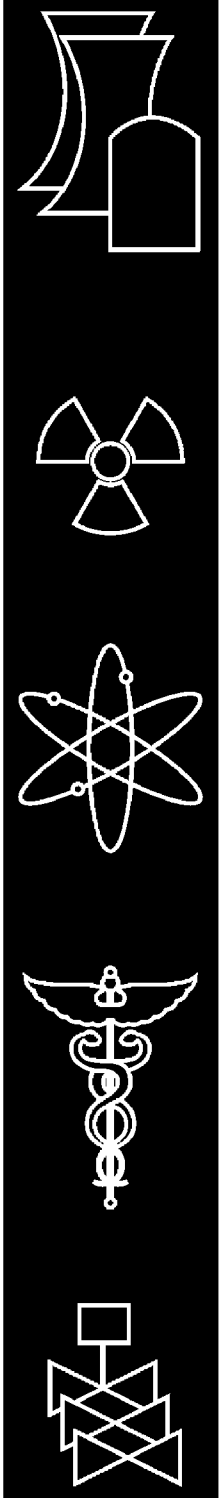
NUREG-1437
Supplement 16



Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 16

Regarding
Quad Cities Nuclear Power Station, Units 1 and 2

Final Report

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555-0001

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Generic Environmental Impact Statement for License Renewal of Nuclear Plants

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Final Report

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Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Abstract

The U.S. Nuclear Regulatory Commission (NRC) considered the environmental impacts of renewing nuclear power plant operating licenses (OLs) for a 20-year period in its *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2, and codified the results in 10 CFR Part 51. The GEIS (and its Addendum 1) identifies 92 environmental issues and reaches generic conclusions related to environmental impacts for 69 of these issues that apply to all plants or to plants with specific design or site characteristics. Additional plant-specific review is required for the remaining 23 issues. These plant-specific reviews are to be included in a supplement to the GEIS.

This supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted to the NRC by the Exelon Generation Company, LLC (Exelon) to renew the OLs for Quad Cities, Units 1 and 2, for an additional 20 years under 10 CFR Part 54. This SEIS includes the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's recommendation regarding the proposed action and responses to comments received on the SEIS.

Regarding the 69 issues for which the GEIS reached generic conclusions, neither Exelon nor the staff has identified information that is both new and significant for any issue that applies to Quad Cities. The staff determined that information provided during the scoping and SEIS comment processes did not call into question the conclusions in the GEIS. Therefore, the staff concludes that the impacts of renewing the Quad Cities OLs will not be greater than impacts identified for these issues in the GEIS. For each of these issues, the staff's conclusion in the GEIS is that the impact is of SMALL[(a)] significance (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel, which were not assigned a single significance level).

Regarding the remaining 23 issues, 15 apply to Quad Cities and are addressed in this SEIS. For 14 of the 15 issues, the staff concludes that the significance of the potential environmental impacts of renewal of the OLs is SMALL. The staff also concludes that for these issues, additional mitigation measures are not likely to be sufficiently beneficial as to be warranted. For the issue of electric shock from induced current along transmission line corridors, the staff concludes that the potential impact is MODERATE for one transmission line and that consideration of additional mitigation measures is warranted. In addition, the staff determined

(a) Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

that information provided during the scoping and SEIS processes did not identify any new issue that requires site-specific assessment.

The NRC staff recommends that the Commission determine that the adverse environmental impacts of license renewal for Quad Cities Units 1 and 2 are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the Environmental Report submitted by Exelon; (3) consultation and discussions with Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of the public comments.

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Executive Summary

By letter dated January 3, 2003, the Exelon Generation Company, LLC (Exelon) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating licenses (OLs) for Quad Cities Units 1 and 2 for an additional 20-year period. If the OLs are renewed, State regulatory agencies and Exelon will ultimately decide whether the two units will continue to operate based on factors such as the need for power or other matters within the state's jurisdiction or the purview of the owners. If the OLs are not renewed, then the units must be shut down at or before the expiration dates of the current OLs, both of which will expire on December 14, 2012.

Section 102 of the National Environmental Policy Act (NEPA) (42 USC 4321) directs that an environmental impact statement (EIS) is required for major Federal actions that significantly affect the quality of the human environment. The NRC has issued regulations implementing Section 102 of NEPA in 10 CFR Part 51. Part 51 identifies licensing and regulatory actions that require an EIS. In 10 CFR 51.20(b)(2), the Commission requires the preparation of an EIS or a supplement to an EIS for the renewal of a reactor OL; 10 CFR 51.95(c) states that the EIS prepared at the OL renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2.[(a)]

Upon acceptance of the Exelon application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing in the Federal Register a notice of intent to prepare an EIS and conduct scoping. The staff visited the Quad Cities site in March 2003 and held two public scoping meetings on April 8, 2003, in Moline, Illinois. In preparing this supplemental environmental impact statement (SEIS) for Quad Cities Units 1 and 2, the staff reviewed the Exelon Environmental Report (ER) and compared it to the GEIS; consulted with other agencies; conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1, the *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Operating License Renewal*, and considered the public comments received during the scoping process. The public comments received during the scoping process that were considered to be within the scope of the environmental review, and the NRC staff responses, are provided in Appendix A, Part 1, of this SEIS.

A draft SEIS was published in November 2003. In December 2003, the staff held two public meetings in Moline, Illinois, to describe the preliminary results of the NRC environmental review, answer questions, and provide members of the public with information to assist them in formulating comments on this SEIS. When the public comment period ended, the staff

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

considered and dispositioned all of the comments received. These comments are addressed in Appendix A, Part II of this SEIS.

This SEIS includes the NRC staff's analysis that considers and weighs the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures for reducing or avoiding adverse effects. It also includes the staff's recommendation regarding the proposed action.

The Commission has adopted the following statement of purpose and need for license renewal from the GEIS:

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than the NRC) decisionmakers.

The evaluation criterion for the staff's environmental review, as defined in 10 CFR 51.95(c)(4) and the GEIS, is to determine

> ... whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

Both the statement of purpose and need and the evaluation criterion implicitly acknowledge that there are factors, in addition to license renewal, that will ultimately determine whether an existing nuclear power plant continues to operate beyond the period of the current OL.

NRC regulations [10 CFR 51.95(c)(2)] contain the following statement regarding the content of SEISs prepared at the license renewal stage:

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) ["Temporary storage of spent fuel after cessation of reactor operation–generic determination of no significant environmental impact"] and in accordance with § 51.23(b).

The GEIS contains the results of a systematic evaluation of the consequences of renewing an OL and operating a nuclear power plant for an additional 20 years. It evaluates 92 environmental issues using the NRC's three-level standard of significance—SMALL, MODERATE, or LARGE—developed using the Council on Environmental Quality guidelines. The following definitions of the three significance levels are set forth in footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

For 69 of the 92 issues considered in the GEIS, the analysis in the GEIS led to the following conclusions:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

These 69 issues were identified in the GEIS as Category 1 issues. In the absence of new and significant information, the staff relied on conclusions as amplified by supporting information in the GEIS for issues designated as Category 1 in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

Of the 23 issues that do not meet the criteria set forth above, 21 are classified as Category 2 issues requiring analysis in a plant-specific supplement to the GEIS. The remaining two issues, environmental justice and chronic effects of electromagnetic fields, were not categorized. Environmental justice was not evaluated on a generic basis and must be addressed in a plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared.

This SEIS documents the staff's evaluation of all 92 environmental issues considered in the GEIS. The staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not renewing the OLs for Quad Cities Units 1 and 2) and alternative methods of power generation. Based on projections made by the U.S. Department of Energy's Energy Information Administration, gas- and coal-fired generation appear to be the most likely power-generation alternatives if the power from Units 1 and 2 is replaced. These alternatives are evaluated in detail, assuming that the replacement power generation plant is located at either the Quad Cities site or an unspecified alternate location.

Exelon and the staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither Exelon nor the staff has identified information that is both new and significant related to Category 1 issues that would call into question the conclusions in the GEIS. Similarly, neither Exelon, the scoping process, nor the staff have identified any new issue applicable to Quad Cities Units 1 and 2 that has a significant environmental impact. Therefore, the staff relies upon the conclusions of the GEIS for all of the Category 1 issues that are applicable to Quad Cities Units 1 and 2.

Exelon's license renewal application presents an analysis of the Category 2 issues that are applicable to Quad Cities Units 1 and 2 plus environmental justice. The staff has reviewed the Exelon analysis for each issue and has conducted an independent review of each issue. Four Category 2 issues are not applicable, because they are related to plant design features or site characteristics not found at Quad Cities. Four Category 2 issues are not discussed in this SEIS, because they are specifically related to refurbishment. Exelon has stated that its evaluation of structures and components, as required by 10 CFR 54.21, did not identify any major plant refurbishment activities or modifications as necessary to support the continued operation of Quad Cities Units 1 and 2 for the license renewal period. In addition, any replacement of components or additional inspection activities are within the bounds of normal plant component replacement, and therefore, are not expected to affect the environment outside the bounds of plant operations evaluated in the U.S. Atomic Energy Commission's 1972 *Final Environmental Statement Related to the Operation of Quad Cities Nuclear Station Units 1& 2*.

Thirteen Category 2 issues related to operational impacts and postulated accidents during the renewal term, as well as the remaining two issues, environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this SEIS. For 12 Category 2 issues and environmental justice, the staff concludes that the potential environmental effects are of SMALL significance in the context of the standards set forth in the GEIS. In addition, the staff determined that appropriate Federal health agencies have not reached a consensus on the

existence of chronic, adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is required. For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for Quad Cities Units 1 and 2 and the plant improvements already made, the staff concludes that four of the candidate SAMAs are cost-beneficial and two other SAMAs are potentially cost-beneficial. However, these SAMAs do not relate to adequately managing the effects of aging during the period of extended operation. Therefore, they do not need to be implemented as part of license renewal pursuant to 10 CFR Part 54.

For one issue, the staff's conclusion is that the potential environmental impact of renewal term operations of Quad Cities Units 1 and 2 is greater than SMALL. The staff concludes that the impact of the potential for electric shock from induced current along transmission line corridors is MODERATE on the portion of the north Nelson line where the calculated induced current exceeds the 5 mA criterion specified in the National Electric Safety Code. Exelon's ER reported a calculated value of 6 mA.

Mitigation measures were considered for each Category 2 issue. Existing measures to mitigate the environmental impacts of plant operation were found to be adequate for 12 issues, and no additional mitigation measures were deemed sufficiently beneficial for these issues to be warranted. However, for the issue of the potential for electric shock along transmission line corridors from transmission line induced current, consideration of further mitigation is warranted. The NRC staff findings related to this issue have been provided to the transmission line owner.

If the Quad Cities OLs are not renewed and the units cease operation on or before the expiration of their current OLs, the adverse impacts of likely alternatives will not be smaller than those associated with continued operation of Quad Cities Units 1 and 2. The impacts may, in fact, be greater in some areas.

The recommendation of the NRC staff is that the Commission determine that the adverse environmental impacts of license renewal for Quad Cities Units 1 and 2 are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the ER submitted by Exelon; (3) consultation with other Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of the public comments.

Abbreviations/Acronyms

°	degree
μ	micro
μCi	microcurie(s)
μCi/mL	microcurie(s) per milliliter
μGy	microgray(s)
μm	micrometer(s)
μSv	microsievert(s)
A/C	air conditioner
AC	alternating current
ac	acres
ACC	averted cleanup and decontamination costs
ADAMS	Agencywide Documents Access and Management System
AEA	Atomic Energy Act of 1954
AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
AOC	averted offsite property damage costs
AOE	averted occupational exposure costs
AOSC	averted onsite costs
APE	averted public exposure costs
AQCR	air quality control region
ATWS	anticipated transients without scram
BMP	best management practice(s)
BOD	biological oxygen demand
Bq	becquerel(s)
Bq/mL	becquerel(s) per milliliter
Btu	British thermal unit(s)
Btu/ft^3	British thermal unit(s) per cubic foot
Btu/kWh	British thermal unit(s) per kilowatt hour
BWR	boiling water reactor
BWROG	boiling water reactor owner's group
C	Celsius
CAA	Clean Air Act
CDF	core damage frequency
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second

Ci	curie(s)
cm	centimeter(s)
cm/s	centimeter(s) per second
COE	cost of enhancement
CWA	Clean Water Act of 1972
DBA	design-basis accident
DC	direct current
DDT	dichloro-diphenyl-trichloroethane
DOE	U.S. Department of Energy
DMR	discharge monitoring report
DSAR	draft safety analysis report
DSM	demand-side management
EIA	Energy Information Administration (of DOE)
EIS	environmental impact statement
ELF-EMF	extremely low frequency-electromagnetic field
EPA	U.S. Environmental Protection Agency
EPU	extended power uprate
EPRI	Electric Power Research Institute
ER	Environmental Report
ESA	Endangered Species Act of 1973
ESRI	Environmental Systems Research Institute
ESRP	Environmental Standard Review Plan
F	Fahrenheit
FAA	U.S. Federal Aviation Administration
FES	final environmental statement
FIVE	fire-induced vulnerability evaluation
FPS	fire-protection system
FR	*Federal Register*
FSAR	final safety analysis report
ft	foot (feet)
ft/s	foot (feet) per second
ft^3	cubic foot (feet)
ft^3/s	cubic foot (feet) per second
ft^3/yr	cubic foot (feet) per year
F–V	Fussel–Veseley
FWS	U.S. Fish and Wildlife Service
g	unit measure of ground acceleration
gal	gallon(s)

gal/s	gallon(s) per second
GEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437
GIS	geographic information systems
gpd	gallon(s) per day
gpm	gallon(s) per minute
Gy	gray(s)
ha	hectare(s)
HCLPF	high confidence low probability of failure
HEPA	high-efficiency particulate air (filter)
HLW	high-level waste
hr	hour(s)
Hz	Hertz
IA DNR	Iowa Department of Natural Resources
IEMA	Illinois Emergency Management Agency
IEPA	Illinois Environmental Protection Agency
IL DNR	Illinois Department of Natural Resources
INEEL	Idaho National Engineering and Environmental Laboratory
in.	inch(es)
IPA	integrated plant assessment
IPE	individual plant examination
IPEEE	individual plant examination of external events
IRS	Illinois Revised Statutes
ISFSI	independent spent fuel storage installation
ISLOCA	interfacing systems loss of coolant accident
J	joule(s)
km	kilometer(s)
km^2	square kilometer(s)
kV	kilovolt(s)
kW	kilowatt(s)
kWh	kilowatt hour(s)
kWh/m^2	kilowatt hour(s) per square meter
L	liter(s)
L/d	liter(s) per day
L/min	liter(s) per minute
L/s	liter(s) per second
lb	pound(s)

lb/MWh	pound(s) per megawatt hour
LERF	large early release frequency
LLC	Limited Liability Corporation
LMS	Lawler, Matusky & Skelly Engineers
LOCA	loss of coolant accident
LOOP	loss of offsite power
LOS	level of service
LR	license renewal
m	meter(s)
m/s	meter(s) per second
m^3	cubic meter(s)
m^3/d	cubic meter(s) per day
m^3/s	cubic meter(s) per second
m^3/yr	cubic meter(s) per year
mA	milliampere(s)
MAB	maximum attainable benefit
MACCS2	MELCOR Accident Consequence Code System 2
Mbq	megabecquerel(s)
Mbq/L	megabecquerel(s) per liter
mGy	milligray(s)
mi	mile(s)
mi^2	square mile(s)
mL	milliliter(s)
mm	millimeter(s)
mph	mile(s) per hour
mrad	millirad(s)
mrem	millirem(s)
mrem/yr	millirem(s) per year
MSA	Metropolitan Statistical Area
MSIV	main steam isolation valve
mSv	millisievert(s)
mSv/yr	millisievert(s) per year
MT	metric ton(s) (or tonne[s])
MT/yr	metric ton(s) (or tonne[s]) per year
MTU	metric ton(s) (or tonne[s])-uranium
MW	megawatt(s)
MWd/MTU	megawatt-day(s) per metric ton (or tonne) of uranium
MW(e)	megawatt(s) electric
MWh	megawatt hour(s)
MW(t)	megawatt(s) thermal

NA	not applicable
NAS	National Academy of Sciences
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act of 1969
NESC	National Electric Safety Code
ng	nanogram(s)
ng/J	nanogram(s) per joule
NHPA	National Historic Preservation Act of 1966
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NO_x	nitrogen oxide(s)
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NREL	National Renewable Energy Laboratory
NWFR	National Wildlife and Fish Refuge
NWPPC	Northwest Power Planning Council
ODCM	*Offsite Dose Calculation Manual*
OL	operating license
PBq	petabecquerel(s)
PCB	polychlorinated biphenyl
pCi	picocurie(s)
pCi/L	picocurie(s) per liter
PDS	plant damage state
PLEX	plant life extention
PM_{10}	particulate matter, 10 micrometers or less in diameter
PRA	probabilistic risk assessment
PSD	prevention of significant deterioration
PV	photovoltaic
RAI	request for additional information
rem	special unit of dose equivalent, equal to 0.01 sievert
REMP	radiological environmental monitoring program
RFP	reactor feed pump
RHR	residual heat removal
RM	river mile(s)
ROW	right of way
RPC	replacement power costs
RRW	risk reduction worth
RWPB	radioactive-waste-processing building

s	second(s)
SAMA	severe accident mitigation alternative
SAR	safety analysis report
SBO	station blackout
SEIS	supplemental environmental impact statement
SER	safety evaluation report
SHPO	State Historic Preservation Office
SIP	state implementation plan
SIRWT	safety injection refueling water storage tank
SO_2	sulfur dioxide
SO_x	sulfur oxide(s)
SSC	structures, systems, and components
Sv	sievert(s), special unit of dose equivalent
TBq	terabecquerel(s)
TEDE	total effective dose equivalent
TLD	thermoluminescent dosimeter
UFSAR	updated final safety analysis report
UMRCC	Upper Mississippi River Conservation Committee
U.S.	United States
USACE	U.S. Army Corps of Engineers
USBC	U.S. Bureau of the Census
USC	United States Code
USDA	U.S. Department of Agriculture
USDI	U.S. Department of Interior
USGS	U.S. Geological Survey
V	volt(s)
VOC	volatile organic compound
yr	year(s)

1.0 Introduction

Under the U.S. Nuclear Regulatory Commission's (NRC's) environmental protection regulations in Title 10 of the Code of Federal Regulations (CFR) Part 51, which implement the National Environmental Policy Act of 1969 (NEPA), renewal of a nuclear power plant operating license (OL) requires the preparation of an environmental impact statement (EIS). In preparing the EIS, the NRC staff is required first to issue the statement in draft form for public comment and then issue a final statement after considering public comments on the draft. To support the preparation of the EIS, the staff has prepared a *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[(a)] The GEIS is intended to (1) provide an understanding of the types and severity of environmental impacts that may occur as a result of license renewal of nuclear power plants under 10 CFR Part 54, (2) identify and assess the impacts expected to be generic to license renewal, and (3) support 10 CFR Part 51 to define the number and scope of issues that need to be addressed by the applicants in plant-by-plant renewal proceedings. Use of the GEIS guides the preparation of complete plant-specific information in support of the OL renewal process.

Exelon Generation Company, LLC (Exelon) operates Quad Cities Units 1 and 2 in Illinois under OLs DPR-29 and DPR-30, which were issued by the NRC. These OLs will both expire on December 14, 2012. On January 3, 2003, Exelon submitted an application to the NRC for renewal of the Quad Cities Units 1 and 2 OLs for an additional 20 years under the procedures in 10 CFR Part 54 (Exelon 2003a). Exelon is a *licensee* for the purposes of its current OLs and an *applicant* for the renewal of the OLs. Pursuant to 10 CFR 54.23 and 51.53(c), Exelon submitted an Environmental Report (ER) in which Exelon analyzed the environmental impacts associated with the proposed license renewal action, considered alternatives to the proposed action, and evaluated mitigation measures for reducing adverse environmental effects (Exelon 2003b).

This report is the plant-specific supplement to the GEIS (the supplemental EIS [SEIS]) for the Exelon license renewal application. This SEIS is a supplement to the GEIS because it relies, in part, on the findings of the GEIS. The staff will also prepare a separate safety evaluation report in accordance with 10 CFR Part 54.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

1.1 Report Contents

The following sections of this introduction (1) describe the background for the preparation of this SEIS, including the development of the GEIS and the process used by the staff to assess the environmental impacts associated with license renewal; (2) describe the proposed Federal action to renew the Quad Cities Units 1 and 2 OLs; (3) discuss the purpose and need for the proposed action; and (4) present the status of Exelon's compliance with environmental quality standards and requirements that have been imposed by Federal, State, regional, and local agencies that are responsible for environmental protection.

The ensuing chapters of this SEIS closely parallel the contents and organization of the GEIS. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. Chapters 3 and 4, respectively, discuss the potential environmental impacts of plant refurbishment and plant operation during the renewal term. Chapter 5 contains an evaluation of potential environmental impacts of plant accidents and includes a consideration of severe accident mitigation alternatives (SAMAs). Chapter 6 discusses the uranium fuel cycle and solid- waste management. Chapter 7 discusses decommissioning, and Chapter 8 discusses alternatives to license renewal. Finally, Chapter 9 summarizes the findings of the preceding chapters and draws conclusions about the adverse impacts that cannot be avoided; the relationship between short-term uses of the human environment and the maintenance and enhancement of long-term productivity; and the irreversible or irretrievable commitment of resources. Chapter 9 also presents the staff's recommendation with respect to the proposed license renewal action.

Additional information is included in appendices. Appendix A contains public comments received on the environmental review for license renewal and staff responses. Appendices B through G, respectively, list the following:

- the preparers of the supplement
- the chronology of the NRC correspondence regarding this SEIS
- the organizations contacted during the development of this SEIS
- Exelon's permit compliance status (Table E-1) and copies of consultation correspondence prepared and sent during the evaluation process
- GEIS environmental issues that are not applicable to Quad Cities Units 1 and 2
- severe accident mitigation alternatives.

1.2 Background

Use of the GEIS, which examines the possible environmental impacts that could occur as a result of renewing individual nuclear power plant OLs under 10 CFR Part 54, and the established license renewal evaluation process support the thorough evaluation of the impacts of the renewal of OLs.

1.2.1 Generic Environmental Impact Statement

The NRC initiated a generic assessment of the environmental impacts associated with the license renewal term to improve the efficiency of the license renewal process by documenting the assessment results and codifying the results in the Commission's regulations. This assessment is provided in the GEIS, which serves as the principal reference for all nuclear power plant license renewal EISs.

The GEIS documents the results of the systematic approach taken to evaluate the environmental consequences of renewing the licenses of individual nuclear power plants and operating them for an additional 20 years. For each potential environmental issue, the GEIS (1) describes the activity that affects the environment, (2) identifies the population or resource that is affected, (3) assesses the nature and magnitude of the impact on the affected population or resource, (4) characterizes the significance of the effect for both beneficial and adverse effects, (5) determines whether the results of the analysis apply to all plants, and (6) considers whether additional mitigation measures would be warranted for impacts that would have the same significance level for all plants.

The NRC's standard of significance was established using the Council on Environmental Quality (CEQ) terminology for "significantly" (40 CFR 1508.27, which requires consideration of both "context" and "intensity"). Using the CEQ terminology, the NRC established three significance levels—SMALL, MODERATE, or LARGE. The definitions of the three significance levels are set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, as follows:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The GEIS assigns a significance level to each environmental issue, assuming that ongoing mitigation measures would continue.

The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, **Category 1** issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely to not be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required in this SEIS unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria of Category 1, and therefore, additional plant-specific review for these issues is required.

In the GEIS, the staff assessed 92 environmental issues and determined that 69 qualified as Category 1 issues, 21 qualified as Category 2 issues, and 2 issues were not categorized. The latter 2 issues, environmental justice and chronic effects of electromagnetic fields, are to be addressed in a plant-specific analysis. Of the 92 issues, 11 are related only to refurbishment, 6 are related only to decommissioning, 67 apply only to operation during the renewal term, and 8 apply to both refurbishment and operation during the renewal term. A summary of the findings for all 92 issues in the GEIS is codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

1.2.2 License Renewal Evaluation Process

An applicant seeking to renew its OLs is required to submit an ER as part of its application (10 CFR 54.23). The license renewal evaluation process involves a careful review of the applicant's ER and assurance that all new and potentially significant information not already

addressed in or available during the GEIS evaluation is identified, reviewed, and assessed to verify the environmental impacts of the proposed license renewal.

In accordance with 10 CFR 51.53(c)(2) and (3), the ER submitted by the applicant must

- provide an analysis of the Category 2 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B in accordance with 10 CFR 51.53(c)(3)(ii)

- discuss actions to mitigate any adverse impacts associated with the proposed action and environmental impacts of alternatives to the proposed action.

In accordance with 10 CFR 51.53(c)(2), the ER does not need to

- consider the economic benefits and costs of the proposed action and alternatives to the proposed action except insofar as such benefits and costs are either (1) essential for making a determination regarding the inclusion of an alternative in the range of alternatives considered or (2) relevant to mitigation

- consider the need for power and other issues not related to the environmental effects of the proposed action and the alternatives

- discuss any aspect of the storage of spent fuel within the scope of the generic determination in 10 CFR 51.23(a) in accordance with 10 CFR 51.23(b)

- contain an analysis of any Category 1 issue unless there is significant new information on a specific issue—this is pursuant to 10 CFR 51.23(c)(3)(iii) and (iv).

New and significant information is (1) information that identifies a significant environmental issue not covered in the GEIS and codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, or (2) information that was not considered in the analyses summarized in the GEIS and that leads to an impact finding that is different from the finding presented in the GEIS and codified in 10 CFR Part 51.

In preparing to submit its application to renew the Quad Cities Units 1 and 2 OLs, Exelon developed a process to ensure that information not addressed in or available during the GEIS evaluation regarding the environmental impacts of license renewal for Quad Cities Units 1 and 2 would be properly reviewed before submitting the ER and to ensure that such new and potentially significant information related to the renewal of the licenses would be identified, reviewed, and assessed during the period of the NRC review. Exelon reviewed the Category 1 issues that appear in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, to verify that the conclusions of the GEIS remained valid with respect to Quad Cities Units 1 and 2. This review

was performed by personnel from Exelon and its support organization who were familiar with NEPA issues and the scientific disciplines involved in the preparation of a license renewal ER.

The NRC staff also has a process for identifying new and significant information. That process is described in detail in *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal (ESRP)*, NUREG-1555, Supplement 1 (NRC 2000). The search for new information includes (1) review of an applicant's ER and the process for discovering and evaluating the significance of new information; (2) review of records of public comments; (3) review of environmental quality standards and regulations; (4) coordination with Federal, State, and local environmental protection and resource agencies; and (5) review of the technical literature. New information discovered by the staff is evaluated for significance using the criteria set forth in the GEIS. For Category 1 issues where new and significant information is identified, reconsideration of the conclusions for those issues is limited in scope to the assessment of the relevant new and significant information; the scope of the assessment does not include other facets of the issue that are not affected by the new information.

Chapters 3 through 7 discuss the environmental issues considered in the GEIS that are applicable to Quad Cities Units 1 and 2. At the beginning of the discussion of each set of issues, there is a table that identifies the issues to be addressed and lists the sections in the GEIS where the issue is discussed. Category 1 and Category 2 issues are listed in separate tables. For Category 1 issues for which there is no new and significant information, the table is followed by a set of short paragraphs that state the GEIS conclusion codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, followed by the staff's analysis and conclusion. For Category 2 issues, in addition to the list of GEIS sections where the issue is discussed, the tables list the subparagraph of 10 CFR 51.53(c)(3)(ii) that describes the analysis required and the SEIS sections where the analysis is presented. The SEIS sections that discuss the Category 2 issues are presented immediately following the table.

The NRC prepares an independent analysis of the environmental impacts of license renewal and compares these impacts with the environmental impacts of alternatives. The evaluation of the Exelon license renewal application began with publication of a notice of acceptance in the *Federal Register* (68 FR 10273 [NRC 2003a]) on March 4, 2003. The staff published a notice of intent to prepare an EIS and conduct scoping (68 FR 12385 [NRC 2003b]) on March 14, 2003. Two public scoping meetings were held on April 8, 2003, in Moline, Illinois. Comments received during the scoping period were summarized in the *Environmental Impact Statement Scoping Process: Summary Report — Quad Cities Units 1 and 2, Illinois* (NRC 2003c) dated June 16, 2003. Comments applicable to this environmental review are presented in Part 1 of Appendix A.

The staff followed the review guidance contained in the ESRP. The staff and its contractors retained to assist the staff visited the Quad Cities site on March 12, 2003, to gather information and to become familiar with the site and its environs. The staff also reviewed the comments received during scoping and consulted with Federal, State, regional, and local agencies. A list of the organizations consulted is provided in Appendix D. Other documents related to Quad Cities were reviewed and are referenced in this report.

On November 13, 2003, The NRC published the Notice of Availability of the draft SEIS in 68 FR 64372 (NRC 2003d). A 75-day comment period began on the date of the publication of the U.S. Environmental Protection Agency Notice of Filing of the draft SEIS to allow members of the public to comment on the preliminary results of the NRC staff's review. During this comment period, two public meetings were held in Moline, Illinois, on December 16, 2003. During these meetings, the staff described the preliminary results of the NRC environmental review and answered questions to provide members of the public with information to assist them in formulating their comments. The comment period for the Quad Cities draft SEIS ended on January 27, 2004. Comments made during the 75-day comment period, including those made at the two public meetings, are presented in Part II of Appendix A of this SEIS. The NRC responses to those comments are also provided.

This SEIS presents the staff's analysis that considers and weighs the environmental effects of the proposed renewal of the Quad Cities OLs, the environmental impacts of alternatives to license renewal, and mitigation measures available for avoiding adverse environmental effects. Chapter 9, "Summary and Conclusions," provides the NRC staff's recommendation to the Commission on whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable.

1.3 The Proposed Federal Action

The proposed Federal action is renewal of the OLs for Quad Cities Units 1 and 2. The Quad Cities nuclear plant is located on the bank of the Mississippi River in Rock Island County, Illinois. The Quad Cities (Moline/East Moline, Rock Island, Davenport, and Bettendorf) are the largest cities within 80 km (50 mi) of Quad Cities Units 1 and 2.

The current OLs for Unit 1 and Unit 2 expire on December 14, 2012. By letter dated January 3, 2003, Exelon submitted an application to the NRC (Exelon 2003a) to renew these OLs for an additional 20 years of operation (i.e., until December 14, 2032).

The plant has two boiling water reactors designed by General Electric Company. Each reactor has a design rating for a net electrical-power output of 930 megawatts electric [MW(e)]. Once-through cooling water from the Mississippi River is used to remove heat from the main (turbine)

condensers via the circulating-water system and from other auxiliary equipment via the service water system. Quad Cities produces enough electricity to supply the needs of 350,000 industrial users, commercial establishments, and residences.

1.4 The Purpose and Need for the Proposed Action

Although a licensee must have a renewed license to operate a reactor beyond the term of the existing OL, the possession of that license is just one of a number of conditions that must be met for the licensee to continue plant operation during the term of the renewed license. Once an OL is renewed, State regulatory agencies and the owners of the plant will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the state's jurisdiction or the purview of the owners.

