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4.0 GENERAL DESCRIPTION OF SITE AND ADJACENT AREAS

This section contains a general description of the physical, biological, aesthetic, and cultural features and conditions of the site and adjacent areas. Physical attributes include location of the site and transmission corridors (Section 4.1), land use at the site and vicinity (Section 4.2), historic resources (Section 4.2.3) geology (Section 4.3), hydrology (Section 4.4), water quality (Section 4.4.3), climate and meteorology (Section 4.9), air quality (Section 4.5), and noise (Section 4.8). Biological attributes include terrestrial ecology (Section 4.6.1) and aquatic ecology (Section 4.6.2). Socioeconomic attributes are discussed in Section 4.7.

4.1 CCNPP SITE AND TRANSMISSION CORRIDORS

A map depicting the location of the CCNPP site and transmission corridors is presented in Figure 4.1-1. The geographical center of the CCNPP site is near 38 degrees, 26 minutes north latitude and 76 degrees, 27 minutes west longitude, approximately 40 miles (64 km) southeast of Washington D.C.

The CCNPP site consists of 2,070 acres (838 hectares) in Calvert County, Maryland on the west bank of the Chesapeake Bay. The proposed CCNPP Unit 3 will be located just south of the existing nuclear power plant Units 1 and 2 within the CCNPP site, as shown in Figure 4.1-2.

The existing CCNPP power transmission system consists of two circuits, the North Circuit, which connects CCNPP to the Waugh Chapel Substation in Anne Arundel County and the South Circuit, which connects CCNPP to Mirant’s Chalk Point Substation in Prince Georges County. The North Circuit is composed of two separate three-phase, 500 kV transmission lines run on a single right-of-way from CCNPP, while the South Circuit is a single three-phase 500 kV line. Figure 4.1-1 also shows both corridors from the CCNPP site to Waugh Chapel and Chalk Point.

Approximately 22 mi (35 km) of the lines in the Northern Circuit are in Calvert County and approximately 25 mi (40 km) are in Anne Arundel County on a 350 ft to 400 ft (106 m to 122 m) wide right-of-way. Each line consists of approximately 182 lattice towers and 47 stylized poles. The lines cross mostly secondary growth hardwood and pine forests, pasture, and farmland. These lines were constructed to deliver power generated at CCNPP to the Waugh Chapel Substation.

In 1994, Baltimore Gas & Electric Company (BGE), now a wholly owned subsidiary of Constellation Energy Group, completed the South Circuit 500 kV line. The 18 mi (29 km) South Circuit parallels the Waugh Chapel lines from CCNPP northward approximately 9 mi (14 km) before diverging in a northwesterly direction to connect with a line at the Chalk Point Substation.

At the time that CCNPP Units 1 and 2 were constructed, the Southern Maryland Electric Cooperative constructed a 69 kV transmission line to the CCNPP site, connecting to an onsite substation to provide offsite power to Units 1 and 2. The unit is connected to the substation via underground lines.

No additional offsite transmission corridors or other offsite land use will be required to connect the new reactor unit to the grid. An onsite 500 kV transmission line of approximately 1.0 mile (1.6 km) in length will have to be constructed to connect the CCNPP Unit 3 substation to the existing Units 1 and 2 substation and to the grid. Additionally, two existing 500 kV circuits that are currently connected to the existing Units 1 and 2 substation will be disconnected from that substation and extended 1.0 mi (1.6 km) to the Unit 3 substation.

4.2 LAND USE

This section describes the land use characteristics of the areas that could potentially be impacted by the construction and operation of CCNPP Unit 3. This section contains three subsections describing the land use: (1) within the CCNPP site, (2) within the immediate vicinity of the site, and (3) across the region. This section also discusses historic sites.

4.2.1 Land Use at Site and Vicinity

4.2.1.1 Land Use at the Site

A map depicting the land use at the CCNPP site is presented in Figure 4.2-1. Land use categories for this map are consistent with the land use classification codes listed in the United States Geological Survey (USGS) "Land Use and Land Cover Data." Calvert Cliffs Nuclear Power Plant, Inc. currently owns the entire CCNPP campus including Units 1 and 2. The CCNPP campus will be divided into a North Parcel and a South Parcel. Calvert Cliffs Nuclear Power Plant, Inc. will retain ownership of the North Parcel. It is expected that ultimate ownership of the South Parcel will reside with a to be formed subsidiary of UniStar Nuclear Energy, LLC.

The areas devoted to major uses of the land within the CCNPP site are summarized in Table 4.2-1. The CCNPP campus is zoned for a combination of light industrial and farm and forest district uses. The portion of the site not used for construction of CCNPP Unit 3 is planned to remain as forest, abandoned farm land, or will be used for proposed wetland mitigation. The land in the vicinity of the CCNPP site is zoned residential to the south, residential, light industrial and rural community district to the west, and farm and forest district to the north. The Chesapeake Bay is to the east. Section 1-2 of the Calvert County Zoning Ordinance exempts qualified commercial power generating facilities from the requirements of the Zoning Ordinance. A qualified commercial power generating facility is a commercial power generating facility as to which a certificate of public convenience and necessity has been issued under Public Utility Companies Article Section(s) 7-205, 7-207 and/or 7-208, Annotated Code of Maryland, as amended from time to time. Calvert County Zoning Ordinance § 1-2.02 and the definition provided in Article 12, thereof.

Table 4.2-1 Land Use on the CCNPP Campus

Land use Category	Acres (Hectares)	Percent
Forest	1,618.6 (655)	78.2
Urban or Built-up	330.7 (133.8)	16
Agriculture	106 (43)	5.1
Water	1.6 (0.7)	0.1
Barren	13 (5.3)	0.6
Total	2,070 (837.7)	100

The Chesapeake Bay Critical Area (CBCA) is a zone encompassing all land and water areas within 1,000 feet from the landward boundaries of State owned or privately owned coastal wetlands and the heads of tides of the Chesapeake Bay. The Critical Area Buffer is a zone encompassing the first 100 ft (30 m) of inshore land measured from mean high water within the 1,000 ft (305 m) CBCA. The CBCA law was enacted by the State of Maryland in 1984 and Calvert County adopted its Critical Area Plan in 1988.

The site plan for CCNPP Unit 3 encroaches within the CBCA. The Co-Applicants are applying for approval from the Critical Area Commission to use these areas. All applicable State and local regulations and ordinances pertaining to the CBCA will be complied with during the construction and operation of CCNPP Unit 3. The CBCA setback is indicated on Figure 4.2-1.

4.2.1.2 Land Use in the Vicinity of the CCNNP Site

The vicinity is defined as the area encompassed within a radius of 8 mi (13 km) surrounding the plant site. Most of the area surrounding the CCNPP campus is bounded by the Chesapeake Bay and the Patuxent River. A map showing major land uses within 8 miles (13 km) of the proposed project is presented in Figure 4.2-2. Major land uses in the 8 mi (13 km) vicinity of the proposed project are summarized in Table 4.2-2. A topographical map of the vicinity is presented in Figure 4.2-3.

Table 4.2-2 Land Use Categories within 8 mi (13 km) Vicinity

Land Use Category	Acres (Hectares)
Open Water	78,238 (31,663)
Forest	28,828 (11,666)
Residential/Urban	13,484 (5,457)
Agriculture	9,843 (3,983)
Wetland	691 (280)
Barren	56 (23)
Not Defined	21 (8)

Calvert County is one of Maryland's 16 counties located in the Maryland Coastal Zone. The Federal Coastal Zone Management Act (CZMA) was enacted in 1972 establishing a Federal Coastal Zone Management (CZM) Program. The CZMA requires that federal actions that are reasonably likely to affect any land or water use, or natural resource of a state's coastal zone be conducted in a manner consistent with the state's federally approved CZM Program. For activities requiring federal permitting, the state would be notified directly by the federal agency involved or by the applicant for input into the project approval process. The State of Maryland CZM Program, administered by the Maryland Department of the Environment (MDE), has been approved by the United States Department of Commerce. The Maryland program is a comprehensive and coordinated program developed for the management of uses and activities that have direct, and potentially significant, effects on coastal resources.

The following recreational, scenic, cultural, and natural landmarks, as well as archaeological and historic sites, are within the 8 mi (13 km) vicinity of the CCNPP site:

- There are no known claims by Native Americans on lands within the site boundary or within the 8 mi (13 km) radius of the CCNPP site.
- Federal lands include the U.S. Naval Recreation Center at Solomons Island in the southern portion of the county. The recreational area is comprised of 295 acres (119 hectares) on the

Patuxent River. The Recreation Center serves U.S. Department of Defense employees from the Patuxent River Naval Air Station (NAS), active duty military officers, and retirees.

- State lands include the Calvert Cliffs Wild Land, which is part of Calvert Cliffs State Park. These lands total approximately 3,030 acres (1,226 hectares), of which 1,079 acres (437 hectares) is the wild land area found in the southern portion of the park. Greenwell State Park is located just across the Patuxent River in St. Mary's County. Greenwell State Park contains 596 acres (241 hectares) of land and lies just within the 8 mi (13 km) radius.

- Calvert County recreational facilities -- Flag Ponds Nature Park, Jefferson Patterson Park and Museum, and Cove Point Park -- are also located within the 8 mi (13 km) vicinity of the CCNPP site. Flag Ponds Nature Park consists of 327 acres (132 hectares) located just north of the CCNPP site. The Jefferson Patterson Park and Museum, consisting of 512 acres (207 hectares), is also the home of the Maryland Archeological Conservation Laboratory and provides preservation and artifact conservation services. Cove Point Park is one of three district parks located in Calvert County (80 acres (32 hectares)) and is the closest to the CCNPP site.

- There are no National Parks, National Forests, or National Monuments within the CCNPP site vicinity.

- The proposed project significantly affects land that was part of a former youth camp, Camp Conoy, which became a part of the CCNPP campus when it was purchased for the original development of the site and construction of CCNPP Units 1 and 2 in 1968. Camp facilities have been made available at times over the intervening years to site employees and their families.

- The Calvert County Board of Commissioners and the Town of Lusby, located southwest of the CCNPP site, have implemented economic development plans to improve and expand the town center for commercial development. A new 92-acre (37.2 hectare) Patuxent Business Park has also been established in the Town of Lusby to promote economic development.

- The Cove Point LNG terminal is located approximately 3.5 miles (5.8 km) south of the CCNPP site.

- Private lands held in trust or through other use restrictions include five land preservation trust property holders that hold various amounts of land throughout Calvert County. These are the American Chestnut Land Trust, the North American Land Trust, the Calvert Farmland Trust, the Cove Point Natural Heritage Trust, and the Southern Calvert Land Trust. The American Chestnut Land Trust holdings include the Parkers Creek Watershed Nature Preserve, which is located just within the 8 mi (13 km) radius north of the CCNPP site.

4.2.2 Land Use in the Region

The region within 50 mi (80 km) of the CCNPP site includes all or part of 15 Maryland counties, 2 Delaware counties, 12 Virginia counties, and parts of Washington, D.C. The 50 mi (80 km) radius of the CCNPP site is bordered by Washington, D.C. to the northwest, Virginia to the southwest, and Delaware to the east, as shown on Figure 4.1-1. Interstate 95 (I-95) passes west of the proposed project connecting with portions of I-495 that are within a 50 mi (80 km) radius of the site. Land acreage devoted to major uses within the 50 mi (80 km) region are presented in Table 4.2-3 and shown on Figure 4.2-4.

Table 4.2-3 CCNPP Site 50 mi (80 km) Land Use Classifications

Classification	Acres	Hectares	Percent of Total
Forest	1,556,430	629,997.3	31.0
Water	1,548,769	626,786.8	30.8
Agriculture	1,023,108	414,051.7	20.4
Urban/Built-up	630,369	255,110.2	12.5
Wetlands	240,288	97,244.6	4.8
Barren Land	13,642	5,521.0	0.3
Undefined	12,822	5,188.9	0.3
Brushland	942	381.0	0.0
Total	5,026,370	2,034,172.0	100.0

4.2.3 Historic Sites

Detailed archaeological and historical surveys of the CCNPP Unit 3 site and associated onsite transmission corridors supporting CCNPP Unit 3 have been conducted. The cultural resources investigation consisted of Phase Ia and Ib surveys that were conducted of the proposed project area between October 2006 and January 2007. GAI Consultants, Inc. conducted the Phase Ia and Ib surveys. The surveyors are listed on the Maryland Historical Trust Preservation Consultant List and have completed similar survey projects in Maryland.

The Phase Ia survey was conducted to identify previously recorded or surface-visible archaeological resources and architectural resources, and to identify those areas with archaeological potential that would require a Phase Ib survey. The Phase Ib survey was conducted to identify subsurface archaeological resources, record all known archaeological and architectural resources in the proposed project area, and to evaluate the recorded resources for eligibility to the National Register of Historic Places.

For purposes of these surveys, the approximate area of physical disturbance is 600 acres (243 hectares) and was based on the location and extent of acreage required for all project-related construction activities. The area for visual effects on architectural resources includes the 600 acres (243 hectares) and extends 1,000 ft (305 m) beyond the 600 acre (243 hectare) boundary.

There are eight areas of cultural resources that could potentially be affected by the proposed project. Tables 4.2-4 and 4.2-5 list the potentially eligible archaeological sites and eligible architectural resources located within the project area. The Maryland State Historic Preservation Officer (SHPO) has acknowledged the potential eligibility of these sites for the National Register. Phase II archaeological and architectural investigations and subsequent on-going consultation with the Maryland SHPO will be performed relating to the potentially eligible sites to determine their eligibility and recommended actions, if the sites cannot be avoided by construction activities. As project design and layout have been refined, two additional areas not included in the original scope of the Phase Ia and Ib investigation have been identified as being within the area of visual effects. Phase Ia and Ib investigations will be conducted on these areas concurrently with the Phase II work on the site and included in the complete Phase I/II report that will be submitted to the SHPO.

Table 4.2-4 Summary of Potentially Eligible Archaeological Sites [a]

Site (MHT No.)	Site Type	Age	NRHP Status
Site 1 (18CV474	Artifact Scatter/ Foundation	19th Century	Insufficient Data
Site 7 (18CV480)	Domestic Site	Mid 19th to 20th Century	Insufficient Data
Site 8 (18CV481)	Domestic Site	19th to early 20th Century	Insufficient Data
Site 9 (18CV482)	Domestic Site	Mid 19th to early 20th Century	Insufficient Data

Notes:
NRHP = National Register of Historic Places
MHT = Maryland Historical Trust
(a) Based on Maryland SHPO comments

Table 4.2.5 Summary of Eligible Architectural Resources [a]

MHT No.	Name	Date	Resource Type	Location	NRHP Status
CT-58	Parran's Park	c1750	Abandoned Farmstead; 3 tobacco barns	In the 600 acre (243 hectare) APE	NRHP Eligible under Criterion A
CT-59	Preston's Cliff, Charles's Gift, The Wilson Farm	c1690	Ruins; 3 tobacco barns and house ruins	In the APE for visual effects	NRHP Eligible under Criteria A and C
CT-1295	Baltimore and Drum Point Railroad	c1890	Abandoned Railroad; railroad bed	In the APE	Offsite portions determined NRHP eligible; project portions NRHP Eligible under Criteria A and C
CT-1312	Camp Conoy	c1930	YMCA Camp; 4 buildings, pavilion, playground, swimming pool, tennis courts	In the APE and adjacent area	NRHP Eligible under Criterion A

Notes:
NRHP = National Register of Historic Places
MHT = Maryland Historical Trust
APE = Area of Potential Effect
(a) Based on Maryland SHPO comments

Research was conducted to identify previously recorded cultural resources located within 10 mi (16 km) of the proposed project site that are listed in the National Register of Historic Places; that have been determined eligible or determined potentially eligible for listing on the National Register of Historic Places; that have not been evaluated for National Register of Historic Places listing; and/or that are listed in the Maryland Register of Historic Places or county and local registers or inventories. Research was conducted at the Maryland Historical Trust (MHT) archives and library, Calvert County Department of Planning and Zoning, St. Mary's County Department of Land Use and Growth Management, and the Dorchester County Planning and Zoning Department. Research was also conducted of the National Register of Historic Places and the list of National Historic Landmarks.

Research identified 1,029 previously surveyed, inventoried, and recorded cultural resources within a 10 mi (16 km) radius of the existing CCNPP site. This number includes historic districts, buildings, sites, and objects. Resource types range from archaeological sites and historic districts with numerous contributing resources, to boats, a lighthouse, churches, dwellings, factories, commercial buildings, cemeteries, parks, and a tree. The resources identified are located in the Maryland counties of St. Mary's, Calvert, and Dorchester. None of the offsite cultural resources are affected by the construction and subsequent operation of the proposed CCNPP Unit 3.

Research was also conducted to address potential impacts to the Southern Maryland Heritage Area and to other Federal cultural heritage programs near the CCNPP site. Consultation with the SHPO indicated that Heritage Areas would not be addressed under Section 106 of the National Historic Preservation Act. Heritage Areas would only be addressed if projects are directly impacting these areas. The construction and operation of CCNPP Unit 3 does not directly impact the Southern Maryland Heritage Area or other Federal cultural heritage programs.

4.3 GEOLOGY

This section contains a brief description of the geologic conditions at and in the vicinity of the CCNPP site.

4.3.1 Geological Setting

The CCNPP site is located in the Coastal Plain Physiographic Province, as shown in Figure 4.3-1. The CCNPP site and vicinity topography consists of gently rolling hills with elevations ranging from about sea level to nearly 130 ft (40 m) msl. The CCNPP site is well drained by short, ephemeral, intermittent, and perennial streams that form a principally dendritic drainage pattern. The longest stream nearest the CCNPP site is Johns Creek, which is approximately 3.5 mi (5.6 km) long and drains into St. Leonard Creek. The ephemeral streams on the South Parcel of the CCNPP site are either tributaries to Johns Creek or flow directly to Chesapeake Bay.

The Chesapeake Bay shoreline forms the eastern boundary of the CCNPP site and generally consists of steep cliffs with narrow beaches at their base. The cliffs reach an elevation of approximately 100 ft (30 m) mean sea level (msl) along the eastern portion of the CCNPP site's shoreline. Observations indicate that the exposed cliff face erodes along nearly vertical, irregular surfaces. The erosion is primarily caused by the undercutting action of waves along the base of the cliffs. Approximately 2,500 ft (762 m) of the shoreline east of the CCNPP site, from the existing CCNPP Units 1 and 2 intake southward to the existing barge jetty, is stabilized against shoreline erosion.

CCNPP Unit 3 will be constructed at a grade elevation of approximately 85 ft (26 m) msl and its perimeter security fencing will be set back approximately 900 ft (274 m) from the Chesapeake Bay shoreline. The bearing layer on which structural fill will be placed to form the foundation for the plant structures is in the Chesapeake Group Choptank formation. The Chesapeake Group is considered to be a confining unit with respect to groundwater conditions.

4.3.2 Stratigraphy

The CCNPP site is located on Coastal Plain sediments ranging in age from Lower Cretaceous to Recent, which, in turn, rest on a pre-Cretaceous basement. The basement rock beneath the site likely consists of rocks similar to those found west of the CCNPP site in the Piedmont Physiographic Province. The Piedmont rocks range in age from Precambrian to Paleozoic. Figure 4.3-2 is a generalized stratigraphic column showing the geologic formations present beneath the CCNPP site and vicinity.

The coastal plain sediments form a wedge that thickens from 0 ft (0 m) at its contact with the Piedmont Province southeastward, to approximately 8,000 ft (2,438 m) along the Maryland coast. The surficial sediments (alluvium and beach deposits, terrace and lowland deposits, and upland deposits) at the CCNPP site consist of Quaternary alluvium in stream valleys and Tertiary Upland deposits consisting of sands and gravels above an elevation of 100 ft (30 m) msl as shown in Figure 4.3-3. Underlying the Upland deposits is the sand-clay sequence of the Chesapeake Group, consisting of the St. Mary's, Choptank and Calvert formations in descending order. The St. Mary's and Choptank formations are exposed in the cliffs along the Chesapeake Bay east of the CCNPP site. They, along with the underlying Calvert formation, have a combined thickness of approximately 245 to 280 ft (75 to 85 m).

The base of the Chesapeake Group is marked by the top of the Piney Point Formation, which is about 20 ft (6 m) thick and is recognized by a distinctive, natural-gamma signature on borehole geophysical logs. The Piney Point together with the upper sandy section of the underlying Nanjemoy formation comprises the Piney Point-Nanjemoy aquifer. The Nanjemoy formation is approximately 180 ft (55 m) thick beneath the CCNPP site.

The Nanjemoy formation is underlain by the Marlboro clay, a thin (approximately 15 to 20 ft (4.6 to 6 m)), maroon clay overlying the Aquia formation. The Aquia formation, a major aquifer in the area, is approximately 150 ft (46 m) thick beneath the CCNPP site.

The lowermost Tertiary stratum beneath the site is the Brightseat formation; a sandy, glauconitic clay approximately 10 to 20 ft (3 to 6 m) thick, which unconformably overlies the Cretaceous stratum.

The Upper Cretaceous Magothy-Mattawan-Monmouth formations conformably underlie the Brightseat formation. These units are very thin beneath the site (possibly 30? ft (9? m)).[1] Further to the north in Queen Anne's County, is the Magothy aquifer. Below the Magothy are the sands and clays of the Cretaceous Potomac Group. Uppermost in this group is the Patapsco formation, a sequence of gray, brown, and red variegated silts and clays interbedded with lenticular, cross-bedded clayey sands and minor gravels. A major aquifer near the Baltimore area, the Patapsco, is largely undeveloped in the vicinity of the CCNPP site. The Patapsco formation is described as being 1,000 to 1,100 ft (305 to 335 m) thick.

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[1] Geologists use a question mark (?) as a standard symbol to explicitly identify uncertainty. The usage of a question mark or query, herein is consistent with usage by the cited documents. This usage is common for both U.S. Geologic Survey publications and Maryland Geologic Survey publications.

Underlying the Patapsco are the Lower Cretaceous Arundel/Patuxent formations (undivided). These two units are difficult to separate in the subsurface in the CCNPP site area because of the similarity of the clays in the two formations. This was described by the upper portion of the (undivided) Arundel/Patuxent formations as variegated, silty clay with thin, very fine sand, and silt interbeds that may be as thick as 150 to 200 ft (46 to 61 m) beneath the CCNPP site. The Arundel formation is not recognized in Southern Maryland. The Patuxent formation consists of a sequence of variegated sands and clays that form a major aquifer near Baltimore, but have not been developed in the vicinity of the CCNPP site. The thickness of the Patuxent formation beneath the CCNPP site is estimated as 600 to 700 ft (183 to 213 m).

Underlying the Arundel/Patuxent formations is the basement rock. It has been indicated that most of the borings that penetrate coastal plain sediments and extend to the underlying basement have encountered metamorphic or igneous rocks. Sparse geophysical and borehole data indicate that the basement likely consists of exotic crystalline magmatic arc material. The thickness of this unit is not known.

4.4 HYDROLOGY

This section describes surface water bodies and groundwater aquifers that could affect or be affected by the construction and operation of CCNPP Unit 3. The site-specific and regional data on the physical and hydrologic characteristics of these water resources are summarized to provide the basic data for an evaluation of impacts on water bodies, aquifers, social and economic structures, and aquatic eco-systems of the area.

The CCNPP campus covers an area of approximately 2070 acres (838 hectares) and is located on the western shore of the Chesapeake Bay in Calvert County near MD 2/4. The climate of the site area is primarily humid subtropical, with hot, humid summers and mild, rainy winters. The topography at the site is gently rolling with steeper slopes along stream banks. Local relief ranges from sea level (NGVD 29) to approximately 130 ft (40 m) with an average relief of approximately 100 ft (30 m). The Chesapeake Bay shoreline near the site, which constitutes the northeastern perimeter, consists mostly of steep cliffs with a narrow beach area.

4.4.1 Surface Water Resources

The CCNPP site is located on a high bluff on the Calvert peninsula within the Chesapeake Bay watershed. The Chesapeake Bay, with a watershed area in excess of 64,000 mi^2 (165,759, km^2), is the largest estuary in the U.S.

The Calvert peninsula is formed by the Chesapeake Bay to the east and the Patuxent River to the west. It has a width of approximately 5 mi (8.0 km) near the CCNPP site. The Patuxent River flows near the CCNPP site from the northwest to the southeast direction, and it discharges into the Chesapeake Bay approximately 8 mi (12.9 km) south of the CCNPP site. Drainage in the vicinity of the CCNPP site includes several small streams and creeks, which fall within two sub-watersheds of the Chesapeake Bay with the drainage divide running nearly parallel to the shoreline. These sub-watersheds include the Patuxent River watershed and the Maryland Western Shore watershed. Figure 4.4-1 shows the Chesapeake Bay watershed and sub-watersheds along with the CCNPP site location.

4.4.1.1 Freshwater Streams

- **Local Drainage**

The CCNPP site is well drained by a natural network of short, ephemeral, intermittent, and perennial streams within the two sub-watersheds. Approximately 80% of the CCNPP site is drained through the St. Leonard Creek drainage basin of the Lower Patuxent River watershed. The remaining 20% drains through the Maryland Western Shore watershed discharging northeastward and directly into the Chesapeake Bay by two unnamed creeks, identified as Branch 1 and Branch 2 in Figure 4.4-2. All the streams that drain the CCNPP site that are located east of MD 2/4 are nontidal.

Runoff from the CCNPP site that lies within the St. Leonard Creek watershed mainly drains through Johns Creek, a tributary to St. Leonard Creek. The tributaries located upstream of MD 2/4 that contribute to Johns Creek are the Goldstein Branch, Laveel Branch, and two unnamed branches identified as Branch 3 and Branch 4 in Figure 4.4-2. The St. Leonard Creek watershed has a drainage area of approximately 35.6 mi^2 (92.2 km^2) and mainly includes St. Leonard Creek and its tributaries, including the Perrin Branch, Woodland Branch, Planters Wharf Creek, Johns Creek and its tributaries, Grovers Creek, Rollins Cove, and Grapevine Cove. The combined flow from these streams discharges into the Patuxent River through St. Leonard Creek. St. Leonard Creek is tidally influenced at the confluence with Johns Creek.

Wetlands near the CCNPP Unit 3 construction area consist of small headwater streams with narrow floodplains and associated riparian forest in the St. Leonard watershed, and minor Chesapeake Bay watershed, minor tributary streams, and associated small impoundments. Major impoundments within the site include the Lake Davies stormwater impoundment, sequential perennial water bodies that drain the dredge spoil disposal area, and the Camp Conoy fishing pond. The Camp Conoy fishing pond is located at the headwaters of unnamed creek Branch 1 as shown in Figure 4.4-2. Runoff from Lake Davies discharges west to Goldstein Branch, which then discharges to Johns Creek. The sequential ponds discharge directly to Johns Creek upstream of Goldstein Branch. Both the Camp Conoy fishing pond and Lake Davies are man-made. The U.S. Fish and Wildlife Service (U.S. FWS) has designated the water bodies within the CCNPP site as palustrine wetlands. Camp Conoy fishing pond and Lake Davies are further sub-classified as unconsolidated bottom permanently flooded and emergent semi-permanently flooded wetlands, respectively. Wetlands along the streams and creeks are mostly classified as forested or scrub-shrub wetlands that are seasonally or temporarily flooded.

- **Patuxent River Watershed**

The Patuxent River is the largest river that is completely contained in Maryland. It drains an area of about 932 mi^2 (2,414 km^2) as shown in Figure 4.4-1, which includes portions of St. Mary's, Calvert, Charles, Anne Arundel, Prince George's, Howard, and Montgomery Counties. The Patuxent River contributes slightly over 1% of the total streamflow delivered annually from the catchment of the Chesapeake Bay Basin. The river basin is situated between two large metropolitan areas, which are Baltimore, Maryland and Washington, D.C. Consequently, the Patuxent River watershed has been subject to significant suburban development. Present land use in the basin is approximately 44% forest, 30% urban, and 26% agriculture.

The Patuxent River watershed is divided into four sub-watersheds:

- Upper Patuxent River watershed,
- Western Branch Patuxent River watershed,
- Middle Patuxent River watershed, and
- Lower Patuxent River watershed.

The Lower Patuxent River watershed area within Calvert County is approximately 174 mi^2 (451 km^2) and covers over 50% of the land in the county. The major rivers contributing to the watershed are the Patuxent River, Hunting, Hall, St. Leonard, and Battle Creeks. The main stem of the Patuxent River is influenced by tidal fluctuation in the Chesapeake Bay. The tidal influence is observed over nearly the entire length of the river in the lower watershed with the head of tide located south of Bowie, Maryland.

4.4.1.2 The Chesapeake Bay Estuary

The Chesapeake Bay is one of the largest and most productive estuarine systems in the world. The Chesapeake Bay main stem, defined by tidal zones, is approximately 195 mi (314 km) long (measured from its entrance at the Atlantic Ocean near Norfolk, Virginia to the mouth of the Susquehanna River near Havre de Grace, Maryland). At the northern end, the estuary is connected to the Atlantic Ocean through the Chesapeake and Delaware Canal. The estuary varies in width from about 3.5 mi (5.6 km) near Aberdeen, Maryland to 35 mi (56 km) near the mouth of the Potomac River, with an approximate width of 6 mi (9.7 km) near the CCNPP site. It has an open surface area of nearly 4,480 mi^2 (11,603 km^2) and, including its tidal estuaries, has approximately 11,684 mi (18,804 km) of shoreline.

On average, the Chesapeake Bay holds more than 18 trillion gallons (68 trillion liters) of water. Although the Chesapeake Bay's length and width are dramatic, the average depth of the bay, including tidal tributary channels, is only about 21 ft (6.4 m). The Chesapeake Bay is shaped like a shallow tray, except for a few deep troughs that are believed to be paleo channels of the Susquehanna River. The troughs form a deep channel along much of the length of the Chesapeake Bay. This deep channel allows passage of large commercial vessels. Because it is so shallow, the Chesapeake Bay is more sensitive than the open ocean to temperature fluctuations and wind. The Chesapeake Bay is irregular in shape and is long enough to accommodate one complete tidal wave cycle at all times.

The main stem of the bay is entirely within Maryland and Virginia. Nearly 50 rivers, with thousands of tributary streams and creeks, drain an area in excess of 64,000 mi^2 (165,759, km^2) forming the Chesapeake Bay Basin. The basin contains more than 150,000 stream miles (241,402 stream km) located in the District of Columbia and parts of six states (New York, Pennsylvania, Maryland, Virginia, West Virginia, and Delaware, as shown in Figure 4.4-1). Nine rivers, including the Susquehanna, Patuxent, Potomac, Rappahannock, York (including its Mattaponi and Pamunkey tributaries), James, Appomattox, and Choptank, contribute over 90% of the Chesapeake Bay's mean annual freshwater inflow. The Susquehanna River, the largest river that enters the bay, drains nearly 43% of the basin. It normally contributes about 50% of the freshwater reaching the Chesapeake Bay. Eighty percent to 90% of the freshwater entering the Chesapeake Bay comes from the northern and western portions of the basin. The remaining 10% to 20% is contributed by the eastern shore. Although the Chesapeake Bay lies totally within the Atlantic Coastal Plain, the watershed includes parts of the Piedmont Province and the

Appalachian Province that provide a mixture of waters to the Chesapeake Bay with variable geochemical and sediment origins.

4.4.2 Groundwater Resources

This section contains a description of the hydrogeologic conditions present at and in the vicinity of the CCNPP site. This section describes the regional and local groundwater resources that could be affected by the construction and operation of CCNPP Unit 3. The regional and site-specific data on the physical and hydrologic characteristics of these groundwater resources are summarized to provide the basic data for an evaluation of potential impacts on the aquifers of the area.

4.4.2.1 Hydrogeologic Setting

The CCNPP site lies within the Coastal Plain Physiographic Province, at a distance of about 50 mi (80 km) east of the Fall Line. The Coastal Plain Physiographic Province is a lowland that is bordered by the Atlantic Ocean to the east and the Fall Line to the west. The Fall Line is a demarcation, separating the eastern, unconsolidated coastal plain sediments from the consolidated rocks of the western physiographic provinces associated with the Appalachian Mountains. Although the Coastal Plain is generally a flat, seaward-sloping lowland, this province has areas of moderately steep local relief that reach elevations of several hundred feet.

