Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

September 20, 2013

10 CFR Part 51

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Sequoyah Nuclear Plant, Units 1 and 2
Facility Operating License Nos. DPR-77 and DPR-79
NRC Docket Nos. 50-327 and 50-328

Subject: **Documents for the Environmental Review of the Sequoyah Nuclear Plant, Units 1 and 2, License Renewal Application – Env 2.B (TAC Nos. MF0057 and MF0058)**

References:
1. TVA Letter to NRC, "Sequoyah Nuclear Plant, Units 1 and 2 License Renewal," dated January 7, 2013 (ADAMS Accession No. ML13024A004)
2. TVA Letter to NRC, "Response to NRC Request for Additional Information Regarding the Environmental Review of the Sequoyah Nuclear Plant, Units 1 and 2, License Renewal Application," dated July 23, 2013 (ADAMS Accession No. ML13206A385)

By letter dated January 7, 2013 (Reference 1), Tennessee Valley Authority (TVA) submitted an application to the Nuclear Regulatory Commission (NRC) to renew the operating license for the Sequoyah Nuclear Plant (SQN), Units 1 and 2. The request would extend the license for an additional 20 years beyond the current expiration date.

By letter dated July 23, 2013 (Reference 2), TVA replied to an NRC request for additional information (RAI) which included an Environmental Reference List of documents that were placed on the Certrec site to facilitate NRC staff review. In an email to TVA on September 6, 2013, Mr. David Drucker, the NRC Environmental Project Manager, requested that specific documents be docketed. Enclosure 1 of this letter contains a Compact Disc (CD) with the requested documents.

Enclosure 2 provides a revision to specific pages of the SQN Environmental Report submitted in Reference 1. The revisions reflect TVA's responses to the NRC RAI in Reference 2.

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There are no new regulatory commitments contained in this submittal.

Consistent with the standards set forth in 10 CFR 50.92(c), TVA has determined that the additional information, as provided in this letter, does not affect the no significant hazards considerations associated with the proposed application previously provided in Reference 1.

Please address any questions regarding this submittal to Henry Lee at (423) 843-4104.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on this 20th day of September 2013.

Respectfully,

J. W. Shea
Vice President, Nuclear Licensing

Enclosures:
1. Environmental Documents CD – Env 2.B
2. Revision to specific pages of the SQN Environmental Report

cc (Enclosures):
NRC Regional Administrator – Region II
NRC Senior Resident Inspector – Sequoyah Nuclear Plant

ENCLOSURE 1

Tennessee Valley Authority

Sequoyah Nuclear Plant, Units 1 and 2 License Renewal

Environmental Documents CD – Env 2.B

Note: The numbers provided in front of the documents listed below refer to the specific questions in the request for additional information (RAI), dated June 7, 2013, from the U.S. Nuclear Regulatory Commission to the Tennessee Valley Authority (ADAMS No. ML13136A358).

Hydrology - Surface Water Resources

1. 1.a.i SQN NPDES Permit renewal application, dated May 2, 2013

2. 1.b Enclosure_1.b.i-1, TVA. 2013. "Study to Confirm the Calibration of the Numerical Model for the Thermal Discharge from Sequoyah Nuclear Plant as Required by NPDES Permit No. TN0026450 of March 2011," WR2013-1-45-152, dated April 2013
3. 1.b Enclosure_1.b.i-2, TVA. 2013. "Estimation of River Flow at Sequoyah Nuclear Plant for NPDES Thermal Compliance". TVA white paper prepared in support of RAI 1.b.i, dated May 2013

4. 1.b.ii.1 Enclosure 1.b.ii-1, Sensitivity of the TVA Reservoir and Power Supply Systems to Extreme Meteorology," Report No. WR28-1-680-111, TVA Engineering Laboratory, Norris, Tennessee, June 1993
5. 1.b.ii.2 Enclosure_1.b.ii-2, River temp, 2007-2013 Excel file containing the SQN daily maximum, 24-hour average upstream ambient river temperature for the from June 2007 through May 2013
6. 1.b.ii.3 Enclosure_1.b.ii-3, SQN NPDES Permit No. TN0026450, expire on 10/31/13 "NPDES Permit No. TN0026450, Authorization to discharge under the NPDES." Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Nashville, Tennessee. January 31, 2011
7. 1.b.ii.4 Enclosure_1.b.ii-4, Potential Impact of Climate Change on Natural Resources in the TVA Region EPRI (2009). "Potential Impact of Climate Change on Natural Resources in the TVA Region." Electric Power Research Institute, Palo Alto, California. November 2009

8. 1.b.iii Enclosure_1.b.iii.xlsx

9. 1.c.i.1 Enclosure_1.c.i-1.pdf, 29p additional information related to the re-entrainment of diffuser effluent
10. 1.c.i.2 Enclosure_1.c.i_2007.xlsx Thermal Discharges data
11. 1.c.i.3 Enclosure_1.c.i_2008.xlsx Thermal Discharges data
12. 1.c.i.4 Enclosure_1.c.i_2009.xlsx Thermal Discharges data
13. 1.c.i.5 Enclosure_1.c.i_2010.xlsx Thermal Discharges data
14. 1.c.i.6 Enclosure_1.c.i_2011.xlsx Thermal Discharges data
15. 1.c.i.7 Enclosure_1.c.i_2012.xlsx Thermal Discharges data
16. 1.c.i.8 Enclosure_1.c.i_2013.xlsx Thermal Discharges data

17. 1.c.ii Enclosure_1.c.ii.xlsx CTLP data
18. 1.c.iii Enclosure_1.c.iii.xlsx CTLP data

19. 1.c.iv.1 Enclosure_1.c.iv_Flow&Stage_2007.xlsx, river flow and reservoir stage
20. 1.c.iv.2 Enclosure_1.c.iv_Flow&Stage_2008.xlsx, river flow and reservoir stage
21. 1.c.iv.3 Enclosure_1.c.iv_Flow&Stage_2009.xlsx, river flow and reservoir stage
22. 1.c.iv.4 Enclosure_1.c.iv_Flow&Stage_2010.xlsx, river flow and reservoir stage
23. 1.c.iv.5 Enclosure_1.c.iv_Flow&Stage_2011.xlsx, river flow and reservoir stage
24. 1.c.iv.6 Enclosure_1.c.iv_Flow&Stage_2012.xlsx, river flow and reservoir stage
25. 1.c.iv.7 Enclosure_1.c.iv_Flow&Stage_2013.xlsx. river flow and reservoir stage
26. 1.c.iv.8 Enclosure_1.c.iv_Temps_2007.xlsx, river temperature
27. 1.c.iv.9 Enclosure_1.c.iv_Temps_2008.xlsx, river temperature
28. 1.c.iv.10 Enclosure_1.c.iv_Temps_2009.xlsx, river temperature
29. 1.c.iv.11 Enclosure_1.c.iv_Temps_2010.xlsx, river temperature
30. 1.c.iv.12 Enclosure_1.c.iv_Temps_2011.xlsx, river temperature
31. 1.c.iv.13 Enclosure_1.c.iv_Temps_2012.xlsx, river temperature
32. 1.c.iv.14 Enclosure_1.c.iv_Temps_2013.xlsx. river temperature

33. 1.c.v.1 Enclosure_1.c.v-1.pdf TVA (2009), "Ambient Temperature and Mixing Zone Studies for SQN as Required by NPDES Permit No. TN0026450 of September 2005," Report No.WR2009-1-45-151, TVA, River Operations, January 2009
34. 1.c.v.2 Enclosure_1.c.v-2.pdf TVA (1990), "The Effect Of SQN On Dissolved Oxygen In Chickamauga Reservoir", Report No. TVA/WR/WQ--90/10, TVA, Resource Development, River Basin Operations, Water Resources, September 1990
35. 1.c.v.3 Enclosure_1.c.v-3.xlsx Excel file containing hourly 10-meter average wind speed and wind direction data from the SQN Environmental Data Station for the period of record from January 2000 through May 2013

36. 1.c.vi Enclosure_1.c.vi-1.pdf TVA. 2009. "Ambient Temperature and Mixing Zone Studies for SQN as Required by NPDES Permit No. TN0026450 of September 2005," WR2009-1-45-151. January 2009

37. 1.c.vii.1 Enclosure_1.c.vii-1_WR28-1-45-100.pdf TVA (1978), "The Natural Thermal Regime of Chickamauga Reservoir in the Vicinity of SQN" Report No. WR28-1-45-100, TVA, Division of Water Management, Water Systems Development Branch, February 1978.
38. 1.c.vii.2 Enclosure_1.c.vii-2_WR28-1-45-101.pdf TVA (1978), "Effect of SQN Discharges on Chickamauga Lake Water Temperatures" Report No. WR28-1-45-101, TVA, Division of Water Management, Water Systems Development Branch, April 1978
39. 1.c.vii.3 Enclosure_1.c.vii-3_WR28-1-45-103.pdf TVA (1979), "Model Study and Analysis of SQN Submerged Multiport Diffuser," Report No. WR28-1-45-103, TVA, Division of Water Management, Water Systems Development Branch, March 1979
40. 1.c.vii.4 Enclosure_1.c.vii-4_WR28-1-45-110.pdf TVA (1982), "A Field Verification of SQN Diffuser Performance Model: One-Unit Operation," Report No. WR28-1-45-110, TVA, Office of Natural Resources, Division of Air and Water Resources, Water Systems Development Branch, October 1982
41. 1.c.vii.5 Enclosure_1.c.vii-5_WR28-1-45-115.pdf TVA (1983), "Validation of Computerized Thermal Compliance and Plume Development at SQN," Report No.WR28-1-45-115, TVA, Office of Natural Resources, Division of Air and Water Resources, Water Systems Development Branch, August 1983
42. 1.c.vii.6 Enclosure_1.c.vii-6_WR28-4-45-125.pdf TVA (1986), "Hydrothermal Aspects Of Chickamauga Reservoir," Report No.WR28-4-45-125, TVA, Office of Natural Resources and Economic Development, Division of Air and Water Resources, Engineering Laboratory, November 1986
43. 1.c.vii.7 Enclosure_1.c.vii-7_WR28-1-45-128.pdf TVA (1987), "SQN Historical Thermal Evaluation," Report No. WR28-1-45-128, TVA, Office of Natural Resources and Economic Development, Division of Air and Water Resources, Engineering Laboratory, March 1983
44. 1.c.vii.8 Enclosure_1.c.vii-8_WR28-3-45-134.pdf TVA (1987), "Quality Program For Verification Of SQN Thermal Computed Compliance System," Report No. WR28-3-45-134, TVA, Office of Natural Resources and Economic Development, Division of Air and Water Resources, Engineering Laboratory, September 1987
45. 1.c.vii.9 Enclosure_1.c.vii-9_WR28-2-45-135.pdf TVA (1987), "SQN," Report No. WR28-2-45-135, TVA, Office of Natural Resources and Economic Development, Division of Air and Water Resources, Engineering Laboratory, September 1987
46. 1.c.vii.10 Enclosure_1.c.vii-10_WR28-1-45-136.pdf TVA (1988), "The Effect of SQN on Temperature and Dissolved Oxygen in Chickamauga Reservoir During Summer 1988," Report No. WR28-1-45-136, TVA, Engineering Laboratory, October 1987
47. 1.c.vii.11 Enclosure_1.c.vii-11_TVA-WR-AB--89-11.pdf TVA (1989), "A Predictive Section 316(a) Demonstration for an Alternative Winter Thermal Discharge Limit for SQN, Chickamauga Reservoir, Tennessee," Report No. TVA/WR/AB--89/11, TVA, Resource Development, Nuclear Power, August 1989
48. 1.c.vii.12 Enclosure_1.c.vii-12_TVA-WR-WQ--980-10.pdf TVA (1990), "The Effect of SQN on Dissolved Oxygen in Chickamauga Reservoir," Report No. TVA/WR/WQ--980/10, TVA, Resource Development, River Basins Operations, September 1990

49. 1.c.vii.13 Enclosure_1.c.vii-13_WR96-1-45-145.pdf TVA (1996), "A Supplemental 316(a) Demonstration For Alternative Thermal Discharge Limits For SQN, Chickamauga Reservoir, Tennessee," Report No. WR96-1-45-145, TVA, Resource Group, Engineering Services, Engineering Laboratory, December 1996
50. 1.c.vii.14 Enclosure_1.c.vii-14_WR2003-1-45-149.pdf TVA (2003), "Study to Confirm the Calibration of the Numerical Model for the Thermal Discharge from SQN as Required by NPDES Permit No. TN0026450 of August 2001 (DRAFT)," TVA, River Systems Operations & Environment, River Operations, June 2003
51. 1.c.vii.15 Enclosure_1.c.vii-15_WR2009-1-45-150.pdf TVA (2009), "Study to Confirm the Calibration of the Numerical Model for the Thermal Discharge from SQN as Required by NPDES Permit No. TN0026450 of September 2005" Report No. WR2009-1-45-150, TVA, River Operations, January 2009
52. 1.c.vii.16 Enclosure_1.c.vii-16_WR2009-1-45-151.pdf TVA (2009), "Ambient Temperature and Mixing Zone Studies for SQN as Required by NPDES Permit No. TN0026450 of September 2005," Report No. WR2009-1-45-151, TVA, River Operations, January 2009. *(Same as Enclosure_1.c.vi-1.pdf provided in TVA response to RAI 1.c.vi)*
53. 1.c.vii.17 Enclosure_1.c.vii-17_WR2009-1-45-152.pdf TVA (2013), "Study to Confirm the Calibration of the Numerical Model for the Thermal Discharge from SQN as Required by NPDES Permit No. TN0026450 of September 2011," Report No. WR2009-1-45-152, TVA, River Operations, April 2013. *(Same as Enclosure_1.b.i-1.pdf provided in TVA response to RAI 1.b.i)*
54. 1.c.vii.18 Enclosure_1.c.vii-18.xlsx Excel file containing velocity measurements recorded at nine locations on July 30-31, 2003

55. 1.c.viii.1 Enclosure_1.c.viii-1.pdf TDEC (2011), NPDES Permit No. TN0026450, TVA—Sequoyah Nuclear Plant, Soddy Daisy, Hamilton County, Tennessee, effective March 1, 2011, Tennessee Department of Environment and Conservation, issuance date January 31, 2011.
56. 1.c.viii.2 Enclosure_1.c.viii-2.pdf Study to Confirm the Calibration of the Numerical Model for the Thermal Discharge from Sequoyah Nuclear Plant as Required by NPDES Permit No. TN0026450 of September 2005.