Thus, for license renewal reviews, the NRC has adopted the following definition of purpose and need from GEIS Section 1.3 (NRC 1996).

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and where authorized, Federal (other than the NRC) decisionmakers.

This definition of purpose and need reflects the Commission's recognition that, unless there are findings in the safety review required by the Atomic Energy Act of 1954 (AEA 1954) or findings in the NEPA environmental analysis that would lead the NRC to reject a license renewal application, the NRC does not have a role in the energy-planning decisions of State regulators and utility officials as to whether a particular nuclear power plant should continue to operate. From the perspective of the licensee and the State regulatory authority, the purpose of renewing an OL is to maintain the availability of the nuclear plant to meet system energy requirements beyond the current term of the plant's license.

1.5 Compliance and Consultations

Exelon is required to hold certain Federal, State, and local environmental permits, as well as meet relevant Federal and State statutory requirements. In the Quad Cities ER (Exelon 2003b), Exelon provided a list of the authorizations from Federal, State, and local authorities for current operations, as well as environmental approvals and consultations associated with renewal of the Quad Cities OLs. Authorizations and consultations most relevant to the proposed OL renewal actions are included in Appendix E.

The staff reviewed the list and consulted with the appropriate Federal, State, and local agencies to identify any compliance or permit issues or environmental issues of concern to the reviewing agencies. These agencies did not identify any new and significant environmental issues. The ER (Exelon 2003b) states that Exelon is in compliance with applicable environmental standards and requirements for Quad Cities Units 1 and 2. The staff has not identified any environmental issues that are both new and significant.

1.6 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

40 CFR Part 1508. Code of Federal Regulations, Title 40, *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act*, Part 1508, "Terminology and Index."

Atomic Energy Act of 1954 (AEA). 42 USC 2011, et seq.

Exelon Generation Company (Exelon). 2003a. *Application for Renewed Operating Licenses, Quad Cities Units 1 and 2*. Docket Nos. 50-254 and 50-265, Warrenville, Illinois.

Exelon Generation Company (Exelon). 2003b. *Applicant's Environmental Report—Operating License Renewal Stage Quad Cities Units 1 and 2*. Docket Nos. 50-254 and 50-265, Warrenville, Illinois.

National Environmental Policy Act of 1969, as amended (NEPA). 42 USC 4321, et seq.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, "Section 6.3–Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*. NUREG-1555, Supplement 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2003a. "Notice of Acceptance for Docketing of Application and Notice of Opportunity for a Hearing Regarding Renewal of Facility Operating License Nos. DPR-29 and DPR-30 for an Additional 20-Year Period." *Federal Register*. Vol. 68, No. 42, pp. 10274–10275 (March 4, 2003).

U.S. Nuclear Regulatory Commission (NRC). 2003b. "Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register*. Vol. 68, No. 50, pp. 12385–12386 (March 14, 2003).

U.S. Nuclear Regulatory Commission (NRC). 2003c. *Environmental Impact Statement Scoping Process: Summary Report—Quad Cities Units 1 and 2, Moline, Illinois*. Washington, D.C. June 16, 2003.

U.S. Nuclear Regulatory Commission (NRC). 2003d. "Exelon Generation Company, LLC, Quad Cities Nuclear Power Station, Units 1 and 2; Notice of Availability of Draft Supplement 16 to Generic Environmental Impact Statement and Public Meeting for the License Renewal of Quad Cities Nuclear Power Station, Units 1 and 2." *Federal Register*. Vol. 68, No. 219, pp. 64372–64373 (November 13, 2003).

2.0 Description of the Nuclear Power Plant and Site and Plant Interaction with the Environment

Exelon Generation Company's (Exelon's) Quad Cities Plant is located on the shore of the Mississippi River near East Moline, Illinois. The plant's two units, Unit 1 and Unit 2, are operating nuclear reactors and are the subject of this action. Each nuclear reactor is a boiling water reactor (BWR) which produces steam that turns turbines to generate electricity. In addition to the nuclear units, the site features intake and discharge canals, auxiliary buildings, switchyards, and a spent fuel pool. The plant and its environs are described in Section 2.1, and the plant's interaction with the environment is presented in Section 2.2.

2.1 Plant and Site Description and Proposed Plant Operation During the Renewal Term

Quad Cities Units 1 and 2 are located on 331 ha (817 ac) of Exelon-owned land in Rock Island County, Illinois. Quad Cities is 32 km (20 mi) northeast of the Quad Cities Metropolitan Area of Davenport and Bettendorf, Iowa, and Rock Island, Moline and East Moline, Illinois (Exelon 2003a). The site is on the east bank of Pool 14 of the Mississippi River, between Lock and Dams 13 and 14 and approximately 810 km (506 mi) upstream from its confluence with the Ohio River. The west bank of the Mississippi River, visible from the plant site, is in Iowa. Figures 2-1 and 2-2 show the site location and features within 80 km (50 mi) and 10 km (6 mi), respectively. There are four counties within the 10 km (6 mi) radius of the site: Rock Island and Whiteside counties in Illinois and Scott and Clinton counties in Iowa. In addition to the two nuclear reactors and associated structures, the site includes a retired spray canal now used as a facility to raise game fish for release into the Mississippi River (Exelon 2003a).

The region surrounding the Quad Cities site was identified by the applicant as being in sparseness Category 4 and proximity Category 2 (Exelon 2003a), using the guidance in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[(a)]

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the GEIS include the "GEIS" and its Addendum 1.

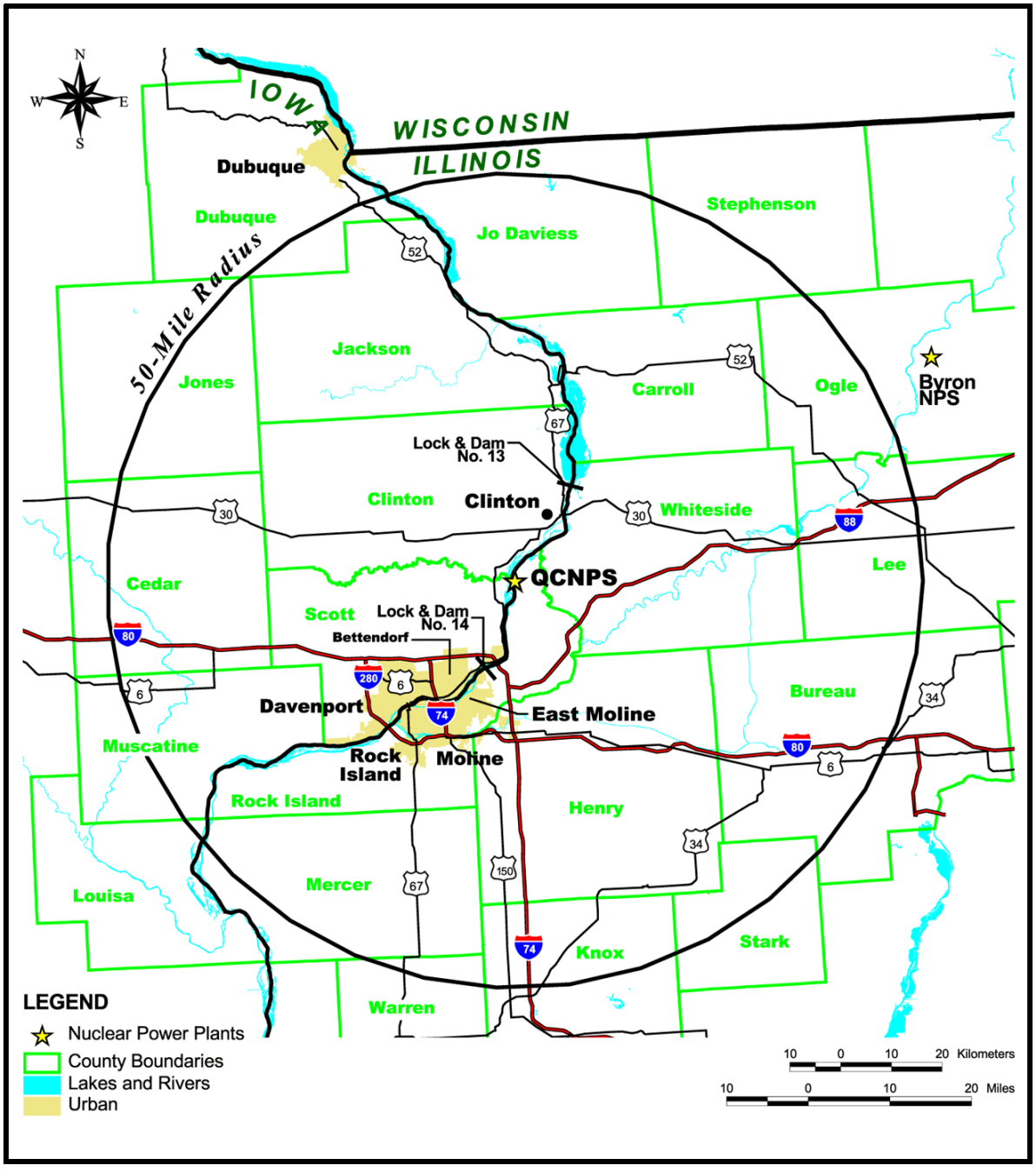

Figure 2-1. Location of Quad Cities, 80-km (50-mi) Region

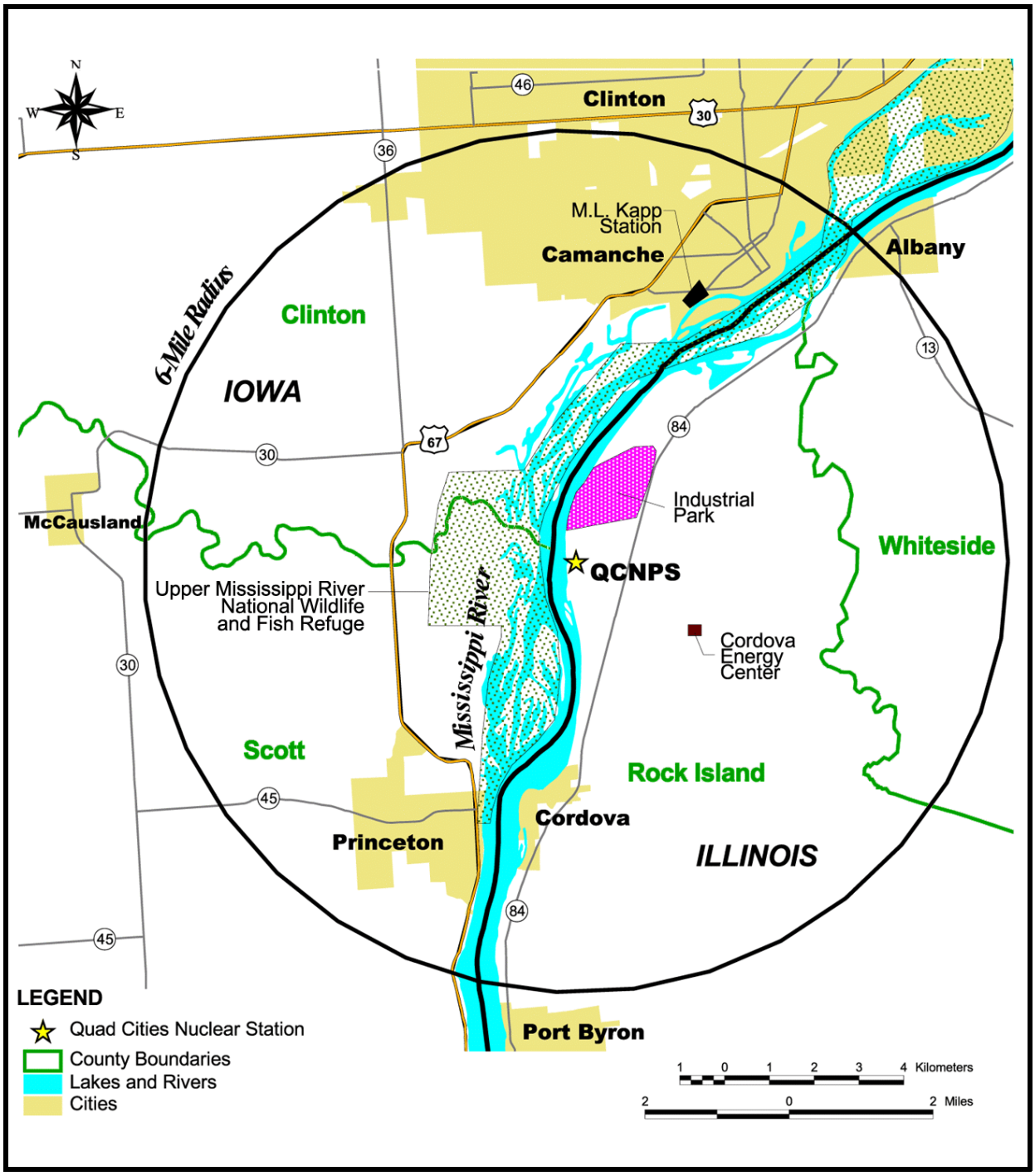

Figure 2-2. Location of Quad Cities, 10-km (6-mi) Region

2.1.1 External Appearance and Setting

The area surrounding the Quad Cities site is rural farmland and woods with an industrial park located 1.6 km (1 mi) north of the station, and the Cordova Energy Center, a gas-fired power plant approximately 1.6 km (1 mi) southeast of the station. The site is flat with a grade level of approximately 2.7 m (9 ft) above maximum flood stage. The Upper Mississippi River National Wildlife and Fish Refuge (NWFR), across the Mississippi River from the Quad Cities site, provides habitat for numerous plant and animal species in wood and wetland areas (Exelon 2003a). The Mississippi River is a source of municipal water and is used for commercial and sport fishing as well as recreational boating.

The major structures include the two reactors, the associated turbine buildings, and ancillary buildings, which are sheathed with metal panels colored in subdued tones, a 94.5-m (310-ft) main stack, and intake and discharge canals. Figure 2-3 identifies the main structures and the station layout. Most of the view of the station is obstructed by evergreen forest, with only the stack and transmission lines being visible from the highway (AEC 1972). The plant structures are clearly visible from the Mississippi River.

2.1.2 Reactor Systems

Quad Cities is a two-unit nuclear-powered steam electric plant. Each unit is a General Electric BWR that produces 2957 megawatts thermal (MW[t])[(a)] with a design net electrical capacity of 930 megawatts electric (MW[e]) per unit. The nuclear fuel is low-enriched uranium dioxide with enrichments below 5 percent by weight uranium-235 and fuel burnup levels less than 60,000 megawatt days per metric ton uranium (MWd/MTU). Unit 1 began commercial operation on February 18, 1973; and Unit 2 began operation on March 10, 1973 (Exelon 2003a). Refueling of the reactors is performed on a 24-month schedule with approximately 33 to 40 percent of the fuel replaced during each refueling outage. At this time, all spent fuel is placed in storage in the spent fuel pool. Exelon plans to build an independent spent fuel storage installation (ISFSI) for storage of spent fuel in dry storage casks. Exelon plans to begin use of the ISFSI in 2005.

Each unit has a primary containment consisting of a drywell, a steel structure that encloses the reactor vessel and related piping, a pressure suppression chamber containing water, and a vent system that connects the drywell to the suppression chamber. The primary containments are designed to limit the release of fission products during a loss-of-coolant accident and contain the reactor vessels, recirculating system and other key components. The reactor building is

(a) In December 2000, Exelon submitted an application for an increase of the rated core thermal power for Quad Cities of 17.8 percent, for an uprated power level from 2511 to 2957 MW(t) (ComEd 2000). The power uprates for both units have been completed.

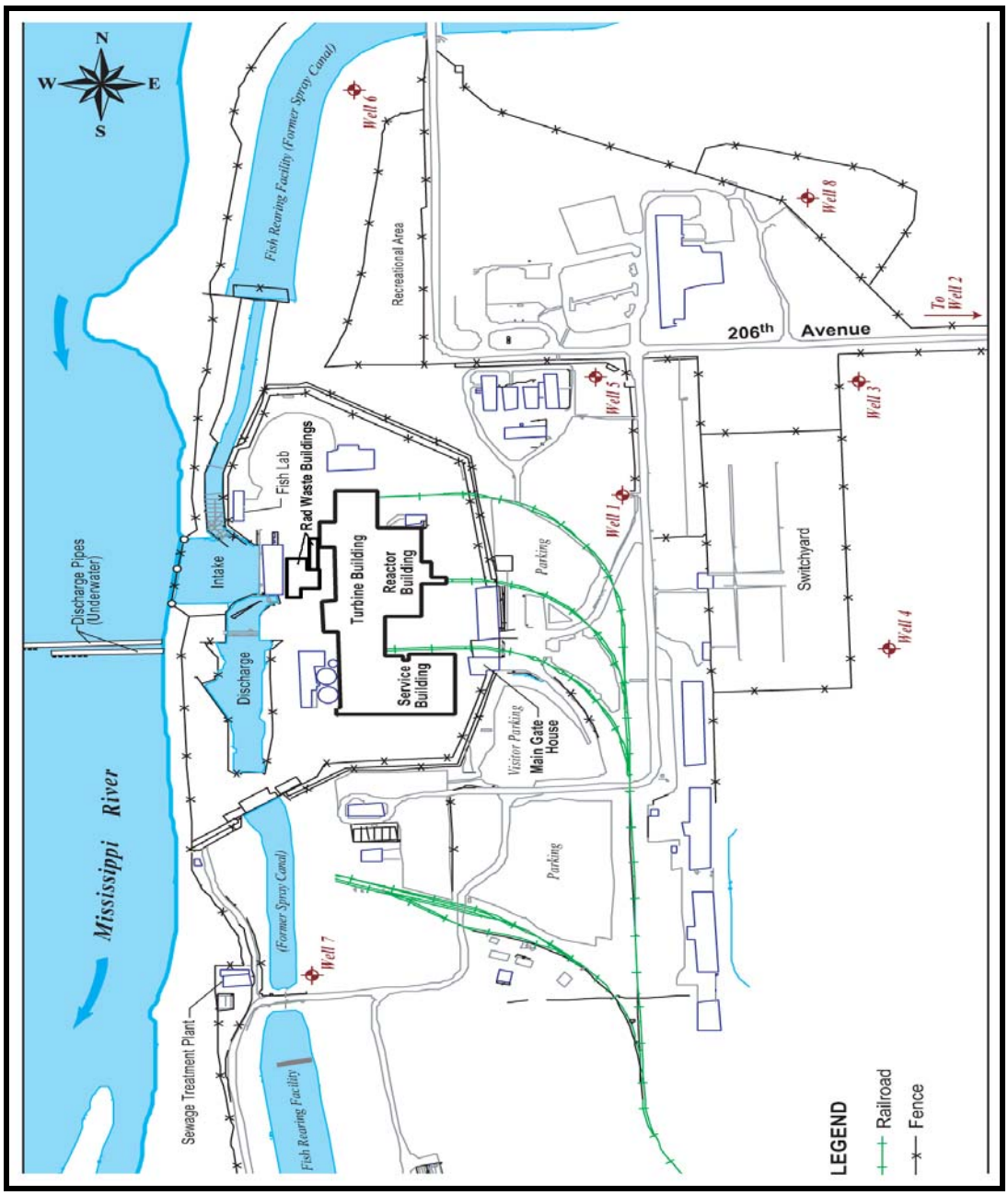

Figure 2-3. Quad Cities Site Layout

shared by both units and contains the primary containments, reactor auxiliary systems, spent fuel storage, and a new fuel storage vault (Exelon 2003c). The concrete reactor building is maintained under a slight negative pressure and provides secondary containment and shielding. The release of the building atmosphere during an accident would be monitored and filtered (Exelon 2003a).

The turbine building is shared by Units 1 and 2 and contains the turbine-generators, exciters, condensers, feedwater and condensate pumps, condenser circulating water systems, and electrical switchgear. The radioactive waste building is a concrete structure located adjacent to the west side of the turbine building. This building is also shared by both units and contains the control, processing, packaging, and storage facilities necessary to process the solid and liquid waste (Exelon 2003c).

2.1.3 Cooling- and Auxiliary-Water Systems

The Mississippi River is the source for cooling and most auxiliary water systems for Quad Cities Units 1 and 2. The plant utilizes a once-through condenser cooling system drawing water from a canal intake structure located along the east side of the river and discharging through submerged piping into the main river channel (Figure 2-4). The total flow of Mississippi River water through Quad Cities Units 1 and 2 for condenser circulating water and service water is approximately 61,000 L/s (970,000 gpm). The temperature increase at the edge of the discharge mixing zone is required to be less than 2.8°C (5°F) above ambient (IEPA 2000b).

Condenser cooling water is withdrawn from the Mississippi River through a canal that is perpendicular to the river flow. The 72 m (235 ft) long canal is 55 m (180 ft) wide, and 3.6 m (12 ft) deep where it meets the river. Intake velocity at the mouth of the canal is approximately 0.3 m/s (1 ft/s). A floating boom, extending to a depth of 84 cm (33 in.), traverses the mouth of the canal to deflect floating material. At the other end of the canal, a trash rack consisting of a series of vertical metal bars spaced 6.3 cm (2.5 in.) apart screens large pieces of debris from the intake. Prior to the circulating water pumps, water flows through 12 sets of traveling screens that have a 1-cm (0.38-in.) mesh, to prevent debris and aquatic organisms from being entrained into the cooling system.

Quad Cities utilizes a two-pipe diffuser system to return cooling water to the river. The two pipes are 4.9 m (16 ft) in diameter and lie on the bottom of the river across the main river flow (Figure 2-4). The combined cooling and service water, with an increase of as much as 15.6°C (28°F) above intake temperature, is discharged into the deepest part of the river through regularly spaced jet nozzles in the pipes. When both units are operating at full power, approximately 61,000 L/s (970,000 gpm) of cooling water are discharged to the river.

The service water system provides strained water from the Mississippi River for cooling several closed-cycle cooling water systems, the recirculation motor-generator set oil coolers, the generator stator coolers, the turbine oil coolers, the generator hydrogen coolers, and other systems. It also is used to wash the circulating water traveling screens and for the fire protection system. The flow rate is variable, and maximum capacity is 4400 L/s (69,000 gpm). The service water pumps draw from the same intake system as the circulating water system. The system discharges to the plant discharge flume that leads to the diffusers.

The Quad Cities plant has used open-cycle cooling (Figure 2-4) since 1983. Between 1974 and 1983, the plant used a three-mile cooling canal with spray coolers and operated in either a closed-cycle mode or partial open-cycle mode. Since the conversion to open-cycle cooling, the canal has been converted to a fish-rearing facility. Walleye and hybrid striped bass fingerlings are reared for release into Pool 14 of the Mississippi River.

Groundwater from five wells is used for domestic water consumption, for raising fish in the former spray canals, and for other industrial purposes that do not include condenser cooling. Groundwater use has averaged 45 L/s (717 gpm) over the last 10 years. In the winter of 1997, groundwater was used to heat the water in the fish-rearing facility while the plant was shut down. Without this period of high use, the 10-year average yield for the site is approximately 31.9 L/s (505 gpm).[(a)]

2.1.4 Radioactive-Waste Management Systems and Effluent-Control Systems

Quad Cities uses liquid, gaseous, and solid radioactive waste management systems to collect and process the liquid, gaseous, and solid wastes that are the by-products of operations, before they are released to the environment. The waste disposal systems for Quad Cities meet the design objectives of 10 CFR Part 50, Appendix I (*Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents*).

Radioactive material in the reactor coolant is the source of gaseous, liquid, and solid radioactive wastes in light water reactors. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products are primarily contained in the sealed fuel rods, but small quantities escape from the fuel rods and contaminate the reactor coolant. Neutron activation of the primary coolant system is also responsible for coolant contamination.

(a) Personal communication with Mark Stuhlman, Exelon Generation Company, October 3, 2003.

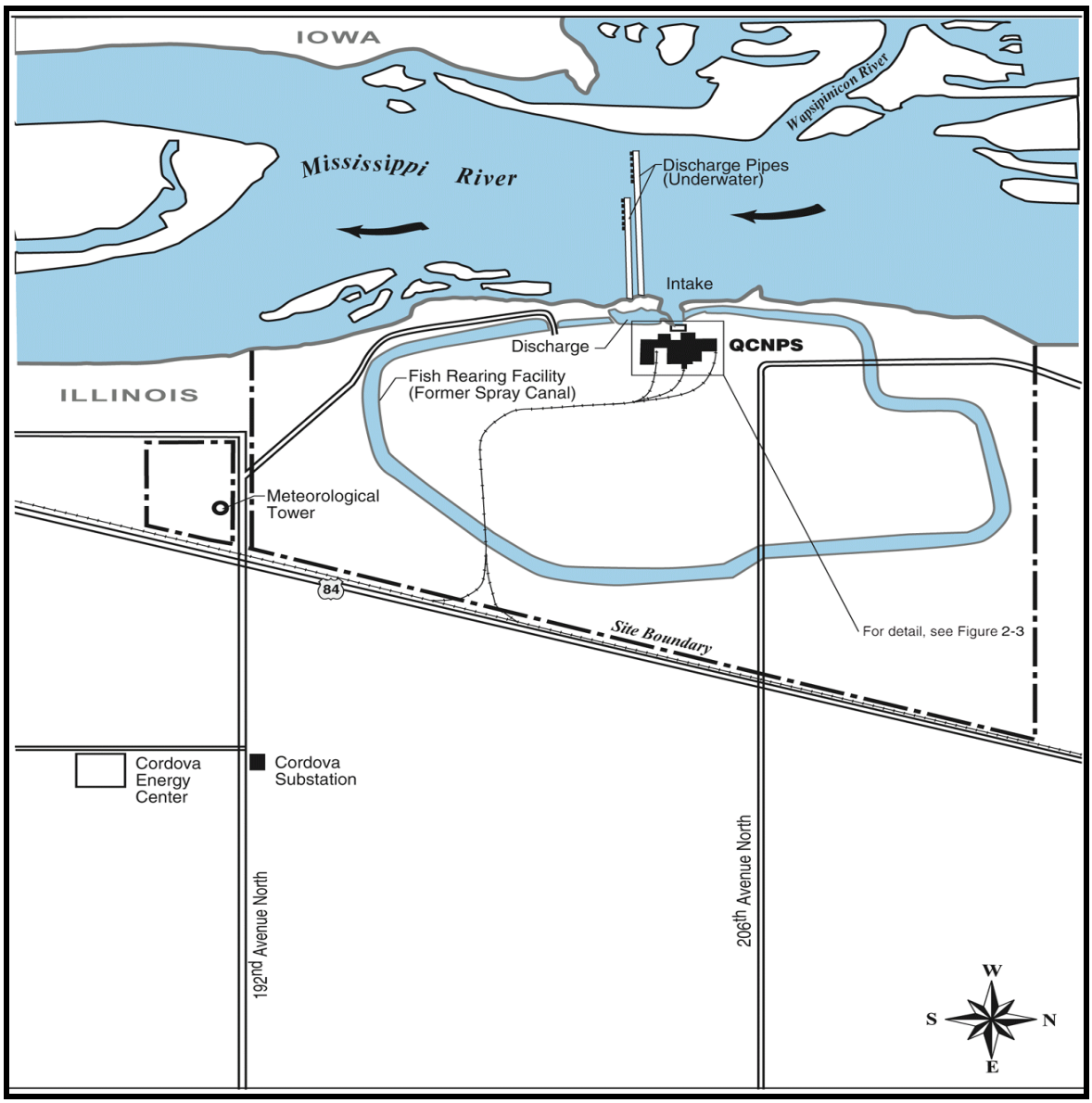

Figure 2-4. Quad Cities Site Cooling System

Nonfuel solid wastes result from treating and separating radionuclides from gases and liquids, and from removing contaminated material from various reactor areas. Solid wastes also consist of reactor components, equipment, and tools removed from service, as well as contaminated protective clothing, paper, rags, and other trash generated from plant-design modifications, operations, and routine maintenance activities. Solid wastes are shipped to a waste processor

for volume reduction before disposal at a licensed burial site. Spent resins and filters are stored or packaged for shipment to a licensed offsite processing or disposal facility.

Fuel rods that have exhausted a certain percentage of their fuel and that have been removed from the reactor core for disposal are called spent fuel. The reactor core is refueled approximately every 24 months. Currently, all spent fuel is stored in the spent-fuel pool located in the reactor building. Exelon also plans to build an ISFSI for storage of spent fuel in dry storage casks. Exelon plans to begin use of the ISFSI in 2005.

The *Offsite Dose Calculation Manual* (ODCM) for Quad Cities (Exelon 2002a) is subject to NRC inspection and describes the methods and parameters used for calculating offsite doses resulting from radioactive gaseous and liquid effluents. It is also used for calculating gaseous and liquid effluent monitoring alarm/trip setpoints for release of effluents from Quad Cities Units 1 and 2. Operational limits for releasing liquid and gaseous effluents are specified to ensure compliance with NRC regulations.

In December 2000, Exelon submitted a request for a license amendment for a power uprate at Quad Cities from 2511 to 2957 MW(t) (ComEd 2000). In December, 2001, the NRC granted Exelon a license amendment allowing an increase in power level to 2957 MW(t) for both units at Quad Cities (NRC 2001b). This power uprate was implemented at both units by the end of 2002. However, because of steam dryer cracking, the Quad Cities units did not operate at the uprated power level for much of calendar year 2003. Therefore, no data are available to assess radiological effluents for full uprate operation at Quad Cities. In December, 2001, the NRC issued an environmental assessment of the power uprate (NRC 2001a). In this assessment, the NRC estimated that the power uprate could potentially increase both gaseous and liquid radiological effluent releases by approximately 18 percent. Even if the increase in radiological effluents is as much as 18 percent because of the power uprate, Quad Cities will still meet all NRC limits for the amounts of radiological effluents that may be released. Therefore, the staff finds that the power uprate does not represent new or significant information which would cause it to revisit the GEIS' Category I determinations applicable to Quad Cities. In its finding, the staff relies on the GEIS' generic determinations regarding the environmental impacts of operation by the current fleet of reactors.

2.1.4.1 Liquid-Waste Processing Systems and Effluent Controls

The Quad Cities liquid radioactive waste system is designed to collect, treat, store, and dispose of radioactive liquid wastes. Radioactive liquid wastes are collected in sumps and drain tanks at various locations and then transferred to appropriate tanks in the radwaste building for processing, storage, and release. Liquid wastes that have been demineralized and purified and meet the criteria for reuse are recycled back into the contaminated condensate storage tank. Wastes that have come in contact with organics or other impurities that do not meet the recycle

requirements are reprocessed or discharged. Liquid wastes meeting the requirements to be discharged are discharged from the plant to the Mississippi River with dilution from the south diffuser or discharge flume weir.