The CCNPP site is underlain by approximately 2,500 ft (762 m) of Coastal Plain sedimentary strata of Cretaceous and Tertiary age that dips southeast. Underlying these sediments are crystalline and metamorphic rocks of Precambrian and Early Paleozoic age. The Cretaceous and Tertiary strata are comprised primarily of sedimentary deposits of silt, clay, sand, and gravel, which exhibit considerable lateral and vertical variations in lithology and texture. The stratum forms a wedge-shaped mass, which thickens and deepens to the southeast from the Fall Line towards the Atlantic Ocean. Water-bearing units within the Coastal Plain sediments consist of unconsolidated to semi-consolidated sand aquifers separated by clay confining units. The sediments that compose the aquifer system were deposited in non-marine, marginal marine, and marine environments during a series of marine transgressions and regressions during Cretaceous and Tertiary times.

Parts of five physiographic provinces are present in Maryland. These include (from west to east):

- Appalachian Plateau Province,
- Valley and Ridge Province,
- Blue Ridge Province,
- Piedmont Province, and
- Coastal Plain Physiographic Province.

Groundwater occurrence is only significant to the site within the Coastal Plain Physiographic Province, specifically, the regional area of southern Maryland.

4.4.2.2 Regional Hydrogeologic Description

For southern Maryland, hydrogeologists have refined the aquifer nomenclature system based on local hydrostratigraphic conditions. From shallow to deep, the local aquifer systems are as follows:

- Surficial aquifer,
- Piney Point-Nanjemoy aquifer,
- Aquia aquifer,
- Magothy aquifer, and
- the Potomac Group of aquifers.

The refined nomenclature will be used to describe the regional hydrogeologic conditions in the vicinity of CCNPP site. A schematic cross-section of the southern Maryland hydrostratigraphic units is shown in Figure 4.4-3.

4.4.2.3 Local and Site-Specific Hydrogeologic Descriptions

The Chesapeake Bay and Patuxent River define the eastern, southern, and western boundaries of Calvert County. The creeks and streams within the area influence the shallow aquifer systems beneath the site. Deeper aquifers are less influenced by incisions of streams and rivers. Natural flow directions in the deeper aquifers are southeasterly from the Fall Line towards the Atlantic Ocean. Localized areas of increasing groundwater withdrawals in southern Maryland have affected both local and regional groundwater movement. With the exception of the surficial aquifer and the Chesapeake Group, recharge areas are west and northwest of the CCNPP site, towards the Fall Line, in Charles County, Prince George's County, and Anne Arundel County.

The topography at the CCNPP site is gently rolling with steeper slopes along stream courses. Local relief ranges from sea level up to approximately elevation 130 ft (40 m) msl with an average elevation of approximately 100 ft (30.5 m). The Chesapeake Bay shoreline consists mostly of steep cliffs with narrow beach areas. The CCNPP site is well drained by short, intermittent streams. A drainage divide, which is generally parallel to the coastline, extends across the CCNPP site. The area to the east of the divide drains into the Chesapeake Bay. The western area is drained by tributaries of Johns Creek and Goldstein Branch, which flow into St. Leonard Creek, located west of MD 2/4, and subsequently into the Patuxent River. The Patuxent River empties into the Chesapeake Bay approximately 10 mi (16 km) southeast from the mouth of St. Leonard Creek.

The geotechnical and hydrogeological investigations provide information on the CCNPP site to depths of 400 ft (122 m) below ground surface. Subsurface information was collected from over 180 borings and cone penetrometer tests (CPT). Forty groundwater observation wells were installed across the CCNPP site, completed in the surficial aquifer and the water-bearing materials in the Chesapeake Group. The wells were located in order to provide adequate distribution with which to determine CCNPP site groundwater levels, subsurface flow directions, and hydraulic gradients beneath the CCNPP site. Well pairs were installed at selected locations to determine vertical gradients. Field hydraulic conductivity tests (slug tests) were conducted in each observation well.

4.4.3 Water Quality

This section describes the site-specific surface water quality characteristics that could be directly affected by plant construction and operation, or that could affect plant water use and effluent disposal within the vicinity of the CCNPP site. Site-specific water quality data was obtained through the Chesapeake Bay Program (CBP) databases, the Co-Applicant's databases, U.S. Geological Survey (USGS), site water body sampling, and other available sources.

The data available and collected for this report are believed to be adequate to characterize the water bodies in terms of suitability for aquatic organisms and to serve as a baseline for assessing if plant construction or operations have impacted water quality. All liquid effluent discharges during plant operation will be monitored and regulated by a National Pollutant Discharge Elimination System (NPDES) permit.

Most of the data available and collected was to characterize the Chesapeake Bay as the most significant water body in the vicinity of the CCNPP site. The most important parameters in terms of evaluating the Chesapeake Bay water quality are salinity, dissolved oxygen (DO), temperature, sediments and chemical contaminants, and nutrients. Because nutrient loading is widely regarded as the Chesapeake Bay's most critical water quality problem, this section examines trends in macronutrient concentrations (total nitrogen, nitrates, ammonia, phosphorus, orthophosphate) in the Chesapeake Bay in the CCNPP vicinity.

Many of these parameters were also measured in samples collected from the onsite water bodies. Groundwater samples were collected to monitor water quality parameters in the surficial and Aquia aquifers in the area of the proposed project.

4.4.3.1 Surface Water – Freshwater Bodies

Surface water channels, including Johns Creek and Goldstein Branch, and four perennial ponds (Camp Conoy fishing pond, Lake Davies, and Ponds 1 and 2) are present within the boundary of CCNPP. Water quality data for the on-site surface water bodies was collected in September 2006 and March 2007 as part of a biological study. A summary of the water quality data collected during these studies are presented in Table 4.4-1 through 4.4-6. Based upon these data, the *in situ* water quality measurements are representative of a healthy aquatic environment in the streams and Camp Conoy fishing pond. Dissolved oxygen greater than 5 parts per million (ppm) and a neutral pH were recorded at Johns Creek, Goldstein Branch, and Camp Conoy fishing pond. Low dissolved oxygen concentrations were detected in Lake Davies and the two ponds during the September survey but were similar to the streams and Camp Conoy fishing pond during the March survey. Total organic carbon, alkalinity, and total dissolved solids are notably higher at Lake Davies and the downstream station on Johns Creek than the other site waters. Despite the low dissolved oxygen concentration at Lake Davies and the two ponds, and the elevated nutrients at Lake Davies, the general water quality of these systems does not indicate that any significant adverse conditions are the result of current operations at the CCNPP site. Additional water quality parameters were tested in the spring survey period to obtain a more complete baseline profile of conditions. The additional testing did not reveal any adverse water quality conditions. In particular, bacteria levels, chlorophyll a, and total petroleum hydrocarbons were low. Metals were largely at nondetected concentrations. However, in Lake Davies elevated levels of barium, calcium, magnesium, potassium and sodium were observed. These findings are consistent with the high conductivity, alkalinity and total dissolved solids measurements in Lake Davies and reflect past disposal of dredged material in adjacent upgradient areas.

To provide a representation of variability in these waters due to meteorological conditions, wet weather (rainfall within the previous 24 hours) and dry weather (no rainfall within the previous 72 hours) samples were taken at the downstream station on Johns Creek and at the Goldstein Branch station in the spring. The wet weather results show increases in BOD, COD, fecal coliform and fecal streptococci, phosphorus, and total suspended solids as would be expected. Wet and dry weather measurements of PAH were also made and none where detected. No petroleum hydrocarbons were detected.

4.4.3.2 Surface Water – Chesapeake Bay

The Chesapeake Bay estuary is a mixing zone of freshwater influx from rivers and streams and salt water from the Atlantic Ocean. Circulation of Bay waters transports sediment, dissolved oxygen, nutrients, chemical contaminants, and planktonic aquatic biota. Freshwater influx flows seaward, above the denser seawater intrusion, forming two wedges moving in opposite directions. The opposing movement of these two wedges, combined with seasonal weather patterns and tidal forces, drives the circulation of nutrients and sediments throughout the Chesapeake Bay.

CCNPP Units 1 and 2 use water from the Chesapeake Bay for condenser cooling, drawing bottom water through a 45 ft (15 m) deep, dredged channel that extends approximately 4,500 ft (1,400 m) offshore. Water passes through the plant in approximately 4 minutes and is discharged from an outfall north of the plant that is approximately 850 ft (260 m) offshore in 10 ft (3 m) of water. A curtain wall that extends to a depth of 30 ft (9 m) across the intake channel limits the cooling water withdrawal to mostly bottom water, although there is evidence that mixing of surface and lower depth water occurs before entrance to the plant. Proposed CCNPP Unit 3 will withdraw makeup water from the Chesapeake Bay through a new intake structure located immediately south of the existing intake structure and within the curtain wall. All cooling system discharges from the new unit, including the cooling tower blowdown, will be discharged to the Chesapeake Bay via a new discharge structure to be built north of the barge pier.

Table 4.4-1 Fall 2006 Water Quality Analytical Data in Streams and Ponds

Water Body	Units	Johns Creek		Goldstein Branch	Camp Conoy fishing pond [a]				Pond 1a	Pond 2a	Lake Davies		
Parameter		JCUS-01	JCDS-01	GB-01	LC-01	LC-02	LC-02 DUP	LC-03	P-01	P-02	LD-01	LD-02	LD-03
Temperature[b]	°F (°C)	64 (18)	59 (15.5)	62 (16.9)	76 (24.9)	70 (21.3)	NA	70 (21.7)	65 (18.4)	63 (17.3)	68 (20)	70 (20.5)	71 (20.7)
Dissolved Oxygen[b]	ppm	6.4	6	6.7	7.6	6.1	NA	6.16	3.21	0.99	3.4	3.4	4
pH[b]	SU	6.4	7.63	7.4	7.8	7.72	NA	7.3	6.7	6.39	7.5	7.7	7.7
Conductivity[b]	µmhos/cm	50	484	737	66	63	NA	62	109	135	1566	1592	1591
Alkalinity	mg/L	3.5	76	100	14	8.5	4.5	4.5	30	56	330	280	270
Biological Oxygen Demand (BOD)	mg/L	<2.0	3.2	5.9	6.3	6.9	<2.0	4.5	18	14	9.8	7.2	9.1
Ammonia	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrate plus Nitrite-N	mg/L	<0.05	<0.05	0.12	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phosphorus Dissolved-P	mg/L	0.021	0.018	0.011	<0.01	0.021	<0.01	0.011	0.011	<0.01	0.22	0.19	0.21
Phosphorus Total-P	mg/L	0.029	0.032	0.079	0.17	0.038	0.067	0.035	0.18	0.095	0.36	0.31	0.29
Total Dissolved Solids	mg/L	30	280	440	35	67	20	48	41	51	980	950	980
Total Kjeldahl Nitrogen	mg/L	2	1.1	<1.0	<1.0	<1.0	<1.0	<1.0	3.1	1.4	2.2	1.8	1.7
Total Organic Carbon	mg/L	5.5	4	3.9	6.1	5.8	5.6	5.7	6.3	6.4	15	16	16
Total Suspended Solids	mg/L	4	5	62 (16.9)	27	<5.0	<5.0	150	56	11	6	6.5	8

Table 4.4-2 Fall 2006 Surface, Mid-Depth and Bottom in Situ Water Quality Data for Lake Canoy and Lake Davies Calvert Cliffs Nuclear Power Plan

Water Body	Units	Camp Conoy fishing pond			Lake Davies		
		LC-01	LC-02	LC-03	LD-01	LD-02	LD-03
Parameter – Surface							
Temperature	°F (°C)	76 (24.9)	70 (21.3)	70 (21.7)	68 (20)	70 (20.5)	71 (20.7)
Dissolved Oxygen	ppm	7.6	6.1	6.16	3.4	3.4	4
pH	SU	7.8	7.72	7.3	7.5	7.7	7.7
Conductivity	µmhos/cm	66	63	62	1566	1592	1591
Parameter – Mid-Depth							
Temperature	°F (°C)	NA	NA	70.6 (21.2)	68 (20)	68.4 (20.2)	68.5 (20.3)
Dissolved Oxygen	ppm	NA	NA	5.68	3.1	2.5	2.5
pH	SU	NA	NA	7.06	7.6	7.6	7.7
Conductivity	µmhos/cm	NA	NA	63	1581	1612	1581
Parameter – Bottom							
Temperature	°F (°C)	77.5 (25.3)	70.4 (21.34)	70.2 (21.2)	67.8 (19.9)	68.4 (20.2)	67.8 (19.9)
Dissolved Oxygen	ppm	6.7	5.88	5.06	2.2	2.6	2.2
pH	SU	7.5	7.44	6.77	7.5	7.6	7.7
Conductivity	µmhos/cm	65	62	62	1563	1608	1576

[a]Pond 1 and Pond 2 are the first and second impoundments downstream of the Camp Conoy fishing pond.
[b]*In situ* measurements for Temperature, Dissolved Oxygen, pH, and Conductivity are for surface readings.

mg/L = Milligrams per liter
µmhos/cm =Microsiemens per centimeter
ppm = Parts per million
SU = Standard Units (pH)
NA = Not applicable. There is no duplicate sampling for *in situ* measurements.

Table 4.4-3 Spring 2007 Water Quality Analytical Data in Streams and Ponds
Calvert Cliffs Nuclear Power Plant

Water Body		Johns Creek			Goldstein Branch		Lake Canoy			Lake Davies			Pond 1	Pond 2
Parameter	**Units**	**JCUS-01**	**JCDS-01 (Dry)**	**JCDS-01 (Wet)**	**GB-01(Dry)**	**GB-01(Wet)**	**LC-01**	**LC-02**	**LC-03**	**LD-01**	**LD-02**	**LD-03**	**P-01**	**P-02**
Conductivity	µS/cm	37	297	---	460	---	61	56	57	1209	1197	1202	79	89
Dissolved Oxygen	mg/L	11.1	12.1	---	13.4	---	11.6	12.8	13.4	18.8	18.6	17.4	11.8	11.5
Odor (Observation)	NA	None	None	None	None	None	None	None	None	None	None	None	None	None
pH	units	6.6	7.5	---	7.3	---	8.1	8.1	7.9	8.3	8.3	8.3	7.5	7.5
Temperature	Centigrade	6.6	13.0	---	11.1	---	14.2	11.8	12.4	11.0	10.9	10.6	9.0	9.9
Turbidity	NTU	4.1	9.9	---	8.1	---	2.4	3.3	3	3.1	3.3	2.8	18.3	10.3
Water Depth	feet	1	---	---	1	1	2	2	3.5	3	4	3	3	1.5
Alkalinity	mg/L	8.5	43	33	62	42	6.5	12	9.5	180	190	190	25	24
BOD	mg/L	<3.0	<3.0	5.6	<3.0	7.3	<3.0	<3.0	<3.0	4.1	4.1	9.1	<3.0	<3.0
Carbon, Total	mg/L	3.4	13.3	12.6	21.7	15.1	5.0	4.1	2.8	8.3	8.4	6.6	9.9	3.8
Carbon, Total Organic	mg/L	2.6	5	5.8	3.7	6.8	2.4	4.2	5.6	8.8	9.7	9.8	4.9	3.3
Chemical Oxygen Demand	mg/L	<10	21	32	<10	35	<10	23	25	37	33	23	28	28
Chloride (Titrimetric, Mercuric Nitrate)	mg/L	6.5	46	46	50	29	7.5	7.0	7.5	120	120	120	7	7.0
Chlorophyll-A	mg/M3	2.9	1.8	2.4	5.4	6.5	2.3	0.89	0.91	4.8	1.4	5.4	4.2	0.89
Color, True	color units	20	25	30	15	35	10	15	25	25	20	15	30	25
Fecal Coliform	MPN/100ml	<2.0*	<2.0*	1600	8*	500*	<2.0*	<2.0*	<2.0*	<2.0*	<2.0*	<2.0*	<2.0*	80*
Fecal Streptococcus	MPN/100ml	<2.0*	12*	90	4*	140*	<2.0*	<2.0*	<2.0*	<2.0*	<2.0*	<2.0*	33*	6.0*
Hardness, Total	mg/L	160	250	190	310	220	180	130	160	580	620	640	180	190
Nitrogen-Ammonia	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrogen, Total Kjeldahl	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Nitrogen, Nitrate-Nitrite	mg/L	0.053	0.15	0.21	0.33	0.26	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.062	<0.050
Petroleum Hydrocarbons, Total	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Phosphorus, Dissolved	mg/L	<0.010	<0.010	0.013	<0.010	0.02	<0.010	<0.010	0.023	0.043	<0.010	<0.010	<0.010	0.013
Phosphorus, Ortho	mg/L	<0.010	<0.010	0.067	<0.010	0.024	0.010	0.010	0.030	0.031	0.040	0.077	<0.010	0.015
Phosphorus, Total	mg/L	0.044	0.034	0.19	0.077	0.21	0.024	0.054	0.086	0.070	0.063	0.014	0.073	0.037
Solids, Total Dissolved	mg/L	49	180	120	320	180	47	61	46	860	900	980	32	63
Solids, Total Suspended	mg/L	<5.0	<5.0	20	<5.0	120	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.5	11
Sulfate	mg/L	11	45	30	130	73	13	15	14	360	520	520	13	14

* Sample analyzed past recommended holding time. Data are relevant for intra-study comparison but should not be used as the basis of management decisions for water use for primary contact recreation.

Table 4.4-4 Spring 2007 Surface, Mid-Depth and Bottom in Situ Water Quality Data for Lake Canoy and Lake Davies
Calvert Cliffs Nuclear Power Plant

Water Body		Lake Canoy			Lake Davies		
Parameter	**Units**	**LC-01**	**LC-02**	**LC-03**	**LD-01**	**LD-02**	**LD-03**
Surface							
Temperature	Centigrade	NA	NA	12.4	11.0	10.9	10.6
Dissolved Oxygen	ppm	NA	NA	13.4	18.8	18.6	17.4
pH	units	NA	NA	7.9	8.3	8.3	8.3
Conductivity	µS/cm	NA	NA	57.0	1209.0	1197.0	1202.0
Turbidity	NTU	NA	NA	3.0	3.1	3.3	2.8
MidDepth							
Temperature	Centigrade	14.2	11.8	NA	11.0	11.0	10.6
Dissolved Oxygen	ppm	11.6	12.8	NA	19.3	18.8	17.5
pH	units	8.1	8.1	NA	8.3	8.3	8.3
Conductivity	µS/cm	61.0	56.0	NA	1208.0	1197.0	1201.0
Turbidity	NTU	2.4	3.3	NA	3.0	3.1	3.0
Bottom							
Temperature	Centigrade	NA	NA	10.3	11.0	10.9	10.2
Dissolved Oxygen	ppm	NA	NA	14.1	19.3	18.8	17.6
pH	units	NA	NA	7.8	8.3	8.3	8.3
Conductivity	µS/cm	NA	NA	54.0	1206.0	1194.0	1195.0
Turbidity	NTU	NA	NA	3.9	3.2	3.2	3.3

Table 4.4-5 Spring 2007 Metals in Streams and Ponds
Calvert Cliffs Nuclear Power Plant

Water Body		Johns Creek			Goldstein Branch		Lake Canoy			Lake Davies			Pond 1	Pond 2
Parameter	**Units**	**JCUS-01**	**JCDS-01 (Dry)**	**JCDS-01 (Wet)**	**GB-01 (Dry)**	**GB-01 (Wet)**	**LC-01**	**LC-02**	**LC-03**	**LD-01**	**LD-02**	**LD-03**	**P-01**	**P-02**
Arsenic	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0028	0.0024	0.0027	<0.0020	<0.0020
Barium	mg/L	0.023	0.027	0.066	0.030	0.04	0.016	0.016	0.016	0.015	0.014	0.015	0.012	0.0088
Cadmium	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Calcium	mg/L	0.98	22	14	52	33	1.9	1.8	1.8	84	84	85	8.7	11
Chromium	mg/L	<0.0025	<0.0025	<0.0025	<0.0025	0.0027	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lead	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	0.003	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Magnesium	mg/L	1.5	7.1	4.7	16	10	2.6	2.5	2.5	62	62	62	2.7	2.7
Mercury	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Potassium	mg/L	0.83	1.8	1.9	2.8	2.5	1.0	1.0	0.99	17	17	17	0.78	0.87
Selenium	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Sodium	mg/L	4.1	30	30	31	20	5.3	5.3	5.4	170	170	170	5.2	5.3

Table 4.4-6 Spring 2007 Polynuclear Aromatic Hydrocarbons (PAHs) in Streams
Calvert Cliffs Nuclear Power Plant

Water Body		Johns Creek		Goldstein Branch	
Parameter	**Units**	**JCDS-01(Dry)**	**JCDS-01 (Wet)**	**GB-01 (Dry)**	**GB-01 (Wet)**
Acenaphthene	µg/L	<10	<10	<10	<10
Acenaphthylene	µg/L	<10	<10	<10	<10
Anthracene	µg/L	<10	<10	<10	<10
Benz(a)anthracene	µg/L	<10	<10	<10	<10
Benzo(a)pyrene	µg/L	<10	<10	<10	<10
Benzo(b)fluoranthene	µg/L	<10	<10	<10	<10
Benzo(g,h,i)perylene	µg/L	<10	<10	<10	<10
Benzo(k)fluoranthene	µg/L	<10	<10	<10	<10
Chrysene	µg/L	<10	<10	<10	<10
Dibenz(a,h)anthracene	µg/L	<10	<10	<10	<10
Florene	µg/L	<10	<10	<10	<10
Fluoranthene	µg/L	<10	<10	<10	<10
Indeno(1,2,3-cd)pyrene	µg/L	<10	<10	<10	<10
Naphthalene	µg/L	<10	<10	<10	<10
Phenanthrene	µg/L	<10	<10	<10	<10
Pyrene	µg/L	<10	<10	<10	<10

In the area of the CCNPP site, predominant physical characteristics of the Chesapeake Bay include sand-bearing sediments, mesohaline salt concentrations, seasonal stratification, current patterns influenced by wind and tides, high levels of localized particulates, and moderate sedimentation and resuspension rates. The local aquatic ecosystem is driven by high spring nutrient influx, turbidity, high primary production and phytoplankton density with an intermediate benthic abundance, and a relatively low biological diversity. Throughout the Bay, contaminant distribution is largely influenced by physical processes, with the movement of water and sediment providing the principal mechanism for transport. Winds, waves, currents, tidal actions, and episodic events such as storms and hurricanes, can cause major resuspension of bottom sediments and associated contaminants, and the frequency and intensity of these physical events will have a fundamental effect on residence time of contaminants in any given area. Likewise, stratification and subsequent mixing will determine vertical, as well as horizontal, movement of contaminants, an important factor in a two-layered estuary like the Chesapeake Bay.

The overall health of the Chesapeake Bay is considered degraded by nutrient, air, sediment, and chemical pollution. High levels of nutrients, such as phosphorus and nitrogen, enter the bay system via stormwater, industrial/utility effluent, and atmospheric deposition. Sediments are washed into the Bay by natural processes including stream and shoreline erosion and stormwater runoff. The mass influx of nutrients and sediments decreases water clarity and stimulates algal production, which can reduce dissolved oxygen in the water column. Low freshwater flows lead to increased salinity and mixing between surface freshwater (higher oxygen levels) and the more saline water (where nutrients become available) below.

Several water quality databases, maintained by state agencies, federal agencies, and non-profit groups, were accessed to locate available and applicable water quality data relevant to the Chesapeake Bay water in the area of the CCNPP site. After examining these databases, the most available data were found within the CBP Water Quality Database (1984 to present). Using this database, the CBP manages water quality data recorded at monitoring stations throughout the Bay and its tributaries, including stations in the area of the CCNPP site. Data from three mainstem monitoring stations (identified on Figure 4.5-1) north of the CCNPP site (CB4.3W, CB4.3C, and CB4.3E) and three mainstem monitoring stations south of the CCNPP site (CB4.4, CB5.1, and CB5.1W) were used to characterize seasonal water quality trends for the Bay waters within the vicinity of the power plant. Water quality data presented in this section of the Technical Report were obtained from these monitoring stations using the CBP database, unless otherwise noted.

Data reviewed for this environmental report was based on water year (WY) 2005 (i.e., the natural, annual water cycle from October 2004 through September 2005). Availability of water quality data varies by parameter and not all data were collected at the same collection events. However, where possible, trends in the available data sets were evaluated for discussion herein.

4.4.3.2.1 Pycnocline

Freshwater flow is less dense than the cooler, saline waters entering the Bay from the Atlantic Ocean creating vertical stratification of the water column and a zone (pycnocline) where the density changes rapidly due to temperature and salinity differences. The pycnocline plays an important role in determining seasonal changes in photosynthesis and nutrient distribution. Stratification and subsequent mixing will determine vertical, as well as horizontal, movement of contaminants, an important factor in a two-layered estuary such as the Chesapeake Bay. In some systems, stratification can represent a physical barrier to the mixing of the water column, thus minimizing the exchange of nutrients and oxygen through the pycnocline.

Sampling is conducted within the Chesapeake Bay to characterize the separate upper and lower water masses. Pycnocline data was obtained through the CBP to identify the depth and thickness of the pycnocline in the area of the CCNPP site. Four monitoring stations (CB4.3C, CB4.3E, CB4.4, and CB5.1) in the CCNPP site vicinity were found to have pycnocline data. A summary of the pycnocline data are provided in Table 4.4-7.

Table 4.4-7 Summary of Pycnocline Data for Selected Chesapeake Bay Monitoring Stations, Water Year 2005

Station ID	Fall		Winter		Spring		Summer		Yearly Average
	Max	Min	Max	Min	Max	Min	Max	Min	
Depth to Pycnocline in feet (meters)									
CB4.3C	37.7 (11.5)	27.9 (8.5)	57.4 (17.5)	11.5 (3.5)	41 (12.5)	11.5 (3.5)	41 (12.5)	14.8 (4.5)	29.2 (8.9)
CB4.3E	34.4 (10.5)	11.5 (3.5)	--	--	44.3 (13.5)	14.8 (4.5)	27.9 (8.5)	14.8 (4.5)	25.7 (7.8)
CB4.4	44.3 (13.5)	18 (5.5)	44.3 (13.5)	27.9 (8.5)	34.4 (10.5)	8.2 (2.5)	41 (12.5)	27.9 (8.5)	31.4 (9.6)
CB5.1	47.6 (14.5)	8.2 (2.5)	54.1 (16.5)	18 (5.5)	41 (12.5)	11.5 (3.5)	37.7 (11.5)	14.8 (4.5)	27.9 (8.5)
Thickness of Pycnocline in feet (meters)									
CB4.3C	16.4 (5)	9.8 (3)	29.5 (9)	3.3 (1)	29.5 (9)	9.8 (3)	23 (7)	3.3 (1)	16.2 (4.9)
CB4.3E	19.7 (6)	16.4 (5)	--	--	6.6 (2)	<3 (<1)	26.2 (8)	9.8 (3)	13.1 (4)
CB4.4	49.2 (15)	9.8 (3)	19.7 (6)	9.8 (3)	32.8 (10)	19.7 (6)	23 (7)	6.6 (2)	19.9 (6.1)
CB5.1	52.5 (16)	6.6 (2)	32.8 (10)	9.8 (3)	49.2 (15)	23 (7)	49.2 (15)	9.8 (3)	23.6 (7.2)

Note:
-- = No data

Based upon WY 2005 data, a pycnocline is established within the vicinity of the CCNPP site throughout the year; however, its depth and thickness fluctuate spatially throughout the seasons. The pycnocline fluctuated in thickness between < 3 ft (1 m) during the spring (at monitoring station CB4.3E) and 57.4 ft (17.5 m), observed during the winter (at monitoring station CB4.3C). In WY 2005, the pycnocline had the most variable thickness at monitoring station CB5.1, which was also the location of the greatest thickness.

4.4.3.2.2 Water Temperature

Seasonal variations in the thermal stratification of the Chesapeake Bay are observed with generally well-mixed conditions during winter and strong stratification during summer. During the winter, stratification is generally limited to ambient temperature and weather patterns that impact surface water temperature. WY 2005 water temperature data are provided in Table 4.4-8.

Water temperature affects chemical and biochemical reaction rates as well as physical processes such as current patterns and contaminant movement. With as little as an 18°F (10°C) water temperature increase, the speed of many chemical and physical reactions can double. Within the Bay, water temperature fluctuates throughout the year, ranging from 34 to 84°F (1 to 29°C).

Based upon the WY 2005 temperature data, presented below, the water temperature dropped quickly in the winter months, with the minimum temperature of 34.9°F (1.6°C) at monitoring station CB4.3C and average temperatures ranging from 42.7 to 43.2°F (6.0 to 6.2°C). The greatest variability in temperature was observed during the fall months, with a maximum temperature of 80.6°F (27.0°C) and a minimum temperature of 53.2°F (11.8°C) recorded at monitoring stations CB4.4 and CB5.1W. Temperatures during the winter showed the lowest variation, with a maximum high temperature of 54.5°F (12.5°C) at monitoring stations CB4.3C, CB4.4, and CB5.1, and a low temperature of 34.9°F (1.6°C) at monitoring station CB4.3C.

Evaluation of the water temperature data compared to the pycnocline data showed unusually high variations in stratification across the Chesapeake Bay. The surface water (above the pycnocline) was found to have higher temperatures during the early spring through summer months that coincide with the establishment of the pycnocline. However, as the surface water temperatures dropped during late fall and winter the pycnocline began to decline, becoming less prominent within the water column.

4.4.3.2.3 Dissolved Oxygen

Dissolved oxygen (DO) concentrations in Chesapeake Bay waters fluctuate throughout the year in response to natural biological and physical processes. During the winter months, DO is relatively high throughout the water column in response to the increased solubility of DO in cooler water, reduced biologic activity and DO uptake, and a homogenizing of the water column produced by vertical mixing during turbulent seasonal weather (wind, storms). In the summer months, solubility decreases, biologic uptake increases, mixing becomes reduced, and the water column becomes stratified with the lowest DO concentrations typically observed below the pycnocline. Bacterial activity in organic material accumulating on the bay floor can produce DO-poor bottom water over large areas and the pycnocline can act as a barrier for bottom water exchange with DO-richer surface waters.

Table 4.4-8 Summary of Temperature Statistics (°F (°C)) for Selected Chesapeake Bay Monitoring Stations, Water Year 2005

Seasonal Statistics	CB4.3W	CB4.3C	CB4.3E	CB4.4	CB5.1W	CB5.1
Fall – September, October, November						
Max	78.3 (25.7)	79.7 (26.5)	79.5 (26.4)	80.6 (27.0)	80.2 (26.8)	79.9 (26.6)
Min	66.6 (19.2)	56.7 (13.7)	66.4 (19.1)	58.1 (14.5)	53.2 (11.8)	58.3 (14.6)
Average	71.9 (22.2)	69.9 (21.1)	73.4 (23.0)	69.7 (21.0)	70.7 (21.5)	69.9 (21.1)
N	15	66	37	74	22	78
Winter – December, January, February						
Max	--	54.5 (12.5)	--	54.5 (12.5)	47.7 (8.7)	54.5 (12.5)
Min	--	34.9 (1.6)	--	35.1 (1.7)	35.6 (2.0)	35.1 (1.7)
Average	--	42.8 (6.0)	--	42.7 (6.0)	43.0 (6.1)	43.2 (6.2)
N	0	69	0	75	10	75
Spring – March, April, May						
Max	61.7 (16.5)	61.5 (16.4)	61.3 (16.3)	61.9 (16.6)	62.8 (17.1)	62.2 (16.8)
Min	38.7 (3.7)	38.3 (3.5)	38.1 (3.4)	38.1 (3.4)	36.9 (2.7)	38.1 (3.4)
Average	51.0 (10.6)	49.0 (9.4)	50.0 (10.0)	49.8 (9.9)	51.2 (10.7)	49.2 (9.6)
N	41	105	93	123	26	131
Summer – June, July, August						
Max	82.9 (28.3)	83.5 (28.6)	83.1 (28.4)	85.3 (29.6)	83.5 (28.6)	84.4 (29.1)
Min	71.6 (22.0)	60.6 (15.9)	60.8 (16.0)	60.6 (15.9)	61.0 (16.1)	61.0 (16.1)
Average	79.0 (26.1)	74.9 (23.9)	75.0 (23.9)	75.4 (24.1)	77.6 (25.3)	74.8 (23.8)
N	50	126	108	135	24	148

Notes:
N = Number of measurements
-- = No data

A summary of WY 2005 DO data is provided as Table 4.4-9. The data indicate that annual DO concentrations decrease with depth. The greatest variation in DO concentrations was observed in the middle of the water column, or within the area of the pycnocline. DO concentrations within the upper portion of the water column, or above the pycnocline, remained the most constant over the year. The lowest recorded DO concentration during the winter, at any depth, was 5.5 mg/L. Water below the pycnocline (benthic) fell into severe hypoxic and anoxic conditions during the summer months. During the summer, low concentrations of 0.1 mg/L occurred at four of the six monitoring stations, and a low concentration of 0.2 mg/L occurred at a fifth. According to the CBP, water quality data gathered between 2003 and 2005 also indicate that only about 29% of the Chesapeake Bay's waters met DO standards during the summer months.