57. 1.d.i Chickamauga TRM 490.5 Physical-Chemical Water Quality Results and Summary 2000-2011

58. 1.e.i SQN 2008 Surface Water Withdrawal Report
59. 1.e.i SQN 2009 Surface Water Withdrawal Report
60. 1.e.i SQN 2010 Surface Water Withdrawal Report
61. 1.e.i SQN 2011 Surface Water Withdrawal Report
62. 1.e.i SQN 2012 Surface Water Withdrawal Report

63. 1.e.iii.2.1 SQN Annual Water Withdrawal Updates for 2008, Jan - June, 193p

64. 1.e.iii.2.1.a SQN Annual Water Withdrawal Updates for 2008, July - Dec, 187p
65. 1.e.iii.2.2 SQN Annual Water Withdrawal Updates for 2009, Jan - June, 299p
66. 1.e.iii.2.3 SQN Annual Water Withdrawal Updates for 2009, July - Dec, 202p
67. 1.e.iii.2.4 SQN Annual Water Withdrawal Updates for 2010, Jan - June, 226p
68. 1.e.iii.2.5 SQN Annual Water Withdrawal Updates for 2010, July - Dec, 204p
69. 1.e.iii.2.6 SQN Annual Water Withdrawal Updates for 2011, Jan - June, 175p
70. 1.e.iii.2.7 SQN Annual Water Withdrawal Updates for 2011, July - Dec, 176p
71. 1.e.iii.2.8 SQN Annual Water Withdrawal Updates for 2012, Jan - June, 176p
72. 1.e.iii.2.9 SQN Annual Water Withdrawal Updates for 2012, July - Dec, 164p
73. 1.e.iii.2.10 SQN Annual Water Withdrawal Updates for 2013, Jan - Feb, 20p
74. 1.e.iii.3 May 21, 2009 letter from SQN to TDEC documenting Required Actions from the March 30, 2009 Division of Solid Waste Management Compliance Evaluation Inspection

Terrestrial Ecology

1. 5.c.i Tennessee Valley Authority Division of FFWD. Forestry Bulletin 143, 24p
2. 5.c.ii Henry, T. H. 2011a. Results of the Tennessee River Valley Shorebird Initiative, 150p
3. 5.c.iii TVA. 1974a. Final Environmental Statement, previously docketed, 764p
4. 5.c.iv TVA. 1974b. Cooling Tower Contract M02712_0044459421, 9p

Meteorology, Air Quality, and Noise

1. 6.a.i.1 SQN GHG Summary.xlsx, a summary of GHG emissions at the SQN location
2. 6.a.i.3 Refrigerant Sources.pdf, lists potential sources of GHG emissions due to refrigerant leaks.
3. 6.a.i.3 TVA - Annual GHG Data Report v3-2 - Final - 01-18-13.xlsx
4. 6.a.i.4 TVA - SQN - FY08 - Annual GHG Data Report v1-6 - Final - 08-14-13.xlsx
5. 6.a.i.5 TVA - SQN - FY09 - Annual GHG Data Report v1-6 - Final - 08-14-13.xlsx
6. 6.a.i.6 TVA - SQN - FY10 - Annual GHG Data Report v1-6 - Final - 08-14-13.xlsx
7. 6.a.i.7 TVA - SQN - FY11 - Annual GHG Data Report v2-4 - Final - 08-14-13.xlsx
8. 6.a.i.8 TVA - SQN - FY12 - Annual GHG Data Report v3-2 - Final - 04-02-13.xlsx
9. 6.a.i.9 TVA - SQN GHG Summary FY08 - FY12 - 08-14-13.xlsx

10. 6.a.ii.2a SQN Air Emissions 5-Year Summary, 4p
11. 6.a.ii.2b SQN Air Emissions 5-Year Summary, HAP emissions from permitted engines, 4p
12. 6.a.ii.3 SQN Air Quality Permit, Expire on.7-17-2017.pdf, 36p
13. 6.a.ii.4 SQN Annual Air Inspection Report 2007.pdf, 35p
14. 6.a.ii.5 SQN Annual Air Inspection Report 2008.pdf, 35p
15. 6.a.ii.6 SQN Annual Air Inspection Report 2009.pdf
16. 6.a.ii.7 SQN Annual Air Inspection Report 2010 .pdf

17. 6.a.ii.8 SQN Annual Air Inspection Report 2011 .pdf
18. 6.a.ii.9 SQN Hours of Operation Annual Air Report 2007.pdf
19. 6.a.ii.10 SQN Hours of Operation Annual Air Report 2008.pdf
20. 6.a.ii.11 SQN Hours of Operation Annual Air Report 2009.pdf
21. 6.a.ii.12 SQN Hours of Operation Annual Air Report 2010.pdf
22. 6.a.ii.13 SQN Hours of Operation Annual Air Report 2011.pdf
23. 6.a.ii.14 SQN Hours of Operation Annual Air Report 2012.pdf, 5p
24. 6.a.ii.15 SQN 2007 TRI Report.pdf, 23p
25. 6.a.ii.16 SQN 2008 TRI Report.pdf, 12p
26. 6.a.ii.17 SQN 2009 TRI Report.pdf, 12p
27. 6.a.ii.18 SQN 2010 TRI Report.pdf, 9p
28. 6.a.ii.19 SQN 2011 TRI Report.pdf, 9p
29. 6.a.ii.20 SQN CY11 TRI Releases.pdf, 9p

30. 6.a.iii.1 SQN Fukushima Diesel Generator Air Emissions.xlsx
31. 6.a.iii.1.a SQN Fukushima DG, diesel pumps/tow truck list, docketed letter, 6p
32. 6.a.iii.2 Fukushima EA.pdf, 63p

33. 6.a.iv.1 Mean Temps 2008-2012.pdf, mean monthly and annual temperatures
34. 6.a.iv.2 Mean Precip 2008-2012.pdf, mean monthly precipitation and annual precipitation
35. 6.a.iv.3.4 SQN_2008-2012_5yr(q).pdf
36. 6.a.iv.3.5 SQN_2008.docx and SQN_2008.pdf
37. 6.a.iv.3.6 SQN_2009.docx and SQN_2009.pdf
38. 6.a.iv.3.7 SQN_2010.docx and SQN_2010.pdf
39. 6.a.iv.3.8 SQN_2011.docx and SQN_2011.pdf
40. 6.a.iv.3.9 SQN_2012.docx and SQN_2012/pdf
41. 6.a.iv.3.11 SQN_Met_2008-2012.xlsx

ENCLOSURE 2

Tennessee Valley Authority

Sequoyah Nuclear Plant, Units 1 and 2 License Renewal

Revision to specific pages of the SQN Environmental Report

Note: Revisions are indicated with additions underlined and deletions lined through in each of the documents listed below.

SQN License Renewal Application Environmental Report, Appendix E

1. Chapter 10, pg 10-13, updated reference list
2. Chapter 10, pg 10-27, updated reference list
3. Figure 2.1-1, pg 2-16, SQN Site Boundary and Aerial Site Layout
4. Figure 3.2-2, pg 3-40, ERCW Intake Structure
5. Section 2.5.1, pg 2-94, pearly mussel identification year
6. Section 2.11.1, pg 2-164, Meteorology Climate
7. Section 2.12, pgs 2-169 to 187, Historic and Archaeological Resources
8. Section 3.2.2.1, pg 3-4, CCW flow of 2.08 fps
9. Section 3.2.8.2, pg 3-26, Wastewater Discharges
10. Section 4.3.5.1, Impingement, pg 4-24, traveling screen flow velocity of 2.08 fps
11. Section 4.20, pg 4-61 to 64, Historic and Archaeological Resources, 40HA22
12. Table 3.2-1, pg 3-34, Hazardous Waste Generation, 2007–2011
13. Table 3.2-2, pgs 3-35 and 3-36, NPDES Permitted Outfalls

Klippel, W. E. and P. W. Parmalee. 1982. Diachronic Variation in Insectivores from Cheek Bend Cave and Environmental Change in the Midsouth. *Paleobiology* 8(4):447–458.

LBNL (Lawrence Berkeley National Laboratory). 2010. *Use of Frequency Metrics to Assess the Planning and Operating Requirements for Reliable Integration of Variable Renewable Generation*. LBNL-4142E, December 2010.

LEC (Lewis Environmental Consulting, LLC). 2008. Baseline Mussel Monitoring Survey at Calvert City Terminal, Tennessee River Mile 14.0 - 14.4 R, 14.2 - 14.5 L, 14.6 - 15.0 R, Livingston and Marshall Counties, Kentucky. Prepared for Calvert City Terminal, LLC.

Lewis, T.M.N. and M.C.K. Lewis. 1995. The McGill Site. In *The Prehistory of the Chickamauga Basin in Tennessee*, ed. L. P. Sullivan, pp. 295-300. University of Tennessee Press: Knoxville, Tenn.

Lundy, Dennis. 2010a. Sequoyah Units 1 and 2 License Renewal Project Request for Information. Response to RFI No. SQN100803-02, SQN Employees by Zip Code and SQN Outage Schedule. August 3, 2010.

Lundy, Dennis. 2010b. Correspondence from Dennis Lundy, Tennessee Valley Authority, to Stacy Burgess, P.G., Enercon Services, Inc., SQN GW Monitoring and Geoprobe Wells. April 13, 2010.

McCollough, C. R. and C. H. Faulkner, ed. 1976. *Third Report of the Normandy Reservoir Salvage Project.* University of Tennessee, Department of Anthropology, Report of Investigations 16.

McCollough, C. R. and C. H. Faulkner, ed. 1978. *Sixth Report of the Normandy Archaeological Project.* University of Tennessee, Department of Anthropology, Report of Investigations 21 and Tennessee Valley Authority Publications in Anthropology 19.

MCD (Mainstream Commercial Divers, Inc.). 2006. Mussel Survey of Snake Creek Mile 0.00–0.15 and Tennessee River Mile 197.0–197.7 in Hardin County, Tennessee. Prepared for Santana Dredging Corporation.

McKee, L., T. Karpynec, and J. Holland. 2010. Phase 1 Cultural Resources Survey of the TVA Sequoyah Nuclear Plant, Hamilton County, Tennessee. Report prepared for Tennessee Valley Authority, Cultural Resources Division, by TRC Environmental Corporation, Nashville, Tenn. On file with Tennessee Valley Authority, Chattanooga, Tenn.

McKee, L., T. Karpynec, S. Cole, and J. Holland. 2013. Phase 1 Cultural Resources Survey of the TVA Sequoyah Nuclear Plant, Hamilton County, Tennessee. Revised Final Report. Report prepared for Tennessee Valley Authority, Cultural Compliance Division, by TRC Environmental Corporation, Nashville, Tenn. On file with Tennessee Valley Authority, Knoxville, Tenn.

MDC (Missouri Department of Conservation). 2011a. "Pink Mucket." Retrieved from <http://mdc.mo.gov/discover-nature/field-guide/pink-mucket> (accessed October 20, 2011).

MDC. 2011b. "Lake Sturgeon." Retrieved from <http://mdc.mo.gov/discover-nature/field-guide/lake-sturgeon> (accessed December 20, 2011).

TSDS (Tennessee Spatial Data Server). 2009. "Public Lands." Retrieved from <http://www.tngis.org/frequently_accessed_data.html> (accessed November 10, 2009).

TVA (Tennessee Valley Authority). 1937. Chickamauga Reservoir Land Map, 8-4160-20. Tennessee Valley Authority, Real Estate Division: Chattanooga, Tenn.

TVA. 1938. McGill Cemetery. Cemetery Relocation Files, Chickamauga Reservoir, RG 142, Records of the Tennessee Valley Authority, National Archives and Records Administration, Southeast Region Branch: Morrow, Ga.