The liquid waste disposal system segregates lower-activity wastes from higher-activity wastes and is divided into four subsystems: 1) floor drains, 2) waste collector, 3) chemical waste, and 4) laundry drain. The liquid wastes from the floor drains are processed through a filter and a demineralizer and routed to the floor drain sample tanks. These wastes are usually outside the criteria for reuse and are returned to the radwaste system for reprocessing or discharged to the river. Wastes that can be reused are returned to the condensate storage station. The wastes collected in the waste collector tank are high-purity wastes with variable radioactive concentrations. These wastes are processed through a filter and one or more demineralizers, then sent to waste sample tanks. If the wastes do not meet reuse criteria, they are returned for reprocessing or discharged to the river. Wastes in the chemical waste system are from laboratory drains, leakage from reactor water cleanup and fuel pool demineralizer drain valves, and decontamination operations. These wastes may be transferred to the floor or equipment drain system or to the chemical waste sample tank. Laundry wastes are filtered and sent to the laundry sample tank for sampling and further filtering, if required, and then discharged to the river.

Liquid wastes are collected in the river discharge tank in batches and released to the river after sampling and analysis through a monitored radioactive liquid waste line, which is alarmed. The discharge from the tanks is combined with station condenser circulating water and directed to the south diffuser line or discharge flume weir. The radioactive waste discharges to the river are monitored and recorded; the monitoring system provides an alarm to operators if expected radiation levels are exceeded. Prior to release, the liquid wastes are kept in holdup tanks for radioactive decay from one hour to one week.

The radwaste system uses four deep-bed demineralizers. Radwaste filter sludges are collected in the waste sludge tank or in the condensate phase-separators. Spent resins from the waste demineralizer are collected in the waste-spent resin tank.

The power uprate to 2957 MW(t) could increase the activity in the liquid waste discharged by 18 percent due to an increase in the flow rate through the condensate demineralizers and increases in the production of fission products and activated corrosion products. Even with these increases, releases will still be within the regulatory limits of 10 CFR Part 50, Appendix I (ComEd 2000).

During 2001, there were 17 batch releases (Exelon 2002c) with a total volume of 5.8×10^6 L (Exelon 2002a) prior to mixing with the station condenser circulating water. In this liquid waste, there was a total fission and activation product activity of 1.04×10^9 Bq (0.028 Ci) and a total

tritium activity of 7.2×10^{11} Bq (19.4 Ci). These volumes and activities are typical of the annual liquid releases for Quad Cities. The actual liquid waste generated is reported in the *Quad Cities Nuclear Power Station's Radioactive Effluent Report for January through December 2001* (Exelon 2002c). See Section 2.2.7 for a discussion of the theoretical doses to the maximally exposed individual as a result of these releases.

Exelon does not anticipate any increase in liquid waste releases on an annual average basis during the renewal period once the increase in releases due to the power uprate has taken effect.

2.1.4.2 Gaseous-Waste Processing Systems and Effluent Controls

The gaseous waste management systems at Quad Cities are designed to filter, monitor, and record the process off-gases before release through the 94.5-m (310-ft) chimney during normal and abnormal plant operation. There is also a system to monitor and record the amount of radioactive material in the air released from the reactor building through the reactor building vent stack (Exelon 2003c). The major source of gaseous effluents from Quad Cities operations are the condenser air ejector effluent and the steam-packing exhaust system effluent which include small quantities of activation gases and noble gases. The gaseous waste system is designed to effectively control and process off-gases and prevent releases over the limits specified in 10 CFR Part 50. The system minimizes releases of radioactive particles to the atmosphere, allowing short-term decay, and minimizes the hazard of explosion of hydrogen and oxygen gas in the off-gas system.

Three systems are used to process gaseous waste: (1) the off-gas system, (2) the turbine-gland seal system, and (3) the mechanical vacuum pump system. The off-gas system collects, contains, and processes the radioactive gases that come from the steam condenser and are exhausted by the steam jet ejectors. The steam is condensed and returned as condensate and the noncondensible gases are sent to a holdup pipe and then processed and sent through the high-efficiency particulate air (HEPA) filters and released through the chimney. The mechanical vacuum pump system establishes and maintains the main condenser vacuum when steam is not available. The vacuum pump effluent is discharged to the chimney (Exelon 2003c). Releases of gaseous effluents are from two release points: the 94.5-m (310-ft) chimney and the reactor building ventilation stack. Natural dispersion of gases occurs by discharge from the chimney due to the combination of height and exit velocity of the effluent and the buoyancy of the exit gases. Releases from the chimney include radioactive gases from the off-gas system, the turbine gland-seal systems, and the standby gaseous treatment system. Exhaust from the reactor building ventilation systems and the drywell ventilation and purge systems for both units are discharged from the reactor building ventilation stack (Exelon 2003c).

The gaseous effluents released from the chimney and the reactor building stack are sampled on a continuous basis. In addition, there are provisions for sampling gaseous effluents manually at process points, such as at the steam jet air ejector or at the exit of the recombiner. The limits for release of gaseous effluents from Quad Cities are given in the ODCM. The power uprate is expected to increase the activity in gaseous effluents by approximately 18 percent. Even with this increase, releases will still be within the regulatory limits of 10 CFR Part 50, Appendix I (ComEd 2000).

During 2001, a total of 8.9×10^{12} Bq (240 Ci) of noble gases was released to the atmosphere. A total of 3×10^{8} Bq (8.1×10^{-3} Ci) of iodine 131, 3.3×10^{12} Bq (89.5 Ci) of tritium, and 7.9×10^{8} Bq (0.021 Ci) of beta-gamma emitters was released in gaseous effluents. These activities are typical of the annual gaseous releases for Quad Cities. The details for these radioactive gaseous releases are reported in the *Quad Cities Nuclear Power Station 2001 Annual Radiological Environmental Operating Report* (Exelon 2002b). See Section 2.2.7 for a discussion of the theoretical doses to the maximally exposed individual as a result of these releases.

Exelon does not anticipate any increase in gaseous waste releases on an annual average basis during the renewal period once the increase in releases due to the power uprate has taken effect.

2.1.4.3 Solid-Waste Processing

The solid-waste management system is used to process, package, and handle wet and dry solid radioactive waste generated as a result of normal operations at Quad Cities. The process control program is used to process all low-level radioactive wet wastes to meet applicable Federal, State, and burial site requirements. For Class A unstable wastes, there is an in-plant cement solid-waste system installed, but it is not normally used. Instead, contract services are used for processing Class A unstable waste. Processing is performed in shielded and ventilated facilities to minimize personnel radiation exposure. Spent-control rod blades and fuel channels are stored in the spent fuel pool to allow for radioactive decay and then packaged and sent offsite for disposal in approved shipping containers.

In 2001, 18 shipments of solid waste were sent to the waste processor and 22 shipments went to the disposal site. For the waste stream of resins, filters, and evaporator bottoms, a volume of 132 m^3 with an activity of 2.93×10^{13} Bq (794 Ci) was shipped in 2001. Dry, active waste shipments in that year totaled 638 m^3 and had an activity of 7.7×10^{11} Bq (20.8 Ci). A volume of 7.12 m^3 and activity of 2.2×10^{15} Bq (6×10^{4} Ci) of irradiated components was shipped offsite in 2001. These volumes and activities are typical of the annual solid-waste production for Quad Cities, and the power uprate is not expected to significantly impact the estimates of shipped radioactive waste (Exelon 2003c). The actual solid waste generated is reported in the

Quad Cities Nuclear Power Station's Radioactive Effluent Report for January through December 2001 (Exelon 2002c).

2.1.5 Nonradioactive Waste Systems

Plant effluents containing chemicals used for plant operation, such as chemicals added to cooling water, process-water streams for control of aquatic fouling and for maintenance of water quality are released from the plant by the cooling-water blowdown discharge to the river. Based on information from the 1972 Final Environmental Statement (FES) and review of recent applicant environmental reports, releases of these chemicals to the river are only a small fraction of established limits (AEC 1972; Exelon 2003a). The station has its own operable sewage treatment plant, licensed by the State of Illinois. The station monitors wastewater streams and discharges to the Mississippi River from the wastewater treatment system, the sanitary waste treatment plant, and the open-cycle diffusers, covered under NPDES Permit No. IL0005037 (Exelon 2003a).

2.1.6 Plant Operation and Maintenance

Routine maintenance performed on plant systems and components is necessary for safe and reliable operation of a nuclear power plant. Maintenance activities conducted at Quad Cities include inspection, testing, and surveillance to maintain the current licensing basis of the plant and to ensure compliance with environmental and safety requirements. Certain activities can be performed while the reactor is operating. Other activities require that the plant be shut down. Long-term outages are scheduled for refueling and for certain types of repairs or maintenance, such as replacement of a major component. Exelon refuels each of the Quad Cities units about every 24 months on a staggered schedule. Each outage is typically scheduled to last about 20 days, and 33 to 40 percent of the core is replaced at each refueling. Approximately 1100 additional workers are onsite during a typical reactor outage.

Exelon performed an aging management review and developed an integrated plant assessment (IPA) for managing the effects of aging on systems, structures, and components in accordance with 10 CFR Part 54. The aging management program is described in the *Application for Renewed Operation Licenses, Quad Cities Nuclear Power Station, Units 1 and 2, Appendix B* (Exelon 2003b). The IPA identified the programs and inspections that are managing the effects of aging at Quad Cities Units 1 and 2. Exelon expects to conduct activities related to the management of aging effects during plant operation or during normal refueling and other outages, but no outages specifically for refurbishment activities are planned. Exelon has no other plans to add additional full-time staff (non-outage workers) at the plant during the license renewal period.

2.1.7 Power Transmission System

Four 345-kV transmission lines connecting Quad Cities Units 1 and 2 to the transmission system were identified in the FES for operation of Quad Cities Units 1 and 2 (AEC 1972). These lines included a pair of lines extending east to the Nelson substation in Illinois (Nelson lines), a line to the Iowa-Illinois Gas and Electric Company's substation 39 in Rock Island County, Illinois (Barstow line), and a line to substation 56 near Davenport, Iowa (Davenport line). According to the FES, the lines to substations 39 and 56 were planned and would have been to an alternate source of power in the area had Quad Cities Units 1 and 2 not been built. The FES only considers the impact of the lines to the Nelson substation. Potential electric shock impacts of the Barstow and Davenport lines, which were built along slightly different rights-of-way, were not considered in the FES.

Exelon describes changes that have been made since 1972 in the way that Quad Cities Units 1 and 2 are connected to the transmission system (Exelon 2003a). Quad Cities Units 1 and 2 are now connected to the transmission system by five lines. The Davenport line now connects the plant to the transmission system at a new substation (substation 91) about 21 km (12.8 mi) from the Quad Cities plant. In 2000, a new substation was built on the Barstow and southern Nelson lines about 3 km (2 mi) southeast of the Quad Cities site. A new 345-kV line (the Rock Creek line) has been constructed from Quad Cities Units 1 and 2 to the Rock Creek substation on the north side of the Mississippi River near Comanche, Iowa. The Nelson line currently terminates at the Northwest Steel and Wire substation, 33 miles from the Quad Cities plant.

The transmission lines considered to be within the scope of this review include the entire lengths of the four transmission lines described in the FES (AEC 1972) and the new line to the Rock Creek substation. These lines and their corridors are shown in Figure 2-5 and listed in Table 2-1. The corridors have a total length of approximately 185 km (115 mi) and cover approximately 880 ha (2200 ac). The Davenport (0401) and Barstow (0402) lines are owned and operated by the MidAmerican Energy Company; the two lines to the Nelson substation (0403 and 0404) are owned and operated by Commonwealth Edison Company (ComEd); and the Rock Creek line (0405) is owned and operated by Alliant Energy (Exelon 2003a).

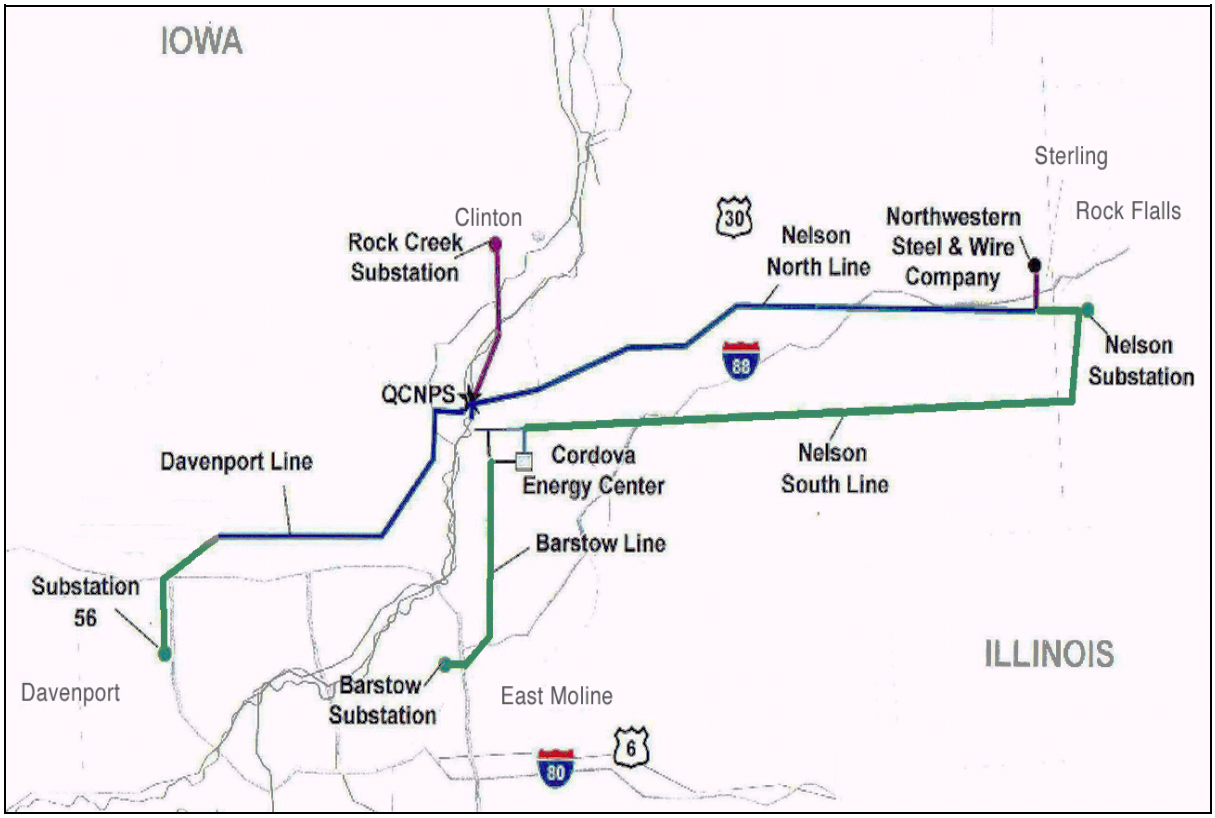

Figure 2-5. Quad Cities Units 1 and 2 Transmission Lines

The Davenport transmission line passes through the Upper Mississippi River NWFR and the Princeton State Wildlife Management Area (in Iowa, managed by the Upper Mississippi River NWFR). Except for these two areas, the transmission line corridors generally pass through agricultural lands cultivated for row crops and pasture that are typical of eastern Iowa and northwestern Illinois. The Davenport and Rock Creek transmission lines cross the Mississippi River, although for a very short distance, and the two Nelson lines cross the Rock River. All five of the lines cross other small creeks and their tributaries.

Table 2-1. Quad Cities Transmission Line Corridors

Substation (line)	Number of Lines	kV	Approximate Corridor Length		Corridor (Right-of-Way) Width		Estimated Corridor Area	
			km	(mi)	m	(ft)	ha	(ac)
Davenport (0401)	1	345	20.6	12.8	55	180	110	280
Barstow (0402)	1	345	28.1[(a)]	17.5[(a)]	158, 44[(b)]	520, 145[(b)]	160[(c)]	400[(c)]
Nelson (South line 0403)	1	345	67.4[(a)]	41.9[(a)]	158, 44[(b)]	520, 145[(b)]	330[(c)]	830[(c)]
Nelson (North line 0404)	1	345	63.9	39.7	44	145	280	700
Rock Creek (0405)	1	345	8.0	5	52	170	40	100
Total	5		185	115			880	2200

Source: Exelon 2003a (Note: Totals are derived based on information in the ER.)

(a) The initial 3.2 km (2 mi) of corridor is shared by Barstow and Nelson South lines. The initial 3.2 km is counted once in the total.
(b) The initial 3.2 km (2 mi) of the corridor is 158 m (520 ft) wide.
(c) The area includes the area of the shared corridor but this area is only included once in the total.

The transmission corridors are maintained by trimming and mowing, and by the use of approved herbicides (Cunningham 2003; Exelon 2003a; Exelon 2003d; Exelon 2003e). Vegetation management follows a three-to-six-year cycle (Cunningham 2003; Exelon 2003e).

2.2 Plant Interaction with the Environment

Sections 2.2.1 through 2.2.8 provide general descriptions of the environment near Quad Cities Units 1 and 2 as background information. They also provide detailed descriptions where needed to support the analysis of potential environmental impacts of refurbishment and operation during the renewal term, as discussed in Chapters 3 and 4. Section 2.2.9 describes the historic and archaeological resources in the area, and Section 2.2.10 describes possible impacts associated with other Federal project activities.

2.2.1 Land Use

The Quad Cities site is located in the Upper Mississippi Basin, on the Illinois side of the Mississippi River approximately 80 km (50 mi) south of the northern boundary of the State of Illinois and 810 km (506 mi) upstream from its confluence with the Ohio River. The site is on moderately high ground that rises abruptly from the surface of the river to form bluffs between 6 m (20 ft) and 12 m (40 ft) high. It is situated in the Meredosia Channel, an ancient channel of the Mississippi River. The topography of the site is flat, with an elevation of 7 m (23 ft) above normal river level and a grade level approximately 2.7 m (9 ft) above the maximum recorded flood stage over a 102-year period. The river flow of the adjacent Pool 14 (an approximately 40-km [25-mi] section), between Lock and Dam 13 and Lock and Dam 14 is controlled below flood stage.

Approximately 40 ha (100 ac) of the western and northern portions of the Quad Cities site (Figure 2-3), are industrial in character, containing the major generating facilities, switchyard, warehouses, training center, offices, parking lots, and roads. Approximately 40 ha (100 ac) of forests, including areas of planted pines along Illinois State Route 84, and 211 ha (527 ac) of open fields and scrub woodlands occupy most of the eastern and southern portions of the site. The retired spray canal, approximately 5 km (3 mi) long and 76 m (250 ft) wide, surrounds the plant and occupies approximately 36 ha (90 ac); it is now utilized as a fish-rearing facility (Exelon 2003a). A publicly available, paved bicycle trail passes along the eastern edge of the site property, adjacent to Route 84. The Rock Island County Land Use Plan designates the site area as industrial use (Rock Island County 1998).

2.2.2 Water Use

The Mississippi River is the source for cooling and most auxiliary water systems. Quad Cities Units 1 and 2 utilize a once-through condenser cooling system. The total design flow of Mississippi River water through Quad Cities Units 1 and 2 for condenser circulating water and service water is 61,000 L/s (970,000 gpm, or 2,160 cfs). At Camanche, Iowa, approximately 10 km (6 mi) upstream of the Quad Cities site, the Mississippi River has an annual mean flow of 1,380,000 L/s (48,750 cfs) (USGS 2000). The Wapsipinicon River flows into the Mississippi River from the west immediately upstream of the Quad Cities site, contributing an additional 48,000 L/s (1700 cfs) (USGS 2000), bringing the average river flow at the Quad Cities site to 1,430,000 L/s (50,500 cfs).

In addition, there are currently five operating wells (Figure 2-3) providing water to various systems on the property. The two primary wells for station operations are Wells 1 and 5. These wells provide water for the domestic drinking water system, make-up demineralizer system, and gland-seal condenser. The largest single use of groundwater is to maintain the former spray canal for raising fish. Water for this purpose is drawn from Well 6 and Well 7.

The final well, Well 8, provides water for fire fighter training exercises. Wells 2, 3, and 4 have been capped or abandoned.

Groundwater use from all wells has averaged 45 L/s (717 gpm) over the last 10 years. In the winter of 1997, groundwater was used to raise the temperature of the water in the fish-rearing facility while the plant was shut down. Without this period of high use, the 10-year average yield for the site is approximately 31.9 L/s (505 gpm).

There is no water piped to the facility from offsite water supply systems. Movement of groundwater at the site typically is toward the Mississippi River, except for short periods associated with high river level.

2.2.3 Water Quality

Quad Cities operates with approximately 61,000 L/s (970,000 gpm) discharged to the river with two units running at full power. The combined cooling and service water, heated 15.6°C (28°F) above the intake temperature, is discharged through two 4.9-m (16-ft) diameter diffuser pipes with nozzles that jet the water into the deepest part of the river channel. Biocides, chlorine, and bromine, are used at the condenser inlets to minimize aquatic growth and bacteria in the condenser tubes. Quad Cities injects a chemical to neutralize the biocide in the discharge bay so that river organisms are not affected by the biocide. A silt dispersant and scale inhibitor are also injected at the river intake. Additionally, biocide, silt dispersant, and a corrosion inhibitor are injected into the service water system.

Sanitary waste from the Quad Cities site is sent to the wastewater treatment system and discharged to the Mississippi River.

In addition to serving the cooling needs of Quad Cites Units 1 and 2, the Upper Mississippi River provides water of sufficiently high quality to serve a variety of other uses, including propagation of fish and wildlife and contact recreation. However, river reach IL-M04, which includes a portion of Pool 14, is identified on the Illinois State 2002 Section 303(d) list of impaired water due to the presence of polychlorinated biphenyls (PCBs).

Pursuant to the Federal Water Pollution Control Act of 1977, also known as the Clean Water Act (CWA), the water quality of the plant effluents is regulated through the National Pollutant Discharge Elimination System (NPDES). The Illinois Environmental Protection Agency (IEPA) is authorized to issue NPDES permits. The current permit (IL0005037) was issued May 26, 2000, and is due to expire May 31, 2005 (IEPA 2000b). This permit specifies effluent limits for pH, total residual chlorine, oil, grease, biological oxygen demand, fecal coliform, total suspended solids, boron, temperature, and flow. Any new regulations promulgated by the U.S. Environmental Protection Agency (EPA) or the State of Illinois would be reflected in future

permits. The Iowa Department of Natural Resources (IA DNR) is also a signatory on the original Illinois NPDES permit, as the effluents discharge to the waters of both states.

The NPDES permit for Quad Cities defines a mixing zone as an area of the river where plant releases mix with river water. The plant is required not to exceed the temperature criteria specified in the NPDES permit outside the mixing zone. To ensure compliance with State of Illinois water quality standards, the NPDES permit for Quad Cities contains monthly maximum temperature limits for "representative locations in the main river" at the edge of the designated mixing zone, a maximum temperature increase 2.8°C (5°F) above ambient at the edge of the mixing zone, and restrictions on the size of the thermal mixing zone (IEPA 2000b).

The NPDES permit for Quad Cities also contains specific requirements for daily continuous monitoring of plant circulating water flows, daily continuous monitoring of discharge temperatures, weekly determination of river flow rate, daily monitoring of the ambient temperature of the river, daily determination of plant load (percent power), and, as warranted, daily determination of the temperature at a river cross-section 152 m (500 ft) downstream from the plant's diffuser system. This monitoring program allows Quad Cities to respond to changing conditions in the river and to adjust power levels to ensure compliance with NPDES temperature limits (IEPA 2000b).

Based on a study of the diffuser system, Exelon concluded that Quad Cities Units 1 and 2 could operate at full load without violating discharge permit limits under most river flow conditions (ComEd 1981). To demonstrate compliance at low river flows, Exelon developed a temperature monitoring curve that allowed calculation of permissible plant load as a function of river flow. With these data and the lack of biological effects in the river, as demonstrated by ongoing monitoring, the parties agreed in 1983 to allow open-cycle operation (Open-Cycle Agreement 1983). The temperature monitoring curve was last modified in 2001 to more accurately represent current conditions. The curve may continue to be modified over the license renewal period, under agreement with the affected parties.

2.2.4 Air Quality

The area in the vicinity of the Quad Cities site has a temperate continental climate with a wide temperature range throughout the year. Climatological records for Moline, Illinois, which is about 40 km (25 mi) southwest of the Quad Cities site, are generally representative of the Quad Cities site. These records indicate that the normal daily maximum temperatures for Moline range from about -2°C (28°F) in January to a high of about 30°C (86°F) in July. Normal minimum temperatures range from about -12°C (11°F) in January to about 18°C (65°F) in July.

The average precipitation is about 99 cm (39 in.) per year. Of this total, about 73 cm (29 in.) falls during the growing season (March through September). There is an average of

approximately 51 thunderstorms per year in the area, with about 50 percent of the thunderstorms occurring in July and August. Based on statistics for the 30 years from 1954 through 1983 (Ramsdell and Andrews 1986), the probability of a tornado striking the site is expected to be about 4×10^{-4} per year.

Wind energy potential is generally rated on a scale of 1 through 7. Areas suitable for wind turbine applications have a rating of 3 or higher. The wind energy potential in the immediate vicinity of the Quad Cities site, which has a rating of 2, may not be suitable for wind energy applications. However, there are areas in Illinois and Iowa where the annual average wind-energy resource is rated 3 or higher and is generally suitable for generation of electricity (Elliott et al. 1986). The wind energy potential for Illinois is estimated to be about 9000 MW (NREL 2003), which is higher than the 1986 estimate.

The Quad Cities site is located within the Metropolitan Quad Cities Interstate Air Quality Control Region. The air quality in the region is designated as better than national standards, in attainment, or unclassified for all criteria pollutants in 40 CFR 81.314 and 40 CFR 81.316. In addition, air quality in all counties in Illinois and Iowa within 80 km (50 mi) is designated as better than national standards, in attainment, or unclassified for all criteria pollutants in 40 CFR 81.314 and 40 CFR 81.316. There is no mandatory Federal Class I area in which visibility is an important value as designated in 40 CFR Part 81 within 160 km (100 mi) of the Quad Cities site.

Diesel generators, boilers, and other activities and facilities associated with Quad Cities Units 1 and 2 emit various pollutants. Emissions from these sources are regulated under Permit 161807AAB issued by the IEPA (IEPA 2000a).

2.2.5 Aquatic Resources

The principal aquatic resources in the vicinity of the Quad Cities site are associated with the Mississippi River. Other important aquatic habitats include several tributaries to the Mississippi River (e.g., the Wapsipinicon River in Iowa that flows into the Mississippi River immediately upstream of the Quad Cities site) and the Quad Cities Units 1 and 2 retired spray canal. The spray canal is currently used to raise walleye (*Stizostedion vitreum*) primarily for release into Pool 14 of the Mississippi River. The transmission lines associated with the Quad Cities Units 1 and 2 cross a number of streams ranging in size from small intermittent streams to the Rock River. Transmission line right-of-way maintenance activities in the vicinity of streams and river crossings employ procedures to minimize erosion and shoreline disturbance while encouraging vegetative cover.

Quad Cities Units 1 and 2 are located on the east bank of Pool 14 of the Mississippi River upstream of Lock and Dam 14. Pool 14 is 47 km (29 mi) long and 4165 ha (10,580 ac) in area (Bowzer and Lippincott 2000). The main channel of the river is approximately 0.6 km (0.4 mi)

wide in the vicinity of the Quad Cities site. The Mississippi River is used for a variety of purposes, including navigation, recreation, tourism, and conservation.

Since 1938 (the year that the current lock and dam system was put in place) the annual flow rate in the Mississippi River has varied from 752.6 to 2619 m^3/s (26,579 to 92,500 cfs) at Clinton, Iowa (USGS 2003a). Flows at the Quad Cities site are about one percent higher due to the contribution of the Wapsipinicon River (AEC 1972). The highest flow rates generally occur in spring (April–June) and the lowest in winter (December–February), with mean monthly flow rates ranging from 732 m^3/s (25,840 cfs) in January to 2551 m^3/s (90,080 cfs) in April (USGS 2003c). Daily flow rates have ranged from a low of 272 m^3/s (9,600 cfs) on December 5, 1976 to a high of 7589 m^3/s (268,000 cfs) on April 23, 2001 (USGS 2003b). The flow of the Mississippi River through Quad Cities Units 1 and 2 for cooling and service water is about 61,000 L/s (970,000 gpm or 2,160 cfs). This is about 4 percent of mean average flow in the river (Section 2.1.3). Sedimentation is one of the most critical resource problems affecting the impounded areas within the Upper Mississippi River, which continues to degrade the quantity and quality of non-channel aquatic habitats. Sediments tend to settle in the deeper portions of the aquatic habitats, which results in a continued loss of depth diversity and simplification of pools (USGS 1999).

The major changes and modifications within the Upper Mississippi River that have had the greatest effect on aquatic resources include: (1) loss of flood plain connectivity due to extensive levee construction, (2) impoundment of the river from construction of locks and dams, (3) river channelization related to navigation, (4) water quality degradation in tributary streams, and (5) invasion of exotic species through man-made navigation projects (UMRCC 1993). The main channel of the Mississippi River is dredged in some reaches to maintain the 2.7-m (9-ft) navigation channel (Fremling and Drazkowski 2000). While pollution from domestic sewage has been reduced since passage of the Federal Water Pollution Control Act of 1972, the Mississippi River still receives contaminants from agricultural, industrial, municipal, and residential sources. The impacts of these contaminants on river biota are largely unknown (Fremling and Drazkowski 2000).

Despite the modifications and multiple competing uses of the Upper Mississippi River, the overall fish biodiversity has been persistent and resilient (USGS 1999). The river's main channel, navigation and wing dams, side channels, sloughs, chutes, backwater lakes and ponds, marsh areas, flooded bottomland forests, and tributaries create diverse habitats for at least 118 species of fish (FWS 1991a). However, overwintering habitats for fish have declined due to water depth reductions caused by sedimentation. Also, recent die-offs of aquatic vegetation have reduced the suitability of many areas as nursery habitats for fishes (Fremling and Drazkowski 2000).

Fish species considered abundant within the Upper Mississippi River include gizzard shad (*Dorosoma cepedianum*), common carp (*Cyprinus carpio*), emerald shiner (*Notropis*

atherinoides), river shiner (*N. blennius*), bullhead minnow (*Pimephales vigilax*), and bluegill (*Lepomis macrochirus*). Common species include longnose and shortnose gar (*Lepisosteus osseus* and *L. platostomus*), bowfin (*Amia calva*), mooneye (*Hiodon tergisus*), spottail shiner (*N. hudsonius*), river carpsucker (*Carpiodes carpio*), quillback (*C. cyprinus*), bigmouth buffalo (*Ictiobus cyprinellus*), shorthead redhorse (*Moxostoma macrolepidotum*), channel catfish (*Ictalurus punctatus*), white and hybrid white bass (*Morone chrysops* and *M. chrysops* x *M. saxatilis*), rock bass (*Ambloplites rupestris*), green sunfish (*Lepomis cyanellus*), and river darter (*Percina shumardi*) (Bowzer and Lippincott 2000; FWS 1991a). Favorite sport fish species include walleye, sauger (*Stizostedion canadense*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieu*), white bass, bluegill, black and white crappie (*Pomoxis nigromaculatus* and *P. annularis*), pumpkinseed (*L. gibbosus*), and channel catfish (FWS 1991a). Commercial fisheries also exist for some species, such as the bigmouth buffalo, common carp, catfish and bullheads, and freshwater drum (*Aplodinotus grunniens*) (FWS 1991a). The carp is the most important non-native fish species in the Mississippi River, comprising most of the commercial harvest; it is the dominant species in the Upper Mississippi River (USGS 1999). Ninety-two fish species have been collected in Pool 14 of the Mississippi River (Bowzer and Lippincott 2000).

