artificial Island was created by placing dredge material on a natural shoal or bar located at a classic inside bend location on the river.

Meteorological Tides

While the semidiurnal tidal motions described above are principally responsible for the vigorous vertical and horizontal motions within the system, more subtle motions at subtidal periods are largely responsible for long-term transport. The Coriolis effect, modified

gravitational circulation, topography, meteorological events, and freshwater pulses may contribute to subtidal circulation. Typical meteorological events include local short-term wind events and large-scale, regional events having durations of approximately 20 days (Reference 2.3-30).

Wong and Garvine examined the relationship between atmospheric forcing and the subtidal response of the Delaware Estuary (Reference 2.3-94). They observed relatively large subtidal sea level fluctuations near the mouth of Delaware Bay, with a maximum range in excess of 1.6 ft. An along-shore wind-stress component over the adjacent continental shelf primarily drove these fluctuations. For example, currents driven by down-shelf winds (winds from the northeast) are steered towards the coast due to the effect of the earth's rotation. As a result, coastal sea levels rise (set-up) and induce a subtidal volume flux into the adjacent Delaware Estuary. An opposite situation occurs for up-shelf (southwest) winds whereby coastal sea levels fall (set-down) and a volume flux is directed out of the Delaware Estuary. This non-local, wind-forcing mechanism (the coastal Ekman effect) was most significant at time scales longer than 3 days. They found local wind forcing over the Delaware Estuary to be less significant.

Wong and Garvine determined that within the interior of the Delaware Estuary subtidal sea level variability is driven not only by wind forcing along the coast, but also by non-local winds over northern Chesapeake Bay (Reference 2.3-94). The latter mechanism sets up and sets down sea levels near the head of Chesapeake Bay and propagates these fluctuations through the C&D Canal into the Transition and lower Tidal River zones. Near Artificial Island, they estimate that two-thirds of the subtidal variability is driven by the coastal Ekman effect; the remaining one-third through coupling with the upper Chesapeake via the C&D Canal. Subtidal current variations on the order of 2.1 feet per second (ft/sec) are observed at the PSEG Site. They determined that the estuarine gravitational circulation was often weaker than the atmospherically driven subtidal current fluctuations (Reference 2.3-94).

Atmospheric forcing may also modify Delaware Estuary variability at tidal frequencies (References 2.3-4 and 2.3-61) with changes in tidal characteristics potentially explained by nonlinear interactions of the tide with surface waves and subtidal motions.

Estuarine Circulation

Mapping of the Delaware Bay Zone subtidal circulation has been done using seabed and surface drifters (Reference 2.3-45). Researchers found that surface drifters launched within the zone moved seaward and toward the DE shore. In contrast, bottom drifters launched off the bay mouth (as far as 25 mi. offshore) moved shoreward and often into the bay, though at slower average speeds. For the period studied, drifter measurements revealed a net surface outflow at 2 in. per second and a mean bottom flow of 0.5 in. per second. These early studies suggested the presence of a relatively weak estuarine gravitational circulation in the Delaware Estuary.

A modification of the traditional two-layer gravitational circulation model to explain the subtidal circulation of Delaware Bay was proposed in 1994 (Reference 2.3-95). Traditional conceptual models of estuarine circulation assume uniform across-estuary depths. However, Delaware Estuary bathymetry is characterized by a deep center channel flanked by shoaling areas along the shores. Under the influence of riverine inflows and associated longitudinal density

gradients, this characteristic across-estuary bathymetry produces a net outflow along both shores, and a return flow concentrated in the deeper part of the channel. Thus, Wong observed two branches of low salinity water along the shores separated by high salinity water over the deep channel and extending to the surface.

Wong's modified gravitational circulation model for Delaware Bay is supported by recent observations. Using a suite of satellite temperature images and statistical techniques, Keiner and Yan reported net outflows along the sides of the Delaware Estuary, and the presence of in-flowing waters over the center channel (Reference 2.3-34). Wong and Munchow observed fronts in the Delaware Bay Zone, regions in which observed salinity and temperature gradients are steep and typically involve small-scale circulation (Reference 2.3-93). In particular, they observed relatively dense waters in the middle of the Delaware Bay Zone, mingling with less dense waters near the shores. On an even smaller scale, Wong observed lateral temperature variations of 3.7°F over a 500 ft. distance within the zone (Reference 2.3-96).

The along-estuary (axial) flows described by Wong's conceptual model are likely coupled with transverse (across-estuary) circulation patterns (Reference 2.3-95). The characteristic across-estuary bathymetry provides greater frictional resistance in the tidal shoals relative to the deep channel. As a result, a transverse shear develops in the tidal flow, with enhanced flows in the channel. The lateral salinity profile is transported or advected further in the channel than in the adjacent shoals (Reference 2.3-33). On a flooding tide, this pattern of differential advection produces relatively higher salinity over the channel and lower salinity along the shores, as simulated by DiLorenzo et al. (Reference 2.3-26). The associated transverse density gradient may produce two transverse circulation cells characterized by converging surface flows (and sinking) at the center of the channel and diverging bottom flows, as observed in other estuaries (Reference 2.3-92). This transverse circulation may aggregate suspended particles, oil slicks and biota along the main axis of the Delaware Estuary.

The modified gravitational circulation model includes two branches of buoyant outflow along the shores separated by a dense inflow centered along the deep channel. However, Wong also reports that local wind may drive two branches of flows along the shores in the direction of local wind stress, and a return flow against the wind concentrated in the deep channel (Reference 2.3-95). These processes may either reinforce or counteract each other, depending on wind magnitude and direction. A strong wind blowing up the Delaware Estuary tends to counteract the modified gravitational circulation and reduce transverse shear. Conversely, a wind blowing down the Delaware Estuary may reinforce the two effects and enhance transverse variability.

An additional feature of Delaware Estuary subtidal variability is the identification of a buoyancy-driven coastal current. This is a seaward flow driven by density differences between brackish Delaware Estuary waters and salty oceanic waters (Reference 2.3-29). This current bends southward at the mouth of Delaware Bay to form a broad (12-mi. wide), slow moving plume along the inner continental shelf off DE (References 2.3-28 and 2.3-36). The coastal current is identifiable by a salinity/temperature signature that is coherent over the length of the Delmarva Peninsula. This current may also contribute to the distribution of river-borne nutrients, larvae, sediments, sewage, toxic chemicals, and spilled oil dominantly along the shore (Reference 2.3-36).

Current Measurement Data at Reedy Point

NOAA has recently installed Acoustic Doppler Current Profiler instrumentation at Reedy Point (station identification DB0201) located at RM 54.1 (Reference 2.3-38), 2 mi. upstream from the PSEG Site. The Delaware Estuary is 2.5 mi. wide at that location, similar to its width at RM 52. Raw current data from that station over an approximately year-long period is assessed. The data provided includes current magnitude and direction (in terms of degrees clockwise from true north). Six-minute current velocity duration curves are developed, treating ebb tide current direction as being from 150 to 165 degrees and flood tide currents as those from 345 to 350 degrees (Figure 2.3-8). Curves are also developed separately for a spring period (February to June 2009) and for a summer period (June to September 2008). Ebb tide velocities were higher than flood tide velocities. Velocities with 10 percent exceedance for flood and ebb tides were 4.0 ft/sec and 3.1 ft/sec, respectively. Maximum ebb and flood tide velocities recorded during those periods were 4.8 ft/sec and 4.1 ft/sec, respectively (Figure 2.3-8).

Water Temperature

Many factors influence water temperatures in the Delaware Estuary. The Delaware Estuary is generally considered to be well-mixed vertically with generally limited thermal stratification. More pronounced stratification can occasionally occur, including during periods of high freshwater inflow rate. Cook (Reference 2.3-6) documented hydrographic transects of salinity and suspended sediment concentration in the Delaware Estuary in March 2003 and in June 2003 (Figure 2.3-9). Similar Delaware Estuary transect plots of seasonal temperature distributions have been presented as part of the SGS NJPDES permit renewal application (Reference 2.3-54).

A long-term temperature record is available at the USGS water quality monitoring station on the Delaware River at Reedy Island (RM 54, which is 2 mi. upstream from the PSEG Site). Daily mean temperature duration statistics are determined and monthly and annual curves plotted based on the period of record (February 1970 to September 2008) (Figure 2.3-10). These curves indicate, for example, that July temperatures during the period of record have ranged from 68°F to 87°F, with the median (50 percent exceedance) temperature being 79.5°F. The monthly statistics are similar for pairs of months, with July and August being the warmest water and with similar probabilities of occurrence. On an annual maximum mean daily basis, temperatures of 82, 85 and 86°F have occurred with return intervals of approximately yearly, 5 yr, and 10 to 15 yr, respectively. Every occurrence of an annual maximum mean daily temperature of 82.4°F or greater has occurred during the period from mid-July through early September. Figure 2.3-11 provides a plot of daily mean water temperature for the period 1991 to 2001. Hourly water temperature data are also available at the Reedy Point monitoring station. Differences in daily maximum and minimum hourly temperatures during 2008 rarely exceeded 3°F.

PSEG completed extensive field data collection and hydrodynamic/hydrothermal modeling in the 1990s for the renewal of the SGS NJPDES permit. SGS uses a once-through cooling water system. HCGS uses a closed-cycle cooling system. Modeling for SGS considered both HCGS and SGS heat discharges into the Delaware River. Figure 2.3-12 shows the temperature contours measured during a flood tide phase on May 29, 1998. Figure 2.3-13 shows modeled temperature contours for a slack phase at end of flood tide conditions for the

same date; these model results are in general agreement with observed temperatures for this event. These figures illustrate that the modeled combined thermal plumes extend along the shoreline, and are carried by the tidal currents to form an elongated plume past the new plant location.

Sediment Transport

Cook (Reference 2.3-6) states that an average of 1,430,000 tons of suspended sediment are delivered to the Delaware Estuary on an annual basis. The Delaware River, Schuylkill River and Christina River contribute approximately 50 percent, 20 percent, and 8 percent, respectively. As is generally the case with watersheds, most of the annual sediment load is delivered during large runoff events. Total suspended solids (TSS) concentrations from DRBC boat run sampling events from 1971 to 1998 have been summarized (Figure 2.3-14) (Reference 2.3-54). The parameter is presented as Total Non-Filterable Residue (TNRES), which is the same as TSS. Median concentrations by month vary from approximately 30 milligrams per liter (mg/L) to 40 mg/L. The figure presents the sample data as percentiles (0 percent [minimum], 25 percent, 50 percent [median], 75 percent, and 100 percent [maximum]).]). These data reflect near-surface concentrations (1-meter depth). Cook also presented suspended sediment concentration transects (concentrations along the length of the river) for two sampling events (Reference 2.3-6) (Figure 2.3-9). These transects depict the turbidity maximum phenomena in the reach that extends along Artificial Island, as described above. These transects also illustrate that suspended solids concentrations are typically higher near the bottom, ranging up to a factor of ten higher than the concentrations nearer the surface.

The sediment type in the Delaware Estuary near RM 52 has been characterized as predominantly fine-grained sediments (silts, clays, fine sand). The area near Artificial Island has been identified as the null point of the Delaware Estuary (the point where ebb and flood tidal phase bottom currents are balanced). The null point is a location where fine sediments are likely to accumulate. Cook (Reference 2.3-6) notes that USACE dredging in recent years (averaging 1 to 2 million metric tons per year) has been limited to the upper Delaware Estuary in the reach from RM 59 to RM 81.

Sediments in this offshore area are expected to be fine-grained, consisting of mostly fine sands with some silts and clays. Near the shore, sediments are typically sandier as a result of shallower water depth and the effect of wave action. Surface sediment samples were collected (Figure 2.3-15) from the 0 to 6 in. depth range and analyzed for grain size. Samples were collected at varying locations within the nearshore areas. Grain-size distribution curves for these samples are presented in Figure 2.3-16. The surface sediments are predominantly medium to fine sands. Sample location AS-15, collected near shore, was comprised of approximately 30 percent silt and clay size, while the other locations had less than 10 percent silts and clays. Sample location AS-17 also consists of gravels.

Sediments in the Delaware Estuary have been studied, although information in the immediate vicinity of the PSEG Site is limited. Cook (Reference 2.3-6) studied sediments at two locations upstream from the PSEG Site at RM 59 near New Castle, DE, and RM 81 near Tinicum Island, PA. Cook reported the bed material at the downstream RM 59 location to be silt and clay, while the upstream site had sandy bed material, reflecting the narrower channel at the upstream location. Cook reported results of sediment resuspension investigations that

included field measurements of velocities to estimate a velocity profile and turbidity. Using various methods, Cook also estimated critical shear stress to be in the range of 1.8 to 2.0 dynes per cubic centimeter (dynes/cm^3), and potentially lower because the monitoring equipment position (somewhat elevated above the bed) likely resulted in missing the initiation of sediment resuspension. The value of M, an empirical constant defining the erosion rate in the Parthenaides and Krone cohesive sediment methods was reported to be approximately 9.0×10^{-5} kg m^{-2} s^{-1}. Based on the analyses presented by Cook, the critical shear stress for initiation of particle movement for sediments at RM 59 and RM 81 are determined to be typical of silt and clay-size sediments that are relatively easily resuspended and transported. Bottom velocities at the vicinity of the PSEG Site are similar or smaller than at RM 59, and similar sediment sizes are resuspended less frequently.

Figure 2.3-17 presents the Delaware Estuary bathymetry near the PSEG Site. The 40-ft. depth navigation channel is located 1.0 mi. offshore and parallel to the shoreline. The water depth along the shoreline drops quickly to 10 to 12 ft., then gradually increases with distance from the shoreline. Most of the near-shore area is in the range of 15 to 25 ft. deep. While there are seasonal variations in climatic conditions and freshwater inflow to the Delaware Estuary, the water levels and currents at the PSEG Site are dominated by tidal controls and no significant seasonal variation in sediment transport or bathymetry is known to exist.

2.3.1.2 Groundwater Resources

The PSEG Site is located within the NJ Coastal Plain aquifer system approximately 18 mi. south of the geological fall line. The fall line is a low east-facing cliff, with the exposed scarp generally trending parallel to the Atlantic coastline that extends from NJ to the Carolinas. The fall line separates the hard Paleozoic metamorphic rocks of the Appalachian Piedmont to the west from the softer Mesozoic and tertiary sedimentary rocks of the Coastal Plain. The hydrogeologic units within the NJ Coastal Plain can be summarized as southeast dipping permeable fine-grained to coarse-grained materials separated by less permeable fine-grained materials, resulting in a multiple aquifer system (Reference 2.3-69). The shallow aquifers in the vicinity of the site are saline and tidally influenced. Regional and local hydrogeology are described in this subsection. New Jersey has designated two Critical Water-Supply Management Areas in the NJ Coastal Plain in response to long-term declines in groundwater levels where groundwater is a primary water supply. The PSEG Site is southwest of the management areas and is not subject to groundwater withdrawal restrictions except as defined in applicable permits. The U.S. Environmental Protection Agency (USEPA) has determined that the NJ Coastal Plain Aquifer System is a sole or principal source of drinking water (Reference 2.3-65).

2.3.1.2.1 Regional Hydrogeology

The regional hydrogeology of southwestern NJ includes overburden sequences that thicken as the underlying bedrock surface dips from the fall line toward the southeast and the Atlantic Ocean. The overlying unconsolidated units reflect this topography and show a corresponding southeasterly dip of approximately 30 feet per mile (ft/mi). Aquifers are generally thicker near the ocean and thin progressively towards the northwest and closer to the western borders of NJ. In some instances, aquifers may thin out entirely. Generally, the ages of the underlying units include Cretaceous, Tertiary, and Quaternary, as shown in the hydrostratigraphic summary on Figure 2.3-18. The formations shown on Figure 2.3-18 only include the major or

more geographically continuous formations. The completed list of aquifers/aquitard units are described below.

Groundwater in the shallow aquifers is generally encountered within 20 ft. of the ground surface and flow is generally toward the Delaware River. The deeper aquifers (below the Merchantville Formation) generally flow southeast, toward the Atlantic Ocean.

Regionally, the aquifer/aquitard sequence generally consists of the following units:

- Alluvium
- Kirkwood-Cohansey
- Vincentown Formation
- Navesink-Hornerstown Formation
- Mount Laurel-Wenonah Formation
- Marshalltown Formation
- Englishtown Formation
- Woodbury Formation
- Merchantville Formation
- Potomac-Raritan-Magothy (PRM) Formations

The Delaware River is the primary surface water body and likely interacts with shallow site groundwater. The river is tidal adjacent to the PSEG Site with a bottom elevation of approximately -40 ft. mean sea level (msl) near mid-channel. Three other smaller surface waters, which may locally interact with groundwater, include Alloway Creek, Hope Creek, and the Salem River. These flow into the Delaware River and are located 2 mi. northeast, 2.5 mi. east, and 7 mi. north of the site, respectively. Several surface water bodies occupy parts of the undeveloped portion of the property. Subsection 2.3.1.1 describes these water bodies.

At the PSEG Site, groundwater is encountered within the shallow hydraulic fill and Alluvium. Regionally, where man-made deposits are not present, shallow groundwater is first encountered in Alluvium or in the Kirkwood-Cohansey units east of the site.

Regionally, aquifers are recharged at areas where they outcrop at the surface near the PSEG Site. Recharge of these aquifers is provided from adjacent aquifers through leaky aquitards, and/or through surface water interactions with groundwater. In some areas, aquifers may receive induced recharge from the Delaware River. Figure 2.3-19 shows the extent of these recharge areas in NJ. Table 2.3-9 summarizes the aquifer and aquitard characteristics of the regional aquifer system.

The PRM is a significant potable groundwater resource regionally (Reference 2.3-67). The nearest supply wells of any significance that withdraw from the PRM are located across the Delaware River in DE, and over 5 mi. to the northeast in Salem, NJ. There are no off-site public water supply wells or private wells within 2 mi. of the PSEG Site. The nearest public potable water supply wells are three wellhead protection areas that range from 2.9 to 3.6 miles to the west and northwest in New Castle County, Delaware (Figure 2.3-20). The deeper aquifers are recharged further northwest and/or by leakage between adjacent aquifers.

Public Water Supply Wells in NJ and wellhead protection areas in NJ and DE within a 25-mi. radius of the PSEG Site are shown on Figure 2.3-20. Table 2.3-10 summarizes the public

supply wells in the area. Table 2.3-11 summarizes the significant groundwater users in the same region.

2.3.1.2.2 Local Hydrogeology

The PSEG Site is located on Artificial Island where the shallow soils consist of fill materials or spoils (hydraulic fill) historically dredged from the adjacent Delaware River. Beneath the hydraulic fill are alluvial deposits (riverbed sands, gravels, and clays). These alluvial deposits represent the original ground surface, which was submerged as the river bed, in this area at the time the dredge spoils were initially placed. The hydraulic fill and the riverbed sands and gravels also constitute the shallow groundwater flow system that overlies either the alluvial clay or the top of the Upper Kirkwood Formation (a clay-rich, semi-confining unit at approximately -39 ft. NAVD). The shallow aquifer is recharged directly by infiltration of precipitation where not impeded by buildings, pavement, or other stormwater diversion structures from the existing plants. The groundwater surface is typically encountered at depths ranging from 5 to 10 ft. below ground surface. However, the hydraulic fill acts as an aquitard and the Delaware Estuary and shallow artificial ponds in the PSEG desilt basin and USACE CDF are likely perched, creating moist to saturated soils extending from ground surface through the hydraulic fill.

Sixteen observation well pairs and sixteen geotechnical borings were completed at the PSEG Site in support of the ESPA. Geotechnical boring logs from this effort, in conjunction with existing data from the PSEG Site, are used to characterize the local hydrogeologic units. Geologic cross-sections have been developed to depict the local geology and represent the associated hydrogeological units. The orientations of these cross-sections are shown on Figure 2.3-22, with the cross-sections presented on Figures 2.3-23 and 2.3-24.

Each of the units encountered at the PSEG Site are described below. The results of hydraulic conductivity tests, as well as interpreted gradients and estimated velocities, are presented in Subsection 2.3.1.2.3.

2.3.1.2.2.1 Fill Deposits

Artificial fill comprises the surface material at the PSEG Site. It consists of typically grayish-brown to brown, silt, clay, and sand with variable silt and clay content, and clayey and silty gravels. The thickness of the artificial fill ranges from 2 to 10 ft., and averages 4 ft. across the northern and eastern portions of the PSEG Site. These materials were placed at the site during previous construction activities and grade downward into hydraulic fill (Reference 2.3-26). Groundwater identified in these borings is likely perched and is not indicative of a continuous hydrogeologic unit.

Hydraulic fill from channel dredging of the Delaware River was historically deposited at the PSEG Site by the USACE. It consists typically of dark gray to dark greenish-gray, highly plastic clay and silt with trace to some organic material, and locally interbedded discontinuous layers of clayey and silty, fine-grained to medium-grained sand up to 5 ft. thick. The thickness of the hydraulic fill ranges from 24 to 44 ft., with an average thickness of 33 ft. across the northern and eastern portions of the PSEG Site. The combined artificial and hydraulic fill stratigraphic sequence overlies alluvial soils at an average elevation of -21 ft. NAVD in the eastern portion of the site. Average elevation of the fill materials (top of the Alluvium) in the

new plant location is -29 ft. NAVD. Due to the clay and silt content of these units, the fill deposits represent an aquitard creating semi-confining conditions for the underlying Alluvium. The hydraulic conductivity of the hydraulic fill is reportedly 1,000 to 10,000 times less than that of the underlying Alluvium (Reference 2.3-1). This is further supported by the piezometric data discussed in Subsection 2.3.1.2.4. The average hydraulic conductivity measured from slug tests for one well (NOW-5U), located at the new plant location and screened in hydraulic fill, was 0.2 ft/day (See Table 2.3-17).

2.3.1.2.2.2 Alluvium

The Alluvium underlies the Fill Deposits and consists of Quaternary age sediments that formerly comprised the bed of the Delaware River. These are also referred to as riverbed deposits. These soils consist typically of gray to grayish-brown, fine-grained to medium-grained sand with trace to little, rounded to angular, fine to coarse gravel, and trace to little silt and clay content. In borings completed in the northern and eastern portions of the PSEG Site, 2 to 5 ft. thick discontinuous layers of fine-grained soils consisting of sandy silts and clays, and highly organic soils consisting of peat, were encountered. In the eastern portion of the PSEG Site, a 4 to 15 ft. thick discontinuous layer of non-organic silt and clay was locally encountered below the alluvial sand and gravel.

The alluvial stratigraphic layer was typically encountered at approximate elevations ranging from -22 to -35 ft. NAVD in the northern portion of the PSEG Site, and at approximate elevations ranging from -16 to -25 ft. NAVD in the eastern portion of the site. The slightly undulating upper surface of the unit generally slopes gently westward towards the Delaware River. The thickness of the Alluvium ranges from 5 to 24 ft. across the PSEG Site. Average thickness in the new plant location is 13 ft., and average thickness in the eastern portion of the site is 18 ft.

The Alluvium represents the shallowest saturated unit having appreciable hydraulic conductivity and transmissivity. Horizontal hydraulic conductivity for this unit, reported from prior studies at Salem and Hope Creek Station, ranges from 0.03 to 2.27 ft/d (see Table 2.3-1). Horizontal hydraulic conductivity measurements from aquifer tests conducted in observation wells located at the proposed new plant site range from 0.4 to 8.0 ft/d (see Table 2.3-17).

2.3.1.2.2.3 Kirkwood Formation

The Kirkwood Formation unconformably underlies the Alluvium and consists of Miocene age marine sediments deposited in a nearshore environment associated with a marine regression. The sediments of the Kirkwood Formation consist of two distinct units. The upper unit of the formation typically consists of dark gray, green, and brown to olive-gray, highly plastic clay and silt with trace fine sand and rounded gravel, trace shell fragments, and trace to little organic content. Locally, interbeds of silty and clayey, fine-grained to medium-grained sand occur within this upper unit. In the eastern portion of the PSEG Site, a thick section of light greenish-gray, silty, fine-grained to medium-grained sand was locally encountered above the finer grained sediments. The upper unit is considered an aquitard separating the Alluvium from the lower Kirkwood and Vincentown water-bearing zones.

There are no site-specific hydraulic conductivity testing data available for the Kirkwood aquitard. Regionally, estimates of the vertical hydraulic conductivity for the Alloway Clay member, the finer grained member of the Kirkwood unit, range from 0.00002 to 0.000052 ft/d (Reference 2.3-71).

The lower basal unit of the Kirkwood Formation typically consists of a 2 ft. to 14 ft. thick layer composed of dark greenish-gray, olive-gray, and dark gray to brown, silty and clayey, fine-grained to medium-grained sand and fine to coarse gravel. The sand and gravel in this lower unit is typically rounded to subangular. The lower Kirkwood is directly above the Vincentown Formation and is in hydraulic communication with the Vincentown where the sands and gravels are present.

The Kirkwood Formation rests on the erosional unconformity formed on top of the underlying Vincentown Formation and its upper surface forms an erosional unconformity with the overlying alluvial sediments. This makes both the elevation of its upper surface as well as the thickness of the unit somewhat variable. In the northern portion of the PSEG Site, the top of the Kirkwood Formation ranges from approximate elevations -34 ft. to -43 ft. NAVD. In the eastern portion of the site, the top of the formation ranges from approximate elevations -31 ft. to -49 ft. NAVD. The thickness of the Kirkwood Formation ranges from 12 ft. to 29 ft. and averages 17 ft. in the northern area of the site. The thickness of the Kirkwood Formation in the eastern portion of the PSEG Site ranges from 14 ft. to 54 ft. and averages 37 ft. The large variation in thickness observed in the Kirkwood Formation is directly related to the undulating contact with the underlying Vincentown Formation, which displays up to 37 ft. of relief in the new plant location, and up to 51 ft. of relief in the eastern portion of the PSEG Site. Conversely, where the top of the Vincentown Formation is topographically low, the Kirkwood Formation is generally thick. Where the top of the Vincentown Formation is topographically high, the Kirkwood Formation is generally thin.

A few of the borings completed during the ESPA investigation did not encounter the lower unit of the Kirkwood Formation, which may indicate the lower unit has some discontinuity across the site or, more likely, that the layer was thinner than the distance between sampling intervals. At boring NB-2, completed in the new plant location, the upper unit of the Kirkwood Formation was not encountered, which is most likely due to fluvial scour during deposition of the overlying alluvial sediments at this location. At boring NB-7, which was completed in the new plant location, sediments of the Kirkwood Formation are completely absent, with alluvial sand and gravel unconformably overlying strongly oxidized Vincentown Formation sediments. This is most likely due to fluvial scour during deposition of the alluvial sediments at this location.

2.3.1.2.2.4 Vincentown Formation

The Vincentown Formation serves as the water-bearing zone for much of the shallow groundwater transport in areas where the Alluvium does not exist. It is also the formation on which the foundations of SGS and HCGS were constructed and will serve as the competent layer for the new plant at the PSEG Site. The formation unconformably underlies the Kirkwood Formation and consists of Paleocene age marine sediments deposited in a neritic, or shallow, marine environment during a marine regression. The Vincentown Formation shows erosional relief on its upper surface. This makes both the elevation of its upper contact and thickness somewhat variable.

In the northern portion of the PSEG Site, the elevation of the top of the formation ranges from -33 ft. to -70 ft. NAVD. In the eastern portion of the site, the elevation ranges from -45 to -91 ft. NAVD. The thickness of the Vincentown Formation ranges from 35 ft. to 79 ft. and averages 52 ft. in the new plant location. Thickness ranges from 37 ft. to 93 ft. and averages 55 ft. in the eastern portion of the site. Due to the erosional nature of the upper surface of the Vincentown Formation, the sediments of the uppermost portion of the unit typically show signs of weathering characterized by oxidation of iron-bearing minerals such as glauconite. The weathering and oxidation of the formation is subject to several post-depositional processes, such as subaerial exposure and fluvial erosion prior to deposition of the overlying sediments, as well as groundwater movement through the formation. This results in distinct but erratic contacts with the underlying unoxidized sediments that are not the result of depositional or stratigraphic control. Oxidized sediments are typically yellowish-brown to reddish-brown and unoxidized sediments are typically light greenish-gray to dark greenish-gray. The oxidized and unoxidized Vincentown Formation sediments are typically composed of glauconitic, calcareous, silty and clayey, fine-grained to medium-grained sand and fine-grained to medium-grained sand with variable silt content. Glauconite is typically present in trace amounts with locally higher concentrations observed during field sampling. The formation contains many discontinuous, friable to indurated, carbonate cemented sandstone layers. These indurated zones are typically 0.1 ft. to 1 ft. thick, as observed from split-spoon sampling and drilling operations. The oxidized and unoxidized sediments display a weak to strong reaction with 10 percent hydrochloric acid.

The Vincentown Unit is described both locally and regionally as a significant water-bearing unit and is comprised of sediments of the Vincetown Formation and the lower portion of the overlying Kirkwood Formation. The hydrogeologic parameter data for the Vincentown Unit have been compiled from a number of pumping and aquifer tests at Salem and Hope Creek Stations. Previously reported site-specific horizontal hydraulic conductivity values range from 0.95 to 14 ft/d (Reference 2.3-8). Horizontal hydraulic conductivity measurements from aquifer tests conducted in observation wells installed for this proposed new plant site range from 0.3 to 10.7 ft/d (See Table 2.3-17).

In general, groundwater in the Vincentown Formation beneath the PSEG Site has relatively high concentrations of chloride and is not adequate for use as a potable water supply.

2.3.1.2.2.5 Hornerstown Formation

The Hornerstown Formation is below the Vincentown Formation and is considered an aquitard. However, in several areas, the sand content suggests that it is in hydraulic

communication with the overlying Vincentown Formation. Sediments of the Hornerstown Formation are typically composed of greenish-gray to very dark greenish-gray, silty and clayey, fine-grained to medium-grained sand, with trace to few shell fragments, trace to few friable to indurated layers, and trace to some glauconite. Glauconite content typically increases with depth and is estimated from field sample observations to comprise greater than 30 percent of the sand fraction near the base of the formation. The formation contains numerous discontinuous, friable to indurated, carbonate cemented sandstone layers. These cemented zones are typically 0.1 to 1 ft. thick, as observed from the split-spoon sampling and drilling operations. In general, the Hornerstown Formation is differentiated from the overlying Vincentown Formation on the basis of increasing silt/clay content and increasing glauconite content. These properties classify it as an aquitard.

The Hornerstown Formation, together with the underlying Navesink Formation comprise an aquitard between the Vincentown and Mount Laurel Formations. There are no site-specific hydraulic conductivity testing data available for the Hornerstown unit. Regionally, estimates of the vertical hydraulic conductivity for the Hornerstown and Navesink Formations range from 0.0005 to 9 ft/d (Reference 2.3-90 and 2.3-71). The relatively higher range of values (e.g. 9 ft/d) are reportedly measures of minor sand layers that are not representative of this units overall vertical hydraulic conductivity (Reference 2.3-71). Horizontal hydraulic conductivity measurements for the Navesink Formation and Hornerstown Sand in Gloucester County range from 30 to 65 gpd/ft^2 (4 to 8.7 ft/d) (Reference 2.3-90).

The Hornerstown Formation consists of Paleocene age marine sediments deposited in a neritic environment during a marine transgression. Borings in the new plant location encountered the top of the Hornerstown Formation at approximate elevations ranging from -105 to -114 ft. NAVD, and in the eastern portion of the PSEG Site at approximate elevations ranging from -127 to -137 ft. NAVD. The formation averages 20 ft. in thickness across the PSEG Site.

2.3.1.2.2.6 Navesink Formation

The Navesink Formation underlies the Hornerstown Formation and, as described in the previous subsection, these two units together comprise an aquitard between the Vincentown and Mount Laurel formations. Sediments of the Navesink Formation are typically composed of very dark greenish-gray to very dark grayish-green and greenish-black, silty and clayey, fine-grained to medium-grained glauconite and quartz sand with trace to little shell fragments.

The Navesink Formation consists of Upper Cretaceous age marine sediments deposited in a neritic environment during a marine transgression. Borings in the northern portion of the PSEG Site encountered the top of the Navesink Formation at approximate elevations ranging from -121 to -133 ft. NAVD, and in the eastern portion of the PSEG Site at approximate elevations ranging from -147 to -157 ft. NAVD. The thickness of the unit averages 24 ft. in the new plant location and thins slightly to the southeast, with an average thickness of 20 ft. in the eastern portion of the PSEG Site.

2.3.1.2.2.7 Mount Laurel Formation

The Mount Laurel Formation and underlying Wenonah Formation create the next major water-bearing zone. This zone is used as a drinking water source for several communities within the region (the closest potable well is approximately 8 mi. from the PSEG Site). Two standby production wells at Salem, PW-2 and PW-3, are screened in this aquifer. Sediments of the Mount Laurel Formation typically consist of dark olive-gray, dark grayish-brown, and greenish-gray, clayey and silty, fine-grained to medium-grained sand, grading with depth into fine-grained to medium-grained sand with variable silt and clay content; all with trace to little glauconite and shell fragments. The amount of glauconite and shell fragments decreases to trace amounts with increasing depth. The upper 15 – 20 ft. of the formation typically contains trace to little, subrounded, coarse-grained sand and fine gravel, and is locally composed of sandy clay.

The Mount Laurel Formation consists of Upper Cretaceous age marine sediments deposited in a nearshore environment during a marine regression. All geotechnical borings advanced during the ESPA investigation penetrated the top of the formation. Borings in the northern portion of the PSEG Site encountered the top of the Mount Laurel Formation at approximate elevations ranging from -145 to -157 ft. NAVD, and at approximate elevations ranging from -168 to -177 ft. NAVD in the eastern portion of the PSEG Site. This corresponds to an apparent southeasterly dip of approximately 30 ft/mi. The unit has an average thickness of 103 ft. in the new plant location and thickens slightly to the southeast, with an average thickness of 111 ft. in the eastern portion of the PSEG Site.

Together with the top of the underlying Wenonah Formation, the Mount Laurel-Wenonah Aquifer ranges from approximately 100 to 125 feet in thickness. The horizontal hydraulic conductivity calculated from a pumping test at the PSEG site ranges 0.67 to 18.7 ft/d (Reference 2.3-8).

2.3.1.2.2.8 Wenonah Formation

The upper Wenonah Formation underlies the Mount Laurel Formation. The Mount Laurel and Wenonah formations are used as a drinking water source for several communities. The formation typically consists of very dark gray to greenish-black, sandy clay with trace shell fragments and trace to few glauconite, and locally consists of clayey and silty, fine-grained to medium-grained sand with trace to few glauconite. The lower Wenonah Formation has an increase in clays and silts and is considered, with the underlying Marshalltown Formation, to be an aquitard.

The Wenonah Formation is of Upper Cretaceous age and consists of marine sediments deposited in a neritic environment during a marine regression. Six of the borings completed during the ESPA investigation penetrated the top of the formation. In the new plant location, the top of the Wenonah Formation was encountered at elevations ranging from -250 to -259 ft. NAVD, and in the eastern portion of the PSEG Site at approximate elevations ranging from -279 to -289 ft. NAVD. The Wenonah Formation has an average thickness of 15 ft. across the PSEG Site.

The Lower Wenonah Formation, together with the upper portion of the underlying Marshalltown Formation comprise the Marshalltown-Wenonah aquitard. There are no site-

specific hydraulic conductivity testing data available for this aquitard. Regionally, estimates of the vertical hydraulic conductivity for the Marshalltown-Wenonah Unit range from 0.0000057 to 0.13 ft/d (Reference 2.3-71).

2.3.1.2.2.9 Marshalltown Formation

The Marshalltown Formation consists of Upper Cretaceous age marine sediments deposited in a neritic environment during a marine transgression and, with the lower Wenonah, acts as an aquitard. Sediments of this unit typically consist of greenish-gray to very dark gray and black, clayey and silty, fine-grained to medium-grained sand, and fine sandy clay of variable plasticity, all with trace to little glauconite content. Trace amounts of shell fragments, pyrite nodules, friable layers, and subrounded fine gravel were locally encountered within the Marshalltown Formation. A natural gamma peak was observed in the geophysical logs at the top of the Marshalltown Formation/base of the overlying Wenonah Formation. This may represent a thin (less than 3 ft. thick) phosphatic hard-ground or lag deposit that formed during the transition from deposition of the Marshalltown Formation to deposition of the Wenonah Formation, and is used to differentiate the two formations at the PSEG Site. The Marshalltown Formation, in general, shows an elevated natural gamma response in comparison to the overlying Wenonah Formation, but is similar to the underlying Englishtown Formation.

Five of the borings completed during the ESPA investigation penetrated the top of the Marshalltown Formation at elevations ranging from -265 to -277 ft. NAVD in the northern portion of the PSEG Site and at approximate elevation -293 ft. NAVD in the eastern portion of the PSEG Site. This corresponds to an apparent southeasterly dip of approximately 30 ft/mi. The Marshalltown Formation is typically 25 ft. thick across the PSEG Site.

2.3.1.2.2.10 Englishtown Formation

The Englishtown Formation consists of Upper Cretaceous age marine sediments deposited in a nearshore environment associated with a marine regression. Sediments in the upper portion of the Englishtown Formation consist of micaceous, very dark greenish-gray to very dark gray and black, sandy silt and clay to clayey sand, with trace shell fragments and trace to little glauconite; grading downward into micaceous, black, highly plastic silt and clay with trace to few fine sand and trace shell fragments. This formation is considered a water-bearing zone with good water quality. However, the yield of this aquifer cannot support site requirements.

There are no site-specific hydraulic conductivity testing data available for the Englishtown Aquifer as this aquifer has not been evaluated locally as a source of water. Regionally, estimates of the horizontal hydraulic conductivity for this unit range from 12 to 67 ft/d based on aquifer and laboratory tests for the unit as represented in Monmouth County, New Jersey (Reference 2.3-71).

Four of the borings advanced during the ESPA investigation penetrated the top of the Englishtown Formation at approximate elevation -291 ft. NAVD in the new plant location and at approximate elevation -319 ft. NAVD in the eastern portion of the PSEG Site. The thickness of the Englishtown Formation ranges from 44 to 49 ft. across the PSEG Site.

2.3.1.2.2.11 Woodbury Formation

The Woodbury Formation consists of Upper Cretaceous age marine sediments deposited in an inner shelf environment associated with a marine regression. Together with the underlying Merchantville Formation, these units are an aquitard between the overlying Englishtown Formation and the underlying PRM. Sediments of the Woodbury Formation consist of very dark gray and black to greenish-black, highly plastic clay with trace glauconite, fine sand, mica, and shell fragments and, locally, with trace indurated layers. The sediments have weak to no reaction with 10 percent hydrochloric acid. Sediments of the Woodbury Formation are similar to those of the upper portion of the overlying Englishtown Formation and the two formations appear to have a gradational contact.

Two deep borings completed during the ESPA investigation penetrated the top of this unit at approximate elevation -336 ft. NAVD in the new plant location and at approximate elevation -368 ft. NAVD in the eastern portion of the PSEG Site. The thickness of the Woodbury Formation ranges from 30 to 36 ft. across the PSEG Site.

2.3.1.2.2.12 Merchantville Formation

The Merchantville Formation and overlying Woodbury Formation comprise an aquitard between the overlying Englishtown water-bearing zone and the underlying PRM. Sediments of the Merchantville Formation consist of greenish-black to black, glauconitic, silt and clay with trace to some fine sand, trace mica, and locally with trace friable to moderately indurated layers.

There are no site-specific hydraulic conductivity testing data available for the Merchantiville-Woodbury Confining Unit. This unit acts as a confining unit over the PRM aquifer and regionally, estimates of the vertical hydraulic conductivity range from 0.000004 to 0.0004 ft/d (Reference 2.3-71).

The Merchantville Formation consists of Upper Cretaceous age marine sediments deposited in a neritic environment during a marine transgression. The two deep borings advanced during the ESPA geological investigation penetrated the top of the Merchantville Formation at approximate elevation -372 ft. NAVD in the northern portion of the PSEG Site and at approximate elevation -398 ft. NAVD in the eastern portion of the PSEG Site. The unit is approximately 30 ft. thick.

2.3.1.2.2.13 Potomac-Raritan-Magothy Units

Hydrogeologically, the PRM formations are identified as a continuous water-bearing zone used as a primary potable water source at the PSEG Site as well as regionally. There are confining units between water-bearing zones, but for the purpose of this ESPA, the PRM is discussed as one unit.

The Magothy Formation disconformably overlies the Potomac Formation and consists of Upper Cretaceous age non-marine sediments deposited in deltaic to nearshore environments. Sediments of the Magothy Formation typically consist of gray to very dark gray, carbonaceous/lignitic clay and silt at the top of the formation, interbedded with sands with variable silt and clay content at the bottom of the formation. The two deep borings advanced

during the ESPA geological investigation penetrated the top of the Magothy Formation at approximate elevation -402 ft. NAVD in the northern portion of the PSEG Site, and in the eastern portion of the PSEG Site at approximate elevation -429 ft. NAVD. The unit ranges from 52 to 55 ft. thick.

For the purposes of this study, the Raritan Formation, although recognized as a distinct formation, is considered to be part of the Potomac Formation at the PSEG Site. However, hydrogeologically, the Upper Raritan aquifer provides good quality groundwater and is tapped by three production wells used by the HCGS (HC-1 and HC-2) and SGS (PW-5). Average production of these wells from 2002 to 2009 was 369 gallons per minute (gpm). The remaining deep production well at the PSEG Site, PW-6, is in the next deeper aquifer, the Middle PRM, but supplies only a small portion of the SGS's groundwater supply needs (less than 10 gpm average from 2002 to 2009) (Table 2.3-24).

The Middle Raritan Clay, 260 to 270 ft. thick, separates the Upper PRM from the Middle PRM. The Middle PRM is thinner (45 to 55 ft. thick) and generally has a lower transmissivity than the Upper PRM. However, transmissivity in the Upper PRM appears to vary more widely than in the Middle PRM. The Middle PRM supplies a relatively low percentage of the groundwater used at the SGS (Reference 2.3-8) (Table 2.3-9).

The Potomac Formation is the deepest stratigraphic unit encountered by the ESP borings at the PSEG Site. The Potomac Formation consists of Lower to Upper Cretaceous age non-marine, continentally derived sediments deposited in anastomising fluvial to deltaic environments (Reference 2.3-59). Two borings completed during the ESP investigation penetrated the top of the Potomac Formation. The top of the formation is at approximate elevation -454 ft. NAVD in the new plant location, and at approximate elevation -484 ft. NAVD in the eastern portion of the PSEG Site. These two borings are along a southeasterly line, approximately in the regional dip direction. The vertical elevation difference corresponds to an apparent southeasterly dip of approximately 34 ft/mi, (less than 1 percent). This is consistent with published range of dip for the NJ Coastal Plain. The top of the Potomac Formation is identified mainly from the geophysical testing conducted in the two deepest borings completed as part of the ESP.

2.3.1.2.3 Observation Well Data

Sixteen observation well pairs were installed in late 2008 through January 2009 to support this ESPA. Groundwater level data are used, in conjunction with existing data from the PSEG Site, to prepare groundwater potentiometric surface maps. The new wells were installed on both the northern portion of the PSEG Site, where the plant will be constructed, and on the eastern portion of the PSEG Site, which may be used as support and/or lay-down areas during construction. Well pairs installed on the new plant location are designated as NOW-1U (upper) and L (lower) through NOW-8U and L. Wells installed on the eastern portion of the PSEG Site are designated as EOW-1U and L, EOW-2U and L, and EOW-4U and L, EOW-5L and U, EOW-6L and U, EOW-8L and U through EOW-10L and U.

At each well pair, the lower or deeper well was installed within the Vincentown or lower Kirkwood aquifer. With the exception of EOW-4U, NOW-5U, and NOW-7U, the upper or shallow wells were installed within the Alluvium. Observation wells EOW-4U, and NOW-5U were installed in the hydraulic fill to assess the properties of the shallow hydraulic fill aquitard.

NOW-7U was installed in the Vincentown Formation just below the hydraulic fill as it was identified as the first adequate water-bearing zone encountered. Observation well construction details are summarized on Table 2.3-12.

Monthly water levels were measured at each observation well to collect sufficient data to characterize groundwater conditions at the PSEG Site, including seasonal fluctuations (Table 2.3-13). These data were then supplemented during the September sampling event with data from existing wells at the PSEG Site. The monthly water-level measurements are used to characterize groundwater flow directions, calculate hydraulic gradients, and ascertain seasonal variations in groundwater levels and flow directions in the two shallow water-bearing units. A 12-month data set, from January 2009 through December 2009, is presented in Table 2.3-13. In addition to the 12 months of data, historic, longer term data are available for some of the existing wells installed in the shallow Alluvium, as well as the Vincentown Formation and the PRM. These data are presented in Table 2.3-14.

Groundwater levels may be affected by precipitation to varying degrees, depending upon the hydrogeologic conditions (e.g. shallow unconfined or deep confined units). Figure 2.3-25 shows monthly precipitation data based on information gathered from the Delaware Environmental Monitoring System for Wilmington Delaware. The figure shows cumulative and monthly precipitation data for 2009 indicating low precipitation totals for fall and winter months and generally higher levels of precipitation in the spring and summer months.

Time series plots of all installed wells installed at the new plant location (north observation wells) and eastern location (east observation wells) are presented in Figures 2.3-26 and 2.3-27, respectively. Water levels for most wells in the each area are shown to be higher from May to October, a period of time that coincides with higher levels of precipitation in 2009. In general, water levels in wells such as NOW-2U, NOW-2L, and EOW-8U, which are located closer to the Delaware River, demonstrate a greater amount of variability due to tidal influences.

Groundwater quality data is presented in Subsection 2.3.3.2.

2.3.1.2.3.1 Alluvium

<u>North Observation Wells</u>

Six wells were screened in the alluvial (or riverbed) deposits that underlie the hydraulic fill. These materials represent the uppermost interval where groundwater transport is likely. As presented on Figure 2.3-28, the 2009 water-level measurements collected for the wells installed on the new plant location show slight seasonal variations with higher water levels in the summer months. These data also reflect slight tidal impacts. It is also clear that the observation well installed within the hydraulic fill, NOW-5U, represents perched conditions and is not as responsive to seasonal variation as the wells installed within the Alluvium.

Groundwater potentiometric contours were interpreted for each measuring event. Groundwater quality samples were collected on a quarterly basis during this period as well. The estimated potentiometric surface contours of the shallow water-bearing zone (Alluvium) are shown for each of the quarterly sampling events in 2009. Potentiometric contours, or groundwater flow directions, for February, April, July and September sampling events are

presented in Figures 2.3-29 through 2.3-32. Although the gradients are not corrected for tidal influences, groundwater flow is generally toward the Delaware River, with a slightly more northerly component during the summer months.

East Observation Wells

Seven wells were screened within the alluvial (or riverbed) deposits that underlie the hydraulic fill. As noted above, these materials represent the most likely interval for groundwater transport in the shallow system. Figure 2.3-33 shows the water-level data in the upper wells on the east location. There is less apparent seasonal variation when compared to new plant location data. This suggests that the north observation wells, which are in closer proximity to the river, exhibit a stronger tidal influence, or may have areas of thinning hydraulic fill. Observation well EOW-4U was screened in the hydraulic fill and therefore the groundwater level data from that location was not used in assessing groundwater flow within the Alluvium.

In addition to the water elevations, two wells within the east location intersected intervals of decomposing organic matter. It was noted during development that observation wells EOW-8U and EOW-10U were off-gassing methane and hydrogen sulfide and continued to off-gas through 2009.

Groundwater contours were interpreted for each round of sampling. During quarterly events, groundwater quality samples were also collected. The interpreted potentiometric surface contours of the shallow, water-bearing zone are shown for each of the quarterly events in 2009. Potentiometric surface contours, or groundwater flow directions, for February, April, July and September sampling events are presented in Figures 2.3-34 through 2.3-37. As noted above, groundwater elevations are not corrected for tidal effects. However, the upper water-bearing zone in the east location discharges to the tidal marsh to the east, and to the Delaware Estuary to the south. The estimated potentiometric surface contours show a groundwater divide in the vicinity of EOW-10U. This is consistent with local topography.

Groundwater gradients, hydraulic properties and tidal influences are discussed in Subsection 2.3.1.2.4.

2.3.1.2.3.2 Vincentown Formation

North Observation Wells

Nine wells were screened within the Vincentown or Vincentown-Kirkwood formations. As depicted on Figure 2.3-38, groundwater levels for these wells show more variation over time. This is most likely due to tidal influences. As noted in both previous studies (References 2.3-1 and 2.3-8), and Subsection 2.3.1.2.4, the overlying Kirkwood Formation is an aquitard creating semi-confining conditions. Additionally, the Vincentown Formation is in direct hydraulic communication with the Delaware River. Therefore, the tidal influences are seen with greater amplitude and farther eastward than as noted in the shallow water-bearing zone.

Groundwater contours were determined for each round of sampling. During quarterly events, groundwater quality samples were also collected. The estimated potentiometric surface contours for the deeper water-bearing zone (Lower Kirkwood and Vincentown formations) are shown for each of the quarterly events in 2009. Potentiometric surface contours, or

groundwater flow directions, for February, April, July and September sampling events are presented in Figures 2.3-39 through 2.3-42. Groundwater within the Vincentown aquifer flows west, toward the Delaware River.

East Observation Wells

Eight wells were screened in the Vincentown or Vincentown-Kirkwood boundary. As evident with the northern wells, and in Figure 2.3-43, monthly water-level fluctuations may be tidally influenced with water levels showing approximately 1-ft. variations between monthly measurements. However, due to the greater distance from the river, the magnitude of the tidal influence on water levels at the east location is expected to be markedly reduced.

Groundwater contours were interpreted for each round of sampling. During quarterly events, groundwater quality samples were also collected. The estimated potentiometric surface contours of the deeper water-bearing zone are shown for each of the quarterly events in 2009. Potentiometric surface contours, or groundwater flow directions, for February, April, July, and September sampling events are presented in Figures 2.3-44 through 2.3-47. Groundwater flow within the Vincentown aquifer is generally similar to that in the shallow aquifer and flows east and south.

2.3.1.2.3.3 Hydrogeologic Properties

Sixteen observation wells each were installed on the new plant and eastern locations to support the ESP application. Water-level measurements have been collected monthly to evaluate flow directions and hydraulic gradients. Additionally, hydraulic conductivity tests were conducted on the observation wells installed on the new plant location to calculate the estimated hydraulic conductivity of the alluvial or upper water-bearing zone, and the Vincentown or lower water-bearing zone. In addition to these activities, a limited tidal study was completed for two well pairs on the new plant location to better characterize the hydraulic communication between the Delaware River and the adjacent upper and lower water-bearing zones.

Hydraulic Gradients

The potentiometric surface of the groundwater in both the upper and lower water-bearing zones follows the regional and local topography and is relatively flat. Groundwater at the new plant location flows generally toward the Delaware River.

Depth to water measurements were collected from wells installed in the new plant location as well as the eastern location and the data used to characterize groundwater flow. During the September event, additional wells from SGS and HCGS were also measured to obtain a broader special distribution of data between the new plant and eastern locations.

Groundwater flow directions and hydraulic gradients were determined for each month by contouring the isopleths from the piezometric head elevations. These contours were established for each data set and average values. Average groundwater gradients in the upper water-bearing zone (or Alluvium) are calculated at 0.00042 feet per foot (ft/ft) in the new plant location, and 0.00188 ft/ft in the eastern location. Average groundwater gradients in the lower water-bearing zone (Vincentown Formation) are calculated at 0.00048 ft/ft in the new

plant location, and 0.00024 ft/ft in the eastern location. A summary of the calculated average gradients from fixed points (assumed to be parallel to flow) as well as measured gradients parallel to groundwater flow direction are presented in Table 2.3-15.

The shallow horizontal gradients in both water-bearing zones suggest that the overall groundwater velocity will be slow. When combined with the hydraulic conductivities discussed below, average groundwater velocities range from 0.0078 feet per day (ft/day) (2.9 feet per year [ft/yr]) to 0.0353 ft/day (12.9 ft/yr) in the upper water-bearing zone (Alluvium) and from 0.0046 ft/day (1.7 ft/yr) to 0.0091 ft/day (3.3 ft/yr) in the lower water-bearing zone (Vincentown Formation).

Vertical Gradients

Vertical gradients are calculated for each well pair. The vertical gradients for each round of water-level readings are shown in Table 2.3-16. In general, there is a slight downward gradient between the upper and lower water-bearing zones. However, because the lower unit is more strongly influenced by tidal fluctuations, these gradients do not significantly impact groundwater flow. The Kirkwood Formation, where present, acts as an aquitard between the two zones, further limiting the hydraulic communication between the two formations.

Hydraulic Conductivity

Hydraulic conductivity tests (commonly referred to as slug tests) were completed in all of the wells installed on the new plant location for this ESP. The data are evaluated using the Bouwer and Rice, Cooper et al., and Hvorslev methods to calculate hydraulic conductivity estimates (References 2.3-5, 2.3-7, and 2.3-32).

Based on all slug test results for the upper wells that are screened in the Alluvium, average hydraulic conductivity values in this unit are calculated to range from 0.4 to 8.0 ft/day. Calculated average hydraulic conductivity values for the lower wells that are screened in the Vincentown Formation (excluding NOW-7U) range from 0.3 to 10.7 ft/day. Unlike other wells screened in the Vincentown, NOW-7U may be hydraulically connected to the alluvial deposit. The average hydraulic conductivity value for observation well NOW-5U, which is screened in the hydraullic fill, is 0.2 ft/day. Average hydraulic conductivity values for individual wells, using all test data, are presented in Table 2.3-17.

Groundwater Velocity

Groundwater velocities are dependent on the hydraulic gradients and the hydraulic conductivity of the water bearing zone. Average horizontal travel times, or velocities in the upper alluvial aquifer are 0.0078 ft/day (2.9 ft/yr) in the new plant area and 0.353 ft/day (12.9 ft/yr) in the eastern locations. Average travel times for groundwater in the lower Vincentown aquifer range from 0.0091 ft/day (3.3 ft/yr) in the new plant location to 0.0046 ft/day (1.7 ft/yr) in the eastern location.

Based on the tidal fluctuations and minimal vertical gradients, the horizontal velocity groundwater is much greater than the vertical velocity making any vertical migration of groundwater insignificant with respect to partial or contaminant transport.

Tidal Influences

A 72-hr. tidal study was completed on observation wells NOW-1L and NOW-1U, and NOW-3L and NOW-3U. Similar to the findings from the studies conducted at the PSEG Site (Reference 2.3-1), a slight tidal influence was observed in the wells installed in the Alluvial deposits, or upper water-bearing zone. A stronger tidal influence was observed in the lower wells installed in the Vincentown Formation.

Observation wells NOW-3U and NOW-3L exhibited average tidal shifts of 0.56 ft. and 2.26 ft., respectively, over the course of the tidal study. The NOW-3 well pair is located approximately 170 ft. from the Delaware River. The NOW-1 pair is located approximately 723 ft. inland to the east. Observation well NOW-1L exhibited an average tidal shift of 0.49 ft. over the course of the tidal study. These data suggest the semi-confined condition of the Vincentown Formation results in an amplified response to tidal change. Both the upper and lower aquifers are in hydraulic communication with the Delaware River, but there is greater response in the wells screened in the lower aquifer. For both geological units, tidal influences dampen or decrease with distance from the river. The responses of the four wells, as compared to the stilling well installed at the barge slip, are presented in Figures 2.3-48 through 2.3-52. A summary of the tidal study is also presented on Table 2.3-18.

2.3.1.2.4 Hydraulic Communication Between Groundwater and Surface Water Bodies

Ten shallow piezometers were installed at depths ranging from 2 to 5 ft. below the bottoms of surface-water bodies at sampling locations AS-1 through AS-6, and AS-8 through AS-11. Each piezometer was constructed with a 1.5-ft. screen interval. These piezometers were used to collect data to characterize the hydraulic communication between the surface-water and underlying groundwater. Piezometer locations are shown on Figure 2.3-21.

Monthly water-level measurements were collected from the six piezometers installed at the PSEG Site. Measurements from the four piezometers installed off-site (AS-1 through AS-3 and AS-11) were collected quarterly. Water-level measurements and construction details are provided in Table 2.3-19.

Based on the data from each piezometer location, and when compared to the potentiometric surface of the water table, the surface-water bodies on-site and within the tidal marsh appear to be perched. There is no conclusive data that indicates that they are receiving bodies or that they recharge the underlying groundwater. It is interpreted that these surface-water bodies on-site and within the tidal marsh are perched on the silty hydraulic fill materials. The streams are strongly influenced by the tides whereas the ponds are relatively stagnant and are recharged by precipitation and stormwater runoff.

These data also indicate that the surface-water bodies do not strongly influence the groundwater flow within the Alluvium of the upper aquifer. Both the measurements from within the piezometers (representative of shallow groundwater) and outside the piezometers (representative of surface-water) are similar for the standing waters and do not correlate to the groundwater measurements collected from the observation wells screened in the upper alluvial deposits. In some of the tidal marshes (i.e. locations AS-4, 5, and 11) the difference between the surface water and groundwater are more pronounced due to the tidal impacts, however the data demonstrate that the shallow groundwater is perched and not in hydraulic

communication with the groundwater present in the Alluvium. These differences were also seen in the other piezometers installed in the tidal marshes (Locations AS-1, 2 and 3) although the differences are not as pronounced.

2.3.1.2.5 Summary

The PSEG Site is located in the NJ Coastal Plain. The regional geology and hydrogeology consists of southeasterly dipping sands and silts. The shallow aquifers beneath the PSEG Site, such as the alluvial deposits and Vincentown aquifer, are in direct contact with the Delaware River, are tidally influenced, saline, and are not considered adequate sources for potable water.

Observation wells were installed at the PSEG Site to better characterize the upper Alluvium as well as the underlying lower (Vincentown) aquifer. Hydrogeologic properties of these aquifers were determined by laboratory testing of soil samples as well as in-situ hydraulic conductivity tests.

Potentiometric contour maps generated from the PSEG Site data indicate that groundwater flow in these units is generally towards the Delaware Estuary, with localized influences from tides and the surrounding marsh. This is shown in the groundwater contours for the PSEG Site from the September data, (supplemented by HCGS and SGS well data) and presented in Figure 2.3-53. The tidal study indicated there is a stronger response to the tidal cycle in the lower (Vincentown) aquifer when compared the response in the shallow riverbed groundwater.

Average horizontal travel times, or velocities in the upper alluvial aquifer are 0.0087 ft/day (3.2 ft/yr) in the new plant area and 0.353 ft/day (12.9 ft/yr) in the eastern location. Average travel times for groundwater in the lower, Vincentown Aquifer, range from 0.0091 ft/day (3.3 ft/yr) in the new plant location to 0.0046 ft/day (1.7 ft/yr) in the eastern location.

The deeper aquifers, such as the Mount Laurel-Wenonah and PRM, are water supply aquifers. These water-bearing zones are also designated by USEPA as sole source. The Mount Laurel-Wenonah was used for water supply at the PSEG Site, but to avoid induced chloride migration from the overlying Vincentown aquifer pumping has been limited. HCGS and SGS currently withdraw water primarily from the PRM. The new plant withdraws groundwater for potable water and sanitary water systems as well as fire protection systems from the PRM. The site water balance (Figure 3.3-1) provides estimates of projected groundwater demand and is discussed further in Subsection 2.3.2.

2.3.1.3 Transmission Corridors

As summarized in Subsection 1.2.5, PSEG completed a conceptual evaluation during development of the ESP application to identify potential transmission requirements associated with the addition of generation at the PSEG Site. This evaluation included the PJM Regional Transmission Expansion Plan, existing operational limits at HCGS and SGS, and other PJM transmission planning inputs. PJM routinely performs analyses of the regional transmission system and forecasts appropriate upgrades to the system as part of its long-term planning cycle. These evaluations are not specific to the addition of new generation at the PSEG Site.

In order to capture the potential effects of developing off-site transmission, PSEG analyzed the potential effects of two new off-site macro-corridors during development of the ESP application. Information pertaining to alternative off-site transmission system corridors considered by PSEG is presented in Subsection 9.4.3. The two, 5-mi. wide macro-corridors analyzed are the South and West Macro-Corridors. The West Macro-Corridor (55 mi. long) generally follows existing transmission line corridors, extending from the PSEG Site to Peach Bottom Substation. The South Macro-Corridor (94 mi. long) also follows existing transmission line corridors and is generally consistent with the MAPP line that was preliminarily planned by PJM to extend from the PSEG Site to the Indian River Substation. Each of these macro-corridors was developed with a common segment. From the PSEG Site, the hypothetical macro-corridor extends north and then west across the Delaware River to the Red Lion Substation. From this location, the potential macro-corridors diverge extending to the west (Peach Bottom) or south (Indian River).

Based on GIS analysis the South Macro-Corridor contains a total of 1697 mi. of linear surface water features (perennial and intermittent streams, channelized waterways). In comparison, the West Macro-Corridor contains a total of 970 mi. of linear surface water features. Perennial streams and channelized waterways represent the majority of the surface water types crossed in each macro-corridor. Additionally, each macro-corridor follows a common alignment from the PSEG Site to the Red Lion Substation (Figure 2.2-6). Consequently, each macro-corridor crosses the Delaware River.

Additional discussion regarding potential off-site transmission and its potential impact is provided in Chapter 4 (Impacts of Construction), Chapter 5 (Impacts of Station Operation) and Chapter 9 (Alternatives).

2.3.2 WATER USE

This subsection describes surface water and groundwater uses that could affect or be affected by the construction and operation of an additional generating plant at the PSEG Site on Artificial Island. Descriptions of the types of consumptive and non-consumptive water uses, identification of their locations, and quantification of water withdrawals and returns are included. Water use, for the purposes of this subsection is broadly defined, encompassing human water supply needs for drinking and domestic uses, industrial uses, and agricultural uses. It also includes instream uses that do not involve water diversion such as navigation, recreation, and aquatic habitat needs that are based on water quality.

With 15 million people utilizing water supplied from the Delaware River Basin, along with in-stream flow needs for maintenance of aquatic habitats and water quality, water use is an important issue in this 13,600-sq. mi. watershed. The location of the new plant along the brackish waters of the Delaware River Estuary minimizes the potential impact on potable water supplies within the watershed. There are on-going programs and projects through the DRBC and other federal, state, and local agencies focused on assessing existing and future water uses and the capability of the system to meet those needs. Basin-wide, 92 percent of the water used (potable and non-potable) comes from surface water sources. Surface storage reservoirs, improved operational plans for reservoirs, water conservation planning/controls, and many other infrastructure and operational approaches have been applied at various locations to manage water use in the watershed. Groundwater resources comprise a relatively small percentage of the overall water volume used, providing 36 percent of the potable water

used in the basin. Measures to expand use of the groundwater resources are being considered in addition to surface water improvements, including options such as aquifer-storage and recovery facilities and desalination of brackish sources. (Reference 2.3-21)

The DRBC was created in 1961 to manage the Delaware River Basin due to the importance of the resource, the numerous and sometimes competing water uses, and the varying needs in the four states that comprise the watershed. The DRBC developed a water use permitting program, developed a water use database, and conducts activities to update and better understand the status of water use in the basin. The DRBC, consequently, is the most comprehensive information source for overall water use in the basin. In addition to the DRBC, the USACE Philadelphia District has an active role in addressing the multi-jurisdictional use and management of the water resources for the Delaware River Basin.

The drought in the early 1960s remains the drought of record. However, less severe, but more geographically limited, droughts have continued to periodically raise concerns about water supply for users within and outside the Delaware River Basin.

The DRBC has summarized detailed basin-wide and regional water use information in an agency report (Reference 2.3-19). In the 2008 *State of the Delaware River Basin Report* (Reference 2.3-14), the DRBC stated that from an overall basin perspective, the basin is in good condition with regard to water use, with human needs being met and other instream needs being studied. Water use is described as stable with multiple potable supply sources available in many areas. Water use efficiency is rated as fair, with indications that better tracking methods and data are needed and that improvements, such as decreasing consumptive uses in some regions, are desirable.

Natural Estuary habitat depends on a freshwater flow that creates a brackish water transition from fresh water habitat to sea water habitat. Water supply intakes located near the upstream boundary of the brackish water zone depend on freshwater inflows to limit the upstream movement of salt water. The PSEG Site is located within the brackish water zone near the boundary between the Delaware Bay Region, the most downstream of the 10 water supply regions defined by the DRBC and the Lower Estuary Region. A summary of historic and projected water withdrawals through 2040 for the Lower Estuary and Bay Regions is provided in Table 2.3-20. The table includes both surface water and groundwater withdrawal data. According to those projections, most of the water diverted for out-of-stream uses is returned to the surface water system. The portion that does not return is the consumptive use fraction. The peak month withdrawal and consumptive uses by sector for successive dry (1995) and wet (1996) years are presented in Table 2.3-21. Consumptive uses are presented in Table 2.3-23 and discussed in more detail below.

The largest water use in the Delaware River system is the thermoelectric power generation sector (Reference 2.3-14). On a basin-wide basis, this sector used 71 percent of the total tracked water withdrawn (peak value, Table 2.3-23). Comparatively, the thermoelectric power generation sector has a low consumptive loss rate (1.6 percent). In the same time period, public water supply accounted for approximately 11 percent of the tracked water use, and 2.3 percent of the public water supply withdrawal was lost to consumptive use.

The PSEG Site is located adjacent to the Delaware Estuary at a point where the water is brackish. This location results in two important conditions: (1) the quantity of surface water available to the site purely on the basis of volume is extremely large because of the water

connection to the ocean, and (2) the surface water available locally is brackish. At this location, water supply problems that exist in the upstream non-tidal portions of the Delaware River and tributaries are not applicable at this site.

2.3.2.1 Regional Surface Water Use

Based on DRBC statistics, 92 percent of the water withdrawn for use in the region is from surface water. For potable water uses, 64 percent is from surface water sources. The distribution of sources and uses vary with location in the watershed. In the lower basin, surface water use is high. Water use information is lacking in some areas, including estimates of irrigation, and particularly agricultural irrigation water use. Water use data is not consistently reported by the various states.

In the last several years, significant effort has been made in the area of water conservation, drought planning, reservoir operations, and water supply infrastructure. Since the drought event in 1999, over 2 billion gal. of water storage capacity has been planned or implemented in New Castle County, DE. During the past decade, water demand in northern DE decreased by approximately 10 percent, which has been attributed to implementation of water conservation measures. (Reference 2.3-14)

The PSEG Site is located on the Delaware River, 52 mi. upstream from the mouth of the Delaware Bay. The Delaware Estuary, or tidally influenced waters, extends to RM 134. At the PSEG Site, the Delaware River water is brackish with an average salinity varying seasonally from 4 ppt during the spring and 8 ppt in the late summer while ranging up to 20 ppt (ocean water has a salinity of approximately 35 ppt). The salinity is maintained in this range by the cyclic, time-varying balance between freshwater inflows upstream and near the PSEG Site in combination with the tidal ebb and flood conditions. The salt line, defined by the DRBC as the location where the 7-day average chloride concentration equals 250 ppm in the tidal Delaware River, normally fluctuates and is located between RM 54 and RM 82. The furthest recorded upstream advance of the salt line was to RM 102 during the drought of record in the early 1960s. Philadelphia, PA uses water from the Delaware River and has intakes upstream of RM 100. Downstream of the salt line, use of surface water from the Delaware River is limited to uses that are compatible with the brackish condition, such as cooling water for industrial and electrical power generation facilities.

Freshwater inflows to the Estuary, which include submarine groundwater discharges, affect the upstream intrusion of salt water. Variations in freshwater inflows and the semidiurnal tides create a continual movement of the salt line (Subsection 2.3.1.1.1). The need to maintain a minimum freshwater flow in the Delaware River to control the upstream advance of salt water is an important regional issue. This need, along with general water supply needs, has resulted in the construction of reservoirs on tributaries to the Delaware River to store water for use and to release during drought periods to maintain a minimum streamflow. These reservoirs are summarized in Table 2.3-22 (Reference 2.3-19). Currently, the operational criteria for this reservoir system include an objective of maintaining a minimum streamflow of 3000 cfs in the Delaware River at Trenton, NJ. The Delaware River Master is responsible for coordinating reservoir operations to meet the minimum flow targets (References 2.3-14, 2.3-18, and 2.3-81). Based on monitoring of streamflow at Trenton, NJ, the reservoir system and operations plans have increased minimum streamflows at that location in the last 30 to 40 yr as compared with low flows that occurred prior to 1970. Streamflow records and statistics for the

USGS Delaware River at Trenton, NJ streamflow gaging station are discussed in greater detail in Subsection 2.3.1.1. Discussion and studies are ongoing to develop an improved approach to operating the reservoir system to best meet the salinity intrusion concern and other water supply and instream flow needs.

Power generation sector facilities located in the Delaware River watershed are summarized in Table 2.3-23. The DRBC has developed an equivalent impact factor (EIF) to tie downstream consumption to upstream movement of the salt line (Reference 2.3-19). DRBC has determined that consumptive use downstream of RM 38 has no discernable effect on chloride movement. However, between RM 38 and 92.4 an EIF curve has been developed to reflect the impact of consumptive use on salinity upstream of RM 92.4. The DRBC site specific EIF used for the PSEG Site is 0.18 (Subsection 5.2.1).

Waters of the United States are classified under the Clean Water Act with respect to their ability to support their designated uses. Each state establishes the designated uses for rivers and streams within that state. The DRBC summarized information from the four states in the Delaware River watershed and determined that 37 percent of the stream river miles in the Delaware River basin do not fully support their designated uses. Delaware Estuary waters in Zone 5 (RM 48.2 to RM 78.8 which includes the Estuary at the PSEG Site), does not support designated uses related to aquatic life and fish consumption (Reference 2.3-20). In Zone 5, low dissolved oxygen concentrations were the major reason for impairment to aquatic life. Polychlorinated biphenyls (PCBs) and mercury contaminants were identified as the major contributor to the impaired use for fish consumption.

2.3.2.1.1 Surface Water Use in the Vicinity

Surface water bodies within the 6-mi. vicinity of the PSEG Site include the Delaware River and several small tributaries. The tributaries in the vicinity include Alloway Creek and Hope Creek on the east bank of the Delaware River in NJ. The major consumptive users of surface water within the 6-mi. vicinity of the PSEG Site are HCGS and SGS.

The Delaware River within a 6-mi. radius of the PSEG Site (Delaware Bay and the tidal reach of the Delaware River) is included in the National Estuary Program. This stretch of the Delaware River serves the largest freshwater port in the world, the Delaware River Port Complex, which has docking facilities in Pennsylvania, NJ and DE. (Reference 2.3-23)

2.3.2.1.2 Surface Water Use at the PSEG Site

As discussed in Subsection 2.1.1, the HCGS has a closed-cycle cooling system equipped with a natural draft cooling tower and associated withdrawal, circulation, and discharge facilities. The HCGS intake withdraws an average of 67 Mgd from the Delaware River. PSEG is authorized by the DRBC for withdrawal and consumptive use by HCGS of groundwater and brackish water from the Delaware Estuary. Some of this water use is a consumptive use as the diverted water is needed to replace water evaporated in the CWS.

PSEG has an NJPDES permit for the SGS that limits intake flow from the Delaware Estuary to a 30-day average of 3024 Mgd of circulating water. PSEG is authorized by the DRBC for withdrawal and consumptive use by SGS of groundwater and brackish water from the Delaware Estuary. Excepting limited consumptive use in the CWS, this SGS water use is

physically only a withdrawal, as essentially all of the diverted flow is returned to the river and not lost volume to the river.

2.3.2.2 Regional Groundwater Use

The NJ Coastal Plain region is underlain by an interbedded sequence of sands and silts that compose a series of aquifers, aquitards, and aquicludes of Quaternary, Tertiary, and Cretaceous ages (Reference 2.3-90) (Subsection 2.3.1.2). Within the Coastal Plain Region these beds generally thicken seaward and dip gently to the southeast between 10 and 60 ft/mi. As discussed in Subsection 2.3.1.2, groundwater occurs in four primary water bearing aquifers beneath the region.

Aquifers are recharged at areas where they outcrop at the surface generally in the vicinity of, or southeast of, the Fall Line (near the NJ western border), from adjacent aquifers through leaky aquitards, and/or through surface water interactions with groundwater. At the PSEG Site, the two shallow water bearing zones are in direct hydraulic communication with the Delaware River.

The primary aquifers in the region are the shallow water-bearing zone and three aquifers: (1) the Vincentown aquifer; (2) the Mount Laurel-Wenonah aquifer; and (3) the PRM aquifer. As described in Subsection 2.3.1, the PRM is a significant, potable groundwater resource regionally. The nearest public supply wells that withdraw from the PRM are located across the Delaware River in DE, and over 5 mi. to the northeast in Salem, NJ.

In 1986, NJ designated two Critical Water-Supply Management Areas in the NJ Coastal Plain in response to long-term declines in groundwater levels where groundwater is the primary water supply. Critical Water-Supply Management Area 1 includes portions of Middlesex, Monmouth, and Ocean counties along the Atlantic Ocean shore. Critical Water-Supply Management Area 2, the nearer Critical Water-Supply Management Area, is northeast of the PSEG Site in portions of Ocean, Burlington, Camden, Atlantic, Gloucester, and Cumberland counties, and a small portion of eastern Salem County. In Critical Water-Supply Management Area 2, groundwater withdrawals were reduced and new allocations limited from the PRM Aquifer. The PSEG Site is southwest of this management area, along the Delaware River, not in a Critical Water-Supply Management Area, and is not subject to the groundwater withdrawal restrictions that are associated with these areas (Reference 2.3-24). As described in Subsection 2.3.1.2, regional aquifers within the NJ Coastal Plain have been designated sole source aquifers by the USEPA (Reference 2.3-65).

Public Water Supply Wells in NJ and wellhead protection areas in NJ and DE within a 25-mi. radius of the PSEG Site are shown on Figure 2.3-20. Available withdrawal rates and well depth information for selected wells that do not fall within wellhead protection areas but are within 25 mi. of the PSEG Site and in NJ and DE are listed in Table 2.3-10. Detailed well information for wells located in wellhead protection areas is not published by DNREC or NJDEP.

2.3.2.2.1 Groundwater Use in the Vicinity

There are no off-site public water supply wells or private wells within 2 mi. of the PSEG Site. The nearest public potable supply wells are three wellhead protection areas that range from 2.9 to 3.6 miles to the west and northwest in New Castle County, Delaware (Figure 2.3-20).

The discussion of local public water use is based on information in Subsection 2.5.2.9.1 and is limited to Salem County and the adjacent counties of Gloucester and Cumberland in NJ and New Castle County in Delaware. Groundwater is the primary source for public water systems in these southern NJ counties. In New Castle County, DE, approximately one quarter of the public water is obtained from a groundwater supply. Groundwater management provisions in the region focus on protecting the lower Mount Laurel-Wenonah and PRM aquifers. Table 2.3-11 lists the major groundwater users (permitted for over 100,000 gpd) in Salem, Gloucester and Cumberland counties. (Reference 2.3-72)

2.3.2.2.1.1 Salem County, New Jersey

Salem County is served by 15 public water systems. In addition to the large public systems, there are some small private systems that serve individual communities such as mobile home parks. Public water systems serve approximately 41,700 persons. Water systems serving the largest populations are Penns Grove Water Supply (14,400 persons served in Salem and Gloucester counties) and the Pennsville Water Department (13,500 persons served). The sources for these systems are primarily groundwater. The total withdrawal of fresh water for public supply in Salem County is 4.42 Mgd (79 percent from groundwater and 21 percent from surface sources) (Reference 2.3-55).

The Penns Grove Water Supply is at 75 percent of capacity. In order to provide additional storage capacity, Carneys Point Township, which receives water from Penns Grove Water Supply, has secured federal and state grants for the Penns Grove Water Supply to construct an additional 500,000 gal. storage tank. The Penns Grove Water Supply Company has requested additional permitted capacity from NJDEP to meet the projected demand.
The NJDEP has designated Salem County an emergency drinking water supply source for the state in its state Water Supply Plan. According to the plan, Salem County is an emergency drinking water supply source for the western metropolitan areas during drought conditions (Reference 2.3-55). This is likely due to the greater storage capacity or potential yield of the aquifer in Salem County as it can be used when other sources are no longer adequate to meet supply demands during droughts. The greater capacity of the aquifer near the PSEG Site further suggests that the increased demand of the new plant can be provided by the PRM aquifer.

2.3.2.2.1.2 Cumberland County, New Jersey

Cumberland County is served primarily by public water systems and some small private systems that serve individual communities such as mobile home parks. Public water systems serve approximately 83,300 persons. Water systems serving the largest populations are Vineland Water & Sewer Utility (33,000 persons served), the Millville Water Department (27,500 persons), and the Bridgeton Water Department (22,770 persons). The sources for these systems are primarily groundwater.

2.3.2.2.1.3 Gloucester County, New Jersey

Gloucester County has 32 public water systems. In addition to the large public systems, there are some small private systems that serve individual communities such as mobile home parks and campgrounds. Public water systems serve approximately 220,450 persons. Water systems serving the largest populations are Washington Municipal Utilities Authority (MUA) (48,000 persons served), the Monroe MUA (26,150 persons served), the Deptford MUA (26,000 persons), and the West Deptford Water Department (20,000 persons). The sources for these systems are primarily groundwater, with the exception of the Deptford MUA, which uses purchased surface water.

2.3.2.2.1.4 New Castle County, Delaware

Seventy-five percent of drinking water in New Castle County comes from surface water sources, and 25 percent is from groundwater. New Castle County is served by three privately owned water utilities and four city-owned water utilities. Public and private water systems serve approximately 542,400 persons. The sources for these systems are ground and surface water.

2.3.2.2.2 Groundwater Use at the PSEG Site

PSEG has authorization from the NJDEP (Reference 2.3-40) and DRBC (Reference 2.3-16) for consumptive use of up to 43.2 million gal. of groundwater per month at the HCGS and SGS combined. The discussion of groundwater in this section includes use at both the HCGS and SGS for the following reasons.

- NJDEP issued a single permit for SGS and HCGS combined. Although each station uses its own wells and there are individual pumping limits for each station's wells, the permit limits are combined. The current permit allows a combined maximum diversion rate for HCGS and SGS of 2900 gpm and limits of actual water diverted to 43.2 million gal. per month (Mgm) and 300 Mgy. The groundwater pumping limit per well, based on the January 1, 2005 permit, is indicated in Table 2.3-24. This limit is consistent with the docket authorization issued by DRBC for groundwater withdrawal (Reference 2.3-16).

- The groundwater distribution systems for HCGS and SGS are interconnected in order to transfer water between the stations, if needed.

Groundwater is the only source of fresh water at the HCGS and SGS. Both stations use fresh water for potable, industrial process make-up, fire protection, and sanitary purposes.

HCGS derives groundwater from two production wells (HC-1 and HC-2) installed to depths of 816 ft. in the Upper Raritan Formation of the PRM Aquifer (Reference 2.3-40). The wells supply two 350,000-gal. storage tanks. Of the total volume, 656,000 gal. of water are reserved for fire protection; the remainder is for potable, sanitary, and industrial purposes including demineralized makeup water.

Groundwater at SGS is withdrawn primarily from two production wells, PW-5 and PW-6, which are installed to depths of 840 ft. and 1,135 ft., respectively, in the Upper and Middle Raritan Formations of the PRM Aquifer. The SGS also has the capability of using two shallower wells,

PW-2 and PW-3, currently classified as stand-by wells by NJDEP (Reference 2.3-40). These wells are installed to depths of 281 ft. and 293 ft., respectively, in the Mount Laurel-Wenonah Aquifer (Reference 2.3-44). The wells supply two 350,000-gal. storage tanks. Of the total volume, 600,000 gal. of water are reserved for fire protection; the remainder is for potable, sanitary, and industrial purposes including demineralized makeup water.

Groundwater Usage

PSEG has authorization from the NJDEP (Reference 2.3-40) and DRBC (Reference 2.3-16) for consumptive use of up to 43.2 million gallons of ground water per month at SGS and HCGS combined. Average production of the primary wells (HC-1, HC-2 and PW-5 from 2002 to 2009 was 369 gallons per minute (gpm). The remaining deep production well, PW-6, is in the next deeper aquifer, the Middle PRM, but supplies a small portion of the SGS's groundwater supply needs (less than 10 gpm average from 2002 to 2009) (Table 2.3-24).

Groundwater elevations were measured during a groundwater study in 1987 by Dames & Moore (Reference 2.3-8) in the shallow alluvial deposit aquifer, the Vincentown Aquifer, the Mount Laurel-Wenonah Aquifer, and the Upper and Middle Raritan Formations of the PRM Aquifer. The groundwater elevation ranges measured for these aquifers are indicated in Table 2.3-13. Of the four primary HCGS/SGS wells, three (PW-5, HC-1, and HC-2) are installed in the Upper Raritan Formation. The fourth (PW-6) is installed in the Middle Raritan Formation.

The groundwater elevation ranges measured in PW-6 (in the Middle Raritan Formation) in 2002, 2003, 2005, 2006, 2007, and 2008 are higher than the elevation recorded in 1987; the ranges of elevations recorded from PW-6 in 2000, 2001 and 2004 bracket the elevation recorded in 1987. These data suggest that the groundwater level in the Middle Raritan formation has remained fairly constant.

The PRM is an important aquifer extending from Mercer and Middlesex counties in NJ to the north and southward into and beyond DE. It is subject to numerous pumping influences (Reference 2.3-42). In 8 of 9 years from 2000 to 2008, the ranges of elevations monitored in wells PW-5, HC-1 and HC-2 in the Upper Raritan Formation bracketed the 1987 data (i.e., were both higher and lower). In 2005, the range was lower than was measured in 1987. Elevation ranges in individual wells and between wells are highly variable. The ranges exhibit a consistent pattern of high variability.

The groundwater demand placed on the PRM has resulted in a decrease in the elevation of the piezometric surface that has been historically observed in the counties of Camden, Middlesex, and Monmouth (Reference 2.3-70). The development of these piezometric surface reductions was observed in wells completed in the middle and lower aquifers between 1973 and 1978. The declines may have been a result of an increase in the amount of extraction from the lower aquifer which began in approximately 1973. Coincident cones of depression in the upper and middle/lower PRM suggest that significant communication occurs between these aquifers (Reference 2.3-70). Furthermore PRM aquifer withdrawals in Camden County have been previously shown to influence water levels at significant lateral distances resulting in water level reductions in Salem and Gloucester counties (Reference 2.3-70).

Groundwater withdrawals in central and southern NJ increased from 1904 to a peak in the mid/late 1970s. They then dropped off precipitously in the mid 1980s (References 2.3-70 and 2.3-89). A slower rate of declining withdrawals continued until 1995 (Reference 2.3-89). Water levels in lower PRM observation wells located in NJ and DE generally increased during the period from the mid-1980s to the late 1990s, as documented by the USGS (Reference 2.3-85). Decreased consumptive use and greater controls on water withdrawals by NJ in favor of surface water withdrawals allowed water levels in the PRM to recover in central NJ from the over-pumping of the 1970s (Reference 2.3-89).

Station pumping wells completed in the PRM have exhibited relatively stable to slightly decreasing water levels during the period 2000 to 2008. A study by the USGS clearly shows that the pumping centers north of the C&D Canal influence water levels in the lower PRM in the Artificial Island vicinity. The interconnected nature of the lower and middle units of the PRM in conjunction with this study suggest that water levels in the middle PRM are influenced by and related to water levels in the lower PRM (Reference 2.3-84). A more recent USGS study (Reference 2.3-88) indicates that DE withdrawals from the middle and lower PRM had increased as of 2003. This appears to have resulted in reduced regional water levels in this area of the lower PRM. These effects continued to influence water levels at Artificial Island in both the lower and middle units of the PRM. Water level monitoring at the station is consistent with the regional water level changes resulting from the increased withdrawals in DE (Reference 2.3-88).

The information described above suggests that the observed decrease in water levels in observation wells located at the PSEG Site is part of a larger regional trend rather than a result of station-related withdrawals. This is supported by data documenting increased water withdrawals in southern New Castle County, DE and water level maps prepared by the USGS as part of a long-term groundwater monitoring program. The PSEG Site is not included in either the Southeastern Pennsylvania Ground Water Protected Area, or a NJ Critical Area, and the DRBC monitors these regional groundwater sources (Reference 2.3-23).

2.3.3 WATER QUALITY

2.3.3.1 Surface Water

The new plant withdraws makeup water from the Delaware River through a new intake structure located upstream of the existing HCGS and SGS intake structures (Section 3.4). All surface water discharge from the new plant, including cooling tower blowdown, is discharged to the Delaware River via a new discharge structure constructed upstream from the HCGS and SGS discharge structures. As described in Subsection 2.3.1, the Delaware River is the predominant water body in the region.

The NJDEP and the DRBC monitor water quality of the Delaware River. Additionally, the USGS measures river stage and water quality at several gauging stations along the River, with the location of the new plant identified as RM 52. The Delaware River is a significant regional water resource that borders NJ, DE, PA, and NY. There is extensive historic and on-going data collection and analysis covering a wide range of water quality and ecological conditions in the river.

The DRBC has documented Delaware Estuary water quality in various reports. A summary of monitoring in the Delaware Estuary for the years 1999 through 2003 (Reference 2.3-15) provides one of the most comprehensive summaries of DRBC monitoring efforts. A total maximum daily load (TMDL) study for the Estuary resulted in a program to address PCBs (References 2.3-14 and 2.3-17). Dissolved oxygen has been historically identified as a water quality parameter of concern. However, there is uncertainty regarding the effects of natural conditions on dissolved oxygen, versus the potential impacts of human activities (Reference 2.3-14).

In addition to the DRBC and the NJDEP, the USACE has collected water quality data for various purposes. One of the most recent efforts was related to the proposed navigation channel deepening (Reference 2.3-63).

The Delaware River near Philadelphia is not brackish, and has long been a major public water supply source. One of the historical water quality concerns is salinity intrusion, or the most upstream advance of the salt line. The salt line location has been monitored and studied extensively over the years with regard to how various natural and human activities affect salinity and water quality in general.

Water quality in the Delaware River at the PSEG Site is the integrated result of a complex system. The PSEG Site is located where the hydrodynamic conditions associated with tidal flows and salinity combine to result in relatively low primary biological productivity and relatively high turbidity. This location is also referred to as the turbidity maxima in the Estuary.

River water quality near the PSEG Site is affected not only by the ebb and flow of the tidal river, but also by circulation in the water body resulting from winds, complex hydrodynamic conditions associated with tides, and other physical conditions. Salinity and water temperature have been documented to vary across the 2.5 mi. wide river near the PSEG Site, in part due to the horizontal variation in depths in the transverse section where depths range from the 40-ft. deep navigation channel to the shallower waters along the shore.

Surface water samples were collected quarterly from 11 locations on the PSEG Site and from the near-by water bodies. Samples were collected from the Delaware River, from the artificial ponds at the new plant location, from the marsh creeks from Hope Creek and Alloway Creek. Sampling locations are shown on Figure 2.3-15.

Samples were collected and submitted to Test America of Shelton, Connecticut for the analyses recommended in NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan*, including:

- Suspended solids
- Total dissolved solids
- Hardness
- Biochemical oxygen demand
- Chemical oxygen demand
- Phosphorus
- Nitrogen forms
- Alkalinity
- Chlorides

- Selected inorganics (calcium, sodium, potassium, magnesium, lead and mercury)
- Coliform
- Phytoplankton

Field parameters were also measured for temperature, dissolved oxygen, salinity, color, turbidity, pH and specific conductance. Samples were submitted for off-site laboratory analysis of tritium to an outside independent laboratory (Test America, Inc.). A summary of the data is presented on Tables 2.3-25, 2.3-26, and 2.3-27 and is discussed below.

Delaware River Locations

One Delaware River surface water sample location, AS-8, was sampled quarterly. A summary of the data is shown in Table 2.3-25 and these data show that the water is of poor to moderate quality. Salinity ranged from 4 to 14 ppt; coliform was present in each round of data ranging from low (6 colony forming units [CFUs]) to too numerous to count (TNTC). For the inorganic metals, calcium, lead, magnesium, potassium, sodium and zinc were detected in each round of data. Mercury was not detected in any of the samples. Tritium was not detected in any of the samples collected from location AS-8.

Artificial Ponds

As noted above, there are several shallow artificial ponds at the PSEG Site. Surface water samples were collected quarterly from locations AS-4, AS-9 and AS-14 and the analytical data summarized on Table 2.3-26.

As these ponds are not in direct communication with the Delaware River, but are perched on the hydraulic fill, the salinity ranges from 1 ppt to 2 ppt while the temperature ranged from 3°C to 29°C. Total coliform ranged from 13 CFU to TNTC. The fecal coliform results were much lower (maximum result of 101 CFUs). For the inorganic data, calcium, magnesium, potassium and sodium were detected in all samples collected with lead and zinc detected in ten of the 15 samples collected (total sample number included duplicate samples). Mercury was not detected in any samples.

Tritium was reported in one of the samples collected from AS-4. The reported concentration was below the laboratory reporting limit and the value was qualified as being within the uncertainties range provided by the lab. Tritium was not detected in subsequent rounds, and it is likely that the detection represents a laboratory false positive. This is supported by the fact that these samples are not located within a migration pathway that could be from a potential tritium source such as HCGS or SGS.

Marsh Locations

Seven sampling locations (AS-1, AS- 2, AS- 3, AS-5, AS-6, AS-10, and AS-11) were located within the tidal marshes located on and around the PSEG Site. A summary of the data are presented on Table 2.3-27. Similar to the data from the Delaware River, coliform results ranged from low levels (1 CFU) to TNTC. Temperature measurements collected in the field ranged from 2°C to 27°C and are similar to the artificial ponds.

For the inorganic samples from the marsh locations, calcium magnesium, potassium, sodium, and zinc were reported in all samples. Lead was detected in 26 of the 29 samples, with an average concentration of 0.004 mg/L. Mercury was not detected in any samples collected from the marsh locations.

Tritium was reported during one event at AS-10. Similar to the detection reported at AS-4, the reported concentration at AS-10 was below the laboratory reporting limit and the value was qualified as being within the uncertainties range provided by the lab. Tritium was detected in the subsequent rounds, and it is likely that the detection represents a laboratory false positive. This is supported by the fact that these samples are not located within a migration pathway that could be from a potential tritium source such as HCGS or SGS.

2.3.3.2 Groundwater

2.3.3.2.1 Regional Groundwater Quality

Groundwater quality in the shallow aquifers and water bearing zones is poor. They are saline and not suitable for potable water. As noted in Subsection 2.3.2, the deeper aquifers, including the Mount Laurel-Wenonah and the PRM are used as potable sources and are designated by USEPA as sole source aquifers. The two shallow water bearing zones, the alluvial deposits and the Vincentown Formations are the ones most likely to be impacted by construction. The PRM aquifer will be used for groundwater withdrawals during new plant construction and operation.

2.3.3.2.2 Local Groundwater Quality

As described in Subsection 2.3.1, there are several aquifers or water bearing zones located below the PSEG Site. The shallow aquifers, the Alluvium and the Vincentown Aquifer, are both saline and are considered of poor quality. Alternatively the deeper underlying Mount Laurel-Wenonah and PRM aquifer are of higher quality and are sources of potable water. They are also considered sole source aquifers as designated by the USEPA.
As the shallow aquifers are the most likely to be impacted from construction activities as well as ongoing operations, eight well pairs were installed in both the new plant and eastern locations. With the exception of two locations (EOW-4U, and NOW-5U) each well pair was designed to characterize groundwater in the upper or Alluvium and the lower or Vincentown Formation. Observation wells EOW-4U and NOW-5U were installed above the Alluvium, within the hydraulic fill. At these locations, the groundwater is perched and not in direct hydraulic communication with the underlying aquifer.

Groundwater samples were collected using Low Flow/Low Stress sampling methods. (Reference 2.3-66). For 2009, samples were collected quarterly from each location and submitted to Test America Laboratories. The locations of these observation wells on the new plant and eastern locations are shown on Figure 2.3-21.

Samples were collected and submitted to Test America of Shelton, Connecticut for the analyses recommended in NUREG-1555, including:

- Suspended solids
- Total dissolved solids

- Hardness as calcium carbonate ($CaCO_3$)
- Biochemical oxygen demand
- Chemical oxygen demand
- Phosphorus
- Nitrogen forms
- Alkalinity
- Chlorides
- Selected Inorganics (calcium, iron, sodium, potassium, magnesium, lead and mercury)
- Coliform
- Carbon dioxide
- Silica

Field parameters were also measured for temperature, dissolved oxygen, salinity, color, turbidity, pH and specific conductance. Samples were also submitted for analysis of tritium to an off-site independent laboratory (Test America, Inc.). A summary of the data is presented on Tables 2.3-28 through 2.3-31.

The data show that the groundwater in both the Vincentown and Alluvium aquifers is saline and is not considered suitable for drinking water at the PSEG Site. The deeper Mount Lauren-Wenonah and PRM aquifers are suitable potable water sources and are protected by USEPA as sole-source aquifers. However, these aquifers are located below several aquitards and are therefore not characterized for water quality.

<u>Hydraulic Fill</u>

Two observation wells (EOW-4U and NOW-5U) were screened within the Hydraulic Fill. In general the water quality within the hydraulic fill is consistent with the underlying Alluvium, with the following exceptions. Total coliform was only detected at a 22 CFU in one round from EOW-4U, however total coliform counts at NOW-5U ranged from TNTC in the first two rounds to very low numbers in the summer and fall events. Fecal coliform was not detected in any sample at these locations.
For inorganics, naturally occurring calcium, iron, magnesium potassium and sodium were detected in each of the locations at concentrations consistent with water samples from the wells screened within the underlying alluvium. Most of the detected inorganics exceed the NJDEP drinking water standards. Mercury was detected during the July sampling event at an estimated value of 0.00014 mg/L at EOW 4U. Lead was detected at an estimated concentration of 0.0015 mg/L during the same July sampling event at observation well EOW-4U.

Groundwater within the hydraulic fill is saline, with elevated specific conductance and turbidity and relatively neutral pH levels ranging from 6.6 to 7.3. One round of sampling indicated an elevated pH of 10.4. This reading is suspect as it was not consistent with the other rounds and represents the highest reading for samples collected from the upper wells. This data corresponds to the round of sampling where mercury and lead were detected in groundwater suggesting that the elevated pH, or the source/cause of the elevated pH may have affected the reported metal concentrations.

No tritium was detected in samples collected from either of the wells screened within the hydraulic fill.

Alluvial Deposits

Thirteen wells were screened within the alluvial deposits; six at the northern location and seven at the east location. One additional well, NOW-7U was screened just below the Alluvium and for the purpose of this ESP is considered to represent the shallow or upper water bearing zones.

Groundwater samples collected from the upper zone indicated that the water is not suitable for a potable source, as it contains elevated chloride concentrations and other parameters. Naturally occurring metals (calcium, iron, magnesium, potassium and sodium) are also present. NJDEP has published the secondary drinking water standard for chlorides at 250 mg/L. Twenty-three of the 64 samples collected from these wells reported the presence of lead in groundwater at concentrations ranging from 0.00099 mg/L to 0.02 mg/L, as compared to the drinking water standard of 0.005 mg/L. With the exception of observation wells EOW-1U, EOW-8U and NOW-1U, lead was detected in at least one round of sampling for the remaining 12 wells screened in the Alluvium.

The results from the hardness, total dissolved solids, and coliform also indicated that the groundwater is of poor water quality. Total coliform was detected in 28 of the 64 samples ranging from non-detected to TNTC. However, fecal coliform was only detected in three samples with a maximum count of 29 CFU at EOW-1U (during the Spring 2009 sampling event). The groundwater color noted on the field data reports ranged from clear to turbid and corresponded to the measured turbidity levels.

Tritium was reported in two groundwater samples collected from EOW-1U (summer sampling event) and EOW-6U (winter sampling event) at concentrations of 340 pCi/L and 710 pCi/L respectively. Tritium was only detected during one sampling event at each location. Split samples were submitted to separate laboratories with non-detected results. When considering the uncertainty of the data and the single detect at each location, it is likely that these results represent false positives or laboratory contamination. These data are not indicative of a release and do not suggest that groundwater at these locations has been impacted by the a adjacent plantsa local tritium release. This is supported by the fact that these locations wells are not located within a migration pathway that could be from a potential tritium source such as HCGS or SGS and the tritium release at SGS is not associated with that historic release and does not represent any new release of tritium to the environment.

Two of the upper wells installed in the eastern location EOW-8U and EOW-10 began to off-gas methane immediately after installation. This is attributed to the naturally occurring organic materials and former wetland vegetation in those areas prior to the construction of Artificial Island. The chemical data from these two locations do not suggest that the presence of the methane impacts water chemistry.

Vincentown Aquifer

Groundwater samples collected from the deeper or lower observation wells also show elevated concentrations of the naturally occurring inorganics, indicating that this aquifer is also not suitable for a potable water source at the PSEG Site. Lead was detected in 5 of the 64 samples at concentrations ranging from 0.00053 mg/L to 0.0134 mg/L with an average of

0.00254 mg/L, compared to the NJDEP drinking water standards of 0.005 mg/L. Lead was detected at an estimated value (i.e. below the laboratory reporting limit) in one sample collected from EOW-8L during the summer sampling event only. Lead was detected in samples collected from NOW-2L, NOW-4L, NOW-5L and NOW-6L. With the exception of NOW-4L, detections were not repeated and the low values suggest that it is from either seasonal fluctuations in the water chemistry or from a laboratory artifact. Lead detections were reported during the spring (May 2009) and summer (July 2009) sampling events. Such low concentrations may also be false positives reported by the laboratory, and although the data have been validated, the data do not suggest a plume of lead impacted groundwater at the PSEG Site. No mercury was reported in any samples.

Total coliform was detected in 35 of the 64 samples. No fecal coliform was reported in any sample. The total coliform is likely to due to the fact that the Vincentown aquifer is in direct hydraulic communication with the Delaware River and is tidally influenced, therefore some mixing with river water may occur. Alternatively, where there are areas where the overlying Kirkwood aquitard is thin or missing, groundwater in the Alluvium (that also contained elevated coliform) migrates downward.

Field parameters are similar to those measured in the upper Alluvium. The groundwater within the Vincentown Formation is brackish with measured total dissolved solids concentrations ranging 884 to 10,000 mg/L. The range of dissolved oxygen is lower (ranging from 0.11 to 7 mg/L) and the range of pH is 6.2 to 10.6. As noted above, the color of the samples corresponded to the measured turbidity, from clear to cloudy.

Deeper Aquifers

As noted in Subsection 2.3.2, groundwater quality of both the Mount Laurel-Wenonah and PRM are suitable for potable use. Several pumping wells withdraw water from the PRM to supply the existing HCGS and SGS. Routine sampling is performed by SGS and HCGS to confirm that all water quality parameters are within acceptable limits to support potable use of this water (Section 6.6). Data collected as part of this program are reported to NJDEP to ensure that the water quality meets both USEPA and NJDEP criteria and is safe for consumption.

2.3.4 REFERENCES

2.3-1 ARCADIS, “Remedial Investigation Report, PSEG Nuclear, LLC, Salem Generating Station, Hancock’s Bridge, New Jersey,” March 2004.

2.3-2 ARCADIS, “Site Investigation Report, Salem Generating Station, PSEG Nuclear, LLC, Salem Generating Station, Hancock’s Bridge, New Jersey,” July 15, 2006.

2.3-3 Aubrey Consulting, Inc., “Numerical Circulation Model Implementation: Salem and Hope Creek Nuclear Generating Stations Data Interpretation and Modeling Results,” Cataumet, Massachusetts, November 1995.

2.3-4 Bender, L. and K. Wong, “The Effect of Wave-Current Interaction on Tidally Forced Estuarine Circulation,” 1993, Journal of Geophysical Research, 98(C9).

2.3-5 Bouwer, H., and R.C. Rice, “A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells,” Water Resources Research, v. 12, No. 3, pp. 423 – 428, 1976.

2.3-6 Cook, T.L., “Observations of Sediment Transport in the Delaware Estuary During Spring Runoff Conditions**,”** a thesis submitted to the faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Master of Science in Marine Studies, 2004, http://www.geo.umass.edu/grads/cook/tcook_thesis.pdf, accessed July 21, 2009.

2.3-7 Cooper, H.H., J.D. Bredehoeft, and I.S. Papadopulos, “Response of a Finite-Diameter Well to an Instantaneous Charge of Water,” Water Resources Research, v. 3, no. 1, pp. 263 – 269, 1967.

2.3-8 Dames & Moore, 1988. “Final Report Study of Groundwater Conditions and Future Water-Supply Alternatives Salem/Hope Creek Generating Station, Artificial Island, Salem County, New Jersey,” PSE&G. July 15, 1988.

2.3-9 Dames & Moore, “Groundwater Supply Investigation, Hope Creek,” 1974.

2.3-10 Dames & Moore, “Report of Foundation Studies, Proposed Salem Nuclear Generating Station, Salem, New Jersey, Public Service Electric & Gas Company,” August 28, 1968.

2.3-11 Dames & Moore, “Groundwater Supply Well #5,” 1974.

2.3-12 Dames & Moore, “Investigation of Saline Production Well No. 4,” 1970.

2.3-13 Dames & Moore, “Interim Progress Report – Results of Test Boring/Groundwater Supply Investigation, Salem Generating Plant – Units 1 & 2,” 1968.

2.3-14 Delaware River Basin Commission, “Delaware River, State of the Basin Report 2008,” Website, http://www.nj.gov/drbc/SOTB/index.htm, 2008, accessed June 26, 2009.

2.3-15 Delaware River Basin Commission, “Delaware Estuary Monitoring Report, Covering Monitoring Developments and Data Collected or Reported during 1999 – 2003,” E.D. Santoro, September 2004, Website, http://www.state.nj.us/drbc/04MonRpt/, accessed May 12, 2009.

2.3-16 Delaware River Basin Commission, Groundwater Withdrawal, Docket No. D-90-71 Renewal, West Trenton, NJ, November 1, 2000.

2.3-17 Delaware River Basin Commission, “Study of the Loadings of Polychlorinated Biphenyls from Tributaries and Point Sources to the Tidal Delaware River,” June 1998.

2.3-18 Delaware River Basin Commission, The Role of the Delaware River Master in Interstate Flow Management, 2004, Website, http://www.state.nj.us/drbc/river_master.htm, accessed September 1, 2009.

2.3-19 U.S. Army Corps of Engineers, (Delaware River Basin Commission, Water Supply/Demand Status Report for the Delaware River Basin (Draft), September 2005), as incorporated in:

U.S. Army Corps of Engineers. "Enhancing Multi-jurisdictional Use and Management of Water Resources for the Delaware River Basin, NY, NJ, PA, and DE December 2008", http://www.nj.gov/drbc/ArmyCorps/index.htm, accessed on January 14, 2010.

2.3-20 Delaware River Basin Commission, Delaware River Basin Water Code, 18 CFR 410, August 2007 with Amendments through September 27, 2006.

2.3-21 Delaware River Basin Commission, Tenth Report to the Governor and the General Assembly Regarding the Progress of the Delaware Water Supply Coordinating Council, Prepared by: the Delaware Department of Natural Resources and Environmental Control; Delaware Geological Survey; and University of Delaware College of Human Services, Education, and Public Policy Institute for Public Administration – Water Resources Agency, April 28, 2008.

2.3-22 Delaware River Basin Commission, Delaware River Stream Mileage System, Website, http://www.state.nj.us/drbc/mileage.htm, accessed December 31, 2009.

2.3-23 Delaware River Basin Commission, Information about the Delaware River, http://www.state.nj.us/drbc/thedrb.htm, Trenton, NJ, 2008.

2.3-24 Delaware River Basin Commission, Welcome to the DRBC Section 3.8 Project Application Status Page, Website, http://www.state.nj.us/drbc/dockets/status.htm, Trenton, NJ, June 2009.

2.3-25 Department of Natural Resources and Environmental Control, Well Database, Division of Water resources, Water Supply Section, Well Permits Branch, August 25, 2009.

2.3-26 DiLorenzo, J.L., P. Huang, M.L. Thatcher, and T.O. Najarian, "Dredging Impacts on Delaware Estuary Tides, In Estuary and Coastal Modeling III," Proceedings of the 3rd International Conference, Oak Brook, Illinois, September 8 – 10, 1993, ASCE J. Wirwy. Port Cstl. and Oc. Div.

2.3-27 Federal Emergency Management Agency (FEMA), Flood Insurance Study, Township of Lower Alloways Creek, New Jersey, Salem County, October 18, 1982, accessed July 14, 2009. http://map1.msc.fema.gov/idms/IntraView.cgi?KEY=96614241&IFIT=1.

2.3-28 Garvine, R.W., "Sub-Tidal Frequency Estuary Shelf Interaction: Observations near Delaware Bay," 1991, Journal of Geophysical Research, 96(C4):7049 – 7,064.

2.3-29 Garvine, R.W., R. McCarthy, and K.C. Wong, "The Axial Salinity Distribution in the Delaware Estuary and its Weak Response to River Discharge," Estuarine, Coastal and Shelf Science. 35:157 – 165, 1992.

2.3-30 Goodrich, D.M., "Nontidal Exchange Processes at the Chesapeake Bay Entrance," In Proceedings of the National Conference on Hydraulic Engineering, New York ASCE, 1987.

2.3-31 Harleman, D.R.F., "One-Dimensional Models, In Estuarine Modeling: An Assessment, Capabilities and Limitations for Resource Management and Pollution Control," by Tracor, Inc., for the Water Quality Office, Environmental Protection Agency, February 1971.

2.3-32 Hvorslev, M. J., "Time Lag and Soil Permeability in Ground Water Observations," U.S. Army Corps of Engineers, Waterways Experiment Station, Bulletin Number 36, 50 pp., 1951.

2.3-33 Huzzey, L.M., "The Lateral Density Distribution in a Partially Mixed Estuary," Estuarine, Coastal and Shelf Science, 9:351 – 358, 1988.

2.3-34 Keiner, L. and X. Yan, "Empirical Orthogonal Function Analysis of Sea Surface Temperature Patterns in Delaware Bay," 1997, Trans. IEEE. 35(5):1299 – 1306.

2.3-35 NOT USED

2.3-36 Munchow, A. and R.W. Garvine, "Dynamical Properties of a Buoyancy-Driven Coastal Current," 1993, Journal Of Geophysical Research, 98:20,063 – 20,077.

2.3-37 National Oceanic and Atmospheric Administration (NOAA) National Weather Service, Hydrometeorlogical Design Studies Center, Precipitation Frequency Data Server, NOAA Atlas 14, New Jersey 39.460N 75.508W, 0 ft. http://hdsc.nws.noaa.gov/hdsc/pfds/orb/New Jersey_pfds.html, accessed July 16, 2009.

2.3-38 National Oceanic and Atmospheric Administration (NOAA), Reedy Point, Station ID: db0201, Current Data, Website, http://tidesandcurrents.noaa.gov/ports/ports.shtml?stn=db0201+Reedy%20Point&port=db, accessed July 15, 2009.

2.3-39 New Jersey Department of Environmental Protection, Open Public Records, Website, http://datamine2.state.nj.us/DEP_OPRA/OpraMain/get_long_report?, accessed April 30, 2009.

2.3-40 New Jersey Department of Environmental Protection, Water Allocation Permit WAP040001, Trenton, NJ, December 20, 2004.

2.3-41 New Jersey Geological Survey, Digital Geodata Series DGS98-5, Aquifers of New Jersey, Website, http://www.nj.gov/dep/njgs/geodata/dgs98-5.htm, accessed February 11, 2010.

2.3-42 New Jersey Geological Survey, Widmer, K. Geology of the Groundwater Resources of Mercer County. Trenton, New Jersey, Geological Report Series No. 7, 1965.

2.3-43 NOT USED

2.3-44 Page, Leo, No. 6 Test and Production Well, 1981.

2.3-45 Pape, E.H. and R.W. Garvine, "The Subtidal Circulation in Delaware Bay and Adjacent Shelf Waters," 1982, Journal of Geophysical Research, 87:7955 – 7970.

2.3-46 Parker, B.B., "Frictional Effects on the Tidal Dynamics of a Shallow Estuary," 1984, Ph.D. Dissertation, Johns Hopkins University.

2.3-47 Pennsylvania Department of Conservation and Natural Resources, Crum Creek Watershed Conservation Plan, Website, http://www.dcnr.state.pa.us/brc/rivers/riversconservation/registry/CrumCreek/VI.WATER%20RESOURCES.final.pdf, p. 28, accessed June 4, 2009.

2.3-48 PSEG Nuclear, LLC, Applicant's Environmental Report – Operating License Renewal Stage, Salem Generating Station, Units 1 and 2, Nuclear Regulatory Commission Docket Numbers 50-272 and 50-311, License Numbers DPR-70 and DPR-75 (respectively), Revision 0, August 2009.

2.3-49 PSEG Nuclear LLC, Letter to Ms. Diane E. Zalaskus, NJDEP, PSEG Nuclear LLC Water Allocation Permit, Program Interest ID 2216P, Activity Number WAP040001, First Quarter Report – 2009, dated April 17, 2009.

2.3-50 PSEG Nuclear LLC, Letter to Ms. Diane E. Zalaskus, NJDEP, PSEG Nuclear LLC Water Allocation Permit, Program Interest ID 2216P, Activity Number WAP040001, Second Quarter Report – 2009, dated July 21, 2009.

2.3-51 PSEG Nuclear LLC, Letter to Ms. Diane E. Zalaskus, NJDEP, PSEG Nuclear LLC Water Allocation Permit, Program Interest ID 2216P, Activity Number WAP040001, Third Quarter Report – 2009, dated October 29, 2009.

2.3-52 PSEG Nuclear LLC, Letter to Ms. Diane E. Zalaskus, NJDEP, PSEG Nuclear LLC Water Allocation Permit, Program Interest ID 2216P, Activity Number WAP040001, First Quarter Report – 2009, dated January 14, 2010.

2.3-53 Public Service Enterprise Group (PSEG), "Hope Creek Generating Station Updated Final Safety Analysis Report," p. 2.4.1, 1988.

2.3-54 Public Service Enterprise Group (PSEG),NJPDES Permit Renewal Application for Salem Generating Station, Appendix C, R.B. Biggs and R.J. Horwitz, sponsors, 1999.

2.3-55 Salem County, NJ, Website, http://www.salemcountynj.gov/cmssite/downloads/Farmland_Preservation/Ch4%20Land%20Use%20Planning.pdf, accessed September 4, 2009.

2.3-56 Schwartz, M.C., "Significant Groundwater Input to a Coastal Plain Estuary: Assessment from Excess Radon," Estuarine, Coastal and Shelf Science, 56(1), 31-42, 2003.

2.3-57 Sharp, J.H., L. Cifuentes, R.B. Coffin, and J.R. Pennock, "The Influence of River Variability on the Circulation, Chemistry, and Microbiology of the Delaware Estuary," 1986, Estuaries. 9:261 – 269.

2.3-58 Spoljaric, N., "LANDSAT View of Delaware with Geological Interpretation," 1979, Delaware Geologic Survey Open File Report No. 12.

2.3-59 Sugarman, P., K.G. Miller, J.V. Browning, A.A. Kulpecz, P.P. McLaughlin, Jr., and D.H. Monteverde, "Hydrostratigraphy of the New Jersey Coastal Plain: Sequences and Facies Predict Continuity of Aquifers and Confining Units," Stratigraphy, Vol. 2, no.3, pp. 259 – 275, 2005.

2.3-60 Sutton, C.C., J.C. O'Herron, II, and R.T. Zappalorti, "The Scientific Characterization of the Delaware Estuary," The Delaware Estuary Program (DRBC Project No. 321; HA File No. 93.21. 200 pages and appendices, 1996, Website, http://www.delawareestuary.org/science_reports_full_list.asp, PDE-DELEP-Report-96-02-SciChar.pdf, accessed July 28, 2009.

2.3-61 Trowbridge, J. and K. Wong, "Some Observational Evidence on the Effect of Atmospheric Forcing on Tidal Variability in Upper Delaware Bay," 1990, Journal of Geophysical Research.

2.3-62 U.S. Army Corps of Engineers, "National Inventory of Dams," Website, https://nid.usace.army.mil/, accessed July 16, 2009.

2.3-63 U.S. Army Corps of Engineers, Philadelphia District, Delaware River Main Channel Deepening Project, Supplemental Environmental Impact Statement, June 1997.

2.3-64 U.S. Army Corps of Engineers, Philadelphia District, Delaware Estuary Salinity Intrusion Study, Water Resources Investigation, December 1982, http://www.nap.usace.army.mil/cenap-pl/deldocs/o19.pdf, accessed March 11, 2009.

2.3-65 U.S. Environmental Protection Agency, Federal Register Notice, Volume 53, No. 122, Page 23791, Sole Source Aquifer Determination for the NJ Coastal Plain Aquifer System, Website, http://www.epa.gov/r02earth/water/aquifer/coast/fr_coast.htm, June 24, 1988, accessed September 8, 2009.

2.3-66 U.S. Environmental Protection Agency (USEPA), *Low Stress (low flow) purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells,* Region I (SOP #GW0001), July 1996.

2.3-67 U.S. Environmental Protection Agency, Safe Drinking Water Information System, Washington, DC, Website, http:\\www.epa.gov/enviro/html/sdwis/sdwis_ov.htm, accessed March 26, 2009.

2.3-68 U.S. Geological Survey, "Delaware River Study Unit Description," National Water-Quality Assessment Program, Website, http://NJ.usgs.gov/nawqa/delr/su.descrpt.html, 1999, accessed July 28, 2009.

2.3-69 U.S. Geological Survey, “Documentation of Revisions to the Regional Aquifer System Analysis Model of the New Jersey Coastal Plain,” Lois M. Veronin, Water-Resources Investigations Report 03-4268, 2003.

2.3-70 U.S. Geological Survey, “Evaluation of Water Levels in Major Aquifers of the New Jersey Coastal Plain, 1978, U. S. Department of the Interior, Water-Resources Investigations Report 82-4077,” Walker, R. L., 1983.

2.3-71 U.S. Geological Survey, “Ground-Water Flow in the New Jersey Coastal Plain,” Mary Martin, Professional Paper 1404-H,” 1998.

2.3-72 U.S. Geological Survey, “Hydrogeology of, Water Withdrawal from, and Water Levels and Chloride Concentrations in the Major Coastal Plain Aquifers of Gloucester and Salem Counties, New Jersey, Water Resources Investigations Report 98-4136,” 1999.

2.3-73 U.S. Geological Survey, “01459350 Nockamixon Reservoir Near Ottsville, PA, 1999a,” Website, http://pa.water.usgs.gov/ar/wy99/pdfs/01459350.pdf, p. 1, accessed February 22, 2009.

2.3-74 U.S. Geological Survey, “USGS Station 01482800 Delaware River at Reedy Island Jetty, DE. 2009”, Website, http://waterdata.usgs.gov/de/nwis/dv/?site_no=01482800&referred_module=sw, accessed June 30, 2009.

2.3-75 U.S. Geological Survey, “Lakes & Reservoirs in Christina River Basin, 2005,” Website, http://pa.water.usgs.gov/ar/wy05/new-pdfs/christina-lakes.pdf, p. 1, accessed February 22, 2009.

2.3-76 U.S. Geological Survey, “Lakes & Reservoirs in Delaware River Basin, 2004,” Website, http://ny.water.usgs.gov/pubs/wdr/wdrny041/rept.delaware2004.pdf, p. 1 – 2, accessed February 22, 2009.

2.3-77 U.S. Geological Survey, “Lakes & Reservoirs in Lackawaxen River Basin, 1999b,” Website, http://pa.water.usgs.gov/ar/wy99/pdfs/lackawaxen-lakes.pdf, p. 1, accessed February 22, 2009.

2.3-78 U.S. Geological Survey, “Lakes & Reservoirs in Lehigh River Basin,” Website, http://pa.water.usgs.gov/ar/wy01/pdfs/lehigh-lakes.pdf, p. 1, accessed February 22, 2009.

2.3-79 U.S. Geological Survey, “Lakes & Reservoirs in Schuylkill River Basin,” Website, http://pa.water.usgs.gov/ar/wy01/pdfs/schuylkill-lakes.pdf, p. 1, accessed February 22, 2009.

2.3-80 U.S. Geological Survey, “National Elevation Dataset,” Website, http://seamless.usgs.gov/website/seamless/viewer.htm, accessed February 2, 2009.

2.3-81 U.S. Geological Survey, "Office of the Delaware River Master," Website, http://water.usgs.gov/osw/odrm/intro.html, accessed July 3, 2009.

2.3-82 U.S. Geological Survey, "Reservoirs in Delaware River Basin," Website, http://pubs.usgs.gov/wdr/2005/wdr-nj-05-1/pdf/Delaware05.pdf, accessed July 31, 2009.

2.3-83 U.S. Geological Survey, "1:250,000 – Scale Hydrologic Units of the United States, 1994," Website, http://water.usgs.gov/GIS/metadata/usgswrd/XML/huc250k.xml#stdorder, accessed February 2, 2009.

2.3-84 U.S. Geological Survey, "Simulation of Ground-Water Flow and Movement of the Freshwater-Saltwater Interface in the New Jersey Coastal Plain," Pope, D. and A. Gordon. Water-Resources Investigations Report 98-4216, 1999.

2.3-85 U.S. Geological Survey, 2001b, Simulation of Ground-Water Flow in the Potomac-Raritan- Magothy Aquifer System Near the Defense Supply Center Philadelphia, and the point Breeze Refinery, Southern Philadelphia County, Pennsylvania, New Cumberland, Pennsylvania, U. S. Department of the Interior, U.S. Geological Survey, Water-Resources Investigations 01-4218, C. L. Schreffler, 2001.

2.3-86 U.S. Geological Survey, "USGS Stream Gage 01483050 Alloway Creek at Hancock's Bridge, New Jersey," Website, http://nwis.waterdata.usgs.gov/NJ/nwis/peak/?site_no=01483050& accessed June 25, 2009.

2.3-87 U.S. Geological Survey, "USGS Stream Gage 01463500 Delaware River at Trenton, New Jersey," Website, http://waterdata.usgs.gov/nj/nwis/monthly/?referred_module=sw&site_no=01463500&por_01463500_5=147753,00060,5,1912-10,2009-01&format=html_table&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list, accessed July 28, 2009.

2.3-88 U.S. Geological Survey, Water-Level Conditions in Selected Confined Aquifers of the New Jersey and Delaware Coastal Plain, 2003. 135p. Reston, Virginia, U. S. Department of the Interior, Scientific Investigations Report 2008-5145, V. T. DePaul, R. Rosman, and P. J. Lacombe, 2009.

2.3-89 U.S. Geological Survey, 2001a, Water Levels in, Extent of Freshwater in, and Water Withdrawals from Ten Confined Aquifers, New Jersey and Delaware Coastal Plain, 1998. Reston, Virginia, U. S. Department of the Interior, Water- Resources Investigations 00-4143, Lacombe, P.J., and R. Rosman, 2001.

2.3-90 U.S. Geological Survey/State of New Jersey, "Geology and Ground-Water Resources of Salem County, New Jersey," State of New Jersey Department of Conservation and Economic Development, Division of Water Policy and Supply, Special Report No. 33. J. Rosenau, S. Lang, G. Hilton, and J. Rooney, 1969.

2.3-91 University of Delaware College of Marine Studies and New Jersey Marine Sciences Consortium, Edited by J.H. Sharp, "The Delaware Estuary: Research as Background for Estuarine Management and Development, A Report to the Delaware River and Bay Authority," available at http://www.nap.usace.army.mil/cenap-pl/b14.pdf, July 1983.

2.3-92 Valle-Levinson, A. and K.M. Lwiza, "The Effects of Channels and Shoals on Exchange between the Chesapeake Bay and the Adjacent Ocean," 1995, Journal of Geophysical Research, 100:18,551 – 18,563.

2.3-93 Wong, K.C. and A. Munchow, "Buoyancy Forced Interaction Between the Estuary and Inner Continental Shelf," Continental Shelf Research, 15:59 – 88, 1995.

2.3-94 Wong, K.C. and R.W. Garvine, "Observations of Wind-Induced, Subtidal Variability in the Delaware Estuary," 1984, Journal of Geophysical Research, 89:10,589 – 10,597.

2.3-95 Wong, K.C., "On the Nature of Transverse Variability in a Coastal Plain Estuary," Journal of Geophysical Research, 1994, 99(C7):14,209 –14,222.

2.3-96 Wong, K.C., "On the Relationship Between Long-Term Salinity Variations and River Discharge in the Middle Reach of Delaware Bay," Journal of Geophysical Research, 100 (c10):20, 705 – 20, 713, 1995.

2.3-97 State of New Jersey, Office of Information Technology (OIT), Overview, Website, http://www.state.nj.us/it/oit/over/, accessed February 12, 2009.