State water quality standards have been developed to meet the DO needs of the Chesapeake Bay's aquatic life, and the standards vary with depth, season, and duration of exposure. The standards generally require 5.0 mg/L of DO for ideal aquatic conditions. If the water column contains DO concentrations below 2.0 mg/L, the water is considered "severely hypoxic," and DO concentrations below 0.2 mg/L are considered "anoxic." Evidence suggests there has been an increase in the intensity and frequency of hypoxia and anoxia in the Chesapeake Bay waters over the past 100 to 150 years, most notably since the 1960s.

Availability of DO is an important factor for biological and chemical processes within the Chesapeake Bay waters. Oxygen-rich shallow waters are most essential in the spring for spawning of aquatic species, and mortality rates for most aquatic species typically increase as DO concentrations decrease. DO additionally drives chemical processes such as the rate of flocculation, adsorption, and/or desorption of dissolved compounds (to organic or inorganic surfaces) within the Chesapeake Bay. Experiments have shown that the metals most strongly influenced by anoxia are manganese, zinc, nickel, and lead. Dissolved oxygen levels can drive the release of metals from sediments within the Chesapeake Bay due to oxidative/reductive processes. Elevated DO concentrations cause the release of such metals as copper and zinc, therefore causing greater contaminant exposure to organisms in the water column. On the other hand, decreased levels of oxygen (hypoxia or anoxia) cause metals to be bound in sediments, thus increasing exposure to bottom-dwelling organisms.

4.4.3.2.4 Salinity

Salinity levels are graduated vertically and horizontally within the Chesapeake Bay due to freshwater flows and are generally higher along the Bay's eastern shore. A summary of the WY 2005 seasonal salinity statistics is presented in Table 4.4-10.

Based upon the WY 2005 CBP monitoring data as described in Table 4.4-10, salinity concentrations ranged between 4.06 parts per thousand (ppt) in spring and 22.18 ppt in summer. Salinity concentrations showed the least uniformity in spring, likely due to the high freshwater inflow caused by seasonal rainfall and snow melt; winter and fall showed the most uniform salinities.

Salinity is a key factor in an estuarine ecosystem that affects distribution of living resources, circulation, and an integral fate and transport mechanism of chemical contaminants within the Chesapeake Bay. Aquatic species have varying degrees of tolerance for salinity. Because salinity affects various physiological mechanisms in an organism, such as movement across cell membranes, it can affect an organism's biological functioning, thus influencing how the organism may respond to the presence of contaminants. Most aquatic organisms therefore move to areas within the Chesapeake Bay with suitable habitat conditions. Salinity affects movement of waters by influencing stratification in the water column and determines what form chemical contaminants are likely to take, making them less available for uptake by Chesapeake Bay organisms.

Table 4.4-9 Summary of Dissolved Oxygen Concentrations (mg/L) for Selected Chesapeake Bay Monitoring Stations, Water Year 2005

Seasonal Statistics	CB4.3W	CB4.3C	CB4.3E	CB4.4	CB5.1W	CB5.1
Fall – September, October, November						
Max	9.1	9.2	8.1	8.6	10.1	8.3
Min	4.6	0.2	0.2	0.2	5.1	0.2
Average	7.6	4.6	4.4	4.8	7.1	4.7
N	15	66	37	74	22	78
Winter – December, January, February						
Max	--	13.6	--	13.2	13.8	13.3
Min	--	5.5	--	5.7	10.6	5.8
Average	--	10.1	--	9.9	11.9	9.8
N	0	69	0	75	10	75
Spring – March, April, May						
Max	13.2	12.6	12.5	12.8	13	12.3
Min	3.1	1.2	1.4	1.3	7.9	0.9
Average	9.3	7.1	7.7	7.0	10.7	7.1
N	41	105	93	123	26	131
Summer – June, July, August						
Max	10.2	10.4	9.2	9.8	9.7	8.6
Min	0.2	0.1	0.1	0.1	3.0	0.1
Average	5.7	2.7	2.8	2.7	6.4	2.1
N	50	126	108	135	24	148

Notes:
N = Number of measurements
-- = No data

Table 4.4-10 Summary of Salinity Statistics (parts per thousand) for Selected Chesapeake Bay Monitoring Stations, Water Year 2005

Seasonal Statistics	CB4.3W	CB4.3C	CB4.3E	CB4.4	CB5.1W	CB5.1
Fall – September, October, November						
Max	14.87	20.78	20.29	21.55	15.41	21.83
Min	7.93	7.93	8.89	9.98	8.44	10.69
Average	11.13	15.59	14.50	16.03	12.60	16.60
N	15	66	37	74	22	78
Winter – December, January, February						
Max	--	18.83	--	19.87	10.24	20.08
Min	--	5.82	--	7.12	8.69	8.38
Average	--	13.17	--	14.73	9.66	15.32
N	0	69	0	75	10	75
Spring – March, April, May						
Max	11.8	19.11	18.14	19.52	10.69	20.01
Min	4.6	4.06	4.3	4.42	5.39	4.18
Average	8.37	12.42	11.78	13.30	8.78	14.15
N	41	105	93	123	25	131
Summer – June, July, August						
Max	15.07	21.48	20.64	22.18	15	21.9
Min	10.5	10.56	10.63	10.95	9.33	10.95
Average	11.98	15.83	15.45	16.38	12.46	17.38
N	50	126	108	135	24	148

Notes:
N = Number of measurements
-- = No data

4.4.3.2.5 Nutrients and Chemical Contaminants

Runoff within the Lower Maryland Western Shore watershed carries pollutants, such as nutrients and sediments, to rivers and streams that drain into the Chesapeake Bay. The entire watershed includes a land area of 83 mi^2 (215 km^2), with agricultural land uses comprising the second largest land use category at 14%; forested land made up 53% of the watershed area. Fertilizers containing nitrogen and phosphorus that are applied to agricultural lands are predominant sources of nutrient pollutants in stormwater.

Most of the Chesapeake Bay mainstem, all of the tidal tributaries, and numerous segments of nontidal rivers and streams are listed as Federal Water Pollution Control Act Section 303(d) “impaired waters” largely because of low DO levels and other problems related to nutrient pollution. The CCNPP site lies within the Lower Maryland Western Shore watershed, characterized by inflow from the Patuxent River, Fishing Creek, Parkers Creek, Plum Point Creek, Grays Creek and Grover Creek. According to the MDE listing of Section 303(d) waters, the Patuxent River is the only contributing water body within the watershed with Section 303(d) status. The discussion of Section 303(d) waters is limited to those in the watershed in the area of the CCNPP site.

The Patuxent River Lower Basin was identified on the 1996 Section 303(d) list submitted to the U.S. Environmental Protection Agency (EPA) by the MDE as impaired by nutrients and sediments, with listings of bacteria for several specified tidal shellfish waters added in 1998, and listings of toxics, metals, and evidence of biological impairments added in 2002. The Section 303(d) segments within the Patuxent River have been identified as having low priority. Only waters that may require the development of Total Maximum Daily Loads (TMDL) or that require future monitoring need a priority designation. Two approved TMDLs are already established within Calvert County, including TMDL for fecal coliform for restricted shellfish harvesting areas and a TMDL for mercury in Lake Lariat. While the current Section 303(d) list identifies the lower Patuxent River and greater Chesapeake Bay as low priority for TMDL development, it does not reflect the high level of effort underway to identify and document pollution loadings in the watersheds.

Pursuant to the Federal Water Pollution Control Act, the water quality of effluent discharges to the Chesapeake Bay and its tributaries is regulated through NPDES. CCNPP Units 1 and 2 maintain a current NPDES permit, State Discharge Permit 92-DP-0187; NPDES MD0002399. At the time of renewal in June 2004, the MDE was unaware of any major issue that would prevent renewal, and it was granted. The MDE noted that any new regulations promulgated by U.S. EPA or the MDE would be included in future permits and those may include development and implementation of TMDLs. NPDES data collected in 2005 were reviewed to determine the nature of effluent discharges from the CCNPP site. Discharge parameters including biologic oxygen demand, chlorine (total residual), bromine (total residual), cyanuric acid, fecal coliform, oil and grease, pH, temperature, and total suspended solids were reported. Based upon the data reviewed, all discharges were within the acceptable range and no discharge violations were reported.

4.4.3.2.6 Sediments

The lands surrounding the Chesapeake Bay are mostly comprised of Pleistocene era deposits. Erosion of these deposits along the shoreline releases sediment that flows southward as littoral drift. The general flow of nearshore sediment transport is from north of Long Beach to a location just north of CCNPP. The CCNPP site is situated in an area of net loss of sediment as the result of a circulating eddy in the Flag Pond State Park area. The eddy influences the transport and deposition of sediments along the shoreline, most evidently to the south of the CCNPP site in the area of Cove Point. Cove Point is a littoral promontory that is slowly moving in a southerly direction, due to the transport and deposition of shoreline erosion sediments from beaches two to three miles to the north.

Turbulent weather conditions, prevailing wind patterns, currents, and tidal forces influence the spatial distribution of chemical contaminants in the Chesapeake Bay by driving resuspension of benthic sediments. Resuspension rates are generally higher in well-mixed areas, while sediments become buried faster and incorporated into the bottom in less vigorously mixed environments. Stratification in the water column due to temperature or salinity gradients can additionally limit the height to which eroded sediments can be resuspended, keeping them low in the water column. Within the Chesapeake Bay, burial rates of heavy metals and movement of chemical pollutants out of sediments is moderate due to sedimentation and resuspension rates and low benthic cycling. Based upon the localized flow rates and pycnocline data presented in this section, resuspended bottom sediments are likely to settle rapidly within the area of the CCNPP site.

The bottom of the Chesapeake Bay in the CCNPP site area is characterized as having a hard substrate composed of compacted sand, mud, and calcareous shell fragments, overlain in some areas by scattered stones of various sizes. Sediment grabs were collected in September 2006 to assess the sediments and benthic biota. The samples were taken in the vicinity of the CCNPP Unit 3 discharge point (sample CCNPP-1) and at two locations within 500 ft (152 m) of this point and were analyzed for the following physical/chemical parameters:

- percent solids,
- ammonia nitrogen,
- total Kjeldahl nitrogen (TKN),
- total phosphorous,
- metals (Cd, Cr, Cu, Hg, Pb, Zn, As),
- pesticides,
- Polychlorinated Biphenyl (PCB) congeners,
- volatile organic compounds (VOCs),
- semivolatile organic compounds (SVOCs) (including polyaromatic hydrocarbons),
- grain size,
- total organic carbon, and
- specific gravity.

Concentrations of TKN, total organic carbon, total phosphorus, arsenic, chromium, lead, zinc, and PCB-18 were detected at levels that were above their respective method detection limits; however, based upon he relatively low concentrations of these analytes in samples, there is no evidence of sediment contamination.

4.4.3.3 Groundwater

Five groundwater production wells provide the process and domestic water for the operation of CCNPP Units 1 and 2. During the site characterization for CCNPP Unit 3, 145 borings were drilled and 40 observation wells were installed, primarily to monitor groundwater elevations. In May 2007, production Well No. 5 was drilled and observation wells OW 752-A, OW 319-A, and OW 319-B were sampled to collect groundwater quality data for the surficial and Aquia aquifers. The well completion data for the wells sampled is presented in Table 4.4-11. The groundwater sample analytical results are presented in Table 4.4-12.

As shown in Table 4.4-12, there are differences in the surficial aquifer groundwater across the site and between the surficial aquifer and the deeper groundwater sampled beneath the site. For the surficial aquifer samples, the metals concentrations are generally twice as high, the water is more alkaline and has elevated chloride, nitrate, phosphorus, pH, and total suspended solids concentrations in the groundwater sample from the eastern part of the site (well OW 319-A) compared to the western sample (OW 752-A). Alkalinity, hardness, calcium, magnesium, and silicon are higher in the sample from the Upper Chesapeake Unit (well OW 319-B) than in samples from the other aquifers. The sample from the Aquia Aquifer (Well No. 5) has the highest sodium and potassium concentrations and most of the other parameters are intermediate in concentration between the surficial and Upper Chesapeake Unit samples. The detections of bacteria in the samples are believed to be the result of contamination during sampling rather than contamination in the aquifer from a septic system source, especially since fecal coliforms were not detected.

While groundwater wells provide CCNPP Units 1 and 2 with domestic water service and de-mineralized makeup water, the Chesapeake Bay is the sole source of water for the once-through cooling system utilized at CCNPP Units 1 and 2. All CCNPP Units 1 and 2 liquid effluents are combined before being discharged to the Chesapeake Bay through a submerged outfall. Both the quantity of the water pumped (from the groundwater wells and the Chesapeake Bay) and quality of the water discharged to the Bay are regulated and permitted by the State of Maryland.

As required by 10 CFR 50.75(g), CCNPP Units 1 and 2 reported detection of low-level tritium within a piezometer tube located within the CCNPP site. According to the Calvert Cliffs Nuclear Power Plant Effluent and Waste Disposal 2005 Annual Report, the detection was identified during routine annual samples collected in December 2005 from piezometers that were installed to access the shallow groundwater beneath the CCNPP site. Tritium was detected within the water from one piezometer at an activity of approximately 1,800 pCi/L (72 Bq/L), but no gamma activity was detected. Subsequent sampling confirmed the presence of low levels of tritium in the piezometer, however, tritium was not detected at the remaining three piezometers. Since December 2006 detection, tritium has not been detected within any of the four piezometers during routine ongoing monitoring. CCNPP has identified the source as leaking piping, which has been corrected to prevent recurrence.

Table 4.4-11 Well Construction Data for Wells Sampled at CCNPP May 31, 2007

Well	Ground Surface Elevation ft (m)	Well Pad Elevation ft (m)	Top of Casing Elevation ft (m)	Boring Depth ft (m)	Well Depth ft (m)	Screen Interval Depth ft (m)		Screen Interval Elevation ft (m)		Filterpack Interval Depth ft (m)		CCNPP Hydrostratigraphic Unit
						Top ft (m)	Bottom ft (m)	Top ft (m)	Bottom ft (m)	Top ft (m)	Bottom ft (m)	
OW 319A	103.13 (31.4)	103.31 (31.5)	104.91 (32)	35.0 (10.7)	32.0 (9.8)	20.0 (6.1)	30.0 (9.1)	83.1 (25.3)	73.1 (22.3)	15.0 (4.6)	35.0 (10.7)	Surficial Aquifer
OW 319B	103.53 (31.6)	103.85 (31.6)	105.35 (32.1)	85.0 (25.9)	82.0 (25)	70.0 (21.3)	80.0 (24.4)	33.5 (10.2)	23.5 (7.2)	65.0 (19.8)	85.0 (25.9)	Upper Chesapeake Unit
OW 752A	95.3 (29.0)	95.73 (29.2)	97.0 (29.6)	37.0 (11.3)	37.0 (11.3)	25.0 (7.6)	35.0 (10.7)	70.3 (21.4)	60.3 (18.4)	19.0 (5.6)	37.0 (11.3)	Surficial Aquifer

All elevations are in feet (m) above the North American Vertical Datum of 1927 (NAVD 27).

Table 4.4-12 Summary of Analytical Results for Groundwater Well Sampling at CCNPP May 31, 2007

Parameter	Units	OW 752A Surficial Aquifer	OW 319A Surficial Aquifer	OW 319B Upper Chesapeake Unit	OW 319B Duplicate Upper Chesapeake Unit	CCNPP Well No. 5 Aquia Aquifer	Rinse Blank
Metals							
Arsenic	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Barium	mg/ L	0.027	0.055	0.044	0.044	0.025	<0.010
Cadmium	mg/ L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Calcium	mg/ L	1.5	9.2	85	85	7.0	0.62
Chromium	mg/ L	<0.0049	0.025	<0.0031	<0.0030	<0.0025	<0.0025
Iron	mg/ L	1.8	23	8.0	8.0	3.2	<0.10
Lead	mg/ L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Magnesium	mg/ L	1.4	3.2	3.1	3.1	2.3	<0.10
Mercury	mg/ L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Potassium	mg/ L	1.5	3.7	2.4	2.4	10.0	<0.10
Selenium	mg/ L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Silicon	mg/ L	6.3	13	16	16	5.3	2.3
Silver	mg/ L	<0.012	<0.012	<0.001	<0.001	<0.012	<0.001
Sodium	mg/ L	4.9	8.3	9.9	9.8	29	1.5
Non-metals							
Alkalinity, Bicarbonate	mg/ L	<5	24.6	190	187	101	<5
Alkalinity, Total as CaCO3	mg/ L	<2.2	24.6	190	187	101	<2.2
Carbon Dioxide	mg/ L	**	85.4	21.3	21	20	<5
Biologic Oxygen Demand	mg/ L	<2	<3	<3	<3	<2	<2
Chemical Oxygen Demand	mg/ L	21	24	26	28	26	<10
Chloride (Titrimetric, Mercuric Nitrate)	mg/ L	4	10	10	12	2	<1
Color, True	color units	5	10	5	5	<5	<5
Enterococci	MPN/100ml	<1	410.6	2	<1	387.3	<1

Parameter	Units	OW 752A Surficial Aquifer	OW 319A Surficial Aquifer	OW 319B Upper Chesapeake Unit	OW 319B Duplicate Upper Chesapeake Unit	CCNPP Well No. 5 Aquia Aquifer	Rinse Blank
Total Coliform	MPN/100ml	<1	17.1	<1	<1	1,299.70	<1
Fecal Coliform	MPN/100ml	<1	<1	<1	<1	<1	<1
Hardness, Total	mg/L	29	190	300	300	120	9
Nitrogen, Ammonia	mg/L	<1	<1	<1	<1	<1	<1
Nitrogen, Organic	mg/L	<1	<1	<1	<1	<1	<1
Nitrogen, Total Kjeldahl	mg/L	<1	<1	<1	<1	<1	<1
Nitrogen, Nitrite	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrogen, Nitrate	mg/L	<0.050	2.9	<0.050	<0.050	<0.050	<0.050
Odor, Threshold	TON	<1	16	8	16	<1	<1
pH*	SU	3.93	5.76	7.25	7.25	7.01	7.4
Phosphorus, Ortho	mg/L	<0.010	<0.010	<0.010	<0.010	0.010	<0.010
Phosphorus, Total	mg/L	0.031	0.064	0.081	0.034	0.041	<0.010
Total Dissolved Solids (TDS)	mg/L	92	110	230	310	210	<10
Total Suspended Solids (TSS)	mg/L	21	210	50	43	12	<2
Sulfate	mg/L	22	20	20	22	7.5	<1
Temperature	ºF (ºC)	65.2 (18.4)	69.3 (20.7)	63.2 (17.3)	63.2 (17.3)	68.0 (20.0)	69.1 (20.6)
Turbidity	NTU	7	60	49	37	4.1	<0.10

Notes:
SU = Standard Units (pH)
mg/L = Milligrams per liter
TON = Threshold odor number
MPN = Most probable number per 100
NTU = Nephelometric turbidity unit
* = Field Measurement
** = Carbon Dioxide could not be determined due to nondetected alkalinity and low pH

4.5 AMBIENT AIR QUALITY

4.5.1 Federal and State Standards

The federal Clean Air Act, which was comprehensively amended in 1990, requires the U.S. EPA to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The Clean Air Act established two types of national air quality standards:

- Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly.

- Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

The pollutants for which EPA has established NAAQS are called "criteria" pollutants. Table 4.5-1 lists the criteria pollutants and the NAAQS values. Units of measure for the standards are parts per million (ppm), milligrams per cubic meter of air (mg/m^3), and micrograms per cubic meter of air ($\mu g/m^3$). These ambient standards have been adopted by Maryland (COMAR 26.11.04.04). In addition, Maryland has a state ambient air quality standard (SAAQS) for fluorides (COMAR 26.11.04.01).

Table 4.5-1 National Primary and Secondary Ambient Air Quality Standards

Pollutant	Standard Value
Carbon Monoxide (CO) 8-hour Average 1-hour Average (both only primary standards)	 9 ppm (10 mg/m^3) 35 ppm (40 mg/m^3)
Lead (Pb) Quarterly Average	 1.5 $\mu g/m^3$
Nitrogen Dioxide (NO_2) Annual Arithmetic Mean	 0.053 ppm (100 $\mu g/m^3$)
Ozone (O_3) 8-hour Average	 0.08 ppm (157 $\mu g/m^3$)
Particulate Matter (PM-10) Annual Arithmetic Mean 24-hour Average (Maryland State standard only)	 50 $\mu g/m^3$ 150 $\mu g/m^3$
Particulate Matter (PM-2.5) Annual Arithmetic Mean 24-hour Average	 15 $\mu g/m^3$ 35 $\mu g/m^3$
Sulfur Dioxide (SO_2) Annual Arithmetic Mean 24-hour Average 3 hour maximum (secondary standard only)	 0.03 ppm (80 $\mu g/m^3$) 0.14 ppm (365 $\mu g/m^3$) 0.05 ppm (1300 $\mu g/m^3$)

MDE monitors air quality with a State-wide network of instruments that routinely measure the concentrations of pollutants such as ozone and fine particles. These monitors, which are located primarily in areas of high population density (as well as areas downwind of the urban core and major sources of emissions) where maximum concentrations are expected. Data from these monitors are used to determine whether air quality standards are being met.

4.5.2 2004-2006 Air Quality Monitoring Data

MDE does not monitor ambient air quality in the immediate vicinity of the CCNPP site because the area is not densely populated and exceedances of the NAAQS are not expected to occur. The EPA's modeling guidance states that if there are no monitors located in the vicinity of a source, a "regional site" may be used to determine background concentrations in an area. A "regional site" is one that is located away from the area of interest but is impacted by similar natural and distant man-made sources. Ambient air quality monitoring data from the MDE monitor nearest the CCNPP site for 2004-2006 are summarized in Table 4.5-2. Except for ozone, monitored values are well below the NAAQS and no exceedances of any other NAAQS has been measured.

Table 4.5-2 2004-2006 MDE Ambient Air Quality Data

Pollutant	MDE Monitor Closest to CCNPP	Parameter	Values for 2004-2006
CO	Old Town Baltimore City (72 miles)	1-hr max concentration 8-hr max concentration # of 1-hr NAAQS exceedances # of 8-hr NAAQS exceedances	9.3 ppm 4.0 ppm 0 0
Pb	MDE has not monitored lead in recent years because ambient concentrations measured in the 1980s were much lower than the NAAQS	Not applicable	Not applicable
NO2	Beltsville Prince George's County (59 miles)	Annual concentration # of annual NAAQS exceedances	0.011ppm 0
Ozone	Barstow Calvert County (14 miles)	8-hr max concentration # of days exceeding 8-hr NAAQS	0.092 ppm 5
PM-10	Glen Burnie Anne Arundel (62 miles)	24-hr max concentration Annual mean concentration # of 24-hr NAAQS Exceedances # of annual NAAQS exceedances	53 µg/m^3 21 µg/m^3 0 0
PM2.5	Upper Marlboro Prince George's County (37 miles)	24-hr max concentration Annual mean concentration # of 24-hr NAAQS exceedances # of annual NAAQS exceedances	44 µg/m^3 14 µg/m^3 0 0

Pollutant	MDE Monitor Closest to CCNPP	Parameter	Values for 2004-2006
SO2	Essex Baltimore County (78 miles)	3-hr max concentration 24-hr max concentration Annual mean concentration # of 3-hr NAAQS exceedances # of 24-hr NAAQS exceedances # of annual NAAQS exceedances	0.092 ppm 0.021 ppm 0.005 ppm 0 0 0

4.5.3 Attainment Status

Areas either attain the air quality standards or are characterized as nonattainment for failing to meet the NAAQS. Specifically, nonattainment areas are geographic areas in which the ambient concentration of a criteria air pollutant is higher than the NAAQS for that pollutant or the area is regulated as if it were nonattainment because of its location in a designated transport region for a criteria pollutant or precursor.

Calvert County is part of the Southern Maryland Intrastate Air Quality Control Region (AQCR), as designated in 40 CFR 81.156. For ozone, Calvert County is part of the metropolitan Washington DC-MD-VA region. The attainment status of Calvert County with regard to the NAAQS as listed in 40 CFR81.321 is as follows:

Pollutant	Attainment Status
Carbon Monoxide	Unclassifiable/attainment
Lead	Attainment
Nitrogen Dioxide	Cannot be classified or better than national standards
Ozone (8-hour)	Nonattainment Subpart2/Moderate
Particulate Matter (PM-2.5)	Unclassifiable/attainment
Particulate Matter (PM-10)	Attainment
Sulfur Dioxide	Attainment

EPA designated the Washington region, including Calvert County, as moderate nonattainment for the 8-hour ozone standard in April 2004. The region has a deadline of June 15, 2010, to meet the 8-hour ozone standard. In addition to Calvert County, the ozone nonattainment area includes: Montgomery, Prince George's, Frederick, and Charles Counties in Maryland; Fairfax County, Arlington County, City of Alexandria, City of Falls Church, City of Fairfax, Prince William County, Loudoun County, City of Manassas, and City of Manassas Park in Virginia; and the District of Columbia.

MDE's research has shown that transported pollution, that is, air pollution blowing in from other states, is a significant factor contributing to Maryland's ozone nonattainment. Such transported pollutants contribute up to 70 percent of pollutant levels in Maryland during air quality episodes. At times, transported pollution arriving in Maryland outweighs local emissions as the dominant contributor to Maryland's continued nonattainment status for ozone. On other occasions, depending on the weather, both transport and "home grown" pollution are equally important in Maryland's worst air pollution days.

For areas designated as nonattainment, the EPA requires a plan describing how emissions will be reduced to attain and maintain the NAAQS. The EPA-required plan, called a State Implementation Plan (SIP), for the Washington region (including Calvert County) presents air quality data showing measures planned to achieve attainment of the federal standard for ozone by the fall of 2009. The plan includes a list of measures to reduce pollution from ozone-forming gases, including substantial reductions of the ozone precursor, nitrogen oxides, resulting from the recently enacted Maryland Healthy Air Act. In addition to these federal and state measures, local governments and agencies in the region are encouraging wind energy and low emissions vehicles, and are building upon their energy efficiency programs.

4.6 ECOLOGY

4.6.1 Terrestrial Ecology

The terrestrial ecology of the CCNPP site, including the CCNPP Unit 3 construction area, was characterized in a series of field studies conducted over a one year period extending from May 2006 to April 2007. The field studies include a flora survey, a faunal survey, a rare tiger beetle survey, a rare plant survey, and a wetlands delineation report. The subsections below summarize relevant information from each of these studies and provide other data on existing terrestrial ecology.

4.6.1.1 Terrestrial Habitats

The flora survey covers each plant community type (terrestrial habitat type) observed on the CCNPP site in 2006 and 2007. A map of the plant community types is presented in Figure 4.6-1, and each plant community type is briefly discussed below.

- Lawns and Developed Areas (Gray in Figure 4.6-1) - Lawns and developed areas occur over a broad area in the east-central part of the CCNPP site (surrounding the two existing CCNPP reactor units) and in Camp Conoy. Camp Conoy includes several athletic fields and other lawn areas surrounding recreational facilities. Other than scattered trees and shrubs planted as ornamental landscaping, the lawns on the CCNPP site consist only of a groundcover stratum. Most of the lawns consist of cool season grasses (grasses that typically seed during spring and fall) such as tall fescue *(Festuca arundinacea)*, bluegrass *(Poa pratensis)*, large crabgrass *(Digitaria sanguinalis)*, and Bermuda grass *(Cynodon dactylon)*. Common broadleaf weeds typical of lawns are also present, such as white clover *(Trifolium repens)*, broadleaf plantain *(Plantago major)*, dandelion *(Taraxicum officinale)*, and yellow hawkweed *(Hieracium pretense)*.

- Old Field (Yellow and Light Brown in Figure 4.6-1) - The largest area of old field vegetation in the CCNPP site is on the dredge spoils deposited since the early 1970s on lands extending west from CCNPP Units 1 and 2 (Yellow in Figure 4.6-1). The dredge spoils are covered by a dense stand of phragmites (*Phragmites australis*). Phragmites is a perennial grass that can grow to more than 10 ft (3 m) tall and typically infests brackish and fresh tidal and nontidal marshes. Its presence on the dredge spoil piles is likely a result of propagules (seeds and rhizome fragments) carried with dredge spoils excavated from the shoreline. Other plants typical of old fields, such as common blackberry (*Rubus allegheniensis*) and tall fescue (*Festuca arundinacea*), are also present on the dredge spoils but are not as prevalent as phragmites. Old field vegetation is also located in some small fields in the northwestern part of the CCNPP Unit 3 construction area, in scattered forest clearings around the perimeter of the dredge spoils, and in other developed areas on the CCNPP site, as well as along roadsides (Light Brown in Figure 4.6-1). Many such areas were disturbed during construction of CCNPP Units 1 and 2 and various support facilities, such as the Independent Spent Fuel Storage Installation (ISFSI). Vegetation in these areas is dominated by tall fescue, sericea lespedeza *(Lespedeza cuneata)*, common blackberry, Canada goldenrod *(Solidago canadensis)*, and asters *(Aster sp.)*.

- Mixed Deciduous Forest (Light Green in Figure 4.6-1) - Most forested uplands on the CCNPP site, as well as the southern and western parts of the CCNPP Unit 3 construction area, support deciduous forest dominated by tulip poplar *(Liriodendron tulifera*), chestnut oak *(Quercus prinus)*; white oak *(Quercus alba)*; black oak *(Quercus velutina)*, southern red oak *(Quercus falcata)*, and scarlet oak (*Quercus coccinia)*; American beech (*Fagus grandifolia);* and Virginia pine *(Pinus virginiana)*. Other canopy trees include hickories such as pignut hickory *(Carya glabra)* and bitternut hickory (*Carya cordiformis)*, red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua)*, swamp chestnut oak *(Quercus michauxii)*, and black gum (*Nyssa sylvatica*). The forest understory consists of dense patches of mountain laurel *(Kalmia latifolia)*, pawpaw (*Asimina trilobata*), and American holly *(Ilex opaca)*, with scattered but frequent saplings of canopy species. Ground cover is sparse except where recently fallen trees have left gaps in the tree canopy. Scattered patches of the following species are present in the groundcover: partridgeberry *(Mitchella repens)*, Christmas fern *(Polystichum acrostichoides)*, common violet *(Viola papilionacea*), and large whorled pogonia *(Isotria verticillata)*.

- Mixed Deciduous Regeneration Forest (Dark Green in Figure 4.6-1) - Several areas of relatively level highlands that formerly supported mixed deciduous forest have been subjected to timber harvest activities within the past 20 years. These areas presently support dense thickets of deciduous trees and Virginia pines. The deciduous trees consist of tulip poplar, oaks, sweet gum, and red maple. Virginia pine is generally more frequent in the regenerating forest than in adjoining areas of mature mixed deciduous forest. The regenerating forest lacks a distinct understory but does contain scattered mountain laurel and American holly. Little groundcover is present other than along fire roads or in other small openings.

- Well-Drained Bottomland Deciduous Forest (Light Red in Figure 4.6-1) - Areas of well-drained soils in lowlands adjoining Johns Creek, Goldstein Branch, their headwaters, and other streams on the CCNPP site support bottomland deciduous forest dominated by tulip poplar, American beech, sweet gum, black gum, and red maple. This vegetation represents an ecotone (transition) between the mixed deciduous forest on the adjoining upland slopes and the bottomland hardwood forest in wetter areas closer to the stream channel. The understory is generally sparse, although some mountain laurel and American holly are present. While groundcover is generally sparse, dense patches of New York fern *(Thelypteris noveboracensis*) are frequent. (Note: Bottomland deciduous forest outside of the area addressed by the wetland delineation is mapped as a single unit (purple) rather than separated into well-drained and poorly-drained components.)

- Poorly Drained Bottomland Deciduous Forest (Dark Red in Figure 4.6-1) - Areas of poorly-drained, seasonally saturated soils in lowlands adjoining Johns Creek, Goldstein Branch, their headwaters, and other streams on the CCNPP site support bottomland hardwood forest dominated by red maple, sweet gum, and black gum. The shrub layer is generally sparse. The groundcover is generally dense, dominated by ferns such as New York fern, sensitive fern *(Onoclea sensibilis*), and royal fern (*Osmunda regalis*); sedges and rushes such as tussock sedge *(Carex stricta)*, eastern bur-reed (*Sparangium americanum*), and soft rush (*Juncus effusus)*; and forbs such as lizard tail (*Saururus cernuus*) and skunk cabbage (*Symplocarpus foetidus*). (Note: Bottomland deciduous forest outside of the area addressed by the wetland delineation is mapped as a single unit (purple) rather than separated into well-drained and poorly drained components.)