The abundance of walleye and hybrid striped bass has increased in the vicinity of the Quad Cities site since 1985 due to stocking of these fish (Bowzer and Lippincott 2000; LaJeone and Monzingo 2000). The walleye are reared in the Quad Cities Units 1 and 2 inactive spray canal, while the hybrid white bass are maintained in the fish laboratory at the Quad Cities site (Exelon 2003a). Conservatively, the adult walleye population in Pool 14 is comprised of 30 percent stocked fish, with lesser, yet measurable contributions to downstream pools (LaJeone and Monzingo 2000). Riverine species, such as the freshwater drum, channel catfish, flathead catfish (*Pylodictis olivaris*), and white bass have generally increased in Pool 14; while backwater species, such as white and black crappies have generally decreased due to degradation of the backwater areas and sloughs from sedimentation associated with operation of the 2.7-m (9-ft) navigation channel (Bowzer and Lippincott 2000).

Due to the importance of vegetation as both a food and habitat resource, and its influence on physicochemical conditions in the river, the status of aquatic and terrestrial vegetation has been documented within the Upper Mississippi River. For example, wild celery (*Vallisneria americana*) produces a vegetative tuber that is important as a food item for migratory waterfowl. It became the dominant submersed plant around 1960 within much of the river between Pools 4 and 19. Purple loosestrife (*Lythrum salicaria*) is an introduced wetland plant that forms dense monotypic stands, replaces many native wetland plants, and has no food value for wildlife. Introduced submersed species, such as Eurasian water milfoil (*Myriophyllum spicatum*) cause nuisance problems throughout the river system (Fremling and Drazkowski 2000). Kohrt (1999) summarized the status of vegetation in Pool 14 of the Mississippi River over three growing seasons. Wild celery demonstrated a greatly increasing trend. Other plant species or groups whose status showed an increasing trend over three growing seasons included: submersed

aquatic plants, arrowhead (*Sagittaria* spp.), purple loosestrife, and Eurasian water milfoil. Those plant species or groups whose status was static over those three growing seasons included: floating-leaved aquatic plants, emergent aquatic plants, terrestrial plants, forest plants, and sago pondweed (*Potamogeton pectinatus*). Factors that affect submersed aquatic vascular plants include weather and hydrology, sedimentation, suspended solids and water clarity, and consumption and disturbance by fish and wildlife. The impoundments for the navigation system on the Mississippi River favor submersed aquatic vegetation by increasing shallow water surface area and stabilizing low-discharge water levels (USGS 1999).

Generally, benthic macroinvertebrate densities are low throughout the Upper Mississippi River, but site-specific areas of high density do occur. The non-channel areas of the Upper Mississippi River consistently support more benthic macroinvertebrates than the channel areas (USGS 1999). The impoundments in the Mississippi River have provided habitat for hexagenian mayflies that thrive in areas where there is a silt bottom and well-oxygenated water. These mayflies are an important food resource for many fish and wildlife species. However, their populations will decrease as pool areas and backwaters are lost to sedimentation (Fremling and Drazkowski 2000).

The Upper Mississippi River contains a rich assemblage of freshwater mussels. Historically, as many as 50 species of mussels have been documented from the Upper Mississippi River, but only 30 species have been reported in recent surveys. Two of these are listed as Federally endangered; and most of the rest are rare (i.e., listed as endangered, threatened, rare, or of special concern by one or more states [USGS 1999]). The freshwater mussels have been adversely impacted by activities such as the pearl button and cultured pearl industries, siltation (associated with agriculture, poor land management, and impoundments), pollution from agricultural and industrial chemicals, establishment and maintenance of the navigation channel, and competition from exotic species, particularly the zebra mussel (*Dreissena polymorpha*) (Exelon 2003a; USGS 1999). A high mussel die-off occurred in Pools 14 and 15 in the 1980s, but the cause was not identified (USGS 1999).

Mussels are often found in dense aggregations called mussel beds. While these beds may be miles apart, an individual bed can be up to several miles long (USGS 1999). Thirty-one species of unionid have been collected from Pool 14. The most abundant species include threeridge (*Amblema p. plicata*; 37.9 percent), pimpleback (*Quadrula p. pustulosa*; 16.4 percent), plain pocketbook (*Lampsilis cardium*; 10.1 percent), Wabash pigtoe (*Fusconaia flava*; 6.2 percent), threehorn wartyback (*Obliquaria reflexa*; 5.8 percent), mapleleaf (*Quadrula quadrula*; 4.8 percent), and giant floater (*Pyganodon grandis*; 4.5 percent) (Exelon 2003a). These species are widespread and relatively common throughout the Mississippi River and its tributaries (Cummings and Mayer 1992). Populations of fingernail clams (Sphaeriidae) have declined in certain reaches of the Upper Mississippi River during recent decades. The declines

have occurred chiefly during low-flow periods associated with droughts (Fremling and Drazkowski 2000).

The zebra mussel became established in the Upper Mississippi River by 1992 and has continued to spread throughout the river system. Their increase causes a decline among many native mussels, as it can out-compete native species for oxygen and food and is so prolific that it can smother native mussel beds (FWS 2001c). The zebra mussel has also increasingly displaced other macroinvertebrates, such as hydropsychid caddisflies that live on submerged hard surfaces (Fremling and Drazkowski 2000).

Aquatic species that are listed by the FWS, the State of Illinois, or the State of Iowa and that have the potential to occur in the vicinity of Quad Cities site are presented in Table 2-2.

The Higgins' eye pearlymussel (*Lampsilis higginsii)* was listed as a Federally endangered species on June 14, 1976 (41 FR 24064) (FWS 1976). It is only found in the Mississippi River, St. Croix River in Wisconsin, the Wisconsin River, and the Rock River in Illinois. It was never abundant, historically comprising only about 0.5 percent of the mussel population. At the time the original recovery plan was written in 1983, the Higgins' eye pearlymussel had undergone a 53 percent decrease in its known range (FWS undated). The Higgins' eye pearlymussel most frequently occurs in medium to large rivers with current velocities of about 0.15 to 0.46 m/s (0.49 to 1.51 ft/s) and in depths of 1.0 to 6.0 m (3.3 to 19.7 ft) with firm, coarse sand or mud-gravel substrates (FWS 2000a, 2001b). It is generally found in mussel beds with at least 15 other species present (FWS 2003b).

Table 2-2. Federally Listed and Illinois and Iowa State-Listed Aquatic Species Potentially Occurring in Rock Island and Whiteside Counties, Illinois, and Clinton and Scott Counties, Iowa

Scientific Name	Common Name	Federal Status	Illinois Status	Iowa Status
Cumberlandia monodonta	spectaclecase	—	E	E
Ellipsaria lineolata	butterfly	—	T	T
Lampsilis higginsii	Higgins' eye pearlymussel	E	E	E
Ligumia recta	black sandshell	—	T	—
Plethobasus cyphyus	sheepnose	—	E	E
Acipenser fulvescens	lake sturgeon	—	E	E
Ammocrypta clarum	western sand darter	—	E	T
Hybopsis amnis	pallid shiner	—	E	—

E = Endangered; T = Threatened; — = Not listed or not afforded protection

Sources: FWS (2000b, 2001a, 2003c); Herkert (1992, 1998); IA DNR (2002); IL DNR (1999); Upper Mississippi River NWFR (undated).

No critical habitat has been designated for the Higgins' eye pearlymussel. However, ten Essential Habitat Areas for the Higgins' eye pearlymussel occur within the Upper Mississippi River watershed. Essential Habitat Areas are locations known to contain reproducing populations of the Higgins' eye pearlymussel in association with a healthy and diverse unionid community (e.g., mussel beds) (FWS 1998). An Essential Habitat Area begins approximately 1.6 km (1.0 mi) downstream of Quad Cities, Units 1 and 2 at River Mile (RM) 505.5 and continues to RM 503.0 at Cordova, Illinois (FWS 2003b).

The only other Essential Habitat Area located downstream of the Quad Cities site occurs in Pool 15 in the Sylvan Slough at RMs 485.5 through 486.0. The other Essential Habitat Areas are in Pools 9 and 10 of the Mississippi River, St. Croix River, and the Wisconsin River (FWS 2003b). Nearly all of the remaining habitat for the Higgins' eye pearlymussel within the Mississippi River occurs within the navigation channel. In a 2000 Biological Opinion, the FWS concluded that the continued operation and maintenance of the navigation channel would jeopardize the continued existence of the Higgins' eye pearlymussel (FWS 2000a).

Suitable host species for the glochidia (mussel larvae) of the Higgins' eye pearlymussel include sauger, freshwater drum, largemouth bass, smallmouth bass, walleye, yellow perch (*Perca flavescens*), and black crappie; while marginal host species include bluegill, northern pike (*Esox lucius*), and green sunfish (FWS 2003b). Most of these fish species are common to abundant and widespread; thus, it is doubtful that the presence of fish hosts is a limiting factor affecting the Higgins' eye pearlymussel (Rasmussen 1979).

A number of aquatic species have been designated as threatened or endangered by the State of Illinois and the State of Iowa. These include four freshwater mussels and three fish species (Table 2-2). The spectaclecase (*Cumberlandia monodonta*) inhabits large rivers with swiftly flowing waters among boulders in patches of sand, cobble, or gravel in areas where current is reduced (Cummings and Mayer 1992). Within Illinois, it is currently restricted to the Mississippi River (Heckert 1992). The butterfly (*Ellipsaria lineolata*) usually inhabits medium to large rivers. It inhabits areas of strong current on coarse sand or gravel bottoms and at water depths from a few inches to four feet (Parmalee 1967). The black sandshell (*Ligumia recta*) is a medium to large river species that occurs in riffles or raceways on firm sand or gravel bottoms at depths of four-to-six feet or more. It is less tolerant of siltation and pollution than many other mussel species (Cummings and Mayer 1992; Heckert 1998; Parmalee 1967). The sheepnose (*Plethobasus cyphyus*) inhabits currents of medium to large rivers in gravel or mixed sand and gravel substrates at depths of up to 2 m (6.6 ft) (Cummings and Mayer 1992; Parmalee 1967). Reasons for the decline of these mussel species are similar to those discussed above for the Higgins' eye pearlymussel: dredging, sand and gravel mining, siltation, pollution, and/or zebra mussels (Herkert 1992, 1998).

Several State-listed fish species have been infrequently collected from Pool 14 of the Mississippi River (Bowzer and Lippincott 2000). The lake sturgeon (*Acipenser fulvescens*)

inhabits the bottoms of lakes and larger rivers that are usually 5 to 9 m (16 to 30 ft) deep over mud, sand or gravel substrates (Page and Burr 1991). Reasons for the decline of the lake sturgeon include impoundments, channelization, pollution, and overfishing (Pflieger 1975; Smith 1979). Within Illinois, the pallid shiner (*Hybopsis amnis*) is confined to the Mississippi and Kankakee rivers. It occurs in pools with negligible current, clear water, and sand-silt substrate. It is apparently intolerant of excessive siltation and turbidity (Herkert 1992). While the pallid shiner is not listed for Iowa in Table 2-2, it was listed as rare by Duyvejonck (1996) and as depleted (not included on Iowa endangered fishes list but meriting special concern) by Menzel (1981). The western sand darter (*Ammocrypta clarum*) inhabits rivers and is restricted to habitats of almost pure sand. It avoids strong currents, preferring the quiet margins of the stream channels and shallow backwaters. It is nocturnal, burying itself in sand during the day. The reason for its decline is probably the result of siltation (Pflieger 1975; Smith 1979).

Several other State-listed fish species have been collected from Pool 14 of the Mississippi River in conjunction with the long-term fisheries monitoring done near the Quad Cities site (Bowzer and Lippincott 2000). These species include: chestnut lamprey (*Ichthyomyzon castaneus*, Iowa threatened), grass pickerel (*Esox americanus*, Iowa threatened), pearl dace (*Margariscus margarita*, Iowa endangered), weed shiner (*Notropis texanus*, Illinois and Iowa endangered), and longnose sucker (*Catostomus catastomus*, Illinois threatened) (IA DNR 2002; IL DNR 1999). There is the potential that some of these records could be misidentifications. For example, within Illinois the longnose sucker is confined to Lake Michigan. Smith (1979) believed that an old record of the longnose sucker from the Rock River was almost certainly based on a misidentified white sucker. In other cases, the Mississippi River is not the primary habitat for the species (e.g., pearl dace and weed shiner) (Page and Burr 1991; Smith 1979).

2.2.6 Terrestrial Resources

The Quad Cities site consists of approximately 331 ha (817 ac) of both developed and undeveloped areas. The developed areas mostly occupy the western half of the site. Undeveloped areas are located generally on the eastern half of the site and support habitats that include open fields and planted pines. Approximately 22 ha (55 ac) are leased for farming (i.e., hay). Prior to plant operations, the primary use of the site was agricultural and residential (AEC 1972).

The site is located in an area with sandy soil and little bushy or wooded habitat. The agricultural lands in the vicinity are used for grain and cattle forage crops (AEC 1972). It is expected that a number of the species (i.e., especially terrestrial mammals) inhabiting adjacent areas to the Quad Cities site will also use the limited natural areas within the boundaries of the site. Other local areas with important habitats are the river islands located nearby and the area adjacent to the river in Scott and Clinton counties in Iowa. These areas, which are generally encompassed by the Upper Mississippi River NWFR and the Princeton Wildlife Management Area, provide

upland and bottomland habitats including hardwood forests, grasslands, agricultural fields, islands, wetlands, sloughs, lakes, and shoreline (FWS 2000c). Birds (e.g., migratory passerines, raptors, waterfowl, shorebirds) use the area extensively. The wetlands, forests, and prairies are used by more than 50 species of mammals that include deer, raccoon, muskrat, red and gray fox, coyote, weasel, mink, badger, skunk, river otter, and many other small mammals (FWS 2000c; AEC 1972).

The Princeton Wildlife Management Area is a 482 ha (1190 ac) habitat management unit within the Upper Mississippi River NWFR constructed to provide optimum habitat conditions for fish and wildlife species. The water levels within these units are managed to provide emergent vegetation and mud/sand flats to maintain diverse habitat types for many wetland-dependent species (FWS 2000c). Flood plain forest habitats dominate this management area and include species such as silver maples, green ash, and cottonwoods. Large numbers of bald eagles use this area during the winter months, in addition to waterfowl and migratory passerines (IBB 2002).

A total of five transmission lines (Table 2-1 and Figure 2-5) connect Quad Cities Units 1 and 2 to the electric grid (Exelon 2003a; AEC 1972). These lines occupy 880 ha (2200 ac) of land along 185 km (115 mi) of right-of-way (ROW) that traverses mainly agricultural land along with some natural terrestrial habitats (Exelon 2003a; AEC 1972). Approximately 90 to 95 percent of the transmission corridor can be classified as agricultural. The transmission lines include the Davenport line (Line 0401), the Barstow line (Line 0402), the south Nelson line (Line 0403), the north Nelson line (Line 0404), and the Rock Creek line (Line 0405).

The Davenport transmission line runs 20.6 km (12.8 mi) with a ROW of 55 m (180 ft). It crosses the Mississippi River and the Upper Mississippi River NWFR immediately south of the Quad Cities site as it runs from Illinois into Iowa. The portion of the Upper Mississippi River NWFR traversed by the Davenport corridor is within the Princeton Wildlife Management Area. This area is managed by the IDNR under a cooperative agreement with the Savanna District of the Upper Mississippi River NWFR; the portion of the Davenport corridor crossing this area is just slightly more than 1.6 km (1 mi) in length. All ROW maintenance activities for this transmission line that occur in the refuge must be reviewed and approved by the FWS through the Savanna District Office of the Upper Mississippi River NWFR. The transmission line then crosses predominantly agricultural land with an exception of a short passage (less than 0.8 km [less than 0.5 mi]) through dense timber and one crossing of a lesser distance through sparse timber.

Although the Davenport transmission line crosses agricultural lands for the remainder of its run, it also transverses several small creeks and their tributaries (e.g., Lost Creek, Hickory Creek, and Duck Creek tributaries) (Exelon 2003a; FWS 2000c; AEC 1972).

The Barstow transmission line runs 28.1 km (17.5 mi), sharing the initial 3.2 km (2 mi) of the corridor with the south Nelson line. The initial 3.2 km (2 mi) has a ROW of 158 m (520 ft), with the remainder a ROW of 44 m (145 ft). The Barstow line passes through agricultural lands (i.e., row crops and pasture) throughout its entire corridor that are typical of eastern Iowa and northwestern Illinois. The Barstow line also crosses Zuma Creek and its tributaries several times along its run (Exelon 2003a; AEC 1972).

The corridor for the south Nelson transmission line runs 67.4 km (41.9 mi) with a ROW of 158 m (520 ft) for the first 3.2 km (2 mi), followed by a 44-m (145-ft) ROW. The north Nelson corridor runs for 63.9 km (39.7 mi) with a 44-m (145-ft) ROW. The terrain traversed by these lines is mostly flat farmland. Both lines cross the Rock River and several small creeks (e.g., Rock Creek, Deer Creek, or Lynn Creek). Both Nelson transmission lines terminate at the Nelson Transmission substation approximately 64 km (40 mi) due east of Quad Cities (AEC 1972).

The Rock Creek transmission line runs through the industrial park just north of Quad Cities Station and then crosses the river into Iowa. This line has a ROW of 52 m (170 ft) and is 8 km (5 mi) long (Exelon 2003a). Its corridor crosses the Mississippi River and the Savanna District of the Upper Mississippi River NWFR approximately 3 km (2 mi) north of the site[(a)] (Exelon 2003a). The Savanna District extends along both sides of the Mississippi River and covers three navigational pools, including Pool 14 where the Quad Cities site is located. The Rock Creek transmission line crosses only open water and riparian habitats within the Upper Mississippi River NWFR.[(b)] All ROW maintenance activities for this transmission line that occur in the refuge must be reviewed and approved by the FWS through the Savanna District Office of the Upper Mississippi River NWFR.

With the exception of the Upper Mississippi River NWFR and the Princeton Wildlife Management Area, the Quad Cities transmission lines traverse lands cultivated for row crops and pasture that are typical of eastern Iowa and northwestern Illinois. The Quad Cities transmission lines do not cross any State or Federal parks — other than the aforementioned refuge and wildlife management area — wildlife refuges or wildlife management areas (Exelon 2003a).

The transmission corridors are maintained by mowing (Cunningham 2003; Exelon 2003d), trimming, tree removal, and by the use of approved herbicides (Exelon 2003a; Exelon 2003d; Exelon 2003e; Cunningham 2003). Unless otherwise noted, vegetation management follows a

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(a) Personal communication with Ed Britton, District Manager, Savanna District, Upper Mississippi National Wildlife and Fish Refuge, May 8, 2003.

(b) Personal communication with Ed Britton, District Manager, Savanna District, Upper Mississippi National Wildlife and Fish Refuge, May 8, 2003.

three-year cycle within the Davenport and Barstow corridors (Exelon 2003d), a five-year cycle within both Nelson corridors (Cunningham 2003), and a six-year cycle within the Rock Creek corridor (Exelon 2003e). Herbicide application is performed according to label specifications by certified applicators. Pre-activity surveys are carried out along the Nelson corridors, although not along the other three transmission line corridors (Cunningham 2003). Training is provided to line maintenance staff in identifying Federally and State listed species — and the species' habitats — that may occur in the vicinity of both Nelson lines and the Rock Creek line, as well as steps to take if one of these species is encountered while carrying out maintenance activities (Cunningham 2003; Exelon 2003e).

Table 2-3 presents terrestrial species that are listed, proposed for listing, or candidates for listing by the Federal government or the States of Iowa and Illinois. State or Federally listed species that could occur in the vicinity of the Quad Cities site include three plants, one reptile, one bird, one mollusk, and two mammals. Of these species, six are Federally protected under the Endangered Species Act (ESA). They are the Indiana bat (*Myotis sodalis*; endangered), Iowa Pleistocene snail (*Discus macclintocki*; endangered), bald eagle (*Haliaeetus leucocephalus*; threatened), western prairie fringed orchid (*Platanthera praeclara*; threatened), eastern prairie fringed orchid (*Platanthera leucophaea*; threatened) and the prairie-bush clover (*Lespedeza leptostachya*; threatened). No designated critical habitat exists for any of the listed species on or in the vicinity of Quad Cities Station. No terrestrial species in the area are proposed for listing or are candidates for listing.

The Indiana bat was originally listed in 1967 as Federally endangered. Its decline is largely attributed to cave destruction and disturbance (FWS 1991b). The Indiana bat is very small, with a wingspan of 23 to 28 cm (9 to 11 in.) and weighing approximately 9 g (0.3 ounces) (FWS 2003c). In winter, the Indiana bat uses limestone caves or abandoned mines for hibernation, although some hibernate under bridges, in old buildings, or under loose bark and in hollows of trees (Nelson 2003; FWS 1991b). This species forages for insects along stream corridors, within the canopy of flood plain and upland forests, over clearings with early successional vegetation (old fields), along the borders of croplands, along wooded fence rows, and over farm ponds and in pastures. It has been shown that the foraging range for the bats varies by season, age, and sex and ranges up to 33 ha (81 ac) (Nelson 2003). Roosting and rearing of young usually occurs in caves, although it may occur in the loose bark of trees (FWS 1991b). Exelon has not noted any Indiana bats in the vicinity of the Quad Cities site or its associated transmission lines. Undeveloped portions of the Quad Cities site have not been surveyed for the Indiana bat.[(a)] The FWS notes that the bat may occur in all counties in Iowa south of Interstate 80 (Nelson 2003). Interstate 80 is a major east-west highway in Illinois and Iowa approximately 5 miles south of the Quad Cities site. The Iowa Department of Natural

(a) Personal communication with Ed Cunningham during Quad Cities site audit, March 12, 2003.

Resources did not note any occurrences of threatened or endangered species in the vicinity of the transmission lines associated with Quad Cities (Brandrup 2002).

Table 2-3. Terrestrial Species Listed as Endangered or Threatened or Candidates for Listing by the FWS or the States of Illinois and Iowa That Occur or Potentially Occur Within Rock Island, Whiteside, and Lee Counties, Illinois, and Clinton and Scott Counties, Iowa

Scientific Name	Common Name	Federal Status	Illinois Status	Iowa Status
Mammals				
Myotis sodalis	Indiana bat	E	E	—
Lutra canadensis	river otter	—	T	—
Birds				
Haliaeetus leucocephalus	bald eagle	T	T	—
Mollusks				
Discus macclintocki	Iowa Pleistocene snail	E	E	—
Reptiles				
Heterodon nasicus	western hognose snake	—	T	—
Plants				
Platanthera praeclara	western prairie fringed orchid	T	—	—
Platanthera leucophaea	eastern prairie fringed orchid	T	E	—
Lespedeza leptostachya	prairie bush-clover	T	E	—

T = Threatened; E = Endangered.

— = Not listed or not afforded protection

Sources: FWS (1999a, 1999b, 2002); Brandrup (2002); Pietruszka (2002); Nelson (2003); IL DNR (1999); Herkert (1992, 2002).

The Federally endangered Iowa Pleistocene snail was originally listed in July 1978 (43 FR 28932 [FWS 1978]). This small land snail inhabits algific (i.e., cold producing) talus slopes, within the leaf litter of cool and moist hillsides (Nelson 2003; FWS 2002). It breeds from late March to August by laying two-to-six eggs in this leaf litter, with the eggs hatching approximately 28 days later. The snail feeds on fallen leaves of birch and maple trees or dogwood shrubs. Climate change is attributed as the primary cause of long-term decline of this snail although the most immediate threats are from habitat degradation and destruction, human disturbance, and livestock grazing, as well as misapplication of pesticides (FWS 1997; FWS 2002). The snail has been found in approximately 30 sites in Iowa and Illinois (FWS 2002) with

none noted by Exelon at Quad Cities (Exelon 2003a). Suitable habitat is unlikely to occur at the site or in the immediate vicinity of Quad Cities transmission lines and their corridors, with the majority of traversed land characterized as flat and agricultural (Exelon 2003a).

The bald eagle was originally listed as endangered by the FWS in 1978, but population increases prompted downlisting to threatened status in 1995, and the species is currently proposed for delisting (64 FR 36453 [FWS 1999c]). The bald eagle is a common visitor to the Upper Mississippi River Valley, within which the Savanna District of the Upper Mississippi River NWFR is located and the Quad Cities site is adjacent. The bald eagle uses this area as a winter migration corridor and for summer nesting habitat. During the October to March timeframe, hundreds of bald eagles congregate in the area to feed on fish, typically near lock and dams or in ice-free backwater areas (FWS 2000c). These attractive winter feeding grounds include open water areas created by the warm water effluents from the power plant (Nelson 2003). The Savanna District also documents nesting activity, usually on islands or along backwater shorelines (FWS 2000c). Bald eagles build their nests in large trees near rivers or lakes and often use the same nest year after year. The Savanna district notes that presently there are seven active bald eagle nesting territories and some of these nests have been known to successfully produce young (FWS 2000c). The nearest known bald eagle nest to the Quad Cities site is located at RM 514.3 on Beaver Island and has been established for over a decade with observed success in producing young. This nest is approximately 8 RM (7 mi, 11.3 km) north of the Quad Cities site and 5 RM (4.5 mi, 7.2 km) north of the Rock Creek transmission line. No other known bald eagle nests occur in the vicinity of the Quad Cities site or its associated transmission lines.[(a)]

The Federally threatened western prairie fringed orchid was listed as threatened in 1989, along with the eastern prairie fringed orchid (54 FR 39857 [FWS 1989]). It occurs in mesic to wet tallgrass prairies and meadows, but is also found in old fields or roadside ditches (FWS 1996; FWS 2003c). The western prairie fringed orchid is restricted to areas west of the Mississippi River and is known to occur in about 75 sites in 8 states (FWS 2003a). The prairie fringed orchids are mostly threatened by conversion of its habitats to cropland other habitat loss activities. Other threats include invasive species competition, wetland destruction, intensive hay mowing, fire suppression, and overgrazing (FWS 2003c; Herkert 2002). Based on the known distribution of the species, it is unlikely to be found at the Quad Cities site, but it could be found along the Davenport and Rock Creek transmission lines.

The eastern prairie fringed orchid also occupies mesic to wet tallgrass prairie or grassland habitats (Herkert 2002; FWS 2003c; Nelson 2003). However, it can also occupy bogs, fens, and sedge meadows (FWS 2003c). This species formerly occurred throughout Illinois yet has

(a) Personal communication with D. Dee, Field Staff, Savanna District, Upper Mississippi River NWFR, September 23, 2003.

been nearly eliminated from all but northeastern Illinois. There are 30 known Illinois populations; no known populations occur in Whiteside County, although it could occur in Rock Island or Lee counties (records for these counties are no longer extant [Herkert 2002]). No occurrences of either species (eastern or western prairie fringed orchid) have been documented for the Quad Cities site or in areas along its associated transmission lines (Exelon 2003a). Neither the undeveloped portions of the Quad Cities site nor the transmission corridors have been surveyed for these species.[(a)]

The Federally threatened (52 FR 781 [FWS 1987]) prairie-bush clover occurs on dry gravel and sand prairies (Herkert 2002). It is found only in the tallgrass prairie region of four Midwestern states and is currently found at fewer than 40 sites in 23 counties of Iowa, Illinois, Minnesota, and Wisconsin (FWS 2003c), although it could occur throughout Illinois (Nelson 2003). Fourteen known populations occur in Illinois at present with five of these populations protected on public land; none of these known populations occur in Rock Island or Whiteside counties, although a recent record of a population is known for Lee County (Herkert 2002). Undeveloped portions of the Quad Cities site have not been surveyed for the prairie bush-clover.[(a)] The decline of the prairie bush-clover is primarily due to the historic loss of tallgrass prairie habitat from conversion to agricultural land, and this species tends to only occur presently in areas that escaped plowing due to being too rocky or steep (FWS 2003c).

Two species, the river otter and the western hognose snake, are listed as threatened by the Illinois Department of Natural Resources (IL DNR 1999). The river otter uses habitats that include streams, rivers, lakes, ponds, drainage ditches, and backwater areas. It is active during the day and at night and feeds on fish, frogs, and crayfish (IL DNR 1999). The Savanna District of the Upper Mississippi River NWFR notes that river otters do occur in the vicinity of Quad Cities and its associated transmission lines (FWS 2000c; Pietruszka 2002).[(b)] The river otter is increasing in population due to the success of a reintroduction project carried out by the Iowa Department of Natural Resources, and the first legal harvest in many years may occur in 2005.[(b)]

The western hognose snake could occur on or in the vicinity of the Quad Cities site and its associated transmission lines (IL DNR undated). This snake is recorded in sandy areas in the northwestern and west-central parts of Illinois, with a preference for dry, sandy prairie areas (Herkert 1992). The primary cause for its decline is habitat destruction. This species is known to occur in Whiteside, Rock Island, and Lee counties, with recent documented occurrences (Herkert 1992). The Savanna District of the Upper Mississippi River NWFR notes the snake does occur in the district's area (FWS 2000c) and the IDNR has documented an occurrence of

(a) Personal communication with Ed Cunningham during the Quad Cities site audit, March 12, 2003.

(b) Personal communication with Ed Britton, District Manager, Savanna District, Upper Mississippi National Wildlife and Fish Refuge, May 8, 2003.

this snake in the vicinity of the Quad Cities site in 1977 (Pietruszka 2002). Undeveloped portions of the Quad Cities site have not been surveyed for the western hognose snake.[(a)]

2.2.7 Radiological Impacts

Exelon has conducted a radiological environmental monitoring program (REMP) around the Quad Cities site since 1968 (AEC 1972). Through this program, radiological impacts to workers, the public, and the environment are monitored, documented, and compared to the appropriate standards. The objectives of the REMP are:

- Provide representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of members of the public resulting from the station operation.

- Verify that the measurable concentrations or radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways.

Radiological releases are summarized in the annual reports titled, *The Quad Cities Nuclear Power Station 2001 Annual Radiological Environmental Operating Report* (Exelon 2002b) and, *Quad Cities Nuclear Power Station's Radioactive Effluent Report for January through December 2001* (Exelon 2002c). The limits for all radiological releases are specified in the Quad Cities ODCM, and these limits are designed to meet Federal standards and requirements (Exelon 2002a). The REMP includes monitoring of the aquatic environment (fish, invertebrates, and shoreline sediment), atmospheric environment (airborne radioiodine, gross beta and gamma), terrestrial environment (vegetation), and direct radiation (Exelon 2002a).

A review of the historical data on releases and the resultant dose calculations revealed that the doses to maximally exposed individuals in the vicinity of Quad Cities were a small fraction of the limits specified in the EPA's environmental radiation standards in 40 CFR Part 190, as required by 10 CFR 20.1301(d). For 2001 (the most recent year for which data were available), the total effective dose equivalent (TEDE) due to licensed activities at the Quad Cities site calculated for the maximally exposed individual for the year 2001 was 0.069 mSv (6.9 mrem). Most of this dose is due to the direct radiation from Units 1 and 2 (0.064 mSv [6.4 mrem]). The balance of the calculated dose, (0.0059 mSv [0.59 mrem]), is attributable to radiological effluent releases (Exelon 2002b). Calculations were performed using the plant effluent-release data, onsite meteorological data, and appropriate pathways identified in the ODCM.