TVA. 1940. Igou Cemetery. Cemetery Relocation Files, Chickamauga Reservoir, RG 142, Records of the Tennessee Valley Authority, National Archives and Records Administration, Southeast Region Branch: Morrow, Ga.

TVA. 1942. The Chickamauga Project: A Comprehensive Report on the Planning, Design, Construction and Initial Operations of the Chickamauga Project. Technical Report No. 6.

TVA. 1951. Aerial photograph of the Sequoyah Nuclear Plant Site. Image C13138 (May 13). TVA Research Library, Knoxville, Tennessee.

TVA. 1968. Aerial photograph of the Sequoyah Nuclear Plant Site. Image 62172 (August 23). TVA Research Library, Knoxville, Tennessee.

TVA. 1974a. *Final Environmental Statement Sequoyah Nuclear Plant Units 1 and 2*. February 13, 1974.

TVA. 1974b. Cooling Tower Contract M02712_0044459421, Invitation, Bid and Acceptance, Guaranteed Data, Performance Under Specified Design Conditions. TVA Reference No. 74C53-83659.

TVA. 1977. Aerial photograph of the Sequoyah Nuclear Plant Site. Image 141100 (October 21). TVA Research Library, Knoxville, Tennessee.

TVA. ca. 1977. Oblique aerial photograph of the Sequoyah Nuclear Plant Site. Tennessee Valley Authority, Knoxville, Tennessee.

TVA. 1979. Recent Mollusk Investigations on the Tennessee River. Prepared by Tennessee Valley Authority, Division of Environmental Planning, Water Quality and Ecology Branch.

TVA. 1980. Aerial photograph of the Sequoyah Nuclear Plant Site. Image 1969-95 (June 9). TVA Research Library, Knoxville, Tennessee.

TVA. 1984. Aquatic Environmental Conditions in Chickamauga Reservoir During Operation of Sequoyah Nuclear Plant, Third Annual Report. TVA/ONR/WRF-85/1a.

TVA. 1986. Aquatic Environmental Conditions in Chickamauga Reservoir During Operation of Sequoyah Nuclear Plant, Fifth Annual Report, 1985. TVA/ONRED/WRF-86/5a.

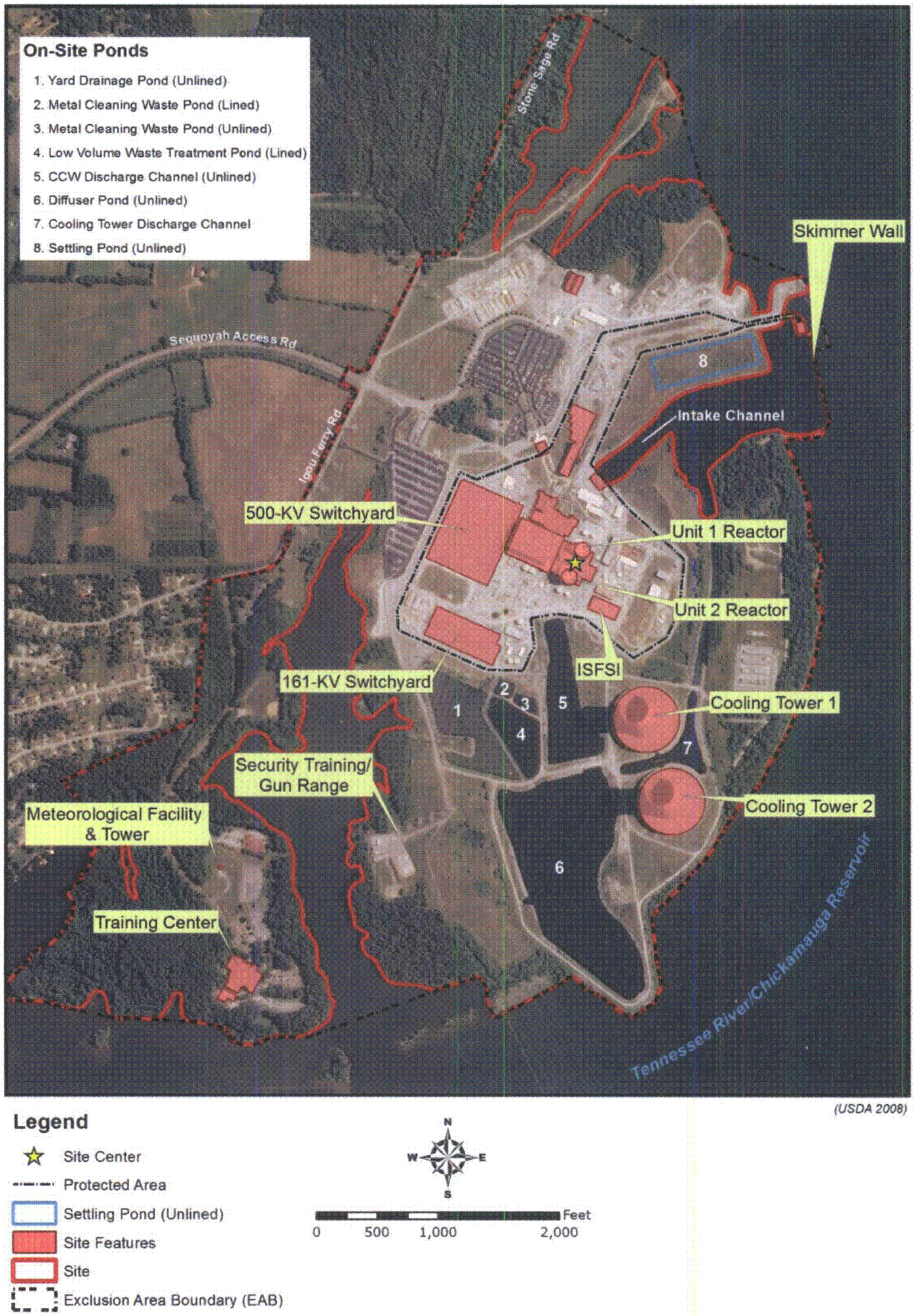

Figure 2.1-1
SQN Site Boundary and Aerial Site Layout

Figure 3.2-2
ERCW Intake Structure

dromedary pearlymussel glochidia, like other freshwater mussels, comprises water (until encysted on a fish host) and fish body fluids (once encysted). (USFWS 2001)

The dromedary pearlymussel inhabits small to medium, low turbidity, high to moderate gradient streams. The species is commonly found near riffles on sand and gravel substrates with stable rubble. Though commonly associated with shallow, high-velocity riffles and shoals, individuals have been found in deeper (up to 18 feet in depth), slower waters. (USFWS 2001)

Many of the historic populations of the dromedary pearlymussel were apparently lost when the river sections they inhabited were impounded (USFWS 2001). One individual was identified in ~~the late 1970s~~ 1918 approximately 3 miles from SQN (TVA 2011b). The Chickamauga Reservoir habitat adjacent to SQN is not suitable to sustain a breeding population of dromedary mussels due to the impoundment of the Tennessee River (Third Rock 2010b).

Only three reproducing populations of dromedary pearlymussel are believed to be present in the Powell and Clinch rivers (USFWS 2001). Therefore, they are not likely to be identified along transmission line routes crossing water bodies.

Pink Mucket Mussel

Pink mucket mussels are a rounded to slightly elongated mussel. The posterior end is bluntly pointed in males. Females are shorter and may be nearly square. They are 3–5 inches long. (MDC 2011a)

The shell is thick, inflated, and smooth. Growth-rest lines produce ridges and dark-stained grooves. The outer layer of the shell is yellowish-brown to chestnut-colored in mature individuals. Broad, faint, green rays may cover the shell, but are usually absent from adult shells. (MDC 2011a)

This mussel is found in mud and sand, and in shallow riffles and shoals swept free of silt in major rivers and tributaries. It buries itself in sand or gravel, with only the edge of its shell and its feeding siphons exposed. (USFWS 1997)

In the early 1960s, pink mucket mussels were identified approximately 5.5 miles from SQN (TVA 2011b). Due to the river impoundment, habitat in Chickamauga Reservoir adjacent to SQN is not suitable to sustain breeding populations of mussels; however, relic populations could potentially be present within the vicinity (Third Rock 2010b). The species has not been recorded as occurring within transmission line ROWs; however, suitable habitat may occur in the portions of the in-scope ROWs that cross large free-flowing streams or rivers.

2.5.2 State-Protected Species

As shown in Table 2.5-1, TDEC has designated six species as endangered, two as threatened, and five as species of special concern (two of which are commercially exploited). An additional three species are deemed in need of management. These 16 species are gibbous panic grass (*Sacciolepis striata*), pink lady's slipper (*Cypripedium acaule*), ovate-leaved arrowhead

2.11 Meteorology and Air Quality

2.11.1 Climate

The SQN site is in the eastern Tennessee portion of the southern Appalachian region, which is dominated much of the year by the Azores-Bermuda anticyclonic circulation represented in the annual normal sea level pressure distribution. This circulation over the southeastern United States is most pronounced in the fall and is accompanied by extended periods of fair weather and widespread atmospheric stagnation. In winter, the normal circulation pattern becomes more varied as the eastward-moving migratory high and low pressure systems associated with the mid-latitude westerly current bring alternating cold and warm air masses into the area with resultant changes in wind direction, wind speed, atmospheric stability, precipitation, and other meteorological elements. In summer, the migratory systems are less frequent and less intense, and the area is under the dominance of the western edge of the Azores-Bermuda anticyclone with a warm, moist air influx from the Atlantic Ocean and the Gulf of Mexico. (TVA 2011p, Section 2.3.1.2)

The terrain features of the region have some effect on the general climate. With the mountain ridge and valley terrain aligned northeast-southwest over eastern Tennessee, there is a definite bimodal upvalley-downvalley wind flow in the lower atmosphere at an elevation of 500 to 1,000 feet during much of the year. A detectable lake breeze circulation resulting from discontinuities in differential surface heating between land and water is not expected because of the relatively narrow width of the Tennessee River as it flows southwestward through the valley area. (TVA 2011p, Section 2.3.1.2)

Using National Climatic Data Center (NCDC) data for Chattanooga, Tennessee, the all-time highest temperature was 106°F recorded on July 28, 1952, while the all-time lowest temperature was recorded as -10°F on January 21, 1985. Monthly average temperatures range from 31°F in January to 90°F in July. During the year, the typical number of days with temperatures at or below 32°F is 58, while the typical number of days with temperatures at or above 90°F is 48. The highest rainfall in a 24-hour period was recorded in Chattanooga, Tennessee, measuring 7.61 inches March 29–30, 1886. The most rain in a single year measured 73.70 inches in 1994, while the average annual precipitation for Chattanooga is 54.50 inches for the period 1971–2000. (NWS 2010)

Winds at the site are relatively light with the most prevalent wind direction being from the north-northeast. Winds from the northeast and southwest quadrants are more frequent than winds from the ~~southwest~~ southeast and northwest quadrants. The highest wind speeds come from the southwest. (TVA 2011a, Section 3.16.1.3)

Precipitation patterns near the site show an average of 117 days annually with 0.01 inches or more of precipitation. The average monthly precipitation is 4.81 inches, with the maximum monthly average, 6.76 inches, occurring in March, and the minimum monthly average, 2.86 inches, occurring in October. The extreme monthly maximum and minimum is 16.58 inches in November and 0.09 inches in October, respectively. (TVA 2011p, Section 2.3.2.2)

2.12 Historic and Archaeological Resources

Under the National Historic Preservation Act (NHPA) of 1966, as amended [16 USC 470], TVA as a federal agency is required to identify and manage historic properties located on land affected by TVA undertakings.

Prior to taking any action to implement an undertaking, Section 106 of the NHPA [16 USC 470] requires federal agencies to do the following:

- Take into account the effects of an undertaking on historic properties, including any district, site, building, structure, or object included in or eligible for inclusion in the National Register of Historic Places (NRHP).
- Afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment on such undertaking.

~~State historic preservation officers serve as proxies~~ The State Historic Preservation Officer (SHPO) serves as proxy to the ACHP [16 USC 470; 36 CFR Part 800]. The Tennessee Historical Commission (THC) has been consulted by TVA concerning the license renewal application for SQN and any potential effects on historic properties (see Attachment B). Consultation included submission of a Phase 1 cultural resource survey report (McKee et al. 2010) and supplemental 10-mile architectural sensitivity report (Karpynec 2010) documenting the results of record searches and the Phase 1 survey. The investigations were conducted in compliance with Section 106 of the NHPA, as amended, and the implementing regulations contained therein [36 CFR Part 800]. TVA also consulted with the Tennessee SHPO in 2010 concerning the Draft Supplemental Environmental Impact Statement (DEIS) for the Units 1 and 2 operating license renewal (see Attachment B).

As required by federal regulations [36 CFR Part 800], Native American groups recognized as stakeholders at SQN were consulted by TVA with the opportunity for comment (see Attachment B). TVA has consulted with the following federally recognized Indian tribes regarding properties within the proposed project's area of potential effect (APE) that may be of religious and cultural significance to them and eligible for the NRHP: Cherokee Nation, Eastern Band of Cherokee Indians, United Keetoowah Band of Cherokee Indians in Oklahoma, The Chickasaw Nation, Seminole Tribe of Florida, Muscogee (Creek) Nation of Oklahoma, Alabama-Coushatta Tribe of Texas, Alabama-Quassarte Tribal Town, Kialegee Tribal Town, Thlopthlocco Tribal Town, Absentee Shawnee Tribe of Oklahoma, Eastern Shawnee Tribe of Oklahoma, and the Shawnee Tribe.