Table 2.3-1
Delaware River Subbasins and Drainage Areas Above and Below the PSEG Site

USGS Hydrologic Unit Code Subbasin			Approximate Drainage Area (sq. mi.)	
No.	**I.D.**	**USGS Subbasin Name**	**Upstream of Site**	**Downstream of Site**
1	02040101	Upper Delaware	1191	0
2	02040102	East Branch Delaware	836	0
3	02040104	Middle Delaware-Mongaup-Brodhead	1532	0
4	02040103	Lackawaxen	593	0
5	02040105	Middle Delaware-Musconetcong	1345	0
6	02040106	Lehigh	1367	0
7	02040203	Schuylkill	1924	0
8	02040201	Crosswicks-Neshaminy	543	0
9	02040202	Lower Delaware	1092	0
10	02040205	Brandywine-Christina	731	34
11	02040204	Delaware Bay	70	676
12	02040206	Cohansey-Maurice	250	794
13	02040207	Broadkill-Smyrna	0	638
Estimated Delaware River Drainage Area at Site			**11,474**	**2142**

Reference 2.3-83

Table 2.3-2
Selected Point Precipitation Frequency Estimates (Inches)[a]

Average Recurrence Interval (years)	5 Min	60 Min	24 Hours	7 Days	30 Days	60 Days
1	0.35	1.19	2.65	3.91	7.33	11.13
5	0.48	1.79	4.16	5.93	10.29	15.09
10	0.54	2.06	4.96	6.97	11.57	16.59
25	0.60	2.41	6.18	8.48	13.29	18.48
100	0.70	2.96	8.42	11.17	16.02	21.19
500	0.79	3.58	11.76	14.96	19.26	23.98

a) 39.460 North latitude, 75.508 West longitude

Reference 2.3-37

Table 2.3-3 (Sheet 1 of 2)
Inventory of Reservoirs in the Delaware River Basin

Name of Dam or Reservoir	Owner or Operator	Primary Purpose	Source	Drainage Area Above Dam (sq. mi.)	Total Storage (100's of ac-ft)	Spillway Elevation, ft. NAVD 1988	Date Completed
Pepacton Reservoir	NY City Department of Environmental Protection	Water supply and flow augmentation	East Branch Delaware River	372	4600	1279	1954
Cannonsville Reservoir	NY City Department of Environmental Protection	Water supply and flow augmentation	West Branch Delaware River	454	3030	1150	1963
Neversink Reservoir	NY City Department of Environmental Protection	Water supply and flow augmentation	Neversink River	92.5	1420	1439	1953
Jadwin Reservoir	USACE	Flood control	Dyberry Creek	65	473	1052	1960
Prompton Reservoir	USACE	Flood control	West Branch Lackawaxen River.	60	728	1204	1961
Lake Wallenpaupack	Pennsylvania Power & Light	Hydroelectric	Lackawaxen River	228	2090	1189	1925
Mongaup System	Mirant NY – Gen, LLC	Hydroelectric	Mongaup River	Varies[(b)]	Varies[(b)]	Varies[(b)]	Varies[(b)]
F.E. Walter Reservoir	USACE	Flood control and recreation	Lehigh River	289	1110	1449	1961
Wild Creek Reservoir	Bethlehem Authority	Water supply	Wild Creek	22	125	819	1941
Penn Forest Reservoir	Bethlehem Authority	Water supply	Wild Creek	17	185	1000	1958
Beltzville Reservoir	USACE	Multipurpose	Pohopoco Creek	96	1040	650	1969
Still Creek Reservoir	Tamaqua Area Water Authority	Water supply	Still Creek	7	83	1181	1933
Lake Hopatcong	NJ Division of Parks and Forestry	Water supply	Musconetcong River	25	482	923	1887
Merrill Creek Reservoir	Merrill Creek Owner's Group	Flow augmentation	Merrill Creek	3	460	928	1988

Table 2.3-3 (Sheet 2 of 2)
Inventory of Reservoirs in the Delaware River Basin

Name of Dam or Reservoir	Owner or Operator	Primary Purpose	Source	Drainage Area Above Dam (sq. mi.)	Total Storage (100's of ac-ft)	Spillway Elevation, ft. NAVD 1988	Date Completed
Blue Marsh Reservoir	USACE	Flood control and water supply	Schuylkill River	175	500	306	1979
Nockamixon Reservoir	Delaware Commission of Natural Resources	Recreation	Tohickon Creek	73	665	394	1973
Ontelaunee Reservoir	Reading Area Water Authority	Water supply	Maiden Creek	192	228	--	1935
Lake Galena	Bucks County Commissioners	Water supply	Neshaminy Creek	16	171	--	1973
Green Lane Reservoir	Aqua Pennsylvania, Inc.	Water supply	Perkiomen Creek	71	134	285	1957
Chambers Lake	Chester County Water Resources Authority	Multipurpose	Birch Run	5	20	587	1997
Marsh Creek Reservoir	Delaware Commission of Natural Resources	Water supply, flood control, and recreation	Brandywine Creek	20	222	359	1973
Springton Dam (Geist Reservoir)	Aqua Pennsylvania, Inc.	Water supply	Crum Creek	21.5	107	266[a]	1931
Hoopes Reservoir	City of Wilmington, DE	Water supply	Red Clay Creek	N/A	110	339[a]	1931
Newark Reservoir	City of Newark, DE	Water supply	White Clay Creek	0	9.2	188	2006

References 2.3-47, 2.3-73 through 2.3-79, and 2.3-82.

a) Estimated
b) The Mongaup system consists of five privately-owned reservoirs (Toronto, Cliff Lake, Swinging Bridge, Mongaup Falls, and Rio)

Table 2.3-4
Tributary Streams in the Vicinity of the PSEG Site

Tributary Name	Delaware River Mile
Lower Deep Creek	44
Mad Horse Creek	45
Fishing Creek	47
Hope Creek	48
Blackbird Creek	50
Appoquinimink River	51
Silver Run	53
Augustine Creek	53
Alloway Creek	54
St. Georges Creek	56
Salem River	58
Chesapeake and Delaware Canal	59
Mill Creek	60

Reference 2.3-22

Table 2.3-5
Monthly and Annual Mean Daily Streamflow Statistics – Delaware River at Trenton, New Jersey (Period of Record February 1, 1913 through May 3, 2009)

Period	Streamflow (cfs)	Streamflow (cfs) for Given Non-Exceedance Frequency				
	Mean	Median (50%)	Minimum (0%)	10%	90%	Maximum (100%)
Annual	11,879	8100	1240	3070	24,800	279,000
January	12,772	9280	1900	4275	23,950	129,000
February	12,900	9860	2200	4850	24,810	110,000
March	20,563	16,500	3000	7506	36,680	214,000
April	22,165	18,000	4460	8959	39,200	230,000
May	13,970	11,600	3160	6096	24,800	139,000
June	9462	6800	1420	3889	16,800	224,000
July	7101	4920	1240	2700	12,700	110,000
August	6001	4210	1320	2300	10,800	279,000
September	6196	3940	1250	2170	11,100	181,000
October	7350	4380	1240	2260	15,050	121,000
November	10,760	7835	1240	2810	22,300	107,000
December	13,232	9690	1400	4000	26,800	118,000

Reference 2.3-87

Table 2.3-6
Monthly Mean Streamflow Statistics – Delaware River at Trenton, New Jersey (Period of Record October 1912 through September 2008)

	Flow (cfs)			
Month	**Minimum**	**Median**	**Mean**	**Maximum**
January	2539	11,595	12,916	34,950
February	3500	12,085	12,924	31,640
March	7715	19,295	20,627	60,840
April	6828	21,265	22,273	52,680
May	5074	12,100	13,977	31,690
June	2572	7176	9462	33,460
July	1548	5451	7101	25,720
August	1808	4442	6001	30,290
September	1762	4272	6196	32,570
October	1632	5105	7362	28,710
November	1868	10,440	10,765	27,340
December	2037	11,550	13,086	42,860

Reference 2.3-68

Table 2.3-7
Flood Discharge Frequency – Alloway Creek

Location	Drainage Area (sq. mi.)	Peak Discharge (cfs)			
		10-year	50-year	100-year	500-year
At Confluence with Delaware River	59.6	2740	4520	5450	7800
At Salem-Hancocks Bridge Road	51.6	2440	4020	4850	6600

Reference 2.3-27

Table 2.3-8
Summary of Selected Physical Features of the Delaware Estuary

Physical Feature	Location / Statistic	Measure
Length	Falls at Trenton to Mouth of Bay	133.3 mi.
Width	Minimum within Estuary	0.12 mi.
	Maximum within Estuary	27 mi.
Depth	Mean	19 ft.
	Navigation Channel	30 – 40 ft.
Surface Area	Open Water (Main Stem and Creeks)	758.7 sq. mi.
	Marsh Plain Areas	246.8 sq. mi.
	Total	1005.5 sq. mi.
Volume	Total Estuary	4.5×10^{11} ft^3
	Tidal Prism	1.4×10^{11} ft^3
Mean Tidal Range	Cape May Point (RM 0)	4.8 ft.
	Reedy Point (RM 54)	5.5 ft.
	Trenton (RM 133)	8.1 ft.
Flow	Tidal (Mouth of Bay)	5,190,000 cfs
	Average Freshwater Inflow (total)	20,240 cfs
Watershed	Total Area	13,533 sq. mi.
	Estuary Drainage Area	5987 sq.mi.

Reference 2.3-54.

Table 2.3-9 (Sheet 1 of 3)
Regional and Site-Specific Aquifer Characteristics

Formation	Transmissivity	Hydraulic Conductivity	Total Porosity	Storage Coefficient	Specific Capacity (gpm/ft)	Leakance (ft/d per ft.)	Reference
Fill		6.5 ft/d					2.3-1
Alluvium Aquifer	13.2 to 440 gpd/ft	0.9 to 13.1 gpd/ft^2					2.3-71
		2.95 ft/d					2.3-1
Kirkwood Aquitard		Kz = 0.00002 to 0.00005 ft/d					2.3-71
						1e-5/d	2.3-84
Basal Kirkwood-Vincentown Aquifer					0.5 to 8.3		2.3-90
	5000 to 11,000 gpd/ft				0.3 to 1.9		2.3-8
	530 ft^2/d						2.3-71
	2000 to 2500 ft^2/d						2.3-84
	1987 to 2791 ft^2/d						2.3-69
Hornerstown - Navesink Aquitard		30 to 65 gpd/ft^2	0.522 – 0.543				2.3-90
		Kz = 0.42 gpd/ft^2					2.3-71
		Kz = 0.005 to 9 ft/d					2.3-71
						5e-5/d	2.3-84
						3.35e-5 to 6.87e-5/d	2.3-69
Mount Laurel - Wenohah Aquifer	7000 gpd/ft	18.7 ft/d					2.3-13
		10 ft/d	0.444		0.7 to 9		2.3-90
	7500 to 14,000 gpd/ft						2.3-12
	4900 to 8,700 gpd/ft				0.2 to 3.8		2.3-8
	360 to 1.430 ft^2/d	13 to 19 ft/d					2.3-71
	1000 ft^2/d						2.3-84
	726 to 922 ft^2/day						2.3-69

Table 2.3-9 (Sheet 2 of 3)
Regional and Site-Specific Aquifer Characteristics

Formation	Transmissivity	Hydraulic Conductivity	Porosity	Storage Coefficient	Specific Capacity (gpm/ft)	Leakance (ft/d per ft.)	Reference
Marshalltown-Wenohah Aquitard		0.001 to 0.01 gpd/ft^2					2.3-90
		Kz = 0.0000057 to 0.13 ft/d					2.3-71
						6e-6/d	2.3-84
						5.91e-6 to 7.13e-6/d	2.3-69
Englishtown Aquifer					up to 10		2.3-90
	1100 to 2,100 ft^2/d	12 to 67 ft/d					2.3-71
	500 ft^2/d						2.3-84
	415 to 552 ft^2/d						2.3-69
Merchantville-Woodbury Confining Unit		Kz = 0.00000087 to 0.03 ft/d					2.3-71
						3e-6/d	2.3-84
						2.15e-6 to 3.85e-6/d	2.3-69
Upper PRM Aquifer	10,000 to 25,000 gpd/ft						2.3-11
	15,000 to 25,000 gpd/ft						2.3-9
	9000 to 27,000 gpd/ft				10.6 to 26.7		2.3-8
	870 to 24,210 gpd/ft	240 ft/d					2.3-71
	2000 ft^2/d						2.3-84
	1086 to 2419 ft^2/d						2.3-69

Table 2.3-9 (Sheet 3 of 3)
Regional and Site-Specific Aquifer Characteristics

Formation	Transmissivity	Hydraulic Conductivity	Porosity	Storage Coefficient	Specific Capacity (gpm/ft)	Leakance (ft/d per ft.)	Reference
Confining Unit, Upper to Middle PRM		Kz = 0.084 ft/d					2.3-71
						2e-6/d	2.3-84
						1.797e-7 to 2.69e-7/d	2.3-69
Middle PRM Aquifer	4700 to 11,500 gpd/ft						2.3-11
	8590 gpd/ft	129.5 ft/d		0.0025			2.3-44
	670 to 4000 gpd/ft						2.3-8
	4000 ft^2/d						2.3-84
	3024 to 3813 ft^2/d						2.3-69
Confining Unit, Middle to Lower PRM						5e-6/d	2.3-84
						7.19e-7 to 1.67e-5/d	2.3-69
Lower PRM Aquifer	2300 to 16,600 ft^2/d						2.3-71
	4000 to 5000 ft^2/d						2.3-84
	4844 to 5299 ft^2/d						2.3-69

Kz = Vertical hydraulic conductivity.
d = day

Units of transmissivity in gallons per day per foot are converted to ft^2/d by dividing by 7.48 gallons per cubic foot.
Units of hydraulic conductivity in gallons per day per square foot are converted to ft/d by dividing by 7.48 gallons per cubic foot.

Table 2.3-10 (Sheet 1 of 11)
Summary of Public Water Supply Wells within a 25-Mile Radius of the PSEG Site[c]

Well Identification	Owner	County	Total Depth[a]	Pump Rate (gpm)
New Jersey				
NJGS0000000260	J & J Community Park	Cumberland	0	14.6
NJGS0000000261	J & J Community Park	Cumberland	0	14.6
NJGS0000000365	Handy's Mobile Park	Salem	0	9
NJGS0000000366	Handy's Mobile Park	Salem	0	20
NJGS0000000368	Country Club Estates Mobile Home	Salem	0	0
WSWL0000066937	South Jersey Water Supply Co.	Gloucester	270	250
WSWL0000066939	Penns Grove Water Supply Co.	Gloucester	0	270
WSWL0000066944	Penns Grove Water Supply Co.	Salem	371	400
WSWL0000067026	Woodstown Water Dept.	Salem	0	600
WSWL0000067035	Penns Grove Water Supply Co.	Salem	79	450
WSWL0000067056	NJ American Water Co.	Gloucester	219	700
WSWL0000067059	Pennsville Township Water Dept.	Salem	119	700
WSWL0000067065	Penns Grove Water Supply Co.	Salem	62	250
WSWL0000067068	Penns Grove Water Supply Co.	Gloucester	104	270
WSWL0000067075	Penns Grove Water Supply Co.	Salem	96	300
WSWL0000067102	Pennsville Township Water Dept.	Salem	106	700
WSWL0000067105	NJ American Water Co.	Gloucester	166	0
WSWL0000067119	Harrisonville Mobile Home Park	Gloucester	151	48
WSWL0000067142	Penns Grove Water Supply Co.	Salem	87	250
WSWL0000067145	Swedesboro Water Dept.	Gloucester	322	500
WSWL0000067147	South Jersey Water Supply Co.	Gloucester	398	500
WSWL0000067153	NJ American Water Co.	Gloucester	106	0
WSWL0000067154	Woodstown Water Dept.	Salem	151	400
WSWL0000067168	Auburn Village Water Supply	Salem	0	0

Table 2.3-10 (Sheet 2 of 11)
Summary of Public Water Supply Wells within a 25-Mile Radius of the PSEG Site[c]

Well Identification	Owner	County	Total Depth[a]	Pump Rate (gpm)
New Jersey, cont.				
WSWL0000067201	Woodstown Water Dept.	Salem	1143.8	550
WSWL0000067202	Consumers NJ Water Co.	Gloucester	240	0
WSWL0000067203	Consumers NJ Water Co.	Gloucester	235	0
WSWL0000067213	South Jersey Water Supply Co.	Gloucester	256	1200
WSWL0000067214	Salem Water Dept.	Salem	171	250
WSWL0000067340	Elmer Borough Water Dept.	Salem	573	400
WSWL0000067516	Picnic Grove Mobile Homes	Salem	0	47
WSWL0000067529	Harding Woods Mobile Home Park	Salem	0	180
WSWL0000067530	Harding Woods Mobile Home Park	Salem	0	175
WSWL0000067634	Elmer Borough Water Dept.	Salem	520	400
WSWL0000081691	Christy Enterprises	Gloucester	310	12
WSWL0000065052	Fairton Trailer Park	Cumberland	60	45
WSWL0000066928	Pennsville Township Water Dept.	Salem	242	400
WSWL0000066988	Penns Grove Water Supply Co.	Salem	84	500
WSWL0000067001	Auburn Village Water Supply	Salem	270	100
WSWL0000067007	Swedesboro Water Dept.	Gloucester	343	600
WSWL0000067021	NJ American Water Co.	Gloucester	0	120
WSWL0000067022	NJ American Water Co.	Gloucester	229	700
WSWL0000067545	Harrisonville Mobile Home Park	Gloucester	247	70
WSWL0000067579	Picnic Grove Mobile Homes	Salem	0	47
WSWL0000068642	Fairton Trailer Park	Cumberland	59	20
WSWL0000068645	Bridgeton Water Dept.	Cumberland	107	200
WSWL0000068652	Bridgeton Water Dept.	Cumberland	126	500

Table 2.3-10 (Sheet 3 of 11)
Summary of Public Water Supply Wells within a 25-Mile Radius of the PSEG Site[c]

Well Identification	Owner	County	Total Depth[a]	Pump Rate (gpm)
New Jersey, cont.				
WSWL0000068666	Bridgeton Water Dept.	Cumberland	136	500
WSWL0000068673	Bridgeton Water Dept.	Cumberland	120	500
WSWL0000068684	Bridgeton Water Dept.	Cumberland	152	800
WSWL0000068685	Bridgeton Water Dept.	Cumberland	114	350
WSWL0000068686	Bridgeton Water Dept.	Cumberland	193	350
WSWL0000068699	Leisure Arms Complex	Salem	0	25
WSWL0000068700	Leisure Arms Complex	Salem	0	25
WSWL0000068717	Tips Trailer Park & Sales	Cumberland	70	60
WSWL0000068767	Tips Trailer Park & Sales	Cumberland	0	40
WSWL0000068795	Upper Deerfield Township Water Dept.	Cumberland	186	0
WSWL0000068800	Bridgeton Water Dept.	Cumberland	110	0
WSWL0000068807	Bridgeton Water Dept.	Cumberland	126	0
WSWL0000068809	Upper Deerfield Township Water Dept.	Cumberland	196	0
WSWL0000068837	Seabrook Water Co.	Cumberland	185	800
WSWL0000068881	Fairton Trailer Park	Cumberland	52	45
WSWL0000069155	U.S. Dept of Justice/Federal Bureau of Prisons	Cumberland	130	250
WSWL0000069166	U.S. Dept of Justice/Federal Bureau of Prisons	Cumberland	120	250
WSWL0000069176	Millville Water Dept.	Cumberland	153	700
WSWL0000069083	Holly Tree Acres	Salem	0	30
WSWL0000069105	Holly Tree Acres	Salem	137	30
WSWL0000069106	Holly Tree Acres	Salem	137	30
WSWL0000070413	Swedesboro Water Dept.	Gloucester	0	400
WSWL0000070414	Woodstown Water Dept.	Salem	0	425
WSWL0000070417	Pennsville Township Water Dept.	Salem	248	250

Table 2.3-10 (Sheet 4 of 11)
Summary of Public Water Supply Wells within a 25-Mile Radius of the PSEG Site[c]

Well Identification	Owner	County	Total Depth[a]	Pump Rate (gpm)
New Jersey, cont.				
WSWL0000070418	Salem Water Dept.	Salem	157	500
WSWL0000070420	South Jersey Water Supply Co.	Gloucester	285	120
WSWL0000070435	Penns Grove Water Supply Co.	Salem	392	275
WSWL0000070444	Laux Lakeview Mobile Home Park Inc.	Gloucester	0	100
WSWL0000070445	Laux Lakeview Mobile Home Park Inc.	Gloucester	0	100
WSWL0000070446	Laux Lakeview Mobile Home Park Inc.	Gloucester	0	65
WSWL0000070447	Laux Lakeview Mobile Home Park Inc.	Gloucester	0	100
WSWL0000070835	Bridgeton Water Dept.	Cumberland	93	525
WSWL0000070838	Seabrook Water Co.	Cumberland	0	600
WSWL0000070839	Seabrook Water Co.	Cumberland	0	600
WSWL0000070888	Tips Trailer Park & Sales	Cumberland	0	0
WSWL0000070889	Tips Trailer Park & Sales	Cumberland	0	40
WSWL0000078126	Consumers NJ Water Co.	Gloucester	0	350
WSWL0000078127	Consumers NJ Water Co.	Gloucester	0	350
WSWL0000091158	South Jersey Water Supply Co.	Gloucester	270	1200
WSWL0000138942	Bridgeton Water Dept.	Cumberland	94	0
WSWL0000138947	Bridgeton Water Dept.	Cumberland	400	500
WSWL0000138948	Bridgeton Water Dept.	Cumberland	0	500
WSWL0000138949	Salem Water Dept.	Salem	165	324
WSWL0000138950	Bridgeton Water Dept.	Cumberland	405	500
WSWL0000139268	Bridgeton Water Dept.	Cumberland	108	0
WSWL0000139269	Bridgeton Water Dept.	Cumberland	92	0
WSWL0000176817	Pennsville Township Water Dept.	Salem	153	0

Table 2.3-10 (Sheet 5 of 11)
Summary of Public Water Supply Wells within a 25-Mile Radius of the PSEG Site[c]

Well Identification	Owner	County	Total Depth[a]	Pump Rate (gpm)
New Jersey, cont.				
WSWL0000176818	Pennsville Township Water Dept.	Salem	269	0
WSWL0000190792	NJ American Water Co.	Gloucester	105	700
WSWL0000191667	Hopewell Place Senior Apartments	Cumberland	82	75
WSWL0000191528	Holly Tree Acres	Salem	0	20
WSWL0000191530	Fairton Trailer Park	Cumberland	60	0
WSWL0000191565	Picnic Grove Mobile Homes	Salem	0	24
WSWL0000191567	Country Club Estates Mobile Home	Salem	0	50
WSWL0000191568	Harrison Mobile Park	Salem	93	25
WSWL0000191573	Harrison Mobile Park	Salem	0	25
WSWL0000191681	Handy's Mobile Park	Salem	187	30
WSWL0000191682	Harding Woods Mobile Home Park	Salem	105	200
WSWL0000215097	Seabrook Water Co.	Cumberland	335	30
WSWL0000215958	Pennsville Township Water Dept.	Salem	0	500
WSWL0000293710	Country Club Estates Mobile Home	Salem	0	15
WSWL0000454591	Rainbow Convalescent Center	Salem	88	30
WSWL0000475741	Rainbow Convalescent Center	Salem	90	30
WSWL0000708077	J & J Community Park	Cumberland	563	20
WSWL0000824635	Pennsville Township Water Dept.	Salem	0	500
WSWL0000831109	Woodstown Water Dept.	Salem	155	200
WSWL0000842061	Penns Grove Water Supply Co.	Salem	0	275

Table 2.3-10 (Sheet 6 of 11)
Summary of Public Water Supply Wells within a 25-Mile Radius of the PSEG Site[c]

Well Identification	Owner	Watershed	Total Depth[a]	Pump Rate (gpm)
Delaware				
84445	St. Georges	C & D Canal East	142	10
168612	DelDOT	Dragon Run Creek	59	10
69050	Hollingsworth, Diamond State	Dragon Run Creek	250	10
69051	Petroleum, Eastern	Dragon Run Creek	160	10
69052	Stapleford, Charles Sr.	Dragon Run Creek	302	10
90632	Parkway Gravel Inc.	C & D Canal East	160	30
171554	Edwards, Richard	Red Lion Creek	85	10
177079	71 Holding Company	C & D Canal East	275	15
65280	Madic Inc., Michael	C & D Canal East	76	20
63015	Thirty Three, Forty Limited	C & D Canal East	37	10
80752	Motiva Enterprises LLC	Red Lion Creek	45	10
77305	St Georges Association	Dragon Run Creek	275	20
94029	DelDOT	Dragon Run Creek	64	20
79910	Blaschko, John W.	Red Lion Creek	50	10
90632	Parkway Gravel Inc.	C & D Canal East	160	30
91916	Parkway Gravel	C & D Canal East	200	30
96341	Blaschko, John W.	Red Lion Creek	35	10
102661	Buttocoula, Louis	Appoquinimink River	152	10
192969	Whiteman, Marty	Appoquinimink River	125	10
102872	Genes Body Shop	Appoquinimink River	39	10
103777	New Castle County	Appoquinimink River	190	60
105016	Hearne, William A.	Appoquinimink River	200	0
107232	Whiteman, Mike	Appoquinimink River	100	50

Table 2.3-10 (Sheet 7 of 11)
Summary of Public Water Supply Wells within a 25-Mile Radius of the PSEG Site[c]

Well Identification	Owner	Watershed	Total Depth[a]	Pump Rate (gpm)
Delaware, cont.				
105151	Zoar Methodist Church	Appoquinimink River	201	20
154043	Glorious Church of God	Blackbird Creek	140	20
158489	Frog Hollow LLC	Appoquinimink River	162	30
161541	Artesian Water Company Inc.	Appoquinimink River	118	20
167920	McKeown, Robert	Appoquinimink River	157	10
185045	Stanley Builders	Appoquinimink River	184	10
190088	Delaware Solid Waste Authority	Blackbird Creek	132	20
204315	Averill, Ron	Blackbird Creek	70	10
202974	New Castle County	Appoquinimink River	121	20
36214	Wyoming Block Co.	Blackbird Creek	157	60
50682	Tappahanna	Blackbird Creek	30	5
62905	Mummford & Miller, Concrete	Appoquinimink River	200	20
72425	Salvage, Fred D.	Blackbird Creek	150	20
74671	Calotex, Delaware Inc.	Blackbird Creek	120	10
77049	Middletown Seventh-Day Adventist	Appoquinimink River	95	20
77648	Mumford & Mille	Appoquinimink River	90	10
83331	Harvey & Harvey	Blackbird Creek	130	20
91490	DEL DOT Div of Highways	Appoquinimink River	118	10
43962	Kirkwood Soccer Club	Army Creek	215	900
43963	Artesian Water Company Inc.	Army Creek	225	300
101760	Artesian Water Company Inc.	Army Creek	170	700
103480	Crab Rib	C & D Canal East	105	10
106649	United Water Delaware	Dragon Run Creek	295	25

Table 2.3-10 (Sheet 8 of 11)
Summary of Public Water Supply Wells within a 25-Mile Radius of the PSEG Site[c]

Well Identification	Owner	Watershed	Total Depth[a]	Pump Rate (gpm)
Delaware, cont.				
194042	Parkway Gravel	Red Lion Creek	152	25
194043	Parkway Gravel	Red Lion Creek	187	25
194044	Parkway Gravel	Red Lion Creek	402	25
36504	City of Delaware City	Dragon Run Creek	720	300
62314	Chesapeake, Canal Partners	C & D Canal East	280	10
83253	Colonial School	Dragon Run Creek	350	30
88603	Mullins, William F.	C & D Canal East	80	20
80405	Shopping Center (undesignated)	Dragon Run Creek	120	20
78555	Carroll, Chester	Dragon Run Creek	250	20
80167	Colonial School,	Dragon Run Creek	700	0
10429	State of DE DAS/DFM	C & D Canal East	190	100
90048	Crab Rib	C & D Canal East	120	20
99719	U.S. Postal Service	Army Creek	208	10
1[b]	Gunning Bedford	Dragon Run Creek	341	0
169693	Diamond State Realty Co.	C & D Canal East	125	20
89283	Farm Land Holdings LLC	C & D Canal East	125	30
89284	Farm Land Holdings LLC	C & D Canal East	135	30
89285	Farm Land Holdings LLC	C & D Canal East	130	30
101153	Stanley Builders	C & D Canal East	505	300
102151	Artesian Water Company Inc	C & D Canal East	400	400
102224	Hickey, John & Amy	C & D Canal East	135	10
104063	U.S. Army Corps of Engineers	C & D Canal East	268	20
105156	Artesian Water Company Inc.	C & D Canal East	495	100

Table 2.3-10 (Sheet 9 of 11)
Summary of Public Water Supply Wells within a 25-Mile Radius of the PSEG Site[c]

Well Identification	Owner	Watershed	Total Depth[a]	Pump Rate (gpm)
Delaware, cont.				
105157	Davis, Leola B.	C & D Canal East	792	0
156288	Artesian Water Company Inc.	C & D Canal East	625	50
162618	Artesian Water Company Inc.	C & D Canal East	152	0
199537	Tidewater Utilities	C & D Canal East	170	0
41871	Lester, Earl	C & D Canal East	80	30
39786	Mazik, Ken	Dragon Run Creek	289	20
53347	Buckson, Newlin	C & D Canal East	37	10
43368	Reybold Homes	Dragon Run Creek	240	80
68944	Tidewater Utilities, Inc.	C & D Canal East	80	0
68945	Norfolk Southern Railroad	C & D Canal East	230	75
59152	Walker, Guy	C & D Canal East	165	20
54126	Mt. Pleasant Trailer Park	C & D Canal East	45	25
75180	Common Wealth	C & D Canal East	115	10
78973	Tidewater Utilities, Inc.	C & D Canal East	160	160
99469	Artesian Water Company Inc.	C & D Canal East	534	580
82242	Tidewater Utilities, Inc.	C & D Canal East	80	160
82244	Tidewater Utilities, Inc.	C & D Canal East	95	160
74785	Gentlemens Farmers Rest Inc.	C & D Canal East	103	150
84135	Tidewater Utilities, Inc.	C & D Canal East	120	0
10757	Commodore Macdo	Dragon Run Creek	35	0
1202	DNREC-Fish & Wildlife	C & D Canal East	105	0
98112	Artesian Water Company	C & D Canal East	300	0
93214	New Group Investments	Appoquinimink River	160	30

Table 2.3-10 (Sheet 10 of 11)
Summary of Public Water Supply Wells within a 25-Mile Radius of the PSEG Site[c]

Well Identification	Owner	Watershed	Total Depth[a]	Pump Rate (gpm)
Delaware, cont.				
99806	Artesian Water Company Inc.	Appoquinimink River	740	800
102217	Gilchrist, Robert A.	Appoquinimink River	200	80
109874	Artesian Water Company Inc.	Appoquinimink River	435	0
110612	Artesian Water Company Inc.	Appoquinimink River	330	200
108202	Artesian Water Company Inc.	Appoquinimink River	450	300
111065	Artesian Water Company Inc.	Appoquinimink River	740	300
111968	Artesian Water Company Inc.	Appoquinimink River	238	0
168004	Conoco, Inc.	Appoquinimink River	220	15
178412	St Andrews School of DE, Inc.	Appoquinimink River	389	15
188292	Artesian Water Company Inc.	Appoquinimink River	983	550
179292	Tidewater Utilities, Inc.	Appoquinimink River	180	90
185186	Artesian Water Company Inc.	Appoquinimink River	300	250
185232	Tidewater Utilities, Inc.	Appoquinimink River	230	75
196919	Artesian Water Company Inc.	Blackbird Creek	300	250
39676	Town of Middletown	Appoquinimink River	846	250
37195	New Castle County	Appoquinimink River	70	25
58805	Pre Holding Hampstead LLC	Appoquinimink River	201	35
53259	Bailey, James	Blackbird Creek	310	20
72100	Justice of the Peace	Appoquinimink River	118	10
89852	Reed, Charolet	Appoquinimink River	170	40
70172	Howard Cohen, Middletown	Appoquinimink River	165	25
82787	Diamond	Appoquinimink River	201	20
10454	Wicks, Christopher	Appoquinimink River	375	250

Table 2.3-10 (Sheet 11 of 11)
Summary of Public Water Supply Wells within a 25-Mile Radius of the PSEG Site[c]

Well Identification	Owner	Watershed	Total Depth[a]	Pump Rate (gpm)
Delaware, cont.				
10745	Cantwell Water	Appoquinimink River	228	0
10746	Cantwell Water	Appoquinimink River	168	0
10765	Children Castle	Appoquinimink River	150	0
10766	St Andrews School of DE, Inc	Appoquinimink River	650	0
10767	St Andrews School of DE, Inc	Appoquinimink River	181	0
10772	Delaware State	Appoquinimink River	206	0
71254	Tidewater Utilities, Inc.	Appoquinimink River	163	250
96299	Tidewater Utilities, Inc.	C & D Canal East	160	150
96300	Tidewater Utilities, Inc.	C & D Canal East	170	150
98363	Fas Mart	Blackbird Creek	160	10
30021	Camp Ground Inco, Delmarva	Blackbird Creek	165	0
30022	Williams Assoc.	Blackbird Creek	178	0
97960	Tidewater Utilities, Inc.	Appoquinimink River	220	80
33392	Hampson, Leonora	Appoquinimink River	200	50
84852	Reed, Charolet	Appoquinimink River	160	40
585	South Market	Appoquinimink River	200	0
30148	Townsend	Blackbird Creek	206	150
10099	City of Delaware City	Dragon Run Creek	235	100
58900	Odessa Motel, Larry Cox	Appoquinimink River	201	20

a) Depths provided in feet below ground surface.
b) Permit number presented as in the DE DNR database, however, the number is likely an error.
c) Public water supply wells within DE and NJ not inclusive of wells that are mapped in wellhead protection areas. Wellhead protection areas in DE and NJ are shown on Figure 2.3-20.

References 2.3-39 and 2.3-25

Table 2.3-11 (Sheet 1 of 8)
Summary of Groundwater Users within the 25-Mile Radius[b]

Program ID	Program Interest Name	Activity Number[a]	Activity type Description	Effective Start Date	Expiration Date
Gloucester County, NJ					
2029P	Air Products & Chemicals Inc.	WAP980001	Water Allocation Permit - Renewal	6/23/1999	12/31/2010
5383	Aqua New Jersey Inc. (Woolwich)	WAP050002	Water Allocation Permit - Minor Modification	1/1/2006	12/31/2010
2272P	Beckett Golf Club Inc.	WAP990001	Water Allocation Permit - Renewal	10/30/2002	12/31/2010
2401P	BP Terminal No. 4555	WAP070001	Water Allocation Permit - Renewal	12/1/2008	11/30/2018
2530P	Bridgeport Disposal LLC	WAP050001	Water Allocation Permit - Minor Modification	6/1/2005	4/30/2014
2495E	Chemical Leaman Tanklines	EQP080001	Water Allocation Permit Equivalency - Renewal	10/1/2008	9/30/2018
5244	Clayton Borough Water Dept.	WAP040001	Water Allocation Permit - Modification	4/1/2005	3/31/2015
2014P	Colonial Estates	WAP080001	Water Allocation Permit - Renewal	11/1/2008	10/31/2018
5336	Deptford Township Municipal Utilities Authority	WAP070001	Water Allocation Permit - Administrative Modification	5/1/2007	12/31/2010
5142	East Greenwich Township	WAP060001	Water Allocation Permit - Renewal	1/1/2007	12/31/2016
2251P	E.I. Dupont Denemours & Company Inc. Repauno Plant	WAP040002	Water Allocation Permit - Renewal	9/1/2005	8/31/2015
2099P	Ferro Corp	WAP070001	Water Allocation Permit - Minor Modification	5/9/2007	7/31/2014
5135	Glassboro Borough Water Dept.	WAP080001	Water Allocation Permit - Renewal	11/1/2008	10/31/2018
2280P	Gloucester County Pitman Golf Course	WAP030001	Water Allocation Permit - Renewal	10/1/2004	12/31/2013
2423P	Grasso Foods Inc.	WAP990001	Water Allocation Permit - Renewal	6/30/2000	12/31/2010

Table 2.3-11 (Sheet 2 of 8)
Summary of Groundwater Users within the 25-Mile Radius[b]

Program ID	Program Interest Name	Activity Number[a]	Activity type Description	Effective Start Date	Expiration Date
Gloucester County, NJ, cont.					
5253	Greenwich Township Water Dept.	WAP000001	Water Allocation Permit - Renewal	10/19/2001	12/31/2010
2469E	Helen Kramer Landfill Superfund Site	EQP080001	Water Allocation Permit Equivalency - Renewal	10/1/2008	9/30/2018
2227P	Hercules Groundwater Treatment	WAP070002	Water Allocation Permit - Minor Modification	1/1/2008	4/30/2012
2391P	Inversand Co.	WAP960001	Water Allocation Permit - Renewal	1/20/1998	12/31/2010
4059PS	Logan Generating Company LP	WAP050001	Water Allocation Permit - Renewal	11/1/2006	10/31/2016
5314	Mantua Township Municipal Utilities Authority	WAP080001	Water Allocation Permit - Minor Modification	9/1/2008	6/30/2012
2291P	Maple Ridge Golf Course	WAP010001	Water Allocation Permit - Renewal	10/24/2002	12/31/2011
5161	Monroe Township Municipal Utilities Authority	WAP050001	Water Allocation Permit - Modification	6/1/2007	5/31/2017
5153	National Park Borough Water Dept.	WAP070001	Water Allocation Permit - Renewal	4/1/2008	3/31/2018
5147	Newfield Borough Water Dept.	WAP030001	Water Allocation Permit - Renewal	8/1/2004	6/30/2014
5375	NJ American Water - Bridgeport	WAP070001	Water Allocation Permit - Modification	8/1/2008	7/31/2018
5183	NJ American Water - Harrison	WAP070002	Water Allocation Permit - Hearing Appeal Modification	4/1/2008	7/31/2017
5003	NJ American Water Logan System	WAP030001	Water Allocation Permit - Renewal	3/1/2004	12/31/2013

Table 2.3-11 (Sheet 3 of 8)
Summary of Groundwater Users within the 25-Mile Radius[b]

Program ID	Program Interest Name	Activity Number[a]	Activity type Description	Effective Start Date	Expiration Date
Gloucester County, NJ, cont.					
2425P	Nustar Asphalt Refining LLC	WAP040001	Water Allocation Permit - Minor Modification	9/1/2005	10/31/2012
5130	Paulsboro Water Dept.	WAP070001	Water Allocation Permit - Renewal	10/1/2007	9/30/2017
5137	Pitman Borough Water Dept.	WAP000001	Water Allocation Permit - Renewal	10/30/2002	2/28/2011
2215P	Preferred Real Estate Investments	WAP060001	Water Allocation Permit - Renewal	4/1/2007	3/31/2012
2336P	RE Pierson Materials Corp.	WAP020001	Water Allocation Permit - Renewal	9/1/2003	2/28/2013
4073PS	River Winds at West Deptford	WAP990001	Water Allocation Permit - New	4/17/2003	11/30/2012
2543P	Sahara Sand ff Franklin Inc.	WAP020001	Water Allocation Permit - New	3/26/2003	11/30/2012
2234P	Solvay Solexis Inc.	WAP080001	Water Allocation Permit - Modification	4/1/2009	3/31/2019
2205P	Sunoco Inc. (R&M) Eagle Point Facility	WAP060001	Water Allocation Permit - Administrative Modification	10/1/2006	6/30/2015
5105	Swedesboro Water Dept.	WAP010001	Water Allocation Permit - Renewal	11/26/2001	10/31/2011
2424E	USEPA Lipari Landfill Superfund Site	EQP910001	Water Allocation Permit Equivalency - New	12/2/1991	
2204P	Valero Refining Co. - NJ	WAP070002	Water Allocation Permit - Renewal	7/1/2008	6/30/2018
1281D	Valero Refining Co. NJ	DWP080001	Temporary Dewatering Permit - New	6/1/2009	7/31/2012
2177P	Violet Packing LLC	WAP980001	Water Allocation Permit - Renewal	12/30/1999	12/31/2010
5194	Washington Township Municipal Utilities Association	WAP060001	Water Allocation Permit - Modification	2/1/2008	1/31/2018
5192	Wenonah Borough Water Dept.	WAP010001	Water Allocation Permit - Renewal	9/11/2002	1/31/2011

Table 2.3-11 (Sheet 4 of 8)
Summary of Groundwater Users within the 25-Mile Radius[b]

Program ID	Program Interest Name	Activity Number[a]	Activity type Description	Effective Start Date	Expiration Date
Gloucester County, NJ, cont.					
5304	West Deptford Township - Public Works	WAP050001	Water Allocation Permit - Renewal	11/1/2006	10/31/2016
5319	Westville Borough Water Dept.	WAP000001	Water Allocation Permit - Renewal	1/31/2003	12/31/2010
2257P	Westwood Golf Club	WAP060001	Water Allocation Permit - Renewal	5/1/2007	4/30/2017
2365P	Wheelabrator Gloucester Co. LP	WAP980001	Water Allocation Permit - Renewal	12/30/1999	12/31/2010
5347X	Woodbury City Water Dept	WAP030001	Water Allocation Permit - Renewal	9/1/2004	8/31/2012
5347X	Woodbury City Water Dept	WAP990001	Water Allocation Permit - Modification	9/1/2004	8/31/2012
5159	Woodbury Heights Borough Water Utility	WAP060001	Water Allocation Permit - Renewal	4/1/2007	3/31/2017
Salem County, NJ					
2413P	B & B Poultry Co. Inc.	WAP060001	Water Allocation Permit - Renewal	12/1/2007	11/30/2017
2104P	Deepwater Generating Station	WAP980001	Water Allocation Permit - Renewal	3/20/2001	12/31/2010
2122P	Dupont Chambers Works	WAP070002	Water Allocation Permit - Minor Modification	11/1/2007	5/31/2012
5215	Elmer Borough Water Dept.	WAP990001	Water Allocation Permit - Renewal	12/1/2003	11/30/2013
5170	Harding Woods Mobile Home Park	WAP040001	Water Allocation Permit - Administrative Modification	7/29/1999	2/28/2009
5328	NJ American Water - Pennsgrove	WAP070002	Water Allocation Permit - Minor Modification	6/1/2007	7/31/2016
2421P	Pedricktown Cogeneration Company	WAP070001	Water Allocation Permit - Renewal	7/1/2008	6/30/2018

Table 2.3-11 (Sheet 5 of 8)
Summary of Groundwater Users within the 25-Mile Radius[b]

Program ID	Program Interest Name	Activity Number[a]	Activity type Description	Effective Start Date	Expiration Date
Salem County, NJ, cont.					
5047	Pennsville Township Water Dept.	WAP020001	Water Allocation Permit - Modification	10/1/2005	9/30/2015
2166P	Polyone Corp.	WAP080001	Water Allocation Permit - Minor Modification	12/1/2008	12/30/2014
2216P	Salem and Hope Creek Generating Station	WAP040001	Water Allocation Permit - Minor Modification	1/1/2005	1/31/2010
5290	Salem City Water Dept.	WAP020001	Water Allocation Permit - Modification	5/1/2005	3/31/2015
2528P	Town & Country Golf Links	WAP010001	Water Allocation Permit - New	1/1/2006	12/31/2015
2497P	Wild Oaks Country Club	WAP050001	Water Allocation Permit - Renewal	5/1/2007	4/30/2012
5167	Woodstown Borough Water Dept.	WAP070001	Water Allocation Permit - Modification	6/1/2009	5/31/2019
Cumberland County, NJ					
2095P	Alcan Packaging Inc.	WAP070001	Water Allocation Permit - Minor Modification	8/1/2008	6/30/2012
2010P	Atlantic Coast Freezers	WAP080001	Water Allocation Permit - Renewal	10/1/2008	9/30/2018
5398	Berrymans Branch Mobile Home Park	WAP070001	Water Allocation Permit - New	7/1/2008	6/30/2018
5032	Bridgeton City Water Dept.	WAP980001	Water Allocation Permit - Modification	8/1/2003	1/31/2013
2448P	Cape May Foods LLC doing business as Lamonica Fine Foods	WAP020001	Water Allocation Permit - Renewal	11/1/2003	9/30/2012

Table 2.3-11 (Sheet 6 of 8)
Summary of Groundwater Users within the 25-Mile Radius[b]

Program ID	Program Interest Name	Activity Number[a]	Activity type Description	Effective Start Date	Expiration Date
Cumberland County, NJ, cont.					
2220P	Clement Pappas Co. Inc.	WAP010001	Water Allocation Permit - Renewal	9/27/2002	1/31/2011
5364	Fairton Federal Correctional Institute	WAP970001	Water Allocation Permit - Renewal	12/23/1997	12/31/2010
5399	Fairview Manor Mobile Home Park	WAP070001	Water Allocation Permit - New	5/1/2008	4/30/2018
2552P	Gerresheimer Glass Inc.	WAP030001	Water Allocation Permit - Minor Modification	8/12/2004	7/31/2014
2254P	Hanson Aggregates	WAP990001	Water Allocation Permit - Modification	3/26/2003	12/31/2012
2098P	Kimble Glass Inc.	WAP980001	Water Allocation Permit - Renewal	6/14/2002	12/31/2010
2436P	Mays Landing Sand & Gravel Co. Dorchester Plant	WAP070001	Water Allocation Permit - Renewal	3/1/2008	2/28/2018
5316	Millville City Water Dept.	WAP980001	Water Allocation Permit - Renewal	9/10/2002	6/30/2011
2467E	Nascolite (Potentially Responsible Parties) Group	EQP950001	Water Allocation Permit Equivalency - New	3/24/1995	
5367	NJ State Prison Bayside	WAP980001	Water Allocation Permit - Modification	2/21/2002	3/31/2010
2443P	Purex Industries	WAP010001	Water Allocation Permit - Renewal	10/30/2002	10/31/2011
2030P	Ricci Brothers Sand Co.	WAP070001	Water Allocation Permit - Minor Modification	5/1/2007	5/31/2016
2221P	Seabrook Farms	WAP050001	Water Allocation Permit - Renewal	4/1/2006	3/31/2016
2237P	Shieldalloy Metallurgical Corp.	WAP060001	Water Allocation Permit - Renewal	8/1/2007	7/31/2017
2440P	South State Inc.	WAP980001	Water Allocation Permit - Renewal	12/29/1998	12/31/2010

Table 2.3-11 (Sheet 7 of 8)
Summary of Groundwater Users within the 25-Mile Radius[b]

Program ID	Program Interest Name	Activity Number[a]	Activity type Description	Effective Start Date	Expiration Date
Cumberland County, NJ, cont.					
2219P	Unimin Corp	WAP050002	Water Allocation Permit - Renewal	7/1/2006	6/30/2016
5376	Upper Deerfield Township	WAP070001	Water Allocation Permit - Modification	4/1/2008	3/31/2018
2485E	USEPA Region II Vineland Chemical Co. Superfund	EQP070002	Water Allocation Permit Equivalency - Modification	8/1/2008	7/31/2018
2003P	US Silica Co	WAP040001	Water Allocation Permit - Modification	4/1/2005	3/31/2015
2282P	US Silica Co. Port Elizabeth Plant	WAP080001	Water Allocation Permit - Renewal	7/1/2008	6/30/2018
5148	Vineland City Water Utility	WAP060001	Water Allocation Permit - Modification	8/1/2007	7/31/2017
2405P	Vineland Kosher Poultry Co.	WAP040001	Water Allocation Permit - Minor Modification	5/1/2004	12/31/2010
2026P	Whibco Inc.	WAP970001	Water Allocation Permit - Renewal	6/30/1997	5/31/2008
Delaware					
53066	Star Enterprises	NA	Dragon Run Creek	2/1/1983	10/24/1983
53066	Star Enterprises	NA	Dragon Run Creek	2/1/1983	10/24/1983
216229	Highland View LLC	NA	Dragon Run Creek	10/3/2006	3/2/2007
216229	Highland View LLC	NA	Dragon Run Creek	10/3/2006	3/2/2007
10059	Motiva Enterprises LLC	NA	Dragon Run Creek	1/1/1956	1/1/1956
10059	Motiva Enterprises LLC	NA	Dragon Run Creek	1/1/1956	1/1/1956

Table 2.3-11 (Sheet 8 of 8)
Summary of Groundwater Users within the 25-Mile Radius[b]

Program ID	Program Interest Name	Activity Number[a]	Activity type Description	Effective Start Date	Expiration Date
Delaware, cont.					
43962	Kirkwood Soccer Club	NA	Army Creek	7/23/1979	9/17/1979
163874	Motiva Enterprises LLC	NA	Dragon Run Creek	2/19/1999	9/16/1999
163874	Motiva Enterprises LLC	NA	Dragon Run Creek	2/19/1999	9/16/1999

a) NA – “Activity numbers” are not a Delaware Department of Natural Resources database field
b) Public water supply wells within DE and NJ. Summary includes permitted groundwater use of greater than 100,000 gallons per day.

References 2.3-25 and 2.3-39

Table 2.3-12
Observation Well Installation Details

Well ID	Northing NAD83[b]	Easting NAD83[b]	Screen Interval (ft. bgs)	Reference Point Elevation[a] (ft. NAVD 88)	Formation
New Plant Location					
NOW-1U	234542.7	198443.4	46-56	15.20	Alluvium
NOW-1L	234564.0	198449.8	80-90	15.19	Vincentown
NOW-2U	235207.4	197754.9	52-62	10.80	Alluvium
NOW-2L	235227.7	197752.8	103-113	11.18	Vincentown
NOW-3U	234552.8	197885.2	40-50	7.71	Alluvium
NOW-3L	234565.5	197897.9	90-100	7.66	Vincentown
NOW-4UB	233963.0	198147.1	42-52	13.56	Alluvium
NOW-4L	233972.7	198147.9	73-83	14.08	Vincentown
NOW-5U	234907.5	198444.5	20-30	10.23	Hydraulic Deposits
NOW-5L	234927.5	198438.4	90-100	10.54	Vincentown
NOW-6U	235269.4	198313.5	35-45	8.59	Alluvium
NOW-6L	235287.9	198312.8	80-90	7.95	Vincentown
NOW-7U	234975.8	199694.3	48-58	8.25	Alluvium / Vincentown Boundary
NOW-7L	234973.4	199675.9	85-95	8.70	Vincentown
NOW-8U	234141.6	199755.9	37-47	11.68	Alluvium
NOW-8L	234139.1	199736.2	100-110	11.61	Vincentown
Eastern Location					
EOW-1U	232321.6	202758.0	38-48	18.01	Alluvium
EOW-1L	232297.6	202758.1	95-105	17.91	Vincentown
EOW-2U	233274.6	202157.9	39-49	16.51	Alluvium
EOW-2L	233271.5	202177.7	99-109	16.73	Vincentown
EOW-4U	231791.9	202012.1	22-32	22.73	Hydraulic Deposits
EOW-4L	231772.9	202021.2	110.2-120.2	22.31	Vincentown
EOW-5U	233056.8	203007.3	35-45	15.85	Alluvium
EOW-5L	233039.7	203021.5	110-120	16.17	Vincentown
EOW-6U	232587.1	203281.4	47-57	15.99	Alluvium
EOW-6L	232588.1	203300.7	90-100	15.23	Vincentown
EOW-8U	231144.2	203520.4	30-40	18.38	Alluvium
EOW-8L	231163.5	203516.0	67-77	17.89	Vincentown
EOW-9U	230917.2	202826.0	50-60	20.67	Alluvium
EOW-9L	230925.6	202844.6	117.5-127.5	18.21	Vincentown
EOW-10U	231687.2	203521.3	17-27	14.79	Alluvium
EOW-10L	231706.7	203521.9	85-95	14.27	Vincentown

ft. bgs = feet below ground surface, determined from well installation records
a) Reference point elevation includes any modifications made to well riser
b) NJ State Plane Coordinate System; U.S. Survey Feet

Table 2.3-13
Groundwater Elevations (ft. NAVD), January to December 2009

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Avg	Std dev	Range
New Plant Area – Hydraulic Fill															
NOW-5U	2.54	2.04	2.12	2.07	1.20	2.74	2.59	2.12	2.55	2.87	2.53	3.20	2.38	0.51	2.0
New Plant Area – Alluvium															
NOW-1U		0.36	0.61	0.59	0.66	1.32	1.14	0.94	1.13	1.22	1.18	-0.48	0.79	0.53	1.80
NOW-2U	-0.10	-0.42	-0.48	-0.17	-0.08	2.04	-0.41	1.72	2.08	2.19	-0.20	0.88	0.59	1.11	2.67
NOW-3U	-0.21	-0.36	0.15	-0.19	0.18	1.20	0.56	0.66	1.13	1.18	0.60	1.23	0.51	0.59	1.59
NOW-4UB		0.03	0.46	0.36	0.40	1.18	1.00	0.75	0.95	1.09	0.95	1.34	0.77	0.41	1.31
NOW-6U	0.50	0.35	0.76	0.62	0.65	1.35	1.12	0.98	1.31	1.31	1.15	1.44	0.96	0.37	1.09
NOW-7U	0.40	0.18	0.74	0.77	0.79	1.40	1.14	1.07	1.41	1.46	1.01	1.64	1.00	0.44	1.46
NOW-8U	0.72	0.41	0.84	0.74	0.86	1.57	1.24	1.21	1.38	1.39	1.15	1.57	1.09	0.37	1.16
New Plant Area – Vincentown															
NOW-1L		0.25	0.56	0.50	0.65	1.58	1.07	1.14	1.54	1.66	1.02	1.67	1.06	0.51	1.42
NOW-2L	-0.05	-0.31	-0.32	-0.20	0.74	2.16	-0.17	1.86	2.82	2.15	-0.01	1.10	0.81	1.16	3.14
NOW-3L	-0.14	-0.25	-0.40	0.10	-0.99	1.63	0.10	1.69	1.90	1.38	0.61	1.25	0.57	0.97	2.89
NOW-4L	-0.71	-0.30	-0.01	-0.16	0.37	1.70	0.43	1.20	1.80	1.56	0.43	1.45	0.65	0.86	2.51
NOW-5L	0.54	-0.19	0.31	0.35	0.52	1.54	0.93	0.73	1.54	1.59	0.65	1.57	0.84	0.60	1.78
NOW-6L	-0.11	-0.08	0.26	0.17	-0.58	1.56	0.88	0.80	1.54	1.63	1.04	0.21	0.61	0.74	2.21
NOW-7L	0.39	-0.81	0.59	0.70	0.71	1.11	0.87	0.94	1.34	1.39	0.75	1.51	0.79	0.61	2.32
NOW-8L	0.50	0.36	0.70	0.79	0.90	1.54	1.15	1.14	1.44	1.43	1.08	1.51	1.05	0.40	1.18
Eastern Location – Hydraulic Fill															
EOW-4U	13.66	13.20	12.90	13.91	13.88	13.50	12.33	12.26	13.99	13.35	14.03	15.33	13.36	0.63	1.77
Eastern Location – Alluvium															
EOW-1U	0.95	0.90	1.20	1.08	1.18	1.74	1.51	(a)	2.54	1.59	1.52	1.79	1.45	0.47	1.64
EOW-2U	2.92	2.80	2.83	2.49	2.70	3.02	2.96	(a)	2.74	3.09	2.87	3.40	2.89	0.24	0.91
EOW-5U	1.03	0.83	1.16	1.10	1.19	1.70	1.45	1.43	1.61	1.59	0.51	1.78	1.28	0.38	1.27
EOW-6U	1.00	0.79	1.20	1.12	1.16	1.71	1.45	1.43	1.59	1.60	1.49	1.78	1.36	0.30	0.99
EOW-8U	0.72	1.02	1.47	0.95	1.27	-0.21	1.73	1.65	1.46	1.70	1.46	2.27	1.29	0.63	2.48
EOW-9U	-0.06	0.08	0.50	0.55	0.35	1.20	0.78	0.75	1.21	1.13	0.86	2.69	0.84	0.71	2.75
EOW-10U	0.52	1.43	1.37	1.32	1.39	2.07	1.58	1.52	1.71	1.85	1.86	2.30	1.58	0.45	1.78
Eastern Location – Vincentown															
EOW-1L	0.79	0.62	0.92	0.98	0.95	1.59	1.29	(a)	1.59	1.59	1.27	1.59	1.20	0.36	0.97
EOW-2L	1.06	0.74	1.25	1.18	1.12	1.74	1.42	1.39	1.76	1.67	1.43	1.72	1.37	0.32	1.02
EOW-4L	0.62	0.51	1.09	0.90	1.00	1.75	1.33	1.19	1.85	1.91	(a)	1.59	1.25	0.48	1.40
EOW-5L	1.09	0.92	1.30	1.25	0.86	1.79	1.51	2.39	1.78	1.74	1.49	1.77	1.49	0.44	1.53
EOW-6L	0.98	0.70	1.30	1.14	1.06	-0.12	1.45	0.47	1.80	0.74	1.45	1.74	1.06	0.55	1.92
EOW-8L	0.12	0.13	0.60	0.55	0.68	1.48	0.94	0.85	1.59	1.61	1.05	1.27	0.91	0.52	1.49
EOW-9L	0.45	0.41	0.68	0.77	0.97	1.68	1.28	1.05	1.86	1.86	1.18	1.49	1.14	0.51	1.45
EOW-10L	0.60	0.66	1.12	0.94	0.35	1.66	1.36	1.24	1.71	1.76	1.34	1.61	1.20	0.47	1.41

a) Data evaluated as inconsistent with data set and therefore not used for ESPA evaluation.

b) Blank cell indicates no reading.

Table 2.3-14

Groundwater Elevation Data Range (in Feet NAVD 88) for HCGS and SGS Groundwater Wells, 2000 – 2009

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Mount Laurel/Wenonah[(a)]	3.08 to -3.12	3.68 to -1.12	4.08 to 0.16	3.28 to 0.86	3.48 to -7.82	13.78 to 0.68	3.58 to 1.08	3.56 to 0.96	3.88 to 1.58	3.78 to 1.36
Salem Well (PW-2)	2.36 to -1.64	2.26 To -0.14	2.96 to 0.16	2.66 to 0.86	2.96 to -0.14	10.06 to 1.36	2.66 to .56	3.56 to 0.96	2.76 to 1.66	3.26 to 1.36
Salem Well (PW-3)	3.08 to -3.12	3.68 to -1.12	3. 48 to 0.28	3.28 to 0.88	3.48 to -7.82	13.78 to 0.68	3.58 to 1.08	2.98 to 0.98	3.88 to 1.58	3.78 to 1.48
Middle Raritan[(a)]	-35.85 to -64.75	-42.45 to -54.15	-42.45 to 45.15	-40.45 to -45.65	-41.55 to -52.65	-35.75 to -45.45	-44.75 to -46.25	-45.35 to -48.35	-45.35 to -51.35	-43.65 to -48.75
Salem Well (PW-6)	-35.85 to -64.75	-42.45 to -54.15	-42.45 to -45.15	-40.45 to -45.65	-41.55 to -52.65	-35.75 to -45.45	-44.75 to -46.25	-45.85 To -48.35	-45.35 to -51.35	-43.65 to -48.75
Upper Raritan[(a)]	-28.93 to -68.35	-41.53 to -72.13	-54.33 to -74.94	-55.73 to -74.35	-57.94 to -84.35	-60.94 to -86.35	-53.94 to -81.35	-55.94 to -83.35	-53.93 to -88.35	-57.73 to -83.94
Salem Well (PW-5)	-28.93 to -67.73	-41.53 to -72.13	-54.33 to -66.23	-55.73 to -70.73	-58.23 to -78.13	-64.33 to -80.73	-59.33 to -75.33	-63.03 to -79.63	-54.63 to -74.33	-57.73 to -71.03
Hope Creek Well (HC-1)	-59.94 to -67.94	-58.94 to -65.94	-57.94 to -74.94	-60.94 to -71.94	-57.94 to -83.94	-60.94 to -74.94	-53.94 to -73.94	-55.94 to -65.94	-53.94 to -71.94	-60.94 to -83.94
Hope Creek Well (HC-2)	-61.35 to -68.35	-60.35 to -70.35	-58.35 to -74.35	-61.35 to -74.35	-69.35 to -84.35	-73.35 to -86.35	-69.35 to -81.35	-70.35 to -83.35	-63.35 to -88.35	-60.35 to -75.45

a) The aquifer range includes data from all production wells monitored in that aquifer. Individual well ranges are provided directly below the summary line.

Reference 2.3-48

Table 2.3-15
Summary of Horizontal Hydraulic Gradients

	Maximum Hydraulic Gradient (ft/ft)	Average Gradients (ft/ft)	Gradients From Average Potentiometric Surface[a] (ft/ft)
New Plant Location – Alluvium			
Measured	0.00235	0.00042	0.00050
Fixed Locations[b]	0.00139	0.00066	0.00050
New Plant Location – Vincentown			
Measured	0.00200	0.00048	0.00062
Fixed Locations[b]	0.00293	0.00069	0.00088
Eastern Location – Alluvium			
Measured	0.00407	0.00188	0.00092
Fixed Locations[b]	0.00099	0.00045	0.00045
Eastern Location – Vincentown			
Measured	0.00167	0.00024	0.00019
Fixed Locations[b]	0.00025	0.00004	0.00004

Notes:

a) Gradients from Average Potentiometric Surface are calculated from the contours generated from the average groundwater elevations considering data collected from January 2009 through December 2009.

b) Gradients calculated from the fixed locations: gradients are calculated from the head difference between NOW-1U/L and NOW-3U/L for the new plant location and between EOW 1U/L and EOW 9L/U for the eastern location.

Table 2.3-16 (Sheet 1 of 2)
Summary of Vertical Hydraulic Gradients

Well ID	Screen Interval (ft. bgs)	Reference Point Elevation[(a)] (ft. NAVD 88)	Observed Aquifer/Aquitard	Average Groundwater Elevation (ft. NAVD 88)	Center Point of Well Screen (ft. bgs)	Distance (ft. NAVD 88)	Average Vertical Gradient (ft.)
New Plant Location							
NOW-1U	46-56	15.20	Alluvium	0.92	51	34	-0.00412
NOW-1L	80-90	15.19	Vincentown	1.06	85		
NOW-2U	52-62	10.80	Alluvium	0.59	57	51	-0.00431
NOW-2L	103-113	11.18	Vincentown	0.81	108		
NOW-3U	40-50	7.71	Alluvium	0.51	45	50	-0.00120
NOW-3L	90-100	7.66	Vincentown	0.57	95		
NOW-4UB	42-52	13.56	Alluvium	0.77	47	31	0.00387
NOW-4L	73-83	14.08	Vincentown	0.65	78		
NOW-5U	20-30	10.23	Hydraulic Fill	2.6	25	70	0.02514
NOW-5L	90-100	10.54	Vincentown	0.84	95		
NOW-6U	35-45	8.59	Alluvium	0.96	40	45	0.00778
NOW-6L	80-90	7.95	Vincentown	0.61	85		
NOW-7U	48-58	8.25	Upper Vincentown/ Alluvium	1.0	53	37	0.00162
NOW-7L	85-95	8.70	Vincentown	0.94	90		
NOW-8U	37-47	11.68	Alluvium	1.09	42	63	0.00063
NOW-8L	100-110	11.61	Vincentown	1.05	105		
Eastern Location							
EOW-1U	38-48	18.01	Alluvium	1.45	43	57	0.00439
EOW-1L	95-105	17.91	Vincentown	1.2	100		
EOW-2U	39-49	16.51	Alluvium	2.89	44	60	0.02533
EOW-2L	99-109	16.73	Vincentown	1.37	104		
EOW-4U	22-32	22.73	Hydraulic Fill	14.56	27	88	0.15125
EOW-4L	110-120	22.31	Vincentown	1.25	115		
EOW-5U	35-45	15.85	Alluvium	1.28	40	65	-0.00323
EOW-5L	110-120	16.17	Vincentown	1.49	105		

Table 2.3-16 (Sheet 2 of 2)
Summary of Vertical Hydraulic Gradients

Well ID	Screen Interval (ft. bgs)	Reference Point Elevation[(a)] (ft. NAVD 88)	Observed Aquifer/Aquitard	Average Groundwater Elevation (ft. NAVD 88)	Center Point of Well Screen (ft. bgs)	Distance (ft. NAVD 88)	Average Vertical Gradient (ft.)
Eastern Location, cont.							
EOW-6U	47-57	15.99	Alluvium	1.36	52	43	0.00442
EOW-6L	90-100	15.23	Vincentown	1.17	95		
EOW-8U	30-40	18.38	Alluvium	1.43	35	37	0.01405
EOW-8L	67-77	17.89	Vincentown	0.91	72		
EOW-9U	50-60	20.67	Alluvium	0.67	55	67.5	-0.00696
EOW-9L	117.5-127.5	18.21	Vincentown	1.14	122.5		
EOW-10U	17-27	14.79	Alluvium	1.67	22	68	0.00691
EOW-10L	85-95	14.27	Vincentown	1.2	90		

a) Reference point elevation includes any modifications made to well riser
b) ft. bgs = feet below ground surface, determined from well installation records
b) Negative values indicate an upward vertical hydraulic gradient

Table 2.3-17
Summary of Average Hydraulic Conductivities

Well	Formation	Average Result (ft./day)
Shallow		
NOW-1U	Alluvium	8.0
NOW-2U	Alluvium	8.0
NOW-3U	Alluvium	0.3
NOW-4UB	Alluvium	0.9
NOW-5U	Hydraulic Fill	0.2
NOW-6U	Alluvium	3.5
NOW-7U	Vincentown	1.4
NOW-8U	Alluvium	0.4
Deep		
NOW-1L	Vincentown	4.5
NOW-2L	Vincentown	3.6
NOW-3L	Vincentown	1.4
NOW-4L	Vincentown	10.7
NOW-5L	Vincentown	1.7
NOW-6L	Vincentown	6.2
NOW-7L	Vincentown	2.4
NOW-8L	Vincentown	0.3

Table 2.3-18
Summary of Tidal Study Results

Measurement Location	Unit	Barge Slip	NOW-1L	NOW-1U	NOW-3L	NOW-3U
Max High Tide	ft. NAVD 88	3.57	1.38	Tidal influence not observed in this observation well	2.03	0.95
Min High Tide	ft. NAVD 88	2.36	1.12		1.5	0.58
Max Low Tide	ft. NAVD 88	-3.52	0.65		-0.75	0.41
Min Low Tide	ft. NAVD 88	-2.27	0.86		-0.18	0.09
Average Tidal Shift	ft.	5.85	0.49		2.26	0.56
Average Periodicity	hr.	6.9	6.5		7	7.3
Average Phase Lag to Barge Slip	min.	N/A	-66		-19	-62

Table 2.3-19
Summary of Surface Water and Shallow Groundwater Elevations at Piezometers

Location ID	1/30/2009	2/27/2009	3/29/2009	4/24/2009	5/22/2009	6/19/2009	7/23/2009	8/16/2009	9/17/2009	10/16/2009	11/11/2009	12/10/2009
AS-01 - inside	N/A	NM	N/A	N/A	0.64	N/A	NM	N/A	NM	N/A	N/A	1.12[a]
AS-01 - outside	N/A	NM	N/A	N/A	Dry	N/A	NM	N/A	NM	N/A	N/A	-0.43[a]
AS-02 - inside	N/A	NM	N/A	N/A	-0.04	N/A	0.20	N/A	0.14	N/A	N/A	N/A
AS-02 - outside	N/A	NM	N/A	N/A	2.52	N/A	1.75	N/A	1.59	N/A	N/A	N/A
AS-03 - inside	N/A	NM	N/A	N/A	-1.99	N/A	-1.94	N/A	-2.02	N/A	N/A	N/A
AS-03 - outside	N/A	NM	N/A	N/A	-0.23	N/A	-0.15	N/A	-2.02	N/A	N/A	N/A
AS-04 - inside	Frozen	4.19	4.04	4.49	4.34	4.09	3.55	3.02	3.73	3.55	3.88	4.32
AS-04 - outside	4.32	4.18	4.16	4.38	4.30	4.16	3.63	3.12	3.67	3.52	3.82	4.37
AS-05 - inside	-0.41	0.54	0.17	0.58	-0.23	1.40	1.15	-3.63	1.63	1.21	1.27	1.46
AS-05 - outside	0.58	-0.09	-0.21	-0.13	-0.29	1.23	0.10	0.25	3.31	2.98	0.48	0.97
AS-06 - inside	0.80	0.93	1.14	0.83	0.86	1.74	Dry	0.73	3.09	3.23	1.95	1.87
AS-06 - outside	1.20	Dry	Dry	Dry	Dry	2.51	1.09	Dry	Dry	Dry	Dry	Dry
AS-08-pre-outside[b]	0.70	0.82	0.68	0.70	0.73	2.71	0.81	1.47	3.50	1.46	1.42	0.80
AS-08-pre-inside[b]	0.51	0.76	0.89	1.43	1.00	1.54	1.37	1.11	1.86	3.42	-2.17	2.27
AS-08-post-outside[b]	1.70	NM	2.25	1.87	1.26	Dry	0.76	1.48	3.25	NM	Dry	0.77
AS-08-post-inside[b]	0.46	NM	1.43	1.21	1.04	Dry	1.34	2.80	1.90	NM	Dry	2.00
AS-09 - inside	Frozen	5.76	5.45	6.00	5.84	5.94	3.98	5.82	5.85	3.00	5.82	5.97
AS-09 - outside	6.24	5.87	5.89	5.97	5.81	5.93	5.37	5.83	5.83	5.75	5.80	6.17
AS-10 - inside	1.84	3.12	2.99	3.45	3.15	3.32	2.62	3.02	3.47	-0.06	3.42	3.70
AS-10 - outside	3.52	3.14	3.12	3.24	3.09	3.11	2.95	3.02	3.25	3.08	3.17	3.68
AS-11 - inside	N/A	NM	N/A	N/A	0.09	N/A	1.08	N/A	1.06	N/A	N/A	N/A
AS-11 - outside	N/A	NM	N/A	N/A	0.70	N/A	2.11	N/A	2.04	N/A	N/A	N/A

Elevation data reported in feet NAVD 88
N/A = not applicable
NM = could not be sampled / not measured
a) Data measured on 1/07/10
b) The first and last reading of each event is conducted at PZ-8 so that a tidal change encompassing all water measurements can be evaluated

Table 2.3-20
Water Withdrawal Estimates (Mgd) by Source in Delaware River Basin – Lower Estuary and Bay Regions

	Groundwater			Surface Water		
	1995	2020	2040	1995	2020	2040
Total Withdrawals						
Lower Estuary	50.5	60.5	86.9	3586.5	5056.7	6285.1
Delaware Bay	89.7	92.5	108.2	67.2	65.7	64.4
Consumptive Use						
Lower Estuary	11.1	11.6	13.8	41.0	51.0	59.7
Delaware Bay	29.0	26.2	25.1	16.7	15.3	14.1

Reference 2.3-19

Table 2.3-21
Peak Month Withdrawal and Consumptive Uses by Sector for Dry Year (1995) and Wet Year (1996)

Sector	Peak Withdrawal (Mgd)		Peak Consumptive Use (Mgd)	
	1995	1996	1995	1996
Agriculture	186.5	93.5	167.9	84.1
Commercial/Industrial	13.9	12.0	1.4	1.2
Public Water Supply	1057.3	959.7	224.7	204.0
Domestic	89.5	6.3	18.4	1.3
Mining	113.5	103.5	17.0	15.5
Non-Agricultural Irrigation	17.8	8.3	16.0	7.5
Industrial	1174.1	893.9	55.6	46.5
Hydroelectric Power Generation	322.8	446.7	0.0	0.0
Thermoelectric Power Generation	5973.4	6272.9	85.4	82.1
Other	19.6	9.4	0.5	0.2
Totals	8968.4	8806.2	587.1	442.4

Reference 2.3-19

Table 2.3-22
Delaware River Basin Water Supply Reservoirs

Reservoir	Purpose[a]	Storage (Million Gallons) WS/WSA/P	Storage (Million Gallons) Flood Loss Reduction	Location
Water Supply				
Penn Forest	WS	6510		Wild Creek; Carbon County, PA
Wild Creek	WS	3910		Wild Creek; Carbon County, PA
Still Creek	WS	2701		Still Creek; Schuylkill County, PA
Ontelaunee	WS	3793		Martins Creek; Berks County, PA
Green Lane	WS	4376		Perkiomen Creek; Montgomery County, PA
Geist	WS	3512		Crum Creek; Delaware County, PA
Edgar Hoopes	WS	2199		Tributary to Red Clay Creek; New Castle County, DE
Union Lake	WS	3177		Maurice River; Cumberland County, NJ
Hopatcong	WS[b]	5995		Musconetcong River; Sussex, Morris County, NJ
Nockamixon	WS[c]	11,990		Tohickon Creek; Bucks County, PA
New York City Reservoirs				
Cannonsville	WS, WSA	98,400		West Branch Delaware River; Delaware County, NY
Neversink	WS, WSA	35,581		Neversink River, Sullivan County, NY
Pepacton	WS, WSA	147,926		East Branch Delaware River; Delaware County, NY
Hydroelectric Power Generation				
Lake Wallenpaupack	P	29,813		Wallenpaupack Creek; Wayne County, PA
Mongaup System	P	15,314		Mongaup River, Sullivan County, NY
Multipurpose or Flood Loss Reduction				
Prompton	FL	None	6614	West Branch Lackawaxen River; Wayne County, PA
Beltzville	WSA, FL	12,978	8797	Pohopoco Creek; Carbon County, PA
Marsh Creek	WS, WSA, FL[d]	4040	1160	Marsh Creek; Chester County, PA
Chambers Lake	WS, WSA	383	None	Birch Run; Chester County, PA
Blue Marsh	WSA, FL	4757	10,554	Tulpehocken Creek; Berks County, PA
Lake Galena	WS, FL	1629	1127	North Branch Neshaminy Creek; Bucks County, PA
Francis E. Walter	FL	None	35,190	Lehigh River; Luzerne, Carbon County, PA
Jadwin	FL	None	7983	Dyberry Creek; Wayne County, PA
Merrill Creek	WSA	15,640	None	Merrill Creek; Hunterdon County, NJ
Total Storage		414,624		

a) WS – Water Supply, WSA – water supply primarily for flow augmentation, P – hydroelectric power generation, FL – Flood Loss
b) Emergency use only
c) Used for flow maintenance during emergencies
d) Used for flow maintenance in Brandywine Creek

Reference 2.3-19

Table 2.3-23
Water Withdrawals and Consumptive Use by Power Generation Facilities (1995 Average Demands)

Site Name	Withdrawal (Mgd)	Consumptive Use (Mgd)	
		Actual	EIF Adjusted
Exelon – Limerick Unit	35.6	27.1	27.1
PSEG – Salem and Hope Creek	2473.4	15.3	2.3
Exelon – Eddystone Unit	716.1	4.3	3.6
Connective – Hay Road	537.8	4.1	2.4
PSEG – Mercer Station	461.4	2.9	2.9
Wheelabrator Gloucester County, LP	16.3	1.6	1.6
Reliant Energy – Gilbert (1-3)	15.1	1.5	1.5
Reliant Energy – Portland	219.7	1.5	1.5
Logan Generating County, LP	1.4	1.4	1.0
PP&L – Martins Creek	58.3	1.4	1.4
Exelon – Cromby	223.0	1.3	1.3
Reliant Energy – Titus (surface water withdrawal)	12.9	1.1	1.1
Wheelabrator Frackville Energy County Inc.	1.7	1.1	1.1
Panther Creek Partners	1.0	1.0	1.0
Reliant Energy – Yards Creek	7.2	0.7	0.7
PSEG – Burlington Station	85.5	0.6	0.6
Northampton Generating- Lehigh River	0.6	0.6	0.6
Exelon – Delaware Unit	75.4	0.5	0.5
Conectiv – Deepwater Station	103.3	0.4	0.2
Chambers Cogen - Carneys Point	3.1	0.3	0.2
Exelon – Schuylkill Unit	36.8	0.3	0.3
Warren Energy Resource County, LP	0.2	0.1	0.1
Peco Energy Co – Richmond	1.3	0.1	0.1
Reliant Energy Gilbert (8)	1.2	0.1	0.1
Northeastern Power – Silverbrook Mine	0.1	0.1	0.1
Pedricktown Cogen/Conectiv	0.5	0.0	0.0
Reliant Energy – Titus (Wells)	0.2	0.0	0.0
Tractebel Electricity & Gas	0.1	0.0	0.0
Reliant Energy – Gilbert	0.0	0.0	0.0
Great Bear Hydropower, Inc.	145.4	0.0	0.0
PP&L – Wallenpaupack	189.0	0.0	0.0
Total	5423.6	69.4	53.3

EIF – Equivalent Impact Factor
Reference 2.3-19

Table 2.3-24
HCGS and SGS Annual Groundwater Pumpage (Mgy) (2002 – 2009)

Water Supply Well	Pumpage								
	Pump Limit	2002 Pumpage	2003 Pumpage	2004 Pumpage	2005 Pumpage	2006 Pumpage	2007 Pumpage	2008 Pumpage	2009 Pumpage
Salem Generating Station									
PW-2	300 gpm	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
PW-3	600 gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PW-5	800 gpm	87.2	98.5	107.9	133.8	108	104	127.3	112.1
PW-6	600 gpm	1.7	1.6	4.2	3.7	1	8	13.2	8.7
Total Groundwater Pumpage per Year	N/A	89 (169 gpm)	100 (190 gpm	112 (213 gpm)	138 (262 gpm)	109 (207 gpm)	112 (213 gpm)	141 (267 gpm)	121 (230 gpm)
Hope Creek Generating Station									
HC-1	750 gpm	36.5	38.5	49.7	36.7	39.7	49.6	40.8	34.7
HC-2	750 gpm	35.5	34.9	53.9	44.8	41.7	47.5	42.7	44.7
Total Groundwater Pumpage per Year	N/A	72 (137 gpm)	73 (140 gpm)	104 (197 gpm)	82 (155 gpm)	81 (155 gpm)	97 (185 gpm)	84 (159 gpm)	79 (151 gpm)
Total Salem and Hope Creek Generating Stations									
Groundwater Pumpage per Year	N/A	161 (306 gpm)	174 (330 gpm)	216 (410 gpm)	219 (417 gpm)	190 (362 gpm)	209 (398 gpm)	224 (426 gpm)	200 (381 gpm)

N/A – Not Applicable
References 2.3-48, 2.3-49, 2.3-50, 2.3-51, and 2.3-52

Table 2.3-25 (Sheet 1 of 2)
Summary of Analytical Data – Artificial Pond Locations (AS-8)

Chem Class	Parameter	Units	Detects	Samples	Min DL[(a)]	Max DL[(a)]	Min	Max	Mean[(b)]
Metals (Total)	Calcium	mg/L	4	4			78.6	115	99
	Lead	mg/L	4	4			0.0025	0.0066	0.0048
	Magnesium	mg/L	4	4			192	288	250
	Potassium	mg/L	0	4			62.4	91	78
	Sodium	mg/L	4	4			1600	2490	2100
	Zinc	mg/L	4	4			0.0184	0.0321	0.026
	Mercury	mg/L	0	4	0.0002	0.0002			
Inorganics	Alkalinity, Total	mg/L	4	4			60.8	65.7	63
	Ammonia	mg/L	4	4			0.058	0.31	0.13
	Biochemical Oxygen Demand	mg/L	4	4			0.84	5.2	2.4
	Chemical Oxygen Demand	mg/L	4	4			46.9	74.8	67
	Chloride	mg/L	4	4			2940	5070	4200
	Cyanide, Total	mg/L	1	4	0.03	0.03	0.0425	0.0425	
	Hardness as CaCO3	mg/L	4	4			987	1470	1300
	Nitrate as N	mg/L	3	4	0.1	0.1	0.29	0.59	0.32
	Nitrate+Nitrite as N	mg/L	3	4	1	1	0.7	2.2	1.3
	Nitrite as N	mg/L	2	4	2.5	5	0.15	1.2	1.3
	Nitrogen, Total Kjeldahl	mg/L	4	4			0.36	0.64	0.52
	Orthophosphate	mg/L	0	4	0.1	0.5			
	Phosphorus, Total as P	mg/L	4	4			0.16	0.23	0.19
	Sulfate	mg/L	4	4			365	638	500
	Total Dissolved Solids	mg/L	4	4			5340	7780	6800
	Total Suspended Solids	mg/L	4	4			85	207	150

Table 2.3-25 (Sheet 2 of 2)
Summary of Analytical Data – Artificial Pond Locations (AS-8)

Chem Class	Parameter	Units	Detects	Samples	Min DL[(a)]	Max DL[(a)]	Min	Max	Mean[(b)]
Radionuclides	Tritium	pCI/L	0	5	-110	210			
Chlorophyll	Chlorophyll a, Corrected	mg/m^3	4	4			5.3	16	12
	Pheophytin-a	mg/m^3	4	4			2.7	17	8.7
Coliform	Fecal Coliform	COL/100 ml	5	5			6	TNTC	NA
	Fecal Streptococcus	COL/100 ml	5	5			12	TNTC	NA
	Total Coliform	COL/100 m;	5	5			67	TNTC	NA
Field Parameters	Specific Conductivity	µSiemens/cm	5	5			7390	25,000	13,000
	Dissolved Oxygen	mg/L	5	5			7.7	12.9	11
	pH	S.U.	5	5			4.7	8.4	6.5
	Salinity	ppt	5	5			4	14	8.2
	Temperature	°C	5	5			3	30	17
	Turbidity	NTUs	5	5			39.5	381	150

mg/L - milligram per liter
pCi/L - picoCurie per liter
mg/m^3 - milligram per meter cube
COL/100 ml - Colony Forming Units per 100 milliliter
µSiemens/cm - microSiemens per centimeter
S.U. - standard units
g/L - gram per liter
°C - degrees Celsius
NTU - Nephelometric Turbidity Units
ppt - parts per thousand
TNTC- too numerous to count

a.) Range of non-detects represents the range of detection limits for non-detects. Detection limits for Tritium represent the range of minimum detectable activity which may be reported as a positive or negative value depending upon the calculated uncertainty associated with each sample.
b.) Average values were calculated using one half the detection limit for those samples reported as non detected and where more than one detection was reported.

Table 2.3-26 (Sheet 1 of 2)
Summary of Analytical Data – Artificial Pond Locations (AS-4, AS-9, AS-14)

Chem Class	Parameter	Units	Detects	Samples	Min DL[(a)]	Max DL[(a)]	Min	Max	Mean[(b)]
Metals (Total)	Calcium	mg/L	12	12			23.3	75.3	56
	Lead	mg/L	8	12	0.0025	0.005	0.00057	0.0099	0.0027
	Magnesium	mg/L	12	12			23.3	94.2	61
	Potassium	mg/L	12	12			16.2	31.1	23
	Sodium	mg/L	12	12			243	496	410
	Zinc	mg/L	8	12	0.025	0.05	0.0067	0.0463	0.017
	Mercury	mg/L	0	12	0.0002	0.0002			
Inorganics	Alkalinity, Total	mg/L	12	12			115	304	0.18
	Ammonia	mg/L	12	12			0.058	0.45	7.6
	Biochemical Oxygen Demand	mg/L	12	12			2.9	26.2	69
	Chemical Oxygen Demand	mg/L	12	12			23.9	158	660
	Chloride	mg/L	12	12			314	951	390
	Cyanide, Total	mg/L	1	12	0.01	0.01	0.0043	0.0043	
	Hardness as CaCO3	mg/L	12	12			213	572	0.061
	Nitrate as N	mg/L	1	12	0.1	0.1	0.18	0.18	
	Nitrate+Nitrite as N	mg/L	5	12	0.5	1	0.12	1.1	0.38
	Nitrite as N	mg/L	6	12	0.5	1	0.055	0.6	2.4
	Nitrogen, Total Kjeldahl	mg/L	12	12			0.8	5.9	0.096
	Orthophosphate	mg/L	1	12	0.1	0.1	0.15	0.15	
	Phosphorus, Total as P	mg/L	12	12			0.075	0.59	180
	Sulfate	mg/L	12	12			33.3	530	1500
	Total Dissolved Solids	mg/L	12	12			887	2060	49
	Total Suspended Solids	mg/L	12	12			3.7	314	91

Table 2.3-26 (Sheet 2 of 2)
Summary of Analytical Data – Artificial Pond Locations (AS-4, AS-9, AS-14)

Chem Class	Parameter	Units	Detects	Samples	Min DL[(a)]	Max DL[(a)]	Min	Max	Mean[(b)]
Radionuclides	Tritium	pCI/L	1	12	70	270	270	270	
Chlorophyll	Chlorophyll a, Corrected	mg/m^3	12	12			14	178	52
	Pheophytin-a	mg/m^3	10	12	1	1	8	114	31
Coliform	Fecal Coliform	COL/100 ml	11	12	1	1	1	90	32
	Fecal Streptococcus	COL/100 ml	12	12			2	72	36
	Total Coliform	COL/100 m;	12	12			13	TNTC	NA
Field Parameters	Specific Conductivity	µSiemens/cm	13	13			1170	28,400	6378
	Dissolved Oxygen	mg/L	13	13			5	1198	101
	pH	S.U.	13	13			5.93	8.1	7.29
	Salinity	ppt	12	13	1	1	1	2	1.1
	Temperature	°C	13	13			3	29	19.38
	Turbidity	NTUs	13	13			10.1	712	123.72

mg/L - milligram per liter
pCi/L - picoCurie per liter
mg/m^3 - milligram per meter cube
COL/100 ml - Colony Forming Units per 100 milliliter
µSiemens/cm - microSiemens per centimeter
S.U. - standard units
g/L - gram per liter
°C - degrees Celsius
NTU - Nephelometric Turbidity Units
ppt - parts per thousand
TNTC- too numerous to count

a) Range of non-detects represents the range of detection limits for non-detects. Detection limits for Tritium represent the range of minimum detectable activity which may be reported as a positive or negative value depending upon the calculated uncertainty associated with each sample.
b) Average values were calculated using one half the detection limit for those samples reported as non detected and where more than one detection was reported.

Table 2.3-27 (Sheet 1 of 2)
Summary of Analytical Data – Marsh Locations (AS-1, AS- 2, AS- 3, AS-5, AS-6, AS-10, and AS-11)

Chem Class	Parameter	Units	Detects	Samples	Min DL[(a)]	Max DL[(a)]	Min	Max	Mean[(b)]
Metals (Total)	Calcium	mg/L	28	28			43	122	74
	Lead	mg/L	25	28	0.0025	0.005	0.0011	0.0087	0.0036
	Magnesium	mg/L	28	28			56	356	150
	Mercury	mg/L	0	28	0.0002	0.0002			
	Potassium	mg/L	28	28			19.9	111	46
	Sodium	mg/L	28	28			334	2940	1200
	Zinc	mg/L	28	28			0.0129	0.34	0.045
Inorganics	Alkalinity, Total	mg/L	28	28			53.2	278	110
	Ammonia	mg/L	27	28	0.1	0.1	0.033	0.4	0.13
	Biochemical Oxygen Demand	mg/L	27	28	2	2	1.1	79.8	5.2
	Chemical Oxygen Demand	mg/L	28	28			10.8	103	43
	Chloride	mg/L	28	28			548	6150	2300
	Cyanide, Total	mg/L	1	28	0.01	0.01	0.0308	0.0308	
	Hardness as CaCO3	mg/L	28	28			339	1770	790
	Nitrate as N	mg/L	17	28	0.1	1	0.077	1.1	0.34
	Nitrate+Nitrite as N	mg/L	22	28	1	2.5	0.28	2.5	1.1
	Nitrite as N	mg/L	12	28	0.1	10	0.094	1.2	0.99
	Nitrogen, Total Kjeldahl	mg/L	28	28			0.31	4.1	0.75
	Orthophosphate	mg/L	2	28	0.1	0.5	0.15	0.3	0.077
	Phosphorus, Total as P	mg/L	28	28			0.067	1.6	0.24
	Sulfate	mg/L	28	28			75.8	650	280
	Total Dissolved Solids	mg/L	28	28			1400	9200	3900
	Total Suspended Solids	mg/L	28	28			8	2460	150

Table 2.3-27 (Sheet 2 of 2)
Summary of Analytical Data – Marsh Locations (AS-1, AS- 2, AS- 3, AS-5, AS-6, AS-10, and AS-11)

Chem Class	Parameter	Units	Detects	Samples	Min DL(a)	Max DL(a)	Min	Max	Mean(b)
Radionuclides	Tritium	PCI/L	1	28	-70	310	290	290	
Chlorophyll	Chlorophyll a, Corrected	mg/m^3	28	28			2.2	243	21
	Pheophytin-a	mg/m^3	18	28	1	1	1.4	100	7
Coliform	Fecal Coliform	COL/100 ML	27	28	1	1	1	TNTC	NA
	Fecal Streptococcus	COL/100 ML	28	28			5	TNTC	NA
	Total Coliform	COL/100 ML	27	28	1	1	132	TNTC	NA
Field Parameters	Specific Conductivity	μSiemens/cm	29	29			1360	93,500	9477
	Dissolved Oxygen	mg/L	29	29			4.6	13.3	8.7
	pH	S.U.	29	29			4.7	8.6	6.8
	Salinity	ppt	29	29			1	9	3.4
	Temperature	°C	28	29	1	1	2	27	17.5
	Turbidity	NTUs	29	29			26.2	449	116.7

mg/L - milligram per liter
pCi/L - picoCurie per liter
mg/m^3 - milligram per meter cube
COL/100 ML - Colony Forming Units per 100 milliliter
μSiemens/cm - microSiemens per centimeter
S.U. - standard units
g/L - gram per liter
°C - degrees Celsius
NTU - Nephelometric Turbidity Units
ppt - parts per thousand
TNTC- too numerous to count

a) Range of non-detects represents the range of detection limits for non-detects. Detection limits for Tritium represent the range of minimum detectable activity which may be reported as a positive or negative value depending upon the calculated uncertainty associated with each sample.
b) Average values were calculated using one half the detection limit for those samples reported as non detected and where more than one detection was reported.

Table 2.3-28 (Sheet 1 of 2)
Summary of Analytical Data for Upper (Alluvium) New Plant Observation Well Locations

Chem Class	Parameter	Units	Detects	Samples	Min DL[(a)]	Max DL[(a)]	Min	Max	Mean[(b)]
Metals (Total)	Calcium	mg/L	32	32			89.4	365	170
	Iron	mg/L	32	32			3.66	57.9	33
	Lead	mg/L	13	32	0.0025	0.005	0.00099	0.0031	0.0021
	Magnesium	mg/L	32	32			84.9	328	240
	Mercury	mg/L	0	32	0.0002	0.0002			
	Potassium	mg/L	32	32			19.4	73	47
	Sodium	mg/L	32	32			1110	2660	1600
Metals (Dissolved)	Silica crystalline quartz	mg/L	32	32			14.4	55.9	33
Inorganics	Alkalinity, Total	mg/L	32	32			530	1390	1100
	Ammonia	mg/L	32	32			2.5	58.1	33
	Bicarbonate as HCO3	mg/L	32	32			530	1390	1100
	Biochemical Oxygen Demand	mg/L	28	32	2	20	1.7	256	39
	Carbon Dioxide	mg/L	32	32			36	150	95
	Chemical Oxygen Demand	mg/L	32	32			33.9	565	170
	Chloride	mg/L	32	32			1670	4160	2900
	Hardness as CaCO3	mg/L	32	32			1180	1940	1400
	Nitrate as N	mg/L	6	32	0.1	2	0.11	0.76	0.21
	Nitrate+Nitrite as N	mg/L	4	32	1	5	1.2	1.2	1.8
	Nitrite as N	mg/L	7	32	1	5	0.23	0.48	1.8
	Nitrogen, Total Kjeldahl	mg/L	29	32	0.1	0.5	0.6	17.3	6.5
	Orthophosphate	mg/L	0	32	0.1	0.1			
	Phosphorus, Total as P	mg/L	32	32			0.035	5.6	3
	Sulfate	mg/L	12	32	1	1	0.69	89.4	13
	Total Dissolved Solids	mg/L	32	32			4150	7030	5500
	Total Suspended Solids	mg/L	32	32			19	216	130

Table 2.3-28 (Sheet 2 of 2)
Summary of Analytical Data for Upper (Alluvium) New Plant Observation Well Locations

Chem Class	Parameter	Units	Detects	Samples	Min DL[(a)]	Max DL[(a)]	Min	Max	Mean[(b)]
Radionuclides	Tritium	pCI/L	0	32	-130	220			11
Coliform (CFU)	Fecal Coliform	COL/100 ml	1	32	1	1	2	2	0.55
	Fecal Streptococcus	COL/100 ml	9	32	1	1	1	54	5.9
	Total Coliform	COL/100 ml	11	32	1	1	8	TNTC	NA
Field Parameters	Specific Conductivity	µSiemens/cm	35	35			4160	95000	19000
	Dissolved Oxygen	mg/L	10	35	0.1	0.1	0.7	3.6	0.53
	Eh	mv	35	35			-240	15	-150
	pH	S.U.	35	35			6.5	10.4	7.0
	Salinity	ppt	35	35			2	9	5.4
	Temperature	°C	35	35			12	21	16
	Turbidity	NTUs	34	35	0.1	0.1	2.5	604	94

mg/L - milligram per liter
pCi/L - picoCurie per liter
mg/m³ - milligram per meter cube
COL/100 ML - Colony Forming Units per 100 milliliter
µSiemens/cm - microSiemens per centimeter
S.U. - standard units
g/L - gram per liter
°C - degrees Celsius
NTU - Nephelometric Turbidity Units
ppt - parts per thousand
TNTC- too numerous to count

a) Range of non-detects represents the range of detection limits for non-detects. Detection limits for Tritium represent the range of minimum detectable activity which may be reported as a positive or negative value depending upon the calculated uncertainty associated with each sample.
b) Average values were calculated using one half the detection limit for those samples reported as non detected and where more than one detection was reported.

Table 2.3-29 (Sheet 1 of 2)
Summary of Analytical Data for Upper (Alluvium) Eastern Observation Well Locations

Chem Class	Parameter	Units	Detects	Samples	Min DL[(a)]	Max DL[(a)]	Min	Max	Mean[(b)]
Metals (Total)	Calcium	mg/L	32	32			81.7	193	130
	Iron	mg/L	32	32			17	75.3	47
	Lead	mg/L	10	32	0.005	0.005	0.0014	0.02	0.0041
	Magnesium	mg/L	32	32			97.8	382	270
	Mercury	mg/L	1	32	0.0002	0.0002	0.00014	0.00014	
	Potassium	mg/L	32	32			27.3	87.3	69
	Sodium	mg/L	32	32			194	2710	1900
Metals (Dissolved)	Silica crystalline quartz	mg/L	32	32			8.14	47.8	26
Inorganics	Alkalinity, Total	mg/L	32	32			389	1310	960
	Ammonia	mg/L	32	32			9.5	49.9	33
	Bicarbonate as HCO3	mg/L	32	32			389	1310	960
	Biochemical Oxygen Demand	mg/L	32	32			1.6	237	31
	Carbon Dioxide	mg/L	32	32			34	140	79
	Chemical Oxygen Demand	mg/L	31	32	36	36	44.5	482	200
	Chloride	mg/L	32	32			61.5	5280	3500
	Hardness as CaCO3	mg/L	32	32			720	1890	1500
	Nitrate as N	mg/L	8	32	0.1	2	0.061	0.11	0.11
	Nitrate+Nitrite as N	mg/L	3	32	0.1	5	1.2	1.2	1.7
	Nitrite as N	mg/L	7	32	0.1	5	0.2	0.48	1.7
	Nitrogen, Total Kjeldahl	mg/L	29	32	0.5	2.6	2	51.4	8.4
	Orthophosphate	mg/L	0	32	0.1	0.1			
	Phosphorus, Total as P	mg/L	32	32			0.85	4.9	2.7
	Sulfate	mg/L	7	32	0.1	1	0.98	791	92
	Total Dissolved Solids	mg/L	32	32			1500	8270	6200
	Total Suspended Solids	mg/L	32	32			74	413	170

Table 2.3-29 (Sheet 2 of 2)
Summary of Analytical Data for Upper (Alluvium) Eastern Observation Well Locations

Chem Class	Parameter	Units	Detects	Samples	Min DL[(a)]	Max DL[(a)]	Min	Max	Mean[(b)]
Radionuclides	Tritium	pCI/L	2	32	-180	180	340	710	38
Coliform (CFU)	Fecal Coliform	COL/100 ml	1	32	1	1	29	29	
	Fecal Streptococcus	COL/100 ml	5	32	1	4	1	TNTC	NA
	Total Coliform	COL/100 ml	18	32	1	1	1	TNTC	NA
Field Parameters	Specific Conductivity	µSiemens/cm	32	32			2090	99,900	20,000
	Dissolved Oxygen	mg/L	18	32	0.1	0.1	0.1	6.5	0.76
	Eh	mv	32	32			-250	-1	-160
	pH	S.U.	32	32			6.4	10.4	7.1
	Salinity	ppt	32	32			1	40	8.1
	Temperature	°C	32	32			12	19	15
	Turbidity	NTUs	27	32	0.1	0.1	0.3	999	140

mg/L - milligram per liter
pCi/L - picoCurie per liter
mg/m³ - milligram per meter cube
COL/100 ML - Colony Forming Units per 100 milliliter
µSiemens/cm - microSiemens per centimeter
S.U. - standard units
g/L - gram per liter
°C - degrees Celsius
NTU - Nephelometric Turbidity Units
ppt - parts per thousand
TNTC- too numerous to count

a) Range of non-detects represents the range of detection limits for non-detects. Detection limits for Tritium represent the range of minimum detectable activity which may be reported as a positive or negative value depending upon the calculated uncertainty associated with each sample.
b) Average values were calculated using one half the detection limit for those samples reported as non detected and where more than one detection was reported.

Table 2.3-30 (Sheet 1 of 2)
Summary of Analytical Data for Lower (Vincentown) New Plant Observation Well Locations

Chem Class	Parameter	Units	Detects	Samples	Min DL[(a)]	Max DL[(a)]	Min	Max	Mean[(b)]
Metals (Total)	Calcium	mg/L	32	32			129	553	270
	Iron	mg/L	32	32			4	56.6	17
	Lead	mg/L	4	32	0.0025	0.005	0.00053	0.0134	0.0026
	Magnesium	mg/L	32	32			80.4	356	220
	Mercury	mg/L	0	32	0.0002	0.0002			0.000
	Potassium	mg/L	32	32			12.2	122	35
	Sodium	mg/L	32	32			1600	3030	2200
Metals (Dissolved)	Silica crystalline quartz	mg/L	32	32			8.87	36.5	19
Inorganics	Alkalinity, Total	mg/L	32	32			268	855	560
	Ammonia	mg/L	30	32	0.37	0.38	0.3	53	7.4
	Bicarbonate as HCO3	mg/L	32	32			268	855	560
	Biochemical Oxygen Demand	mg/L	26	32	2	4	2	128	11
	Carbon Dioxide	mg/L	32	32			1.2	60	30
	Chemical Oxygen Demand	mg/L	30	32	18.1	19.7	31.6	293	110
	Chloride	mg/L	32	32			3590	5750	4500
	Hardness as CaCO3	mg/L	32	32			809	1890	1600
	Nitrate as N	mg/L	2	32	0.1	2	0.11	0.36	0.19
	Nitrate+Nitrite as N	mg/L	2	32	1	5	1.2	1.2	2
	Nitrite as N	mg/L	7	32	1	5	0.22	0.48	2
	Nitrogen, Total Kjeldahl	mg/L	24	32	0.1	3.5	0.3	8.1	1.8
	Orthophosphate	mg/L	0	32	0.1	0.5			
	Phosphorus, Total as P	mg/L	32	32			0.053	3	0.35
	Sulfate	mg/L	29	32	1	1	0.64	238	58
	Total Dissolved Solids	mg/L	32	32			884	8900	7000
	Total Suspended Solids	mg/L	32	32			46	1130	100

Table 2.3-30 (Sheet 2 of 2)
Summary of Analytical Data for Lower (Vincentown) New Plant Observation Well Locations

Chem Class	Parameter	Units	Detects	Samples	Min DL[(a)]	Max DL[(a)]	Min	Max	Mean[(b)]
Radionuclides	Tritium	pCI/L	0	32	-110	160			
Coliform (CFU)	Fecal Coliform	COL/100 ml	2	32	1	1	1	1	0.53
	Fecal Streptococcus	COL/100 ml	4	32	1	1	1	38	2.1
	Total Coliform	COL/100 ml	15	32	1	1	4	TNTC	NA
Field Parameters	Specific Conductivity	µSiemens/cm	35	35			8070	83,600	16,000
	Dissolved Oxygen	mg/L	16	35	0.1	0.1	0.4	7	0.69
	Eh	mv	35	35			-390	-1	-160
	pH	S.U.	35	35			6.7	10.6	7.4
	Salinity	ppt	35	35			4	14	8.2
	Temperature	°C	35	35			11	19	15
	Turbidity	NTUs	27	35	0.1	0.1	0.2	637	59

mg/L - milligram per liter
pCi/L - picoCurie per liter
mg/m³ - milligram per meter cube
COL/100 ML - Colony Forming Units per 100 milliliter
µSiemens/cm - microSiemens per centimeter
S.U. - standard units
g/L - gram per liter
°C - degrees Celsius
NTU - Nephelometric Turbidity Units
ppt - parts per thousand
TNTC- too numerous to count

a) Range of non-detects represents the range of detection limits for non-detects. Detection limits for Tritium represent the range of minimum detectable activity which may be reported as a positive or negative value depending upon the calculated uncertainty associated with each sample.
b) Average values were calculated using one half the detection limit for those samples reported as non detected and where more than one detection was reported.

Table 2.3-31 (Sheet 1 of 2)
Summary of Analytical Data for Lower (Vincentown) Eastern Observation Well Locations

Chem Class	Parameter	Units	Detects	Samples	Min DL[(a)]	Max DL[(a)]	Min	Max	Mean[(b)]
Metals (Total)	Calcium	mg/L	32	32			169	757	440
	Iron	mg/L	32	32			1.6	86.6	31
	Lead	mg/L	1	32	0.0025	0.005	0.0028	0.0028	0.002
	Magnesium	mg/L	32	32			116	417	260
	Mercury	mg/L	0	32	0.0002	0.0002			0.000
	Potassium	mg/L	32	32			7.64	67.9	37
	Sodium	mg/L	32	32			2130	3120	2700
Metals (Dissolved)	Silica crystalline quartz	mg/L	32	32			14	31.9	26
Inorganics	Alkalinity, Total	mg/L	32	32			326	918	600
	Ammonia	mg/L	29	32	0.76	0.99	0.83	16.8	4.7
	Bicarbonate as HCO3	mg/L	32	32			326	918	600
	Biochemical Oxygen Demand	mg/L	28	32	2	4	0.74	139	13
	Carbon Dioxide	mg/L	32	32			23	100	61
	Chemical Oxygen Demand	mg/L	32	32			28.3	325	140
	Chloride	mg/L	32	32			4330	6730	5600
	Hardness as CaCO3	mg/L	32	32			1930	2420	2200
	Nitrate as N	mg/L	13	32	0.1	2	0.11	0.11	0.25
	Nitrate+Nitrite as N	mg/L	1	32	1	5	1.2	1.2	
	Nitrite as N	mg/L	5	32	1	5	0.44	0.46	2
	Nitrogen, Total Kjeldahl	mg/L	24	32	0.42	2.9	0.46	4.5	1.3
	Orthophosphate	mg/L	0	32	0.1	0.1			
	Phosphorus, Total as P	mg/L	32	32			0.09	2.3	0.69
	Sulfate	mg/L	32	32			12.6	281	97
	Total Dissolved Solids	mg/L	32	32			7470	10,000	9000
	Total Suspended Solids	mg/L	32	32			20.7	269	100

Table 2.3-31 (Sheet 2 of 2)
Summary of Analytical Data for Lower (Vincentown) Eastern Observation Well Locations

Chem Class	Parameter	Units	Detects	Samples	Min DL[(a)]	Max DL[(a)]	Min	Max	Mean[(b)]
Radionuclides	Tritium	pCI/L	0	32	-120	260			
Coliform (CFU)	Fecal Coliform	COL/100 ml	0	32	1	1			
	Fecal Streptococcus	COL/100 ml	1	32	1	1	2	2	
	Total Coliform	COL/100 ml	20	32	1	1	1	TNTC	NA
Field Parameters	Specific Conductivity	µSiemens/cm	33	33			12,900	79,800	20,000
	Dissolved Oxygen	mg/L	10	33	0.1	0.1	0.11	4.6	0.5
	Eh	mv	33	33			-310	-5	-140
	pH	S.U.	33	33			6.2	9.9	6.9
	Salinity	ppt	33	33			4	23	11
	Temperature	°C	33	33			9	17	15
	Turbidity	NTUs	16	33	0.1	0.1	2.4	179	24

mg/L - milligram per liter
pCi/L - picoCurie per liter
mg/m³ - milligram per meter cube
COL/100 ML - Colony Forming Units per 100 milliliter
µSiemens/cm - microSiemens per centimeter
S.U. - standard units
g/L - gram per liter
°C - degrees Celsius
NTU - Nephelometric Turbidity Units
ppt - parts per thousand
TNTC- too numerous to count

a) Range of non-detects represents the range of detection limits for non-detects. Detection limits for Tritium represent the range of minimum detectable activity which may be reported as a positive or negative value depending upon the calculated uncertainty associated with each sample.
b) Average values were calculated using one half the detection limit for those samples reported as non detected and where more than one detection was reported.

2.4 ECOLOGY

This section provides a description and characterization of the terrestrial and aquatic ecosystems potentially affected by the construction and operation of the new plant at the PSEG Site. Consultations with the NJDEP (Reference 2.4-142), DE Department of Natural Resources and Environmental Control (DNREC) (Reference 2.4-38), and U.S. Fish and Wildlife Service (USFWS) were initiated for information regarding ecological resources in the vicinity of the PSEG Site. This consultation process was used to obtain agency input regarding threatened and endangered species, sensitive habitats, commercial and recreational species, and other ecological characteristics for the site and vicinity.

2.4.1 TERRESTRIAL ECOLOGY

This subsection presents the terrestrial ecology of the PSEG Site and the 6-mi. vicinity based on historical data collected in support of HCGS and SGS licensing, recorded information provided by resource agencies, and supplemental field surveys conducted in 2009 - 2010. Historic field studies include plant and animal surveys conducted on and in the vicinity of the PSEG Site. These historic field studies include:

- Studies conducted on the terrestrial ecology of Artificial Island and vicinity including birds, mammals, herpetofauna (reptiles and amphibians), and vegetation (References 2.4-24, 2.4-87, 2.4-220, 2.4-221, 2.4-222).

- Wetland delineation studies documenting wetlands on and near the PSEG Site (References 2.4-1).

- Annual biological monitoring reports by PSEG (1995 to 2009) documenting vegetation and fish as part of the PSEG Estuary Enhancement Program (EEP) both on-site and in the PSEG Site vicinity (References 2.4-153 through 2.4-157 and 2.4-159 through 2.4-166).

- Terrestrial ecological studies conducted for the PSEG access road widening project in the early 1980s, documenting birds, mammals, vegetation and fish (Reference 2.4-158).

- Annual breeding bird surveys conducted by the USGS (1966 to 2007) along the Greenwich route within the vicinity of the PSEG Site (Reference 2.4-213).

- Annual mid-winter waterfowl surveys conducted by the USFWS (2005 to 2009) along Stow Creek, Hope Creek, and Alloway Creek (Reference 2.4-200).

- Annual Christmas Bird Count conducted by the Audubon Society (2004 to 2008) in Salem County (Reference 2.4-7).

Historical studies from the 1970s and 1980s are used as background information, but are not reported in detail as they may not reflect current conditions. Data from the last 5 yr was used as the primary source for characterization of existing baseline conditions, except for faunal groups such as mammals and herpetofauna where site-specific data were not available within the last 5 yr. Field studies of mammals and herpetofauna in the coastal marsh habitat were

based primarily on opportunistic observation, therefore older historical studies are used to provide a broader characterization of these faunal groups.

2.4.1.1 Terrestrial Habitats

Land use and land cover (LULC) data from NJDEP is used to identify land cover types at the PSEG Site and within the off-site areas potentially affected by the proposed causeway (Figures 2.4-1 and 2.4-2). This NJDEP database is used for the site and near off-site areas (causeway) in NJ as it provides a refinement of USGS LULC mapping. Field reconnaissance was performed within the PSEG Site to confirm the land cover types mapped by NJDEP. The LULC information presented in Figure 2.4-2 identifies the plant community types on the PSEG Site and in near off-site areas. Plant communities within this area represent terrestrial habitat types and are grouped into the three general habitat categories (wetland and aquatic habitat, old field habitat, and developed land uses).

The LULC information presented in Figure 2.4-3 identifies the land cover types within the 6-mi. vicinity. USGS LULC data is used for other areas within the 6-mi vicinity as this provides a unified land cover mapping system for both DE and NJ. Land cover types within this 6-mi. vicinity represent terrestrial habitat types in the following categories:

- open water
- developed open space
- developed low intensity
- developed medium intensity
- developed high intensity
- barren land
- deciduous forest
- evergreen forest
- mixed forest
- pasture hay
- cultivated crops
- woody wetlands
- emergent herbaceous wetlands

The locations of floral surveys conducted along eight walking transects established on the PSEG Site are depicted in Figure 2.4-4. Table 2.4-1 provides a list of habitats present at each transect location based on the LULC. Additionally, representative portions of the proposed causeway and areas adjacent to the existing access road were surveyed qualitatively. Each area was surveyed in the spring, summer, and fall during the 2009 growing season to account for seasonal variability of the vegetation within the PSEG Site. At each survey location, the presence of each plant species was recorded. Within the eight study transects, relative abundance for each species is classified as abundant, common, occasional, uncommon, or rare. These surveys covered each plant community type (terrestrial habitat type) observed on the PSEG Site.

2.4.1.1.1 On-Site and Near Off-Site Habitats

2.4.1.1.1.1 Wetlands and Aquatic Habitat

Wetlands and aquatic habitat include the following land cover types (Figure 2-4-1):

- Artificial lakes
- Deciduous scrub/shrub wetlands
- Disturbed wetlands
- Herbaceous wetlands
- Managed wetland in maintained lawn greenspace
- *Phragmites*-dominated interior wetlands
- *Phragmites*-dominated coastal wetlands
- Saline marsh
- Tidal rivers, inland bays, and other tidal waters
- Wetland rights-of-way

Based on LULC mapping, wetlands and aquatic habitats occupy 363 ac. within the PSEG Site boundary (Table 2.4-2). This is 44 percent of the total site acreage. On-site, this cover type consists primarily of wetlands in the USACE CDF, desilt basins, and emergent wetlands dominated by the common reed *Phragmites australis*. Nearly half of this habitat (156 ac.) is represented by *Phragmites*-dominated coastal wetlands characterized by a degraded coastal marsh community consisting of near-monocultures of the invasive strain of common reed. The majority of the proposed causeway off-site is comprised of *Phragmites*-dominated coastal marsh. However, large expanses of coastal marsh north of Alloway Creek have been restored to native saltmarsh as part of the PSEG EEP. Characteristic species of native saltmarsh include *Spartina alterniflora* and *S. cynosuroides*.

A wetland delineation was also performed to develop a more complete understanding of jurisdictional wetlands on the PSEG Site. Relative to LULC mapping, delineated wetlands provide a more accurate baseline of wetland type and extent and can be used to support both impact assessment and future permitting. Wetlands are considered an important habitat on the PSEG Site. Additional discussion of delineated wetlands is provided in Subsection 2.4.1.3.4.

2.4.1.1.1.2 Old Field Habitat

A number of NJDEP LULC cover types may be collectively grouped as old field habitat. Old field communities are previously disturbed lands that have become naturalized by plants in varying stages of succession. The previous uses of old field areas for equipment, piling, piping, and steel storage and laydown during the SGS and HCGS construction has resulted in low quality, compacted soil. The old field areas on-site remain degraded, even after decades of succession. Due to the poor soil characteristics, old field habitat on-site is anticipated to remain degraded. The old field habitat on-site is used intermittently as laydown and storage for the existing site operations at HCGS and SGS. Old field habitat includes the following land cover types:

- Deciduous brush/shrubland
- Old field (<25 percent brush covered)

- *Phragmites*-dominated old field
- Upland rights-of-way, undeveloped

Old field habitat occupies 137 ac. (17 percent) of the PSEG Site (Table 2.4-2). This group of land cover types is mainly represented in the southeast portion of the PSEG Site. Scattered old field communities consisting of one or more land cover types also occur sporadically in the north and west portions of the PSEG Site. Over half of the old field habitat (69 ac.) is represented by old field (less than 25 percent brush covered) land cover type. Common herbaceous species within this habitat include common reed, mugwort (*Artemisia vulgaris*), Queen Anne's lace (*Daucus carota*), fescue species (*Festuca* sp.), Chinese lespedeza (*Lespedeza cuneata*), yellow sweet clover (*Melilotus officinalis*), plantain (*Plantago virginica*), goldenrod (*Solidago altissima*), and purpletop (*Tridens flavus*). Eastern red cedar (*Juniperus virginiana*) is also variously represented in these old field habitats. A small section of old field habitat is present at the northern end of the proposed causeway (Figure 2.4-2).

2.4.1.1.1.3 Developed Land Uses

Land cover types generally maintained to support human activities are collectively grouped as developed land uses. NJDEP LULC cover types included in this category are:

- Altered lands
- Industrial
- Urban or built-up land
- *Phragmites*-dominated urban area
- Recreational land
- Transportation/communication/utilities
- Upland rights-of-way, developed

Developed lands occupy 320 ac. (39 percent) of the PSEG Site (Table 2.4-2). Industrial land cover attributable to the operational uses of SGS and HCGS represents a majority (235 ac.) of the developed land on-site. These land cover types are concentrated on the west portion of the site and include paved roads, parking lots, buildings, and a recreational area at an abandoned ball field. Developed land uses along the proposed causeway occur at the north end of the causeway and include Money Island Road and residential areas along the road.

2.4.1.1.1.4 Agricultural Land

Agricultural lands occur only in the near-site areas at the north end of the proposed causeway along Money Island Road. These lands consist of cultivated fields in upland areas in the rural landscape of Salem County. They are seasonally characterized by such crops as wheat and soybeans, as well as weedy species such as crabgrass (*Digittaria* sp.), barnyard grass (*Echinochloa* sp.), ragweed (*Ambrosia* sp.), and other species.

2.4.1.1.2 Six-Mile Vicinity Habitat

USGS LULC data (2001) is used to characterize the land cover within the vicinity. While this database is less precise than that developed by NJDEP, its use for the vicinity provides for a unified mapping of lands within both DE and NJ. The following habitats are represented with the 6-mi. vicinity:

- Barren land
- Developed land
- Cultivated cropland
- Pasture hay
- Deciduous forest
- Evergreen forest
- Mixed forest
- Emergent herbaceous wetland
- Woody wetland
- Open water

The PSEG Site is located in a coastal area along the Delaware River, and water and wetland cover types dominate the vicinity. Open water associated with the Delaware River and Delaware Bay occupies 26,733 ac. (37 percent) of the 6-mi. vicinity. Emergent herbaceous wetland (predominantly coastal marsh) occupies 16,379 ac. (23 percent), and woody wetland occupies 8870 ac. (12 percent). Agricultural land cover types consisting of cultivated cropland (12,808 ac.) and pasture hay (3533 ac.) account for 23 percent of the land cover in the vicinity. Deciduous forest occupies 2455 ac. (3 percent) and is typically associated with stream valleys that are not suitable for cultivation. Developed lands, which include high, medium, low, and open space developed land, occupy 894 ac. (1 percent) within the 6-mi. vicinity. Barren lands, evergreen forest, and mixed forest each account for less than 1 percent of the land cover in the vicinity (Table 2.4-3).

2.4.1.2 Wildlife

Plant communities within the project area support a diverse array of wildlife species. Tables 2.4-4 and 2.4-5 provide representative lists of wildlife species based on previous studies and recent studies performed as part of the ESPA. Tidal marsh communities support a diverse wildlife community characterized by waterfowl (ducks, geese), wading birds (egrets, herons), shorebirds, raptors (osprey, northern harrier, bald eagle), various mammal species (whitetail deer, cottontail rabbit, muskrat, and other rodents), and herpetofauna.

In contrast, upland communities support a diversity of wildlife, but fewer water-dependent species and more taxa that are typically associated with more mesic (moist) and drier habitats. For example, bird communities may be more dominated by species that frequent trees and shrubs such as songbirds, woodpeckers and other cavity-nesting species, as well as neotropical migratory birds (warblers) and upland game birds (e.g., wild turkey). Additionally, uplands support a different assemblage of mammals including a variety of bat species, rodents (groundhog, squirrels, chipmunks, white-footed mouse, etc.), and carnivorous species (red and gray fox, raccoon, striped skunk, etc.).

2.4.1.2.1 Birds

A records review to identify bird species reported to be near the PSEG Site was conducted (Subsection 2.4.1 for a list of historical studies). Additional field studies completed in 2009 - 2010 include general site reconnaissance and observation, waterfowl spot counts, roadside bird surveys (similar to those conducted by the USGS), and transect surveys. Additionally, representative portions of the proposed causeway and areas adjacent to the existing access road were surveyed qualitatively. Bird survey locations are shown in Figure 2.4-4.

A walking survey was performed along each of eight on-site transects to provide current information regarding bird use of the PSEG Site. One transect in the southeast portion of the site (TS-06) was only surveyed in the winter and spring of 2009. This transect was limited to two seasons as TS-06 was replaced by one of the transects at the USACE CDF and TS-07 and TS-08 are in the same habitat type (old field). All surveys were conducted in 2009 except for the winter sampling for the locations at the USACE CDF, which was conducted in January 2010. Surveys were conducted on two separate days during each season (winter, spring, summer, fall) and entailed the identification and inventory of all birds seen or heard within approximately 65 ft. of the transect centerline. Two roadside survey routes were also established in the vicinity of the site (Figure 2.4-4) and were surveyed seasonally (winter, spring, summer, and fall). Two observers stopped at 0.5-mi. intervals to record all birds seen or heard during a 3-minute sampling period on one datasheet for each survey route. Each route was driven on two separate dates during each season. Seven on-site waterfowl spot count locations and one location within the site vicinity were also established and surveyed seasonally. Two observers recorded all water birds (waterfowl, wading birds) seen or heard at each location. These field studies, on-site and within the vicinity of the site, are used in part to characterize the current assemblage of bird species and to aid in the identification of important species within the vicinity of the PSEG Site.

During the course of the 2009-2010 field surveys, 15,112 birds were observed, representing 125 species (Table 2.4-6). Typical bird species observed during field surveys included a mix of songbirds and waterfowl such as northern cardinal (*Cardinalis cardinalis*), song sparrow (*Melospiaz melodia*), killdeer (*Charadrius vociferus*), red-winged blackbird (*Agelaius phoeniceus*), American crow (*Corvus brachyrhynchos*), Canada goose (*Branta canadensis*), mallard (*Anas platyrhynchos*), and American black duck (*Anas rubripes*). Table 2.4-6 also provides a summary of birds previously reported by the USGS, USFWS, and Audubon Society (References 2.4-213, 2.4-200, and 2.4-7, respectively).

The majority of the natural habitats on the PSEG Site are dominated by common reed. This monoculture of *Phragmites* does not provide optimum breeding/nesting habitat for many birds, therefore most of the birds observed on the site are likely using it for migratory and foraging purposes. Marsh wrens and red-winged black birds are two observed species that could use the fringe of the common reed habitat for breeding/nesting. Most of the raptor species observed on-site (northern harriers, bald eagles, and ospreys) forage near water. The Delaware River borders the PSEG Site to the west and south, and therefore it provides moderate to good foraging for these species. Ospreys have been observed nesting in transmission towers within the site vicinity along the existing access road and the proposed causeway. The old field habitat at the southeast portion of the site contains saplings of eastern red cedar and autumn olive, and does provide some breeding and nesting opportunities for songbirds. Typical songbirds observed in this area included northern cardinal, song sparrow, gray catbird, common yellow throat, and yellow warbler.

Many species of wading birds observed within the site and vicinity likely use the area for foraging. Observed species include great blue heron, green heron, little blue heron, great egret, snowy egret, cattle egret, glossy ibis, black-crowned night heron, black-necked stilt, greater yellowlegs, and lesser yellowlegs (Table 2.4-6). Although there are no known rookeries (colonial nesting grounds) within the PSEG Site or the 6-mi. vicinity, there is a large rookery approximately 9 mi. north of the site on the Delaware River at Pea Patch Island. Pea Patch Island is part of Fort Delaware State Park. The rookery is located on the northern,

undeveloped end of the island and is the largest heron and egret rookery on the east coast of the United States (Reference 2.4-36). Pea Patch Island provides breeding habitat for 5000 to 12,000 breeding pairs of wading birds (Reference 2.4-149). The nine species of birds that breed at this rookery are the great blue heron, great egret, little blue heron, snowy egret, cattle egret, yellow-crowned night heron, black-crowned night heron, glossy Ibis, and tricolored heron (Reference 2.4-35).

2.4.1.2.2 Mammals

In 2009-2010, qualitative surveys were conducted to identify mammal species found in the various habitats at the PSEG Site. All surveys were conducted in 2009 except for the winter sampling for the locations at the USACE CDF, which was conducted in January 2010. Prior to initiating field surveys, a records review was conducted to identify mammals which may occur in the region (Subsection 2.4.1 for a list of historical studies). This included information from NJ and DE wildlife management agencies regarding game species that are legally hunted and trapped in the vicinity, and agency consultation regarding listed mammal species that may occur in the area. Figure 2.4-4 identifies mammal survey locations. Methods used in the mammal survey included general site reconnaissance and observation, road kills, and incidental observations along study transects (Subsection 2.4.1.2.1). Additionally, representative portions of the proposed causeway and areas adjacent to the existing access road were surveyed qualitatively. The transects were surveyed on foot on two separate days during each season (winter, spring, summer, fall) wherein two observers together inventoried all mammals seen or heard within approximately 65 ft. of the transect centerline. Supplemental field studies within the PSEG Site and vicinity are used in part to characterize the assemblage of mammal species and to aid in the identification of important species within the PSEG Site. A prior comprehensive study by PSEG was used to characterize small mammal communities of the marsh habitat. Over 4000 trap-nights of effort were conducted in various marsh sites to identify small mammals (Table 2.4-4) (Reference 2.4-158).

The most common mammal species observed during the 2009-2010 field surveys included white-tailed deer, raccoon, eastern cottontail, opossum, and eastern gray squirrel. Mammal species not observed in 2009-2010 but previously collected, include the short-tailed shrew, meadow vole, house mouse, marsh rice rat, white-footed mouse, Norway rat, masked shrew, and meadow jumping mouse. In the winter 2009, a black bear (incidental) was observed by PSEG plant security. The list of mammals observed or expected to occur on-site and within the site vicinity is recorded in Table 2.4-4. Many species of bats and other mammals expected to occur near the site are active mainly at night and were not readily observed during the field studies.

2.4.1.2.3 Herpetofauna

Qualitative surveys were conducted in the spring, summer and fall of 2009 to identify herpetofauna species found in the various habitats at the PSEG Site. Prior to initiating field surveys, a records review was conducted to identify herpetofauna expected to occur in the region. This review included information from NJ and DE wildlife management agencies regarding records and established ranges of representative species and agency consultation regarding listed herpetofauna which may occur in the area. These records searches were supplemented with additional field studies conducted in 2009. Herpetofauna survey locations are identified on Figure 2.4-4.

Methods used in the reptile and amphibian survey included general site reconnaissance and observation, spring night-time audio surveys (breeding chorus) for calling frogs and toads, and transect surveys along the same eight study transects as described in Subsection 2.4.1.2.1 for birds and Subsection 2.4.1.2.2 for the mammals (Figure 2.4-4). Additionally, representative portions of the proposed causeway and areas adjacent to the existing access road were qualitatively surveyed. Supplemental field studies within the PSEG Site and vicinity are used in part to characterize the assemblage of amphibian and reptile species, and to aid in the identification of important species within the PSEG Site.

The most common herpetofauna species observed or heard during field surveys included the eastern painted turtle (*Chrysemys picta picta*), northern spring peeper (*Pseudacris crucifer*), and southern leopard frog (*Rana sphenocephala*). In July 2009, green tree frogs (*Hyla cinerea*) were observed at the PSEG Site in ponds within the desilt basins in the northwestern portion of the site. It is a resident species of DE and has not been previously recorded in NJ.

The list of herpetofauna observed on-site and within the vicinity of the PSEG Site is recorded in Table 2.4-5, including those recorded during an intensive historical study on Artificial Island (Reference 2.4-87). Federal and/or NJ listed turtles include the loggerhead, Atlantic green, leatherback, Hawksbill, and Kemp's ridley, and, therefore are considered important species. None of these species were observed at the PSEG Site in the 2009 studies.

2.4.1.3 Important Terrestrial Species and Habitats

The NJDEP, DNREC, and USFWS were consulted for information regarding sensitive species and habitats in the vicinity of the PSEG Site (References 2.4-38 and 2.4-142). Letters of correspondence, phone conversations, and personal meetings were held with NJDEP and DNREC to obtain agency input regarding threatened and endangered species, sensitive habitats, commercial and recreational species, and other characteristics for the site and vicinity. Although a response has not yet been received from USFWS regarding the new plant, USFWS did correspond with PSEG in response to a request for information on the presence of threatened and endangered species in support of the HCGS and SGS license renewal applications (References 2.4-203 and 2.4-204). Information from these consultations was used as the basis for identifying important species and habitats.

NUREG-1555 defines important species as:

- Species listed or proposed for listing as threatened or endangered by the USFWS or the state in which the project is located
- Commercially or recreationally valuable species
- Species essential to the maintenance and survival of rare or commercially or recreationally valuable species
- Species critical to the structure and function of local terrestrial ecosystems
- Species that could serve as biological indicators of effects on local terrestrial ecosystems

Table 2.4-7 provides a tabulation of recorded endangered and threatened species identified through correspondence with resource agencies as potentially occurring in the region surrounding the PSEG Site. Each of the listed bird species potentially occurring in the study area are listed by NJ and/or DE and are not federally listed species. Each of these species

has either been observed historically in the vicinity of the PSEG Site (Reference 2.4-158) or has been observed recently as part of the ESPA data collection activities. Most of these species are widely foraging (bald eagle and red-shouldered hawk) or species associated with upland habitats (Cooper's hawk and red-headed woodpecker) that are unlikely to nest in the immediate project area. By comparison, ospreys are known to nest on transmission towers along both access corridors. Northern harrier is a ground nesting and widely foraging species that may also nest in the study area. The remaining species (fish and sea turtles) listed in Table 2.4-7 are discussed in Subsection 2.4.2.2.1.

Table 2.4-8 lists each terrestrial species considered to be important for the PSEG Site and vicinity, according to the criteria in NUREG-1555. Each of these species is discussed in more detail in the following subsections.

2.4.1.3.1 Birds

Based on the results from the 2009-2010 survey, as well as sightings from the other recent bird surveys, 20 bird species are identified as important species at or in the vicinity of the PSEG Site. These species are considered important because they are either state listed in NJ or DE as endangered or threatened, or are of recreational value to the public.

2.4.1.3.1.1 Cooper's Hawk

The Cooper's hawk (*Accipiter cooperii*) is a state listed species whose breeding population is listed as threatened in NJ. The non-breeding population is designated as stable (Table 2.4-8). In the early part of the 20th century, Cooper's hawks were shot and killed as they were suspected to prey upon poultry and game birds. Through the 1950s and 1970s, habitat loss and the pesticide dichlorodiphenyltrichloroethane (DDT) had a significant impact on the NJ Cooper's hawk population. This triggered its listing as endangered in NJ in 1974. With the ban of DDT and the reforestation of many lands, Cooper's hawk populations began to recover sufficiently to support the reclassification of this species in NJ, from endangered to threatened, in 1999. The loss of large forests remains the primary reason for its continued protection (Reference 2.4-135).

Cooper's hawks have historically inhabited large tracts of deciduous, coniferous, and mixed forests. As forested landscapes have fragmented, the Cooper's hawk has adapted by inhabiting smaller woodlots within agricultural, suburban, and urban landscapes. Nests are built against trunks in mature trees 20 to 90 ft. high. Nesting occurs from early April to mid-June and clutch sizes typically consist of four eggs. The incubation period is 30 to 35 days. The young are fledged by mid-September (Reference 2.4-29).