(a) Personal communication with Ed Cunningham during the Quad Cities site audit, March 12, 2003.

Plant and the Environment

2.2.8 Socioeconomic Factors

The staff reviewed the applicant's ER (Exelon, 2003a), the Updated Final Safety Analysis Report (UFSAR) (Exelon, 2003c), information from the US Bureau of the Census, and information obtained from several county, city, and economic development staff during a site visit to the Quad Cities vicinity from March 11 to March 13, 2003. The following information describes the economy, population, and communities in the region of Quad Cities.

2.2.8.1 Housing

Exelon employs approximately 1000 workers at Quad Cities Units 1 and 2, with about 850 being permanent employees. Approximately 54 percent of these employees live in Rock Island and Whiteside counties, and 23 percent live in Scott County. The remaining 23 percent of the employees reside in 16 other counties in both Illinois and Iowa.

Given the predominance of Quad Cities employees living in Rock Island, Whiteside, and Scott counties and the absence of likely significant socioeconomic effects in other, more distant locations, the focus of the analyses undertaken in this SEIS is on these three counties (Exelon 2003a).

Exelon refuels Quad Cities Units 1 and 2 on a 24-month cycle. During these refueling outages, site employment increases by approximately 1100 temporary workers for 20 days. Most of these temporary workers are assumed to be located in the same geographic areas as permanent Exelon staff.

Table 2-4 shows the number of housing units and vacancies in the Quad Cities vicinity for 1990 and 2000. These data show a reasonable consistency among the various geographic units in vacancy rates for 1990 and 2000. The pattern mirrors the growth in population, shown in Table 2-6. Homeowner and rental vacancy show a general consistency between the two census years for most of the jurisdictions.

Rock Island and Scott counties have developed comprehensive land-use plans that encourage growth within the existing municipalities and infrastructure. Whiteside County does not have a formal land-use plan but uses zoning and use permits as methods of directing growth to areas currently served by infrastructure (Exelon 2003a).

Table 2-4. Housing Units and Housing Units Vacant (Available) by County During 1990 and 2000

	1990	2000	Approximate Percentage Change 1990 to 2000
Rock Island County, IL			
Housing Units	63,327	64,489	2
Vacant Units	4010	3777	-6
Whiteside County, IL			
Housing Units	24,000	25,025	4
Vacant Units	1260	1341	6
Scott County, IA			
Housing Units	61,379	65,649	7
Vacant Units	3941	3315	-16
Source: USBC 2000			

2.2.8.2 Public Services

- **Water Supply**

At the present time, the water supply systems in all three counties are operating substantially below their maximum capacities. The Quad Cities site pumps groundwater for use as potable water and is not connected to a municipal system (Exelon 2003a). The three counties most affected by current Quad Cities employees, in terms of consumption of domestic water—Rock Island and Whiteside counties in Illinois, and Scott County in Iowa— are served by a variety of small- to medium-sized water companies and by domestic water wells in the unincorporated areas of the three counties. The current maximum capacity of the major suppliers in each county exceeds the average daily demand by a factor of from 1.7 to 2.9 and averages 2.3 times demand for all three counties (Exelon 2003a).

- **Education**

In 2002, approximately 62,000 students attended schools in Rock Island, Whiteside and Scott counties. Although the region's school districts do not keep track of Quad Cities employees' children, Table 2-5 shows the total enrollment for students in the Quad Cities vicinity.

Table 2-5. School District Enrollment in Counties with Significant Numbers of Quad Cities Employees

County	Enrollment
Scott, IA	27,130
Rock Island, IL	24,519
Whiteside, IL	10,367
Total	62,016

Source: National Center for Educational Statistics, 2003

- **Transportation**

  Route 84 provides road access to the Quad Cities site. Route 84 is a two-lane paved road oriented in a generally north-south direction along the eastern bank of the Mississippi River. Route 84 intersects with Interstate 80, the major east-west route in the region, approximately 23 km (14 mi) south of the Quad Cities site. Interstate 88 branches east from Interstate 74 about 16 km (10 mi) south of the Quad Cities site. Illinois State Route 74 turns west just north of its intersection with Illinois State Route 88, and it becomes Interstate 80, providing access to Des Moines and other points west. The Quad Cities vicinity is served by an international airport and river barge traffic, in addition to the active trucking activity that makes use of the interstate freeway (Exelon 2003a).

  Route 84 is used by employees traveling from the Quad Cities vicinity, from other points south of the site in Rock Island County, and from Whiteside County north of the site. Scott County employees travel across the Interstate 80 bridge and then north on Route 84, along with other employees traveling from Rock Island County to the site. Employees coming from Whiteside County travel south on Route 84 to reach the site (Exelon 2003a).

2.2.8.3 Offsite Land Use

Rock Island County is predominately rural, consisting of farmland and woods. The county's population in 2000 was 149,374. The county contains 1170 km^2 (452 mi^2) or 117,000 ha (289,000 ac) of land/water area. Land use patterns in the county reflect the key importance of livestock production and agriculture to the area. Current land cover in the county by category is: cropland (37.3 percent), grassland (30.2 percent), forest/woodland (12.6 percent), wetland (4.6 percent), urban/built-up (8.1 percent), open water (7.0 percent), and barren/exposed land (0.2 percent) (IL DNR 1996). Agriculture is also a significant land use in nearby Scott and Whiteside counties, representing 77 percent and 88 percent of land area, respectively (USDA 1997).

Annual property taxes from Quad Cities Units 1 and 2 accounted for approximately 2.7 percent of Rock Island County's total levee extension and approximately 2.8 percent of the county's total collections available for distribution for the years 1997 to 2000. The local Cordova taxing districts for the township, library, school district, road and bridge district, and fire department all derive significant revenue from the plant (Rock Island County Board of Review 2002). Negotiations are underway with Rock Island County for a graduated reduction in payments to minimize the financial disruption to county and local operations caused by a change in the Rock Island County methods of plant value assessment due to the deregulation of the utility industry in the State of Illinois (Exelon 2003a).

Rock Island County utilizes four major tools in an effort to manage current and future land use: County Land Use Plan, County Zoning Ordinance, County Land Evaluation and Assessment Program, and County Subdivision Resolution. The county had a population increase of 0.4 percent during 1990 and 2000 after having experienced a 10.4 percent decline in population between 1980 and 1990 (Exelon 2003a). Strong farmland preservation policies in Rock Island and Scott counties dictate that settlement will occur mainly in existing municipalities rather than in rural unincorporated areas (Bi-State Regional Commission 2002). Whiteside County uses a combination of zoning ordinance and use permits to guide county development.

The Quad Cities Metropolitan Statistical Area, consisting of the cities of Davenport and Bettendorf, Iowa, and Rock Island, Moline and East Moline, Illinois, is located about 32 km (20 mi) southwest of the site with a combined population in 2000 of 359,062; an increase of 8201 from 1990 (Bi-State Regional Commission 2002). The nearest town, situated approximately 6 km (4 mi) south from the site, is the village of Cordova, Illinois, with 623 residents in 2000. The nearest population center is the city of Clinton, Iowa, which is approximately 11 km (7 mi) northeast from the site (AEC 1972).

The area immediately surrounding the site is predominantly rural, consisting of farmland and woods; however, there is an industrial park approximately 1.6 km (1 mi) north from the site. A gas-fired, 500-megawatt generating plant (Cordova Energy Center) is located approximately 1.6 km (1 mi) southeast from the site and a 235-megawatt coal-fired electrical generating station (M.L. Kapp) is located 4 km (2 mi) north from the site (Exelon 2003a). Rock Island, Scott, and Whiteside counties are actively seeking to attract and to assist in the development of industrial parks to foster economic growth and promote job creation.

2.2.8.4 Visual Aesthetics and Noise

The lands surrounding the Quad Cities site are largely agricultural, with an industrial park directly north from the site and a gas-fired power plant southeast from the site. The major buildings are metal-sheathed structures with the metal panels covered in subdued tones. The highest portions of the major buildings, the stack, and the transmission lines are clearly visible

from Illinois Route 84 and the Mississippi River. Much of the view of the station is obstructed by a grove of evergreen trees along the highway. The transmission line towers used on the site are four-legged open-steel structures. The river crossing towers are painted red and white to increase their visibility for safety purposes (AEC 1972).

The noise from most equipment is confined within the plant buildings, yielding boundary noise at the ambient level (AEC 1972). Testing of on-site and off-site warning sirens occurs monthly.

2.2.8.5 Demography

All or parts of 21 counties are located within 80 km (50 mi) of Quad Cities (Figure 2-2). Of these counties, 13 are in Illinois, and 8 are in Iowa. Between 1990 and 2000, the area's population grew 2.3 percent to 359,062, well below the growth of the State of Iowa (5.4 percent), Illinois (8.6 percent), the Midwest (7.9 percent), and the nation (13.2 percent) in the same decade.

According to U.S. Bureau of the Census (USBC) 2000 information, at least 281,423 people live within 32 km (20 mi) of Quad Cities (Exelon 2003a). Applying the GEIS sparseness measures, Quad Cities has a population density of 86 persons/km^2 (224 persons/mi^2) within 32 km (20 mi) and falls into the least-sparse category, Category 4 (having greater than or equal to 46 persons/km^2 [120 persons/mi^2] within 32 km [20 mi]). As estimated from USBC 2000 information, at least 656,527 people live within 80 km (50 mi) of Quad Cities (Exelon 2003a). This equates to a population density of 32 persons/km^2 (83 persons/mi^2) within 80 km (50 mi), which is classified as Category 2 (no city with 100,000 or more persons and between 50 and 190 persons per square mile within 80 km [50 mi]). Applying the GEIS sparseness and proximity matrix, Quad Cities is classified as sparseness Category 4 and proximity Category 2, resulting in the conclusion that Quad Cities is located in a medium-population area.

There are no known Native American lands or reservations within 80 km (50 mi) of the Quad Cities site.

Table 2-6 shows estimated population numbers for the three counties where the majority of the Quad Cities site employees have lived from 1980 and are expected to live through 2030. By the year 2030, the populations of Rock Island and Whiteside counties are projected to decrease at average annual rates of 0.2 percent, in contrast to the growth rate of 0.5 percent projected for the State of Illinois during the same period. The population of Scott County is expected to increase at an average annual rate of 0.4 percent, while Iowa is projected to have an annual average growth rate of 0.1 percent and rise to 3 million people (Exelon 2003a).

Table 2-6. Regional Demographics

	Estimated Populations and Average Annual Growth Rates in Rock Island and Whiteside Counties, Illinois, and Scott County, Iowa from 1980 to 2030					
	Rock Island County		Whiteside County		Scott County	
Year	Population	Percent	Population	Percent	Population	Percent
1980	165968	-0.1	65970	0.5	160022	1.2
1990	148723	-1	60186	-0.9	150979	-0.6
2000	149374	0.4	60653	0.1	158668	0.5
2010	150990	0.1	58773	-0.3	171960	0.8
2020	149574	-0.1	57987	-0.1	171283	0
2030	142219	-0.5	56517	-0.3	179740	0.5

Source: Exelon 2003a.

Exelon uses Census 2000 data from the U.S. Bureau of the Census to describe general demographic characteristics in the Quad Cities vicinity and for the minority portion of the environmental justice calculations. Exelon used Census 1990 data for the low-income portion of the environmental justice calculations (Exelon 2003a). The discussion of demography in this section and environmental justice in Section 4.4.6 relies on Census 2000 data, which now includes both population and economic data (Geolytics Software 2000).

- **Resident Population Within 80 km (50 mi)**

  Table 2-7 presents the population distribution within 80 km (50 mi) of Quad Cities for the year 2000.

Table 2-7. Population Distribution in 2000 Within 80 km (50 mi) of Quad Cities

0 to 16 km (0 to 10 mi)	16 to 32 km (10 to 20 mi)	32 to 48 km (20 to 30 mi)	48 to 64 km (30 to 40 mi)	64 to 80 km (40 to 50 mi)	Total
29906	253556	139946	99163	131938	654509

Source: Geolytics Software 2000.

- **Transient Population**

  There is little transient population, either for recreation or for agriculture, in the vicinity of Quad Cities. Almost all of the laborers on farms in the area are believed to be residents in the area. Seasonal migrant labor plays little or no role in field agriculture in the region.

- **Agricultural Labor**

  Agriculture contributes significantly to the Quad Cities and surrounding regional economy. Principal crops in the region include corn, soybeans, and hay. According to the U.S. Department of Agriculture's 1997 Census of Agriculture, receipts from all agricultural products totaled $49.8 million in Rock Island County and $157.0 million in Whiteside County in 1997. For the State of Illinois, the total from agricultural products was $8.6 billion. Receipts from agricultural products in Scott County totaled $95.1 million. Iowa's total from agricultural products was $11.9 billion (USDA 1997).

2.2.8.6 Economy

The Quad Cities region has a transportation network of trucking and rail terminals, interstate highway access to east-west and north-south routes, one international and a number of regional airports, and access to international seaports via the Mississippi River, giving the area access to both domestic and international markets (Exelon 2003a). The unemployment rates are similar among all the jurisdictions, ranging from just below 3 percent for Iowa to just over 4 percent for Rock Island County. Median household income varies from $38,600 for Rock Island County to $42,700 in Scott County, compared with $40,600 for the Quad Cities Metropolitan Statistical Area, $39,500 for Iowa, nearly $47,000 for Illinois, and nearly $42,000 for the nation (USBC 2000).

A recession in the 1980s and the accompanying farm crisis affected both the agricultural and traditional heavy manufacturing sectors of the economy. While the area is still recovering from this period, a shift has occurred from an economy that was dominated by agriculture to one that is now centered on services, including the gaming industry.

From 1980 to 1996, the nonprofessional employment service sector in Rock Island County increased by 121 percent, manufacturing declined by 41 percent, durable goods employment declined by 54 percent, and non-electrical machine production declined by 63 percent. By 1997, the leading economic employment sectors were services (32 percent), retail trade (22 percent), and manufacturing (19 percent) (Exelon 2003a).

In 1997, the leading economic employment sectors in Whiteside County were manufacturing (36 percent), services (28 percent), and retail trade (20 percent). In Scott County for that same

year, the leading sectors were services (34 percent), retail trade (24 percent), and manufacturing (19 percent) (Exelon 2003a). Table 2-8 lists the largest companies in terms of employment in the Illinois-Iowa Quad Cities vicinity.

Table 2-8. Largest Employers in the Illinois and Iowa Quad Cities Vicinity

Company	Number of Employees
Deere and Company	7317
Rock Island Arsenal	6000
Genesis Medical Center	3000
ALCOA	2513
Trinity Regional Health	2500
IBP, Inc.	2300
MidAmerica Energy Company	1200
Kraft Foods North America, Inc.	1200
Illini Hospital	950
CNH Global	816
ComEd	800
APAC Customer Service	800
KONE, Inc.	600
Bituminous Casualty Corp	520

Source: Quad Cities Development Group, 2003.

There are a number of large industrial parks in various stages of planning, implementation, and completion in Rock Island, Henry, and Whiteside counties in Illinois and Scott County in Iowa. In recent years, developments along the Mississippi riverfront designed to complement the corporate presence in the area and to attract convention and shopping have been built or are in the process of being built, both in Iowa and Illinois.

In the State of Illinois, sub-county entities, particularly townships, play a major role in local real property tax administration. Each local taxing body examines its fiscal needs and creates a budget, then extends a levee, or proposed claim, to the county in an amount that will cover the portion of its proposed budget that is to be covered by local real property taxes. The county then evaluates the assessed value of the real property in the township and associated taxing bodies with the total levee and develops a tax rate schedule to issue property tax bills to property owners. The county collects the taxes and redistributes them to the local agencies (Exelon 2003a).

In 1997, the State of Illinois deregulated the electric power utility industry, which, in turn, led to a change in the method used to assess the value of utilities' real property for county tax purposes. Before deregulation, utility real property was assessed on the basis of depreciated book value. Following deregulation, real property was assessed on the basis of fair market value. Because fair market values are influenced by economic conditions and market forces, current fair market values are expected to differ from (and generally be lower than) depreciated book values, with attendant lower overall tax revenues, at current tax rates. Therefore, it is anticipated that Rock Island County's property tax revenues from Quad Cities Units 1 and 2 will most likely be lower than in the past. Table 2-9 lists the amount of Quad Cities tax payments to Rock Island County and collections of available distributions. In addition, Exelon has appealed its 2001 real property assessment and associated tax bill and is negotiating a graduated reduction in payments to minimize the final disruption to the districts caused by a sudden revenue reduction (Exelon 2003a). Exelon is also appealing its 2002 real property assessment and tax bill. The appeal process and any attendant negotiations over assessed value and tax payments are outside the scope of the current SEIS; it is noted that tax revenues from Quad Cities Units 1 and 2 will likely be lower in the future, although how much lower is not known at this time.

Table 2-9. Quad Cities Contributions to Rock Island County Operating Budgets

Year	Property Tax Paid by Quad Cities	Percent of Collections Available for Distribution	Rock Island County Collections Available for Distribution to Districts
1997	$3,241,673	2.8	$117,630,496
1998	$3,394,251	2.8	$122,356,796
1999	$3,524,299	2.7	$129,713,348
2000	$3,607,871	2.7	$135,791,633

Source: Exelon 2003a.

2.2.9 Historic and Archaeological Resources

This section discusses the cultural background and the known historic and archaeological resources at the Quad Cities site and in the surrounding area.

2.2.9.1 Cultural Background

The region around the Quad Cities site contains numerous prehistoric and historic Native American and Euro-American cultural resources. The applicant's ER mentions 322 properties

listed in the National Register of Historic Places for the four counties near Quad Cities Units 1 and 2 (Exelon 2003a). These registered properties are mostly historic Euro-American places and none are located in areas affected by operation of the Quad Cities site. The region of the United States in the vicinity of the Quad Cities site is rich in prehistoric archaeological remains as well (Fowler and Hall 1978).

"Paleo Indians" occupied North America from 10,000 to 12,000 years ago, living off the land and subsisting on large game that has since become extinct. From approximately 10,000 years ago and lasting until approximately 1 AD, "archaic people" were present in the native oak/hickory deciduous forests of the area where they hunted animals and gathered plants. (State of Illinois 2001). Following the existence of these people came the "Woodland" culture, which archaeologists define as occupying the region between 500 BC and 900 AD. In the Woodland culture, Native Americans became regionally distinct cultural entities. Woodland people were dependent on maize agriculture, lived in villages, practiced a religion manifested by burial mounds, used the bow and arrow in hunting, and began to make pottery (Fowler and Hall 1978).

The "Mississippian" culture followed the Woodland culture from 900 to 1500 AD. This culture is seen as a complex society of people who lived in large fortified villages, built temple mounds, and practiced improved agricultural methods (Fowler and Hall 1978).

Known examples of older prehistoric sites are rare on the banks of the Mississippi River, but Native American archaeological sites that date to the Woodland and Mississippian periods are fairly common. Albany Mounds, a middle Woodland site located just south of the present town of Albany and less than 16 km (10 mi) from the Quad Cities site, is located on the Mississippi River flood plain (Illinois State Museum 2000). Locally, the majority of recorded prehistoric archaeological sites are found either on top of or within terraces of the Mississippi River and its tributaries.

The Native American societies in the project region shared several important characteristics at the time they were first contacted by Europeans. These included an economic base that combined hunting and gathering with growing corn; and an annual settlement cycle that varied between population concentrations into semi-permanent river-side villages in summer, large camps in winter, and population dispersal among scattered camps in the spring and fall (Callender 1978).

The Quad Cities site was on the edge of several tribal territories at the time of historic contact. Territorial boundaries were in flux throughout the historic period and until the mid-Nineteenth Century. By the mid-1600s eastern tribes were displaced to the west and had begun to put pressure on the tribes in the region where Quad Cities is located today. By 1650, the Miami had settled in northwestern Illinois and probably had encompassed the Quad Cities site within their territory. The country of the loosely affiliated Illinois tribes was several tens of kilometers

to the west and south when Europeans made first note of their existence. In 1673, the Illinois occupied a region that extended from the southern tip of Lake Michigan westward into Iowa and south into Arkansas (Bauxar 1978).

Upon settling near the present day Quad Cities site, the Miami were in conflict with the Sioux, who occupied territories to the north and west, and shortly after 1700 the Miami moved out of the area. By the 1730s, Sauk and Fox peoples occupied the lands abandoned by the Miami. They lived on the banks of the Mississippi River as far south as the mouth of the Rock River. In just 10 years, they left the area (Bauxar 1978).

The Sauk and Fox were back in the vicinity of Quad Cities by the late 1700s. After defeat by the Chippewa in 1783 at their village above the mouth of the Wisconsin River, they withdrew down the Mississippi River, establishing villages on both sites of the river as far south as the mouth of the Des Moines River.

By 1829, under pressure from Euro-American settlement and with the encouragement of the territorial governor, Sauk and Fox leaders moved their villages to the west side of the Mississippi River. The Sauk and Fox continued to make visits to the Illinois side to hunt and gather, but in 1832, U.S. General Henry Atkinson engaged in a campaign against them that defeated the tribes and definitively removed them from the territory east of the Mississippi River.

The Potawatomi are also said to have expanded their territory into the project area in the 1800s (Clifton 1978). The Kickapoo may have passed through the area around 1700 (Tanner 1986). All lands in the region surrounding the Quad Cities site were ceded in treaties dating to the decade of the 1830s. By the 1870s there were no recognized Native American villages near the project area.

Today, there are tribes in Texas, Oklahoma, Kansas, Iowa, Wisconsin, and Michigan who could, because of past association with lands at or near Quad Cities, have an interest in the plans for operation of Quad Cities Units 1 and 2. They include Kickapoo, Sauk and Fox, Iowa, and Potawatami tribal organizations.

2.2.9.2 Historic and Archaeological Resources at Quad Cities

The applicant's ER makes no mention of historic architecture, historic landscape, traditional cultural property, or archaeological sites recorded at the Quad Cities site in Illinois (Exelon 2003a). The NRC did conduct historic and archaeological site file searches at repositories in Illinois, where it found a record of an archaeological site at or near Quad Cities. That record dates to 1933 when the University of Chicago documented an archaeological site that contained surface features, which "look remarkably like Indian mounds," in association with

stone tools and pottery. They attributed the archaeological site to the Woodland period and plotted it on land that would eventually be used by Quad Cities.

The original environmental statement related to operation of Quad Cities (AEC 1972) incorrectly concluded that there were no known archaeological remains in the immediate vicinity of the station near Cordova, Illinois. The U.S. Department of Interior commented on the draft environmental statement in late August 1972, by expressing concern over the proposed construction of a spray canal and its potential to affect archaeological resources (USDI 1972). The U.S. Department of Interior recommended that the Atomic Energy Commission should consult with archaeologist Charles Bareis.

By the first week of September 1972, Bareis had written a letter to the Commission noting that on "page 16 of the Environmental Statement, it is stated that there is an absence of archaeological materials at the plant site. This is an error because a check of our records indicates that at least one archaeological site, Ri-60, consisting of five mounds, were or are located in the plant area" (Bareis 1972a).

Within less than three weeks, Bareis again wrote to the Commission to report that he had conducted a reconnaissance survey on a portion of a spray canal then under construction near the Mississippi River (Bareis 1972b). Bareis found no evidence of archaeological materials in the canal right-of-way south of the plant and a few "areas of interest" in the right-of-way north of the plant. Though he felt what he had observed had little likelihood of proving significant, he recommended "use of due caution" during excavation.

2.2.10 Related Federal Project Activities and Consultations

The staff reviewed the possibility that the activities of other Federal agencies might impact the renewal of the Quad Cities OLs. Any such activities could result in cumulative environmental impacts and the possible need for a Federal agency to become a cooperating agency for the preparation of the SEIS.

Quad Cities Units 1 and 2 are located on the east side of Pool 14 of the Mississippi River, a reservoir that was established by the U.S. Army Corps of Engineers and continues to be subject to routine maintenance, such as dredging.

Federal facilities and lands in proximity to the Quad Cities site are the Rock Island Arsenal, Savanna Army Depot, and the Upper Mississippi River NWFR. The Rock Island Arsenal is located 32 km (20 mi) south in the City of Rock Island and the Savanna Army Depot is 48 km (30 mi) north near Hanover, Illinois. The Upper Mississippi River NWFR is located on the Iowa

side of the Mississippi River, across from the Quad Cities site. It was established in 1924 to protect bottomland habitat and extends 418 km (261 mi) along the west shore of the Mississippi River.

After reviewing the Federal activities in the vicinity of Quad Cities, the staff determined there are no Federal project activities that could result in cumulative impacts or would make it desirable for another Federal agency to become a cooperating agency for preparing this SEIS.

The NRC is required under Section 102 of the National Environmental Policy Act (NEPA) to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved. The NRC consulted with the U.S. Department of the Interior, Fish and Wildlife Service, and the consultation correspondence is included in Appendix E.

2.3 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

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3.0 Environmental Impacts of Refurbishment

Environmental issues associated with refurbishment activities are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[(a)] The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required in this supplemental environmental impact statement (SEIS) unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1 and, therefore, additional plant-specific review of these issues is required.

License renewal actions may require refurbishment activities for the extended plant life. These actions may have an impact on the environment that requires evaluation, depending on the type of action and the plant-specific design. Environmental issues associated with refurbishment that were determined to be Category 1 issues are listed in Table 3-1.

Environmental issues related to refurbishment considered in the GEIS for which these conclusions could not be reached for all plants, or for specific classes of plants, are Category 2 issues. These are listed in Table 3-2.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

Table 3-1. Category 1 Issues for Refurbishment Evaluation

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Impacts of refurbishment on surface water quality	3.4.1
Impacts of refurbishment on surface water use	3.4.1
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Refurbishment	3.5
GROUND-WATER USE AND QUALITY	
Impacts of refurbishment on ground-water use and quality	3.4.2
LAND USE	
Onsite land use	3.2
HUMAN HEALTH	
Radiation exposures to the public during refurbishment	3.8.1
Occupational radiation exposures during refurbishment	3.8.2
SOCIOECONOMICS	
Public services: public safety, social services, and tourism and recreation	3.7.4; 3.7.4.3; 3.7.4.4; 3.7.4.6
Aesthetic impacts (refurbishment)	3.7.8

Category 1 and Category 2 issues related to refurbishment that are not applicable to Quad Cities because they are related to plant design features or site characteristics not found at Quad Cities are listed in Appendix F.

The potential environmental effects of refurbishment actions would be identified, and the analysis would be summarized within this section, if such actions were planned. Exelon Generation Company, LLC (Exelon) indicated that it has performed its integrated plant assessment, the evaluation of structures and components pursuant to 10 CFR 54.21, to identify activities that are necessary to continue operation of Quad Cities Units 1 and 2 during the requested 20-year period of extended operation. These activities include replacement of certain components as well as new inspection activities and are described in the Environmental Report (Exelon 2003). However, Exelon stated that the replacement of these components and the additional inspection activities are within the bounds of normal plant component replacement and inspections; therefore, they are not expected to affect the environment outside the bounds of plant operations as evaluated in the final environmental statement (AEC 1972). In addition, Exelon's evaluation of structures and components as required by 10 CFR 54.21 did not identify any major plant refurbishment activities or modifications necessary to support the

continued operation of Quad Cities Units 1 and 2 beyond the end of the existing operating licenses. Therefore, refurbishment is not considered in this SEIS.

Table 3-2. Category 2 Issues for Refurbishment Evaluation

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53 (c)(3)(ii) Subparagraph
TERRESTRIAL RESOURCES		
Refurbishment impacts	3.6	E
THREATENED OR ENDANGERED SPECIES (FOR ALL PLANTS)		
Threatened or endangered species	3.9	E
AIR QUALITY		
Air quality during refurbishment (nonattainment and maintenance areas)	3.3	F
SOCIOECONOMICS		
Housing impacts	3.7.2	I
Public services: public utilities	3.7.4.5	I
Public services: education (refurbishment)	3.7.4.1	I
Offsite land use (refurbishment)	3.7.5	I
Public services, transportation	3.7.4.2	J
Historic and archaeological resources	3.7.7	K
ENVIRONMENTAL JUSTICE		
Environmental justice	Not addressed[(a)]	Not addressed[(a)]

(a) Guidance related to environmental justice was not in place at the time the GEIS and the associated revision to 10 CFR Part 51 were prepared. If a licensee plans to undertake refurbishment activities for license renewal, environmental justice must be addressed in the licensee's environmental report and the staff's environmental impact statement.

3.1 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

Exelon Generation Company, LLC (Exelon). 2003a. *Applicant's Environmental Report—Operating License Renewal Stage Quad Cities Nuclear Power Station Units 1 and 2. License Nos. DPR-29 and DPR-30*. Warrenville, Illinois.

U.S. Atomic Energy Commission (AEC). 1972. *Final Environmental Statement Related to the Operation of Quad-Cities Nuclear Power Station, Units 1 and 2, Commonwealth Edison Company and the Iowa-Illinois Gas and Electric Company*. Docket Nos. 50-254 and 50-265, Washington, D.C. September 1972.

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4.0 Environmental Impacts of Operation

Environmental issues associated with operation of a nuclear power plant during the renewal term are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[(a)] The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required.

This chapter addresses the issues related to operation during the renewal term that are listed in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, and are applicable to the Quad Cities plant. Section 4.1 addresses issues applicable to the Quad Cities plant cooling system. Section 4.2 addresses issues related to the transmission lines and onsite land use. Section 4.3 addresses the radiological impacts of normal operation. Section 4.4 addresses issues related to the socioeconomic impacts of normal operation during the renewal term. Section 4.5 addresses issues related to groundwater use and quality. Section 4.6 discusses the impacts of renewal-term operations on threatened and endangered species. Section 4.7 addresses potential new and significant information that was identified during the scoping period.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

Section 4.8 addresses cumulative impacts of operations during the renewal term. The results of the evaluation of environmental issues related to operation during the renewal term are summarized in Section 4.9. Finally, Section 4.10 lists references cited in the chapter. Category 1 and Category 2 issues that are not applicable to Quad Cities because they are related to plant design features or site characteristics not found at Quad Cities are listed in Appendix F.