- Herbaceous Marsh Vegetation (Light Blue in Figure 4.6-1) - Herbaceous marsh vegetation occurs throughout much of the broad bottomland areas adjoining Johns Creek in the western part of the CCNPP site as well as in localized gaps in the forest cover in the narrower bottomlands adjoining the headwaters of Johns Creek, Goldstein Branch, and other streams. It is dominated in many places by invasive phragmites. Other areas are dominated by sedges, rushes, and bulrushes; lizard tail, which forms localized dense patches; and various other wetland forbs such as dotted smartweed *(Polygonum punctatum*), Pennsylvania smartweed (*Polygonum pensylvanicum)*, jewelweed (*Impatiens capensis)*, and halberd-leaved tearthumb (*Polygonum arifolium)*. These areas include a marshy fringe surrounding the shore of Camp Conoy fishing pond, two smaller impoundments on the stream carrying the outflow from the fishing pond to the Chesapeake Bay, a constructed wetland in the northwestern part of the CCNPP site, and a marshy fringe surrounding a stormwater detention pond west of a dock on the Chesapeake Bay.

- Successional Hardwood Forest (Dark Brown in Figure 4.6-1) - Small patches of forest on recently disturbed lands in the central part of the CCNPP site support forest cover dominated by fast-growing tree species that establish in sunny areas such as old fields. Dominant tree species include black locust *(Robinia pseudoacacia*), black cherry (*Prunus serotina),* and eastern red cedar (*Juniperus virginiania*). The understory generally consists of the same shrub, vine, and herbaceous species described for old field vegetation. Most of the canopy trees are less than 10 in (25.4 cm) in diameter at breast height (DBH). The canopy trees cast only weak shade and allow dense undergrowth by old field species.

Most lands elsewhere on the CCNPP site support the habitats described above. Where the Chesapeake Bay shoreline has not been developed with the existing reactor units and barge dock, it consists of a narrow sandy beach at the base of steep, sandy cliffs. The beach is generally less than 20 ft (6 m) wide during normal low tides. There are no tidal marshes on the CCNPP site. However, small tidal marshes are present in the Flag Ponds Natural Area north of the CCNPP site and on the shoreline of tidal reaches of St. Leonard's Creek and its tributaries. Some forested areas close to the Chesapeake Bay or other tidal waters support forest dominated by loblolly pine (*Pinus taeda*), and some inland areas support forest dominated by Virginia pine. The latter consist primarily of recently abandoned farmlands or other lands recently disturbed and left to naturally regenerate.

4.6.1.2 Important Terrestrial Species and Habitats

Table 4.6-1 lists each species and habitat identified as important for the CCNPP site and surrounding area according to the criteria in U.S. NRC NUREG-1555. 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 and 50 CFR 17.12, by the U.S. FWS, 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 terrestrial ecosystems; or 5) species that could serve as biological indicators of effects on local terrestrial ecosystems. Floral and faunal surveys that document observations made on the CCNPP site between May 2006 through April 2007 are summarized herein.

Three plant communities occurring on the CCNPP site are identified as important habitats: herbaceous marsh vegetation, poorly drained bottomland deciduous forest, and well-drained bottomland deciduous forest and are shown in Figure 4.6-1. Herbaceous marsh vegetation and poorly-drained bottomland deciduous forest meet the definition of wetlands established in 33 CFR 328.3 for the Federal Clean Water

Act and COMAR 26.23.01.01(B)(62) for the Maryland Nontidal Wetland Protection Act. The exact boundaries of wetlands in the CCNPP site area were delineated between May 2006 and September 2006 using routine onsite procedures in the Corps of Engineers Wetlands Delineation Manual. The wetland boundaries were marked in the field using sequentially numbered flags. The coordinates for each flag were determined in the field as part of a land survey. Well-drained bottomland deciduous forest habitat in the CCNPP site area occurs in stream valley lands that are too well-drained to meet the regulatory definition of a wetland but still occur in floodplains.

Table 4.6-1 Important Terrestrial Species and Habitats

Name	Common Name	Description	Location	Rationale
Mammals				
Odocoileus virginianus	White-tail Deer	Large, herbivorous mammal. Favors forest edge habitat. Game species.	Observed frequently in all habitats in the CCNPP site area. Likely to be abundant elsewhere on the CCNPP site and surrounding landscape.	Recreationally valuable species
Birds				
Piranga olivacea	Scarlet Tanager	Neotropical migratory bird that breeds in North America in late spring and early summer and winters in Central and South America in fall and winter. Favors large tracts of forest, especially forest with lots of dead or declining trees, for breeding territory.	Heard frequently throughout forested areas on the CCNPP site. Likely common in other forested areas in surrounding landscape.	FID bird
Haliaeetus leucocephalus	Bald Eagle	Large, piscivorous (fish-eating) bird.	Four nests are known to exist on the CCNPP site, three of which were active during the 2007 breeding season. Observed flying along cliffs east of the CCNPP site.	Federal Threatened Maryland Threatened
Insects				
Cicindela dorsalis dorsalis	Northeastern Beach Tiger Beetle	Small beetle inhabiting sandy beaches.	Cliffs and beaches (primarily beaches) on Chesapeake Bay (eastern edge of the CCNPP site and north of CCNPP Units 1 and 2).	Federal Threatened Maryland Endangered

Name	Common Name	Description	Location	Rationale
Cicindela puritana	Puritan Tiger Beetle	Small beetle inhabiting sandy shores on fresh and brackish waters. Limited to shorelines of Connecticut River in Connecticut and Chesapeake Bay in Maryland. Feeds on other insects (i.e., insectivorous). Spends approximately 23 months of roughly 2 year life cycle in shallow underground tunnels in sand.	Cliffs and beaches on Chesapeake Bay (eastern edge of the CCNPP site).	Federal Threatened Maryland Endangered
Plants				
Centrosema virginianum	Spurred Butterfly Pea	Perennial forb.	Maryland Natural Heritage Program has record of occurrence on the CCNPP site southwest of the CCNPP Unit 3 construction area. Observed in August 2006 in Johns Creek floodplain.	Maryland Rare
Kalmia latifolia	Mountain Laurel	Evergreen woody shrub.	Forms dense stands in the understory of many upland forested areas throughout the CCNPP Unit 3 construction area, the CCNPP site, and surrounding landscape.	Ecosystem Critical, Biological Indicator
Liriodendron tulipifera	Tulip Poplar	Deciduous tree.	Dominant tree in most upland forest areas in the CCNPP Unit 3 construction area, the CCNPP site, and surrounding landscape.	Ecosystem Critical, Biological Indicator
Quercus prinus	Chestnut Oak	Deciduous tree.	Dominant tree in most sloping and dry upland forest sites in the CCNPP Unit 3 construction area, the CCNPP site, and surrounding landscape.	Ecosystem Critical, Biological Indicator
Quercus shumardii	Shumard's Oak	Deciduous tree.	Possible occurrence in Johns Creek floodplain.	Maryland Threatened

Name	Common Name	Description	Location	Rationale
Solidago speciosa	Showy Goldenrod	Perennial forb with showy yellow flowerheads consisting of hundreds of small yellow flowers.	Several locations on forest edges in Camp Conoy.	Maryland Threatened
Thelypteris noveboracensis	New York Fern	Perennial fern.	Forms dense groundcover in large patches in Mesic Deciduous Forest and Bottomland Deciduous Forest.	Ecosystem Critical, Biological Indicator
Habitats				
Herbaceous Marsh Vegetation		Dominated by sedges, rushes, bulrushes, and grasses and forbs typical of poorly drained soils.	Fringes of Camp Conoy fishing pond and other ponds; floodplain areas on the CCNPP Unit 3 construction area and elsewhere on the CCNPP site that lack tree canopy.	Wetland Floodplain
Poorly Drained Bottomland Deciduous Forest		Dominated by red maple, sweet gum, and black gum with understory of ferns.	Primarily in bottoms of stream valleys.	Wetland Floodplain
Well-Drained Bottomland Deciduous Forest		Dominated by tulip poplar, American beech, sweet gum, black gum, and red maple.	Primarily in bottoms of stream valleys.	Wetland Floodplain
Flag Ponds Nature Park		327 acres (132 hectares) park comprising a matrix of sandy beach, tidal marsh, freshwater marsh, freshwater pond, and forest habitats.	Directly north of the CCNPP site.	County-Owned Preserve
Calvert Cliffs State Park		3,030 acres (1,226 hectares) forested park containing same upland and wetland habitats as natural areas on CCNPP site area. 1079 acres (436.7 hectares) are designated as wildland area and 550 acres (222.6 hectares) are designated as public hunting area.	Directly south of the CCNPP Unit 3 construction area.	State-Owned Preserve

Two areas outside of but close to the CCNPP site are also identified as important habitats. The first is the Flag Ponds Natural Area, situated immediately north of the CCNPP site. The second is Calvert Cliffs State Park, situated immediately south of the CCNPP site.

4.6.1.3 Habitat Importance

- White-tail Deer - White-tail deer are habitat generalists but tend to favor areas at the edge of forests. Because of the ability of the white-tail deer to adapt to a variety of habitats, their populations are not generally sensitive to localized habitat changes.

- Bald Eagle - Bald eagles tend to return and reuse nests from previous years. Any construction close to the active bald eagles nests on the CCNPP site could discourage use of those nests in the future. Trees on top of the cliffs above the Chesapeake Bay along the eastern edge of the CCNPP site provide some of the best bald eagle habitat in Calvert County. Local populations of bald eagle would be sensitive to loss or degradation of forested habitats adjoining the cliffs.

- Scarlet Tanager (and other Forest Interior Birds) - Recent aerial photographs of southern Calvert County suggest that the forested areas in the northern, southern and southwestern parts of the CCNPP site, including areas within the Unit 3 construction area draining to Johns Creek, provide some of the largest remaining blocks of unfragmented forest habitat in the region. Most areas of Calvert County outside of the CCNPP site and adjoining state parks (Calvert Cliffs State Park and Flag Ponds Natural Area) have experienced fragmentation caused by agricultural land uses, road construction, and construction of rural residences and small residential subdivisions. Therefore, the forested areas on the CCNPP site, including those close to Johns Creek in the CCNPP Unit 3 construction area, are likely valuable in sustaining localized populations of the scarlet tanager and other forest interior birds.

- Puritan and Northeastern Beach Tiger Beetles - The undeveloped cliffs and beaches on the CCNPP site provide some of the best remaining habitat, both locally and nationally, for these two insect species with very specific habitat requirements.

- Plants - None of the plant species identified as important are highly dependent on the CCNPP Unit 3 construction area or CCNPP site for their survival. Loss of suitable habitats in the CCNPP Unit 3 construction area would cumulatively contribute to the risk for population declines for each species but not likely result in immediate declines in regional populations.

4.6.1.4 Disease Vector and Pest Species

A disease vector is an organism (commonly an insect) that carries disease agents (commonly bacteria or fungi) to a receptor host, which can be human, domestic or wild animals, or crops or wild plants. The only disease vector known to occur on the CCNPP site is the deer tick (*Ixodes scapularis*), which transmits Lyme Disease to humans. Lyme Disease is a non-fatal but debilitating disease whose victims can display fever and severe joint pain. The causal agent is a bacterium, *Borrelia burgdorferi*, which is transmitted by the deer tick from white-tail deer, squirrels, rodents, and other mammalian wildlife to humans.

No pest species are known to be widespread over the CCNPP site and surrounding areas. However, two non-native invasive plant species were found to be prevalent at several locations on the CCNPP site in

2006. The most widespread is phragmites, which forms dense stands over large areas of wetlands and dredge spoils in the CCNPP site. Phragmites is a perennial grass species with hollow culms (stems) that can grow to more than 10 ft (3 m) in height. Flowers develop by mid summer and are arranged in tawny spikelets with tufts of silky hair. Flowering and seed set occur between July and September. Germination occurs in spring on exposed moist soils. Vegetative spread by below-ground rhizomes (roots) can result in dense patches with up to 20 stems per square foot (200 stems per square meter). Phragmites is capable of vigorous vegetative reproduction and often forms dense, nearly monospecific stands. Although some phragmites stands are of genotypes native to North America, most large stands of phragmites in North America today are considered to be of non-native genotypes.

Another non-native invasive plant species, Japanese stiltgrass (*Microstegium vimineum*), forms scattered patches in the groundcover of some forested areas in the CCNPP site. It occurs mostly in areas with a history of soil disturbance, such as along the sides of roadways and trails. Where it occurs, it has likely precluded the development of other more ecologically valuable groundcover.

4.6.1.5 Wildlife Travel Corridors

Wildlife tends to move across landscapes using distinct corridors of favorable habitat. Movement of most forest wildlife across fragmented agricultural and suburban landscapes is enhanced by linear corridors of forest that can consist of forested hedgerows, forested stream valleys, or forested ridge tops. The minimum width for a forest corridor to benefit wildlife is not known but may vary among wildlife species depending on body size. Wildlife movement is also enhanced by strings of closely spaced patches of favorable habitat that form “stepping stones” across areas of unfavorable habitat. For forest wildlife, such stepping stones can consist of woodlots in agricultural landscapes or parks and other undeveloped forest tracts in suburban landscapes.

The landscape of southern Calvert County consists predominantly of forest land broken by small agricultural fields, small developed areas referred to as “town centers,” rural residences on lots of one to a few acres, and small subdivisions of single-family houses on small lots. The landscape is crossed by a network of forested stream valleys that consist of forested floodplains adjoined by steep forested slopes. These stream valleys form corridors that facilitate the movement of forest wildlife around farm fields and developed areas.

The central part of the CCNPP site consists mostly of open land surrounding the existing reactors. The remainder of the CCNPP site, the Calvert Cliffs State Park to the south, and the Flag Ponds Natural Area to the north include large blocks of forest land. The forested stream valley surrounding Goldstein Branch and its tributaries along the western perimeter of the project site form a corridor that may facilitate the north-south movement of wildlife. The forested stream valley surrounding Johns Creek and its tributaries may facilitate east-west movement.

4.6.1.6 Existing Natural and Human-Induced Ecological Effects

While most of the CCNPP site area north and south of the CCNPP Unit 3 construction area consists of contiguous forest cover, forest cover in the central part of the CCNPP site, including the north-central and northwestern parts of the CCNP Unit 3 construction area, has been fragmented by development of facilities serving the existing reactors, by dredge material disposal, and by development of recreational facilities at Camp Conoy. This fragmentation has reduced the habitat value of some forested areas in the northern part of the CCNPP Unit 3 construction area and adjoining Camp Conoy for wildlife such as the forest interior bird species that require large blocks of forest to successfully live and nest. However, the observation of several forest interior dwelling bird (FID) species in forest lands south of Camp Conoy and along Johns Creek indicates that forest cover in those areas have not become substantially fragmented.

Several areas of mixed deciduous forest on uplands west of Camp Conoy Road were clear cut for timber within the last 20 years but presently support dense stands of regenerated deciduous tree saplings. Some of the former clear cuts are on slopes near Johns Creek where forest interior bird species were observed in 2006. Although the clear cuts may have temporarily reduced habitat quality for forest interior bird species, the effects seem to have diminished with regeneration of tree cover. However, large canopy trees over 12 in (30 cm) DBH are limited to areas not recently clear cut, mostly on steep slopes and lands east of Camp Conoy Road. Prescribed burns are not conducted to manage vegetation anywhere on the CCNPP site, and there have not been any substantial wildfires in the past several decades.

Several upland areas in the northern part of the CCNPP Unit 3 construction area were used for farming until recently. These areas presently support old field vegetation. No areas on the CCNPP site are presently used for farming or grazing, although several large areas around the existing reactors, along paved roads, and in Camp Conoy are kept regularly mowed. Areas under several electric transmission lines in the CCNPP Unit 3 construction area and elsewhere on the CCNPP site are periodically mowed and treated with herbicides to prevent regeneration of trees under the conductors.

There is no evidence that the CCNPP Unit 3 construction area has been subjected to substantial recent environmental stresses such as insect or disease outbreaks or storm damage. Occasional fallen canopy trees were observed throughout forested areas of the CCNPP Unit 3 construction area, especially on the slopes adjoining Johns Creek and its headwaters. These trees may have been felled by the winds from Hurricane Isabel, which passed through Calvert County on September 19, 2005. Large areas of oak-dominated forests in central Maryland experienced multiple rounds of defoliation by gypsy moths in the late 1980s. However, large numbers of dead trees, as might have resulted from a localized gypsy moth (*Lymantria dispar*) outbreak. were not observed anywhere within the CCNPP Unit 3 construction area during the 2006 floral survey.

4.6.1.7 Regulatory Consultation

The Maryland Natural Heritage Program, operated by the DNR, was consulted for information on known occurrences of Federally-listed and State-listed threatened, endangered, or special status species and critical habitats. The U.S. FWS was also contacted regarding Federally-listed species and critical habitats. Copies of responses from both agencies are in Appendix A. Identification of the important species discussed above was based in part on information provided by that consultation.

4.6.2 Aquatic Ecology

4.6.2.1 Aquatic Habitats

4.6.2.1.1 Freshwater Bodies Onsite

Freshwater bodies at the CCNPP site were described in Section 4.4. In addition, a separate wetlands delineation study was conducted. It describes the area as a steeply rolling landscape dissected by a dendritic pattern of stream valleys with narrow floodplains adjoined by steep side slopes whose grade exceeds 25% in places. Large areas in the north-central part of the site have been graded to accommodate existing facilities and the dredge spoil disposal area. The eastern part of the site, including most lands east of Camp Conoy Road, drains directly into the Chesapeake Bay. Drainage enters a series of unnamed intermittent and first-order perennial streams that flow generally eastward. The streams become increasingly incised as they approach the cliffs and discharge across the narrow beach into the Bay. All stream reaches on the site are nontidal; the cliffs prevent tidal influence from extending west of the beach.

The western part of the site, west of Camp Conoy Road, drains toward the Patuxent River. Lands west of Camp Conoy Road drain into intermittent headwaters of Johns Creek, which flows west under MD 2/4 and ultimately to the Patuxent River. Most lands in the northwestern part of the CCNPP site flow into the headwaters of the Goldstein Branch. Goldstein Branch flows south, close to the western CCNPP site perimeter, entering Johns Creek just east of Maryland Route 2/4. A small area in the northern part of the CCNPP Unit 3 site drains to the north and east into small streams that flow to the Chesapeake Bay south of CCNPP Units 1 and 2; these are shown as Branch 1 and Branch 2 on Figure 4.4-2. The dredge spoil disposal area drains to the man-made Lake Davies, which discharges into a tributary to Goldstein Branch as well as through wetlands to Johns Creek. Three other ponds, Camp Conoy fishing pond, Pond 1, and Pond 2, retain surface water onsite before discharging to Chesapeake Bay.

Surveys of the benthic macroinvertebrates and fish inhabiting selected onsite streams and ponds were conducted during September 2006 and March 2007. Benthic invertebrates were collected using techniques developed for low gradient, nontidal streams. Fish sampling followed the guidance provided in the Maryland Biological Stream Survey Sampling Manual. At each sampling station, standard water quality field measurements were made, and water samples were collected for laboratory analysis of nutrients and other physico-chemical parameters. At the same time, habitat quality was assessed using the survey sampling guidance. The results of the biological survey are presented in Tables 4.6-2, 4.6-3, and 4.6-4 and are summarized for each water body in the following sections.

- <u>Johns Creek</u>: Two locations in Johns Creek were sampled: one upstream and one downstream of a reach without a defined stream channel that has filled in with the invasive reed, Phragmites. Water quality at both locations indicated a healthy stream; however, the downstream station reflects discharge from Lake Davies, where dredge spoils from previous dredging have been deposited. Benthic invertebrate and fish assemblages at the downstream location were excellent, and the overall habitat assessment produced an optimal score. The upstream location, however, supported only one species of fish, the eastern mudminnow (*Umbra pygmaea*), during the fall and two species (mudminnow and the least brook lamprey, *Lamptera aepyptera*) during spring. Lack of species richness and diversity at this station may be due to the headwater nature, where species numbers are typically limited as well as to the fact that the stream channel immediately downstream is undefined and may be dry or nearly dry during some parts of the year.

  Differences in the benthic community of the two reaches were also apparent. The upstream location was numerically dominated by oligochaetes and chironomids; the downstream location by amphipods during the fall and amphipods and ostracods during the spring. Both locations supported at least two of the three groups of aquatic insects that are considered indicators of nondegraded streams (*Ephemeroptera*, *Plecoptera*, and *Trichoptera*). Although both locations scored in the "optimal" category on the habitat assessment, the upstream location had a lower overall score, as expected. The difference in the overall scores of the two reaches is attributable to lack of substrate, cover, and pool variability at the upstream location. Johns Creek downstream station had the highest score of all locations sampled during both fall and spring.

- Goldstein Branch: One location in Goldstein Branch, upstream from its confluence with Johns Creek, was sampled. This location had similar dissolved oxygen and pH, but higher conductivity, alkalinity, and total dissolved solids (TDS), compared with Johns Creek. Species richness of the fish community was similar to Johns Creek, but abundance was lower. Benthic invertebrate abundance and species richness were lower than in Johns Creek during fall, but higher during spring. The reach supported all three groups of aquatic insects that are considered indicators of nondegraded streams (*Ephemeropter*, *Plecopter*, and *Trichoptera*). The overall habitat assessment produced an optimal score and was similar to the upstream location at Johns Creek. The drop in score between fall and spring was attributed to off-site construction activities.

Table 4.6-2 Survey Results for Johns Creek (Fall 2006)

Parameter	Upstream (JCUS-01)**	Downstream (JCDS-01)**
Total Number of Individual Invertebrates	1,628/591	1,414/247
Total Number of Invertebrate Taxa	29/23	33/32
Total Number of Individual Fish	4/15	105/98
Total Number of Fish Species	1/2	8/8
Overall Habitat Quality *	147/147	167/163

Notes: * Any value greater than 139 is considered optimal.
** Sample points from biological survey

Table 4.6-3 Survey Results for Goldstein Branch (Fall 2006)

Parameter	GB-01**
Total Number of Individual Invertebrates	1,238/845
Total Number of Invertebrate Taxa	24/34
Total Number of Individual Fish	65/107
Total Number of Fish Species	7/8
Overall Habitat Quality *	149/144

Notes: * Any value greater than 139 is considered optimal.
** Sample points from biological survey

Table 4.6-4 Dip Net Survey Results for Lakes and Ponds (Fall 2006)

Parameter	Lake Davies	Pond 1	Pond 2	Camp Conoy fishing pond
Total Number of Individual Invertebrates	10,719/21,544	2,972/4,181	1,817/785	4,157/4,217
Total Number of Invertebrate Taxa	17/23	20/17	21/18	52/50
Total Number of Individual Fish	81/0	56/35	8/32	213/86
Total Number of Fish Species	1/0	5/3	4/3	6/5

Note: Overall habitat quality values are only calculated for streams.

- Impoundments: Water quality in Camp Conoy fishing pond was representative of a healthy pond. Six species of fish were collected; the eastern mosquitofish (*Gambusia affinis*) and the bluegill (*Lepomis macrochirus*) were numerically dominant, which is typical of an impoundment of this nature and consistent with the fact that mosquitofish have been stocked in the past. The benthic invertebrate assemblage was more diverse than in the other three impoundments. Two of the three taxa of aquatic insects that are sensitive to degraded aquatic conditions, Ephemoptera, and Trichoptera, were present in Camp Conoy fishing pond; the stoneflies (*Plecoptera*) were absent from all impoundments at the site.

  Neither Lake Davies nor the ponds had adequate DO (greater than 5 ppm) to be considered a healthy habitat during fall, but DO was high and similar to the other sampling locations during the spring survey. In Lake Davies, the DO dropped as low as 2.2 ppm at the bottom and in Pond 2, DO was less than 1.0 ppm during the fall survey. Fish species in the ponds were the same as those collected in Camp Conoy fishing pond, except for the absence of the larger gamefish (white crappie (*Pomoxis annularis*) and largemouth bass (*Micropterus salmoides*)). Benthic invertebrate assemblages were dominated by chironomids in the two lakes, and by oligochaetes in the two ponds. Neither *Trichoptera* nor *Plecoptera* occurred in any samples from Lake Davies or the ponds, although *Ephemoptera* were present.

  No federal or state rare, threatened, or endangered aquatic species were reported during site surveys.

  The American eel (*Anguilla rostrata*) was collected from every water body sampled, except Lake Davies.

- Nontidal Wetlands: Nine assessment areas were described based on field surveys conducted in 2006 and early 2007. Wetland Assessment Areas are defined as contiguous wetland and aquatic areas with a high degree of hydrological interaction and biological similarity. Assessment Areas I, II, and III correspond to small unnamed watersheds that drain directly to the Chesapeake Bay (Assessment Area III flows out of the proposed project plant and construction area before reaching the Chesapeake Bay). Assessment Areas IV, V, and VI form the Johns Creek watershed (upstream of Goldstein Branch). Assessment Area IV constitutes the up-gradient headwaters to Johns Creek and their adjoining wetlands, while Assessment Area V constitutes the main channel and adjoining wetlands of Johns Creek. Assessment Area VI comprises a sequence of man-made basins carrying runoff from the Lake Davies dredged material disposal area to Johns Creek. Assessment Area VII constitutes the headwaters, main channel, and associated wetlands of Goldstein Branch. Assessment Area VIII consists of a small cluster of seepages and headwaters that flow north to ultimately contribute to Woodland Branch and St. Leonard Creek, which eventually drain into the Patuxent River. Assessment Area IX comprises a series of seepages and headwaters that drain into a storm drain system under the existing developed portion of the CCNPP site. Wetland functions and values for the nine assessment areas at the site are provided in Table 4.6-5.

The greatest overall functions and values are provided by Assessment Area V, which consists of the main channel of Johns Creek and its adjoining wetlands. Within the CCNPP site, Johns Creek remains largely free of human disturbance. It flows through a stream valley bounded throughout on both sides by mature deciduous forest cover free of agricultural or urban development. The channel is generally diffuse and poorly defined, spreading its flow through dense wetland vegetation that is more than 100 ft (30.5 m) wide at many locations. The vegetation is capable of attenuating flow velocity, filtering out dissolved nutrients or contaminants in the water and causing suspended sediment to settle out before flowing downstream to the tidal waters of St. Leonard's Creek.

Many of the same functions and values are provided by Assessment Area IV, which consists of the seepages, springs, and headwaters that flow into the upper end of Johns Creek. The reach of Johns Creek east of MD 2/4 constitutes one of the largest remaining systems of headwaters and streams whose watershed is still largely forested.

The Camp Conoy fishing pond (part of Assessment Area II) is not open to the public and has been used in the past by Constellation employees; recreation is therefore identified as a principal function for Assessment Area II.

Table 4.6-5 Summary of Functions and Values for Assessment Areas

Function or Value	Wetland Assessment Areas *								
	I	II	III	IV	V	VI	VII	VIII	IX
Functions									
Groundwater Recharge/Discharge	√	√	√	√	√		√	√	
Floodflow Alteration									
Fish and Shellfish Habitat		√			√		√		
Sediment/Toxicant Retention		√	√	√	√	√	√	√	
Nutrient Removal		√	√	√	√	√	√	√	
Production Export		√	√	√	√	√	√	√	
Sediment/Shoreline Stabilization		√			√	√			
Wildlife Habitat	√	√	√	√	√	√	√	√	√
Values									
Recreation		√	√	√	√		√	√	
Educational/Scientific Value			√	√	√			√	
Uniqueness/Heritage		√	√	√	√			√	
Visual Quality/Aesthetics		√						√	√

Legend:
√ (boxed) Function or Value Present
√ Function or Value Principal
Note: *As shown in the Wetlands Delineation Study

4.6.2.1.2 Chesapeake Bay

The Chesapeake Bay is fed by freshwater flows from a 64,000 square mile (166,000 km^2) drainage basin that touches parts of 6 states, as well as the District of Columbia. This freshwater is mixed in almost equal proportions with saline water from the Atlantic Ocean, forming the largest estuary in the United States. In addition to its role as a center of commerce and shipping, the Bay is home to dozens of species of wildlife and produces millions of pounds of seafood for domestic and international markets. In recent years, government, industry, and the public have focused efforts on reversing the processes that have led to a decline in the quality of the Bay for both wild species and the human population. Pollution, nutrient enrichment, and over-harvesting of estuarine species are among the key threats to the health of the Bay.

Both government and non-government reports on the status of the Chesapeake Bay reach the same conclusion: the overall health of the ecosystem remains degraded. Much of the extensive restoration effort expended during the last 20 years has merely kept the Chesapeake Bay from becoming even more severely impacted by the growing human population in the area.

The Chesapeake Bay Foundation assigned the Chesapeake Bay an overall score of 29 (out of a possible 100) based on measures of pollution, habitat, and fisheries. Despite the failing grade, the score was 2 points higher than in the last three years, indicating a slight improvement.

The CBP annual health assessment reached the following conclusions:

- Water Quality: Most of the Chesapeake Bay's waters are degraded. Each summer, a large expanse of its waters does not hold enough oxygen to support striped bass, crabs, and oysters. Algal blooms fed by nutrient pollution block sunlight from reaching the underwater bay grasses needed to support aquatic life. Sediment from urban development and agricultural lands is carried into the Chesapeake Bay, clouding its waters and covering critical oyster reef habitat. Currently, about one-third of the Chesapeake Bay water quality goals are being met.

- Habitats and Lower Food Web: The Chesapeake Bay's critical habitats and food webs are at risk. Nutrient and sediment runoff have harmed bay grasses and bottom habitat. Excessive algae growth has pushed the Chesapeake Bay food web out of balance. A large portion of the Chesapeake Bay's wetlands has been lost to development. Currently, the Chesapeake Bay's habitats and lower food web are at about one-third of desired levels.

- Benthic Organisms: In 2005, about 41% of the Chesapeake Bay's benthic habitat was considered healthy as measured by the composite Benthic Index of Biotic Integrity. This is likely due to persistent low dissolved oxygen levels during the summer. Reduced amounts of nutrients, sediment and chemical contaminants flowing into the Chesapeake Bay will help these bottom dwelling communities improve.

- Phytoplankton: Microscopic plants commonly called algae are an excellent indicator of the health of the Chesapeake Bay's surface waters, as they are especially sensitive to changes in nutrient pollution and water clarity. Phytoplankton form the base of the food web. While increased populations provide more food to organisms further up the food web, too much or the wrong type of algae can harm the overall health of the Chesapeake Bay. In some cases, harmful algal blooms can impact human health. Scientists assess microscopic algal community health with a Phytoplankton Index of Biotic Integrity. Data from Spring 2005 show that about 9% of the Chesapeake Bay's phytoplankton communities were considered healthy.

- Fish and Shellfish: Many of the Chesapeake Bay's fish and shellfish populations are below historic levels. The number of adult blue crabs is below the long term average for the seventh straight year and oyster populations are at or near historic lows. American shad are recovering slowly, while other species like striped bass show mixed signals. Current striped bass populations exceed restoration goals, but approximately 60% to 70% are infected by a disease called mycobacteriosis. Researchers are currently working to understand the extent and severity of the disease and the extent to which environmental conditions in the Chesapeake Bay influence it.

Important Estuarine Species

A list of estuarine species considered important in the project area was compiled based on the criteria of NRC NUREG-1555 and summarized in Table 4.6-6. 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 and 50 CFR 17.12, by the U.S. FWS, 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 terrestrial ecosystems; or 5) species that could serve as biological indicators of effects on local terrestrial ecosystems. A single species may meet more than one of the five criteria.

For this analysis, these criteria are further defined as:

- Species Under Special Protection: Threatened, Endangered, or Candidate Species: Any species that is known to occur or could occur in the Chesapeake Bay or near the CCNPP site that is afforded special protection under the federal Endangered Species Act, or under the equivalent State of Maryland law, is defined as an important species.

- Commercially Harvested Species: Finfish and shellfish that rely on habitat in the vicinity of the CCNPP site during any life stage, and are commercially harvested to a substantial degree, are considered important resources.

- Recreational Target Species: Finfish and shellfish that rely on habitat in the vicinity of the CCNPP site during any life stage, and are preferentially taken by recreational anglers or trappers to a substantial degree are considered important resources.

- Keystone Species: Any species that is essential to maintaining the structure and function of the estuarine ecosystem in the vicinity of the CCNPP site will be identified as important.

- Indicator Species: A species whose abundance, distribution, or condition is known or believed to be a reliable predictor of the status of another species of interest is considered an important species.