The Cooper's hawk is largely a predator of other birds. Up to 80 percent of a Cooper's hawk's diet is other birds and the remainder is composed of mammals. Size of avian prey ranges from smaller birds, such as warblers and sparrows, to larger birds, such as quail and flickers. Typical mammal prey is squirrel and rabbit. Cooper's hawks use either an ambush or a stealth approach to collect prey on the ground, in flight, or in trees and shrubs (Reference 2.4-29).

Cooper's hawks were rarely observed on-site or in the vicinity of the PSEG Site during the 2009-2010 field survey, and were only observed in the fall. On-site, one Cooper's hawk was observed perched in a small tree (one of the few trees present) near the northwest corner of

the site. Based on forested habitat requirements, this species is likely incidental to the site, but could be a resident of the site vicinity. It has also been observed near the PSEG Site in previous surveys (Reference 2.4-29) (Table 2.4-6).

2.4.1.3.1.2 Red-Shouldered Hawk

The red-shouldered hawk (*Buteo lineatus*) is not a federally listed species, but in the State of NJ the breeding population is listed as endangered and the non-breeding population is listed as threatened (Table 2.4-8). As with many birds of prey in the early to mid-1900s, red-shouldered hawks were shot and killed because of the suspicion that they preyed on poultry and game species. Habitat loss in the form of forest clearing and the filling of wetlands caused populations to decline. The state's breeding pairs were estimated at 36 by the late 1980s and early 1990s. Based on this information, the red-shouldered hawk was reclassified as state endangered in 1991 (Reference 2.4-135).

Suitable habitat for the red-shouldered hawk is typically associated with some form of water (swamp, marsh, river, stream, or pond), but varies from bottomland hardwoods and riparian areas to upland deciduous and mixed forests. Nests are constructed in trees 30 to 60 ft. high, near main trunks and below the canopies, in deciduous or mixed forests. Nesting occurs from late March to early May and clutch sizes usually contain 2 to 4 eggs. The incubation period is approximately 33 days. The young are typically fledged by September (Reference 2.4-30).

The red-shouldered hawk is a bird of prey feeding on mammals, birds, reptiles, and amphibians during daylight hours. The red-shouldered hawk perches atop the forest canopy (6 to 15 ft. high) and drops down on prey. Typical perches, other than trees, include poles, fences, and hay bales. These hawks may also occasionally hunt from the ground by catching prey as it emerges from a burrow (Reference 2.4-30).

No red-shouldered hawks were observed during the 2009-2010 field survey. However, they have been identified in recent years near the site by the Audubon Society Christmas Bird Count (Reference 2.4-7) (Table 2.4-6).

2.4.1.3.1.3 Northern Harrier

The northern harrier (*Circus cyaneus*) is not a federally listed species, but is listed as endangered by NJ and DE (Table 2.4-8). Once a thriving bird of prey, the northern harrier was shot and killed due to suspected predation on poultry and other game birds. Populations continued to decline through the 1900s as a result of habitat loss due to the draining and filling of coastal wetlands. In the 1950s and 1960s, northern harrier populations further declined from reproductive failure caused by the pesticide DDT (Reference 2.4-135).

The northern harrier inhabits open areas such as tidal marshes and estuaries, wetlands, pastures, grasslands, meadows, and woodland areas. Unlike most other hawks and raptors, the northern harrier nests on the ground in the higher and drier portions of the marsh, field, or meadow. Nests are constructed of sticks and grasses. Clutch sizes usually consist of 4 to 5 eggs which are incubated for 31 to 32 days. The young are fledged from the nest at 30 to 35 days (Reference 2.4-143).

Northern harriers prey upon rodents, small mammals, frogs, reptiles, insects, small birds, and the carcasses of dead animals. Similar to an owl, the northern harrier has a facial disk that provides directional hearing. With the addition of their soft feathers for quiet flight, the northern harrier is an exceptional hunter able to fly low and silent to plunge on unsuspecting prey (Reference 2.4-143).

During 2009-2010 field survey, northern harriers were commonly observed in all seasons near open areas both on-site and in the vicinity of the PSEG Site. Northern harriers were observed foraging above the marsh. Although northern harriers were not observed nesting on-site or in the vicinity of the PSEG Site, they are ground nesters and could be nesting near the study area. The northern harrier was also identified near the PSEG Site by USGS and the Audubon Society (References 2.4-213 and 2.4-7) (Table 2.4-6).

2.4.1.3.1.4 Bald Eagle

While the bald eagle (*Haliaeetus leucocephalus*) is no longer a federally listed species, it is listed in NJ and DE as endangered and it is also protected federally under the Bald and Golden Eagle Protection Act. In the vicinity of the site, its NJ status is listed as endangered for foraging habitat (Table 2.4-8). Even before the use of DDT, habitat destruction, shootings, and poisonings had already reduced the population of bald eagles. By 1970, only one bald eagle nest remained in NJ, and it was listed as endangered (Reference 2.4-135). With the ban of DDT in 1972, captive breeding programs, reintroduction efforts, law enforcement, and nest site protection, the bald eagle has recovered to a point where there are an estimated 53 breeding pairs in NJ, and 39 breeding pairs in DE (Reference 2.4-202).

Bald eagles roost in forested areas (Reference 2.4-135), but forage in areas near water such as rivers, lakes, and marshes. They nest in the tops of large, mature trees and typically reuse their nests year after year. Nests are very large reaching up to 10 ft. across and can weigh up to one-half ton. Typical clutch sizes range from 1 to 3 eggs which hatch in approximately 35 days. The young can fly within 3 months and are fully fledged a month later (Reference 2.4-202).

Bald eagles are very large, weighing up to 14 lb., and have a wingspan of 8 ft. Due to their large size, they require a large forage base. The main prey item for a bald eagle is fish, but they also feed on waterfowl, turtles, rabbits, snakes, and other small animals (Reference 2.4-202). Bald eagles use a sit and watch foraging behavior, relying on large perch trees near water. In NJ, ideal locations for foraging are the Delaware River, Delaware Bay, and associated tidal marshes (Reference 2.4-135)

During the 2009-2010 field survey in all seasons, bald eagles were occasionally observed flying on-site and perched along the Delaware River at the south end of the PSEG Site. On-site use by the bald eagle is likely for foraging. It has been identified in recent years near the site in the Audubon Society's Christmas Bird Count (Reference 2.4-7) (Table 2.4-6). In nesting surveys conducted annually by the NJDEP, during the 5-yr span from 2004 to 2008, bald eagles have nested within a 6-mi. radius of the PSEG Site (References 2.4-136 through 2.4-140). Two nests were observed, one near the town of Elsinboro, and the other along Alloway Creek.

2.4.1.3.1.5 Osprey

The osprey (*Pandion haliaetus*) is not a federally listed species, but its breeding population is listed by NJ as threatened (Table 2.4-8). In the 1800s, ospreys were an abundant species in NJ, but population declines have been attributed to habitat loss, elimination of nest trees, egg collecting, shootings, and reproductive failure attributable to the use of DDT. Efforts to improve reproductive success, such as banning the use of DDT, reintroductions, and the construction of nesting platforms, slowly improved the number of breeding pairs in NJ (Reference 2.4-135). Nest platforms have also been constructed by PSEG in the Alloway Creek Watershed Wetland Restoration Site as part of the PSEG EEP program.

Ospreys inhabit areas close to water including coastal rivers, marshes, bays, and inlets, as well as inland rivers and lakes. Nesting occurs on live or dead trees, man-made nesting platforms, light poles, channel markers, abandoned duck blinds, or other artificial structures close to water offering unobstructed views of the surrounding area. The osprey's acceptance and use of these artificial nesting sites has played a key role in this species' recovery (Reference 2.4-135). Nests are constructed of sticks, lined with softer vegetation. Breeding begins in April or May. Nests typically contain 2 to 4 eggs that hatch in approximately 40 days. Nestlings fledge 48 to 76 days later, but continue to receive food from their parents for 2 to 8 weeks after fledging (Reference 2.4-89).

The vast majority (99 percent) of an osprey's diet consists of fish. Ospreys are very opportunistic in that they eat whatever fish species are accessible. However, given the abundances of fish in a given area, their diet may only consist of 2 to 3 species. Ospreys hunt for prey while in flight rather than from a perch. Ospreys carry fish to perches for eating (Reference 2.4-89).

During the 2009-2010 field survey, ospreys were occasionally observed in the spring and summer both on-site and in the vicinity of the PSEG Site (Table 2.4-6). Active osprey nests were observed on transmission towers along the current access road, on the transmission towers that run from the plant north towards Money Island Road, and on man-made nesting platforms along Alloway Creek. Osprey have also been identified near the site in the USGS Breeding Bird Survey (BBS) (Reference 2.4-213). In an osprey nesting and productivity study conducted annually, beginning in 2006, by the NJ Division of Fish and Wildlife, it was reported that the number of young per nest in the Salem County-Artificial Island area has averaged between 1.7 and 2.0 birds from 2006 to 2008 (Reference 2.4-141). Additionally, The Nature Conservancy conducted an annual nesting and productivity study beginning in 1999 on PSEG EEP wetland restoration sites. The Alloway Creek wetland restoration site is the only site within the 6-mi. vicinity of the PSEG Site. Nesting platforms have been monitored at this wetland site since 2001. The number of young per nest has ranged from zero to three for 2001 to 2009. There are four nesting platforms on the Alloway Creek Watershed Wetland restoration site. The number of active nests each year has varied (Reference 2.4-190).

2.4.1.3.1.6 Red-Headed Woodpecker

The red-headed woodpecker (*Melanerpes erythrocephalus*) is not a federally listed species, but its breeding and non-breeding populations are listed by NJ as threatened (Table 2.4-8). In the late 1800s, observations of several hundred red-headed woodpeckers were reported during the fall migration in the northeast United States. At the turn of the 20th century, and into

the 1970s, large population declines were evident as a result of mortality from vehicle collisions, competition with the European starlings (*Sturnus vugaris*) for nesting sites, feather harvest for hats, and farmers killing them because of damage to fruit and berry crops. As a result of these population declines, NJ listed the red-headed woodpecker as threatened in 1979 (Reference 2.4-135).

Habitat for the red-headed woodpecker includes open woods, deciduous forests, forest edges, river bottoms, orchards, grasslands with scattered trees and clearings (Reference 2.4-8). They prefer habitats with dead or dying trees for use as nesting sites, and sparse undergrowth to facilitate foraging (Reference 2.4-135). Red-headed woodpeckers are cavity nesters. Cavities are 10 to 12 centimeters (cm) (3.9 to 4.7 inches [in.]) wide and 20 to 60 cm (7.9 to 23.6 in.) deep, with an opening 5 to 6 cm (2.2 to 2.4 in.) in diameter. They typically lay 3 to 10 eggs between April and July, followed by an incubation period of 12 to 14 days. They may produce two broods a year. Young leave the nest 24 to 31 days after hatching. Both parents care for the young (Reference 2.4-8).

Red-headed woodpeckers are omnivorous, with a diet including insects, spiders, worms, nuts, seeds, berries, fruit, and occasionally small mammals. They may also eat the young and eggs of bluebirds, house sparrows, and chickadees. These woodpeckers either search for food from a perch or from the ground. Much of the food found by red-headed woodpeckers is stored in existing natural or anthropogenic cavities or crevices (Reference 2.4-8).

No red-headed woodpeckers were observed during the 2009-2010 field survey, nor have they been reported in the USGS BBS or the Audubon Society's Christmas Bird Count (References 2.4-213 and 2.4-7).

2.4.1.3.1.7 Northern Pintail

The northern pintail (*Anas acuta*) is considered an important species due to its recreational value as a game species hunted in the vicinity of the PSEG Site. The northern pintail is one of the most hunted ducks throughout its range. Since northern pintails migrate, they are protected by the Migratory Bird Treaty Act, although hunting provisions allow for sport harvest. In the summer, these birds are found in the Northern Hemisphere. In the winter, they migrate south (Reference 2.4-167), with populations from NJ and DE probably over wintering in Mexico.

Northern pintails are found in or near aquatic habitats such as marshes, ponds, lakes, rivers, canals, and flooded grain fields. They mate in early May, but can lay a second clutch of eggs as late as July if the nest is destroyed by predators or weather. A nest usually consists of a clutch of 7 to 9 eggs with an incubation period typically 22 to 24 days. As soon as the young hatch, the hen leads them to water to start foraging. The young can fly 46 to 47 days after hatching. Sexual maturity is reached at the age of 1 year (Reference 2.4-167).

Newly hatched chicks forage on dead insects on the surface of the water, while juveniles and adults forage under the water surface on snails, water bugs, and roots of aquatic plants. Northern pintail also forage on grain in fields, naturally occurring seeded plants, pondweeds, and grasses (Reference 2.4-167).

Northern pintails were observed once in the spring in the northwest portion of the site during the 2009-2010 field survey. It was not observed during any other season. Since this species was observed only in the spring, it is likely that its use of the site is limited to the migratory period. Additionally, northern pintails have been observed during the annual surveys conducted by the USFWS in the vicinity of the PSEG Site (Reference 2.4-200) (Table 2.4-6).

2.4.1.3.1.8 Green-Winged Teal

The green-winged teal (*Anas crecca*) is considered an important species because of its recreational value as a game species. It is hunted in the vicinity of the PSEG Site. Green-winged teals are the second most hunted ducks in the United States. Green-winged teal migrate, and therefore they are protected by the Migratory Bird Treaty Act, although hunting provisions allow for sport harvest. During the breeding season, they are found throughout Canada and the cooler climates of the northeastern United States. They winter in the western and southern United States and parts of Mexico. Green-winged teal inhabit shallow inland wetlands, ponds, and coastal marshes and exhibit a preference for areas with vegetation and muddy bottoms. Green-winged teal feed in shallow water near the shoreline or in mudflats on almost any aquatic plant, seed, or invertebrate. (Reference 2.4-171)

Courtship and pairing begins in September, and egg-laying is delayed until May. Nests contain 5 to 6 eggs which are cared for solely by the female. The male leaves the female once the eggs are laid. The incubation period typically lasts 23 days (Reference 2.4-171).

Green-winged teal were occasionally observed on-site and within the vicinity of the PSEG Site in the winter and spring during the 2009-2010 field survey. Individuals were observed at ponds in the northwest portion of the site and at a pond and marsh creek in the vicinity of the site. This species was observed only in the late winter and spring, and likely uses the site during migration or as part of its overwintering habitat. They have been observed in the vicinity of the PSEG Site during the annual surveys (References 2.4-200 and 2.4-7) (Table 2.4-6).

2.4.1.3.1.9 Mallard

The mallard is considered an important species because of its recreational value as a game species. It is hunted in the vicinity of the PSEG Site. Since mallards migrate, they are protected by the Migratory Bird Treaty Act, although hunting provisions allow for sport harvest. Mallards are abundant and widespread and are found in nearly every region of the Northern Hemisphere. They are heavily hunted waterfowl species in North America (Reference 2.4-168).

Mallards inhabit any productive waters, including wetlands, lakes, ponds, streams, and coastal waters. Mallards consume many foods, including vegetation, worms, insects, gastropods, arthropods, and grains from crops (Reference 2.4-168).

Courtship and pairing begins as early as October with mating occurring in March. Males leave females soon after mating. Nesting consists of a clutch size of 9 to 13 eggs that are laid in a ground nest near water. The incubation period typically ranges from 26 to 28 days. After the breeding season, mallards form flocks and migrate south to feed until breeding resumes. In

areas where food is abundant, mallards may over winter in the same area in which they breed (Reference 2.4-168).

Mallards were commonly observed both on-site and in the vicinity of the PSEG Site in the winter, spring, and fall during the 2009-2010 field survey. On-site, they were observed at a number of locations including the Delaware River, marsh creeks, and ponds. In the vicinity of the site, they were observed on ponds and marsh creeks. The birds were likely migratory at the site and vicinity, foraging along their migration path. Mallards have also been reported in the PSEG Site vicinity by the USGS BBS, USFWS, and Audubon Society (References 2.4-213, 2.4-200, and 2.4-7, respectively) (Table 2.4-6).

2.4.1.3.1.10 American Black Duck

The American black duck (*Anas rubripes*) is considered an important species due to its recreational value as a game species. It is hunted in the vicinity of the PSEG Site. Since American black ducks migrate, they are protected by the Migratory Bird Treaty Act, although hunting provisions allow for sport harvest. They breed from the central to north-central United States and into Canada. They winter from the Gulf Coast of Florida (FL) to Bermuda (Reference 2.4-17).

American black ducks inhabit a variety of both fresh and brackish waters, including lagoons, marshes, bogs, lakes, ponds, streams, bays, and estuaries. They often select nesting sites near or adjacent to agricultural lands during breeding season. Male-female pairing begins towards the end of September and breeding occurs in March and April. Nests are made on the ground, concealed by thick vegetation, and contain 9 to 10 eggs. Males typically leave the female within 2 weeks of egg-laying. The incubation period lasts approximately 27 days. The rate of nest destruction by crows and raccoons is high (Reference 2.4-17**)**

The diet of an American black duck consists of seeds and vegetation from both aquatic plants and crops. They also eat a variety of invertebrates including insects, mollusks, and crustaceans. They do not dive to feed, but do submerge their upper body when feeding in shallow water (Reference 2.4-17).

American black ducks were commonly observed at the PSEG Site and vicinity in the winter, spring, and summer during the 2009-2010 field survey. They were observed at various locations on-site, including the Delaware River, marsh creeks, and ponds. In the vicinity of the site, they were observed on ponds and marsh creeks. This species is likely to be a resident and migrant within the vicinity of the PSEG Site. American black ducks have also been reported from the PSEG Site vicinity by surveys (References 2.4-213, 2.4-200, and 2.4-7) (Table 2.4-6).

2.4.1.3.1.11 Ring-Necked Duck

The ring-necked duck (*Aythya collaris*) is considered an important species because of its recreational value as a game species. It is hunted in the vicinity of the PSEG Site. Ring-necked ducks migrate, and therefore they are protected by the Migratory Bird Treaty Act, although hunting provisions allow for sport harvest. Ring-necked ducks are found throughout North America and the West Indies, with breeding range throughout most of Canada (Reference 2.4-115).

Ring-necked ducks habitat preference is shallow water areas with abundant aquatic vegetation (submergent or emergent) including wetlands (Reference 2.4-84), marshes, swamps, and bogs (Reference 2.4-115). Nests are constructed near open water on stands of floating or flooded vegetation. Nest construction and care for the eggs and young are provided solely by the female (Reference 2.4-84). Egg-laying occurs in May with a typical clutch size of 8 to 9 eggs, followed by an incubation period of 26 to 27 days (Reference 2.4-115).

Ring-necked ducks dive for food (Reference 2.4-84) consisting of seeds, pondweeds, and tubers. Vegetation compromises approximately 80 percent of their diet. Additional elements of their diet include insect larvae, mollusks, worms, and crustaceans (Reference 2.4-115).

Ring-necked ducks were occasionally observed on-site in the winter and spring during the 2009-2010 field survey. They were observed on ponds in the northwest portion of the site and were likely just migrants. They have also been reported near the PSEG Site in previous surveys (Table 2.4-6).

2.4.1.3.1.12 Greater Scaup

The greater scaup (*Aythya marila*) is considered an important species because of its recreational value as a game species. It is hunted in the PSEG Site vicinity. Greater scaup migrate and therefore are protected under the Migratory Bird Treaty Act, although hunting provisions allow for sport harvest. The greater scaup breeds in the high Arctic and winters along coastal areas of North America (Reference 2.4-14).

Greater scaups are found in lakes, rivers, near shore coastal waters, bays, estuaries, and lagoons. They prefer shallower water for foraging. Breeding occurs in May or June in the Arctic. They construct nests on the ground in shallow depressions near water, in thick vegetation, cracks in rocks, or under woody shrubs (Reference 2.4-14). Nests usually contain 6 to 9 eggs that are incubated for 23 to 28 days. The female leads the young to water shortly after hatching to feed. Young cannot fly until they are 40 to 45 days old (Reference 2.4-174).

Greater scaup are omnivores. Their diet consists mainly of mollusks in the winter, in addition to insects, insect larvae, worms, crustaceans, small fish, roots, seeds, and other aquatic vegetation (Reference 2.4-14).

Greater scaup were observed on-site only once in the winter during the 2009-2010 field survey. This one occurrence was a flock of 131 birds observed on the Delaware River in the south end of the site. These were likely migrants resting along their migration path. Although the PSEG Site and vicinity are within their migration path, the greater scaup have not been reported to occur in the PSEG Site vicinity in previous area surveys conducted by the USGS, USFWS, Audubon Society (References 2.4-213, 2.4-200, and 2.4-7, respectively) (Table 2.4-6).

2.4.1.3.1.13 Bufflehead

The bufflehead (*Bucephala albeola*) is considered an important species because of its recreational value as a game species. It is hunted in the PSEG Site vicinity. Buffleheads range throughout Canada and Alaska. Their migratory and non-breeding range extends

through the United States and into northern Mexico (Reference 2.4-170). Buffleheads migrate, and therefore they are protected by the Migratory Bird Treaty Act, although hunting provisions allow for sport harvest.

Bufflehead are found in freshwater lakes or ponds. They are cavity nesters and seek out the cavities excavated by northern flickers (*Colaptes auratus*), but also use nest boxes. They do not excavate or modify the cavity after it is selected. Males and females form long-term monogamous pair bonds. Six to 11 eggs are laid in May and are incubated for 28 to 33 days. The young remain in the nest for one day after hatching and then are led to water (Reference 2.4-170). Mature trees do not exist on-site. Consequently, there is no suitable nesting habitat (tree cavities) available for buffleheads.

Buffleheads are diving ducks that feed in shallow open water. Their diet consists primarily of insects, crustaceans, and mollusks. They also eat seeds from aquatic plants. Duckling buffleheads are able to forage on their own almost immediately after hatching and are never fed by a parent (Reference 2.4-170).

Buffleheads were rarely observed at the PSEG Site during the 2009-2010 field survey. One winter observation occurred on a pond in the northwest portion of the site. They have been reported to occur in the site vicinity in previous studies (References 2.4-213, 2.4-200, and 2.4-7) (Table 2.4-6).

2.4.1.3.1.14 American Coot

The American coot (*Fulica americana*) is considered an important species because of its recreational value as a game species. It is hunted in the PSEG Site vicinity. American coots migrate and therefore are protected under the Migratory Bird Treaty Act, although hunting provisions allow for sport harvest. Through the summer, American coots are found in southern Canada and the northern United States. In the winter, they are found in the southern United States from FL to California (Reference 2.4-15).

American coots inhabit many types of waterways, but are predominantly found utilizing the shallow water of lakes, ponds, and marshes. They prefer freshwater, but occasionally occupy brackish water. Mating occurs in May or June with both the male and female caring for the eggs and young. Nests are constructed on the ground in vegetation close to the water. Nests typically contain 8 to 10 eggs and are incubated for approximately 23 days. The young fly in 5 to 6 weeks, and are independent approximately 2 months after the hatch (Reference 2.4-15).

American coots dive for food consisting of fish, tadpoles, insects, amphibians, mollusks, crustaceans, and benthic aquatic vegetation. Although American coots can forage for their own food, they have been known to take food from other birds (Reference 2.4-15).
American coots were rarely observed at the PSEG Site during the 2009-2010 field survey. One winter observation occurred on a pond in the northwest portion of the site and was likely a migrant. American coots have been reported in the project vicinity by the Audubon Society (Reference 2.4-7) (Table 2.4-6).

2.4.1.3.1.15 Canada Goose

The Canada goose (*Branta canadensis*) is considered an important species because of its recreational value as game species. It is hunted in the PSEG Site vicinity. Canada geese are found all through the United States and North America. They typically spend the summer in Canada, and then migrate south for the winter to the United States. Some Canada geese are year-round residents where ample forage is available. Canada geese migrate and therefore are protected under the Migratory Bird Treaty Act, although hunting provisions allow for sport harvest (Reference 2.4-45).

Canada geese are found in open, grassy habitats near waterways. Aquatic habitats in which they may be found include lakes, ponds, rivers, streams, and marshes. They may also be found in man-made areas such as golf courses, agricultural lands, airports, and parks. Canada geese breed as early as March and as late as June. Males and females pair for each breeding season. Some pairs may stay together for more than one breeding season. Clutch size ranges from 2 to 9 eggs and incubation lasts for 23 to 30 days. The female chooses the nest site, builds the nest, and incubates the eggs. The male defends the nesting area. Nests are constructed on the ground out of twigs and grass. After the young hatch, they are able to follow the parents around. Both parents provide care for the young that fledge 68 – 78 days after hatching (Reference 2.4-45).

Canada geese feed on vegetation on both land and in water. When on land, they eat grasses, wheat, beans, rice, or corn. When in the water, they extend their necks underwater to sift the bottom for vegetation. (Reference 2.4-45)

Canada geese were abundantly observed in all seasons at the PSEG Site and vicinity during the 2009-2010 field survey. They were observed in a variety of habitats on the site including the Delaware River and ponds. In the vicinity of the site, they were observed on ponds and marsh creeks. These birds could have been either residents or migrants. They have been reported in the vicinity of the PSEG Site by the USGS, USFWS, and Audubon Society (Table 2.4-6).

2.4.1.3.1.16 Snow Goose

The snow goose (*Anser caerulescens*) is considered an important species because of its recreational value as a game species. It is hunted in the PSEG Site vicinity. Snow geese breed in the northeast Arctic. They leave their breeding grounds in September and head south to wintering grounds in the Midwest (Reference 2.4-95), portions of the western United States, and along the East Coast states (Reference 2.4-28). Snow geese leave their wintering grounds in March to return to the Arctic (Reference 2.4-95). Snow geese migrate and therefore are protected under the Migratory Bird Treaty Act, although hunting provisions allow for sport harvest.

Snow geese breed in the Arctic in low grassy tundra fairly close to water (lakes, rivers, floodplains, seas). Mating season begins in April and nesting occurs in June. Snow geese breed in colonies that can reach the tens of thousands. Nests are constructed on the ground in shallow depressions having a layer of dry vegetation and down feathers from the mother. Clutches size ranges from 3 to 5 eggs that are incubated for 23 to 25 days. Fledging of the young occurs 45 to 49 days from the time they hatch (Reference 2.4-95).

Snow geese are herbivores, feeding on a variety of plants including the roots. Their bills are especially strong for digging up roots. They forage on the aquatic vegetation in wetlands and estuaries, but also frequently feed in agricultural fields containing corn, wheat, or oats. (Reference 2.4-95)

Snow geese were abundantly observed in the winter and spring both at the PSEG Site and within the PSEG Site vicinity during the 2009-2010 field survey. Flocks with as many as 1000 birds were observed flying along the Delaware River near the site and foraging in agricultural fields in the vicinity of the site. These large flocks were likely migrants. They have been reported in the PSEG Site vicinity during the annual Mid-Winter Waterfowl Survey conducted by the USFWS for the years 2005 to 2009 (Reference 2.4-200), and the Audubon Society's Christmas Bird Count Survey for the years 2004 to 2008 (Reference 2.4-7) (Table 2.4-6).

2.4.1.3.1.17 Hooded Merganser

The hooded merganser (*Lophodytes cucullatus*) is considered an important species because of its recreational value as a game species. It is hunted in the PSEG Site vicinity. They breed at a number of sites across the United States and Canada. Wintering grounds include the coast of California and Atlantic and Gulf coastal areas from DE to Texas (TX). Hooded mergansers migrate and therefore are protected under the Migratory Bird Treaty Act, although hunting provisions allow for sport harvest. (Reference 2.4-172)

Hooded merganser breeding habitat typically consists of forested wetlands. Their wintering and migratory habitats include freshwater and brackish bays, estuaries and tidal creeks, rivers, streams, ponds, and lakes. Breeding occurs in March and April. Hooded mergansers nest in the cavity of trees or in man-made nest boxes 4 to 15 ft. off the ground. Clutch size ranges from 7 to 15 eggs and the incubation period averages 33.5 days. The young are fully fledged approximately 5 weeks after hatching. Hooded mergansers are a diving duck and feed primarily on aquatic insects, fish, and crustaceans. (Reference 2.4-172)

Hooded mergansers were rarely observed at the PSEG Site during the 2009-2010 field survey. One bird was observed at a pond in the northwest portion of the site in the winter. They have also been reported to occur near the site during the annual Mid-Winter Waterfowl Survey conducted by the USFWS and the Audubon Society's Christmas Bird Count Survey (Table 2.4-6).

2.4.1.3.1.18 Common Merganser

The common merganser (*Mergus merganser*) is considered an important species because of its recreational value as a game species. It is hunted in the vicinity of the PSEG Site. In North America, common mergansers may breed as far north as Canada and Alaska (Reference 2.4-11), while wintering in the southwest, Midwest, and northeast United States (Reference 2.4-27). Common mergansers migrate and therefore are protected under the Migratory Bird Treaty Act, although hunting provisions allow for sport harvest.

Common mergansers have a preference for forested areas along streams and rivers, but can also be found near lakes, ponds, and coastal waters. Males and females form breeding pairs in the winter that last for at least one breeding season. Breeding occurs in May and June.

Nesting occurs in the crevice of a tree, on the ground in tangled bushes, or in abandoned hawk nests. Clutch sizes range from 9 to 12 eggs with an incubation period of 28 to 35 days. The young are skillful divers within 8 days of hatching. The mothers leave the young within 30 to 50 days of hatching, before the young can fly. The young fledge and fly 60 to 85 days after hatching (Reference 2.4-11).

Common mergansers are divers, locating their prey by sight. Common mergansers primarily eat fish, but when fish are scarce they consume amphibians, insects, mollusks, worms, and aquatic plants (Reference 2.4-11).

During the 2009-2010 field survey, common mergansers were occasionally observed both on the PSEG Site and vicinity in the winter and were likely migrants. They were observed on the Delaware River, at the south end of the site and in a marsh creek in the vicinity of the site. They were also reported to occur in the PSEG Site vicinity during the annual Mid-Winter Waterfowl Survey conducted by the USFWS for the years 2005 to 2009, and during the Audubon Society's Christmas Bird Count Survey for the years 2004 to 2008 (Table 2.4-6).

2.4.1.3.1.19 Red-Breasted Merganser

The red-breasted merganser (*Mergus serrator*) is considered an important species because of its recreational value as a game species. It is hunted near the PSEG Site. In North America, red-breasted mergansers breed in Alaska, the northern United States (Minnesota, Wisconsin, Michigan, Maine), and Canada. Wintering grounds are along the coasts of the Atlantic Ocean, Pacific Ocean, Gulf of Mexico, Great Lakes. They also winter along large inland waterways as far south as Mexico. Red-breasted mergansers migrate and therefore are protected under the Migratory Bird Treaty Act, although hunting provisions allow for sport harvest (Reference 2.4-42).

Red-breasted mergansers are found in most types of water including ponds, lakes, rivers, streams, and coastal areas in brackish or saltwater. They usually forage in shallow water, but also been found to forage in deep water. Breeding occurs in the months of May to June. Young hatch in July and fledge in September or October. Nests are constructed on the ground near water, in thick vegetation, and consist of twigs, grasses, and feathers. Clutch sizes range from 5 to 24 eggs that are incubated for 30 to 31 days (Reference 2.4-42).

The major part of the diet of the red-breasted merganser is small fish (more than 75 percent) with the remaining part consisting of amphibians, fish eggs, aquatic worms, and crustaceans. They prefer to dive for prey in shallow water, but hunt in deeper water if prey is abundant. They hunt alone or with other red-breasted mergansers to herd schooling fish (Reference 2.4-42).

During the 2009-2010 field survey, the red-breasted mergansers were only observed in the spring at the PSEG Site. They were observed at a pond in the northwest portion of the site. They have been reported to occur in the vicinity of the site during the annual Mid-Winter Waterfowl Survey conducted by the USFWS, and during the Audubon Society's Christmas Bird Count Survey (Table 2.4-6).

2.4.1.3.1.20 Wild Turkey

The wild turkey (*Meleagris gallopavo*) is considered an important species because of its recreational value as a game species. It is hunted in the area of the PSEG Site. They are one of the most widely distributed upland game bird of North America. The wild turkey is distributed throughout most of the eastern United States, as well as portions of the western United States and northern Mexico. (Reference 2.4-113)

The wild turkey's preferred habitat consists of hardwood and mixed forests. They also spend time foraging in open areas such as pastures, agricultural fields, orchards, and marshes. Courtship begins in late January in the southern states and in late February in the northern states. Males attract females by gobbling and strutting and breed with multiple females in one breeding season. Females provide all parental care and build nests on the ground in thick vegetation or cover. Clutches usually consist of 8 to 15 eggs that are incubated for 25 to 31 days. Young are able to walk and feed within 24 hr. of hatching. Male poults disperse in the fall, while female poults stay with the mother until the next spring (Reference 2.4-113).

Wild turkey diet consists mostly of plant material including acorns, other nuts, seeds, buds, and leaves. They also eat insects and salamanders. Wild turkeys mainly forage on the ground, but occasionally perch on low shrubs and trees to eat fruits or buds (Reference 2.4-113).

Wild turkeys were observed both at the PSEG Site and vicinity in all seasons during the 2009-2010 field survey. On-site they were rarely observed due to lack of suitable habitat. However, in the vicinity of the site where habitat is more suitable, wild turkeys were commonly observed. This species is a resident of the area. They have also been reported near the PSEG Site in the USGS BBS (Table 2.4-6).

2.4.1.3.2 Mammals

No federally or state listed mammals are reported for the PSEG Site and vicinity. Important as game species, the white-tailed deer, river otter (*Lutra canadensis*), and muskrat (*Ondatra zibethicus*) are identified as important mammal species at the PSEG Site. White-tailed deer are considered important because they are recreationally hunted in the area of the PSEG Site. The river otter and muskrat are considered important because they are commercially trapped in the area of the PSEG Site.

2.4.1.3.2.1 River Otter

The river otter (*Lontra canadensis*) is considered to be an important species because it is a species commercially trapped for its pelt. In North America, river otter is found throughout Canada and the United States, with the exceptions of southern California, New Mexico, TX, and desert regions of Nevada and Colorado, and along the Rio Grande and Colorado rivers in Mexico (Reference 2.4-44).

River otters inhabit areas with access to water and a stable supply of food. These habitats include both freshwater and coastal environments such as lakes, rivers, marshes, swamps, and estuaries. As indicated by their distribution, they can tolerate both warm and cold environments and a range of elevations. They generally avoid areas with polluted water. The

river otter builds its den in the burrow of another animal or a natural cavity in a log or riverbank. These dens usually have underwater entrances and tunnels leading to nesting chambers. (Reference 2.4-44)

Male and female otters come together only for mating. One male usually breeds with several females. River otters breed in the late winter or early spring with most of the young born in March and April. The gestation period is typically two months, but young may be born up to one full year after mating occurs as otters have the ability to delay implantation of the fertilized egg. Breeding occurs once per year with the litter size ranging from 1 to 6. Young are born with fur, and are dependent on the female parent to nurse and care for them. The young are weaned at 3 months of age and are independent from 6 months to 1 year of age (Reference 2.4-44).

The diet of a river otter consists of prey found in or near water including amphibians, fish, turtles, crayfish, crabs, and other aquatic invertebrates. Occasionally, river otter may eat birds, eggs, small mammals, and aquatic plants. Otters normally catch fish species that are slower moving, like suckers. Prey is captured by mouth and aided by whiskers that are able to detect moving prey in the water (Reference 2.4-44).

River otters were observed at the PSEG Site and vicinity in the spring and summer during the 2009-2010 field survey. They were observed along the Delaware River in the south end of the site and in the marsh along the plant access road in the vicinity of the site.

2.4.1.3.2.2 Muskrat

The muskrat (*Ondatra zibethicus*) is considered an important species because of its commercial value as a furbearer. They are distributed from northern North America to the Mexican border, including the coast of the Gulf of Mexico (Reference 2.4-144).

Muskrats are found in aquatic environments including ponds, lakes, swamps, marshes, rivers, and streams. They typically live in large family groups. Muskrats dig tunnels into banks for shelter. They build nests atop a stable base (i.e., tree stump) piled with vegetation. In warmer climates in the south, muskrats breed year-round. In colder climates in the north, muskrat breeding is more limited. The gestation period is 29 to 30 days with litter sizes of approximately six. Within 10 days of birth, young muskrats are able to swim. Within 21 days, they are fully weaned. Within 30 days, they are independent. Parental care is provided solely by the female parent (Reference 2.4-144).
Muskrats are primarily herbivores, eating aquatic vegetation and also agricultural crops. They consume one-third of their body weight in food each day. In the summer, they prefer to consume the roots of plants, including those abundant near the site (*Phragmites* sp. and *Spartina* spp.). In the winter, they swim under the ice to eat those same plants (Reference 2.4-144).

Muskrats were observed at the PSEG Site and in the vicinity during the spring and summer. Muskrats were observed near the ponds at the northwest portion of the site, and in marsh habitats in the vicinity of the site. Several nesting mounds were observed in areas on-site and within the vicinity, where both *Phragmites* sp. and *Spartina* spp. are prevalent.

2.4.1.3.2.3 White-Tailed Deer

The white-tailed deer (*Odocoileus virginianus*) is considered an important species because of its recreational value as a game species. Limited deer hunting is authorized under controlled conditions during archery season on specified, undeveloped portions of the PSEG Site to cull the deer herd for automotive safety reasons. In North America, they are distributed throughout most of the United States and southern Canada (Reference 2.4-43).

White-tailed deer inhabit a large variety of environments. They are found in large forests, grasslands, swamps, farmland, and brushy-scrub areas with dense thickets that provide shelter and edges to provide ample food. White-tailed deer are herbivores, feeding on a variety of vegetation including shrubs, buds and twigs of trees, conifer twigs and cones, and crops. They typically feed in the hours preceding and following dawn and dusk (Reference 2.4-43).

Mating occurs from October to December. If the doe does not mate during a 24-hr. period, she comes into heat a second time, approximately 28 days later. The gestation period is 6-1/2 months. Bucks are polygamous and mate with several females in a breeding season. A doe usually has one fawn during the first breeding year, with a litter of two and, uncommonly, three or four in subsequent years. Fawns are able to walk at birth and are weaned at 8 to 10 weeks of age. Sexual maturity is reached during their second year (Reference 2.4-43).

White-tailed deer were observed in the PSEG Site and vicinity during the 2009-2010 field survey in the *Phragmites*-dominated wetland habitat and more frequently in the old field habitat. The old field habitat is the only area on-site that provides forage for white-tailed deer. The old field habitat on-site is used intermittently as laydown and storage for the existing site operations at SGS and HCGS.

2.4.1.3.3 Plant Communities

Characterization of terrestrial plant communities in the vicinity of the PSEG Site is based on records review (recorded distributional records), agency consultation with NJDEP, DNREC, and USFWS, and on-site investigation. On-site methods included vegetative cover type mapping and field confirmation, general site reconnaissance, and transect surveys. Pedestrian transect surveys (Figure 2.4-4) were performed during the growing season in the spring, summer and fall 2009 to record the terrestrial plant species growing on-site. Supplemental field studies within the site are used in part to characterize the assemblage of terrestrial plant species, and to aid in the identification of important species within the PSEG property boundary. Most of the site includes disturbed *Phragmites*-dominated wetlands and old field habitat, therefore plant species typically encountered are generally opportunistic weedy species. Common species on the PSEG Site include broomsedge (*Andropogon virginicus*), common reed, mugwort, Queen Anne's lace, and fescue, as described in Subsection 2.4.1.1. Table 2.4-9 lists the terrestrial plants observed on-site during the 2009 surveys.

Using the methodology outlined in Subsection 2.4.1.3, the only terrestrial plants identified as important at the PSEG Site are cordgrass species (*Spartina* spp.). Within the PSEG Site and vicinity, cordgrass species include *Spartina alterniflora*, *S. cynosuroides*, and *S. patens*, all of which are key or matrix species of salt and brackish tidal wetlands or marshes. *Spartina* spp.

have generally been replaced within the PSEG Site and vicinity by an invasive strain of *Phragmites australis*, common reed. *Spartina* spp. meet the definition of important species as it is deemed critical to the structure and function of local terrestrial ecosystems, namely coastal saltmarsh wetlands. PSEG actively manages for *Spartina* spp. in their EEP, wherein monocultures of the invasive strain of *Phragmites* are controlled and/or tidal exchange is reestablished to provide a competitive advantage to the native saltmarsh matrix species. Consequently, *Spartina* spp. is abundant in the restored tidal marsh areas managed under the EEP (Reference 2.4-159).

Spartina spp. are rhizomatous, perennial warm-season grasses common in saline or brackish marshes of the intertidal zone along the Atlantic and Gulf coasts. Mature plants produce seed in the fall, but seed viability is short-lived and variable (Reference 2.4-12). While seeds are important for colonizing new areas, they appear to be unimportant in maintaining established stands.

2.4.1.3.4 Important Habitats – Wetlands

Wetlands are under the regulatory authority and jurisdiction of the USACE and NJDEP and are identified as important terrestrial habitat at the PSEG Site. The objective of the Clean Water Act (CWA) is to maintain and restore the chemical, physical, and biological integrity of the waters of the United States. Section 404 of the CWA authorizes the Secretary of the Army, acting through the Chief of Engineers, to regulate, via a permit system, the discharge of dredged or fill material into the waters of the United States, including wetlands. In NJ, coastal wetlands are regulated under the NJ Wetlands Act of 1970 and freshwater wetlands are also regulated under the NJ Freshwater Wetlands Protection Act. Development in coastal or freshwater wetlands requires authorization in the form of permits from the NJDEP and USACE.

Jurisdictional coastal wetlands in NJ are mapped by NJDEP. However, unmapped freshwater wetlands must be delineated by the permit applicant. As stipulated in NJAC 7:7A-2.3, freshwater wetlands on the PSEG Site were delineated in support of a request for a letter of interpretation (LOI) (References 2.4-1). Wetlands in off-site areas potentially impacted by the proposed causeway were also delineated as part of the ESPA in accordance with the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (Reference 2.4-51).

Most of PSEG Site is surrounded by degraded tidal marsh dominated by near monocultures of the invasive strain of *Phragmites australis*, common reed. This is true of the majority of the tidal marsh surrounding Hope Creek, Alloway Creek, and associated smaller marsh creeks. The PSEG EEP manages the Alloway Creek Watershed Wetland Restoration Site just north of Alloway Creek. Due to the ongoing management and restoration efforts, *Phragmites* monocultures have been replaced by native saltmarsh species such as *Spartina alterniflora*, *S. cynosuroides*, *S. patens*, *Polygonum hydropiper*, and *Sagittaria latifolia*. Some areas on Artificial Island, such as the CDF (used by the USACE for placement of Delaware River dredge spoils) and the PSEG Site desilt basins (used by PSEG to dispose of sediment and dredge material removed from the intake structure, intake areas of the river, and barge slips) have been diked and are no longer tidally influenced.

Figure 2.4-5 identifies the jurisdictional wetlands (considered important terrestrial habitat) on the site mapped by NJDEP (coastal wetlands) and delineated on-site as part of the ESPA

(USACE CDF facility and PSEG's desilt basin, and freshwater wetlands). A total of 164.9 ac. of coastal wetlands, 70.6 ac. of CDF/desilt basin wetlands, and 87.2 ac. of freshwater wetlands have been mapped on the PSEG Site (Table 2.4-2).

Coastal wetlands on the PSEG Site consist of degraded systems that are characterized by altered hydrology and a hydrophytic vegetation community that is dominated by a monoculture of *Phragmites*. Most of the coastal wetlands occur in the northern portion of the PSEG Site and extend to the contiguous coastal wetlands of Alloway Creek and Hope Creek marshes. Channelized portions of marsh creeks are evident in Figure 2.4-5 that demonstrate the altered hydrology of these on-site coastal wetlands.

Wetlands were also identified within the CDF and PSEG's desilt basin in the northern portion of the PSEG Site. The ponded water present in this area is due in part to lack of operational drainage features within the CDF. The USACE operates the CDF intermittently. These wetlands have been determined to be hydrologically perched systems (Section 2.3.2) that are isolated from the adjacent coastal wetlands and have a hydroperiod that is primarily controlled by precipitation. Water depth in both of these areas is very shallow, typically ranging from 1 to 3 ft. These communities are periodically disturbed as they occur in active, licensed disposal facilities. Plant communities in these degraded wetlands are also of low quality and are characterized by a monoculture of *Phragmites*.

Freshwater wetlands are primarily located on the eastern portion of the PSEG Site. These systems are predominantly tidal wetlands that are contiguous with the coastal wetlands mapped by the New Jersey Wetlands Act of 1970. Functionally they are similar to the coastal wetlands and are tidally influenced systems. These systems are also dominated by a monoculture of *Phragmites*.

PSEG submitted a request for a LOI to the NJDEP for the existing 734-ac. PSEG property. An LOI is the official NJDEP determination establishing the presence, absence, or boundaries of freshwater wetlands and transition areas on a given site. In addition to the LOI, a jurisdictional determination (JD) request will be submitted to the USACE regarding the wetlands in the CDF and desilt basins on-site. This provides the basis for the final PSEG Site wetland determination and impact assessment. PSEG continues to work with NJDEP and USACE to finalize wetland boundaries in accordance with the LOI and JD process.

2.4.1.4 Disease Vectors and Pest Species

Disease vectors are defined as any organisms, most often insects and arthropods, which transfer disease-causing pathogens from a host to humans (Reference 2.4-198). The Salem County Department of Public Health was contacted to obtain information about the presence of local disease vectors. On the PSEG Site, the only known disease vector is the blacklegged or deer tick (*Ixodes scapularis*) which transmits the bacterial pathogen (*Borrelia burgdorferi)* from small rodents, squirrels, and deer to humans (References 2.4-18 and 2.4-19).

The only pest species on the PSEG Site is the invasive strain of common reed that crowds out native wetland or marsh plant species. Non-native to NJ marshes, it first appeared in the Delaware Estuary during the 1950s, following several years of repeated disturbance by hurricanes (Reference 2.4-157**)**. Common reed is a perennial grass species with stalks growing to more than 12 ft. in height (Reference 2.4-197). A wetland species that occurs in

marshes and along rivers, lakes, and ponds, it tolerates moderate salinity and thrives in disturbed wetland areas (References 2.4-157 and 2.4-173). Once established in an area from seed, it reproduces mainly through vegetative growth by rhizomes and stolons, which are underground roots and stems that create large, dense stands of near monoculture communities (References 2.4-157 and 2.4-197).

2.4.1.5 Wildlife Travel Corridors

In diverse landscapes, wildlife travel along areas of favorable habitat connecting to areas meeting their basic needs of food and shelter. On a local level, typical travel corridors on the ground may include brushy or forested hedgerows, fencerows, stream riparian zones, or ridge tops. The PSEG Site is essentially a landmass elevated above the surrounding coastal habitats (marsh and river), and therefore it represents more of a habitat island than a wildlife travel corridor. Habitats on the PSEG Site are dominated by early successional habitats and do not represent travel corridors. Alloway Creek and the associated coastal wetlands are part of an expansive coastal wetland complex that follows the coastline of NJ. This wide area may be considered part of a larger corridor that could be used by fauna as part of dispersal and seasonal movement within the project vicinity.

In the context of the region, the Delaware River makes up the west and south boundary for the PSEG Site and is part of the Atlantic Flyway (Reference 2.4-4)(Figure 2.4-6). Many migratory birds, especially waterfowl and shorebirds, use the Atlantic Flyway as a migratory travel corridor between winter foraging grounds and spring/summer breeding grounds. Additionally, raptors observed on-site (bald eagles, northern harriers, and ospreys) use the Delaware River as a travel corridor when searching for foraging and nesting areas.

2.4.1.6 Existing Ecological Effects and Environmental Stresses

The northeast and east portions of the PSEG Site consist of contiguous marsh habitat, while the southwest portions of the PSEG Site consist of existing land uses that are actively used for HCGS and SGS. Artificial Island is a man-made land mass created through the disposition of Delaware River dredge spoils behind a naturally occurring sandbar and bulkhead. Developed land uses for HCGS and SGS result in a disturbed landscape with limited habitat value for wildlife use. Additionally, the habitats associated with the licensed disposal facilities (e.g., the USACE CDF and PSEG's desilt basin) are also disturbed areas that are subject to the effects of on-going disposal activities. However, resident wildlife can still use the large areas of similar habitat to the north and east of the PSEG Site. The abundance and diversity of species of mammals, reptiles and amphibians, and birds observed on-site or in the site vicinity indicate that there is ample habitat in the area (Tables 2.4-4, 2.4-5, and 2.4-6, respectively). Consequently, the degree of on-site disturbance does not present a substantial source of stress to the health and stability of the surrounding ecosystems.

Upland areas in the southeast of the PSEG Site are characterized by a series of naturalized mounds and old field areas. These features are associated with the laydown and disposal area of HCGS and SGS construction materials. Over the years, this area has become naturalized and saplings (e.g., eastern red cedar) have become established as part of an old field habitat. Soils are poorly developed in this area of the site, therefore succession is occurring slowly. However, this area provides some habitat diversity and additional wildlife value relative to the common reed-dominated marsh that surrounds it.

There are several water resources on-site. These resources include marsh creeks, the Delaware River, and several artificial ponds. These water resources provide value (habitat for food and shelter) to many species of mammals, waterfowl, shorebirds, amphibians, and reptiles.

Based on the 2009-2010 field survey, there is no evidence that the PSEG Site has been subjected to recent environmental stresses, such as insect and disease outbreaks or damage from strong storms.

2.4.1.7 Ongoing Ecological Studies

PSEG conducts various ecological monitoring near the new plant as part of the EEP in conjunction with their NJPDES permit for SGS. Given the proximity of the new plant to SGS, these studies are directly applicable for the new plant. The ongoing annual ecological monitoring studies include:

- Impingement and entrainment sampling at the SGS circulating water intake structure
- Fish monitoring in the Delaware River and marsh creeks by the use of trawls, seines, and weirs
- Fish ladder monitoring at tributaries of the Delaware River
- Vegetative cover and geomorphology monitoring at four wetland restoration sites and two reference sites

Since 1995, PSEG has conducted a comprehensive wetland restoration program and biological monitoring program. The restoration program has successfully restored several common reed-dominated and other degraded wetland areas as part of the program encompassing more than 14,550 ac. throughout the Delaware Estuary in NJ and DE in accordance with site-specific NJDEP approved Management Plans. The common reed communities are treated using herbicide, or tidal exchange is reestablished to allow native marsh species (such as saltmarsh cordgrass) to repopulate the wetland sites. The monitoring is conducted in accordance with an NJDEP approved *Improved Biological Monitoring Work Plan* program. Each site is monitored yearly for successful restoration (Reference 2.4-159).

2.4.1.8 Off-Site Transmission and Access Corridors

2.4.1.8.1 Off-Site Transmission

As summarized in Subsection 1.2.5, PSEG completed a conceptual evaluation during development of the ESP application to identify potential transmission requirements associated with the addition of generation at the PSEG Site. This evaluation included the PJM Regional Transmission Expansion Plan, existing operational limits at HCGS and SGS, and other PJM transmission planning inputs. PJM routinely performs analyses of the regional transmission system and forecasts appropriate upgrades to the system as part of its long-term planning cycle. These evaluations are not specific to the addition of new generation at the PSEG Site.

In order to capture the potential effects of developing off-site transmission, PSEG analyzed the potential effects of two new off-site macro-corridors during development of the ESP application. Information pertaining to alternative off-site transmission system corridors considered by PSEG is presented in Subsection 9.4.3. The two, 5-mi. wide macro-corridors

analyzed are the South and West Macro-Corridors. The West Macro-Corridor (55-mi. long) generally follows existing transmission line corridors, extending from the PSEG Site to Peach Bottom Substation. The South Macro-Corridor (94-mi. long) also follows existing transmission line corridors and is generally consistent with the MAPP line that was preliminarily planned by PJM from the PSEG Site to the Indian River Substation. Each of these macro-corridors is developed with a common segment. From the PSEG Site, the hypothetical macro-corridor extends north and then west across the Delaware River to the Red Lion Substation. From this location, each of the potential macro-corridors diverge extending to the west (Peach Bottom) or south (Indian River).

The characteristics of land cover within each hypothetical macro-corridor are presented in Table 2.4-10. Based on overall differences in macro-corridor length, the total land area within the South Macro-Corridor (316,429 ac.) is notably greater than the area contained within the West Macro-Corridor (191,523 ac.). Cultivated cropland (121,895 ac., 39 percent) is the largest land cover type within the South Macro-Corridor. Other major land cover types within the South Macro-Corridor include combined wetlands (20 percent), deciduous forest (13 percent), pasture hay (11 percent), and open water (8 percent). Comparatively, pasture hay (46,055 ac., 24 percent) is the largest land cover type within the West Macro-Corridor. Other major land cover types within the West Macro-Corridor include cultivated cropland (19 percent), deciduous forest (18 percent), wetlands (14 percent combined), and open water (11 percent).

In addition to the wetlands identified as part of the land cover analysis, National Wetland Inventory (NWI) wetlands within the 5-mi. macro-corridor are presented in Table 2.4-11. A total of 94,413 ac. of wetlands and open water areas mapped by NWI are contained within the 5-mi. wide South Macro-Corridor and 35,516 ac. within the West Macro-Corridor. Estuarine and marine wetlands dominate the wetland types, accounting for 49,257 ac. in the South Macro-Corridor and 15,362 ac. in the West Macro-Corridor. Freshwater forested/shrub wetlands are the second most abundant type, accounting for 24,408 ac. and 7337 ac. in the South and West Macro-Corridors, respectively. Estuarine and marine deepwater habitats associated with the Delaware River are also common, accounting for 12,607 ac. in the South Macro-Corridor, and 6680 ac. in the West Macro-Corridor. The other relatively common wetland type represented within the macro-corridor area is freshwater emergent wetland, consisting of 5457 ac. in the South Macro-Corridor and 4188 ac. in the West Macro-Corridor.

Additional discussion regarding potential off-site transmission and its potential impact is provided in Chapter 4 (Impacts of Construction), Chapter 5 (Impacts of Station Operation) and Chapter 9 (Alternatives).

2.4.1.8.2 Access Corridor

Additional access road capacity is needed to address the future transportation needs for the PSEG Site. A new access is conceptually designed as a three-lane causeway to be constructed on elevated structures for its entire length through the coastal wetlands. The proposed causeway extends northeast from the PSEG Site along or adjacent to the existing Red Lion transmission corridor to Money Island Road, with an at-grade roadway continuing to the intersection of Money Island Road and Mason Point Road (Figure 2.4-3). The alignment runs roughly 200 ft. east of, and parallel to, the existing Red Lion transmission line for most of its length. Through the coastal wetlands, the causeway is constructed on elevated structures,

thereby reducing environmental impacts. Existing land uses along the alignment of the proposed causeway are illustrated in Figure 2.4-3 and summarized as part of the vicinity in Table 2.4-3. Additional discussion regarding the proposed access road and its potential impact is provided in Chapter 4 (Impacts of Construction) and Chapter 5 (Impacts of Station Operation).

2.4.2 AQUATIC ECOLOGY

2.4.2.1 Aquatic Habitats

2.4.2.1.1 Creeks and Ponds On or Near the PSEG Site

Water bodies on or near the PSEG Site include three ponds and a network of interconnected marsh creeks (Figure 2.4-7). The marsh creeks include four major drainages – Mill Creek, Alloway Creek, Fishing Creek, and Hope Creek. In addition, there are a large number of small to medium size interconnected streams throughout the area north and east of the PSEG Site. All but the most upstream intermittent segments of these streams are tidally influenced and considered estuarine. All are connected to the Delaware River. Water in the streams ranges from oligohaline (saline rating of 0.5 to 5 ppt) to mesohaline (saline rating of 5 to 18 ppt), depending on the amount of freshwater discharge and the tidal height (Reference 2.4-86).

There are freshwater ponds in the northwest area of the PSEG Site. These water bodies are artificial ponds that are located within the USACE CDF facility and PSEG's active, licensed desilt basin. The ponds are perched water bodies (Subsection 2.3.2) and are hydrologically isolated from the adjacent coastal wetlands. Habitat associated with these water bodies is of poor quality as they are characterized by shallow depth, and silt and sand substrates. They are part of licensed disposal facilities, therefore their configuration and permanence are transitory as they are subject to use as a disposal area for material dredged as part of on-going maintenance activities. The CDF facility and desilt basins may not be considered jurisdictional waters of the United States. As stated in Section 2.4.1.3.4, a jurisdictional determination request will be submitted to the USACE regarding the determination of wetlands in the CDF and desilt basins on-site.

Surveys of the benthic macroinvertebrates and fish inhabiting the ponds and the smaller marsh creeks on or near the PSEG Site were performed from winter 2009 through winter 2010 (Figure 2.4-8). A ponar dredge was used to collect macroinvertebrates. This was the primary methodology in historical studies from Artificial Island (References 2.4-25, 2.4-86, and 2.4-178). Fish were collected using seines and weirs set at high tide and retrieved at low tide. These methods are used in the EEP for PSEG's SGS (Reference 2.4-159). As part of the EEP, fish surveys of the larger marsh creek segments have been performed since 1995. The systems sampled in those studies that are nearest the PSEG Site are Mill Creek and Alloway Creek (north of the site) and Mad Horse Creek (east of the site) (Figure 2.4-9).

In ponds, results of the most recent surveys indicate that fish communities are numerically dominated by small taxa such as sheepshead minnow (*Cyprinodon variegatus*), banded killifish (*Fundulus diaphanus*), and mummichog (*Fundulus heteroclitus*), as well as juvenile specimens of larger taxa such as common carp (*Cyprinus carpio*), pumpkinseed (*Lepomis gibbosus*), and bluegill (*Lepomis macrochirus*) (Table 2.4-12). Total abundance was greater in the spring, summer, and fall, compared to the winter survey, primarily reflecting recruitment of

young-of-the-year. Fish species richness was also lower in the winter. Benthic macroinvertebrate communities consisted primarily of oligochaete worms (e.g. *Limnodrilus* spp.) and non-biting midges (e.g., *Chironomus*); abundance in these systems was markedly greater in the spring than in the fall (Table 2.4-13).

Small creek fish collections in 2009 demonstrated numerical dominance by mummichog, with occasional Atlantic menhaden (*Brevoortia tyrannus*) and sheepshead minnow (Table 2.4-14). Mummichog is the most abundant species in all seasons. Richness is consistently low, varying from one to three species except at Station AS-05 in the fall, where five species were collected. Macroinvertebrate communities in small marsh creeks are largely comprised of oligochaetes (*Limnodrilus* and other tubificids) and amphipods (primarily *Gammarus daiberi* and *Leptocheirus plumulosus*) (Table 2.4-15). Total richness ranged from four to seven taxa in these samples. In 2009, samples of macroinvertebrate communities from large marsh creek segments, amphipods are numerically dominant; primarily represented by *Corophium* sp. and *Gammarus daiberi* (Table 2.4-15). The amphipod, *Leptocheirus plumulosus*, the isopod *Cyathura polita*, and the polychaete worm *Nereis succinea* are occasionally common. Richness is low in these samples, varying from three to seven taxa. As was noted for the pond habitats, macroinvertebrate abundance and taxonomic richness values were much lower in the fall than in the spring.

In the most recent (2003 to 2007) EEP collections from larger segments of marsh creeks, consistently abundant species are the bay anchovy (*Anchoa mitchilli*), Atlantic menhaden, and white perch (*Morone americana*) (Table 2.4-16). Species generally common and occasionally abundant include weakfish (*Cynoscion regalis*), striped bass (*Morone saxatilis*) and hogchoker (*Trinectes maculatus*). Smaller marsh creek segments surveyed in the EEP over the same period are generally dominated by mummichog, with bay anchovy, Atlantic silverside (*Menidia menidia*), and white perch consistently common. Total richness ranges from 17 to 28 species in the large marsh creek segments, but is lower (6 to 17 species) in the small segments (Table 2.4-16).

2.4.2.1.2 Delaware River

2.4.2.1.2.1 Fish

An extensive amount of data exists to describe the fish community in the Delaware River near the PSEG Site. Ecological studies near Artificial Island have been performed since the late 1960s (Reference 2.4-86). Annual summaries of impingement and entrainment at SGS from 1995 through 2007 are available as part of the PSEG EEP (References 2.4-153 through 2.4-157 and 2.4-159 through 2.4-166). Impingement sampling was also performed at the HCGS in 1986 and 1987 (References 2.4-221 and 2.4-222). For this analysis, impingement and entrainment data from the most recent 5 yr (2003 to 2007) at the SGS are the primary source of information. The 13-yr SGS dataset and the HCGS dataset from the mid-1980s are each compared to the 5-yr SGS dataset to evaluated sensitivity.

In addition to the impingement and entrainment collections, trawling and seining surveys have been conducted annually in the Delaware River near the PSEG Site. Trawl collections were performed using a 16-ft. semi-balloon otter trawl, with the nets towed on the bottom for 10 min. at a speed of 6 ft/sec against the direction of the tide (Reference 2.4-159). In 2003 and 2004, pelagic trawls were also performed. Sampling events were performed during

daylight hours once per month from April through November. Data from river zones 6 and 7 (RM 40 to RM 60) are considered for this analysis. Seining was performed using a 100-ft. long, 6-ft. deep, bagged haul seine with one-quarter inch nylon mesh. The seine was set by boat perpendicularly to the shore until the bag was reached. The remainder of the net was set in an arc-like fashion back to shore (Reference 2.4-159). During daylight hours, one sampling event was performed per station twice monthly from July through October and once monthly in June and November. As with the trawl collections, data from stations between RM 40 and RM 60 are considered for this analysis.

Impingement data from SGS reveal the high species richness of the fishery in the Delaware River, with the catch including freshwater, marine, and anadromous species. Collections from 2003 through 2007 have been numerically dominated by white perch, Atlantic croaker, and weakfish (Table 2.4-17). Other abundant species include hogchoker, bay anchovy, spotted hake (*Urophycis regia*), striped bass, blueback herring (*Alosa aestivalis*), gizzard shad (*Dorosoma cepedianum*), and Atlantic silverside. The total impingement density at SGS ranged from 2424 to 4331 individuals per million cubic meters (m^3) or 264.17 per million gallons (Mg), with a 5-yr average of 3243 per million m^3. Total richness varies from 50 to 61 species annually, with 82 species encountered over the 5-yr period. If the 13-yr SGS dataset is considered, the same 10 species are the most abundant with regard to density, and the order of abundance is similar (Table 2.4-18).

With regard to the comparison between SGS impingement from 2003 through 2007 and HCGS impingement in 1986 and 1987, most of the abundant species (e.g., Atlantic croaker, bay anchovy, weakfish and hogchoker) are the same at both stations (Table 2.4-19). Two exceptions are white perch (among the most abundant species in SGS but not HCGS samples) and naked goby (*Gobiesoma bosc*) (among the most abundant species in HCGS but not SGS samples). Other species common in HCGS impingement samples but not in those at SGS, include oyster toadfish (*Opsanus tau*), northern pipefish (*Syngnathus fuscus*), striped cusk-eel (*Ophidion marginatum*), and American eel (*Anguilla rostrata*). Compositional differences may be associated with intake locations, sampling methodology, and/or gear type differences between the two studies. Seasonal variation in impingement density largely reflects the differential collection of white perch and Atlantic croaker, which were the two most abundant species in winter (accounting for 84 percent of the total catch), spring (46 percent), and fall (83 percent) (Table 2.4-20). The summer samples were numerically dominated by weakfish, which comprised 68 percent of the total, on average.

Total impingement density was greatest in the fall (2003 to 2007 mean equals 1,193 per million m^3) and least in the spring (483 per million m^3). Total richness was highest in the fall, with 62 species collected over the 5-yr period considered, followed by summer (57), spring (53), and winter (46). Common species, other than the three mentioned above, generally differ in abundance by season. Blueback herring was most numerous in winter samples, whereas bay anchovy was more numerous in the spring. Gizzard shad and Atlantic silverside were most numerous in fall and winter collections. Striped bass was most abundant in the summer and fall. Hogchoker was abundant in the spring, summer, and fall, but not in the winter (Table 2.4-20).

Entrainment data from SGS reflect numerical dominance by bay anchovy, and to lesser extents, naked goby, striped bass, and Atlantic croaker (Table 2.4-21). Atlantic menhaden and weakfish are also common. Total entrainment density over the 5-yr period ranges from 54 to

264 individuals per million m^3, with a mean of 146 per million m^3. Total richness typically varies between 31 and 36 species, but was somewhat higher (44) in 2006. If the 13-yr SGS dataset is considered, the same composition and abundance patterns are evident as in the 5-yr data set. Bay anchovy and naked goby are the community dominants, with striped bass and Atlantic croaker abundant, and weakfish and Atlantic menhaden common (Table 2.4-18). With regard to seasonal variation of entrainment, eggs are most numerous in the summer (281,361 per million m^3) and spring (142,777 per million m^3) due to the high numbers of bay anchovy (Table 2.4-22). Similarly, larvae were primarily encountered in summer (267,726 per million m^3) and spring (132,188), reflecting the differential seasonal abundance of several community members, including bay anchovy (mostly summer), naked goby (mostly summer), and striped bass (mostly spring). Atlantic croaker larvae are most numerous in the fall, and Atlantic menhaden larvae are most numerous in the spring and fall. Juvenile specimens, principally Atlantic croaker, are most abundant in the fall (54,607 per million m^3). In the summer, most juveniles were bay anchovy. Adults in entrainment samples are mostly bay anchovy in the spring and naked goby in the summer and fall). Total richness in the larval subset of the collections is greatest in the spring (28 species) and summer (27). In the juvenile subset, richness ranges between 20 and 24 species in the spring, summer, and fall. Richness is generally low (less than 10 species) in the egg and adult subsets of entrainment samples (Table 2.4-22).

Results of bottom trawling surveys performed in the Delaware River in the vicinity of PSEG Site from 2003 through 2007 generally reflect the same community composition as demonstrated by the impingement surveys. Numerically dominant species include bay anchovy, weakfish, Atlantic croaker, white perch, hogchoker, and spotted hake (Table 2.4-23). Other consistently common species are American eel, striped cusk-eel, and oyster toadfish. In pelagic trawl samples conducted in 2003 and 2004, bay anchovy, weakfish, and Atlantic croaker were also abundant, but other species common in bottom trawl collections were not. Only presence/absence data are available for seine collections of the 5-yr period examined. This was done because abundance data were presented in percent composition rather than raw numbers by each river segment. Generally, the same species were encountered as in the trawl surveys. Exceptions were primarily small cyprinodontid species (e.g., mummichog, striped killifish) or juvenile centrarchids but also included an Atlantic sturgeon in 2003. Total abundance in bottom trawl surveys ranged from 6110 to 12,492 fish between 2003 and 2007 (Table 2.4-23). Greater abundance (18,087 to 19,166 individuals) was obtained in the pelagic trawl samples of 2003 and 2004. Total richness is comparable among surveys of the three methods, ranging from 21 to 34 species over the 5-yr period considered. No clear long-term temporal patterns of either richness or abundance are evident.

2.4.2.1.2.2 Macroinvertebrates

Benthic macroinvertebrate assemblages in the Delaware River near the PSEG Site were surveyed using ponar dredge samplers from 1971 through 1976 (References 2.4-86 and 2.4-178). Additionally, surveys of the benthic macroinvertebrate communities in the Delaware River near the PSEG Site were performed in the spring and fall of 2009.

In the historical samples of the 1970s, the most diversely represented groups are the polychaete worms (9 taxa), bivalve mollusks (8 taxa), and amphipod crustaceans (8 taxa) (Table 2.4-24). Important taxa in terms of density and biomass include:

- oligochaete worm (*Paranais litoralis)*
- polychaetes (*Polydora* sp. and *Scolecolepides viridis)*
- amphipods (*Corophium lacustre* and *Gammarus* spp.)
- isopods (*Cyathura polita* and *Edotea triloba)*
- opossum shrimp (*Neomysis americana*)
- barnicle (*Balanus improvisus)*
- decapod shrimps (sand shrimp [*Crangon septemspinoza]* and daggerblade grass shrimp [*Palaemonetes pugio]*)
- brachyurans (true crabs) – blue crab *(Callinectes sapidus*), estuarine mud crab (*Rhithropanopeus harrisii*), and red-jointed fiddler crab (*Uca minax*)

Another commercially important benthic macroinvertebrate species, the eastern oyster (*Crassostrea virginica*), was encountered in benthic studies near the PSEG Site, but in small numbers (Reference 2.4-178).

Crustaceans, primarily amphipods and isopods, dominated the collections taken from the Delaware River in 2009 (Table 2.4-25). Although abundance was not high in spring samples, the isopod *Chiridotea almyra* and the amphipods *Corophium lacustre*, *Gammarus daiberi*, and *Monoculodes edwardsi* were the most common species. Abundance was even lower in the fall surveys. Taxa richness was generally low, ranging from 2 to 10 taxa in the spring, and from 0 to 3 in the fall.

2.4.2.2 Important Aquatic Species

NUREG-1555 defines important species as: (1) species listed or proposed for listing as threatened, endangered, candidate, or of concern in 50 CFR 17.11 by the USFWS, or the state in which the project is located; (2) commercially or recreationally valuable species; (3) species essential to the maintenance and survival of rare or commercially or recreationally valuable species; (4) species critical to the structure and function of local aquatic ecosystems; or (5) species that could serve as biological indicators of effects on local aquatic ecosystems.

A list of aquatic species considered important in the project area was compiled based on these criteria and is summarized in Table 2.4-26.

2.4.2.2.1 Threatened/Endangered Species and Candidates for Listing

The NJDEP, DNREC, and USFWS were consulted for information regarding sensitive species and habitats in the vicinity of the PSEG Site (References 2.4-38 and 2.4-142). Letters of correspondence, phone conversations, and personal meetings were held with NJDEP and DNREC to obtain agency input regarding threatened and endangered species, sensitive habitats, commercial and recreational species, and other characteristics for the PSEG Site and vicinity. A response has not yet been received from USFWS regarding the new plant. However, USFWS has responded to a request for information on the presence of threatened and endangered species within the project area of the HCGS and SGS in regards to PSEG's

operating license renewal (References 2.4-203 and 2.4-204). Information from these consultations was used as the basis for identifying important species and habitats.

Two fish and five turtle species listed as either federally endangered or state endangered by NJ and/or DE are considered for this analysis (Table 2.4-26). The life history of each species is summarized below along with known environmental requirements and distribution within the Delaware River ecosystem.

In addition, seven species of unionid mussels are listed as threatened or endangered in NJ and/or DE. These include three species in the genus *Alasmidonta*: dwarf wedge mussel (*A. heterodon*), triangle floater (*A. undulata*), and brook floater (*A. varicosa*); two species of *Lampsilis*: yellow lampmussel (*L. cariosa*) and eastern lampmussel (*L. radiata*); tidewater mucket (*Leptodea ochracea*) and eastern pondmussel (*Ligumia nasuta*). Dwarf wedge mussel is also federally listed as endangered. While sometimes found in waters with tidal influence, these are freshwater species and are unlikely to occur in the brackish marsh creeks on or near the PSEG Site. However, all have been collected from the Delaware River watershed (Reference 2.4-3). Three of the listed species, dwarf wedge mussel, brook floater, and eastern lampmussel, have only been found in the upper Delaware River watershed, far upstream of the site. Two species, triangle floater and eastern pondmussel, have been found in Delaware River tributaries in Gloucester County, the next county upstream from Salem County. The remaining two species, yellow lampmussel and tidewater mucket, have not been found closer than Camden County, two counties upstream from Salem County. Given the lack of documented distribution of these freshwater unionid mussel species within the immediate vicinity of the PSEG Site, further discussion of their life history is not presented in this report.

2.4.2.2.1.1 Shortnose Sturgeon

The shortnose sturgeon (*Acipenser brevirostrum*) is an anadromous bony fish federally listed as endangered in 1967 (Reference 2.4-122).

Shortnose sturgeon inhabit rivers and estuaries along the east coast of North America from the St. John River in New Brunswick, Canada to the St. Johns River in FL (Reference 2.4-122). The type specimen of this species was collected in the Delaware River (Reference 2.4-92). Their current distribution in the system is considered to be from Philadelphia, PA upstream to Trenton, NJ (Reference 2.4-122). Masnik and Wilson report 36 specimens collected in the Delaware River from 1954 to 1979, primarily in gill nets and bottom trawls (Reference 2.4-108). A shortnose sturgeon was collected in a bottom trawl from the Delaware River near the PSEG Site in 2004 (Reference 2.4-162).

Shortnose sturgeon prefer nearshore marine, estuarine, and riverine habitats within large river systems (Reference 2.4-122). Freshwater feeding habitats for adults are over shallow (1 to 5 m [3.3 to 16.4 ft.]) muddy bottom areas with abundant macrophytes in the spring, and deeper 5 to 25 m (16.4 to 82.0 ft)) water from late summer through winter. In saline waters, shortnose sturgeon are known to feed over sandy mud or mud bottoms at depths of 5 to 10 m (16.4 to 32.8 ft) (Reference 2.4-33). Spawning habitat is upriver in the faster-moving fresh water areas of rivers over gravel to rubble-sized substrate (Reference 2.4-34).

Male shortnose sturgeon are sexually mature at 2 to 13 yr of age, with the length of time to maturation increasing moving northward in latitude. In females, sexual maturity is delayed an

additional 3 to 4 yr. Spawning appears to occur near the middle of April in the Delaware River. Eggs sink to the bottom and adhere to the substrate, with hatching occurring 8 – 13 days later. At hatching, larvae are dark grey with large yolk sacs. Early growth is rapid (Reference 2.4-34). Shortnose sturgeon feed primarily on benthic organisms, such as crustaceans and insect larvae and on gastropods (Reference 2.4-33). Shortnose sturgeon longevity appears to be in excess of 30 yr throughout its range (Reference 2.4-34).

Although the shortnose sturgeon was rarely a target of commercial fishing, it was frequently taken incidentally in Atlantic sturgeon harvests (Reference 2.4-122). The decline in this species between 1900 and the 1950s may have been due to incidental harvest and destruction of large numbers by the shad fishing industry, in combination with a decline in water quality (particularly with regard to low dissolved oxygen levels prior to sewage treatment advances) in the freshwater portion of their ranges (Reference 2.4-108). In addition, construction of dams on river systems likely resulted in substantial loss of habitat or limitation of access to historical spawning grounds (Reference 2.4-122).

2.4.2.2.1.2 Atlantic Sturgeon

The Atlantic sturgeon (*Acipenser oxyrinchus*) is on the candidate species list under the Endangered Species Act (ESA) (Reference 2.4-130). It is also listed as an endangered species in Delaware (Table 2.4-26).

The Atlantic sturgeon was historically present in approximately 40 rivers between St. Croix, Maine (ME) to the St. Johns River in FL (Reference 2.4-123). The current reported range is slightly smaller, from the Kennebec River in ME to the Satilla River in Georgia (GA). Spawning is reported to occur in at least 14 rivers within this range (Reference 2.4-130). It is believed that the Delaware River historically supported a large stock of Atlantic sturgeon. Gill net surveys by the DE Division of Fish and Wildlife collected over 1700 juveniles near Artificial Island and the Cherry Island Flats (slightly upstream) between 1991 and 1998.(Reference 2.4-6) Atlantic sturgeon individuals were collected in 2006 and 2007 SGS impingement collections (References 2.4-159 and 2.4-160).

For spawning, Atlantic sturgeon prefer silt-free, high gradient habitat over boulder, bedrock, gravel-cobble and/or coarse sand substrates. Juveniles and adults often congregate in upper estuary habitats near the saltwater interface, traveling in both directions throughout the summer and fall. Adults may spend years between spawning periods in marine waters. (Reference 2.4-76).

Atlantic sturgeon mature late, and reportedly begin spawning at ages of 12+ yr for males to 15+ yr for females. Spawning adults migrate upriver in the spring and early summer. Eggs are demersal and adhere to bottom substrates. Hatching occurs in 4 to 6 days, and larvae absorb their yolk sacs in another 10 days then begin downstream movement. Juveniles continue to migrate downstream to estuarine waters. Individuals grow rapidly, and may later move to coastal waters (Reference 2.4-47). Atlantic sturgeon is a long-lived species, with a 60-yr old specimen once reportedly encountered (Reference 2.4-123).

A major fishery for Atlantic sturgeon existed in the late 1800s to support a caviar market (Reference 2.4-6). The Delaware River once supported the largest known population of the species. A recent telemetry study indicated that although a remnant population of spawning

Atlantic sturgeon exists in the Delaware River, it is too early to determine whether recovery is occurring (Reference 2.4-177). While over harvest likely led to the initial collapse of the fishery, factors continuing to impede recovery include habitat loss due to dam construction, water pollution (particularly that associated with hypoxic events), and salinity changes.

2.4.2.2.1.3 Loggerhead Turtle

The loggerhead sea turtle (*Caretta caretta*) has a particularly large head housing powerful jaw muscles (Reference 2.4-126). Its shell and legs are reddish-brown, with brown to yellow markings over the remainder of its body. It can grow to approximately 3 ft. in length and weigh approximately 250 lb. on average (Reference 2.4-126).

Loggerhead turtles are highly migratory. Adult loggerheads are known to make extensive migrations between foraging areas and nesting beaches (Reference 2.4-210). The loggerhead turtle is globally distributed. It inhabits tropical, subtropical, and temperate waters of the Indian, Pacific, and Atlantic oceans (Reference 2.4-196). The ESA listed the loggerhead turtle as threatened throughout its range on July 28, 1978 (Reference 2.4-126). DE and NJ list the loggerhead turtle as endangered (Reference 2.4-196).

Most of the populations in the United States occur in FL and along the coastal islands of GA and the Carolinas (Reference 2.4-196). A small number of loggerheads nest regularly in Virginia (VA) and less often north to NJ. Nesting has recently occurred on barrier islands along the TX coast. Delaware Bay and Chesapeake Bay are important summer habitat for juveniles. During the summer, loggerhead turtles migrate from their nesting beaches in the Carolinas and GA into and near Delaware Bay. Loggerhead turtle densities in Delaware Bay are similar to that in Chesapeake Bay (Reference 2.4-126). It is unclear whether the turtles over-winter in Delaware Bay.

The loggerhead is wide-ranging. It may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers. Loggerheads nest on ocean beaches and occasionally on estuarine shorelines with suitable sand. Most loggerhead hatchlings originating from United States beaches are believed to lead a pelagic existence in the North Atlantic gyre for an extended period of time, perhaps as long as 10 to 12 yr (Reference 2.4-210). Once they reach a certain size, these juvenile loggerheads begin recruiting to coastal areas in the western Atlantic where they become benthic feeders in lagoons, estuaries, bays, river mouths, and shallow coastal waters. Loggerhead turtles eat many types of invertebrates, in particular mollusks and crustaceans. This can cause change in the seabed due to mining the sediments for their favorite prey (Reference 2.4-126). These juveniles occupy coastal feeding grounds for a decade or more before maturing and making their first reproductive migration; the females returning to their natal beach to nest (Reference 2.4-210).

There is no reported loggerhead turtle nesting along Delaware Bay beaches, though they do forage in the bay. Loggerhead turtles are the most commonly observed sea turtle species in the vicinity of SGS. In 1991, 23 loggerhead sea turtles were recovered from the SGS cooling water intake area. Mitigation measures to reduce incidental intake of sea turtles at the SGS were implemented in 1992 to 1993. Between 1993 and 2001, six loggerhead turtles were stranded at the SGS; none since 2001. The condition of the animals or reasons for their take are not known. In the early 1990s, sonic and satellite tracking studies of loggerhead sea

turtles incidentally taken at the SGS were conducted. These studies indicate that the released turtles did not show a particular affinity for the SGS intake but rather moved throughout the estuary.

2.4.2.2.1.4 Atlantic Green Turtle

Green turtles *(Chelonia mydas)* derive their name from their greenish-colored fat (Reference 2.4-118). Adults have a smooth carapace (upper shell) that is usually brown, with a lighter plastron (bottom shell) and light brown heads with yellow markings. The adult green sea turtle grows to a maximum size of approximately 4 ft. and a weight of approximately 440 lb. (Reference 2.4-206). The ESA listed the green turtle on July 28, 1978. In United States Atlantic and Gulf of Mexico waters, green turtles are found in inshore and nearshore waters from TX to Massachusetts (MA), the U.S. Virgin Islands, and Puerto Rico (Reference 2.4-118).

The green turtle is globally distributed and generally found in tropical and subtropical waters along continental coasts and islands between 30 degrees north and 30 degrees south. Green turtles are thought to inhabit coastal areas of more than 140 countries and nest in over 80 countries. In the United States, green turtles nest primarily along the central and southeast coast of FL. Present estimates range from 200 to 1100 females nesting annually. They do not nest in DE or NJ. The breeding populations in the United States are listed as endangered; elsewhere in the United States the species is listed by the federal government as threatened (Reference 2.4-118); the States of DE and NJ have listed the green turtle as endangered and threatened, respectively (Reference 2.4-192).

Green turtles are generally found in fairly shallow waters (except when migrating) inside reefs, bays, and inlets. The turtles are attracted to lagoons and shoals with an abundance of submerged aquatic vegetation (Reference 2.4-206). Adult green turtles feed almost exclusively on sea grass and algae (Reference 2.4-118).

The green turtle is not reported to nest along Delaware Bay beaches but may move into the bay to feed. Green turtles are occasionally observed in Delaware Bay. A total of three Atlantic green turtles have been captured at SGS since it began operations, all between the years of 1980 and 1992. Their known presence in the Delaware Bay has resulted in the USACE implementing dredging restrictions in portions of Delaware Bay and the Delaware River to protect the green turtles (Reference 2.4-192).

2.4.2.2.1.5 Leatherback Turtle

The leatherback turtle (*Dermochelys coriacea*) is the largest, deepest diving, and most wide ranging of all sea turtles. Leatherback turtles have an unusual carapace composed of a mosaic of small bones covered by connective tissue with seven longitudinal ridges (References 2.4-121 and 2.4-209). The skin is black with some paler spots. The front flippers lack claws and are proportionally longer than other sea turtles (Reference 2.4-121). The adult leatherback can reach up to 8 ft. in length and 2000 lb. (Reference 2.4-209).

The leatherback turtle is distributed worldwide in tropical and temperate waters of the Atlantic, Pacific, and Indian oceans. In the continental United States, a small nesting population (35 females per year) occurs on the east coast of FL. The ESA listed the leatherback turtle as

endangered on June 2, 1970 (Reference 2.4-209). Delaware and NJ also list the leatherback turtle as endangered (Reference 2.4-195).

Leatherbacks are commonly known as pelagic animals, but they also forage in coastal waters (Reference 2.4-121). In fact, leatherbacks are the most migratory and wide ranging of sea turtle species. Jellyfish are the main staple of its diet, but it is also known to feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed (Reference 2.4-209). After nesting in tropical areas, female leatherbacks migrate to more temperate latitudes, which support high densities of jellyfish prey in the summer (Reference 2.4-121).

The leatherback turtle is not reported to nest along Delaware Bay beaches but may move into the bay to feed (Reference 2.4-195). However, they have not been taken at SGS since initiation of preoperational and operational monitoring studies.

2.4.2.2.1.6 Hawksbill Turtle

Hawksbill turtles (*Eretmochelys imbricata)* derive their name from their prominent hooked beaks (Reference 2.4-207). The shape of the mouth allows the hawksbill turtle to reach into holes and crevices of coral reef to find sponges, their primary food source as adults, and other invertebrates (Reference 2.4-119). Adults have a dark brown carapace with yellow streaks and spots and a yellow plastron. The adult hawksbill sea turtle grows to a maximum size of approximately 3 ft. and a weight of approximately 200 lb. (Reference 2.4-207). The ESA listed the hawksbill turtle as endangered on June 2, 1970. In the continental United States, the species is recorded from all the Gulf States and along the east coast as far north as MA. However, sightings north of FL are rare (Reference 2.4-119).

The hawksbill turtle has circumtropical global distribution. It is generally found from 30 degrees north to 30 degrees south latitude in the Atlantic, Pacific, and Indian oceans and associated bodies of water (Reference 2.4-119). The hawksbill is primarily associated with reefs, mangroves, and keys. The species is a solitary nester from spring through late fall on coastal sand beaches, often in vegetation (Reference 2.4-193). Within the continental United States, nesting is rare and restricted to the southeast coast of FL and the Florida Keys (Reference 2.4-119).

In the United States, the species is listed as endangered by the United States federal government; the States of DE and NJ have both listed the hawksbill turtle as endangered (Reference 2.4-193).

Hawksbill turtles use different habitats at different stages of their life cycle, but are most commonly associated with coral reefs. In Atlantic populations, juveniles are believed to be pelagic, taking shelter in floating algal mats and drift lines of flotsam and jetsam. After a few years in the pelagic zone, small juveniles recruit to coastal foraging grounds; this shift in habitat also involves a shift in feeding strategies, from feeding primarily at the surface to feeding below the surface on a more varied diet. While they prefer coral reef habitat, they also inhabit mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent (Reference 2.4-119).

The hawksbill turtle does not nest along Delaware Bay beaches but may move into the Bay to feed. They have not been taken at the SGS since preoperational and operational monitoring studies were initiated.

2.4.2.2.1.7 Kemp's Ridley Turtle

The Kemp's ridley turtle *(Lepidochelys kempii)* is believed to be the most endangered of the sea turtles. It has a triangular-shaped head with a hooked beak with large crushing surfaces. Hatchlings are black (Reference 2.4-208). The almost circular carapace is grayish-green. The plastron is pale yellowish to cream colored. Adult Kemp's ridley turtles, considered the smallest marine turtles in the world, weigh approximately 100 lb. and carapaces measure between 24 –28 in. in length. In the continental United States, it is distributed throughout the Gulf of Mexico and United States Atlantic seaboard, from FL to New England (Reference 2.4-120). The ESA listed the Kemp's ridley turtle as endangered on December 2, 1970. Delaware and NJ both list the Kemp's ridley turtle as endangered (Reference 2.4-194).

The range of the Kemp's ridley includes the gulf coasts of Mexico and the United States, and the Atlantic coast of North America as far north as Nova Scotia and Newfoundland. Most nests for the Kemp's ridley are on coastal beaches in the Mexican States of Tamaulipas and Veracruz. After leaving their nesting beach, hatchlings are believed to become entrained in eddies within the Gulf of Mexico, where they are dispersed within the Gulf of Mexico and Atlantic by oceanic surface currents to coastal shallow water habitats. This shift in habitat involves a shift in diet. After its pelagic stage this turtle becomes a shallow water benthic feeder with a diet consisting primarily of crabs (Reference 2.4-208). Juveniles and subadults may be found along the eastern seaboard where they travel northward following vernal warming. They then return south during winter as temperatures begin to drop (Reference 2.4-194).

The Kemp's ridley turtle is not reported to nest along Delaware Bay beaches, but it has been observed foraging in Delaware Bay. In 1992, two dead Kemp's ridley sea turtles were found at the SGS cooling water intake; the cause of mortality was not reported. Implementation of mitigation measures in 1993 reduces the likelihood of additional turtle strandings; no Kemp's ridley turtles have been stranded at the SGS since that time.

2.4.2.2.2 Commercial and Recreational Species

Twenty-one aquatic species expected to be present in the Delaware River near the PSEG Site are harvested commercially and/or recreationally in NJ and/or DE. An additional four species (blueback herring, alewife, bay anchovy, and Atlantic silverside) are included because they are thought to meet the selection criteria of either keystone species or indicator species. They are designated as representative important species in PSEG's long-term biological monitoring program. All of these species have been encountered in preoperational or current biological monitoring for the HCGS and SGS. These species are listed in Table 2.4-27.

2.4.2.2.2.1 Blueback Herring

The blueback herring (*Alosa aestivalis*) is a member of the clupeid family, and is difficult to distinguish from the closely related alewife with which it is grouped. The blueback herring is also referred to as river herring (Reference 2.4-97). It is anadromous, spending most of its life

in marine environs and returning to fresh water to spawn (Reference 2.4-90). Blueback herring grow to 10 to 11 in. in length and 8 to 9 ounces in weight (Reference 2.4-97).

The blueback herring's native range is along the Atlantic Coast from Cape Breton, Nova Scotia to the St. Johns River in FL. This species also has moved into non-native areas in several eastern states, and reportedly has been released or stocked into several inland reservoirs (Reference 2.4-73). Blueback herring are commercially harvested in DE, with 1434 lb. taken in 2007 (Reference 2.4-125). They have been collected in impingement samples at SGS in all years since 1995 at a 13-yr average annual rate of 62.5 per million m^3 (Table 2.4-18). They also have been encountered in nearby marsh creeks during EEP surveys (Table 2.4-16). They were not collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009. In a program beginning in 1994, PSEG installed fish ladders to assist the migrations of river herring (blueback herring and alewife) through lakes and impoundments that separate over 1000 ac. of lakes and impoundments, and 117 mi. of upstream habitat from the Delaware estuary.

Blueback herring spawn in deep, swift fresh water over hard substrate in the spring. Juveniles spend 3 to 7 months in fresh water, then migrate to the ocean (Reference 2.4-73). They form schools, and winter near the bottom out from the coast (Reference 2.4-52). They feed on plankton, primarily copepods and pelagic shrimp (Reference 2.4-13).

2.4.2.2.2.2 Alewife

The alewife (*Alosa pseudoharengus*) is a member of the clupeid family, and is closely related to the blueback herring described in Subsection 2.4.2.2.2.1. It is anadromous, spending most of its life in marine environs and returning to fresh water to spawn (Reference 2.4-90). Adult alewives average 10 to 11 in. in length but can reach 15 in. Average weight is 8 to 9 ounces (Reference 2.4-13).

Alewives have sea-run populations ranging from Newfoundland to South Carolina (Reference 2.4-102). They have also been successfully introduced to lakes, notably the Great Lakes (Reference 2.4-90). They have been collected in impingement samples at the SGS in all years since 1995 at a 13-yr average annual rate of 12.2 per million m^3 (Table 2.4-18). They also have been encountered in samples from nearby marsh creeks during EEP surveys (Table 2.4-16). They were not collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

Alewives spawn from late February through April, somewhat earlier than blueback herring. They spawn in diverse lotic and lentic habitats over a wide range of substrates such as gravel, sand, detritus and submerged vegetation (Reference 2.4-102). They are broadcast spawners, with demersal eggs that are not particularly adhesive. After spawning, adults migrate downstream. Eggs hatch in less than a week and young begin feeding on minute plankton (Reference 2.4-90). Juveniles remain in freshwater nursery areas through spring and summer. In the fall, they move downstream to brackish water, then eventually to the sea (Reference 2.4-102). Sea-run alewives then remain in salt water until sexual maturity at 3 to 4 yr of age (Reference 2.4-13). They form schools and feed on diatoms, copepods, shrimps, insects, small fishes, squids and fish eggs (Reference 2.4-219).

2.4.2.2.2.3 American Shad

The American shad (*Alosa sapidissima*) is another anadromous member of the clupeid family (Reference 2.4-78). In size, it is the largest member of the family, averaging 20 to 24 inches in length and 3+ lb. (Reference 2.4-103). The American shad is commercially caught in rivers and estuaries, and is an important food fish (Reference 2.4-98). Their eggs are also considered a delicacy (Reference 2.4-216). Commercial harvests in NJ and DE totaled 58,981 lb. and 71,442 lb., respectively, in 2007 (Reference 2.4-125).

The American shad is distributed along the Atlantic Coast from southern Labrador to northern FL (Reference 2.4-78). It was introduced to the Sacramento and Columbia rivers in the Pacific Northwest in the late 1800s, and is now widely distributed throughout the Pacific. American shad populations have declined substantially in the last century, and a fishing moratorium is in effect across much of its range in the Mid-Atlantic states (Reference 2.4-98). They have been collected in impingement samples at SGS in all years since 1995 at a 13-yr average annual rate of 8.5 per million m^3 (Table 2.4-18). They also have been encountered occasionally in samples from nearby marsh creeks during EEP surveys (Table 2.4-16). They were not collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

American shad enter rivers to spawn in early spring when water temperatures are 50 to 55 °F (Reference 2.4-13). Between the hours of sundown and midnight, females release their eggs over sand and pebble substrates in shallow areas (Reference 2.4-218). The eggs are semi-buoyant, and begin moving downstream immediately, floating in open water or rolling along the bottom. Eggs hatch in 4 to 9 days (Reference 2.4-13). They develop into juveniles in approximately one month, and remain in the river until the fall when they migrate to the ocean (Reference 2.4-218). American shad develop into adults in the marine environment, feeding primarily on plankton, small crustaceans, and small fish. They enter freshwater to spawn after 4 to 5 yr for males and 5 to 6 yr for females (Reference 2.4-103).

2.4.2.2.2.4 Bay Anchovy

The bay anchovy (*Anchoa mitchilli*) is a small, schooling fish. It is one of the most abundant fish in estuarine and coastal habitats along the eastern United States (Reference 2.4-181). It is also a key species in the food web of those systems, being a major consumer of plankton and itself a major food for predatory fish (Reference 2.4-23).
The bay anchovy ranges along the coasts of the Atlantic and the Gulf of Mexico, although it is reportedly absent from the Florida Keys. It is abundant off Massachusetts. Rhode Island, NJ, and in Chesapeake Bay (Reference 2.4-116). The bay anchovy is commonly found in shallow tidal areas with muddy bottoms and brackish waters, and it tolerates a wide range of salinities (Reference 2.4-53). In impingement samples at SGS, bay anchovy have been collected in all years since 1995 at a 13-yr average annual rate of 136.6 per million m^3 (Table 2.4-18). They also have been consistently abundant in samples from nearby marsh creeks during PSEG EEP surveys (Table 2.4-16). They were not collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

The bay anchovy is believed to have an extended spawning period, from late April through late September. Spawning occurs in the evening or at night in estuarine waters where water temperatures are at least 12°Celsius (°C) (53.6°F) and salinity exceeds 10 ppt. Eggs are pelagic and found throughout the water column, but are more numerous near the surface and

hatch in approximately 24 hr. (Reference 2.4-116). Growth is rapid, and individuals reach maturity a few months after hatching (Reference 2.4-181). Life span is approximately 3 yr. (Reference 2.4-23). Bay anchovies are planktivorous, and feed mostly on microcrustaceans such as copepods, as well as mysid shrimps, small fishes, gastropods, and isopods (Reference 2.4-53).

2.4.2.2.2.5 American Eel

The American eel (*Anguilla rostrata*) is a widely distributed catadromous species, reproducing in the sea after spending most of its life in fresh or brackish water (Reference 2.4-48). Females are larger than males of the same age, and can grow to 4 ft. in length and weigh over 16 lb. (Reference 2.4-94). Eels are taken both recreationally and commercially, and are a popular food fish in Europe (Reference 2.4-151). Commercial harvests in NJ and DE totaled 164,356 lb. and 139,648 lb., respectively, in 2007 (Reference 2.4-125). Recreational harvests in 2007 totaled 44,616 individuals in NJ and 238 in DE (References 2.4-117 and 2.4-124).

American eels are widely distributed along the Atlantic coast from Greenland to Brazil, and are found in streams and rivers across much of the eastern United States (Reference 2.4-217). In impingement samples at SGS, they have been collected in all years since 1995 at a 13-yr average annual rate of 5.4 per million m^3 (Table 2.4-18). They also have been encountered consistently in samples from nearby marsh creeks during PSEG EEP surveys (Table 2.4-16). American eels were collected in both small marsh creeks (1 specimen at Station AS-05 in February) and ponds (one specimen at Station AS-09 in both July and September) near the PSEG Site in 2009.

American eels reach their sexual maturity in 3 to 20+ yr (Reference 2.4-175). Generally in the fall, sexually mature eels begin migrating from freshwater or estuarine areas to the Sargasso Sea, a warm water area in the middle of the North Atlantic (Reference 2.4-94). Spawning is believed to occur in late winter and early spring, and hatching likely begins in February and continues through April (Reference 2.4-48). Larvae drift on the Gulf Stream and reach the Atlantic coast in approximately 1 year (Reference 2.4-199). At that time, the eel undergoes a transformation from the transparent, leaf-shaped leptocephalus stage to the elver stage that more resembles the adult. The 2 to 3.5 in. long juveniles may remain in estuarine environs or begin migrating into fresh waters. Upon reaching 2 yr of age and a length of 22 to 31 in., the eels are considered to be sexually immature adults (Reference 2.4-94). As adults, eels are opportunistic carnivores, and feed on small fishes and benthic invertebrates, and often on other eels (Reference 2.4-112).

2.4.2.2.2.6 Atlantic Menhaden

The Atlantic menhaden (*Brevoortia tyrannus*) is a member of the clupeid family, but unlike the other clupeids discussed in previous subsections, it is not anadromous (Reference 2.4-104). They can reach lengths of 14 in. and weights of 1 lb. They are the second most important species harvested (by quantity) in the United States. The Atlantic menhaden is processed for several consumer products and is used as bait for commercial and recreational fishing. It is a key species in the coastal and estuarine food web, being a major consumer of phytoplankton and plant detritus, and itself a major food for predatory fish, birds, and mammals (Reference 2.4-22). Commercial harvests in NJ and DE totaled 37,634,929 lb. and 85,067 lb., respectively, in 2007 (Reference 2.4-125).

The range of Atlantic menhaden extends along the Atlantic coast from Nova Scotia to central FL (Reference 2.4-169). They are particularly abundant in Chesapeake Bay, and are also numerous in coastal waters from NJ to VA, mostly within 5 mi. of the shore (Reference 2.4-22). They have been collected in impingement samples at SGS in all years since 1995 at a 13-yr average annual rate of 30.6 per million m^3 (Table 2.4-18). They also have been common or abundant in samples from nearby marsh creeks during PSEG EEP surveys (Table 2.4-16). Atlantic menhaden was common at the small marsh creek Station AS-06, with 31 individuals collected in May and 13 collected in July. This was the only location where the species was encountered in surveys near the PSEG Site in 2009.

Spawning can occur throughout the year in estuaries and coastal waters, but there are definite spring and fall spawning peaks in the Middle and North Atlantic regions. Eggs are pelagic and hatch at sea in approximately 2 days (Reference 2.4-169). Larvae then move into the shallow portions of estuaries, where they spend approximately 1 year (Reference 2.4-22). In the fall, juveniles congregate into large schools and immigrate to the ocean. Sexual maturity is typically reached at 2 yr of age, with a length of 9 – 10 inches in the Middle Atlantic Bight. Adults consume zooplankton, larger phytoplankton, and chain-forming diatoms (Reference 2.4-169). They can live up to 8 yr, but individuals older than 6 yr of age have been rare since the 1960s (Reference 2.4-22).

2.4.2.2.2.7 Black Sea Bass

The black sea bass (*Centropristus striata*) is a member of the serranid family. It is highly valued by both commercial and recreational fishermen throughout the Mid-Atlantic as a food fish (Reference 2.4-5). They are commonly found around rock jetties and on rocky bottoms in shallow water (Reference 2.4-54). They can grow to a length of 2 ft. and a weight of 7.5 lb., but most adults average 1.5 lb. (Reference 2.4-13). Commercial harvests of black sea bass in NJ and DE totaled 480,238 lb. and 72,675 lb., respectively, in 2007 (Reference 2.4-125). Recreational harvests totaled 5997 individuals in NJ and 7805 in DE, in 2007 (References 2.4-124 and 2.4-117) (Table 2.4-27).

The range of the black sea bass is primarily along the Atlantic coast from Cape Cod, MA to northeastern FL, with greatest abundances occurring between the Capes of NJ and North Carolina (NC) (Reference 2.4-109). They have been collected in low numbers in impingement samples at SGS in 9 yr, between 1995 and 2007 with a 13-yr average annual rate of 0.6 per million m^3 (Table 2.4-18). They have not been encountered in samples from nearby marsh creeks during PSEG EEP surveys (Table 2.4-16), nor were they collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

Most sea bass are hermaphroditic, reproducing both as male and female at some point in their life (Reference 2.4-109). Generally, they begin life as females and change sex to become males when they reach 9 to 13 inches in length (Reference 2.4-5). They spawn from mid-May through late June off the coast of NJ, and eggs float in the water column until hatching in 2 to 5 days (Reference 2.4-13). The larvae drift in coastal waters until they reach approximately 0.5 inches in length, when they become bottom dwelling (Reference 2.4-109). Juveniles migrate to estuaries and bays, seeking shelter in habitats such as submerged aquatic vegetation, oyster reefs, and other structures (Reference 2.4-5). Juveniles and adults

feed on benthic invertebrates such as rock crabs, hermit crabs, squids, and razor clams (Reference 2.4-109).

2.4.2.2.2.8 Conger Eel

The conger eel (*Conger oceanicus*) is a bottom-dwelling fish that superficially resembles the American eel, but can be distinguished by the more anterior origin of the dorsal fin. It is generally larger than the American eel, measuring up to 7 ft. in length and occasionally reaching weights of 22 lb. or more (Reference 2.4-13). Eels are taken commercially. Harvests in NJ and DE totaled 41,399 lb. and 1241 lb., respectively, in 2007 (Reference 2.4-125).

Conger eels are widely distributed along the Atlantic coast from Cape Cod, Massachusetts to northern FL, and in the northern Gulf of Mexico (Reference 2.4-55). They occur from the coastal portions of estuaries to the edge of the continental shelf (Reference 2.4-93). They have been collected in low numbers in impingement samples at SGS in 8 yr between 1995 and 2007 at a 13-yr average annual rate of 0.3 per million m^3 (Table 2.4-18). They have not been encountered in samples from nearby marsh creeks during PSEG EEP surveys (Table 2.4-16). No conger eels were collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

The life history of the conger eel has several similarities to that of the American eel. The spawning season appears to extend from late summer through winter, with mature adults migrating from coastal or estuarine areas to the Sargasso Sea (Reference 2.4-31). They likewise pass through the larval stage as a broad and thin, transparent, leptocephalus (Reference 2.4-13). Larvae metamorphose into juveniles (elvers) that are shorter in length (Reference 2.4-85). Conger eel diet varies with size. Smaller individuals feed primarily on decapod crustaceans, whereas larger eels consumed more fish, including other eels (Reference 2.4-93).

2.4.2.2.2.9 Weakfish

The weakfish (*Cynoscion regalis*) is a member of the sciaenid (drum) family. It is indigenous to the Atlantic coast of the United States (Reference 2.4-74). Its name derives from its weak mouth tissues, which are easily damaged by fish hooks (Reference 2.4-39). They may reach 29 inches in length and 12 lb. in weight (Reference 2.4-106). Weakfish are taken both recreationally and commercially, and are an important food fish (Reference 2.4-74). Commercial harvests in NJ and DE totaled 164,506 lb. and 24,588 lb., respectively, in 2007 (Reference 2.4-125). Recreational harvests in 2007 totaled 181,654 individuals in NJ and 3300 in DE (References 2.4-124 and 2.4-117).

Weakfish are widely distributed along the Atlantic coast, ranging from Cape Cod, MA to FL (Reference 2.4-176). They are occasionally reported as far north as the Bay of Fundy (Reference 2.4-13). They are most abundant off the Atlantic coast from NC to NY (Reference 2.4-74). In impingement samples at SGS, they have been collected in all years since 1995 at a 13-yr average annual rate of 586.1 per million m^3 (Table 2.4-18). They also have been consistently encountered, and were occasionally abundant in samples from nearby marsh creeks during PSEG EEP surveys (Table 2.4-16). No weakfish were collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

Spawning activity for weakfish takes place in the spring and summer following a northern migration to nearshore coastal water and estuarine areas in the Delaware Bay. Spawning season extends from May to mid-July (Reference 2.4-114). Eggs are buoyant, and hatch after 36 to 40 hr. (Reference 2.4-13). Larvae move from the water column to the bottom (Reference 2.4-114). Larvae and juveniles primarily eat copepods, followed by mysid shrimp and anchovies as development progresses (Reference 2.4-74). Weakfish average 7 inches in length after their first growing season (Reference 2.4-106). Adults feed on a variety of animals, including a variety of crustaceans and mollusks, but primarily on fish (Reference 2.4-13). All weakfish are mature after 2 yr. Their potential lifespan is generally 12 yr (Reference 2.4-106).

2.4.2.2.2.10 Channel Catfish

The channel catfish (*Ictaluras punctatus*) is a member of the ictalurid (bullhead catfish) family. It is a freshwater species commonly found in estuarine waters (Reference 2.4-105). Adults range from 12 to 32 inches in length and 1 to 15 lb. in weight (Reference 2.4-151). They are a valuable food fish, and are commercially raised for market (Reference 2.4-133). They also are harvested both recreationally and commercially, with a commercial harvest in DE of 6922 lb. in 2007 (Reference 2.4-125). Recreational harvests in 2007 totaled 24,245 individuals in NJ and 26,800 in DE (References 2.4-124 and 2.4-117).

The range of channel catfish includes the central drainages of the United States to southern Canada and northern Mexico (Reference 2.4-56). In NJ, they are typically found in clear, warm lakes and moderately large, to large rivers over clean sand, gravel, or rock/rubble substrate (Reference 2.4-133). Their preferred habitat is deep pools around logs, rocks, or other structures suitable for hiding (Reference 2.4-105). Channel catfish have been collected in impingement samples at SGS in all but 1 year between 1995 and 2007, at a 13-yr average annual rate of 4.8 per million m^3 (Table 2.4-18). They also have been consistently encountered, and were occasionally abundant in samples from nearby marsh creeks during PSEG EEP surveys (Table 2.4-16). They were not collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

Spawning activity for the channel catfish occurs in late spring, when water temperatures reach 75°F. They select nest sites in depressions, crevices, or undercut banks, and females lay their eggs in these nests (Reference 2.4-105). After hatching, the larvae are guarded by the male for 7 to 8 days before leaving the nest site. In Midwestern streams and rivers, channel catfish averages 2.6 inches in length at the end of their first year. They mature after 4 to 5 yr, at lengths of 12 to 15 in (Reference 2.4-151). Adults feed on a variety of animals, including fish, insects and crustaceans (Reference 2.4-133). They also feed on plant material. They are nocturnal feeders, using their chemosensitive barbels to compensate for poor eyesight (Reference 2.4-105). Channel catfish can live more than 10 yr, but their typical life span is 6 to 7 yr (Reference 2.4-151).

2.4.2.2.2.11 Spot

The spot (*Leiostomus xanthurus*) is a member of the sciaenid (drum) family. Its common name is derived from the large black spot located above and behind its gill cover (Reference 2.4-96). They are abundant in marine areas along the Atlantic coast (Reference 2.4-9) and are considered an important ecological link in the transfer of energy from estuarine habitats to the waters of the adjacent continental shelf (Reference 2.4-96). They are a food fish, and have substantial commercial and recreational fisheries associated with them (Reference 2.4-180). The commercial harvests in NJ and DE totaled 4474 lb. and 128,208 lb., respectively, in 2007 (Reference 2.4-125). A total of 239,299 spot were harvested recreationally in DE in 2007 (References 2.4-124 and 2.4-117).

Spot range along the Atlantic coast from Cape Cod, Massachusetts to the Bay of Campeche in Mexico. They are found in coastal waters at depths up to 60 m (197 ft.) over sandy and muddy bottoms, but migrate into bays and estuaries in the spring. They can tolerate wide ranges of salinity (<1 to 37 ppt) and temperature (35 to 95°F) (Reference 2.4-9). In impingement samples at SGS, they have been collected in all years since 1995 at a 13-yr average annual rate of 14.2 per million m^3 (Table 2.4-18). They also have been consistently encountered, and were occasionally abundant in samples from nearby marsh creeks during PSEG EEP surveys (Table 2.4-16). No spot were collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

2.4.2.2.2.12 Atlantic Silverside

The Atlantic silverside (*Menidia menidia*) is a small, schooling fish that is abundant in the shore zone of salt marshes, estuaries and tidal creeks along the eastern United States (Reference 2.4-49). Adults are generally 4 to 4.5 inches in length, up to a maximum of 5.5 in. (Reference 2.4-13). Atlantic silverside is an important forage species for striped bass, Atlantic mackerel, and bluefish (Reference 2.4-10).

The Atlantic silverside ranges along the east coast of North America from the Gulf of St. Lawrence in Canada to northeastern FL (Reference 2.4-57). They frequently inhabit sand or gravel shorelines, often among growths of sedge grass (Reference 2.4-13). In impingement samples at SGS, they have been collected in all years since 1995 at a 13-yr average annual rate of 46 per million m^3 (Table 2.4-18). They also have been common and occasionally abundant in samples from nearby marsh creeks during PSEG EEP surveys (Table 2.4-16). They were not collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

In the Mid-Atlantic region, they spawn from late March through June. Spawning occurs during daylight hours coinciding with high tide. Eggs are demersal and adhere to eelgrass, cordgrass, and other substrates in estuarine intertidal zones. Eggs generally hatch in 3 to 15 days depending on water temperature. Larvae are 3.8 to 5 millimeters (mm) (0.15 to 0.20 in.) at hatching, and transformation to the juvenile stage occurs prior to approximately 20 mm (0.8 in.). Atlantic silversides reach the adult stage in the late fall (Reference 2.4-49). They have an expected life span of 2 yr (Reference 2.4-57). Adults are omnivorous, feeding mostly on copepods, mysid shrimps, decapods shrimps, amphipods, cladocerans, fish eggs, young squid, annelid worms, and mollusk larvae. They also consume insects, algae and diatoms (Reference 2.4-13).

2.4.2.2.2.13 Northern Kingfish

The northern kingfish (*Menticirrhus saxatilis*) is a member of the sciaenid (drum) family. They are an excellent food fish and are popular with saltwater anglers (Reference 2.4-26). They are also harvested commercially (Reference 2.4-223). They typically range from 10 to 14 inches in length and from 0.5 to 1.5 lb. in weight, but can reach 21 in. and 3.3 lb. (Reference 2.4-26). Commercial harvests in DE totaled 689 lb. in 2007 (Reference 2.4-125). Recreational harvests in 2007 totaled 17,442 individuals in NJ and 23,995 in DE (References 2.4-124 and 2.4-117).

The range of the northern kingfish is the western Atlantic from Massachusetts to southern FL, and the Gulf of Mexico from FL to Yucatan, Mexico (Reference 2.4-58). They prefer shallow coastal waters with a muddy-sand substrate. They also inhabit high salinity bays and estuaries (Reference 2.4-223). Northern kingfish appear regularly along the Atlantic coast from late April through October. They are believed to over winter offshore in deeper water (Reference 2.4-26). In impingement samples at SGS, they have been collected in all years except one since 1995 at a 13-yr average annual rate of 4.2 per million m^3 (Table 2.4-18). In samples from nearby marsh creeks performed during PSEG EEP surveys, no northern kingfish were collected from large segments of the Alloway Creek system in 2005. One individual was found in a large segment of the Mad Horse Creek system in 2006 (Table 2.4-16). No northern kingfish were collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

Spawning activity for northern kingfish takes place from April until August, typically at the bottoms of bays and sounds. Eggs are buoyant and hatch in approximately 2 days. The young grow quickly in the first year of life (Reference 2.4-26). Northern kingfish achieve lengths of 4 to 6 in. by their first winter, 10 in. by the second, and 14 in. by the third. Sexual maturity generally occurs at 2 yr of age for males and 3 yr for females (Reference 2.4-13). They are bottom feeders and have a diet that includes shrimp, small mollusks, worms, young fish, crabs and other crustaceans (Reference 2.4-26).

2.4.2.2.2.14 Silver Hake

The silver hake (*Merluccius bilinearis*) is a member of the merlucciid family (Reference 2.4-59). Adults average 14 inches in length, but may achieve a maximum length of 30 in. and a weight of 5 lb., respectively (Reference 2.4-13). They are an excellent food fish and are marketed fresh, smoked, or frozen (Reference 2.4-59). They are harvested commercially, but are not widely pursued by recreational anglers (Reference 2.4-13). The commercial harvest in NJ totaled 997,211 lb. in 2007 (Reference 2.4-125).

Silver hake distribution is primarily along the northern Atlantic coast, from Newfoundland to South Carolina (Reference 2.4-59). They are particularly abundant between Cape Sable, Nova Scotia and New York (Reference 2.4-13). They are found over a variety of depths, from shallow coastal waters to depths exceeding 400 m (Reference 2.4-41). In impingement samples at the SGS, they have been collected in 9 yr of the period between 1995 and 2007, and at a 13-yr average annual rate of 0.2 per million m^3 (Table 2.4-18). During the same period, they were not encountered in PSEG EEP samples from marsh creeks near the PSEG Site (Table 2.4-16), nor were they collected in 2009 surveys of small marsh creeks or ponds on the PSEG Site.

Spawning activity for silver hake occurs in offshore waters of the ocean and reaches its peak in May and June in the Mid-Atlantic (Reference 2.4-41). The eggs are buoyant, and hatch in approximately 2 days. Juveniles move to deeper water by the end of their first summer or autumn, but individuals may migrate into the shallower waters of estuaries in the following late spring or early summer (Reference 2.4-13). Most silver hake reach sexual maturity at age 2. Females grow faster and live longer than the males. Males attain a maximum age of 10 yr and a length of 17 in. compared to 12 yr and 26 in. for females (Reference 2.4-41). They are voracious predators, with young hake feeding on crustaceans such as krill and pandalid shrimps, whereas adults feed on herring, menhaden, alewives, silversides, young mackerel and other hakes, as well as squid (Reference 2.4-13).

2.4.2.2.2.15 Atlantic Croaker

The Atlantic croaker (*Micropogonias undulatus*) is a member of the sciaenid (drum) family and is pursued by both commercial and recreational fishermen (Reference 2.4-91). They can reach maximum lengths of 22 in. and weights of 5.5 lb. (Reference 2.4-60). Commercial harvests in NJ and DE totaled 1,357,999 lb. and 13,648 lb., respectively, in 2007 (Reference 2.4-125). Recreational harvests in 2007 totaled 43,190 individuals in NJ and 281,284 in DE (References 2.4-124 and 2.4-117).

The Atlantic croaker ranges along the Atlantic coast from Cape Cod, MA to southern GA and along the northern coast of the Gulf of Mexico. They occur over mud and sandy mud bottoms in coastal waters and estuaries where nursery and feeding grounds are located (Reference 2.4-60). In impingement samples at the SGS, they have been collected in all years since 1995 at a 13-yr average annual rate of 946.6 per million m^3 (Table 2.4-18). In samples from nearby marsh creeks collected during PSEG EEP surveys, they were encountered commonly and were frequently abundant, in the Mad Horse Creek, Mill Creek, and Alloway Creek systems from 2003 to 2007 (Table 2.4-16). However, no Atlantic croaker were collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

The Atlantic croaker spawns in offshore waters on the continental shelf in the fall (Reference 2.4-224). Eggs are pelagic, and hatch in less than one week (Reference 2.4-81). Larvae are carried into coastal inlets by tidal currents, and undergo diel migrations from deep water in the day to shallows at night. Juveniles remain in the estuarine nursery areas until the following spring or early summer (Reference 2.4-91) and attain lengths of 5.5 to 7 in. after 1 year (Reference 2.4-224). Atlantic croakers over-winter in deeper coastal waters, and generally mature by the end of their second year (Reference 2.4-91). They feed primarily on worms, crustaceans and smaller fishes (Reference 2.4-60).

2.4.2.2.2.16 White Perch

The white perch (*Morone americana*) is in the family Moronidae. It is widespread and abundant in fresh, brackish and coastal waters (Reference 2.4-61). They average 8 to 10 inches in length and approximately 1 lb. but can reach 15 in. and over 2 lb. (Reference 2.4-13). They are valued both commercially and recreationally, and are trophically important as both prey and predator (Reference 2.4-182). Commercial harvests in NJ and DE totaled 27,527 lb. and 55,971 lb., respectively, in 2007 (Reference 2.4-125). Recreational harvests in 2007 totaled 421,390 individuals in NJ and 27,441 in DE (References 2.4-124 and 2.4-117).

The native range of white perch includes Atlantic slope drainages from the St. Lawrence/Lake Ontario drainage in Quebec to the Pee Dee River drainage in South Carolina (Reference 2.4-212). However, they have also become established in the Great Lakes and in many inland states of the United States. They are most numerous in brackish water, and are most commonly found in depths of 12 ft. or less (Reference 2.4-13). In impingement samples at SGS, they have been collected in all years since 1995 at a 13-yr average annual rate of 792.4 per million m^3 (Table 2.4-18). In samples from nearby marsh creeks collected during EEP surveys, white perch have been consistently found, often in high numbers in the Mad Horse Creek, Mill Creek, and Alloway Creek systems from 2003 to 2007 (Table 2.4-16). White perch were collected in both small marsh creeks (Stations AS-05 and AS-06 in July and Station AS-05 in September) and ponds (one specimen at Station AS-09 in May) near the PSEG Site in 2009.

White perch spawn in estuaries, rivers, lakes, and marshes, generally in freshwater but occasionally in brackish water. Estuarine populations spawn from May through July (Reference 2.4-182). The eggs are demersal and immediately attach to bottom substrates. Eggs generally hatch in 6 days (Reference 2.4-13). Post-larvae and juveniles remain in the inshore areas of estuaries and creeks for up to 1 year. As temperatures decrease in the autumn of the following year, they return to brackish waters and over-winter in deep pools of tidal creeks and tributaries or deep waters of rivers and bays (Reference 2.4-182). When living in coastal or brackish water, white perch feed on fish eggs and fry of many species, young squids, shrimps, crabs and other invertebrates (Reference 2.4-13).

2.4.2.2.2.17 Striped Bass

The striped bass (*Morone saxatilis*) is another member of the moronid family and is one of the primary gamefish along the Atlantic coast. They grow to very large sizes, with average length/weight ratios of 24 in./5 lb., 36 in./20 lb., and 48 in./40 lb. (Reference 2.4-13). The commercial harvest in Delaware in 2007 totaled 188,670 lb. in 2007 (Reference 2.4-125). Recreational harvest totaled 108,025 individuals in NJ and 9106 in DE (References 2.4-124 and 2.4-117).

The range of the striped bass is along the Atlantic coast from the St. Lawrence River in Canada to the St. Johns River in FL, and in the Gulf of Mexico from western FL to Louisiana. It has also been introduced widely in river systems and freshwater impoundments of North America. The Mid-Atlantic coast is particularly important for striped bass, as most of the major spawning grounds are found within this region.(Reference 2.4-50) In impingement samples at SGS, they have been collected in all years since 1995 at a 13-yr average annual rate of 63.6 per million m^3 (Table 2.4-18). In samples from nearby marsh creeks collected during EEP surveys, striped bass have been encountered frequently, and occasionally in high numbers between 2003 and 2007 (Table 2.4-16). Striped bass were collected in small marsh creeks (Station AS-05 in May, July, and September and Station AS-06 in May) but not in ponds near the PSEG Site in 2009.

Striped bass are anadromous, and spawn in the Mid-Atlantic region from April through June in or near fresh water. Eggs are semi-buoyant, and hatch in 1 to 3 days. Larvae develop for 23 to 68 days, depending on temperature, before reaching the juvenile stage.(Reference 2.4-50) Juveniles eat small shrimps and other crustaceans, annelid worms, and insects (Reference

2.4-62). Individuals reach maturity in 2 to 3 yr for males and in 4 to 5 yr for females (Reference 2.4-50). Adults feed on a variety of fishes and invertebrates (Reference 2.4-62).

2.4.2.2.2.18 Summer Flounder

The summer flounder (*Paralichthys dentatus*) is in the family Paralichthyidae, and is a left-handed (lies on its right side, with both eyes on the left side) flatfish. It can grow to a length of 3 ft. and a weight of 15 lb., but averages 20 in. and 3 lb. (Reference 2.4-13) It is an excellent food fish, and an important species in both recreational and commercial harvests (Reference 2.4-186). Commercial harvests in NJ and DE totaled 1,697,504 lb. and 5456 lb., respectively, in 2007 (Reference 2.4-125). Recreational harvests in 2007 totaled 573,601 individuals in NJ and 98,988 in DE (References 2.4-124 and 2.4-117).

The range of the summer flounder is along the Atlantic coast from Maine to northern FL. They prefer hard sandy substrate into which they can burrow, but also use salt marsh creeks and seagrass beds with muddy or silty substrates in lower and mid-estuary habitats (Reference 2.4-63). In impingement samples at SGS, they have been collected in all years since 1995 at a 13-yr average annual rate of 4.7 per million m^3 (Table 2.4-18). They have been occasionally collected in low numbers during surveys from nearby marsh creeks performed during EEP surveys from 2003 to 2007 (Table 2.4-16). No summer flounder were collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

The spawning habits of the summer flounder are not well documented, but patterns have been deduced from catch trends for larvae and commercial harvests. They are believed to spawn sometime between late fall and early spring near the bottom of continental shelf waters in depths of 30 to 200 m (100 to 650 ft.). The eggs are pelagic, and hatch in 2 to 3 days at temperatures of approximately 21°C (70°F). Larvae are transported to estuarine nursery areas by currents, and young-of-the-year remain there during development (Reference 2.4-77). By the time the young are approximately 1 inch in length, the right eyes have migrated to the left sides of the fish and their physical appearance resembles that of the adult. Older summer flounder move into the coastal waters and spend the winter and early spring in deeper (50 to 150 m [150 to 1500 ft.]) waters. They are very active predators, and feed primarily on smaller fish of a variety of species, squids, crabs, shrimps, other crustaceans and mollusks, worms, and sand dollars (Reference 2.4-13).

2.4.2.2.2.19 Butterfish

The butterfish (*Peprilus tricanthus*) is a small but valued food fish in the family Stromateidae (Reference 2.4-64). Adults are typically 6 to 9 inches in length, but may reach 12 in., and rarely exceed 1 lb. in weight (Reference 2.4-13). Commercial harvests in NJ and DE totaled 176,679 lb. and 937 lb., respectively, in 2007 (Reference 2.4-125).

The range of the butterfish is along the Atlantic coast from eastern Newfoundland and the Gulf of St. Lawrence southward to eastern FL. It also occurs in the Gulf of Mexico (Reference 2.4-64). They are primarily found between the Gulf of Maine and Cape Hatteras, NC. They migrate in response to seasonal changes in water temperature, moving northward and inshore in the summer and southward and offshore in the winter.(Reference 2.4-147) They are pelagic, and form loosely grouped schools (Reference 2.4-40). In impingement samples at SGS, they have been collected in 10 of 13 yr between 1995 and 2007, at a 13-yr average annual rate of 0.7 per

million m^3 (Table 2.4-18). They were not collected in 2003 to 2007 surveys from nearby marsh creeks performed as part of the EEP (Table 2.4-16). They were not collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

The spawning period for butterfish extends from May through October, with peak activity in July and August (Reference 2.4-40). Spawning appears to occur a few miles out at sea, with spent adults returning to coastal waters. The eggs are buoyant, and larvae hatch in approximately 2 days. The transformation to a juvenile stage, with physical characteristics resembling those of adults occurs before the fish is 1 in. long. The juveniles grow to lengths of 2 to 4 in. by the winter of their first year, sometimes living in the shelter of jellyfish tentacles (Reference 2.4-13). Most butterfish are sexually mature by age 1, and all are mature by age 2 yr. Few individuals exceed 4 yr of age (Reference 2.4-40). Adults feed mainly on jellyfish, squids, arrow worms, crustaceans, and other worms (Reference 2.4-64).

2.4.2.2.2.20 Black Drum

The black drum (*Pogonias cromis*) is one of the largest members of the sciaenid family, commonly exceeding 30 lb., and occasionally exceeding 100 lb. (Reference 2.4-187). It is an important species in terms of both commercial and recreational fisheries, and is a valued food fish (Reference 2.4-185). Commercial harvests in NJ and DE totaled 1518 lb. and 37,712 lb., respectively, in 2007 (Reference 2.4-125). Recreational harvests in 2007 totaled 13,986 individuals in NJ and 5020 in DE (References 2.4-124 and 2.4-117).

The range of the black drum is the western Atlantic Ocean from the Bay of Fundy southward to Argentina, and the Gulf of Mexico. They are common from Chesapeake Bay south to FL, and are most abundant along the TX coast (Reference 2.4-185). Black drum are usually found over sand and sandy mud bottoms in coastal waters, particularly in areas with large river runoffs (Reference 2.4-65). In impingement samples at SGS, they have been collected in 11 of 13 yr between 1995 and 2007, at a 13-yr average annual rate of 4.8 per million m^3 (Table 2.4-18). They were commonly encountered in nearby marsh creeks, but rarely in large numbers, in EEP surveys performed in 2003 to 2007 (Table 2.4-16). No black drum were collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

The spawning period for black drum in the Gulf of Mexico occurs primarily in February and March, but can extend to June or July. Eggs are pelagic, and generally hatch in less than 1 day). Juveniles prefer the shallow, nutrient-rich waters of tidal creeks, but can tolerate wide ranges of temperatures and salinities. It is hypothesized (Reference 2.4-145) that individuals of this species move from bays into the gulf at approximately 4 yr of age. Black drum are sexually mature by the end of their second year, at lengths of approximately 1 ft. (Reference 2.4-185). They can live to ages of 35 yr or older, and as adults feed primarily on oysters, mussels, crabs, shrimp, and occasionally fish (Reference 2.4-88).