2.12.1 Prehistoric Era

The following discussion is derived from the 2010 Phase I cultural resources survey report contracted for the SQN LRA (McKee et al. 2010), including all references to McKee et al. (2010) and all unreferenced content. All references cited other than McKee et al. (2010) have been independently researched or verified. The survey defined the entire SQN site as the APE. The survey area also included two small islands separated from the Chickamauga Reservoir shoreline by a small distance, immediately west of a row of transmission structures (visible in Figure 2.12-4). In TVA's subsequent consultation with the Tennessee SHPO regarding the DEIS for the SQN Units 1 and 2 operating license renewal in October 2010, the correct APE was presented, which excluded those islands (see Attachment B).

According to McKee, the vicinity of the SQN property is likely to have been continuously occupied by humans since at least 12,000 years before present (BP). Archaeological records for the Tennessee River valley document four major prehistoric occupational periods with some overlap of cultural markers: Paleo-Indian (12,500 BP–10,000 BP), Archaic (10,000 BP– 2,500 BP), Woodland (3,000 BP–1,100 BP), and Mississippian (1,100 BP–400 BP or AD 900– 1600).

Prehistoric occupation of the region surrounding the study area has been studied through archaeological research since the late 19th century. The first large-scale excavations in the Guntersville Basin of the Tennessee River occurred in the 1930s by the Works Progress Administration (WPA) and TVA, which provided detailed information on the long prehistoric sequence of the region (Webb and Wilder 1951). In Tennessee, the regional prehistory is understood largely based on intensive investigations in the Normandy Reservoir on the upper Duck River (Faulkner and McCollough 1973, 1974, 1977, 1978, 1982a, 1982b; McCollough and Faulkner 1976, 1978) as well as excavations in the Tellico Reservoir (Chapman 1973, 1975, 1976, 1979, 1994; Davis 1990; Schroedl 1975, 1978). To a lesser extent, various archaeological projects undertaken to fulfill state and federal environmental regulations have also contributed to our understanding of regional settlement patterns. The following discussion draws on these and other sources to provide a basic overview of the prehistoric period.

Paleo-Indian Period

Paleo-Indian adaptation throughout the region was likely characterized by small, highly mobile bands that moved from place to place as preferred resources were depleted and new supplies were sought (Kelly and Todd 1988). During the Early and Middle Paleo-Indian periods, these bands are thought to have practiced generalized hunting and gathering, but concentrated on hunting now extinct megafauna, including mastodon (*Mammut americanum*) and bison (*Bison antiquus*). The exploitation of Late Pleistocene faunal assemblages by the earliest inhabitants in the southeast is attested by the Coates-Hines site (40WM31) in Williamson County, Tennessee, where mastodon remains were discovered in association with Paleo-Indian artifactual material (Breitburg et al. 1996).

South of the project area in Jackson County, Alabama, diagnostic Paleo-Indian artifacts were recovered from Russell Cave (1JA940) during excavations by the Smithsonian Institution and National Park Service (Miller 1957a, 1957b, 1965). Stone tool (lithic) artifacts define the Paleo-Indian diagnostic assemblages and include the typically lanceolate and fluted forms like the Clovis and eastern fluted Gainey and Bull Brook; fluted and unfluted lanceolate forms with modified bases such as Cumberland, Quad, and Parkhill; and typically unfluted, notched, and unnotched lanceolate forms such as the Dalton and Holcombe bifaces.

Two preeminent Paleo-Indian sites in the region, Dust Cave and the Stanfield-Worley bluff shelter, are situated southwest of the current project area along the middle portion of the Tennessee River in Colbert and Lauderdale counties, Alabama. The Stanfield-Worley bluff shelter (1CT125) exhibits nearly 8,000 square feet of shelter floor and cultural material encompassing 8,000 years of aboriginal occupation, and has yielded radiocarbon dates as early as 9640+/-450 BP associated with Paleo-Indian artifacts (DeJarnette et al. 1962). Dust Cave (1LU496), a multi-component habitation cave site near Florence, Alabama, has also yielded a stratified Late Paleo-Indian cultural assemblage dated from 10,500-10,000 BP (Driskell 1994, 1996).

Archaic Period

As the continental glaciers retreated northward, large game species became extinct or migrated north with the retreating tundra and were replaced by modern faunal and floral species. Archaic populations adapted accordingly to rely on white-tailed deer, turkey, fish, and smaller mammals, including ~~white-tailed deer, turkey, squirrels, rabbits, and fish~~ squirrels and rabbits. Subsistence strategies also shifted to incorporate seasonal exploitation of vegetal resources such as nuts, berries, seeds, bulbs, and greens.

Intensive exploitation of local resources led to increased population growth throughout the Archaic Period in the southeast and a corresponding reduction in group territory size. Archaic populations gradually became less mobile as villages began to be reoccupied annually. Intensive exploitation of food resources is reflected in substantial quantities of fire-cracked rock on many Archaic sites. This artifact class results from stone boiling techniques using skin bags or wooden bowls prior to the adoption of pottery (Goodyear 1988) and the construction of more prominent, stone-lined, high-heat hearths at repeatedly used campsites.

Early Archaic

Early Archaic populations in ~~northeastern Alabama~~ the southeastern United States continued to subsist in ways closely resembling those of earlier Paleo-Indian hunters and foragers. In contrast to Paleo-Indian adaptations, the Early Archaic appears to represent a shift to a more localized subsistence pool based on the seasonal harvest of plant and animal resources. Diagnostic artifacts of the Early Archaic include chipped stone tools with side- and corner-notched hafting elements such as Kirk Corner Notched, Palmer, Plevna, Lost Lake, Pine Tree, and some Big Sandy forms (Cambron and Hulse 1983).

Middle Archaic

The Middle Archaic is generally seen as a difficult time for prehistoric populations, coinciding with the warmer and drier Hypsithermal Interval. Beginning at about 8000 BP, postglacial warming intensified, resulting in a series of environmental changes in parts of the east that influenced cultural developments. Local inhabitants throughout the Midwest and mid-south may have experienced occasional long droughts during this period (Deter-Wolf 2004), given paleo-environmental evidence for such drought (Brackenridge 1984; Klippel and Parmalee 1982).

By the end of the Middle Archaic, there is overwhelming evidence of a complex late Middle Archaic trading/interaction network that likely extended from the Great Lakes to the Gulf Coast. This interaction network is adequately reflected in mortuary objects containing raw materials exotic to the region of final disposition (marine shell beads, non-local chert) and in the widespread occurrence of morphologically similar non-utilitarian artifacts (Deter-Wolf 2004). This phenomenon has been best documented for northern Mississippi by Johnson and Brookes (1989) and Peacock (1988), who describe a string of "Benton phase" sites in the upper Tombigbee drainage linked by the co-occurrence of such diagnostic markers as Turkey Tails, oversized Bentons, and double-pointed bifaces manufactured from Fort Payne chert.

Late Archaic

During the Late Archaic, modern climatic conditions prevailed throughout North America. This environmental change resulted in increasingly moist conditions throughout the American southeast, and a corresponding boom in local plant and animal life. Prehistoric peoples took advantage of the new, lush conditions while living along major streams where water, plants, and animals were increasingly plentiful.

Evidence of initial plant domestication is reflected in the appearance of cultigens in Late Archaic deposits throughout the southeast. Evidence from sites in Illinois, Kentucky, and Tennessee demonstrates that squash, gourd, and sunflower were well established by 3000 BP (Adovasio and Johnson 1981). Some of the earliest evidence of structural remains in the southeast has been documented for the Late Archaic in the Upper Duck River valley, south of Nashville (Faulkner and McCollough 1974).

South of the project area along the Tennessee River, the Late Archaic period can be divided into two distinct cultural units or phases: the Lauderdale phase and the Bluff Creek phase. The Lauderdale phase represents the classic "Shell Mound Archaic" in this area and may be in need of some refinement or subdivision as new data become available. Along the western Middle Tennessee River, mussel beds provided abundant freshwater invertebrates for exploitation by prehistoric inhabitants. The Lauderdale phase shell mound sites in this vicinity are quite extensive and comprise an organic midden of shell, cultural debris, and human interments accreted over many generations of successive occupation. Jenkins (1974) has suggested that these mound sites were occupied from early spring to early fall, when the local shellfish harvest would be optimum. Jenkins concludes that for the rest of the year, Lauderdale peoples would have moved into the uplands to exploit diverse game animals, plants, and nuts.

The Late Archaic Bluff Creek phase (3200–2500 BP) spans the traditional date of 3000 BP used to divide the Late Archaic from the subsequent Early Woodland period. The Bluff Creek phase is distinguished by fiber-tempered Wheeler series ceramics (ca. 3500–2800 BP) (Futato 1979; Walthall and Jenkins 1976). Ceramics first made their appearance on the Atlantic coastal plain in estuarial settings around 4500 BP. However, it was not until quite later, around 3500–3000 BP, that the Wheeler series made its debut in northern Alabama (Futato 1979; Jenkins 1975; Sassaman 2002).

Woodland Period

The Woodland period in the region is also divided into three sub-periods: Early (3000–2200 BP), Middle (2200–1650 BP), and Late (1650–1100 BP) Woodland. This period has been traditionally linked to sedentism, population growth, and organizational complexity as manifested in the intensive cultivation of crops, establishment of well-defined village settlements, the construction of ceremonial mounds, and the appearance of pottery. However, recent research has proven that all these traditionally Woodland cultural markers have more ancient roots dating back to the Archaic (see above for discussion of Wheeler ceramics; Fritz 1997; Sassaman 1993, 2002; Saunders et al. 1994). In this respect, the beginnings of the Woodland period in Alabama mark only a gradual transition from subsistence and settlement patterns of the Archaic within a similar deciduous forest environment. However, technological refinement and ideological changes clearly distinguish the Woodland period from its predecessor.

Early Woodland

This initial part of the Woodland period is more of a transitional time from the Late Archaic, as seen in the gradual adoption of ceramics and the shift in subsistence and settlement patterns (Anderson and Mainfort 2002). While a variety of indigenous cultigens had been exploited prior to 3000 BP, the Early Woodland period saw the beginnings of intensive agriculture or horticulture (Watson 1989). Various plants, including goosefoot, maygrass, knotweed, sumpweed, little barley, and sunflower began to be systematically exploited, and in some cases show morphological variations suggesting the beginnings of domestication (Gremillion 1998, 2002).

Middle Woodland

The construction of earthen mounds, which had begun throughout the southeast during the Middle Archaic period, saw rapid increase throughout the Middle Tennessee River valley during the Middle Woodland. South and west of the current project area, the Copena mortuary complex of the Middle Tennessee River valley features the greatest concentration of Middle Woodland burial mounds in the region (Anderson and Mainfort 2002).

Copena represents one of the most widespread Middle Woodland manifestations in the southeast. Webb (1939) first described Copena occupations for the Wheeler Basin. Additional data arise from the Middle Tennessee Valley, where the Copena phase appears around 1800–1400 BP. Copena is no longer regarded as a conventional cultural phase, but rather a social-mortuary pattern shared by local social groups residing in the Middle Tennessee Valley (Cole 1981). Copena sites contain high frequencies of limestone-tempered, plain and carved, paddle-stamped ceramic sherds. Fabric-impressed, cord-marked, brushed, and rocker-stamped ceramics also occur, but less often.

Burial practices for Copena groups include accretional burials in earthen mounds, usually at some distance from the villages. Artifacts interred in Copena burials include copper earspools, bracelets, breastplates, greenstone celts, beads, marine shell cups and beads, and large steatite elbow pipes. Presumably, these finely crafted artifacts were placed with the dead as a means to note their achieved social rank. It is likely that the Copena mortuary cult peaked around 1600 BP (Walthall 1972). By around 1700 BP, the Middle Woodland peoples of northern Alabama became increasingly isolated, as a result of an apparent breakdown in long-distance trade routes. By about 1500 BP, Copena ways had vanished and the populations of northern Alabama were developing local economic adaptations and practicing less stylized burial ceremonialism.

Late Woodland

The Late Woodland period is less well defined in material culture in the region than earlier Woodland occupations (e.g., Walthall 1972). However, recent research has indicated that general Woodland cultural markers (i.e., ceramic production, mound building, and intensive agriculture) continue and even intensify during the Late Woodland (Jefferies 1994; Nassaney and Cobb 1991; Wood and Bowen 1995). Evidence of regional interaction and long distance trade as well as emphasis on burial ceremonialism decreases as cultural groups of this period apparently became more socially isolated. Increased social isolation is also in evidence, as many Late Woodland villages appear to have been fortified. A decrease of ceremonial markers and elite trade goods, however, should not mask the more significant reality of growth in population and agricultural production during this period that led into the Mississippian Period (Nassaney and Cobb 1991). As for technological change, the relatively rapid shift from the larger projectile points of the previous periods to the smaller Madison and Hamilton types is thought to reflect the development of the bow and arrow during the Late Woodland.