A sixth criterion was also evaluated - status as a potential nuisance to plant operation. However, no nuisance aquatic species is expected to occur in the vicinity of the Project Area.

In addition, information regarding additional estuarine and marine species were evaluated, e.g., Weakfish (*Cynoscion regalis*), Summer Flounder (*Paralicthys dentatus*), Spotfin Killifish (*Fundulus luciae*), and the Soft Shell Clam (*Mya arenaria*). These estuarine and marine species were determined not to be important species as defined above, because they do not meet any of the six criteria.

Table 4.6-6 Important Species in the Chesapeake Bay Near the CCNPP Site

Species (Scientific Name)	Commercially Harvested	Recreational Target	Keystone Species	Indicator Species
Threatened and Endangered Species				
Shortnose Sturgeon * *Acipenser brevirostrum*				
Atlantic Sturgeon *Acipenser oxyrhynchus*	X (Moratorium since 1997)			
Atlantic Loggerhead Turtle * *Caretta caretta*				
Kemps Ridley Turtle * *Lepidochelys kempii*				
Harvested Fish				
American Shad *Alosa sapidissima*	X			
Bay Anchovy *Anchoa mitchilli*	X		X	
Atlantic Menhaden *Brevoortia tyrannus*	X		X	X
Atlantic Croaker *Micropogonias undulatus*	X	X		
Striped Bass *Morone saxitilis*	X	X		
Spot *Leiostomus xanthurus*	X	X		
White Perch *Morone americana*	X	X		
Bluefish *Pomatomus saltatrix*	X	X		
American Eel *Anguilla rostrata*	X	X		
Harvested Invertebrates				
Blue Crab *Callinectes sapidus*	X	X		
American Oyster *Crassostrea virginica*	X			X
Other Important Resources				
Submerged Aquatic Vegetation (SAV)			X	X
Plankton			X	X

Note:
* Threatened and Endangered Species are not allowed to be taken in the Chesapeake Bay.

Each important species is described in the following subsections in terms of the following parameters, providing a context within which site-related effects may be measured and interpreted:

- Critical life support (natural history) requirements, including spawning areas, nursery grounds, food habits, feeding areas, wintering areas, and migration routes (including maps),
- Temporal and three-dimensional spatial distribution and abundance, especially in the discharge area and receiving water body (including maps),
- Seasonal catch data (location, volume, and value) for commercially and recreationally important species, and
- Existing stressors and adverse effects not related to the proposed project.

4.6.2.2.1 Threatened or Endangered Species

Two fish and two sea turtle species in the project area are afforded special protection under the Endangered Species Act: the Shortnose and Atlantic Sturgeon, and the Loggerhead and Kemp's Ridley Turtle.

- <u>The Shortnose Sturgeon</u> (*Acipenser brevirostrum)* is an anadromous bony fish that has historically inhabited sluggish tidal rivers and nearshore marine waters of the western Atlantic coast, including the Chesapeake Bay. The ancestral range of this species is believed to extend from the St. John River in New Brunswick, Canada, to the St. Johns River in Florida. It moves up river channels to spawn in fresh water. Although this fish once supported an enormous international export business, the stock plummeted during the 1900s due to overharvesting. The Shortnose Sturgeon was listed as federally endangered in 1967 and is an endangered species under Maryland law. Deteriorating water quality (especially low dissolved oxygen) and placement of dams that restrict its access to historical spawning grounds have likely inhibited the strong comeback that could have been expected once legal protections were put in place. In 1979, BGE researchers captured a Shortnose Sturgeon during trawl studies in the vicinity of the CCNPP site. Other isolated individuals may use the area intermittently; however, no Shortnose Sturgeon is known to have spawned in the Chesapeake Bay in decades. In August, 2006, a female with eggs was captured as she swam up the Potomac, presumably to spawn. It is not known whether she spawned, but biologists consider it doubtful, since males are exceedingly rare in the area. Intensive efforts by biologists to document the presence of this species in the Chesapeake are ongoing. Another female was captured near the Choptank River entrance in 2007. One Shortnose Sturgeon was captured during trawl studies in 1979. No Shortnose Sturgeon has been captured in impingement samples at CCNPP Units l and 2.

- <u>The Atlantic Sturgeon</u> (*Acipenser oxyrhynchus*) is a larger, longer-lived relative of the Shortnose Sturgeon and once supported a robust fishery in the Chesapeake Bay. It is currently on the candidate species list maintained by the National Oceanic and Atmospheric Administration (NOAA) Fisheries, because it is undergoing a status review under the Endangered Species Act. The decline of the Atlantic Sturgeon was not as sudden or steep as that of the Shortnose Sturgeon, but its populations are currently depleted. In late 1997, a moratorium on the harvest of wild Atlantic Sturgeon was implemented and remains in effect until there are at least 20 protected year classes in each spawning stock, which may take up to 40 or more years. The sturgeon's dependence on both estuarine and freshwater habitat makes it susceptible to harm from habitat degradation due to pollution, physical barriers to spawning areas, channelization or elimination of backwater habitats, de-watering of streams, and physical destruction of spawning grounds. The Maryland Department of Natural Resources (DNR) conducted a trial stocking experiment in 1996 to investigate the viability of juvenile hatchery fish that were released on the Eastern Shore. During the subsequent 5 years, 14% of the juveniles were recaptured, suggesting that habitat conditions were adequate to support growth and survival. Recent changes to the water quality goals in the Chesapeake Bay are expected to result in habitat improvements for both sturgeon species.

- Atlantic Loggerhead Turtles (*Caretta caretta*) occur throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. The Loggerhead is the most abundant species of sea turtle found in U.S. coastal waters, including the Chesapeake Bay. Approximately 2,000 to 10,000 young Loggerheads forage in the bay each summer for horseshoe crabs, jellyfish, and mollusks. They are most often seen near the mouths of rivers, in water greater than 13 ft (4 m) deep. Most sightings are in the Virginia portion of the bay, where salinity is higher. In addition to the well-known juveniles, it has been reported that up to 5% of the Loggerheads in Chesapeake Bay are adult females who are taking time off between nesting efforts. The stock structure of the U.S. population of Loggerheads is poorly understood. Some evidence suggests that individuals nesting in Georgia represent a population distinct from the Florida nesters. If so, the northern population may be more severely threatened. NOAA Fisheries suggests that it may become necessary to consider listing them as endangered. Adult Loggerheads are known to make extensive migrations between foraging areas and nesting beaches. The Virginia Institute of Marine Science Sea Turtle Program actively tracks individuals that nest on Virginia beaches in an effort to determine the migration routes of these turtles. At present, the place of origin of an individual turtle cannot be determined. Turtles feeding in the Chesapeake Bay may represent a number of nesting populations worldwide. At the global level, the primary threat to Loggerhead turtle populations is incidental capture in fishing gear, especially in longlines and gillnets, but also in trawls, traps and pots, and dredges. NOAA Fisheries is currently implementing a program to evaluate the incidence of bycatch of sea turtles in various types of gear, including pound nets in the Chesapeake Bay.

- The Kemp's Ridley Turtle (*Lepidochelys kempii*) is one of the smallest of the sea turtles, with adults reaching about 2 ft (0.6 m) in length and weighing up to 100 lbs. The Kemp's Ridley Turtle has been on the endangered species list since 1970. Nesting occurs in spring on Mexican beaches. After leaving the nesting beach, hatchlings are believed to become entrained in eddies within the Gulf of Mexico, where they are dispersed within the Gulf and Atlantic by oceanic surface currents until they reach about 7.9 in (20 cm) in length, (or about two years of age) at which size they enter coastal shallow water habitats. A sizeable group of the Kemp's Ridley Turtle spends the summers in the Chesapeake Bay, although most remain in the higher salinity waters of the Virginia portion of the bay. This turtle is a shallow water benthic feeder with a diet consisting primarily of crabs. The principal threats to this species occur on the nesting beaches, where both deliberate and accidental disturbances interfere with nesting success and in accidental take by fisheries vessels. Restoration of the species requires protecting sub-adult and adult animals by the use of turtle excluder devices on shrimp trawls wherever turtles occur.

4.6.2.2.2 Harvested Fish

Nine species of fish that are harvested commercially or recreationally in the Chesapeake Bay are considered important in the project area:

- The American Shad (*Alosa sapidissima*) is one of six shad and herring species to occur in the Chesapeake Bay. From January to June, shad older than about four years old enter the Chesapeake Bay to spawn in fresh or near-fresh tributaries as far north as the Susquehanna River. Shad usually complete the spawning run without feeding and move far enough upstream for the eggs to drift downstream and hatch before reaching saltwater. After spawning, the adult either dies or resumes its long pelagic migration. Within a month, young fish are feeding on zooplankton in the Chesapeake Bay. More than 70% die before leaving the estuary. Historically, it is likely that American shad spawned in suitable waters across the Atlantic coast. Current spawning runs are limited by physical barriers as well as degraded water quality. These impediments to spawning, added to overharvesting, spurred Maryland to implement a fishing moratorium in 1980. Virginia concurred in 1994, making it illegal to harvest American shad anywhere in the Chesapeake Bay. Stocks are being enhanced in three ways: (1) Restoring native spawning habitat by removing dams or building fishways; (2) supplementing wild stocks with hatchery fish; and (3) improving water quality. A low of several hundred American shad per year was reported in the early 1980s. The most recent data available show an average of 101,140 per year between 2003 and 2005. The increased abundance falls short of the long term restoration goal of two million fish per year. The Atlantic States Marine Fisheries Commission has identified habitat areas of particular concern for the American shad, including spawning sites, nursery areas, inlets that provide access to coastal bays, estuaries, and riverine habitat upstream to spawning grounds; and sub-adult and adult nearshore ocean habitat. The abundance of the closely related hickory shad (*Alosa mediocris*) dropped so low in the Chesapeake Bay in the late 1970s that a moratorium on commercial and recreational capture in Maryland's portion of the Chesapeake Bay was implemented in 1981. Although the population is increasing, the moratorium remains in place. Ocean landings of hickory shad are still allowed and Maryland recorded landings of less than 4,000 lb (1800 kg) in 2004.

- The Bay Anchovy (*Anchoa mitchilli*) is the most abundant fish in the Chesapeake Bay. Through predator-prey relationships, the bay anchovy forms a link between zooplankton and top game fish. Striped bass, bluefish, and other sport fish, as well as some birds and mammals, depend on the abundance of bay anchovy to sustain them. In one study, bay anchovy accounted for up to 65% of the biomass consumed by striped bass in the Bay. The bay anchovy spawns throughout the Bay. In summer months from 1995 to 2000, bay anchovy eggs comprised more than 94% of the fish eggs in the plankton of the Middle Bay portion of the Chesapeake Bay. More than 75% of all larval fish collected in ichthyoplankton tows were bay anchovy. The bay anchovy is not commercially harvested. However, bay anchovy populations in the Chesapeake Bay fluctuate annually. Since 1994, the bay anchovy population in the Chesapeake Bay has been on a long term decline, the first ever recorded for the species. In recent years, recruitment of bay anchovy has been lower than expected, based on the various trawl surveys. Although the specific causes of the decline are not well understood, it is known that oxygen levels below 3.0 mg/L can be lethal to eggs and larvae. Dissolved oxygen greater than 2.0 mg/L is critical for adult survival.

- The Atlantic Menhaden (*Brevoortia tyrannus*) is a key component of the estuarine food web, consuming plankton and small fish while being consumed by larger predatory fish. Adults are present in near proximity to the CCNPP site year round. In the Middle Bay, spring egg collections were comprised of more than 80% menhaden. Unlike the bay anchovy, however, the Atlantic menhaden is directly targeted by commercial harvesters. In 2004, more than 3 million lb (1.4 million kg) were landed in Maryland. Atlantic menhaden stocks across the Atlantic coast are stable. However, reduced abundance in the Chesapeake Bay, a key nursery area, has been reported. Due to the concern over the steady decline in recruitment in the Chesapeake Bay, fisheries managers have recently (starting in 2006) capped the commercial harvest of Atlantic menhaden for 5 years. The limits on harvest of Atlantic menhaden are based on the importance of Atlantic menhaden to predatory fish, including the striped bass and bluefish.

- The Atlantic Croaker (*Micropogonias undulates*) is one of the top ten recreational finfish in the Chesapeake Bay. Adults are abundant in the Bay from March to October. They move offshore and south along the Atlantic coast in the fall. Juveniles are present essentially year round. Spawning occurs over the shelf in fall and winter. The Atlantic croaker is a bottom-feeding generalist, consuming benthic invertebrates and some fish. It is associated with muddy substrates in depths less than 400 ft (120 m), in a wide range of salinity and temperature conditions. All of the major predatory fish in the Chesapeake Bay, including striped bass, flounder, shark, spotted seatrout, other croaker, bluefish, and weakfish include croaker in their diet. The Atlantic croaker is a perennial favorite of the human population, as well, ranking within the top 10 species caught by anglers. Historically, the Chesapeake Bay region accounted for the majority of Atlantic Coast croaker landings. Recreational landings in the region have been declining since 1986. After a sharp decline in commercial landings during the 1970s and 1980s, Atlantic croaker landings in Maryland increased to close to 1 million lb (454,000 kg) per year for most of the 1990s. In fact, commercial landings in 2001 were higher than at any time since 1956, indicating a rebound of the Atlantic croaker fishery in the Chesapeake Bay.

- The Striped Bass (*Morone saxitilis*) (also known as rockfish) is the dominant predator in the Chesapeake Bay. Juveniles and adults occur in the Chesapeake Bay year round. The abundance and distribution of the striped bass affect countless other species, including the Atlantic menhaden. Juvenile striped bass feed on zooplankton and benthic invertebrates. Adults eat a variety of other important fish, including bay anchovy, Atlantic menhaden, spot, Atlantic croaker, and white perch. This large anadromous species has a complex life history that centers on the Chesapeake Bay, where historically, about 90% of the Atlantic population spawned. Distribution patterns are influenced by the age, sex, degree of maturity and the river in which they were born. Successful completion of the striped bass life cycle requires a variety of habitats including spawning sites, nursery areas, passages between inland spawning and estuarine nursery habitats, and offshore wintering grounds. Commercial and recreational landings in the Chesapeake Bay generally increased from the 1930s through the mid-1970s, then declined sharply through the mid-1980s. Aside from direct overfishing, it is thought that low dissolved oxygen increased stress on the fish, making them susceptible to disease. A moratorium on all striped bass fishing in Maryland in 1985, and in Virginia in 1989, allowed the population to rebound. According to DNR, 602,506 lb (273,292 kg) of striped bass were harvested from the south central area of the Chesapeake Bay near the CCNPP site in 2004. This was one of the top 10 greatest years of harvest since data collection began in 1944. Concerns about the future of this fishery remain. A large percentage of striped bass appear to be malnourished and up to 70% of the population is infected with mycobacteriosis, a type of wasting disease. The impact of this disease on sustainability of the stock is not well understood at this time.

- The Spot (*Leiostomus xanthurus*), like the Atlantic croaker, occupies a middle position in the Chesapeake Bay food web, as a consumer of benthic invertebrates and as prey for striped bass, bluefish, weakfish, shark, and flounder. The spot is a generalized omnivorous bottom feeder that ranges throughout the Chesapeake Bay from April through October. The spot is broadly tolerant of temperature and salinity fluctuations. Spawning occurs offshore, then the young move into the estuary for rearing. In addition to their central role in the food web, spot are important to both commercial harvesters and recreational anglers. Inter-annual variability in spawning conditions leads to unpredictable landings. No long term declines, however, have been noted. Commercial landings are highest during the fall migration out of the Chesapeake Bay, when they are taken as by-catch from the pound net fishery in the lower Bay. According to DNR, commercial catches in Maryland have exceeded 100,000 lb (45,000 kg) annually since 1998.

- White Perch (*Morone americana*) migrate from the open Chesapeake Bay into the tidal-fresh portions to spawn from April to June over the sandy bottoms of brackish or tidal-fresh rivers. Young white perch remain nearshore downstream from their hatching areas for several months, foraging for insect larvae and crustaceans. Adult white perch overwinter in the deeper channels of the Chesapeake Bay. They never move into the open ocean. White perch are heavy consumers of fish eggs, including those of the striped bass. The white perch is considered a delicious table fish, and supports an important recreational fishery in the Chesapeake Bay. It is also commonly taken as by-catch by commercial harvesters. Large schools of white perch are vulnerable to capture when they aggregate to feed on herring. According to DNR, commercial catches in Maryland have exceeded 1 million lb (453,000 kg) annually since 1995.

- The Migratory Bluefish (*Pomatomus saltatrix*) visits the Chesapeake Bay area from spring to fall; it spawns offshore in the Chesapeake region in July. Juvenile bluefish move into the bay during late summer. Larger juveniles and adult bluefish have broad habitat tolerances, and range throughout the Chesapeake Bay in search of forage fish. Its diet is varied, consisting of fish species at all depths, including Atlantic menhaden, weakfish, and croaker. As a large, mobile predator, it competes with the striped bass for food. About 20% of the bluefish caught commercially in the U.S. are landed in the Chesapeake Bay, making bluefish a significant fishery in the area. The majority of the catch is in the Virginia portion of the Chesapeake Bay. Historic highs and lows in the harvest have occurred during the last 70 years. Until about 1992, commercial landings of bluefish in Maryland routinely exceeded 200,000 lb (90,000 kg) annually. Although overall stocks of bluefish in the Atlantic are increasing, landings in the Chesapeake Bay are on the decline, possibly due to over-harvesting. According to DNR, about 52,000 lb (23,000 kg) of bluefish were landed by commercial fishermen in 2004. The bluefish ranked first in number and weight among sportfish in the Chesapeake Bay for nearly 20 years, until the current decline began in 1990. Recreational landings outnumber commercial landings by at least 5 times. DNR implemented a management plan in 1990 in response to concerns about declining regional bluefish stocks.

- The American or Common Eel (*Anguilla rostrata*) is a widely distributed catadromous species, which lives predominately in rivers, lakes, and estuaries, but spawns in the Atlantic Ocean. The American eel is abundant year-round in all tributaries to the Chesapeake Bay. During the 5 to 20 years the American eel spends in the Chesapeake Bay, it feeds at night on insects, mollusks, crustaceans, worms, and other fish. In all its life stages, the American eel is an important prey species, as it is consumed by a variety of fish, aquatic mammals, and birds. The American eel is caught in commercial eelpots. Most eels landed in the Chesapeake Bay area are juveniles, or "glass eels," which are exported to Europe and Asia. Recreational anglers do not typically target the eel for consumption, although they are often bought for use as bait for striped bass and other sport fish. In 2005, the Atlantic States Marine Fisheries Commission determined that eel abundance had fallen since the late 1970s to mid-1980s, and was at or near historic lows along the entire Atlantic coast. The decline was not attributed to any particular cause although several possible factors such as harvest, habitat loss, predation, hydroturbine mortality, disease, parasitism, and reduced fecundity resulting from pollution were noted. The commercial catch in 1981 was more than 700,000 lb (317,000 kg) in both Maryland and Virginia, but has been declining ever since. The American eel is currently being considered for special protection under the Endangered Species Act, which may affect the way the species is managed by the Atlantic States Marine Fisheries Commission. The American eels mature slowly (reproducing at age 8 to 24 years), and are vulnerable to targeted harvest during seasonal migrations, which occur before the first spawning of new adults.

4.6.2.2.3 Harvested Invertebrates

Two species of invertebrates have been historically important to commercial and recreational harvesters near the CCNPP site, and throughout the Chesapeake Bay: the Blue Crab and the American Oyster. Both species are now severely depleted, and under strict management provisions.

- The Blue Crab (*Callinectes sapidus*) plays a vital role in the Chesapeake Bay region as both predator and prey. The Chesapeake Bay is the largest producer of crabs in the country, supporting major commercial and recreational fisheries. In most years, at least 30% of the nation's blue crabs come from Chesapeake Bay waters. According to the CBP, annual commercial harvests can approach 100 million lb (45.4 million kg) of crab. Blue crabs range from the upper Chesapeake Bay near freshwater tributaries down to the mouth of the Chesapeake Bay. Although mating occurs in the areas near the CCNPP site, the females typically migrate down-bay to a spawning and hatching area approximately 70 mi (110 km) south of the CCNPP site, where an appropriate salinity of approximately 23 to 28 parts per thousand (ppt) occurs. The number of mature female Chesapeake Bay blue crabs, or spawning stock, remains below the long term average. The 2006 winter survey conducted by DNR showed that the total number of crabs in the Chesapeake Bay was low compared with historical averages, but stable. In 2006, the Chesapeake Bay Foundation issued a Chesapeake Bay score of 38%, or grade C for the blue crab. Reasons for the observed reduction in harvest are complex, but may include over-harvesting, loss of habitat, and degradation of water quality. Juvenile crabs are closely tied to submerged aquatic vegetation, and may suffer a decline when submerged aquatic vegetation is unavailable for use as habitat and nursery grounds. Crabs are bottom feeders, and can be sensitive to low dissolved oxygen near the substrate.

- The American Oyster (*Crassostrea virginica*) is highly valued in the Chesapeake Bay but has been declining since the late 1800s due to over-harvesting, parasites, disease, and poor water quality. After 2 to 3 weeks in the plankton, as weak swimmers, larval oysters attach to the Chesapeake Bay substrate in a place where they will become permanently attached as adults. From there, a healthy oyster provides many services to the Chesapeake Bay ecosystem, including filtering the water, producing planktonic larvae that feed a variety of larval fish, and creating a physical structure with its shell that many other animals use for shelter and foraging. Efforts to restore the oyster fishery include expanding the amount of clean, hard surfaces for oyster spat (juvenile oysters) to settle, increasing the number of breeding adult oysters and developing methods for controlling oyster diseases. Oyster breeding and nursery areas occurred near the CCNPP site and were relocated to the Patuxent River during CCNPP Units 1 and 2 construction as a mitigation measure. Oysters have not occurred in sufficient number for commercial fishery near the CCNPP site since at least 1971. The lack of harvestable numbers was confirmed during an oyster survey conducted in fall 2006.

4.6.2.2.4 Other Important Resources

In addition to the fish and invertebrates already mentioned, submerged aquatic vegetation and plankton are considered important resources in the project area:

- Submerged aquatic vegetation (SAV) includes a group of about 16 rooted plant species that live within the shallows of the Chesapeake Bay and its tributaries. This vital resource provides refuge and nursery habitat for numerous organisms, increases the structural complexity of the bottom, adds oxygen to the water, and prevents erosion and sedimentation. In addition, microscopic algae and protozoa use the leaves of SAV as attachment locations. Small fish are attracted to these areas for feeding. Decaying leaves are consumed by zooplankton, which are then eaten by larval fish. SAV is considered an indicator group because the plants respond quickly and dramatically to degradation of water quality. At one time, SAV covered about 200,000 shallow and shoreline acres (81,000 hectares) of the Chesapeake Bay. Acreage has fluctuated widely over the past few decades. In 2004, bay grasses covered 72,935 acres (29,516 hectares). Although this value represented an increase over previous years, it is still only about 42% of what experts believe to be necessary for complete restoration of function. Acreage of SAV in the middle and lower Chesapeake Bay has diminished even more significantly over the past decade. In addition, late in 2005 much of the SAV in the lower Chesapeake Bay died, possibly due to high temperatures. In 2006, the Chesapeake Bay Foundation issued a Chesapeake Bay score of 18% (failing grade) in the SAV category. No SAV was observed during the September 2006 and March 2007 surveys in the immediate vicinity of the CCNPP site.

- Plankton (Phytoplankton and Zooplankton) are organisms of the open water that drift on currents and tides. Phytoplankton are plants or algae that manufacture their own food using nutrients in the water. Zooplankton are animals that generally consume phytoplankton. A small but significant component of the plankton consists of bacterial cells. Although most plankton are tiny, they range in size from microscopic bacteria and plants to larger animals, such as jellyfish. In the Chesapeake Bay, plankton provides the nutritional support for the entire fisheries industry. Plankton are short-lived and highly responsive to both positive and negative environmental changes. As such, plankton are useful indicators of overall environmental quality. Phytoplankton abundance is a readily visible measure of invisible nutrient loads in the Chesapeake Bay. The composition and abundance of zooplankton are predictors of near term fisheries abundance, as most larval fish rely on zooplankton to grow to a size large enough to compete as a predator. Some species, such as blueback herring, alewife, and shad, rely on mesozooplankton food their entire lives. The influence of zooplankton on striped bass and white perch in the Chesapeake Bay is well documented. Striped bass, white perch, and yellow perch depend on mesozooplankton and microzooplankton as larvae, and shift to larger prey as they grow. The role of zooplankton in the Chesapeake Bay is an area of active research. The overall health of the zooplankton in the Chesapeake Bay is suboptimal, and worsening in most reaches. Despite universal improving trends, zooplankton food levels for migratory fish larvae are currently inadequate in most major spawning/nursery areas. Sharp declines in mesozooplankton abundance were noted in almost all of the middle and lower Chesapeake Bay mainstem and lower tributary reaches. At the station nearest to the CCNPP site (just north of the CCNPP site), a 32% drop in abundance from 1984 to 2002 was reported. In contrast, abundances of the smaller microzooplankton increased in the mid Chesapeake Bay. The overall zooplankton food base for important forage fish such as bay anchovy, menhaden, and immature stages of other resident species is declining and shifting to smaller sizes. However, some positive trends have been documented, likely in response to improvements in water quality. Significant increases in mesozooplankton abundance indicate an improving trend in the overall food base for fish in some areas, especially where water quality significantly improved, as in the Patuxent River. Monitoring of phytoplankton using a Phytoplankton Index of Biotic Integrity showed that about 9% of the Chesapeake Bay's phytoplankton communities were considered healthy in Spring 2005.

4.6.2.3 Aquatic Habitat

Onsite streams and ponds were described in terms of the typical surface water habitats in the area. Headwater streams in general are considered important; however, there is nothing of regional significance about these particular streams. All of the onsite aquatic species mentioned in this section are common in the area. No loss of stream and pond critical habitat is expected.

The Chesapeake Bay is considered important estuarine habitat to most, if not all, of the estuarine species identified in the area. However, none of the important species in the vicinity of the project are endemic to Chesapeake Bay. All of them range widely throughout the mid-Atlantic coast, and most occur in the Gulf of Mexico, as well.

The portion of the Chesapeake Bay nearest the CCNPP site is of lower relative importance in terms of productivity than other areas of the Bay. Estuarine species that use the Bay as nursery grounds need SAV and tidal marshes for nutrient-rich forage for larvae and young nontidal marshes, as well as for protective cover from predators. The area near the CCNPP site has no SAV and does not provide critical habitat for any species.

The National Marine Fisheries Service (NMFS) designated Essential Fish Habitat (EFH) for each life stage of federally managed marine fish species in the Chesapeake Bay area; the bluefish is the only important species in the project area that is federally managed, and for which EFH has been designated. EFH is defined in Title 50 CFR Section 600.10 implementing the EFH provisions of the Magnuson-Stevens Fishery Conservation and Management Act as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. Bluefish eggs and larvae are found only offshore, so no EFH occurs in Chesapeake Bay. For juvenile bluefish, all major estuaries between Penobscot Bay, Maine and St. Johns River, Florida, are EFH. Generally juvenile bluefish occur in North Atlantic estuaries from June through October, Mid-Atlantic estuaries from May through October, and South Atlantic estuaries March through December, within the "mixing" and "seawater" zones. Adult bluefish are found in North Atlantic estuaries from June through October, Mid-Atlantic estuaries from April through October, and in South Atlantic estuaries from May through January in the "mixing" and "seawater" zones. Bluefish adults are highly migratory and distribution varies seasonally and according to the size of the individuals comprising the schools. Bluefish are generally found in normal shelf salinities (greater than 25 parts per thousand).

Four threatened and endangered aquatic species known to occur in the area include two species of sturgeon and two species of sea turtles. No sturgeon is known to have spawned in the Chesapeake in decades. The sea turtles that occasionally use the Chesapeake Bay nest much further south, outside the Chesapeake Bay watershed.

4.6.2.4 Other Preexisting Environmental Stresses

Pollution, nutrient enrichment, and over-harvesting of estuarine species are among the key threats to the health of the Chesapeake Bay. Based on conditions throughout 2006, the Patuxent River Watershed portion of the Chesapeake Bay received a grade of D- (23%) from the Chesapeake Bay Foundation based on very poor water clarity and chlorophyll a, moderate dissolved oxygen conditions, poor benthic and phytoplankton scores, and loss in bay grasses.

4.6.2.5 Agency Consultation

Affected Federal, State and Regional agencies will be contacted regarding the potential impacts to the terrestrial ecosystem resulting from plant construction. The Maryland Natural Heritage Program, operated by the DNR, was consulted for information on known occurrences of Federally-listed and State-listed threatened, endangered, or special status species and critical habitats. Identification of the important species discussed above was based in part on information provided by that consultation. The U.S. FWS was consulted via letter dated April 12, 2007 and responded on May 22, 2007 stating that no federally protected, threatened, or endangered species are known to exist within the proposed project area except for the occasional transient species, but qualified the response by stating that if additional information on the distribution of listed or proposed species becomes available, this determination may be reconsidered. The consultation occurred prior to identification of the eagle's nest in the project vicinity and additional consultation is planned, as previously stated herein. The U.S. FWS and the DNR will be provided an opportunity to review these further findings.

4.6.3 Wetlands

4.6.3.1 Overview

A wetlands delineation of selected portions of the CCNPP campus was concluded in June 2007. Nine Wetland Assessment Areas were identified within the defined Project Area.

4.6.3.2 Wetland Assessment Area I

Wetland Area: Approximately 1.8 Acres (0.7 Hectares) (Including Stream Channels)
Wetland Delineation Boundary: Approximately 7,500 Linear Feet (2,286 Meters)

Assessment Area I consists of a system of streams and narrow strips of adjoining wetlands draining lands north of Camp Conoy and south of the existing reactors. One stream originates in a swale close to the northwest corner of Camp Conoy and flows north and east. A second stream originates as the outflow from an existing stormwater basin south of the existing reactors. The two streams join in a forested valley north of Camp Conoy and flow east into the Chesapeake Bay just south of the existing CCNPP barge dock. The streams appear to carry perennial flow. A third stream originates at a small seepage north of the central part of Camp Conoy and flows north to the main stream. Its flow regime appears to be intermittent.

Stream channels are largely defined by steep embankments. The stream channels are deeply incised and lack adjacent vegetated wetlands at most points. Where they occur, strips of adjoining emergent vegetation are generally under 2 or 3 ft (0.6 or 0.9 m) in width.

4.6.3.3 Wetland Assessment Area II

Wetland Area: Approximately 6.2 Acres (2.5 Hectares)
(Including Stream Channels and Camp Conoy Fishing Pond)
Wetland Delineation Boundary: Approximately 9,900 Linear Feet (3,018 Meters)

Assessment Area II consists of the Camp Conoy fishing pond, constructed by excavation and stream channel impoundment, and associated wetlands and stream channels. It includes: 1) three stream channels, seepages, and bordering wetlands that originate up-gradient (west and southwest) of the pond; 2) three small, isolated wetlands, on forested slopes up-gradient (west and southwest) of the pond; 3) the pond basin and wetland fringe; and 4) the outlet stream channel with two small impoundments.

The stream channels up-gradient of the Camp Conoy fishing pond begin at distinct seepages and become adjoined by narrow strips of forested wetlands as they flow downhill. These strips vary in width from a few feet to more than 100 ft (30.5 m). The three isolated wetlands on the slopes up-gradient of the pond consist of groundwater seepages that percolate back underground. Most of the pond consists of open water no greater than 3 or 4 ft (0.9 or 1.2 m) in depth. The pond is fringed by a zone of emergent wetlands generally between 10 and 30 ft (3 and 9 m) in width.

The stream channel carrying the outflow from the pond is fringed by forested wetlands, except where two small impoundments occur. Water depth is shallow (generally less than 2 ft (0.6 m)) throughout both impoundments, thus both consist primarily of emergent wetlands rather than open waters. The first impoundment contains approximately 0.75 acres (0.30 hectare) of emergent wetlands. The second impoundment contains approximately 0.25 acres (0.10 hectare) of emergent wetlands. Just down-gradient (northeast) of the eastern most impoundment, flow from the stream channel falls over a low cliff onto a narrow sandy beach at the Chesapeake Bay. The cliffs block tidal influence from Assessment Area II.