2.4.2.2.2.21 Bluefish

The bluefish (*Pomatomus saltatrix*) is the sole member of the family Pomatomidae (Reference 2.4-152). Large adults along the Atlantic coast are commonly about 30 inches in length and weigh 10 to 12 lb. (Reference 2.4-13), but can reach weights of 30 lb. (Reference 2.4-110). Bluefish are commercially important, but considered even more valuable as a recreational species due to their abundance, good flavor, and reputation as voracious

predators and excellent fighters (Reference 2.4-152). Commercial harvests in NJ and DE totaled 1,403,717 lb. and 19,551 lb., respectively, in 2007 (Reference 2.4-125). Recreational harvests in 2007 totaled 819,362 individuals in NJ and 95,166 in DE (References 2.4-124 and 2.4-117).

Bluefish are found nearly worldwide in tropical and temperate waters; the exception is in the eastern Pacific (Reference 2.4-66). In the western Atlantic, they range from Cape Cod, Massachusetts southward to Brazil and Argentina. They inhabit both inshore and offshore areas of coastal regions, with younger individuals commonly found in estuaries and river mouths (Reference 2.4-110). Adults are most common along surf beaches and rock headlands in clean, high energy waters, but also can be found in estuaries and brackish water (Reference 2.4-66). In impingement samples at the SGS, they have been collected in all years since 1995 at a 13-yr average annual rate of 5.6 per million m^3 (Table 2.4-18). They have been occasionally collected in low numbers from nearby marsh creeks during EEP surveys performed in 2003 to 2007 (Table 2.4-16). No bluefish were collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

Bluefish in the Mid-Atlantic region spawn between June and August, with activity primarily occurring offshore over the continental shelf when water temperatures are between 64°F and 74°F (Reference 2.4-110). Juveniles remain offshore over the continental shelf for the remainder of the warm season, by which time many have reached lengths of nearly 8 in. (Reference 2.4-152). The juveniles, called snappers, feed on copepods, shrimps, small lobsters and crabs, larval fish and larval mollusks (Reference 2.4-110). Adults congregate in large schools and migrate seasonally in response to the temperatures of the coastal waters (Reference 2.4-13). Adult bluefish feed on a variety of fish species and on crustaceans and cephalopods (Reference 2.4-66). They reportedly wreak havoc on populations of their prey, injuring and killing many more individuals than they actually consume (Reference 2.4-13). Both male and female bluefish reach sexual maturity by the end of their second year (Reference 2.4-110). Their maximum life span is reported to be 9 yr (Reference 2.4-66).

2.4.2.2.2.22 Northern Sea Robin

The northern sea robin (*Prionotus carolinus*) is a species in the family Triglidae. Its name derives from its enlarged pectoral fins, which are used to uncover prey from bottom substrates (Reference 2.4-100). Adults are typically less than 12 inches in length, but may reach 15 to 16 in.(Reference 2.4-13). The northern sea robin is a food fish, but is used for fish meal, pet food, fertilizer, and as bait for lobsters and flatfish (Reference 2.4-46). The commercial harvest in NJ in 2007 totaled 6666 lb. in 2007 (Reference 2.4-125). Recreational harvests totaled 14,949 individuals in NJ and 1498 in DE (Reference 2.4-124 and 2.4-117).

The range of the northern sea robin is tropical and temperate areas worldwide (Reference 2.4-100). In the western Atlantic, it is found from Nova Scotia to central FL; it also occurs in the Gulf of Mexico (Reference 2.4-46). They are most commonly found in shallow water over sandy bottoms, but have been encountered at depths exceeding 70 m (230 ft.) (Reference 2.4-100). In impingement samples at SGS, they have been collected in all years since 1995 at a 13-yr average annual rate of 11.1 per million m^3 (Table 2.4-18). They were not collected from nearby marsh creeks in 2003 to 2007 EEP surveys (Table 2.4-16), nor were they encountered in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

The spawning period for the northern sea robin in this region probably extends from late spring through the summer months. The eggs are buoyant, and hatching occurs in approximately 60 hr. at a temperature of 72°F. The adults are voracious predators, feeding on a variety of crustaceans, mollusks, annelid worms, and small fish (Reference 2.4-13).

2.4.2.2.2.23 Winter Flounder

The winter flounder (*Pseudopleuronectes americanus*) is in the family Pleuronectidae, and is a right-handed (lies on its left side, with both eyes on the right side) flatfish. Adults encountered inshore (in or near bays and estuaries) are generally 12 to 15 inches in length and weigh 1.5 to 2 lb. Some winter flounder can reach lengths of 25 in. and up to 8 lb. (Reference 2.4-13). The winter flounder is an excellent food fish, is a major commercial species, and is the most important recreationally caught flounder in inshore waters of the Mid-Atlantic (Reference 2.4-77). The commercial harvest in NJ totaled 379,615 lb. in 2007 (Reference 2.4-125). The recreational harvest totaled 169,686 individuals in NJ in 2007(Reference 2.4-124).

The range of the winter flounder is along the Atlantic coast from Labrador, Canada to Georgia (Reference 2.4-67). They generally occur in inshore bays and estuaries during the winter, and migrate to deeper water in the summer (Reference 2.4-80). Winter flounder are found over a variety of substrates from soft muddy sand to hard sand or clay, to pebble or gravel (Reference 2.4-13). In impingement samples at SGS, they have been collected in all but 1 year from 1995 through 2007 at a 13-yr average annual rate of 2.4 per million m^3 (Table 2.4-18). They were not collected from nearby marsh creeks in 2003 to 2007 EEP surveys (Table 2.4-16). No winter flounder were collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

Spawning occurs inshore from November through June, at night in shallow inshore waters (Reference 2.4-77). Eggs are demersal, sinking to the bottom and adhering to each other to form large clumps. Incubation takes 15 to 18 days at water temperatures of 37°F to 38°F. (Reference 2.4-13) Their first summer, juveniles remain in the shallow waters of the bays and estuaries where they were spawned (Reference 2.4-77). Young winter flounder first feed on diatoms, followed by small crustaceans (particularly isopods) and some worms and mollusks. The diet of the adults is confined to smaller organisms such as shrimps, amphipods, small crabs, annelid worms, small mollusks, and fish. Winter flounder are believed to be sexually mature at 3 yr of age, and approximately 8 in. or more in length (Reference 2.4-13). They may eventually reach 15 to 20 yr of age (Reference 2.4-80).

2.4.2.2.2.24 Windowpane Flounder

The windowpane flounder (*Scophthalmus aquosus*) is in the family Scophthalmidae (Reference 2.4-68). It is a left-handed (lies on its right side, with both eyes on the left side) flatfish. Adults are generally 10 to 12 inches in length and weigh 0.5 to 0.75 lb., but some can reach lengths of 18 in. and weigh up to 2 lb. Although it was in demand as a food fish during World War II (Reference 2.4-13), it is reportedly not currently a target of the commercial fishing industry (Reference 2.4-20). Nevertheless, a total of 46,972 were harvested commercially in NJ in 2007 (Reference 2.4-125).

Windowpane flounder is distributed in estuaries, nearshore waters, and the continental shelf of the northwestern Atlantic from the Gulf of St. Lawrence in Canada to northern FL (Reference 2.4-20). They are most abundant from Georges Bank, out from the Gulf of Maine, to southern Virginia (Reference 2.4-79). The adults are generally found over substrates of mud or fine-grained sand where water temperatures are below 26.8°C (80°F), at depths of 1 to 75 m (3 to 250 ft.), and within a salinity range of 5.5 to 36 ppt (Reference 2.4-20). In impingement samples at SGS, they have been collected in all but 1 year from 1995 through 2007, at a 13-yr average annual rate of 2.4 per million m^3 (Table 2.4-18). In 2003 to 2007 surveys from nearby marsh creeks performed as part of the EEP, a single specimen was collected while trawling in the Mad Horse Creek system (Table 2.4-16). No windowpane flounder were collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

Windowpane flounder spawning begins in February or March in inner shelf waters, and peaks in the Middle Atlantic Bight in May. However, there is either an extended spawning season, or a later (autumn) peak in the central and southern portions of the Bight. Eggs are buoyant, and hatch in 8 days at a typical temperature of 11°C (52°F). (Reference 2.4-20) Windowpane flounder mature when they are in their third or fourth year, at lengths of 9 to 10 in. Adults feed on mysid shrimps and other small crustaceans as well as annelid worms, sea cucumbers, squids and other small mollusks. Although fish are evidently not as important in the diet as invertebrates, species such as hake, herrings, launce, and silversides have been found in the stomachs of windowpane flounder (Reference 2.4-13). Their maximum reported age is 7 yr (Reference 2.4-68).

2.4.2.2.2.25 Scup

The scup (*Stenotomus chrysops*) is a deep-bodied, laterally-flattened member of the family Sparidae (Reference 2.4-13). Adults are generally less than 14 inches in length and 2 lb. in weight (Reference 2.4-111). Some can reach lengths of 18 in. and weigh 3 to 4 lb. Scup is an excellent food fish, and is highly sought by recreational anglers (Reference 2.4-13). It is also harvested commercially (Reference 2.4-69). The commercial harvest in NJ totaled 1,575,159 lb. in 2007 (Reference 2.4-125). Recreational harvests in 2007 totaled 83,417 individuals in NJ and 1507 in DE (References 2.4-124 and 2.4-117).

The range of the scup is along the Atlantic coast from Nova Scotia, Canada, to FL (Reference 2.4-69), but it is most common between Cape Cod, Massachusetts and Cape Hatteras, NC (Reference 2.4-111). Scup congregate in schools over smooth bottom substrate, and are generally found inshore in the spring and summer. They move off the coast in late October or November (Reference 2.4-13). Scup are members of an offshore wintering guild of species that also includes summer flounder, black sea bass, and northern sea robin. Scup adults are

generally found in water temperatures between 6°C and 27°C (43°F and 82°F), at depths less than 30 m (100 ft.), and within a salinity range of 20 to 31 ppt (Reference 2.4-184). In impingement samples at SGS, scup have only been collected twice in the period from 1995 through 2007, at a 13-yr average annual rate of 0.3 per million m^3 (Table 2.4-18). In 2003 to 2007 surveys from nearby marsh creeks performed as part of the EEP, a single specimen was collected while trawling in the Alloway Creek system in 2003 (Table 2.4-16). No scup were collected in surveys of small marsh creeks or ponds on the PSEG Site in 2009.

Along southern New England, scup spawn from May through August, with peak activity occurring in June (Reference 2.4-13). The eggs are buoyant, and hatch in 2 to 3 days depending on water temperature (Reference 2.4-184). Scup reach sexual maturity at age 2, and spawn once a year beginning in early spring (Reference 2.4-13). They can reach 14 yr of age. Adults feed on bottom invertebrates such as small crabs, annelid worms, clams, mussels, jellyfish, and sand dollars (Reference 2.4-111).

2.4.2.2.3 Harvested Invertebrates

Six species of invertebrates occurring near the PSEG Site have been harvested commercially in NJ and/or DE. These species are: blue crab, eastern oyster, horseshoe crab, northern quahog clam, knobbed whelk (*Busycon carica*) and channeled whelk (*Busycotypus canaliculatus*) (Reference 2.4-117). The whelk species have been collected primarily along the Atlantic coast; and although they have been encountered in Delaware Bay, the sites have been 30 mi. or more downriver of the PSEG Site (Reference 2.4-75). Thus, distribution and life history information for the two whelk species is not included in this report.

2.4.2.2.3.1 Blue Crab

The blue crab (*Callinectes sapidus*) is a decapod crustacean in the family Portunidae (Reference 2.4-82). When fully grown, the crab's carapace is approximately 7 in. wide by 4 in. long, and it weighs 1 to 2 lb. It is the most common edible crab along the east coast of the United States and in the Gulf of Mexico (Reference 2.4-188). The blue crab is a major commercial species nationally and in the Mid-Atlantic region, with harvests of 4,636,368 lb. in NJ and 3,799,489 lb. in DE in 2007 (Reference 2.4-125).

The natural range of the blue crab is along the Atlantic coast from Nova Scotia to northern Argentina. It has also been introduced into Asia and Europe (Reference 2.4-82). Blue crab are bottom-dwellers in habitats ranging from low salinity waters of bays and estuaries to ocean waters. They are found in shallow waters at the low tide line down to depths of 120 ft. (Reference 2.4-188). As adults, they are tolerant of wide ranges of temperatures (15 to 30°C [59°F to 86°F]), and salinity, but they cannot tolerate low dissolved oxygen conditions (Reference 2.4-82). In impingement samples at SGS, they have been collected in all years since 1995, and since 2003 at a 5-yr average annual rate of 727 per million m^3 (Table 2.4-17). Blue crab are also common or abundant in 2003 to 2007 surveys off nearby marsh creeks performed during the EEP (Table 2.4-16). However, they have not been collected in 2009 macroinvertebrate surveys of the Delaware River, marsh creeks or ponds in the vicinity of the PSEG Site, possibly because the sampling gear used (ponar dredge) is not effective in capturing this species.

Mating among blue crabs follows the terminal (pubertal) molt of the female. Males are attracted to females by a pheromone females release prior to the molt (Reference 2.4-82). After mating, females migrate to higher salinity (greater than 20 ppt) habitats prior to fertilizing the eggs up to several months later with stored sperm (Reference 2.4-188). The female broods the fertilized eggs for 14 to 17 days, then release the newly hatched larvae to float in offshore areas. Larval development consists of 8 stages taking approximately 2 months to complete. The post-larvae (termed megalops) return to the estuaries for further growth and development (Reference 2.4-82). Juveniles molt several times over 12 to 18 months before eventually reaching sexual maturity. The typical life span of adults is 3 yr. Blue crabs feed on clams, oysters, and mussels, and a variety of other vegetable and animal matter (Reference 2.4-188). They are themselves prey for eels, drum, herons, and turtles, as well as other blue crabs and humans (Reference 2.4-82).

2.4.2.2.3.2 Eastern Oyster

The eastern, or American, oyster (*Crassostrea virginica*) is a marine bivalve in the family Ostreidae (Reference 2.4-183). It commonly grows to approximately 10 cm (4 in.) in length, but can occasionally reach 20 cm (8 in.) (Reference 2.4-189). The eastern oyster is an important food species, and is eaten smoked, cooked, or fresh. This species supports an important commercial industry along the Atlantic coast and in the Gulf of Mexico (Reference 2.4-183). This wide-ranging commercial fishery harvested over 100,000 metric tons in 2002 (Reference 2.4-71).

The eastern oyster lives in shallow saltwater bays, lagoons, and estuaries along the Atlantic coast from the Gulf of St. Lawrence in Canada, to Key Biscayne, FL, and along the Gulf of Mexico (Reference 2.4-183). In Delaware Bay, oysters are found from the mouth to areas just below the PSEG Site on the NJ shore. Populations, as inferred from commercial harvests, decreased from the early 1900s through the rest of the 20th century, in large part due to protozoan parasites. Since 2001, oyster abundance has continued to decline despite careful management and harvest restrictions; but stock assessments released in 2007 indicated at least modest improvement. Oysters attach to many hard substrates, but generally colonize by attaching to other oysters and dead shells. Large aggregations are referred to as oyster reefs (Reference 2.4-189). They can tolerate a wide range of temperatures, and prefer waters of relatively high salinity. Although adults can tolerate 5 to 32 ppt salinity, embryo development and growth are optimal within a narrower (15 to 23 ppt) range (Reference 2.4-183). They were occasionally found near the PSEG Site in ponar surveys from the Delaware River in the 1970s (Table 2.4-24) (Reference 2.4-191).

In the Mid-Atlantic, the eastern oyster spawns from late spring into the fall. Spawning is initiated when one or more males release sperm and a pheromone into the water, triggering females to release their eggs (Reference 2.4-183). Fertilized eggs develop a shell within hours. In 2 to 3 weeks, larvae find attachment points and excrete a glue to stay in place (Reference 2.4-189). Larvae usually set in established oyster beds or where shell substrate is present (Reference 2.4-183). Sexual maturity is associated with size rather than age (Reference 2.4-146). Oysters spawn as males in their first year, but change gender as they grow larger and spawn as females. They are filter feeders, and their diet consists of naked flagellates, diatom plankton, ostracods, and small eggs (Reference 2.4-183). Under optimum conditions, oysters can live for up to 20 yr (Reference 2.4-146).

2.4.2.2.3.3 Horseshoe Crab

The horseshoe crab (*Limulus polyphemus*) is a marine arthropod in the subphylum Chelicerata, which also contains ticks and mites, and is not as closely related to crabs, which are in the subphylum Crustacea. They can grow up to 2 ft. in length (including the tail) and weigh over 10 lb. (Reference 2.4-99) Their eggs are an important food for migrating shorebirds, and the crabs themselves are important in medical research (Reference 2.4-107). The horseshoe crab is also a major commercial species in the region, with a harvest of 229,602 lb. in DE in 2007 (Reference 2.4-125).Collections of horseshoe crabs have not been reported in surveys associated with the EEP between 1995 and 2007, nor were they reported in macroinvertebrate surveys on the Delaware River near the PSEG Site in the 1970s (Table 2.4-24).

Horseshoe crabs are most commonly found in the Gulf of Mexico and along the northern Atlantic coast of North America. Delaware Bay is a primary area of annual migration, and hosts the largest concentration of spawning horseshoe crabs worldwide (Reference 2.4-205). Along the NJ shore, spawning adults have been reported from Sea Breeze to Cape May, approximately 15 mi. downstream of the PSEG Site. Spawning farther upstream is likely restricted by salinities that are below the crabs' preferred range of 18 to 25 ppt (Reference 2.4-214). Reproduction is initiated in May, with males arriving at the shoreline first and clasping onto the backs of arriving females (Reference 2.4-99). Females lay eggs in clusters in the sand, typically at the high tide mark. Eggs take approximately a month to develop and hatch, and larvae are carried out by the next high tide (Reference 2.4-21). The young move into progressively deeper waters, continuing to molt. They reach sexual maturity in 9 to 12 yr, and have total life spans of approximately 20 yr. Horseshoe crabs are omnivorous scavengers, and feed on small bivalves, mollusks, worms, dead fish, and algae (Reference 2.4-99).

2.4.2.2.3.4 Northern Quahog Clam

The northern quahog clam (*Mercenaria mercenaria*) is a small (3 in. or less) member of the family Veneridae (Reference 2.4-16). It is an edible species, and is important in aquaculture along the Atlantic coast, particularly between Virginia and FL (Reference 2.4-72). It is also an important commercial species in the region, with harvests of 239,733 lb. in NJ and 44,336 lb. in DE in 2007 (Reference 2.4-125). However, it has not been reported from surveys associated with the EEP between 1995 and 2007, nor were they encountered in macroinvertebrate surveys on the Delaware River near the PSEG Site in the 1970s (Table 2.4-24). Although they have not been found in close proximity to the PSEG Site, they have been collected from the Delaware Bay approximately 30 mi. downstream (Reference 2.4-75).

The northern quahog clam ranges along the Atlantic coast from the Gulf of St. Lawrence, Canada to southern FL, and along the coast of the Gulf of Mexico from FL to TX (Reference 2.4-83). The species has also been introduced to the Pacific coast of North America, and to regions of the coasts of Europe and Asia (Reference 2.4-72). They are found from the intertidal zone of coastal lagoons and estuaries on mud and sand flats to depths of 10 m (Reference 2.4-16). The temperature tolerance range for growth is 9°C to 30 °C (48°F to 86°F), with optimum growth occurring between 18°C and 25°C (64°F and 77°F) (Reference 2.4-72). The optimum salinity range is 20 to 35 ppt, which is higher than the range (0.5 to 18 ppt) typically found near the study area. Adults tolerate higher salinity better than larvae or juveniles (Reference 2.4-16).

Spawning of the northern quahog clam is initiated by water temperature reaching approximately 23°C (73°F) (Reference 2.4-16). Males discharge sperm into the water, which stimulates females to release eggs and fertilization is external (Reference 2.4-72). The fertilized eggs develop into trochophore larvae in 12 to 14 hr. and into veligers by the end of 24 hr. (Reference 2.4-16). These larvae are free-swimming and feed on phytoplankton and other organic materials for 7 to 21 days before metamorphosis into benthic forms with the familiar bivalve shell and foot (Reference 2.4-72). They then secrete byssal threads and attach to the bottom. The clams are sexually mature by the end of the second year, and the life span has been estimated to be 12 to 20 yr, with older (50+ yr) specimens occasionally encountered (Reference 2.4-72).

2.4.2.2.4 Other Important Resources

In addition to the fish and invertebrates already mentioned, submerged aquatic vegetation and plankton, if present, are considered important resources in the project area.

2.4.2.2.4.1 Submerged Aquatic Vegetation

Submerged aquatic vegetation (SAV) includes the several rooted plant species living in the shallows of the Delaware River and its tributaries. This habitat provides refuge as nursery habitat for numerous organisms, increases the structural complexity of the bottom, adds oxygen to the water, and resists erosion and sedimentation. In addition, microscopic algae and protozoa use the leaves of SAV as attachment locations, and invertebrates and small fish are attracted to these areas for feeding. Decaying leaves are consumed by zooplankton, which are in turn eaten by larval fish.

No SAV were located during the surveys conducted to support this application. SAV has not been considered an important resource in the Delaware River near the PSEG Site either presently or historically (Reference 2.4-225). The Delaware Estuary is extremely turbid, with over one million tons of sediment estimated to be deposited in the tidal portion of the river annually. Turbidity is highest at the lower river/upper bay interface, a segment which includes Artificial Island, and is greater near the shore where wind and wave action resuspend and redistribute sediment particles. Thus, conditions for SAV are poor.

2.4.2.2.4.2 Plankton (Phytoplankton and Zooplankton)

The term plankton refers to organisms of the open water that drift on currents and tides. Phytoplankton are microscopic plants that live suspended in the water, with little mobility, and whose distributions are principally determined by local water movements. They are the primary producers and, combined with waterborne detritus, form the basis of the local estuarine food web (Reference 2.4-86). Zooplankton are animals that generally consume phytoplankton. They include microzooplankton and mesozooplankton as well as macrozooplankton (shrimp, amphipods, and larval fish), and the megazooplankton that include the true jellyfish.

Phytoplankton and zooplankton were surveyed in the Delaware River near the PSEG Site from 1973 through 1976 (Reference 2.4-86). Results of these studies indicate that the most important phytoplankton taxa appeared to be *Skeletonema costatum*, *Melosira* spp., and *Chaetoceros* spp., although over 100 genera were identified. The most productive periods occurred during the warmer months. Production was much less in the colder months. The

greatest rate of production consistently occurred at the surface, and lessened to approximately zero at depths of approximately 2 m (7 ft.). The researchers concluded that the observed conditions, such as, seasonal production restricted to a relatively shallow euphotic zone, suggest that production by phytoplankton supplies a small part of the local primary food base. The greater proportion is provided by plant and animal detritus, which sink and accumulate in the bottom waters. Microzooplankton collections identified over 100 taxa, of which 57 were arthropods. Annual mean density generally ranged between 30,000 and 40,000 organisms per m^3, with seasonal peaks occurring during the period between April and June. Dominant taxa included rotifers and copepods (largely nauplii). Macroinvertebrate plankton samples were comprised of 46 taxa (32 arthropods), of which the dominant ones included the amphipods *Gammarus* spp., the mysid shrimp *Neomysis americana*, the brachyurans *Rhithropanopeus harrisii* and *Uca minax*, and the isopod *Chiridotea almyra*. Seasonal variations in total density were not as consistent as were observed for the phytoplankton, and were generally related to short-lived differential abundances of a few dominant taxa (Reference 2.4-86).

2.4.2.2.5 Nuisance Species

Nuisance aquatic species have not been commonly encountered in the vicinity of the PSEG Site. In 2000, an algal bloom caused a fish kill in two DE creeks approximately 50 mi. downstream in the estuary. No Asian clams (*Corbicula* spp.) or invasive blue mussels (*Mytilus* spp.) were discussed in Delaware River studies near Artificial Island performed in the 1970s (References 2.4-25 and 2.4-86); nor were individuals of these groups encountered in collections near the PSEG Site performed in 2009. A single Asian shore crab (*Hemigrapsus sanguineus*) was collected in surveys at the marsh creek Station AS-02 in May of 2009 (Table 2.4-15). The presence of two other invasive species, the Chinese mitten crab (*Eriocheir sinensis*) and the snakehead fish (*Channa argus*) has also been reported in the Delaware River. Mitten crabs are considered potential competitors with blue crabs, and can damage estuarine and stream habitat by extensive burrowing (Reference 2.4-215). Four mature male mitten crabs were captured in commercial crab pots in late May 2007 from waters near New Castle County, DE (References 2.4-215 and 2.4-101). Concerns about the snakehead fish are that they could reduce the numbers of native species by out-competing them for food or eating them directly (Reference 2.4-179). A specimen was collected by an angler from the Delaware River north of the Navy Yard in Philadelphia in September 2005, and it is considered likely that at least a small population is present in the tidal Delaware River (Reference 2.4-70). These species may represent challenges to the aquatic communities near the PSEG Site, but there does not appear to be a presence of nuisance species capable of blocking or biofouling the new plant's cooling water intake system or causing other significant operational problems.

2.4.2.3 Habitat Importance and Essential Fish Habitat

2.4.2.3.1 Habitat Importance

On-site streams and ponds described in earlier sections are representative of the typical surface water habitats near the PSEG Site. Although these habitats are important, there is nothing of regional significance about these particular streams or ponds. All the species encountered in 2009-2010 survey of these habitats are common in the area.

The Delaware River is an important estuarine habitat (Figure 2.4-3), but none of the important species found in the vicinity of the project area are endemic to this segment of the river (Subsection 2.4.2.2). All of these species range widely throughout the Mid-Atlantic coast, and/or in other coastal/estuarine areas or in inland waters.

2.4.2.3.2 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation Management Act (16 United States Code §§ 1801 to 1883), as amended by the Sustainable Fisheries Act of 1996, directs the NOAA National Marine Fisheries Service (NMFS) to protect and conserve the habitat of marine, estuarine, and anadromous finfish, as well as mollusks and crustaceans. This essential fish habitat (EFH) is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The legislation directs regional fisheries management councils to identify EFH for the managed species, minimize adverse effects on EFH caused by fishing, and identify other actions to encourage EFH conservation and enhancement (Reference 2.4-131). Federal agencies are required to consult with NMFS (using existing consultation processes for the National Environmental Policy Act, the ESA, or the Fish and Wildlife Coordination Act) on any action that they authorize, fund or undertake that may adversely affect EFH. The regional fisheries management council responsible for EFH protection in Delaware Bay is the Mid-Atlantic Regional Fisheries Management Council.

The Mid-Atlantic Regional Fisheries Management Council has established EFH for various life stages of 16 species of fish in the Delaware Estuary, where the PSEG Site is located (Reference 2.4-127). Those species are red hake, winter flounder, windowpane flounder, American plaice, bluefish, Atlantic sea herring, butterfish, summer flounder, scup, black sea bass, king mackerel, Spanish mackerel, cobia, clearnose skate, little skate, and winter skate. All of these species are expected in Delaware Bay. All of these species except the king mackerel, plaice and cobia have been collected in one or more years at SGS.

Recent evaluation of EFH in the vicinity of HCGS concluded that EFH salinity requirements were only met for four species of fish in that portion of the river. These are summarized in Table 2.4-28.

The EFH for the life stages of those species summarized in Table 2.4-28 (Reference 2.4-128) includes:

- Muddy or sandy bottom habitat (windowpane flounder, winter flounder, summer flounder)
- Estuarine bottom habitat (winter flounder)
- Pelagic waters (winter flounder, butterfish)
- Bottom waters (winter flounder)
- Demersal waters (summer flounder)

All of these habitats exist in the vicinity of the PSEG Site.

2.4.2.3.2.1 Butterfish

EFH has been designated in the vicinity of the proposed CWIS, discharge, and barge facility construction area for juvenile butterfish. Juvenile butterfish, size range 16 to 120 mm (0.63 to

4.72 in.) standard length, often live in the shelter of large jellyfish during their first summer. Butterfish are a pelagic species (Reference 2.4-32). Juvenile butterfish have not been collected in entrainment samples between 1995 and 2007, nor have they been collected from marsh creeks in the vicinity of the PSEG Site in extensive surveys conducted as part of the EEP. In addition, immature butterfish (larvae and juveniles) were not collected during entrainment sampling conducted from 1995 to 2007 at SGS. Larger juveniles and adults may occur in the vicinity of the PSEG Site from the spring to fall. Butterfish have been collected in impingement samples at SGS.

2.4.2.3.2.2 Windowpane Flounder

EFH has been designated in the vicinity of the proposed CWIS, discharge, and barge facility construction area for eggs, larvae, juvenile and adult windowpane flounder. Windowpane flounder larvae and juveniles have been collected in entrainment samples at SGS and adults have been collected in impingement samples (Tables 2.4-17 and 2.4-18).

Juvenile windowpane flounder have been reported in shallow and deep waters in studies conducted in the northeast and Mid-Atlantic states. Adult windowpane flounder are year-round residents off the coast of NJ and move around as part of their habits. They tolerate a wide range of salinities and temperatures and tend to avoid water with low dissolved oxygen. Eggs are buoyant and hatch after approximately eight days at appropriate water temperatures. Larvae are approximately 2 mm (0.8 in.) at hatching and are pelagic until they reach approximately 10 mm (0.39 in.), after which they settle to the bottom (Reference 2.4-20).

Windowpane flounder habitat is found in the vicinity of the PSEG Site.

2.4.2.3.2.3 Winter Flounder

EFH has been designated in the vicinity of the proposed CWIS, discharge, and barge facility construction area for eggs, larvae, juvenile and adult winter flounder. Winter flounder larvae and juveniles have been collected in entrainment samples at SGS and adults have been collected in impingement samples (Tables 2.4-12 and 2.4-13).

All life stages of the winter flounder have been reported in inshore waters of DE and NJ. Adult winter flounder are year-round residents off the coast of NJ and move around as part of their habits, probably in search of waters that fall within their preferred temperature range. They migrate inshore to spawn in the fall and early winter, and selection of spawning bed largely determines the distribution of eggs, larvae and juveniles. Eggs are demersal, adhesive, and usually clumped, and are generally found in shallow areas, especially on sand. Larvae, although negatively buoyant, are initially planktonic but quickly becoming bottom-oriented and are usually distributed in inshore habitats. Juveniles spend approximately 1 year in shallow waters before dispersing to deeper waters underlain by fine sediments. (Reference 2.4-150) Habitat for winter flounder is found in the vicinity of the PSEG Site.

2.4.2.3.2.4 Summer Flounder

EFH has been designated in the vicinity of the proposed CWIS, discharge, and barge facility construction area for juvenile and adult summer flounder. Summer flounder larvae and

juveniles have been collected in entrainment samples at SGS and adults have been collected in impingement samples (Tables 2.4-12 and 2.4-13).

Adult and juvenile summer flounder have been reported in Delaware Bay, most especially in the middle and lower Delaware Estuary. Summer flounder usually inhabit coastal and estuarine waters in warmer months and then migrate offshore in the fall and winter to spawn, homing back to the same inshore areas the following summer. Juveniles and adults are benthic in habit. Juveniles make use of different estuarine habitats, but in NJ and DE marsh creeks are especially important nursery areas. (Reference 2.4-148) Salinity and temperature are important determinants of distribution in addition to substrate preferences. Habitat for summer flounder is found in the vicinity of the PSEG Site.

2.4.2.4 Preexisting Environmental Stresses

As discussed in Section 2.3.1.1.3, Delaware River discharge is affected by upstream water diversions and the operations of reservoirs on upstream tributaries. The amount of freshwater inflow has an insignificant effect on the salinity and other water quality characteristics due to the large tidal influences. These influences are the primary effects on the ecology of the estuary in the vicinity of the PSEG Site. In addition, it is considered non-supporting with regard to drinking water uses due to contamination by mercury and polychlorinated biphenyls, which also may negatively affect the resident aquatic communities. General factors that can have large-scale impacts on the estuary include dredging and industrial accidents. The Delaware River Main Channel Deepening Project to be undertaken by the USACE may eventually commence, and if so will lead to direct disturbances of bottom habitat as well as increasing turbidity in the estuary. The most recent major industrial contamination involved the oil tanker *Athos I*, which spilled approximately 265,000 gallons of crude oil in late November 2004 (Reference 2.4-201).

2.4.2.5 Off-Site Transmission Corridors

As summarized in Subsection 1.2.5, PSEG completed a conceptual evaluation during development of the ESP application to identify potential transmission requirements associated with the addition of generation at the PSEG Site. This evaluation included the PJM Regional Transmission Expansion Plan, existing operational limits at HCGS and SGS, and other PJM transmission planning inputs. PJM routinely performs analyses of the regional transmission system and forecasts appropriate upgrades to the system as part of its long-term planning cycle. These evaluations are not specific to the addition of new generation at the PSEG Site.

In order to capture the potential effects of developing off-site transmission, PSEG analyzed the potential effects of two new off-site macro-corridors during development of the ESP application. Information pertaining to alternative off-site transmission system corridors considered by PSEG is presented in Subsection 9.4.3. The two, 5-mi. wide macro-corridors analyzed are the South and West Macro-Corridors. The West Macro-Corridor (55-mi. long) generally follows existing transmission line corridors, extending from the PSEG Site to Peach Bottom Substation. The South Macro-Corridor (94-mi. long) also follows existing transmission line corridors and is generally consistent with the MAPP line that was preliminarily planned by PJM to extend from the PSEG Site to the Indian River Substation. Each of these macro-corridors is developed with a common segment. From the PSEG Site, the hypothetical macro-corridor extends north and then west across the Delaware River to the Red Lion Substation.

From this location, each of the potential macro-corridors diverge extending to the west (Peach Bottom) or south (Indian River).

Based on the configuration of the macro-corridors, both the South and the West Macro-Corridors cross the Delaware River at RM 62, and the West Macro-Corridor also crosses the Susquehanna River near Peach Bottom. The Delaware River is tidal in this area, with flow rates and water levels dominated by tidal cycles (Subsection 2.3.1). Aquatic biota in the area of the proposed Delaware River transmission line crossing is similar to that in the vicinity of the PSEG Site as described in Subsection 2.4.2.1.2. Detailed evaluation of aquatic biota in the area of the Susquehanna River crossing would be completed when a final decision is made on transmission needs and if the final design included an instream structure.

Numerous smaller surface water systems consisting of streams and channels occur along both corridors. Table 2.4-29 presents the length of the streams within each 5-mi. wide macro-corridor. With regard to the streams crossed by the potential macro-corridors, the stream classifications are represented by USGS as channelized waterway, intermittent stream, and perennial stream. There are a total of 1700 mi. of streams within the 5-mi. wide South Macro-Corridor and 970 mi. of streams within the West Macro-Corridor. Coastal marsh, stream characteristics and associated aquatic biota are expected to be similar to that characterized for the marsh creeks adjacent to the PSEG Site as described in Subsection 2.4.2.1. In more upland settings, the aquatic systems potentially crossed by the macro-corridors are likely to vary in terms of water quality and habitat characteristics based on the type and intensity of surrounding land uses. Similarly, aquatic biotal residing in these systems are also likely to vary in diversity, abundance, and community composition based on these characteristics.

2.4.2.6 Access Corridor

Aquatic habitats within the footprint of the proposed causeway include medium-sized to large-sized segments of marsh creeks. Fish species that have historically been encountered in similar habitats near the study area are listed in Table 2.4-16. Macroinvertebrates collected during the course of the present study are listed in Table 2.4-15. No rare, threatened, or endangered species have been reported from the area anticipated to be affected.

Although these habitats are generally important, there is nothing of regional significance about these particular streams or ponds. All the species encountered in surveys of these habitats are common in the area. No significant loss of on-site stream and pond important habitat is expected.

2.4.3 REFERENCES

2.4-1 PSEG, Application for Letter of Interpretation for Salem and Hope Creek Generating Stations, 2009, Submitted to NJDEP Landuse Regulation Program on August 13, 2009.

2.4-2 NOT USED

2.4-3 American Museum of Natural History, Freshwater Mussels of the New York Metropolitan Region and New Jersey, A Guide to their Identification, Biology and Conservation, Website, http://cbc.amnh.org/mussel. 2009, accessed June 3, 2009.

2.4-4 Atlantic Flyway Council, Flyways.us, Website, http://www.flyways.us/flyways/atlantic, accessed February 11, 2010.

2.4-5 Atlantic States Marine Fisheries Commission, Species Profile: Black Sea Bass Joint Management Yields Positive Results for Popular Mid-Atlantic Fish, ASMFC Fisheries Focus 14:5-7, 2005.

2.4-6 Atlantic Sturgeon Status Review Team, Status Review of Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*), Report to National Marine Fisheries Service, Northeast Regional Office, February 23, 2007.

2.4-7 Audubon Society, Annual Christmas Bird Count for Salem County, Website, http://audubon2.org/cbchist/count_table.html, 2004-2008, accessed July 9, 2009.

2.4-8 Axley, E., Red-headed woodpecker (*Melanerpes erythrocephalus*), Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Melanerpes_erythrocephalus.html#47f8ae0e188901307303089371a3ee5b, 2002, accessed July 9, 2009.

2.4-9 Bare, L., *Leiostomus xanthurus*, Spot, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Leiostomus_xanthurus.html, Animal Diversity Web, 2001, accessed June 19, 2009.

2.4-10 Bayliff, W.H., The Life History of the Silverside, *Menidia menidia*. Chesapeake Biological Laboratory Publication No. 90, 1950, Fay et al. 1983.

2.4-11 Becker, R. and A. Fraser, Common Merganser (*Mergus merganser*), Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Mergus_merganser.html, 2006, accessed August 18, 2009.

2.4-12 Biber, P.D. and J.D. Caldwell, Seed Germination and Seedling Survival of *Spartina alternifolia Loisel*, American Journal of Agriculture and Biological Sciences, Vol. 3(3). Pages 633-638, 2008.

2.4-13 Bigelow, H.B. and W.C. Schroeder, Fishes of the Gulf of Maine, Fishery Bulletin of the Fish and Wildlife Service, No. 74, Contribution No. 592, Woods Hole Oceanographic Institution, 1953.

2.4-14 BirdLife International, Species Factsheet: Greater Scaup (*Aythya marila*). http://www.birdlife.org/datazone/species/index.html?action=SpcHTMDetails.asp&sid=482&m=0, 2009, accessed August 6, 2009.

2.4-15 Bridgman, A., American coot (*Fulica americana*), Animal Diversity Web, Website, http://animdiversity.ummz.umich.edu/site/accounts/information/Fulica_americana.html, 2003, accessed August 11, 2009.

2.4-16 Burdette, B., *Mercenaria mercenaria*, Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Mercenaria_mercenaria.html, 2001, accessed July 7, 2009.

2.4-17 Byerly, T., American black duck (*Anas rubripes*), Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Anas_rubripes.html, 2000, accessed August 5, 2009.

2.4-18 Centers for Disease Control, Division of Vector-Borne Infectious Diseases, Lyme Disease, Website, http://www.cdc.gov/ncidod/dvbid/Lyme/, 2009, accessed September 10, 2009.

2.4-19 Centers for Disease Control, Division of Vector-Borne Infectious Diseases, Lyme Disease Transmission, Website, http://www.cdc.gov/ncidod/dvbid/lyme/ld_transmission.htm, 2007, accessed September 10, 2009.

2.4-20 Chang, S., Berrien, P.L., Johnson, D.L., Morse, W.W., Essential Fish Habitat Source Document: Windowpane, Scophthalmus aquosus, Life History and Habitat Characteristics, NOAA Tech Memo NMFS NE 137; 32 p., 1999.

2.4-21 Chesapeake Bay Program, Bay Field Guide – Horseshoe Crab, Website, http://www.chesapeakebay.net/bfg_horseshoe_crab.aspx?menuitem=14425, 2009, accessed April 22, 2009.

2.4-22 Chesapeake Bay Ecological Foundation, Inc. (CBEF), Atlantic menhaden (*Brevoortia tyrannus*), Website, http://www.chesbay.org/forageFish/menhaden.asp, 2009, accessed June 17, 2009.

2.4-23 Chesapeake Bay Ecological Foundation, Inc. (CBEF), Bay Anchovy (*Anchoa mitchelli*), Website, http://www.chesbay.org/forageFish/anchovy.asp, 2009, accessed June 16, 2009.

2.4-24 Clark, R.S., Studies of the Marsh and Terrestrial Ecology of Artificial Island and Vicinity, Salem, NJ, May-December 1974.

2.4-25 Connelly, R.A., G.A. Hayes, and R.A. Tudor, Abundance and Distribution of Benthic Macroinvertebrates, Report to Public Service Electric and Gas Co., Newark, NJ, 1977.

2.4-26 Corbett, H., Northern Kingfish, A Profile, Website, http://www.nj.gov/dep/fgw/artkingfish.htm, 2009, accessed April 21, 2009.

2.4-27 Cornell Lab of Ornithology, All About Birds, Common Merganser, Website, http://www.allaboutbirds.org/guide/common_merganser/id, 2009, accessed September 11, 2009.

2.4-28 Cornell Lab of Ornithology, All About Birds, Snow Goose, Website, http://www.allaboutbirds.org/guide/Snow_Goose/id, 2009, accessed September 11, 2009.

2.4-29 Cornell Lab of Ornithology, Birds in Forested Landscapes, Cooper's Hawk, http://www.birds.cornell.edu/bfl/speciesaccts/coohaw.html, Website, 2009, accessed June 25, 2009.

2.4-30 Cornell Lab of Ornithology, Birds in Forested Landscapes, Red-shouldered Hawk, Website, http://www.birds.cornell.edu/bfl/speciesaccts/reshaw.html, 2009, accessed July 1, 2009.

2.4-31 Correia, A.T., K.W. Able, C. Antunes, and J. Coimbra, Early Life History of the American Conger Eel (Conger oceanicus) as revealed by ototlith microstructure and microchemistry of metamorphosing leptocephali, Marine Biology 145:477-488, 2004.

2.4-32 Cross, J.N., Zetlin, C.A., Berrien, P.L., Johnson, D.L., McBride, C., Essential Fish Habitat Source Document: Butterfish, Peprilus triacanthus, Life History and Habitat Characteristics, NOAA Tech Memo NMFS NE 145; 42 p., Website, http://www.nefsc.noaa.gov/nefsc/publications/tm/tm145/, 1999, accessed August 8, 2009.

2.4-33 Dadswell, M.J., Biology and Population Characteristics of the Shortnose Sturgeon (*Acipenser brevirostrum*), LeSueur 1818 (*Osteichthyes: Acipenseridae*) in the St. John River Estuary, New Brunswick, Canada, Canadian Journal of Zoology 57:2186-2210, 1979.

2.4-34 Dadswell, M.J., B.D. Taubert, T.S. Squiers, D. Marchette, and J. Buckley, Synopsis of Biological Data on Shortnose Sturgeon (*Acipenser brevirostrum*), LeSueur 1818, NOAA Technical Report NMFS 14, 45 p., 1984.

2.4-35 Delaware Audubon Society, Important Bird Areas in DE, Website http://www.DEaudubon.org/birding/globaliba.html, 2004, accessed October 1, 2009.

2.4-36 Delaware Birding Trail, Site #6, Fort Delaware State Park, Website, http://www.DEbirdingtrail.org/drc2.html, 2007, accessed October 1, 2009.

2.4-37 Delaware Department of Natural Resources and Environmental Control, Endangered Species of Delaware, 2008, Website, http://www.dnrec.state.de.us/nhp/information/endangered.shtml, accessed April 22, 2009.

2.4-38 Delaware Department of Natural Resources and Environmental Control. "Rare, Threatened and Endangered Species, Unique Natural Communities, and Other Significant Natural Resources, Letter from Edna J. Stetzar dated March 31, 2009."

2.4-39 Delaware Sea Grant, Sea Trout, *Cynoscion regalis*, Website, http://www.ocean.udel.edu/mas/seafood/seatrout.html, 2009, accessed April 22, 2009.

2.4-40 Dery, L.M., Atlantic Butterfish, (*Peprilus tricanthus*), Website, http://www.nefsc.noaa.gov/fbi/age-man/butt/butttext.htm, 2009, accessed June 25, 2009.

2.4-41 Dery, L.M. 2009. Silver Hake, (*Merluccius bilinearis*), Website, http://www.nefsc.noaa.gov/fbi/age-man/slhk/slhktext.htm, 2009, accessed April 22, 2009.

2.4-42 Dewey, T., Red-breasted Merganser (*Mergus serrator*), Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Mergus_serrator.html, 2009, accessed August 19, 2009.

2.4-43 Dewey, T., White-tailed Deer (*Odocoileus virginianus*), Animal Diversity Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Odocoileus_virginianus.html 2003, accessed August 25, 2009.

2.4-44 Dewey, T. and E. Ellis, River Otter (*Lontra canadensis*), Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Lontra_canadensis.html, 2003, accessed August 24, 2009.

2.4-45 Dewey, T. and H. Lutz, Canada goose (*Branta canadensis*), Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Branta_canadensis.html, 2002, accessed August 11, 2009.

2.4-46 Discover Life, *Prionotus Carolinus* (*Linnaeus, 1771*), Website, http://www.discoverlife.org/20/q?search=Prionotus+carolinus&b=FB1243, 2009, accessed July 6, 2009.

2.4-47 Dovel, W.L. and T.J. Berggren, Atlantic Sturgeon of the Hudson Estuary, New York, New York Fish and Game Journal 30:140-172, 1983.

2.4-48 Facey, D.E. and M.J. Van Den Avyle, Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North Atlantic) – American Eel, U.S. Fish and Wildlife Service Biological Report 82 (11.74), U.S. Army Corps of Engineers, TR EL-82-4. 28 p., 1987.

2.4-49 Fay, C.W., R.J. Neves, and G.B. Pardue, Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic) – Atlantic Silverside, U.S. Fish and Wildlife Service, Division of Biological Services, FWS/OBS- 82 (11.10), U.S. Army Corps of Engineers, TR EL-82-4, 15 p., 1983.

2.4-50 Fay, C.W., R.J. Neves, and G.B. Pardue, Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic) – Striped Bass, U.S. Fish and Wildlife Service, Division of Biological Services, FWS/OBS- 82 (11.8), U.S. Army Corps of Engineers, TR EL-82-4, 36 p., 1983.

2.4-51 Federal Interagency Committee for Wetland Delineation, Federal Manual for Identifying and Delineating Jurisdictional Wetlands, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S. Department of Agriculture Soil Conservation Service, Washington, D.C., Cooperative Technical Publication. 76 pp. plus appendices, 1989.

2.4-52 Fishbase, *Alosa aestivalis*, Blueback shad, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?id=1574, 2009, accessed June 16, 2009.

2.4-53 Fishbase, *Anchoa mitchilli*, Bay Anchovy, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=545, 2009, accessed June 16, 2009.

2.4-54 Fishbase, *Centropristis striata*, Black seabass, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=361, 2009, accessed June 17, 2009.

2.4-55 Fishbase, *Conger oceanicus*, American conger, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=300, 2009, accessed June 18, 2009.

2.4-56 Fishbase, *Ictaluras punctatus*, Channel catfish, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=290, 2009, accessed June 18, 2009.

2.4-57 Fishbase, *Menidia menidia*, Atlantic silverside, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=339, 2009, accessed June 19, 2009.

2.4-58 Fishbase, *Menticirrhus saxatilis*, Northern kingfish, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=410, 2009, accessed June 22, 2009.

2.4-59 Fishbase, *Merluccius bilinearis*, Silver hake, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=323, 2009, accessed April 20, 2009.

2.4-60 Fishbase, *Micropogonias undulatus*, Atlantic croaker, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=408, 2009, accessed June 24, 2009.

2.4-61 Fishbase, *Morone americana*, White perch, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=355, 2009, accessed June 25, 2009.

2.4-62 Fishbase, *Morone saxatilis*, Striped bass, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=353, 2009, accessed June 25, 2009.

2.4-63 Fishbase, *Paralichthys dentatus*, Summer flounder, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=1338, 2009, accessed June 25, 2009.

2.4-64 Fishbase, *Peprilus tricanthus*, Butterfish, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=492, 2009, accessed June 25, 2009.

2.4-65 Fishbase, *Pogonias cromis*, Black drum, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=425, 2009, accessed June 25, 2009.

2.4-66 Fishbase, *Pomatomus saltatrix*, Bluefish, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=364, accessed July 6, 2009.

2.4-67 Fishbase, *Pseudopleuronectes americanus*, Winter flounder, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=524, accessed July 6, 2009.

2.4-68 Fishbase, *Scopthalmus aquosus*, Windowpane, Website, http://www.fishbase.sinica.edu.tw/Summary/SpeciesSummary.php?ID=530, 2009, accessed July 6, 2009.

2.4-69 Fishbase, *Stenotomus chrysops*, Scup, Website, http://www.fishbase.org/Summary/SpeciesSummary.php?ID=452, 2009, accessed July 6, 2009.

2.4-70 Florida Museum of Natural History, Ichthyology, It's In The River: The Dreaded Snakehead, Website, http://www.flmnh.ufl.edu/fish/innews/dreaded2005.html, December 16, 2005, accessed November 25, 2009.

2.4-71 Food and Agriculture Organization of the United Nations (FAO), Fisheries and Aquaculture, *Crassostrea virginica* (Gmelin, 1791) (Ostreidae). Website, http://www.fao.org/fishery/culturedspecies/Crassostrea_virginica/en, 2009, accessed June 4, 2009.

2.4-72 Food and Agriculture Organization of the United Nations (FAO), Fisheries and Aquaculture, *Mercenaria mercenaria* (Linnaeus, 1758) (*Veneridae*), Website http://www.fao.org/fishery/culturedspecies/Mercenaria_mercenaria/en, 2009, accessed July 7, 2009.

2.4-73 Fuller, P. and Jacobs, G., *Alosa aestivalis*. USGS Non-Indigenous Aquatic Species Database, Gainesville, FL, Website, http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=488, 2009, accessed June 16, 2009.

2.4-74 Gillum, F., *Cynoscion regalis*, Website, http://animaldiversity.ummz.umich.edu.site.accounts/information/Cynoscion_regalis.html, 2002, accessed June 18, 2009.

2.4-75 Global Biodiversity Information Facility, Free and Open Access to Biodiversity Data, Website, http://www.gbif.net/species. 2009, accessed June 3, 2009.

2.4-76 Greene, K.E., J.L. Zimmerman, R.W. Laney, and J.C. Thomas-Blate, Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*), Chapter 8 in: Atlantic Coast Diadromous Fish Habitat: A Review of Utilization, Threats, Recommendations for Conservation, and Research Needs, Atlantic States Marine Fisheries Commission Habitat Management Series No. 9, Washington, DC, 2009.

2.4-77 Grimes, B.H., M.T. Huish, J.H. Kerby, and D. Moran, Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic) – Summer and Winter Flounder, U.S. Fish and Wildlife Service Biological Report No. 82 (11.112), U.S. Army Corps of Engineers, TR EL-82-4. 18 p., 1989.

2.4-78 Haas-Castro, R., Status of Fishery Resources off the Northeastern US: American Shad. Website, http://www.nefsc.noaa.gov/sos/spsyn/af/shad, 2006, accessed June 16, 2009.

2.4-79 Hendrickson, L., Windowpane Flounder, Website, http://www.nefsc.noaa.gov/sos/spsyn/fldrs/window, 2006, accessed July 6, 2009.

2.4-80 Hendrickson, L., P. Nitschke, and M. Terceiro, Winter flounder, Website, http://www.nefsc.noaa.gov/sos/spsyn/fldrs/winter, 2009, accessed July 6, 2009.

2.4-81 Hildebrand, S.F. and L.E. Cable, Fourteen Teleostean Fishes at Beaufort, NC, Bulletin of the U.S. Bureau of Fisheries 46:383-488, 1930.

2.4-82 Hill, K., *Callinectes sapidus* (Blue Crab), Website, http://www.sms.si.edu/IRLspec/Callin_sapidu.htm, 2004, accessed July 7, 2009.

2.4-83 Hill, K., *Mercenaria mercenaria*, Website, http://www.sms.si.edu/irLspec/Mercen_mercen.htm, 2004, accessed July 7, 2009.

2.4-84 Hohman, W.L. and R.T. Eberhardt, Ring-Necked Duck (Aythya collaris), The Birds of North America Online (A. Poole, Editor), Ithaca-Cornell Lab of Ornithology, Website, http://bna.birds.cornell.edu/bna/species/329/articles/introduction, 1998, accessed August 5, 2009.

2.4-85 Hood, P.B., K.W. Able, and C.B. Grimes, Biology of the Conger Eel Conger Oceanicus in the Mid-Atlantic Bight, I, Distribution, Age, Growth and Reproduction, Marine Biology 98:587-596, 1988.

2.4-86 Ichthyological Associates, Inc. (IA), An Ecological Study of the Delaware River near Artificial Island 1968 – 1976: A Summary, Report to Public Service Electric and Gas Co., Newark, NJ, 1980.

2.4-87 Ichthyological Associates, Inc., The Terrestrial Ecology of Artificial Island and Vicinity, 1972-1978: A Summary, Prepared for Public Service Electric and Gas Company, 1980.

2.4-88 Indian River FL (IRF), Black drum, Website, http://indian-river.fl.us/fishing/fish/drumblac.html, 2009, accessed April 21, 2009.

2.4-89 Kirschbaum, K. and P. Watkins, 2000, Osprey (*Pandion haliaetus*), Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Pandion_haliaetus.html, 2000, accessed July 8, 2009.

2.4-90 Kraft, C.E., D.M. Carlson, and M. Carlson, *Inland fishes of New York (Online),* Version 4.0 Department of Natural Resources, Cornell University, and the New York State Department of Environmental Conservation, Website, http://pond.dnr.cornell.edu/nyfish, 2006, accessed June 16, 2009.

2.4-91 Lassuy, D.R., Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Gulf of Mexico) – Atlantic croaker, U.S. Fish and Wildlife Service, Division of Biological Services, FWS/OBS- 82 (11.3), U.S. Army Corps of Engineers, TR EL-82-4. 12 p., 1983.

2.4-92 LeSueur, C.A., Description of Several Species of Chondropterygious Fishes of North America, with Their Varieties, Transactions of the American Philosophical Society 1:383-395, 1818, quoted in Masnik, M.T. and J.H. Wilson, 1980.

2.4-93 Levy, A., K.W. Able, C.B. Grimes, and P. Hood, Biology of the Conger Eel Conger Oceanicus in the Mid-Atlantic Bight, II, Foods and Feeding Ecology, Marine Biology 98:597-600, 1988.

2.4-94 Littoral Society, American Eel (*Anguilla rostrata*), Website, http://www.littoralsociety.org/userfiles/doccenter.Species%20Spotlight%20American%20eel.pdf, 2009, accessed June 17, 2009.

2.4-95 Logue, J., Snow goose (*Anser caerulescens*), Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Anser_caerulescens.html, 2002, accessed August 17, 2009.

2.4-96 Maier, P., Spot, (*Leiostomus xanthurus*), Website, http://www.dnr.sc.gov/cwcs/pdf/Spot.pdf, 2009, accessed June 19, 2009.

2.4-97 Maine Department of Marine Resources, Recreational Fisheries, Blueback herring (*Alosa aestivalis*), Website, http://maine.gov/dmr/recreational/anglerguide/doyouknowyourcatch/documents/bluebackherring.pdf, 2009, accessed June 16, 2009.

2.4-98 MarineBio, *Alosa sapidissima*, American shad, Website, http://marinebio.org/species.asp?id=443, 2009, accessed June 16, 2009.

2.4-99 MarineBio, *Limulus polyphemus*, Horseshoe Crab, Website, http://marinebio.org/species.asp?id=281, 2009, accessed July 15, 2009.

2.4-100 MarineBio, *Prionotus carolinus*, Northern Sea Robin, Website, http://marinebio.org/species.asp?id=43, 2009, accessed July 6, 2009.

2.4-101 Maryland Department of Natural Resources, inFocus, Chinese Mitten Crab Watch, Website, http://www.dnr.state.md.us/dnrnews/infocus/mitten_crab.asp, accessed November 25, 2009.

2.4-102 Maryland Department of Natural Resources, Maryland Fish Facts, Alewife and Blueback Herring (*Alosa pseudoharengus* and *Alosa aestivalis*), Website, http://www.dnr.state.md.us/fisheries/fishfacts/herring.asp. 2009, accessed June 16, 2009.

2.4-103 Maryland Department of Natural Resources, Maryland Fish Facts, American shad (*Alosa sapidissima*), Website, http://www.dnr.state.md.us/fisheries/fishfacts/shad.asp, 2009, accessed June 16, 2009.

2.4-104 Maryland Department of Natural Resources, Maryland Fish Facts: Atlantic Menhaden (*Brevoortia tyrannus*), Website, http://www.dnr.state.md.us/fisheries/fishfacts/menhaden.asp. 2009, accessed June 17, 2009.

2.4-105 Maryland Department of Natural Resources, Maryland Fish Facts: Channel Catfish (*Ictaluras punctatus*), Website, http://www.dnr.state.md.us/fisheries/fishfacts/channelcatfish.asp, 2009, accessed June 18.

2.4-106 Maryland Department of Natural Resources, Maryland Fish Facts: Gray weakfish (*Cynoscion regalis*). http://www.dnr.state.md.us/fisheries/fishfacts/weakfish.asp, 2009, accessed April 22, 2009.

2.4-107 Maryland Fishery Resources Office, Horseshoe Crab Tagging Program, Website, http://www.fws.gov/northeast/marylandfisheries/projects/Horseshoe%20crab.html. 2009, accessed July 15, 2009.

2.4-108 Masnik, M.T. and J.H. Wilson, Assessment of the Impacts of the Salem and Hope Creek Stations on Shortnose Sturgeon, *Acipenser brevirostrum* LeSueur, U.S. Nuclear Regulatory Commission, NUREG 0671, 101 p., 1980.

2.4-109 Massachusetts Division of Marine Fisheries, Species Profiles, Black Sea Bass, Website, http://www.mass.gov/dfwele/dmf/recreationalfishing/blackseabass.htm, 2009, accessed April 21, 2009.

2.4-110 Massachusetts Division of Marine Fisheries, Species Profiles, Bluefish, Website, http://www.mass.gov/dfwele/dmf/recreationalfishing/bluefish.htm, 2009, accessed April 21, 2009.

2.4-111 Massachusetts Division of Marine Fisheries, Species Profiles, Scup, Website, http://www.mass.gov/dfwele/dmf/recreationalfishing/scup.htm#profile, accessed April21, 2009.

2.4-112 McCord, J.W., American Eel, *Anguilla rostrata*, Website, http://www.dnr.sc.gov/cwcs/pdf/AmericanEel.pdf, 2004, accessed June 17, 2009.

2.4-113 McCullough, J. and K. Kirschbaum, Wild Turkey (*Meleagris gallopavo*), Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Meleagris_gallopavo.html, 2001, accessed August 20, 2009.

2.4-114 Mercer, L.P., Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic) – Weakfish, U.S. Fish and Wildlife Service Biological Report 82 (11.109), U.S. Army Corps of Engineers, TR EL-82-4. 17 p., 1989.

2.4-115 Morrison, K., Ring-Necked Duck (Aythya collaris), Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Aythya_collaris.htm, 2000, accessed August 5, 2009.

2.4-116 Morton, T., Species Profiles, Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic) – Bay Anchovy, U.S. Fish and Wildlife Service Biological Report 82 (11.97), 13 p., 1989.

2.4-117 National Oceanic and Atmospheric Administration, Delaware Recreational Fishery Statistics Catch, 2008, Snapshot Query for 2007, Website, http://www.st.nmfs.noaa.gov/st1/recreational/queries/catch/snapshot.html, accessed July 8, 2009.

2.4-118 National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Green Turtle, Website, http://www.nmfs.noaa.gov/pr/species/turtles/green.htm, 2009, accessed June 17, 2009.

2.4-119 National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Hawksbill Turtle, Website, http://www.nmfs.noaa.gov/pr/species/turtles/hawksbill.htm, 2009, accessed June 23, 2009.

2.4-120 National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Kemp's Ridley Turtle, Website, http://www.nmfs.noaa.gov/pr/species/turtles/kempsridley.htm, 2009, accessed June 23, 2009

2.4-121 National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Leatherback Turtle, Website, http://www.nmfs.noaa.gov/pr/species/turtles/leatherback.htm 2009, accessed June 23, 2009.

2.4-122 National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources. Shortnose Sturgeon (*Acipenser brevirostrum*)., Website, http://www.nmfs.noaa.gov/pr/species/fish/shortnosesturgeon.htm, 2009, accessed June 11, 2009.

2.4-123 National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Species of Concern, Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*), Website, http://www.nmfs.noaa.gov/pr/pdfs/species/atlanticsturgeon_detailed.pdf, 6 p., 2009.

2.4-124 National Oceanic and Atmospheric Administration, New Jersey Recreational Fishery Statistics Catch Snapshot, 2008, Query for` 2007, Website, http://www.st.nmfs.noaa.gov/st1/recreational/queries/catch/snapshot.html, accessed July 8, 2009.

2.4-125 National Oceanic and Atmospheric Administration, National Marine Fisheries Service, New Jersey and Delaware Annual Commercial Landing Statistics by Species, 2008, Query for 2007. Website, http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html, accessed July 8, 2009.

2.4-126 National Oceanic and Atmospheric Administration, NOAA Damage Assessment, Remediation, and Restoration Project, The Delaware Estuary Watershed (The Delaware Project), Species Life History, Website, http://mapping2.orr.noaa.gov/portal/Delaware/lifehistory_other.html, 2009, accessed June 23, 2009.

2.4-127 National Oceanic and Atmospheric Administration, Northeast Regional Office, Summary of Essential Fish Habitat (EFH) Designation, 10' X 10' Square Coordinates, Website, http://www.nero.noaa.gov/hcd/STATES4/new_jersey/39207520.html, 2009, accessed August 7, 2009.

2.4-128 National Oceanic and Atmospheric Administration, Northeast Regional Office, Summary of Essential Fish Habitat (EFH) and General Habitat Parameters for Federally Managed Species, Website, http://www.nero.noaa.gov/hcd/efhtables.pdf, 2009, accessed August 7, 2009.

2.4-129 National Oceanic and Atmospheric Administration, "Rare, Threatened or Endangered Species in the Vicinity of the Project Site Letter from Mary A. Colligan dated April 15, 2009."

2.4-130 NatureServe, *Acipenser oxyrinchus*, Atlantic Sturgeon, Website, http://www.natureserve.org/explorer/servlet/NatureServe?sourceTemplate=tabular_report, 2009, accessed June 12, 2009.

2.4-131 New England Fishery Management Council, Mid-Atlantic Fishery Management Council, South Atlantic Fishery Management Council, and NOAA National Marine Fisheries Service, Essential Fish Habitat, Guide to Essential Fish Habitat Designations in the Northeastern United States, Website, http://www.nero.noaa.gov/hcd/webintro.html, 2009, accessed August 7, 2009.

2.4-132 New Jersey Department of Environmental Protection, Bureau of Geographic Information Systems, 2002 Land Use/Land Cover by Watershed Management Area, http://www.state.nj.us/dep/gis/lulc02cshp.html#top, Trenton, New Jersey, 2002, accessed October 5, 2009.

2.4-133 New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Channel Catfish, Website, http://www.state.nj.us/dep/fgw/fish_ch_cat.htm, 2009, accessed June 18, 2009.

2.4-134 New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Non-Game Species Program, Report of State Wildlife Grants (T-1-4), Endangered, Threatened, and Rare Wildlife Conservation Projects, Report for Project Year September 1, 2007 – August 31, 2008, Website, http://www.state.nj.us/dep/fgw/ensp/pdf/swgreports/swg_report07-08.pdf.

2.4-135 New Jersey Department of Environmental Protection, Division of Fish and Wildlife, New Jersey's Endangered and Threatened Wildlife, Website, http://www.state.nj.us/dep/fgw/tandespp.htm, 2004, accessed April 22 and June 29, 2009.

2.4-136 New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Raptors in New Jersey, Bald Eagle Information, 2004 Eagle Report, Website, http://www.state.nj.us/dep/fgw/ensp/pdf/eglrpt04.pdf.

2.4-137 New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Raptors in New Jersey, Bald Eagle Information, 2005 Eagle Report, Website, http://www.state.nj.us/dep/fgw/ensp/pdf/eglrpt05.pdf.

2.4-138 New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Raptors in New Jersey, Bald Eagle Information, 2006 Eagle Report, Website, http://www.state.nj.us/dep/fgw/ensp/pdf/eglrpt06.pdf.

2.4-139 New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Raptors in New Jersey, Bald Eagle Information, 2007 Eagle Report, Website, http://www.state.nj.us/dep/fgw/ensp/pdf/eglrpt07.pdf.

2.4-140 New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Raptors in New Jersey, Bald Eagle Information, 2008 Eagle Report, Website, http://www.state.nj.us/dep/fgw/ensp/pdf/eglrpt08.pdf.

2.4-141 New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Raptors in New Jersey, Osprey Information, The 2008 Osprey Project in New Jersey, Website, http://www.state.nj.us/dep/fgw/ensp/pdf/osprey08.pdf.

2.4-142 New Jersey Department of Environmental Protection, Rare Species Information for Lower Alloways Creek Township, Salem County, Letter from Herbert A. Lord dated April 1, 2009.

2.4-143 New Jersey Marine Sciences Consortium, All Hands on Deck: A Harbor Education Program, Key Species – Northern Harrier, Website, http://www.njmsc.org/Education/AHOD/TeacherResources.html, 2009, accessed July 6, 2009.

2.4-144 Newell, T., Muskrat (*Ondatra zibethicus*), Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Ondatra_zibethicus.html, 2000, accessed August 24, 2009.

2.4-145 Osburn, H.R. and G.C. Matlock, Black Drum Movement in Texas Bays, North American Journal of Fisheries Management 4:523-530, 1984, quoted in Sutter et al., 1986.

2.4-146 Osborne, P., Eastern Oyster, *Crassostrea virginica*, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Crassostrea_virginica.html, 1999, accessed July 8, 2009.

2.4-147 Overholtz, W., Butterfish, *Peprilus tricanthus*, Website, http://www.nefsc.noaa.gov/sos/spsyn/op/butter/, 2009, accessed April 21, 2009.

2.4-148 Packer, David B., Sara J. Griesbach, Peter L. Berrien, Christine A. Zetlin, Donna L. Johnson, and Wallace W. Morse, *Essential Fish Habitat Source Document:* Summer Flounder, *Paralichthys dentatus*, Life History and Habitat Characteristics, 1999, NOAA Technical Memorandum NMFS NE 151, http://www.nefsc.noaa.gov/nefsc/publications/tm/tm151/, accessed September 30, 2009.

2.4-149 Parsons, K.C. Heron Nesting at Pea Patch Island, Upper Delaware Bay, USA: Abundance and Reproductive Success, Colonial Water Birds 18(1) 69-78, Website, Available at: http://www.jstor.org/pss/1521400, 1995.

2.4-150 Pereira JJ, Goldberg R, Ziskowski JJ, Berrien PL, Morse WW, Johnson DL., Essential Fish Habitat Source Document: Winter Flounder (*Pseudopleuronectes americanus*) Life History and Habitat Characteristics, NOAA Tech Memo NMFS NE 138; 39 p., 1999, in Hendrickson et al., 2006.

2.4-151 Pflieger, W.L., The Fishes of Missouri, Missouri Department of Conservation, Jefferson City, MO. 372 p., 1997.

2.4-152 Pottern, G.B., M.T. Huish, and J.H. Kerby, Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic) – Bluefish, U.S. Fish and Wildlife Service Biological Report No. 82 (11.94), U.S. Army Corps of Engineers, TR EL-82-4. 20 p., 1989.

2.4-153 Public Service Electric and Gas Company, Biological Monitoring Program – 1999 Annual Report, PSE&G Estuary Enhancement Program, 2000.

2.4-154 Public Service Electric and Gas Company, Biological Monitoring Program –1998 Annual Report, PSE&G Estuary Enhancement Program, 2000.

2.4-155 Public Service Electric and Gas Company, Biological Monitoring Program – 1997 Annual Report, PSE&G Estuary Enhancement Program, 1998.

2.4-156 Public Service Electric and Gas Company, Biological Monitoring Program – 1996 Annual Report, Newark, N.J, 1996.

2.4-157 Public Service Electric and Gas Company, Biological Monitoring Program – 1995 Annual Report, 1996.

2.4-158 Public Service Electric and Gas Company, Environmental Impact Statement in Support of Application to the State of New Jersey for CAFRA and Type B Wetlands Permits, Artificial Island Access Road Widening Project, Lower Alloways Creek Township, County of Salem, State of New Jersey, October 1982.

2.4-159 Public Service Enterprise Group, Biological Monitoring Program –2007 Annual Report, PSEG Estuary Enhancement Program, 2008.

2.4-160 Public Service Enterprise Group, Biological Monitoring Program –2006 Annual Report, PSEG Estuary Enhancement Program, 2007.

2.4-161 Public Service Enterprise Group, Biological Monitoring Program – 2005 Annual Report, PSEG Estuary Enhancement Program, 2006.

2.4-162 Public Service Enterprise Group, Biological Monitoring Program – 2004 Annual Report, PSEG Estuary Enhancement Program, 2005.

2.4-163 Public Service Enterprise Group, Biological Monitoring Program – 2003 Annual Report, PSEG Estuary Enhancement Program, 2004.

2.4-164 Public Service Enterprise Group, Biological Monitoring Program – 2002 Annual Report, PSE&G Estuary Enhancement Program, 2003.

2.4-165 Public Service Enterprise Group, Biological Monitoring Program – 2001 Annual Report, PSE&G Estuary Enhancement Program, 2002.

2.4-166 Public Service Enterprise Group, Biological Monitoring Program – 2000 Annual Report, PSE&G Estuary Enhancement Program, 2001.

2.4-167 Robinson, J., Northern Pintail (*Anas acuta*), Animal Diversity Web, Website,http://animaldiversity.ummz.umich.edu/site/accounts/information/Anas_acuta.html, 2002, accessed August 4, 2009.

2.4-168 Rodgers, D., Mallard (*Anas platyrhynchos*), Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Anas_platyrhynchos.html, 2001, accessed August 4, 2009.

2.4-169 Rogers, S.G. and M.J. Van Den Avyle, Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (South Atlantic) – Atlantic menhaden, U.S. Fish and Wildlife Service, Division of Biological Services, FWS/OBS- 82 (11.11), U.S. Army Corps of Engineers, TR EL-82-4, 20 p., 1983.

2.4-170 Roof, J., Bufflehead (*Bucephala albeola*), Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Bucephala_albeola.html, 1999, accessed August 10, 2009.

2.4-171 Roof, J., Green-Winged Teal (*Anas crecca*), Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Anas_crecca.html, 1999, accessed August 4, 2009.

2.4-172 Roof, J., Hooded Merganser (*Lophodytes cucullatus*), Animal Diversity Web, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Lophodytes_cucullatus.html, 1999, accessed August 17, 2009.

2.4-173 Saltonstall, K., Cryptic Invasion by a Non-Native Geonotype of the Common Reed, *Phragmites australis*, into North America, Proceedings of the National Academy of Sciences, 99(4) 2445-2449, Website, Available at: http://www.pnas.org/content/99/4/2445.full.pdf+html, 2002.

2.4-174 Seattle Audubon Society Bird Web, Species Factsheet: Greater Scaup (Aythya marila), Website, http://birdweb.org/Birdweb/bird_details.aspx?id=79#nesting, 2009, accessed August 6, 2009.

2.4-175 Shepherd, G**.,** Status of Fishery Resources off the Northeastern US, American Eel, Website, http://www.nefsc.noaa.gov/sos/spsyn/op/eel/, 2006, accessed June 16, 2009.

2.4-176 Shepherd, G.R., Weakfish (*Cynoscion reg*alis), Website, http://www.nefsc.noaa.gov/fbi/age-man/weak/weaktext.htm, 1997, accessed June 18, 2009.

2.4-177 Simpson, P.C. and D.A. Fox, Atlantic Sturgeon in the Delaware River: Contemporary Population Status and Identification of Spawning Areas, Report for Project No. NA05NMF4051093. 41 p., 2007.

2.4-178 Smith, R.W., A Quantitative Study of Benthic Macroinvertebrates of the Delaware River in the Vicinity of Artificial Island, Report to Public Service Electric and Gas Co., Newark, NJ., 1972.

2.4-179 Smithsonian Magazine, Science & Nature, Invasion of the Snakeheads, Website, http://www.smithsonianmag.com/science-nature/snakeheads.html, accessed on November 25, 2009.

2.4-180 Smithsonian Marine Station at Fort Pierce, *Leiostomus xanthurus*, Spot, Website, http://www.sms.si.edu/IRLSpec/Leiosto_xanthu.htm, 2009, accessed June 19, 2009.

2.4-181 South Carolina Department of Natural Resources and National Oceanic and Atmospheric Administration, ACE Basin Characterization Study, Bay Anchovy, Website, http://www.dnr.sc.gov/marine/mrri/acechar/specgal/bayanch.htm, 2009, accessed June 16, 2009.

2.4-182 Stanley, J.G. and D.S. Danie, Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North Atlantic) – White Perch, U.S. Fish and Wildlife Service, Division of Biological Services, FWS/OBS- 82 (11.7), U.S. Army Corps of Engineers, TR EL-82-4, 12 p., 1983.

2.4-183 Stanley, J.G. and M.A. Sellers, Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic) – American Oyster, U.S. Fish and Wildlife Service Biological Report No. 82 (11.65), U.S. Army Corps of Engineers, TR EL-82-4, 25 p., 1986.

2.4-184 Steimle, F.W., C.A. Zetlin, P.L. Berrien, D.L. Johnson, and S. Chang, Essential Fish Habitat Source Document: Scup, Stenotomus chrysops, Life History and Habitat Characteristics, NOAA Technical Memorandum NMFS NE 149, 13 p., 1999.

2.4-185 Sutter, F.C., R.S. Waller, and T.D. McIlwain, Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Gulf of Mexico) – Black Drum, U.S. Fish and Wildlife Service Biological Report No. 82 (11.51), U.S. Army Corps of Engineers, TR EL-82-4, 10 p., 1986.

2.4-186 Terceiro, M., Status of Fishery Resources Off the Northeastern U.S., Summer Flounder (*Paralichthys dentatus*), Website, http://www.nefsc.noaa.gov/sos/spsyn/fldrs/summer/, 2006, accessed April 22, 2009.

2.4-187 Texas Parks and Wildlife Division (TPWD), Black Drum (*Pogonias cromis*), Website, http://www.tpwd.state.tx.us/huntwild/wild/species/blackdrum/, 2009, accessed April 21, 2009.

2.4-188 Texas Parks and Wildlife Division (TPWD), Blue Crab (*Callinectes sapidus*), Website, http://www.tpwd.state.tx.us/huntwild/wild/species/bluecrab/, 2009, accessed July 7, 2009.

2.4-189 Texas Parks and Wildlife Division (TPWD), Eastern Oyster (*Crassostrea virginica*), Website, http://www.tpwd.state.tx.us/huntwild/wild/species/easternoyster/, 2009, accessed July 8, 2009.

2.4-190 The Nature Conservancy, The, Ecological Assessment Report, Field activities conducted by The Nature Conservancy staff from the Delaware Bayshores Program Office, 2008, Eldora, New Jersey.

2.4-191 U.S. Army Corps of Engineer, Philadelphia District, Delaware Bay Oyster Restoration Project, Delaware and New Jersey, Final Environmental Assessment, Website, available at http://www.nap.usace.army.mil/cenap-pa/oyster/final07/FINALoysterEA07.pdf, June 2007.

2.4-192 U.S. Army Corps of Engineers, USACE Threatened, Endangered, and Sensitive Species Protection and Management System, Green Turtle, Website, http://el.erdc.usace.army.mil/tessp/profile.cfm?Type=Marine%20Turtles&Name=Green%20Turtle&View=Species, accessed June 17, 2009.

2.4-193 U. S. Army Corps of Engineers, USACE Threatened, Endangered, and Sensitive Species Protection and Management System, Hawksbill, Website, http://el.erdc.usace.army.mil/tessp/profile.cfm?Type=Marine%20Turtles&Name=Hawksbill&View=Species, 2009, accessed June 23, 2009.

2.4-194 U.S. Army Corps of Engineers, USACE Threatened, Endangered, and Sensitive Species Protection and Management System, Kemp's Ridley, Website, http://el.erdc.usace.army.mil/tessp/profile.cfm?Type=Marine%20Turtles&Name=Kemp%27s%20Ridley%20(=%20Atlantic%20Ridley)&View=Species, 2009, accessed June 23, 2009.

2.4-195 U.S. Army Corps of Engineers, USACE Threatened, Endangered, and Sensitive Species Protection and Management System, Leatherback, Website, http://el.erdc.usace.army.mil/tessp/profile.cfm?Type=Marine%20Turtles&Name=Leatherback&View=Species, accessed June 23, 2009.

2.4-196 U.S. Army Corps of Engineers, USACE Threatened, Endangered, and Sensitive Species Protection and Management System, Loggerhead Turtle, Website, http://el.erdc.usace.army.mil/tessp/profile.cfm?Type=Marine%20Turtles&Name=Loggerhead&View=Species, accessed June 23, 2009.

2.4-197 U.S. Department of Agriculture, Natural Resources Conservation Service, Common Reed (*Phragmites australis*) Plant Fact Sheet, Website, http://plants.usda.gov/java/nameSearch?keywordquery=common+reed&mode=comname&submit.x=12&submit.y=7, 2005, accessed September 9, 2007.

2.4-198 U.S. Environmental Protection Agency, Infectious Diseases Associated with Environmental Exposures or Conditions, Website, http://cfpub.epa.gov/eroe/index.cfm?fuseaction=detail.viewInd&showQues=Human%20Health&ch=48&lShowInd=0,313,281&subtop=381&lv=list.listByQues&r=201582. 2009, accessed September 10, 2009.

2.4-199 U.S. Fish and Wildlife Service, The American Eel (*Anguilla rostrata*), Website, http://www.fws.gov/northeast/ameel/facts.html, 2009, accessed June 17, 2009.

2.4-200 U.S. Fish and Wildlife Service, Annual Mid-Winter Waterfowl Survey for Stowe, Hope, and Alloway Creeks, Website, Available at: http://mbdcapps.fws.gov/, 2005-2009, accessed 2009.

2.4-201 U.S. Fish and Wildlife Service, Chesapeake Bay Field Office, *Athos 1* Oil Spill, Website, http://www.fws.gov/chesapeakebay/newsletter/spring05/athosspill.htm, accessed December 1, 2009.

2.4-202 U. S. Fish and Wildlife Service, Migratory Bird Program: Bald Eagle, Website, http://www.fws.gov/migratorybirds/baldeagle.htm, 2007, accessed July 7, 2009.

2.4-203 U.S. Fish and Wildlife Service, Response to Request for Information on the Presence of Federally Listed Endangered and Threatened Species in the Vicinity of the Existing Salem and Hope Creek, Generating Stations, Letter from the Acting Supervisor, September 9, 2009.

2.4-204 U.S. Fish and Wildlife Service, Response to Request for Information on Threatened or Endangered Species for the Salem and Hope Creek Generating Stations, Letter from the Leopoldo Miranda, August 18, 2009.

2.4-205 U.S. Fish and Wildlife Service, Shorebird Technical Committee, Peer Review Panel, *Delaware Bay Shorebird-Horseshoe Crab Assessment Report and peer Review*, Available at http://library.fws.gov/Bird_Publications/DBshorebird.pdf, June 2003.

2.4-206 U. S. Fish and Wildlife Service, Species Profile, Green Sea Turtle, Website, http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=C00S, 2009, accessed June, 17, 2009.

2.4-207 U.S. Fish and Wildlife Service, Species Profile, Hawksbill Sea Turtle, Website, http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=C00E, 2009, accessed June 23, 2009.

2.4-208 U.S. Fish and Wildlife Service, Species Profile, Kemp's Ridley Sea Turtle, Website, http://www.fws.gov/northFL/SeaTurtles/Turtle%20Factsheets/Kemps-Ridley-Sea-Turtle.htm 2009, accessed June 23, 2009.

2.4-209 U.S. Fish and Wildlife Service, Species Profile, Leatherback Sea Turtle, Website, http://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/leatherback-sea-turtle.htm, 2009, accessed June 23, 2009.

2.4-210 U.S. Fish and Wildlife Service, Species Profile, Loggerhead Sea Turtle, Website, http://www.fws.gov/northFL/SeaTurtles/Turtle%20Factsheets/loggerhead-sea-turtle.htm 2009, accessed June 23, 2009.

2.4-211 U.S. Geological Survey, National Land Cover Database 2001, Use/Land Cover, http://www.mrlc.gov/nlcd.php, 2001, accessed October 5, 2009.

2.4-212 U.S. Geological Survey, Nonindigenous Species, *Morone americana*, http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=777, 2009, accessed June 25, 2009.

2.4-213 U.S. Geological Survey, 1966-2007 Species List, Annual Breeding Bird Surveys, Route Greenwich, Website, http://www.mbr-pwrc.usgs.gov/cgi-bin/rtena226.pl?59002, 2006.

2.4-214 University of Delaware College of Marine and Earth Studies and the Sea Grant College Program, Natural History, Beach Site Selection, Website, http://www.ceoe.udel.edu/horseshoecrab/research/site.html#top, accessed November 18, 2009.

2.4-215 University of Delaware, UDaily, Website, http://www.udel.edu/PR/UDaily/2007/jun/mitten061107.html, accessed November 25, 2009.

2.4-216 University of Massachusetts (UMass), American shad (*Alosa sapidissima*), Website, http://www.bio.umass.edu/biology/conn.river/shad.html, 2009, accessed June 16, 2009.

2.4-217 University of Michigan Museum of Zoology (UMMZ), (Anguilla rostrata) American eel, Website, http://animaldiversity.ummz.umich.edu/site/accounts/information/Anguilla_rostrata.html, 2009, accessed June 17, 2009.

2.4-218 Virginia Department of Game and Inland Fisheries (VDGIF), American shad (*Alosa sapidissima*), Website, http://www.dgif.virginia.gov/wildlife/fish/details.asp?fish=010040, 2009, accessed June 16, 2009.

2.4-219 Virginia Institute of Marine Science (VIMS), Alewife (*Alosa pseudoharengus*), Website, http://www.fisheries.vims.edu/anadromous/alewife.htm, 2009, accessed June 16, 2009.

2.4-220 V.J. Schuler and Associates, An Environmental Monitoring Program 1974-1984 on Diamondback Terrapin Nesting and Osprey Nesting/Bald Eagle Occurrence in the Vicinity of Artificial Island, a Summary, March 28, 1985.

2.4-221 V.J. Schuler Associates, Inc., 1986 Annual Report – Artificial Island Ecological Studies, January 1 through December 21, 1986, Salem Generating Station Unit No. 1 and Unit No. 2 and Hope Creek Generating Station Unit No. 1, February 19, 1988.

2.4-222 V.J. Schuler Associates, Inc., 1987 Annual Report – Artificial Island Ecological Studies, Report to Public Service Electric and Gas Co., Newark, NJ, 1989.

2.4-223 Wenner, C.A. and P. Webster, Kingfishes, Website, http://www.dnr.sc.gov/cwcs/pdf/Kingfish.pdf, 2009, accessed June 22, 2009.

2.4-224 Whitaker, J.D., Atlantic Croaker (*Micropogonias undulates*) Website, http://www.dnr.sc.gov/cwcs/pdf/Croaker.pdf, 2009, accessed June 24, 2009.

2.4-225 Widjeskog, Lee, Regional Superintendent, New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Personal communication, March 9, 2009.

Table 2.4-1
Summary of Terrestrial Surveys Conducted within the PSEG Site and Vicinity, 2009 – 2010

Terrestrial Survey Location	2009-2010 Terrestrial Surveys				Habitat Type[(a)]
	Birds	Mammals	Herps	Vegetation	
TS-01	X				W, O, D, A, F
TS-02	X				W, O, D, A, F
TS-03	X	X	X	X	W, D
TS-04	X	X	X	X	W, D
TS-05	X	X	X	X	W, O
TS-06	X	X	X	X	O
TS-07	X	X	X	X	O
TS-08	X	X	X	X	O
TS-09	X		X		W
TS-10	X		X		W
TS-11	X		X		W
TS-12	X		X		W
TS-13	X		X		W
TS-14	X		X		W
TS-15	X		X		W
TS-16	X		X		W
TS-17	X	X	X	X	W, D
TS-18	X	X	X	X	W, D

a) Habitat Types

W = wetlands and other aquatic resources

O = old field

D = developed land uses

A = agriculture

F = forest

Table 2.4-2
Land Use/Land Cover within the PSEG Site Property Boundary

NJ LULC Categories	Area (ac.)	Percent of Site
Wetland and Aquatic Habitat		
Artificial Lakes	40.3	4.9
Deciduous Scrub/Shrub Wetlands	4.6	0.5
Disturbed Wetlands (Modified)	4.3	0.5
Herbaceous Wetlands	5.8	0.6
Managed Wetland in Maintained Lawn Greenspace	3.8	0.4
Phragmites-Dominated Interior Wetlands	118.7	14.5
Phragmites-Dominated Coastal Wetlands	155.6	19.0
Saline Marsh	0.2	0.0
Tidal Rivers, Inland Bays, and Other Tidal Waters	5.6	0.6
Wetlands Rights of Way	23.8	2.5
Subtotal	**362.7**	**44.3**
Old Field Habitat		
Deciduous Brush/Shrubland	6.0	0.7
Old Field (<25 percent Brush Covered)	69.4	8.5
Phragmites-Dominated Old Field	31.9	3.9
Upland Rights-of-Way Undeveloped	29.5	3.6
Subtotal	**136.8**	**16.7**
Developed Land Uses		
Altered Lands	14.8	1.8
Industrial	234.5	28.6
Other Urban or Built-up Land	55.8	6.8
Phragmites-Dominated Urban Area	0.5	0.1
Recreational Land	4.9	0.6
Transportation/Communication/Utilities	8.5	1.0
Upland Rights-of-Way Developed	0.5	0.1
Subtotal	**319.5**	**39.0**
Total	**819.0**	**100.0**
Delineated Wetlands		
Coastal Wetlands	164.9	20.1
Unmapped Coastal (Freshwater) Wetlands	87.2	10.6
CDF/Desilt Basin Wetlands	70.6	8.6
Total	**322.7**	**39.3**

References 2.4-132 and 2.4-1

Table 2.4-3
Land Use/Land Cover within the 6-Mile Vicinity of the PSEG Site

USGS Categories	Area (ac.)	Percent of Vicinity
Barren Land	632.9	0.9
Developed Lands	893.8	1.2
Cultivated Crops	12,808.1	17.7
Pasture Hay	3533.0	4.9
Deciduous Forest	2455.2	3.4
Evergreen Forest	64.3	0.1
Mixed Forest	12.9	0.0
Emergent Herbaceous Wetlands	16,379.2	22.6
Woody Wetlands	8869.9	12.3
Open Water	26,732.5	36.9
Total	**72,381.6**	**100.0**

Reference 2.4-211

Table 2.4-4 (Sheet 1 of 2)
Mammals Observed On-Site and in the Vicinity of the PSEG Site,
2009 – 2010

		2009-2010 Field Survey						
		Season				Approximate Location		
Scientific Name	Common Name	Winter	Spring	Summer	Fall	Site	Vicinity	Prior Survey[c]
Pouched Mammals								
Didelphis virginiana	Opossum	X	X	X			TS-01	(b)
Insectivores								
Blarina brevicauda	Short-tailed shrew							X
Sorex cinereus	Masked shrew							X
Bats								
Eptesicus fuscus	Big brown bat							(b)
Lasiurus borealis	Red bat							(b)
Myotis lucifugus	Little brown myotis							(b)
M. keenii	Keen's myotis							(b)
M. septentrionalis	Eastern pipistrelle							(b)
M. subulatus	Small-footed myotis							(b)
Rabbits								
Sylvilagus floridanus	Eastern cottontail	X	X	X		TS-03		(b)
Gnawing Mammals								
Marmota monax	Groundhog		X				TS-01, TS-02, TS-09	
Microtus pennsylvanicus	Meadow vole							X
Mus musculus	House mouse							X
Ondatra zibethicus	Muskrat		X	X		TS-03, TS-13	TS-01, TS-02, TS-09	(b)
Oryzomya paulaustris	Marsh rice rat							X
Peromyscus leucopus	White-footed mouse							X
Rattus norveigicus	Norway rat							X
Sciurus carolinensis	Eastern gray squirrel	X	X	X	X		TS-01, TS-02, TS-09	(b)
Synaptomys cooperi	Southern bog lemming							(b)
Zapus hudsonius	Meadow jumping mouse							X

**Table 2.4-4 (Sheet 2 of 2)
Mammals Observed On-Site and in the Vicinity of the PSEG Site,
2009 – 2010**

Scientific Name	Common Name	2009-2010 Field Survey						Prior Survey[c]
		Season				Approximate Location		
		Winter	Spring	Summer	Fall	Site	Vicinity	
Flesh Eaters								
Canus latrans	Coyote			X		TS-17, TS-18		
Lontra canadensis	River otter		X	X		TS-15	Plant access road	
Mephitis mephitis	Striped skunk		X				TS-09	
Mustela frenata	Long-tailed weasel							(b)
Procyon lotor	Raccoon	X	X	X			TS-02	(b)
Urocyon cinereoargenteus	Gray fox							(b)
Ursus americanus	Black bear	X[a]				Near entrance gate		
Vulpes fulva	Red fox				X		TS-02	(b)
Even-Toed Hoofed Mammals								
Odocoileus virginianus	White-tailed deer	X	X	X	X	TS-06, TS-07, TS-08, TS-14, TS-15	TS-01, TS-02	(b)

a) Observed by PSEG Site Security
b) Not observed, but may occur within vicinity
c) Reference 2.4-158

Table 2.4-5 (Sheet 1 of 2)
Reptiles and Amphibians Observed On-Site and in the Vicinity of the PSEG Site, 2009 – 2010

Scientific Name	Common Name	Season			Location		Prior Survey[a]
		Spring	Summer	Fall	Site	Vicinity	
Frogs/Toads							
Bufo woodhousii fowleri	Fowler's toad	X			TS-10, TS-12, TS-13, TS-16		X
Hyla cinerea	Green treefrog		X		TS-10, TS-12		
Hyla versicolor	Eastern gray treefrog	X	X	X		TS-01, TS-02	X
Pseudacris crucifer	Northern spring peeper	X			TS-10, TS-12, TS-13, TS-14, TS-15, TS-16		X
Pseudacris triseriata kolmi	NJ chorus frog						X
Rana catesbeiana	Bullfrog						X
Rana clamitans melanota	Green frog						X
Rana palustris	Pickerel frog						X
Rana sphenocephala	Southern leopard frog	X			TS-10, TS-12, TS-13, TS-14, TS-16	TS-09	X
Rana sylvatica	Wood frog						X
Scaphiopus holbrooki	Eastern spadefoot toad						X
Acris c. crepitans	Northern cricket frog						X
Salamanders/Skinks/Newts							
Ambystoma maculatum	Spotted salamander						X
Ambystoma opacum	Marbled salamander						X
Ambystoma t. tigrinum	Eastern tiger salamander						X
Desmognathus f. fuscus	Northern dusky salamander						X
Dremictylus v. viridescens	Red-spotted newt						X
Eumeces fasciatus	Five-lined skink						X
Euryea b. bislineata	Northern two-lined salamander						X
Hemidactylium scutatum	Four-toed salamander						X
Plethodon c. cinereus	Red-backed salamander						X
Pseufotriton r. ruber	Northern red salamander						X

Table 2.4-5 (Sheet 2 of 2)
Reptiles and Amphibians Observed On-Site and in the Vicinity of the PSEG Site, 2009 – 2010

Scientific Name	Common Name	Season			Location		Prior Survey[(a)]
		Spring	Summer	Fall	Site	Vicinity	
Turtles							
Caretta c. caretta	Atlantic loggerhead						X
Chelonia m. mydas	Atlantic green turtle						X
Chelydra serpentina	Common snapping turtle	X	X	X	TS-01, TS-04, TS-10, TS-13, plant road near cooling tower		X
Chrysemys picta picta	Eastern painted turtle	X	X		TS-10, TS-13, TS-14, TS-16		X
Chrysemys rubriventris	Red-bellied turtle						X
Clemmys muhlenbergi	Bog turtle						X
Clemmys quttita	Spotted turtle						X
Dermochelys c. coriacea	Atlantic leatherback						X
Eretmochetys f. imbricate	Atlantic hawksbill						X
Kinosternon s. subrubrum	Eastern mud turtle						X
Lepidochelya kempi	Kemp's ridley sea turtle						X
Malaclemys terrapin	Diamond-backed terrapin	X	X		TS-15	Plant access road	X
Sternotherus odoratus	Stinkpot						X
Terrapene c. carolina	Eastern box turtle						X
Snakes							
Carphophis a. amoenus	Eastern worm snake						X
Coluber c. constrictor	Northern black snake						X
Diadophis p. edwardsi	Northern ringneck snake						X
Elaphe obsoleta obsoleta	Black rat snake	X			TS-06		X
Haldea v. valeriae	Eastern earth snake						X
Heterodon platyrhinos	Eastern hognose snake						X
Lampropeltis triangulum temporalis	Coastal plain milk snake						X
Lampropeltis g. getulus	Eastern kingsnake						X
Natrix s. sipedon	Northern water snake						X
Natrix septemvittata	Queen snake						X
Opheodrys aestivus	Rough green snake						X
Storeria dekayi dekayi	Northern brown snake	X			TS-10		X
Thamnophis s. sauritus	Eastern ribbon snake						X
Thamnophis sirtalis sirtalis	Eastern garter snake	X				TS-02	X

a) Reference 2.4-87

Table 2.4-6 (Sheet 1 of 12)
Birds Observed Seasonally On-Site and in the Vicinity of the PSEG Site, 2009 – 2010

		2009-2010 Field Survey									
		Season					Location				
Scientific Name	Common Name	Winter[d]	Spring	Summer	Fall	Total All Seasons	Site	Vicinity	BBS[a]	FWS[b]	Audubon[c]
Loons											
Gavia stellata	Red-throated loon										X
Grebes											
Podilymbus podiceps	Pied-billed grebe										X
Pelicans and Cormorants											
Phalacrocorax auritus	Double-crested cormorant		0	19	20	**39**	TS-11, TS-15	TS-02			X
Herons, Egrets, Bitterns, and Ibises											
Ardea alba	Great egret		12	10	13	**35**	TS-10, TS-11, TS-12, TS-15, TS-16	TS-01, TS-02, TS-09	X		X
Ardea herodias	Great blue heron	1	10	6	3	**20**	TS-06, TS-11, TS-15, TS-18	TS-01, TS-02, TS-09	X		
Bubulcus ibis	Cattle egret		15	6	32	**53**		TS-01, general field reconn. (Hancocks Bridge Rd.), TS-02	X		
Butorides virescens	Green heron		34	2		**36**	TS-13	TS-02	X		
Egretta caerulea	Little blue heron		1	1		**2**		TS-01	X		X
Egretta thula	Snowy egret		4	1	2	**7**	TS-13	TS-01, TS-02, TS-09	X		
Nycticorax nycticorax	Black-crowned night heron		2	2		**4**		General field reconn. (Alloways Creek, Hope Creek)	X		
Plegadis falcinellus	Glossy ibis		48	1		**49**		TS-01, TS-09	X		X
Waterfowl											
Aix sponsa	Wood duck								X		X
Anas acuta	Northern pintail		4			**4**	TS-16			X	X
Anas americana	American wigeon									X	X

Table 2.4-6 (Sheet 2 of 12)
Birds Observed Seasonally On-Site and in the Vicinity of the PSEG Site, 2009 – 2010

		2009-2010 Field Survey									
		Season					Location				
Scientific Name	Common Name	Winter[d]	Spring	Summer	Fall	Total All Seasons	Site	Vicinity	BBS[a]	FWS[b]	Audubon[c]
Anas clypeata	Northern shoveler										X
Anas crecca	Green-winged teal	7	25			**32**	TS-10, TS-12, TS-16	TS-01, TS-09		X	X
Anas platyrhynchos	Mallard	35	93		1	**129**	TS-03, TS-06, TS-08, TS-10, TS-11, TS-12, TS-13, TS-14, TS-15, TS-16, TS-17	TS-01, TS-02, TS-09	X	X	X
Anas rubripes	American black duck	43	97	7		**147**	TS-08, TS-10, TS-11, TS-12, TS-13, TS-14, TS-15, TS-16, TS-17, TS-18	TS-01, TS-02, TS-09	X	X	X
Anas strepera	Gadwall									X	X
Aythya affinis	Lesser scaup										X
Aythya americana	Redhead										X
Aythya collaris	Ring-necked duck	12	23			**35**	TS-12, TS-16				X
Aythya marila	Greater scaup	131				**131**	TS-15				
Aythya sp.	Scaup sp.									X	
Aythya valisineria	Canvasback									X	X
Branta canadensis	Canada goose	1041	258	81	49	**1429**	TS-05, TS-10, TS-11, TS-12, TS-16, TS-17	TS-01, TS-02	X	X	X
Bucephala albeola	Bufflehead	4				**4**	TS-12			X	X
Bucephala sp.	Goldeneye sp.										
Chen caerulescens	Snow goose	2071	85			**2156**	TS-10, TS-11, TS-15	TS-01, TS-02, TS-09		X	X
Clangula hyemalis	Long-tailed duck										X
Cygnus columbianus	Tundra swan									X	X
Cygnus olor	Mute swan		3			**3**	TS-16			X	X

Table 2.4-6 (Sheet 3 of 12)
Birds Observed Seasonally On-Site and in the Vicinity of the PSEG Site, 2009 – 2010

		2009-2010 Field Survey									
		Season					Location				
Scientific Name	Common Name	Winter[d]	Spring	Summer	Fall	Total All Seasons	Site	Vicinity	BBS[a]	FWS[b]	Audubon[c]
Lophodytes cucullatus	Hooded merganser	1				**1**	TS-12			X	X
Melanitta perspicillata	Surf scoter										X
Mergus merganser	Common merganser	12				**12**	TS-15	TS-09		X	X
Mergus serrator	Red-breasted Merganser		2			**2**	TS-10			X	X
Mergus sp.	Merganser sp.									X	
Oxyura jamaicensis	Ruddy duck										X
Vultures, Hawks, Falcons											
Accipiter cooperii	Cooper's hawk				4	**4**	TS-17	TS-01	X		X
Accipiter gentilis	Northern goshawk										X
Accipiter striatus	Sharp-shinned hawk				1	**1**		TS-01			X
Buteo jamaicensis	Red-tailed hawk	11	9	1	5	**26**		TS-01, TS-02	X		X
Buteo lagopus	Rough-legged hawk										X
Buteo lineatus	Red-shouldered Hawk										X
Buteo platypterus	Broad-winged hawk								X		X
Buteo sp.	Unknown raptor	2				**2**		TS-01			X
Cathartes aura	Turkey vulture	52	43	16	15	**126**	TS-07, TS-18	TS-01, TS-02	X		
Circus cyaneus	Northern harrier	11	7	3	1	**22**	TS-03, TS-06, TS-12, TS-16, TS-17, TS-18	TS-01, TS-02, TS-09	X		X
Coragyps atratus	Black vulture		2			**2**		TS-01, TS-02	X		
Falco columbarius	Merlin										X
Falco peregrinus	Peregrine falcon										X
Falco sparverius	American kestrel								X		X

Table 2.4-6 (Sheet 4 of 12)
Birds Observed Seasonally On-Site and in the Vicinity of the PSEG Site, 2009 – 2010

		2009-2010 Field Survey									
		Season					Location				
Scientific Name	Common Name	Winter [d]	Spring	Summer	Fall	Total All Seasons	Site	Vicinity	BBS[a]	FWS[b]	Audubon[c]
Haliaeetus leucocephalus	Bald eagle	3	8	3	2	**16**	TS-05, TS-06, TS-08, TS-15, TS-17	TS-02			X
Pandion haliaetus	Osprey		16	13		**29**	TS-04, TS-05, TS-08, TS-10, TS-11, TS-15	TS-01, TS-02, TS-09	X		
Gallinaceous Birds											
Colinus virginianus	Northern bobwhite		5		1	**6**	TS-06, TS-07, TS-08	TS-01, TS-02	X		
Cranes, Rails, Coots											X
Fulica americana	American coot		1			**1**	TS-16				X
Meleagris gallopavo	Wild turkey	6	72	10	4	**92**	General field reconn. (plant access road near TS-06)	TS-01, TS-02	X		
Phasianus colchicus	Ring-necked Pheasant	1	1			**2**	TS-07	general field reconn. (Abott's Farm Rd.)	X		X
Rallus limicola	Virginia rail			1		**1**		general field reconn. (Alloways Creek)			X
Rallus longirostris	Clapper rail								X		X
Shorebirds											
Actutis macularia	Spotted sandpiper		3			**3**	TS-15	TS-02	X		X
Calidris alpina	Dunlin		20			**20**		TS-01			X
Calidris minutilla	Least sandpiper		140	1	5	**146**	TS-03, TS-04, TS-09, TS-10, TS-15	TS-01			
Catoptrophorus semipalatus	Willet								X		
Charadrius semipalmatus	Semipalmated plover		76	2		**78**	TS-15	TS-01			
Charadrius vociferus	Killdeer	18	44	22	2	**86**	TS-03, TS-04, TS-05, TS-06, TS-08, TS-10, TS-11, TS-12, TS-15, TS-17, TS-18	TS-01, TS-02	X		X

Table 2.4-6 (Sheet 5 of 12)
Birds Observed Seasonally On-Site and in the Vicinity of the PSEG Site, 2009 – 2010

		2009-2010 Field Survey									
		Season					Location				
Scientific Name	Common Name	Winter[(d)]	Spring	Summer	Fall	Total All Seasons	Site	Vicinity	BBS[(a)]	FWS[(b)]	Audubon[(c)]
Chroicocephalus philadelphia	Bonaparte's gull										X
Gallinago delicata	Wilson's snipe										
Gulls and Terns											X
Himantopus mexicanus	Black-necked stilt		1			**1**	TS-10				X
Larus argentatus	Herring gull	10				**10**	TS-15	TS-02	X		X
Larus atricilla	Laughing gull		27	2		**29**	TS-03, TS-06, TS-07, TS-08, TS-15, TS-17, TS-18	TS-02	X		
Larus DEnsis	Ring-billed gull	48	169	22	27	**266**	TS-03, TS-04, TS-05, TS-06, TS-07, TS-08, TS-11, TS-15, TS-17, TS-18	TS-01, TS-02, TS-09	X		X
Larus marinus	Great black-backed gull	13	28	77	143	**261**	TS-11, TS-15, TS-16, TS-17, TS-18	TS-01, TS-09			X
Larus pipixcan	Franklin's gull		16			**16**		TS-01			
Scolopax minor	American woodcock		2			**2**	TS-08				X
Sterna forsteri	Forster's tern		1	14		**15**	TS-11, TS-12, TS-15, TS-16				X
Sterna hirundo	Common tern		3			**3**	TS-16	TS-01			
Tringa flavipes	Lesser yellowlegs		77	2	29	**108**	TS-10	TS-01, TS-09			
Tringa melanoleuca	Greater yellowlegs		91			**91**		TS-09			
Pigeons and Doves											
Columba livia	Rock dove			1	1	**2**	TS-05	TS-02	X		X
Zenaida macroura	Mouning dove	36	62	41	107	**246**	TS-04, TS-05, TS-06, TS-07, TS-08, TS-18	TS-01, TS-02	X		X

Table 2.4-6 (Sheet 6 of 12)
Birds Observed Seasonally On-Site and in the Vicinity of the PSEG Site, 2009 – 2010

		2009-2010 Field Survey									
		Season					Location				
Scientific Name	Common Name	Winter[d]	Spring	Summer	Fall	Total All Seasons	Site	Vicinity	BBS[a]	FWS[b]	Audubon[c]
Cuckoos											
Coccyzus americanus	Yellow-billed cuckoo		1	1		**2**		TS-01, TS-02	X		
Coccyzus erythropthalmus	Black-billed cuckoo								X		
Owls											
Bubo virginianus	Great horned owl								X		X
Otus asio	Eastern screech-Owl								X		X
Tyto alba	Barn owl										X
Goatsuckers											
Caprimulgus carolinensis	Chuck-Will's-widow										
Swifts and Hummingbirds											
Archilochus colubris	Ruby-throated hummingbird		1	1		**2**		TS-01	X		
Chaetura pelagica	Chimney swift			1		**1**		TS-02	X		
Kingfishers											
Ceryle alcyon	Belted kingfisher	3		1	1	**5**		TS-01, TS-02	X		X
Woodpeckers											
Colaptes auratus	Northern flicker	2			5	**7**		TS-01, TS-02	X		X
Dryocopus pileatus	Pileated woodpecker		1			**1**		TS-01			
Melanerpes carolinus	Red-bellied woodpecker	13	21	2	9	**45**		TS-01, TS-02	X		X
Picoides pubescens	Downy woodpecker	9	4	5	3	**21**		TS-01, TS-02	X		X
Picoides villosus	Hairy woodpecker								X		X

Table 2.4-6 (Sheet 7 of 12)
Birds Observed Seasonally On-Site and in the Vicinity of the PSEG Site, 2009 – 2010

		2009-2010 Field Survey									
		Season					Location				
Scientific Name	Common Name	Winter[d]	Spring	Summer	Fall	Total All Seasons	Site	Vicinity	BBS[a]	FWS[b]	Audubon[c]
Perching Birds											
Agelaius phoeniceus	Red-winged blackbird	575	419	100	1,067	**2161**	TS-03, TS-04, TS-05, TS-06, TS-07, TS-08, TS-17, TS-18	TS-01, TS-02	X		X
Ammodramus savannarum	Grasshopper Sparrow		1			**1**		TS-01	X		
Anthus rubescens	American pipit										X
Baeolophus bicolor	Tufted titmouse	14	14	3	5	**36**		TS-01, TS-02	X		X
Bombycilla cedrorum	Cedar waxwing								X		X
Cardinalis cardinalis	Northern cardinal	26	112	24	5	**167**	TS-03, TS-04, TS-05, TS-06, TS-07, TS-17, TS-18	TS-01, TS-02	X		X
Carduelis pinus	Pine siskin	2				**2**		TS-01			X
Carduelis tristis	American goldfinch		32	15	21	**68**	TS-03, TS-04, TS-05, TS-06, TS-07, TS-14, TS-18	TS-01, TS-02	X		X
Carpodacus mexicanus	House finch	4	3	1		**8**		TS-01	X		X
Carpodacus purpureus	Purple finch		1	5	6	**12**		TS-01, TS-02			X
Catharus guttatus	Hermit thrush										X
Certhia americana	Brown creeper										X
Cistothorus palustris	Marsh wren		15	7		**22**	TS-03, TS-18	TS-01, TS-02	X		X
Contopus virens	Eastern wood pewee		3	4		**7**		TS-01, TS-02	X		
Corvus brachyrhynchos	American crow	19	55	12	27	**113**	TS-04	TS-01, TS-02	X		X
Corvus ossifragus	Fish crow	13	34	30	19	**96**	TS-04, TS-05, TS-07, TS-08	TS-01, TS-02	X		X

Table 2.4-6 (Sheet 8 of 12)
Birds Observed Seasonally On-Site and in the Vicinity of the PSEG Site, 2009 – 2010

		2009-2010 Field Survey									
		Season					Location				
Scientific Name	Common Name	Winter[d]	Spring	Summer	Fall	Total All Seasons	Site	Vicinity	BBS[a]	FWS[b]	Audubon[c]
Cyanocitta cristata	Blue jay	40	18	8	33	**99**	TS-07	TS-01, TS-02	X		X
Dendroica coronata	Yellow-rumped warbler		10			**10**	TS-04	TS-01, TS-02			X
Dendroica discolor	Prairie warbler		1			**1**		TS-01	X		
Dendroica palmarum	Palm warbler										X
Dendroica petechia	Yellow warbler		79	9	3	**91**	TS-03, TS-04, TS-06, TS-07, TS-08, TS-17	TS-01, TS-02	X		
Dendroica pinus	Pine warbler		4			**4**		TS-01, TS-02	X		
Dolichonyx oryzivorus	Bobolink		1			**1**	TS-03				
Dumetella carolinensis	Gray catbird	1	90	44	37	**172**	TS-03, TS-04, TS-05, TS-06, TS-07, TS-08, TS-17, TS-18	TS-01, TS-02	X		X
Empidonax virescens	Acadian flycatcher								X		
Eremophila alpestris	Horned lark		1			**1**		TS-01	X		X
Euphagus carolinus	Rusty blackbird										X
Geothlypis triachas	Common Yellowthroat		120	13	9	**142**	TS-03, TS-04, TS-05, TS-06, TS-07, TS-08, TS-17, TS-18	TS-01, TS-02	X		X
Guiraca caerulea	Blue grosbeak				2	**2**		TS-01	X		
Helmitheros vermivorus	Worm-eating warbler								X		
Hirundo rustica	Barn swallow		91	37	3	**131**	TS-03, TS-04, TS-05, TS-06, TS-07, TS-08, TS-17, TS-18	TS-01, TS-02	X		
Hylocichla mustelina	Wood thrush		13	2		**15**		TS-01, TS-02	X		
Icteria virens	Yellow-breasted chat		14	2		**16**	TS-03, TS-04, TS-06, TS-07, TS-08	TS-01, TS-02	X		

Table 2.4-6 (Sheet 9 of 12)
Birds Observed Seasonally On-Site and in the Vicinity of the PSEG Site, 2009 – 2010

		2009-2010 Field Survey									
		Season					Location				
Scientific Name	**Common Name**	**Winter[d]**	**Spring**	**Summer**	**Fall**	**Total All Seasons**	**Site**	**Vicinity**	**BBS[a]**	**FWS[b]**	**Audubon[c]**
Icterus galbula	Baltimore oriole								X		
Icterus spurius	Orchard oriole		5			**5**	TS-06, TS-08	TS-01	X		
	Dark-eyed junco										X
Melospiza georgiana	Swamp sparrow								X		X
Melospiza melodia	Song sparrow	51	76	17	18	**162**	TS-03, TS-04, TS-05, TS-06, TS-07, TS-08, TS-17, TS-18	TS-01, TS-02	X		X
Mimus polyglottos	Northern mockingbird	8	34	17	9	**68**	TS-04, TS-05, TS-06, TS-07, TS-08, TS-18	TS-01, TS-02	X		X
Mniotilta varia	Black and white warbler		1			**1**		TS-02	X		
Molothrus ater	Brown-headed cowbird		101	8	1	**110**	TS-03, TS-04, TS-05, TS-07, TS-08, TS-17, TS-18	TS-01, TS-02	X		X
Myiarchus crinitus	Great crested flycatcher				1	**1**		TS-02	X		
Oporornis formosus	Kentucky warbler		9			**9**		TS-01, TS-02	X		
Parula americana	Northern parula								X		
Passer domesticus	House sparrow	4	29	24	24	**81**	TS-05	TS-01, TS-02	X		X
Passerculus sandwichensis	Savannah sparrow		2			**2**	TS-04				X
Passerella iliaca	Fox sparrow										X
Passerina cyanea	Indigo bunting		23	19		**42**	TS-03, TS-04, TS-07, TS-17	TS-01, TS-02	X		
Petrochelidon pyrrhonota	Cliff swallow				16	**16**		TS-01			
Pipilo erythrophthalmus	Eastern towhee		19	9	2	**30**		TS-01, TS-02	X		X

Table 2.4-6 (Sheet 10 of 12)
Birds Observed Seasonally On-Site and in the Vicinity of the PSEG Site, 2009 – 2010

		2009-2010 Field Survey									
		Season					Location				
Scientific Name	**Common Name**	**Winter[(d)]**	**Spring**	**Summer**	**Fall**	**Total All Seasons**	**Site**	**Vicinity**	**BBS[(a)]**	**FWS[(b)]**	**Audubon[(c)]**
Piranga olivacea	Scarlet tanager								X		
Piranga rubra	Summer tanager								X		
Poecile atricapillus	Black-capped chickadee	9	3	3	2	**17**		TS-01, TS-02			
Poecile carolinensis	Carolina chickadee			1		**1**		TS-01	X		X
Polioptila caerulea	Blue-gray gnatcatcher		14	1		**15**		TS-01, TS-02	X		
Progne subis	Purple martin			5		**5**		TS-02	X		
Protonotaria citrea	Prothonotary warbler		1			**1**		TS-01			
Quiscalus quiscula	Common grackle	51	77	18	1	**147**	TS-04, TS-06, TS-07, TS-08	TS-01, TS-02	X		X
Regulus calendula	Ruby-crowned kinglet										X
Regulus satrapa	Golden-crowned kinglet										X
Riparia riparia	Bank swallow								X		
Sayornis phoebe	Eastern phoebe		1		1	**2**	TS-17	TS-01, TS-02	X		X
Seiurus aurocapillus	Ovenbird		4			**4**		TS-01, TS-02	X		
Seiurus motacilla	Louisiana waterthrush		2			**2**		TS-01	X		
Setophaga ruticilla	American redstart								X		
Sialia sialis	Eastern bluebird	8	0	4	7	**19**		TS-01, TS-02	X		X
Sitta canadensis	Red-breasted nuthatch										X
Sitta carolinensis	White-breasted nuthatch		3	4	3	**10**		TS-01, TS-02			X

Table 2.4-6 (Sheet 11 of 12)
Birds Observed Seasonally On-Site and in the Vicinity of the PSEG Site, 2009 – 2010

		2009-2010 Field Survey									
		Season					Location				
Scientific Name	Common Name	Winter[d]	Spring	Summer	Fall	Total All Seasons	Site	Vicinity	BBS[a]	FWS[b]	Audubon[c]
Sphyrapicus varius	Yellow-bellied sapsucker					**4**					X
Spizella arborea	American tree sparrow	4					TS-17				X
Spizella passerina	Chipping sparrow	6	47	7		**60**	TS-03, TS-04, TS-05, TS-06, TS-07, TS-08, TS-17, TS-18	TS-01, TS-02	X		X
Spizella pusilla	Field sparrow		8	7		**15**	TS-03	TS-01, TS-02	X		X
Stelgidopteryx serripennis	Northern rough-winged swallow								X		
Sturnella magna	Eastern meadowlark	7	1			**8**	TS-06	TS-01, TS-02	X		X
Sturnus vulgaris	European starling	151	327	510	545	**1533**	TS-03, TS-04, TS-06, TS-07, TS-08, TS-18	TS-01, TS-02	X		X
Tachycineta bicolor	Tree swallow	3	570	187	2,112	**2872**	TS-03, TS-04, TS-05, TS-06, TS-07, TS-08, TS-17, TS-18	TS-01, TS-02	X		
Thryothorus ludovicianus	Carolina wren	29	17	7	13	**66**	TS-05, TS-06, TS-07, TS-08	TS-01, TS-02	X		X
Toxostoma rufum	Brown thrasher		11			**11**	TS-03, TS-04, TS-07	TS-01, TS-02	X		X
Troglodytes aedon	House wren	2	2	3	3	**10**	TS-07	TS-01, TS-02	X		
Troglodytes troglodytes	Winter wren										X
Turdus migratorius	American robin	35	119	65	5	**224**	TS-04, TS-05, TS-06, TS-07, TS-08	TS-01, TS-02	X		X
Tyrannus tyrannus	Eastern kingbird		1	8		**9**	TS-04	TS-01, TS-02	X		
Vermivora pinus	Blue-winged warbler								X		
Vireo flavifrons	Yellow-throated vireo								X		
Vireo griseus	White-eyed vireo		5			**5**		TS-01, TS-02	X		

Table 2.4-6 (Sheet 12 of 12)
Birds Observed Seasonally On-Site and in the Vicinity of the PSEG Site, 2009 – 2010

		2009-2010 Field Survey									
		Season					Location				
Scientific Name	Common Name	Winter[d]	Spring	Summer	Fall	Total All Seasons	Site	Vicinity	BBS[a]	FWS[b]	Audubon[c]
Vireo olivaceus	Red-eyed vireo		1	2		**3**		TS-02	X		
Wilsonia citrina	Hooded warbler								X		
Zonotrichia albicollis	White-throated sparrow	10	21			**31**	TS-03, TS-04, TS-06	TS-01, TS-02			X
Zonotrichia leucophrys	White-crowned Sparrow	2	3		1	**6**	TS-03	TS-01			X
Total Number of Birds Observed		**4670**	**4336**	**1620**	**4486**	**15,112**					
Total Number of Species		**51**	**103**	**73**	**57**	**125**					

a) Reference 2.4-213
b) Reference 2.4-200
c) Reference 2.4-7
d) Winter survey consists of species counts conducted in 2009 at field transects, roadside locations, and waterfowl locations, but also includes species counts of field transects and waterfowl locations on the USACE property in 2010.

Table 2.4-7
Recorded Endangered and Threatened Species Potentially Occurring in the Vicinity of the PSEG Site[a]

Scientific Name	Common Name	Federal Status	NJ Status	DE Status
Birds				
Accipiter cooperii	Cooper's hawk		T	
Buteo lineatus	Red-shouldered hawk		E/T[b]	
Circus cyaneus	Northern harrier		E	E
Haliaeetus leucocephalus	Bald eagle[d]		E	E
Melanerpes erythrocephalus	Red-headed woodpecker		T/T[b]	
Pandion haliaetus	Osprey		T/T[b]	
Fish				
Acipenser brevirostrum	Shortnose sturgeon	E	E	
Acipenser oxyrhynchus	Atlantic sturgeon	C	E	E
Reptiles				
Chelonia mydas	Atlantic green turtle	T	T	E
Caretta caretta	Atlantic loggerhead turtle	T	E	E
Dermochelys coriacea	Leatherback turtle	E	E	
Lepidochelys kempii	Kemp's ridley turtle	E	E	E
Glyptemys muhlenbergii	Bog turtle[c]	T		E

E = Endangered; T = Threatened; C = Candidate

a) Potential for occurrence based on habitat types found within the site and 6-mi. vicinity and along proposed causeway
b) Breeding/Non-breeding
c) Not recorded during the 2009 field studies or in any other historical records.
d) Also protected under the Bald and Golden Eagle protection Act.

Table 2.4-8
Important Terrestrial Species Potentially Occurring within the Vicinity of the PSEG Site

Scientific Name	Common Name	Rationale
Birds		
Anas acuta	Northern pintail	Recreational
Anas crecca	Green-winged teal	Recreational
Anas platyrhynchos	Mallard	Recreational
Anas rubripes	American black duck	Recreational
Aythya collaris	Ring-necked duck	Recreational
Aythya marila	Greater scaup	Recreational
Branta canadensis	Canada goose	Recreational
Bucephala albeola	Bufflehead	Recreational
Chen caerulescens	Snow goose	Recreational
Lophodytes cucullatus	Hooded merganser	Recreational
Fulica americana	American coot	Recreational
Mergus merganser	Common merganser	Recreational
Mergus serrator	Red-breasted merganser	Recreational
Accipiter cooperii	Cooper's hawk	NJ listed (Threatened breeding population/Stable non-breeding population)
Buteo lineatus	Red-shouldered hawk	NJ listed (Endangered breeding population/Threatened non-breeding population)
Circus cyaneus	Northern harrier	NJ/DE listed (Endangered)
Haliaeetus leucocephalus	Bald eagle	NJ (foraging Endangered on-site and population Endangered in vicinity of site)/DE listed (Endangered)[a]
Pandion haliaetus	Osprey	NJ listed (Threatened)
Meleagris gallopavo	Wild turkey	Recreational
Melanerpes erythrocephalus	Red-headed woodpecker	NJ listed (Threatened)
Mammals		
Ondatra zibethicus	Muskrat	Commercial
Lutra canadensis	River otter	Commercial
Odocoileus virginianus	White-tailed deer	Recreational
Plants		
Spartina spp.	Saltmarsh cordgrass	Critical to saltmarsh ecosystem

a) Also protected under the Bald and Golden Eagle protection Act.