Mississippian Period

The Mississippian period has been the subject of much research throughout the southeast. Its cultural manifestations began along the middle course of the Mississippi River between present-day St. Louis, Missouri, and Vicksburg, Mississippi. Mississippian culture underwent major development at the site of Cahokia in the American Bottom and spread primarily along major river systems to all parts of the southeast. From 1000 BP until initial European contact about 400 years ago, Mississippian groups occupied local and regional territories along major rivers including the Tennessee, the Cumberland, and the Forked Deer rivers.

Mississippian populations were substantial and centered in permanent villages that far exceeded those of the Woodland period in size. These villages were primarily supported through the cultivation of maize in fertile alluvial valleys. The Northern Flint variety of maize seems to have been established in the region by around 1200 BP (Buikstra et al. 1988). In addition to maize, Mississippian populations relied on other ~~domesticants~~ domesticates, including beans and squash. Domesticated crops were further supplemented with wild foods that contributed to aboriginal diets in the southeast for previous millennia, including wild plants and animals such as nuts, berries, greens, deer, turkey, and aquatic animals.

The Mississippian Period saw a resurgence of shared regional religious icons similar to those manifested during the Middle Woodland. This ideological assemblage is commonly referred to as the "Southeastern Ceremonial Complex" and is defined by a shared body of symbolism, artistic motifs, and artifact types (Waring and Holder 1945). Common motifs include the forked or weeping eye, the hand-eye, the bi-lobed arrow, the cross with a sunburst circle, and representations of anthropomorphic beings. This iconography often appeared on shell gorgets, embossed copper and stone plates, pottery, stone maces, and a variety of other elaborate and specialized artifacts. While the structure of the Southeastern Ceremonial Complex centered on religious iconography and prestige goods, the complex seems to have also served the centralization of political authority in Mississippian cultures.

Status distinctions were also reflected in variation of Mississippian burials. Burials of higher status individuals usually occurred in conical mound earthworks. Distinctive stone box graves of the Middle Cumberland culture are considered regional markers of Mississippian mortuary activity (Dowd 2008; Smith 1992). These graves, lined with slabs of limestone, often include elaborate non-utilitarian funerary furniture and one or multiple human burials. Stone box graves also appear in earth mounds. These were apparently erected by arranging numerous stone box coffins in tiers or layers before piling up dirt to create a mound. Low-status individuals were interred in family cemetery plots near their residences.

2.12.2 Historic Era

The earliest European contact with the general area of what is now Hamilton County consisted of Spanish expeditions in the 16th century. When English explorers arrived in the 17th century, the Cherokee tribe was the dominant native group, with control of an area including eastern Tennessee, western North Carolina, and northern Georgia (Chapman 1985, page 99). American settlers began moving into Cherokee territory in the late 18th century, and Hamilton County was established in 1819. In 1838, the Cherokees were removed from the area by federal troops. An acceleration in white settlement followed.

Following European contact and settlement, the project area was used primarily for timber and agriculture. Early roads through the area connected the first county seat of Hamilton County, Dallas, with Chattanooga and Igou's Ferry, which was located on the SQN site (McKee et al. 2010, page 25). Harrison replaced Dallas as the county seat in 1840, leading to the decline of Dallas.

Igou's Ferry was established by General Samuel Igou (1790–1856) on property he owned by the river. The ferry connected roads on the east and west banks. A road near the present-day site still bears the name Igou Ferry Road. General Igou, his wife Mary Ann Igou, son A.C.S. Igou, other Igou family members, and others are ~~is~~ buried in the Igou Cemetery, still in existence on the SQN site and maintained by TVA (Figure 2.12-1). The cemetery contains approximately 50 graves, some of which are unmarked.

During the Civil War, the Union Army guarded the ferry in 1863 and probably used the farmsteads near the crossing for their camp (McKee et al. 2010, page 25). After the war, Dallas declined further, but Igou's Ferry was still in existence and served by a postal route that followed the west bank of the Tennessee River from Chattanooga. According to a 1913 Tennessee Geological Survey map, Igou's Ferry was still operational at that time (McKee et al. 2010, page 27), but by 1936, a TVA survey of the area showed no active ferry.

TVA surveyed the area again in 1937 in preparation for the creation of Chickamauga Reservoir. A second cemetery was documented on the SQN site, identified as the McGill Cemetery #1 (TVA 1938). ~~Sometime before 1983,~~ In 1969, the 11 graves from this cemetery were relocated to a nearby cemetery associated with the same family group (McKee et al. 2010, pages 27, 38-39).

Chickamauga Reservoir was completed in 1940. The waters of the reservoir covered all lands below the 683-foot contour level, including the site of Igou's Ferry. Most of the former house sites in SQN were not inundated, but property owners were permitted to retain possession and remove buildings for salvage prior to the end of the calendar year of 1939 (TVA 1942, page 232-33).

2.12.3 Cultural Resource Properties

The earliest known documentation of cultural resources on the grounds now occupied by SQN (Figure 2.12-1) was the 1913 recording and testing of site 40HA22 by C. B. Moore (Moore 1915, pages 390-392). Moore described the site as containing a mostly undisturbed mound, 52 feet in diameter and 7.5 feet high, and a light scatter of midden material in the surrounding cultivated field. His excavation into the mound identified nine human burials. The site was revisited in 1936 by Buckner, who reported that the mound was still visible with ceramic fragments on the surface (Buckner 1936).

The 1930s produced pre-inundation surveys and related work for the Chickamauga Reservoir. This work included the recording and testing of site 40HA20, known as the McGill Site (different from McGill Cemetery), also located within the current SQN boundaries (Figure 2.12-1). The results of the testing of 40HA20 are discussed in a compilation on the prehistory of the Chickamauga Reservoir (Lewis and Lewis 1995, pages 295-300), where the site is interpreted as a Late Woodland/Early Mississippian mound complex. Site 40HA20 was first recorded for the Tennessee Division of Archaeology Site Survey Records by Buckner in 1936 (Buckner 1936).

During that same year, 1936, Buckner also recorded the only known archaeological sites located outside, but within 0.5 miles of, the SQN APE. These adjacent sites range from a Late Archaic or later (unknown) period village site with projectile points and ceramics (40HA21) to a Paleo-Indian/Transitional Paleo-Indian open habitation/lithic workshop with projectile points and ground-stone tools (40HA43), both now inundated by Chickamauga Reservoir, to an unknown period burial ground with 8–10 visible stone graves (40HA46), located on the bluff overlooking the Tennessee River (Buckner 1936).

~~TVA also surveyed the SQN area in 1937 to produce the original property acquisition map for Chickamauga Reservoir~~ TVA completed a civil survey of property acquired for the creation of Chickamauga Reservoir in 1937, resulting in the original property acquisition (TVA 1937). The map ~~documented~~ documents public and private roads, structures, fields, orchards, fences, property boundaries, and cemeteries, along with other information, and ~~displayed~~ at least 14 residences and associated structures along with two cemeteries within the current SQN ~~boundaries~~ boundary (McKee et al. 2010, pages 27, 37-38). Additional work by TVA on the two cemeteries soon followed with records of names and locations of burials (TVA 1938; TVA 1940). ~~Following the cemetery reports, no known cultural resource investigations occurred on the SQN grounds until 1973, when they were conducted in association with the original construction of SQN.~~

Beginning in October 1968, TVA civil surveyors began recording information about the Igou and McGill No. 1 cemeteries. Because the McGill No. 1 Cemetery (containing nine graves) was located within the construction area for SQN, TVA relocated all nine graves to the McGill No. 2 Cemetery in May 1969. McGill No. 2 Cemetery is located on the right descending bank of Chickamauga Reservoir opposite TRM 486, approximately 800 feet west of the SQN property boundary near the northernmost extension of the site. In May 1972, TVA civil surveyor M. Cecil Chaffin contacted persons in the local community with knowledge of the Igou Cemetery. A group of four living descendants of individuals interred in the Igou Cemetery visited the cemetery with Mr. Chaffin on August 8, 1972. TVA subsequently made a plat map of the Igou Cemetery and constructed an access road for public access to the cemetery. TVA has cleared vegetation within the adjacent transmission line ROW.

Because construction began at SQN early in the development of historic preservation regulations, no comprehensive archaeological survey was conducted on the SQN site prior to construction of the plant. TVA conducted an archaeological survey in 1973, but it was conducted after construction of the plant had begun (Calabrese et al. 1973). Although construction was not yet complete, the emphasis of the 1973 report was that both previously recorded archaeological sites (40HA20 and 40HA22) were destroyed during the construction of SQN prior to the archaeological survey (Calabrese et al. 1973, page 1; McKee et al. 2010, page 37). The 1973 survey located only one intact cemetery (the Igou Cemetery) and remnants suggesting one possible former house.

The past surveys of the area specific to SQN were conducted before the Secretary of the Interior's Historic Preservation Professional Qualification Standards were issued on September 29, 1983 (48 FR 44716). When TVA began developing assessments for continued production at SQN, new cultural resource surveys were done. Two modern surveys were subsequently conducted at SQN. The first was a 2009 Phase 1 survey (Jones and Karpynec 2009) conducted in the preparation of an environmental assessment (EA) for a proposed SQN steam generator replacement project, which included a proposed new barge slip and a storage building. The APE for the 2009 undertaking was limited to three separate locations within SQN for potential direct effects and a 0.5-mile (indirect or visual effect) APE for considering architectural resources. As stated in the EA (TVA 2009a, page 13), the survey confirmed that the APE had been disturbed previously by the construction of SQN. No cultural resources were identified by the survey, and no historic properties were identified within the 0.5-mile viewshed of the proposed actions.

The second modern investigation was a Phase 1 archaeological survey conducted for the entire SQN site in early 2010 in preparation for the LRA (McKee et al. 2010). The APE for the survey was defined as the entire area occupied by SQN (Figure 2.12-1). The APE for architectural field studies included those portions of a 0.5-mile area surrounding the plant facility where a visual link to the plant was unobstructed by topography or vegetation (McKee et al. 2010, page 1). The archaeological investigation focused on shoreline areas and the limited amount of undeveloped land within the APE.

~~Results of t~~ The 2010 Phase 1 archaeological survey ~~confirmed the 1973 findings that sites 40HA20 and 40HA22 were destroyed during plant construction. Figures 2.12-3 and 2.12-4 document construction-related disturbance in the locale of site 40HA20~~ identified no traces of sites 40HA20 or 40HA22. The report authors concluded by agreeing with Calabrese et al. (1973) that both sites were completely destroyed during construction of SQN. Figure 2.12-2 documents the SQN plant site prior to construction, showing the locale of site 40HA20 in May 1951 (left) and August 1968 (right). Figure 2.12-3 documents the SQN site during construction in October 1977 (left) and after construction in June 1980 (right). ~~Figure 2.12-5~~ Figure 2.12-4 documents construction-related disturbance in the vicinity of the area thought to be the location of 40HA22.

A search of THC records ~~also~~ conducted as part of the 2010 Phase 1 archaeological survey found no previously recorded architectural resources on SQN or within the 0.5-mile visual APE. Previously identified aboveground resources on SQN included the Igou and the McGill cemeteries. ~~During the records investigation, it was determined that for the original SQN construction, the burials at the McGill Cemetery were disinterred and moved to McGill Cemetery #2, across the Tennessee River (see Attachment B).~~

The 2010 Phase 1 archaeological survey identified one new site (40HA549) and three isolated finds. Site 40HA549 was interpreted as a short-term open habitation represented by three artifacts, including one small quartz flake and two complete Early/Middle Archaic projectile points found in two positive shovel tests. The three isolated finds consisted of separate occurrences of lithic flakes and debitage. TVA determined the site and all three isolated finds ineligible for the NRHP, and the THC concurred by letter dated May 10, 2010.

Two architectural/aboveground resources were also identified (HS-1 and HS-2 in McKee et al. 2010). HS-1 is a ca. 1930, one-story gable-front house located beyond the APE but within 0.1 miles of the APE boundary and within the 0.5-mile viewshed. HS-2 is the previously investigated Igou Cemetery located in the SQN APE. TVA determined both of these resources ineligible for listing ~~on~~ in the NRHP due to a lack of historic and architectural distinction, and the THC concurred by letter dated May 10, 2010. Archaeological sites within the 0.5-mile radius of SQN are summarized in Table 2.12-1.

The Igou Cemetery (HS-2), which contains about 45–50 graves, is in the southwestern portion of the APE near the security practice firing range. It is maintained by TVA, and access is ~~only~~ granted ~~by special permission~~ to any Igou family member who requests it. The cemetery is in no danger of disturbance or destruction from SQN operations, as TVA plans to avoid the cemetery in accordance with the Tennessee laws regarding the treatment of human remains (see Attachment B).