4.6.3.4 Wetland Assessment Area III

Wetland Area: Approximately 0.8 Acres (0.3 Hectares) (Including Stream Channels)
Wetland Delineation Boundary: Approximately 4,100 Linear Feet (1,250 Meters)

Assessment Area III consists of a stream and bordering wetlands near the southeastern corner of the Project Area. The stream originates at four separate seepage points that merge then flow southeast to the Project Area’s southern boundary, and then to the Chesapeake Bay. The channels are generally not sharply defined by distinct banks. An intermittent stream channel originates near Camp Conoy Road and flows east into the main stream system. This intermittent stream channel, which carries surface runoff from land near Camp Conoy Road, is deeply incised and lacks adjoining wetlands.

4.6.3.5 Wetland Assessment Area IV

Wetland Area: Approximately 12.9 Acres (5.2 Hectares) (Including Stream Channels)
Wetland Delineation Boundary: Approximately 38,600 Linear Feet (11,765 Meters)

Assessment Area IV consists of a system of headwater streams and bordering wetlands forming the upper part of Johns Creek. One headwater stream subsystem and associated wetlands originates at a cluster of seepages to the north, near existing CCNPP facilities. It flows generally to the southwest.

The other headwater stream subsystem and associated wetlands originates at seepages south on privately owned forested land south of the CCNPP site. It flows generally to the northwest.

The two stream subsystems merge at a point approximately 1,800 ft (549 m) west of Camp Conoy. The ridge separating lands that flow west to Assessment Area IV and east to Assessment Areas I, II and III roughly corresponds to Camp Conoy Road.

4.6.3.6 Wetland Assessment Area V

Wetland Area: Approximately 7.9 Acres (3.2 Hectares) (Including Stream Channels)
Wetland Delineation Boundary: Approximately 12,500 Linear Feet (3,810 Meters)

Assessment Area V consists of the main channel of Johns Creek and bordering wetlands. Johns Creek flows west, exiting the western perimeter of the Project Area near the confluence with Goldstein Branch and exiting the CCNPP site just east of MD 2/4. The upstream limit of tidal influence on Johns Creek lies substantially west of MD 2/4, close to St. Leonard Creek. Hence, none of the wetlands in Assessment Area V are under tidal influence.

The landward boundary of wetlands north of Johns Creek continues west for approximately 1,000 additional feet (305 meters). There are no slope-side seepages along the stretch of wetland boundary.

Assessment Areas IV and V are hydrologically connected, and their division is arbitrary. As a general distinction, Assessment Area IV comprises the headwaters of Johns Creek, while Assessment Area V comprises the main channel. The width of the stream channel and associated floodplain ranges from 100 to more than 200 feet (30.5 to more than 61 meters) in Assessment Area V, wider than anywhere in Assessment Area IV. A few seepages that form intermittent tributaries on the slope north of the Johns Creek main channel are included in Assessment Area V, even though they are headwaters.

The southern Wetland Delineation Project Area perimeter roughly follows the south shore of Johns Creek, and tributaries entering Johns Creek from the slope to the south are therefore not included as part of Assessment Area V.

4.6.3.7 Wetland Assessment Area VI

Wetland Area: Approximately 14.0 Acres (5.7 Hectares)
(Including Stream Channels and Unregulated Water Area)
Wetland Delineation Boundary: Approximately 6,400 Linear Feet (1,951 Meters)

Assessment Area VI consists of the old Lake Davies sediment basins, a series of man-made basins south of the existing Lake Davies dredged spoils disposal area in the central part of the Project Area. These sequentially connected basins carry storm water runoff from the dredge spoils area to Johns Creek and Goldstein Branch. Assessment Area VI is hydrologically connected to Johns Creek. But unlike the natural tributaries contributing flow to Johns Creek in Assessment Areas IV and V, Assessment Area VI consists of wetlands within man-made basins that are the result of extensive grading and dredge spoil placement.

4.6.3.8 Wetland Assessment Area VII

Wetland Area: Approximately 12.4 Acres (5.0 Hectares) Including Stream Channels
Wetland Delineation Boundary: Approximately 27,220 Linear Feet (8,297 Meters)

Assessment Area VII consists of Goldstein Branch, its headwaters, associated headwater stream channels and seepages, and narrow strips of adjacent wetlands. Several seepage areas and associated headwaters contribute flow to Goldstein Branch. The northernmost reach of a headwater to Goldstein Branch is located in a forested swale near the northwestern corner of the Project Area. Another headwater originates from multiple seepages in sloping forest land south of an open field and wooden barn in the northwestern quadrant of the Project Area. The landward edge of wetlands west of Goldstein Branch are located off of the CCNPP Site.

Several other unnamed headwaters to Goldstein Branch and narrow strips of adjoining wetlands are included in Assessment Area VII. A system of headwaters that originate as seepages on sloping lands west of the Lake Davies dredge spoil area generally flow south and west into Goldstein Branch. An isolated depression of the Lake Davies dredge spoil appears to be hydrologically connected via the water table to this headwater system. There is also a tributary carrying flow from the main Lake Davies storm water basin west into Goldstein Branch. A wetland mitigation project previously completed by Constellation offsets wetland impacts from a prior construction project on the CCNPP Site.

Goldstein Branch is itself tributary to Johns Creek. Assessment Area VII is therefore hydrologically connected to other Assessment Areas associated with Johns Creek (Assessment Areas IV, V and VI), and the division is arbitrary. Most surface runoff entering Johns Creek up-gradient (east) of Goldstein Branch originates in a predominantly forested landscape, and most surface runoff entering Assessment Area VI originates on dredge spoils. In contrast, most surface runoff entering Goldstein Branch originates in a mixed landscape of forest, crop, and offsite rural residential land uses. Goldstein Branch can therefore be characterized as a distinct stream system from the upper reaches of Johns Creek.

4.6.3.9 Wetland Assessment Area VIII

Wetland Area: Approximately 0.4 Acres (0.2 Hectares) (Including Stream Channels)
Wetland Delineation Boundary: Approximately 3,000 Linear Feet (914 Meters)

Assessment Area VIII consists of headwaters and adjoining wetlands that originate at seepages on a forested slope immediately south of Calvert Cliffs Parkway in the northern part of the Project Area. Separate seepages form narrow headwaters. The headwaters merge to form a single main stream channel, adjoined by forested wetlands, at a point approximately 150 ft (46 m) south of Calvert Cliffs Parkway. Another broad seepage area contributes flow from the east. The stream flows north under Calvert Cliffs Parkway and ultimately to Woodland Branch, which flows north and west into St. Leonard Creek.

4.6.3.10 Wetland Assessment Area IX

Wetland Area: Approximately 1.1 Acres (0.4 Hectares) (Including Stream Channels)
Wetland Delineation Boundary: Approximately 3,000 Linear Feet (914 Meters)

Assessment Area IX consists of seepages, headwaters, and adjoining wetlands within a patch of undeveloped forest land directly west of an existing CCNPP parking lot. The forest land slopes generally east. The headwaters originate at seepages low on the slope and flow generally eastward, with separate headwaters originating at seepages elsewhere. Storm drains collecting runoff from around the existing transmission switchyard feed a ditch that contributes additional flow to the wetlands.

Assessment Area IX is the only remnant of a stream system that formerly flowed east to the Chesapeake Bay. Most of that stream system was filled to construct the existing power generation units and associated developed area. Flow from Assessment Area IX enters a storm drain and is piped under the developed area to the east. Flow from the storm drain system is ultimately discharged at a stormwater basin feeding into Assessment Area I.

4.7 SOCIOECONOMIC FEATURES

This section describes the socioeconomic characteristics of the areas that could potentially be impacted by the construction and operation of CCNPP Unit 3. This section contains two subsections: 1) Demography, and 2) Community Characteristics.

These sections include a discussion about the socioeconomic characteristics of Calvert County and St. Mary’s County, which are the primary areas of concern for the socioeconomic impact assessment. The borders of these counties extend less than 30 mi (48 km) from the CCNPP site. Calvert County is located in the southern part of Maryland on a peninsula bounded by the Chesapeake Bay and the Patuxent River. St. Mary’s County is located to the west of Calvert County, on the western border of the Patuxent River. Potential socioeconomic impacts, if any, arising from the proposed plant are likely to be confined to these two counties because a majority of the existing workforce for CCNPP Units 1 and 2 reside in these counties and it is assumed that the potential in-migrating construction and operational workforces for CCNPP Unit 3 are most likely to reside in this same two-county area.

As of November 2006, a total of 833 employees work at the CCNPP site. Of this total, 793 of them are Constellation Energy employees and 40 are contractors. More than 91% of the current workforce at CCNPP resides in Calvert County or St. Mary’s County. Of the 833 employees at the CCNPP site, approximately 560 (67%) of the workers had a home address in Calvert County and approximately 200 (24%) of these workers had a home address in St. Mary's County.

4.7.1 Demography

Calvert County and St. Mary's County have experienced steady population growth for the last three and one-half decades, from 1970 to 2005. The combined population of Calvert County and St. Mary's County grew an annual average of 3.9% from 1970 to 1980, 3.5% from 1980 to 1990, and an annual average of 2.6% from 1990 to 2000. From 2000 to 2005, the population of Calvert County grew an annual average of 3.5%, about three times the annual average U.S. population growth rate of 1.2% per year. During that same period, the population of St. Mary's County grew an annual average of 2.3%, also substantially more than the average growth rate in the U.S.

Population densities have increased in both counties from 2000 to 2005. The year 2000 population densities were 377 people per square mile in Calvert County and 239 people per square mile in St. Mary's County. In comparison, the 2005 population density in Calvert County was 409 people per square mile and the population density in St. Mary's County was 267.4 people per square mile. Nationally, the average population density was 83.8 people per square mile in 2005.

The age compositions of Calvert County and St. Mary's County are generally comparable to Maryland and the U.S. for persons under 5 years of age and for persons 18 years and over. However, both counties had somewhat smaller portions of people 65 years and older than found for Maryland and the U.S. The percentage of females in all four jurisdictions was similar. Table 4.7-1.

There were also similarities in the ethnic compositions of the two counties and the U.S. These three jurisdictions had comparable percentages of Caucasians and African-Americans. However, both counties had substantially fewer people of Hispanic/Latino origins. In comparison, the State of Maryland had substantially lower proportions of Caucasians and greater proportions of African-Americans than the two counties. The State also had more than twice as many persons of Hispanic/Latino origins than the two counties.

Table 4.7-1 Select Demographic and Economic Characteristics

Demographic and Economic Characteristics	Calvert County	St. Mary's County	State of Maryland	U.S.
Population Levels, Change, Density:				
Total Population, 2000	74,563	86,211	5,296,486	281,421,906
Total Population Estimate, 2004	86,434	94,921	5,558,058	293,656,842
Average Annual Percent Change, 2000-2004	4.0%	2.5%	1.2%	1.1%
Population per square mile, 2000	376.5	238.6	541.9	79.6
Age Composition:				
Persons under 5 years old, 2004	6.1%	7.0%	6.7%	6.8%
Persons 18 years and over, 2004	73.5%	73.4%	74.9%	75%
Persons 65 years old and older, 2004	9.2%	9.2%	11.4%	12.4%
Gender Composition:				
Females, 2004	50.7%	49.9%	51.6%	50.8%
Ethnic Composition:				
Caucasians, 2004(1)	84.7%	82.1%	64.5%	80.4%
African-Americans , 2004(1)	12.8%	13.9%	29.1%	12.8%
Persons of Hispanic/Latino origin, 2004(2)	1.9%	2.2%	5.4%	14.1%
Income Characteristics:				
Median Household Income, 2003	$71,488	$58,651	$54,302	$43,318
Persons below poverty, 2003	5.3%	7.4%	8.8%	12.5%

Notes:

(1). Persons describing themselves as being of one race only
(2). Persons of Hispanic or Latino Origin may be of any race

4.7.2 Community Characteristics

4.7.2.1 General Economy

Generally, the economy across the two-county area can be viewed as being economically diverse, healthy, and stable.

Employment in the professional and technical services, health care and social services, state and local government, and in the civilian branch of the federal government account for the 33,186 jobs or 39% of the employment in the two-county area. The relative high average salaries of workers are directly attributable to the large number of positions in these industrial sectors. The construction industry makes up a relatively small portion of total employment, representing slightly more than 10% of employment in Calvert County and less than 5% in St. Mary's County. Employment in fishing, forestry, and agricultural services has witnessed a decline in the last two decades. Employment in the farming sector, alone, also has been in decline for the last twenty years as the region has experienced pressures from the rapid population growth.

In 2000, 52,433 workers in total were employed in Calvert County and St. Mary's County. The unemployment rate in the region remains well below state and national averages. The unemployment rate in May 2006 in Calvert County was 2.8%; in St. Mary's County the unemployment rate was 3.2%. In comparison, the May 2006 unemployment rate in the State of Maryland was 4.2%, and nationally it was 4.6%. The number of jobs in the two counties is increasing at a rate that is approximately three times the rate of job expansion in the State of Maryland as a whole.

The Calvert Cliffs Nuclear Power Plant is the second largest employer in Calvert County, employing 833 people to operate CCNPP Units 1 and 2. The Patuxent River Naval Air Station (NAS) is the largest employer in St. Mary's County. It is the headquarters of the Naval Air Systems Command, the Naval Warfare Center Aircraft Division, home of the U.S. Naval Test Pilot School, and is the base for the VC-6 Unmanned Aerial Vehicle Detachment. There are 10,500 civilian and military employees and 9,300 contractor employees for a total employment at the Patuxent River Naval Air Station in Fiscal Year 2005 of 19,800 persons. Eighty-three percent of the Patuxent River Naval Air Station employees lived in either St. Mary's County or Calvert County.

The 2003 median household income in Calvert County was $71,488, approximately 65% higher than the national average for that year of $43,318. The 2003 median household income in St. Mary's County of $58,651 was approximately 35% higher than the national average that year. Much of the relatively high median household income can be attributed to growth in the number of higher income households in both counties as the area continues to attract highly paid technical and professional personnel associated with the technology-based industries.

Information provided by the Maryland Department of Labor indicates that Calvert County has 1,770 businesses, of which 15 businesses employ 100 or more workers. Major non-governmental employers in Calvert County in 2005 included Calvert Memorial Hospital with 915 employees, Constellation Energy with 793 employees (excluding contractors), ARC of Southern Maryland with 375 employees, Wal-Mart with 310 employees, DynCorp with 296 employees, and Recorded Books with 291 employees.

St. Mary's County has over 1,830 businesses, of which 37 businesses employ 100 or more workers each. In 2005, the largest employers in the county include Patuxent River Naval Air Station (NAS) with 10,500 employees, DynCorp/CSC with 1,500 employees, Eagan, McAllister Associates, Inc. with 1,000 employees, St. Mary's Hospital with 900 employees, and BAE Systems with 854 employees. The Patuxent River NAS plays a significant role in the county's economy. This facility includes the U.S. Naval Air Systems Command, and the Naval Air Warfare Center Aircraft Division, and also provides employment for 200 defense contractors. In 2005, the Patuxent NAS directly employed about 3,000 military personnel and about 7,500 civilians. In addition, its supporting contractors employed about 9,300 workers. Major defense-related employers supporting the Patuxent NAS included BAE Systems Lockheed Martin, Northrop Grumman, Titan Systems, Wye Laboratories, and Boeing.

4.7.2.2 Housing

Calvert County had a total of 27,576 housing units in 2000, and the County had a significantly larger proportion of single family units than the 2005 Maryland state average. Of the total units, 25,447 were occupied and 2,129 (7.7%) were unoccupied. Of the total number of occupied units in Calvert County, 14.8% were occupied by renters. The unoccupied units were relatively equally comprised of units available year-around and those available only seasonally or occasionally, with 1,125 units available year-around and 1,004 units available seasonally. Of the available housing units in 2000, the vast majority of units had plumbing and kitchen facilities, with the exception of 146 units.

St. Mary's County had a total of 34,081 housing units in 2000, and a significantly larger proportion of single family units than the 2005 Maryland state average of 76%. Of the total units, 30,642 were occupied and 3,439 (10.1%) were unoccupied. Of the total number of occupied units in St. Mary's County, 28.2% were occupied by renters. There were almost twice as many year-round units available as seasonal or occasional units, with 2,223 units available year-round and 1,216 units available seasonally. Of the available housing units in 2000, the vast majority of units had plumbing and kitchen facilities, with the exception of 432 units.

4.7.2.3 Primary and Secondary Education

The two county-wide school districts have a total of 51 public schools with 33,983 students enrolled. There are also a total of 33 private schools in the two-county area, with 3,814 students enrolled.

4.7.2.4 Major Roads and Highways

The area includes the following major roads and highway systems:

- There are no interstate highways in Calvert County or St. Mary's County.

- The major highway in the area is MD 2/4, which passes the CCNPP site on a north-south axis, with MD 4 crossing the Patuxent River at the south end of Calvert County and continuing into St. Mary's County. MD 2/4 has two lanes going in each direction, with selected left and right hand turn lanes and some traffic lights at busy intersections.

- Access into Calvert County is also available via MD 231. This is a two-lane road with bridge access to southern Charles County.

In addition to highway access, the CCNPP site has its own barge dock that is used for delivery of large equipment or large quantities of materials.

4.8 SITE NOISE

The principal noise sources associated with operation of CCNPP Unit 3 are the switchyard, transformers, and Circulating Water Supply System cooling tower. In addition, two of the four Emergency Service Water System cooling towers will normally be in operation. Because previous environmental assessments did not include noise measurements made at the CCNPP site and surrounding environs that could be used to establish a baseline noise level, surveys conducted in November 2006 and August 2007 to measure ambient environmental community noise levels.

4.8.1 Environmental Noise Survey

Environmental sound levels were measured continuously at eight area-wide locations over a two-day period during both leaf-on and leaf-off seasonal conditions. Any noise emissions from the existing CCNPP Units 1 and 2 were expected to be highest during leaf-off season due to the lack of tree leaf noise reduction. However, the two surveys found that the residual sound levels at monitoring locations S1, S2, and S3 – the nearest residential receptors – were consistent regardless of season. The residual sound level is the most common for evaluating community noise in residential environments. The combined results of both the leaf-on and leaf-off surveys provide baseline environmental noise measurements for use in assessing any new noise introduced by the addition of Unit 3.

Figure 4.8-1 shows the location of the eight monitoring sites. P1 was placed near where CCNPP Units 1 and 2 are audible and dominant. There are single-family residences at locations N1 through S3, except for location P1, which are representative of the closest potentially sensitive receptors in all directions from the CCNPP site. In addition, four eagle nest sites are situated on the CCNPP campus: two to the south, one to the northern portion of the campus, and one in the construction area. The closest potentially sensitive receptors represent existing conditions and can be used to assess potential noise impacts from CCNPP Unit 3.

For the leaf-off survey, the instantaneous sound level was measured at each location on a continuous and simultaneous basis over the two-day period using precision data loggers. In addition, attended measurements were carried out at each location during day and night periods using hand-held precision data loggers. For the leaf-on survey, continuous monitoring occurred only at the most critical receptors (S1, S2 and S3) as determined by the leaf-off survey. Attended measurements occurred at all locations for both surveys.

4.8.2 Metrics for Noise Assessment

The overall sound level is defined as the summed level in decibels over the entire audible frequency range of approximately 20 to 20,000 cycles/second (Hertz). The A-weighted sound level, dBA, is a convenient single number to quantify the entire spectrum of a sound.

Percentile levels, or exceedence levels, designated L1, L10, L50 and L90 are statistically derived units over the sampling period. They are the levels exceeded for 1%, 10%, 50% and 90% of the sampling time. The L90 percentile level is the most common for evaluating community noise in residential environments. L90 is the “residual” sound level, which is the quasi-steady level that occurs in the absence of all identifiable sporadic sound levels occurring over the interval. The vast majority of all residual sound levels found in communities come from far away, unidentifiable steady levels from traffic or industrial sources.

The average, designated Leq, is the equivalent steady sound level that has the same acoustic energy as the actual time varying signal. It is the energy average, not the arithmetic average over the period. The 24-hour day-night sound level, or Ldn, is calculated from the average hourly Leq sound level over a 24-hour period, with a 10 dBA weighting factor added to all levels during the nighttime period from 10 PM to 7 AM to account for greater sensitivity to noise at night. The State of Maryland regulates the maximum allowable noise levels at residential receptors to 65 dBA during the daytime (7 AM to 10 PM) and 55 dBA during the nighttime (10 PM to 7 AM). These regulatory limits are intended to achieve environmental "goals," which for a residential area is a Ldn value equal to 55 dBA. This level is the same as recommended by the U.S. EPA to the Department of Housing and Urban Development (HUD) as a goal for outdoors in residential areas as part of noise abatement and control (CFR, 2007c). However, for the purposes of the HUD regulation, sites with a Ldn value of 65 dBA and below are acceptable and allowable.

4.8.3 Results of Noise Survey

Table 4.8-1 tabulates the major survey results at all locations for commonly used sound level metrics to assess noise impact. Location P1 is at the plant and can be considered the control point. The other locations are at or near residences. Whether the Maryland environmental goal of Ldn equal to 55 dB(A) is realized depends on location and environmental conditions. More remote locations (S2 and S3), for example, are within the environmental goal. Conversely, locations near noise sources, such as MD 2/4 (W2) or an existing saw mill (W3), are above or near the environmental goal. Wind conditions also have an effect, as the Ldn increases with increased wind speed. Apart from these effects, Ldn noise levels of below 60 to 65 dBA are considered to be of small significance. All measurements taken had a Ldn value below 65 dBA except near the highway (W2) and on the plant site (P1). The survey results document existing conditions for typical and representative periods during the leaf-on and leaf-off seasons.

4.8.4 Noise Associated with Transmission Lines

CCNPP Unit 3 will use the existing off-site transmission lines used for CCNPP Units 1 and 2. However, two new approximately one-mile long 500 kV transmission lines will be installed to connect the substation for Units 1 and 2 to the new Unit 3 substation and the grid. The environmental impact of noise associated with the transmission lines was previously assessed in the CCNPP Units 1 and 2 license renewal application and the NRC's application review. Corona noise for a 500 kV line may range between 59 and 64 dBA. It is estimated that corona noise from a 500 kV line during a worst-case rain with heavy electrical loads is 59.3 dBA. For reference, normal speech has a sound level of approximately 60 dB and a bulldozer idles at approximately 85 dB.

Table 4.8-1 Summary of Ambient Environmental Sound Levels (dBA) for Commonly Used Metrics to Assess Noise Level Impact

Location [a]	Minimum L90 [b]	Average Daytime L90 [c]	Ldn [d]	Ldn [e], [g]
P1	Note [f]	Note [f]	65	65
N1	34	44	55	56
W1	30	40	49	52
W2	37	56	65	66
W3	33	46	59	60
S1	31	42	49	51
S2	30	36	49	51
S3	30	35	53	55

Notes:

(a) See Figure 4.8-1.
(b) Minimum measured hourly L90 over two-day survey period.
(c) Arithmetic average of measured hourly L90 for the 28 hours from 7 A.M. to 10 P.M.
(d) Calculated for 24 hours with lowest wind speed, nearly calm or still.
(e) Calculated for 24 hours with increasing wind speed.
(f) Control point located on the CCNPP Units 1 and 2 site area.
(g) DNL for leaf-on survey not included due to cicada/insect sounds.

4.9 WEATHER

This section describes the general climate, severe weather phenomena, and local meteorology near the CCNPP site.

4.9.1 General Climate

The CCNPP site is located in Calvert County. Calvert County is in that portion of Maryland commonly referred to as Southern Maryland, and is located on the Coastal Plain. The weather data used to create this narrative is from the period 1971-2000.

Seasons are well-defined. Winter is the dormant season for plant growth due to low temperatures rather than drought. Spring and fall are characterized by a rapid succession of warm and cold fronts associated with storm systems that generally move from a westerly direction. Summers are warm to hot. The higher humidity along the Atlantic coast causes the summer heat to feel more oppressive and the winter cold to feel more penetrating than for drier climates.

At times, the Appalachian Mountains provide some protection from arctic air outbreaks in the winter. The mountain barrier may cause warming of the air descending the eastern slopes by as much as 10°F (6°C). In situations when high pressure is located over New England and a low pressure system is over the Ohio Valley, cold low-level winds may travel southwestward and be held east of the mountains.

4.9.1.1 Winds

The prevailing winds at the surface are determined by the frequency and intensity of anticyclones and cyclones that persist or move over the area. The majority of anticyclonic circulation over the northern portion of North America in winter brings a high percentage of cold northwesterly winds to Maryland. Therefore, the prevailing winds are from the northwesterly quadrant from October through June. In the summer, this pattern changes as the semi-permanent Atlantic High moves northwestward and dominates the circulation of air over the eastern United States. A flow of warm, moist air spreads over the area with winds from the southwesterly quadrant most of the time. During the summer, the northern portion of North America is dominated by low pressure and the mean storm track is displaced north of Maryland. Surface mean wind speeds range from 9 to 10 mph (4 to 5 mps) in summer to 10 to 12 mph (5 to 5.4 mps) in winter and early spring. The highest mean wind speeds are associated with the frequent passages of well-developed cyclones and anticyclones in the early spring.

4.9.1.2 Storm Tracks

Almost all migrating cyclones and anticyclones cross the U.S. from west to east. The greater numbers of cyclones travel in a northeastward direction in a path about 300 to 500 mi (483 to 805 km) north of Maryland. Storms that originate in the Gulf of Mexico, the southeastern U.S. or adjacent Atlantic coastal regions, frequently move northeastward or northward along the Atlantic Coast and can bring violent, destructive weather to the Maryland region. As these storms, commonly referred to as “nor’easters” approach from the south, strong easterly to northeasterly winds bring widespread rains and cause higher than normal tides along the Atlantic Coast and on the west side of the Chesapeake Bay. Tropical cyclones or hurricanes that develop in the West Indies, the Caribbean, or the Gulf of Mexico sometimes move into, but rarely pass entirely over the State of Maryland. These systems also cause cloudy weather, heavy rains, and high tides.

4.9.1.3 Temperatures

Mean annual temperatures range from 48°F (9°C) in Northern Maryland to 58°F (14°C) in the lower Chesapeake Bay area. The winter climate on the Coastal Plain of Maryland is intermediate between the cold of the northeast and the mild weather of the South. The average frost penetration is about 5 in (12.7 cm) in extreme Southern Maryland; in extremely cold winters, maximum frost penetration may be double the average depth. Summer is characterized by considerable warm weather with at least several hot, humid periods. Nights are usually comfortable.

On the average, temperatures of 90°F (32°C) or higher occur 15 to 25 days per year along the shores of the Chesapeake Bay. The average number of days per year with minimum temperature of 32°F (0°C) or lower is about 80 along the shores of the southern Chesapeake Bay area. Average relative humidity is lower in the winter and early spring, from February through April, and highest in the late summer and early fall, from August to October.

4.9.1.4 Precipitation

Annual average precipitation is about 40 to 46 in (102 to 117 cm). Distribution is uniform throughout the year. Although the heaviest precipitation occurs in the summer, this is the season when severe droughts are most frequent. Summer precipitation is less dependable and more variable than in winter. Annual precipitation deficits of over 16 in (40 cm) occurred during extreme droughts of the 1930s, 1960s, and in the period from 1998-2002. Annual average snowfall along the coast ranges from 8 to 10 in (20 to 25 cm). Annual snowfall totals vary considerably from one year to another.

The most favorable situation for rain is when there is a well-developed high pressure system over New England or the St. Lawrence Valley and a well-developed low pressure system over Georgia, Tennessee or the Ohio Valley. The reverse of this situation usually produces clear, dry weather.

4.9.2 Severe Weather Phenomena

4.9.2.1 Tornadoes

Tornadoes occur infrequently in Maryland compared with areas such as the Great Plains. Of the ones that do occur, most are small and result in nominal losses. However, two strong tornadoes hit Central and Southern Maryland within an eight month period in 2001-2002. About 25% of the tornadoes occur in Southern Maryland. Approximately 70% of the tornadoes occur between 2:00 PM and 9:00 PM with most occurring from 3:00 PM to 6:00 PM. The annual average number of tornadoes and strong-violent tornadoes (F2-F5) are four and one, respectively. Late July is indicated as the date of maximum tornado threat for the part of Maryland that includes the CCNPP site.

In the period from January 1, 1950, through December 31, 2006, 12 tornados were reported in Calvert County. This corresponds to an annual average of 0.2 tornados per year. The magnitude of the tornados ranged from F0 to F2, as designated by the National Weather Service. An F0 tornado has estimated wind speeds less than 73 mph (33 mps). An F1 tornado has estimated wind speeds between 73 and 112 mph (33 and 50 mps). An F2 tornado has estimated wind speeds between 113 and 157 mph (50 and 70 mps). In Calvert County, the 12 tornadoes had paths with widths estimated to range from 51 to 600 ft (16 to 183 m).

4.9.2.2 Hurricanes and Tropical Storms

Hurricanes sometimes move into but rarely pass entirely over the CCNPP site. National Hurricane Center statistics list only two direct hits on Maryland during the period from 1851 to 2004; neither of these was a major (greater than Category 2) hurricane. Note that the Saffir-Simpson Hurricane Scale ranks hurricanes on a scale of 1-5 based on the intensity of the storm. In the eastern U.S., hurricane season begins June 1st and ends November 30th.

The NOAA Coastal Services Center reports that there were 96 tropical storms and hurricanes that passed within 100 nautical miles (185 km) of Calvert County, Maryland, during the period from 1851 through 2005. Of these 96 events, eight were Category 1 hurricanes, two were Category 2 hurricanes, and one was a Category 3 hurricane. The hurricanes occurred in the months of August, September, and October. The tropical storms occurred in the months of July, August, September, and October. In addition to the hurricanes and tropical storms, there were 41 extratropical storms, 33 tropical depressions, and four subtropical depressions that passed within 100 nautical miles (185 km) of Calvert County, Maryland, during the period from 1851 through 2005.

Recent hurricanes and tropical storms affecting Calvert County include:

- September 1, 2006 – the remnants of Tropical Storm Ernesto dropped between 7 and 10 in (18 to 28 cm) of rain in Calvert County.

- September 19-20, 2003 – the remnants of Hurricane Isabel dropped approximately 1.5 in (3.5 cm) of rain in Calvert County over two days.

- July 3, 2003 – the remnants of Tropical Storm Bill dropped between 1 and 3 in (2.54 and 7.62 cm) of rain in parts of Calvert County.

- June 15, 2001 – the remnants of Tropical Storm Allison dropped between 1.5 and 3.5 in (3.8 and 8.9 cm) of rain in Calvert County.

4.9.2.3 Thunderstorms

Thunderstorms are reported at any given station in the vicinity of Calvert County on an average of 30 to 40 days per year based on information from the National Climatic Data Center. They occur in all months of the year, but the majority occur in May through August (75% to 80%). They occur less than once per month from November to February. Thunderstorms are most likely to occur during the afternoon and evening hours.

4.9.2.4 Lightning

The methodology for estimating lightning strike frequencies includes consideration of the attractive area of structures. The method consists of determining the number of lightning flashes to earth per year per square kilometer and then defining an area over which the structure can be expected to attract a lightning strike. There are four flashes to earth per year per square kilometer in the vicinity of the CCNPP site. The total attractive area, A, of a structure with length L, width W, and height H, for lightning flashes with a current magnitude of 50% of all lightning flashes is defined as:

$$A = LW + 4H (L + W) + 12.57 H^2$$

The following building dimensions were used to conservatively estimate the attractive area of CCNPP Unit 3 (these values are much larger than the dimensions for the tallest building which measure approximately 58 m x 58 m x 60 m; they are also larger than the approximate dimensions of the combined containment, the four safeguards buildings, the access building, the fuel building, and the nuclear auxiliary building):

L = 215 m, W = 140 m, H = 40 m

The total attractive area is therefore equal to 0.11 square kilometers. Consequently, the lightning strike frequency computed using Marshall's methodology for CCNPP Unit 3 is 0.44 flashes per year.

4.9.2.5 Droughts

Droughts in Calvert County occur most frequently during the summer season based on data from the National Climatic Data Center. Annual precipitation deficits of over 16 in (40 cm) occurred during extreme droughts of the 1930s, 1960s, and in the period of 1998-2002.

4.9.2.6 High Winds

Occurrences of winds greater than 50 knots (58 mph (94.34 kph)) observed in Calvert County were retrieved from the National Climatic Data Center. During the period from June 2, 1980, through December 31, 2006, there were 17 recorded occurrences of wind speed ranging from 50 to 90 knots (58 to 104 mph (94.34 to 167.33 kph)). The highest wind speed of 90 knots (104 mph (167.33 kph)) was recorded on April 21, 2000, during a thunderstorm. The second highest wind speed of 67 knots (78 mph (125.52 kph)) was recorded on October 8, 1996, during a wind event.