4.1 Cooling System

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B that are applicable to Quad Cities Units 1 and 2 cooling-system operation during the renewal term are listed in Table 4-1. Exelon Generation Company, LLC (Exelon) stated in its Environmental Report (ER) that no new information existed for the issues that would invalidate the GEIS conclusions (Exelon 2003a). The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of the issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-1. Category 1 Issues Applicable to the Operation of the Quad Cities Units 1 and 2 Cooling System During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Altered current patterns at intake and discharge structures	4.2.1.2.1; 4.4.2
Temperature effects on sediment transport capacity	4.2.1.2.3; 4.4.2.2
Scouring caused by discharged cooling water	4.2.1.2.3; 4.4.2.2
Eutrophication	4.2.1.2.3; 4.4.2.2
Discharge of chlorine or other biocides	4.2.1.2.4; 4.4.2.2
Discharge of sanitary wastes and minor chemical spills	4.2.1.2.4; 4.4.2.2
Discharge of other metals in waste water	4.2.1.2.4; 4.4.2.2
Water use conflicts (plants with once-through cooling systems)	4.2.1.3
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Accumulation of contaminants in sediments or biota	4.2.1.2.4; 4.4.3; 4.4.2.2
Entrainment of phytoplankton and zooplankton	4.2.2.1.1; 4.4.3

Table 4-1. (contd)

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
Cold shock	4.2.2.1.5; 4.4.3
Thermal plume barrier to migrating fish	4.2.2.1.6; 4.4.3
Distribution of aquatic organisms	4.2.2.1.6; 4.4.3
Premature emergence of aquatic insects	4.2.2.1.7; 4.4.3
Gas supersaturation (gas bubble disease)	4.2.2.1.8; 4.4.3
Low dissolved oxygen in the discharge	4.2.2.1.9; 4.4.3
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.2.2.1.10; 4.4.3
Stimulation of nuisance organisms (e.g., shipworms)	4.2.2.1.11; 4.4.3
HUMAN HEALTH	
Microbiological organisms (occupational health)	4.3.6
Noise	4.3.7

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows:

- Altered current patterns at intake and discharge structures. Based on information in the GEIS, the Commission found that

  > Altered current patterns have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of altered current patterns at intake and discharge structures during the renewal term beyond those discussed in the GEIS.

- Temperature effects on sediment transport capacity. Based on information in the GEIS, the Commission found that

  > These effects have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of temperature effects on sediment transport capacity during the renewal term beyond those discussed in the GEIS.

- Scouring caused by discharged cooling water. Based on information in the GEIS, the Commission found that

  > Scouring has not been found to be a problem at most operating nuclear power plants and has caused only localized effects at a few plants. It is not expected to be a problem during the license renewal term.

The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of scouring caused by discharged cooling water during the renewal term beyond those discussed in the GEIS.

- Eutrophication. Based on information in the GEIS, the Commission found that

  > Eutrophication has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of Eutrophication during the renewal term beyond those discussed in the GEIS.

- Discharge of chlorine or other biocides. Based on information in the GEIS, the Commission found that

  > Effects are not a concern among regulatory and resource agencies, and are not expected to be a problem during the license renewal term.

The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a); the scoping process; the staff's site visit; the staff's evaluation of other available information, including the National Pollutant Discharge Elimination System (NPDES) permit for Quad Cities, Discharge Monitoring Reports (DMRs), and discussion with the NPDES compliance office; and public comments

on the draft SEIS. Therefore, the staff concludes that there are no impacts of discharge of chlorine or other biocides during the renewal term beyond those discussed in the GEIS.

- Discharge of sanitary wastes and minor chemical spills. Based on information in the GEIS, the Commission found that

  > Effects are readily controlled through NPDES permit and periodic modifications, if needed, and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a); the scoping process; the staff's site visit; the staff's evaluation of other available information, including the NPDES permit for Quad Cities, DMRs, and discussion with the NPDES compliance office; and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of discharges of sanitary wastes and minor chemical spills during the renewal term beyond those discussed in the GEIS.

- Discharge of other metals in waste water. Based on information in the GEIS, the Commission found that

  > These discharges have not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems and have been satisfactorily mitigated at other plants. They are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a); the scoping process; the staff's site visit; the staff's evaluation of other available information, including the National Pollutant Discharge Elimination System (NPDES) permit for Quad Cities, DMRs, and discussion with the NPDES compliance office; and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of discharges of other metals in waste water during the renewal term beyond those discussed in the GEIS.

- Water use conflicts (plants with once-through cooling systems). Based on information in the GEIS, the Commission found that

  > These conflicts have not been found to be a problem at operating nuclear power plants with once-through heat dissipation systems.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the

draft SEIS. Therefore, the staff concludes that there are no impacts of water-use conflicts associated with the once-through cooling system during the renewal term beyond those discussed in the GEIS.

- Accumulation of contaminants in sediments or biota. Based on information in the GEIS, the Commission found that

  > Accumulation of contaminants has been a concern at a few nuclear power plants but has been satisfactorily mitigated by replacing copper alloy condenser tubes with those of another metal. It is not expected to be a problem during the license renewal term.

The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of accumulation of contaminants in sediments or biota during the renewal term beyond those discussed in the GEIS.

- Entrainment of phytoplankton and zooplankton. Based on information in the GEIS, the Commission found that

  > Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of entrainment of phytoplankton and zooplankton during the renewal term beyond those discussed in the GEIS.

- Cold shock. Based on information in the GEIS, the Commission found that

  > Cold shock has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems, has not endangered fish populations or been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds, and is not expected to be a problem during the license renewal term.

The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of cold shock during the renewal term beyond those discussed in the GEIS.

- Thermal plume barrier to migrating fish. Based on information in the GEIS, the Commission found that

  > Thermal plumes have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of thermal plume barriers to migrating fish during the renewal term beyond those discussed in the GEIS.

- Distribution of aquatic organisms. Based on information in the GEIS, the Commission found that

  > Thermal discharge may have localized effects but is not expected to effect the larger geographical distribution of aquatic organisms.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts on the distribution of aquatic organisms during the renewal term beyond those discussed in the GEIS.

- Premature emergence of aquatic insects. Based on information in the GEIS, the Commission found that

  > Premature emergence has been found to be a localized effect at some operating nuclear power plants but has not been a problem at Quad Cities and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the

draft SEIS. Therefore, the staff concludes that there are no impacts of premature emergence of aquatic insects during the renewal term beyond those discussed in the GEIS.

- Gas supersaturation (gas bubble disease). Based on information in the GEIS, the Commission found that

  > Gas supersaturation was a concern at a small number of operating nuclear power plants with once-through cooling systems but has been satisfactorily mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of gas supersaturation during the renewal term beyond those discussed in the GEIS.

- Low dissolved oxygen in the discharge. Based on information in the GEIS, the Commission found that

  > Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system but has been effectively mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of low dissolved oxygen during the renewal term beyond those discussed in the GEIS.

- Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses. Based on information in the GEIS, the Commission found that

  > These types of losses have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's

site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses during the renewal term beyond those discussed in the GEIS.

- Stimulation of nuisance organisms (e.g., shipworms). Based on information in the GEIS, the Commission found that

  > Stimulation of nuisance organisms has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where previously it was a problem. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of stimulation of nuisance organisms during the renewal term beyond those discussed in the GEIS.

- Microbiological organisms (occupational health). Based on information in the GEIS, the Commission found that

  > Occupational health impacts are expected to be controlled by continued application of accepted industrial hygiene practices to minimize worker exposures.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of microbiological organisms during the renewal term beyond those discussed in the GEIS.

- Noise. Based on information in the GEIS, the Commission found that

  > Noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the

draft SEIS. Therefore, the staff concludes that there are no impacts of noise during the renewal term beyond those discussed in the GEIS.

The Category 2 issues related to cooling system operation during the renewal term that are applicable to Quad Cities Units 1 and 2 are discussed in the section that follows and are listed in Table 4-2.

Table 4-2. Category 2 Issues Applicable to the Operation of the Quad Cities Units 1 and 2 Cooling System During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
AQUATIC ECOLOGY(FOR PLANTS WITH ONCE-THROUGH AND COOLING POND HEAT-DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	4.2.2.1.2; 4.4.3	B	4.1.1
Impingement of fish and shellfish	4.2.2.1.3; 4.4.3	B	4.1.2
Heat shock	4.2.2.1.4; 4.4.3	B	4.1.3
HUMAN HEALTH			
Microbiological organisms (public health)(plants using lakes or canals, or cooling towers, or cooling ponds that discharge to a small river)	4.3.6	G	4.1.4

4.1.1 Entrainment of Fish and Shellfish in Early Life Stages

For plants with once-through cooling systems, entrainment of fish and shellfish in early life stages into cooling-water systems associated with nuclear power plants is considered a Category 2 issue, requiring a site-specific assessment before license renewal. To perform this evaluation, the staff reviewed the Quad Cities Units 1 and 2 ER (Exelon 2003a); visited the Quad Cities site; and reviewed the applicant's State of Illinois NPDES Permit IL0005037, issued on May 26, 2000, and in force until May 31, 2005 (IEPA 2000).

Section 316(b) of the Clean Water Act (CWA) requires that any standard established pursuant to Sections 301 or 306 of the CWA shall require that the location, design, construction, and capacity of cooling-water-intake structures reflect the best technology available for minimizing adverse environmental impacts (33 USC 1326). Entrainment of fish and shellfish into the cooling system is a potential adverse environmental impact that can be minimized by the best technology available.

The fish community of Pool 14 has been monitored yearly by the applicant since 1971 to detect any potential impacts of Quad Cities Units 1 and 2 operation. There are no indications that entrainment has had a destabilizing impact on fish populations (Exelon 2003a). Naturally occurring environmental perturbations (e.g., droughts, floods, and severe winters), the modification of the river to accommodate barge navigation, and land use within the watershed have had the greatest influences on fish populations (Section 2.2.5).

In Pool 14, the ichthyoplankton drift typically runs from mid-April through late July. There is minimal to no difference in density between day versus night collections nor in depth within the water column (LaJeone and Monzingo 2000). Freshwater drum dominate the drift, comprising over 80 percent of the eggs and 57 percent of the larvae. Other common species include emerald shiner and common carp. Lesser contributions come from sunfishes, gizzard shad, and buffaloes (LaJeone and Monzingo 2000).

Under a very conservative scenario of total mortality of all entrained ichthyoplankton, projected entrainment losses could be as high as 5.4 percent during the peak periods of the occurence of fish eggs and larvae in the water column (La Jeone and Monzingo 2000). However, as long as discharge temperatures do not exceed 37.8°C (100°F), some entrainment survival does occur (LaJeone and Monzingo 2000). Lawler Matusky Skelly Engineers (LMS) estimated that with 100 percent entrainment, mortality would impact 0.1 to 0.7 percent of total larvae that pass the plant (LMS 1985). However, after applying entrainment survival data to freshwater drum, common carp, and buffalo species, the entrainment losses of these species were from 0.0006 to 0.10 percent, 0.0000 to 0.0055 percent, and 0.000 to 0.004 percent, respectively. These projections of cropping are not considered to adversely affect the fish community of Pool 14 (LaJeone and Monzinga 2000).

The staff reviewed the available information provided by Exelon in the Quad Cities Units 1 and 2 ER (Exelon 2003a) related to the CWA 316(b) permitting process. Based on the results of past entrainment studies and the operating history of Quad Cities Units 1 and 2's intake structure, the staff concludes that the potential impacts of entrainment of fish and shellfish in the early life stages into the cooling water intake system are SMALL, and further mitigation measures are not warranted.

4.1.2 Impingement of Fish and Shellfish

For plants with once-through cooling systems, impingement of fish and shellfish on debris screens of cooling-water system intakes is considered a Category 2 issue, requiring a site-specific assessment before license renewal. To perform this evaluation, the staff reviewed the Quad Cities Units 1 and 2 ER (Exelon 2003a); visited the Quad Cities site; and reviewed the applicant's State of Illinois NPDES Permit IL0005037, issued on May 26, 2000, and in force until May 31, 2005 (IEPA 2000).

Section 316(b) of the CWA states that any standard established pursuant to Section 301 or 306 of the CWA requires that the location, design, construction, and capacity of cooling-water-intake structures reflect the best technology available for minimizing adverse environmental impacts (33 USC 1326). Impingement of fish and shellfish on the debris screens of the cooling system is a potential adverse environmental impact that can be minimized by the use of best technology available.

Commonwealth Edison submitted a supplemental CWA Section 316(b) Demonstration in 1981 that evaluated impingement at Quad Cities Units 1 and 2, and concluded that losses due to impingement were minimal. This demonstration was approved by both the Iowa Department of Environmental Quality and the Illinois Environmental Protection Agency (IEPA) in 1981. From 1972 to 1983, the Quad Cities station operated in a closed-cycle or partial closed-cycle mode. Included in an agreement (Open Cycle Agreement 1983) to allow the return of open-cycle operation was a commitment to construct and operate a fish production facility to mitigate potential impingement/entrainment impacts (LaJeone and Monzingo 2000).

The current NPDES permit requires Exelon to monitor fish impingement once weekly. Each year's data are tabulated and compared to historical fish impingement data. The results are submitted to the IEPA. The IEPA then evaluates the impingement data as part of the NPDES renewal process which occurs every five years.

At the low river flow of 453 m^3/s (16,000 ft^3/s), mean intake velocity with all pumps operating is about 0.5 m/s (1.5 ft/sec) at the traveling screens. Intake velocity measurements taken at the entrance to the intake forebay averaged less than 0.3 m/s (1.0 ft/sec) at a river flow of 850 m^3/s (30,000 cfs). At average river flows of 1,530 m^3/s (54,000 cfs), intake velocities are lower. When ambient river water temperature falls below 4.4°C (40°F) in the late autumn, cooling water requirements for the station can be reduced by one half. This is accomplished by opening the ice-melt recirculation line and by idling one condenser circulating water pump from each unit. During this period, current velocities at the forebay entrance and traveling screens are also reduced by about 50 percent (LaJeone and Monzingo 2000).

Eighty fish species have been identified from impingement samples (Bowzer and Lippincott 2000). Gizzard shad and freshwater drum dominate the impinged species, accounting for 90 percent of the numbers and biomass of all fish impinged. Far lower contributions are made by bluegill, white bass, and channel catfish at 5 percent, 1.9 percent, and 1.7 percent by number, respectively (LaJeone and Monzingo 2000). Generally, impingement increases during the autumn and remains high throughout the winter and spring. The greatest numbers are impinged during the winter months, with fewest during the May to August period. Gizzard shad impingement peaks in January and February, coincident with stresses of freezing or near-freezing water temperatures. Freshwater drum numbers peak in March or April. Impingement is primarily comprised of young-of-year or yearlings (LaJeone and Monzingo 2000). Annual impingement estimates have ranged from 59,000 fish in 1981 to 2,989,000 fish in 1989; with

weight of fish impinged ranging from 1200 kg (2650 lb) in 1981 to 153,700 kg (338,850 lb) in 1989 (Bowzer and Lippincott 2000).

Fish impingement at the Quad Cities site, though relatively high, does not adversely impact the fish community because the vast majority of fish impinged by the site during winter are dead or moribund upon their arrival in the intake forebay (LaJeone and Monzingo 2000). There have been no measurable changes to the fish community of Pool 14 related to the Quad Cities Units 1 and 2, and no indications that impingement has had a destabilizing impact on fish populations (LaJeone and Monzingo 2000). Naturally occurring environmental perturbations (e.g., droughts, floods, and severe winters), the modification of the river to accommodate barge navigation, and land use within the watershed have had the greatest influences on fish populations (Section 2.2.5). Because the Quad Cities site operates as a "base load" facility, there is only minor variation in cooling water usage between years. Therefore, wide annual fluctuations in the numbers of fish impinged are indicative of actual changes in fish abundance in the pool, as well as a measure of seasonal and hydrologic effects on fish survival (Bowzer and Lippincott 2000).

The staff has reviewed the available information. Based on the results of past impingement studies and the operating history of the Quad Cities Units 1 and 2 intake structure, the staff concludes that the potential impacts of impingement of fish and shellfish are SMALL, and further mitigation measures are not warranted.

4.1.3 Heat Shock

For plants with once-through cooling systems, the effects of heat shock are listed as a Category 2 issue and require plant-specific evaluation before license renewal. The NRC made impacts on fish and shellfish resources resulting from heat shock a Category 2 issue because of continuing concerns about thermal-discharge effects and the possible need to modify thermal discharges in the future in response to changing environmental conditions (NRC 1996). Information to be considered includes (1) the type of cooling system (whether once-through or cooling pond) and (2) evidence of a CWA Section 316(a) variance or equivalent State documentation. To perform this evaluation, the staff reviewed the Quad Cities Units 1 and 2 ER (Exelon 2003a); visited the Quad Cities site; and reviewed the applicant's State of Illinois NPDES Permit IL0005037, issued on May 26, 2000, and in force until May 31, 2005 (IEPA 2000).

Quad Cities Units 1 and 2 have a once-through heat dissipation system. Commonwealth Edison submitted a supplemental CWA Section 316(a) Demonstration in 1981 that evaluated thermal discharges at Quad Cities plant. This demonstration was approved by both the Iowa Department of Environmental Quality and the Illinois EPA in 1981 (Exelon 2003a). Quad Cities Units 1 and 2 have been able to operate at full power in the open-cycle mode while still meeting

State water temperature standards under most river flow conditions. The site utilizes river water at the rate of 61,000 L/s (970,000 gpm) and condenser cooling water is warmed a maximum of 15.6°C (28°F) above ambient before being discharged to the river. Heated condenser water is completely mixed with river water and meets the 2.8°C (5°F) criterion within 152 m (500 ft) downstream of the diffuser pipes (LaJeone and Monzingo 2000). Under low flow conditions, power levels sometimes have to be reduced to ensure that the NPDES permit temperature limits are not exceeded. Under normal circumstances, Quad Cities Units 1 and 2 meet State water quality (temperature) standards. Exelon has consistently operated Quad Cities Units 1 and 2 in compliance with the thermal-discharge limits established for the plant by the IEPA. Therefore, no formal CWA Section 316(a) variance in accordance with 40 CFR 125 has been needed or sought by the facility.

Thermal discharges related to the operation of Quad Cities Units 1 and 2 affect a relatively small area of the Mississippi River. The required thermal mixing zone does not exceed 10.5 ha (26 acres). This is only about 0.25 percent of the area of Pool 14 (4165 ha [10,292 acres]). Furthermore, it extends no more than 152 m (500 ft) downstream of the point of discharge. Section 2.2.5 discusses the major changes and modifications to the Upper Mississippi River that have had an effect on aquatic resources. Thermal discharges have not been implicated as having caused any adverse impacts on fish or shellfish. A major mussel bed, which is one of the Essential Habitat Areas for the endangered clam, the Higgins' eye pearlymussel (*Lampsilis higginsii)*, is located at River Miles 505.5 through 503.0 (Section 2.2.5). This mussel bed is over 1.6 km (1.0 mi) downstream of the Quad Cities site and mixing zone. Therefore, this mussel bed is not affected by thermal discharges.

The staff has reviewed the available information, and on the basis of the conditions of the NPDES permit and the operating history of the Quad Cities Units 1 and 2 discharge, concludes that the potential impacts of discharged heated water from the cooling-water-intake system to aquatic biota are SMALL, and further mitigation measures are not warranted.

4.1.4 Microbiological Organisms (Public Health)

The effects of microbiological organisms on human health are listed as a Category 2 issue and require plant-specific evaluation before license renewal. The annual flow of the Mississippi River near the Quad Cities site is 4.5×10^{10} m^3 (1.6×10^{12} ft^3) per year, which is less than the 8.9×10^{10} m^3 (3.15×10^{12} ft^3) per year threshold value in 10 CFR 51.53(c)(3)(ii)(G). Thus, the effects of its discharge on microbiological organisms must be addressed for Quad Cities Units 1 and 2.

The Category 2 designation is based on the magnitude of the potential public-health impacts associated with thermal enhancement of the enteric pathogens (*Salmonella* sp. and *Shigella* sp.), the *Pseudomonas aeruginosa* bacterium, thermophilic fungi, a number of

Legionella sp. bacteria species, and pathogenic strains of the free-living amoebae *(Naegleria fowleri* and *Acanthamoeba sp.)* (NRC 1999). Generally, Quad Cities Units 1 and 2 discharge temperatures do not exceed 44.2 °C (111.6 °F). In July and August, 2001, daily temperatures in the discharge canal ranged from 32.1 to 43.3 °C (89.7 to 110°F) and below those known to be conducive to the growth and survival of thermophilic pathogens (Exelon 2003a). Based on these average daily temperatures in the discharge canal, coupled with the dilution provided by the Mississippi River, the thermophilic microorganisms are not expected to cause any appreciable public health risk (Mudgett 2002). The State of Iowa Department of Public Health also concurs that there is no significant threat to the public from thermophilic microorganisms attributable to operation of Quad Cities Unit 1 and 2 (Barton 2002). Disinfection of the Quad Cities Units 1 and 2 sewage treatment plant effluent and NPDES permit requirements to monitor fecal coliforms in this effluent further reduces the potential for the heated discharge to be a seed source or inoculant for pathogenic microorganisms (Exelon 2003a).

The staff independently reviewed the Quad Cities Units 1 and 2 ER (Exelon 2003a); visited the Quad Cities site; and reviewed the applicant's State of Illinois NPDES Permit IL0005037, issued on May 26, 2000, and effective until May 31, 2005 (IEPA 2000). Based on its review of this information, coupled with the fact that Quad Cities Units 1 and 2 operations and cooling systems are not expected to change significantly over the license renewal term, the staff concludes that the potential impacts to public health from microbiological organisms resulting from the Quad Cities Units 1 and 2 cooling-water discharges are SMALL, and further mitigation is not warranted.

4.2 Transmission Lines

The Final Environmental Statement for Quad Cities Units 1 and 2 (AEC 1972) describes four transmission lines that connect Quad Cities Units 1 and 2 with the transmission system – two lines to the Nelson substation, one line to the Davenport substation near Davenport, Iowa, and one line to Barstow substation near Rock Island, Illinois. Environmental impacts of the lines to the Davenport and Barstow substations were not evaluated in the FES because the lines were planned before Quad Cities, and the lines would have been built even if Quad Cities Units 1 and 2 had not been built. Changes to lines connecting Quad Cities Units 1 and 2 to the transmission system are described in the applicant's ER (Exelon 2003a). The changes include addition of a fifth line from Quad Cities to the Rock Creek substation, which is approximately 8 km (5 mi) north. The scope of this review includes the full length of all five lines.

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to transmission lines from Quad Cities Units 1 and 2 are listed in Table 4-3. Exelon stated in its ER that it is not aware of any new and significant information associated with the renewal of the Quad Cities Units 1 and 2 OLs. The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping

process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the staff's review and GEIS conclusions, as codified in Table B-1 of the GEIS, for each of these issues follows:

- Power line right-of-way management (cutting and herbicide application). Based on information in the GEIS, the Commission found that

  > The impacts of right-of-way maintenance on wildlife are expected to be of small significance at all sites.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of power line right-of-way management during the renewal term beyond those discussed in the GEIS.

Table 4-3. Category 1 Issues Applicable to the Transmission Lines During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
TERRESTRIAL RESOURCES	
Power line right-of-way management (cutting and herbicide application)	4.5.6.1
Bird collision with power lines	4.5.6.2
Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	4.5.6.3
Floodplains and wetland on power line right of way	4.5.7
AIR QUALITY	
Air quality effects of transmission lines	4.5.2
LAND USE	
Onsite land use	4.5.3
Power line right of way	4.5.3

- Bird collision with power lines. Based on information in the GEIS, the Commission found that

  > Impacts are expected to be of small significance at all sites.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of bird collisions with power lines during the renewal term beyond those discussed in the GEIS.

- Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock). Based on information in the GEIS, the Commission found that

  > No significant impacts of electromagnetic fields on terrestrial flora and fauna have been identified. Such effects are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of electromagnetic fields on flora and fauna during the renewal term beyond those discussed in the GEIS.

- Floodplains and wetlands on power line right of way. Based on information in the GEIS, the Commission found that

  > Periodic vegetation control is necessary in forested wetlands underneath power lines and can be achieved with minimal damage to the wetland. No significant impact is expected at any nuclear power plant during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of power-line right-of-way on floodplains and wetlands during the renewal term beyond those discussed in the GEIS.

- Air quality effects of transmission lines. Based on the information in the GEIS, the Commission found that

  > Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no air quality impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

- Onsite land use. Based on information in the GEIS, the Commission found that

  > Projected onsite land use changes required during... the renewal period would be a small fraction of any nuclear power plant site and would involve land that is controlled by the applicant.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no onsite land use impacts during the renewal term beyond those discussed in the GEIS.

- Power line right of way (land use). Based on information in the GEIS, the Commission found that

  > Ongoing use of power line right of ways would continue with no change in restrictions. The effects of these restrictions are of small significance.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of power line right of way on land use during the renewal term beyond those discussed in the GEIS.

There is one Category 2 issue related to transmission lines, and another issue related to transmission lines that is being treated as a Category 2 issue. These issues are listed in Table 4-4 and are discussed in Sections 4.2.1 and 4.2.2.

Table 4-4. Category 2 and Uncategorized Issues Applicable to the Quad Cities Transmission Lines During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
HUMAN HEALTH			
Electromagnetic fields, acute effects (electric shock)	4.5.4.1	H	4.2.1
Electromagnetic fields, chronic effects	4.5.4.2	NA	4.2.2

4.2.1 Electromagnetic Fields, Acute Effects (Electric Shock)

In the GEIS, the Commission found that without a review of the conformance of each nuclear plant transmission line with National Electrical Safety Code (NESC 1997) criteria, it is not possible to determine the significance of the electric shock potential. Evaluation of individual plant transmission lines is necessary because the issue of electric shock safety was not addressed in the licensing process for some plants. For other plants, land use in the vicinity of transmission lines may have changed, or power distribution companies may have chosen to upgrade line voltage. To comply with 10 CFR 51.53(c)(3)(ii)(H), the applicant must provide an assessment of the potential shock hazard if the transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the NESC for preventing electric shock from induced currents.

The five lines that are within the scope of this review were examined by the applicant to identify the configuration where the potential for current-induced shock would be the greatest. The electric field strength and induced current were calculated for a large tractor-trailer truck parked beneath the line for each limiting configuration (Exelon 2003a; Exelon 2003b) using the AC/DCLINE computer code produced by the Electric Power Research Institute (EPRI 1992).

Calculated induced currents exceeded the NESC 5-mA induced current standard at only one location on the five lines within the scope of this review. The maximum calculated induced current on the North Nelson line was 6.0 mA at a location where the line crosses a county road. However, since large truck traffic on the road is very infrequent, it is considered unlikely that a large truck would park under the line.

The staff concludes that the impact of the potential for electric shock is MODERATE on the segment of the north Nelson line where calculated induced currents exceed 5 mA. Consideration of mitigation is warranted in the vicinity of this line segment. By letter dated September 22, 2003, the NRC staff informed Exelon Energy Delivery (who owns, operates, and

maintains the portion of the transmission system to which this finding applies) of its findings (NRC 2003c). The impacts of the potential for electric shock are SMALL on the remaining portion of the north Nelson line, the south Nelson line, the Barstow line, the Rock Creek line, and the Davenport line where the induced currents are calculated to be 5 mA or less. No additional mitigation is warranted on these lines and line segments.

4.2.2 Electromagnetic Fields, Chronic Effects

In the GEIS, the chronic effects of 60-Hz electromagnetic fields from power lines were not designated as Category 1 or 2, and will not be until a scientific consensus is reached on the health implications of these fields.

The potential for chronic effects from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy (DOE). A recent report (NIEHS 1999) contains the following conclusion:

> The NIEHS concludes that ELF-EMF [extremely low frequency-electromagnetic field] exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

This statement is not sufficient to cause the staff to change its position with respect to the chronic effects of electromagnetic fields. The staff considers the GEIS finding of "not applicable" still appropriate and will continue to follow developments on this issue.

4.3 Radiological Impacts of Normal Operations

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to Quad Cities Units 1 and 2 in regard to radiological impacts are listed in Table 4-5. Exelon stated in the Quad Cities ER (Exelon 2003a) that it is not aware of any new and significant information associated with the renewal of the Quad Cities Units 1 and 2 OLs. The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the

GEIS (NRC 1996, 1999). For all of those issues, the staff concluded in the GEIS that the impacts are SMALL and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-5. Category 1 Issues Applicable to Radiological Impacts of Normal Operations During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
HUMAN HEALTH	
Radiation exposures to public (license renewal term)	4.6.2
Occupational radiation exposures (license renewal term)	4.6.3

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows:

- Radiation exposures to public (license renewal term). Based on information in the GEIS, the Commission found that

  > Radiation doses to the public will continue at current levels associated with normal operations.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of radiation exposures to the public during the renewal term beyond those discussed in the GEIS.

- Occupational radiation exposures (license renewal term). Based on information in the GEIS, the Commission found that

  > Projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages, and would be well below regulatory limits.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of occupational radiation exposures during the renewal term beyond those discussed in the GEIS.

There are no Category 2 issues related to radiological impacts of routine operations.

4.4 Socioeconomic Impacts of Plant Operations During the License Renewal Period

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to socioeconomic impacts during the renewal term are listed in Table 4-6. Exelon stated in its ER (Exelon 2003a) that it is not aware of any new and significant information associated with the renewal of the Quad Cities Units 1 and 2 OLs. Further, Exelon has determined that there is no need to undertake major refurbishment or replacement actions to maintain important systems, structures, and components during the license renewal period.

The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS (NRC 1996, 1999). For these issues, the staff concluded in the GEIS that the impacts are SMALL and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-6. Category 1 Issues Applicable to Socioeconomics During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
SOCIOECONOMICS	
Public services: public safety, social services, and tourism and recreation	4.7.3; 4.7.3.3; 4.7.3.4; 4.7.3.6
Public services: education (license renewal term)	4.7.3.1
Aesthetic impacts (license renewal term)	4.7.6
Aesthetic impacts of transmission lines (license renewal term)	4.5.8

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows:

- Public services: public safety, social services, and tourism and recreation. Based on information in the GEIS, the Commission found that

  > Impacts to public safety, social services, and tourism and recreation are expected to be of small significance at all sites.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's

site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts on public safety, social services, and tourism and recreation during the renewal term beyond those discussed in the GEIS.

- Public services: education (license renewal term). Based on information in the GEIS, the Commission found that

  > Only impacts of small significance are expected.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts on education during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts (license renewal term). Based on information in the GEIS, the Commission found that

  > No significant impacts are expected during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no aesthetic impacts during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts of transmission lines (license renewal term). Based on information in the GEIS, the Commission found that

  > No significant impacts are expected during the license renewal term.

  The staff has not identified any new and significant information during the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Therefore, the staff concludes that there are no aesthetic impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

Table 4-7 lists the Category 2 socioeconomic issues, which require plant-specific analysis, and environmental justice, which was not addressed in the GEIS.

Table 4-7. Environmental Justice and GEIS Category 2 Issues Applicable to Socioeconomics During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
SOCIOECONOMICS			
Housing impacts	4.7.1	I	4.4.1
Public services: public utilities	4.7.3.5	I	4.4.2
Offsite land use (license renewal term)	4.7.4	I	4.4.3
Public services, transportation	4.7.3.2	J	4.4.4
Historic and archaeological resources	4.7.7	K	4.4.5
Environmental justice	Not addressed[(a)]	Not addressed[(a)]	4.4.6

(a) Guidance related to environmental justice was not in place at the time the GEIS and the associated revision to 10 CFR Part 51 were prepared. Therefore, environmental justice must be addressed in the licensee's environmental report and the staff's environmental impact statement.