Table 2.4-9 (Sheet 1 of 7)
Terrestrial Plants Observed Seasonally On-Site and in the Vicinity of the PSEG Site, 2009

			Season Observed			Qualitative Abundance in Area Surveyed[a]									
Botanical Name	**Common Name**	**Taxa**	**Spring**	**Summer**	**Fall**	**TS-03**	**TS-04**	**TS-05**	**TS-06**	**TS-07**	**TS-08**	**TS-17**	**TS-18**	**Causeway[b]**	**Existing Access Road[c]**
Trees/Saplings															
Acer negundo	Box elder	1	1			R									
Acer rubrum	Red maple	1	1	1											x
Acer saccharinum	Silver maple	1	1												x
Albizzia julibrissin	Mimosa	1	1	1	1										x
Baccharis halimifolia	Groundsel tree, sea myrtle	1	1	1	1	O	C	C	O	C					x
Celtis occidentalis	Hackberry	1	1	1		U									
Diospyros virginiana	Persimmon	1	1	1	1										x
Gleditsia triacanthos	Honey locust	1	1												x
Juglans nigra	Black walnut	1	1												x
Juniperus virginiana	Eastern red cedar	1	1	1	1			O	O	O	C				x
Liquidambar styraciflua	Sweetgum	1	1	1											x
Morus alba	White mulberry	1	1	1	1	O	O								x
Nyssa sylvatica	Blackgum	1		1											x
Paulownia tomentosa	Empress tree	1		1											x
Platanus occidentalis	Sycamore	1		1											x
Populus deltoides	Cottonwood	1	1	1	1				R						x
Populus grandidentata	Bigtooth aspen	1			1										x
Prunus serotina	Wild black cherry	1	1	1	1		O		R	O					x
Quercus rubra	Northern red oak	1		1											x
Robinia pseudoacacia	Black locust	1		1											x
Salix nigra	Black willow	1	1	1	1										x

Table 2.4-9 (Sheet 2 of 7)
Terrestrial Plants Observed Seasonally On-Site and within the Vicinity of the PSEG Site, 2009

			Season Observed			Qualitative Abundance in Area Surveyed[(a)]									
Botanical Name	**Common Name**	**Taxa**	**Spring**	**Summer**	**Fall**	**TS-03**	**TS-04**	**TS-05**	**TS-06**	**TS-07**	**TS-08**	**TS-17**	**TS-18**	**Causeway[(b)]**	**Existing Access Road[(c)]**
Trees/Saplings, cont.															
Salix sp.	Willow		1												x
Sassafras albidum	Sassafras	1	1	1	1										x
Shrubs															
Eleagnus umbellata	Autumn olive	1	1	1	1		O	U	O	C	C				x
Myrica cerifera	Wax myrtle	1	1												x
Rhus copallinum	Winged sumac	1	1	1	1			U			R				x
Rhus glabra	Smooth sumac	1	1	1	1	R	U								x
Rhus typhina	Staghorn sumac	1	1	1											x
Rosa multiflora	Multiflora rose	1	1	1	1		O	R	O	C	O				x
Rubus sp.	Blackberry	1		1						U					x
Sambucus canadensis	Common elderberry	1	1			O									
Symphoricarpos orbiculatus	Coralberry	1			1										x
Viburnum dentatum	Arrow-wood	1	1	1			R								x
Vines															
Campsis radicans	Trumpet creeper	1	1	1											x
Lonicera japonica	Japanese honeysuckle	1	1	1	1		C	C	O	C					x
Parthenocissus quinquefolia	Virginia creeper	1	1	1	1	U				O					x
Toxicodendron radicans	Poison ivy	1	1	1	1					C					x
Vicia villosa	Hairy vetch	1	1				U				O				
Vitis sp.	Wild grape	1	1	1											x

Table 2.4-9 (Sheet 3 of 7)
Terrestrial Plants Observed Seasonally On-Site and within the Vicinity of the PSEG Site, 2009

			Season Observed			Qualitative Abundance in Area Surveyed[(a)]									
Botanical Name	**Common Name**	**Taxa**	**Spring**	**Summer**	**Fall**	**TS-03**	**TS-04**	**TS-05**	**TS-06**	**TS-07**	**TS-08**	**TS-17**	**TS-18**	**Causeway[(b)]**	**Existing Access Road[(c)]**
Herbs															
Achillea millefolium	Common yarrow	1	1												x
Allium canadense	Onion	1		1							U				
Amaranthus cannabinus	Tidalmarsh amaranth	1			1									x	
Ambrosia artemisiifolia	Common ragweed	1	1	1	1	O	C	O		A	O				
Andropogon virginicus	Broomsedge	1	1	1	1		U	O	A	A	O	U	U		x
Apocynum cannabinum	Dogbane	1	1	1	1		O	O		O					x
Arenaria serpyllifolia	Thyme-leaf sandwort	1	1			U			C		O				
Artemisia vulgaris	Mugwort	1	1	1	1	A	A	A	A	C	A	A	O		x
Artemisia sp.				1								U			
Asclepias syriaca	Common milkweed	1	1	1	1			O	U	O	O	O			x
Aster sp.		1			1	U	U								
Capsella bursa-pastoris	Shepard's purse	1	1			O									
Carex sp.	Sedge		1						U						
Carex stricta	Upright sedge	1	1												x
Carex vulpinoidea	Fox sedge	1	1					U							
Cichorium intybus	Chickory	1		1	1										x
Cirsium vulgare	Bull thistle	1	1		1		U				R				x
Conyza canadensis	Horseweed	1		1	1		R					A	U		x
Cyperus strigosus	False nutsedge	1		1	1	U	U			U					
Daucus carota	Queen Anne's lace	1	1	1	1	O	C	C	C	C	C				x
Digitaria ischaemum	Smooth crabgrass	1			1					O	O	O	U		
Echinochloa crusgalli	Barnyard grass	1		1	1	U	U								

Table 2.4-9 (Sheet 4 of 7)
Terrestrial Plants Observed Seasonally On-Site and within the Vicinity of the PSEG Site, 2009

			Season Observed			Qualitative Abundance in Area Surveyed[(a)]									
Botanical Name	**Common Name**	**Taxa**	**Spring**	**Summer**	**Fall**	**TS-03**	**TS-04**	**TS-05**	**TS-06**	**TS-07**	**TS-08**	**TS-17**	**TS-18**	**Causeway[(b)]**	**Existing Access Road[(c)]**
Herbs, cont.															
Eleocharis palustris	Common spike rush	1	1	1						A					
Eleocharis ovata	Ovate spike rush	1			1					U					
Erigeron annuus	Annual fleabane	1	1	1	1		C	O		R	U				
Erigeron strigosus	Daisy fleabane	1		1				U							
Eupatorium serotinum	Late boneset	1	1	1	1	O	C	O	U	C	U	U			x
Festuca sp.	Fescue	1	1	1	1	O	O	A	A		C		O		x
Galium aparine	Cleavers	1	1			U		U							x
Geranium carolinianum	Carolina crane's-bill	1	1	1		O						C	O		
Glycine max	Soybean	1	1	1											x
Hordeum jubatum	Foxtail barley	1	1	1		U		R	U	R		A			
Humulus japonicus	Japanese hops	1			1	O									
Hypericum punctatum	Spotted St. John's wort	1	1						U		U				
Impatiens capensis	Orange touch-me-not	1	1												x
Juncus acuminatus	Rush	1		1				O		O					x
Juncus effusus	Soft rush	1	1	1	1			R		O					
Juncus tenuis	Path rush	1	1					O		U					
Juncus torreyi	Torrey's rush	1		1						O					
Lactuca serriola	Prickly lettuce	1		1		R									
Lactuca sp.					1						U				
Lamium amplexicaule	Henbit	1	1			R									x
Lepidium campestre	Field cress	1	1								U	U			
Lepidium sp.	Field cress		1			O									

Table 2.4-9 (Sheet 5 of 7)
Terrestrial Plants Observed Seasonally On-Site and within the Vicinity of the PSEG Site, 2009

			Season Observed			Qualitative Abundance in Area Surveyed[a]									
Botanical Name	**Common Name**	**Taxa**	**Spring**	**Summer**	**Fall**	**TS-03**	**TS-04**	**TS-05**	**TS-06**	**TS-07**	**TS-08**	**TS-17**	**TS-18**	**Causeway[b]**	**Existing Access Road[c]**
Herbs, cont.															
Lepidium virginicum	Poor-man's pepper	1	1	1		O			O			O			
Lespedeza cuneata	Chinese lespedeza	1	1	1	1					A	C				x
Lycopus americanus	American bugle weed	1	1	1						U					
Matricaria matricarioides	Pineapple weed	1	1	1		R									
Melilotus albus	White sweet clover	1		1	1	C	O	O		U					x
Melilotus officinalis	Yellow sweet clover	1	1	1	1	O	A	A	C	U	C				x
Mimulus alatus	Sharpwing monkeyflower	1			1					U					
Myosotis micrantha	Blue scorpion grass	1	1	1		U		O	C	C	C	C			x
Nuttallanthus texenis		1	1							R		C	R		
Oenothera biennis	Evening primrose	1	1		1					R	R	U			x
Onoclea sensibilis	Sensitive fern	1	1												x
Oxalis stricta	Common yellow wood-Sorrel	1	1	1	1	U			O	O	O				x
Panicum capillare	Witch-grass	1	1	1								R			x
Panicum clandestinum	Panic grass	1		1								R			
Panicum dichotomum	Cypress panicgrass	1			1	O	U					U			
Panicum sp.	Panic grass			1	1						O		A		
Panicum virgatum	Switchgrass	1			1										x
Phragmites australis	Common reed	1	1	1	1	A	A	A	A	A		A	A	x	x
Phytolacca americana	Pokeweed	1	1	1	1	O						U	U		x
Plantago lanceolata	English plantain	1	1	1	1			O	U						x
Plantago rugelii	American plantain	1		1	1	C	O								

Table 2.4-9 (Sheet 6 of 7)
Terrestrial Plants Observed Seasonally On-Site and within the Vicinity of the PSEG Site, 2009

			Season Observed			Qualitative Abundance in Area Surveyed[a]									
Botanical Name	Common Name	Taxa	Spring	Summer	Fall	TS-03	TS-04	TS-05	TS-06	TS-07	TS-08	TS-17	TS-18	Causeway[b]	Existing Access Road[c]
Herbs, cont.															
Plantago virginica	Plantain	1	1	1			U			A		C			
Poa compressa	Canada bluegrass	1	1	1	1			A		U	A				x
Polygonum hydropiper	Water pepper	1		1	1	U				U				x	x
Polygonum perfoliatum	Mile-a-minute vine	1	1	1	1	U	U	R				C	O	x	x
Polygonum persicaria	Spotted ladysthumb	1			1								U		
Polygonum sp.					1								U		
Ranunculus scleratus	Cursed crowfoot	1	1			U									
Ranunculus sp.	Buttercup	1	1			U									x
Rumex acetosella	Red sorrel	1	1	1						U		C			x
Rumex crispus	Curly dock	1	1	1	1	C		O	U	U					x
Sagittaria latifolia	Arrowhead	1		1	1									x	x
Scirpus americanus	Olney's-threesquare	1		1											x
Scirpus atrovirens	Black bulrush	1		1											x
Scirpus robustus	Sturdy bulrush	1			1									x	
Scleranthus annuus	Annual knawel	1	1									O			
Senecio vulgaris	Common groundsel	1	1	1			U								x
Setaria faberi	Giant foxtail grass	1		1	1	R	O								
Setaria viridus	Green foxtail grass	1			1		C	U		C	C				
Sibara virginica	Virginia rock cress	1	1			U		U							
Solanum carolinense	Carolina horsenettle	1			1						R				
Solidago altissima	Canada goldenrod	1		1	1		O	C		C	O				x
Solidago graminifolia	Lance-leaved goldenrod	1			1					U					

Table 2.4-9 (Sheet 7 of 7)
Terrestrial Plants Observed Seasonally On-Site and within the Vicinity of the PSEG Site, 2009

			Season Observed			Qualitative Abundance in Area Surveyed[(a)]									
Botanical Name	**Common Name**	**Taxa**	**Spring**	**Summer**	**Fall**	**TS-03**	**TS-04**	**TS-05**	**TS-06**	**TS-07**	**TS-08**	**TS-17**	**TS-18**	**Causeway[(b)]**	**Existing Access Road[(c)]**
Herbs, cont.															
Solidago sempervirens	Seaside goldenrod	1			1		U	O		O					x
Solidago sp.	Goldenrod		1	1			O	C	C	C	O				x
Spartina alterniflora	Smooth cordgrass	1		1	1									x	x
Spartina cynosuroides	Big cordgrass	1			1									x	
Spartina patens	Salt-meadow cordgrass	1	1												x
Spergula morisonii	Spurrey	1	1	1								O	O		
Taraxacum officinale	Common dandelion	1	1	1	1			U							x
Thlaspi arvense	Field penny-cress	1	1	1		O									
Tridens flavus	Purpletop	1		1	1			C			C				x
Trifolium arvense	Rabbit foot clover	1	1								U				
Trifolium repens	White clover	1	1	1							U				x
Typha latifolia	Cattail	1		1										x	
Verbascum thapsus	Common mullein	1	1	1	1		U			U	U				
Viola bicolor	Violet	1	1								U				
Xanthium strumarium	Common cocklebur	1		1	1	U						U			
Zea mays	Corn	1		1											x
Total Taxa		**134**	**92**	**91**	**72**										

a) Abundance Categories: A=abundant; C=common; O=occasional; U=uncommon; R=rare
b) Surveyed by boat at selected creek locations along proposed causeway - presence/absence only, abundance categories not assigned
c) Represents baseline conditions of roadside vegetation along existing access road - presence/absence only, abundance categories not assigned

Table 2.4-10
Land Use/Land Cover (LULC) (Acres) within Each Off-Site Transmission Macro-Corridor

	6-Mile Vicinity	6 to 50+ Mile Region	Total	Percent
South Corridor[a]				
Open Water	4468	21,686	26,154	8%
Developed - Open Space	282	6360	6642	2%
Developed - Low Intensity	199	5696	5895	2%
Developed - Medium Intensity	90	2684	2774	1%
Developed - High Intensity	192	1394	1586	1%
Barren Land	493	3110	3603	1%
Deciduous Forest	2243	39,052	41,295	13%
Evergreen Forest	58	4106	4165	1%
Mixed Forest	11	1807	1817	1%
Pasture Hay	3416	32,175	35,591	11%
Cultivated Crops	11,704	110,191	121,895	39%
Woody Wetlands	7742	18,707	26,448	8%
Emergent Herbaceous Wetlands	11,648	26,915	38,563	12%
Total	**42,545**	**273,884**	**316,429**	**100%**
West Corridor[b]				
Open Water	1976	18,744	20,721	11%
Developed - Open Space	98	7609	7706	4%
Developed - Low Intensity	97	8769	8867	5%
Developed - Medium Intensity	64	3726	3789	2%
Developed - High Intensity	191	1420	1610	1%
Barren Land	351	2570	2921	2%
Deciduous Forest	1086	33,969	35,055	18%
Evergreen Forest	13	1064	1077	1%
Mixed Forest	9	32	42	0%
Pasture Hay	934	45,122	46,055	24%
Cultivated Crops	4310	31,396	35,706	19%
Woody Wetlands	4276	11,534	15,810	8%
Emergent Herbaceous Wetlands	7675	4490	12,164	6%
Total	**21,077**	**170,446**	**191,523**	**100%**

a) Total length = 94 mi.
b) Total length = 55 mi.

Table 2.4-11
National Wetland Inventory (NWI) Wetlands within the 5-Mile Wide Macro-Corridor Study Area

	5-Mi. Wide Corridor		
South Corridor[(a)]	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**
Estuarine and Marine Deepwater	3858	8749	12,607
Estuarine and Marine Wetland	16,551	32,707	49,257
Freshwater Emergent Wetland	1522	3934	5457
Freshwater Forested/Shrub Wetland	1677	22,730	24,408
Freshwater Pond	284	1017	1301
Lake	1	766	767
Riverine	17	328	344
Other	63	208	271
Total	**23,973**	**70,440**	**94,413**
West Corridor[(b)]			
Estuarine and Marine Deepwater	2347	4333	6680
Estuarine and Marine Wetland	10,121	5241	15,362
Freshwater Emergent Wetland	1400	2788	4188
Freshwater Forested/Shrub Wetland	1164	6173	7337
Freshwater Pond	172	833	1005
Lake	1	335	336
Riverine	17	414	430
Other	63	114	177
Total	**15,285**	**20,231**	**35,516**

a) Total length = 94 mi.
b) Total length = 55 mi.

Table 2.4-12
Species Composition and Abundance of Fish Collections from Ponds on the PSEG Site, by Season, 2009[b]

Scientific Name	Common Name	February[a]		May			July			September		
Stations		AS-04	AS-09	AS-04	AS-09	AS-014	AS-04	AS-09	AS-14	AS-04	AS-09	AS-014
Anguilla rostrata	American eel							1			1	
Cyprinodon variegatus	Sheepshead minnow			19			78					41
Cyprinus carpio	Common carp								105	37		
Fundulus diaphanus	Banded killifish			50			8			6		
Fundulus heteroclitus	Mummichog			41		1			51	1		16
Gambusia affinis	Mosquitofish		1									
Lepomis gibbosus	Pumpkinseed		20	34	3		230	6	27			
Lepomis macrochirus	Bluegill				49			50				
Menidia beryllina	Inland silverside	4		8	1		2			54	3	73
Micropterus salmoides	Largemouth bass		1		1			10			71	
Morone americana	White perch				1						3	
Total Number of Individuals		4	22	152	55	1	318	67	183	98	78	130
Total Number of Species		1	3	5	5	1	4	4	3	4	4	3

a) Sampling location AS-14 was established after the February 2009 sampling event and therefore no data was obtained for the winter season. Winter sampling at AS-14 could not be performed in January 2010 due to ice cover.

b) Information in this table collected as part of ESPA sampling program.

Table 2.4-13
Taxonomic Composition and Abundance in Macroinvertebrate Surveys Collected by Ponar Dredge in Ponds on the PSEG Site, 2009[(a)]

	Spring			Fall		
Scientific Name	**AS-04**	**AS-09**	**AS-14**	**AS-04**	**AS-09**	**AS-14**
PHYLUM NEMATODA						
Unidentified *Nematoda*		1				
PHYLUM ANNELIDA						
Class Oligochaeta						
Limnodrilus sp.	51	137	48			
Pristina sp.		1				
Unidentified *Naididae*		1				
Unidentified *Oligochaeta*					1	
Unidentified *Tubificidae*	11	185		2		
PHYLUM ARTHROPODA						
Subphylum Crustacea						
Order Amphipoda						
Gammarus daiberi	1	1				
Order Isopoda						
Cyathura polita				1		
Subphylum Mandibulata						
Class Insecta						
Order Diptera						
Ceratopogonidae	5					
Chironomus sp.	117	6	31			
Glyptotendipes sp.	1		1			
Micropsectra sp.	2					
Polypedilum sp.	1					
Tanypus sp.	3	2	4			
Tanytarsus sp.	1					
Unidentified *Chironomidae*	2					
Total Number of Individuals	195	334	84	3	1	0
Total Number of Taxa	11	8	4	2	1	0

a) Information in this table collected as part of ESPA sampling program.

Table 2.4-14
Species Composition and Abundance of Fish Collections from Small Marsh Creeks on or near the PSEG Site, by Season, 2009[(a)]

Scientific Name	Common Name	February			May			July			September		
		AS-05	AS-06	AS-10	AS-05	AS-06	AS-10	AS-05	AS-06	AS-10	AS-05	AS-06	AS-10
Anguilla rostrata	American eel	1											
Brevoortia tyrannus	Atlantic menhaden					31			13				
Notemigonus crysoleucas	Golden shiner										1		
Ameiurus nebulosus	Brown bullhead										2		
Cyprinodon variegatus	Sheepshead minnow									10			
Fundulus heteroclitus	Mummichog	51	56	37	49	40	16	21	16	282	11	9	56
Morone americana	White perch							4	3		1		
Morone saxatilis	Striped bass				1	2		1			1		
Gobiesoma bosc	Naked goby	1											
Total number of individuals		53	56	37	50	73	16	26	32	292	16	9	56
Total number of species		3	1	1	2	3	1	3	3	2	5	1	1

a) Information in this table collected as part of ESPA sampling program.

Table 2.4-15 (Sheet 1 of 2)
Taxonomic Composition and Abundance in Macroinvertebrate Surveys Collected by Ponar Dredge in Marsh Creeks on or near the PSEG Site, 2009[(a)]

Scientific Name	Spring 2009							Fall 2009						
	Large Marsh Creeks				Small Marsh Creeks			Large Marsh Creeks				Small Marsh Creeks		
	AS-01	AS-02	AS-03	AS-11	AS-05	AS-06	AS-10	AS-01	AS-02	AS-03	AS-11	AS-05	AS-06	AS-10
PHYLUM NEMERTEA														
Unidentified *Nemertea*								1						
PHYLUM ANNELIDA														
Unidentified *Annelida*								1						
Class Oligochaeta														
Limnodrilus sp.					15	52	19						1	
Unidentified *Naididae*				1										
Unidentified *Tubificidae*					29	68	11							
Unidentified *Oligochaeta*			1	1	3									
Class Polychaeta														
Ampharetidae					4	6						1		
Marenzellaria viridis								1			1			
Nereis (=Neanthes) succinea		1	21							1				
Nereis virens						8								
Unidentified *Polychaeta*	1	2	1	4	4									
PHYLUM MOLLUSCA														
Class Pelecypoda														
Mya arenaria											1			
Rangea cuneata			1											
Unidentified *Pelecypoda*				2										
PHYLUM ARTHROPODA														
Subphylum Crustacea														
Order Amphipoda														
Corophium sp.		705	163	1	1									
Gammarus sp.						68	1							
Gammarus daiberi		33	37		11	75								
Leptocheirus plumulosis				12	8	116								
Photis sp.	4													
Unidentified *Amphipoda*	4	2	3	1	2	7								

Table 2.4-15 (Sheet 2 of 2)
Taxonomic Composition and Abundance in Macroinvertebrate Surveys Collected by Ponar Dredge in Marsh Creeks on or near the PSEG Site, 2009[a]

Scientific Name	Spring 2009							Fall 2009						
	Large Marsh Creeks				Small Marsh Creeks			Large Marsh Creeks				Small Marsh Creeks		
	AS-01	AS-02	AS-03	AS-11	AS-05	AS-06	AS-10	AS-01	AS-02	AS-03	AS-11	AS-05	AS-06	AS-10
Order Decapoda														
Callinectes sapidus									1					
Hemigrapsus sanguineus		1												
Order Isopoda														
Chiridotea almyra				3										
Cyathura polita		9		1	2									
Edotea triloba			1											
Order Mysidacea														
Neomysis sp.	3													
Neomysis americana		3												
Subphylum Mandibulata														
Class Insecta														
Order Diptera														
Chironomus sp.					5	1	13							1
Serromyia sp.							4							
Total Number of Individuals	12	756	228	26	84	401	48	3	1	1	2	1	1	1
Total Number of Taxa	4	8	8	9	11	9	5	3	1	1	2	1	1	1

a) Information in this table collected as part of ESPA sampling program.

Table 2.4-16 (Sheet 1 of 10)
Species Composition and Abundance in Fish Surveys of Small (Sampled by Weir) and Large (Sampled by Trawling) Segments of Marsh Creek Systems in the Vicinity of the PSEG Site, 2003 – 2007

		2003					
		Mad Horse Creek		Alloway Creek		Mill Creek	
Scientific Name	**Common Name**	**Large**	**Small**	**Large**	**Small**	**Large**	**Small**
Anguilla rostrata	American eel	1	2	51	5	11	3
Alosa aestivalis	Blueback herring	3	-	14	-	-	-
Alosa mediocris	Hickory shad	-	-	-	-	2	-
Alosa pseudahorengus	Alewife	7	-	63	-	7	2
Alosa sapidissima	American shad	-	-	1	-	-	-
Brevoortia tyrannus	Atlantic menhaden	20	3	78	-	12	2
Clupea harengus	Atlantic herring	3	-	-	-	-	-
Clupea spp.	Unidentified herrings	-	-	-	-	-	-
Clupeidae	Unidentified herrings	-	-	-	-	-	-
Dorosoma cepedianum	Gizzard shad	-	-	-	-	15	-
Anchoa hepsetus	Broad-striped anchovy	-	-	-	-	-	-
Anchoa mitchilli	Bay anchovy	317	10	579	8	480	1471
Carassius auratus	Goldfish	-	-	15	-	-	-
Cyprinus carpio	Common carp	-	-	-	-	1	1
Hybognathus regius	Eastern silvery minnow	-	-	4	1	12	1
Notemigonus crysoleucas	Golden shiner	-	-	-	-	-	-
Notropis hudsonius	Spottail shiner	-	-	1	-	-	-
Catostomus commersoni	White sucker	-	-	-	-	-	-
Ameiurus catus	White catfish	1	-	14	-	2	-
Ameiurus nebulosus	Brown bullhead	-	-	190	-	29	9
Ictaluras punctatus	Channel catfish	1	-	186	-	3	-
Opsanus tau	Oyster toadfish	-	-	-	-	-	-
Fundulus heteroclitus	Mummichog	76	177	1	1849	-	822
Fundulus majalis	Striped killifish	-	-	-	-	-	1
Lucania parva	Rainwater killifish	-	-	-	-	-	-
Menidia menidia	Atlantic silverside	701	48	-	19	1	15
Syngnathus fuscus	Northern pipefish	2	-	1	-	-	-
Morone americana	White perch	109	5	5329	59	686	15
Morone saxatillis	Striped bass	65	3	1122	4	18	1
Morone sp.	Unidentified percithyids	-	-	1	-	13	-
Lepomis cyanellus	Green sunfish	-	-	-	-	-	-
Lepomis gibbosus	Pumpkinseed	-	-	-	-	-	-
Lepomis macrochirus	Bluegill	-	-	1	-	-	-
Micropterus salmoides	Largemouth bass	-	-	-	-	-	-
Pomoxis nigromaculatus	Black crappie	-	-	-	-	-	-
Etheostoma olmstedi	Tessellated darter	-	-	-	-	-	-
Perca flavescens	Yellow perch	-	-	3	-	-	-
Pomatomus saltatrix	Bluefish	2	-	5	-	1	-
Stentotomus chrysops	Scup	-	-	1	-	-	-

Table 2.4-16 (Sheet 2 of 10)
Species Composition and Abundance in Fish Surveys of Small (Sampled by Weir) and Large (Sampled by Trawling) Segments of Marsh Creek Systems in the Vicinity of the PSEG Site, 2003 – 2007

		2003					
		Mad Horse Creek		Alloway Creek		Mill Creek	
Scientific Name	**Common Name**	**Large**	**Small**	**Large**	**Small**	**Large**	**Small**
Bairdiella chrysoura	Silver perch	-	-	5	1	-	-
Cynoscion regalis	Weakfish	13	-	24	-	40	1
Leiostomus xanthurus	Spot	1	-	3	-	-	-
Menticirrhus saxatilis	Northern kingfish	-	-	-	-	-	-
Micropogonias undulatus	Atlantic croaker	20	-	87	-	7	-
Pogonias cromis	Black drum	78	-	9	-	2	-
Sciaenidae	Unidentified drums	-	-	-	-	-	-
Mugil curema	White mullet	-	-	-	-	-	-
Gobiosoma bosc	Naked goby	2	92	14	5	-	5
Etropus microstomus	Smallmouth flouder	-	-	-	-	-	-
Paralichthys dentatus	Summer flounder	3	1	2	-	-	-
Scopthalmus aquosus	Windowpane flounder	-	-	-	-	-	-
Trinectes maculatus	Hogchoker	49	-	497	-	55	-
Symphurus plagiusa	Blackcheek tonguefish	-	-	-	-	-	-
Number of individuals		4169	502	1055	3668	1062	87
Number of species		26	11	21	17	23	7
Callinectes sapidus	Blue crab	280	76	49	10	15	2

Table 2.4-16 (Sheet 3 of 10)
Species Composition and Abundance in Fish Surveys of Small (Sampled by Weir) and Large (Sampled by Trawling) Segments of Marsh Creek Systems in the Vicinity of the PSEG Site, 2003 – 2007

		2004					
		Mad Horse Creek		Alloway Creek		Mill Creek	
Scientific Name	Common Name	Large	Small	Large	Small	Large	Small
Anguilla rostrata	American eel	6	6	47	2	11	12
Alosa aestivalis	Blueback herring	4	-	11	-	-	-
Alosa mediocris	Hickory shad	2	-	17	2	-	-
Alosa pseudahorengus	Alewife	8	-	61	63	7	-
Alosa sapidissima	American shad	-	-	30	-	1	-
Brevoortia tyrannus	Atlantic menhaden	516	-	147	33	44	1
Clupea harengus	Atlantic herring	-	-	-	-	-	-
Clupea spp.	Unidentified herrings	-	-	-	-	-	-
Clupeidae	Unidentified herrings	-	-	-	-	-	-
Dorosoma cepedianum	Gizzard shad	-	-	-	-	13	-
Anchoa hepsetus	Broad-striped anchovy	-	-	-	-	-	-
Anchoa mitchilli	Bay anchovy	553	79	370	11	722	303
Carassius auratus	Goldfish	-	-	-	-	-	-
Cyprinus carpio	Common carp	-	-	9	-	1	5
Hybognathus regius	Eastern silvery minnow	-	-	-	-	3	7
Notemigonus crysoleucas	Golden shiner	-	-	-	-	-	1
Notropis hudsonius	Spottail shiner	-	-	-	-	-	-
Catostomus commersoni	White sucker	-	-	-	-	-	-
Ameiurus catus	White catfish	-	-	126	-	2	6
Ameiurus nebulosus	Brown bullhead	4	-	73	5	44	31
Ictaluras punctatus	Channel catfish	-	-	216	1	1	-
Opsanus tau	Oyster toadfish	-	-	-	-	-	-
Fundulus heteroclitus	Mummichog	11	197	2	708	5	4540
Fundulus majalis	Striped killifish	-	-	-	-	-	-
Lucania parva	Rainwater killifish	-	-	-	-	-	-
Menidia menidia	Atlantic silverside	78	67	-	8	3	31
Syngnathus fuscus	Northern pipefish	1	-	3	-	-	-
Morone americana	White perch	197	2	4176	37	811	62
Morone saxatillis	Striped bass	51	-	314	2	11	-
Morone sp.	Unidentified percithyids	-	-	10	-	2	-
Lepomis cyanellus	Green sunfish	-	-	-	-	-	-
Lepomis gibbosus	Pumpkinseed	-	-	1	-	-	-
Lepomis macrochirus	Bluegill	-	-	-	1	-	-
Micropterus salmoides	Largemouth bass	-	-	1	-	-	-
Pomoxis nigromaculatus	Black crappie	-	-	-	-	-	-
Etheostoma olmstedi	Tessellated darter	-	-	-	-	-	-
Perca flavescens	Yellow perch	-	-	6	-	-	-
Pomatomus saltatrix	Bluefish	1	-	5	-	2	-
Stentotomus chrysops	Scup	-	-	-	-	-	-

Table 2.4-16 (Sheet 4 of 10)
Species Composition and Abundance in Fish Surveys of Small (Sampled by Weir) and Large (Sampled by Trawling) Segments of Marsh Creek Systems in the Vicinity of the PSEG Site, 2003 – 2007

		2004					
		Mad Horse Creek		Alloway Creek		Mill Creek	
Scientific Name	**Common Name**	**Large**	**Small**	**Large**	**Small**	**Large**	**Small**
Bairdiella chrysoura	Silver perch	4	-	3	-	-	-
Cynoscion regalis	Weakfish	23	-	126	-	19	2
Leiostomus xanthurus	Spot	1	-	6	-	-	-
Menticirrhus saxatilis	Northern kingfish	-	-	-	-	-	-
Micropogonias undulatus	Atlantic croaker	8	-	325	-	122	-
Pogonias cromis	Black drum	14	-	3	-	5	1
Sciaenidae	Unidentified drums	1	-	2	-	-	-
Mugil curema	White mullet	-	-	2	-	-	-
Gobiosoma bosc	Naked goby	3	14	10	4	-	-
Etropus microstomus	Smallmouth flouder	-	-	-	-	-	-
Paralichthys dentatus	Summer flounder	3	-	3	-	-	-
Scopthalmus aquosus	Windowpane flounder	-	-	-	-	-	-
Trinectes maculatus	Hogchoker	20	-	478	-	21	-
Symphurus plagiusa	Blackcheek tonguefish	-	-	-	-	-	-
Number of individuals		1509	365	6583	877	1850	5002
Number of species		21	6	28	13	20	13
Callinectes sapidus	Blue crab	231	82	71	11	30	7

Table 2.4-16 (Sheet 5 of 10)
Species Composition and Abundance in Fish Surveys of Small (Sampled by Weir) and Large (Sampled by Trawling) Segments of Marsh Creek Systems in the Vicinity of the PSEG Site, 2003 – 2007

		2005					
		Mad Horse Creek		Alloway Creek		Mill Creek	
Scientific Name	Common Name	Large	Small	Large	Small	Large	Small
Anguilla rostrata	American eel	5	3	25	2	10	-
Alosa aestivalis	Blueback herring	4	-	7	-	1	239
Alosa mediocris	Hickory shad	1	-	16	-	-	1
Alosa pseudahorengus	Alewife	5	2	70	-	3	252
Alosa sapidissima	American shad	-	-	2	-	1	-
Brevoortia tyrannus	Atlantic menhaden	958	4	75	-	185	108
Clupea harengus	Atlantic herring	-	-	-	-	-	-
Clupea spp.	Unidentified herrings	-	-	-	-	-	-
Clupeidae	Unidentified herrings	-	-	6	-	-	6
Dorosoma cepedianum	Gizzard shad	-	-	6	2	11	4
Anchoa hepsetus	Broad-striped anchovy	-	-	-	-	2	-
Anchoa mitchilli	Bay anchovy	278	9	134	6	289	19
Carassius auratus	Goldfish	-	-	-	-	-	-
Cyprinus carpio	Common carp	-	-	6	3	1	-
Hybognathus regius	Eastern silvery minnow	-	-	-	-	-	3
Notemigonus crysoleucas	Golden shiner	-	-	-	-	-	-
Notropis hudsonius	Spottail shiner	-	-	-	-	-	-
Catostomus commersoni	White sucker	-	-	-	-	-	1
Ameiurus catus	White catfish	-	-	7	-	-	-
Ameiurus nebulosus	Brown bullhead	-	-	39	7	7	12
Ictaluras punctatus	Channel catfish	-	-	32	-	2	-
Opsanus tau	Oyster toadfish	-	-	-	-	-	-
Fundulus heteroclitus	Mummichog	5	49	-	445	1	2785
Fundulus majalis	Striped killifish	-	-	-	-	-	-
Lucania parva	Rainwater killifish	-	1	-	-	-	-
Menidia menidia	Atlantic silverside	50	84	-	22	-	115
Syngnathus fuscus	Northern pipefish	-	-	1	-	-	-
Morone americana	White perch	126	8	133	-	230	57
Morone saxatillis	Striped bass	12	1	-	-	3	1
Morone sp.	Unidentified percithyids	-	-	11	-	1	1
Lepomis cyanellus	Green sunfish	-	-	-	-	-	-
Lepomis gibbosus	Pumpkinseed	-	1	-	-	-	-
Lepomis macrochirus	Bluegill	-	-	-	1	-	-
Micropterus salmoides	Largemouth bass	-	-	-	-	-	-
Pomoxis nigromaculatus	Black crappie	-	-	-	-	-	-
Etheostoma olmstedi	Tessellated darter	-	-	1	-	-	-
Perca flavescens	Yellow perch	-	-	4	-	-	-
Pomatomus saltatrix	Bluefish	7	-	7	-	5	-
Stentotomus chrysops	Scup	-	-	-	-	-	-

Table 2.4-16 (Sheet 6 of 10)
Species Composition and Abundance in Fish Surveys of Small (Sampled by Weir) and Large (Sampled by Trawling) Segments of Marsh Creek Systems in the Vicinity of the PSEG Site, 2003 – 2007

		2005					
		Mad Horse Creek		Alloway Creek		Mill Creek	
Scientific Name	**Common Name**	**Large**	**Small**	**Large**	**Small**	**Large**	**Small**
Bairdiella chrysoura	Silver perch	18	-	20	-	1	-
Cynoscion regalis	Weakfish	14	-	358	-	6	11
Leiostomus xanthurus	Spot	86	13	622	5	252	47
Menticirrhus saxatilis	Northern kingfish	-	-	-	-	-	-
Micropogonias undulatus	Atlantic croaker	26	-	330	7	28	-
Pogonias cromis	Black drum	30	-	44	-	13	3
Sciaenidae	Unidentified drums	1	-	-	-	-	-
Mugil curema	White mullet	-	-	-	-	-	-
Gobiosoma bosc	Naked goby	-	1	5	2	-	3
Etropus microstomus	Smallmouth flouder	-	-	-	-	-	-
Paralichthys dentatus	Summer flounder	-	-	1	-	-	-
Scopthalmus aquosus	Windowpane flounder	-	-	-	-	-	-
Trinectes maculatus	Hogchoker	8	-	127	-	3	-
Symphurus plagiusa	Blackcheek tonguefish	-	-	-	-	-	-
Number of individuals		1634	176	4169	502	1055	3668
Number of species		17	12	26	11	21	17
Callinectes sapidus	Blue crab	375	176	115	45	29	46

Table 2.4-16 (Sheet 7 of 10)
Species Composition and Abundance in Fish Surveys of Small (Sampled by Weir) and Large (Sampled by Trawling) Segments of Marsh Creek Systems in the Vicinity of the PSEG Site, 2003 – 2007

		2006					
		Mad Horse Creek		Alloway Creek		Mill Creek	
Scientific Name	Common Name	Large	Small	Large	Small	Large	Small
Anguilla rostrata	American eel	6	1	NS	1	9	1
Alosa aestivalis	Blueback herring	-	-	NS	-	-	-
Alosa mediocris	Hickory shad	-	-	NS	-	-	-
Alosa pseudahorengus	Alewife	-	-	NS	-	-	-
Alosa sapidissima	American shad	2	-	NS	-	-	-
Brevoortia tyrannus	Atlantic menhaden	9	11	NS	2	52	32
Clupea harengus	Atlantic herring	-	-	NS	-	-	-
Clupea spp.	Unidentified herrings	-	-	NS	-	-	-
Clupeidae	Unidentified herrings	-	-	NS	-	-	-
Dorosoma cepedianum	Gizzard shad	3	-	NS	1	36	31
Anchoa hepsetus	Broad-striped anchovy	-	-	NS	-	-	-
Anchoa mitchilli	Bay anchovy	254	12	NS	1	702	77
Carassius auratus	Goldfish	-	-	NS	-	-	-
Cyprinus carpio	Common carp	-	-	NS	-	7	1
Hybognathus regius	Eastern silvery minnow	-	-	NS	-	1	-
Notemigonus crysoleucas	Golden shiner	-	-	NS	-	-	-
Notropis hudsonius	Spottail shiner	-	-	NS	-	-	-
Catostomus commersoni	White sucker	-	-	NS	-	-	-
Ameiurus catus	White catfish	1	-	NS	-	-	-
Ameiurus nebulosus	Brown bullhead	1	-	NS	4	119	74
Ictaluras punctatus	Channel catfish	3	-	NS	-	4	1
Opsanus tau	Oyster toadfish	1	-	NS	-	-	-
Fundulus heteroclitus	Mummichog	19	50	NS	1178	3	1565
Fundulus majalis	Striped killifish	-	-	NS	-	-	-
Lucania parva	Rainwater killifish	-	-	NS	-	-	-
Menidia menidia	Atlantic silverside	3	2	NS	7	-	58
Syngnathus fuscus	Northern pipefish	-	-	NS	-	-	-
Morone americana	White perch	485	9	NS	10	1305	67
Morone saxatillis	Striped bass	16	-	NS	-	9	1
Morone sp.	Unidentified percithyids	-	-	NS	-	-	-
Lepomis cyanellus	Green sunfish	-	-	NS	-	1	-
Lepomis gibbosus	Pumpkinseed	-	-	NS	-	-	-
Lepomis macrochirus	Bluegill	-	-	NS	-	-	-
Micropterus salmoides	Largemouth bass	-	-	NS	-	-	-
Pomoxis nigromaculatus	Black crappie	-	-	NS	-	1	-
Etheostoma olmstedi	Tessellated darter	-	-	NS	-	-	-
Perca flavescens	Yellow perch	-	-	NS	-	-	-
Pomatomus saltatrix	Bluefish	-	-	NS	-	3	1
Stentotomus chrysops	Scup	-	-	NS	-	-	-

Table 2.4-16 (Sheet 8 of 10)
Species Composition and Abundance in Fish Surveys of Small (Sampled by Weir) and Large (Sampled by Trawling) Segments of Marsh Creek Systems in the Vicinity of the PSEG Site, 2003 – 2007

		2006					
		Mad Horse Creek		Alloway Creek		Mill Creek	
Scientific Name	Common Name	Large	Small	Large	Small	Large	Small
Bairdiella chrysoura	Silver perch	10	-	NS	-	1	-
Cynoscion regalis	Weakfish	9	-	NS	-	6	-
Leiostomus xanthurus	Spot	4	-	NS	-	88	-
Menticirrhus saxatilis	Northern kingfish	1	-	NS	-	-	-
Micropogonias undulatus	Atlantic croaker	190	-	NS	2	656	5
Pogonias cromis	Black drum	-	-	NS	-	-	-
Sciaenidae	Unidentified drums	-	-	NS	-	-	-
Mugil curema	White mullet	-	-	NS	-	-	-
Gobiosoma bosc	Naked goby	2	2	NS	1	-	1
Etropus microstomus	Smallmouth flouder	-	-	NS	-	-	-
Paralichthys dentatus	Summer flounder	1	-	NS	-	-	-
Scopthalmus aquosus	Windowpane flounder	1	-	NS	-	-	-
Trinectes maculatus	Hogchoker	40	-	NS	-	3	-
Symphurus plagiusa	Blackcheek tonguefish	1	-	NS	-	-	-
Number of individuals		1062	87	NS	1207	3006	1915
Number of species		23	7	NS	10	19	14
Callinectes sapidus	Blue crab	572	275	NS	122	90	137

Table 2.4-16 (Sheet 9 of 10)
Species Composition and Abundance in Fish Surveys of Small (Sampled by Weir) and Large (Sampled by Trawling) Segments of Marsh Creek Systems in the Vicinity of the PSEG Site, 2003 – 2007

		2007					
		Mad Horse Creek		Alloway Creek		Mill Creek	
Scientific Name	Common Name	Large	Small	Large	Small	Large	Small
Anguilla rostrata	American eel	16	7	NS	1	10	3
Alosa aestivalis	Blueback herring	-	-	NS	-	11	-
Alosa mediocris	Hickory shad	-	-	NS	-	1	-
Alosa pseudahorengus	Alewife	1	-	NS	-	9	-
Alosa sapidissima	American shad	10	-	NS	-	15	-
Brevoortia tyrannus	Atlantic menhaden	65	15	NS	-	84	72
Clupea harengus	Atlantic herring	-	-	NS	-	-	-
Clupea spp.	Unidentified herrings	-	-	NS	-	1	-
Clupeidae	Unidentified herrings	-	-	NS	-	-	-
Dorosoma cepedianum	Gizzard shad	-	-	NS	-	141	46
Anchoa hepsetus	Broad-striped anchovy	-	-	NS	-	-	-
Anchoa mitchilli	Bay anchovy	305	10	NS	-	568	82
Carassius auratus	Goldfish	-	-	NS	-	-	1
Cyprinus carpio	Common carp	-	-	NS	-	5	4
Hybognathus regius	Eastern silvery minnow	-	-	NS	-	1	3
Notemigonus crysoleucas	Golden shiner	-	-	NS	-	-	-
Notropis hudsonius	Spottail shiner	-	-	NS	-	-	-
Catostomus commersoni	White sucker	-	-	NS	-	-	-
Ameiurus catus	White catfish	4	-	NS	-	-	-
Ameiurus nebulosus	Brown bullhead	2	-	NS	3	49	23
Ictaluras punctatus	Channel catfish	4	-	NS	-	2	-
Opsanus tau	Oyster toadfish	-	-	NS	-	-	-
Fundulus heteroclitus	Mummichog	-	20	NS	582	-	2693
Fundulus majalis	Striped killifish	-	-	NS	-	-	-
Lucania parva	Rainwater killifish	-	-	NS	-	-	-
Menidia menidia	Atlantic silverside	75	15	NS	8	4	106
Syngnathus fuscus	Northern pipefish	-	-	NS	-	1	-
Morone americana	White perch	210	3	NS	5	1040	19
Morone saxatillis	Striped bass	60	-	NS	-	40	-
Morone sp.	Unidentified percithyids	33	-	NS	-	4	-
Lepomis cyanellus	Green sunfish	-	-	NS	-	-	-
Lepomis gibbosus	Pumpkinseed	-	-	NS	-	-	-
Lepomis macrochirus	Bluegill	-	-	NS	-	-	-
Micropterus salmoides	Largemouth bass	-	-	NS	-	-	-
Pomoxis nigromaculatus	Black crappie	-	-	NS	-	-	-
Etheostoma olmstedi	Tessellated darter	-	-	NS	-	-	-
Perca flavescens	Yellow perch		-	NS	-	-	-
Pomatomus saltatrix	Bluefish	-	-	NS	-	2	1
Stentotomus chrysops	Scup	-	-	NS	-	-	-

**Table 2.4-16 (Sheet 10 of 10)
Species Composition and Abundance in Fish Surveys of Small (Sampled by Weir) and Large (Sampled by Trawling) Segments of Marsh Creek Systems in the Vicinity of the PSEG Site, 2003 – 2007**

		2007					
		Mad Horse Creek		Alloway Creek		Mill Creek	
Scientific Name	Common Name	Large	Small	Large	Small	Large	Small
Bairdiella chrysoura	Silver perch	2	-	NS	-	-	-
Cynoscion regalis	Weakfish	22	-	NS	-	31	-
Leiostomus xanthurus	Spot	30	-	NS	-	53	6
Menticirrhus saxatilis	Northern kingfish	-	-	NS	-	-	-
Micropogonias undulatus	Atlantic croaker	50	-	NS	-	113	-
Pogonias cromis	Black drum	82	-	NS	-	46	2
Sciaenidae	Unidentified drums	1	-	NS	-	-	-
Mugil curema	White mullet	-	-	NS	-	-	-
Gobiosoma bosc	Naked goby	10	2	NS	5	1	5
Etropus microstomus	Smallmouth flouder	6	-	NS	-	-	-
Paralichthys dentatus	Summer flounder	2	-	NS	-	-	-
Scopthalmus aquosus	Windowpane flounder	-	-	NS	-	-	-
Trinectes maculatus	Hogchoker	59	-	NS	-	11	-
Symphurus plagiusa	Blackcheek tonguefish	-	-	NS	-	-	-
Number of individuals		1049	72	NS	604	2243	3066
Number of species		20	7	NS	6	23	15
Callinectes sapidus	Blue crab	578	193	NS	65	129	112

References 2.4-159 through 2.4-163

NS – Not Sampled

Table 2.4-17 (Sheet 1 of 3)
Species Composition and Density (#/10^6 m^3) in Impingement Samples at SGS, 2003 – 2007

		Study Year					5-Year
Scientific Name	**Common Name**	**2003**	**2004**	**2005**	**2006**	**2007**	**Mean**
Petromyzon marinus	Sea lamprey	0.74	0.14	0.28	0.21	0.57	0.4
Acipenser oxyrhynchus	Atlantic sturgeon				0.05	0.05	0.1
Anguila rostrata	American eel	2.79	4.12	4.2	4.39	5.75	4.3
Conger oceanicus	Conger eel		0.07	0.28		0.05	0.1
Alosa aestivalis	Blueback herring	23.27	156.55	19.75	25.37	17.76	48.5
Alosa pseudoharengus	Alewife	4.84	25.99	8.19	2.41	7.66	9.8
Alosa sapidissima	American shad	6.43	43.24	10.11	4.01	16.98	16.2
Brevoortia tyrannus	Atlantic menhaden	6.26	4.82	22.22	44.00	27.49	21.0
Clupea harengus	Atlantic herring				0.21		0.2
Dorosoma cepedianum	Gizzard shad	21.05	26.61	53.11	22.43	87.22	42.1
Anchoa hepsetus	Striped anchovy	0.11	0.07		0.11	0.36	0.2
Anchoa mitchilli	Bay anchovy	89.5	93.89	49.33	202.44	132.62	113.6
Umbra pygmnea	Eastern mudminnow		0.07		0.05	0.05	0.1
Cyprinus carpio	Common carp	0.17	0.17	0.07		0.05	0.1
Hybognathus regis	Silvery minnow	16.67	16.67	5.37	4.66	2.85	9.2
Notemingonus crysoleucas	Golden shiner		0.21			0.05	0.1
Ameiurus catus	White catfish	0.06			0.21	0.1	0.1
Ameiurus nebulosis	Brown bullhead	1.71	2.31	0.28	0.11	0.31	0.9
Ictalurus punctatus	Channel catfish	4.84	14.74	2.55	1.28	32.77	11.2
Synodus foetens	Inshore lizardfish		0.07			0.1	0.1
Opsanus tau	Oyster toadfish	0.28	0.28	1.31	2.89	2.33	1.4
Lophius americanus	Goosefish	0.06					0.1
Urophycis chuss	Red hake				10.81		10.8
Urophycis regia	Spotted hake	59.17	159.97	24.15	267.32	11.75	104.5
Merluccius bilinearis	Silver hake	0.11	0.07		0.16		0.1
Ophidion marginatum	Striped cusk-eel	12.8	5.45	31.92	3.16	12.63	13.2
Strongylura marina	Atlantic needlefish	0.51	0.28	0.21	0.11	0.1	0.2
Cyprinodon variegatus	Sheepshead minnow		0.14	0.07			0.1
Fundulus heteroclitus	Mummichog	1.59	1.82	0.62	0.48	1.81	1.3
Fundulus majalis	Striped killifish	1.19	1.26	0.83	3.32	0.16	1.4
Membras martinica	Rough silverside		0.7	0.34		0.21	0.4
Menidia beryllina	Inland silverside		0.14	0.48			0.3
Menidia menidia	Atlantic silverside	35.67	25.71	24.08	46.89	44.52	35.4

Table 2.4-17 (Sheet 2 of 3)
Species Composition and Density (#/10^6 m^3) in Impingement Samples at SGS, 2003 – 2007

Scientific Name	Common Name	Study Year 2003	2004	2005	2006	2007	5-Year Mean
Gasterosteus aculeatus	Threespine stickleback	0.17	4.89	0.55	0.11	0.05	1.2
Hippocampus erectus	Lined seahorse		0.07	0.14	0.05		0.1
Syngnathus fuscus	Northern pipefish	3.47	2.03	1.93	2.46	4.5	2.9
Prionotus carolinus	Northern sea robin	0.63	0.77	2.68	23.82	5.9	6.8
Prionotus evolans	Striped sea robin	0.46	0.21	0.07			0.2
Morone americana	White perch	1771.18	2113.19	1042.62	360.51	429.81	1143.5
Morone saxatilus	Striped bass	159.93	110.86	29.72	10.22	47.88	71.7
Centropristis striata	Black sea bass	0.06			0.54	0.31	0.3
Lepomis cyanellus	Green sunfish			0.07			0.1
Lepomis gibbosus	Pumpkinseed	0.06	0.07		0.16	0.1	0.1
Lepomis macrochirus	Bluegill	1.59	3.28	2.48	3.91	1.5	2.6
Lepomis microlophus	Redeared sunfish	0.06	0.07				0.1
Micropterus salmoides	Largemouth bass				0.05		0.1
Pomoxis annularis	White crappie				0.05		0.1
Pomoxis nigromaculatus	Black crappie	0.06		0.14			0.1
Perca flavescens	Yellow perch	1.59	2.58	1.93	1.12	6.21	2.7
Pomatomus saltatrix	Bluefish	8.14	11.67	2.06	7.44	2.95	6.5
Caranx hippos	Crevalle jack	0.06	0.14	0.14	0.11		0.1
Selene vomer	Lookdown	0.06			0.16	0.05	0.1
Trachinotus carolinus	Florida pompano					0.05	0.1
Trachinotus falcatus	Permit	0.06					0.1
Archosargus probatocephalus	Sheepshead				0.11	0.05	0.1
Stenotomus chrysops	Scup		3.91			0.1	2.0
Bairdiella chrysoura	Silver perch	0.11	9.15	7.22	12.26	4.71	6.7
Cynoscion regalis	Weakfish	530.71	725.72	930.88	343.81	379.65	582.2
Leiostomus xanthurus	Spot	0.8	0.14	55.11	10.38	3.73	14.0
Menticirrhus saxatilis	Northern kingfish		16.28	7.36	3.69	18.95	11.6
Micropogonias undulatus	Atlantic croaker	101.22	626.74	845.57	1405.31	951.09	786.0
Pogonias cromis	Black drum	0.85	0.07	8.26	0.21	5.85	3.0

Table 2.4-17 (Sheet 3 of 3)
Species Composition and Density (#/10^6 m^3) in Impingement Samples at SGS, 2003 – 2007

		Study Year					5-Year
Scientific Name	**Common Name**	**2003**	**2004**	**2005**	**2006**	**2007**	**Mean**
Chaetodipterus faber	Atlantic spadefish					0.1	0.1
Chaetodon ocellatus	Spotfin butterflyfish	0.06			1.45	0.21	0.6
Mugil cephalus	Striped mullet	0.68					0.7
Mugil curema	White mullet			0.55			0.6
Tautoga onilis	Tautog			0.07	0.05		0.1
Astroscopus guttatus	Northern stargazer	0.06	0.07		0.05	0.41	0.1
Hypsoblennius hentz	Feather blenny				0.05		0.1
Gobiosoma bosci	Naked goby	4.1	5.87	2.61	1.5	2.43	3.3
Dormitator maculatus	Fat sleeper				0.05		0.1
Peprilus alepidotus	Harvestfish					0.78	0.8
Peprilus triacanthus	Butterfish	0.46			1.82		1.1
Scomberomorus maculatus	Spanish mackerel		0.07				0.1
Etropus microstomus	Smallmouth flounder	0.23	0.14	0.14	0.75	19.52	4.2
Paralichthys dentatus	Summer flounder	2.5	4.82	0.83	7.82	3.42	3.9
Paralichthys oblongus	Fourspot flounder		0.14				0.1
Scophthalmus aquosus	Windowpane flounder	3.19	2.51	0.96	10.71	0.1	3.5
Pseudopleuronectes americanus	Winter flounder	1.31	0.14	1.17	1.77		1.1
Trinectes maculatus	Hogchoker	102.3	99.4	136.57	184.72	126.98	130.0
Symphurus plagiusa	Blackcheek tonguefish	0.06			0.05	0.31	0.1
Sphoeroides maculatus	Northern puffer	0.06			0.05	0.05	0.1
Total density		2986.1	4330.6	3341.6	3044.4	2424.1	3243.3
Number of species		56	57	50	61	58	56.4
Callinectes sapidus	Blue crab	76.4	171.3	1895.8	694.7	797.7	727.2

References 2.4-159 through 2.4-163

Table 2.4-18 (Sheet 1 of 5)
Comparison of Species Composition and Mean Density (#/10^6 m^3) in Impingement and Entrainment Samples at SGS, 5-Year Mean (2003 – 2007) Versus 13-Year Mean (1995 – 2007)

		Impingement			Entrainment		
Scientific Name	Common Name	5-Year Mean	13-Year Mean	Occurrence Frequency*	5-Year Mean	13-Year Mean	Occurrence Frequency[(a)]
Petromyzon marinus	Sea lamprey	0.4	0.5				
Mustelus canis	Smooth dogfish	0.0	0.0	1			
Rhinoptera bonasus	Cownose ray	0.0	0.0	1			
Acipenser oxyrhynchus	Atlantic sturgeon	0.1	0.0				
Anguila rostrata	American eel	4.3	5.4	8	0.1	0.1	8
Conger oceanicus	Conger eel	0.1	0.3	5		0.0	1
Alosa aestivalis	Blueback herring	48.5	62.5	8	0.0	0.0	6
Alosa pseudoharengus	Alewife	9.8	12.2	8	0.0	0.0	3
Alosa sapidissima	American shad	16.2	8.5	8		0.0	3
Brevoortia tyrannus	Atlantic menhaden	21.0	30.6	8	1.6	1.8	8
Clupea harengus	Atlantic herring	0.2	3.7	7	0.0	0.0	5
Dorosoma cepedianum	Gizzard shad	42.1	39.3	8		0.0	5
Opisthonema oglinum	Atlantic thread herring	0.0	0.0	1			
Anchoa hepsetus	Striped anchovy	0.2	0.2	5		0.0	1
Anchoa mitchilli	Bay anchovy	113.6	136.6	8	88.7	74.6	8
Umbra pygmnea	Eastern mudminnow	0.1	0.0				
Cyprinus carpio	Common carp	0.1	0.1	3	0.0	0.0	3
Hybognathus regius	Silvery minnow	9.2	4.3	7	0.0	0.0	1
Notemingonus crysoleucas	Golden shiner	0.1	0.0	2			
Notropis analostanus	Satinfin shiner	0.0	0.0	1			
Notropis hudsonius	Spottail shiner	0.0	0.0	1			
Carpiodes cyprinus	Quillback carpsucker	0.0			0.1	0.0	
Catostomus commersoni	White sucker	0.0	0.0	2	0.0	0.0	

Table 2.4-18 (Sheet 2 of 5)
Comparison of Species Composition and Mean Density (#/10^6 m^3) in Impingement and Entrainment Samples at SGS, 5-Year Mean (2003 – 2007) Versus 13-Year Mean (1995 – 2007)

		Impingement			Entrainment		
Scientific Name	Common Name	5-Year Mean	13-Year Mean	Occurrence Frequency*	5-Year Mean	13-Year Mean	Occurrence Frequency[(a)]
Ameiurus catus	White catfish	0.1	0.1	4			
Ameiurus nebulosis	Brown bullhead	0.9	0.8	8			
Ictalurus punctatus	Channel catfish	11.2	4.8	8	0.0	0.0	
Oncorhynchus mykiss	Rainbow trout	0.0	0.0	1			
Osmerus mordax	Rainbow smelt	0.0	0.0	1			
Synodus foetens	Inshore lizardfish	0.1	0.0	2	0.0	0.0	2
Opsanus tau	Oyster toadfish	1.4	3.7	8	0.0	0.0	2
Lophius americanus	Goosefish	0.1	0.0	2			
Gobiesox strumosus	Skilletfish	0.0	0.0	2			
Urophycis chuss	Red hake	10.8	1.0	2			
Urophycis regia	Spotted hake	104.5	144.3	8	0.0	0.0	4
Merluccius bilinearis	Silver hake	0.1	0.2	6			
Ophidion marginatum	Striped cusk-eel	13.2	19.6	8	0.0	0.0	3
Strongylura marina	Atlantic needlefish	0.2	0.2	5	0.0	0.0	5
Cyprinodon variegatus	Sheepshead minnow	0.1	0.0	2	0.0	0.0	
Fundulus diaphanus	Banded killifish	0.0	0.1	3	0.0	0.0	
Fundulus heteroclitus	Mummichog	1.3	2.2	8	0.0	0.0	6
Fundulus luceia	Spotfin killifish	0.0	0.0	2			
Fundulus majalis	Striped killifish	1.4	1.1		0.0	0.0	
Membras martinica	Rough silverside	0.4	0.1	1	0.1	0.0	2
Menidia beryllina	Inland silverside	0.3	0.1	1	0.2	0.1	1
Menidia menidia	Atlantic silverside	35.4	46.0	8	0.3	0.5	8
Apeltes quadraticus	Fourspine stickleback	0.0	0.1	3			

Table 2.4-18 (Sheet 3 of 5)
Comparison of Species Composition and Mean Density (#/10^6 m^3) in Impingement and Entrainment Samples at SGS, 5-Year Mean (2003 – 2007) Versus 13-Year Mean (1995 – 2007)

		Impingement			Entrainment		
Scientific Name	Common Name	5-Year Mean	13-Year Mean	Occurrence Frequency*	5-Year Mean	13-Year Mean	Occurrence Frequency[(a)]
Gasterosteus aculeatus	Threespine stickleback	1.2	29.8	8		0.0	1
Fistularia tabacaria	Bluespotted cornetfish	0.0	0.0	2			
Hippocampus erectus	Lined seahorse	0.1	0.1	6			
Syngnathus fuscus	Northern pipefish	2.9	3.6	8	0.1	0.2	8
Prionotus carolinus	Northern sea robin	6.8	11.1	8	0.0	0.0	3
Prionotus evolans	Striped sea robin	0.2	0.7	2	0.0	0.0	2
Morone americana	White perch	1143.5	792.4	8	0.6	1.2	7
Morone saxatilus	Striped bass	71.7	63.6	8	10.8	7.4	8
Centropristis striata	Black sea bass	0.3	0.6	6			
Acantharchus pomotis	Mud sunfish		0.0	1			
Lepomis auritus	Redbreast sunfish	0.0	0.0	1			
Lepomis cyanellus	Green sunfish	0.1	0.0				
Lepomis gibbosus	Pumpkinseed	0.1	0.1	6			
Lepomis macrochirus	Bluegill	2.6	1.8	7	0.0	0.0	1
Lepomis microlophus	Redeared sunfish	0.1	0.0				
Micropterus salmoides	Largemouth bass	0.1	0.0				
Pomoxis annularis	White crappie	0.1	0.0	1		0.0	1
Pomoxis nigromaculatus	Black crappie	0.1	0.1	4			
Orthopristis chrysoptera	Pigfish	0.0	0.0	1			
Etheostoma olmstedi	Tessellated darter	0.0	0.0	2			
Perca flavescens	Yellow perch	2.7	8.2	8	0.0	0.0	4
Pomatomus saltatrix	Bluefish	6.5	5.6	8		0.0	2
Caranx hippos	Crevalle jack	0.1	0.2	5			

Table 2.4-18 (Sheet 4 of 5)
Comparison of Species Composition and Mean Density (#/10^6 m^3) in Impingement and Entrainment Samples at SGS, 5-Year Mean (2003 – 2007) Versus 13-Year Mean (1995 – 2007)

		Impingement			Entrainment		
Scientific Name	Common Name	5-Year Mean	13-Year Mean	Occurrence Frequency*	5-Year Mean	13-Year Mean	Occurrence Frequency[(a)]
Selene vomer	Lookdown	0.1	0.1	2			
Trachinotus carolinus	Florida pompano	0.1	0.0	3			
Trachinotus falcatus	Permit	0.1	0.0	2			
Eucinostomus argenteus	Spotfin mojarra	0.0	0.0	2			
Archosargus probatocephalus	Sheepshead	0.1	0.0	2			
Lagodon rhomboides	Pinfish	0.0	0.0	1			
Stenotomus chrysops	Scup	2.0	0.3	1			
Bairdiella chrysoura	Silver perch	6.7	4.5	8	0.0	0.0	2
Cynoscion regalis	Weakfish	582.2	586.1	8	1.2	2.8	8
Leiostomus xanthurus	Spot	14.0	14.2	8	0.1	0.0	6
Menticirrhus americanus	Southern kingfish	0.0	0.0	1			
Menticirrhus saxatilis	Northern kingfish	11.6	4.2	8	0.0	0.0	
Micropogonias undulatus	Atlantic croaker	786.0	946.6	8	5.9	7.0	8
Pogonias cromis	Black drum	3.0	4.8	6	0.0	0.0	2
Chaetodipterus faber	Atlantic spadefish	0.1	0.0	2			
Chaetodon ocellatus	Spotfin butterflyfish	0.6	0.2	4			
Mugil cephalus	Striped mullet	0.7	0.1	3			
Mugil curema	White mullet	0.6	0.0	1			
Tautoga onilis	Tautog	0.1	0.0		0.0	0.0	
Ammodytes americanus	American sand lance	0.0			0.0	0.0	1
Astroscopus guttatus	Northern stargazer	0.1	0.3	5		0.0	1
Trichiurus lepturus	Atlantic cutlassfish	0.0	0.0	1			
Hypsoblennius hentz	Feather blenny	0.1	0.0	2		0.0	3

Table 2.4-18 (Sheet 5 of 5)
Comparison of Species Composition and Mean Density (#/10^6 m^3) in Impingement and Entrainment Samples at SGS, 5-Year Mean (2003 – 2007) Versus 13-Year Mean (1995 – 2007)

		Impingement			Entrainment		
Scientific Name	Common Name	5-Year Mean	13-Year Mean	Occurrence Frequency*	5-Year Mean	13-Year Mean	Occurrence Frequency[a]
Gobiosoma bosc	Naked goby	3.3	3.3	8	32.7	28.5	8
Microgobius thalassinus	Green goby	0.0	0.0	1	0.0	0.0	
Dormitator maculatus	Fat sleeper	0.1	0.0				
Peprilus alepidotus	Harvestfish	0.8	0.3	3			
Peprilus triacanthus	Butterfish	1.1	0.7	8			
Scomberomorus maculates	Spanish mackerel	0.1	0.0	3		0.0	1
Etropus microstomus	Smallmouth flounder	4.2	2.0	7	0.0	0.0	4
Paralichthys dentatus	Summer flounder	3.9	4.7	8	0.1	0.1	7
Paralichthys oblongus	Fourspot flounder	0.1	0.0	1			
Scophthalmus aquosus	Windowpane flounder	3.5	2.4	7	0.0	0.0	2
Pseudopleuronectes americanus	Winter flounder	1.1	2.4	8	0.0	0.0	4
Trinectes maculatus	Hogchoker	130.0	223.3	8	0.1	0.1	8
Symphurus plagiusa	Blackcheek tonguefish	0.1	0.1	2	0.0	0.0	3
Sphoeroides maculatus	Northern puffer	0.1	0.1	3	0.0	0.0	2
Total density		3243	3247.2		142.7	124.4	
Number of species		82	104		47	57	

a) Number of years in the period 1995 - 2002 in which the species was encountered.

References 2.4-153 through 2.4-157 and 2.4-159 through 2.4-166.

Table 2.4-19 (Sheet 1 of 3)
Comparison of Species Composition and Density (#/10^6 m^3) Between Impingement Samples at SGS (2003 – 2007) and Samples at HCGS (1986 – 1987)

Scientific Name	Common Name	SGS 5-Year Mean	HCGS 1986-1987
Petromyzon marinus	Sea lamprey	0.4	0.1
Acipenser oxyrhynchus	Atlantic sturgeon	0.1	
Anguila rostrata	American eel	4.3	19.7
Conger oceanicus	Conger eel	0.1	0.6
Alosa aestivalis	Blueback herring	48.5	5.3
Alosa pseudoharengus	Alewife	9.8	1.1
Alosa sapidissima	American shad	16.2	0.2
Brevoortia tyrannus	Atlantic menhaden	21.0	4.9
Clupea harengus	Atlantic herring	0.2	
Dorosoma cepedianum	Gizzard shad	42.1	2.0
Anchoa hepsetus	Striped anchovy	0.2	0.2
Anchoa mitchilli	Bay anchovy	113.6	521.5
Umbra pygmnea	Eastern mudminnow	0.1	1.5
Cyprinus carpio	Common carp	0.1	
Hybognathus regius	Silvery minnow	9.2	
Notemingonus crysoleucas	Golden shiner	0.1	
Ameiurus catus	White catfish	0.1	0.1
Ameiurus nebulosis	Brown bullhead	0.9	2.2
Ictalurus punctatus	Channel catfish	11.2	1.0
Synodus foetens	Inshore lizardfish	0.1	
Opsanus tau	Oyster toadfish	1.4	46.5
Lophius americanus	Goosefish	0.1	
Urophycis chuss	Red hake	10.8	0.9
Urophycis regia	Spotted hake	104.5	12.5
Merluccius bilinearis	Silver hake	0.1	0.1
Ophidion marginatum	Striped cusk-eel	13.2	27.2
Strongylura marina	Atlantic needlefish	0.2	
Cyprinodon variegatus	Sheepshead minnow	0.1	0.6
Fundulus diaphanus	Banded killifish	0.0	2.2
Fundulus heteroclitus	Mummichog	1.3	1.9
Fundulus majalis	Striped killifish	1.4	0.5
Membras martinica	Rough silverside	0.4	
Menidia beryllina	Inland silverside	0.3	3.5
Menidia menidia	Atlantic silverside	35.4	17.3
Gasterosteus aculeatus	Threespine stickleback	1.2	1.8
Hippocampus erectus	Lined seahorse	0.1	0.3
Syngnathus fuscus	Northern pipefish	2.9	42.0
Prionotus carolinus	Northern sea robin	6.8	1.5

Table 2.4-19 (Sheet 2 of 3)
Comparison of Species Composition and Density (#/10^6 m^3) Between Impingement Samples at SGS (2003 – 2007) and Samples at HCGS (1986 – 1987)

Scientific Name	Common Name	SGS 5-Year Mean	HCGS 1986-1987
Prionotus evolans	Striped sea robin	0.2	
Morone americana	White perch	1143.5	25.3
Morone saxatilus	Striped bass	71.7	0.7
Centropristis striata	Black sea bass	0.3	2.4
Lepomis cyanellus	Green sunfish	0.1	
Lepomis gibbosus	Pumpkinseed	0.1	2.4
Lepomis macrochirus	Bluegill	2.6	2.1
Lepomis microlophus	Redeared sunfish	0.1	
Micropterus salmoides	Largemouth bass	0.1	
Pomoxis annularis	White crappie	0.1	
Pomoxis nigromaculatus	Black crappie	0.1	3.4
Perca flavescens	Yellow perch	2.7	0.1
Pomatomus saltatrix	Bluefish	6.5	1.0
Caranx hippos	Crevalle jack	0.1	0.2
Selene vomer	Lookdown	0.1	
Trachinotus carolinus	Florida pompano	0.1	
Trachinotus falcatus	Permit	0.1	
Archosargus probatocephalus	Sheepshead	0.1	
Stenotomus chrysops	Scup	2.0	
Bairdiella chrysoura	Silver perch	6.7	3.8
Cynoscion regalis	Weakfish	582.2	169.2
Leiostomus xanthurus	Spot	14.0	2.1
Menticirrhus saxatilis	Northern kingfish	11.6	
Micropogonias undulatus	Atlantic croaker	786.0	1063.9
Pogonias cromis	Black drum	3.0	0.3
Chaetodipterus faber	Atlantic spadefish	0.1	
Chaetodon ocellatus	Spotfin butterflyfish	0.6	0.2
Mugil cephalus	Striped mullet	0.7	
Mugil curema	White mullet	0.6	
Tautoga onilis	Tautog	0.1	
Astroscopus guttatus	Northern stargazer	0.1	0.8
Hypsoblennius hentz	Feather blenny	0.1	
Gobiosoma bosc	Naked goby	3.3	296.8
Dormitator maculatus	Fat sleeper	0.1	
Peprilus alepidotus	Harvestfish	0.8	
Peprilus triacanthus	Butterfish	1.1	
Scomberomorus maculates	Spanish mackerel	0.1	

Table 2.4-19 (Sheet 3 of 3)
Comparison of Species Composition and Density (#/10^6 m^3) Between Impingement Samples at SGS (2003 – 2007) and Samples at HCGS (1986 – 1987)

Scientific Name	Common Name	SGS 5-Year Mean	HCGS 1986-1987
Etropus microstomus	Smallmouth flounder	4.2	0.6
Paralichthys dentatus	Summer flounder	3.9	5.5
Paralichthys oblongus	Fourspot flounder	0.1	
Scophthalmus aquosus	Windowpane flounder	3.5	2.3
Limanda ferruginea	Yellowtail flounder	0.0	0.1
Pseudopleuronectes americanus	Winter flounder	1.1	0.3
Trinectes maculatus	Hogchoker	130.0	119.0
Symphurus plagiusa	Blackcheek tonguefish	0.1	
Lactophrys triqueter	Smooth trunkfish	0.0	0.1
Sphoeroides maculatus	Northern puffer	0.1	0.1
Total density		3243	2421.6
Number of species		82	53

References 2.4-159 through 2.4-163, 2.4-219, and 2.4-222

**Table 2.4-20 (Sheet 1 of 3)
Seasonal Patterns of Species Composition and Mean Density (#/10^6 m^3) in Impingement Samples at SGS, 2003 – 2007**

Scientific Name	Common Name	Winter	Spring	Summer	Fall
Petromyzon marinus	Sea lamprey	0.33			0.04
Acipenser oxyrhynchus	Atlantic sturgeon	0.01	0.01		
Anguila rostrata	American eel	0.59	1.58	0.91	0.81
Conger oceanicus	Conger eel			0.01	0.07
Alosa aestivalis	Blueback herring	24.70	10.46	0.89	11.48
Alosa pseudoharengus	Alewife	1.88	0.80	1.82	4.55
Alosa sapidissima	American shad	4.94	1.27	2.55	6.18
Brevoortia tyrannus	Atlantic menhaden	0.71	12.57	4.97	1.80
Clupea harengus	Atlantic herring	0.03	0.02		
Dorosoma cepedianum	Gizzard shad	22.12	0.10	0.07	19.70
Anchoa hepsetus	Striped anchovy			0.07	0.04
Anchoa mitchilli	Bay anchovy	7.03	64.72	14.35	25.84
Umbra pygmnea	Eastern mudminnow	0.04			
Cyprinus carpio	Common carp	0.01	0.02	0.20	
Hybognathus regis	Silvery minnow	5.57	0.46		3.39
Notemingonus crysoleucas	Golden shiner	0.01	0.01	0.02	
Ameiurus catus	White catfish	0.03		0.02	0.02
Ameiurus nebulosis	Brown bullhead	0.65	0.11	0.04	0.05
Ictalurus punctatus	Channel catfish	9.04	0.36	0.24	0.37
Synodus foetens	Inshore lizardfish			0.01	0.02
Opsanus tau	Oyster toadfish	0.02	0.49	0.52	0.25
Lophius americanus	Goosefish		0.01		
Urophycis chuss	Red hake	0.20	2.25		0.01
Urophycis regia	Spotted hake	16.74	91.49		2.13
Merluccius bilinearis	Silver hake		0.04		0.04
Ophidion marginatum	Striped cusk-eel		1.18	5.28	4.89
Strongylura marina	Atlantic needlefish		0.04	0.14	
Cyprinodon variegatus	Sheepshead minnow		0.04		
Fundulus heteroclitus	Mummichog	0.13	0.45	0.03	0.68
Fundulus majalis	Striped killifish	0.25	0.09	0.02	0.87
Membras martinica	Rough silverside		0.07	0.08	0.06
Menidia beryllina	Inland silverside		0.01	0.06	0.01
Menidia menidia	Atlantic silverside	11.46	1.40	4.16	16.59
Gasterosteus aculeatus	Threespine stickleback	0.99	0.08		
Hippocampus erectus	Lined seahorse	0.01	0.04		

**Table 2.4-20 (Sheet 2 of 3)
Seasonal Patterns of Species Composition and Mean Density (#/10^6 m^3) in Impingement Samples at SGS, 2003 – 2007**

Scientific Name	Common Name	Winter	Spring	Summer	Fall
Syngnathus fuscus	Northern pipefish	0.03	0.29	1.04	1.21
Prionotus carolinus	Northern sea robin	0.46	5.49	0.42	1.03
Prionotus evolans	Striped sea robin			0.06	0.06
Morone americana	White perch	429.32	123.07	22.09	573.08
Morone saxatilus	Striped bass	11.42	3.56	24.30	23.81
Centropristis striata	Black sea bass		0.19		0.01
Lepomis cyanellus	Green sunfish				0.02
Lepomis gibbosus	Pumpkinseed	0.02	0.01	0.02	0.02
Lepomis macrochirus	Bluegill	0.45	0.67	0.42	0.78
Micropterus salmoides	Largemouth bass			0.01	
Pomoxis annularis	White crappie	0.01			
Pomoxis nigromaculatus	Black crappie	0.01	0.03		
Perca flavescens	Yellow perch	2.12	0.22	0.02	0.15
Pomatomus saltatrix	Bluefish		1.59	2.60	1.17
Caranx hippos	Crevalle jack			0.03	0.04
Selene vomer	Lookdown			0.02	0.02
Trachinotus carolinus	Florida pompano			0.01	
Trachinotus falcatus	Permit				0.01
Archosargus probatocephalus	Sheepshead	0.01			0.02
Stenotomus chrysops	Scup		0.48	0.21	
Bairdiella chrysoura	Silver perch	0.01		3.18	1.88
Cynoscion regalis	Weakfish	0.01	5.38	382.30	16.50
Leiostomus xanthurus	Spot	0.24	2.24	3.42	7.33
Menticirrhus saxatilis	Northern kingfish			2.05	6.63
Micropogonias undulatus	Atlantic croaker	221.68	97.56	44.17	414.29
Pogonias cromis	Black drum	0.18		0.18	2.87
Chaetodipterus faber	Atlantic spadefish				0.02
Chaetodon ocellatus	Spotfin butterflyfish			0.17	0.09
Mugil cephalus	Striped mullet	0.02			0.12
Mugil curema	White mullet				0.13
Tautoga onilis	Tautog	0.01			0.02
Astroscopus guttatus	Northern stargazer		0.02	0.02	0.08
Hypsoblennius hentz	Feather blenny				0.01
Gobiosoma bosc	Naked goby		0.78	0.82	1.44
Dormitator maculatus	Fat sleeper				0.01
Peprilus alepidotus	Harvestfish			0.03	0.12
Peprilus triacanthus	Butterfish		0.05	0.15	0.17

Table 2.4-20 (Sheet 3 of 3)
Seasonal Patterns of Species Composition and Mean Density (#/10^6 m^3) in Impingement Samples at SGS, 2003 – 2007

Scientific Name	Common Name	Winter	Spring	Summer	Fall
Scomberomorus maculates	Spanish mackerel			0.01	
Etropus microstomus	Smallmouth flounder	0.01	0.16	0.03	4.26
Paralichthys dentatus	Summer flounder	0.05	2.30	0.93	0.36
Paralichthys oblongus	Fourspot flounder			0.02	
Scophthalmus aquosus	Windowpane flounder	0.15	3.54	0.03	
Pseudopleuronectes americanus	Winter flounder		0.37	0.35	0.02
Trinectes maculatus	Hogchoker	2.60	45.06	36.22	35.73
Symphurus plagiusa	Blackcheek tonguefish		0.03	0.03	0.01
Sphoeroides maculatus	Northern puffer		0.01	0.02	
Total density		776.30	483.27	561.84	1193.41
Number of species		46	53	57	62

References 2.4-159 through 2.4-163

Table 2.4-21 (Sheet 1 of 3)
Species Composition and Density (#/100 m^3) in Entrainment Samples from SGS, 2003 – 2007

Name	Egg	Larva	Juvenile	Adult	2003	2004	2005	2006	2007	5-Year Mean
American eel		X	X	X	0.12	0.06	0.21	0.12	0.18	0.1
Clupeidae		X	X		0.02	0.01	0.01	0.02	0.07	0.0
Alosa sp.		X	X		0.08	0.07	0.06		0.04	0.1
Blueback herring		X	X		0.01	0.03	0.01	0.01	0.01	0.0
Alewife		X	X		0.02	0.03	0.01	0.03	0.05	0.0
Atlantic menhaden	X	X	X		0.20	0.47	1.06	5.02	1.47	1.6
Atlantic herring		X						0.01		0.0
Bay anchovy	X	X	X	X	13.15	100.52	54.58	101.45	173.80	88.7
Cyprinidae		X			0.01	0.01	0.01	0.23	0.01	0.1
Common carp		X			0.01	0.01		0.01		0.0
Eastern silvery minnow		X							0.01	0.0
Catostomidae		X						0.01	0.01	0.0
Quillback carpsucker		X						0.09		0.1
White sucker		X						0.01		0.0
Channel catfish		X						0.01		0.0
Inshore lizardfish			X			0.01				0.0
Oyster toadfish			X				0.01			0.0
Spotted hake			X		0.01	0.01		0.01	0.01	0.0
Striped cusk-eel			X	X		0.01	0.01	0.01		0.0
Atlantic needlefish		X	X			0.01		0.01	0.01	0.0
Sheepshead minnow				X					0.01	0.0
Fundulus sp.		X				0.01	0.02	0.02	0.01	0.0
Banded killifish		X		X		0.01	0.01			0.0
Mummichog		X	X		0.01	0.01	0.01	0.02	0.01	0.0
Striped killifish		X						0.01		0.0
Rough silverside	X			X				0.14	0.04	0.1

Table 2.4-21 (Sheet 2 of 3)
Species Composition and Density (#/100 m^3) in Entrainment Samples from SGS, 2003 – 2007

Name	Egg	Larva	Juvenile	Adult	2003	2004	2005	2006	2007	5-Year Mean
Menidia sp.	X	X	X	X	0.01	0.10	0.12	2.25	0.28	0.6
Inland silverside	X	X	X	X		0.01	0.62	0.03	0.02	0.2
Atlantic silverside	X	X	X	X	0.15	0.47	0.55	0.28	0.12	0.3
Northern pipefish		X	X	X	0.07	0.07	0.10	0.06	0.05	0.1
Northern sea robin			X				0.01			0.0
Striped sea robinsea robin			X		0.01					0.0
Morone sp.		X			0.87	0.44	0.40	0.11	10.69	2.5
White perch	X	X	X		0.44	0.64	0.25	0.55	1.21	0.6
Striped bass	X	X	X		5.07	1.84	4.02	0.54	42.34	10.8
Centrarchidae		X						0.01		0.0
Bluegill			X		0.01					0.0
Yellow perch		X			0.02	0.01	0.01	0.01	0.02	0.0
Sciaenidae		X			0.01	0.01	0.01	0.01		0.0
Silver perch		X	X	X			0.02	0.03	0.02	0.0
Weakfish	X	X	X		0.43	1.10	2.09	0.70	1.44	1.2
Spot		X	X		0.01		0.25	0.01	0.03	0.1
Northern kingfish		X	X					0.01	0.01	0.0
Atlantic croaker		X	X		2.63	5.05	5.56	10.51	5.88	5.9
Black drum		X	X		0.01		0.01		0.02	0.0
Tautog		X						0.01		0.0
American sand lance		X				0.01				0.0
Gobiosoma sp.		X		X			0.01		0.01	0.0
Naked goby	X	X	X	X	30.09	22.33	30.86	54.89	25.42	32.7
Green goby		X	X	X			0.02	0.02	0.01	0.0
Smallmouth flounder		X	X		0.01	0.01	0.01	0.02		0.0
Summer flounder		X	X		0.08	0.06	0.01	0.12	0.11	0.1

Table 2.4-21 (Sheet 3 of 3)
Species Composition and Density (#/100 m^3) in Entrainment Samples from SGS, 2003 – 2007

Name	Egg	Larva	Juvenile	Adult	2003	2004	2005	2006	2007	5-Year Mean
Windowpane		X	X		0.01			0.01		0.0
Winter flounder		X	X		0.01		0.02	0.02	0.02	0.0
Hogchoker		X	X		0.07	0.05	0.09	0.09	0.09	0.1
Blackcheek tonguefish			X					0.01		0.0
Northern puffer		X				0.01				0.0
Total density					53.7	133.5	101.1	177.5	263.5	146.2
Number of species					31	33	35	44	36	57

References 2.4-159 through 2.4-163

Table 2.4-22 (Sheet 1 of 4)
Seasonal Patterns of Species Composition and Mean Density (#/10^6 m^3) in Entrainment Samples at SGS, 2003 – 2007

Common Name	Winter				Spring			
	Eggs	Larvae	Juvenile	Adult	Eggs	Larvae	Juvenile	Adult
American eel		585.19	223.02			261.62	87.16	
Blueback herring			11.73			4.38	4.71	
Alewife			6.05			127.82	2.39	
Atlantic menhaden	6.05	53.92	4855.22		319.65	1008.00	4761.95	
Atlantic herring			6.05					
Bay anchovy			392.16	6.18	142,045.94	41,356.00	1089.24	440.00
Common carp						4.79		
Silvery minnow						3.63		
White sucker								
Channel catfish								
Inshore lizardfish								
Oyster toadfish								
Spotted hake			5.95				18.15	
Striped cusk-eel							0.99	2.42
Atlantic needlefish							0.99	
Sheepshead minnow								1.21
Banded killifish						1.10		
Mummichog						6.69		
Striped killifish								
Rough silverside					95.95			
Inland silverside				2.89		544.61		
Atlantic silverside			9.07	14.43	64.61	845.11	48.05	14.47
Northern pipefish			8.74			1.32	42.91	2.64
Northern sea robin								
Striped sea robin								
White perch			68.60		1.21	2178.28	25.11	
Striped bass					182.29	50,717.97	452.70	
Bluegill								
Yellow perch						57.88		

Table 2.4-22 (Sheet 2 of 4)
Seasonal Patterns of Species Composition and Mean Density (#/10^6 m^3) in Entrainment Samples at SGS, 2003 – 2007

Common Name	Winter				Spring			
	Eggs	Larvae	Juvenile	Adult	Eggs	Larvae	Juvenile	Adult
Silver perch						1.21	1.21	
Weakfish					62.01	1200.04	423.45	
Spot						33.10	179.32	
Northern kingfish								
Atlantic croaker	3.02	18.04	9001.74			1.32	966.41	
Black drum						8.21		
Tautog						1.32		
American sand lance						6.94		
Naked goby		2.79	3.02	5.59	4.84	33,776.70	38.88	81.51
Green goby				3.16				
Smallmouth flounder							0.99	
Summer flounder		93.78	277.61			5.88	30.27	
Windowpane flounder						7.01		
Winter flounder						20.53	8.81	
Hogchoker			2.97			5.61	1.10	
Blackcheek tonguefish								
Northern puffer						0.99		
Total Density	9.07	753.72	14,871.93	32.25	142,776.50	132,188.06	8184.79	542.25
Number of Species	2	5	14	5	8	28	21	6

Table 2.4-22 (Sheet 3 of 4)
Seasonal Patterns of Species Composition and Mean Density (#/10^6 m^3) in Entrainment Samples at SGS, 2003 – 2007

Common Name	Summer				Fall			
	Eggs	Larvae	Juvenile	Adult	Eggs	Larvae	Juvenile	Adult
American eel		3.44	26.61	1.68			11.62	
Blueback herring		38.69	10.66				45.62	
Alewife		241.80	6.53					
Atlantic menhaden		463.31	131.68			890.76	262.42	
Atlantic herring								
Bay anchovy	280,645.21	80,216.01	12,128.00	30.59	9.26	1662.27	2566.15	6.23
Common carp		3.24						
Silvery minnow								
White sucker		1.62						
Channel catfish		1.62						
Inshore lizardfish			1.63					
Oyster toadfish			4.90					
Spotted hake								
Striped cusk-eel								
Atlantic needlefish		1.81	3.24					
Sheepshead minnow								
Banded killifish								5.64
Mummichog		13.31	1.68				20.47	
Striped killifish		1.62						
Rough silverside	117.15			1.81				
Inland silverside	5.05	70.09						
Atlantic silverside	10.13	621.45	54.12	57.90			2.92	25.21
Northern pipefish		1.68	303.66	29.95			22.75	5.75
Northern sea robin			1.63					

Table 2.4-22 (Sheet 4 of 4)
Seasonal Patterns of Species Composition and Mean Density (#/10^6 m^3) in Entrainment Samples at SGS, 2003 – 2007

Common Name	Summer				Fall			
	Eggs	Larvae	Juvenile	Adult	Eggs	Larvae	Juvenile	Adult
Striped sea robin			1.68					
White perch	1.62	849.55	125.91				136.15	
Striped bass		2513.81	1400.80				13.31	
Bluegill							4.44	
Yellow perch								
Silver perch		15.16	23.47				2.92	
Weakfish	530.00	2008.95	3056.87				35.50	
Spot		6.53	66.93				3.41	
Northern kingfish		1.81	3.24					
Atlantic croaker		1134.91	2504.82		2.92	4616.31	54,607.08	
Black drum		5.00					3.41	
Tautog		1.62						
American sand lance								
Naked goby	51.49	179,031.12	1723.09	189.73		121.77	145.22	182.65
Green goby						5.69	2.84	
Smallmouth flounder		4.86	1.68			2.92		
Summer flounder						272.05	249.01	
Windowpane flounder		1.62						
Winter flounder								
Hogchoker		471.25	6.75			4.44	12.57	
Blackcheek tonguefish			1.62				2.92	
Northern puffer								
Total Density	281,360.65	267,725.88	21,591.20	311.66	12.18	7576.21	58,150.73	225.48
Number of Species	7	27	24	6	2	8	20	5

References 2.4-159 through 2.4-163

Table 2.4-23 (Sheet 1 of 4)
Species Composition and Abundance in Fish Surveys of the Delaware River (River Miles 40 – 60) near the PSEG Site, 2003 – 2007

		2003			2004		
Scientific Name	**Common Name**	**Trawl (Bottom)**	**Trawl (Pelagic)**	**Seine**	**Trawl (Bottom)**	**Trawl (Pelagic)**	**Seine**
Acipenser brevirostrum	Shortnose sturgeon				1		
Acipenser oxyrhinchus	Atlantic sturgeon			x			
Anguilla rostrata	American eel	167		x	64	3	x
Conger oceanicus	Conger eel						
Hyporhamphus unifasciatus	Halfbeak						
Alosa aestivalis	Blueback herring		14	x		43	x
Alosa pseudoharengus	Alewife	30	22	x	3	42	x
Alosa sapidissima	American shad		5	x		7	x
Brevoortia tyrannus	Atlantic menhaden		22	x		22	x
Clupea harengus	Atlantic herring	1	22				
Dorosoma cepedianum	Gizzard shad			x		1	x
Anchoa hepsetus	Striped anchovy		40	x		6	
Anchoa mitchilli	Bay anchovy	84	11,694	x	305	8568	x
Cyprinus carpio	Common carp			x			x
Hybognathus regius	Eastern silvery minnow			x			
Ameiurus catus	White catfish				3		x
Ameiurus nebulosus	Brown bullhead	1			1		
Ictaluras punctatus	Channel catfish	19		x	79		x
Synodus foetans	Inshore lizardfish						
Opsanus tau	Oyster toadfish	81			12		
Gobiesox strumosus	Skilletfish						
Urophysis chuss	Red hake	1					
Urophysis regia	Spotted hake	1019	87		232		
Ophidion marginata	Striped cusk-eel	155	3		14	1	
Strongylura marina	Atlantic needlefish		1	x		1	
Cyprinodon variegatus	Sheepshead minnow			x			
Fundulus diaphanus	Banded killifish						x
Fundulus heteroclitus	Mummichog			x			x
Fundulus luciae	Spotfin killifish						x
Fundulus majalis	Striped killifish			x			x
Membras martinica	Rough silverside						
Menidia beryllina	Inland silverside						
Menidia menidia	Atlantic silverside		24	x		2	x

Table 2.4-23 (Sheet 2 of 4)
Species Composition and Abundance in Fish Surveys of the Delaware River (River Miles 40 – 60) near the PSEG Site, 2003 – 2007

		2003			2004		
Scientific Name	**Common Name**	**Trawl (Bottom)**	**Trawl (Pelagic)**	**Seine**	**Trawl (Bottom)**	**Trawl (Pelagic)**	**Seine**
Syngnathus fuscus	Northern pipefish	1	6	x		6	x
Prionotus carolinus	Northern sea robin	9	1		2	1	
Prionotus evolans	Striped sea robin		1				
Morone americana	White perch	468	16	x	674	38	x
Morone saxatilis	Striped bass	126	27	x	56	7	x
Centropristis striata	Black sea bass	2					
Enneacanthus gloriosus	Bluespotted sunfish						
Lepomis macrochirus	Bluegill			x			
Micropterus salmoides	Largemouth bass						
Etheostoma olmstedi	Tessellated darter				1		
Pomatomus saltatrix	Bluefish		4	x		7	x
Caranx hippos	Crevalle jack						
Trachinotus carolinus	Pompano						
Stenotomus chrysops	Scup						
Bairdiella chrysoura	Silver perch					1	
Cynoscion regalis	Weakfish	267	468	x	1707	546	x
Leiostomus xanthurus	Spot			x			
Menticirrhus saxatilis	Northern kingfish	1			29		
Micropogonias undulatus	Atlantic croaker	3260	6663		7626	8725	x
Pogonias cromis	Black drum			x	1		x
Chaetodipterus faber	Atlantic spadefish						
Mugil curema	White mullet			x			
Astroscopus guttatus	Northern stargazer		1				
Chasmodes bosquianus	Striped blenny						
Gobiosoma bosc	Naked goby	87	27		17	40	
Peprilus triacanthus	Butterfish					3	
Scomberomerus maculatus	Spanish mackerel					1	x
Etropus microstomus	Smallmouth flounder		1				
Paralichthys dentatus	Summer flounder	1			2		x
Scophthalmus aquosus	Windowpane flounder				2		
Pseudopleuronectes americanus	Winter flounder				1		
Trinectes maculatus	Hogchoker	1192	17	x	1660	16	
Symphurus plagiusa	Blackcheek tonguefish						
Total number of individuals		6972	19,166		12,492	18,087	
Total number of species		21	23	27	23	23	24

Table 2.4-23 (Sheet 3 of 4)
Species Composition and Abundance in Fish Surveys of the Delaware River (River Miles 40 – 60) near the PSEG Site, 2003 – 2007

		2005		2006		2007	
Scientific Name	Common Name	Trawl (Bottom)	Seine	Trawl (Bottom)	Seine	Trawl (Bottom)	Seine
Acipenser brevirostrum	Shortnose sturgeon						
Acipenser oxyrhinchus	Atlantic sturgeon						
Anguilla rostrata	American eel	93	x	70	x	46	x
Conger oceanicus	Conger eel					2	
Hyporhamphus unifasciatus	Halfbeak						x
Alosa aestivalis	Blueback herring	6	x			2	x
Alosa pseudoharengus	Alewife	9	x			22	x
Alosa sapidissima	American shad		x	1	x	1	x
Brevoortia tyrannus	Atlantic menhaden		x	1	x		x
Clupea harengus	Atlantic herring						
Dorosoma cepedianum	Gizzard shad	2	x		x		x
Anchoa hepsetus	Striped anchovy		x		x		x
Anchoa mitchilli	Bay anchovy	105	x	227	x	220	x
Cyprinus carpio	Common carp		x		x		
Hybognathus regius	Eastern silvery minnow	2		1			
Ameiurus catus	White catfish	1	x	3	x	7	x
Ameiurus nebulosus	Brown bullhead		x	2			
Ictaluras punctatus	Channel catfish	33	x	5	x	20	x
Synodus foetans	Inshore lizardfish				x		
Opsanus tau	Oyster toadfish	36		33		49	
Gobiesox strumosus	Skilletfish					1	
Urophysis chuss	Red hake			2			
Urophysis regia	Spotted hake	34		457		60	
Ophidion marginata	Striped cusk-eel	66		30		17	
Strongylura marina	Atlantic needlefish		x				
Cyprinodon variegatus	Sheepshead minnow						
Fundulus diaphanus	Banded killifish						
Fundulus heteroclitus	Mummichog		x		x		x
Fundulus luciae	Spotfin killifish						
Fundulus majalis	Striped killifish		x		x		x
Membras martinica	Rough silverside						x
Menidia beryllina	Inland silverside				x		
Menidia menidia	Atlantic silverside		x		x		x
Syngnathus fuscus	Northern pipefish	7		1		4	

Table 2.4-23 (Sheet 4 of 4)
Species Composition and Abundance in Fish Surveys of the Delaware River (River Miles 40 – 60) near the PSEG Site, 2003 – 2007

		2005		2006		2007	
Scientific Name	**Common Name**	**Trawl (Bottom)**	**Seine**	**Trawl (Bottom)**	**Seine**	**Trawl (Bottom)**	**Seine**
Prionotus carolinus	Northern sea robin	3		9		9	
Prionotus evolans	Striped sea robin						
Morone americana	White perch	470	x	243	x	435	x
Morone saxatilis	Striped bass	169	x	9	x	9	x
Centropristis striata	Black sea bass			2		12	
Enneacanthus gloriosus	Bluespotted sunfish				x		
Lepomis macrochirus	Bluegill						
Micropterus salmoides	Largemouth bass		x				
Etheostoma olmstedi	Tessellated darter						
Pomatomus saltatrix	Bluefish		x		x	2	x
Caranx hippos	Crevalle jack		x		x		
Trachinotus carolinus	Pompano						x
Stenotomus chrysops	Scup			1		5	
Bairdiella chrysoura	Silver perch	9	x	8		7	x
Cynoscion regalis	Weakfish	4497	x	682	x	845	x
Leiostomus xanthurus	Spot	147	x	1	x	29	x
Menticirrhus saxatilis	Northern kingfish	8	x	46	x	87	x
Micropogonias undulatus	Atlantic croaker	2001	x	3295	x	2948	x
Pogonias cromis	Black drum	9	x		x	10	x
Chaetodipterus faber	Atlantic spadefish					3	
Mugil curema	White mullet		x				x
Astroscopus guttatus	Northern stargazer	1				6	
Chasmodes bosquianus	Striped blenny	1					
Gobiosoma bosc	Naked goby	21		2		2	
Peprilus triacanthus	Butterfish			1			
Scomberomerus maculatus	Spanish mackerel						
Etropus microstomus	Smallmouth flounder			1		25	
Paralichthys dentatus	Summer flounder	4	x	1		4	x
Scophthalmus aquosus	Windowpane flounder	1		14			
Pseudopleuronectes americanus	Winter flounder	1					
Trinectes maculatus	Hogchoker	1854		1594	x	1221	x
Symphurus plagiusa	Blackcheek tonguefish			10			
Total number of individuals		9590		6752		6110	
Total number of species		28	29	30	25	31	28

x = present in collections from PSEG Beach Seine Program

References 2.4-159 through 2.4-163

Table 2.4-24 (Sheet 1 of 3)
Macroinvertebrate Taxa Collected in Ponar Surveys from the Delaware River near Artificial Island, 1971 – 1976

		Survey Year				
Scientific Name	**Common Name**	**1971**	**1972**	**1973**	**1974**	**1976**
PHYLUM PORIFERA						
Class Demospongidae						
Microciona prolifera	Red beard sponge		X	X	X	X
PHYLUM CNIDARIA						
Class Hydrozoa						
Cordylophora caspia		X	X	X		X
Diadumene leucolena	Ghost anemone			X	X	X
Garveia franciscana		X	X	X	X	X
Hartlaubella gelatinosa		X	X	X	X	X
Sertularia argentea	Squirrel's tail hydroid	X	X	X	X	X
PHYLUM PLATYHELMINTHES						
Class Turbellaria						
Euplana gracilis						X
Stylochus ellipticus			X	X	X	X
PHYLUM NEMERTEA (RHYNCHOROELA)						
Unidentified Nemertea				X	X	X
PHYLUM NEMATODA						
Unidentified Nematoda		X				
PHYLUM ANNELIDA						
Class Hirudinea						
Unidentified leech		X	X	X	X	
Class Oligochaeta						
Paranais litoralis		X	X	X	X	X
Class Polychaeta						
Eteone heteropoda						X
Glycera dibranchiata				X	X	X
Goniadidae					X	X
Hypaniola grayi						X
Laeonereis culveri				X	X	X
Nereis succinea		X	X	X	X	X
Polydora sp.				X	X	X
Sabellaria vulgaris						X
Scolecolepides viridis				X	X	X
Streblospio benedicti				X	X	X
PHYLUM MOLLUSCA						
Class Gastropoda (Snails)						
Corambe obscura (Boridella obscura)						X
Turbonilla sp.						X

**Table 2.4-24 (Sheet 2 of 3)
Macroinvertebrate Taxa Collected in Ponar Surveys from the Delaware River near Artificial Island, 1971 – 1976**

Scientific Name	Common Name	Survey Year 1971	1972	1973	1974	1976
Class Pelecypoda						
Crassostrea virginica	Eastern oyster	X	X	X	X	X
Macoma balthica	Baltic macoma	X	X	X	X	X
Macoma tenta	Elongate macoma					X
Modiolus demissus	Ribbed mussel	X	X	X	X	X
Mulinia lateralis	Dwarf surfclam				X	X
Mya arenaria	Soft-shell clam					X
Mytilopsis(Congeria leucophaeata)	Dark falsemussel		X	X	X	X
Rangea cuneata	Common rangia	X	X	X	X	X
Macoma sp.						X
PHYLUM ARTHROPODA						
Subphylum Chelicerata						
Class Arachnida						
Acarina	Aquatic mites	X				
Subphylum Crustacea						
Order Amphipoda (Scuds)						
Caprellidae			X			
Corophium lacustre		X	X	X	X	X
Gammarus spp.		X	X	X	X	X
Leptocheirus plumulosis		X	X	X	X	X
Melita nitida			X	X	X	X
Monoculodes edwardsi				X	X	X
Parahaustorius sp.				X	X	X
Parapleustes sp.						X
Order Cumacea (Hooded shrimps)						
Leucon americanus			X	X	X	X
Order Decapoda						
Callinectes sapidus	Blue crab				X	X
Crangon septemspinoza	Sand shrimp	X	X	X	X	X
Palaemonetes pugio	Daggerblade grass shrimp	X	X	X	X	
Panopeus herbstii	Atlantic mud crab	X				
Rhithropanopeus harrisii	Estuarine mud crab	X	X	X	X	X
Order Isopoda (Pill bugs, wood lice)						
Cassidinidea lunifrons			X	X		X
Chiridotea almyra		X	X	X	X	X
Cyathura polita		X	X	X	X	X
Edotea triloba		X	X	X	X	X
Order Mysidacea (Opossum shrimps)						
Mysidopsis bigelowi						
Neomysis americana		X	X	X	X	X
Order Thoracica						
Balanus improvisus	Bay barnacle	X	X	X	X	X

**Table 2.4-24 (Sheet 3 of 3)
Macroinvertebrate Taxa Collected in Ponar Surveys from the Delaware River near Artificial Island, 1971 – 1976**

Scientific Name	Common Name	Survey Year[(a)] 1971	1972	1973	1974	1976
Subphylum Mandibulata						
Class Insecta						
Order Diptera						
Chironomidae	Non-biting midges	X	X	X	X	X
Tipulidae	Craneflies		X			X
PHYLUM BRYOZOA (ECTOPROCTA)						
Class Gymnolaemata						
Amathia vidovici		X	X	X	X	X
Membraniporidae						X
PHYLUM CHORDATA						
Class Ascidiacea						
Molgula manhattensis	Sea grape		X			X

Reference 2.4-25

a) No data reported for 1975.

Table 2.4-25
Taxonomic Composition and Abundance in Macroinvertebrate Surveys Collected by Ponar Dredge in the Delaware River near the PSEG Site, 2009[a]

	Spring				Fall			
Scientific Name	**AS-07**	**AS-12**	**AS-13**	**AS-15**	**AS-07**	**AS-12**	**AS-13**	**AS-15**
PHYLUM ANNELIDA								
Class Oligochaeta								
Unidentified Enchytraeidae								1
Unidentified Naididae	1			1				
Unidentified Oligochaeta								1
Class Polychaeta								
Unidentified Polychaeta	2		5	15				
Order Spionida (Spionids)								
Marenzelleria viridis				9				21
PHYLUM MOLLUSCA								
Class Pelecypoda								
Mya arenaria	1							
Rangea cuneata	1							
PHYLUM ARTHROPODA								
Subphylum Crustacea								
Order Amphipoda (Scuds)								
Unidentified Amphipoda				1				
Corophium lacustre	5							
Corophium sp.				1				
Gammarus sp.	2		6					
Gammarus daiberi	3							
Haustorius canadensis	1							
Monoculodes edwardsi	4	1		12				
Protohaustorius wigleyi			1					
Order Isopoda (Pill bugs, wood lice)								
Chiridotea almyra	7	10						
Chiridotea sp.			6	2				
Cyathura polita	2							
Order Mysida (Mysids)								
Neomysis americana			3	2				
Total number of individuals	29	11	21	43	0	0	0	23
Total number of taxa	10	2	5	5	0	0	0	1

a) Information in this table collected as part of ESPA sampling program.

Table 2.4-26 (Sheet 1 of 2) Important Aquatic Species Potentially Occurring in the Vicinity of the PSEG Site

Scientific Name	Common Name	Rationale
Invertebrates		
Horseshoe crab	*Limulus polyphemus*	Commercial - NJ and DE
Eastern oyster	*Crassostrea virginica*	Commercial - NJ and DE
Northern quahog clam	*Mercenaria mercenaria*	Commercial - NJ and DE
Blue crab	*Callinectes sapidus*	Commercial - NJ and DE
Fish		
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered - federal
Atlantic sturgeon	*Acipenser oxyrhynchus*	Endangered candidate – federal; Endangered - DE
American eel	*Anguilla rostrata*	Commercial/recreational - NJ and DE
Conger eel	*Conger oceanicus*	Commercial - NJ and DE
Blueback herring	*Alosa aestivalis*	Representative Important Species - NJPDES
Alewife	*Alosa pseudoharengus*	Representative Important Species - NJPDES
American shad	*Alosa sapidissima*	Commercial - NJ and DE
Atlantic menhaden	*Brevoortia tyrannus*	Commercial - NJ and DE
Bay anchovy	*Anchoa mitchilli*	Representative Important Species - NJPDES
Channel catfish	*Ictaluras punctatus*	Commercial - DE; recreational - NJ and DE
Silver hake	*Merluccius bilinearis*	Commercial - NJ
Atlantic silverside	*Menidia menidia*	Representative Important Species - NJPDES
Northern sea robin	*Prionotus carolinus*	Commercial - NJ; recreational - NJ and DE
White perch	*Morone americana*	Commercial/recreational - NJ and DE
Striped bass	*Morone saxatilis*	Commercial - DE; recreational - NJ and DE
Black sea bass	*Centropristis striata*	Commercial/recreational - NJ and DE
Bluefish	*Pomatomus saltatrix*	Commercial/recreational - NJ and DE
Scup	*Stenotomus chrysops*	Commercial - NJ; recreational - NJ and DE
Weakfish	*Cynoscion regalis*	Commercial/recreational - NJ and DE
Spot	*Leiostomus xanthurus*	Commercial - NJ and DE; recreational - DE
Northern kingfish	*Menticirrhus saxatilis*	Commercial/recreational - NJ and DE
Atlantic croaker	*Micropogonias undulatus*	Commercial/recreational - NJ and DE
Black drum	*Pogonias cromis*	Commercial/recreational - NJ and DE
Butterfish	*Peprilus tricanthus*	Commercial - NJ and DE
Summer flounder	*Paralichthys dentatus*	Commercial/recreational - NJ and DE
Windowpane flounder	*Scophthalmus aquosus*	Commercial - NJ
Winter flounder	*Pseudopleuronectes americanus*	Commercial - NJ; recreational - NJ

Table 2.4-26 (Sheet 2 of 2)
Important Aquatic Species Potentially Occurring in the Vicinity of the PSEG Site

Scientific Name	Common Name	Rationale
Other Vertebrates		
Atlantic loggerhead turtle	*Caretta caretta*	Threatened – federal; Endangered – NJ and DE
Atlantic green turtle	*Chelonia mydas*	Threatened – federal and NJ; Endangered – DE
Leatherback turtle	*Dermochelys coriacea*	Endangered – federal; Endangered – NJ and DE
Hawksbill turtle	*Eretmochelys imbricata*	Endangered – federal; Endangered – NJ and DE
Kemp's ridley turtle	*Lepidochelys kempii*	Endangered – federal; Endangered – NJ and DE

References 2.4-37, 2.4-129, and 2.4-13442

Table 2.4-27
Commercial and Recreational Harvests of Important Species in NJ and DE (2007)

Common Name	Scientific Name	Commercial Harvest (Pounds) DE[(a)]	Commercial Harvest (Pounds) NJ[(a)]	Recreational Harvest (Number) DE[(b)]	Recreational Harvest (Number) NJ[(c)]
Blue crab	*Callinectes sapidus*	3,799,489	4,636,368		
Horseshoe crab	*Limulus polyphemus*	229,602			
Northern quahog clam	*Mercenaria mercenaria*	44,336	239,733		
American eel	*Anguilla rostrata*	139,648	164,356	238	44,616
Conger eel	*Conger oceanicus*	1241	41,399		
Blueback herring	*Alosa aestivalis*	1434		1408	21,583
American shad	*Alosa sapidissima*	71,442	58,981		
Atlantic menhaden	*Brevoortia tyrannus*	85,067	37,634,929		
Channel catfish	*Ictaluras punctatus*	6922		26,800	24,245
Silver hake	*Merluccius bilinearis*		997,211		
Northern sea robin	*Prionotus carolinus*		6666	1498	14,949
White perch	*Morone americana*	55,971	27,527	27,441	421,390
Striped bass	*Morone saxatilis*	188,670		9106	108,025
Black sea bass	*Centropristis striata*	72,675	480,238	7805	5997
Bluefish	*Pomatomus saltatrix*	19,551	1,403,717	95,166	819,362
Scup	*Stenotomus chrysos*		1,575,159	1507	83,417
Weakfish	*Cynoscion regalis*	24,588	164,506	3,300	181,654
Spot	*Leiostomus xanthurus*	128,208	4474	239,299	
Northern kingfish	*Menticirrhus saxatilis*	689		23,995	17,442
Atlantic croaker	*Micropogonais undulatus*	13,648	1,357,999	281,284	43,190
Black drum	*Pogonais cromis*	37,712	1518	5020	13,986
Butterfish	*Peprilus tricanthus*	937	176,679		
Summer flounder	*Paralichthys dentatus*	5456	1,697,504	98,988	573,601
Windowpane flounder	*Scophthalmus aquosus*		46,972		
Winter flounder	*Pseudopleuronectes americanus*		379,615		169,686

a) Reference 2.4-125
b) Reference 2.4-117
c) Reference 2.4-124

Table 2.4-28
EFH for Relevant Federally Managed Species in the Vicinity of the PSEG Site

Scientific Name	Common Name	Egg	Larva	Juvenile	Adult
Prepilus triacanthus	Butterfish			X	
Scophthalmus aquosus	Windowpane flounder	X	X	X	X
Pleuronectes americanus	Winter flounder	X	X	X	X
Paralicthys dentatus	Summer flounder			X	X

Table 2.4-29
Stream Length (miles) within Each Potential Off-Site Transmission Macro-Corridor

		5-Mi. Wide Corridor		
South Corridor[(a)]		**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**
Channelized Waterway		197.3	431.2	628.5
Intermittent Stream		0.2	130.0	130.2
Perennial Stream		320.4	617.6	938.0
	Total	**518.0**	**1178.8**	**1696.7**
West Corridor[b]				
Channelized Waterway		140.0	184.0	324.1
Intermittent Stream		0.0	79.7	79.7
Perennial Stream		236.0	330.3	566.3
	Total	**376.0**	**594.0**	**970.1**

a) Total length = 94 mi.
b) Total length = 55 mi.

2.5 SOCIOECONOMICS

This section characterizes the current socioeconomic resources within the 50-mi. region surrounding the PSEG Site. It provides the basis for assessing potential impacts to these resources as a result of the construction and operation of the new plant at the PSEG Site. The socioeconomic resources characterized are demographics, community characteristics, historic properties, and populations potentially subject to environmental justice considerations.

The characterization of socioeconomic resources is presented on a spatial and temporal (demography) basis. The larger geographic area of analysis is a circular region extending 50 mi. from the center point of the new plant. Socioeconomic resources are also characterized for the 10-mi. vicinity, the 5-mi. low population zone (LPZ), and the exclusion area as required by NUREG-1555, *Standard Review Plans for Environmental Reviews of Nuclear Power Plants: Environmental Standard Review Plan.*

For purposes of socioeconomic analysis, it is assumed that the residential distribution of the new plant construction and operational workforce resembles the residential distribution of the current workforce for HCGS and SGS, as shown in Table 2.5-1. Approximately 96.8 percent of the current workforce of the existing plants resides within nine counties in four states. Five of these counties are in NJ and include Salem (41.0 percent), Gloucester (14.6 percent), Cumberland (10.0 percent), Camden (3.6 percent), and Burlington (2.4 percent). Two PA counties are Chester (3.6 percent) and Delaware (2.5 percent). The remaining two counties are New Castle, DE (17.0 percent) and Cecil, MD (2.1 percent).

The remaining 3.2 percent of the workforce resides in 22 other counties and five other states, with one to nine employees (0.1 to 0.6 percent of the existing workforce) per county. A total of 82.6 percent of the operational workforce for SGS and HCGS resides in Salem, Gloucester, and Cumberland counties in NJ, and New Castle County, DE. The construction and operational workforce of the new plant is assumed to have the same distribution. Therefore, these four counties represent the socioeconomic Region of Influence and serve as the basis for assessment of potential project effects from construction and operation.

2.5.1 DEMOGRAPHY

The demography within the vicinity and region of the PSEG Site is characterized in the following subsections. This characterization includes a description of the resident and transient population distribution from 0 to 10 mi. and the resident population distribution from 10 to 50 mi. for:

- 2000, the resident populations from the U.S. Census Bureau (USCB) census
- 2010, the year of application submittal
- 2021, the first year of operation
- 2031 to 2081, the life of the plant at 10-yr increments

This section also provides a description of resident population characteristics within the 0 to 10 mi. vicinity, the nearest special facilities and population centers, the 0 to 5 mi. LPZ, and the population densities within 20 mi. and 50 mi. of the site. As shown in Table 2.5-2, the 0 to 10 mi. vicinity includes parts of the four county Region of Influence in DE and NJ. The 10 to 50 mi. area includes parts or all of an additional 21 counties within DE, MD, NJ, and PA. Twenty-

five counties, in four states, fall within 0 to 50 mi. of the PSEG Site, including all three counties in DE, seven counties each in MD and NJ, and eight counties in PA.

Using USCB 2000 census block data (Reference 2.5-124), population estimates are developed for concentric circles divided into 22.5 degree sectors extending in intervals from 0 to 1 mi., 1 to 2 mi., 2 to 3 mi., 3 to 4 mi., 4 to 5 mi., 5 to 10 mi., 10 to 20 mi., 20 to 30 mi., 30 to 40 mi., and 40 to 50 mi. These intervals and sectors for the 0 to 10 mi. and 10 to 50 mi. areas are shown in Figures 2.5-1 and 2.5-2, respectively. For each sector grid, the percentage of each census block's land area that fall within that sector, is calculated using the GIS software ArcMap 9.2. The equivalent proportion of each census block's population is assigned to each sector grid. If portions of two or more census blocks fall within the same sector grid, the proportional population estimates for each census block are summed to obtain the population estimate.

Population projections for 2010 are derived from the net change between the 2000 USCB population data and the 2008 USCB population estimates for each county. This net change over the eight-year period was extrapolated for an additional two years to derive the 2010 county population projections. The difference between the 2000 USCB population data and the derived 2010 population projection was used to determine the overall rate of change for each county. These rates of change were applied to the USCB 2000 census block data to obtain estimates of population change and distribution by sector and grid.

Within the 0 to 10 mi. radius, USCB 2000 local population data and USCB 2007 local population estimates were used to refine 2010 projected populations, using the methodology described in the previous paragraph. These local rates of changes were used to modify the census block data within the 0 to 10 mi. radius. The 2010 county level projections were held constant for the remaining portion of the county that fell outside the 0 to 10 mi. radius, and the rate of change for this portion of the county was adjusted proportionately.

The developed population baseline for 2010, which includes the redistributed local populations, is used to develop projections for 2021 and 2031. Using USCB census data and estimates, DE, MD, NJ, and PA have published population projections out to 2025 (NJ) and 2030 (DE, MD, and PA) at the county level (References 2.5-27, 2.5-60, 2.5-76, 2.5-89). The 2010 populations are determined by using the USCB growth rates for the 2000 through 2008 period (Reference 2.5-121). From 2010 onward, the growth rates are derived from published county population projections for each of the four states. These derived growth rates are used to extrapolate the baseline 2010 estimates out to 2021 and 2031 for each county within each state. No published data is available beyond the 2031 projections. Population projections beyond 2031 are based on the county-specific annual growth rate calculated for each county between 2021 and 2031. The county-specific growth rates for this 10-yr period are used to develop the population projections for each successive 10-yr period (2041, 2051, 2061, 2071 and 2081).

2.5.1.1 Current and Projected Population Levels

2.5.1.1.1 Resident Population Distribution within 0 to 10 Miles

Figure 2.5-1 shows a 10-mi. radius sector chart from the center point for the new plant location, which is north (N) of and adjacent to HCGS. A total of 96 individual sectors are included in the 0 to 10 mi. area.

Resident population data are calculated for each of the 96 sectors. The resultant population distributions are summarized in Table 2.5-3 by distance and year. Based on 2000 USCB census data, 33,871 people reside within 10 miles of the new plant. Approximately 94 percent of the population resides in the 5 to 10 mi. area. There is no resident population within 2 mi. of the PSEG Site. An estimated 75 individuals reside within 2 to 3 mi. of the site. The most densely populated sectors are the west-southwest (WSW), west (W), west-northwest (WNW) and northwest (NW) sectors located in DE, with a combined population of 17,690 residents. The north-northeast (NNE), northeast (NE), east-northeast (ENE), and east (E) sectors in NJ have a combined population of 11,351 residents. The nearest residence to the PSEG Site is approximately 2.8 mi. west in DE. The closest residences in Salem County are more than 3 mi. from the PSEG Site.

The three largest communities in the 10-mi. vicinity, based on USCB 2007 population estimates, are Middletown, DE (11,153), Pennsville Township, NJ (13,363), and Salem, NJ (5678) (Table 2.5-4). Lower Alloways Creek and Elsinboro Townships are the NJ townships nearest to the PSEG Site with 2007 estimated populations of 1883 and 1054, respectively. Hancocks Bridge is nearest community and is located 5 mi. east of the PSEG Site in Lower Alloways Creek Township. A comparison of the Census 2000 data and 2007 estimates indicates that Middletown grew over the 7-yr period at an average rate of 8.8 percent per year, as compared to an average rate of only 0.7 percent per year (2000 to 2008) for all of New Castle County, DE. Salem City, NJ experienced an average rate of decline of 0.4 percent per year over this 7-yr period, while Salem County grew at an average rate of 0.4 percent per year. Cumberland County grew at an annual rate of 0.9 percent.

Using the population projection methodology described in Subsection 2.5.1 to determine the 2010 to 2081 projected populations, the population within 10 mi. of the PSEG Site is projected to increase from 33,871 in 2000 to 42,743 in 2010 (Table 2.5-3). This represents an annual rate of growth of 2.35 percent per year, primarily due to the rapid growth in the Middletown-Odessa-Townsend, DE area. The population is projected to reach 45,527 in 2021 and 60,892 by the end of the new plant operation (2081).

2.5.1.1.2 Transient Population Distribution within 0 to 10 Miles

In addition to the permanent resident population within 10 mi. of the PSEG Site, there are transient populations comprised of people that do not live within the 10-mi area but enter this area on a routine basis for employment, education (schools and daycare), recreation (parks, wildlife areas, resorts, beaches, lodging, and restaurants), and medical care (hospitals and assisted living). These transient populations are shown in Table 2.5-5, based primarily on surveys conducted in 2009 (Reference 2.5-44). Inmates at correctional facilities are considered to be transients, but there are no such facilities within a 10-mi. radius of the PSEG Site (Reference 2.5-44).

The 2008 transient population within the 10-mi. area is estimated to be 12,085, with the majority of the transient population occurring within 5 to 10 mi. of the PSEG Site. Assuming the transient population grows at the same rate as the resident population, the transient population within 10 mi. is projected to increase to 12,549 in 2010, 13,378 in 2021, and 18,063 in 2081.

Approximately 97.8 percent of the transient population within 10 miles of the PSEG Site is located between 5 and 10 mi. away and no individuals are less than 3 mi. from the PSEG Site. No transient facilities are within 3 mi. of the PSEG Site, however occasional recreational users and hunters visit portions of the Mad Horse Creek WMA in NJ, the Delaware River, adjoining coastal marsh systems, and the Cedar Swamp and Augustine WMAs in DE that fall within this 3-mi. radius. The main access points for these three WMAs fall outside the 3-mi. area. The daily usage data collected at these points provides the best estimates of where the major usage occurs, because there is limited land access to areas beyond the main access points.

Transients in the 10-mi. area are primarily school students, tourists, employees (other than those at SGS and HCGS), and people undergoing medical care. As shown in Table 2.5-6, 66 percent of the transient population is located in DE and 34 percent in NJ. The transient population in NJ is concentrated in the NNE sector, and in the NNW to WSW sectors in DE. Students attending schools within the area comprise 34 percent of the transients. Visitors and tourists at local resorts, beaches, wildlife areas, parks, and marinas make up 26 percent of the transient population. Employees commuting to work represent another 34 percent of the transients, while people seeking medical care represent the smallest component of the transient population, at 5 percent.

An undetermined portion of the transient population is double counted as they may reside in the 10 mile area surrounding the site. A survey was performed to collect information on the number of people per household and number of school age children per household within the 10-mi. vicinity. Based on this information, it is estimated that 72.7 percent of the students attending schools within the 10-mi. area are residents. Therefore, the number of students counted as transients in Table 2.5-6 represents 27.3 percent of all students attending schools within the 10-mi. vicinity. There are a number of influences on the future size and distribution of transient populations. For example, a large new employer locating in the area could dramatically increase the number of transient employees. Conversely, consolidation of several small schools into a single larger facility could increase or decrease this population based on the choice of location (for example, 9 mi. versus 11 mi. from the center point), and the area that the school serves.

2.5.1.1.3 Resident Population Distribution within 10 to 50 Miles

Sixty-four sectors fall within the 10- to 50-mile area from the PSEG Site as indicated in Figure 2.5-2. Population data are calculated for each of the sectors. The resultant population distributions are summarized in Table 2.5-7 by distance and year. Based on Census 2000 data, an estimated 5,230,454 residents are located within 50 mi. of the PSEG Site; 5,196,583 people reside within 10 to 50 mi. Less than 1 percent of the regional population resides within 10 mi. of the site.

Populations within 10 to 20, 20 to 30, 30 to 40 and 40 to 50 mi. represent 9.5, 12.7, 35.2, and 42.0 percent of the regional population, respectively. 10.1 and 22.8 percent of the regional population are within 20 and 30 mi. of the PSEG Site, respectively, while over 77 percent is within 30 to 50 mi. Over 70 percent of the 10 to 50 mi. population resides in the N, NNE, or NE sectors. This distribution corresponds with the location of the primary population centers in the region. The three largest population centers within the region are Philadelphia in the NNE (1,517,550), Camden in the NE (79,904), and Wilmington in the N (72,664). Based on the population projection methodology described in Subsection 2.5.1, the areas within 10 to 20 mi. and 20 to 30 mi. of the PSEG Site center point have 2000 to 2010 average annual growth rates of 0.8 and 1.1 percent, respectively. This is more than double the 0.4 percent annual growth rate within 30 to 40 mi. The area within 40 to 50 mi. of the PSEG Site had the lowest average annual growth rate at 0.2 percent. The Philadelphia metropolitan area falls in this 30 to 50 mi. area and accounts for the majority of its population.

Table 2.5-7 shows that projected population levels within the 50-mi. region increase to 5,806,512 at the projected construction completion date (2021) for the new plant and increase to 8,138,635 by the end of the plant life (2081). Within 10 to 20 mi. of the plant, the population is projected to increase from 2010 to 2021 from 535,164 to 579,362, and from 535,164 to 828,052 in 2081. The greatest increase in population is in the 20 to 30 mi. area with projected populations of 737,825 in 2010, 811,029in 2021, and 1,321,698 in 2081. The lowest projected population growth is 40 to 50 mi. from the PSEG Site where populations are projected as 2,237,530 in 2010 and 2,346,225 in 2021, and 3,024,126 in 2081.

2.5.1.1.4 Complete Distribution and Projection of the Resident Population

Table 2.5-8 shows the distribution and projection of the resident population for all 16 sectors and distances from 2000 to 2081. The most populated sectors are the NNE, NE and N, while the least populated sectors are the south-southeast (SSE), southwest (SW), and southeast (SE). Based on 2010 population projections, the NNE sector contains 37.5 percent (2,045,463) of the total population (5,460,955) within 50 mi. of the PSEG Site, the NE sector 18.9 percent (1,034,261), and the N sector 11.5 percent (626,269). The SSE, SW, and SE sectors each contain less than one percent, and cumulatively 1.4 percent (77,966), of the total population within the 50-mi. region.

2.5.1.2 Population Data by Political Jurisdiction

All or parts of 25 counties are located within 50 mi. of the PSEG Site (Figure 2.5-2). As in Section 2.5, Cumberland, Gloucester, and Salem counties in NJ, and New Castle County in DE, are the four counties most affected by the construction and operation of a new plant at the PSEG Site. Portions of Cumberland, Salem and New Castle counties account for all of the area within 10 mi. of the PSEG site (Figure 2.5-1). As presented in Table 2.5-9, growth rates in Salem County were lower than the other counties and typically lower than statewide averages in both NJ and DE. While Salem County had a 7.2 percent population increase from 1970 to 1980, the county experienced negative growth in the decade from 1990 to 2000 (from 65,294 to 64,285). More recent data indicates that the population has increased to 66,141 (2.9 percent increase) from the years 2000 to 2008. By comparison, the growth rates of Gloucester, Cumberland and New Castle counties were higher over similar time periods. Overall, Gloucester County has experienced the highest rate of growth in the Region of Influence.

All or part of the following jurisdictions (other than counties) are located within 10 mi. of the PSEG Site: Salem City, Lower Alloways Creek Township, Elsinboro Township, Pennsville Township, Quinton Township, Stow Creek Township, and Greenwich Township (all within NJ); and Delaware City, Middletown, Odessa, and Townsend (all within DE), as well as unincorporated areas of New Castle County in Delaware. Table 2.5-9 shows the USCB populations for these political jurisdictions for 1970, 1980, 1990, 2000, and 2007 to 2008. These data indicate that the population of Salem City, NJ has steadily declined from 7648 in 1970 to 5678 in 2007 (a decline of 26 percent). By contrast, the population of Middletown, DE has increased by 191 percent, from 3834 to 11,153 (between the years 1990 to 2007). Between these extremes, most of the other jurisdictions exhibit slow rates of change, often fluctuating between small gains and losses of population from decade to decade.

2.5.1.2.1 Characteristics of the Resident Population

Table 2.5-10 presents demographic profiles from USCB 2000 for the counties and local jurisdictions presented in Table 2.5-9. County and state 2000 census information is also updated with information from the USCB 2005 – 2007 American Community Survey (ACS) 3-yr estimates for NJ, DE, and the four counties representing the socioeconomic Region of Influence. These profiles describe social structure characteristics such as gender, age, racial make-up, income, poverty levels, educational attainment, and housing characteristics for the four counties; and selected local communities within these counties that are likely to be affected by the construction and operation of a new plant.

2.5.1.2.1.1 New Jersey

Comparing USCB 2000 averages for the counties within 10 mi. and NJ, Cumberland County has the lowest per capita income ($17,376), lowest levels of educational attainment, lowest median home values ($91,200) and the highest percentages of families and individuals living below the poverty line (11.3 percent). The racial profile exhibits the lowest percentage of whites (65.9 percent) and the highest percentage of Blacks (20.2 percent). The county also exhibits the highest ratio of Hispanics (19.0 percent), an ethnic category that is enumerated independently of racial identity. Compared to the other counties, Cumberland has more foreign born individuals and more households in which a language other than English is spoken. These numbers (foreign born and foreign language household) are below NJ state averages. In common with the other counties, Cumberland County has low numbers of Asians, as well as all other racial categories. The median age of the population is younger than the other counties. It is the only county in the four-county Region of Influence in which males are a majority of the population. The large and growing Hispanic population may be the most distinctive element of the demographic profile for this county.

Gloucester County has the highest percentage of whites (87.1 percent), highest incomes ($22,708), home values ($120,100), levels of educational attainment, and home ownership in the four-county Region of Influence. The per capita income in USCB 2000 is approximately 84 percent of the NJ average, and the county exhibits lower levels of families and individuals living below the poverty line (4.3 percent, versus 11.3 and 7.2 percent for Cumberland and Salem Counties, respectively).

Salem County falls between Cumberland and Gloucester Counties on most of the demographic profile items. Based on USCB 2000 data, the population of Salem County is

older (median age 38.0) than the other counties in the four-county Region of Influence, as well as the state (36.7) or national (35.3) averages. The per capita income is $20,874 which is lower than the state average. The numbers of families and individuals living below the poverty line are higher than state averages. High school graduation rates in Salem County are close to the state average, but attainment of a college degree is slightly more than half of the state average. Owner-occupied housing in Salem County is 73 percent, which is higher than the state average (65.6 percent). The amount of vacant housing in Salem County (7.1 percent) is approximately the same as the state average (7.4 percent).