4.9.2.7 Hail

Twenty hail events were reported in Calvert County between October 9, 1962, and December 31, 2006. These data were retrieved from the National Climatic Data Center. Hail stone diameters ranged from 0.75 to 2 in (1.9 to 5.1 cm). The largest hail stone diameter was recorded on July 15, 1996.

4.9.2.8 Ice Storms

Five ice storm events were reported in Calvert County between January 14, 1999, and December 31, 2006. These data were retrieved from the National Climatic Data Center. Ice thickness ranged from 0.2 to 1 in (0.5 to 2.5 cm). The largest ice accumulation was recorded on January 30, 2000.

4.9.2.9 Snow Storms

Twenty-five snow storm events occurred in Calvert County between December 28, 1993, and December 31, 2006. These data were retrieved from the National Climatic Data Center. Snow amounts ranged from a trace to 16.5 inches (41.9 cm).

4.9.3 Local Meteorology

The local meteorological conditions of the CCNPP site and the surrounding area are taken into account by using onsite (CCNPP) and offsite National Weather Service (NWS) data sources. The onsite meteorological program has been recording data since the 1970s. The NWS is from three sites – BWI Airport, Norfolk, VA, and Richmond, VA.

The meteorological tower for the CCNPP site is located in an open field off Calvert Cliffs Parkway north of the CCNPP Unit 1 and 2 Independent Spent Fuel Storage Installation (ISFSI). The elevation at the base of the tower is approximately 125 ft (38 m) above mean sea level (msl). The tower instrumentation consists of wind speed, wind direction, and duplicate sets of aspirated temperature sensors located at 197 ft (60 m) and 33 ft (10 m) above ground level. A tipping bucket rain gauge is located approximately 30 ft (9.1 m) from the meteorological tower in an open field and a barometric pressure device is located in the Met Building. No moisture measurements (dew point or wet bulb temperature, relative humidity) are currently taken. The onsite meteorological monitoring program was designed, and has been operated, according to U.S. NRC Regulatory Guide 1.23, Revision 0. The data recovery goal of 90% was met for each of the six years of data (2000 through 2005).

4.9.3.1 Temperature and Relative Humidity

For the period from January 2000 through December 2005, the monthly mean temperature at the CCNPP site ranged from 34.3°F (1.3°C) in January to 75.1°F (23.9°C) in July. The monthly mean extreme maximum temperature was 78.3°F (25.7°C) in July and the monthly mean extreme minimum temperature was 29.5°F (-1.4°C) in January. The monthly mean daily maximum temperature was 81.8°F (27.7°C) in July and the monthly mean daily minimum temperature was 28.5°F (-1.9°C) in January. The maximum hourly temperature was 96.3°F (35.7°C) in July and the minimum hourly temperature was 8.5°F (-13.1°C) in December. The frequency of occurrence of hourly temperature values falling below the freezing point (32°F or 0°C) is less than 10%.

4.9.3.2 Precipitation and Fog

For the period from January 2000 through December 2005, the monthly mean precipitation at the CCNPP site ranged from 1.53 in (38.86 mm) in February to 4.54 in (115.06 mm) in July. Annual precipitation was 35.06 in (890.52 mm). Monthly percent frequency of occurrence of precipitation at the CCNPP site ranged from 4.26% in September to 7.87% in April. Heavy rainfalls occur infrequently at the CCNPP site – rainfall rates in excess of 0.5 in/hr (12.7 mm/hr) occurred less than 0.06% of the time during the 6-year period. The extreme hourly precipitation was 2.2 in (55.9 mm) on April 15, 2003.

The monthly mean number of days with heavy fog at the three NWS sites for the period 1971-2000 was obtained. The annual average number of days with heavy fog reported was 19.7 days at Norfolk, 24.4 days at BWI Airport, and 27.1 days at Richmond. The frequency of heavy fog is relatively evenly distributed throughout the year.

4.9.3.3 Monthly Mixing Heights

Monthly average mixing height values for the period 1996-2005 were calculated from the daily average values for each month of each year based on twice daily mixing height data from the National Climatic Data Center. These data were taken from the upper air and surface NWS stations closest to the CCNPP site (i.e., Wallops Island and Patuxent River, respectively). Overall monthly average mixing height values were calculated from the individual monthly average values; for example, the January overall monthly average mixing height value of 1978 ft (603 m) is the average of all of the individual January mixing height values. The monthly average mixing heights ranged from 1,880 ft (573 m) in December to 2,959 ft (902 m) in July. The annual average mixing height was 2,454 ft (748 m).

4.9.3.4 Wind Speed and Direction

Figures 4.9-1 and 4.9-2 depict annual wind rose plots of the CCNPP 2000-2005 meteorological data for the 33 ft (10 m) and 197 ft (60 m) elevations.

The annual prevailing wind direction (the direction from which the wind blows most often) at the CCNPP site at the 33 ft (10 m) level is from the southwest, approximately 14% of the time. Winds from the southwest through west sectors occur approximately 26% of the time. Conversely, winds from the northeast through east sectors occur approximately 14% of the time. The annual prevailing wind direction at the 197 ft (60 m) level is from the southwest, approximately 10% of the time. Winds from the southwest through west sectors occur approximately 20% of the time. Conversely, winds from the northeast through east sectors occur approximately 13% of the time. As is normally the case, there are more observations of calm winds at the lower level than at the upper level (0.33% versus 0.03%). At both the 33 ft (10 m) and 197 ft (60 m) levels, winds occur most infrequently from the east-southeast.

During the winter months (December through February), the prevailing wind direction at both levels is from the northwest, approximately 13% of the time at both levels. Winds from the southwest are the next most dominant, occurring approximately 11% of the time at the 33 ft (10 m) level and approximately 9% of the time at the 197 ft (60 m) level. During the spring months (March through May), the prevailing wind direction at both levels is from the southwest, approximately 12% of the time at the lower level and 11% of the time at the upper level.

During the summer months (June through August), the prevailing wind direction at both levels is from the southwest, approximately 18% of the time at the lower level and 14% of the time at the upper level. During the autumn months (September through November), the prevailing wind direction at the 33 ft (10 m) level is from the southwest, approximately 12% of the time. At the 197 ft (60 m) level, the prevailing wind directions are from the north-northeast and from the south-southwest, approximately 9% of the time. The north-northeast flow dominates in September and October and the south-southwest flow dominates in November.

The most prevalent wind speed class on an annual basis for the 33 ft (10 m) level is the 4 to 7 mph (1.8 to 3.1 mps) class, which occurs approximately 47% of the time. The most prevalent wind speed class on an annual basis for the 197 ft (60 m) level is the 8 to 12 mph (3.6 to 5.4 mps) class, which occurs approximately 40% of the time.

On a seasonal basis, the most prevalent wind speed class for the 33 ft (10 m) level is the 4 to 7 mph (1.8 to 3.1 mps) class which occurs approximately 42% of the time during the winter months (December through February), 45% of the time during the spring months (March through May), 54% during the summer months (June through August), and 46% during the autumn months (September through November). At the 197 ft (60 m) level, the most prevalent wind speed class is the 8 to 12 mph (3.6 to 5.4 mps), which occurs approximately 38% during the winter months (December through February), 38% during the spring months (March through May), 47% during the summer months (June through August), and 38% during the autumn months (September through November).

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Legend

- CCNPP Site Boundary
- Substation
- Transmission Line
- Primary Highway with Limited Access
- Primary Road
- Urban Area
- County Boundary
- Delaware
- Maryland
- Virginia
- Water

FIGURE 4.1-1 Rev. 0

CCNPP SITE 500 kV CIRCUIT CORRIDORS

CCNPP UNIT 3 CPCN

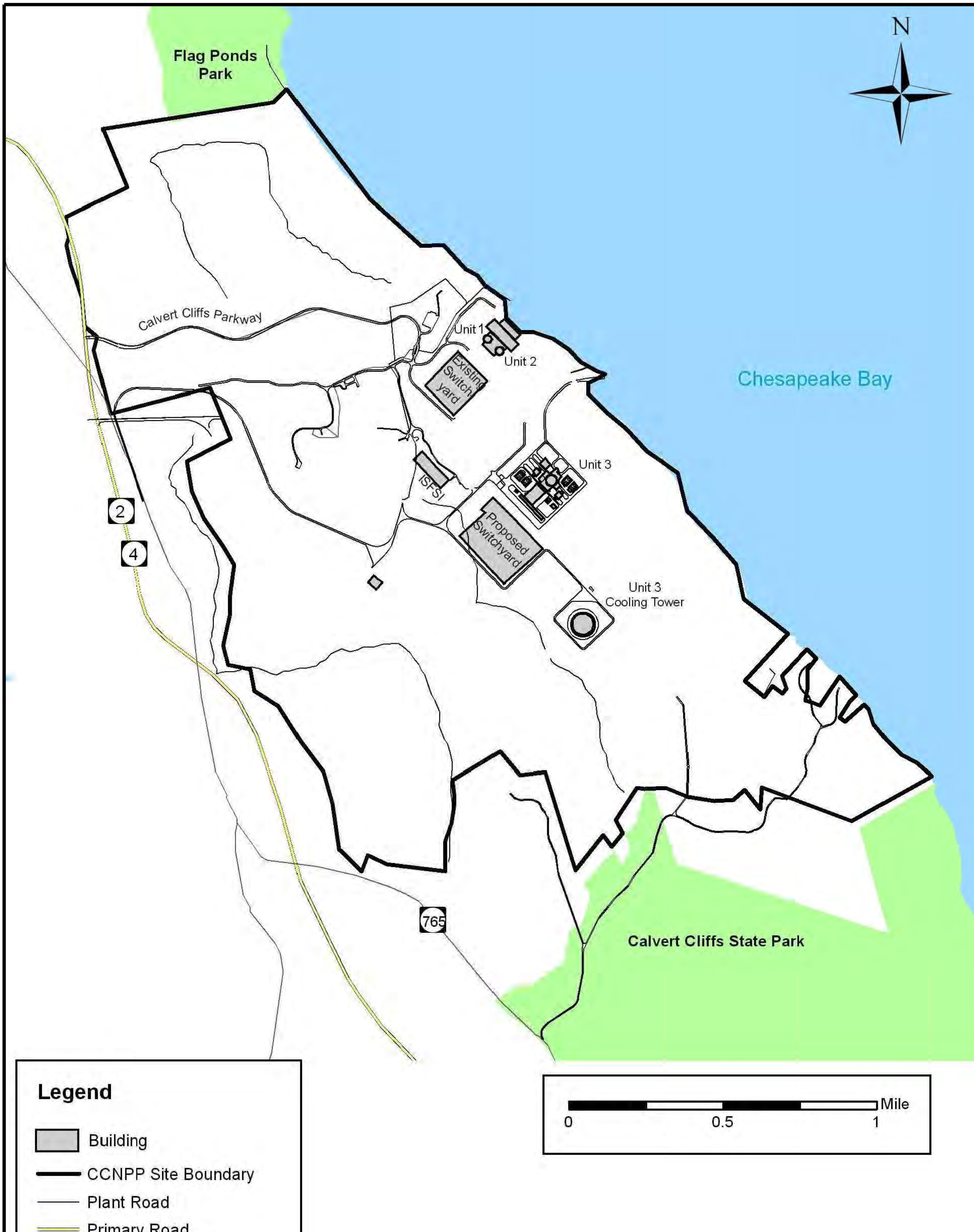


FIGURE 4.1-2 **Rev. 0**

CCNPP SITE AND PROPOSED NEW PLANT LAYOUT

CCNPP UNIT 3 CPCN

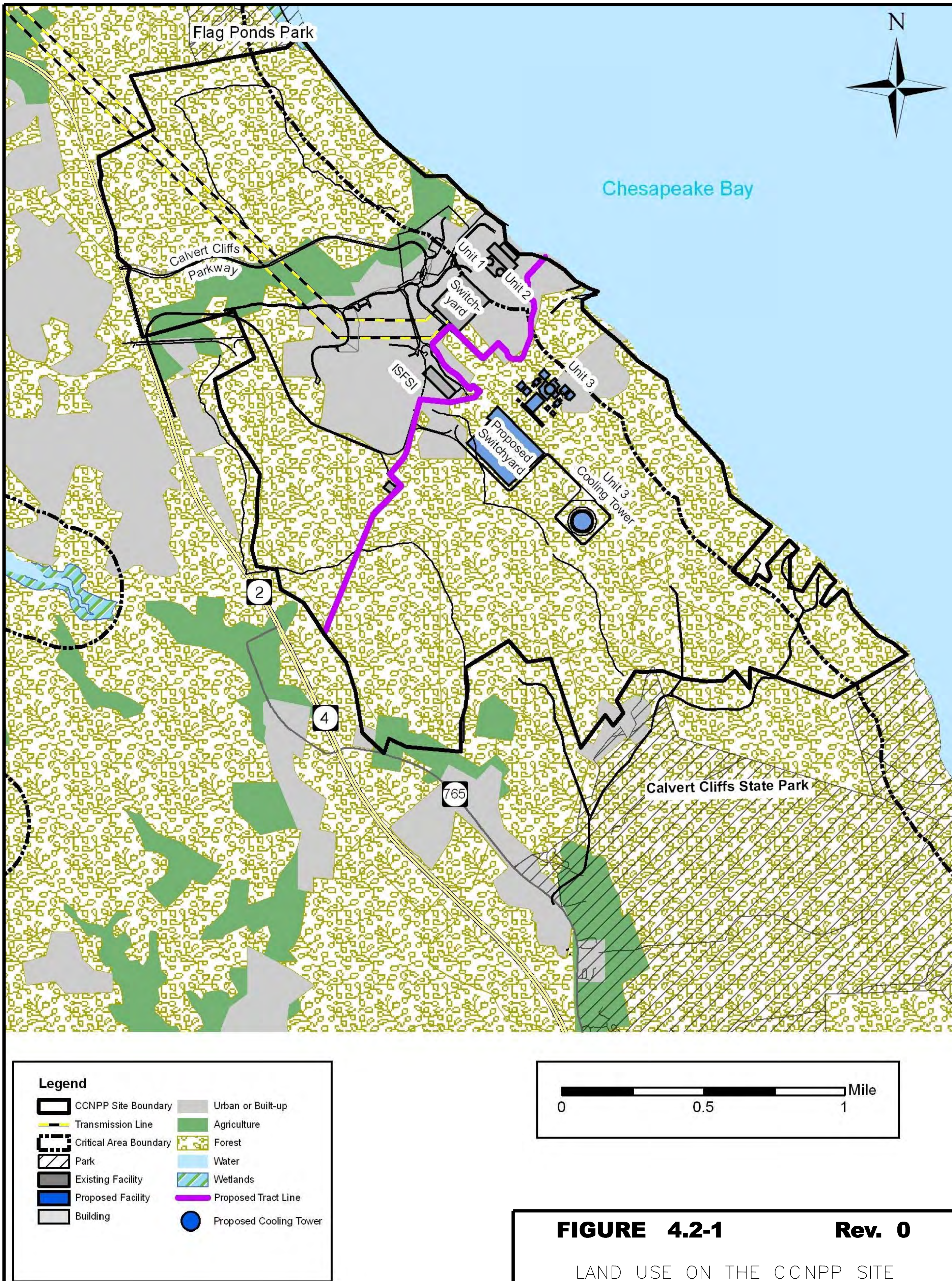


FIGURE 4.2-1 **Rev. 0**

LAND USE ON THE CCNPP SITE

CCNPP UNIT 3 CPCN

Figure 4.2-2 **Rev. 0**

CCNPP 8 mi (13 km) Land Use

CCNPP Unit 3 CPCN

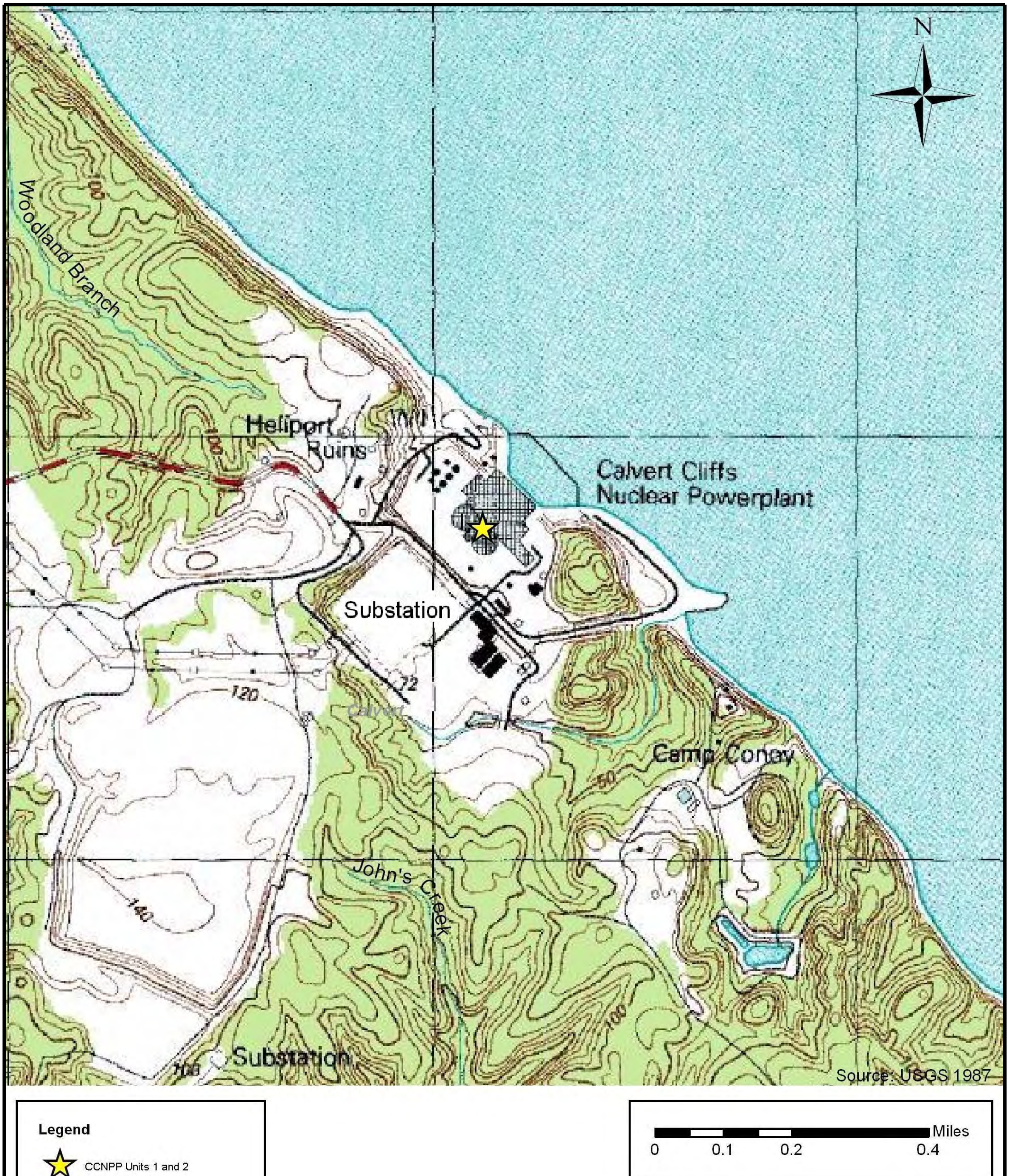


FIGURE 4.2-3 **Rev. 0**

CCNPP SITE TOPOGRAPHIC MAP

CCNPP UNIT 3 CPCN

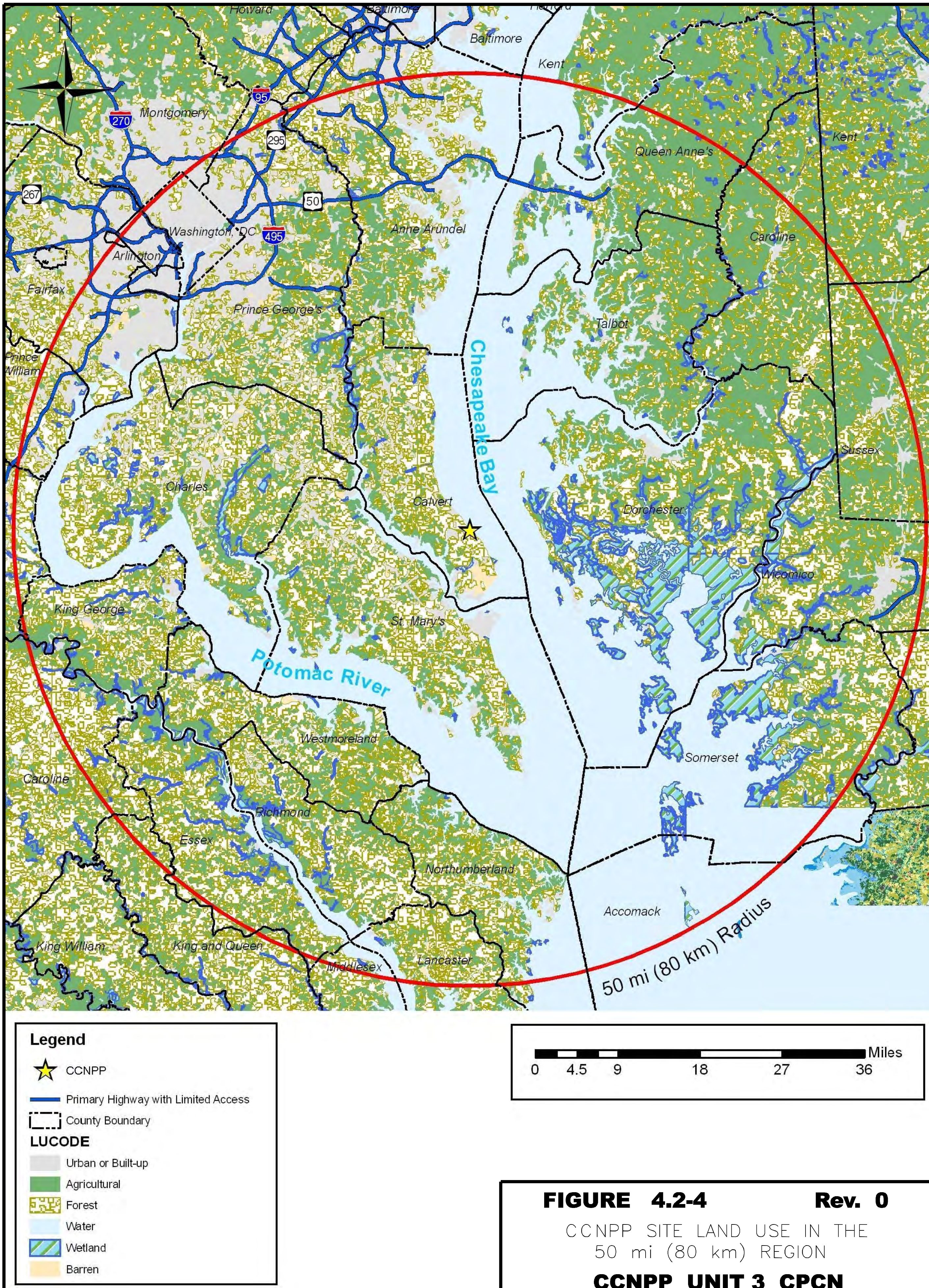


FIGURE 4.2-4 **Rev. 0**

CCNPP SITE LAND USE IN THE 50 mi (80 km) REGION

CCNPP UNIT 3 CPCN

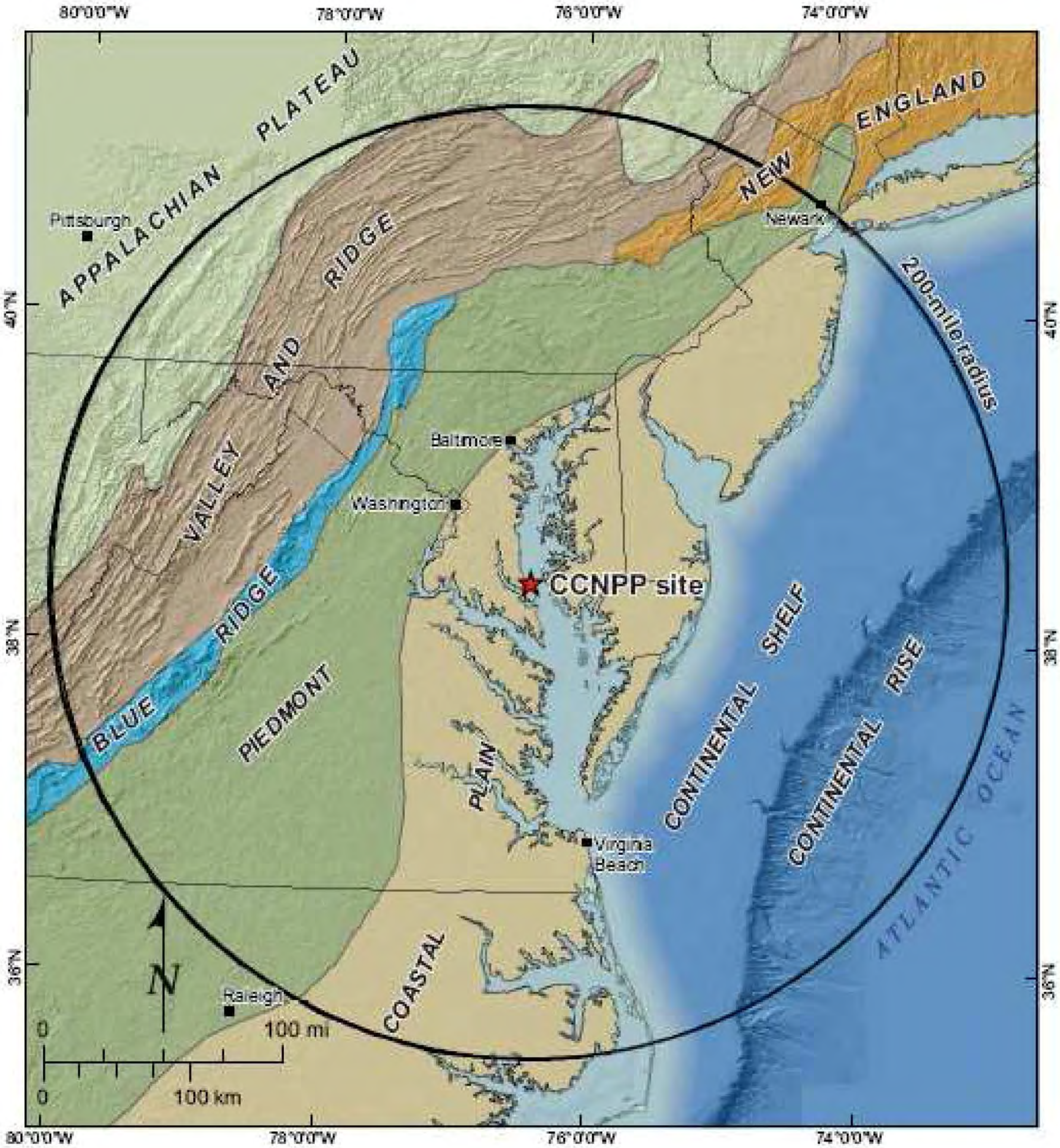


FIGURE 4.3-1 **Rev. 0**

MAP OF REGIONAL PHYSIOGRAPHIC PROVINCES

CCNPP UNIT 3 CPCN

ERA	PERIOD	EPOCH		AGE (Ma)	UNIT	THICKNESS (FT)
Cenozoic	Quarter-nary	Holocene		0.01	**Alluvium & Beach Deposits**	0-50
		Pleistocene		1.8	**Terrace & Lowland Deposits**	
	Tertiary	Pliocene		5.3	**Upland Deposits**	0-50
		Miocene	Upper	11.2		
			Middle	16.4	**Chesapeake Group** St. Marys Formation Choptank Formation Calvert Formation	245-280
		Eocene	Middle	49	**Piney Point Formation**	20
			Lower	54.8	**Nanjemoy Formation**	180
		Paleocene	Upper	61	**Marlboro Clay** **Aquia Formation**	165-170
			Lower	65	**Brightseat Formation**	10-20
Mesozoic	Cretaceous	Upper		99	**Magothy, Monmouth, Matawan Formations undifferentiated**	30?
		Lower		144	**Potomac Group** **Patapsco Formation** **Arundel/Patuxent Formations (undivided)**	1000-1100 750-900
Proterozoic/ Paleozoic				543+	**Metamorphic/Igneous**	Not Known