4.4.1 Housing Impacts During Operations

To determine housing impacts, the applicant followed Appendix C of the GEIS (NRC 1996), which presents a population characterization method based on two factors, "sparseness" and "proximity" (GEIS Section C.1.4 [NRC 1996, 1999]). Sparseness measures population density within 32 km (20 mi) of the site, and proximity measures population density and city size within 80 km (50 mi). Each factor has categories of density and size (GEIS Table C.1), and a matrix is used to rank the population category as low, medium, or high (GEIS Figure C.1).

Data from the U.S. Bureau of the Census (USBC) 2000 Census of Population indicates that approximately 283,000 persons live within 32 km (20 mi) of the Quad Cities site. Within this radius, the population density is 86 persons/km^2 (224 persons/mi^2). Thus, the Quad Cities site falls into Category 4 of the GEIS sparseness classification (greater than or equal to 46 persons/km^2 [120 persons/mi^2] within 32km [20 mi] NRC 1996). In addition, there are five communities with populations exceeding 25,000 within 32 km (20 mi) of the Quad Cities site.

An analysis of data from the 2000 Census indicates that approximately 657,000 persons reside within 80 km (50 mi) of the Quad Cities site, for a population density of 32 persons/km^2 (83 persons/mi^2) in this radius. The Census 2000 data show that one city, Davenport, Iowa, has a population of 98,359, which places the Quad Cities region in Category 2 proximity classification (no city with 100,000 or more persons and between 20 and 73 persons/km^2 [50 and 190 persons/mi^2] within 80 km [50 mi]). However, Davenport grew at 3.2 percent over the 1990–2000 decade and within the next few years, it is possible that the Quad Cities region will

be in the Category 3 proximity classification (one or more cities with 100,000 or more persons and less than 73 persons/km^2 [190 persons/mi^2] within 80 km [50 mi]).

Currently, the Quad Cities region is classified in sparseness Category 4 and proximity Category 2, resulting in classification of the Quad Cities region as a medium-population area according to the GEIS Sparseness and Proximity Matrix (NRC 1996). When the Davenport population exceeds 100,000, the region will be considered a high-population area. Therefore, the Quad Cities site is in a regional population context in which SMALL housing and employment impacts from license renewal would be expected.

In 10 CFR Part 51, Subpart A, Appendix B, Table B-1, the NRC concluded that impacts on housing availability are expected to be of small significance at plants located in a medium-population area where growth-control measures are not in effect. The Quad Cities site is located in a medium-population area, and although Rock Island, Whiteside, and Scott counties and their municipal governments attempt to direct growth within the established growth boundaries without sprawl, growth-control measures are not in effect. Based on the NRC criteria, Exelon expects housing impacts to be SMALL during continued operations (Exelon 2003a).

SMALL impacts result when no discernible change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no housing construction or conversion is required to meet new demand (NRC 1996). The GEIS assumes that no more than a total additional staff of 60 permanent workers might be needed at each unit during the license renewal period to perform routine maintenance and other activities related to license renewal. Although Exelon expects to perform these routine activities during scheduled outages, they assumed they would not add more than 60 total employees to their permanent staff during the license renewal period (Exelon 2003a). This addition of 60 permanent workers, plus 139 indirect jobs (Exelon 2003a), would result in an increased demand for a total of 199 housing units around the Quad Cities site (153 housing units for Rock Island, Whiteside, and Scott counties).[(a)] The demand for the existing housing units could be met with the construction of new housing or use of existing, unoccupied housing. In an area that has a population of more than 368,000, this demand would not create a discernible change in housing availability, change in rental rates or housing values, or spur much new construction or conversion. As a result, Exelon concludes that the impacts would be SMALL and mitigation measures would not be necessary (Exelon 2003a).[(b)]

(a) This assumes 77 percent of the new hires reside in the three counties (See Section 2.2.8.1).
(b) Exelon's estimate of 153 housing units is likely to be an "upper bound" estimate. Most of the potentially new jobs would most likely be filled by existing area residents, thus creating no, or little, net demand for housing.

The staff reviewed the available information relative to housing impacts and Exelon's conclusions. Based on this review, the staff concludes that the impact on housing during the license renewal period would be SMALL, and further mitigation is not warranted.

4.4.2 Public Services: Public Utility Impacts During Operations

An analysis of impacts on the public water supply system considered both plant demand and plant-related population growth. Section 2.2.2 describes the Quad Cities Units 1 and 2 permitted withdrawal rate and actual use of water. The plant is not connected to a municipal water system because it uses groundwater from its own wells. Exelon plans no refurbishment in conjunction with this license renewal, so plant demand will not change beyond current demands (Exelon 2003a).

To estimate the potential increase in demand for water resulting from new employment, it was assumed that there might be an increase of up to 60 permanent employees during license renewal, which might result in 199 direct and indirect new jobs, that, given the average household size, would result in a net overall population increase of approximately 516 persons and 199 households as a result of those jobs. These were distributed according to the current distribution of Quad Cities employees across the three most affected counties, Rock Island and Whiteside counties in Illinois and Scott County in Iowa and compared with the water service capacities of the larger water service companies in these counties (Exelon 2003a). Table 4-8 shows the results of these estimates. The staff finds that the impact of increased water use on area water systems is SMALL and that further mitigation is not warranted.

Table 4-8. Water Supply and Estimated Potential Additional Consumption from Direct and Indirect New Employment During the Renewal Term

County	Estimated Number of Persons	Consumption (Based on 80 Gallons/day)	Water Supplier Capacity	Additional Consumption Capacity
Rock Island	122	9760	53 MGD	0.02%
Whiteside	165	13200	16.5 MGD	0.08%
Scott	118	9440	32 MGD	0.03%

Source: Exelon 2003a.

4.4.3 Offsite Land Use During Operations

Offsite land use during the license renewal term is a Category 2 issue (10 CFR 51, Subpart A, Appendix B, Table B-1). Table B-1 of 10 CFR 51 Subpart A, Appendix B notes that "significant

changes in land use may be associated with population and tax revenue changes resulting from license renewal."

Section 3.7.5 and 4.7.4 of the GEIS define the magnitude of land-use changes as SMALL if little new development and minimal changes to an area's land-use pattern result. MODERATE change results if considerable new development and some changes to the land-use pattern occur. The magnitude of change is LARGE if large-scale new development and major changes in the land-use pattern occur.

Exelon has identified a maximum of 60 additional employees during the license renewal term plus an additional 139 indirect jobs (total 199) in the surrounding community (Exelon 2003a). Using this upper-bound employment assumption, the staff calculated that there could be an increase in total population within the two states of 517 people during the license renewal term.

Section 3.7.5 of the GEIS (NRC 1996) states that if plant-related population growth is less than 5 percent of the study area's total population, offsite land-use changes would be small, especially if the study area has established patterns of residential and commercial development, a population density of at least 23 persons/km^2 (60 persons/mi^2), and at least one urban area with a population of 100,000 or more within 80 km (50 mi). Population growth related to Quad Cities license renewal will be less than 5 percent of the area's 2000 total population of 654,509; the area has established patterns of residential and commercial development, a population density of well over 32 persons/km^2 (83 persons/mi^2), and the conjoined urban area (Quad Cities Metropolitan Statistical Area composed of Davenport and Bettendorf, Iowa, and Rock Island, Moline, and East Moline, Illinois) with a population of 359,062 in 2000 within the 80-km (50-mi) radius. Consequently, the staff concludes that population changes resulting from license renewal are likely to result in SMALL offsite land-use impacts.

Tax revenue can affect land use because it enables local jurisdictions to be able to provide the public services (e.g., public facilities and utilities) necessary to support development. Section 4.7.4.1 of the GEIS states that the assessment of tax-driven, land-use impacts during the license renewal term should consider (1) the size of the plant's payments relative to the community's total revenues, (2) the nature of the community's existing land-use pattern, and (3) the extent to which the community already has public services in place to support and guide development. If the plant's tax payments are projected to be small relative to the community's total revenue, tax-driven, land-use changes during the plant's license renewal term would be SMALL, especially where the community has pre-established patterns of development and has provided adequate public services to support and guide development. Section 4.7.2.1 of the GEIS states that if tax payments by the plant owner are less than 10 percent of the taxing jurisdiction's revenue, the significance level would be SMALL. If the plant's tax payments are projected to be medium to large relative to the community's total revenue, new tax-driven, land-use changes would be MODERATE.

Annual property taxes from Quad Cities Units 1 and 2 accounted for approximately 2.7 percent of Rock Island County's total levee extension and approximately 2.8 percent of the county's total collections available for distribution for the years 1997 to 2000. However, the local Cordova taxing districts for the township, library, school district, road and bridge district, and fire department derive significant revenue (31 to 73 percent of their total revenue from all sources) from the plant (Rock Island County Board of Review 2002).

Negotiations are underway between Exelon and Rock Island County for a graduated reduction in payments to minimize the financial disruption to county and local operations caused by a change in the methods of plant value assessment due to the deregualtion of the utility industry in the State of Illinois (Exelon 2003a). The local taxing districts that rely on the plant for a large portion of their revenue will be adversely affected to a significant degree by the decline in tax receipts. However, this decline is not related to the proposed license renewal for Quad Cities Units 1 and 2.

Since no major refurbishment activites are planned at the Quad Cities site during the license renewal term, no new incremental sources of plant-related tax payments are expected that could influence land use in Rock Island County by fostering considerable growth. Therefore, the staff concludes that tax-related land use impacts caused during the plant's license term renewal are SMALL.

Rock Island County utilizes four major tools in an effort to manage growth and sprawl throughout the county. Strong farmland preservation policies in Rock Island County dictate that settlement is to occur mainly in existing municipalities rather than in rural unincorporated areas (Bi-State 2002). Similarly, Scott County, Iowa and Whiteside County, Illinois, also seek to guide their counties' development. Therefore, any possible population growth emanating from plant property taxes or employment during the plant's license renewal term are likely to be channeled to county-targeted growth locations where utilities, facilities, and services can accommodate growth and thus the impacts of these changes would be SMALL.

Based on the information presented above, the staff concludes that offsite land-use impacts are likely to be SMALL and additional mitigation is not warranted.

4.4.4 Public Services: Transportation Impacts During Operations

Currently, Quad Cities employs approximately 850 staff and 130 contract/matrixed workers. The upper-bound potential increase in permanent staff during the license renewal term is 60 additional workers, or approximately 6 percent of the current permanent and contract workforce of approximately 980 employees. The State of Illinois Department of Transportation does not make level of service (LOS) determinations in rural, non-metropolitan areas such as

the Quad Cities site, unless it is deemed necessary, and therefore, none of the roads in the vicinity of the site has had a LOS determination.

The staff reviewed Exelon's assumptions and resulting conclusions. The staff concludes that any impact of Quad Cities employees on transportation service degradation is likely to be SMALL and does not require further mitigation.

4.4.5 Historic and Archaeological Resources

The National Historic Preservation Act (NHPA), as amended through 1992, requires Federal agencies to take into account the potential effects of their undertakings on historic properties. The historic-review process mandated by Section 106 of the NHPA is outlined in regulations issued by the Advisory Council on Historic Preservation in 36 CFR Part 800, as amended through 2001. Renewal of an OL for a nuclear power plant is an undertaking that could possibly affect either known or potential historic properties that may be located at the plant. Therefore, in accordance with the provisions of NHPA, the NRC is required to make a reasonable effort to identify historic properties in the area of potential effect. If no historic properties are present or affected, the NRC is required to notify the State Historic Preservation Office before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve possible adverse effects of the undertaking. In general, lands within the boundaries of a nuclear-plant site fall into one of the following categories:

(1) Areas with No Potential for archaeological resources. These areas include lands where past disturbances related to the construction of the power station and appurtenant facilities have taken place to such an extent that once-extant cultural resources are no longer present. No further archaeological investigations would be recommended for these areas.

(2) Areas with Low Potential for archaeological resources. Lands within the plant site that fall into this category are those that are relatively undisturbed but that possess characteristics that would normally indicate a low possibility for most types of cultural resources to occur. For the most part, these lands have a degree of slope greater than 15 percent. For most of these areas, further archaeological work would not be necessary, although there could be smaller areas within the larger zone where specific ground conditions could require investigation.

(3) Areas with Moderate-to-High Potential for archaeological resources. These areas are classified as those that are relatively undisturbed by past activities and have a likelihood for prehistoric and historic archaeological sites, according to local models of prehistoric and historic land use and settlement patterning. Archaeological investigation would be recommended prior to undertaking any ground-disturbing activities in these areas.

The Quad Cities site is an area of moderate-to-high potential. There are no known historic resources at the Quad Cities site. However, there are reports of archaeological resources on the Quad Cities site (Bareis 1972a, 1972b). A prehistoric Woodland-period archaeological site associated with Quad Cities property was recorded by archaeologists in 1933. In 1972, archaeologists found some areas of archaeological interest in a reconnaissance during construction of a spray canal.

The Quad Cities property has not been investigated by professional archaeologists at a level that would conclusively determine the current presence or absence of archaeological sites, or define the significance of any such resources that may exist on these lands. The Quad Cities license renewal application for continued operations does not include proposals for future land-disturbing activities or structural modifications beyond routine maintenance at the plant nor does it guarantee against such disturbances.

Exelon initiated communication with the Iowa and Illinois state historic preservation offices by letters dated April and January of 2002 (Jury 2002a, 2002b). The letters express Exelon's desire to assess the effects of the license renewal on historic properties, as required by the NRC of applicants for operating license renewal. The letters specifically include within the purview of the undertaking the Quad Cities site itself and five related transmission lines built to connect Quad Cities to the regional transmission system. The applicant notes in its letters that it does not expect the operation of Quad Cities, including maintenance of the identified transmission lines, through the license renewal term to adversely affect cultural or historical resources. The applicant further notes in the letters that “No major structural modifications have been identified for the purposes of supporting license renewal. Any maintenance activities necessary to support license renewal would be limited to previously disturbed areas. No additional land disturbance is anticipated in support of license renewal.” Finally, a request is made in the letters for state concurrence with a determination that operations at Quad Cities during the period of the license renewal would have “…no effect on any historic or archeological properties.”

Both the Illinois and Iowa historic preservation offices responded to the applicant’s letters, concurring that the operation and management of the Quad Cities Units 1 and 2 would not affect historic properties. The Illinois Historic Preservation Agency wrote on February 7, 2002, that it had reviewed the undertaking in accordance with regulations to implement Section 106 of the National Historic Preservation Act. Illinois authorities agreed that no historic properties are affected by the undertaking as described by the applicant (Haaker 2002). The State Historical Society of Iowa wrote on June 24, 2002, that it had reviewed the information submitted by the applicant. Iowa authorities agreed that they “could concur with a determination of no historic properties affected” if the project occurred as described by the applicant and if the NRC petitioned for the state’s views in accordance with regulations to implement Section 106 of the National Historic Preservation Act (Jones 2002).

The NRC forwarded letters to the state historic preservation offices in Iowa and Illinois. The letters include a request for confirmation of their previous conclusion that no historic properties are affected by the decision to renew the Quad Cities license (NRC 2003a and 2003b). In letters dated February 26, 2004, state historic preservation offices in Iowa and Illinois concurred that no historic properties are affected by the proposed license renewal (Haaker 2004; Jones 2004).

The staff reviewed the applicant's assumptions and resulting conclusions as they relate to historic and archaeological resources and determined that archaeological resources have been found on the Quad Cities site. The setting of the Quad Cities site adjacent to the Mississippi River, combined with the reports of archaeological finds on and adjacent to the station, indicate a high potential for discovery of significant resources. These considerations require adequate plans to protect archaeological sites from inadvertent disturbance or destruction. The staff found that procedures in place were not protective of archaeological resources that may be present at the Quad Cities site. Exelon modified the procedures to include the following two provisions (Exelon 2003c):

- Contact the Illinois Historic Preservation Agency for guidance on requirements for an archaeological survey when any undertaking would disturb sediments at the station at depths below previous disturbance, or below the present surface in previously undisturbed areas. [Note: previous disturbance is defined by the documented disturbance area and depth for projects previously reviewed by the NRC and determined to be not significant. Areas or sediments that extend beyond these boundaries are previously undisturbed.]

- Once guidance is received from the Illinois Historic Preservation Agency, adhere to that guidance.

Based on the staff's review and the procedure changes implemented by the applicant, the impact of license renewal on historic and archaeological resources is SMALL and additional mitigation is not warranted.

4.4.6 Environmental Justice

Environmental justice refers to a Federal policy in which Federal actions should not result in disproportionately high and adverse impacts on minority[(a)] or low-income populations. Executive Order 12898 (59 FR 7629) directs Federal executive agencies to consider environmental justice under NEPA. The Council on Environmental Quality (CEQ) has provided

(a) The NRC guidance for performing environmental justice reviews defines "minority" as American Indian or Alaskan Native, Asian, Native Hawaiian or other Pacific Islander, Black races, or Hispanic ethnicity. "Other" races and multiracial individuals may be considered as separate minorities (NRC 2001).

guidance for addressing environmental justice (CEQ 1997). Although the Commission is not subject to the Executive Order, the Commission has voluntarily committed to undertake environmental justice reviews. Specific guidance is provided in the NRC Office of Nuclear Reactor Regulation Office Instruction LIC-203, *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues* (NRC 2001).

For the purpose of the staff's review, a minority population is defined to exist if the percentage of minorities within the census block groups[(a)] in each state within the 80 km (50 mi) potentially affected by the renewal of Quad Cities Units 1 and 2 operating licenses exceeds the corresponding percentage of minorities in the state of which it is a part by 20 percentage points, or if the corresponding percentage of minorities within the census block group is at least 50 percent. A low-income population is defined to exist if the percentage of low-income population within a census block group exceeds the corresponding percentage of low-income population in the state of which it is a part by 20 percentage points, or if the corresponding percentage of low-income population within a census block group is at least 50 percent. For census block groups within Rock Island and Whiteside counties, for example, the percentage of minority and low-income populations is compared to the percentage of minority and low-income populations in Illinois. For block groups in Scott County, the percentage of minority and low-income populations is compared with the percentage of minority and low-income populations in Iowa.

Exelon used U.S. Bureau of the Census 2000 data for the minority portion of the Environmental Justice calculations and Census 1990 data for the low-income portion of the Environmental Justice calculations, the most current data available at the time of publication of the ER (Exelon 2003a). This discussion of minority and low-income status relies on Census 2000 data, which now includes both population and economic data. Geographic Information System (GIS) software was used to analyze Census 2000 population data. The census data used are from Geolytics, Inc. (Geolytics, 2000).

Figure 4-1 shows the location of census block groups identified as having minority status, according to the above criteria. Figure 4-2 shows the location of census block groups identified as low-income status, according to NRC criteria.

(a) A census block group is a combination of census blocks, which are statistical subdivisions of a census tract. A census block is the smallest geographic entity for which the Census Bureau collects and tabulates decennial census information. A census tract is a small, relatively permanent statistical subdivision of counties delineated by local committee of census data users in accordance with Census Bureau guidelines for the purpose of collecting and presenting decennial census data. Census block groups are subsets of census tracts (USBC 1999).

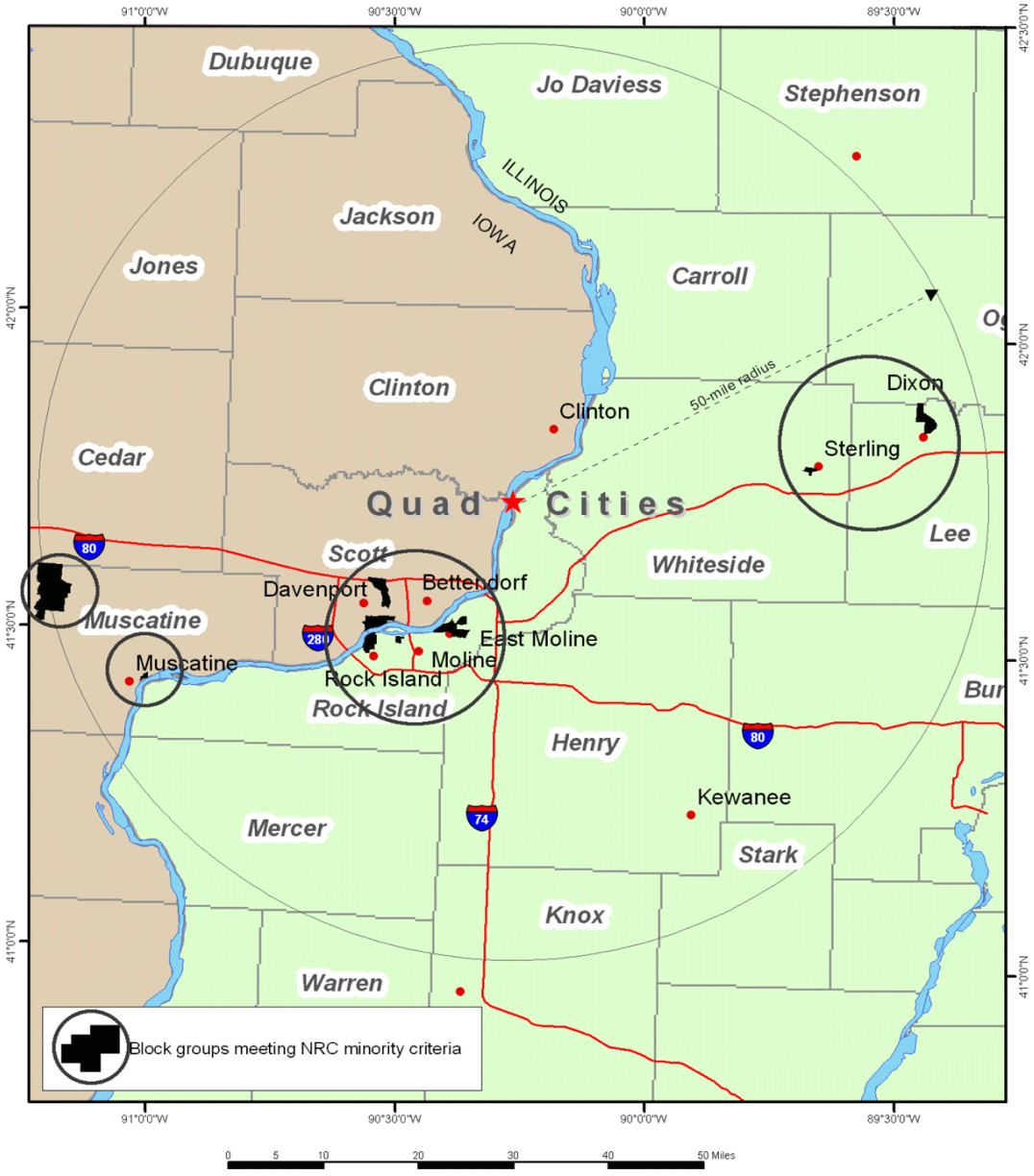

Figure 4-1. Geographic Distribution of Minority Populations (shown in shaded areas) Within 80 km (50 mi) of Quad Cities Based on 2000 Census Block Group Data

Figure 4-2. Geographic Distribution of Low-Income Populations (shown in shaded areas) Within 80 km (50 mi) of Quad Cities Based on 1990 Census Block Group Data

The closest minority-status block groups to the Quad Cities site are in the East Moline/Moline area, approximately 24 km (15 mi) south of the plant. The low-income block groups nearest the plant are in the vicinity of Clinton, Iowa, about 14 km (9 mi) north of the Quad Cities site; the next nearest block groups to the plant are in the East Moline area about 24 km (15 mi) south of the plant. With the locations of minority and low-income populations identified, the staff proceeded to evaluate whether any of the environmental impacts of the proposed action could affect these populations in a disproportionately high and adverse manner. Based on staff guidance (NRC 2001), air, land, and water resources within 80 km (50 mi) of the Quad Cities site were examined. Within that area, of the potential environmental impacts that could affect human populations, all of these were considered SMALL for the general population.

The pathways through which the environmental impacts associated with the Quad Cities license renewal can affect human populations are discussed in each associated section. The staff then evaluated whether minority and low-income populations could be disproportionately affected by these impacts. The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing through which the populations could be disproportionately affected. In addition, the staff did not identify any location-dependent disproportionate impacts affecting these minority and low-income populations. The staff concludes that offsite impacts from Quad Cities to minority and low-income populations would be SMALL and no additional mitigation actions are warranted.

4.5 Groundwater Use and Quality

There are no Category 1 issues related to groundwater use and quality for Quad Cities Units 1 and 2. The Category 2 issues related to groundwater use conflicts during the renewal term that are described in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 and applicable to Quad Cities Units 1 and 2 are discussed in the section that follows and are listed in Table 4-9.

Table 4-9. Category 2 Issue Applicable to Groundwater Use Conflicts of the Quad Cities Units 1 and 2 During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
AQUATIC ECOLOGY (FOR PLANTS WITH ONCE-THROUGH AND COOLING POND HEAT-DISSIPATION SYSTEMS)			
Groundwater use conflicts (potable and service water, and dewatering; plants that use >100 gpm)	4.8.1.1; 4.8.1.2	C	4.5

For plants using greater than 100 gallons per minute (gpm) of groundwater, the potential use conflict is a Category 2 issue, requiring a site-specific assessment prior to license renewal.

The staff independently reviewed the Quad Cities ER (Exelon 2003a) and visited the site.

The NRC made groundwater use conflicts a Category 2 issue because, at a withdrawal rate of more than 100 gpm, a cone of depression could extend offsite. This could deplete the groundwater supply available to offsite users, an impact that could warrant mitigation. Information needed to address this issue includes: (1) the Quad Cities Units 1 and 2 groundwater withdrawal rate (whether greater than 100 gpm), (2) the drawdown at offsite location, and (3) impact on neighboring wells.

Quad Cities groundwater use has averaged 45 L/s (717 gpm) over the last 10 years and, therefore, the issue of groundwater use conflicts does apply. In the winter of 1997, groundwater was used to heat the water in the fish-rearing facility while the plant was shut down. During this period, groundwater use from Well 7 was six times normal use. Without this period of high use, the 10-year average yield for the site is approximately 31.9 L/s (505 gpm).

The Quad Cities site is located in the Meredosia Channel, an ancient channel of the Mississippi River. The Meredosia Channel has been filled over many thousands of years with unconsolidated sediments ranging in depth from approximately 15 to 91 m (50 to 300 ft) (Blume 1966). Water for industrial and home use in the region comes from both wells and the Mississippi River.

Groundwater resources in the region are developed from three aquifer systems. These consist of the alluvial aquifer, the shallow Silurian dolomite aquifer, and the artesian Cambrian-Ordovician aquifer. Some wells within a few miles of the station pump at rates up to 44.2 L/s (700 gpm). These are in the upper alluvial aquifer at depths of 6 to 30 m (20 to 100 ft) below ground surface (AEC 1972). Groundwater in the area is encountered at depths from approximately 5 to 6 m (17 to 21 ft). The groundwater gradient in this aquifer is relatively flat and generally flows to the Mississippi River, except during periods of high river flow (Blume 1966).

During periods of pumping, groundwater levels in site wells are monitored by Exelon to determine whether drawdown is taking place that might impact offsite groundwater users. Due to extensive reservoir of groundwater associated with the Meredosia Channel, it is unlikely that Quad Cities operation would result in noticeable changes in the groundwater levels and Exelon has not observed a lowering of water levels in site wells (Exelon 2003a). Therefore, groundwater use conflict impacts would be SMALL, if any, and mitigation measures would not be warranted.

4.6 Threatened or Endangered Species

Threatened or endangered species are listed as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue is listed in Table 4-10.

Table 4-10. Category 2 Issue Applicable to Threatened or Endangered Species During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
THREATENED OR ENDANGERED SPECIES (FOR ALL PLANTS)			
Threatened or endangered species	4.1	E	4.6

This issue requires consultation with appropriate agencies to determine whether threatened or endangered species are present and whether they would be adversely affected by the continued operation of the nuclear power plant during the license renewal term. The presence of threatened or endangered species in the vicinity of the Quad Cities site is discussed in Sections 2.2.5 and 2.2.6. On January 11, 2002, Exelon corresponded with the FWS and requested information on the potential impacts of relicensing on threatened and endangered species (Jury 2002c). The FWS indicated that they had no objection to the relicensing action on February 12, 2002 (Millar 2002). On March 12, 2003, the NRC independently contacted the FWS to request information on threatened and endangered species and the impacts of relicensing (NRC 2003c). In response, on June 6, 2003, the FWS provided additional information regarding federally listed species that have been observed or may occur in the vicinity of the Quad Cities site and its associated transmission lines (Nelson 2003a). On August 12, 2003, the NRC requested additional information from the FWS for an expanded scope of the transmission lines under review for re-licensing (NRC 2003d). The FWS responded on September 15, 2003, with the requested information (Nelson 2003b).

The staff has prepared a biological assessment evaluating the potential impacts on aquatic and terrestrial threatened, endangered, or candidate species resulting from the operation of Quad Cities for an additional 20 years during the license renewal period. The staff concluded that Quad Cities license renewal will have no effect on the Higgins' eye pearlymussel, Indiana bat, Iowa Pleistocene snail, bald eagle, western prairie fringed orchid, eastern prairie fringed orchid and the prairie bush-clover. In a letter dated December 4, 2003, the staff transmitted the staff's biological assessement to the FWS and requested concurrence on staff's determination (NRC, 2003d). The FWS concurred with the staff's conclusions in a letter dated January 15, 2004 (Nelson 2004). The staff's biological assessment and the letter from FWS are included in Appendix E to this SEIS.

4.6.1 Aquatic Species

As described in Section 2.2.5, the Higgins' eye pearlymussel (*Lampsilis higginsii*) is the only Federally listed (endangered) aquatic species in the vicinity of the Quad Cities site. As discussed in Section 2.2.5, an Essential Habitat Area for the Higgins' eye pearlymussel is located 1.6 to 4.0 km (1.0 to 2.5 mi) downstream from the Quad Cities site. The presence of the Higgins' eye pearlymussel in this area suggests that past operation of Quad Cities Units 1 and 2 has not adversely affected the species. In addition, Quad Cities Units 1 and 2's cooling-water intake and discharge are closely monitored under the NPDES program, and permit limits are reviewed on a regular basis by state regulatory agencies to ensure the protection of aquatic biota (Exelon 2003a).

There are no plans to conduct refurbishment or construction at Quad Cities Units 1 and 2. Therefore, the staff has concluded that continued operation of the plant under license renewal is not likely to adversely affect the Higgins' eye pearlymussel. The FWS concurred with the staff conclusions in a letter dated January 15, 2004 (Nelson 2004). Thus, it is the staff's findings that the impact on threatened or endangered aquatic species from an additional 20 years of operation of Quad Cities Units 1 and 2 would be SMALL, and additional mitigation is not warranted.

4.6.2 Terrestrial Species

Federally listed threatened and endangered terrestrial species that have the potential to occur on or in the vicinity of the Quad Cities site or the transmission lines associated with Quad Cities Units 1 and 2 are described in Section 2.2.6. These species include the Indiana bat, Iowa Pleistocene snail, bald eagle, western prairie fringed orchid, eastern prairie fringed orchid and the prairie bush-clover.