On March 29, 2013, a TVA archaeologist conducted a reconnaissance of the locations of previously recorded archaeological sites at SQN and identified a dense scatter of fire-cracked rock (indicative of prehistoric cooking features) and a light density of chert artifacts near the recorded location of 40HA22 outside the SQN site boundary. On April 9, 2013, two TVA archaeologists and an NRC archaeologist visited the location as part of the SQN LRA ER site audit. The TVA archaeologists identified, in addition to the artifacts, the relatively intact remains of an earthen burial mound. The artifact scatter and burial mound appear to be intact parts of site 40HA22. In the opinion of TVA archaeologists, the intact portion of 40HA22 is eligible for listing in the NRHP. TVA has sent an updated site form to the Tennessee Division of Archaeology in Nashville and has prepared a revised version of the 2010 survey report to correct the errors. (McKee et al. 2013) In addition, TVA has reopened consultation with the Tennessee SHPO on TVA's determination concerning the eligibility of 40HA22 for listing in the NRHP and has also reopened consultation with federally recognized Indian tribes (see Attachment B). TVA has no plans for ground-disturbing activity within the recently discovered intact portion of 40HA22; however, if such plans are proposed in the future, TVA will conduct studies and consultation to seek ways to avoid, minimize, or mitigate any possible project effects on 40HA22. However, the location of the newly identified extant portion of 40HA22 is outside the SQN site boundary.

As part of the assessment for the LRA, a supplemental records study and report focused on a 10-mile radius sensitivity analysis for potential visual effects on architectural historic properties. The 10-mile radius was drawn from a point equidistant between the two cooling towers at SQN (~~Figure 2.12-2~~Figure 2.12-5). The study considered all previously recorded architectural properties within the radius covering portions of Bradley, Hamilton, and Meigs counties, Tennessee. Architectural information included maps and county architectural survey files housed at the THC in Nashville. (Karpynec 2010)

The study located five NRHP-listed properties (~~Figure 2.12-2~~ Figure 2.12-5 and Table 2.12-2). The Hiram Douglas House (nominated in 1973); the Brown House (nominated in 1973); the Pleasant L. Matthews House (nominated in 1976); and the Retro School (nominated in 2010) are located in Hamilton County. The fifth, in Meigs County, is the Bradford Rymer Barn (nominated in 1982). For the three properties nominated after SQN operations began, potential adverse effects on the visual integrity of the properties were already determined inconsequential to the nomination. The two resources nominated in 1973 are both located more than 4 miles from SQN, and the view of the cooling towers is blocked by intervening topography. In fact, all five properties are located more than 4 miles from SQN, in valleys where intervening topography blocks the view of SQN.

The 10-mile architectural study also reported buildings of historical interest that have never been assessed as eligible or not eligible for the NRHP, including seven individual buildings, the closest of which is approximately 7.2 miles southeast of SQN, and multiple buildings in the town of Soddy~~,~~ including the downtown district, approximately 5.8 miles northwest of SQN. However, none of these properties ~~have~~ has been determined eligible for the NRHP by the THC, and all are at distances and in topographic positions where visual effects from continued operations at SQN are implausible.

To summarize, the 2010 Phase 1 archaeological survey report for the SQN site identified no significant cultural resources within the SQN APE and recommended that no further investigation of cultural resources is necessary in connection with the LRA and any future undertakings at SQN. The APE for the Phase 1 survey included all land within the SQN site boundary (as well as a pair of small islands that are outside the SQN site boundary). A site files search of the 6-mile radius in November 2011 confirmed that there are no newly recorded archaeological sites within the SQN APE that were not identified in the 2010 report.

One archaeological site (40HA22) that had been thought, until April 2013, to have been completely destroyed by the construction of SQN, is now known to be extant and likely eligible for listing in the NRHP. The site was originally recorded in a location that is partially within the SQN property boundary. However, based on new information, this site is located outside the SQN property boundary. TVA has updated the site form for 40HA22 at the Tennessee Division of Archaeology with this new information, prepared a revised version of the 2010 survey report to correct the errors, and submitted a copy of the revised report to the Tennessee SHPO for comment. TVA has reopened consultation with the SHPO and federally recognized Indian tribes.

The 10-mile architectural sensitivity study found that no historic properties would receive adverse impacts from continued operation of SQN. In letters dated May 5 and May 20, 2010, TVA received concurrence with the findings and recommendations of the report from the THC (see Attachment B). In a letter dated November 4, 2010, TVA received concurrence from the THC that based on the Draft Supplemental EIS, the project area contains no historic properties (see Attachment B). A site file update review was subsequently conducted by TRC in December 2011 and no new historic properties were found within the 10-mile radius (Barrett 2011).

No specific properties of religious or cultural significance were identified through tribal consultation. Comments were received from three of the 13 tribes contacted: the Alabama-Coushatta Tribe of Texas, the United Keetoowah Band of Cherokee Indians in Oklahoma, and the Seminole Band of Florida. All concurred with the finding of no effects from continued operation of SQN (see Attachment B).

As a federal agency, TVA is required to assess any future undertakings or inadvertent discoveries under Section 106 [36 CFR Part 800] or Section 110 of the NHPA. These assessments ensure that existing or potentially existing cultural resources are adequately considered, and it assists TVA in meeting state and federal expectations.

Table 2.12-1
Cultural Resources on SQN and Within 0.5-Mile of SQN Boundary

Site[a]	In SQN APE	NRHP
40HA22	~~Yes~~ No	~~Destroyed/not eligible~~ Eligible pending SHPO concurrence
40HA20	Yes	Destroyed/not eligible
40HA21	No	Not assessed/inundated by reservoir
40HA43	No	Not assessed
40HA46	No	Not assessed
40HA549	Yes	Not eligible
HS-1	No	Not eligible
HS-2	Yes	Not eligible

(Calabrese et al. 1973; McKee et al. 2010; TVA 2011a; McKee et al. 2013)

a. All sites are in Hamilton County.

Table 2.12-2
Architectural Historic Properties Within a 10-Mile Radius of SQN

Site	County	Listed NRHP
Hiram Douglas House	Hamilton	Yes
Brown House	Hamilton	Yes
Pleasant L. Matthews House	Hamilton	Yes
Retro School	Hamilton	Yes
Bradford Rymer Barn	Meigs	Yes

(Barrett 2011; Karpynec 2010)

Figure 2.12-1
SQN Site with Area of Potential Effect Shown

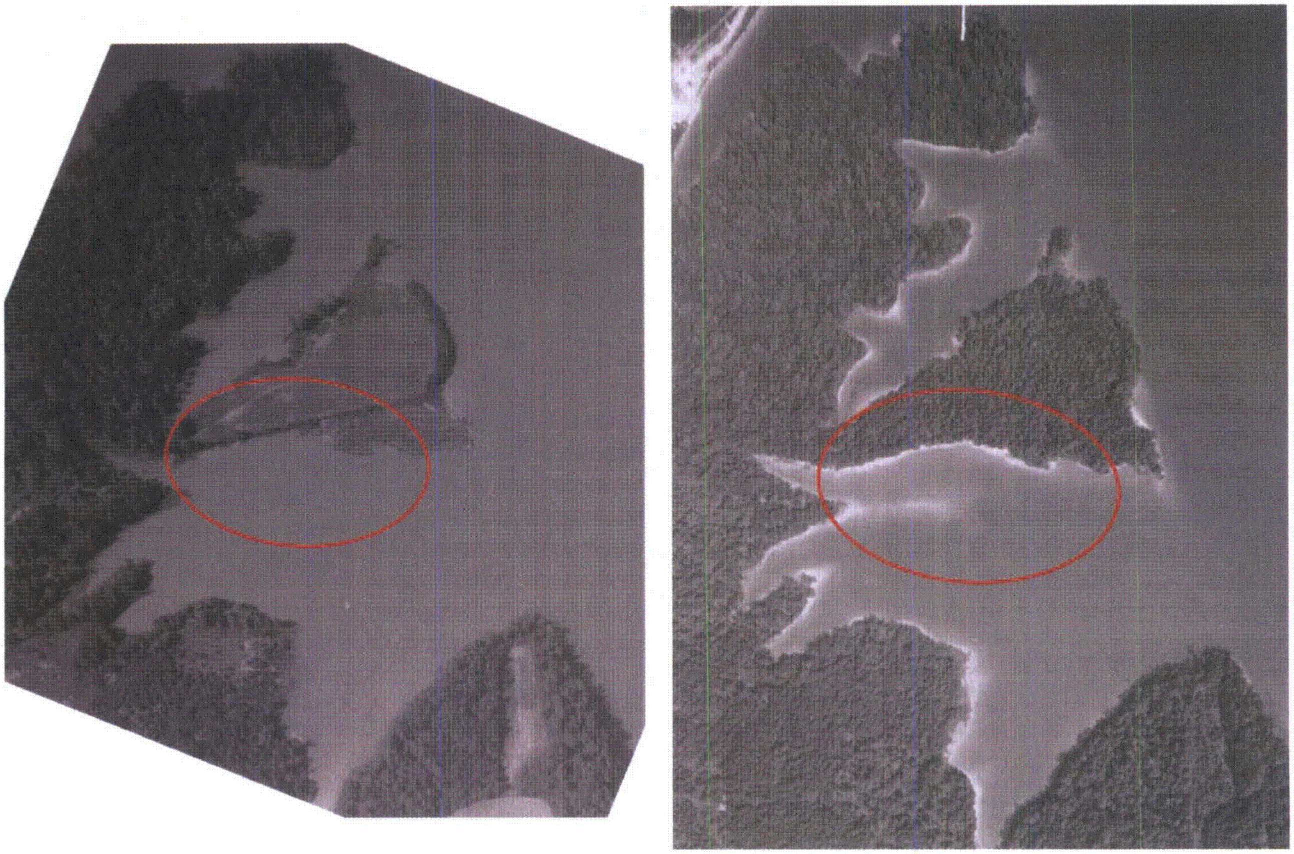

Figure 2.12-2
Aerial Photographs of SQN Plant Site Prior to Construction

Locale of 40HA20 in May 1951 (left) (TVA 1951) and August 1968 (right) (TVA 1968)

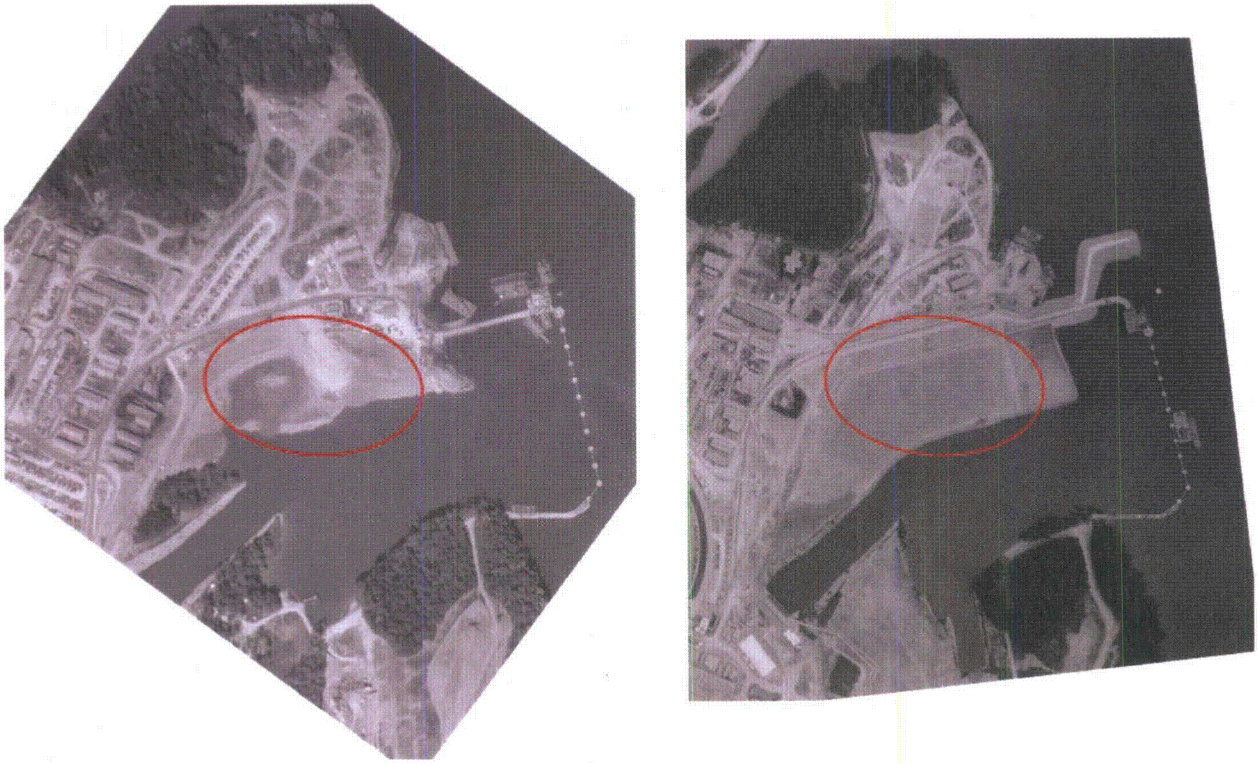

Figure 2.12-3
Aerial Photographs of SQN Plant Site During and After Construction

Locale of 40HA20 in October 1977 during construction (left) (TVA 1977)
and in June 1980 after construction (right) (TVA 1980)