FIGURE 4.3-2 **Rev. 0**

CCNPP SITE–SPECIFIC STRATIGRAPHIC COLUMN

CCNPP UNIT 3 CPCN

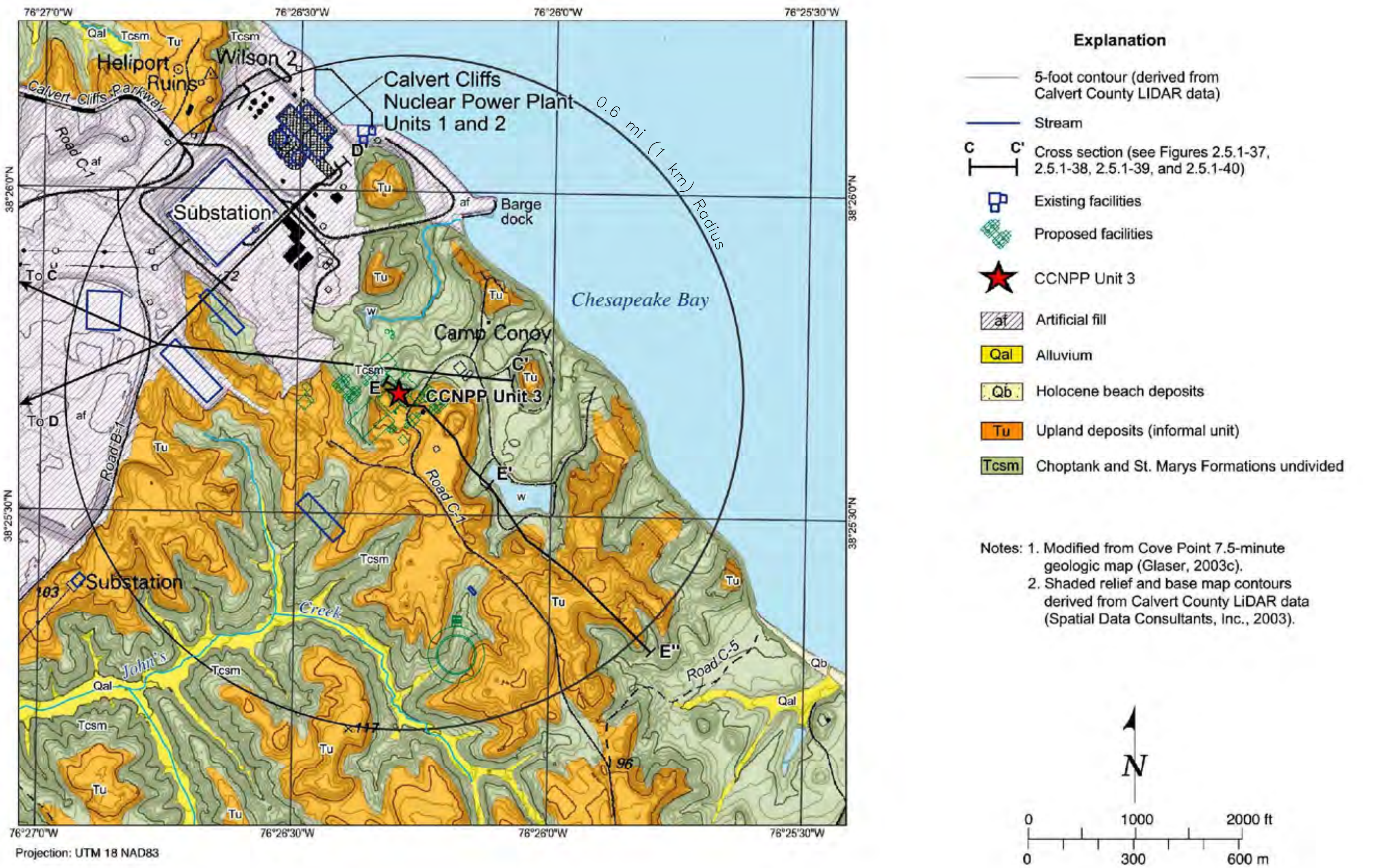


FIGURE 4.3-3 **Rev. 0**

CCNPP SITE 0.6 mi (1 km) GEOLOGIC MAP

CCNPP UNIT 3 CPCN

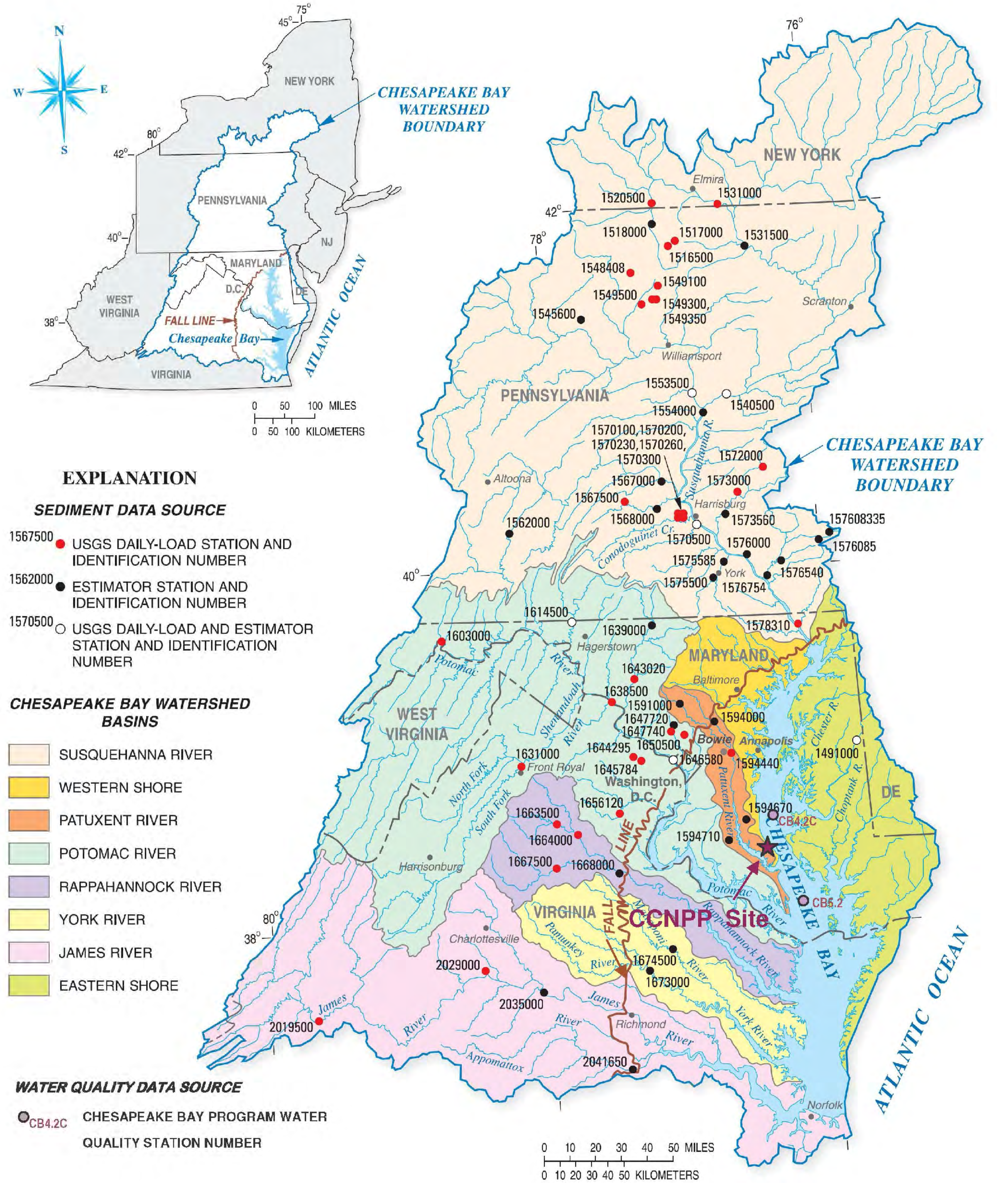


FIGURE 4.4-1 **Rev. 0**

CHESAPEAKE BAY WATERSHED

CCNPP UNIT 3 CPCN

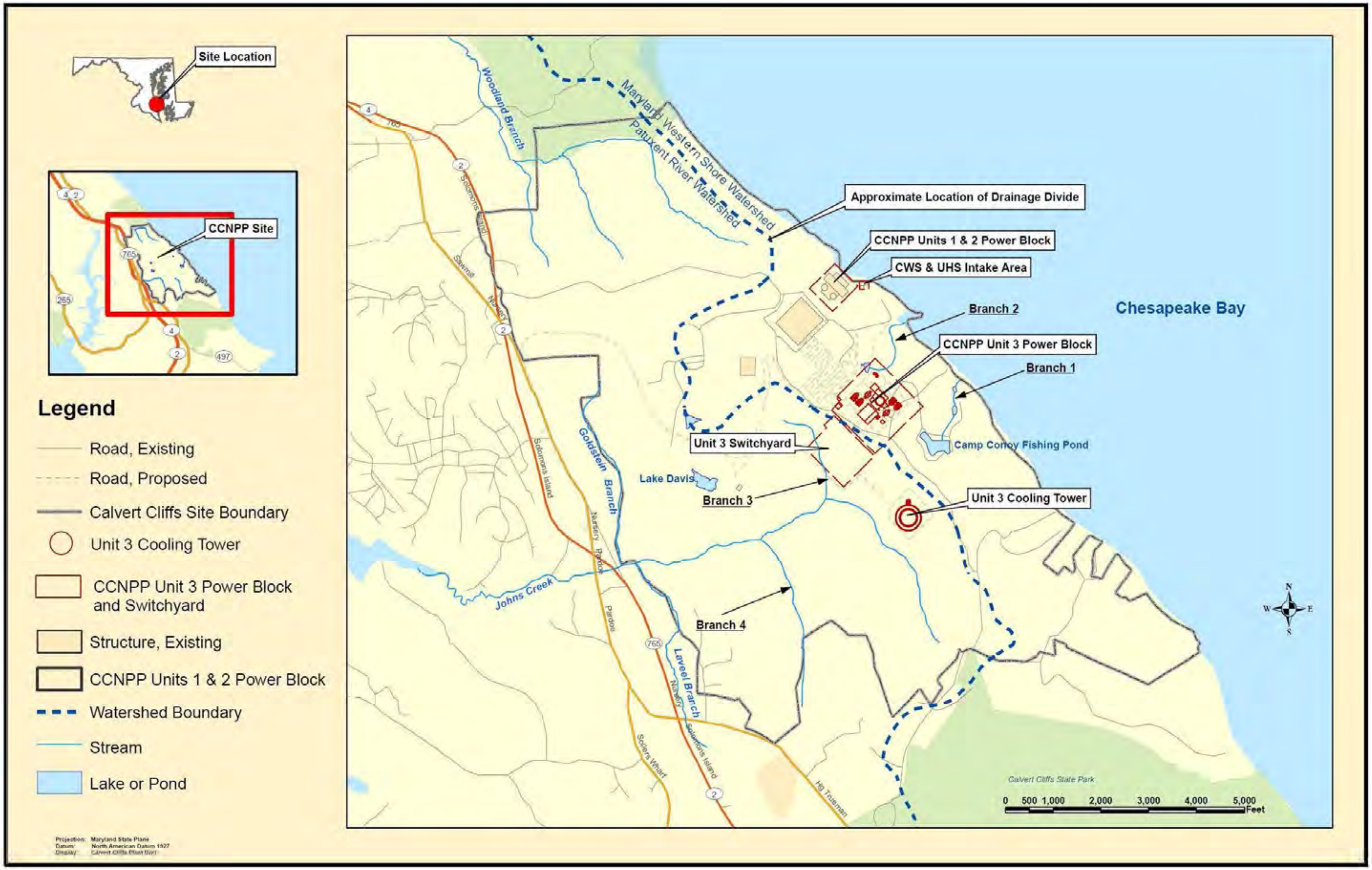


FIGURE 4.4-2 **Rev. 0**

CCNPP SITE AREA TOPOGRAPHY AND DRAINAGE

CCNPP UNIT 3 CPCN

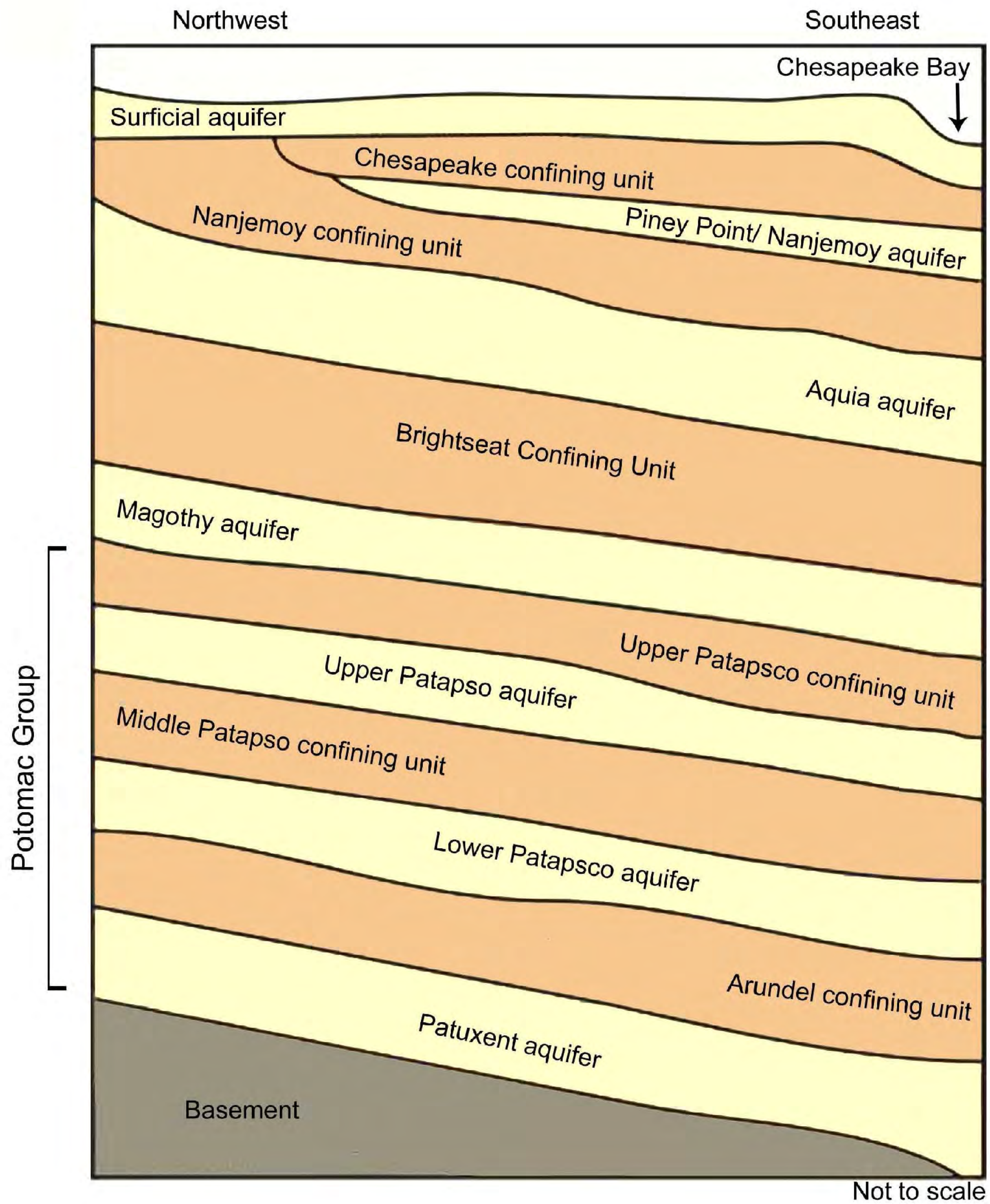


FIGURE 4.4-3 **Rev. 0**

SCHEMATIC CROSS-SECTION OF SOUTHERN MARYLAND HYDROSTRATIGRAPHIC UNITS

CCNPP UNIT 3 CPCN

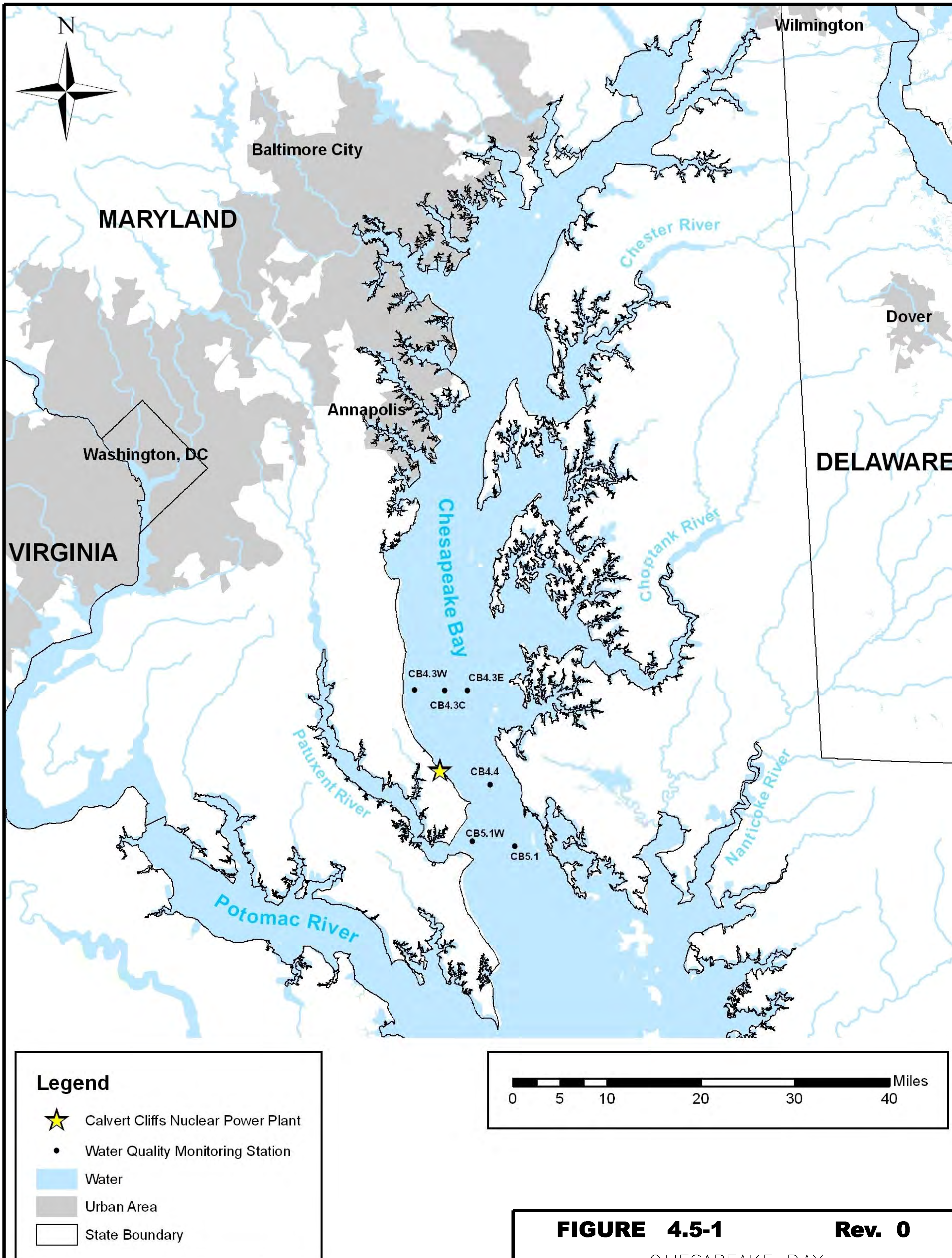


FIGURE 4.5-1 **Rev. 0**

CHESAPEAKE BAY
WQ MONITORING STATIONS

CCNPP UNIT 3 CPCN

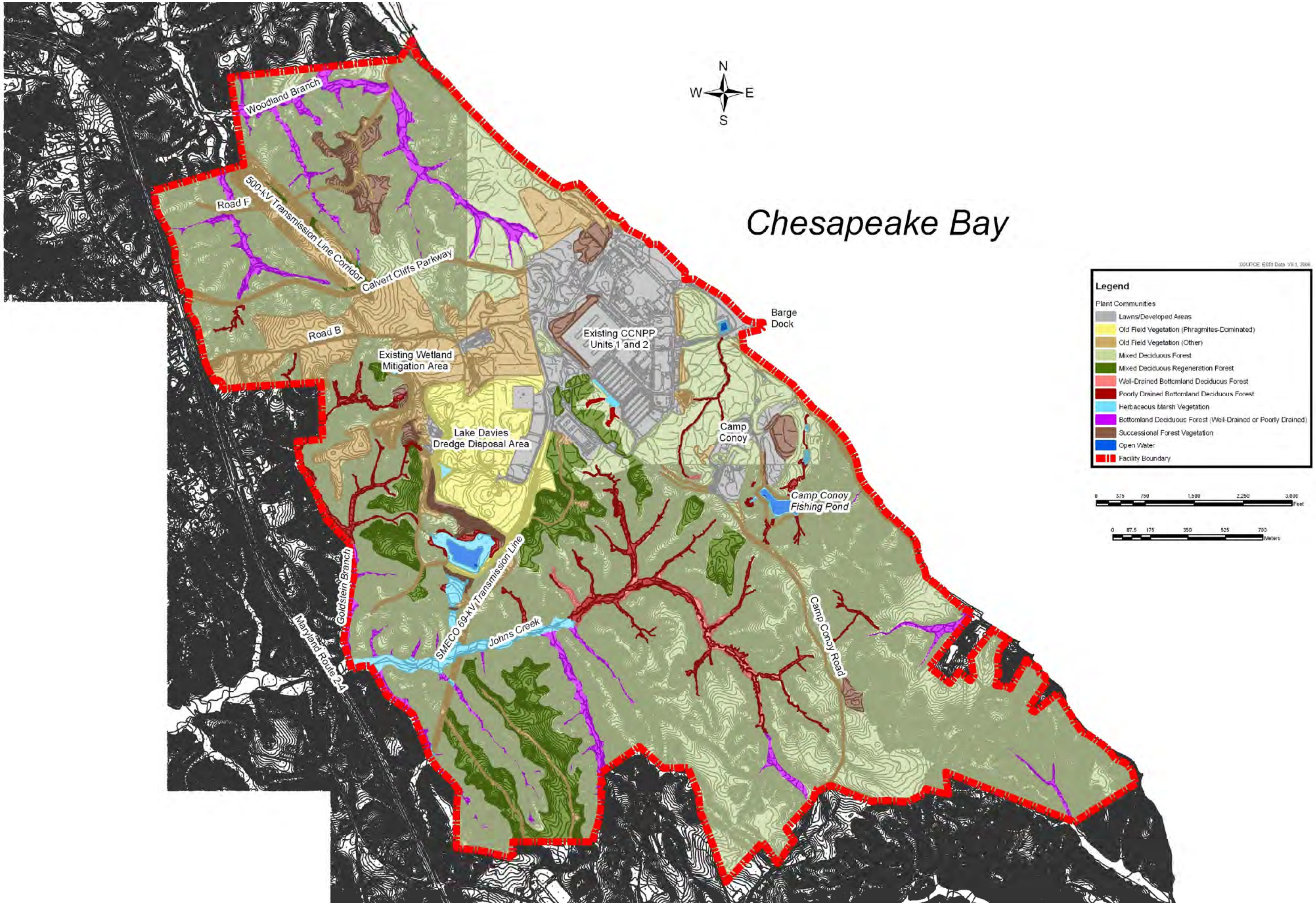
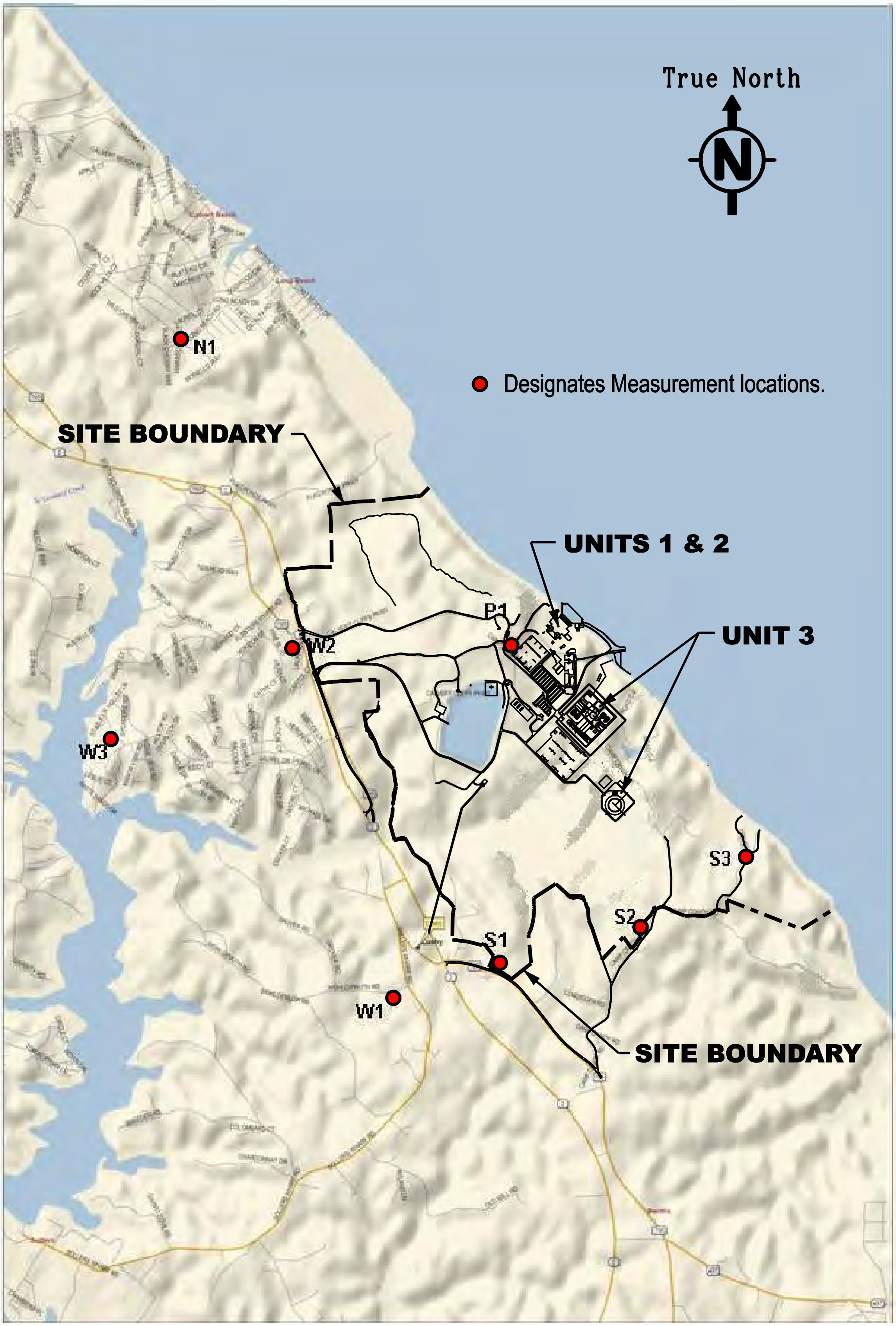


FIGURE 4.6-1 **Rev. 0**

PLANT COMMUNITY
(NATURAL HABITAT MAP)

CCNPP UNIT 3 CPCN



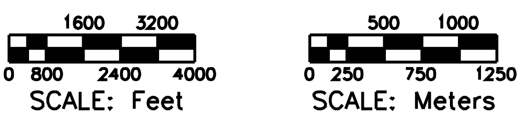


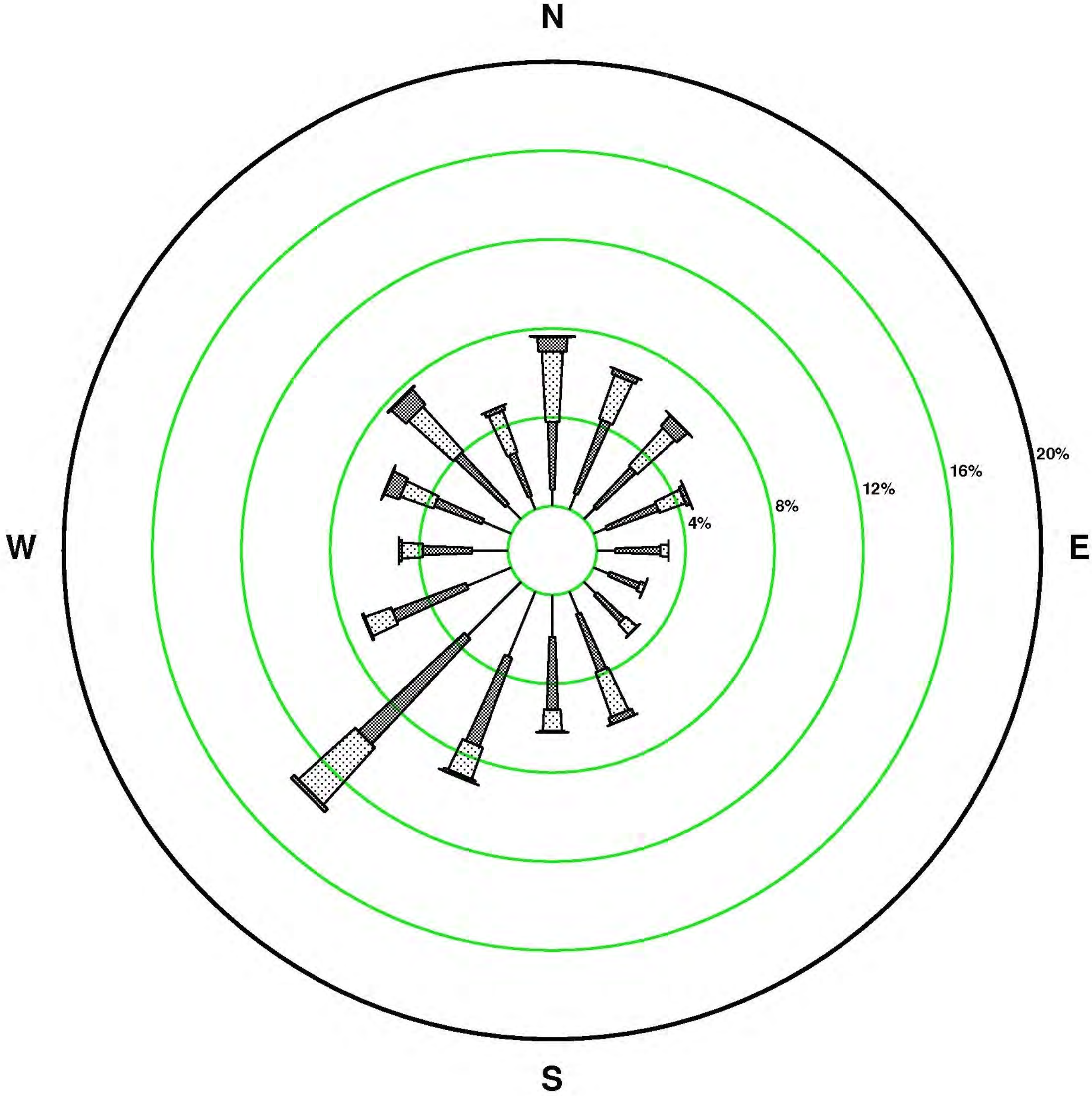
FIGURE 4.8-1 **Rev. 0**

BASELINE SOUND SURVEY MEASUREMENT LOCATIONS

CCNPP UNIT 3 CPCN

CC STATION JAN 2000 – DEC 2005

33–FOOT WIND DATA



STABILITY CLASS ALL

CALM WINDS 0.33%

NOTE: Frequencies indicate direction from which the wind is blowing.

WIND SPEED (MPH)

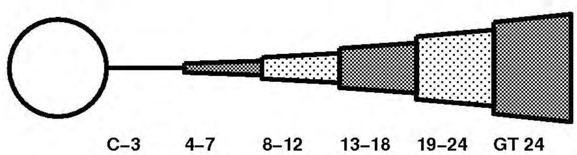


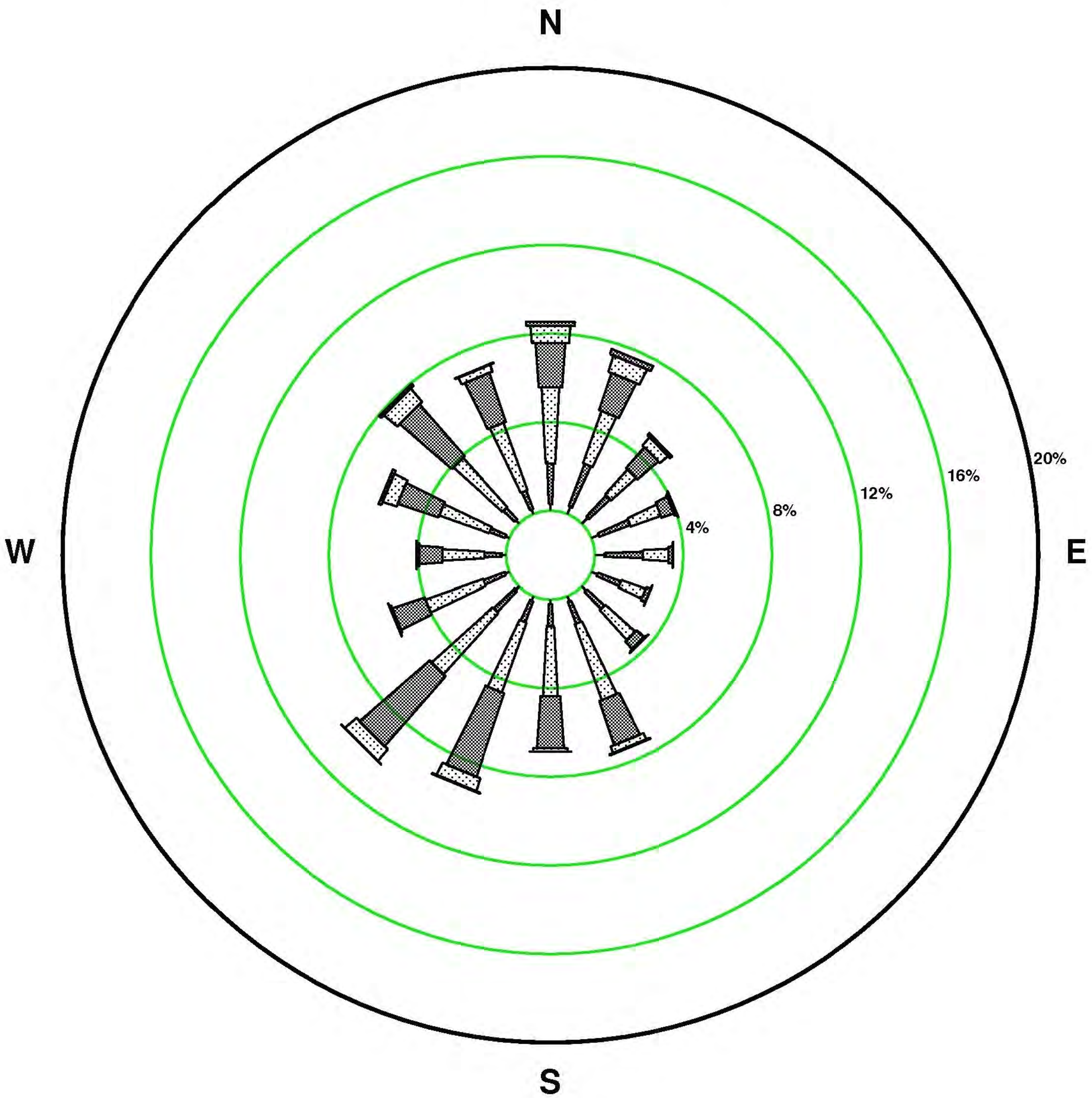
FIGURE 4.9-1 **Rev. 0**

CCNPP 33 ft (10m) ANNUAL WIND ROSE

CCNPP UNIT 3 CPCN

CC STATION JAN 2000 – DEC 2005

197–FOOT WIND DATA



STABILITY CLASS ALL

CALM WINDS 0.03%

NOTE: Frequencies indicate direction from which the wind is blowing.

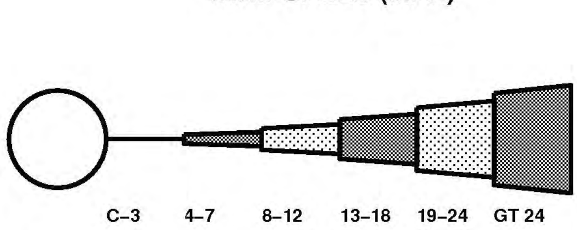


FIGURE 4.9-2 **Rev. 0**

CCNPP 197 ft (60m) ANNUAL WIND ROSE

CCNPP UNIT 3 CPCN