All species presented in Table 2-3 could occur in counties within which Quad Cities Units 1 and 2 are located or which are traversed by transmission lines associated with Quad Cities Units 1 and 2. These listed species are associated with upland woodlands, prairie, algific (i.e., cold producing) talus slopes, riparian and open water habitats. Although most of the transmission lines transverse agricultural areas, some natural habitats are crossed (e.g., the Upper Mississippi River NWFR). However, the bald eagle is the only Federally listed species that has been observed or documented to occur along the transmission lines. One other Federally listed species, the Iowa Pleistocene snail, is known to occur on north-facing slopes of driftless areas (i.e., areas with little or no glacial deposits) in Clinton County, Iowa, occupying algific talus slopes at the outlet of underground ice caves along limestone bluffs (Nelson 2003a). This highly restricted habitat is not likely to be found at the site or along the transmission lines.

No documented occurrences of other Federally listed species in Table 2-3 have been noted along these transmission lines, within their ROWs, or in the vicinity of Quad Cities Units 1 and 2.

Bald eagles visit the open water and riparian habitats on or near Quad Cities Units 1 and 2, as well as its Davenport and Rock Creek transmission lines, during winter migration and use this area for summer nesting. Foraging bald eagles may be attracted to the open water areas in the Mississippi River caused by the plant's thermal discharge during the winter months when the river is icing over (Nelson 2003a). Approximately one to two bald eagles per year have been observed by FWS to collide with the Rock Creek transmission line, in the segment that crosses the Mississippi River, with subsequent mortality.[(a)] However, relative to the numbers of bald eagles in the area, this impact is observed to be of small significance.[(a)]

Although no management actions for bald eagle nesting and breeding areas (i.e., those actions recommended by the Management Guidelines and Breeding Areas of the Northern States Recovery Plan for the Bald Eagle [Grier et al. 1983]) have been needed along the Quad Cities transmission lines, it is anticipated that Exelon, MidAmerican, Alliant, and their vegetation management contractors would implement such actions upon identification of a nest. Vegetation management staff would follow Best Management Practices (BMPs) to identify needed management actions and implement them to protect the bald eagle and its habitat. Additionally, it is anticipated that appropriate raptor incident reporting for any incidences of bald eagle injury or mortality along these transmission lines would be carried out by Exelon, MidAmerican, Alliant and their vegetation management contractors. Currently, no bald eagle incident reports have been necessary due to no observed injuries or mortalities in the area of Quad Cities and its transmission lines by Exelon or its contractors.

The NRC assessed the impacts of transmission lines on avian populations in its GEIS on the effects of nuclear power plant license renewal (NRC 1996). In the GEIS, the NRC concluded that mortality resulting from bird collisions with transmission lines associated with license renewal and an additional 20 years of operation would be of small significance. This conclusion was based on: (1) no indication in the existing literature that collision mortality is high enough to result in population-level effects and, (2) the lack of known instances where nuclear power plant lines affect large numbers of individuals in local areas.

Although undeveloped areas of the Quad Cities site have not been surveyed for Federally listed species, these areas are not affected by ongoing plant operations and no refurbishment activities that could disturb these areas are planned. In addition, maintenance activities occurring along the transmission lines are limited by using a vegetation management strategy

(a) Personal communication with E. Britton, District Manager, Savanna District, Upper Mississippi National Wildlife and Fish Refuge, May 8, 2003.

that minimizes the need for cutting, mowing, and the application of herbicides (Cunningham 2003; Exelon 2003d; Exelon 2003e).

Based on the staff's review of the applicant's environmental report, the staff's independent analysis, and consultation with the FWS, the staff has concluded that continued operation of the plant during the license renewal term is not likely to adversely affect the bald eagle and will have no effect on other listed or proposed endangered or threatened species within the immediate vicinity of Quad Cities site and its associated transmission lines. This conclusion, contained in the staff's biological assessment, was submitted to the FWS in December 2003. The FWS concurred with the staff's biological assessment in a letter dated January 15, 2004 (Nelson 2004). The applicant currently plans no power plant refurbishment activities. The staff anticipates that BMPs for protecting Federally listed species and their habitats, while carrying out vegetation management activities, will be implemented by Exelon, MidAmerican, Alliant, and their contractors. Therefore, it is the staff's finding that the impact on threatened or endangered species of an additional 20 years of operation of Quad Cities Units 1 and 2, and the associated transmission lines, would be SMALL and further mitigation is not warranted.

4.7 Evaluation of Potential New and Significant Information on Impacts of Operation During the Renewal Term

The staff has not identified any new and significant information on environmental issues listed in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, related to operation during the renewal term from the staff's independent review of the Quad Cities ER (Exelon 2003a), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments on the draft SEIS. Processes for identification and evaluation of new information are described in Section 1.2.2, License Evaluation Process.

4.8 Cumulative Impacts of Operations During the Renewal Term

The staff considered potential cumulative impacts during the evaluation of information applicable to each of the potential impacts of operations during the renewal term identified within the GEIS. For the purposes of this analysis past actions were those related to the resources at the time of the plant licensing and construction, present actions are those related to the resources at the time of current operation of the power plant, and future actions are considered to be those that are reasonably foreseeable through the end of plant operation. Therefore, the analysis considers potential impacts through the end of the current license term, as well as the 20-year license renewal term. The geographical area over which past, present, and future actions that could contribute to cumulative impacts is dependent on the type of action considered, and is described below for each impact area.

The impacts of the proposed action, as described in Section 4.0, are combined with other past, present, and reasonably foreseeable future actions which would affect the same resources inpacted by Quad Cities regardless of what agency (Federal or non-Federal) or person undertakes such other actions. These combined impacts are defined as "cumulative" in 40 CFR 1508.7 and include individually minor but collectively significant actions taking place over a period of time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

4.8.1 Cumulative Impacts Resulting from Operation of the Plant Cooling System

For the purposes of this analysis, the geographic area considered for cumulative impacts resulting from operation of the Quad Cities Units 1 and 2 cooling system is the Upper Mississippi River,[(a)] particularly within Pool 14. As discussed in Section 4.1, the staff found no new and significant information indicating that the conclusions regarding any of the cooling system-related Category 1 issues as related to Quad Cities are inconsistent with the conclusions in the GEIS (NRC 1996). Additionally, the staff determined that none of the cooling system-related Category 2 issues were likely to have greater than a SMALL impact on local water quality and aquatic resources.

The cumulative effects of past actions have resulted in the existing conditions on local water quality and aquatic resources. Section 2.2.5 discusses the major changes and modifications within the Upper Mississippi River that have had the greatest effects on aquatic resources. These include agriculture, forestry, natural resource utilization (e.g., pearl button industry and commercial and recreational fishing), river modifications, and industrial, municipal, and residential developments. The 29 navigation dams constructed to create the 2.7-m (9-ft) navigation channel between St. Louis, Missouri and Minneapolis, Minnesota have created broad, shallow impoundments within the Upper Mississippi River. Dredging is routinely required in some reaches to maintain the navigation channel (Fremling and Drazkowski 2000). Dams and levees have caused increased sedimentation within the river. Some reaches of the river are polluted from past industrial and agricultural discharges (USGS 1999).

The lock and dam system has increased the water surface per linear mile of river, which has increased total photosynthesis of the river. This has resulted in an increase in pounds of fish per linear mile than existed before river impoundment. However, there have been general decreases in floodplain forests, submerged aquatic plants, freshwater mussels, fingernail

(a) The Upper Mississippi River is the 1667-km (1036-mi) reach from St. Anthony Falls in Minnesota to the mouth of the Ohio River at Cairo, Illinois.

clams, other bottom-dwelling invertebrates, and some fish species (Fremling and Drazkowski 2000). Also, movement of many fish species throughout the Upper Mississippi River has been impeded by the dams (USGS 1999). As the quantity and quality of backwater habitat has become increasingly scarce and degraded due to sedimentation, riverine fish species have increased in abundance while lacustrine species have decreased (Bowzer and Lippincott 2000). However, there is little evidence to suggest that there has been a substantial net loss of fish species in the Upper Mississippi River since the 1800s (USGS 1999).

Non-native species (e.g., common carp, grass carp, purple loosestrife, Eurasian milfoil, and zebra mussel) are also adversely impacting native species. The zebra mussel has been particularly devastating to native freshwater mussels (Fremling and Drazkowski 2000); and the common carp now comprises most of the commercial harvest and is the dominant species in the Upper Mississippi River (USGS 1999).

Management and protection of fish and wildlife resources are provided, in part, by the three National Wildlife Refuges contained within the Upper Mississippi River: Upper Mississippi River National Wildlife and Fish Refuge, Trempealeau National Wildlife Refuge, and the Mark Twain National Wildlife Refuge (Fremling and Drazkowski 2000).

The staff concludes that the SMALL impacts of Quad Cities Units 1 and 2 cooling system operations, including entrainment and impingement of fish and shellfish, heat shock, or any of the cooling system-related Category 1 issues are not contributing to an overall decline in water quality or the status of the fishery or other aquatic resources. The annual stocking of walleye and hybrid striped bass by Quad Cities has contributed to an increase in gamefish resources within Pool 14, with lesser increases within several downstream pools (LaJeone and Monzingo 2000).

Future contributions to cumulative impacts to aquatic resources within the Upper Mississippi River would generally occur from those actions that currently cause impacts (e.g., maintenance of the navigation channel and associated barging, human habitation, urban and industrial development, agriculture, commercial and recreational fisheries, and spread of non-native species). Proposed increases in commercial traffic within the river may increase the rate of sedimentation (Fremling and Drazkowski 2000). The quality of the aquatic resources within the Upper Mississippi River will continue to decline unless inputs of sediments, nutrients, and toxic substances are reduced or eliminated (Fremling and Drazkowski 2000). It is predicted that without active management (e.g., habitat rehabilitation), the navigation pools within the Upper Mississippi River will continue to progress toward shallow, more uniform conditions. This will lead to poorer water and substrate quality, reduction of submerged aquatic plant and benthic invertebrate populations, and less diverse fish communities (USGS 1999).

There is a potential for severe impacts to aquatic resources from large oil or chemical spills within the Upper Mississippi River, but the risk of such spills is relatively small. However, a

major oil spill did occur in the Mississippi River in 1963 (UMRCC 1993). The probability of smaller spills is higher, but the impacts from such spills would probably be small, temporary, and additive and unlikely to severely affect aquatic resources, especially if spill response activities are undertaken when such events occur.

The non-native round goby (*Neogobius melanostomus*), which is currently common in the Upper Illinois Waterway, may be a future threat to the Upper Mississippi River. It is an aggressive and highly territorial species that can displace native species and eat their eggs. It also has a high reproductive potential and tolerates extreme water-quality conditions (USGS 1999). Five species of Asian carp now occur in the United States. As mentioned, the common carp is a dominant species within the Upper Mississippi River. The grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molotrix*) and bighead carp (*H. nobilis*) have also become established within the Upper Mississippi River during the past 20 years (Chick 2002). These mostly occur in the southern Illinois area (e.g., Pool 26) (Koel et al. 2000), although the grass carp has been collected in Pool 14 (Bowzer and Lippincott 2000). These species can impact native species by destroying habitat, reducing water quality, and by consuming aquatic vegetation (grass carp) or planktonic organisms (silver and bighead carp) (USGS 2003). The silver and bighead carp have the potential to adversely affect every species of fish within the Upper Mississippi River (Chick 2002). The black carp (*Mylopharyngodon piceus*) primarily occurs in aquaculture ponds in Arkansas and Mississippi (Koel et al. 2000). However, it has been collected in the Mississippi River, but is not believed to have established reproducing populations as yet (USGS 2003). This species feeds almost exclusively on mussels and snails, therefore, if it becomes established within the Upper Mississippi River it could further threaten freshwater mussels (USGS 2003).

The staff, while preparing this assessment, assumed that other industrial, commercial, or public installations could be located in the general vicinity of the Quad Cities site prior to the end of Quad Cities Units 1 and 2 operations. The intake of water from, and the discharge of water to, the Upper Mississippi River from these facilities would be regulated by the IEPA, the Wastewater Section of the Iowa Water Quality Bureau, or other agencies, just as the Quad Cities Units 1 and 2 is presently regulated by the IEPA. The intake and discharge limits for each installation are set considering the overall or cumulative impact of all of the other regulated activities in the area. Compliance with the Clean Water Act and NPDES permits minimizes the cumulative effects on aquatic resources. Continued operation of Quad Cities Units 1 and 2 will require renewed discharge permits from the IEPA which will address changing requirements so that cumulative water quality objectives are served. Therefore, the staff concludes that the potential cumulative impacts contributed by the continued operation of Quad Cities Units 1 and 2 will be SMALL, and that no additional mitigation measures are warranted.

4.8.2 Cumulative Impacts Resulting from Continued Operation of the Transmission Lines

The continued operation of the Quad Cities electrical transmission facilities was evaluated to determine if there is the potential for interactions with other past, present, and future actions that could result in adverse cumulative impacts to terrestrial resources such as wildlife populations, and the size and distribution of habitat areas; and aquatic resources such as wetlands and floodplains. For the purposes of this analysis, the geographic area that encompasses the past, present, and foreseeable future actions that could contribute to adverse cumulative effects is the area within 80 km (50 mi) of the Quad Cities site, as depicted in Figure 2-1.

As described in Section 4.2, the staff found no new and significant information indicating that the conclusions regarding any of the transmission line-related Category 1 issues as related to Quad Cities are inconsistent with the conclusions within the GEIS. The staff anticipates that Exelon, MidAmerican, Alliant and their contractors will follow BMPs for ROW vegetation management over all of its transmission line corridors that are protective of wildlife and habitat resources, including floodplains and wetlands. There are no State or Federally regulated wetlands at the Quad Cities site or within the transmission line right-of-way connecting Quad Cities to the power grid. Therefore, continued operation and maintenance of these ROWs are not likely to contribute to a regional decline in wetland or floodplain resources. Using BMPs for vegetation management ensures minimal disturbance to wildlife and may improve the habitat within the transmission line corridors relative to many of the surrounding land uses.

Based on the expectation that BMPs for protecting Federally listed species and their habitats will be implemented by Exelon, MidAmerican, Alliant and their contractors while carrying out vegetation management activities along transmission lines, it is the staff's determination that the cumulative impacts of the continued operation of the Quad Cities transmission lines will be SMALL, and that no additional mitigation is warranted.

4.8.3 Cumulative Radiological Impacts

The radiological dose limits for protection of the public and workers have been developed by the EPA and the NRC to address the cumulative impact of acute and long-term exposure to radiation and radioactive material. As described in Section 2.2.7, the public and occupational doses resulting from operation of Quad Cities are within regulatory limits, and as described in Section 4.3, the impacts of these doses are SMALL. For the purposes of this analysis, the area within an 80-km (50-mi) radius of the Quad Cities site was included (Figure 2-1). EPA regulation 40 CFR 190 limits the dose to members of the public from all sources in the nuclear fuel cycle in the United States, including all the nuclear power plants, fuel fabrication facilities, waste disposal facilities, and transport of fuel and waste. In addition, the radiological

environmental monitoring program conducted by Exelon in the vicinity of Quad Cities measures radiation and radioactive material from all sources, including Quad Cities; therefore, the monitoring program measures cumulative radiological impacts. The NRC and the States of Illinois and Iowa would regulate any reasonably foreseeable future actions in the vicinity of Quad Cities that could contribute to cumulative radiological impacts.

Therefore, the staff determined that the cumulative radiological impacts of continued operation of Quad Cites will be SMALL, and that no additional mitigation is warranted.

4.8.4 Cumulative Socioeconomic Impacts

Much of the analyses of socioeconomic impacts presented in Section 4.4 of this SEIS already incorporates cumulative impact analysis because the metrics used for quantification only make sense when placed in the total or cumulative context. For instance, the impact of the total number of additional housing units that may be needed can only be evaluated with respect to the total number that will be available in the impacted area. Therefore, the geographical area of the cumulative analysis varies depending on the particular impact considered, and may depend on specific boundaries, such as taxation jurisdictions or may be distance related, as in the case of Environmental Justice.

The continued operation of Quad Cities is not likely to add to any cumulative socioeconomic impacts beyond those already evaluated in Section 4.4. In other words, the impacts of issues such as transportation or offsite land use are likely to be non-detectable beyond the regions previously evaluated and will quickly decrease with increasing distance from the site. The staff determined that the impacts on housing, public utilities, public services, and environmental justice would be SMALL. The staff determined that the impact on off-site land use is SMALL because, as no refurbishment actions are planned at Quad Ciites, no new incremental sources of plant-related tax payments are expected that could influence land use by fostering considerable growth. There are no reasonably forseeable scenarios that would alter these conclusions regarding cumulative impacts.

Related to historic resources, no archaeological or historical architectural surveys have been completed for Quad Cities. There are no indications that standing buildings and structures at Quad Cities carry any historical value, however, there are reports of archaeological finds on or in the vicinity of Quad Cities. These reports and the location of the plant on an alluvial terrace of the Mississippi River translate to a high potential for the discovery of archaeological remains during any future ground disturbance that might occur over the period of extended operation under NRC license. The licensee recognizes the potential that archaeological remains may be present in undisturbed areas and at undisturbed depths at Quad Cities, and, given that recognition, management procedures employed by Exelon should protect against damage to important archaeological sites. The NRC staff has concluded that with the company procedure

requiring additional archaeological review in the event of activities in areas not previously disturbed, and with a commitment of the licensee to contact the Illinois Historic Preservation Agency for direction on level of effort necessary for archaeological survey in such project areas, the impacts of license renewal would be SMALL. Under these circumstances there is no reason to believe that the continued operation and maintenance of the Quad Cities site would impact any significant archaeological resources without consideration of those resources, and therefore the contribution to a cumulative impact on historic resources is considered SMALL.

4.8.5 Cumulative Impacts on Groundwater Use and Quality

The Quad Cities site is located in the Meredosia Channel, an ancient channel of the Mississippi River. The Meredosia Channel has been filled over many thousands of years with unconsolidated sediments ranging in depth from approximately 15 to 91 m (50 to 300 ft) (Blume 1966). It is expected that these waters communicate strongly with the present channel. The groundwater gradient in this aquifer is relatively flat and generally flows towards the river, except during periods of high river flow (Blume 1966).

There are groundwater withdrawals at Quad Cities, and Exelon imports no other potable water from local utilities for plant use. The impact of current water usage has been determined in Section 4.5 to be SMALL. Based on the fact that Exelon has determined that the long term water table levels have not dropped, the Quad Cities site is not causing a detectable change in the regional groundwater usage, nor has the regional water table dropped, and therefore the cumulative impact is SMALL and no mitigation measures are warranted.

4.8.6 Cumulative Impacts on Threatened or Endangered Species

The geographic area considered in the analysis of potential cumulative impacts to threatened or endangered species includes Clinton and Scott Counties, Iowa; Lee, Rock Island, and Whiteside Counties, Illinois; and the waters of the Upper Mississippi River, particularly within Pool 14. As discussed in Sections 2.2.5 and 2.2.6, there are several threatened or endangered species that occur within this area. The staff's findings presented in Section 4.6 are that continued operation of Quad Cities Units 1 and 2 would have a SMALL effect on these species. The staff's findings were documented in a biological assessment, and forwarded to the FWS for its concurrence in December 2003. The FWS concurred with the staff's biological assessment in a letter dated January 15, 2004 (Nelson 2004). No critical habitat, as designated by the Endangered Species Act, occurs in the area affected by the Quad Cities site; therefore, cumulative impacts on critical habitats are not addressed.

4.8.6.1 Aquatic Species

The only Federally protected aquatic species that occurs in the area of the Quad Cities site is the endangered Higgins' eye pearlymussel (*Lampsilis higginsii*). As mentioned in Section 2.2.5, past actions that have adversely affected the freshwater mussels (including the Higgins' eye pearlymussel) within the Upper Mississippi River have included the pearl button and cultured pearl industries, siltation, chemicals, establishment and maintenance of the navigation channel, commercial and recreational navigation, and introduced species (particularly the zebra mussel). Channel navigation maintenance activities are now routinely coordinated with the FWS and state natural resource agencies in order to minimize or avoid impacting riverine habitat. Nevertheless, in its Biological Opinion for the operation and maintenance of the navigation channel on the Upper Mississippi River (FWS 2000b), the FWS determined that the project (continuation of current operation and maintenance activities for another 50 years) would jeopardize the continued existence of the Higgins' eye pearlymussel. The major adverse effect would be associated with continuing upstream transport of zebra mussels by barge traffic. Currently, there are no effective ways to control established populations of zebra mussels at the scale required to eliminate their threat to the Higgins' eye pearlymussel (FWS 2003). The reintroductions of the endangered mussel into rivers from which it has been extirpated have been conducted since 2000, but it is too early to determine the success of these reintroductions (FWS 2003).

Maintenance activities (e.g., dredging, disposal, clearing and snagging, channel revetments) may affect individuals or populations of the Higgins' eye pearlymussel at a local scale. However, through the Section 7 process of the Endangered Species Act, impacts to the mussel from these activities would be avoided or minimized (FWS 2000b). Similarly, permit requirements under Section 401 and 404 of the Clean Water Act and Section 7 consultation would avoid or minimize future impacts to the Higgins' eye pearlymussel from barge fleeting and port facility developments. Permit requirements and Section 7 consultation would also be required for other developments (e.g., power plants) within the Upper Mississippi River. Therefore, potential impacts to the Higgins' eye pearlymussel from these types of future developments would be small to negligible. For example, MidAmerican Energy relocated a portion of a mussel bed that was located within the proposed outfall area for a 500-megawatt generating facility near Cordova, Illinois. This effort was successful in relocating mussels, including Higgins' eye pearlymussels, allowing the plant to be conducted without adversely impacting the species (MidAmerican Energy Holdings Company 2001). However, other residential, industrial, and recreational activities not requiring Section 7 consultation or water quality permits would be likely to increase in the future, and may alter habitat conditions for the Higgins' eye pearlymussel (FWS 2000b).

As discussed in Section 4.8.1, there is the potential for other non-native species to become established within the Upper Mississippi River in the future. One non-native mussel that could impact the Higgins' eye pearlymussel in the same manner as the zebra mussel is the quagga

mussel (*Dreissena bugensis*). This species is already established in the lower Great Lakes and has been found in the Upper Mississippi River near St. Louis, Missouri (FWS 2000b). If the black carp becomes established in the Upper Mississippi River, it could pose a threat to the Higgins eye pearlymussel because it feeds upon mussels (Chick 2002).

There are only 10 Essential Habitat Areas for the Higgins' eye pearlymussel within the entire Upper Mississippi River watershed (one in the Wisconsin River, three in the St. Croix River, and six in the Mississippi River) (FWS 2003). Only two of these Essential Habitat Areas, both located in Wisconsin, are located within the 3-m (9-ft) navigation channel (FWS 2000b). One of the Essential Habitat Areas is located 1.6 to 4.0 km (1.0 to 2.5 mi) downstream from the Quad Cities site at Cordova, Illinois. The presence of the Higgins' eye pearlymussel in this area suggests that the operation of Quad Cities Units 1 and 2 has not adversely affected the species. Walleye (which are annually released as part of the fish production operation at the Quad Cities site) is one of several suitable host species for Higgins' eye pearlymussel glochidia (FWS 2003). Thus, the release of walleye may have a small benefit to the mussels that occur downstream from the Quad Cities site. However, the Essential Habitat Area at Cordova, Illinois (as well as the two in Wisconsin that occur within the navigation channel) has become severely infested with zebra mussels (FWS 2003).

4.8.6.2 Terrestrial Species

Six Federally listed terrestrial species may occur in the area of the Quad Cities site and its associated transmission lines (Table 2-3). However, five of these species, the Indiana bat, Iowa Pleistocene snail, western and eastern prairie fringed orchids, and the prairie bush-clover, have not been reported from the Quad Cities site or its associated transmission lines. The staff, as a result, determined in Section 4.6 that continued operation of Quad Cities would have no effect on any of these five species. Therefore, the continued operation of Quad Cities will not contribute to a regional cumulative impact on these five federally listed species, regardless of whether or not other actions occur that could have adverse impacts.

The only Federally listed species known to occur near the Quad Cities site and its associated transmission lines is the bald eagle. As mentioned in Section 2.2.6, the increases in the bald eagle population prompted downlisting from Federally-endangered to Federally-threatened status in 1995 and the species is currently proposed for delisting (64 FR 36453 [FWS 1999]). Past actions that have adversely affected the bald eagle include the widespread use of DDT and other organochlorine pesticides shortly after World War II for mosquito control. Eagles ingested dichloro-diphenyl-trichloroethane (DDT) contaminated fish which caused thinning of the shells of their eggs, which in turn resulted in nesting failures. The use of DDT was banned in 1972 by the U.S. Environmental Protection Agency, marking the first major step in the bald eagle recovery. Other past actions adversely impacting the bald eagle include the construction of impoundments and water level regulation (i.e., altering habitats and species composition), extensive logging and agricultural conversion, urban development, dredging, channel structures

and revetments, tow traffic, development of fleeting areas and port facilities, human disturbance (especially during critical nesting periods, March through May for this region) and recreational activities (FWS 2000b).

Prior to the first Europeans arriving on the North American continent, it is estimated that 250,000-500,000 bald eagles were extant in 45 of the 48 contiguous states. The breeding range of the bald eagle was greatly impacted and diminished during the 1800-1900's, with present day breeding primarily occurring in northern California, Alaska, Oregon, Washington, Minnesota, Wisconsin, Michigan, Maine, the Chesapeake Bay area, Florida, the tri-state corner of Idaho, Montana, and Wyoming, and in parts of Canada (FWS 2000a). The lowest estimated nesting pairs for the lower 48 contiguous states occurred in 1963 with 487 counted. Recovery efforts across the states have resulted in this number rising to approximately 6,000 nesting pairs in 1998 and with close to 7,000 young produced (FWS 2000b). The proposal for delisting occurred on July 6, 1999 (64 FR 36453 [FWS 1999]). Specifically, the recovery goal for the northern states recovery region, within which the Quad Cities site and its associated transmission lines occur, is to re-establish a self-sustaining population and to have 1200 occupied breeding areas by the year 2000. This goal was achieved and exceeded with over 2,000 occupied territories in the northern state region in 1998 (FWS 2000b).

The Upper Mississippi River System represents an area of significant winter use for the bald eagle, especially in areas where the river is not frozen over and adequate perch sites are available. These areas provide important and stable feeding areas during periods where high caloric intake is needed (FWS 2000b). As discussed in section 2.2.6, the open water areas in the Mississippi River created by the warm water discharges from Quad Cities represent a feeding area for the bald eagle and the forest bottomlands within the vicinity offer suitable perching sites. It is not surprising that the bald eagle has a known and successful (i.e., in producing young) nesting site upstream of the site, while many bald eagles have been noted and documented to use areas near and in the vicinity of Quad Cities and its transmission lines during winter. The FWS notes that high use areas, during winter, within this northern states region include those areas with heated effluent discharged by power plants (FWS 2000b; Nelson 2003a). Furthermore, it is noted by the FWS (2000b) that during most winters, considerable open water exists for bald eagle use in the region and such habitat is not limiting for this species.

Three habitat components for winter bald eagle management exist and include (1) feeding, (2) daytime perching, and (3) night roost areas. The preferred perching areas are trees within 30 m (100 ft) of the shore (FWS 2000b). The Quad Cities site and some of its transmission lines offer excellent feeding and daytime perching sites (i.e., Rock Island and Davenport transmission lines in particular). Removal or disturbance of roost sites could adversely affect bald eagles, causing them to abandon the use of their wintering areas; protection of these sites is therefore important (FWS 2000b). The staff expects that Exelon, MidAmerican, Alliant, and their vegetation management contractors will work with the FWS and State agencies to ensure

that any maintenance operations for the transmission lines minimize any adverse impacts on the bald eagle (Cunningham 2003; Exelon 2003d; Exelon 2003e).[(a)]

The staff determined in Section 4.6 that continued operation of Quad Cities is not likely to adversely affect the bald eagle. Maintenance activities (e.g., dredging, disposal, clearing and snagging, channel structures/revetments) may affect the bald eagle locally. However, through the Section 7 process of the Endangered Species Act, impacts to the bald eagle from these activities would be avoided or minimized (FWS 2000b). In addition, the geographic area under this review is largely rural and agricultural with not much opportunity for further timber clearing and agricultural conversion (i.e., it is already predominantly converted to agricultural use). Further urban development would, in all likelihood, impact agricultural areas, as natural areas are protected within the Upper Mississippi River NWFR and the Princeton Wildlife Management Area in the vicinity of Quad Cities Station. Human disturbance, as a consequence, is minimized by their management strategies. Quad Cities is not planning any refurbishment activities in the future and is not aware of other activities in the vicinity of the Quad Cities facility that would contribute to the cumulative impact on the bald eagle.

Based on the expectation that Exelon, MidAmerican, Alliant and their contractors will implement BMPs for vegetation management and the staff's finding that there will be no adverse impacts on threatened or endangered species during the period of extended operations, the staff has determined that the cumulative impacts to threatened or endangered species due to continued operation of the Quad Cities site and associated transmission lines would be SMALL, and that additional mitigation measures would not be warranted.

4.8.7 Conclusions Regarding Cumulative Impacts

The staff considered the potential impacts resulting from operation of Quad Cities Units 1 and 2 during the license renewal term and other past, present, and future actions in the Quad Cities area.

For each impact area, the staff's determination is that the potential cumulative impacts resulting from operation during the license renewal term are SMALL, and additional mitigation is not warranted.

(a) Personal communication between Ed Britton, District Manager, Savanna District, Upper Mississippi River NWFR, May 8, 2003.

4.9 Summary of Impacts of Operations During the Renewal Term

Neither Exelon nor the staff is aware of information that is both new and significant related to any of the applicable Category 1 issues associated with the Quad Cities operation during the renewal term. Consequently, the staff concludes that the environmental impacts associated with these issues are bounded by the impacts described in the GEIS. For each of these issues, the GEIS concluded that the impacts would be SMALL and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

Plant-specific environmental evaluations were conducted for 13 Category 2 issues applicable to Quad Cities operation during the renewal term and for environmental justice and chronic effects of electromagnetic fields. For 12 issues and environmental justice, the staff concluded that the potential environmental impact of renewal term operations of Quad Cities would be of SMALL significance in the context of the standards set forth in the GEIS and that additional mitigation would not be warranted. In addition, the staff determined that a consensus has not been reached by appropriate Federal health agencies regarding chronic adverse effects from electromagnetic fields. Therefore, no evaluation of this issue is required.

For one issue, the staff's conclusion is that the potential environmental impact of renewal term operations of Quad Cities Units 1 and 2 is greater than SMALL. The staff concludes that the impact of the potential for electric shock is MODERATE on the portions of the north Nelson line where calculated induced currents exceed 5 mA. For this issue, consideration of further mitigation by the transmission line owner, Exelon Power Delivery, is recommended.

4.10 References

10 CFR Part 51. Code of Federal Regulations, Title 10*, Energy,* Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions.”

36 CFR Part 800. Code of Federal Regulations, Title 36*, Parks, Forest, and Public Property,* Part 800, “Protection of Historic and Cultural Resources.”

40 CFR 125. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 125, "Criteria and Standards for the National Pollutant Discharge Elimination System (NPDES)."

40 CFR 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

40 CFR 1508. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1508, "Terminology and Index."

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