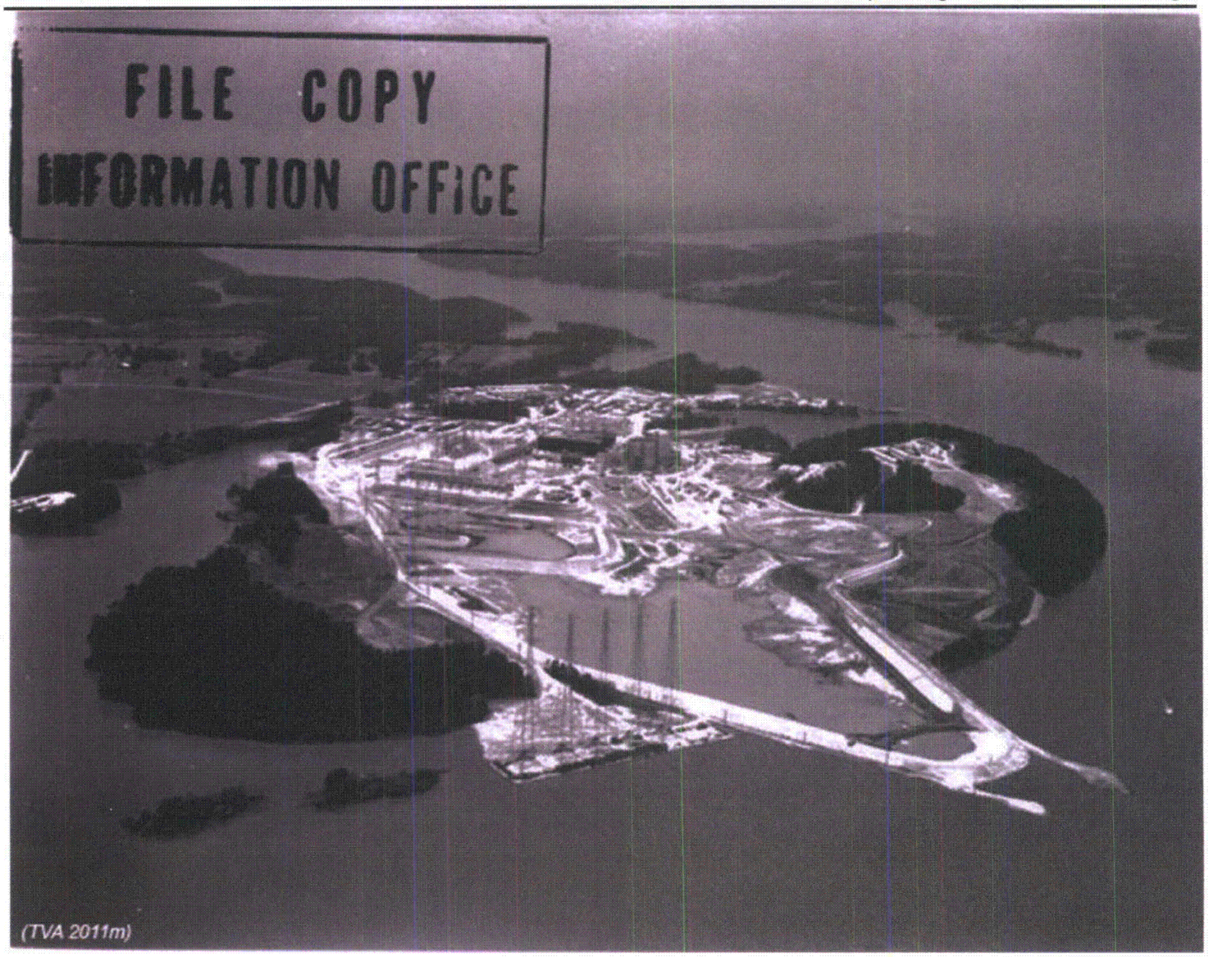

Figure 2.12-4
Oblique Aerial Photograph Taken During SQN Plant Construction Between October 1971 and February 1973

Locale of 40HA22—View to north-northeast (TVA ca. 1977)

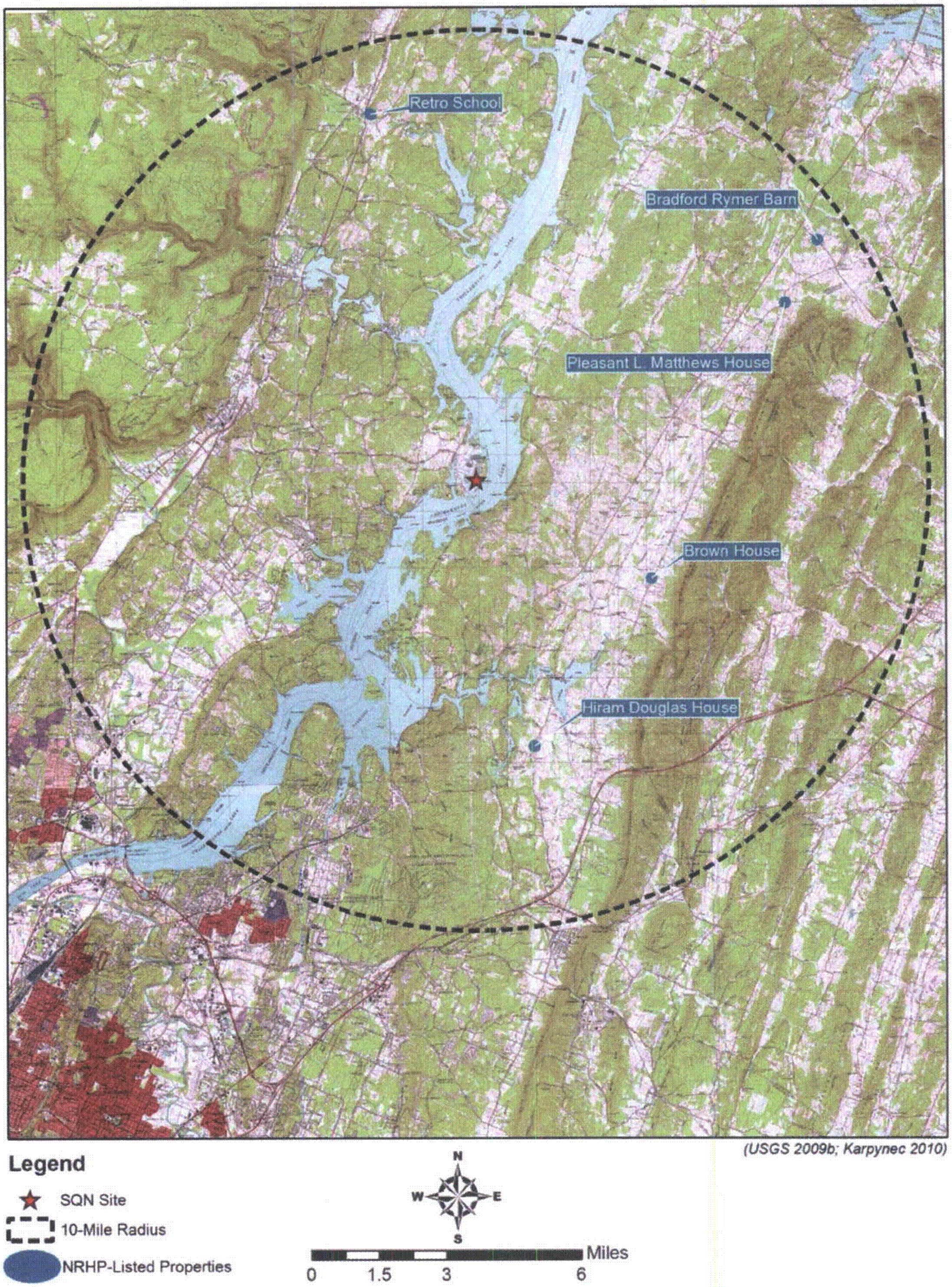

Figure 2.12-~~2~~5
10-Mile Vicinity for SQN Site with Associated Historical Properties

velocity of approximately ~~1.7~~ 2.08 feet per second (fps), three screens for each unit (Figure 3.2-1). The traveling screens have 3/8-inch square openings and are designed to trap smaller trash and any larger-sized trash that may have passed through the trash racks. (TVA 2011q, Section 2.1; SQN 2011b) Differential pressure across each traveling screen is monitored by an air bubbler system. When a preset differential pressure of water is reached across the screen, the screen wash pump is started. When a preset pressure is established at the screen wash nozzles, the screen motors are automatically started, and the screens are washed until the pump is manually stopped. (TVA 2011p, Section 10.4.5.2) Each screen will pass a flow of 189,000 gpm at low water depth of 28 feet in the intake channel and the rate of travel of the screens is approximately 10 feet per minute. (TVA 2011q, Section 2.1)

The CCW system is designed to operate in any of three modes: open, helper, or closed. In the open mode, the water bypasses the cooling tower lift pumps and is returned to Chickamauga Reservoir through the diffuser pond and the discharge diffusers.

In the helper mode, the water is pumped into the cooling towers by the lift pumps, then passes through the cooling towers where part of the waste heat is liberated directly to the atmosphere. The cooled water is returned to Chickamauga Reservoir. (TVA 2011p, Section 10.4.5.2) During the helper mode, four lift pumps are designed to deliver approximately 560,000 gpm at a head of 82 feet to each cooling tower (TVA 2011q, Section 1.3). The pumps are in the cooling tower pumping station at the downstream end of the discharge pond. The cooling towers are designed to reject waste heat to the atmosphere, thereby cooling the CCW when river flow/temperatures do not permit direct CCW discharge to the river. (TVA 2011p, Section 10.4.5.2)

The amount of cooling water loss due to evaporation and drift from the cooling towers depends on a number of factors, such as the amount and temperature of flow delivered to the cooling towers and local meteorology. When the plant is operated in helper mode, the net consumption of water for a single day will be larger than the annual average day. For example, when operated under design conditions (a conservative upper-bounding scenario), the net loss of water due to evaporation and drift in the cooling towers is about 45 MGD (70 cfs). In a similar fashion, on a daily basis, the river flow is often lower than the annual average flow. Based on the current operating policy for the TVA reservoir system, the daily average river flow past the SQN site can be as low as 3,000 cfs. However, in practice, the river flow past SQN seldom drops below a daily average of 6,000 cfs. Thus, on a daily average basis, the net consumptive loss due to cooling tower operation is not likely to exceed roughly 1.2 percent of the river flow past the SQN site. (TVA 2012j)

In the closed mode, the water is pumped through the cooling towers where the waste heat is liberated directly to the atmosphere and then returned to the intake channel. (TVA 2011p, Section 10.4.5.2) However, it should be noted that although the physical capability exists to operate in the "closed mode," it is not utilized because it would result in significant power derates. Closed-mode testing after plant start-up determined that significant derates would be involved because the cooling tower performance was not sufficient. To improve cooling tower performance, increased cooling tower capacity would likely be required prior to closed-mode operation, from some combination of replacing the fill material, converting from a cross-flow to a counter-flow recycled, treated, or disposed of to minimize the present and future threat to human health and the environment. (SQN 2011e, Section I)

Programs that have been implemented at the facility to reduce, to the extent feasible, waste generated, treated, accumulated or disposed are described in SQN's Hazardous Waste Minimization Plan. This plan, which identifies previous waste streams eliminated and current waste streams generated at the facility, is updated annually and used in conjunction with procedures associated with waste management (0-TI-ENV-000-002, Solid, Special, Hazardous, and Mixed Waste Management) and chemical control (0-TI-CEM-260-282.0, Chemistry Chemical Traffic Control, and SPP-5.4, Chemical Traffic Control) to minimize waste generation to the maximum extent practicable. (SQN 2008b; SQN 2009c; TVA 2009e)

3.2.8.2 Wastewater Discharges

Some amount of chemical and biocide wastes are produced from processes used to control the pH in the coolant, scale, and corrosion; to regenerate resins; and to clean and defoul the condenser. These waste liquids are typically combined with cooling water discharges in accordance with the site's NPDES Permit TN0026450. The current SQN NPDES permit authorizes discharges from seven outfalls (five external and two internal). The outfalls and their associated effluent limits are listed in Table 3.2-2.

~~As shown in Figure 2.1-1 and listed in Table 3.2-2, SQN has constructed several onsite ponds to support plant operations. The yard drainage pond identified as the settling pond (Outfall 118) in the NPDES permit, one of the metal cleaning waste ponds (Outfall 107), and the diffuser pond associated with Outfall 101 are unlined, whereas the low volume waste treatment pond (Outfall 103) is lined.~~As shown in Figures 2.1-1 and 3.2-2 and listed in Table 3.2-2, SQN has constructed several onsite ponds to support plant operations. The yard drainage pond (discharges to Outfall 101), a settling pond used to dewater dredge material (discharges to Outfall 118), one of the metal cleaning waste ponds (Internal Monitoring Point 107), and the diffuser pond (discharges to Outfall 101) are unlined, whereas the other metal cleaning waste pond (Internal Monitoring Point 107) and the low volume waste treatment pond (Internal Monitoring Point 103) are lined. No groundwater monitoring requirements are imposed by the NPDES permit as it relates to the use of these ponds.