The white population and the black population in Salem County are both higher than the state averages. Asian and Hispanic populations are below the state averages. Foreign-born residents make up 2.5 percent of the county population, compared to 17.5 percent of NJ's population. Only 6.3 percent of Salem County households speak a language other than English at home, compared to a state average of 25.5 percent.

Within Salem County, the largest concentrations of black populations and people living below the poverty level reside in Salem City. USCB 2000 reports that 56.8 percent of Salem City residents are black, and that 24.7 percent of families, and 26.6 percent of individuals live below the poverty line. The population is younger than the county average, with a median age of 33.5, compared to 38.0 for the county. People 18 yr and older total 69.0 percent in the city compared to 74.4 percent in the county. However, the population 65 yr and over is approximately the same for the city and the county. Males comprise 44.6 percent of the population. The per capita income of Salem City residents is $13,559. This is lower than the county ($20,874) and state averages ($27,006).

Compared to county and state averages, fewer Salem City residents have completed high school or college and fewer people live in owner-occupied housing (41 percent versus 73 percent for the county). The value of owner-occupied housing is lower than the county average ($74,300 versus $105,200) while the percentage of vacant housing is more than twice the county average (16.8 percent versus 7.1 percent).

Quinton Township is the only other local jurisdiction in the NJ portion of the study area with a per capita income ($18,921) below the Salem County average. It is also below the county average for educational attainment. More families and fewer individuals live below the poverty level. Quinton is above average for percent of owner-occupied housing (84 percent versus 73 percent for the county) and has a smaller percentage of vacant housing (5.2 percent versus 7.1 percent for the county). Its racial profile is similar to county averages, while the median age of the population is 1 year over the Salem County average.

Economic and housing indicators for Elsinboro, Lower Alloways Creek and Pennsville townships are generally above Salem County averages, with Elsinboro generally scoring higher than the other townships. Families or individuals living in poverty range from 2 percent in Elsinboro Township to 4 percent in Lower Alloways Creek Township. Elsinboro has the highest owner-occupied housing, but also has more than twice the vacant housing units. Educational attainment for the three localities is similar to the county average. The number of racial minorities in all three townships is low; over 95 percent of the population in these localities is white, compared to the county average of 81.2 percent. The gender profiles are generally similar to the Salem County profile, but the median age of the Elsinboro population

is 5.6 yr older than the county average, while the median age for the other two townships is 1.3 to 1.5 yr over the county average.

A small portion of Stow Creek and Greenwich townships fall within the 10-mi. area. These townships have higher median ages (40.7 and 43.4, respectively), educational attainment, percentage of owner-occupied homes (87.9 percent and 86.2 percent, respectively), and median home values ($114,400 and $112,000, respectively) than the other NJ political jurisdictions. The populations in these two townships are predominantly white (93.4 percent and 90.0 percent, respectively). A small percent (5.7 percent and 6.1 percent, respectively) of the families are below poverty level.

2.5.1.2.1.2 Delaware

In DE, New Castle County accounts for approximately 64 percent of the total state 2000 population, which results in little differentiation in the demographic profiles between the county and state. In the areas within 10 mi. of the PSEG Site, demographic profiles are available for four municipalities, two of which represent populations of less than 500 persons each. Much of the population in this area resides in unincorporated areas for which specific demographic profiles are not available.

Middletown is the largest municipality in the area within 10 mi. of the PSEG Site. Middletown has a residential population that increased markedly from 3834 in 1990 to 11,153 in 2007 (Table 2.5-9). The population of the town was reported as 6161 in USCB 2000. At that time, the community exhibited a 4.8 percent gender gap. It also had the highest percentage of population under 5 yr of age (9.3 percent), the lowest over 65 years (7.9 percent) and the youngest median age (30.9 yr) of any jurisdiction in the vicinity. The racial distribution was similar to the county average; 74.4 percent white and 21.3 percent black. Per capita income was below the county average. Families and individuals living below the poverty level were highest among the DE municipalities within 10 mi. of the PSEG Site, and educational attainment was the lowest. Median home values and percent vacant housing ranked in the middle of the range of DE municipalities in the vicinity, while percent owner-occupied was the lowest.

The oldest and wealthiest municipality was the small community of Odessa (population 286 in 2000) (Table 2.5-9), with 17.8 percent over 65 yr, and a median age of 42. Odessa had the highest percentage of whites and lowest percentage of all minorities. Per capita income was highest among the DE municipalities within 10 mi. of the PSEG Site and the only municipality higher than the county average. No families, and 3.2 percent of individuals, lived below the poverty level. Household and family sizes were among the smallest in the study area, and educational attainment was the highest. Percent owner-occupied housing was average for the DE municipalities within 10 mi. of the PSEG Site, median home value was highest, and percent vacancy was lowest.

Delaware City, and the small community of Townsend, in comparison to the averages for New Castle County, have more whites, half as many blacks, and fewer other races, foreign born, or households that speak a foreign language at home. Both have per capita incomes below the county average. Delaware City has an average number of families and individuals living in poverty; Townsend has far fewer. High school attainment is slightly below average, but college graduation rates are less than half the county average. Owner-occupied housing is

above the county average while the median value of those homes is well below the county average.

2.5.1.3 Low Population Zone

The LPZ for the new plant is the area within 5 mi. of the new plant center point (Reference 2.5-133) and is illustrated in Figure 2.5-3. This area is dominated by the open waters of Delaware River and Bay and the low coastal wetlands to the east and west of the PSEG Site. Much of these coastal wetlands are state owned and managed as wildlife areas and are protected from future development. Most of the land within 2 mi. of the PSEG Site in NJ is owned by PSEG, NJDEP or by the USACE. The majority of the privately owned land within this LPZ is managed for agricultural production and private access hunting and fishing.

A total of 1929 people resided within the LPZ as of USCB 2000 (Figure 2.5-3). Two sectors (W and WNW) have a combined population of 877 (45.5 percent of LPZ total). The most populated sector in NJ was the ENE sector, with a total of 229 residents (11.9 percent) within the LPZ. The population within the LPZ is projected to grow to 2047, 2178, and 2903 by the years 2010, 2021, and 2081, respectively (Table 2.5-3).

2.5.1.4 Special Facilities and Population Centers

2.5.1.4.1 Special Facilities

Ninety-six special facilities were identified within the 10-mi. radius of the PSEG Site. These special facilities include schools and daycare centers, employers, parks and recreation areas, medical and assisted-living facilities, and lodgings where people may have to be evacuated by responsible officials during an emergency. Table 2.5-11 lists the schools and daycare centers, their sectors, and approximate distance from the PSEG Site. Table 2.5-12 lists additional employment locations including medical and assisted-living facilities. Table 2.5-13 lists parks and recreation areas, and lodging.

As shown in Table 2.5-11, a total of 39 schools and daycare centers are located within the 10-mi. radius of the PSEG Site. Twenty-four of these educational facilities are located in DE and 15 are in NJ. Twenty-one of these schools and daycare centers are between 8 and 10 mi. from the PSEG Site, five are less than 7 mi., and one is less than 5 mi. from the PSEG Site. In NJ, the majority (nine) of the schools and daycare centers are to the NNE, at distances varying from 5.4 to 9.0 mi. In DE, the schools and daycare centers are fairly evenly distributed between the WSW, W, WNW, and NW sectors. Twenty-two of these special facilities are located in DE between 8 and 10 mi. from the center point of the PSEG Site and 10 are located between 7 and 10 mi. from the site. School enrollments range from a low of 4 students to a high of over 1700.

While PSEG's HCGS and SGS are major employers (1574 employees), they are not considered special facilities. Excluding HCGS and SGS, a total of 28 employers are located within the vicinity; 15 in DE and 13 in NJ (Table 2.5-12). The highest concentration of employers occurs in the NNW and W sectors of DE, with most located between 9.6 to 9.9 mi. from the PSEG Site. The remaining businesses are 7.2 to 8.9 mi. away. Twelve of the businesses in NJ are located in the NNE sector at a distance of 6.9 to 9.1 mi. and one in the ENE sector at a distance of 5.9 mi. Employee estimates range from 3 to 720 for businesses

in this area, with Valero Oil Refinery (600) in Delaware City, Mannington Mills (550) in Salem City, Memorial Hospital (720) in Salem City, and the Office of Salem County (491) in Salem City, being the largest employers. The Valero Oil Refinery closed in late 2009. The final disposition of the refinery, including the potential for sale and/or reopening is not currently known. All the remaining businesses have from 3 to 150 employees. (Reference 2.5-44)

As indicated in Table 2.5-13, there are 27 parks and recreational facilities in the vicinity. The 27 recreational areas are distributed between DE and NJ, and are generally located along the Delaware River or its tributaries. Daily usage rates vary from 10 to 300 people for the 13 areas in NJ, and from 6 to 350 people for the 14 areas in DE. Total daily usage at all the DE and NJ recreational areas is estimated to be approximately 1900 and 1200 people, respectively.

There are 12 medical and assisted-living facilities located within the 10-mi. radius of the PSEG Site (Table 2.5-12). Seven medical and assisted-living facilities are located in DE, near Middletown and Delaware City. Three of the five medical and assisted-living facilities in NJ are located in and around Salem City, and the remaining two are located near Pennsville and Hancock's Bridge.

Lodging facilities within the 10-mi. radius of the PSEG Site are listed on Table 2.5-13. Three are located in DE (Smyrna-Middletown area) and one is in Salem City, NJ. These are small facilities ranging in capacity from 16 to 34 units for DE, and 41 units in NJ (Reference 2.5-44).

2.5.1.4.2 Population Centers

A list of the population centers (defined in 10 CFR 100.3 as densely populated communities containing more than about 25,000 residents) located within the 50-mi. radius of the PSEG Site is shown in Table 2.5-14. The sector, distance, USCB 2000 and 2007 estimated populations, and annual growth rates of these population centers are also included. There are no population centers of 25,000 or more within a 0 to10 mi. radius of the PSEG Site. Seventeen population centers exist within 10 to 50 mi. of the PSEG Site. The nearest population centers are in DE and include Newark, Dover and Wilmington, with estimated populations of 29,992, 35,811 and 72,868, respectively in 2007 (Reference 2.5-122). A comparison of USCB 2000 data and 2007 population estimates indicates that Newark and Dover populations have increased at annual rates of 0.7 and 1.6 percent, respectively; while Wilmington's population has increased 0.04 percent annually. These communities are located 15 to 20 mi. NW, S, and N of the PSEG Site, respectively. The nearest population center in NJ is the town of Bridgeton, which has an estimated 2007 population of 24,575, and therefore may be considered a population center per the 10 CFR 100.3 definition of "about 25,000 residents." The nearest boundry of Bridgeton is 15.5 miles east of the new plant center point.

The largest population center, Philadelphia (population 1,449,634, in 2007), is located over 30 mi. to the NNE. Philadelphia's population has been decreasing since 2000 at an annual rate of approximately 0.7 percent. Vineland and Millville are the closest population centers in NJ and are located 20 to 25 mi. to the E and ESE from the PSEG Site, respectively. Vineland has an estimated 2007 population of 58,505, while Millville has an estimated population of 28,459. Both communities have experienced population increases since 2000 at annual rates of approximately 0.6 percent for Vineland and 0.8 percent for Millville. The remaining 10

population centers are located 20 to 49 mi. from the PSEG Site, with 2007 estimated populations ranging from 28,179 to 78,675.

2.5.1.5 Population Density for Socioeconomic Analyses

The distribution and density of populations living in proximity to nuclear plants are an important consideration in the siting, relicensing or expansion of generating facilities.

NUREG-1437 (*Generic Environmental Impact Statement for License Renewal of Nuclear Plants*) presents a population characterization methodology based on two factors: sparseness and proximity. Sparseness measures population density and city size within 20 mi. of a site and categorizes the demographic information, as presented in Table 2.5-15. Additionally, proximity is described in NUREG-1437 as a measure of population density and city size within 50 mi. of a site. Based on these population indicators, NUREG-1437 uses the matrix presented in Table 2.5-16 to rank the population density category as low, medium, or high. Data from USCB 2000 and ArcMap 9.2 are used to determine demographic density characteristics in the vicinity of the proposed new plant. 529,579 people live within 20 mi. of the PSEG Site (Tables 2.5-3 and 2.5-7). This area represents 1256 sq. mi., yielding a population density of approximately 422 persons per square mile (sq. mi.). Based on the NUREG – 1437 criteria within the sparseness matrix, this density is in the least sparse category: (Category 4 [greater than or equal to 120 persons per sq. mi. within 20 mi.]) for the PSEG Site.

A total of 5,230,454 people live within 50 mi. of the PSEG Site (Table 2.5-7). This area represents approximately 7854 sq. mi., yielding a population density of 666 persons per sq. mi. Based on the criteria within the NUREG-1437 proximity matrix, the population density is classified as Category 4 (greater than or equal to 190 persons per sq. mi. within 50 mi.). According to the NUREG sparseness and proximity matrices (regional population ranks of sparseness Category 4 and proximity Category 4) the PSEG Site is in a high population area.

2.5.1.6 Exclusion Area Boundary

Most of the land within the EAB (Figure 3.1-2) is owned by PSEG. As described in Section 2.1, PSEG is developing an agreement in principle with the USACE to acquire an additional 85 ac. immediately to the north of HCGS. Therefore, with the land acquisition, the entire PSEG Site is 819 acres. The specific timing of land acquisition is not currently known and is subject to further PSEG and USACE actions. However, the agreement in principle with the USACE serves to establish the basis for eventual land acquisition and EAB control, necessary to support the issuance of a future COL. Although a portion of the exclusion area extends beyond the PSEG property boundaries, no one resides within the exclusion area and the closest residence is more than 2 mi. away from the EAB. The agreement in principle with the USACE provides a reasonable assurance that PSEG will have exclusive control over the area within the EAB by the time a COL is issued.

2.5.2 COMMUNITY CHARACTERISTICS

This subsection addresses the following community characteristics within the 50-mi. radius of the PSEG Site:

- economic base
- political tax jurisdictions and regional planning authorities
- personal income and housing
- education system
- aesthetics and recreation
- tax structure and distribution of present revenues
- land use
- community infrastructure and public services
- transportation

Portions of four counties are located within a 10-mi. radius of the new plant location, two in DE (New Castle and Kent) and two in NJ (Cumberland and Salem). An additional 21 counties are located within the region (50-mi. radius) of the plant location including one in DE, seven in MD, five in NJ, and eight in PA. Table 2.5-2 lists the counties located within the vicinity and region of the plant location, by state.
Table 2.5-17 lists the average number of PSEG employees assigned to HCGS or SGS, by state and county along with associated payroll information. An average of 83 percent of the PSEG employees for HCGS and SGS reside in four counties for the period from 2005 to 2008. These counties are New Castle in DE (17.4 percent) and Salem (40.8 percent), Gloucester (14.6 percent), and Cumberland (10.3 percent) in NJ. Burlington (2.4 percent) and Camden (4.2 percent) counties in NJ, and Chester (3.0 percent) and Delaware (2.3 percent) counties in PA accounted for another 11.9 percent of the permanent workforce at the two plants. Approximately 97 percent of the permanent work force for SGS and HCGS reside in NJ (73.2 percent), DE (17.5 percent), and PA (6.7 percent). The remaining 3 percent reside in MD (2.1 percent) and other states outside the region (Table 2.5-17).

Approximately 81 percent of the total compensation (salaries, wages, and fringe benefits) paid to permanent employees at SGS and HCGS from 2005 to 2008 was to residents of New Castle, Cumberland, Gloucester, and Salem counties. Approximately 97 percent of the total compensation was paid to employees residing in NJ (70.6 percent), DE (18.5 percent), and PA (8.2 percent). The remaining 3 percent was paid to residents in MD (2.3 percent) and other states outside the region (Table 2.5-17).

As the majority of the SGS and HCGS workforce come from a four-county area, the following discussion focuses on New Castle County in DE, and Cumberland, Gloucester, and Salem counties in NJ as the Region of Influence. The greatest potential for any adverse and/or beneficial impacts are likely to be reflected in these counties.

2.5.2.1 Economic Base

This subsection characterizes the following categories which contribute to the economic base of the 25-county region and four-county Region of Influence:

- Major industries and associated employment levels
- Heavy construction industries and associated labor force
- Total labor force by construction trade category
- Unemployment levels and future employment outlook
- Characterization of construction and operations workforce associated with the new plant

2.5.2.1.1 Regional Economic Base (50-Mile Radius)

2.5.2.1.1.1 Major Industries and Associated Employment Levels

The major economic centers located within 50 mi. of the PSEG Site are Baltimore in Baltimore County, MD, Camden in Camden County, NJ, Philadelphia in Philadelphia County, PA, and Wilmington in New Castle County, DE. These economic centers represent concentrations of people and businesses that contribute significantly to the regional economy. Table 2.5-18 lists the top employers in these counties within 50 mi. of the plant site. Table 2.5-19 lists the available total workforce within the region.

The three DE counties have diversified industries. The top 15 employers employ a total of 103,176 of the available labor force (442,902 in 2008). The State of DE government is the largest employer (17,346). Dover Air Force Base (military) in Kent County is the state's second largest public employer. Financial (in New Castle County) and healthcare companies (in New Castle and Kent counties) are the largest private employers, with 17,000 and 16,450 employees, respectively. The manufacturing sector is also a top employer accounting for more than 14,000 employees. Two food processing companies, Mountainaire Farms of DelMarVa and Perdue, Incorporated, in Sussex County have a combined total of 6,185 employees (Table 2.5-18).

The top 20 employers in the seven MD counties employ a total of 82,183 of the available labor force (687,862 in 2008) in these counties. Seventeen of the top 20 employers are located in Baltimore County with a total of 65,384 employees. The two of the other three top employers are located in Harford County and one in Cecil County. Government agencies, educational facilities, and healthcare providers accounted for 13 out of the top 20 employers, with 33,536, 18,249, and 15,134 employees, respectively. Aberdeen Proving Grounds, (government-military) in Harford County, is the second largest employer in the 7-county area (Table 2.5-18).

The top 20 employers in the seven NJ counties employ a total of 81,338 of the available labor force (954,898). Eleven of the top 20 employers are located in Atlantic County and employ 39,607 people. Seven are located in Burlington and Camden counties, employing 36,950 people. Ten of the top employers are casinos located in Atlantic City with a combined employment of 36,657. The largest single employer is Lockheed Martin in Burlington County, which employs 10,873 at four locations. Healthcare facilities account for six of the top employers with a total of 23,114 employees.

Fifteen of the top 20 employers in the eight Pennsylvania counties are located in Philadelphia County, and employ the majority of the available workforce (2,670,937 in 2008) in these counties. Large employers include government agencies, educational facilities, and healthcare providers with a total of 76,465 employees. Delaware, Chester, and Montgomery are the only other counties to have top employers (one, three and two top employers, respectively).

2.5.2.1.1.2 Heavy Construction Industries and Construction Trade Workforce

Construction of a new plant at the PSEG Site starts in 2016. Heavy construction industry and construction trade workforce projections for relevant construction trades within the region are available for 2016 for DE, MD, NJ, and PA, and are shown in Table 2.5-20. Based on these projections, a large number of the required construction trade workforce is expected to be available at the estimated construction start time. The size of the construction trade workforce in the 25-county area varies from a low of 29,400 for the three DE counties to a high of 105,980 for the seven PA counties (no separate statistics were available for York County, PA).

While a construction trade workforce of approximately 234,000 is projected to be available within 50 mi. of the plant, some construction trades may have a limited number of workers available for construction of the new plant at the PSEG Site due to other construction projects. These include boilermakers (385), insulation workers (2700), millwrights (1215), and structural iron and steel workers (2340).

2.5.2.1.1.3 Labor Force and Employment Trends

Table 2.5-21 presents the breakdown of employment for the 25 counties within a 50-mi. radius of the PSEG Site using the 11 categories of the U.S. Department of Commerce's Bureau of Economic Analysis (BEA). The data are summarized for the appropriate counties in each state for 1990, 2000, and 2007. All four states are similar in that the services, government, retail trade, and financial (finance, insurance, and real estate) sectors represent more than 75 percent of the total employment for 2007. PA had the highest percentage of employees in the service sector (46.4 percent). NJ is highest in the government sector (14.3 percent), DE had the highest percentage in the financial sector (13.1 percent), and MD in the construction sector (7.7 percent). DE and MD had the highest annual growth rates from 1990 to 2007, 1.5 and 1.7 percent, respectively, whereas NJ had a total employment growth rate of 1.1 percent, and PA 0.7 percent. Agricultural services, forestry, fishing and hunting (hereafter referred to as agricultural) declined in all four states during this period ranging from annual losses of 7.3 percent (PA) to 9.4 percent (MD).

Based on the 2007 BEA data, the services industry employed the greatest number of employees (39.2 percent) in the three DE counties. Other important sectors of employment in the three DE counties include government (12.9 percent); financial (13.1 percent), and retail trade (11.8 percent). From 1990 to 2007, the services, financial, and construction sectors had the highest annual growth rates in the three counties, ranging from 2.2 percent (construction) to 3.8 percent (services). The farm, manufacturing, retail trade, transportation and utilities, and wholesale trade sectors all experienced declines ranging from 0.4 percent (retail trade) to 9.0 percent (manufacturing). The decline in manufacturing was much higher in the three DE counties than for the other counties in the other three states, which had rates of decline ranging from 2.1 percent in NJ to 2.7 percent in PA.

The services industry employed the greatest number of workers (42 percent) in the seven MD counties within 50 mi. of the PSEG Site in 2007. Government (12.3 percent), retail (11.9 percent), and financial (11.3 percent) were also major employment sectors. The financial, construction, and services sectors had the highest growth rates in the seven MD counties, with growth rates ranging from 1.7 percent (construction) to 4.0 percent (services). Government and mining sector employment in the MD counties only increased 0.3 percent and 0.1 percent, respectively, whereas all the remaining sectors experienced declines ranging from 0.4 percent (wholesale trade) to 5.1 percent (transportation and utilities) to 9.4 percent for agricultural (Table 2.5-21).

The four top employment sectors for the seven NJ counties were services (40.9 percent), government (14.3 percent), retail trade (12.3 percent), and financial (9 percent). Annual growth rates in employment were highest in the NJ counties for the services, construction, farm, and financial sectors; ranging from a low of 2 percent (farm and financial) to a high of 3.0 percent (services). Government employment increased 0.6 percent from 1990 to 2007. All remaining employment sectors in the NJ counties experienced declines in employment ranging from 0.4 percent for wholesale trade, 4.2 percent for transportation and utilities, and 7.6 percent for agricultural (Table 2.5-21).

Similar to NJ, MD and DE, the service (46.4 percent), retail trade (10.3 percent), government (9.5 percent), and financial sectors (9.2 percent) in the eight PA counties had the highest employment. In addition to having the highest percentage of employees in the service sector, PA also had the highest percentage of employees in the manufacturing sector (8.7 percent). PA had the lowest annual rates of increase in employment. The highest annual growth rates were for the services (2.9 percent), construction (1.3 percent), and financial (1.0 percent) sectors. All remaining sectors experienced declines in employment from 0.1 percent for government, 2.7 percent for manufacturing, and 7.3 percent for agricultural (Table 2.5-21).

Table 2.5-19 presents labor workforce, employment, and unemployment trends for the 25-county region for 1995, 2000, and 2008. Collectively, the three counties in DE had the highest growth in the total labor force at 15.6 percent, while the seven counties in MD had the highest growth in the number of workers employed, at 16.2 percent from 1995 to 2008. The DE and MD counties had higher growth rates for both total labor force and numbers of workers employed than the counties in NJ and PA. The counties in PA had the lowest rate of growth in labor force and number employed, averaging approximately 10 percent for both categories. The rate of increase for the counties in NJ was 10.9 percent for the total labor force and 12.0 percent for the number employed. Being the least populated of the four states, DE had the smallest 2008 labor force, while the most populated state, PA, had the largest labor force. The number of employed has been increasing for the four states. However, the rate of increase was less during 2000 to 2008 than during 1995 to 2000.

A comparison of the numbers of unemployed indicates that the counties in the four states experienced a decrease in unemployment between 1995 and 2000 (18.5 percent to 40.2 percent). However, from 2000 to 2008 all the counties experienced increases in unemployment. The percent increase in the unemployment rate ranged from 35.7 percent for the MD counties to 61.1 percent for the NJ counties. DE's unemployment rates were the lowest, ranging from 3.3 percent to 4.8 percent, while NJ had the highest unemployment rates (4.0 percent to 7.0 percent).

2.5.2.1.1.4 Characterization of Construction Workforce

Large scale construction projects require a sizeable workforce that includes construction trade workers and supervisors, engineering contractors, quality control personnel, vendor staff and contractors, and start-up personnel.

Table 2.5-22 presents the workforce expected to support construction of a two-unit AP1000 plant, and is used as a guide for characterizing the labor force of the Region of Influence (Subsection 2.5.2.1.2). Additionally, as indicated in Table 2.5-23, construction of a two-unit AP1000 must be supported by a labor force that is available for an extended time period. Most of the required workforce is trade labor. The three largest trade workforce requirements are for electricians/instrument fitters (12.0 percent), structural steel and iron workers (12.0 percent), and pipefitters (11.0 percent). Carpenters (6.7 percent), laborers (6.7 percent) and operating engineers (5.4 percent) account for 19 percent of the required construction trade workforce. The non-trade workforce accounts for 30 percent (1230) of the peak workforce requirement. Operations and maintenance and start-up staff account for 11 percent of the total non-trade workforce. The vendors and subcontractors, and the engineering, procurement and construction (EPC) contractor non-trade workforce represent 10 percent. Indirect labor supporting trade labor represents 7 percent of the peak construction labor.

2.5.2.1.2 Economic Base within the Four-County Region of Influence

2.5.2.1.2.1 Major Industries and Associated Employment Levels

The major economic centers within the four-county Region of Influence are Wilmington in New Castle County, Vineland in Cumberland County, Washington Township in Gloucester County, and Pennsville Township in Salem County. These economic centers represent concentrations of people and businesses that contribute significantly to the regional economy. Table 2.5-24 lists the top 10 employers for these counties. Table 2.5-25 lists the available total workforce within the Region of Influence.

The top employers in New Castle County had a workforce of 44,200. While Wilmington has a resident population of less than 80,000 (Table 2.5-14), favorable corporate laws in DE attract many large national and international businesses. Many of these businesses have offices in New Castle County, principally in the Wilmington-Newark area. Four of the top 10 employers are financial institutions (Bank of America, J P Morgan Chase & Co., Chase Manhattan, and Wilmington Trust) employing approximately 18,500 workers. Two major manufacturing companies, DuPont and AstraZeneca, account for another 12,200 employees. Two healthcare providers, Christiana Care Health Systems and Alfred I. DuPont Hospital, employ another 9200 workers combined (Table 2.5-24).

The three counties in NJ have smaller populations than New Castle County and are less industrialized. Consequently, employers tend to be smaller and more localized. The top 10 employers for these three counties employ a total of 24,666 workers (Table 2.5-24). Healthcare providers, manufacturers, and service providers are the main employers in these three counties. The top employers for each of the three counties are South Jersey Hospital System (Health Services) in Cumberland, Underwood Hospital Systems (Heath Services) in Gloucester, and PSEG (Utilities) in Salem. Companies providing financial services are not among the top employers in any of the three NJ counties.

The top 10 employers in Cumberland County employ a total of 8931 workers in 2008. Healthcare providers, retail trade, and manufacturing companies account for nine of the 10 top employers. Two healthcare providers, South Jersey Hospital System and Elwyn, employ 3311 workers. Three retail trade companies (Wal-Mart, WaWa, and ShopRite) employ 2541 workers. Manufacturing companies include two glass companies (Gerrsheimer Glass and Durand Glass) and two food companies (General Mills/Progresso and Seabrook Brothers & Sons) and employ 2579 workers.

Five different employment categories are represented by the top 10 employers in Gloucester County. These top employers have 9290 workers. Two of the three largest employers are healthcare providers, Underwood Memorial Hospital (1860 employees) and Kennedy Memorial Hospital (1200 employees). The second largest employer is Rowan University (education services) with 1300 employees. Three manufacturing companies (Direct Group, Missa Bay, LLC, and Sony DADC) employ 2150 workers. Two transportation and warehousing entities (U.S. Postal Service and Delaware Valley Floral Group) and two wholesale trade companies (U.S. Foodservices and Godwin Pumps) have 2780 employees. (Table 2.5-24).

Of the four counties in the Region of Influence, Salem County has the lowest population with 6445 workers within six employment sectors. The utilities, manufacturing and health services sectors had the most employees (2050, 2437, and 950), respectively. PSEG (utilities) and E. I. DuPont (manufacturing) are the two top employers with 1624 and 1250 workers, respectively. Two other manufacturing companies (Mannington Mills and Anchor Glass) employ 1187 employees.

In addition to the major industries in the four-county Region of Influence, a commercial fishery does exist in the immediate vicinity of the PSEG Site (Delaware River and surrounding coastal marsh). However, the commercial fishing activities are small, for the most part family-based, operations. Use of the waters and lands surrounding the PSEG Site by commercial fishermen and trappers is reflected in the harvest information presented in Section 2.4.

2.5.2.1.2.1.1 Heavy Construction Industries and Construction Trade Workforce

Workforce projection data by construction trade was developed by the labor departments of the four counties for 2016 (Table 2.5-26). The four-county Region of Influence has a projected 2016 total construction trade workforce of 34,523. More than half of this total is in New Castle County. The Cumberland County and Salem County year 2016 construction trade workforces are 4450 and 2050, respectively. Gloucester County is projected to have a more diverse construction trade workforce with a projected 2016 total of 10,000.

2.5.2.1.2.1.2 Labor Force and Employment Trends

A breakdown of the employed labor force, by industry, for the four-county Region of Influence is shown in Table 2.5-27 for 1990, 2000, and 2007. Employment and unemployment trends for these counties are listed in Table 2.5-25.

Based on BEA data, the service industries accounted for approximately 43 percent of the total employment in New Castle County in 2007 (Table 2.5-27). The number of employees in the service sector has increased by 87 percent from 1990 to 2007. The financial sector is the second fastest growing employment industry with a 54 percent increase. The other two major

employment sectors in New Castle County are government and retail trade. The construction sector had the third highest growth (29 percent) from 1990 to 2000. The number of workers employed by the farm, transportation and utility, and retail trade sectors has decreased since 2007, offsetting gains between 1990 and 2000. Since 2000, farm, transportation, and retail trade employment have all declined by 32, 28, and 29 percent, respectively

The service, government, retail trade, and manufacturing sectors employ the most workers in Cumberland County. Farm, agricultural, government, and services were the only sectors showing consistent increases in employment from 1990 to 2007. Employment in the service and farm sectors increased by 64 and 41 percent, respectively. Employment in the government and agricultural sectors increased by 33 and 26 percent, respectively. The mining, manufacturing, and financial sectors decreased in employment during this period (52, 39, and 34 percent, respectively).

In Gloucester County, services, retail trade, and government employed the most workers. Six of the employment sectors showed an increase in employment from 1990 to 2007. Over this period, total growth within the employment sectors ranged from 6 to 306 percent. Services had the highest number of employees and a growth rate of 85 percent. While the mining sector had the fewest employees, the number of workers employed increased by 306 percent. Construction, financial, government, and wholesale trade sector employment increased by 48, 51, 30, and 81 percent, respectively. Agricultural, farm, and manufacturing were the only sectors to decline in employment. The agricultural sector had the largest decline (76 percent) from 1990 to 2007. Employment in the manufacturing sector declined consistently from 1990 to 2007, whereas employment increased for the agricultural and farm sectors from 1990 to 2000 then declined back below 1990 employment levels from 2000 to 2007.
The 2007 total employment in Salem County was 30,555. Major employment sectors include services, government, transportation and utilities, retail trade, and manufacturing. The financial, government, services, and transportation and utilities were the only sectors showing consistent increases in employment from 1990 to 2007. Increases in employment in these sectors ranged from 15 percent (government) to 48 percent (financial). While the farm sector had an overall increase in employment of 8 percent since 1990, the number of workers in this sector decreased from 2000 to 2007. The manufacturing sector has consistently declined a total of 45 percent since 1990. The wholesale and retail trade sectors have also declined at an overall rate of 18 and 19 percent, respectively

Labor workforce, employment and unemployment trends for the four-county Region of Influence are presented in Table 2.5-25 for 1995, 2000, and 2008. New Castle County had a 2008 labor force that was slightly larger than all the total labor force for Cumberland, Gloucester and Salem counties. Of the three NJ counties, Gloucester had the largest labor force and also had the largest increase in labor force and number employed 23.6 and 25.1 percent, respectively. New Castle County had the second largest increase, at approximately 12 percent for both labor force and number employed. Salem County had very little growth in its labor force and number of employed from 1995 to 2008. The labor force in Cumberland and Gloucester counties increased with higher growth in the 2000 to 2008 period than the 1995 to 2000 period. The number of persons employed decreased from 2000 to 2008 in New Castle and Salem Counties. The greatest percentage decrease in the number of employed was in Salem County, with a 2.3 percent decline from 2000 to 2008, compared to a 3.1 percent increase from 1995 to 2000. An increasing trend in the number of employed occurred in Cumberland and Gloucester counties with a 3.2 and 13.1 percent increase from 2000 to

2008, compared to 5.2 and 10.6 percent from 1995 to 2000, respectively. Increases in labor force and number of employed in New Castle were slightly below DE averages. Labor force and number of employed increases for Salem and Cumberland counties were below NJ averages, but Gloucester County's increases were more than twice as high as the state's average.

A comparison of the number of unemployed indicates that all four counties experienced a decrease in unemployment between 1995 and 2000, 16.2 percent in New Castle County and 41 percent in each of the other three counties. However, from 2000 to 2008, all the counties experienced increases in unemployment, ranging from 46.7 percent for Cumberland County to 74.1 percent for Gloucester County. The unemployment rate for New Castle County was the lowest, ranging from 3.2 to 4.7 percent and slightly lower than the DE averages in 1995 and 2000. Unemployment rates in Cumberland, Gloucester, and Salem counties were generally higher than the averages for NJ. The unemployment rates were highest in Cumberland County, ranging from 5.8 to 9.9. Unemployment rates for 2008 are still below the 1995 rates in Cumberland, Gloucester, and Salem counties, but are above the 1995 rates in New Castle County (Table 2.5-25).

2.5.2.2 Political Tax and Regional Planning Authorities

The construction and operation of a new plant at the PSEG Site results in the payment of taxes to political tax jurisdictions in DE, MD, NJ, and PA. Currently PSEG owns the HCGS and SGS in Lower Alloways Creek Township and the Energy and Environmental Resource Center (EERC) in Salem City. As of 2008, there were 1574 employees at the generating stations and 50 at the EERC. PSEG and these employees are paying a variety of taxes to political jurisdictions within DE, MD, NJ, and PA. These include payroll taxes (federal and state) for employees, sales and usage taxes for purchases, taxes on property owned and corporate income tax associated with revenues from HCGS and SGS. A new plant constructed at the PSEG Site results in similar taxes being paid to these political tax jurisdictions.

Regional planning authorities are responsible for coordinating and controlling the use of regional resources, promoting economic development, and establishing standards for protecting the environment. Most of the regional planning agencies in the region of the PSEG Site are metropolitan planning organizations mandated by the Federal Highway Administration to oversee federal funds for transportation projects.

2.5.2.2.1 Political Tax Jurisdictions

About 83 percent of PSEG's workforce at the existing HCGS and SGS are employees residing in New Castle County, DE (17.4 percent of total employees) and Salem, Gloucester, and Cumberland counties in NJ (40.8, 14.6, and 10.3 percent of total employees, respectively). Camden County, NJ was the only other political tax jurisdictions whose residents received more than 4 percent of the total payroll (Table 2.5-17). During the 2005 to 2008 period, PSEG purchased more than $3 billion in goods and services required for the operation of the HCGS and SGS. As indicated in Table 2.5-28, 97 percent of these purchases were in DE, NJ, and PA. Payroll and purchases are expected to follow a similar pattern for a new plant. The tax rates for these three states and five counties are discussed below.

2.5.2.2.1.1 Delaware Taxes

The DE assesses a variable tax rate on earned income. The income tax rate increases from 0.5 percent (taxable income of $20,500) to 5.95 percent (for taxable incomes over $60,000) (Table 2.5-29). PSEG spent a total of $30.5 million on materials and services in DE from 2005 to 2008 (Table 2.5-28). DE has no sales tax. Property tax on owned property is assessed at the county and municipal levels. The rates for New Castle County include the county assessment and assessments for local municipalities and school districts. The county collects $0.56 per $100 of assessed value, while the various municipalities and their associated school districts collect from $1.86 to $3.532 per $100 of assessed value. PSEG employees owning property in New Castle County are required to pay property tax. PSEG is not expected to own property in this county as a result of the construction and operation of a new plant. Public Service Enterprise Group does not pay corporate income tax in DE because it has no tax nexus in DE. PSEG Power, LLC and PSEG Nuclear, LLC income taxes are included in those paid by Public Service Enterprise Group. Therefore, additional tax revenues from a new plant at the PSEG Site, to political jurisdictions in DE, are resident employee payroll and property taxes.

2.5.2.2.1.2 New Jersey

Earned income in NJ is assessed at a variable rate of 1.4 percent (up to $20,000) to 8.97 percent (over $500,000) of taxable income. Generally a sales tax of 7 percent is assessed by NJ on purchases that are not specifically exempted by statute. All real property located in the state is subject to property tax unless specifically exempted by statute. Real property taxes are assessed and collected by the assessors and collectors of the respective cities and townships, but are subject to supervision and review by the county boards of taxation. The rates vary with county and municipality or township. The range of rates for Cumberland, Gloucester, and Salem counties are shown in Table 2.5-29. In addition to PSEG employees paying taxes on owned property in their respective towns/counties of residence, PSEG also owns property in Salem City and Lower Alloways Creek Township and must pay property taxes. The Salem City and Lower Alloways Creek Township property tax rates are $3.34 and $1.03 per $100 of assessed value, respectively. PSEG also pays property taxes for EEP restoration and preservation properties in Salem, Cumberland and Cape May counties in NJ. PSEG has a tax nexus in NJ, therefore a 9 percent corporate income tax is expected to apply to NJ taxable income from the new plant.

2.5.2.2.1.3 Pennsylvania

PA has a flat tax rate of 3.07 percent on earned income, with no standard deductions or personal exemptions (Table 2.5-29). A sales tax of 6 percent is collected on the purchases of materials and services (with exceptions) by the state. Taxes on real estate and personal property are assessed by the counties, school districts, and municipalities. The tax rates on real estate and personal property vary with each county, and with each school district and municipality within the counties. Public Service Enterprise Group pays a corporate income tax to PA because it has tax nexus in PA. PSEG Power, LLC and PSEG Nuclear, LLC income taxes are paid by Public Service Enterprise Group. PSEG Power, LLC and PSEG Nuclear, LLC pay taxes to PA.

2.5.2.2.2 Regional Planning Authorities

The primary regional planning authorities with jurisdiction within a 50-mi. radius of the PSEG Site are the Delaware Valley Regional Planning Commission (DVRPC), Wilmington Area Planning Council (WILMAPCO), South Jersey Transportation Planning Organization (SJTPO), and the Delaware River Basin Commission (DRBC). These regional planning authorities are focused primarily on transportation and water use and quality.

The DVRPC is comprised of members from a nine-county area in NJ and PA. Eight of these counties are in the 50-mi region and include Bucks, Chester, Delaware, Montgomery and Philadelphia counties in PA, and Burlington, Camden and Gloucester counties in NJ. The ninth county is Mercer County. This regional planning authority is comprised of representatives from the federal government, States of NJ and PA, and the nine counties. It is the federally designated metropolitan planning organization (MPO) for the greater Philadelphia area. As such, it is responsible for identifying and prioritizing regional transportation projects and allocating federal and local matching funds accordingly. Its long-range mission is to promote the core goals of increasing safety and mobility, decreasing congestion, supporting strong communities, protecting natural resources, and rebuilding existing highway and transit systems. The DVRPC had a 2008 operating budget of $23.5 million, and the 2009 to 2012 transportation improvement projects they oversee is expected to total $1.5 billion for NJ and $4 billion for PA (Reference 2.5-31). Coordination is required only if construction and operation of the new plant requires major roadway improvements under their jurisdiction. Coordination with DVRPC is not expected for the new plant.

The SJTPO is a MPO for the southern NJ region. Formed in mid-1993, SJTPO replaced three smaller MPOs, while incorporating other areas not previously served. Covering Atlantic, Cape May, Cumberland, and Salem counties, SJTPO works to provide a regional approach to solving transportation problems. In addition, SJTPO adopts long-range plans to guide transportation investment decisions, and maintains the eligibility of its member agencies to receive federal transportation funds for planning, capital improvements, and operations. Coordination with SJTPO is necessary if construction and operation of the new plant requires major improvements to roadways in Salem County. This need will be determined during the development of a COL application.

WILMAPCO is the federally designated MPO for Cecil County, MD, and New Castle County, DE. Its long-range plans are similar to the DVRPC, with a 2008 operating budget of $2.28 million. WILMAPCO is expected to oversee approximately $1.1 billion in transportation improvement projects from 2009 to 2012 (Reference 2.5-138). WILMAPCO coordination is required if construction and operation of the new plant requires major improvements to roadways under their jurisdiction. Coordination with WILMAPCO is not anticipated for the new plant.

The DRBC includes four commissioners (DE, NJ, NY and PA) and a federal representative appointed by the President of the United States. The commission is responsible for water quality protection, water supply allocation, regulatory review (permitting), water conservation initiatives, watershed planning, drought management, flood loss reduction, and recreation within the Delaware River Basin. The DRBC has both planning and regulatory functions with regard to projects that affect water use and water quality of Delaware River waters. Funding for the DRBC comes from the signatory parties, project review fees, water use charges, and

federal, state, and private grants. The DRBC's Fiscal Year 2009 budget is $5.088 million, most of which comes from the four states and federal government (Reference 2.5-28). Construction and operation of the new plant at the PSEG Site results in consumptive and noncontact cooling water use of the Delaware River and discharge of effluents to the river. Dockets for the water use/withdrawal are required from the DRBC.

2.5.2.3 Personal Income and Housing

This subsection provides an overview of the personal income levels and housing availability at the regional level and within the four-county Region of Influence (Tables 2.5-30, 2.5-31, and 2.5-32).

2.5.2.3.1 Personal Income within the 50-Mile Region

Personal income increased for all the counties within 50-mi. of the PSEG Site from 1990 to 2007 (Table 2.5-30). Personal incomes were highest in the eight PA counties (2007 average of $44,598), and lowest in the three DE counties (2007 average of $35,993). Average personal income for these counties was lower than the statewide averages in MD, DE, and NJ and higher in PA. The 2007 state wide average personal incomes were $3000 and $12,000 higher than the counties in MD and NJ, respectively. The counties in PA had 2007 average personal incomes approximately $6000 higher than the statewide averages. Increases in personal incomes in the 25 counties varied from a low of 3.7 percent for the seven NJ counties to a high of 4.5 percent for the seven MD counties. The eight counties in PA include Philadelphia County, which has the sixth largest population in the United States. As such, it is one of the major economic centers within the United States, and the surrounding counties benefit from this economic activity. This accounts for higher personal incomes in these eight counties. Camden, Burlington, and Gloucester counties in NJ and New Castle County in DE are close enough to Philadelphia to also benefit from this economic activity. The remaining counties in NJ and those in MD within 50 miles of the PSEG Site are too far removed to benefit from this economic activity. Additionally, these counties are more rural with lower populations, and limited economic activity and associated personal income.

2.5.2.3.2 Personal Income within the Four-County Region of Influence

The 2007 average personal income for the four-county Region of Influence, ranged from a low of $29,599 for Cumberland County to a high of $45,755 for New Castle County. Of the three NJ counties in the Region of Influence, Gloucester had the highest personal income, $37,331. Average annual growth of personal incomes from 1990 to 2007 ranged from 3.2 percent for Cumberland to 4.1 percent for Gloucester County. The annual growth of personal income in Salem County was 3.6 percent, which was the second lowest growth in the Region of Influence. The higher personal income in New Castle County is a result of its higher population and proximity to the Philadelphia metropolitan area. Salem County, on the other hand, has the smallest population and has limited development to preserve open space. While Cumberland County has a larger population than Salem County, it is further from the Philadelphia area and also has limited development. Gloucester has the largest population of the three NJ counties in the Region of Influence portions of this county lie adjacent to the Philadelphia metropolitan area (Table 2.5-9).

2.5.2.4 Housing

During 2005 to 2008, a total of 1488 (approximately 99 percent) of the 1504 average number of people employed at HCGS and SGS lived within a 50-mi. radius of the PSEG Site (Table 2.5-17). Over the 2005 to 2008 employment period, 73.0 percent of these employees resided in NJ, 17.5 percent in DE, 6.7 percent in PA and 2.1 percent in MD. Approximately 83 percent of the HCGS and SGS employees (1250) resided in the counties of Salem, Cumberland, Gloucester, and New Castle. Another 16 percent if these employees (238) lived in 14 of the remaining counties within 50 mi. of the PSEG Site. The operations and maintenance workforce for the new plant, is expected to have a similar pattern of residential distribution.

2.5.2.4.1 Housing within the 50-Mile Region

The large workforce within a 50-mi radius of the PSEG Site means a large majority of these workers have existing homes and do not require new housing. Some workers relocate to the area or choose to move closer to the new plant. An abundant supply of vacant homes is available on a regional basis (Table 2.5-31). According to the USCB, the number of vacant units in the 2005-2007 survey is approximately 380,000 for the region. The seven counties in MD had the least vacant units (31,500), while the eight counties in PA had the most vacant units (179,300). The number of vacant units increased between 1990 and 2005 to 2007 in all four states. NJ had the lowest overall increase of 13.7 percent, while DE and PA both increased approximately 42 percent. The 2005 to 2007 median home value was similar for the 18 counties in DE, NJ, and PA, averaging $216,000 to $218,000. The average cost of homes in the seven Maryland counties was higher at approximately $278,300. The median value of homes within the region have shown an overall increase between 2000 and 2005 to 2007, ranging from a low of 69 percent for the eight counties in PA to a high of 108 percent for the counties in MD. The median value of homes for 2008 and 2009 are not currently available from USCB. However, it is likely that the percentage increase in home values from 2000 to 2009 is less than those noted between the 2000 and 2005 to 2007 period due to the nationwide housing market declines during 2008 and 2009.

These data indicate that there is an abundance of housing available in the 25-county region, and the value of these homes has appreciated since 1990.

2.5.2.4.2 Housing within the Four-County Region of Influence

There were 273,102 owner-occupied, 95,278 renter-occupied, and 30,181vacant units available for the period 2005 to 2007 for the four-county Region of Influence (Table 2.5-32). The number of vacant units provides an indication of the housing that would be available for construction and operations workforces for the PSEG Site. The available housing units varied from a low of 2240 in Salem County to a high of 17,639 in New Castle County. Of the available 30,181 housing units in 2005 to 2007, 16,583 were rental units, ranging from a low of 685 rental units in Salem County to a high of 10,586 rental units in New Castle County. Salem County decreased in the number of rental units available between 2000 and 2005 to 2007 by 15.8 percent, while the number of rental units increased by 70.3 percent in New Castle County and 23.2 percent in Gloucester County. Median monthly rental rates in 2005 to 2007 varied from a low of $620 in Cumberland County to a high of $764 in New Castle County. The overall rate of growth in vacant units was lowest in Cumberland and Salem counties at 44 percent, and highest in New Castle County at 88 percent. The 2005 to 2007

median home values were lowest for Cumberland and Salem counties ($156,500 and $173,600, respectively) and highest for New Castle ($237,400) and Gloucester ($220,400) counties. The median home value in the four counties has increased, ranging from 65 percent in Salem County to 84 percent in Gloucester County. The difference in the number of available units and the median home values appears to be related to differences in population, development goals, and proximity to Philadelphia. As indicated in Subsection 2.5.1, Cumberland and Salem counties have smaller populations, promote open space and preservation of farmlands, and have no large municipalities located near Philadelphia. New Castle and Gloucester counties have larger populations, promote economic development, and New Castle County has two major population centers (Wilmington and Newark) in close proximity to Philadelphia.

Less than 10 percent of the vacant units within the 25-county region are located in the four-county Region of Influence. This number (30,181) is still considerable and compares favorably to the anticipated requirements of the construction and operational workforces.

2.5.2.5 Education System

There are a large number of public schools and institutions of higher learning in the 25-county region and the four-county Region of Influence. The number of public schools, enrollments, and unused capacities for the Region and Region of Influence are provided in Tables 2.5-33 and 2.5-34. The number of colleges and universities and enrollments are provided in Table 2.5-35.

2.5.2.5.1 Schools within the 50-Mile Radius

2.5.2.5.1.1 Public Schools

In 2008, enrollments in the 1376 schools identified for the 25-county region totaled 831,982 students. There were 789 elementary schools with a total enrollment of 383,158 students; 324 middle schools with a total enrollment of 185,360 students; and 263 high schools with a total enrollment of 263,464 students. The counties in PA had the largest populations and, therefore, had the largest enrollment (418,435) and number of schools (644). Four hundred and forty public schools were identified in the seven counties in NJ and these schools had an enrollment of 236,405 students. DE has 179 schools within the 50-mi. radius with a total enrollment of 104,609 students. The seven counties in MD had the fewest schools (113) and lowest in total enrollment (72,533 students) (Table 2.5-33).

Capacities of the schools in the region were readily available for 149 schools in DE and 113 schools in MD. Based on these capacity data, it is estimated that the schools in the three DE counties are at 81 percent of their capacity. As of 2008, elementary, middle, and high schools in DE had enrollments equivalent to 80, 84, and 81 percent of their respective capacities. The seven counties in MD are at approximately 92 percent of their capacity, with elementary, middle and high school enrollments equivalent to approximately 96, 80, and 96 percent of their respective capacities.

2.5.2.5.1.2 Colleges and Universities

The eight counties in PA within 50 mi. of the PSEG Site had 53 colleges and universities with enrollments of 219,865; most were located in Philadelphia County. Temple University, University of Pennsylvania, Drexel University, and Community College of Philadelphia are the largest institutions of higher learning in the eight counties in PA. DE has nine colleges and universities located within the 50-mi. radius, with enrollments of 48,039. The University of Delaware is the largest with 20,352 students. Eleven colleges and universities are located in the portions of the seven NJ counties that are within 50 mi. of the PSEG Site, and these have a combined enrollment of 59,820 students. The largest of these is Rowan University with an enrollment of 9770 students. The portions of the seven counties in MD in the 50-mi. radius had the least number of colleges and universities (3). These three institutions had a combined enrollment of 10,565 with Harford Community College having the largest enrollment (5841) (Table 2.5-35).

2.5.2.5.2 Schools within the Four-County Region of Influence

Three hundred eight public schools were identified in Cumberland, Gloucester, Salem, and New Castle counties, and these schools had a combined enrollment of 162,435 students (Table 2.5-34). There are 185 elementary, 71 middle schools, and 52 high schools within the four counties. Ten colleges and universities with total enrollments of 59,724 students are located in the four counties (Table 2.5-35).

2.5.2.5.2.1 Public Schools

Fifty-seven schools were identified in Cumberland County with a combined total enrollment of 26,679 students. Of the 57 schools, seven are high schools, 11 are middle schools, and 39 are elementary schools. The combined total enrollments for these high, middle, and elementary schools are 7706, 4125, and 14,848, respectively. The average enrollment per school is 1101 for high schools, 375 for middle schools, and 381 for elementary schools. There is one proposed new high school in Cumberland County, and several schools are undergoing expansions to add capacity for projected future enrollments due to projected population growth (References 2.5-62 and 2.5-107).

Gloucester County had the most schools and highest enrollments of the three NJ counties with 85 schools and a combined total enrollment of 49,693 students. The 14 high schools had an enrollment of 14,442 students or a per school average of 1032 students. Seventeen middle schools had enrollments totaling 11,452, and 54 elementary schools had enrollments of 23,799 students. The average enrollment per school for these middle and elementary schools was 674 and 441 students, respectively. No new schools are currently planned. However, many of the schools are undergoing expansion to add capacity for projected increases in enrollments due to projected population growth in the county (Reference 2.5-107).

Being the least populated of the four Region of Influence counties, Salem County had the fewest schools (39) and lowest enrollments. The seven high schools, 12 middle schools and 20 elementary schools had combined enrollments of 3764, 2812, and 5561 students, respectively. The average enrollment per school for high (538), middle (234) and elementary (278) schools were the lowest of the four counties. A new middle school has been proposed

and many of the schools are undergoing expansion to add capacity based on projected population growth in the county (References 2.5-37 and 2.5-107).

New Castle County had the most schools (127) and highest combined enrollment (73,926 students) of the four counties. Twenty-four high schools had a total enrollment of 20,863 students, or 869 students per school. Thirty-one middle schools had a total enrollment of 16,622 students, or 536 students per school. A total of 36,441 students were enrolled in 72 elementary schools for a per school enrollment of 506 students. Capacity data was available for 50 of the 127 schools in New Castle County. Overall, the schools in New Castle County have an unused capacity of 22.8percent. Elementary schools are at 80 percent of capacity, middle schools at 71 percent of capacity, and high schools at 79 percent of capacity. Many of the schools are undergoing expansion and some new schools are planned to add capacity based on projected population growth in the county (Reference 2.5-3).

2.5.2.5.2.2 Colleges

Ten colleges and universities are located within the four-county Region of Influence. Six of these are located in New Castle County with a total enrollment of 38,690 students. The University of Delaware had the highest enrollment, 20,352 students. Wilmington University and Delaware Technical/Community College were the other major institutions of higher learning with 2008 enrollments of 8353 and 7519, respectively. The remaining four colleges and university were located in Cumberland (1), Gloucester (2), and Salem (1) counties. Rowan University had the highest enrollment (9770) of the four NJ educational institutions and is located in Gloucester County. Gloucester County College had the second highest enrollment (6135 students), and Cumberland County and Salem Community Colleges had enrollments of 3822 and 1306 students, respectively (Table 2.5-35).

2.5.2.6 Aesthetics and Recreation (50-Mile Region)

2.5.2.6.1 Visual Resources

Visual resources of the immediate area of the PSEG Site include those of the adjacent Delaware River, the coastal marsh environment, the developed PSEG Site, and the rural/low density residential lands in the uplands. The USACE CDF is surrounded by a berm, which is covered by an invasive strain of *Phragmites.* The area within 15 mi. of the site is primarily used for agriculture.

The area adjacent to the PSEG Site is in the Delaware River Estuary Transition Zone. The Delaware River, comprised of riverine viewscapes, consists of large expanses of open water, occasional recreational and commercial watercraft, and distant vegetated shorelines.

The existing structures of the HCGS and SGS represent a developed viewshed within the immediate area of the PSEG Site. As noted in Section 2.2, the HCGS and SGS occupy 373 ac. of the 734-ac. site currently owned by PSEG. The land use within the property boundary is industrial. Visible structures include the turbine buildings, the reactor containment buildings for each station, and the existing HCGS cooling tower, which is the tallest on-site structure. This natural draft cooling tower rises 512 ft. above the surrounding landscape. The cooling tower, and its associated plume, is prominently visible. The nearest residence to the new plant is 2.8 mi. in DE (W direction), and 3.4 mi. in NJ (ENE direction). There are no major highways close

enough to the site for the public to have close-up view of the existing plants or the cooling tower. Wooded areas on uplands exist two to four miles to the east of the site that obstruct the view of the containment, turbine buildings, and support structures from local roads. No trees or structures exist to the west of the site and all structures are fully visible from the river by boat.

Coastal marsh viewscapes are characterized by expanses of herbaceous-dominated plant communities interspersed by tidally influenced channels and marsh creek systems. Transmission lines cross the marsh from SGS and HCGS, and are apparent from various vantage points. The lands immediately north of the PSEG Site are part of the 305-ac. confined disposal facility (CDF) and adjacent land owned by the USACE and NJDEP (Section 2.3). This CDF area has been used since approximately 1900 as a disposal area for materials derived from maintenance dredging of the navigation channel in the Delaware River. These lands are flat marshlands or fill areas surrounded by earth berms rising over 20 ft. above the surrounding marsh.

The viewscapes of the upland areas are characterized by predominantly open, herbaceous lands in cultivation, dominated by weedy naturalized plant communities, or characterized by scattered broken woodlots. The terrain is almost uniformly flat coastal plain, with minimal relief. The highest elevation in the county has not been specifically reported, but is likely one of seven low rises in Upper Pittsgrove Township. Sea level is the lowest point in Salem County. A roadway network consisting of Alloway Creek Neck Road and other smaller local roadways is part of the upland viewscape.

2.5.2.6.2 Recreation

Table 2.5-36 provides a summary listing of national parks, national wildlife refuges (NWR), private parks, state parks, wildlife management areas (WMA), and other parks within 50 mi. of the PSEG Site. Figure 2.5-5 shows the location of the major recreational areas within the region.

Within DE, the portions of the three counties within the 50-mi. radius include two NWRs (Bombay and Prime Hook, 25,978 ac. combined) and 12 state parks (7469 ac.). Within the four-county Region of Influence, New Castle County has 11 state parks totaling 7403 ac. (Table 2.5-36).

MD has portions of seven counties that fall within the 50-mi. radius that include two NWRs (Susquehanna and Eastern Neck), one national trust, three private parks and six state parks. A total of 39,711 ac. of these recreational lands occur in the seven MD counties (Table 2.5-36).

NJ has the greatest land area within the 50-mi. radius dedicated to recreational use (217,196 ac.). This includes two NWRs (Cape May and Supawna Meadows) which together make up 15,600 ac. Additional recreational resources include three land trusts (8365 ac.) and eight state parks (193,231 ac.). The National Park Service has designated a 300-mi. long area of the NJ coastline as the NJ Coastal Heritage Trail. This area is an auto-trail which extends from Deepwater on the Delaware River to Raritan Bay on the Atlantic Ocean. The NJ Coastal Heritage Trail is comprised of five regions Sandy Hook, Barnegat Bay, Absecon, Cape May, and Delsea (Refernce 2.5-139). Portions of the Delsea, Cape May, and Absecon regions are

located within the 50-mi. radius of the PSEG Site. Within the four-county Region of Influence, Cumberland County has a total of 7756 ac. that is committed to two natural land trusts (Glades Wildlife Refuge and Peak Reserve). Salem County has 17,775 ac. that are primarily associated with the Supawna Meadows NWR (4600 ac.), four state parks (12,566 ac.), the Burdon Hill Preserve (609 ac.), Mad Horse Creek WMA (9500 ac.), and Abbott Meadows (1011 ac.) (Table 2.5-36). A portion of the Delsea Region of the NJ Coastal Heritage Trail is located in Salem and Cumberland Counties, including a Welcome Center at Fort Mott State Park. PA has the lowest acreage dedicated to recreational land within the 50-mi. radius. Within the eight PA counties within 50 mi. from the PSEG Site, a total of 17,775 ac. of lands are recreational. This includes 200 ac. of the John Heinz NWR at Tinicum, 3500 ac. at Valley Forge National Historical Park, 9718 ac. within six state parks, and 4357 ac. within 17 land trusts (Table 2.5-36).

Festivals and sporting events throughout the region bring in tourists year round. The closest park to the PSEG Site is Meadow View Acres Campground in Salem, approximately 7 miles east of the PSEG Site. The Supawna Meadows NWR is also close to the Meadow View Acres Campground.

The National Park Service and USFWS track annual visitations to the major National Parks, and NWRs. Data from SSAR Table 2.1-6 indicate that 5.97 million people visit the five NWRs and two national parks located within 50 mi. of the new plant on an annual basis.

As indicated in Table 2.5-13, 27 recreational facilities are identified within 10 mi. of the PSEG Site. Transient data for recreation facilities within 10 mi. of the new plant in Table 2.5-6 shows that approximately 3100 people visit these facilities on a daily basis. The average daily usage for the 27 recreational facilities is 110 visitors per day.

Public recreational use is also available on PSEG-owned lands in the EEP, which includes marsh and uplands areas along the Delaware Bay in NJ and DE. The EEP is a large-scale wetlands restoration program that includes day-use public facilities for ecotourism recreation, education and research.

2.5.2.7 Tax Structure and Distribution of Present Revenues

The HCGS, SGS and EERC had a total payroll of $614.2 million from 2005 to 2008 (Table 2.5-17). As indicated in Table 2.5-28, more than $3 billion of materials and services were purchased for the operation and maintenance of the HCGS, SGS, and EERC over this same period of time. Property taxes paid for the facilities and EEP mitigation site properties owned by PSEG are listed in Table 2.5-37. DE, NJ, and PA accounted for 97 percent of the total purchases and payroll expenditures. A breakdown of the purchases, payrolls and property taxes paid to these states is presented below.

2.5.2.7.1 Delaware

The total payroll for HCGS, SGS, and EERC employees living in DE (over 99 percent in New Castle County) from 2005 to 2008 was $113.3 million (Table 2.5-17). Purchases of material and services over this same period of time for DE amounted to $30.5 million (Table 2.5-28). The precise amount of income tax and property tax paid by HCGS, SGS, and EERC employees residing in DE is not known.

2.5.2.7.2 New Jersey

Payroll expenditures and purchases of materials and services related to the operation and maintenance of the HCGS, SGS, and EERC in NJ were 71 and 65 percent of the respective total expenditures. From 2005 to 2008, payroll expenditures and purchases totaled $432.8 million (Table 2.5-17) and $2.013 billion (Table 2.5-28) in NJ. The income tax paid to NJ from the payroll expenditures is not known. At a tax rate of 7 percent on taxable purchases, NJ received considerable tax revenues from the 2005 to 2008 purchases of materials and services. Property tax revenues from the HCGS, SGS, and EERC employees that were residents and owned property in NJ are not known; however, over 1000 employees resided in the counties of Burlington, Camden, Cumberland, Gloucester, and Salem from 2005 to 2008. More than 600 of the NJ employees lived in Salem County.

As indicated in Table 2.5-37, PSEG paid property taxes for HCGS and SGS to Salem County and Lower Alloways Creek Township. Property taxes for the EERC were paid to Salem City. PSEG owns portions of several EEP mitigation sites and paid property taxes on these to the townships in which they are located. The property taxes paid to Salem City totaled $1.4 million from 2005 to 2009 or 2.8 percent of the total property tax revenues collected by the city. A total of $6.4 million of property taxes were paid to Lower Alloways Creek Township from 2005 to 2009. This represented 54.4 percent of the total property taxes collected from 2005 to 2009. Residents do not pay taxes on residences, local school taxes, or local open space municipal taxes to Lower Alloways Creek Township. The residents pay Salem County taxes and county open space taxes. As such, property taxes collected in Lower Alloways Creek Township are not retained by the township but are provided to Salem County, which provides services to residents of Lower Alloways Creek Township.

PSEG owns portions of several restoration and preservation sites managed under the EEP. PSEG retains ownership of these restored wetland and upland parcels, and paid a total of $1.4 million in property taxes to eight townships from 2005 to 2009 (Table 2.5-37).

2.5.2.7.3 Pennsylvania

From 2005 to 2008, approximately 8 percent of the HCGS, SGS, and EERC employees resided in PA with a total payroll of $50.6 million (Table 2.5-17). The majority of these employees lived in Chester County. During this same period, purchases of materials and services for the HCGS, SGS and EERC from PA accounted for 31.1 percent of the total purchases or $964 million (Table 2.5-28). The amount of income tax and property tax collected by the State of Pennsylvania and Chester County is not specifically known. Tax revenues to PA come from sales tax (6 percent) collected on the purchases.

2.5.2.8 Land Use

This subsection provides a characterization of land use planning within each of the four counties of the Region of Influence. All of these counties have planning departments which maintain land use plans and related documents. In NJ, the counties provide resources and services to municipalities and townships, and participate in regional planning organizations. Land use zoning is administered at the municipal level. NJ has a statewide land use plan and has established a process for certifying county and local plans under the State Plan.

2.5.2.8.1 New Castle County

New Castle County is the northernmost county in DE, and has the highest population density of the three counties in the state, with a density of 1239 people per sq. mi. Population growth is influenced by the accessibility to the major metropolitan areas of Philadelphia, northern NJ, New York City, and Washington, DC. Zoning ordinances at the municipal and county level set the permitted uses and intensities of uses for New Castle County. State-certified comprehensive plans adopted by the county and municipalities establish future land uses for these jurisdictions and guide development patterns. Zoning must reflect the future land-use designation in the comprehensive plan.

Agricultural and residential/urban uses accounted for approximately 29 and 28 percent respectively, of New Castle County's land area in 2002 (Reference 2.5-67). New Castle County's 2007 comprehensive plan update, projects an additional 40,805 households by 2030 and new land requirements (principally open and agricultural lands) for these new households of over 15,300 ac. (Reference 2.5-100). With this continued growth in New Castle County, particularly south of the C&D Canal, residential land use is expected to be the largest land use. New Castle County includes two of DE's three largest cities (Newark and Wilmington) and the rapidly growing Middletown-Odessa-Townsend area in southern New Castle County. A comparison of the 2000 USCB data and 2007 estimates indicates that the Middletown-Odessa-Townsend area has grown over the 7-yr period at an average rate of 8.8 percent per year as compared to an average rate of only 0.7 percent per year for New Castle County (Table 2.5-4). Permitted land use and intensities of use across New Castle County are established by both municipal zoning ordinances and the county's unified development code (Reference 2.5-69).

The *New Castle County Comprehensive Plan-2007 Update* (Reference 2.5-67) generally calls for medium-high density residential and commercial development along major roadways and within existing developments in northern New Castle County. Pockets of industrial and office uses are planned across the northern part of the county. Low and very-low density residential developments are planned for most of the remaining areas in the county, particularly those areas south of the Middletown-Odessa-Townsend area.

The *2004 Strategies for State Policies and Spending* (Reference 2.5-102) generally prioritizes the most intense state investments for areas north of the C&D Canal, south of the canal along Routes 301, 13, and 1, and in and around municipalities. Large areas along the Delaware Bay, C&D Canal, and throughout the county are limited to development due to environmental constraints and protections. The majority of the level 4 areas (the least intense investment level) in New Castle County are found south of the Middletown-Odessa-Townsend region. State-certified comprehensive plans, laying the groundwork for future growth and development, have been adopted by the majority of the New Castle County municipalities.

As the most heavily developed county in DE, New Castle County has large areas of existing commercial and industrial uses. This characteristic creates the opportunity for the development of additional complementary uses and the revitalization of underutilized sites. Municipalities have outlined their growth plans in comprehensive plans and the state has generally promoted investment in existing communities through the Livable Delaware program

(Reference 2.5-102). Many municipalities have land appropriately zoned for economic development purposes.

Due to environmentally sensitive features, nearly 200,000 ac. in New Castle County are either completely or partially protected from development by the Unified Development Code (Reference 2.5-69). These protections inhibit certain economic-development efforts in these areas. Intense economic-development efforts are inhibited in the area generally south of the Middletown-Odessa-Townsend area due to the lack of public sewer provision in the area and land-use policies allowing for only very-low-density residential development in the area.

2.5.2.8.2 Salem County

Salem County has the smallest population and slowest rate of growth among the four Region of Influence counties (Table 2.5-9). While Salem County has no measures to limit growth, several strategies are in place to influence the location of potential growth. The county has a master plan to guide future commercial and industrial development within portions of the county that already have sufficient infrastructure to sustain such development. Residential development is encouraged to concentrate in established communities. Several measures are in practice to promote and sustain the county's agricultural base, which had a value of approximately $72.5 million in 2002. In addition to protecting farmland and farming practices, these measures help to reinforce the programs guiding the location of industrial, commercial and residential development.

Land use planning and economic development objectives are documented in the *Salem County Smart Growth Plan; Open Space and Recreation Plan* and *Farmland Preservation Plan* (References 2.5-93, 2.5-95, and 2.5-96). These three plans represent the Salem County's master plan for land use and economic development.

The *2004 Salem County Smart Growth Plan* (Salem County, 2004) (References 2.5-93 and 2.5-97) established strategic goals to promote smart growth within the county's planned growth corridor (Delaware River and I-295/NJ Turnpike). Since 1996, Salem County and municipal leadership have participated in economic development conferences and collaborated with business groups and people interested in the future of the county. The consensus of these efforts is that future growth should be directed to the developed areas of the county, where it is supported by existing infrastructure and major roadways, and should be managed to embrace the traditional agricultural nature of the county. This vision is consistently represented throughout the county's *2004 Smart Growth Plan*. The Growth Management Element of this plan encourages concentrating development within developed areas, preserving open space, and maintaining the county's rural character and the community character of rural towns and villages. The Economic Development portion of the plan details the need to enhance and sustain rural environments, encourage agribusiness and tourism, and direct future development efforts to those areas most suited to or capable of growth. In support of the plan to concentrate new development in existing developed areas, the Agriculture Development Board specifically excludes the I-295 corridor from the county's 188 sq. mi. Agriculture Development Area, and these areas do not appear as prime farmlands in the Office of State Planning database (References 2.5-93 and 2.5-97).

Salem County's approach to the relationship between commercial and residential development and the promotion of agriculture is addressed in the *2008 Farmland Preservation*

Plan (References 2.5-96 and 2.5-97). According to this plan, Salem County's total area is 216,320 ac. and 130,835 of the total acreage is farm-assessed property (which includes cropland, woodland, farm structures, and the wetlands and waterways that are located on these farms). There are 753 farms in Salem County, totaling 96,238 ac. A total of 23,571 ac. of farmland are permanently preserved in Salem County due to the efforts of the Salem County Agriculture Development Board and the State Agriculture Development Committee. There are an additional 334 acres pending preservation this year; once these farms are preserved Salem County will have permanently protected 23,905 ac. of farmland. As of 2006, this represents:

- 18 percent of the land under farmland assessment
- 11 percent of the total land in the County
- 24.8 percent of the active farmland

Salem County is a largely rural area with 38 percent of its land devoted to tilled farmland and agricultural uses (Reference 2.5-93). The county also contains a significant amount of low lying land, with 30 percent of its land covered by wetlands, and 5 percent of its land composed of open waters. Forests (17 percent) and urban areas (10 percent) comprise the remainder of Salem County. Open space lands in Salem County include national wildlife refuges, wildlife management areas, and state, county, and local parks. Approximately 25 percent of 216,320 ac. in the county are permanently protected as open space:

- 28,322 acres are permanently protected as open space
- 23,571 acres of farmland are permanently preserved

The Open Space Recreation and Farmland Preservation Plans offer interconnected systems of open space and farmland preservation for the county. These preservation corridors are a system based upon: blueways, to protect surface and groundwater; greenways, as linear corridors preserving the rich forests, stream buffers, and wildlife habitats; and brownways, to ensure conservation of agricultural fields and pastures. The 10-yr goal of the *2008 Farmland Preservation Plan* is to have an additional 26,000 ac. of farmlands preserved (Reference 2.5-96). Accomplishment of this plan is through a variety of incentive plans, including land donation or bargain sale, out-right purchase, easement purchases, cost-offsets for setting aside land for agricultural use, and transfer of development rights. County and municipal tax assessments are used to help fund the farmland and open space preservation program.

2.5.2.8.3 Cumberland County

Cumberland County, NJ, is located to the south of Salem County, encompasses approximately 500 sq. mi. and has over 40 mi. of Delaware Bay coastline. It is similar to Salem County in that it has extensive wetlands along the Delaware Bay coastline, and agriculture is a mainstay of its economy. The nursery and landscape industry remains the leading sector of the agricultural industry in the area. Cumberland County accounts for 16 percent of the entire state agricultural market value. In addition to maintaining its strong agricultural base, the county has targeted industry sectors that include health care, construction, hospitality/tourism, and advanced manufacturing.

The Department of Planning and Development for Cumberland County describes its land use policy as a balance between economic development, infrastructure requirements, and

environmental preservation. The county has developed a number of plans covering economic development, environment, open space and recreation, and transportation. Combined, these represent a comprehensive and coordinated strategy for the growth, development, and conservation in Cumberland County. The principal plans are described below.

The *2005 Western/Southern Cumberland Region Strategic Plan* (Reference 2.5-18) is the most recent strategic plan and focuses primarily on economic development. The Plan, which focuses on 12 municipalities in the western and southern portion of Cumberland County, listed the following goals:

- Address the existing needs for jobs, infrastructure and economic development
- Provide balance between economic development and environmental protection
- Achieve intermunicipal agreement on development goals and strategies

This strategic plan focuses on strongly targeting and recruiting specific manufacturing industries (specialized laboratory glass manufacturing, packaging and shipping container manufacturing), business services (commercial printing, financial services and support centers, and call/customer service centers), and industries that support the pharmaceutical industry cluster in Central NJ and Southeastern Pennsylvania, including the growing biotech industry.

The *2000-2001 Cumberland County Economic Development Strategy for Action* (Reference 2.5-16) identified the following strategic goals:

- Focus county economic development in and around existing centers and villages
- Identify ways that business costs in Cumberland County can be reduced
- Continue to expand and improve training and educational opportunities
- Maintain and improve the quality of life for the county's businesses, citizens and visitors
- Target specific industrial development projects

The goals are being addressed by the Cumberland County Empowerment Zone Corporation (2009). This corporation focuses on targeted areas in Bridgeton, Millville, Vineland and Port Norris. The targeted communities have significant economic and social needs. Empowerment Zone designation enhances Cumberland County's ability to link its communities with other economic development opportunities in the area. Working relationships with these partner communities ensure that new growth and development occur in ways that protect the natural, cultural and historic character of the area. Economic development projects are promoted in these communities through loans, bonds and tax incentives that foster job creation, business development/expansion, technical assistance and training, transportation, educational programs, and community development.

The *1996 Cumberland County Farmland Preservation, Open Space, Parks and Recreation Trust Fund Plan* (Reference 2.5-16) was based on several principles. It recognized the importance of recreational facilities to health and fitness, and hunting, fishing and birding to Cumberland County's ecotourism program; that agriculture has long been the backbone of

Cumberland County's economy, generating over $2 billion per year and employing over 5000 people; that farms require relatively little public services; and that businesses view these attributes to be important aspects of the County's quality of life. In order to promote and preserve these principles, the county assesses a tax of $0.01 per $100 of assessed property value. These revenues go to the Cumberland County Farmland Preservation, Open Space, Parks and Recreation Trust Fund Plan to be used as matching funds for the County's Easement Purchase Farmland Preservation Program.

2.5.2.8.4 Gloucester County

Gloucester County is located north of Salem County and is almost the same size at 215,471 ac. With an estimated population of 287,860 people in 2008 (Table 2.5-9) it has almost four times the population of Salem County and almost twice the population of Cumberland County. Since 1990, its rate of growth has been higher than Cumberland County, higher than the average for NJ, and much higher than Salem County (Table 2.5-9). Much of the population and growth has been concentrated in suburban communities in the north part of the county, which are adjacent to major population centers in Delaware and Philadelphia Counties, Pennsylvania and Camden County, NJ. Another concentration of population is clustered around Glassboro, in the center of the county. The south and southeast portions of the county are predominantly rural and more closely resemble the agricultural character of Salem and Cumberland counties.

Gloucester County has prepared two planning documents for economic development and preservation of open space and farmlands. The *2008 Comprehensive Economic Development Plan for Gloucester County* (Reference 2.5-108) identifies areas of high economic growth potential and measures to promote this growth. The *2008 Comprehensive Farmland Preservation for Gloucester County* (Reference 2.5-64) identifies the County's Agricultural Development Areas and targets specific farmland preservation projects within these areas.

The goals established in the *2008 Comprehensive Economic Development Plan for Gloucester County* are as follows:

- Expand and diversify the County's economic base
- Reduce unemployment, municipal distress, and economic inequities
- Focus development and jobs around centers of employment and population
- Improve public transportation
- Enhance and coordinate local, state, and regional marketing efforts to promote the County

While this plan promotes the development of a broader and stronger economic base, the plan calls for new industrial and commercial development to be centers-based. The pattern of development is expected to be condensed so that new industry is located in industrial parks or in redevelopment areas. New town centers are expected to be created in the more rapidly developing municipalities in order to focus commercial activity more effectively. The agricultural industry is expected to be enhanced through the promotion of farm markets and support for the economics of agriculture, thereby more effectively preserving the land base. The aim of these planning efforts is to minimize the loss of green space, farmlands, and other open spaces.

According to the *2008 Comprehensive Farmland Preservation for Gloucester County*, farmland preservation is a crucial link in preventing the concentration of active farmland from falling below critical levels. Since the program's inception in 1989, Gloucester County has preserved 10,559 ac. of farmland. In 2002, a total 50,753 ac. of active, productive farmland contributed approximately $66 million to the county's economic base. The county has established the goal of preserving 1000 acres of farmland per year for each of the next 10 yr for a total of 20,559 ac. of preserved farmland by the end of 2017. To accomplish this goal, efforts are focused on delineating the County's Agricultural Development Area. Eleven farmland preservation projects within this area have been identified. Funding for the farmland preservation program is from the Gloucester County Farmland and Open Space Preservation Fund and from the issuance of bonds by Gloucester County Board of Freeholders. A levy of four cents is collected by the county for this fund and bonds totaling $27 million have been issued for farmland and open space preservation.

2.5.2.9 Community Infrastructure and Public Services

Public services and community infrastructure consist of public water and waste water treatment systems, police and fire departments, medical facilities, social services, and schools. They are typically located within municipalities or near population centers. Schools have previously been described in Subsection 2.5.2.5.

Potential effects of the new plant development at the PSEG Site include alterations (additions) to the demography in the communities within the four-county Region of Influence. This additional population and the potential development that it represents may have secondary effects on the support services offered by these same communities. This subsection provides a characterization of these resources as a baseline for the assessment of these potential secondary impacts in Subsections 4.4.2 and 5.8.2.

2.5.2.9.1 Public Water Supplies and Water Treatment Systems

This subsection provides a characterization of the existing public water supplies and waste water treatment systems within the four-county Region of Influence. Table 2.5-38 lists the largest municipal water suppliers that each serve more than 5000 people in the counties of Salem, Gloucester, Cumberland and New Castle. It also indicates their peak daily demands, total daily capacity and excess capacity.

Waste water treatment is provided by local jurisdictions. The treatment method used is based on the jurisdiction's needs and the technology and funds available. Table 2.5-39 details public waste water treatment systems, their permitted capacities, and their average daily usage.

2.5.2.9.1.1 Salem County

The communities of Salem County are served by a total of 15 public water systems. In addition to the large public systems, there are some small private systems that serve individual communities such as mobile home parks. Public water systems serve approximately 41,700 people in Salem County. The water systems serving the largest populations are those in Penns Grove which serves approximately 14,400 people in Salem and Gloucester counties (for this discussion, all customers of Penns Grove are assumed to reside in Salem County). The Pennsville Water Department serves approximately 13,500 people, making it the second-

largest provider of treated water in the county. The source for these water supply systems is primarily groundwater. Collectively, the three largest water suppliers in Salem County serve a population of 34,105, meeting a peak daily demand of 5.29 Mgd. These three providers have a total combined capacity of 8.75 Mgd, resulting in a net excess capacity of 3.53 Mgd (Table 2.5-38).

The present capacity utilization of the Penns Grove Water Supply is approximately 75 percent. In order to provide additional storage capacity, Carneys Point Township, which receives water from Penns Grove Water Supply, has secured federal and state grants for the Penns Grove Water Supply to construct an additional 500,000 gallon storage tank. The Penns Grove Water Supply Company has requested additional permitted capacity from NJDEP to meet the projected demand (Reference 2.5-97).

In Salem County, a population of 35,393 is served by eight wastewater treatment plants that range in size from 0.02 Mgd to 1.88 Mgd. The three smallest units serve 1820 people in Lower Alloways Creek Township. The service population in Salem City (5793) generates an average of 0.86 Mgd and is served by a plant with a capacity of 1.40 Mgd, resulting in an excess capacity of 0.54 Mgd. The average daily usage for all of Salem County is 4.17 Mgd and the total available capacity is 5.95 Mgd, which leaves an excess capacity of 1.78 Mgd (Table 2.5-39).

2.5.2.9.1.2 Cumberland County

The three largest public water systems in Cumberland County serve approximately 83,300 people. Water systems serving the largest populations are Vineland Water and Sewer Utility (33,000 people), the Millville Water Department, (27,500 people) and the Bridgeton Water Department, (22,770 people). The sources of these systems are primarily ground water. These systems supply a peak daily demand of 25.52 Mgd with a capacity of 26.95 Mgd. The net excess capacity of these systems is 1.43 Mgd. Twelve small private systems serve additional customer populations throughout Cumberland County (Table 2.5-38).

Sewer service is provided to 83,925 residents of Cumberland County by three treatment works with a combined capacity of 20.2 Mgd. County-wide usage of 11.4 Mgd results in a net excess capacity of 8.8 Mgd (Table 2.5-39).

2.5.2.9.1.3 Gloucester County

Gloucester County has 32 public water systems serving approximately 220,450. Water systems serving the largest populations are Washington Municipal Utilities Authority (48,000 people), the Monroe Municipal Utilities Authority (26,145 people), the Deptford Municipal Utilities Authority (26,000 people), and the West Deptford Water Department (20,000 people). The sources for these systems are primarily groundwater with the exception of the Deptford Municipal Utilities Authority, which uses purchased surface water. The 14 largest systems (excluding Penns Grove Water Supply) (Subsection 2.5.2.9.1.1) provide a peak daily demand of 42.34 Mgd to a customer base of 211,234. These systems have a net excess capacity of 20.84 Mgd (Table 2.5-38).

Five treatment plants in Gloucester County range in size from maximum capacity of 0.4 to 24.1 Mgd (Table 2.5-39). The population with sewer service generates 19.3 Mgd and the total available capacity is 27.1 Mgd, resulting in excess capacity of 7.8 Mgd (Table 2.5-39).

2.5.2.9.1.4 New Castle County

Seventy-five percent of drinking water in New Castle County comes from surface water sources and 25 percent is from groundwater. New Castle County is served by three privately owned water utilities and four city-owned water utilities. Table 2.5-38 lists the daily demand, total capacity and excess capacity for these seven water systems, which serve a population of 542,400 customers. For the four systems that report average daily production; a population of 287,400 uses an average of 36 Mgd. The five systems that report maximum capacity can provide up to 101.3 Mgd. For the four systems that report both average daily usage and peak capacity, there is an excess capacity of 38.3 Mgd.

A significant portion of New Castle County's population is served by the Wilmington Sewage Treatment Plant, which has a maximum capacity of approximately103 Mgd. Two small plants in Delaware City and Port Penn provide wastewater treatment for an additional population of 2141. The county has net excess waste water treatment capacity of 31.8 Mgd (Table 2.5-39).

2.5.2.9.2 Police, Fire, and Medical Services

2.5.2.9.2.1 Police Protection

Table 2.5-40 provides police and fire protection data for the 25 counties within a 50 mi. radius of the PSEG Site and highlights data from the four counties within the Region of Influence. Based on 2007 Federal Bureau of Investigation law enforcement statistics and 2007 Census Bureau population estimates, the ratio of police to citizens varies from 1:424 (one officer for 424 residents) in each of the seven MD counties to 1:566 for the seven NJ counties. The estimated total number of state, county, and municipal police ranged from 1780 for the three DE counties to over 9800 for the eight PA counties.

Salem County had the lowest ratio of residents per police officer at 241, based on an estimated total of 273 state, county, and municipal police officers within the county. There are seven municipal police departments with a total of 95 police officers in Salem County. These departments vary considerably in size from one officer (Elmer) to 24 officers (Pennsville). Carneys Point and Salem City are comparable to Pennsville in size with 22 and 23 police officers, respectively. Gloucester had the highest ratio at one police officer to 832 residents, based on an estimated 343 police officers county-wide. Of this total, 168 officers worked for 11 different police departments across the county. These police departments varied in size from 6 officers (Newfield) to 45 officers (Glassboro). Cumberland County had a ratio of 387 residents per police officer. Only three police departments were reported by the Federal Bureau of Investigation: Bridgeton, Millville and Vineland. A total of 298 police officers are employed at these municipal police departments. Bridgeton has the smallest police force at 62 officers and Vineland the largest at 155 officers.

New Castle County had the second highest ratio of 478 residents per police officer. An estimated 1101 state, county, and municipal law enforcement officers are employed in the county. Of this total 432 officers work for eight different municipal police departments. The

Wilmington Police Department is the largest with 302 police officers, followed by the Newark Police Department with 65 police officers. Delaware City has the smallest operational police department which is staffed by two officers.

2.5.2.9.2.2 Firefighting and Emergency Medical Services

Fire protection and emergency medical services (paramedics) are typically characterized by residents-per-firefighter ratios. Table 2.5-40 lists these ratios for the 25 counties in the 50-mi. region and four-county Region of Influence. The seven counties in MD had the lowest number of residents per firefighter (132) while the eight counties in PA had the highest ratio (273 residents per firefighter). The total number of firefighters for the three DE counties was 4040 (213 residents per firefighter) while the eight counties in PA had the highest number at 19,057 firefighters. Many of the fire and emergency service departments are staffed by volunteers and this accounts for the higher numbers of firefighters as compared to the number of police officers.

For the three NJ counties in the Region of Influence, the ratio varied from 195 in Cumberland County to 215 for Gloucester County. Gloucester County had the highest number of fire and emergency service personnel (1326) with a resultant ratio of 215 residents per staff member. These three counties have a total of 2728 fire and emergency service personnel to respond to fires and other emergencies (Table 2.5-40).

Firefighting and related services (emergency medical services) in Salem County are provided by approximately 37 organizations. Services include firefighting, ambulance, rescue, emergency medical, and paramedical. A county-wide 911 system routes emergency calls to the appropriate responder. Most of the county's 605 firefighters and emergency service personnel are volunteers, while some of the providers of emergency medical or paramedic services are salaried. The Salem City Fire Department operates four volunteer fire companies. Elsinboro Township operates a combined fire and ambulance station. Lower Alloways Creek Township maintains a firefighting station and a separate ambulance station. Response services are augmented through a variety of mutual aid agreements among these organizations. For example, the Salem City Fire Department participates in a mutual aid community that includes the townships of Elsinboro, Mannington and Pennsville. Four fire departments in Salem County maintain full emergency medical services; county-wide availability of such resources is accomplished through the mutual aid agreements. Additionally, Underwood-Memorial hospital provides mobile intensive care units with paramedic personnel. Many of the municipalities in Cumberland and Gloucester County follow this same mode of operation.

Of the four counties in the Region of Influence, New Castle had the highest number of fire and emergency service personnel (1649). Most of the fire fighters and emergency service personnel are volunteers and are members of the New Castle County Volunteer Firefighter's Association. This association's membership includes a total of 22 volunteer fire departments, one career fire department, and three industrial fire brigades.

2.5.2.9.2.3 Medical Services

As indicated in Table 2.5-24, there are major hospitals/hospital systems within the Region of Influence. South Jersey Hospital Regional Medical Center in Vineland and Elmer Hospital in

Elmer are located in Cumberland County. Underwood Memorial Hospital and Kennedy Memorial Hospital are located in Woodbury and Sewell in Gloucester County. Memorial Hospital of Salem is located in Salem City in Salem County. A.I. Dupont Hospital for Children is located in Wilmington, and Christiana Care Health System in Wilmington and Newark in New Castle County. As indicated in Table 2.5-41, the hospitals within the Region of Influence have a combined capacity of 1925 beds.

Table 2.5-41 lists the number of licensed beds and number of physicians for the 25 counties within the 50 mi. region of the new plant and four-county Region of Influence. Within the 25-county region there are an estimated 24,000 hospital beds and over 32,000 physicians. Based on the population of the counties within the region, the number of physicians per 1000 residents varies from 2.4 for the seven NJ counties (4460 physicians), to 4.0 for the eight PA counties (20,582 physicians). The eight PA counties have a total of 15,723 hospital beds and the highest number of beds per 1000 persons (3.0). The seven MD counties had the lowest number of beds (1836) and also the lowest number of hospital beds per 1000 persons (1.5). In addition to having the lowest ratio of physicians per 1000 residents, the seven counties in NJ had the second lowest ratio of beds per 1000 people (2.2).

There are an estimated combined total of 613 physicians and 759 hospital beds in Cumberland, Gloucester, and Salem counties. The combined total 2007 population of these three counties is 507,000 and this yields a ratio of 1.2 for the number of physicians and 1.5 for the number of beds per 1000 people. By comparison, New Castle County has a comparable population size to the total for these three counties, but has almost two times the number of physicians and 400 more hospital beds.

2.5.2.9.2.4 Social Services and Major Community Structures

Social services primarily handles family and children services; public health, and mental health; developmental disabilities; and addictive diseases; and aging services. Social services in DE are overseen by the DE Department of Health and Social Services. Social services in MD are overseen by Maryland Department of Health and Mental Hygiene. Social services in NJ are overseen by NJ Department of Health and Senior Services. Social services in PA are overseen by the Pennsylvania Department of Health.

All counties in NJ are required to have public health facilities, and these facilities must meet the standards established by the NJ Department of Health and Senior Services. Salem and Cumberland counties share a common Department of Public Health and Safety facility located in Salem City. Cumberland also has a Department of Health that is located in Milleville, NJ. Gloucester County has its Department of Health and Senior Services in Sewell. These public health facilities provide services under categories of communicable disease, environmental, nursing, public health preparedness and response, and special child. Services include communicable disease response, education, sexually transmitted disease clinic and immunizations, environmental investigations, monitoring and enforcement; counseling, and health screening (Reference 2.5-74).

The NJ Department of Human Services also has offices in each county to provide financial support, transportation, supplement Medicare, health and wellness support, assistance with housekeeping, and finding affordable housing for people with disabilities, traumatic brain damage, and AIDS. In Cumberland, Gloucester, and Salem counties, the Office for the

Disabled or Office of Disability Services are located in the cities of Millville, Woodbury, and Salem, respectively. The NJ Department of Human Services also operates the Vineland Development Center in Cumberland County in the City of Vineland. This development center provides care and training for persons who have mental retardation and/or other developmental disabilities (Reference 2.5-75).

The State of DE Department of Health and Social Services has an office in New Castle County and provides a variety of services including child support enforcement, developmental disabilities, long-term care resident protection, Medicaid and Medicare assistance, public health, substance abuse and mental health, and assistance for the aging and adults with disabilities (Reference 2.5-20). DE Department of Health and Social Services operates the Governor Bacon Health Center located in Delaware City. This 292-ac. campus is the center for a 94-bed long-term care residential facility which provides intermediate care. Other special programs provided on the campus include, the privately contracted Meadows Program, and the Recovery Center of DE, an alcohol and drug rehabilitation program. The Herman M. Holloway, Sr. Campus is a 100-ac. campus located in the city of New Castle. This facility serves as the home of the DE Psychiatric Center, the only state-operated psychiatric facility for the care and treatment of mentally ill adults. Other DE Department of Health and Social Services social service facilities located in New Castle County include: the Emily P. Bissell Hospital, a long-term care facility in Wilmington; seven State Service Centers for people who experience difficulty in meeting their basic needs of food, housing, utilities, medication and other necessities; and one Child Support Enforcement facility, four community mental health facilities (crisis services), and a Treatment Access Center (substance abuse and mental health).

Major community structures within Salem City and Hancocks Bridge (the two communities closest to the PSEG Site) include churches, community centers, and a library. The Lower Alloways Creek Township Community Center and the United Methodist Church are located in Hancocks Bridge. The Tri-County Community Action Center, Salem Free Public Library, and 31 churches of various denominations are located in Salem City. The church denominations located in Salem City include African Methodist Episcopal, Baptist, Catholic, Episcopal, Evangelical, Jehovah Witnesses, Methodist, Pentecostal, Presbyterian, Seventh-Day Adventists, and Society of Friends. Non-denominational churches in Salem City include Harvest Time Worship Center and Spirit of Life Fellowship.

2.5.2.9.3 Emergency Planning

The four states within the 50-mi. radius of the PSEG Site all have agencies that are responsible for developing and implementing emergency plans for mobilizing resources required to protect their citizens against biological, chemical, radiological, flooding and storm events. These state level agencies are the DE Emergency Management Agency (DEMA), Maryland Emergency Management Agency, New Jersey Office of Emergency Management (NJOEM), and the Pennsylvania Emergency Management Agency. These agencies coordinate with power plant owners, the FEMA, and the NRC to develop emergency response plans in the event of an accidental radiological release. Each of these agencies is responsible for coordinating their respective responsibilities in the event of an accidental radiological release.

Delaware and NJ are the only two states that fall within the 10-mi. Emergency Planning Zone (EPZ) around the PSEG Site. DEMA and NJOEM have developed Radiological Emergency Response Plans (RERP). The primary responsibility for public implementation of the emergency response plans reside with the NJ State Police and the DE Department of Safety and Homeland Security.

The NJOEM falls under the Homeland Security Branch of the NJ State Police. Within this Branch, the Radiological Emergency Response Planning & Technical Unit has the responsibility for emergency preparedness. The unit's staff responds on a 24-hr. basis to all radiological incidents or potential incidents that occur in, or threaten NJ. The majority of the 10-mi. portion of the EPZ in NJ covers Salem County. A small portion of Cumberland County is also within the EPZ, however, it is very close to the 10-mi. boundary and the area is sparsely populated. Therefore, major evacuation efforts are focused on the Salem County portion of the EPZ. The NJOEM is responsible for mobilizing law enforcement officers and fire fighters within the county to help evacuate this portion of Salem County. As indicated in Table 2.5-40, approximately 273 law enforcement personnel (including NJ State Police officers) and 605 firefighters are available within Salem County to assist with evacuation efforts.

DEMA is a division within the DE Department of Safety and Homeland Security. It is the lead state agency for coordination of comprehensive emergency preparedness, training, response, recovery and mitigation services in order to save lives, protect Delaware's economic base, and reduce the impact of emergencies. In the event of an accidental radiological release requiring evacuation of the areas of New Castle County and a small portion of Kent County located within the 10-mi. EPZ, DEMA mobilizes the law enforcement personnel and fire fighters to manage and control traffic flow, maintain order, and aid in the evacuation of people requiring special assistance (elderly, disabled, ill, and children). As indicated in Table 2.5-40, approximately 1101 law enforcement and 1649 firefighters are available within New Castle County to assist with evacuation efforts.

2.5.2.10 Transportation

The primary roadways near the PSEG Site in Salem County, NJ are:

- The existing Site Access Road/Alloway Creek Neck Road
- Locust Island Road (Salem-Hancocks Bridge Road)
- Grieves Parkway
- NJ Routes 45 and 49

New Jersey has two major highways in the area of the PSEG Site:

- Interstate Route 295
- New Jersey Turnpike

There are no accessible highways or railroads in NJ within 7 mi. of the PSEG Site.

As shown in Figure 2.5-6, several major highways are located within the region and include Interstate Routes 76, 95, 276, 295, 476, 495 and 676.

Public transportation is available in all four of the counties within the Region of Influence. The Cumberland Area Transit System provides bus transportation service to residents who are 60 and over, disabled, Veterans, blind, and the general public. The Gloucester County Special

Transportation Service provides transportation to residents who are 60 and over, disabled or who are eligible for Medicaid. The Salem County Specialized Transportation Service is available to residents who are 60 and over and disabled. New Castle County public transportation is provided by the Delaware Transit Corporation which has its principal hub in Wilmington. This transit corporation provides full-service busing, including paratransit services and has fixed bus routes available through much of New Castle County. The NJ Transit has several bus routes that serve local needs, as well as service to Philadelphia and Atlantic City. NJ Transit provides two local bus routes in Gloucester and Salem Counties, nine bus routes that provide service to Philadelphia, and one bus route for service to Atlantic City.

2.5.2.10.1 Roads

Major highways are shown on Figure 2.5-6. Salem County is traversed by two major highways, Interstate Route 295 and the NJ Turnpike. In relation to the new plant center point, NJ Routes 45 and 49 are located 7.5 mi. northeast, and Interstate Route 295 is 14 mi. to the north. DE Route 9 is located 3.1 mi. to the west. DE Routes 1 and 13 are located just over 5 mi. to the west.

The existing access road is the only land access to the PSEG Site. The combined HCGS and SGS workforce uses this road. 7 mi. east of the PSEG Site, it intersects County Road (CR) 658, which has a north-south orientation.

The workforce of HCGS and SGS travel to the PSEG Site from locations to the north, northeast, or northwest, and use a variety of interstate, state, and secondary roads for access. PSEG proposes construction of a causeway from the PSEG Site to the intersection of Money Island Road and Masons Point Road to the north-northeast. The construction and operational workforce for the new plant is expected to use this causeway in lieu of the existing access road. The proposed causeway is 4.8 mi. long and connects to CR 627. Figure 2.5-7 presents the existing roadway network that is located in proximity to the proposed causeway.

Planned transportation projects within Salem County that may affect traffic flow to and from the PSEG Site were investigated by reviewing the Draft 2010-2019 State Transportation Improvement Plan (Reference 2.5-80). According to this plan, roadway improvements being considered in Salem County that may be used by plant-related traffic include the following:

- Resurfacing of Commissioners Pike from Woodstown Road (CR 603) to Watson Mill Road (CR 672)
- Reconstruction of Salem Hancocks Bridge Road (CR 658) from Route 49 to Hagarville Road (CR 637)
- Reconstruction of Salem Hancocks Bridge Road (CR 658) from Hagarville Road (CR 637) to Fort Elfsborg Road (CR 624)
- Reconstruction of Salem Hancocks Bridge Road (CR 658) from Fort Elfsborg Road (CR 624) to Hancocks Bridge

2.5.2.10.2 Road and Highway Mileage within the Region and Region of Influence

Table 2.5-42 shows the highway mileage within the 50-mi. radius of the PSEG Site and highlights the miles of roadway within the four-county Region of Influence. Of the total roadway mileage within the 50-mi. radius (51,764), 1.9 percent is either interstate or

expressway roads, 12.9 percent is arterial roadways, and 14.2 percent is collector roads. Local roads account for the majority of the roadway network, representing approximately 71 percent of the entire transportation system within the 50-mi. radius. In the four-county Region of Influence, more than 90 percent of the total mileage is paved (References 2.5-24 and 2.5-79).

2.5.2.10.2.1 Traffic Conditions

Table 2.5-43 lists the roadways and annual average daily traffic counts (AADTs) for the roads in the area of the PSEG Site for which traffic counts were available. Vehicle volume on the roads, as measured by AADT counts, reflects the urban and rural character of Salem County, NJ in the area of the PSEG Site. The largest volume of traffic occurs on NJ Route 49 between NJ Route 45 and Yorke Street in Salem City where the recorded volume in 2005 was 12,920 vehicles per day (vpd). The second highest volume roadway is NJ Route 45 north of NJ Route 49 between CR 657 and Howell Street where the recorded volume in 2007 was 8748 vpd. Volumes in the area of Fort Elfsborg Road and Money Island Road are low (below 500 vpd). The locations of these sites, along with several others, are identified on Figure 2.5-7.

2.5.2.10.2.2 Atlantic Coast Hurricane Evacuation Routes

The State of NJ has identified coastal evacuation routes to support emergency management activities in response to hurricanes. Within Salem County the following identified coastal evaluation routes have application to the PSEG Site: CR 623 between Canton and Salem, CR 667 between Harmersville and Woodmere, NJ Route 49 north to I-295, CR 551 north to Interstate 295, NJ Route 49 south to Bridgeton, and NJ Route 45 from Salem to Woodstown (Reference 2.5-82).

2.5.2.10.3 Rail

Major rail lines or rail systems within the region include those owned by Conrail, Amtrak, Southeastern Pennsylvania Transportation Authority, Port Authority Transit Corporation, and Southern Railroad of New Jersey.

As shown in Figure 2.5-6, there are no major railroads within 8 mi. of the PSEG Site. The nearest railroad is located 8.2 mi. to the north-northeast. There is no passenger rail service in the immediate area. The closest Amtrak stations to the PSEG Site are in Newark, DE, (17 mi.) and Wilmington, DE (18 mi.).

2.5.2.10.4 Waterways

The Delaware Bay, Delaware River, Chesapeake Bay, and C&D Canal represent the major waterways within the region. As indicated in Section 2.1, the PSEG Site is located at RM 52, 14 mi. south of the Delaware Memorial Bridge. Barge traffic has access to the PSEG Site by way of the Delaware River barge slips at the southern end and western portion of the PSEG Site.

2.5.2.10.5 Airports

There are nine general aviation and business airports within 50 mi. of the PSEG Site (Table 2.5-44 and Figure 2.5-8). The Philadelphia International Airport in PA is the closest major airport within 50 mi. that provides commercial flights (Reference 2.5-34). In DE, the New Castle County Airport provides limited commercial and private air services to and from other major airports in the area. Several large commercial airports are located outside the 50-mi. radius and include Trenton-Mercer Airport, Atlantic City International Airport, and Baltimore Washington International Airport.

2.5.3 HISTORIC PROPERTIES

PSEG performed cultural resource studies in support of the ESP for the PSEG Site consisting of a GIS analysis, a records level review of properties listed on the National Register of Historic Properties (NRHP) and field surveys. GIS/records reviews were performed on an area within a 10-mi. radius of the PSEG Site. Field surveys and reviews consisted of Phase I archaeological surveys of the upland portion of the proposed causeway and an underwater survey of nearshore areas within the Delaware River. An archaeological survey was not performed at the PSEG Site on Artificial Island. Artificial Island was constructed using hydraulic fill taken from the Delaware Bay and is unlikely to contain intact archaeological resources within the fill material. However, studies considered the potential occurrence of any intact prehistoric soils (paleosols) underneath the hydraulic fill.

2.5.3.1 Prehistoric Background

The prehistory of southern NJ is divided into three broad periods describing Native American habitation and development: (1) the Paleoindian period, (2) the Archaic period, and (3) the Woodland period. All time periods are described chronologically in years Before Present (BP).

The Paleoindian period (14,800 to 10,000 BP) represents the earliest evidence of human occupation. Small groups of hunter-gatherers likely moved across the landscape exploiting resource-rich environments. Paleoindian artifacts typically associated with this period include a variety of lithic tools with the Clovis projectile point the most recognizable artifact. There are no identified stratified Paleoindian sites in southern NJ. Evidence for this period comes from the recovery of isolated Clovis points.

The Archaic period (circa 10,000 to 3000 BP) is subdivided into Early Archaic, Middle Archaic, and Late Archaic periods. The social organization during the Early (10,000 to 8500 BP) and Middle Archaic periods (8500 to 6000 BP) continued with mobile groups of hunter-gatherers with an increasingly sedentary lifestyle during the Late Archaic period (6000 to 3000 BP).

The Woodland period is subdivided into the Early Woodland, Middle Woodland, and Late Woodland periods. Changes that occurred during the Woodland period include the appearance of pottery and the introduction of the bow and arrow. The Early Woodland period (3250 to 2500 BP) is characterized by the appearance of flat bottomed vessels tempered with soapstone and Jack’s Reef Corner-Notched, Fishtail, Hellgrammite, and Meadowood projectile points. The appearance of jars and pots decorated with net impressions and cord marking occurred during the Middle Woodland period (2000 to 1100 BP). The Late Woodland

period (1000 to 400 BP) saw more intricate pottery decorations including Riggins Fabric-Impressed, Point Peninsula, and Owasco (Reference 2.5-46).

2.5.3.2 Historic Background

The Dutch were the first Europeans to explore the Delaware Bay area. By 1631, they had established a trading post and whaling station near Gloucester Point. Dutch influence weakened due to conflicts with local Native American tribes, culminating in the destruction of the trading post and whaling station circa 1632. The Swedes and Finns began to settle the Delaware Bay area and constructed Fort Christina in Wilmington, DE, around 1638. By the 1660s, the Swedes had also settled on the NJ side of Delaware Bay with an initial settlement just south of present day Salem City at Fort Elfsborg. Salem City was incorporated in 1695, with Salem County boundaries established in 1748. Salem County had an active role during the American Revolution. The British captured Salem City in 1778. Throughout the 19th and 20th centuries, southern NJ was primarily an agricultural economy based on tobacco, rye, barley, flax, hemp, cabbage, lettuce, and root vegetables. Water-based trade was also important and, by the end of the 19th century, 13 wharves were located on the Salem River (Reference 2.5-46).

2.5.3.3 Archaeological Sites within or Near the PSEG Site

2.5.3.3.1 Upland Archaeology

PSEG performed a Phase I archeological survey on a 0.9-mi. upland portion of the proposed causeway, including adjacent parcels for potential parking and lay-down areas. Archaeological surveys were performed by qualified archaeologists. Surveys were performed following consultation with the NJ Historic Preservation Office (HPO) and used methodologies established by the State of New Jersey.

The Phase I field survey identified six archaeological sites (28SA179, 28SA180, 28SA181, 28SA182, 28SA183 and 28SA186) (Table 2.5-45). All but site 28SA186 are multi-component sites with artifacts dating to the Archaic and Woodland periods, and to the mid 18th to 19th centuries. Site 28SA186 is a historic site dating to the mid 18th to 19th century. The presence of sand-tempered and grit-tempered pottery, flake debitage, and historic ceramics spanning the 18th to 19th centuries identifies these sites. Historic ceramics include porcelains, stonewares, and pearlwares (Reference 2.5-46).

All six sites are recommended as potentially eligible for inclusion in the NRHP. Table 2.5-45 provides a description of these sites. Based on initial causeway alignments, three sites (28SA181, 28SA182, 28SA183) are located in areas that can be avoided during final causeway design. Sites 28SA179, 28SA180 and 28SA186 are located within the proposed causeway footprint. Additional coordination with the NJ HPO will be conducted during causeway geotechnical investigations and detailed design, as part of the NJ land use permitting process to identify further Phase II investigation scope and a Historic Properties Management Plan may be necessary.

2.5.3.3.2 Underwater Archaeology

In response to consultation with the NJ HPO, an underwater archaeological survey was conducted near the proposed intake and barge facility. The survey consisted of the use of magnetometer, sidescan sonar, and subbottom profiler equipment to evaluate the potential presence of underwater anomalies that may represent archaeological resources. The survey area consisted of an approximate 100-ac. area potentially affected by dredging and near-shore construction activities. This survey created a 3-D map of the bay floor that is used to evaluate anomalies that may represent subsurface archaeological remains associated with sunken ships, barges or boats.

The survey identified a total of 84 magnetic anomalies, 17 sidescan sonar targets, and no subbottom profiler impedance contrasts within the project area, as identified in Figure 2.5-9. Three clusters of magnetic anomalies and two associated acoustic images exhibit characteristics indicative of vessel remains. The survey identified three near-shore features (clusters) in the proximity of the proposed barge facility and intake structure that may represent potential archaeological structures. Cluster 1 is represented by two magnetic anomalies and a sonar image that have characteristics suggestive of either shipwreck remains or bulkhead material. Cluster 2 is represented by five magnetic anomalies and a sonar image that consist of an area of small debris. The complex nature of the anomalies and debris on the bottom surface may be associated with vessel remains. Cluster 3 is composed of four magnetic anomalies. Although the Cluster 3 anomalies have no corresponding sonar image, the complex nature of the magnetic signature may be suggestive of shipwreck remains (Reference 2.5-83).

It is not known if these features are archaeological sites. Further coordination will be conducted with the NJ HPO during detailed design and subsequent NJ and USACE permitting regarding the need for additional investigations of these sites if it is determined that they are unavoidable.

2.5.3.3.3 Buried Prehistoric Soils at the PSEG Site

Background research conducted prior to the field survey showed no previously identified archaeological sites associated with buried prehistoric soils (paleosols) located on or within a 10-mi. radius of the PSEG Site. In about 1900, the USACE began disposal of dredge spoils behind a naturally occurring sandbar and bulkhead projecting into the Delaware River (Reference 2.5-46). Over the years, this diked area was enlarged to accommodate additional spoils materials produced through dredging activities associated with the maintenance of the Delaware River navigation channel. As this area was filled in and enlarged, it became known as Artificial Island. Due to the use of hydraulic fill to construct the island, intact archaeological deposits are considered unlikely within the fill material. Review of soil borings collected in 2009 as part of a geotechnical investigation of the PSEG Site was performed to determine if intact paleosols were buried during the construction of Artificial Island. The soil borings reveal a soil stratigraphy consisting of 40 to 50 ft. of hydraulic fill material overlying a rocky streambed deposit. Review reveals no evidence to support the presence of buried prehistoric soils underneath Artificial Island.

2.5.3.4 Historic Structures and Districts Identified within the Vicinity of the PSEG Site

Table 2.5-46 lists historic structures and districts listed on the NRHP and located within a 10-mi. radius of the PSEG Site. The 10-mi. radius covers counties in both DE and New Jersey. There are 10 NRHP-listed properties identified in NJ and 78 NRHP listed properties identified in DE.

The NJ portion of the vicinity contains districts located in Salem City and several properties located within the vicinity of the Hancocks Bridge community. Salem City is 7-1/2 mi. north of the PSEG Site and contains three historic districts. The Hedge-Carpenter-Thompson Historic District contains Late Victorian architecture dating to the mid 19th to early 20th century. The Broadway Historic District is a historically African-American neighborhood while the Market Street Historic District contains architecture associated with the city's commerce, industry, and government. Another collection of historic properties is located in the Hancocks Bridge community, 5 mi. east of the PSEG Site. The Hancocks Bridge community contains examples of regional architecture with the Ware House (circa 1730), the Hancock House (circa 1734), and the Alloways Creek Friends Meeting House. The Alloways Creek Friends Meeting House, an 18th century structure, served the community as a meeting place for religious activities. The Abel and Mary Nicholson House (circa 1722) is located 1.5 mi. west of the Hancocks Bridge community and was constructed by one of the first families to settle Fenwick's Colony (Salem City) (Reference 2.5-46 and Reference 2.5-65).

Eight historic districts are located in the DE portion of the vicinity. The nearest historic district, the Port Penn Historic District, is located 4.2 mi. from the PSEG Site. The furthest districts, the Townsend Historic District and the Middletown Historic District, are located 9.7 mi. from the PSEG Site. While the remaining historic properties are primarily houses distributed throughout the vicinity, additional properties include a Civil War fort, canals, hotels, and churches. Constructed in the mid 19th century, Fort Delaware played a prominent role during the American Civil War. The fort is located 8.9 mi. from the PSEG Site on Pea Patch Island in the Delaware River.

The Eastern Lock of the C&D Canal is a transportation related property used during the early 19th to early 20th century. It is located 8.4 mi. from the PSEG Site. The two NRHP listed hotels include the Short's Landing Hotel Complex located northeast of the community of Smyrna and the Augustine Beach Hotel. Constructed during the mid 19th century, the Augustine Beach Hotel was a recreational attraction through the 20th century. The hotel is located 3.9 mi. from the PSEG Site just south of Port Penn. Historic churches distributed throughout the vicinity include the Old Union Methodist Church, St. Joseph's Church, Old Drawyers Church, Old St. Paul's Methodist Episcopal Church, Old St. Anne's Church, and St. Georges Presbyterian Church (Reference 2.5-65).

2.5.3.5 Potentially Eligible Structures and Districts in Near Off-Site Areas.

This section describes several features of the project vicinity in the near off-site areas that are potentially affected by off-site access road development. The John Mason House is potentially eligible for the NRHP as a house and as a contributing element to the Elsinboro/Lower Alloways Creek Rural Agricultural Historic District (Reference 2.5-134). This potential district was identified by the Cultural Resource Consulting Group in 1996 and reported as part of the

PSEG EEP. The district was described as a collection of late seventeenth to nineteenth century farmhouses associated with salt hay farming and includes the John Mason House. The John Mason house is located at the intersection of Money Island Road and Mason Point Road and is anticipated to be outside of the zone of construction for the proposed causeway.

2.5.3.6 Native American and State Agency Consultation

New Jersey currently does not have a federally recognized Native American tribe.

Representatives from MACTEC and PSEG conducted meetings in February and August 2009 with the NJ HPO and the DE State Historic Preservation Office (SHPO). The February meeting with the NJ Historic Preservation Office consisted of a review of the Phase I archaeological investigation and overall project approach for historic properties. An additional meeting was held in August to review the results from the Phase I investigation and to discuss viewshed issues for historic properties located within the 10-mi. radius of the PSEG Site. Consultation with the DE SHPO concentrated on viewshed issues at NRHP listed historic properties located within the 10 mi. radius of the PSEG Site. Consultation with the NJ HPO and the DE SHPO will continue throughout the duration of the new plant licensing process.

2.5.3.7 Transmission Corridors

As summarized in Subsection 1.2.5, PSEG completed a conceptual evaluation during development of the ESP application to identify potential transmission requirements associated with the addition of generation at the PSEG Site. This evaluation included the PJM Regional Transmission Expansion Plan, existing operational limits at HCGS and SGS, and other PJM transmission planning inputs. PJM routinely performs analyses of the regional transmission system and forecasts appropriate upgrades to the system as part of its long-term planning cycle. These evaluations are not specific to the addition of new generation at the PSEG Site.

In order to capture the potential effects of developing off-site transmission, PSEG analyzed the potential effects of two new off-site macro-corridors during development of the ESP application. Information pertaining to alternative off-site transmission system corridors considered by PSEG is presented in Subsection 9.4.3. The two, 5-mi. wide macro-corridors analyzed are the South and West Macro-Corridors. The West Macro-Corridor (55-mi.) generally follows existing transmission line corridors, extending from the PSEG Site to Peach Bottom Substation. The South Macro-Corridor (94-mi.) also follows existing transmission line corridors and is generally consistent with the MAPP line that was preliminarily planned by PJM to extend from Indian River Substation to the PSEG Site. Each of these macro-corridors was developed with a common segment. From the PSEG Site, the hypothetical macro-corridor extends north and then west across the Delaware River to the Red Lion Substation. From this location, each of the potential macro-corridors diverge extending to the west (Peach Bottom) or south (Indian River).

Based on GIS analysis of NRHP listed sites, the South Macro-Corridor contains a total of 147 listed properties within the 5-mi. wide area. New Castle and Kent counties (DE) contain the most sites (61 and 54, respectively), whereas fewer sites are found in the macro-corridor in Salem (NJ) and Sussex County (DE) (11 and 21, respectively). In comparison, the West Macro-Corridor contains a total of 52 NRHP listed sites. The three counties containing NRHP listed sites in the macro-corridor are New Castle (21), Cecil (MD, 20), and Salem (11).

Additional discussion regarding potential off-site transmission and its potential impact is provided in Chapter 4 (Impacts of Construction), Chapter 5 (Impacts of Station Operation) and Chapter 9 (Alternatives).

2.5.4 ENVIRONMENTAL JUSTICE

2.5.4.1 Methodology

The USEPA defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies" (Reference 2.5-128). Concern that minority and/or low-income populations may bear a disproportionate share of adverse health and environmental impacts led President Clinton to issue Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, in 1994, to address these issues. The order directs federal agencies to consider environmental justice issues within their programs, policies, and decision-making.

Both the Council on Environmental Quality (Reference 2.5-15) and NRC, LIC 203, Revision 1, *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues* provide guidance for addressing environmental justice. The NRC concluded that potential environmental justice impacts could reasonably be limited to a geographic area within a 50-mi. radius of a nuclear site. Secondly, the NRC concluded that the state was appropriate as the geographic area for comparative context for impact analysis. NRC's methodology identifies minority and low-income populations within the 50-mi. region and then determines if these populations could receive disproportionately high adverse impacts from the proposed action. PSEG has adopted this approach for identifying the minority and low-income populations and associated impacts that could be affected by the proposed action. This subsection identifies populations that may be the subject of environmental justice considerations. Potential adverse impacts to these populations are identified and discussed in Chapters 4 and 5.

USCB 2000 data along with geographic information system software (ArcGIS) is used to determine the minority characteristics of resident populations by block group. Block groups represent the smallest subdivision of a census tract for which the Census Bureau tabulates population data. If any part of a block group is located within 50 mi. of the new plant, the entire block group is included in the analysis. A total of 4616 block groups are evaluated as part of this analysis (Table 2.5-47).

2.5.4.2 Minority Populations

The NRC defines a "minority" as persons having American Indian or Alaskan Native, Asian, Native Hawaiian or other Pacific Islander, Black (including African Americans), or Hispanic ethnicity. Additionally, NRC's guidance requires that (1) all other single minorities are to be treated as one population and analyzed (collectively referred to as "Other"), (2) multiracial populations are to be analyzed, and (3) the aggregate of all minority populations (collectively referred to as "Aggregate") is to be treated as one population and analyzed collectively. The guidance indicates that a minority population exists if either of the following two conditions exists:

- The minority population of the block group of the impacted area exceeds 50 percent
- The minority population percentage of the impacted area significantly (20 percentage points) exceeds the geographic area chosen for comparative analysis

For each of the 4616 block groups within the 50-mi. radius, PSEG the percentage of the block group's population represented by each minority is calculated. If any block group minority percentage exceeded 50 percent, then the block group is identified as containing a minority population. Depending on which state the block groups fell within, the states of DE, MD, NJ, and PA were selected as the geographic area for comparative analysis for the block groups. Percentages of each minority category within each state are then calculated. If any block group percentage exceeded the corresponding state percentage by more than 20 percent, then a minority population is determined to exist.

Table 2.5-47 presents the results of the analysis for minority populations. The table displays the total number of block groups for each county, the number of block groups meeting the criteria for each category of minority population, and the totals for the complete 50-mi. radius. The percentage of each minority category within each state is also presented as the basis for determining block groups that meet the criteria. The distribution of minority block groups within the 50-mi. radius is displayed in Figures 2.5-10 to 2.5-16.

Minority populations vary between the four states. The statewide Black population ranged from 9.9 percent of the population in PA to 27.7 percent in MD (Table 2.5-47). Comparatively, the population of Asians varied from 1.8 percent in PA to 5.7 percent in NJ. The category for Other varied from 1.5 percent in PA to 5.4 percent in NJ and Multiracial varied from 1.3 percent in PA to 2.7 percent in NJ. Populations of American Indian or Alaskan Native and Native Hawaiian or Other Pacific Islander groups accounted for less than 1 percent in all of the states. The Aggregate population varied from 14.6 percent in PA to 36.0 percent in MD. For persons of Hispanic ethnicity, statewide percentages of these populations varied from 3.2 percent in PA to 13.3 percent in NJ.

Of the 4616 census block groups within the 50-mi radius, 1332 met the NRC criteria for Black minority population and 1583 met the criteria for Aggregate. A total of 285 census blocks met the criteria for Hispanic, 188 for Other and 85 for Asian populations. Only 10 census blocks met the criteria for the Multiracial ethnic group. A single census block met the criteria for American Indian or Alaskan Native and none met the criteria for Native Hawaiian or Other Pacific Islander. For all categories but the Aggregate in MD, the "more than 20 percent greater than the state average" is the limiting criterion. For the Aggregate category in MD, 50 percent is the controlling criterion. As illustrated by a comparison of Figures 2.5-10 through 2.5-15, many census block groups met the criteria for two or more categories.

2.5.4.3 Low-Income Populations

NRC guidance defines low-income households based on statistical poverty thresholds. A block group is considered low-income if either of the following two conditions is met:

- The minority population of the block group of the impacted area exceeds 50 percent

- The minority population percentage of the impacted area significantly (20 percentage points) exceeds the geographic area chosen for comparative analysis

The number of low-income households in each census block group is divided by the total households for that block group to obtain the percentage of low-income households per block group. Table 2.5-47 and Figure 2.5-16 illustrate the number and distribution of low-income block groups within the 50-mi. radius from the PSEG Site based on NRC's criteria. Table 2.5-47 also presents the percentage of low-income households within each state.

Low-income households varied from 8.3 percent of total households in MD and NJ to 11.0 percent of households in PA. Among the 4616 census block groups within the 50-mi. radius, 666 met the NRC criteria. Figures 2.5-10 through 2.5-15 illustrate that many of these are also minority and/or Hispanic census block groups.

2.5.4.4 Distribution of Minority and Low-Income Populations

Table 2.5-47 presents the distribution of all classifications of environmental justice populations within the region. This distribution is illustrated for most classifications in Figures 2.5-10 through 2.5-15 (American Indian or Native Alaskan is not illustrated as this population is limited to a single block group in Philadelphia County). The majority of all environmental justice populations are concentrated within Philadelphia County, PA. Additional concentrations occur in Delaware and Montgomery counties, PA; Camden County, NJ; and New Castle County, DE. Table 2.5-48 indicates that the portion of Philadelphia County within the 50-mi. region represented 38.3 percent of all block groups. With respect to the 50-mi. radius, this portion of Philadelphia County included 73.6 percent of all Black minority block groups, 85.9 percent of Asian, 75.0 percent of Other, 90.0 percent of Multiracial, 74.0 percent of Aggregate, 68.4 percent of Hispanic, and 83.5 percent of low-income household block groups.

The four counties that account for over 82 percent of combined employment at SGS and HCGS have been previously characterized as the socioeconomic Region of Influence (Subsection 2.5.2). As compared to the above description of Philadelphia County, this four-county area represented 15.1 percent of all block groups within the 50-mi. radius, 8.1 percent of all Black block groups, 0.0 percent of Asian, 9.0 percent of Other, 7.3 percent of Aggregate, 9.9 percent of Hispanic, and 5.5 percent of low-income household block groups (the counties highlighted in Table 2.5-48). More than half of the Black, Aggregate, and low-income block groups within the Region of Influence occur in New Castle County, DE; whereas the preponderance of Other and Hispanic populations are shared between both New Castle and Cumberland counties. One Multiracial and no Asian block groups occur within the four county Region of Influence.

Within 10 mi. of the PSEG Site, all three of the block groups that encompass Salem City record minority populations of Black and Aggregate categories (Figures 2.5-10 through 2.5-15). One of the Salem City block groups meets the NRC criterion for low-income households. In Middletown, DE, one block group meets the NRC criteria for Black and Aggregate minority populations. No other block groups within the 10-mi. radius meet any of the NRC criteria for minority, ethnic or low-income household classification.
Between 10 and 20 mi. of the PSEG Site, a concentration of block groups that meet NRC criteria occurs along the I-95 corridor through Wilmington, DE, and other communities in New Castle County. This area includes block groups that meet NRC criteria for one or more of the

following categories: Black, Other, Multiracial, Aggregate, Hispanic, and low-income household.

Other locations within the 10 to 20-mi. radius include several Black and Aggregate block groups in Dover, DE to the south, and a single low-income block group in Cecil County, MD to the west-northwest.

In Salem County, NJ, Pennsville has several Black and Aggregate block groups, one Hispanic, and one low-income block group. A single minority block group meeting NRC criteria characterized by Black populations is located in rural Pilesgrove Township. In Cumberland County, NJ, the city of Bridgeton includes block groups meeting one or more of NRC criteria for minorities (Black, Other, Aggregate), Hispanic ethnicity, and low-income household. Similarly, a rural area north of Bridgeton includes two block groups meeting NRC criteria for Black and Aggregate, and one block group meeting NRC criteria for low-income household.

Within the 10 to 20-mi. radius, there are no minority block groups that meet NRC criteria for Asian races.

A search was made for information regarding other potential groups (e.g., subsistence based populations) that may be vulnerable to potential disproportionate impacts. No such special population groups are identified. Potential populations occur at a distance from the PSEG Site at which they are not vulnerable to potential construction and/or operational effects.

2.5.4.5 Minority and Low-Income Population Trends

Short-term trends for minority and low-income populations for counties with half or more of their area within the 50-mi. radius are presented in Table 2.5-49. Population data from U.S. Census American Fact Finder, which compares 2000 USCB data and the 2005 to 2007 Data from the ACS suggest that there is little to no growth of the White population. Comparatively, the Black population is slow growing, and the growth of Asian and Hispanic populations is rapid.

For the 16 counties presented in Table 2.5-49, the White population grew by a total of 1085 persons, or 0.027 percent. As a share of the total, the White population declined in 15 of the 16 counties, from 79.7 percent to 78.1 percent, overall.

Over the same time period, the Black population grew by 51,625, for a net growth of 4.4 percent. The Black share of total population grew in 13 of the 16 counties, from 23.8 to 24.4 percent, overall. This pattern can be compared to national population data, in which Blacks had a growth rate of 7 percent and accounted for 12.3 percent of the population in USCB 2000 data and 12.4 percent in the 2005 to 2007 ACS.

The Asian population exhibited the most rapid growth of any minority category, demonstrating a net increase of 51,746 and a percent increase of 28.3. The Asian population grew from 3.7 to 4.6 percent of the total population and shows proportional growth in 14 of the 16 counties. These trends compare closely with national data in which the Asian population has grown from 3.6 to 4.3 percent, representing a growth rate of 26.8 percent.

The rate of growth for the Hispanic population within the 50-mi. region was also high, with a net growth of 81,422 and an overall growth rate of 25.0 percent. The Hispanic share of total population grew from 6.6 to 8.1 percent. While the rate of growth is close to the national average of 24.8 percent, the regional population of Hispanics is about one-half of the national figure of 14.7 percent in the 2005 to 2007 ACS.

During the period between the 2000 Census and the 2005 to 2007 ACS, the percent of families living below the poverty level increased on a proportional basis in 14 of the 16 counties. The largest increase was recorded in Cumberland County (11.3 to 13.4 percent). By comparison, the largest decrease was in Salem County, NJ (7.2 to 6.3 percent).

The percent of families living below the poverty level is generally lower than the national average. Only two counties (Cumberland, NJ and Philadelphia, PA) exceed the national average; however, they accounted for 33.6 percent of regional population in Census 2000 and 31.8 percent in the 2005 to 2007 ACS.

The short-term trends illustrated in Table 2.5-49 reflect a continuation of trends reported in a demographic study of the greater Philadelphia region, most of which overlaps the 50-mi. radius (Reference 2.5-29). Seven of the 10 counties addressed in the DVRPC study are included in Table 2.5-49. Results of the DVRPC study are summarized in Table 2.5-50. From 1980 to 2000, the population of the DVRPC 10-county region grew by 8.6 percent, from 5,421,835 to 5,887,672. During this period, the White population declined by 50,707, but minority races (exclusive of Hispanics) grew by approximately 45 percent, from 1.14 million to over 1.65 million. The proportion of Whites in the population declined from 79.1 percent in 1980 to 71.9 percent in 2000. During the same period, the proportion of Blacks grew from 18.4 to 20.0 percent, and Asians grew from 1.0 to 3.5 percent. The Hispanic ethnic group, which may include individuals of any race, grew from 2.5 to 5.3 percent of the population in the 10-county area.

2.5.4.6 Migrant Populations

The U.S. Department of Agriculture conducts a Census of Agriculture that collects information on migrant workers. Results of the 2007 Census were released in February 2009. Farm operators were asked whether any hired or contract workers were migrant workers. A migrant worker is defined as a farm worker whose employment requires travel that prevents the worker from returning to his permanent place of residence the same day (Reference 2.5-126). The Census of Agriculture reports the number of farms that employed migrant labor in 2007, but is inconclusive regarding actual numbers of migrant farm workers in each county. Table 2.5-51 provides information on farms within the 50-mi. radius of the PSEG Site that employ general farm labor as well as those employing migrant labor. Although the number of migrant workers is not reported, the number of farms employing migrant labor can be compared to the larger number of farms employing general farm labor and the still larger number of farms that do not employ hired labor.

As illustrated in Table 2.5-51, four counties in southern NJ (Atlantic, Cumberland, Gloucester and Salem) and one county in PA (Chester) account for a relatively large share of farms that employ migrant labor. Table 2.5-52 illustrates the important role these farms play in NJ's agricultural economy. These four NJ counties account for 24.6 percent of all farms in the state but encompass 33.1 percent of statewide agricultural land area. This area also includes

28.6 percent of all farms that use hired labor, and employs 54.3 percent of all farm workers within the state. The four counties account for 52 percent of all farms hiring migrant workers in NJ.

The 2007 Census of Agriculture also collected information on the racial characteristics of farm operators. Table 2.5-53 provides information on minority farm operators within the 50-mi. radius from the PSEG Site. In general, minority farm operators represent only a small proportion of all farm operators in this area. On an individual basis, the largest number of Hispanic farm operators (46) is found in Chester County, PA. The highest number of Black farm operators (17) work in Gloucester County, NJ and the most Asian farm operators (8) are in Salem County, NJ.

2.5.5 NOISE

Monitoring to establish ambient day and night noise levels, during normal plant operating conditions, was conducted at seven locations around the perimeter of the PSEG Site and near key plant facilities. The location of each of the noise monitoring stations is shown in Figure 2.5-17. Monitoring was for short-term (10 minute) continuous measurements, because of the remote nature of the site and the distance to the nearest residences and recreational or other public use facilities,. Day and night measurements were taken at each location. Sources of environmental sounds noted during the observations at the PSEG Site included the HCGS cooling tower, vehicle traffic, overhead transmission lines, transformers, heating, ventilating, and air conditioning units, and aircraft in the area. PSEG security operates a small arms firing range on-site. The firing range was not active during the monitoring periods.

A commonly used measure of noise is A-weighted decibels (dBA). The overall sound level is defined as the summed level in decibels over the entire audible frequency range of approximately 16 to 20,000 cycles per second (Hertz). Measurements are recorded as Equivalent Sound Levels (L_{eq}) which is the average of the varying sound levels over the measurement period at each location. The USEPA has determined that L_{eq} is an appropriate measure for establishing protective noise levels (Reference 2.5-129).

The monitoring results for L_{eq} for each location for the day and night measurement periods and the location and site specific attributes are presented in Table 2.5-54. The L_{eq} ambient noise samples indicate higher noise levels at two locations, near the cooling tower (location 5) and the high-use on-site road (location 3). However, the higher noise levels recorded at location 3 reflect the effects of activities associated with an operating work force shift change during the pre-dawn hours. At location 5, no noticeable variation in the sound level was obtained, reflecting a relatively steady sound level due to continuous operation of the HCGS cooling tower.

The noise monitoring data indicate that noise levels associated with plant operations (cooling tower, switchyard, work force shift traffic, etc.) attenuate to levels well below 65 dBA at more distant locations along the eastern and western property boundaries. This is evident from recorded noise levels at locations 2 and 6, at which maximum values were reported to be 51.6 dBA (Table 2.5-54).

2.5.6 REFERENCES

2.5-1 About.com, Philadelphia/South Jersey: Largest Employers in the Greater Philadelphia / South Jersey Area, Website, http://philadelphia.about.com/od/employment/a/large_employers.htm, accessed on August 18, 2009.

2.5-2 Adkins Arboretum, Who We Are, Website, http://www.adkinsarboretum.org/, accessed on August 31, 2009.

2.5-3 Appoquinimink School District, 2009, Construction; Available online at http://www.apposchooldistrict.com/construction.cfm, 2009, accessed August 10, 2009.

2.5-4 Atlantic Cape Community College, College Experiences Highest Enrollment Ever, Website, http://www.atlantic.edu/about/news/article.php?article=643, accessed on August 31, 2009.

2.5-5 Baltimore County, Department of Economic Development, Baltimore County's Largest Employers, Website, http://www.baltimorecountymd.gov/Agencies/economicdev/edd_memployers.html, Revised July 2009, accessed July 21, 2009.

2.5-6 Baltimore County Public Schools, September 2008 Enrollments, Projections, and Capacities Report, Office of Strategic Planning, Towson, MD, 2009.

2.5-7 Braintrack.com, College and University Directory, Pennsylvania College Of Optometry, Website, http://www.braintrack.com/college/u/pennsylvania-college-of-optometry, accessed on August 18, 2009.

2.5-8 Brandywine Park, Friends of Wilmington Parks, Website, http://www.brandywinepark.org/parks.html, accessed on October 2, 2009.

2.5-9 Burlington County, Top List of Full-time Employees, Website, http://www.co.burlington.nj.us/departments/economic/development/employers/lists/fulltime.htm, accessed on July 22, 2009.

2.5-10 Baltimore Metropolitan Council, Baltimore County, Maryland, Major Employers List, Private Sector Employers, Website, http://www.baltometro.org/content/view/35/197/, accessed August 11, 2009.

2.5-11 Camden County Improvement Authority, Top Employers, Top Camden County Employers 2006 – 2007, Website, http://business.camdencounty.com/TopEmployers.aspx, accessed July 22, 2009.

2.5-12 Caroline County, Outdoors Hunting and Shooting Sports, Website, http://www.tourcaroline.com/outdoors-hunting.shtml, accessed on August 31, 2009.

2.5-13 Cecil County Public Schools, Budget Request: Fiscal Year 2010, Board of Education, Elkton, MD, 2009.

2.5-14 CollegeToolkit.com, Colleges and Universities by State, Website, https://www.collegetoolkit.com/college-search/colsearchstate.aspx, accessed on August 17, 2009.

2.5-15 Council on Environmental Quality, Environmental Justice Guidance Under the National Environmental Policy Act, Executive Office of the President, Washington, D.C., December 10, 1997.

2.5-16 Cumberland County, New Jersey, Planning for the Future, Economic Development, A Summary of Cumberland County Planning Initiatives, Cumberland County Economic Development Strategy for Action (2001); Cumberland Empowerment Zone (2009); and Cumberland County Farmland Preservation Open Space, Parks, and Recreation Trust Plan (1996), Website, http://www.co.cumberland.nj.us/content/173/251/761/2947/3098/2975/default.aspx, 2001, accessed August 11, 2009.

2.5-17 Cumberland County, New Jersey, Top Employers in Cumberland County, Non-Government Employers of 100 or More Employees, Website,http://www.co.cumberland.nj.us/content/165/183/555/4050.aspx, January 2009, accessed August 24, 2009.

2.5-18 Cumberland Development Corporation, Western/Southern Cumberland Region Strategic Plan – The Plan, Bridgeton, NJ.

2.5-19 Delaware Department of Education, DE Enrollment Reports: Detailed Enrollment Reports (1997-2009), Website, http://www.doe.k12.de.us/reports_data/enrollment/files/Sept30Enrollment08.xls, accessed on June 16, 2009.

2.5-20 Delaware Department of Health and Social Services, DHSS Divisions and Programs, Website, http://dhss.delaware.gov/dhss/main/dhssdivs.htm, 2009, accessed August 13, 2009.

2.5-21 Delaware Department of Labor, Delaware Department of Labor, Delaware 2016 Occupation and Industry Projections, Website, http://www.delawareworks.com/oolmi/Information/LMIData/Projections/Delaware.aspx, accessed July 20, 2009.

2.5-22 Delaware Department of Natural Resources and Environmental Control, Protecting the Sources of Your Drinking Water, Fast Facts, Dover, DE, 2007.

2.5-23 Delaware Department of Natural Resources and Environmental Control, Source Water Assessment of the United Water Delaware Public Water Supply Intake Located on the Christina River at Smalleys Pond, Available at http://www.wr.udel.edu/swaphome_old/phase2/Final_assess/SurfaceWater/UWD%20Smalleys%20SWALL.pdf, 2002.

2.5-24 Delaware Department of Transportation, Highway Performance Monitoring Systems (HPMS) Mileage and Travel Data Summary, Website, http://www.deldot.gov/information/projects/hpms/pdfs/mileage_travel_cty2005.pdf, 2005, accessed August 7, 2009.

2.5-25 Delaware Economic Development Office, Delaware Property Tax Rates 2008-2009, Website, http://dedo.delaware.gov/pdfs/main_root/publications/2008-2009_Property_Tax_Report.pdf, September 2008.

2.5-26 Delaware Economic Development Office, Comprehensive Economic Development Strategy for the State of Delaware, New Castle Co. Water Supply Facts, 2005.

2.5-27 Delaware Population Consortium (DPC), Annual Population Projections Data Tables, Version 2008 (Excel), http://stateplanning.delaware.gov/information/dpc_projections.shtml, October 31, 2008, accessed May 18, 2009.

2.5-28 Delaware River Basin Commission, DRBC Budget – 2009 Fiscal Year, Website, http://www.state.nj.us/drbc/budget.htm, March 2009, accessed July 31, 2009.

2.5-29 Delaware Valley Regional Planning Commission, Demographic Trends and Forecasts in the Philadelphia Region, April 2008.

2.5-30 Delaware State Parks, Please Choose a Park, Website, http://www.destateparks.com/park/index.asp, accessed on August 31, 2009.

2.5-31 Delaware Valley Regional Planning Commission, 2009 Weekly Planner – 2008 Annual Report, Good Planning, Website, Available at http://www.dvrpc.org/reports/AR2008.pdf, February 2009.

2.5-32 Delaware State Police, 2005 Annual Report, Website, http://dsp.delaware.gov/2005%20Annual%20Report.pdf, 2005, accessed March 17, 2009.

2.5-33 Delaware State Police, 2006-2007 Annual Report, Website, http://dsp.delaware.gov/2006-07%20Annual%20Report.pdf, accessed on August 18, 2009.

2.5-34 Federal Aviation Administration, Airport Data (5010) & Contact Information, Website, http://www.faa.gov/airports/airport_safety/airportdata_5010/, 2009, accessed February 22, 2009.

2.5-35 Federal Aviation Administration, Community: J. Hughes Technical Center in Atlantic City, Website, http://www.faa.gov/about/office_org/headquarters_offices/ato/tc, accessed on July 20, 2009.

2.5-36 Federal Bureau of Investigation, Police Employee Data by State, County, and City, Website, http://www.fbi.gov/ucr/cius2007/police/index.html, accessed on October 9, 2009.

2.5-37 Garrison Architects, Salem Considers Two New Schools, Website, http://www.garrisonarch.com/n-SalemSchools011705.html, 2005, accessed August 10, 2009.

2.5-38 Gloucester County Economic Development, Facts and Incentives, Major Employers, Website, http://www.co.gloucester.nj.us/Government/Departments/EconomicDev/factsinc/majoremp.cfm, accessed August 24, 2009.

2.5-39 Harford County Public Schools, September 30, 2008 Enrollment Report, Website, http://hcps.org/schools/Enrollmentreports.aspx, accessed on October 19, 2009.

2.5-40 Holiday Park Campground, Holiday Park Campground on Maryland's Eastern Shore, Website, https://holidaypark.com/, accessed on August 31, 2009.

2.5-41 Hoover's, PHH Corporation Company Overview, Website, http://hoover's.com/phh-corp/--ID__137686--/free-co-factsheet.xhtml, accessed on July 20, 2009.

2.5-42 Kent County, Maryland Parks and Recreation: Sassafras River Natural Resource Management Area, Website, http://www.kentcounty.com/gov/parkrec/parks/sassaf.htm, accessed on September 1, 2009.

2.5-43 Kent Economic Partnership, Dover Major Employers – Kent County, Delaware, Website, http://www.kentpartnership.org/pdf/Kent%20County%20Major%20Employers%202009%20_new.pdf, accessed July 20, 2009.

2.5-44 KLD Engineering, P.C., Development of Evacuation Time Estimates, Salem and Hope Creek Nuclear Generating Stations, Commack, New York, 2009.

2.5-45 Lockheed Martin, Careers for College Students in the Northeast, Website, http://lockheedmartinjobs.com/college_locations_northeast.asp, accessed on July 20, 2009.

2.5-46 MACTEC Engineering and Consulting, Inc., "Report of Phase I Archaeological Survey for Selected Portions of Two Access Road Alternatives," PSEG Early Site Permit Application Salem County, New Jersey, December 30, 2009.

2.5-47 Manta, Air Liquide America LP profile based on data provided by Dun and Bradstreet, 2009, Website, http:/www.manta.com/company/mm77bp3, accessed June 11, 2009.

2.5-48 Manta, Autotype Holdings (USA), Inc. profile based on data provided by Dun and Bradstreet, 2009, Website, http:/www.manta.com/company/mm2s0m1, accessed June 11, 2009.

2.5-49 Manta, Delstar Technologies, Inc. profile based on data provided by Dun and Bradstreet, 2009, http:/www.manta.com/company/mmmm29ctk, accessed June 11, 2009.

2.5-50 Manta, Letica Corporation profile based on data provided by Dun and Bradstreet, 2009, Website, http:/www.manta.com/company/mmj9wv0, accessed June 11, 2009.

2.5-51 Manta, Memorial Hospital of Salem County, Inc. profile based on data provided by Dun and Bradstreet, 2009, Website, http://www.manta.com/coms2/dnbcompany_dy11qv, accessed June 10, 2009.

2.5-52 Maryland Department of Business and Economic Development, Maryland Employers in Cecil County, Maryland, Website, http://www.choosemaryland.org/Resources/pdffiles/briefeconomicfacts/CecilBEF.pdf, accessed on February 27, 2009.

2.5-53 Maryland Department of Business and Economic Development, Maryland Momentum, Maryland Employers in Harford County, Maryland, Website, http://www.choosemaryland.org/Resources/pdffiles/briefeconomicfactsy/HarfordCountyBEF.pdf, accessed on February 25, 2009.

2.5-54 Maryland State Department of Education, Maryland School Performance Record: Enrollment Data, Website, http://msp.msde.state.md.us/downloadindex.asp, accessed on July 27, 2009.

2.5-55 Maryland State Department of Labor, Licensing, and Regulation, Maryland Occupational Projections 2006-2016 (Baltimore County, Susquehanna, and Uppershore), Website, http://www.dllr.maryland.gov/lmi/iandoproj/, accessed on October 6, 2009.

2.5-56 Maryland State Department of Natural Resources, Eastern Maryland Public Lands, Website, http://www.dnr.state.md.us/publiclands/eastern.html, accessed on October 2, 2009.

2.5-57 Maryland State Department of Natural Resources, Central Maryland Public Lands, Website, http://www.dnr.state.md.us/publiclands/central.html, accessed on September 1, 2009.

2.5-58 Maryland State Department of Natural Resources, Maryland Forestry and Parks Centennial 1906-2006: History, The Nature Center at Martinak State Park, Website, http://www.dnr.state.md.us/centennial/MartinekSP_History.asp, accessed on August 31, 2009.

2.5-59 Maryland Public School Construction Program, Facility Inventory, Website, http://www.pscp.state.md.us/fi/MainSheet1.cfm, accessed on October 19, 2009.

2.5-60 Maryland State Data Center, Population Projections, Projections by Type for All Counties - Historic Census 1970 to 2000, Projected 2005 to 2030, Population Projections: XLS, Website, http://www.mdp.state.md.us/msdc/dw_Popproj.htm, accessed May 18, 2009.

2.5-61 Maryland State Highway Administration, 2009, Annual Highway Mileage Reports, 2008 HISD-FCMI-ALL Report. Available online at http://www.sha.maryland.gov/SHAServices/TrafficReports/OPPE/hisdreports.asp, accessed July 23, 2009.

2.5-62 Millville Public Schools, Millville Public Schools Strategic Plan, Website, http://www.millville.org/counties/cumberland/0610/schools/home/Board/strategic_plan.pdf, Revised July 21, 2008, accessed August 7, 2009.

2.5-63 Montgomery County Economic Development Corporation, Major Employers, Website, http://www.montcoedc.com/business/major.aspx, January 2009, accessed July 22, 2009.

2.5-64 Morris Land Conservancy, County of Gloucester Comprehensive Farmland Preservation Plan – 2008, Clayton, NJ.

2.5-65 National Register of Historic Places, Website, http://www.nps.gov/nr/, 2009, accessed August 5, 2009.

2.5-66 Natural Lands Trusts, Nature Preserves in Greater Philadelphia Area, Website, http://www.natlands.org/preserves/default.asp, accessed on August 31, 2009.

2.5-67 New Castle County, Delaware Comprehensive Development Plan – 2007, Website, http://www2.nccde.org/landuse/Planning/ComprehensivePlan/default.aspx, 2007, accessed August 7, 2009.

2.5-68 New Castle County, Delaware, Office of Redevelopment, Major Employers, Website, http://www2.nccde.org/redevelopment/Pages/Employers.aspx, accessed August 24, 2009.

2.5-69 New Castle County, Delaware, 2009. Unified Development Code-New Castle County: Chapter 40 of the New Castle County Code, Unified Development Code. Available online at http://www.co.new-castle.de.us/CZO/maintain/allCodePub.asp, 2009, accessed August 7, 2009.

2.5-70 New Jersey Department of Education, Fall Survey Collections: Enrollments 2007-2008, Website, http://www.state.nj.us/education/data/enr/enr08/stat_doc.htm, accessed on June 12, 2009.

2.5-71 New Jersey Department of Environmental Protection, Open Public Records Act, SDW – Water System General Information, Website, http://datamine2.state.nj.us/DEP_OPRA/OpraMain/get_long_report?, accessed July 28, 2009.

2.5-72 New Jersey Department of Environmental Protection, Division of Parks and Forestry, New Jersey State Parks, Forests, Recreation Areas and Marinas, Website, http://www.state.nj.us/dep/parksandforests/parks/parkindex.html, accessed on September 2, 2009.

2.5-73 New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Wildlife Management Areas, Website, http://www.state.nj.us/dep/fgw/wmaland.htm, accessed on April, 24, 2009.

2.5-74 New Jersey Department of Health and Senior Services, Programs and Services, Website, http://www.state.nj.us/health/commiss/org.shtml, 2009, accessed August 13, 2009.

2.5-75 New Jersey Department of Human Services, Division of Disability Services, Trenton, NJ, 2009, http://www.state.nj.us/humanservices/, accessed on 3-21-10.

2.5-76 New Jersey Department of Labor, Population & Labor Force Projections, Projections of Total Population by County: New Jersey, 2004 to 2025, Website, http://www.wnjpin.net/OneStopCareerCenter/LaborMarketInformation/lmi03/index.html, accessed May 18, 2009.

2.5-77 New Jersey Department of Labor, New Jersey Resident Population by Municipality: 1930 – 1990, http://www.wnjpin.net/OneStopCareerCenter/LaborMarketInformation/lmi01/poptrd6.htm, accessed June 12, 2009.

2.5-78 New Jersey Department of Labor and Workforce Development, Long-term Occupational Employment Projections, Website, http://lwd.state.nj.us/lpaapp/DataTools.html?newPage=OccProjInstant, accessed on October 6, 2009.

2.5-79 New Jersey Department of Transportation, Bureau of Transportation Data Development (BTDD), 2007, Roadway Systems Section, New Jersey's Roadway Mileage and Daily VMT by Functional Classification Distributed by County; http://www.nj.gov/transportation/refdata/roadway/pdf/hpms2007/VMTFCC_07.pdf, Accessed June 6, 2009.

2.5-80 New Jersey Department of Transportation, Draft FY 2010 - 2019 Statewide Transportation Improvement Program, Website, http://www.state.nj.us/transportation/capital/stip1019/, 2009, accessed July 30, 2009.

2.5-81 New Jersey Department of Transportation, Roadway Information and Traffic Counts - Interactive Traffic Count Reports. Website, http://www.state.nj.us/transportation/refdata/roadway/traffic_counts/, 2009, accessed July 30, 2009.

2.5-82 New Jersey Office of Environmental Management, Protective Actions: NJ Coastal Evacuation Maps; Website, http://www.state.nj.us/njoem/plan/pdf/maps/salem_evac.pdf, accessed July 30, 2009.

2.5-83 MACTEC Engineering and Consulting, Inc. December 2009. Submerged Cultural Resources Survey of a Proposed Barge Facility and Water Intake. PSEG Early Site Permit Environmental Review, Delaware River, Salem County, New Jersey. Report Submitted to New Jersey Historic Preservation Office.

2.5-84 Pennsylvania Department of Conservation and Natural Resources, State Parks: Philadelphia and the Countryside, Website, http://www.dcnr.state.pa.us/stateparks/parks/region_philadelphia.aspx, accessed on September 2, 2009.

2.5-85 Pennsylvania Department of Education, PreK-12 School Statistics: Public School Enrollments, 2007-2008, Website, http://www.education.state.pa.us/portal/server.pt/community/pre_k-12_schools_statistics/8775/home, accessed on September 8, 2009.

2.5-86 Pennsylvania Department of Labor and Industry, Long-term Occupational Employment Projections for Workforce Investment Areas, Website, http://www.paworkstats.state.pa.us/gsipub/index.asp?docid=409, accessed on September 29, 2009.

2.5-87 Pennsylvania Department of Revenue, Tax Rates for Individual Taxpayers and Sales and Use Tax, Website, http://www.revenue.state.pa.us/revenue/, accessed August 1, 2009.

2.5-88 Pennsylvania Department of Transportation (PENN DOT), 2007, Highway Statistics, Highway Functional Classification, Website, http://www.dot.state.pa.us/Internet/Bureaus/pdPlanRes.nsf/infoBPRHighwayStats2008Rpt, 2007, accessed June 9, 2009.

2.5-89 Pennsylvania State Data Center, Estimates and Projections: Pennsylvania County Population Projections, 2000 – 2030, Website, http://pasdc.hbg.psu.edu/pasdc/PA_Stats/estimates_and_projections/estimates.html, accessed May 18, 2009.

2.5-90 Philadelphia Inquirer, The Top 100 Businesses in the Philadelphia Region, 2008 100 Top Non-Governmental Employers, Website, http://www.philly.com/business/top10100/21567844.html, 2009, accessed July 21, 2009.

2.5-91 Rowan University, About Rowan University at Camden, Website, http://www.rowan.edu/camden/about/index.cfm, accessed on July 24, 2009.

2.5-92 Rutgers University, Rutgers-Camden at a Glance, Website, http://www.camden.rutgers.edu/about-us/rutgers-camden-glance, accessed on August 18, 2009.

2.5-93 Rukenstein and Associates, *Smart Growth Plan: Delaware River and I-295/NJ Turnpike Planned Growth Corridor,* Salem County, New Jersey, January, 2004.

2.5-94 Salem County, New Jersey, An Economic Resource Guide, The Best Side of the Bay, Website, available at http://www.salemcountynj.gov/cmssite/downloads/new%20tourism/Salem_Co_NJ06.pdf, accessed on March 21, 2010.

2.5-95 Salem County, New Jersey, Open Space and Farmland Preservation Plan, Volume 2: Farmland Preservation Plan, August 2008, Available at http://www.salemcountynj.gov/cmssite/default.asp?contentID=1101.

2.5-96 Salem County, New Jersey, Open Space and Farmland Preservation Plan, Volume 1: Open Space and Recreation Plan, December 2006, Available at http://www.salemcountynj.gov/cmssite/default.asp?contentID=1101.

2.5-97 Salem County, New Jersey, Smart Growth Plan: Delaware River and I-295/NJ Turnpike Planned Growth Corridor Salem County, New Jersey, 2004, Salem City, NJ.

2.5-98 Select Greater Philadelphia, Burlington County, New Jersey Economic Profile, Website, www.selectgreaterphiladelphia.com/data/counties/burlington.cfm, accessed on July 22, 2009.

2.5-99 State of Delaware, Comprehensive Annual Financial Report – Fiscal Year Ended June 30, 2008, Dover, DE, 2009.

2.5-100 State of Delaware, Delaware CEDS, Delaware Economic Development Office (DEDO), A Comprehensive Economic Development Strategy for the State of Delaware – New Castle County Land Use Facts, Website, http://dedo.delaware.gov/ceds/downloads/landuseN_factsheet.pdf, September 2005, accessed August 7, 2009.

2.5-101 State of Delaware, Delaware Department of Education, Planning, Detailed School Level Enrollment History (1997 to 2009) Excel File, Grade Sum, Website, http://www.doe.k12.de.us/reports_data/planning.shtml, accessed September 8, 2009.

2.5-102 State of Delaware, Office of Management and Budget, Budget Development, Planning, and Administration, Office of State Planning Coordination, Livable Delaware: The Strategies for State Policies and Spending, Website, http://stateplanning.delaware.gov/strategies/strategies.shtml, 2004, accessed August 11, 2009.

2.5-103 State of Delaware, Department of Finance, Division of Revenue, 2008 State Income Tax Table, Website, http://revenue.delaware.gov/services/current_pit/TY08_TaxTable.pdf, accessed on July 31, 2009.

2.5-104 State of New Jersey, Department of the Treasury, Division of Taxation, Corporation Business Tax, Income Tax, and Sales and Use Tax, Website, http://www.state.nj.us/treasury/taxation/corp_over.shtml, accessed July 31, 2009.

2.5-105 State of New Jersey Casino Control Commission, The New Jersey Casino Industry Facility Statistics, Website, http://www.state.nj.us/casinos/financial/histori/docs/annual_report_infac_%202008.pdf, accessed on July 16, 2009.

2.5-106 State of New Jersey Commission on Higher Education, Fall 2008 Enrollment in New Jersey Colleges and Universities, Website, http://www.nj.gov/highereducation/statistics/Enr2008.htm, accessed on August 31, 2009.

2.5-107 State of New Jersey, Schools Development Authority, School project information throughout the State of New Jersey, Cumberland County; Gloucester County, and Salem County, Website,

http://www.njsda.gov/Schools/Visit_My_School.asp, 2009, accessed August 10, 2009.

2.5-108 Triad Associates, Comprehensive Economic Development Strategy for Gloucester County, 2008, Website, http://www.co.gloucester.nj.us/Government/Departments/EconomicDev/ceds.cfm Vineland, NJ.

2.5-109 Underwood Memorial Hospital, About Underwood Memorial Hospital, Website, http://www.umhospital.org/about/index.html, accessed on July 22, 2009.

2.5-110 University of Delaware, UD Facts and Figures, 2007-2008: Enrollment, Website, http://www.udel.edu/IR/fnf/0708/enrol.html, August 18, 2009.

2.5-111 University of Medicine and Dentistry of New Jersey, Fast Facts, Website, http://www.umdnj.edu/about/fastfacts.pdf, accessed on August 18, 2009.

2.5-112 U.S. Bureau of Economic Analysis, CA1-3; Per Capita Personal Income for 1995, 2000, and 2007, Website, http://www.bea.gov/regional/reis/default.cfm?selTable=CA1-3&section=2, accessed on June 9, 2009.

2.5-113 U.S. Bureau of Economic Analysis, CA25: Total Employment by Industry for 1990 and 2000, Website, http://www.bea.gov/regional/reis/default.cfm?selTable=CA25&series=SIC, accessed February 26, 2009.

2.5-114 U.S. Bureau of Economic Analysis, CA25: Total Employment by Industry for 2007, Website, http://www.bea.gov/regional/reis/default.cfm?selTable=CA25&series=NAICS, accessed February 26, 2009.

2.5-115 U.S. Bureau of Labor Statistics, Labor Force Data by County, 1995 Annual Averages, Website, ftp://ftp.bls.gov/pub/special.requests/la/laucnty95.txt, accessed on August 24, 2009.

2.5-116 U.S. Bureau of Labor Statistics, Labor Force Data by County, 2000 Annual Averages, Website, ftp://ftp.bls.gov/pub/special.requests/la/laucnty00.txt, accessed on August 24, 2009.

2.5-117 U.S. Census Bureau, County Population Census Counts 1900-1990, by State, Website, http://www.census.gov/population/censusdata/cencounts, accessed on May 8, 2009.

2.5-118 U.S. Bureau of Labor Statistics, Labor Force Data by County, 2008 Annual Averages, Website, ftp://ftp.bls.gov/pub/special.requests/la/laucnty08.txt, accessed on August 24, 2009.

2.5-119 U.S. Census Bureau, American FactFinder, Fact Sheet, 2000, and 2005-2007, American Community Survey 3-Year Estimates, Demographic Data Profile Highlights, Website, http://factfinder.census.gov/servlet/ACSSAFFFacts?_event=&geo_id=01000US

&_geoContext=01000US%7C04000US10&_street=&_county=&_cityTown=&_state=04000US10&_zip=&_lang=en&_sse=on&ActiveGeoDiv=&_useEV=&pctxt=fph&pgsl=040&_submenuId=factsheet_1&ds_name=ACS_2008_3YR_SAFF&_ci_nbr=null&qr_name=null&reg=null%3Anull&_keyword=&_industry=, accessed February 9, 2009.

2.5-120 U.S. Census Bureau, Table 4: Annual Estimates of Population for Incorporated Places, 2000 to 2007, by State, Website, http://www.census.gov/popest/cities/SUB-EST2007-4.html, accessed on May 8, 2009.

2.5-121 U.S. Census Bureau, Geographical Comparison Tables, Population Estimates 2000 to 2008, by State and County, Website: http://factfinder.census.gov/servlet/GCTGeoSearchByListServlet?ds_name=PEP_2008_EST&_lang=en&_ts=281556534886, accessed on June 8, 2009.

2.5-122 U.S. Census Bureau, American FactFinder, Population Finder, 2000 to 2008 Estimates, Website, http://factfinder.census.gov/servlet/SAFFPopulation?Event=Search&geoid=05000US340, accessed June 10, 2009.

2.5-123 U.S. Census Bureau, American FactFinder, Selected Social Characteristics, 1990 to 2005-2007 American community Survey 3-Year Estimates, Website, http://factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=01000US&-ds_name=ACS_2007_3YR_G00_&-_lang=en&-_caller=geoselect&-format=, accessed May 5, 2009.

2.5-124 U.S. Census Bureau, Census 2000 Summary File 1 ASCII text data files, http://www.census.gov/support/SF1ASCII.html, accessed May 05, 2009.

2.5-125 U.S. Census Bureau, TIGER/Line® Shapefiles, 2008, Website, http://www.census.gov/geo/www/tiger/tgrshp2008/tgrshp2008.html, accessed May 05, 2009.

2.5-126 U.S. Department of Agriculture, 2007 Census of Agriculture, release date February 4, 2009, Website, http://www.agcensus.usda.gov/, accessed July 17, 2009.

2.5-127 U.S. Department of Energy, 2005. DOE NP2010 Nuclear Power Plant Construction Infrastructure Assessment.

2.5-128 U.S. Environmental Protection Agency, Environmental Justice, Website, http://www.epa.gov/compliance/environmentaljustice/index.html, accessed May 20, 2009.

2.5-129 U.S. Environmental Protection Agency, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety," EPA/ONAC 550/9-74-004, March, 1974 (Condensed Version), Washington, D.C.

2.5-130 U.S. Environmental Protection Agency, Safe Drinking Water Information System (SDWIS), Website, http://www.epa.gov/enviro/html/sdwis/sdwis_ov.html, accessed August 6, 2009.

2.5-131 U.S. Fire Administration, USFA National Fire Department Census State Download, http://www.usfa.dhs.gov/applications/census/states.cfm, March 17, 2009.

2.5-132 U.S. Fish and Wildlife Service, List of Wildlife Refuges, by State, Website, http://www.fws.gov/refuges/, accessed on August 31, 2009.

2.5-133 U.S. Nuclear Regulatory Commission. 1984. Final Environmental Impact Statement Related to the Operation of the Hope Creek Generating Station. Docket No. 50-354. U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation. Washington, D.C.

2.5-134 Veit, Richard, and Carla Cielo, Phase IB Cultural Resource Investigations Alloway Creek Watershed Site, PSE & G Watershed Enhancement Program. Cultural Resource Consulting Group. Submitted to Public Services Electric and Gas, 1996.

2.5-135 Waymarking, Alapocas Run State Park - Wilmington, DE" Waymark, Website, http://www.waymarking.com/waymarks/WM4XZD, accessed on August 31, 2009.

2.5-136 Wikipedia, Fort Delaware State Park, Website, http://en.wikipedia.org/wiki/Fort_Delaware_State_Park, accessed on August 31, 2009.

2.5-137 Wikipedia, White Clay Creek State Park, Website, http://en.wikipedia.org/wiki/White_Clay_Creek_State_Park, accessed on August 31, 2009.

2.5-138 Wilmington Area Planning Council (WILMAPCO), Transporter, Fall 2008 – WILMAPCO's 2008 Annual Report, Newark, Delaware.

2.5-139 U.S. Department of Interior, National Park Service, Find a Park, Website, Website, http://www.nps.gov, accessed April 22, 2010.

Table 2.5-1
HCGS and SGS Employee Distribution by State and County as of 2008

Residence State and County	Number of Employees	Percent of Total
New Jersey		
Atlantic	5	0.3
Burlington	37	2.4
Camden	56	3.6
Cape May	5	0.3
Cumberland	157	10.0
Gloucester	230	14.6
Salem	645	41.0
Subtotal	1135	72.1
Delaware		
New Castle	268	17.0
Kent	1	0.1
Subtotal	269	17.1
Pennsylvania		
Berks	4	0.3
Bucks	1	0.1
Chester	56	3.6
Delaware	39	2.5
Lancaster	5	0.3
Montgomery	9	0.6
Philadelphia	2	0.1
Subtotal	116	7.4
Maryland		
Cecil	33	2.1
Harford	3	0.2
Subtotal	36	2.3
Outside 50-mile Radius		
Bergen, NJ	1	0.1
Hunterdon, NJ	1	0.1
Mercer, NJ	1	0.1
Middlesex, NJ	1	0.1
Ocean, NJ	1	0.1
Calvert, MD	1	0.1
Montgomery, MD	1	0.1
Cambria, PA	1	0.1
Columbia, PA	1	0.1
Lehigh, PA	1	0.1
Luzerne, PA	1	0.1
Northumberland, PA	1	0.1
Washington, PA	1	0.1
Subtotal	13	0.8
Other States (5)	5	0.3
Total All States	1574	100
Total Nine Counties[(a)]	1521	96.8
Total Four County Region of Influence[(b)]	1300	82.6

a) Burlington, Camden, Cumberland, Gloucester, Salem, New Castle, Chester, Delaware, and Cecil
b) Cumberland, Gloucester, Salem, and New Castle

**Table 2.5-2
Counties (by State) within 10 Miles
and 50 Miles of the PSEG Site**

State	0 to 10 Miles	10 to 50 Miles
Delaware Counties	Kent New Castle	Kent New Castle Sussex
Maryland Counties		Baltimore Caroline Cecil Harford Kent Queen Anne's Talbot
New Jersey Counties	Cumberland Salem	Atlantic Burlington Camden Cape May Cumberland Gloucester Salem
Pennsylvania Counties		Berks Bucks Chester Delaware Lancaster Montgomery Philadelphia York

Figure 2.5-2

Table 2.5-3
Resident Population Distribution within 0 to10 Miles of the PSEG Site, 2000 to 2081

Year	Distance in Miles						
	0-1	**1-2**	**2-3**	**3-4**	**4-5**	**5-10**	**Total 0-10**
2000	0	0	75	562	1292	31,942	33,871
2010	0	0	82	600	1365	40,696	42,743
2021	0	0	85	642	1451	43,349	45,527
2031	0	0	91	670	1525	45,486	47,772
2041	0	0	96	701	1601	47,731	50,129
2051	0	0	99	731	1681	50,099	52,610
2061	0	0	105	764	1767	52,593	55,229
2071	0	0	110	797	1856	55,219	57,982
2081	0	0	117	835	1951	57,989	60,892
Annual Growth Rate (%) 2000 to 2010	0	0	0.47	0.71	0.52	2.45	2.35

References 2.5-26, 2.5-76, 2.5-124, and 2.5-125

Table 2.5-4
Populations and Growth Rates of Municipalities within 10 Miles of the PSEG Site

Township/Municipality	Population 2000	Population 2007/2008[a]	Annual Growth Rate (%)	Population 2010
Salem County, New Jersey				
Lower Alloways Creek Township	1851	1883	0.25	1897
Quinton Township	2786	2838	0.26	2861
Elsinboro Township	1092	1054	-0.50	1038
Salem	5857	5678	-0.44	5603
Mannington Township	1559	1555	-0.04	1553
Pennsville Township	13,194	13,363	0.18	13,436
Total County	64,285	66,141	0.36	66,613
Cumberland County, New Jersey				
Stow Creek Township	1429	1528	0.96	1573
Greenwich Township	847	886	0.65	903
Total County	146,438	156,830	0.86	159,541
New Castle County, Delaware				
Odessa	286	334	2.24	357
Townsend	346	378	1.27	393
Middletown	6161	11,153	8.85	14,383
Delaware City	1453	1516	0.61	1544
Total County	500,265	529,641	0.72	537,251

References 2.5-122 and 2.5-125

a) 2008 estimates apply to counties, 2007 estimates apply to all others.

Table 2.5-5
Transient Population Distribution within 10 Miles of the PSEG Site, 2008 to 2081

	Distance in Miles						
Year	**0-1**	**1-2**	**2-3**	**3-4**	**4-5**	**5-10**	**Total 0-10**
2008	0	0	0	163	97	11,825	12,085
2010	0	0	0	166	98	12,285	12,549
2021	0	0	0	176	105	13,097	13,378
2031	0	0	0	183	109	13,765	14,057
2041	0	0	0	191	116	14,470	14,777
2051	0	0	0	199	122	15,212	15,533
2061	0	0	0	206	129	15,997	16,332
2071	0	0	0	215	136	16,824	17,175
2081	0	0	0	224	143	17,696	18,063

References 2.5-27, 2.5-44, 2.5-47-- 2.5-51, and 2.5-76

Table 2.5-6
Transient Population Estimates within 10 Miles of PSEG Site, 2008

Distance in Miles	Source of Transients					
	Employers	Recreation	Lodging	Schools and Daycare	Medical Care (Hospitals and Assisted Living)	Totals
0-1	0	0	0	0	0	0
1-2	0	0	0	0	0	0
2-3	0	0	0	0	0	0
3-4	0	163	0	0	0	163
4-5	2	88	0	7	0	97
5-10	4144	2843	121	4114	603	11,825
0-10	4146	3094	121	4121	603	12,085
Percent	34	26	1	34	5	100
Delaware	2244	1899	80	3432	336	7991
Percent of Total						66
New Jersey	1902	1195	41	689	267	4094
Percent of Total						34

References 2.5-21, 2.5-44, and 2.5-47 to 2.5-51.

Table 2.5-7
Resident Population Distribution within 10 to 50 Miles of the PSEG Site, 2000 to 2081[a]

	Population/Distance in Miles					
Year	**10 – 20**	**20 – 30**	**30 – 40**	**40 – 50**	**Total 10 – 50**	**Total 0 – 50**
2000	495,708	663,385	1,839,777	2,197,713	5,196,583	5,230,454
2010	535,164	737,825	1,907,693	2,237,530	5,418,212	5,460,955
2021	579,362	811,029	2,024,369	2,346,225	5,760,985	5,806,512
2031	612,502	875,214	2,134,825	2,434,175	6,056,716	6,104,488
2041	648,433	946,388	2,257,452	2,530,748	6,383,021	6,433,150
2051	687,502	1,025,479	2,393,789	2,636,891	6,743,661	6,796,271
2061	730,126	1,113,552	2,545,595	2,753,673	7,142,946	7,198,175
2071	776,789	1,211,819	2,714,864	2,882,300	7,585,772	7,643,754
2081	828,052	1,321,698	2,903,867	3,024,126	8,077,743	8,138,635
Annual Growth Rate (%) 2000 to 2010	0.77	1.07	0.36	0.18	0.42	0.43

References 2.5-27, 2.5-60, 2.5-76, 2.5-89, 2.5-124, and 2.5-125
a) Population for 0-10 mile vicinity is shown in Table 2.5-3

Table 2.5-8 (Sheet 1 of 4)
Resident Population Distribution and Projections within 50 Miles of the PSEG Site

Year	Sectors	Population/Distance in Miles												
		0 – 1	1 –2	2 – 3	3 – 4	4 – 5	5 – 10	Total 0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	Total 10 – 50	Total 0 – 50
2000	N	0	0	0	0	110	224	334	139,009	121,179	157,479	154,146	571,813	572,147
2010	N	0	0	0	0	105	224	329	146,379	127,017	180,586	171,958	625,940	626,269
2021	N	0	0	0	0	112	240	352	155,730	134,747	210,005	194,320	694,802	695,154
2031	N	0	0	0	0	120	257	377	162,469	140,863	237,903	214,653	755,888	756,265
2041	N	0	0	0	0	129	275	404	169,510	147,356	269,731	237,612	824,209	824,613
2051	N	0	0	0	0	138	295	433	176,867	154,261	306,050	263,562	900,740	901,173
2061	N	0	0	0	0	148	316	464	184,555	161,618	347,503	292,921	986,597	987,061
2071	N	0	0	0	0	158	338	496	192,589	169,469	394,822	326,165	1,083,045	1,083,541
2081	N	0	0	0	0	170	362	532	200,986	177,866	448,847	363,839	1,191,538	1,192,070
2000	NNE	0	0	3	6	33	5611	5653	16,119	132,180	907,397	1,033,412	2,089,108	2,094,761
2010	NNE	0	0	3	5	31	5398	5437	17,013	135,920	883,240	1,003,853	2,040,026	2,045,463
2021	NNE	0	0	3	6	33	5775	5817	18,210	141,555	886,469	1,006,508	2,052,742	2,058,559
2031	NNE	0	0	4	6	36	6186	6232	19,519	147,943	896,061	1,012,808	2,076,331	2,082,563
2041	NNE	0	0	4	7	38	6627	6676	20,924	154,763	906,131	1,019,671	2,101,489	2,108,165
2051	NNE	0	0	4	7	41	7100	7152	22,430	162,055	916,696	1,027,119	2,128,300	2,135,452
2061	NNE	0	0	5	8	44	7606	7663	24,045	169,864	927,771	1,035,179	2,156,859	2,164,522
2071	NNE	0	0	5	8	47	8148	8208	25,777	178,240	939,374	1,043,880	2,187,271	2,195,479
2081	NNE	0	0	5	9	50	8729	8793	27,634	187,239	951,522	1,053,252	2,219,647	2,228,440
2000	NE	0	0	1	6	42	3240	3289	8542	68,340	423,003	492,289	992,174	995,463
2010	NE	0	0	1	5	42	3200	3248	9052	79,314	443,708	498,939	1,031,013	1,034,261
2021	NE	0	0	1	6	44	3423	3474	9707	88,435	473,816	525,180	1,097,138	1,100,612
2031	NE	0	0	2	6	48	3667	3723	10,425	98,741	503,842	550,506	1,163,514	1,167,237
2041	NE	0	0	2	7	51	3928	3988	11,198	110,249	536,375	577,796	1,235,618	1,239,606
2051	NE	0	0	2	7	55	4209	4273	12,029	123,099	571,658	607,203	1,313,989	1,318,262
2061	NE	0	0	2	8	59	4509	4578	12,924	137,449	609,960	638,891	1,399,224	1,403,802
2071	NE	0	0	2	8	63	4830	4903	13,887	153,473	651,580	673,037	1,491,977	1,496,880
2081	NE	0	0	2	9	67	5174	5252	14,923	171,366	696,849	709,835	1,592,973	1,598,225
2000	ENE	0	0	11	30	188	1130	1359	4420	34,671	87,605	42,859	169,555	170,914
2010	ENE	0	0	12	31	193	1160	1396	4681	39,356	94,959	45,462	184,458	185,854
2021	ENE	0	0	12	33	206	1240	1491	5006	43,441	103,127	49,543	201,117	202,608
2031	ENE	0	0	13	36	221	1329	1599	5353	48,004	111,616	53,473	218,446	220,045
2041	ENE	0	0	14	38	237	1424	1713	5724	53,066	120,923	57,732	237,445	239,158
2051	ENE	0	0	15	41	254	1525	1835	6120	58,682	131,133	62,349	258,284	260,119
2061	ENE	0	0	16	44	272	1634	1966	6545	64,915	142,343	67,355	281,158	283,124
2071	ENE	0	0	17	47	291	1750	2105	6999	71,834	154,660	72,783	306,276	308,381
2081	ENE	0	0	19	50	312	1875	2256	7485	79,517	168,204	78,672	333,878	336,134

Table 2.5-8 (Sheet 2 of 4)
Resident Population Distribution and Projections within 50 Miles of the PSEG Site

Year	Sectors	Population/Distance in Miles												
		0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	5 – 10	Total 0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	Total 10 – 50	Total 0 – 50
2000	E	0	0	8	28	25	989	1050	24,456	68,481	21,954	41,989	156,880	157,930
2010	E	0	0	9	29	26	1020	1084	26,614	74,640	23,952	45,739	170,945	172,029
2021	E	0	0	9	31	28	1091	1159	28,407	79,806	26,125	50,365	184,703	185,862
2031	E	0	0	10	33	30	1166	1239	29,724	83,782	28,230	55,176	196,912	198,151
2041	E	0	0	11	36	32	1247	1326	31,103	87,973	30,520	60,446	210,042	211,368
2051	E	0	0	11	38	34	1333	1416	32,546	92,392	33,010	66,219	224,167	225,583
2061	E	0	0	12	41	36	1426	1515	34,056	97,054	35,721	72,543	239,374	240,889
2071	E	0	0	13	44	39	1525	1621	35,637	101,974	38,671	79,472	255,754	257,375
2081	E	0	0	14	47	42	1631	1734	37,292	107,168	41,884	87,062	273,406	275,140
2000	ESE	0	0	0	0	3	350	353	18,638	22,893	9952	22,939	74,422	74,775
2010	ESE	0	0	0	0	3	380	383	20,279	24,928	10,673	21,323	77,203	77,586
2021	ESE	0	0	0	0	3	405	408	21,644	26,606	11,362	22,000	81,612	82,020
2031	ESE	0	0	0	0	3	425	428	22,636	27,825	11,887	22,947	85,295	85,723
2041	ESE	0	0	0	0	3	446	449	23,674	29,100	12,437	23,939	89,150	89,599
2051	ESE	0	0	0	0	3	467	470	24,759	30,434	13,012	24,978	93,183	93,653
2061	ESE	0	0	0	0	4	490	494	25,893	31,829	13,615	26,067	97,404	97,898
2071	ESE	0	0	0	0	4	514	518	27,080	33,288	14,247	27,210	101,825	102,343
2081	ESE	0	0	0	0	4	539	543	28,321	34,813	14,908	28,408	106,450	106,993
2000	SE	0	0	0	0	0	6	6	90	588	37	39,744	40,459	40,465
2010	SE	0	0	0	0	0	6	6	97	641	40	36,596	37,374	37,380
2021	SE	0	0	0	0	0	6	6	104	684	43	37,592	38,423	38,429
2031	SE	0	0	0	0	0	7	7	108	715	45	39,073	39,941	39,948
2041	SE	0	0	0	0	0	7	7	113	748	47	40,611	41,519	41,526
2051	SE	0	0	0	0	0	7	7	118	782	49	42,211	43,160	43,167
2061	SE	0	0	0	0	0	8	8	124	818	51	43,873	44,866	44,874
2071	SE	0	0	0	0	0	8	8	130	856	53	45,601	46,640	46,648
2081	SE	0	0	0	0	0	9	9	135	895	56	47,396	48,482	48,491
2000	SSE	0	0	0	0	0	4	4	119	1200	1027	5588	7934	7938
2010	SSE	0	0	0	0	0	6	6	152	1539	1304	6981	9976	9982
2021	SSE	0	0	0	0	0	6	6	170	1726	1510	8528	11,934	11,940
2031	SSE	0	0	0	0	0	7	7	182	1847	1659	9750	13,438	13,445
2041	SSE	0	0	0	0	0	7	7	195	1976	1824	11,148	15,143	15,150
2051	SSE	0	0	0	0	0	8	8	209	2115	2007	12,745	17,076	17,084
2061	SSE	0	0	0	0	0	8	8	224	2264	2211	14,572	19,271	19,279
2071	SSE	0	0	0	0	0	9	9	239	2422	2439	16,660	21,760	21,769
2081	SSE	0	0	0	0	0	10	10	256	2592	2693	19,048	24,589	24,599

Table 2.5-8 (Sheet 3 of 4)
Resident Population Distribution and Projections within 50 Miles of the PSEG Site

Year	Sectors	Population/Distance in Miles												
		0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	5 – 10	Total 0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	Total 10 – 50	Total 0 – 50
2000	S	0	0	0	0	3	111	114	10,744	62,964	26,379	16,824	116,911	117,025
2010	S	0	0	0	0	4	128	132	13,777	80,752	33,679	21,093	149,301	149,433
2021	S	0	0	0	0	4	139	143	15,453	90,578	38,350	25,476	169,857	170,000
2031	S	0	0	0	0	4	147	151	16,537	96,933	41,554	28,890	183,914	184,065
2041	S	0	0	0	0	4	154	158	17,697	103,733	45,056	32,777	199,263	199,421
2051	S	0	0	0	0	4	163	167	18,938	111,011	48,887	37,202	216,038	216,205
2061	S	0	0	0	0	5	171	176	20,266	118,800	53,084	42,243	234,393	234,569
2071	S	0	0	0	0	5	180	185	21,688	127,135	57,684	47,985	254,492	254,677
2081	S	0	0	0	0	5	190	195	23,209	136,055	62,733	54,529	276,526	276,721
2000	SSW	0	0	0	4	6	566	576	16,445	11,543	9480	14,309	51,777	52,353
2010	SSW	0	0	0	4	7	612	623	20,410	14,540	11,162	16,338	62,450	63,073
2021	SSW	0	0	0	4	7	651	662	22,708	16,471	13,139	19,344	71,662	72,324
2031	SSW	0	0	0	5	7	677	689	24,202	17,802	14,720	21,791	78,515	79,204
2041	SSW	0	0	0	5	8	705	718	25,798	19,249	16,501	24,564	86,112	86,830
2051	SSW	0	0	0	5	8	734	747	27,501	20,825	18,511	27,709	94,546	95,293
2061	SSW	0	0	0	5	8	764	777	29,319	22,542	20,779	31,274	103,914	104,691
2071	SSW	0	0	0	5	9	795	809	31,260	24,413	23,340	35,319	114,332	115,141
2081	SSW	0	0	0	6	9	828	843	33,333	26,456	26,232	39,908	125,929	126,772
2000	SW	0	0	1	6	7	1635	1649	3785	5345	5739	9719	24,588	26,237
2010	SW	0	0	1	6	8	1772	1787	4269	6256	6815	11,477	28,817	30,604
2021	SW	0	0	1	7	8	1885	1901	4645	7170	7856	13,174	32,845	34,746
2031	SW	0	0	1	7	9	1962	1979	4890	7878	8687	14,513	35,968	37,947
2041	SW	0	0	1	7	9	2042	2059	5149	8661	9607	15,995	39,412	41,471
2051	SW	0	0	1	8	9	2126	2144	5423	9525	10,627	17,634	43,209	45,353
2061	SW	0	0	2	8	10	2213	2233	5712	10,481	11,757	19,447	47,397	49,630
2071	SW	0	0	2	8	10	2303	2323	6018	11,536	13,010	21,455	52,019	54,342
2081	SW	0	0	2	9	11	2398	2420	6341	12,703	14,398	23,676	57,118	59,538
2000	WSW	0	0	1	15	142	2979	3137	3297	3450	10,912	26,875	44,534	47,671
2010	WSW	0	0	2	16	154	4262	4434	3687	3722	11,737	28,284	47,430	51,864
2021	WSW	0	0	2	17	163	4532	4714	4303	4170	13,003	29,950	51,426	56,140
2031	WSW	0	0	2	18	170	4718	4908	4782	4454	13,760	30,266	53,262	58,170
2041	WSW	0	0	2	19	177	4911	5109	5335	4764	14,564	30,592	55,255	60,364
2051	WSW	0	0	2	19	184	5112	5317	5975	5104	15,422	30,928	57,429	62,746
2061	WSW	0	0	2	20	192	5321	5535	6718	5479	16,335	31,275	59,807	65,342
2071	WSW	0	0	2	21	200	5539	5762	7582	5893	17,309	31,632	62,416	68,178
2081	WSW	0	0	2	22	208	5766	5998	8588	6352	18,349	32,002	65,291	71,289

Table 2.5-8 (Sheet 4 of 4)
Resident Population Distribution and Projections within 50 Miles of the PSEG Site

Year	Sectors	Population/Distance in Miles 0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	5 – 10	Total 0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	Total 10 – 50	Total 0 – 50
2000	W	0	0	2	124	298	7366	7790	4983	5245	50,087	180,185	240,500	248,290
2010	W	0	0	2	134	322	14,199	14,657	6170	6108	56,270	198,557	267,105	281,762
2021	W	0	0	2	143	343	15,099	15,587	7274	7366	62,969	218,504	296,113	311,700
2031	W	0	0	2	148	357	15,718	16,225	8181	8219	64,348	222,304	303,052	319,277
2041	W	0	0	2	154	371	16,361	16,888	9237	9218	65,758	226,183	310,396	327,284
2051	W	0	0	2	161	386	17,031	17,580	10,471	10,391	67,198	230,141	318,201	335,781
2061	W	0	0	2	167	402	17,729	18,300	11,913	11,770	68,669	234,180	326,532	344,832
2071	W	0	0	2	174	419	18,455	19,050	13,602	13,391	70,173	238,303	335,469	354,519
2081	W	0	0	3	181	436	19,211	19,831	15,582	15,301	71,710	242,510	345,103	364,934
2000	WNW	0	0	48	150	255	3614	4067	22,539	25,101	29,728	23,971	101,339	105,406
2010	WNW	0	0	52	162	276	3906	4396	26,208	30,162	34,621	26,919	117,910	122,306
2021	WNW	0	0	55	173	293	4154	4675	32,151	38,578	41,817	29,726	142,272	146,947
2031	WNW	0	0	57	180	305	4324	4866	37,126	45,710	47,031	30,866	160,733	165,599
2041	WNW	0	0	60	187	318	4501	5066	42,982	54,163	53,142	32,063	182,350	187,416
2051	WNW	0	0	62	195	331	4685	5273	49,881	64,181	60,313	33,321	207,696	212,969
2061	WNW	0	0	64	203	344	4877	5488	58,012	76,052	68,738	34,644	237,446	242,934
2071	WNW	0	0	67	211	358	5077	5713	67,604	90,120	78,647	36,035	272,406	278,119
2081	WNW	0	0	70	220	373	5284	5947	78,925	106,793	90,311	37,500	313,529	319,476
2000	NW	0	0	0	112	155	2429	2696	97,184	27,214	27,081	42,640	194,119	196,815
2010	NW	0	0	0	121	167	2625	2913	104,022	31,899	31,100	46,300	213,321	216,234
2021	NW	0	0	0	129	178	2791	3098	113,104	38,686	35,933	49,289	237,012	240,110
2031	NW	0	0	0	134	185	2906	3225	119,859	44,703	40,473	51,956	256,991	260,216
2041	NW	0	0	0	140	193	3025	3358	127,285	51,704	45,634	54,781	279,404	282,762
2051	NW	0	0	0	145	201	3148	3494	135,481	59,853	51,501	57,775	304,610	308,104
2061	NW	0	0	0	151	209	3277	3637	144,565	69,343	58,177	60,949	333,034	336,671
2071	NW	0	0	0	157	218	3412	3787	154,675	80,401	65,775	64,317	365,168	368,955
2081	NW	0	0	0	164	227	3551	3942	165,975	93,291	74,425	67,892	401,583	405,525
2000	NNW	0	0	0	81	25	1688	1794	125,338	72,991	71,917	50,224	320,470	322,264
2010	NNW	0	0	0	87	27	1798	1912	132,354	81,031	83,847	57,711	354,943	356,855
2021	NNW	0	0	0	93	29	1912	2034	140,746	91,010	98,845	66,726	397,327	399,361
2031	NNW	0	0	0	97	30	1990	2117	146,509	99,795	113,009	75,203	434,516	436,633
2041	NNW	0	0	0	101	31	2071	2203	152,509	109,665	129,202	84,838	476,214	478,417
2051	NNW	0	0	0	105	33	2156	2294	158,754	120,769	147,715	95,795	523,033	525,327
2061	NNW	0	0	0	109	34	2244	2387	165,255	133,274	168,881	108,260	575,670	578,057
2071	NNW	0	0	0	114	35	2336	2485	172,022	147,374	193,080	122,446	634,922	637,407
2081	NNW	0	0	0	118	37	2432	2587	179,067	163,291	220,746	138,597	701,701	704,288

References 2.5-26, 2.5-60, 2.5-76, 2.5-89, 2.5-124, and 2.5-125

Table 2.5-9
Population Statistics for Cumberland, Gloucester, Salem and New Castle Counties and Selected Communities within 10 Miles of the PSEG Site

Political Jurisdiction	1970	1980	1990	2000	2007 to 2008[a]
Cumberland County, NJ					
Population	121,374	132,866	138,053	146,438	156,830
Growth (%)		9.5	3.9	6.1	7.1
Gloucester County, NJ					
Population	172,681	199,917	230,082	254,673	287,860
Growth (%)		15.8	15.1	10.7	13
Salem County, NJ					
Population	60,346	64,676	65,294	64,285	66,141
Growth (%)		7.2	1.0	-1.5	2.9
New Castle County, DE					
Population	385,856	398,115	441,946	500,265	529,641
Growth (%)		3.2	11.0	13.2	5.9
Salem City, NJ					
Population	7648	6959	6883	5857	5678
Growth (%)		-9.0	-1.1	-14.9	-3.1
Lower Alloways Creek Township, NJ					
Population	1400	1547	1858	1851	1883
Growth (%)		10.5	20.1	-0.4	1.7
Elsinboro Township, NJ					
Population	1204	1290	1170	1092	1054
Growth (%)		7.1	-9.3	-6.7	-3.5
Pennsville Township, NJ					
Population	13,296	13,848	13,794	13,194	13,363
Growth (%)		4.2	-0.4	-4.3	1.3
Quinton Township, NJ					
Population	2567	2887	2511	2786	2838
Growth (%)		12.5	-13.0	11.0	1.9
Stow Creek Township, NJ					
Population	1050	1365	1437	1429	1528
Growth (%)		30.0	5.3	-0.6	6.9
Greenwich Township, NJ					
Population	963	973	911	847	886
Growth (%)		1.0	-6.4	-7.0	4.6
Delaware City, DE					
Population	No data available		1682	1453	1516
Growth (%)				-13.6	4.3
Middletown, DE					
Population	No data available		3834	6161	11,153
Growth (%)				60.7	81.0
Odessa, DE					
Population	No data available		303	286	334
Growth (%)				-5.6	16.8
Townsend, DE					
Population	No data available		322	346	378
Growth (%)				7.4	9.2
New Jersey					
Total Population	7,168,164	7,364,823	7,730,188	8,414,350	8,682,661
Growth (%)		2.7	5	8.9	3.2
Delaware					
Total Population	548,104	594,338	666,168	783,600	873,092
Growth (%)		8.4	12.1	17.6	11.4

a) 2008 estimates apply to counties and states, 2007 estimates apply to all others
References 2.5-77, 2.5-117, 2.5-119, 2.5-120, and 2.5-125

Table 2.5-10 (Sheet 1 of 3)
Population Characteristics for Counties and Selected Communities within 10 Miles of the PSEG Site[(a)]

	Census 2000 Demographic Profile					2005-2007 ACS 3-Year Estimates				
Population Characteristics	Cumberland County	Gloucester County	Salem County	New Jersey	United States	Cumberland County	Gloucester County	Salem County	New Jersey	United States
Gender										
Male (%)	51.0	48.4	48.3	48.5	49.1	51.5	48.7	48.8	48.9	49.2
Female (%)	49.0	51.6	51.7	51.5	50.9	48.5	51.3	51.2	51.1	50.8
Age										
Under 5 years (%)	6.3	6.6	6.1	6.7	6.8	7.2	6.0	5.9	6.5	6.9
18 years and over (%)	74.6	73.6	74.4	75.2	74.3	75.5	76.1	76.7	76.0	75.3
65 years and over (%)	13.0	11.7	14.5	13.2	12.4	12.4	11.5	13.9	13.0	12.5
Median Age	35.6	36.1	38.0	36.7	35.3	35.9	37.3	39.2	38.2	36.4
Race/Ethnicity (%)										
White	65.9	87.1	81.2	72.6	75.1	66.9	84.8	80.2	69.7	74.1
Black	20.2	9.1	14.8	13.6	12.3	20.8	9.6	15.5	13.6	12.4
Asian	1.0	1.5	0.6	5.7	3.6	1.1	2.2	0.5	7.3	4.3
Hispanic	19.0	2.6	3.9	13.3	12.5	22.7	3.5	4.9	15.6	14.7
Foreign Born	6.2	3.4	2.5	17.5	11.1	8.3	4.3	2.8	19.7	12.5
Home language not English	20.4	6.5	6.3	25.5	17.9	22.0	7.1	7.2	27.5	19.5
Per capita income	$17,376	$22,708	$20,874	$27,006	$21,587	$21,060	$29,627	$26,581	$33,219	$26,178
Families below poverty (%)	11.3	4.3	7.2	6.3	9.2	13.4	5.4	6.3	6.5	9.8
Individuals below poverty (%)	15.0	6.2	9.5	8.5	12.4	15.1	7.3	9.9	8.7	13.3
Average household size	2.7	2.8	2.6	2.7	2.6	2.9	2.8	2.6	2.7	2.6
Average family size	3.2	3.2	3.1	3.2	3.1	3.5	3.3	3.1	3.3	3.2
High school graduates (%)	68.5	84.3	79.4	82.1	80.4	73.1	88.3	85.7	86.3	84.0
College graduates (%)	11.7	22.0	15.2	29.8	24.4	12.7	25.6	18.0	33.7	27.0
Owner-occupied housing (%)	67.9	79.9	73.0	65.6	66.2	68.4	81.5	75.1	67.4	67.3
Median value owner-occupied	$91,200	$120,100	$105,200	$170,800	$119,600	$156,500	$220,400	$173,600	$358,400	$181,800
Housing vacant (%)	7.0	4.6	7.1	7.4	9.0	8.4	5.4	8.2	9.5	11.6

Table 2.5-10 (Sheet 2 of 3)
Population Characteristics for Counties and Selected Communities within 10 Miles of the PSEG Site[a]

	Census 2000 Demographic Profile						
Population Characteristics	Salem City	Elsinboro Township	Lower Alloways Township	Quinton Township	Pennsville Township	Stow Creek Township	Greenwich Township
Gender							
Male (%)	44.6	47.4	48.3	49.9	48.0	49.2	49.6
Female (%)	55.4	52.6	51.7	50.1	52.0	50.8	50.4
Age							
Under 5 years (%)	8.8	4.8	6.5	5.8	5.7	5.2	5.5
18 years and over (%)	69.0	78.8	75.6	76.4	76.8	76.5	78.0
65 years and over (%)	14.0	19.8	13.9	15.8	15.5	14.5	14.9
Median Age	33.5	43.6	39.5	39.0	39.3	40.7	43.4
Race/Ethnicity (%)							
White	37.5	95.1	96.4	82.1	96.7	93.4	90.0
Black	56.8	3.6	2.2	14.5	1.0	3.5	5.1
Asian	0.2	0.0	0.6	0.3	1.0	0.2	0.2
Hispanic	4.9	0.6	0.5	1.5	1.6	1.7	1.5
Foreign Born	0.8	0.6	0.8	1.8	3.2	2.0	0.5
Home language not English	6.3	1.6	2.6	4.9	5.8	3.9	1.6
Per capita income	$13,559	$25,415	$21,962	$18,921	$22,717	$20,925	$22,233
Families below poverty (%)	24.7	2.1	4.2	7.8	3.1	5.7	6.1
Individuals below poverty (%)	26.6	1.7	7.3	9.3	4.9	6.7	8.0
Average household size	2.4	2.3	2.7	2.6	2.5	2.7	2.6
Average family size	3.1	2.8	3.0	3.0	3.0	3.0	3.1
High school graduates (%)	67.8	83.9	82.4	72.1	82.0	83.1	86.3
College graduates (%)	7.9	16.5	11.7	10.3	13.6	18.9	22.0
Owner-occupied housing (%)	41.0	86.1	81.1	84.0	75.4	87.9	86.2
Median value owner-occupied	$74,300	$110,100	$118,000	$101,300	$103,700	$114,400	$112,000
Housing vacant (%)	16.8	11.7	5.1	5.2	5.4	4.3	9.7

Table 2.5-10 (Sheet 3 of 3)
Population Characteristics for Counties and Selected Communities within 10 Miles of the PSEG Site[a]

	Census 2000 Demographic Profile						2005-2007 ACS 3-Year Estimates	
Population Characteristics	Delaware City	Middle-town	Odessa	Townsend	New Castle County	Delaware	New Castle County	Delaware
Gender								
Male (%)	50.4	47.6	49.0	48.0	48.6	48.6	48.6	48.5
Female (%)	49.6	52.4	51.0	52.0	51.4	51.4	51.4	51.5
Age								
Under 5 years (%)	5.2	9.3	5.7	4.0	6.7	6.6	6.8	6.8
18 years and over (%)	75.2	69.1	80.1	73.1	75.1	75.2	75.8	76.1
65 years and over (%)	12.0	7.9	17.8	12.7	11.6	13.0	11.6	13.4
Median Age	38.3	30.9	42.0	36.5	35.0	36.0	36.9	37.6
Race/Ethnicity (%)								
White	87.5	74.4	94.1	84.1	73.1	74.6	70.8	72.8
Black	10.3	21.3	5.2	11.6	20.2	19.2	22.4	20.3
Asian	0.2	0.8	0.0	0.9	2.6	2.1	3.6	2.8
Hispanic	1.2	5.3	1.0	2.6	5.3	4.8	6.9	6.3
Foreign Born	1.8	4.8	2.6	4.2	6.6	5.7	8.9	7.6
Home language not English	4.4	8.0	5.0	4.3	10.7	9.5	13.9	11.9
Per capita income	$21,992	$18,517	$27,662	$17,671	$25,413	$23,305	$29,845	$27,879
Families below poverty (%)	5.9	8.8	0.0	2.1	5.6	6.5	6.4	7.2
Individuals below poverty (%)	8.5	10.9	3.2	1.7	8.4	9.2	10.2	10.6
Average household size	2.6	2.7	2.4	2.6	2.6	2.5	2.6	2.6
Average family size	3.0	3.1	2.8	3.1	3.1	3.0	3.2	3.1
High school graduates (%)	81.4	78.9	87.4	80.3	85.5	82.6	87.8	85.9
College graduates (%)	14.5	13.4	33.1	15.4	29.5	25.0	31.2	26.6
Owner-occupied housing (%)	78.0	74.2	77.3	78.0	70.1	72.3	71.7	73.6
Median value owner-occupied	$99,300	$119,600	$136,800	$97,500	$136,000	$130,400	$237,400	$225,200
Housing vacant (%)	8.0	8.6	6.3	12.6	5.3	12.9	8.4	15.8

References 2.5-119 and 2.5-121

a) USCB racial demographic data may add up to greater than 100%

Table 2.5-11
Schools and Daycare Facilities within 10 Miles of the PSEG Site

Schools and Daycare Centers	Sector	Distance in Miles
Delaware		
ABC1 Child Care Learning	W	9.6
AdvoServe School	NW	9.4
Alfred Waters Middle School	WNW	8.1
Appoquinimink Early Childhood Center	WSW	9.6
Bethesda Child Development Center	W	9.4
Brick Mill Elementary School	W	7.9
Bright Beginnings Preschool	WNW	8.0
Cedar Lane Elementary School	WNW	8.0
Cedar Lane Early Childhood Center	WNW	8.0
Everett Meredith Middle School	WSW	9.6
Green Acres Preschool	W	6.5
Gunning Bedford Middle School	NW	7.8
Groves Adult High School	WSW	9.6
Kathleen H. Wilbur (Wrangle Hill) Elementary School	NW	10.0
Louis L. Redding Middle School	W	9.1
Middletown High School	W	8.3
Silver Lake Elementary School	W	9.3
St. Andrews School	WSW	8.5
St. Anne's Episcopal School	WSW	8.9
St. George's Technical High School	WNW	7.7
Southern Elementary School	NW	7.7
Townsend Elementary School	WSW	9.6
Townsend Early Childhood Center	SW	9.5
Van Hook Walsh School, Inc.	NW	5.8
New Jersey		
The ARC of Salem County	NNE	9.0
Children’s Space Child Care	NNE	7.4
Community Center	NNE	7.7
Community Center	NE	7.7
Elsinboro Township Elementary School	NNE	5.4
John Fenwick Elementary School	NNE	7.4
Lower Alloways Creek Elementary School	E	7.0
Noah’s Ark	NE	7.6
Quinton Elementary School	NE	8.4
St. John’s Pentecostal Outreach Day Care Center	NNE	7.8
Salem City High School	NNE	6.8
Salem City Middle School	NNE	7.6
Salvation Army Services Center	NNE	7.8
Silver Lake Elementary School	W	9.3
Sugar & Spice Preschool Day Care Center	ENE	4.8

Reference 2.5-44

Table 2.5-12
Employment Locations within 10 Miles of the PSEG Site

Employment Locations	Sector	Distance in Miles
Delaware		
Air Liquide American LP	NNW	8.0
Blackbird Landing Group Home[(a)]	SW	8.4
Broadmeadow Healthcare[(a)]	WSW	9.7
Cornerstone Residential[(a)]	NNW	7.2
DelStar Technologies	W	9.8
Formosa Plastics	NW	9.6
Gateway Foundation (Cottage 2) [(a)]	NNW	7.2
Governor Bacon Health Center[(a)]	NNW	7.2
Johnson Controls, Inc	W	9.7
Letica Corporation	WNW	9.8
MacDermid Autotype, Inc.	WSW	9.9
Middletown Residential Treatment Center[(a)]	W	8.6
Quaker City Motor Parts/NAPA Dist. Center	W	9.7
Silver Lake Day Treatment Center[(a)]	W	8.6
Valero (Delaware City Refinery)[(b)]	NNW	8.9
New Jersey		
Anchor Hocking Glass	NNE	8.0
Cooper Interconnect	NNE	7.6
Homecare & Hospicecare of South Jersey[(a)]	NNE	7.8
Lindsay House[(a)]	NNE	9.5
Lower Alloways Creek Twp: Leisure Arms Complex[(a)]	ENE	5.9
Mannington Mills, Inc	NNE	8.7
Memorial Hospital of Salem County[(a)]	NNE	8.0
Midtown Rest Haven[(a)]	NNE	7.8
National Freight, Inc.	NNE	8.3
Office of Salem County	NNE	7.9
PSEG (EERC)	NNE	6.9
Salem County Mannington Center	NNE	9.1
The ARC of Salem County	NNE	9.0

References 2.5-44, 2.5-47 thru 2.5-51

a) Medical care facilities
b) Industrial employer closed in 2009. Facilities remain in place and are available for reuse.

Other employment locations include schools listed in Table 2.5-11.

Table 2.5-13
Other Special Facilities within 10 Miles of the PSEG Site

Special Facilities	State	Sector	Distance in Miles
Parks and Recreation			
Aquatic Resource Education Center	DE	S	9.9
Augustine Beach Boat Ramp	DE	NW	3.1
Augustine Wildlife Area	DE	NNW	3.6
Cedar Swamp: Collins Beach	DE	S	6.0
Cedar Swamp: The Rock Tract	DE	SW	4.1
Chesapeake & Delaware Canal	DE	NW	6.7
Delaware City Marina	DE	NNW	7.4
Fort Delaware State Park	DE	NNW	7.9
Fort DuPont State Park	DE	NNW	7.2
Frog Hollow Golf Club	DE	W	9.1
Grass Dale Center	DE	NNW	6.6
Port Penn Interpretive Center	DE	NW	3.7
Sliver Lake Park	DE	W	9.2
Vandergrift Golf Club	DE	WNW	5.8
Abbot's Farm	NJ	NE	4.4
Barber's Basin, Inc.	NJ	NNE	7.5
Country Club of Salem	NJ	NNE	6.1
Fort Mott State Park	NJ	N	9.0
Hancock House	NJ	ENE	4.9
Mad Horse Creek WMA	NJ	ESE	7.1
Meadow View Acres Campground	NJ	E	7.8
Penn-Salem Marina	NJ	NNE	8.0
Salem Public Ramp (PSEG)	NJ	NNE	7.3
Salem Boat Club	NJ	NNE	8.2
Stow Creek State Park	NJ	ESE	7.3
Supawna Meadows National Wildlife Refuge	NJ	N	9.5
Wild Oaks Country Club	NJ	ENE	7.4
Lodging			
Mallard Lodge	DE	S	9.9
Parkway Motel	DE	WNW	6.2
Pleasant Hill Motel	DE	WSW	6.9
Salem Motor Lodge	NJ	NNE	7.8

Reference 2.5-44

Table 2.5-14
Population Centers with Over 25,000 People within 50 Miles of the PSEG Site

Population Center	2000 Population Census	2007 Population Estimate	Annual Growth Rate (%)	Distance Sector	Direction Sector
Bel Air North, MD	25,798	28,179	1.27	40 – 50	W
Bel Air South, MD	39,711	45,345	1.91	40 – 50	W
Bridgeton, NJ	22,771	24,575	1.01	10 – 20	E
Camden, NJ	79,904	78,675	-0.22	30 – 40	NE
Chester, PA	36,854	36,695	-0.06	20 – 30	NNE
Dover, DE	32,135	35,811	1.56	10 – 20	S
Drexel Hill, PA	29,364	30,036	0.32	30 – 40	NNE
Essex, MD	39,078	39,643	0.21	40 – 50	WSW
Millville, NJ	26,847	28,459	0.84	20 – 30	ESE
Newark, DE	28,547	29,992	0.71	10 – 20	NW
Norristown, PA	31,282	31,108	-0.08	40 – 50	NNE
Pennsauken, NJ	35,737	35,116	-0.25	40 – 50	NE
Perry Hall, MD	28,705	28,997	0.14	40 – 50	W
Philadelphia, PA	1,517,550	1,449,634	-0.65	30 – 40	NNE
Radnor Township, PA	30,878	31,163	0.13	30 – 40	NNE
Vineland, NJ	56,271	58,505	0.56	20 – 30	E
Wilmington, DE	72,664	72,868	0.04	10 – 20	N

References 2.5-119 and 2.5-122

Distance Sector is to closest boundary of population centers

Table 2.5-15
Description of Sparseness and Proximity Demographic Categories

Demographic Categories Based on Sparseness	
Category	Description
Most sparse	1. Less than 40 persons per sq. mi. and no community with 25,000 or more persons within 20 mi.
	2. 40 to 60 persons per sq. mi. and no community with 25,000 or more persons within 20 mi.
	3. 60 to 120 persons per sq. mi. or less than 60 persons per sq. mi. with at least one community with 25,000 or more persons within 20 mi.
Least sparse	4. Greater than or equal to 120 persons per sq. mi. within 20 mi.
Demographic Categories Based on Proximity	
Category	Description
Not in close proximity	1. No city with 100,000 or more persons and less than 50 persons per sq. mi. within 50 mi.
	2. No city with 100,000 or more persons and between 50 and 190 persons per sq. mi. within 50 mi.
	3. One or more cities with 100,000 or more persons and less than 190 persons per sq. mi. within 50 mi.
In close proximity	4. Greater than or equal to 190 persons per sq. mi. within 50 mi.

NUREG-1437

Table 2.5-16
Generic Environmental Impact Statement Sparseness and Proximity Matrix

	Proximity Value			
Sparseness Value	**1**	**2**	**3**	**4**
1	1.1	1.2	1.3	1.4
2	2.1	2.2	2.3	2.4
3	3.1	3.3	3.3	
4	4.1	4.2		

Low Population Area (grey)

Medium Population Area (white)

High Population Area (black)

NUREG-1437

Table 2.5-17
Operation-Related Payroll for HCGS and SGS (2005 to 2008) for States and Counties within 50 Miles of the PSEG Site

State County	Number of Employees			Total Payroll	
	Range	Average	Percent	2005 to 2008	Percent
Delaware					
Kent	1 – 2	2	0.1%	$801,650	0.1%
New Castle	254 – 269	261	17.4%	$112,544,189	18.3%
Subtotal	256 – 271	263	17.5%	$113,345,839	18.5%
Maryland					
Cecil	27 – 33	29	1.9%	$12,552,333	2.0%
Harford	3	3	0.2%	$1,481,635	0.2%
Subtotal	30 – 36	32	2.1%	$14,033,968	2.2%
New Jersey					
Atlantic	3 – 5	4	0.3%	$1,729,482	0.3%
Burlington	33 – 38	36	2.4%	$15,133,933	2.5%
Camden	56 – 68	64	4.2%	$25,820,401	4.2%
Cape May	5 – 7	6	0.4%	$2,682,541	0.4%
Cumberland	148 – 161	155	10.3%	$60,774,838	9.9%
Gloucester	210 – 230	220	14.6%	$92,672,170	15.1%
Salem	586 – 645	614	40.8%	$234,000,031	38.1%
Subtotal	1072 – 1135	1099	73.0%	$432,813,395	70.5%
Pennsylvania					
Berks	3-4	4	0.2%	$1,677,594	0.3%
Bucks	0 – 1	0	0.0%	$7,606	>0.1%
Chester	37 – 56	45	3.0%	$25,929,807	4.2%
Delaware	29 – 39	34	2.3%	$14,528,833	2.4%
Lancaster	4 – 6	5	0.3%	$2,701,025	0.4%
Montgomery	5 – 9	7	0.4%	$3,371,928	0.5%
Philadelphia	1 – 2	1	0.1%	$139,441	>0.1%
Subtotal	79 – 116	96	6.3%	$48,356,234	7.9%
Total 18 Counties				$608,549,436	99.1%
Total Four Counties[a]	1211 – 1300	1250	83.1%	$499,991,227	81.4%
Total Delaware	256 – 271	263	17.5%	$113,345,839	18.5%
Total Maryland	30 – 38	32	2.1%	$14,296,461	2.3%
Total New Jersey	1072 – 1140	1101	73.2%	$433,607,381	70.6%
Total Pennsylvania	84 – 122	101	6.7%	$50,637,062	8.2%
Counties Outside 50-Mile Area	12 – 19	16	1.1%	$5,703,216	0.9%
Other States	5 – 12	7	0.5%	$2,365,910	0.4%
Total All States	1453 – 1574	1504	100%	$614,252,652	100%

a) New Castle (DE), Cumberland (NJ), Gloucester (NJ), and Salem (NJ)

Table 2.5-18 (Sheet 1 of 2)
Top Employers for Counties within 50 Miles of the PSEG Site

Location	County	Industry	Employees
Three Delaware Counties			
State of Delaware Government[a]	All	Government	17,346
State Schools and Universities[a]	All	Education	16,655
Christiana Care Health System[b]	New Castle	Healthcare	10,790
E.I. Dupont[b]	New Castle	Manufacturing	9484
Dover Air Force Base[b]	Kent	Government	8595
Bank of America[b]	New Castle	Finance	8000
JP Morgan Chase & Co.[b]	New Castle	Finance	6500
AstraZeneca[b]	New Castle	Manufacturing	4600
Wal-Mart, Inc.[a]	New Castle	Retail	3932
Mountainaire Farms of DelMarVa[a]	Sussex	Agriculture	3513
Dover Downs, Inc.[a]	Kent	Entertainment	2929
Bayhealth Medical Center[a]	Kent	Healthcare	2915
Alfred. I. Dupont Institute[a]	New Castle	Healthcare	2745
Perdue Farms, Inc.[a]	Sussex	Agriculture	2672
Wilmington Trust[c]	All	Finance	2500
Total			103,176
Seven Maryland Counties			
Baltimore County Public Schools	Baltimore	Education	13,976
Aberdeen Proving Ground	Harford	Government	12,200
Social Security Administration	Baltimore	Government	9800
Baltimore County Government	Baltimore	Government	8568
Greater Baltimore Medical Center	Baltimore	Healthcare	3331
Centers for Medicare & Medicaid Services—CMS	Baltimore	Government	2968
Erickson Retirement Communities	Baltimore	Healthcare	2809
Franklin Square Hospital Center	Baltimore	Healthcare	2800
W. L. Gore & Associates	Cecil	Manufacturing	2667
T. Rowe Price Associates, Inc.	Baltimore	Finance	2600
Reversal North America Inc.	Baltimore	Manufacturing	2530
University of Maryland Baltimore County	Baltimore	Education	2490
St. Joseph Medical Center	Baltimore	Healthcare	2300
McCormick & Company, Inc.	Baltimore	Manufacturing	2267
CareFirst, Inc.	Baltimore	Healthcare	1962
Upper Chesapeake Health Medical Services	Harford	Healthcare	1932
Lockheed Martin	Baltimore	Manufacturing	1800
Towson University	Baltimore	Education	1783
BD Diagnostic Systems	Baltimore	Manufacturing	1700
Solo Cup Company	Baltimore	Manufacturing	1700
Total			82,183
Seven New Jersey Counties			
Lockheed Martin	Burlington	Manufacturing	10,873
Borgata Hotel and Casino (2008	Atlantic	Entertainment	6840
Virtua - West Jersey Health System	Burlington and Camden	Healthcare	7716
PHH Corp.	Burlington	Finance	5080
Bally's Park Place	Atlantic	Entertainment	4759
Trump Taj Mahal	Atlantic	Entertainment	4096

Table 2.5-18 (Sheet 2 of 2)
Top Employers for Counties within 50 Miles of the PSEG Site

Location	County	Industry	Employees
Cooper University Hospital	Camden	Healthcare	5284
Harrah's	Atlantic	Entertainment	4001
Caesar's	Atlantic	Entertainment	3645
Aztar Corporation	Atlantic	Entertainment	3517
Lourdes Health System	Burlington and Camden	Healthcare	3002
Federal Aviation Administration	Atlantic	Government	2950
Showboat Casino and Hotel	Atlantic	Entertainment	2710
Commerce Bank of Burlington	Burlington	Finance	2664
South Jersey Hospital System	Cumberland	Healthcare	2581
Resorts Casino	Atlantic	Entertainment	2422
Trump Plaza	Atlantic	Entertainment	2406
Kennedy Health System	Camden	Healthcare	2331
Hilton Hotel and Casino	Atlantic	Entertainment	2261
Underwood Memorial Hospital	Gloucester	Healthcare	2200
Total			81,338
Eight Pennsylvania Counties			
U.S. Government	Philadelphia	Government	52,000
Jefferson Health System	Philadelphia	Healthcare	23,000
School District of Philadelphia	Philadelphia	Education	26,000
City of Philadelphia	Philadelphia	Government	30,000
University of Pennsylvania	Philadelphia	Education	20,381
Catholic Archdiocese	Philadelphia	Education	15,400
University of Pennsylvania Health Systems	Philadelphia	Healthcare	14,487
Comcast Corporation	Philadelphia	Information	12,795
Merck & Company, Inc.	Montgomery	Manufacturing	12,500
Catholic Health East	Chester and Philadelphia	Healthcare	11,834
Main Line Health Systems	Montgomery	Healthcare	9990
United Parcel Service	Philadelphia	Transportation	9919
Aramark	Philadelphia	Food Service	9450
Vanguard Group	Chester	Finance	9200
Children's Hospital of Philadelphia	Philadelphia	Healthcare	9150
Southeastern Pennsylvania Transportation Authority	Philadelphia	Transportation	8800
Verizon Communications, Inc.	Philadelphia	Information	8800
WaWa, Inc.	Delaware	Retail	8170
Independence Blue Cross	Philadelphia	Healthcare	8004
Siemens AG	Chester	Manufacturing	7583
Total			307,463

References 2.5-1,2.5-5, 2.5-9, 2.5-10, 2.5-11, 2.5-17, 2.5-35, 2.5-41, 2.5-43, 2.5-45, 2.5-52, 2.5-53, 2.5-63, 2.5-90, 2.5-98, 2.5-99, 2.5-105, and 2.5-109

a) As of 2006
b) As of 2007
c) As of 2009

Table 2.5-19
Employment and Unemployment Trends in the 25 Counties within 50 Miles of the PSEG Site, 1995 to 2008

	Employment/Unemployment			Growth Rate (%)		
	1995	2000	2008	1995-2000	2000-2008	1995-2008
Delaware(Three Counties)						
Labor Force	383,034	416,504	442,902	8.7%	6.3%	15.6%
Employed	366,200	402,777	421,837	10.0%	4.7%	15.2%
Unemployed	16,834	13,727	21,065	-18.5%	53.5%	25.1%
Unemployment Rate	4.4%	3.3%	4.8%			
Maryland (Seven Counties)						
Labor Force	598,045	641,380	687,862	7.2%	7.2%	15.0%
Employed	565,264	618,423	656,699	9.4%	6.2%	16.2%
Unemployed	32,781	22,957	31,163	-30.0%	35.7%	-4.9%
Unemployment Rate	5.5%	3.6%	4.5%			
New Jersey (Seven Counties)						
Labor Force	860,960	892,085	954,898	3.6%	7.0%	10.9%
Employed	800,556	855,956	896,689	6.9%	4.8%	12.0%
Unemployed	60,404	36,129	58,209	-40.2%	61.1%	-3.6%
Unemployment Rate	7.0%	4.0%	6.1%			
Pennsylvania (Eight Counties)						
Labor Force	2,437,182	2,539,670	2,670,937	4.2%	5.2%	9.6%
Employed	2,306,141	2,440,728	2,531,765	5.8%	3.7%	9.8%
Unemployed	131,041	98,942	139,172	-24.5%	40.7%	6.2%
Unemployment Rate	5.4%	3.9%	5.2%			

Reference 2.5-115 thru 2.5-118

Table 2.5-20
Projected Employment Levels for Relevant Construction Trades within 50 Miles of the PSEG Site

Occupation Code	Occupation Title	DE Three Counties	MD Seven Counties	PA Eight Counties[(a)]	New Jersey Seven Counties	Total
471011	First Line Supervisors	2230	4780	7460	4900	19,690
472011	Boilermakers	-	185	460	150	385
472021	Brickmasons/Blockmasons	650	970	2850	1150	6060
472031	Carpenters	4960	7845	22,900	8350	41,795
472051	Cement Mason/Concrete Finishers	690	1120	2230	1250	5000
472061	Construction Laborers	5450	8350	14,000	6350	33,190
472073	Operating Engineers/Equipment Operators	1740	2570	5730	2100	11,780
472111	Electricians	2590	4130	11,610	3550	21,450
472131	Insulation Workers, Floor, Ceiling, and Wall	300	270	410	400	1300
472132	Insulation Workers, Mechanical	340	480	260	50	1400
472141	Painters, Construction and Maintenance	1060	2505	4060	2550	11,535
472152	Plumbers, Pipefitters, and Steamfitters	2380	3610	6580	4200	18,220
472211	Sheet Metal Workers	860	1435	2120	1100	6755
472221	Structural Iron and Steel Workers	250	640	1070	300	2340
499044	Millwrights	190	55	590	250	1215
533032	Truck Drivers, Heavy and Tractor-Trailer	5710	7045	23,650	12,250	51,805
	Totals	29,400	45,990	105,980	48,900	233,920

References 2.5-21, 2.5-55, 2.5-76, and 2.5-86

Projections are for 2016 for DE, MD, and NJ and 2014 for PA
a) Totals do not include York County since no county-specific information was available

Table 2.5-21 (Sheet 1 of 2)
Employment by Industry within 50 Miles of the PSEG Site, 1990 to 2007

Employment Industry	1990	2000	2007	Annual Growth 1990-2007	Percent by Industry 2007
Delaware (Three County)					
Total Employment	422,940	507,820	548,130	1.5%	
Wage and Salary Employment	373,181	441,363	457,322	1.1%	83.4%
Proprietors Employment	49,759	66,457	90,808	3.4%	16.6%
Specific Industry					
Farm	4646	4492	3651	-1.3%	0.7%
Agricultural Services, Forestry, Fishing and Other	3461	1673	No Data	No Data	No Data
Mining	398	No Data	No Data	No Data	No Data
Construction	26,682	31,581	39,248	2.2%	7.2%
Manufacturing	72,988	59,528	13,387	-9.0%	2.4%
Transportation and Utilities	16,931	19,365	10,352	-2.7%	1.9%
Wholesale Trade	14,251	16,371	12,443	-0.8%	2.3%
Retail Trade	70,170	85,741	64,729	-0.4%	11.8%
Finance, Insurance, and Real Estate	44,961	70,499	72,000	2.7%	13.1%
Services	109,501	148,587	214,793	3.8%	39.2%
Government	58,951	66,249	70,838	1.0%	12.9%
Maryland (Seven County)					
Total Employment	560,693	649,681	754,476	1.7%	
Wage and Salary Employment	473,061	540,408	587,083	1.2%	77.8%
Proprietors Employment	87,632	109,273	167,393	3.7%	22.2%
Specific Industry					
Farm	6429	5983	5377	-1.0%	0.7%
Agricultural Services, Forestry, Fishing and Other	6504	6147	1107	-9.4%	0.1%
Mining	609	489	616	0.1%	0.1%
Construction	43,230	41,321	58,363	1.7%	7.7%
Manufacturing	63,725	51,620	40,300	-2.5%	5.3%
Transportation and Utilities	20,322	25,109	7973	-5.1%	1.1%
Wholesale Trade	23,250	26,780	21,543	-0.4%	2.9%
Retail Trade	107,791	122,594	89,929	-1.0%	11.9%
Finance, Insurance, and Real Estate	43,459	56,314	85,181	3.8%	11.3%
Services	157,205	219,648	318,328	4.0%	42.2%
Government	87,718	89,953	92,895	0.3%	12.3%

Table 2.5-21 (Sheet 2 of 2)
Employment by Industry within 50 Miles of the PSEG Site, 1990 to 2007

Employment Industry	1990	2000	2007	Annual Growth 1990-2007	Percent by Industry 2007
New Jersey (Seven County)					
Total Employment	854,014	930,701	1,035,452	1.1%	
Wage and Salary Employment	738,311	800,561	852,773	0.8%	82.4%
Proprietors Employment	115,703	130,140	182,679	2.6%	17.6%
Specific Industry					
Farm	7869	9502	9034	0.8%	0.9%
Agricultural Services, Forestry, Fishing and Other	7475	4306	1800	-7.6%	0.2%
Mining	907	437	471	-3.6%	0.0%
Construction	36,536	46,618	53,851	2.2%	5.2%
Manufacturing	96,643	80,739	66,030	-2.1%	6.4%
Transportation and Utilities	26,624	42,347	12,289	-4.2%	1.2%
Wholesale Trade	41,520	46,595	38,871	-0.4%	3.8%
Retail Trade	149,423	165,354	127,759	-0.9%	12.3%
Finance, Insurance, and Real Estate	65,230	69,317	93,514	2.0%	9.0%
Services	249,208	322,963	423,811	3.0%	40.9%
Government	133,416	136067	147,669	0.6%	14.3%
Pennsylvania (Eight Counties)					
Total Employment	2,747,757	2,979,754	3,138,972	0.7%	
Wage and Salary Employment	2,386,596	2,580,547	2,622,328	0.5%	83.5%
Proprietors Employment	361,161	399,207	516,644	2.0%	16.5%
Specific Industry					
Farm	23,247	23,924	21,384	-0.5%	0.7%
Agricultural Services, Forestry, Fishing and Other	22,581	28,178	5765	-7.3%	0.2%
Mining	3588	2884	2667	-1.6%	0.1%
Construction	143,125	15,1178	180,162	1.3%	5.7%
Manufacturing	450,051	396,844	274,207	-2.7%	8.7%
Transportation and Utilities	113,083	128,735	103,695	-0.5%	3.3%
Wholesale Trade	145,606	138,349	123,350	-0.9%	3.9%
Retail Trade	432,975	472,630	324,802	-1.6%	10.3%
Finance, Insurance, and Real Estate	241,127	250,407	289,657	1.0%	9.2%
Services	867,786	1,090,724	1,455,802	2.9%	46.4%
Government	304,588	294,066	299,059	-0.1%	9.5%

References 2.5-78, 2.5-113, and 2.5-114

Table 2.5-22
Peak Construction Trade Labor and On-Site Labor Estimates for a Two-Unit AP1000 Plant

Workforce	AP1000[(a)] Requirement	Percent
Trade Labor		
Boilermakers	103	2.5%
Carpenters	274	6.7%
Electricians/Instrument Fitters	495	12.0%
Iron Workers	495	12.0%
Insulators	51	1.3%
Laborers	274	6.7%
Masons	51	1.3%
Millwrights	85	2.1%
Operating Engineers	222	5.4%
Painters	51	1.3%
Pipefitters	462	11.2%
Sheetmetal Workers	85	2.1%
Teamsters	85	2.1%
Trade Supervision	137	3.3%
Subtotal	2870	70.0%
Non-Trade Workforce		
Site Indirect Labor	273	6.7%
Quality Control Inspectors	68	1.7%
Vendors and Subcontractors	239	5.8%
EPC Contractor Staff	171	4.2%
Owner's O&M Staff	342	8.3%
Start-up Personnel	103	2.5%
NRC Inspectors	34	0.8%
Subtotal	1230	30.0%
Total Trade and Non-Trade	4100	100.0%

References: 2.5-127

a) Based on two units.

Table 2.5-23
Estimated Construction Workforce Requirements by Construction Month for a Two-Unit AP1000 Plant

Construction Month	Construction Workforce On-site				Percent of Peak Workforce
	Shift 1	Shift 2	Shift 3	Total	
1	125	73	10	208	5%
3	311	182	26	519	13%
6	592	345	49	986	24%
9	872	509	73	1453	35%
12	1059	618	88	1765	43%
15	1246	727	104	2076	51%
18	1432	836	119	2387	58%
21	1619	945	135	2699	66%
24	1806	1054	151	3010	73%
27	1931	1126	161	3218	78%
30	2024	1181	169	3373	82%
33	2117	1235	176	3529	86%
36	2211	1290	184	3685	90%
39	2335	1362	195	3892	95%
42	2460	1435	205	4100	100%
45	2460	1435	205	4100	100%
48	2460	1435	205	4100	100%
51	2460	1435	205	4100	100%
54	2398	1399	200	3996	97%
57	2242	1308	187	3737	91%
60	2055	1199	171	3425	84%
63	1775	1035	148	2958	72%
66	872	509	73	1453	35%
68	343	200	29	571	14%

Reference 2.5-44

Table 2.5-24
Top 10 Employers in Four-County Region of Influence of the PSEG Site

Employer	Employees	Percent	NAICS Category
New Castle, Delaware			
Bank of America	11,000	24.9%	Finance and Insurance
DuPont	9600	21.7%	Manufacturing
Christiana Care Health System	6500	14.7%	Health and Social Assistance
JP Morgan Chase & Co.	3600	8.1%	Finance and Insurance
Alfred I. DuPont Hospital for Children	2700	6.1%	Health and Social Assistance
AstraZeneca	2600	5.9%	Manufacturing
Daimler-Chrysler Corp.[(a)]	2200	5.0%	Manufacturing
Wilmington Trust Co.	2200	5.0%	Finance and Insurance
Happy Harry's, Inc.	2100	4.8%	Retail Trade
Chase Manhattan	1700	3.8%	Finance and Insurance
Total	44,200	100%	
Cumberland, New Jersey			
South Jersey Hospital System	2581	28.9%	Health and Social Assistance
Wal-Mart	1115	12.5%	Retail Trade
Gerresheimer Glass	899	10.1%	Manufacturing
WaWa (multiple locations)	748	8.4%	Retail Trade
Elwyn New Jersey	730	8.2%	Health and Social Assistance
Durand Glass Manufacturing Company	700	7.8%	Manufacturing
ShopRite	678	7.6%	Retail Trade
General Mills/Progresso	500	5.6%	Manufacturing
Tri-County Community Action Agency, Inc.	500	5.6%	Other Services
Seabrook Brothers & Sons, Inc.	480	5.4%	Manufacturing
Total	8931	100%	
Gloucester, New Jersey			
Underwood Memorial Hospital	1860	20.0%	Health and Social Assistance
Rowan University	1300	14.0%	Educational Services
Kennedy Memorial Hospital	1200	12.9%	Health and Social Assistance
US Foodservices	900	9.7%	Wholesale Trade
Direct Group	850	9.1%	Manufacturing
Missa Bay LLC	750	8.1%	Manufacturing
US Postal Service	700	7.5%	Transportation and Warehousing
Godwin Pumps	640	6.9%	Wholesale Trade
Sony DADC	550	5.9%	Manufacturing
Valero Refining Company	540	5.8%	Oil and Gas Refining
Total	9290	100%	
Salem, New Jersey			
PSEG	1624	25.2%	Utilities
E I Du Pont	1250	19.4%	Manufacturing
Mannington Mills	826	12.8%	Manufacturing
Memorial Hospital of Salem County	600	9.3%	Health and Social Assistance
Atlantic City Electric	426	6.6%	Utilities
Richard E. Pierson Construction	400	6.2%	Construction
Anchor Glass	361	5.6%	Manufacturing
McLane NJ	352	5.5%	Wholesale Trade
Elmer Hospital	350	5.4%	Health and Social Assistance
Wal-Mart	256	4.0%	Retail Trade
Total	6445	100%	

References 2.5-17, 2.5-38, 2.5-68, and 2.5-94

a) These industrial employers closed in 2009. Facilities remain in place and are available for reuse.

Table 2.5-25
Employment Trends in the Four-County PSEG Site Region of Influence, 1995 to 2008

	Employment/Unemployment			Growth Rate (%)		
	1995	2000	2008	1995-2000	2000-2008	1995-2008
Delaware						
Labor Force	383,000	409,000	443,000	6.8%	8.3%	15.7%
Employed	366,000	393,000	422,000	7.4%	7.4%	15.3%
Unemployed	17,000	16,000	21,000	-5.9%	31.3%	23.5%
Unemployment Rate	4.4%	3.9%	4.7%			
New Castle County						
Labor Force	245,613	272,540	275,830	11.0%	1.2%	12.3%
Employed	235,222	263,830	262,807	12.2%	-0.4%	11.7%
Unemployed	10,391	8710	13,023	-16.2%	49.5%	25.3%
Unemployment Rate	4.2%	3.2%	4.7%			
New Jersey						
Labor Force	4,067,000	4,188,000	4,497,000	3.0%	7.4%	10.6%
Employed	3,806,000	4,030,000	4,251,000	5.9%	5.5%	11.7%
Unemployed	261,000	157,000	246,000	-39.8%	56.7%	-5.7%
Unemployment Rate	6.4%	3.7%	5.5%			
Cumberland County						
Labor Force	65,112	65,539	69,292	0.7%	5.7%	6.4%
Employed	58,680	61,744	63,726	5.2%	3.2%	8.6%
Unemployed	6432	3795	5566	-41.0%	46.7%	-13.5%
Unemployment Rate	9.9%	5.8%	8.0%			
Gloucester County						
Labor Force	125,789	134,838	155,446	7.2%	15.3%	23.6%
Employed	117,495	129,971	146,971	10.6%	13.1%	25.1%
Unemployed	8294	4867	8475	-41.3%	74.1%	2.2%
Unemployment Rate	6.6%	3.6%	5.5%			
Salem County						
Labor Force	31,477	31,545	31,593	0.2%	0.2%	0.4%
Employed	29,408	30,329	29,618	3.1%	-2.3%	0.7%
Unemployed	2069	1216	1975	-41.2%	62.4%	-4.5%
Unemployment Rate	6.6%	3.9%	6.3%			

References 2.5-115 thru 2.5-118

Table 2.5-26
Projected 2016 Employment Levels for Relevant Construction Trades for PSEG Site Region of Influence

Occupation Code	Occupation Title	Delaware	New Jersey			Total	Workers Required for AP1000
		New Castle	Cumberland	Gloucester	Salem		
471011	First Line Supervisors	1436	350	750	200	2736	137
472011	Boilermakers	0	50	100	0	150	103
472021	Brickmasons/Blockmasons	391	100	400	0	891	0
472031	Carpenters	3193	650	1500	150	5493	274
472051	Cement Mason/Concrete Finishers	405	100	250	0	755	51
472061	Construction Laborers	3451	500	1250	250	5451	274
472073	Operating Engineers/Equipment Operators	966	200	200	200	1566	222
472111	Electricians	1713	250	200	200	2363	495
472131	Insulation Workers, Floor, Ceiling, and Wall	0	0	0	0	0	0
472132	Insulation Workers, Mechanical	269	0	0	0	269	51
472141	Painters, Construction and Maintenance	939	200	750	300	2189	51
472152	Plumbers, Pipefitters, and Steamfitters	1629	500	1150	0	3279	462
472211	Sheet Metal Workers	600	0	550	0	1150	85
472221	Structural Iron and Steel Workers	149	50	100	0	299	495
499044	Millwrights	149	0	100	0	249	85
533032	Truck Drivers, Heavy and Tractor-Trailer	2733	1500	2700	750	7683	85
	Total	18,023	4450	10,000	2050	34,523	2870

References 2.5-21 and 2.5-76

Table 2.5-27 (Sheet 1 of 2)
Employment by Industry for the Four-County Region of Influence for the PSEG Site, 1990 to 2007

Employment Industry	1990	2000	2007	1990-2007 Change (%)
Delaware				
Total Employment	422,940	507,820	548,130	30%
Wage and Salary Employment	373,181	441,363	457,322	23%
Proprietors Employment	49,759	66,457	90,808	82%
Farm	4646	4492	3651	-21%
Agricultural Services, Forestry, Fishing and Other	3461	NA	1119	-68%
Mining	398	NA	238	-40%
Construction	26,682	31,581	39,248	47%
Manufacturing	72,988	59,528	34,262	-53%
Transportation and Utilities	16,931	19,365	16,461	-3%
Wholesale Trade	14,251	16,371	16,243	14%
Retail Trade	70,170	85,741	64,729	-8%
Finance, Insurance, and Real Estate	44,961	70,499	72,000	60%
Services	109,501	148,587	221,348	102%
Government	58,951	66,249	70,838	20%
New Castle County				
Total Employment	298,418	352,024	360,929	21%
Wage and Salary Employment	269,384	313,105	308,713	15%
Proprietors Employment	29,034	38,919	52,216	80%
Farm	665	749	511	-23%
Agricultural Services, Forestry, Fishing and Other	1837	NA	NA	NA
Mining	350	NA	NA	NA
Construction	17,753	20,215	22,947	29%
Manufacturing	53,783	41,420	NA	NA
Transportation and Utilities	12,768	14,365	10,352	-19%
Wholesale Trade	10,976	12,453	12,443	13%
Retail Trade	46,457	54,367	38,767	-17%
Finance, Insurance, and Real Estate	36,581	57,027	56,430	54%
Services	83,710	110,378	156,476	87%
Government	33,538	38,010	39,136	17%
New Jersey				
Total Employment	4,344,458	4,755,379	5,128,341	18%
Wage and Salary Employment	3,755,915	4,100,287	4,184,945	11%
Proprietors Employment	588,543	655,092	943,396	60%
Farm	15,710	18,594	17,115	9%
Agricultural Services, Forestry, Fishing and Other	28,951	39,707	6799	-77%
Mining	4597	2894	3452	-25%
Construction	204,341	212,758	272,204	33%
Manufacturing	603,503	484,165	326,471	-46%
Transportation and Utilities	255,151	302,807	218,621	-14%
Wholesale Trade	292,995	305,660	254,731	-13%
Retail Trade	657,389	723,317	555,402	-16%
Finance, Insurance, and Real Estate	413,173	444,551	542,188	31%
Services	1,268,801	1,616,883	2,161,887	70%
Government	599,847	604,043	656,710	9%

Table 2.5-27 (Sheet 2 of 2)
Employment by Industry for the Four-County Region of Influence for the PSEG Site, 1990 to 2007

Employment Industry	1990	2000	2007	1990-2007 Change (%)
Cumberland County				
Total Employment	68,853	71,076	76,090	11%
Wage and Salary Employment	59,907	62,757	65,721	10%
Proprietors Employment	8946	8319	10,369	16%
Farm	1857	2261	2610	41%
Agricultural Services, Forestry, Fishing and Other	699	730	879	26%
Mining	402	282	194	-52%
Construction	3204	3104	4395	37%
Manufacturing	15,486	12,513	9449	-39%
Transportation and Utilities	2769	3484	NA	NA
Wholesale Trade	2652	2931	2608	-2%
Retail Trade	10,029	11,689	9598	-4%
Finance, Insurance, and Real Estate	6298	3631	4131	-34%
Services	14,063	16,299	23,045	64%
Government	11,394	14,152	15,189	33%
Gloucester County				
Total Employment	92,222	109,742	132,406	44%
Wage and Salary Employment	77,559	95,359	111,880	44%
Proprietors Employment	14,663	14,383	20,526	40%
Farm	1697	1885	1543	-9%
Agricultural Services, Forestry, Fishing and Other	1042	1440	253	-76%
Mining	52	72	211	306%
Construction	6442	7308	9551	48%
Manufacturing	13,134	12,731	10,998	-16%
Transportation and Utilities	3772	4339	3789	0%
Wholesale Trade	4987	8364	9022	81%
Retail Trade	19,657	23,685	20,881	6%
Finance, Insurance, and Real Estate	4966	5505	7519	51%
Services	21,677	28,408	40,024	85%
Government	14,796	16,005	19,293	30%
Salem County				
Total Employment	29,232	28,313	30,555	5%
Wage and Salary Employment	25,119	23,407	24,272	-3%
Proprietors Employment	4113	4906	6283	53%
Farm	1135	1377	1230	8%
Agricultural Services, Forestry, Fishing and Other	474	441	NA	NA
Mining	20	NA	13	-35%
Construction	2082	1368	NA	NA
Manufacturing	5843	3993	3197	-45%
Transportation and Utilities	NA	3368	3445	NA
Wholesale Trade	593	NA	486	-18%
Retail Trade	4107	4301	3331	-19%
Finance, Insurance, and Real Estate	1348	1644	1990	48%
Services	NA	7042	8926	NA
Government	4203	4315	4843	15%

References 2.5-113 and 2.5-114

Table 2.5-28
Salem and Hope Creek Operation-Related Purchases for Materials and Services from 2005 to 2008 with PSEG Site Region

	2005		2006		2007		2008		2005-2008	
Location	Total	Percent	Total	Percent	Total	Percent	Total	Percent	Total	Percent
Delaware										
Kent	$598,406	0.08%	$896,880	0.13%	$468,008	0.06%	$1,201,960	0.13%	$3,165,254	0.10%
New Castle	$11,047,718	1.46%	$6,888,717	1.02%	$5,145,198	0.70%	$4,010,821	0.43%	$27,092,454	0.88%
Sussex	$0	0.00%	$54,066	0.01%	$0	0.00%	$162,822	0.02%	$216,888	0.01%
Subtotal	$11,646,124	1.54%	$7,839,663	1.16%	$5,613,206	0.77%	$5,375,603	0.58%	$30,474,596	0.98%
New Jersey										
Atlantic	$997,281	0.13%	$1,039,627	0.15%	$978,796	0.13%	$582,213	0.06%	$3,597,918	0.12%
Burlington	$29,442,312	3.90%	$17,401,583	2.57%	$15,530,338	2.12%	$18,839,672	2.02%	$81,213,905	2.62%
Camden	$30,259,350	4.01%	$33,917,169	5.01%	$31,551,891	4.30%	$42,383,480	4.55%	$138,111,890	4.46%
Cape May	$69,215	0.01%	$177,096	0.03%	$304,118	0.04%	$90,623	0.01%	$641,053	0.02%
Cumberland	$3,609,487	0.48%	$2,641,832	0.39%	$1,471,294	0.20%	$1,421,037	0.15%	$9,143,649	0.30%
Gloucester	$6,913,373	0.92%	$5,678,890	0.84%	$10,202,580	1.39%	$10,610,463	1.14%	$33,405,305	1.08%
Salem	$5,410,169	0.72%	$5,808,044	0.86%	$4,432,905	0.60%	$7,465,087	0.80%	$23,116,205	0.75%
Subtotal	$76,701,188	10.17%	$66,664,241	9.84%	$64,471,922	8.80%	$81,392,575	8.74%	$289,229,926	9.34%
Pennsylvania										
Berks	$134,981	0.02%	$222,307	0.03%	$2,152,487	0.29%	$2,747,219	0.30%	$5,256,994	0.17%
Bucks	$2,668,500	0.35%	$2,281,241	0.34%	$2,903,224	0.40%	$3,934,709	0.42%	$11,787,674	0.38%
Chester	$3,051,675	0.40%	$3,571,924	0.53%	$3,548,038	0.48%	$6,038,927	0.65%	$16,210,565	0.52%
Delaware	$5,031,707	0.67%	$5,369,771	0.79%	$5,686,324	0.78%	$4,959,199	0.53%	$21,047,002	0.68%
Lancaster	$356,756	0.05%	$515,038	0.08%	$452,057	0.06%	$708,888	0.08%	$2,032,739	0.07%
Montgomery	$10,693,273	1.42%	$10,409,755	1.54%	$10,867,354	1.48%	$19,763,005	2.12%	$51,733,387	1.67%
Philadelphia	$92,304,398	12.24%	$68,524,710	10.12%	$81,229,128	11.08%	$72,501,359	7.79%	$314,559,594	10.16%
York	$94,944	0.01%	$87,819	0.01%	$118,193	0.02%	$243,657	0.03%	$544,614	0.02%
Subtotal	$114,336,236	15.16%	$90,982,565	13.43%	$106,956,805	14.59%	$110,896,963	11.91%	$423,172,570	13.67%
18-County Totals	$202,683,548	26.87%	$165,486,470	24.43%	$177,041,933	24.15%	$197,665,140	21.23%	$742,877,091	24.00%
Total DE	$11,646,124	1.54%	$7,839,663	1.16%	$5,613,206	0.77%	$5,375,603	0.58%	$30,474,596	0.98%
Total NJ	$465,704,144	61.74%	$423,705,892	62.55%	$474,552,530	64.74%	$649,491,837	69.76%	$2,013,454,403	65.04%
Total PA	$261,243,351	34.63%	$227,478,085	33.58%	$233,086,659	31.80%	$242,174,702	26.01%	$963,982,798	31.14%
Other States	$15,707,712	2.08%	$18,345,373	2.71%	$19,764,580	2.70%	$33,955,926	3.65%	$87,773,591	2.84%
Total All States	$754,301,331	100%	$677,369,013	100%	$733,016,975	100%	$930,998,069	100%	$3,095,685,388	100%

Table 2.5-29
Corporate, Income, Property, and Sales Tax Rates for 2008 for States and Region of Influence Counties within a 50-Mile Radius of the PSEG Site

Location	Percent of 2005-2008 PSEG Payroll[(a)]	Percent of 2005-2008 PSEG Purchases[(b)]	Tax Rates (in Percent)				
			Corporate	Income	Property		Sales
					County	Local	
Delaware	18.4	0.98	NA	0.5 – 5.95			0
New Castle	18.3				0.5614	1.8635-3.5267	
New Jersey	70.6	65	9	1.4 – 8.97			7
Cumberland	9.9					3.025-4.888	
Gloucester	15.1					2.199-6.251	
Salem	38.1					1.033-6.190	
Lower Alloways Creek Township						1.033	
Salem City						3.339	
Pennsylvania	8.2	31.1	NA	3.07			6

References 2.5-25, 2.5-87, 2.5-103, and 2.5-104

a) Values from Table 2.5-17
b) Values from Table 2.5-28

Table 2.5-30
Personal Income for 25 Counties within 50 Miles of the PSEG Site and Four-County Region of Influence, 1990 to 2007

	Years			Average Annual
	1990	2000	2007	Growth (%)
Delaware				
New Castle County	$23,810	$34,751	$45,755	3.9%
Three County Average[(a)]	$19,087	$27,585	$35,993	3.8%
State Average[(a)]	$21,422	$30,871	$40,112	3.8%
Maryland				
Seven County Average	$20,420	$31,356	$43,216	4.5%
State Average	$22,852	$34,264	$46,471	4.3%
New Jersey				
Cumberland County	$17,295	$23,375	$29,599	3.2%
Gloucester County	$18,830	$28,027	$37,331	4.1%
Salem County	$19,165	$27,672	$35,236	3.6%
Seven County Average	$20,185	$29,545	$37,698	3.7%
State Average	$24,572	$38,377	$49,511	4.2%
Pennsylvania				
Eight County Average	$22,810	$34,802	$44,598	4.0%
State Average	$19,687	$29,698	$38,793	4.1%

a) Three County Average and State Average values as given in reference Reference2.5-112

Table 2.5-31
Housing Information for Counties within 50 Miles of the PSEG Site, 1990 to 2007

	1990	2000	2005 to 2007[(a)]	Overall Growth (%)
Delaware (Three-County Total)				
Total Housing Units	289,919	343,072	382,149	31.8%
Occupied	247,497	298,736	321,748	30.0%
Owner-Occupied	173,896	216,038	236,646	36.1%
Renter-Occupied	73,601	82,698	85,102	15.6%
Vacant Units	42,422	44,336	60,401	42.4%
Median value (dollars)	NA	124,167	215,667	73.7%
Maryland (Seven-County Total)				
Total Housing Units	423,222	485,953	511,636	20.9%
Occupied	398,049	459,152	480,117	20.6%
Owner-Occupied	273,998	324,765	343,535	25.4%
Renter-Occupied	124,051	134,387	136,582	10.1%
Vacant Units	25,173	26,801	31,519	25.2%
Median value (dollars)	NA	133,686	278,333	108.2%
New Jersey (Seven-County Total)				
Total Housing Units	683,897	740,202	789,408	15.4
Occupied	588,048	641,442	680,395	15.7
Owner-Occupied	421,110	467,521	502,165	19.2
Renter-Occupied	166,938	173,921	178,230	6.8
Vacant Units	95,849	98,760	109,013	13.7
Median value (dollars)		117,814	216,674	83.9
Pennsylvania (Eight-County Total)				
Total Housing Units	1,917,015	2,052,573	2,135,781	11.4%
Occupied	1,790,479	1,921,468	1,956,507	9.3%
Owner-Occupied	1,242,176	1,337,662	1,373,314	10.6%
Renter-Occupied	548,303	583,806	583,193	6.4%
Vacant Units	126,536	131,105	179,274	41.7%
Median value (dollars)	NA	128,700	217,688	69.1%

NA-Not Available
a) Based on three year interim reporting period between census dates
Reference 2.5-123

Table 2.5-32
Housing Information for Four-County Region of Influence of the PSEG Site, 1990 to 2007

	1990	2000	2005-2007	Overall Growth (%)
New Castle County, DE				
Total Housing Units	173,560	199,521	211,073	21.6%
Occupied	164,161	188,935	193,434	17.8%
Owner-Occupied	112,122	132,514	138,742	23.7%
Renter-Occupied	52,039	56,421	54,692	5.1%
Vacant Units	9399	10,586	17,639	87.7%
Rental Units	NA	6216	10,586	70.3%
Median Monthly Rent (dollars)	NA	593	764	28.8%
Median value (dollars)		136,000	237,400	74.6%
Cumberland County, NJ				
Total Housing Units	50,294	52,863	54,749	8.9%
Occupied	47,118	49,143	50,165	6.5%
Owner-Occupied	32,276	33,389	34,322	6.3%
Renter-Occupied	14,842	15,754	15,843	6.7%
Vacant Units	3176	3720	4584	44.3%
Rental Units	NA	2269	2278	0.4%
Median Monthly Rent (dollars)	NA	518	620	19.7%
Median value (dollars)		91,200	156,500	71.6%
Gloucester County, NJ				
Total Housing Units	82,459	95,054	105,426	27.9%
Occupied	78,845	90,717	99,708	26.5%
Owner-Occupied	61,736	72,516	81,213	31.5%
Renter-Occupied	17,109	18,201	18,495	8.1%
Vacant Units	3614	4337	5718	58.2%
Rental Units	NA	2462	3034	23.2%
Median Monthly Rent (dollars)	NA	557	734	31.8%
Median value (dollars)		120,100	220,400	83.5%
Salem County, NJ				
Total Housing Units	25,349	26,158	27,313	7.7%
Occupied	23,794	24,295	25,073	5.4%
Owner-Occupied	17,203	17,724	18,825	9.4%
Renter-Occupied	6591	6571	6248	-5.2%
Vacant Units	1555	1863	2240	44.1%
Rental Units	NA	814	685	-15.8%
Median Monthly Rent (dollars)	NA	516	674	30.6%
Median value (dollars)		105,200	173,600	65.0%

NA-Not Available

Reference 2.5-123

Table 2.5-33
School Enrollments and Capacities within 50 Miles of the PSEG Site, 2008

Location	Number of Schools	Total Enrollments	Average Enrollment	Unused Capacity (%)[(a)]
Delaware (Three Counties)				
High School	36	31,462	874	18.6
Middle School	40	23,760	594	16.3
Elementary School	103	49,387	479	20.5
Subtotals	179	104,609	584	19.0
Maryland (Seven Counties)				
High School	21	23,290	1109	4.4
Middle School	23	15,796	687	20.5
Elementary School	69	33,447	485	4.1
Subtotals	113	72,533	642	8.3
New Jersey (Seven Counties)				
High School	74	75,644	1022	NA
Middle School	95	49,388	520	NA
Elementary School	271	111,373	411	NA
Subtotals	440	236,405	537	
Pennsylvania (Eight Counties)				
High School	132	133,068	1008	NA
Middle School	166	96,416	581	NA
Elementary School	346	188,951	546	NA
Subtotals	644	418,435	650	
Region Totals				
High School	263	263,464	1002	
Middle School	324	185,360	572	
Elementary School	789	383,158	486	
All Schools	1376	831,982	605	

References: 2.5-6, 2.5-13, 2.5-19, 2.5-39, 2.5-54, 2.5-59, 2.5-70, 2.5-85, and 2.5-101

a) Capacity figures are based on 149 schools in Delaware and 113 schools in Maryland. No school capacity data was found for New Jersey and Pennsylvania schools.

Table 2.5-34
School Enrollments and Capacities in the PSEG Site Four-County Region of Influence

Location	Number of Schools	Total Enrollments	Average Enrollment	Unused Capacity (%)[a]
New Castle County, DE				
High School	24	20,863	869	21.3%
Middle School	31	16,622	536	29.4%
Elementary School	72	36,441	506	20.0%
Totals	127	73,926	582	22.8%
Cumberland County, NJ				
High School	7	7706	1101	NA
Middle School	11	4125	375	NA
Elementary School	39	14,848	381	NA
Totals	57	26,679	468	
Gloucester County, NJ				
High School	14	14,442	1032	NA
Middle School	17	11,452	674	NA
Elementary School	54	23,799	441	NA
Totals	85	49,693	585	
Salem County, NJ				
High School	7	3764	538	NA
Middle School	12	2812	234	NA
Elementary School	20	5561	278	NA
Totals	39	12,137	311	

References 2.5-19, 2.5-70, and 2.5-101

a) Capacity figures were only available for 50 schools in DE

Table 2.5-35
Colleges and Universities within 50 Miles of the PSEG Site and Four-County Region of Influence

	Total Enrollments	Number	Institutions[a]	Enrollments
Within 50 Miles				
Delaware (3 counties)	48,039	9		
Maryland (7 counties)	10,565	3	Harford Community College	5841
New Jersey (7 counties)	57,820	11		
Pennsylvania (8 counties)	219,865	53	Community College of Philadelphia	17,334
			Drexel University	20,682
			Temple University	35,489
			University of Pennsylvania	23,980
Total	336,289	76		
	Total Enrollments	**Number**	**Institutions[b]**	**Enrollments**
Region of Influence				
New Castle County, DE	38,690	6	University of Delaware	20,352
			Wilmington University	8353
			Delaware Technical/Community College	7519
Salem County, NJ	1306	1	Cumberland County College	3822
Cumberland County, NJ	3822	1	Rowan University	9770
Gloucester County, NJ	15,906	2	Gloucester County College	6135
			Salem Community College	1306
Total	59,724	10		

a) Includes only major institutions with enrollments greater than 5,000
b) All institutions

References 2.5-4, 2.5-7, 2.5-14, 2.5-91, 2.5-92, 2.5-106, 2.5-110, and 2.5-111

Table 2.5-36
Refuges, Trusts and Parks within 50 Miles of PSEG Site

Location	Total Acres	National Wildlife Refuges #	National Wildlife Refuges Acres	National Trust / Preserves #	National Trust / Preserves Acres	Private Parks #	Private Parks Acres	State Parks #	State Parks Acres
Delaware									
New Castle	7403	0	0	0	0	0	0	11	7403
3 Counties	33,447	2	25,978	0	0	0	0	12	7469
Maryland									
7 Counties	39,711	2	2287	1	400	3	25,900	6	11,124
New Jersey									
Cumberland	7756	0	0	2	7756	0	0	0	0
Gloucester	0	0	0	0	0	0	0	0	0
Salem	17,775	1	4600	1	609	0	0	4	12,566
7 Counties	217,197	2	15,600	3	8365	0	0	8	193,231
Pennsylvania									
8 Counties	17,775	3	3700	17	4357	0	0	6	9718
Total	308,130	9	47,565	21	13,122	3	25,900	32	221,542

References 2.5-2, 2.5-8, 2.5-12, 2.5-30, 2.5-40, 2.5-42, 2.5-56, 2.5-57, 2.5-58, 2.5-66, 2.5-72, 2.5-73, 2.5-84, 2.5-132, 2.5-135, 2.5-136, and 2.5-137

Note: The data for the four counties in the Region of Influence are shaded.