Sanitary sewage from all plant locations is collected and pumped off site to the Moccasin Bend publicly owned treatment works (POTW), where it is managed appropriately. Although not a POTW requirement, SQN conducts radiological sampling and monitoring of the sanitary effluent on a monthly basis.

3.2.8.3 Potable Water

The source of fire protection water and potable water for SQN is the Hixson Utility District. Water supplied by this municipal water system is treated off site in accordance with applicable drinking water standards, and no further treatment for potable water usage is performed on site. The wastewater associated with potable water usage is routed to the sanitary drainage system, which is discharged off site to the Moccasin Bend POTW, where it is treated. (TVA 2011a, Section 3.1.4.1)

4.3.5 Analysis of Environmental Impact

4.3.5.1 Background

Impingement occurs when fish and other aquatic life are trapped against cooling water intake screens. Sometimes fish are unable to swim against the inflow water velocity and become trapped on the traveling screens. Traveling screens are systematically rotated and washed to remove fish and other debris to prevent clogging of the water flow used to cool the plant condensers. Impingement rates typically increase during the late fall and early winter when fish intolerant of lower water temperatures exhibit die-offs.

Section 3.2.2 of the ER describes the cooling water intake system. Flow passes through six traveling screens at a velocity of approximately ~~1.7~~ 2.08 fps, three for each unit (Figure 3.2-3). The traveling screens have 3/8-inch square openings.

As discussed in Section 3.2.2, there is also an ERCW intake structure which supplies cooling water to various heat loads in both the primary and secondary portions of each unit. The ERCW system consists of eight ERCW pumps (11,000 gpm each), four traveling water screens, four screen wash pumps (270 gpm each), and four strainers located at the ERCW pumping station. Supply water for the ERCW pumps enters the pumping station through each of four traveling water screens at a velocity of < 0.50 fps. Because the intake velocity is typically considered best technology available, TVA did not include the ERCW intake structure in this analysis.

SQN operates under an NPDES permit. The initial NDPES permit (TN0026450) was issued by the EPA effective January 15, 1979. This permit required TVA to design and implement an operational stage nonradiological monitoring program to evaluate potential intake and discharge effects of SQN on the aquatic environment of Chickamauga Reservoir, to continue through 2 years of Unit 2 operation. Pursuant to this provision, TVA conducted impingement monitoring during the operational monitoring period from 1980 through 1985 as discussed in the following section. Subsequently, TVA conducted impingement monitoring in December 2001 to February 2002. The 2001–2002 impingement study is also discussed in the following section.

SQN's most recent NPDES permit, TN0026450, became effective on March 1, 2011. Based on 10 CFR 51.53(c)(3)(ii)(B), an assessment of the impact on fish and shellfish resources resulting from impingement is not required, because it was determined in the 2011 permit that SQN was currently in compliance with 316(b) requirements based on best professional judgment. A copy of the current NDPES permit is provided in Attachment C. Based on previous monitoring, it is anticipated that no additional monitoring will be required by the new regulations pursuant to CWA Section 316(b). CWA Section 316(b) is further discussed in Section 5.1.1.

4.3.5.2 Impingement Analysis

1980–1985 Study

In accordance with SQN's 1979 NPDES permit issued by the EPA, TVA began monitoring impingement rates associated with plant operations to detect impacts to the fish community. In

4.20 Historic and Archaeological Resources

4.20.1 Description of Issue

Historic and archaeological resources.

4.20.2 Finding from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, or LARGE. Generally plant refurbishment and continued operation are expected to have no more than small adverse impacts on historic and archaeological resources. However, the NHPA requires the federal agency to consult with the ~~state historic preservation office~~ State Historic Preservation Officer to determine whether there are properties present that require protection. See 10 CFR 51.53 (c)(3)(ii)(K).

4.20.3 Requirement [10 CFR 51.53(c)(3)(ii)(K)]

All applicants shall assess whether any historic or archaeological properties will be affected by the proposed project.

4.20.4 Background

It is unlikely that moderate or large impacts to historic resources would occur at any site unless new facilities or service roads are constructed or new transmission lines are established. However, the identification of historic resources and determination of possible impacts to them must be done on a site-specific basis through consultation with the ~~state historic preservation office~~ State Historic Preservation Officer. The site-specific nature of historic resources and the mandatory NHPA consultation process mean that the significance of impacts to historic resources and the appropriate mitigation measures to address those impacts cannot be determined generically. (NRC 1996, Section 3.7.7)

4.20.5 Analysis of Environmental Impact

4.20.5.1 Refurbishment

As discussed in Section 3.3, no refurbishment activities are planned for SQN license renewal. Therefore, historic and archaeological impacts related to refurbishment are not applicable.

4.20.5.2 License Renewal

As noted in Section 2.4, the SQN site includes a mix of barren land, urbanized open space, and low-, medium-, and high-intensity improvements. SQN also comprises other areas such as open water, forests, grasslands, pastures, and wetlands. Approximately 40 percent of the site is developed.

Known cultural resources on the SQN site and within 0.5 mile of the SQN boundaries are presented in Table 2.12-1. The NRHP-listed architectural properties located within a 10-mile radius of SQN are presented in Table 2.12-2. As discussed in Section 2.12, ~~those cultural~~

~~resources on SQN have been determined not eligible for the NRHP, lacking stylistic or structural elements or characteristics that could meet criteria of eligibility for the NRHP or contribute to the area's sense of historic character. Therefore, impacts to historic properties as a result of renewing the SQN OLs would be SMALL, because no historic properties exist within site boundaries.~~three of the four cultural resources that have been recorded within the SQN property boundary have been determined ineligible for listing in the NRHP because they lack characteristics that could meet criteria of eligibility for the NRHP or contribute to the area's sense of historic character. Site 40HA20 is ineligible because it was apparently destroyed by plant construction, and site 40HA549 is ineligible because it lacks intact buried deposits that could make a significant contribution to existing knowledge of the prehistoric past. In the case of the Igou Cemetery, the ineligible determination is due to the cemetery not meeting any of the "criteria considerations" listed in 36 CFR 60.4, which are required in order for a cemetery to be considered eligible. The Tennessee SHPO has agreed with TVA's determinations of eligibility for all three of these resources. However, one site previously thought to have been destroyed by plant construction (40HA22) has recently been found to be extant, at least in part. Moreover, the location of the site differs from the location indicated by site records maintained by the Tennessee Division of Archaeology. The location of 40HA22 is outside the SQN property boundary, not partly inside the boundary as it was originally recorded. It is TVA's opinion that the site is eligible for listing in the NRHP. TVA has updated the site form for 40HA22 at the Tennessee Division of Archaeology with this new information and prepared a revised version of the 2010 cultural resources survey report to correct the errors. TVA has reopened consultation with the Tennessee SHPO and federally recognized Indian tribes. However, as stated above, site 40HA22 is outside the SQN plant boundary and therefore the only cultural resources within the boundary are 40HA20 (destroyed), 40HA549 (NRHP-ineligible), and the Igou Cemetery (NRHP-ineligible). Therefore, impacts to historic properties as a result of renewing the SQN OLs would be SMALL. For archaeological sites outside SQN site boundaries, adverse impacts would only occur as a result of soil-intrusive activities, and TVA has no plans to conduct such soil-intrusive activities at any location outside of the site boundaries under a renewed license. Therefore, impacts to archaeological sites located outside the site property as a result of renewing the SQN OLs would be SMALL.

Five NRHP-listed aboveground historic properties are located within a 10-mile radius of SQN (see Figure 2.12-2). Such architectural properties are susceptible to any substantial force that could degrade their physical or historical integrity. Physical integrity refers to the structural condition (or soundness) of a historic property such as a house, and can be affected by the nearby operation of heavy equipment or by vibrations from the detonation of explosives. Historical integrity is the ability of a property to convey its significance to the public by virtue of its location, design, setting, materials, workmanship, feeling, and association [36 CFR 60.4]. The historical integrity of a property can be adversely impacted by factors such as noise and visual changes in the property such as modern buildings. SQN plant operations and associated transmission lines produce no intense vibrations or other substantial physical forces that would adversely impact historic properties located outside of the site property, and SQN and its associated facilities produce little noise. Furthermore, three of the five listed properties (the Pleasant L. Matthews house, the Retro School, and the Bradford Rymer Barn) were nominated after SQN operations began, such that potential adverse effects on the visual integrity of the property were already determined inconsequential to the nomination. In fact, all five properties are located more than 4 miles from SQN, in valleys where intervening topography blocks the view of SQN, such that visual impacts from continued operations at SQN are implausible. As a result, impacts on the physical and historical integrity of such properties would be SMALL.

Since the original construction and operation of SQN, historical and archaeological resource reviews have been conducted for proposed projects such as replacement of steam generators for Units 1 and 2 and an ISFSI. In all instances, impacts were determined to be SMALL.

As previously discussed, there are no plans for additional construction or plant refurbishments in conjunction with renewal of the SQN OLs. As a federal agency, TVA is required to assess any future undertakings or inadvertent discoveries under Section 106 [36 CFR Part 800] or Section 110 of the NHPA. These assessments ensure that existing or potentially existing cultural resources are adequately considered, and assist TVA in meeting state and federal expectations.

~~Based on the conclusions and recommendations of the 2010 Phase 1 archaeological survey and concurrence by the THC (see Attachment B), none of the cultural resources identified within the SQN APE are eligible for the NRHP. In addition, no specific properties of special sensitivity or concern were identified through tribal consultation, and all comments received concurred with the finding of no effects (see Attachment B).~~ Based on the conclusions and recommendations of the 2010 Phase 1 archaeological survey, and concurrence by the SHPO, archaeological sites 40HA20 and 40HA549, and the Igou Cemetery are ineligible for listing in the NRHP (see Attachment B). Despite the finding of the 2010 Phase 1 cultural resources survey that 40HA22 was completely destroyed and concurrence from SHPO, TVA has recently found 40HA22 to be extant and, in the opinion of TVA archaeologists, the site is eligible for listing in the NRHP. However, new information shows 40HA22 to be located outside the SQN property boundary, and the renewal of SQN OLs includes no plans for activities that would cause a significant impact on this site. None of the five NRHP-listed historic architectural properties with a 10-mile radius of SQN would be affected by operation or maintenance of SQN and associated transmission lines. No specific properties of special sensitivity or concern were identified through the tribal consultation that TVA carried out at the time of the 2009 and 2010 Phase 1 archaeological surveys, and all comments received concurred with the finding of no effects (see Attachment B).

4.20.6 Conclusion

No refurbishment activities are planned for renewal of SQN OLs. There are also no plans to alter operations, expand existing facilities, or disturb additional land in support of OL renewals. In addition, as discussed in Section 4.20.5 above, no historic properties such as NRHP-eligible or listed archaeological sites exist within the site boundary, and the five aboveground historical sites are located more than 4 miles from the plant in valleys where intervening topography blocks the view of SQN. Therefore, under renewed licenses, the potential impacts on historic properties from continued operation of SQN would be SMALL, and additional mitigation measures are not warranted.

Table 3.2-1
SQN Hazardous Waste Generation, 2007–2011

Year	Pounds
2007	550
2008	882
2009	1,065
2010	5,968
2011	3,990

(SQN 2011e; SQN 2012c)

Table 3.2-2
NPDES Permitted Outfalls

Outfall	Description	Parameter	Limit
101	Diffuser discharge	Flow	Report only (monthly average mgd) Report only (daily maximum mgd)
		Ambient temperature	Report only (daily maximum °C)
		~~River temperature~~	~~Report only (daily maximum °C)~~
		Total residual chlorine	0.10 mg/l monthly average 0.10 mg/l daily maximum
		Toxicity testing	43.2% survival
		Temperature (winter)[a]	5°C daily maximum
		Temperature (summer)[b]	3°C daily maximum
		Temperature rise (all year)[c]	2°C daily maximum
		Temperature ~~rise~~ (all year)[d]	30.5°C daily maximum
103	Low volume waste treatment pond	Flow	Report only (monthly average mgd) Report only (daily maximum mgd)
		Oil and grease	15 mg/l monthly average 20 mg/l daily maximum
		Total suspended solids	30 mg/l monthly average 100 mg/l daily maximum
		pH	6.0–9.0
107	Metal cleaning waste pond	None	None
110[e]	Recycled cooling water	None	None
116	Condenser circulating water backwash	None	None
117	Essential raw cooling water backwash	None	None

**Table 3.2-2 (Continued)
NPDES Permitted Outfalls**

Outfall	Description	Parameter	Limit
118	Settling pond water and stormwater runoff	Flow	Report only (monthly average mgd) Report only (daily maximum mgd)
		Dissolved oxygen	2.0 mg/l minimum
		Settleable solids	1.0 ml/l daily maximum
		Total suspended solids	100 mg/l daily maximum

(SQN 2011c, Part I)

a. Difference between ~~effluent gross~~ instream and upstream temperatures November–March (winter).
b. Difference between instream and upstream temperatures April–October (summer).
c. Instream temperature rate of change °C/hour.
d. Instream temperature °C.
e. Outfall 101 limitations also apply if used as main discharge point in place of Outfall 101.