Table 2.5-37
Taxes Paid by PSEG for the Hope Creek and Salem Generating Stations, and Energy and Environmental Resource Center

Taxing Authority	Year					2005 to 2009
Type of Tax	2005	2006	2007	2008	2009	Total
Salem City						
Property Tax	$220,822	$228,492	$318,910	$265,276	$387,353	$1, 420,853
Salem City Total Tax Revenues	$6,294,613	$6,485,947	$7,389,319	$8,474,461	$8,364,553	$37,008,893
PSEG Percent of Total Tax Revenues	3.5%	3.5%	4.3%	3.1%	4.6%	3.8%
Lower Alloways Creek Township						
Property Tax	$1,269,268	$1,191,870	$1,253,019	$1,168,202	$1,512,997	$6,395,356
Township Total Tax Revenues	$2,325,378	$2,195,746	$2,310,262	$2,145,098	$2,789,386	$11,765,870
PSEG Percent of Total Tax Revenues	54.6%	54.3%	54.2%	54.5%	54.2%	54.4%
Other New Jersey Townships						
Property Tax						
Elsinboro	$30,607	$33,021	$34,932	$38,754	$40,194	$177,508
Hopewell	$4547	$4906	$5190	$9541	$9378	$33,562
Greenwich	$102,400	$110,477	$116,869	$118,124	$117,105	$564,975
Fairfield	$17,652	$19,044	$20,146	$34,989	$26,097	$117,928
Dennis	$7563	$8160	$8632	$9071	$9385	$42,811
Commercial	$66,137	$71,354	$75,482	$80,279	$69,384	$362,636
Maurice River	$11,458	$12,362	$13,077	$14,002	$14,255	$65,154
Lower Alloways Creek	$8259	$8910	$9426	$2328	$756	$29,679
Total for Other Townships	$248,623	$268,234	$283,754	$307,088	$286,554	$1,394,253
Total	$1,738,713	$1,688,596	$1,855,683	$1,740,566	$2,186,904	$9,210,462
Salem County						
County Total Tax Revenues	$40,562,971	$43,382,037	$46,667,551	$50,139,854	$51,302,437	$232,054,850
PSEG Percent of Total Tax Revenues[(a)]	3.7%	3.3%	3.4%	2.9%	3.7%	3.4%

Table 2.5-38 (Sheet 1 of 2)
Major Water Suppliers (Serving 5000 or More People) within PSEG Site Region of Influence

Water System Name	Population Served	Primary Water Source	Total Daily Capacity (Mgd)	Peak Daily Demand (Mgd)	Demand as a % of Capacity	Excess Capacity (Mgd)	Excess as a % of Capacity
Delaware - New Castle County							
Artesian Water Company, Inc.	215,100	Wells	27	NA	NA	NA	NA
City of Wilmington Water	140,000	Surface	61	29	47.5%	32	52.5%
Tidewater Utilities, Inc.	30,000	Ground	NA	NA	NA	NA	NA
United Water Delaware	105,270	Surface	6	2.5	41.7%	3.5	58.3%
New Castle Water Department	6000	Ground	1.3	0.5	38.5%	0.8	61.5%
Middletown Water Department	9900	Ground	NA	NA	NA	NA	NA
Newark Water Department	36,130	Surface	6	4	66.7%	2	33.3%
Total or Average	542,400		101.3	36	35.5%		
Total or Average Excess (4 providers)	287,400		74.3	36	48.5%	38.3	51.5%
New Jersey							
Cumberland County							
Bridgeton Water Department	22,770	Ground	3.31	4.06	122.7%	-0.75	-22.7%
Millville Water & Sewer Utility	27,500	Ground	7.24	6.37	88.0%	0.87	12.0%
Vineland Water & Sewer Utility	33,000	Ground	16.39	15.08	92.0%	1.31	8.0%
Subtotal or Average	83,270		26.95	25.52	94.7%	1.43	5.3%
Gloucester County							
Clayton Water Department	7155	Ground	1.94	1.06	54.6%	0.88	45.4%
Deptford Municipal Water Authority	26,000	Purchased Surface	8.60	4.72	54.9%	3.88	45.1%
Glassboro Water Department	19,238	Ground	6.04	4.13	68.4%	1.91	31.6%
Greenwich Water Department	4921	Ground	1.73	1.30	74.9%	0.43	25.1%
Mantua Municipal Water Authority	11,713	Ground	2.38	2.33	98.2%	0.04	1.8%
Monroe Municipal Water Authority	26,145	Ground	7.15	6.22	86.9%	0.94	13.1%
NJ American Water Company - Logan	5967	Ground	2.15	1.66	77.5%	0.48	22.5%
Paulsboro Water Department	6200	Ground	1.80	1.25	69.3%	0.55	30.7%
Pitman Water Department	9445	Ground	1.59	0.96	60.1%	0.64	39.9%

Table 2.5-38 (Sheet 2 of 2)
Major Water Suppliers (Serving 5000 or more People) within PSEG Site Region of Influence

Water System Name	Population Served	Primary Water Source	Total Daily Capacity (Mgd)	Peak Daily Demand (Mgd)	Demand as a % of Capacity	Excess Capacity (Mgd)	Excess as a % of Capacity
Gloucester County (cont'd)							
NJ American Water Company - Harrison	9450	Ground	3.80	3.80	100.0%	0.00	0.0%
Washington Municipal Water Authority	48,000	Ground	12.92	8.25	63.9%	4.67	36.1%
West Deptford Water Department	20,000	Ground	7.03	4.21	59.9%	2.82	40.1%
Westville Water Department	6000	Ground	1.73	0.70	40.3%	1.03	59.7%
Woodbury Water Department	11,000	Purchased surface	4.32	1.76	40.6%	2.57	59.4%
Subtotal or Average	211,234		63.18	42.34	67.0%	20.84	33.0%
Salem County							
Pennsville Water Department	13,500	Ground	1.87	1.63	87.1%	0.24	12.9%
Hope Creek Water Department	6199	Ground	4.27	1.66	38.7%	2.62	61.3%
Subtotal	19,699		6.15	3.29	53.5%	2.86	46.5%
Gloucester/Salem Shared							
Penns Grove Water Supply Company	14,406	Ground	2.6	2.0	74.5%	0.67	25.5%
Total or Average	328,609		99	73.1	73.9%		
Total or Average Excess						25.8	26.1%

References 2.5-22, 2.5-23, 2.5-26, and 2.5-71

Table 2.5-39
Public Wastewater Treatment Systems in Four-County Region of Influence of PSEG Site

Waste Water Treatment Plants	Population Served	Total Capacity (Mgd)	Average Daily Usage (Mgd)	Usage as a % of Total Capacity	Excess Capacity (Mgd)	Excess as a % of total Capacity (Mgd)
New Castle, DE						
Wilmington STP	503,708	102.8	71.2	69.3%	31.5	30.7%
Delaware City STP	1879	0.50	0.25	50.0%	0.25	50.0%
Port Penn STP	262	0.05	0.04	80.0%	0.01	20.0%
Subtotal or Average	505,849	103.3	71.5	69.2%	31.8	30.8%
Cumberland, NJ						
Cumberland Co. UA-Cohansey RV STP	22,771	7.00	3.41	48.7%	3.59	51.3%
Landis Sewerage Authority	34,307	8.20	5.36	65.4%	2.84	34.6%
City of Millville STP	26,847	5.00	2.59	51.8%	2.41	48.2%
Subtotal or Average	83,925	20.2	11.4	56.2%	8.84	43.8%
Gloucester, NJ						
Gloucester County Utilities Authority	NA	24.1	17.2	71.4%	6.90	28.6%
Greenwich Township STP	4511	1.00	0.91	91.0%	0.09	9.0%
Harrison Township STP	6246	0.40	0.31	77.5%	0.09	22.5%
Logan Township MUA	6032	1.20	0.59	49.2%	0.61	50.8%
Swedesboro Consolidated STP	2008	0.35	0.27	77.1%	0.08	22.9%
Subtotal or Average	18,797	27.1	19.3	71.2%	7.77	28.8%
Salem, NJ						
Carney's pt. TWP SA	7597	1.30	0.72	55.4%	0.58	44.6%
Penns Grove SA	4840	0.75	0.66	88.0%	0.09	12.0%
Pennsville SA	12,083	1.88	1.58	84.0%	0.30	16.0%
Salem City STP	5793	1.40	0.86	61.4%	0.54	38.6%
Woodstown STP	3260	0.50	0.30	60.0%	0.20	40.0%
Lower Alloways Creek-Leisure Arms STP	231	0.02	0.01	50.0%	0.01	50.0%
Lower Alloways Creek-Hancock STP	817	0.05	0.02	40.0%	0.03	60.0%
Lower Alloways Creek-Canton STP	772	0.05	0.02	40.0%	0.03	60.0%
Subtotal or Average	35,393	5.95	4.17	70.1%	1.78	29.9%
Total or Average for Four-County Region of Influence	643,964	156.5	106.3	67.9%	50.2	32.1%

Reference 2.5-130

Table 2.5-40
Police and Fire Personnel within 50 Miles of the PSEG Site and Four-County Region of Influence

Location	Police Personnel	Residents Per Officer	Fire Personnel	Residents Per Firefighter
Delaware				
New Castle	1101	478	1649	319
Three Counties	1780	484	4040	213
Maryland				
Seven Counties	2969	424	9513	132
New Jersey				
Cumberland	402	387	797	195
Gloucester	343	832	1326	215
Salem	273	241	605	109
Seven Counties	3245	566	8823	208
Pennsylvania				
Eight Counties	9855	528	19,057	273

References 2.5-32, 2.5-33, 2.5-36, and 2.5-131

Note: The data for the four counties in the Region of Influence are shaded.

Table 2.5-41
Physicians and Hospital Beds within 50 Miles of the PSEG Site and Four-County Region of Influence

Location	Physicians	Physicians Per 1000 Residents	Hospital Beds	Hospital Beds Per 1000 Residents
Delaware				
New Castle	1708	3.3	1166	2.2
Three Counties	2325	2.7	1955	2.3
Maryland				
Seven Counties	4765	3.8	1836	1.5
New Jersey				
Cumberland	217	1.4	409	2.7
Gloucester	321	1.1	240	0.9
Salem	75	1.1	110	1.7
Seven Counties	4460	2.4	4086	2.2
Pennsylvania				
Eight Counties	20,582	4.0	15,723	3.0

Reference 2.5-123

Note: The data for the four counties in the Region of Influence are shaded.

Table 2.5-42
Road and Highway Mileage within 50 Miles of the PSEG Site and Its Region of Influence

	Mileage							
Location	**Total**	**U.S. Interstates**	**Freeway/ Expressway**	**Principal Arteries**	**Minor Arterial**	**Major Collector**	**Minor Collector**	**Local Roads**
Delaware								
New Castle	2355	41	4	173	138	267	45	1687
Three Counties	6094	41	14	363	301	816	224	4335
State	6094	41	14	363	301	816	224	4335
Maryland								
Seven Counties	7914	126	50	357	669	852	550	5310
State	31,067	481	263	1504	2260	3265	1773	21,521
New Jersey								
Cumberland	1272	0	17	30	204	148	34	839
Gloucester	1613	17	31	89	194	187	14	1,081
Salem	881	9	2	48	42	145	33	602
Seven Counties	11,780	77	159	625	1233	1245	140	8301
State	38,752	431	404	1959	3801	3727	424	28,006
Pennsylvania								
Eight Counties	25,976	309	195	1340	1770	2680	855	18,827
State	121,582	1759	549	4805	8496	12,551	7256	86,166

References 2.5-24, 2.5-61, 2.5-79, and 2.5-88

Note: The data for the four counties in the Region of Influence are shaded.

Table 2.5-43
Annual Average Daily Traffic Counts on Roads in Proximity to the PSEG Site

Roadway and Location	Annual Average Daily Traffic (AADT)	Year
NJ 49, between NJ 45 and York Street	12,920	2005
NJ 45, between CR 657 and Howell Street	8748	2007
Alloway Creek Neck Road, between Grosscup Road and Pancoast Road	3175	2007
Fort Elfsborg Road, between CR 627 and Mason Point	351	2005
Money Island Road, just south of CR 627	403	2006
Chestnut Street, between Grieves Pkwy and Maple Avenue	1787	2008
Grieves Parkway, between CR 625 (Chestnut) and CR 665 (Walnut)	3342	2007
Oak Street, between Chestnut Street and Wesley Street	1324	2007

Reference 2.5-81

Table 2.5-44
International and General Aviation Airports within 50 Miles of the PSEG Site

Airport Name	County	Closest City	State	Type of Airport
New Castle Airport	New Castle	Wilmington	DE	Business Airport of Local Impact
Delaware Airpark	Kent	Cheswold	DE	General Aviation Airport[(a)]
Summit Airport	New Castle	Middletown	DE	General Aviation Airport
Millville Municipal Airport	Cumberland	Millville	NJ	General Aviation Airport
Philadelphia International Airport	Philadelphia	Philadelphia	PA	Business Airport of Regional Impact
Brandywine Airport	Chester	West Chester	PA	General Aviation Airport
Chester County G.O. Carlson Airport	Chester	Coatesville	PA	General Aviation Airport
New Garden Airport	Chester	Toughkenamon	PA	General Aviation Airport
Wings Field	Montgomery	Blue Bell	PA	General Aviation Airport

Reference 2.5-34

a) General aviation (GA) is one of two categories of civil aviation. It refers to all flights other than military and scheduled airline flights, both private and commercial.

Table 2.5-45
Identified Historic Properties Located in the Proposed Causeway and Parking Areas

State Site Number	Site Components	Eligibility
28SA179	Mid 18th to 19th Century, Middle to Late Woodland Period	Both components potentially eligible
28SA180	18th to 19th Century, Middle to Late Woodland Period	Both components potentially eligible
28SA181	18th to 19th Century, Middle to Late Woodland Period	Historic component potentially eligible
28SA182	18th to 19th Century, Middle to Late Woodland Period	Both components potentially eligible
28SA183	18th to 19th Century, Middle to Late Woodland Period	Both components potentially eligible
28SA186	18th to 19th Century	Historic component potentially eligible

Reference 2.5-46

Table 2.5-46 (Sheet 1 of 5)
Historic Properties Listed on the NRHP Located within a 10-Mile Radius of the PSEG Site

Name	Address	City	County	State	Distance from PSEG Site (mi.)
Joseph Ware House	134 Poplar Street	Hancock's Bridge Area	Salem	NJ	3.9
Alloways Creek Friends Meetinghouse	Buttonwood Ave, 150 ft. west of Main Street	Hancock's Bridge	Salem	NJ	4.9
Hancock House	Route 49 and Front Street	Lower Alloways Creek Township	Salem	NJ	5.1
Hedge-Carpenter-Thompson Historic District	Bounded by Hedge, Thompson, South Third streets and Oak Street Alley	Salem	Salem	NJ	8.1
Broadway Historic District	Broadway from Front to Yorke Street	Salem	Salem	NJ	8.2
Market Street Historic District	Market Street from Broadway to Fenwick Creek	Salem	Salem	NJ	8.5
Abel and Mary Nicholson House	Junction of Hancock's Bridge and Fort Elfsborg Road	Elsinboro Area	Salem	NJ	4.8
Sarah and Samuel Nicholson House	2 mi. south of Salem on Amwellbury Road	Salem Area	Salem	NJ	5.4
Benjamin Holmes House	West of Salem on Fort Elfsborg-Hancock's Bridge Road	Salem Area	Salem	NJ	5.8
Fort Mott and Finns Point National Cemetery District	Northwest of Salem on Fort Mott Road	Salem Area	Salem	NJ	9.8
Short's Landing Hotel Complex	Northeast of Smyrna	Smyrna Area	Kent	DE	8.0
Thomas Sutton House	DE 79, with Woodland Beach Wildlife Area	Woodland Beach Area	Kent	DE	9.6
Liston Range Front Lighthouse	1600 Belts Road	Bay View Beach	New Castle	DE	3.3
Old Union Methodist Church	0.2 mi. north of Blackbird Crossroads on U.S. 13	Blackbird Crossroads	New Castle	DE	8.6
Fort Dupont Historic District	DE 9, South of C&D Canal	Delaware City	New Castle	DE	7.9
Delaware City Historic District	Roughly bounded by the Delaware River, Dragon Creek, DE 9, and the C&D Canal	Delaware City	New Castle	DE	8.4
Eastern Lock of the C&D Canal	Battery Park	Delaware City	New Castle	DE	8.4
Chelsea	DE 9	Delaware City	New Castle	DE	8.6

Table 2.5-46 (Sheet 2 of 5)
Historic Properties Listed on the NRHP Located within a 10-Mile Radius of the PSEG Site

Name	Address	City	County	State	Distance from PSEG Site (mi.)
Fort Delaware on Pea Patch Island	Pea Patch Island in the Delaware River	Delaware City	New Castle	DE	8.9
Fairview	U.S. 13	Delaware City Area	New Castle	DE	8.1
Philip Reading Tannery	201 East Main Street	Middletown	New Castle	DE	9.4
Middletown Academy	218 North Broad Street	Middletown	New Castle	DE	9.7
Middletown Historic District	Roughly bounded by Redding, Scott, Lockwood, and Catherine streets	Middletown	New Castle	DE	9.7
St. Joseph's Church	15 West Cochran Street	Middletown	New Castle	DE	9.7
Greenlawn	North Broad Street	Middletown	New Castle	DE	9.8
Okolona	Route 429	Middletown Area	New Castle	DE	5.2
Belleview	Route 428	Middletown Area	New Castle	DE	7.3
Noxontown	South of Middletown off DE 896	Middletown Area	New Castle	DE	8.1
Pharo House	Odessa and Silver Lake Roads	Middletown Area	New Castle	DE	8.6
Maple Grove Farm	Route 299	Middletown Area	New Castle	DE	8.9
Achmester	North of Middletown on SR 429	Middletown Area	New Castle	DE	9.3
Weston	Off DE 71	Middletown Area	New Castle	DE	9.4
Arnold S. Naudain House	South of Middletown on DE 71	Middletown Area	New Castle	DE	9.5
Old St. Anne's Church	South of Middletown off DE 71	Middletown Area	New Castle	DE	9.6
Idalia Manor	Route 13	Mt. Pleasant Area	New Castle	DE	8.1
Old Drawyers Church	U.S. 13	Odessa	New Castle	DE	6.3
Odessa Historic District	Roughly Main and High streets between Appoquinimink River and DE 4	Odessa	New Castle	DE	6.5
Corbit-Sharp House	Southwest corner of Main and 2nd streets	Odessa	New Castle	DE	6.6
Old St. Paul's Methodist Episcopal Church	High Street	Odessa	New Castle	DE	6.6
Appoquinimink Friends Meetinghouse	Main Street	Odessa	New Castle	DE	6.9
A. M. Vail House	Rt. 299	Odessa	New Castle	DE	8.8
Hell Island Site	Address Restricted	Odessa Area	New Castle	DE	3.5

Table 2.5-46 (Sheet 3 of 5)
Historic Properties Listed on the NRHP Located within a 10-Mile Radius of the PSEG Site

Name	Address	City	County	State	Distance from PSEG Site (mi.)
Riverdale	Off Bay View and Silver Run roads	Odessa Area	New Castle	DE	3.9
Green Meadow	Thomas Landing Road (DE 440), Appoquinimink Hundred	Odessa Area	New Castle	DE	4.3
David W. Thomas House	326 Thomas Landing Road, Appoquinimink Hundred	Odessa Area	New Castle	DE	4.8
J. M. Gordon House	Route 44	Odessa Area	New Castle	DE	4.8
J. Vandegrift House	Route 44	Odessa Area	New Castle	DE	5.1
S. Higgins Farm	Route 423	Odessa Area	New Castle	DE	5.4
Misty Vale	Route 423	Odessa Area	New Castle	DE	5.8
Monterey	North of Odessa on Bayview Road	Odessa Area	New Castle	DE	6.1
Fairview	Southeast of Odessa	Odessa Area	New Castle	DE	6.2
Comdr. Thomas MacDonough House	North of Odessa on U.S. 13	Odessa Area	New Castle	DE	6.5
Elm Grange	U.S. 13	Odessa Area	New Castle	DE	6.6
Retirement Farm	U.S. 13	Odessa Area	New Castle	DE	6.8
Mondamon Farm	Route 2	Odessa Area	New Castle	DE	7.0
Hill Island Farm	3379 Dupont Parkway (U.S. 13), Appoquinimink Hundred	Odessa Area	New Castle	DE	7.3
Williams House	1.2 mi. northwest of Odessa on Marl Pit Road	Odessa Area	New Castle	DE	7.8
Duncan Beard Site	Address Restricted	Odessa Area	New Castle	DE	8.0
Old Ford Dairy	U.S. 13	Odessa Area	New Castle	DE	8.1
Sereck Shallcross House	West of Odessa off U.S. 13	Odessa Area	New Castle	DE	8.3
J. K. Williams House	DE 4	Odessa Area	New Castle	DE	8.4
McWhorter House	Route 412	Odessa Area	New Castle	DE	8.7
Fairview	Route 412	Odessa Area	New Castle	DE	9.2
Port Penn Historic District	DE 9	Port Penn	New Castle	DE	4.2
Augustine Beach Hotel	South of Port Penn on DE 9	Port Penn Area	New Castle	DE	3.9
Robert Grose House	1000 Port Penn Road	Port Penn Area	New Castle	DE	5.1

Table 2.5-46 (Sheet 4 of 5)
Historic Properties Listed on the NRHP Located within a 10-Mile Radius of the PSEG Site

Name	Address	City	County	State	Distance from PSEG Site (mi.)
Dilworth House	Off DE 9	Port Penn Area	New Castle	DE	5.3
Ashton Historic District	North of Port Penn on Thornton Road	Port Penn Area	New Castle	DE	5.4
Hazel Glen	West of Port Penn on DE 420	Port Penn Area	New Castle	DE	5.5
Cleaver House	Off Biddle's Corner Road	Port Penn Area	New Castle	DE	6.0
Liston Ranger Rear Light Station	West of Port Penn on DE 2	Port Penn Area	New Castle	DE	7.0
John B. Nelson House	West of Port Penn off U.S. 13	Port Penn Area	New Castle	DE	7.1
Windsor	1060 Dutch Neck Road, St. Georges Hundred	Port Penn Area	New Castle	DE	7.1
Fleming House	Northeast of Smyrna on DE 9	Smyrna Area	New Castle	DE	7.6
Sutton House	Broad and Delaware streets	St. Georges	New Castle	DE	8.8
Vernacular Frame House	Delaware Street	St. Georges	New Castle	DE	8.8
North Saint Georges Historic District	Roughly along Main, Broad, Delaware and Church streets, Red Lion Hundred	St. Georges	New Castle	DE	8.9
St. Georges Presbyterian Church	Main Street	St. Georges	New Castle	DE	8.9
Biddle House	South of St. Georges on U.S. 13	St. Georges Area	New Castle	DE	7.3
Bloomfield	U.S. 13	St. Georges Area	New Castle	DE	9.1
Linden Hill	U.S. 13	St. Georges Area	New Castle	DE	9.4
St. Georges Cemetery Caretaker's House	Kirkwood and St. Georges Rd.	St. Georges Area	New Castle	DE	9.8
Hart House	East of Taylors Bridge on DE 453	Taylors Bridge Area	New Castle	DE	4.1
Liston House	East of Taylors Bridge on DE 453	Taylors Bridge Area	New Castle	DE	4.1
Johnson Home Farm	CR 453 east of junction with DE 9, Blackbird Hundred	Taylors Bridge Area	New Castle	DE	4.4
Reedy Island Range Rear Light	Junction of DE 9 and Road 453	Taylors Bridge Area	New Castle	DE	4.9

Table 2.5-46 (Sheet 5 of 5)
Historic Properties Listed on the NRHP Located within a 10-Mile Radius of the PSEG Site

Name	Address	City	County	State	Distance from PSEG Site (mi.)
Huguenot House	West of Taylors Bridge on DE 9	Taylors Bridge Area	New Castle	DE	6.1
Townsend Historic District	Roughly bounded by Gray, Ginn and South, Lattamus and Main streets and Commerce Street and Cannery Lane and Railroad Avenue	Townsend	New Castle	DE	9.7

Reference 2.5-65

Table 2.5-47
Environmental Justice Populations[a] within 50-Mile Radius of the PSEG Site

State/County	Number of Block Groups	Black	American Indian or Native Alaskan	Asian	Native Hawaiian or Other Pacific Islander	Some Other Race	Multiracial	Aggregate	Hispanic	Low-Income Households
Delaware										
Kent	69	6	0	0	0	0	0	10	0	1
New Castle	352	70	0	0	0	7	1	74	13	21
Sussex	21	2	0	0	0	0	0	2	1	0
Maryland										
Baltimore	70	7	0	0	0	0	0	10	0	1
Caroline	17	2	0	0	0	0	0	2	1	0
Cecil	55	0	0	0	0	0	0	0	0	1
Harford	138	2	0	0	0	0	0	7	2	2
Kent	19	0	0	0	0	0	0	0	0	0
Queen Anne's	16	0	0	0	0	0	0	0	0	0
Talbot	2	0	0	0	0	0	0	0	0	0
New Jersey										
Atlantic	52	2	0	0	0	0	0	2	3	0
Burlington	136	0	0	0	0	0	0	1	0	0
Camden	407	89	0	3	0	28	0	103	40	47
Cape May	53	2	0	0	0	0	0	2	0	0
Cumberland	100	12	0	0	0	10	0	23	14	9
Gloucester	196	16	0	0	0	0	0	11	0	4
Salem	49	9	0	0	0	0	0	7	1	2
Pennsylvania										
Berks	2	0	0	0	0	0	0	0	0	0
Bucks	2	0	0	0	0	0	0	0	0	0
Chester	248	15	0	1	0	1	0	21	8	6
Delaware	463	83	0	7	0	1	0	96	2	13
Lancaster	46	0	0	0	0	0	0	0	0	0
Montgomery	326	35	0	1	0	0	0	41	5	3
Philadelphia	1770	980	1	73	0	141	9	1171	195	556
York	7	0	0	0	0	0	0	0	0	0
Total	4616	1332	1	85	0	188	10	1583	285	666
Percentage of State Population										
Delaware	783,600	19.0	0.4	2.0	0.0	2.1	1.8	25.4	4.8	8.8
Maryland	5,296,486	27.7	0.3	4.0	0.0	1.8	2.1	36.0	4.3	8.3
New Jersey	8,414,350	13.4	0.2	5.7	0.0	5.4	2.7	27.5	13.3	8.3
Pennsylvania	12,281,054	9.9	0.2	1.8	0.0	1.5	1.3	14.6	3.2	11.0

a) Number of block groups that meet NRC criteria for minority and/or low-income populations (NRC, 2004)

Note: Shaded counties are completely within the 50-mile radius

References 2.5-119, 2.5-124, and 2.5-124

Table 2.5-48
Environmental Justice Populations for Selected Counties[a] within 50-Mile Radius of the PSEG Site

County	Total Block Groups		Block Groups with Environmental Justice Populations[b]													
			Black		Asian		Other		Multiracial		Aggregate		Hispanic		Low-Income Household	
	# Blocks	% of Total	# Blocks	% of Total	# Blocks	% of Total	# Blocks	% of Total	# Blocks	% of Total	# Blocks	% of Total	# Blocks	% of Total	# Blocks	% of Total
Delaware																
New Castle	352	7.6%	70	5.3%	0	0.0%	7	3.7%	1	10.0%	74	4.7%	13	4.6%	21	3.2%
New Jersey																
Camden	407	8.8%	89	6.7%	3	3.5%	28	14.9%	0	0.0%	103	6.5%	40	14.0%	47	7.1%
Cumberland	100	2.2%	12	0.9%	0	0.0%	10	5.3%	0	0.0%	23	1.5%	14	4.9%	9	1.4%
Gloucester	196	4.2%	16	1.2%	0	0.0%	0	0.0%	0	0.0%	11	0.7%	0	0.0%	4	0.6%
Salem	49	1.1%	9	0.7%	0	0.0%	0	0.0%	0	0.0%	7	0.4%	1	0.4%	2	0.3%
Pennsylvania																
Chester	248	5.4%	15	1.1%	1	1.2%	1	0.5%	0	0.0%	21	1.3%	8	2.8%	6	0.9%
Delaware	463	10.0%	83	6.2%	7	8.2%	1	0.5%	0	0.0%	96	6.1%	2	0.7%	13	2.0%
Montgomery	326	7.1%	35	2.6%	1	1.2%	0	0.0%	0	0.0%	41	2.6%	5	1.8%	3	0.5%
Philadelphia	1770	38.3%	980	73.6%	73	85.9%	141	75.0%	9	90.0%	1171	74.0%	195	68.4%	556	83.5%
All Others	705	15.3%	23	1.7%	0	0.0%	0	0.0%	0	0.0%	36	2.3%	7	2.5%	5	0.8%
Total	4616		1332		85		188		10		1583		285		666	

a) Includes counties within the four-county Region of Influence and counties containing more than 200 minority block groups

b)"American Indian or Native Alaskan" and "Native Hawaiian or Other Pacific Islander excluded from table due to poor representation within 50-mile radius (Table 2.5.4-1)

Shaded counties comprise the socioeconomic Region of Influence.

References 2.5-119 and 2.5-124

Table 2.5-49
Population Trends in the 50-Mile Region[(a)]

County	Total Population		White		Black		Asian		All Other Minorities		Hispanic		Family-Poverty	
	2000	2005-2007	2000	2005-2007	2000	2005-2007	2000	2005-2007	2000	2005-2007	2000	2005-2007	2000	2005-2007
Delaware														
Kent	126,697	147,974	73.5%	71.3%	20.7%	21.2%	1.7%	2.2%	4.1%	5.3%	3.2%	4.1%	8.1%	8.8%
New Castle	500,265	524,682	73.1%	70.8%	20.2%	22.4%	2.6%	3.6%	4.1%	3.2%	5.3%	6.9%	5.6%	6.4%
New Jersey														
Cumberland	146,438	154,086	65.9%	66.9%	20.2%	20.8%	1.0%	1.1%	12.9%	11.2%	19.0%	22.7%	11.3%	13.4%
Gloucester	254,673	281,218	87.1%	84.8%	9.1%	9.6%	1.5%	2.2%	2.3%	3.4%	2.6%	3.5%	4.3%	5.4%
Salem	64,285	65,789	81.2%	80.2%	14.8%	15.5%	0.6%	0.5%	3.4%	3.8%	3.9%	4.9%	7.2%	6.3%
Atlantic	252,552	269,774	68.4%	65.9%	17.6%	16.3%	5.1%	6.4%	8.9%	11.4%	12.2%	14.1%	7.6%	7.8%
Camden	508,932	513,147	70.9%	66.7%	18.1%	18.7%	3.7%	4.5%	7.3%	10.1%	9.7%	11.7%	8.1%	8.8%
Cape May	102,326	97,555	91.6%	91.0%	5.1%	5.9%	0.6%	0.2%	2.7%	2.9%	3.3%	4.1%	6.4%	6.7%
Maryland														
Caroline	29,772	32,240	81.7%	81.4%	14.8%	13.5%	0.5%	0.8%	3.0%	4.3%	2.7%	4.2%	9.0%	8.6%
Cecil	85,951	98,358	93.4%	91.4%	3.9%	5.1%	0.7%	1.2%	2.0%	2.3%	1.5%	2.1%	5.4%	6.6%
Harford	218,590	238,960	86.8%	83.3%	9.3%	11.4%	1.5%	1.9%	2.4%	3.4%	1.9%	2.5%	3.6%	3.9%
Queen Anne's	40,563	45,826	89.0%	88.9%	8.8%	8.4%	0.6%	1.0%	1.6%	1.7%	1.1%	1.8%	4.4%	4.6%
Pennsylvania														
Chester	433,501	478,821	89.2%	87.6%	6.2%	6.4%	2.0%	3.0%	2.6%	3.0%	3.7%	4.5%	3.1%	3.6%
Delaware	550,864	553,511	80.3%	75.8%	14.5%	17.8%	3.3%	4.3%	1.9%	2.1%	1.5%	2.0%	5.8%	6.7%
Montgomery	750,097	774,424	86.5%	84.3%	7.5%	8.1%	4.0%	5.2%	2.0%	2.4%	2.0%	2.9%	2.8%	3.2%
Philadelphia	1,517,550	1,454,382	45.0%	42.7%	43.2%	43.8%	4.5%	5.4%	7.3%	8.1%	8.5%	10.3%	18.4%	19.3%
Totals	4,956,094	5,058,091	3,947,844	3,948,929	1,181,582	1,233,207	182,570	234,316	(355,903)	(358,362)	326,063	407,485		
Proportional Totals			79.7%	78.1%	23.8%	24.4%	3.7%	4.6%	-7.2%	-7.1%	6.6%	8.1%		
Net Growth		101,997		1085		51,625		51,746		(2459)		81,422		
Percent Growth		2.06%		0.027%		4.4%		28.3%		0.7%		25.0%		
U.S. Totals	281,421,906	298,757,310	211,347,851	221,379,167	34,614,894	37,045,906	10,131,189	12,846,564	25,327,972	27,485,673	35,177,738	43,917,325		
U.S. Proportional			75.1%	74.1%	12.3%	12.4%	3.6%	4.3%	9.0%	9.2%	12.5%	14.7%	9.2%	9.8%
U.S. Net Growth		17,335,404		10,031,315		2,431,012		2,715,376		2,157,701		8,739,586		
U.S. Percent Growth		6.16%		4.7%		7.02%		26.8%		8.5%		24.8%		
Region of Influence[(b)]	465,396	501,093	736,216	765,794	163,323	186,773	18,677	27,099	47,445	46,109	63,466	84,247		
Proportional			158.2%	152.8%	35.1%	37.3%	4.0%	5.4%	10.2%	9.2%	13.6%	16.8%		
Net Growth				29,578		23,449		8422		(1336)		20,781		
Percent Growth				4.0%		14.36%		45.1%		-2.8%		32.7%		

a) Includes counties with half or more of area within the 50-mile radius, (no ACS data for Kent County, Maryland)
b) Region of Influence includes New Castle County (DE), and Cumberland, Gloucester, and Salem counties (NJ)
Note: Shaded counties comprise the socioeconomic Region of Influence
Reference 2.5-119

Table 2.5-50
Population Trends in 10-County Delaware Valley Regional Planning Commission (DVRPC) Region

	1980		2000		1980 to 2000	
Race	**Number**	**Percent**	**Number**	**Percent**	**Net Change**	**% Change**
White	4,286,104	79.1%	4,235,397	71.9%	-50,707	-1.2%
Black	999,086	18.4%	1,176,651	20.0%	177,565	17.8%
Asian/Pacific Islander	53,605	1.0%	203,770	3.5%	150,165	280.1%
Other	83,040	1.5%	271,854	4.6%	188,814	227.4%
Total	5,421,835		5,887,672		465,837	8.6%
Hispanic	135,021	2.5%	314,598	5.3%	179,577	133.0%

Reference 2.5-29

Table 2.5-51
Farms that Employ Migrant Labor in the 50-Mile Region[a]

County	Total Farms	Farms with Hired Labor	Number of Hired Laborers	Farms with Migrant Labor
Delaware	2546	647	3223	75
Kent	825	169	996	22
New Castle	347	81	565	10
Maryland	12,834	3508	14,938	236
Caroline	574	153	681	13
Cecil	583	128	1110	5
Harford	704	155	579	12
Kent	377	111	729	8
Queen Anne's	521	126	587	13
New Jersey	10,327	2415	24,385	470
Atlantic	499	163	5924	78
Camden	225	52	656	17
Cape May	201	46	358	8
Cumberland	615	192	3716	70
Gloucester	669	163	2191	60
Salem	759	172	1407	36
Pennsylvania	63,163	11,722	60,721	811
Chester	1733	580	7708	101
Delaware	79	25	228	2
Montgomery	719	155	888	14
Philadelphia	17	5	(D)	0

a) Includes counties with half or more of area within the 50-mile radius
Note: Shaded counties are included with four-county Region of Influence
(D) = withheld to avoid disclosing data for individual farms

Reference 2.5-126

Table 2.5-52
Farms that Employ Migrant Labor for Selected Counties in New Jersey

	Atlantic	Cumberland	Gloucester	Salem	4-County Total	New Jersey Total
Total Farms	499	615	669	759	2542	10,327
% Farms in State	4.8%	6.0%	6.5%	7.3%	24.6%	
Land in Farms (acres)	30,372	69,489	46,662	96,530	243,053	733,450
% Farm Land in State	4.1%	9.5%	6.4%	13.2%	33.1%	
Farms Hiring Labor	163	192	163	172	690	2415
% Farms Hiring Labor	6.7%	8.0%	6.7%	7.1%	28.6%	
Number of Laborers	5924	3716	2191	1407	13,238	24,385
% Laborers in State	24.3%	15.2%	9.0%	5.8%	54.3%	
Farms Hiring Migrant Labor	78	70	59	36	243	470
% Farms with Migrant Labor	16.5%	14.9%	12.6%	7.7%	51.7%	

Note: Shaded counties are included with four-county Region of Influence.

Reference 2.5-126

Table 2.5-53
Minority Farm Operators in the 50-Mile Region[a]

County	All[b]	All Non-White	% Non-White	Black Operators	Asian Operators	Hispanic Operators
Delaware	3894	127	3.26%	27	36	35
Kent	1243	15	1.21%	4	3	3
New Castle	540	22	4.07%	9	2	11
Maryland	19,917	727	3.65%	223	139	144
Caroline	831	29	3.49%	11	4	8
Cecil	919	20	2.18%	1	0	9
Harford	1113	19	1.71%	4	0	5
Kent	570	9	1.58%	1	1	1
Queen Anne's	800	21	2.63%	1	7	0
New Jersey	16,143	544	3.37%	92	147	207
Atlantic	798	30	3.76%	1	3	24
Camden	353	29	8.22%	13	7	6
Cape May	290	6	2.07%	4	0	1
Cumberland	900	35	3.89%	13	1	10
Gloucester	1070	44	4.11%	17	4	12
Salem	1156	30	2.60%	6	8	9
Pennsylvania	93,316	1239	1.33%	101	100	526
Chester	2734	68	2.49%	8	5	46
Delaware	120	1	0.83%	1	0	0
Montgomery	1081	17	1.57%	2	2	6
Philadelphia	26	5	19.23%	2	0	2

a) Includes counties with half or more of area within the 50-mile radius
b) Data was collected for a maximum of three operators per farm

Note: Shaded counties are included with four-county Region of Influence

Reference 2.5-126

Table 2.5-54
Ambient Noise Levels at the HCGS and SGS in February 2009

Monitoring Location	Location Specific Attributes	Noise Levels (dBA)	
		Day L_{eq}	Night L_{eq}
1	Open Area 500 ft. South of SGS Switchyard near Delaware River Shoreline	58.9	57.4
2	Open Area near Meteorological Tower	51.6	51.6
3	Open Area Adjacent to High-use On-site Road	54.3	65.6
4	Open Area under 500 kV Transmission Line	53.2	53.6
5	Open Area near HCGS Cooling Tower, Small Arms Firing Range, and low-use on-site road	60.9	61.5
6	Open Area near Delaware River Shoreline	43.4	51.6
7	Open Area near Material Services Building, HCGS Intake Pump House and Delaware River Shoreline	52.0	51.6

Notes: L_{eq} is the true equivalent sound level measured over the run time.
Refer to Figure 2.5-17 for the positions of the seven monitoring locations.

2.6 GEOLOGY

This section provides a description of the geologic conditions at and in the vicinity of the PSEG Site. Section 2.5 of the ESPA SSAR presents a detailed site geologic evaluation.

2.6.1 GEOLOGIC SETTING

The PSEG Site lies within the Coastal Plain physiographic province. This province is in the subaerial portion of the North American continental shelf. Within 200 mi. of the PSEG Site, the Coastal Plain province extends eastward from the fall line to the Atlantic Ocean along the length of the North American Atlantic margin (Figure 2.6-1). The fall line marks the area where the upland region (continental bedrock) and a coastal plain (coastal alluvia) meet. The Coastal Plain province is characterized by low-lying, gently rolling terrain developed on sequences of deltaic, shallow marine and continental shelf sediments consisting primarily of unconsolidated to semi-consolidated gravels, sands, silts, and clays that dip gently oceanward. The land surface has been modified by erosional and depositional landforms associated with several cyclical changes in sea level and varies from flat to deeply incised. However, the Coastal Plain province generally exhibits lower topographic relief than the Piedmont province to the west.

The PSEG Site lies within the Outer Coastal Plain physiographic subprovince. The Middle Coastal Plain Terrace subprovince resides outside the site boundary to the east. The Middle Coastal Plain Terraces and the Upland Sands and Gravels subprovinces lie east of the PSEG Site. West-central and south-central portions of the PSEG Site are bordered by the Delaware River channel. (Figure 2.6-2)

Coastal Plain sediments ranging in age from Early Cretaceous to Holocene underlie the PSEG Site. These sediments overlie a basement complex composed of fractured continental crust. The regional stratigraphic column is shown in Figure 2.6-3. Regional geologic maps (Figure 2.6-4) depict the geologic setting for the PSEG Site region. Borings completed as part of this ESP are shown on Figure 2.6-5, and the stratigraphic column (inferred from the site borings) for the PSEG Site (Figure 2.6-6) is discussed in the following subsections.

Subsection 2.6.1.1 describes the PSEG Site stratigraphy. Subsection 2.6.2.1.2 describes the local stratigraphic units and geologic formations.

2.6.2 PSEG SITE STRATIGRAPHY

As part of the ESP, 16 geotechnical borings were completed at the PSEG Site. Figure 2.6-5 shows the locations of these borings and identifies the locations of geologic cross-sections discussed later in this subsection.

Integration and comparison of the regional geologic stratigraphy and geotechnical boring logs provide the basis for developing the site-specific stratigraphic model at the PSEG Site. Fourteen stratigraphic layers, most of which can be correlated to the regional geologic strata, are identified in the borings. The stratigraphic layers encountered during the ESPA exploration at the PSEG Site (Figure 2.6-6) are grouped into the following four periods according to geologic age (from oldest to youngest):

- Cretaceous (Lower and Upper)
- Paleogene (Lower Tertiary)
- Neogene (Upper Tertiary)
- Quaternary (Pleistocene and Holocene)

Stratigraphic cross-sections (Figures 2.6-7 and 2.6-8), and a surface contour map of the top of the Vincentown Formation (Figure 2.6-9), illustrate the stratigraphy and subsurface conditions at the PSEG Site. The following subsection provides a description of stratigraphic units present that fall within each of the geologic time periods listed above.

2.6.2.1.1 PSEG Site Stratigraphic Units and Geologic Formations

Several stratigraphic units are recognized within each of the categories listed in Subsection 2.6.2.1. Descriptions are provided for stratigraphic units that lie within 500 to 600 ft. of the surface, within a depth range considered to be of greater importance in evaluating geologic conditions in the vicinity of the site. The following is a description of these units as they relate to the PSEG Site.

The Lower Cretaceous strata encountered during the geotechnical investigation at the PSEG Site is composed of a single unit, the Potomac Formation, which is recognized in only the deepest borings performed during the investigation. This unit forms the base of the shallow subsurface (less than 500 ft.) profile at the site.

The Upper Cretaceous strata encountered during the geotechnical investigation at the PSEG Site is composed of the following eight formations, listed from oldest to youngest:

- Magothy Formation
- Merchantville Formation
- Woodbury Formation
- Englishtown Formation
- Marshalltown Formation
- Wenonah Formation
- Mount Laurel Formation
- Navesink Formation

The Paleogene strata (Lower Tertiary) encountered during the ESPA investigation at the PSEG Site is composed of two formations, listed from oldest to youngest:

- Hornerstown Formation (Lower Tertiary and Upper Cretaceous)
- Vincentown Formation

The Neogene strata (Upper Tertiary) encountered during the geotechnical investigation at the PSEG Site is composed of the Kirkwood Formation. The Kirkwood Formation is subdivided at the site into upper and lower units based on variations in lithology.

The Quaternary strata encountered during the ESPA investigation at the PSEG Site is composed of two stratigraphic units, listed from oldest to youngest:

- Alluvium
- Artificial and Hydraulic Fill

Subsection 2.6.2.1.2 provides detailed geologic material descriptions.

2.6.2.1.2 Description of PSEG Site Stratigraphic Units and Geologic Formations

The 14 major stratigraphic layers defining the shallow subsurface profile at the PSEG Site occur between the ground surface and 631.5 ft. below ground surface (elevation -615.0 ft. NAVD). The site stratigraphic layers and geologic formations are described and characterized in the following subsections, from the Potomac Formation (oldest formation encountered) to the ground surface (Figures 2.6-6 through 2.6-8).

2.6.2.1.2.1 Cretaceous Strata

2.6.2.1.2.1.1 Potomac Formation

The Potomac Formation is the deepest stratigraphic unit encountered by the ESPA borings at the PSEG Site. The Potomac Formation consists of Lower Cretaceous age non-marine, continentally-derived sediments deposited in multichanneled fluvial to deltaic environments (Reference 2.6-15). Two borings penetrated the top of the Potomac Formation during the geotechnical investigation. The top of the formation is at approximate elevation -454 ft. NAVD in the northern portion of the site, and at approximate elevation -484 ft. NAVD in the eastern portion of the site. These two borings are along a southeasterly line, in the regional dip direction. The vertical elevation difference corresponds to an apparent southeasterly dip of approximately 34 ft/mi (less than 1 percent). This is consistent with the gentle dip reported for the NJ Coastal Plain in SSAR Subsection 2.5.1.1.

At the PSEG Site, the top of the Potomac Formation is interpreted from the geophysical testing conducted in the two deepest borings completed as part of the ESPA investigation. The borings are compared to and correlated with published geophysical logs from the region (References 2.6-14 and 2.6-1) to aid in identification of the top of the stratigraphic unit. Sediments in the upper portion of the Potomac Formation are typically dark gray to gray clay and sand with variable silt content. In the deeper portion of the formation, the sediments are typically mottled gray and red clay.

No borings encountered the bottom of the Potomac Formation during the ESPA investigation.

2.6.2.1.2.1.2 Magothy Formation

The Magothy Formation unconformably overlies the Potomac Formation and consists of Upper Cretaceous age non-marine and marine sediments deposited in fluvial to marginal marine environments (Reference 2.6-15). The two deep borings performed during the ESPA investigation penetrated the top of the Magothy Formation at approximate elevation -402 ft. NAVD, in the northern portion of the PSEG Site, and at approximate elevation -429 ft. NAVD in the eastern portion of the site. This corresponds to an apparent southeasterly dip of approximately 30 ft/mi. Borings showed the unit to range from 52 to 55 ft. thick. Sediments of the Magothy Formation typically consist of gray to very dark gray, carbonaceous/lignitic clay and

silt at the top of the unit, interbedded with sands with variable silt and clay content at the bottom of the unit.

The Magothy Formation is distinguished from the underlying Potomac Formation by comparing and correlating the geophysical logs for the two deep borings, completed as part of the ESPA investigation, with published geophysical logs from the region (References 2.6-14 and 2.6-1).

2.6.2.1.2.1.3 Merchantville Formation

The Merchantville Formation conformably overlies the Magothy Formation. This formation consists of Upper Cretaceous age marine sediments deposited in a neritic or shallow marine environment during a marine transgression, as described in Subsection 2.5.1.1.3.4.1 of the SSAR. The two deep borings performed during the ESPA investigation penetrated the top of the Merchantville Formation at approximate elevation -372 ft. NAVD in the northern portion of the PSEG Site, and at approximate elevation -398 ft. NAVD in the eastern portion of the site. This corresponds to an apparent southeasterly dip of approximately 29 ft/mi. The unit is approximately 30 ft. thick. Sediments of the Merchantville Formation consist of greenish-black to black, glauconitic silt and clay with trace to some fine sand and trace mica; locally with trace friable to moderately indurated layers. Content of glauconite, considered indicative of a continental shelf marine depositional environment with a slow rate of accumulation, ranged from trace to little. The Merchantville Formation is distinguished from the overlying Woodbury Formation by the increase in glauconite content, and general decrease in plasticity and mica content.

2.6.2.1.2.1.4 Woodbury Formation

The Woodbury Formation conformably overlies the Merchantville Formation. This formation consists of Upper Cretaceous age marine sediments deposited in an inner shelf environment associated with a marine regression (Reference 2.6-11). Two deep borings penetrated the top of the unit during the ESPA investigation at approximate elevation -336 ft. NAVD in the northern portion of the site, and at approximate elevation -368 ft. NAVD in the eastern portion of the site. This corresponds to an apparent southeasterly dip of approximately 36 ft/mi. The thickness of the Woodbury Formation ranges from 30 to 36 ft. across the PSEG Site. Sediments of the Woodbury Formation consist of very dark gray and black to greenish-black, highly plastic clay with trace glauconite, fine sand, mica, and shell fragments; and locally with trace indurated layers.

Sediments of the Woodbury Formation are very similar to those of the overlying Englishtown Formation, and the two formations appear to have a gradational contact. The results of the geophysical logging reveal little difference in natural gamma response or resistivity between these two units, or with the underlying Merchantville Formation.

2.6.2.1.2.1.5 Englishtown Formation

The Englishtown Formation conformably overlies the Woodbury Formation and consists of Upper Cretaceous age marine sediments deposited in a near-shore environment associated with a marine regression, as described in Subsection 2.5.1.1.3.4.1 of the SSAR. Five borings were advanced to the top of the unit during the ESPA investigation, at approximate elevation -

291 ft. NAVD in the northern portion of the site, and at approximate elevation -319 ft. NAVD in the eastern portion of the site. This corresponds to an apparent southeasterly dip of approximately 32 ft/mi. The thickness of the Englishtown Formation ranges from 44 to 49 ft. across the PSEG Site. Sediments in the upper portion of the Englishtown Formation consist of micaceous, very dark greenish-gray to very dark gray and black sandy silt and clay to clayey sand, with trace shell fragments and trace to little glauconite. Sediments grade downward into micaceous, black, highly plastic silt and clay with trace to few fine sand and trace shell fragments.

2.6.2.1.2.1.6 Marshalltown Formation

The Marshalltown Formation conformably overlies the Englishtown Formation and consists of Upper Cretaceous age marine sediments deposited in a neritic environment during a marine transgression as described in SSAR Subsection 2.5.1.1.3.4.1. Five borings penetrated the top of the Marshalltown Formation during the ESPA investigation at elevations ranging from -265 to -277 ft. NAVD in the northern portion of the PSEG Site, and at approximate elevation -293 ft. NAVD in the eastern portion of the site. This corresponds to an apparent southeasterly dip of approximately 29 ft/mi. The Marshalltown Formation is approximately 25 ft. thick across the PSEG Site. Sediments of this unit typically consist of greenish-gray to very dark gray and black, clayey and silty, fine to medium sand, and fine sandy clay of variable plasticity, all with trace to little glauconite content. Trace amounts of shell fragments, pyrite nodules, friable layers, and subrounded fine gravel were locally encountered within the Marshalltown Formation.

2.6.2.1.2.1.7 Wenonah Formation

The Wenonah Formation conformably overlies the Marshalltown Formation. This formation consists of Upper Cretaceous age marine sediments deposited in a neritic environment during a marine regression (Reference 2.6-11). Six borings penetrated the top of the formation during the ESPA investigation. The top of the Wenonah Formation was encountered at elevations ranging from -250 to -259 ft. NAVD in the northern portion of the PSEG Site, and at approximate elevations ranging from -279 to -289 ft. NAVD in the eastern portion of the PSEG Site. This corresponds to an apparent southeasterly dip of approximately 33 ft/mi. The Wenonah Formation has an average thickness of approximately 15 ft. across the PSEG Site. The formation typically consists of very dark gray to greenish-black, sandy clay with trace shell fragments and trace to few glauconite fragments. Locally, the formation consists of clayey and silty, fine to medium sand with trace to few glauconite fragments.

2.6.2.1.2.1.8 Mount Laurel Formation

The Mount Laurel Formation conformably overlies the Wenonah Formation and consists of Upper Cretaceous age marine sediments deposited in a near-shore environment during a marine regression (Reference 2.6-11). All geotechnical borings penetrated the top of the formation during the ESPA investigation. The top of the Mount Laurel Formation was encountered at elevations ranging from -145 to -157 ft. NAVD in the northern portion of the PSEG Site, and at approximate elevations ranging from 168 to -177 ft. NAVD in the eastern portion of the PSEG Site. This corresponds to an apparent southeasterly dip of approximately 26 ft/mi. The unit has an average thickness of 103 ft. in the northern portion of the site,

thickening slightly to the southeast, with an average thickness of 111 ft. in the eastern portion of the site.

Sediments of the Mount Laurel Formation typically consist of dark olive-gray, dark grayish-brown, and greenish-gray, clayey and silty, fine to medium sand, grading with depth into fine to medium sand with variable silt and clay content, all with trace to little glauconite, and shell fragments. The amount of glauconite and shell fragments was found to decrease to trace amounts with increasing depth. The upper 15 to 20 ft. of the formation typically contains trace to little subrounded, coarse sand and fine gravel, and is locally composed of sandy clay.

2.6.2.1.2.1.9 Navesink Formation

The Navesink Formation conformably overlies the Mount Laurel Formation. This formation consists of Upper Cretaceous age marine sediments deposited in a neritic environment during a marine transgression (Reference 2.6-11). The top of the Navesink Formation is encountered at elevations ranging from -121 to -133 ft. NAVD in the northern portion of the PSEG Site, and at approximate elevations ranging from -147 to -157 ft. NAVD in the eastern portion of the PSEG Site. This corresponds to an apparent southeasterly dip of approximately 31 ft/mi. The thickness of the unit averages 24 ft. in the northern portion of the site, thinning slightly to the southeast, with an average thickness of 20 ft. in the eastern portion of the site.

Sediments of the Navesink Formation are typically composed of very dark greenish-gray to very dark grayish-green and greenish-black, silty and clayey, fine to medium grained glauconite, and quartz sand with trace to little shell fragments. The Navesink Formation is a distinctive marker unit across the PSEG Site due to its composition being almost entirely glauconite.

2.6.2.1.2.2 Paleogene Strata (Lower Tertiary)

2.6.2.1.2.2.1 Hornerstown Formation

The Hornerstown Formation conformably overlies the Navesink Formation and consists of Upper Cretaceous to Paleocene age marine sediments (Reference 2.6-11). The top of the Hornerstown Formation is encountered at elevations ranging from -105 to -114 ft. NAVD in the northern portion of the PSEG Site, and at approximate elevations ranging from -127 to -137 ft. NAVD in the eastern portion of the PSEG Site. This corresponds to an apparent southeasterly dip of approximately 26 ft/mi. The formation averages 20 ft. thick across the PSEG Site.

Regionally, the Hornerstown Formation is described as well-sorted, almost purely glauconitic sand that imparts a distinctive green color to the unit (Reference 2.6-11). At the PSEG Site, the sediments of the Hornerstown Formation are typically composed of greenish-gray to very dark greenish-gray, silty and clayey, fine to medium sand, with trace to few shell fragments, and trace to some glauconite. Glauconite content typically increases with depth and is estimated from field sample observations to comprise greater than 30 percent of the sand fraction near the base of the formation.

The formation contains numerous, discontinuous, friable to indurated calcium carbonate-cemented sandstone layers. These cemented zones are typically 0.1 to 1 ft. thick, as observed

from split-spoon sampling and drilling operations. The sediments of the Hornerstown Formation are very similar to, and grade into, those of the overlying Vincentown Formation, making the units difficult to distinguish in the field. In general, the Hornerstown Formation is differentiated from the overlying Vincentown Formation on the basis of increasing silt/clay content and increasing glauconite content relative to the Vincentown Formation.

2.6.2.1.2.2.2 Vincentown Formation

The Vincentown Formation serves as the bearing layer for the foundations of the existing nuclear units (Hope Creek and Salem Generating Stations) (References 2.6-12 and 2.6-13). The formation conformably overlies the Hornerstown Formation and consists of Paleocene age marine sediments deposited in a shallow marine environment as sea levels receded (Reference 2.6-11). The Vincentown Formation shows significant erosional relief on its upper surface, making both the elevation of its upper contact and its thickness somewhat variable. In the northern portion of the site, the elevation of the top of the formation ranges from -33 to -70 ft. NAVD. In the eastern portion of the PSEG Site, the elevation ranges from -40 to -91 ft. NAVD. Figure 2.6-9 illustrates the variability of the top of the Vincentown Formation in the northern portion of the site. The thickness of the Vincentown Formation ranges from 35 to 79 ft., averaging 52 ft. in the northern portion of the site. Thickness ranges from 37 to 93 ft. and averages 55 ft. in the eastern portion of the site.

Due to the erosional nature of the upper surface of the Vincentown Formation, the sediments of the uppermost portion of the unit typically show signs of weathering characterized by oxidation of iron-bearing minerals such as glauconite. The weathering and oxidation of the formation is subject to the vagaries of post-depositional processes, such as subaerial exposure and fluvial erosion, prior to deposition of the overlying sediments, as well as groundwater movement through the formation. This results in distinct, but irregular contacts with the underlying unoxidized sediments that are not the result of depositional or stratigraphic control. Oxidized sediments are typically yellowish-brown to reddish-brown, and unoxidized sediments are typically light greenish-gray to dark greenish-gray. The oxidized and unoxidized Vincentown Formation sediments are typically composed of glauconitic, calcareous, silty and clayey, fine to medium sand, and fine to medium sand with variable silt content. Glauconite and shell fragments are typically present in trace amounts with locally higher concentrations observed during field sampling.

The formation contains interbedded calcium carbonate-cemented sandstone layers. These layers are typically 0.1 to 1 ft. thick, as observed from split-spoon sampling and drilling operations.

2.6.2.1.2.3 Neogene Strata (Upper Tertiary)

2.6.2.1.2.3.1 Kirkwood Formation

Where present, the Kirkwood Formation unconformably overlies the Vincentown Formation. This formation consists of Miocene age marine sediments deposited in a delta and shore-dominated shelf environment (Reference 2.6-15). The Kirkwood Formation rests on the erosional unconformity formed on top of the Vincentown Formation, and the upper surface of the Kirkwood Formation forms an erosional unconformity with the overlying alluvial sediments,

making the elevation of the unit's upper surface, as well as the thickness of the unit, somewhat variable. In the northern portion of the PSEG Site, the top of the Kirkwood Formation ranges from approximate elevations of -34 to -43 ft. NAVD. In the eastern portion of the PSEG Site, the top of the formation ranges from approximate elevations of -23 to -49 ft. NAVD. The thickness of the formation ranges from 12 to 29 ft., averaging 17 ft. in the northern portion of the site.

Thickness of the Kirkwood Formation ranges from 14 to 54 ft., and averages 35 ft. in the eastern portion of the site. The large variation in thickness observed in the Kirkwood Formation is directly related to the erosional contact with the underlying Vincentown Formation, which displays up to 37 ft. of relief in the northern portion of the site, and up to 51 ft. of relief in the eastern portion of the site. Where the top of the Vincentown Formation is topographically low, the Kirkwood Formation is generally thick. Where the top of the Vincentown Formation is topographically high, the Kirkwood Formation is generally thin.

The sediments of the Kirkwood Formation consist of two distinct units. The upper unit of the formation typically consists of dark gray, green, and brown to olive-gray, highly plastic clay and silt, with trace fine sand and rounded gravel, trace shell fragments, and trace to little organic content. Locally, interbeds of silty and clayey, fine to medium sand occur within this upper unit. In the eastern portion of the PSEG Site, a thick section of light greenish-gray, silty, fine to medium sand is locally encountered above the finer grained sediments.

The lower, basal unit of the Kirkwood Formation typically consists of a 2 to 14 ft. thick layer composed of dark greenish-gray, olive gray, and dark gray to brown, silty and clayey, fine to medium sand and fine to coarse gravel. The sand and gravel in this lower unit is typically rounded to subangular.

Six of the 16 borings completed during the ESPA investigation did not encounter the lower unit sediments of the Kirkwood Formation. This may indicate that the lower unit has some discontinuity across the site, or that the layer is thinner than the distance between the 5-ft. standard penetration test sample intervals at these locations. Boring NB-2, completed in the northern portion of the site, did not encounter the upper unit of the Kirkwood Formation. This is most likely due to fluvial scour during deposition of the overlying alluvial sediments at this location. At boring NB-7, completed in the northern portion of the PSEG Site, sediments of the Kirkwood Formation are completely absent, with alluvial sand and gravel unconformably overlying strongly oxidized Vincentown Formation sediments. This condition is most likely due to fluvial scour during deposition of the alluvial sediments at this location.

2.6.2.1.2.4 Quaternary Strata

2.6.1.1.2.4.1 Alluvium

Alluvium unconformably overlies the Kirkwood Formation. This stratigraphic unit consists of Quaternary age sediments representing the bed of a former location of the Delaware River (Reference 2.6-13). The unit is typically encountered at approximate elevations ranging from -22 to -35 ft. NAVD in the northern portion of the PSEG Site, and at approximate elevations ranging from -16 to -25 ft. NAVD in the eastern portion of the site. The unit shows a slightly undulating upper surface, and generally slopes gently westward towards the Delaware River. The thickness of the Alluvium ranges from 5 to 24 ft. across the PSEG Site. Average thickness in the

northern portion of the PSEG Site is approximately 13 ft. Average thickness in the eastern portion of the site is approximately 17 ft. Alluvial soils consist typically of gray to grayish-brown, fine to coarse sand with trace to little, rounded to angular, fine to coarse gravel, and trace to little silt and clay content.

In borings completed in the northern and eastern portions of the PSEG Site, 2 to 5 ft. thick discontinuous layers of fine-grained soils, consisting of sandy silts and clays and highly organic soils consisting of peat, were locally encountered intercalated with the alluvial sand and gravel layers. In the eastern portion of the site, a 4 to 15 ft. thick discontinuous layer of non-organic silt and clay was locally encountered below the alluvial sand and gravel. Geophysical logging did not encompass sufficient portions of the Alluvium to allow an interpretation.

2.6.1.1.2.4.2 Hydraulic and Artificial Fill

Hydraulic fill was deposited at the PSEG Site as the result of channel dredging of the Delaware River (Reference 2.6-13). The combined Hydraulic and Artificial Fill stratigraphic unit overlies alluvial soils at an average elevation of -29 ft. NAVD in the northern portion of the site, and at an average elevation of -21 ft. NAVD in the eastern portion of the site. Hydraulic fill consists typically of dark gray to dark greenish-gray, highly plastic clay and silt with trace to some organic material, and locally interbedded discontinuous layers of clayey and silty, fine to medium grained sand up to 5 ft. thick. Thickness of the hydraulic fill ranges from 24 to 44 ft., with an average thickness of 33 ft. across the northern and eastern portions of the site.

Artificial fill comprises the surface material at the PSEG Site, overlying hydraulic fill. Artificial fill consists of typically grayish-brown to brown, silt, clay, and sand with variable silt and clay content, and clayey and silty gravels. Thickness of the artificial fill ranges from 2 to 10 ft., and averages 4 ft. across the northern and eastern portions of the site. These materials were placed at the site during previous construction activities and grade downward into the hydraulic fill.

2.6.3 REFERENCES

2.6-1 Benson, R. N., “Internal Stratigraphic Correlation of the Subsurface Potomac Formation, New Castle County, Delaware, and Adjacent Areas in Maryland and New Jersey,” Delaware Geologic Survey Report of Investigations No. 71, 15 pp., 2006.

2.6-2 Dames & Moore, “Report of Foundation Studies, Proposed Hope Creek Generating Station, Lower Alloways Creek Township, New Jersey Public Service Electric and Gas Company,” May 23, 1974.

2.6-3 Dames & Moore, “Report of Foundation Studies, Proposed Salem Nuclear Generating Station, Salem, New Jersey, Public Service Electric & Gas Company,” August 28, 1968.

2.6-4 Dillon, W. P. and R. N. Oldale, “Late Quaternary Sea-Level Curve: Reinterpretation Based on Glaciotectonic Influence,” Geology 6: 56 – 60, 1978.

2.6-5 Fenneman, N.M. and D.W. Johnson, “Physiographic Divisions of the Conterminous U.S.,” USGS Publications, 1946.

2.6-6 Garrity, C.P. and D.R. Soller, “Database of the Geologic Map of North America,” adapted from the map by J.C. Reed, Jr. and others (2005): U.S. Geological Survey Data Series 424, http://pubs.usgs.gov/ds/424/, 2009.

2.6-7 Hack, J. T., “Geomorphology of the Appalachian Highlands,” in “The Appalachian – Ouachita Orogen in the United States,” in Hatcher, R. D., W. A. Thomas, and G. W. Viele, eds., The Geology of North America, The Geological Society of America, Volume F-2: 459 – 470, 1989.

2.6-8 NOT USED

2.6-9 NOT USED

2.6-10 McKenna, T.E., P.P. McLaughlin, and R.N. Benson, “Characterization of the Potomac Aquifer, an Extremely Heterogeneous Fluvial System in the Atlantic Coastal Plain of Delaware,” in the Atlantic Coastal Plain of Delaware: Delaware Geological Survey Open File Report 45, 2004.

2.6-11 Olsson, R. K., T. G. Gibson, H. J. Hansen, and J. P. Owens, “Geology of the Northern Atlantic Coastal Plain: Long Island to Virginia,” in R. E. Sheridan and J. A. Grow, eds., The Geology of North America, The Atlantic Continental Margin: U. S., Geological Society of America, I-2: 87 – 105, 1988.

2.6-12 Public Service Enterprise Group (PSEG), “Salem Generating Station Updated Final Safety Analysis Report,” p. 2.4.5, February 15, 1987.

2.6-13 Public Service Enterprise Group (PSEG), “Hope Creek Generating Station Updated Final Safety Analysis Report,” p. 2.4.5, 1988.

2.6-14 Sugarman, P.J. and D.H. Monteverde, “Correlation of Deep Aquifers Using Coreholes and Geophysical Logs in Parts of Cumberland, Salem, Gloucester and Camden Counties, New Jersey,” New Jersey Geological Survey, Geologic Map Series 08-1, 2008.

2.6-15 Sugarman, P. J., K. G. Miller, J. V. Browning, A. A. Kulpecz, P. P. McLaughlin, and D. H. Monteverde, “Hydrostratigraphy of the New Jersey Coastal Plain: Sequences and Facies Predict Continuity of Aquifers and Confining Units,” Stratigraphy 2(3): 259 – 275, 2005.

2.6-16 U.S. Geological Survey, “Professional Paper 1680, Plate 1,” http://pubs.usgs.gov/pp/2005/pp1680/pdf/Plate1.pdf, accessed October 21, 2009.

2.7 METEOROLOGY AND AIR QUALITY

This section provides a meteorological description of the new plant site and surrounding climate area. The information supports independent evaluations and assessments of atmospheric diffusion characteristics and new plant impacts on the environment. The information presented here is based on the methodology and data analysis described in SSAR Section 2.3.

Included are regional, local, and site specific climatological and meteorological information.

2.7.1 REGIONAL CLIMATOLOGY

2.7.1.1 Data Sources

Several sources of data are used to characterize regional climatological conditions pertinent to the PSEG Site, as follows:

- Thirty-two yr of data collected during the period of record 1977 through 2008 by the existing HCGS and SGS primary on-site meteorological monitoring system
- Regional Cooperative Network surface observing stations for which Climatography of the United States No. 20 summaries, Daily Surface Data DS 3200 digital datasets, or Climatography of the United States No. 81 summaries are available
- Regional first-order surface observing stations for which Local Climatological Data summaries and International Station Meteorological Climate Summary temperature joint frequency distributions (JFDs) are available
- Regional hourly surface observing stations for which American Society of Heating, Refrigerating and Air-Conditioning Engineers and Air Force Combat Climatology Center climatic design information tables are available
- Tornado, waterspout, hurricane, and other weather event statistics for counties in the area of the PSEG Site, from the National Climatic Data Center online Storm Events Database
- Tracks of tropical cyclones from an NOAA Coastal Services Center historical database, for an area within a radius of 115 nautical miles (nmi) from the PSEG Site
- American Society of Civil Engineers structure design standards for the PSEG Site area
- Maps of relative humidity in the PSEG Site region from the Climate Atlas of the United States

SSAR Subsection 2.3.1.4 provides explanations of the selection of primary sources of regional data used to characterize regional climatology at the PSEG Site. As described in SSAR Subsection 2.3.1.3, the region referred to here is an area surrounding the site that is determined by analysis to be representative of the site climate.

2.7.1.2 General Climate Description

The climate of the PSEG Site region is dominated by winds with offshore components (eastward components, with respect to the Atlantic Ocean shoreline) except in the immediate vicinity of the shoreline. Therefore, the regional climate has a lee shore character which allows features of a continental climate to be present over inland areas. The climate is continental in character, includes extremes, has a marine influence, and is quite changeable.

SSAR Subsections 2.3.1.1 and 2.3.1.2 further describe the general climate of the new plant site.

2.7.1.3 Normal, Mean, and Extreme Regional Climatological Conditions

2.7.1.3.1 Temperature

Extreme temperatures in the PSEG Site climate region range from 108 °F (at Marcus Hook, PA) to -15°F (at Millington 1 SE, NJ). Mean conditions are relatively homogeneous across the surrounding climate area. The mean annual temperature ranges from 56.8°F at Dover, DE, to 53.9°F at Hammonton 1 NE, NJ.

SSAR Subsections 2.3.1.7 and 2.3.2.2.3 identify the sources and locations of the extreme and normal temperature values given above.

2.7.1.3.2 Atmospheric Water Vapor

The mean annual wet bulb temperature at Wilmington, DE, is 48.9°F. Maximum monthly mean wet bulb temperature at Wilmington is 69.0°F in July, and lowest mean monthly wet bulb temperature is 29.0°F in January.

Mean annual dew point temperature at Wilmington is 44.6°F. Highest and lowest mean monthly dew point temperatures at Wilmington are 66.1°F in July and 24.1°F in January. Based on 32 yr of on-site SGS and HCGS data, mean annual dew point temperature is 41.1°F and highest and lowest monthly mean dew point temperatures are 61.5°F in July and 21.0°F in January.

Mean annual relative humidity values at Wilmington and the PSEG Site (based on 32 years of on-site data at HCGS and SGS) are 68 and 65.6 percent, respectively. Based on Wilmington statistics, relative humidity typically reaches a diurnal maximum during early morning (at 0700 local time) and a diurnal minimum typically during early afternoon (at 1300 local time). Mean Wilmington early morning relative humidity (at 0100 local time) exceeds 80 percent during the months of June through October.

SSAR Subsection 2.3.2.2.4 presents the selection criteria and sources for the mean atmospheric water vapor values given above.

2.7.1.3.3 Precipitation

Mean annual total rainfall for the PSEG Site and its climate surroundings ranges from 36.04 in. at the site, to 46.28 in. at Dover, DE. Regional mean annual total snowfall ranges from 7.5 in. at Glassboro 2 NE, NJ, to 19.3 in. at Philadelphia International Airport in PA. Maximum recorded 24-hr. snowfall from records for regional stations is 30.7 in. at Marcus Hook, PA, on January 8, 1996. Maximum recorded 24-hr. water-equivalent precipitation from records for HCGS and SGS and regional stations is 11.68 in. at Marcus Hook, PA, on September 16, 1999, and is associated with Tropical Storm Floyd.

SSAR Subsections 2.3.1.5.4 and 2.3.2.2 present selection criteria, sources, and additional assessment of the precipitation values given above.

2.7.1.3.4 Wind Conditions

The PSEG Site lies within the mid-latitude prevailing westerly wind belt. There is some variation of prevailing winds across southern NJ, from the Atlantic Ocean shoreline at the southeast corner of the state to the Delaware River Valley at the southwest corner of the state.

SSAR Subsections 2.3.1.2 and 2.3.2.2.1 present selection criteria, sources, detailed statistics, and additional assessments of regional wind data that support the mean wind conditions described above.

2.7.2 REGIONAL AIR QUALITY

2.7.2.1 Background Air Quality

There are three areas of interest for air quality as follows.

- Salem County, NJ, in which the PSEG Site is located, is in attainment with the National Ambient Air Quality Standards for all criteria pollutants except ozone. Salem County is non-attainment for ozone (8 hr.).
- New Castle County, DE, which is located to the north and west of the PSEG Site, is in attainment for all criteria pollutants except ozone (8 hr.) and particles with diameters less than 2.5 microns ($PM_{2.5}$).
- Brigantine Wilderness at the Edwin B. Forsythe National Wildlife Refuge in Brigantine, NJ is a Federal Class I area under Section 169A of the Clean Air Act for visibility criteria.

SSAR Subsection 2.3.2.4 provides further discussion of the air quality status of the area.

2.7.2.2 Projected Air Quality

Generation of electricity at the new plant is not a source of criteria or toxic pollutants. Supporting equipment such as cooling towers, auxiliary boilers, emergency diesel generators and/or combustion turbines emit criteria pollutants. Air quality impacts of these sources are

discussed in Subsection 5.8.1.4. Impacts of air emissions during construction are discussed in Subsection 4.4.1.3.

SSAR Subsection 2.3.2.4 presents additional information on particulate emissions from the new plant.

2.7.2.3 Restrictive Dispersion Conditions

Stagnation conditions, which can contribute to pollution episodes occur at the PSEG Site approximately 11 days per year.

The potential for air pollution is also related to atmospheric mixing heights and wind speeds. Table 2.7-1 summarizes approximate mean seasonal and annual morning and afternoon mixing heights and wind speeds interpolated to the new plant site on isopleth maps (Reference 2.7-1). Lowest morning mixing heights occur during summer and highest morning mixing heights occur during winter. Afternoon mixing heights are lowest during winter and highest during summer. Lowest mean wind speeds occur during summer mornings. Highest mean wind speeds occur during spring afternoons.

SSAR Subsection 2.3.1.8 presents additional explanation of, and a source for, stagnation statistics.

2.7.3 SEVERE WEATHER

2.7.3.1 Thunderstorms and Lightning

The data in SSAR Tables 2.3-1 and 2.3-3 indicate that thunderstorms occur at the PSEG Site and in its surrounding climate area at any time of year. The average number of thunderstorm days per year is 27.7 days at Wilmington, DE, during the 61-yr period of record (SSAR Table 2.3-1). The frequency of lightning strikes to earth per square mile per year is approximately 8.6 for the PSEG Site and surrounding area. The power block area of the new plant is an area of approximately 70 ac. or 0.11 square mile. Given the annual average lightning strike to earth frequency of 8.6 per square mile per year, the frequency of lightning strikes in the power block area is 0.95 strikes per year.

SSAR Subsection 2.3.1.5.6 presents sources of the climate statistics and methods described above.

2.7.3.2 Extreme Winds

The basic wind speed is used for design and operating bases. Basic wind speeds are nominal design 3-second gust wind speeds in miles per hour (mph) at 33 ft. above ground for Exposure C category.

The basic wind speed for the PSEG Site is approximately 90 mph. Basic wind speeds reported for hourly weather monitoring stations in the site area are as follows: 100 mph for Dover Air Force Base, 110 mph for Philadelphia, PA, and 100 mph for Wilmington, DE. Therefore, the highest of the four basic wind speed values selected is 110 mph for

Philadelphia. These values apply to a recurrence interval of 50 yr. Wind speed for a 100-yr return period is determined by multiplying the 50-yr return period value by a factor of 1.07. That approach produced a 100-yr return period 3 second gust wind speed for the new plant site area of 117.7 mph.

SSAR Subsection 2.3.1.5.1 presents sources of the climate statistics and methods described above.

2.7.3.3 Tornadoes

Total tornadoes and waterspouts recorded in a surrounding eight-county area during a 59.4-yr period of record were 82 and 1, respectively. The strongest tornado found in the database for Salem County, NJ, is rated F2 and occurred on July 14, 1960. That storm damaged and destroyed several rural and residential structures, and had a path length of 8 mi. and width of 450 yards. The strongest tornado found in the database for New Castle County, DE, is rated F3 and occurred on April 28, 1961. That storm damaged a warehouse, and had a path length of one-quarter mi. and a width of 30 yards.

SSAR Subsection 2.3.1.5.2 presents sources of the climate statistics described above, tornado site characteristics, and a discussion of the regulatory compliance of the new plant tornado site characteristics.

2.7.3.4 Hail, Snowstorms, and Ice Storms

Salem County, NJ, where the PSEG Site is located, and New Castle County, DE, to the west of the PSEG Site, experienced on average less than 0.5 days per year with hail greater than approximately an inch in diameter during the period from 1961 to 1990. The largest hailstones experienced during the period from 1955 to 2009 were of diameter 1.75 in. (golf ball size). Those hailstones occurred on three occasions in Salem County and on three occasions in New Castle County.

On average, during the period from 1961 to 1990, snow fall occurred at the PSEG Site and within the surrounding area during 2.5 to 4.4 days per year, and freezing precipitation occurred in that area during 5.5 to 10.4 days per year. Annual snowfall is highly variable and can range from 10 in. to 50 in. The largest recorded daily snowfall for the site climate region is 30.7 in. at Marcus Hook, Pennsylvania on January 8, 1996. The highest monthly total of 40.0 in. occurred at Hammonton 1 NE, NJ, during February 1899.

Freezing precipitation events in Salem County, NJ, and New Castle County, DE, were reviewed for the period of record 1950 through winter 2008-2009. Those results indicate that freezing precipitation events tend to occur each year. However, maximum thicknesses of ice accumulation are typically 0.1 or 0.2 in. The maximum observed ice thickness in the two counties was approximately 0.5 in.

SSAR Subsection 2.3.1.5.5 indicates sources of the climate statistics described above.

2.7.3.5 Tropical Cyclones

The National Hurricane Center online historical database of tracks of tropical cyclones, including the years 1851 through 2008, was accessed for an area within a radius of 115 mi. around the PSEG Site. The total number of storms identified was 109. Frequencies of tropical storms of various intensities during the 158 year period of record are listed in SSAR Table 2.3-8.

Tropical cyclones have occurred within this area as early in the year as May and as late as November. The highest frequency of storms occurs during September. Monthly frequencies are identified in SSAR Table 2.3-9.

SSAR Subsection 2.3.1.5.3 presents sources of the climate statistics described above.

2.7.4 LOCAL METEOROLOGY

Local meteorology here refers to conditions at the PSEG Site. Those conditions are described using available data collected at the site, and supplemented using data collected within the surrounding site region, as necessary, where sufficient site data are not available.

2.7.4.1 Normal, Mean, and Extreme Values

2.7.4.1.1 Temperature

Extreme temperatures at the PSEG Site and in its climatic region range from 108°F (at Marcus Hook, PA) to -15°F (at Millington 1 SE, NJ). Mean temperatures are relatively homogeneous across the region that includes the site and the climate area that surrounds it. The mean annual temperature ranges from 56.8°F at Dover, DE, to 53.9°F at Hammonton 1 NE, NJ.

SSAR Subsections 2.3.1.7 and 2.3.2.2, present sources of the climate statistics described above.

2.7.4.1.2 Atmospheric Moisture Content

At Wilmington, DE, the mean annual wet bulb temperature is 48.9°F, maximum monthly mean wet bulb temperature is 69.0°F in July, and lowest mean monthly wet bulb temperature is 29.0°F in January.

Mean annual dew point temperature at Wilmington is 44.6°F. Highest and lowest mean monthly dew point temperatures at Wilmington are 66.1°F in July and 24.1°F in January. Based on 32 yr of HCGS and SGS data, mean annual dew point is 41.1°F and highest and lowest monthly mean dew points are 61.5°F in July and 21.0°F in January.

Mean annual relative humidity values at Wilmington and the PSEG Site (based on 32 yr of on-site data at HCGS and SGS) are 68 and 65.6 percent, respectively. Based on Wilmington statistics, relative humidity typically reaches a diurnal maximum during early morning (at 0700 local time) and a diurnal minimum typically during early afternoon (at 1300 local time). Mean

Wilmington early morning relative humidity (at 0100 local time) exceeds 80 percent during the months of June through October.

SSAR Subsection 2.3.2.2.4 presents sources of the climate statistics described above.

2.7.4.1.3 Precipitation

Maximum recorded 24-hr. water-equivalent precipitation from records for HCGS and SGS and regional stations is 11.68 in. at Marcus Hook, PA, on September 16, 1999 and is associated with Tropical Storm Floyd. The maximum monthly water-equivalent precipitation is associated with Tropical Storm Floyd and is 16.13 in. at Marcus Hook, PA.

Maximum recorded 24-hr. snowfall from records for regional stations is 30.7 in. at Marcus Hook, PA, on January 8, 1996. The maximum monthly snowfall from records for regional stations is 40.0 in. at Hammonton, NJ, during February 1899.

The estimated weight of the 100-yr return period ground level snowpack for the PSEG Site is approximately 20 pounds per square foot (lb/ft^2). The estimated weight of the 48–hr. probable maximum winter precipitation is approximately 109 lb/ft^2.

Mean annual total rainfall for HCGS and SGS and its climate surroundings ranges from 36.04 in. at the site, to 46.28 in. at Dover, DE. Mean annual total snowfall at those same stations ranges from 7.5 in. at Glassboro 2 NE, NJ, to 19.3 in. at Philadelphia International Airport, PA.

SSAR Subsections 2.3.1.5.4 and 2.3.2.2 present sources of climate statistics described above, as well as additional information on the probable maximum precipitation.

2.7.4.1.4 Fog

As described in SSAR Table 2.3-1, at Wilmington, DE, the mean annual number of days with heavy fog and visibility less than or equal to one-quarter mi. is 26.1. The frequency of fog at the PSEG Site is expected to be similar to the frequency at Wilmington because of similar geographic features (near the Delaware River) at both locations.

SSAR Subsection 2.3.2.2.6 provides additional basis for selection of the fog statistics described above.

2.7.4.2 Average Wind Direction and Wind Speed Conditions

The PSEG Site lies within the mid-latitude prevailing westerly wind belt. There is some variation of prevailing winds across southern NJ from the Atlantic Ocean shoreline to the Delaware River Valley.

On-site winds from directions other than the two dominant directions, northwest and southeast, appear to be due to a complex mix of several minor phenomena including: flows around transient storm systems, local shoreline breezes, and flow around the southwest perimeter of the Atlantic Ocean high pressure system. The winter wind rose shows more frequent flow from the northwest than any other season. Also, airflows from those directions

are expected during precipitation events, as moist maritime air masses are drawn into low pressure systems to the southwest and west, to feed precipitation areas east and northeast of synoptic-scale low-pressure areas.

SSAR Subsection 2.3.1.2 presents sources of selected regional climate information described above. Subsections 2.3.2.2.1.2 and 2.3.2.2.1.3 present PSEG Site wind statistics.

2.7.4.3 Wind Direction Persistence

SSAR Tables 2.3-21 through 2.3-25 present PSEG Site wind direction/persistence/wind speed distributions for selected durations from 1 hr. through 48 hr. based on 33 ft. level measurements for the 3-yr period 2006 through 2008.

SSAR Subsection 2.3.2.2.1.5 presents additional explanation of the wind direction persistence statistics.

2.7.4.4 Atmospheric Stability

SSAR Table 2.3-26 indicates annual mean joint frequency distributions of wind direction and wind speed versus Pasquill atmospheric stability class for the 3-yr period 2006 to 2008. Stability class is based on the HCGS and SGS on-site primary meteorological tower 150-33 ft. vertical temperature difference (delta-T), and winds are based on 33 ft. level measurements.

Statistics in SSAR Table 2.3-27 shows that E (slightly stable) stability class is most frequent at the site, occurring approximately 34 percent of the time. Class D (neutral) is next most frequent, at approximately 26 percent of the time. Class G (extremely stable), which would be associated with highest estimated χ/Q values for the new plant ground level release, occurs approximately 7 percent of the time.

The χ/Q and ground desposition factor (D/Q) values for the MEI locations are provided in Table 5.4-5. SSAR Subsection 2.3.5 discusses longterm diffusion estimates. SSAR Tables 2.3-33 through 2.3-36 provide the χ/Q and D/Q values.

SSAR Subsection 2.3.2.2.2 presents additional explanation of the atmospheric stability statistics.

2.7.4.5 Topographic Description and Potential Modifications

The terrain in the PSEG Site area out to a distance of approximately 20 mi. is flat to gently rolling. The highest elevation at a radial distance of 25 mi. is approximately 400 ft. above msl, in sectors NW, NNW, and N. The overall highest elevation, through all direction sectors and within a radius of 50 mi., is approximately 975 ft. above msl at a distance of approximately 48 mi. in the NNW direction.

If natural draft cooling towers (NDCTs) are used, they are expected to produce elevated plumes that somewhat alter overall local frequencies of overhead clouds. However, no increases of ground level fog are expected from the cooling systems because of the high release elevation. Additionally, no lasting changes in ground level temperature or moisture are

expected due to high elevations of those plumes, which are typically several hundred feet above the tops of the towers.

If linear mechanical draft cooling towers (LMDCTs) are used, like NDCTs they are also expected to produce elevated plumes that somewhat alter overall local frequencies of overhead clouds. LMDCTs are also expected to produce small increases of ground level fog. An additional 50 hr., or less, of fog are expected per year. A majority of that fog occurs within a distance of approximately 300 meters from the LMDCTs, and most occurs on-site, not affecting roadway conditions in the PSEG Site vicinity or commercial traffic on the Delaware River. No icing events are expected due to the LMDCTs. Additionally, no lasting changes in ground level temperature or moisture are expected due to the very limited number of hours of increased fog.

SSAR Subsection 2.3.2.5 provides additional description of topography of the area near the new plant site. SSAR Subsection 2.3.2.3 provides additional description of potential modifications of the local climate due to the new plant.

2.7.5 REFERENCES

2.7-1 Holzworth, G. C., “Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution throughout the Contiguous United States”, USEPA AP-101, NTIS PB 207 103, U. S. Environmental Protection Agency (USEPA), Office of Air Programs, Research Triangle Park, North Carolina, January 1972.

Table 2.7-1
Mean Seasonal and Annual Morning and Afternoon Mixing Heights and Wind Speeds at the PSEG Site

Parameter	Winter	Spring	Summer	Autumn	Annual
Morning Mixing Height (m)	825	750	600	725	700
Morning Wind Speed (mph)	18.46	15.10	10.07	12.30	12.86
Morning Wind Speed (m/s)	8.25	6.75	4.50	5.50	5.75
Afternoon Mixing Height (m)	1000	1650	1700	1250	1350
Afternoon Wind Speed (mph)	18.46	19.01	13.42	15.66	16.78
Afternoon Wind Speed (m/s)	8.25	8.50	6.00	7.00	7.50

Reference 2.7-1

2.8 RELATED FEDERAL AND OTHER PROJECT ACTIVITIES

This section describes federal and other major activities within the region which may warrant consideration along with the construction and operation of the new plant as part of a cumulative effects analysis in accordance with 40 CFR 1508.25. PSEG chose to identify other non-federal project activities within the region for consideration as part of the cumulative impact analysis required for the PSEG Site. This section does not include a description of the existing HCGS and SGS as the environmental effects of these facilities and their on-going operations are included as part of the baseline conditions characterized earlier in this chapter. The potential federal action related to SGS and HCG is the issuance of a license renewal to extend plant operations. Relevant information regarding the operations of the existing plants is discussed further in the cumulative impact analysis in Section 10.5.

According to the guidance of NUREG-1555, federal project activities meeting the following criteria need to be identified and described:

- Project activities related to the acquisition and/or use of the PSEG Site and transmission corridors or of any other off-site property needed for the proposed project

- Project activities required either to provide an adequate source of plant cooling water or to ensure an adequate supply of cooling water over the operating lifetime of the plant

- Project activities completed as a condition of plant construction or operation

- Project activities that result in significant new power purchases within the applicant's service area that have been used to justify the need for power

- Planned federal projects that are contingent on the new plant construction and operation

According to the guidance of NUREG-1555, the identification of other federal activities related to the granting of licenses, permits or other approvals by other Federal agencies is not included as these activities are subject to their own independent environmental review process.

2.8.1 FEDERAL PROJECT ACTIVITIES

There are two federal project activities identified within the region:

- USACE Delaware River Main Channel Deepening
- Planned land acquisition between USACE and PSEG involving a portion of the USACE CDF that abuts the northern boundary of the existing PSEG property

2.8.1.1 USACE Delaware River Channel Deepening

The USACE actively maintains the shipping channel in the Delaware River and Bay to a depth of approximately 40 ft., specific to the various reaches of the channel (Reference 2.8-11). In

1992, the USACE completed a feasibility study for deepening the Delaware Bay and River main channel from 40 ft. to 45 ft. This feasibility study found that the proposed deepening project was environmentally sound, economically justified and technically feasible. As a result of the feasibility study findings, Congress supported and authorized the proposed channel deepening project. Since 1992, there have been additional authorized modifications to the project. The USACE issued an additional supplemental environmental impact statement (EIS) in 1997 and more recently, an environmental assessment (EA) in 2009. A Project Partnership Agreement was signed by the USACE and the Philadelphia Regional Port Authority in 2008. Initial construction of the project is planned to start in 2010. (Reference 2.8-11)

This deepening project affects a stretch of the Delaware Bay and Delaware River extending from the Philadelphia Harbor (including Camden, NJ) to the mouth of the Delaware Bay. The proposed deepening project follows the existing 40 ft. deep federal main shipping channel alignment. No change is proposed to the existing authorized widths in the straight portions of the channel including the 400-ft. wide channel in Philadelphia Harbor, the 800-ft. wide channel from the Philadelphia Navy Yard to Bombay Hook, and the 1000-ft. wide channel from Bombay Hook to the mouth of the Delaware Bay. However, 11 of the existing 16 bends in the channel will be widened for safer navigation. In addition, the Marcus Hook Anchorage will be deepened to 45 ft.

The USACE estimates that 16 million cubic yards of material may be dredged as part of this project. The dredged material from the river portion is proposed to be placed within existing federal upland CDFs in NJ and DE (Reference 2.8-11).

Project activities in the vicinity of the new plant include deepening of the main channel and widening of two bends on the DE side of the river. The construction of the discharge and intake structures is not located in areas that will be dredged by the USACE. Therefore, this project should not affect the siting and construction of the new plant.

2.8.1.2 Use of USACE Lands

The USACE owns approximately 305 ac. of land to the north of the PSEG property that are used as CDFs for dredge material from Delaware River channel maintenance operations. These CDFs are comprised of three cells, and the southernmost cell abuts the northern PSEG property boundary. This cell is used intermittently and currently consists of fill material that is overgrown by common reed (*Phragmites australis*).

As part of an on-going effort to avoid and minimize impacts to wetlands (coastal wetlands and NJ freshwater wetlands), PSEG has developed a plant layout that uses this previously disturbed CDF and limited adjoining marsh areas as part of its plant facility and construction area. The acquisition of the USACE CDF land reduces the new plant construction and operation impacts to wetlands.

PSEG is developing an agreement in principle with the USACE to acquire an additional 85 ac. immediately to the north of HCGS. Therefore, with the land acquisition, the entire PSEG Site will be 819 acres. The specific timing of land acquisition is not currently known and is subject to further PSEG and USACE actions. However, the agreement in principle with the USACE

serves to establish the basis for eventual land acquisition and EAB control, necessary to support the issuance of a future combined license.

Subsequent to the agreement in principle with the USACE, PSEG will develop a lease agreement for the USACE CDF land to the north of the PSEG Site, depicted on the Site Utilization Plan for the concrete batch plant and temporary construction / laydown use. At the completion of construction, the leased land will be returned to USACE use, subject to any required long-term EAB control conditions. Section 4.3 provides additional detail.

It is anticipated that, as part of the federal decision-making process the USACE will evaluate the potential environmental impacts of the property transfer. This land transfer is expected to be a relevant factor to the overall nature and composition of impacts associated with the construction and operation of the new plant.

2.8.2 NON-FEDERAL PROJECT ACTIVITIES

There are several non-federal project activities within the region that are not dependent on the new plant and are not likely to have any direct impact on its construction and operation. These other major activities will require various federal and state permits. EAs or EISs may also be prepared by any involved federal permitting agencies.

The non-federal project activities identified within the region are as follows:

- Mid-Atlantic Power Pathway
- Liquidfied Natural Gas (LNG) Terminal and Facilities in Logan Township, NJ and Philadelphia, PA
- Southern NJ to Philadelphia Mass Transit and Philadelphia Waterfront Transit Expansions.
- NJ and Philadelphia Port Improvements
- Mad Horse Creek Wildlife Management Area Wetland Restoration

2.8.2.1 Mid-Atlantic Power Pathway (MAPP)

PJM is the Federal Energy Regulatory Commission (FERC) approved Regional Transmission Organization for the District of Columbia and all or parts of 13 states including DE, Illinois, Indiana, Kentucky, MD, Michigan, NJ, North Carolina, Ohio, PA, Tennessee, Virginia, and West Virginia. PJM coordinates the movement of wholesale electricity and manages the high-voltage electric grid. PJM develops Regional Transmission Expansion Plans which identify required transmission system upgrades and enhancements to preserve grid reliability (Reference 2.8-9). In October 2007, the PJM Board approved a new 500 kV interstate electricity transmission line, known as the MAPP that will help relieve congestion on the power grid and provide access to more affordable sources of electricity (Reference 2.8-6).

The proposed line was originally planned to be built primarily along existing rights–of-way and was intended to originate in Possum Point, Virginia and pass through Burches Hill, Chalk Point, Calvert Cliffs, and Vienna generating stations in Maryland, and Indian River and Cedar Creek generating stations in DE before terminating at the SGS. The line was expected to be

overhead construction with the exception of the Chesapeake Bay crossing, which was expected to be submarine cable construction.

In 2009, PJM indicated that the section from Indian River to the SGS is undergoing continuing study, and there are no plans for immediate construction of this project. Subsequently, PJM determined that the MAPP project in its entirety is no longer warranted based on subsequent transmission studies and removed the project from its transmission queue.

2.8.2.2 Liquified Natural Gas Facilities

Two LNG terminals are planned within the region of the PSEG Site. FERC approved British Petroleum's proposed Crown Landing LNG Terminal in Logan Township, NJ, and listed the Freedom Energy Center LNG Import Terminal in Philadelphia as a proposed LNG facility (References 2.8-5 and 2.8-7).

In 2006, FERC issued a final EIS for the Crown Landing LNG Terminal (Reference 2.8-4). This EIS addressed impacts from British Petroleum's proposed LNG off-loading and processing facility to be located on a 175-ac. site along the Delaware River. This new facility would also involve the construction of 11 mi. of natural gas pipeline in NJ and PA from the terminal site to an existing facility in Brookhaven, PA. The facility would include an off-loading pier that extends into DE waters. The project is delayed by jurisdictional disputes between DE and NJ, which resolved in favor of DE. In 2009, Hess Corporation announced that they acquired the British Petroleum project and property to pursue future development of the terminal.

Philadelphia Gas Works has a LNG storage facility in Philadelphia's Port Richmond that stores supplemental gas during the low-demand warm months for use during the peak heating season. Philadelphia Gas Works proposed to modify its current Richmond storage facility to accept LNG from tankers and build an additional storage container to turn the facility into a state-of-the-art import shipping terminal for the delivery of shipments of LNG directly from ocean-going tankers (Reference 2.8-7). The new LNG facility would be called the Freedom Energy Center LNG Import Terminal. However, in February 2006 the Philadelphia City Council voted against any LNG import facility plans within the city's limits (Reference 2.8-1).

These projects remain as either "approved" (Crown Landing LNG Terminal) or "potential" (Freedom Energy Center LNG Import Terminal) projects on FERC's Website, but it is not clear that either project will move forward. Neither of these projects is expected to have any direct impact on the construction and operation of the new plant.

2.8.2.3 Southern New Jersey to Philadelphia Mass Transit and Philadelphia Waterfront Transit Expansions

The Port Authority Transit Corporation, a subsidiary of the Delaware River Port Authority, is currently evaluating the need and potential for expanded rapid transit service to Gloucester, Camden, Cumberland and portions of Atlantic and Salem counties in NJ. Several alternatives for rail transit expansion are being studied. This report discussed a number of alternatives that would benefit the Gloucester, Camden, Cumberland, Atlantic and Salem counties.

The Port Authority Transit Corporation is also evaluating alternatives to expand transit services along Philadelphia's Waterfront. One alternative is a streetcar/trolley service that would serve the waterfront area along the median of Columbus Boulevard, from existing tracks. This service would travel north along the waterfront to a terminus at the Market-Frankfort Line's Spring Garden Station and south to a terminus at the Pier 70 Shopping Plaza. A second alternative is an extension of the Southeastern Pennsylvania Transportation Authority's Subway-Surface Lines that would allow their vehicles to continue eastward to Columbus Boulevard. (Reference 2.8-3)

Neither of these projects is expected to have any direct impact on the construction and operation of the new plant.

2.8.2.4 New Jersey and Philadelphia Ports Improvements

The South Jersey Port Corporation (SJPC) and the Philadelphia Regional Port Authority (PRPA) are proposing to build and improve the current port infrastructure in NJ and Philadelphia. Port expansion and new construction are being considered by the SJPC for Camden and Gloucester counties and at the Philadelphia Naval Yard by PRPA.

The SJPC, which operates marine terminals in Camden County across the Delaware River from Philadelphia, is planning to expand its existing ports in Camden County and is planning to build a new bulk terminal at a 200-ac. site in Paulsboro, in Gloucester County. SJPC has a long-term lease on the Paulsboro property from Paulsboro and is trying to determine how best to configure the terminal, which it intends to open by 2011. Several properties would require environmental remediation before they are ready for development. An environmental study is in progress (Reference 2.8-10).

The PRPA is planning to build Southport, a new 150-ac. container terminal located near the southern tip of the Philadelphia Naval Shipyard (Reference 2.8-8). The USACE Delaware Bay and Delaware River main channel dredging project is integral to the development of PRPA's proposed Southport terminal, as the USACE channel deepening project would provide fill for the Southport facility, specifically for the areas between Piers 122 and 124, as well as a parcel at the east end of the Philadelphia Naval shipyard. In August 2008, a Request for Concessionaire Qualifications was published by the Commonwealth of Pennsylvania for the Southport Development Project as part of the on-going planning effort for the project (Reference 2.8-2).

The proposed SJPC and PRPA projects are not expected to have any direct impact on the construction and operation of the new plant.

2.8.2.5 Mad Horse Creek Wildlife Management Area Habitat Restoration

Under the federal Oil Pollution Act, state and federal natural resource agencies are responsible for restoring the environment and compensating the public for injuries to natural resources and natural resource services resulting from a discharge of oil. As a result of the 2004 *Athos I* oil spill incident on the Delaware River at Paulsboro, NJ, natural resource agencies worked together to determine the extent of injuries, the need for restoration, and the preferred restoration projects to compensate the public. As part of that effort, a plan was

formulated that identified ten preferred restoration projects. Habitat restoration at Mad Horse Creek WMA, which is located in the immediate vicinity of the PSEG Site, was one such project.

The proposed Mad Horse Creek restoration would restore nearly 200 ac. of the Mad Horse Creek WMA to address injuries to shoreline and bird resources. NJDEP and NOAA are proposing a tidal wetland restoration project that would allow construction of *Spartina alterniflora* habitat at the appropriate elevations. Restoration would be accomplished through the removal of fill material to lower the marsh elevation and allow tidal inundation. Additional projects on the site include creation of wet meadow and grassland areas on former agricultural lands. There is no relationship between the restoration project and the new plant.

2.8.3 REFERENCES

2.8-1 City of Philadelphia, Council of the City of Philadelphia Resolution Number 060123 Opposing the Expansion of Philadelphia Gas Works Port Richmond LNG Facility, Adopted 16 February 2006, Philadelphia, PA, Website, http://webapps.phila.gov/council/detailreport/?key=6021, accessed May 24, 2009.

2.8-2 Commonwealth of Pennsylvania, *Philadelphia Southport Marine Container Terminal Development: Request for Concessionaire Qualifications,* Harrisburg, PA, 2008.

2.8-3 Delaware River Port Authority, *Southern New Jersey to Philadelphia Transit Study,* Final Report, Camden, NJ, 2005.

2.8-4 Federal Energy Regulatory Commission, *FERC North American LNG Facilities, Approved,* Website, http://www.ferc.gov/industries/lng/indus-act/terminals/lng-approved.pdf, accessed May 8, 2009.

2.8-5 Federal Energy Regulatory Commission, *Final Environmental Impact Statement on the Crown Landing LNG and Logan Lateral Projects (*Docket *Nos. CP04-411-000 and CP04-416-000, 2006),* Website, http://www.ferc.gov/industries/lng/enviro/eis/2006/04-28-06-eis-crown.asp, accessed June 1, 2009.

2.8-6 Pepco Holdings, *PJM Board Approves PHI's Proposed Interstate Transmission Line500-kV Line Will Increase Capacity to Enhance Reliability, Transmit More Affordable Power*, 17 October 2007 News Release, Washington, DC, 2007.

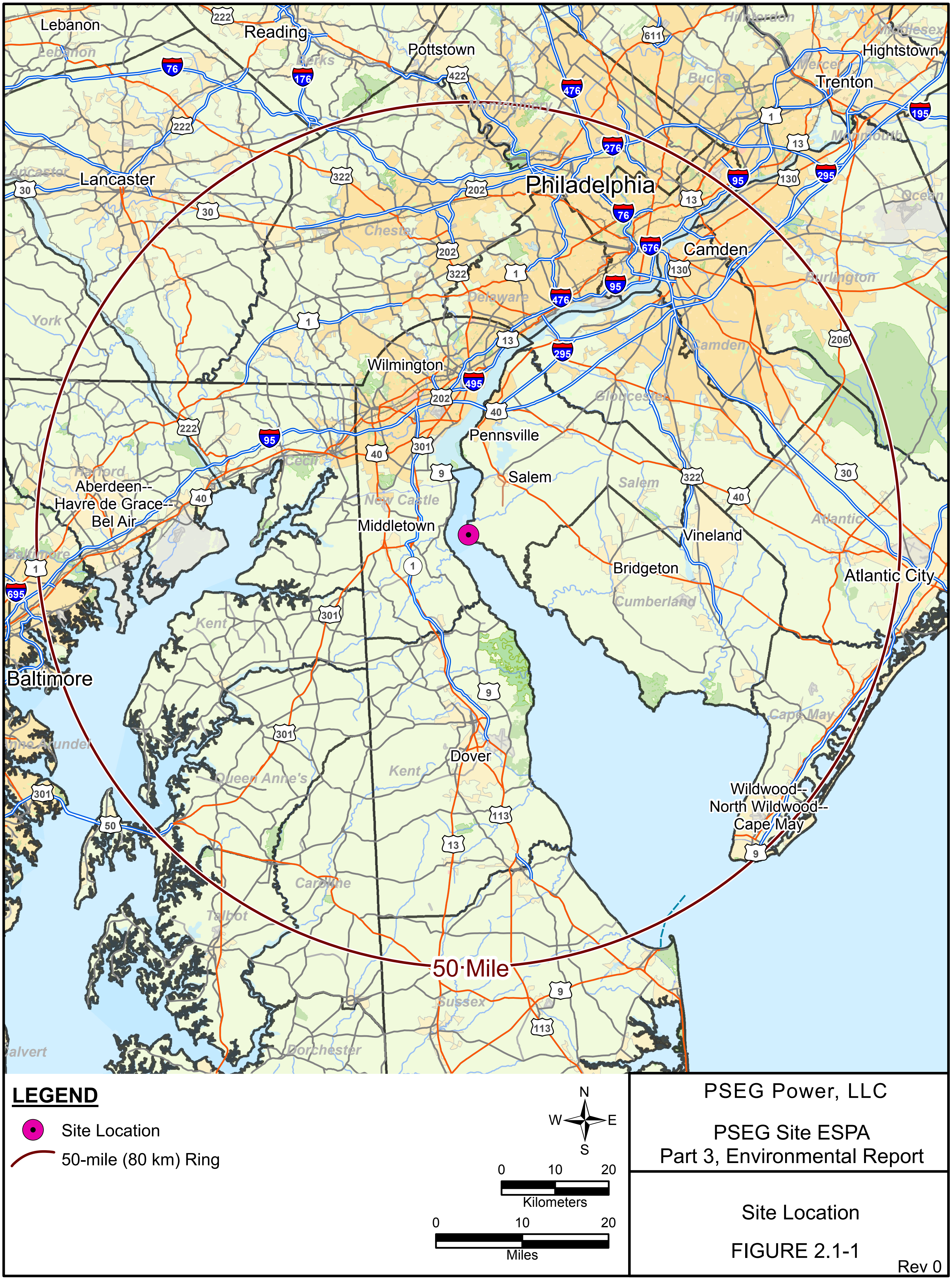
2.8-7 Philadelphia Gas Works, *PGW Reveals Plan for LNG Freedom Energy Center*, 2009, Website, http://www.pgworks.com/archives/45/March%2031,%202005.pdf, accessed March 10, 2009.

2.8-8 Philadelphia Regional Port Authority, *2008 Marketing* Brochure, available online at http://www.philaport.com/marketing/brochure 2008.pdf, accessed March 10, 2009.

2.8-9 PJM Interconnection, Inc., *PJM 2008 Regional Transmission Expansion Plan, Executive* Summary, Valley Forge, PA. 2009.

2.8-10 South Jersey Port Corporation, *SJPC* 2007 *Annual Report,* Camden, NJ, 2008.

2.8-11 U.S. Army Corps of Engineers, *Delaware River Main Stem and Channel Deepening Project*, *Environmental Assessment.* Philadelphia, PA.*,* 2009*.*



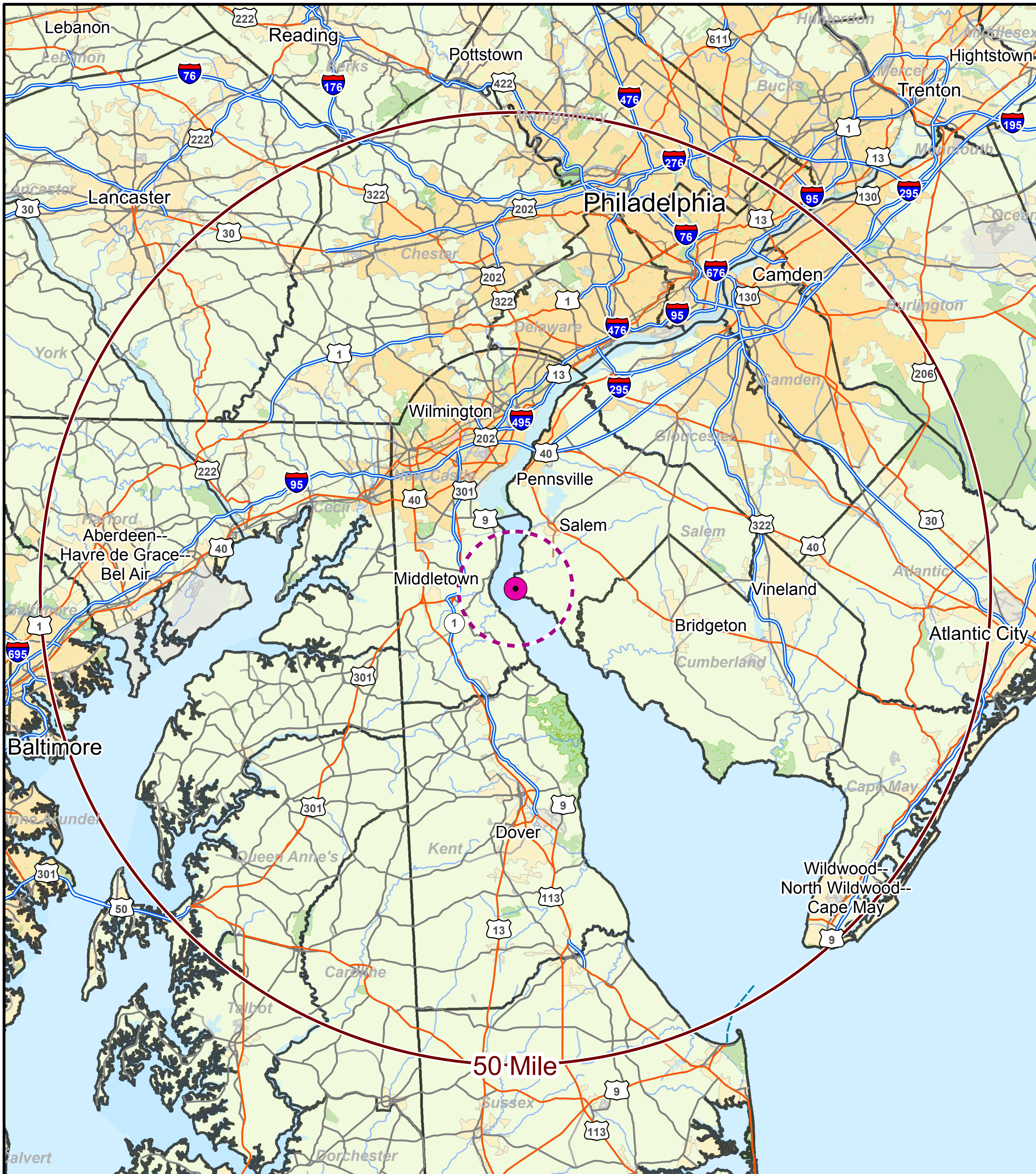
PSEG Power, LLC

PSEG Site ESPA
Part 3, Environmental Report

Site Location

FIGURE 2.1-1

Rev 0



LEGEND

Site Location

6-mile (9.7 km) Vicinity Boundary

50-mile (80 km) Ring

N
W E
S

0 10 20
Kilometers

0 10 20
Miles

PSEG Power, LLC

PSEG Site ESPA
Part 3, Environmental Report

Site Location Vicinity (6-mile)
and Region (50-mile)

FIGURE 2.1-2

Rev 0

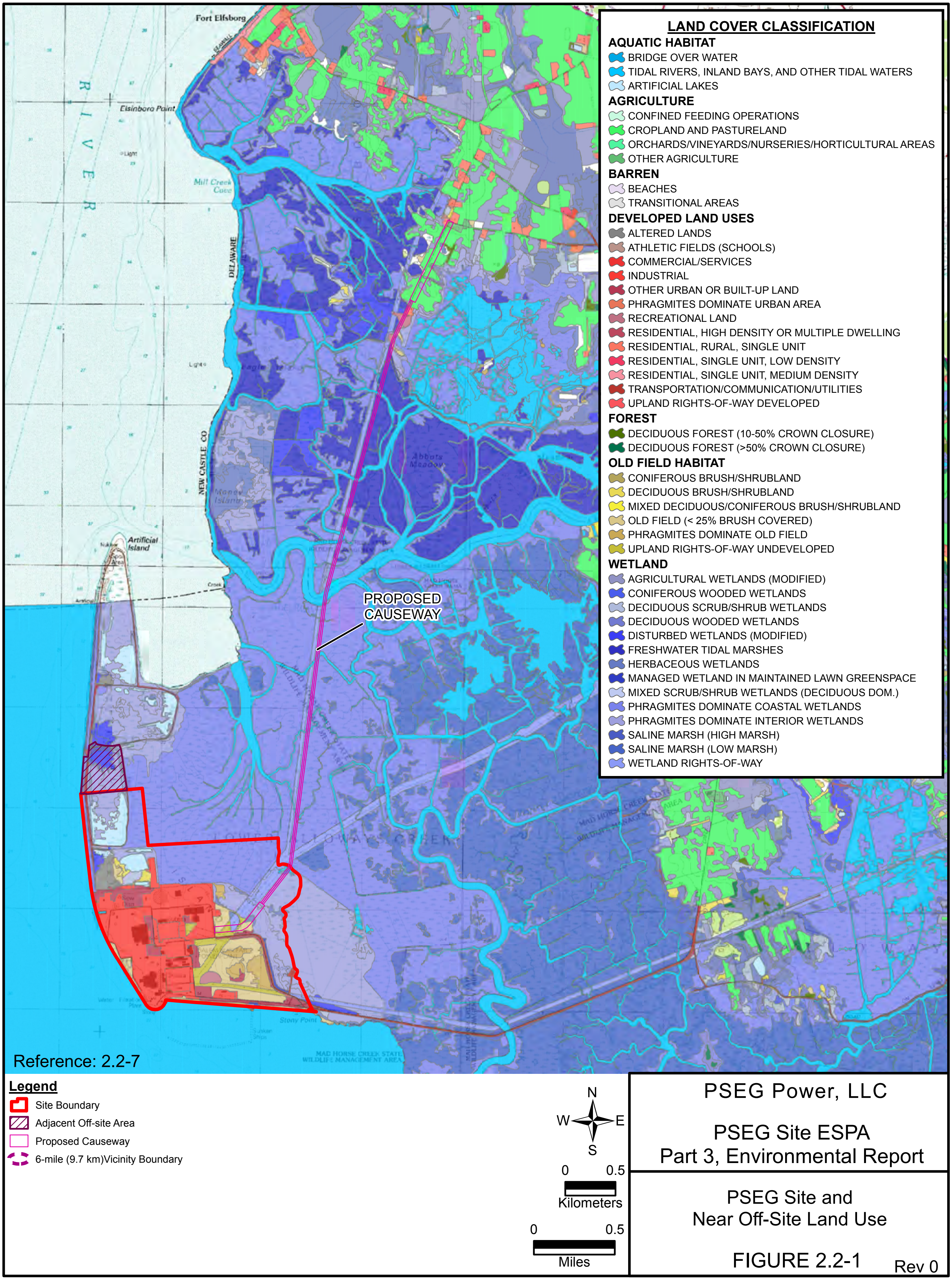
PSEG Power, LLC

PSEG Site ESPA
Part 3, Environmental Report

View of PSEG Site

FIGURE 2.1-3

Rev 0



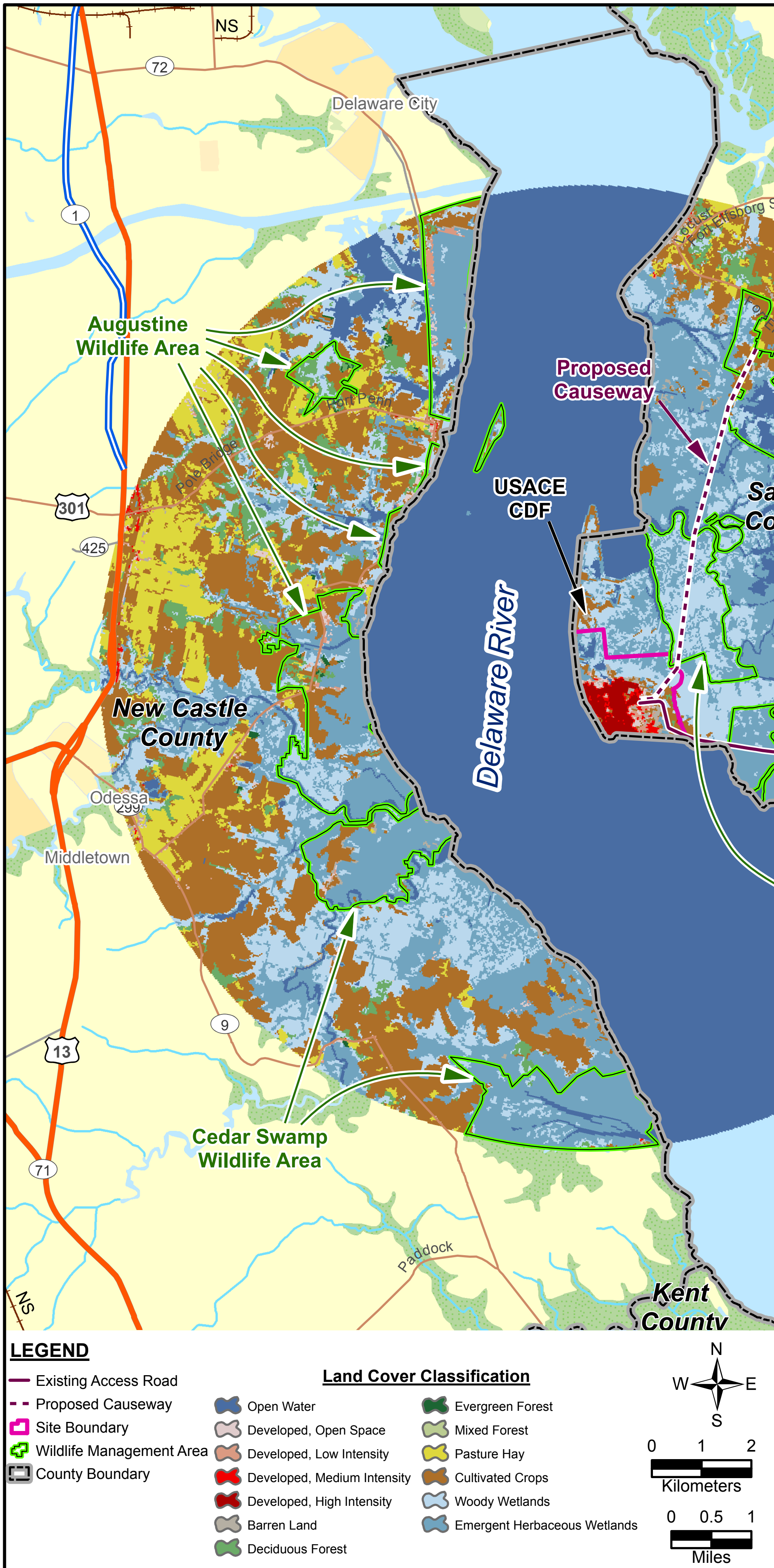
PSEG Power, LLC

PSEG Site ESPA
Part 3, Environmental Report

PSEG Site and
Near Off-Site Land Use

FIGURE 2.2-1

Rev 0



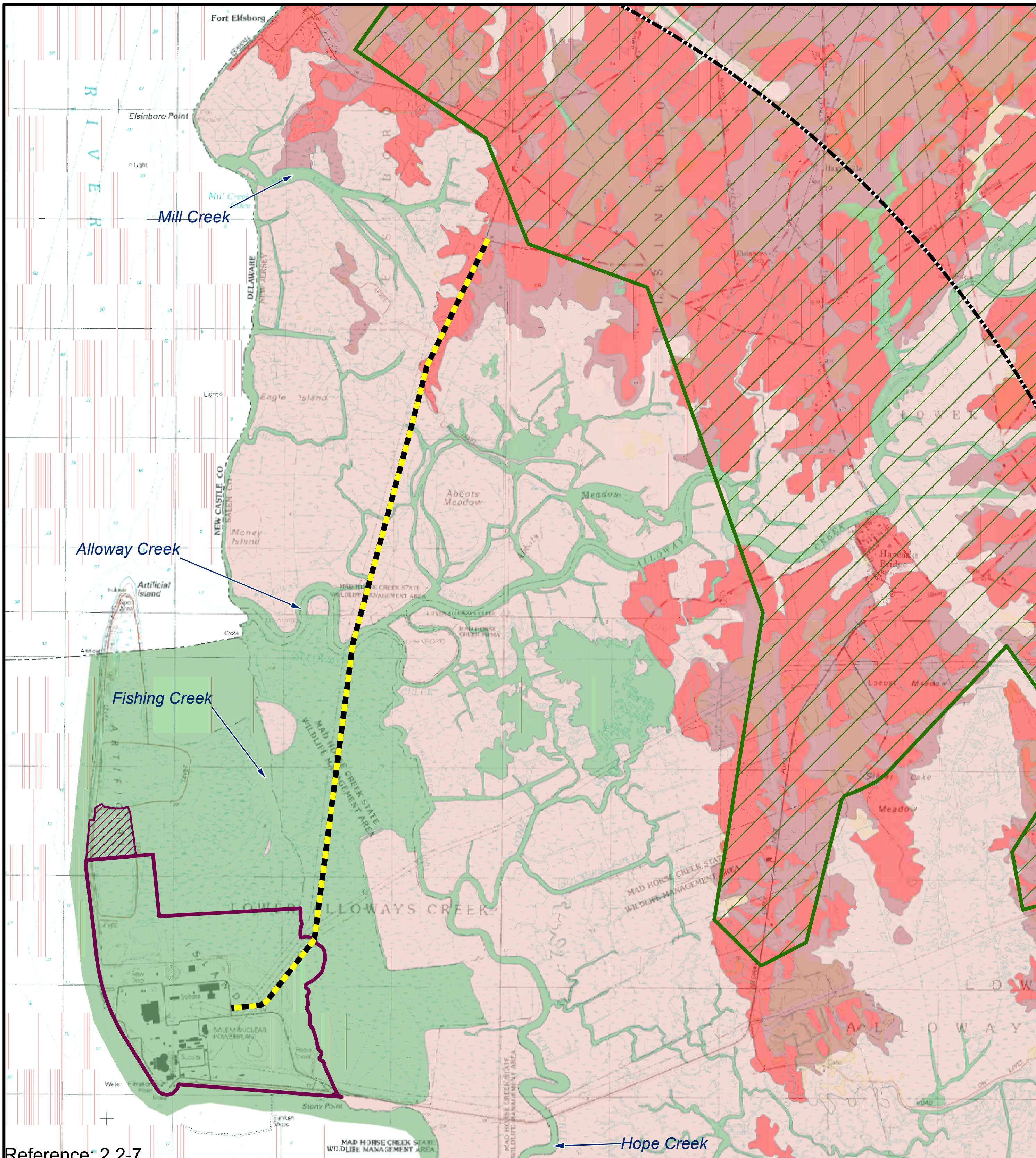
PSEG Power, LLC

PSEG Site ESPA
Part 3, Environmental Report

Land Use within the Vicinity of the PSEG Site

FIGURE 2.2.-2

Rev 0



Reference: 2.2-7

Legend

- Proposed Causeway
- Site Boundary
- Adjacent Off-site Area
- 6-mile (9.7 km) Vicinity Boundary
- Farmland Project Area 3

Prime Farmland

- Prime farmland
- Farmland of statewide importance
- Farmland of unique importance
- Not prime farmland

N W E S

0 0.4 0.8 Kilometers

0 0.4 0.8 Miles

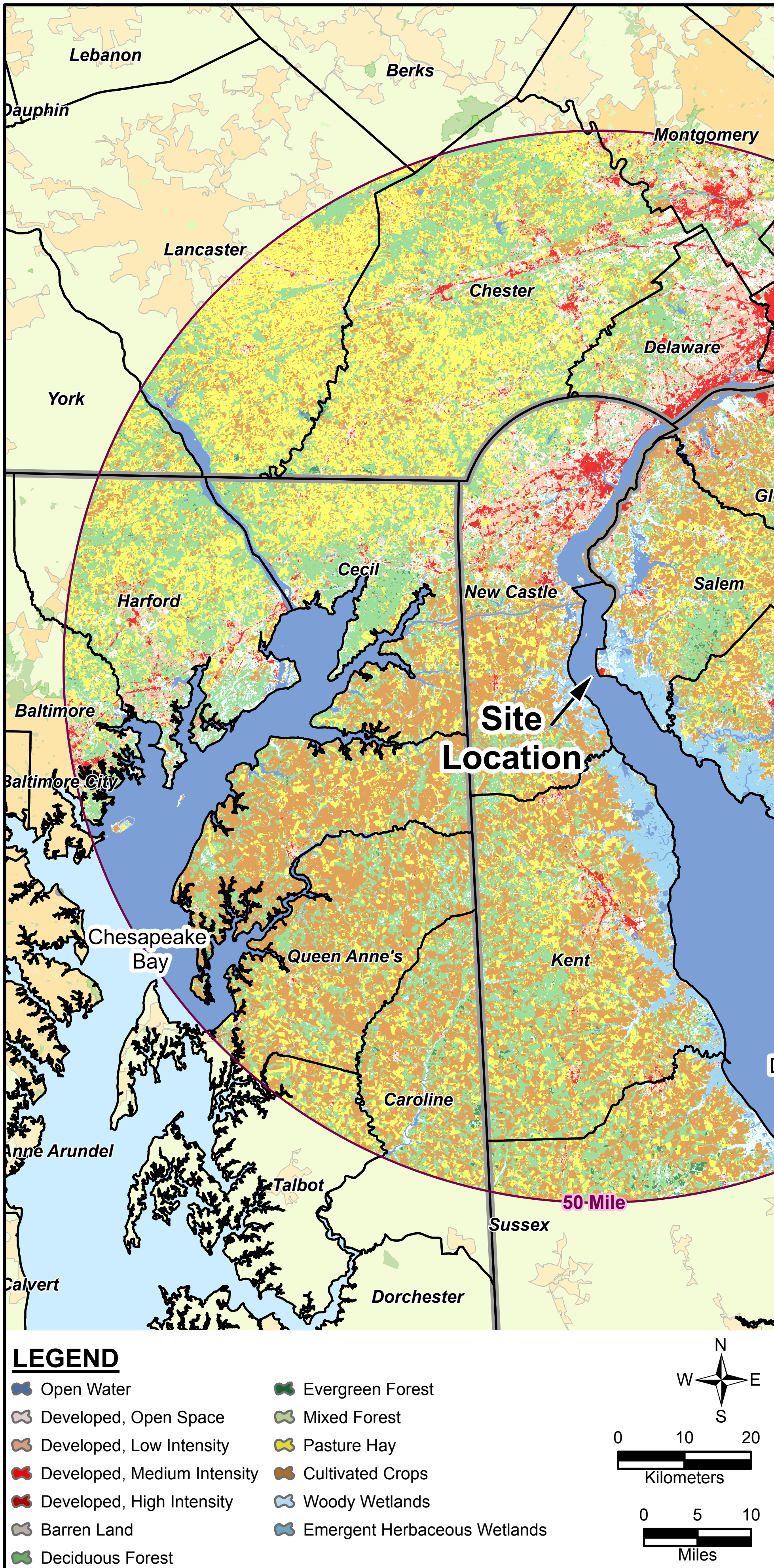
PSEG Power, LLC

PSEG Site ESPA
Part 3, Environmental Report

Farmland Resources

FIGURE 2.2-3

Rev 0



PSEG Power, LLC

PSEG Site ESPA
Part 3, Environmental Report

Regional Land Use

FIGURE 2.2-4

Rev 0