CHAPTER 3

Plant Description

This chapter describes potential impacts from possible plant designs on the selected EGC ESP Site. The specific reactor type for the EGC ESP Site has not been selected; however, sufficient information from a range of possible facilities is available to characterize the proposed development to support the application for an ESP. The bounding parameters outlined in this chapter and in Table 1.4-1 of the SSAR help ensure proper decisions about potential facilities and impacts at the site.

The EGC ESP Facility will be essentially independent of the CPS. With the exception of using the CPS UHS as a source of makeup water, no CPS safety-related systems or equipment will be shared or cross-connected. Raw water for cooling water makeup and other facility services will be provided from a new intake structure located on Clinton Lake adjacent to the CPS intake structure. Facility discharges will use the CPS discharge flume as a discharge path to Clinton Lake. Some structures, such as a warehouse, training buildings, and parking lots, may be shared. Some support facilities, such as domestic water supply and sewage treatment, may also be shared. The existing switchyard will be expanded to accommodate the output of the new facility and to provide the necessary off-site power. Detailed information about the EGC ESP Facility is presented in the sections that follow.

This chapter is organized into the following sections:

- External Appearance and Plant Layout (Section 3.1);
- Reactor Power Conversion System (Section 3.2);
- Plant Water Use (Section 3.3);
- Cooling System (Section 3.4);
- Radioactive Waste Management Systems (Section 3.5);
- Nonradioactive Waste Management Systems (Section 3.6);
- Power Transmission System (Section 3.7); and
- Transportation of Radioactive Materials (Section 3.8).

For purposes of this ER, the site is defined as the property within the CPS fenceline (see Figure 2.1-3). The vicinity is the area within a 6-mi radius from the centerpoint of the site. The region of the site is the area between a 6-mi radius and a 50-mi radius from the centerpoint of the site.

3.1 External Appearance and Plant Layout

The specific technology and design for the proposed reactor(s) have not been selected. Sufficient information from a range of possible plants is available to characterize the proposed development to support the application for an ESP. An architectural rendering of the plant including landscaping will be provided at the COL phase because a specific plant design has not been selected.

The following description is based on generic plant characteristics associated with the various nuclear reactor technologies.

Seven advanced nuclear reactor design alternatives were used to develop bounding information necessary to support this application. The proposed development at the EGC ESP Site may be any one of the following advanced reactor designs, or a new design that falls within the range of surrogate plant parameter information developed to characterize the proposed development:

- PBMR – 8 modules;
- ABWR – 1 unit;
- AP1000 – 2 units;
- ESBWR – 1 unit
- IRIS – 3 units;
- GT-MHR – 4 modules; and
- ACR-700 – 2 units.

The gas reactors are of a low profile design and consist of modular arrangements of four and eight units for the GT-MHR and PBMR, respectively. The water reactors (i.e., the three-unit IRIS, dual-unit AP1000 and ACR-700, and the single-unit BWRs) are similar in appearance to the facility at the CPS.

A set of composite (or bounding) plant parameter values was developed to consider the values for the selected plant designs. Engineering judgment was applied so that the EGC ESP Facility is properly characterized. These PPEs values were used in the following sections of this document and were obtained from Table 1.4-1 of the SSAR.

3.1.1 Plant Location

The site chosen by the Applicant for an ESP is colocated on the CPS Site. This site is located in Harp Township, DeWitt County, approximately 6-mi east of the City of Clinton in Illinois. The EGC ESP Facility will be located approximately 700-ft south of the CPS. Detailed information regarding the proposed EGC ESP Site is provided in Chapter 2.

3.1.2 Planned Physical Activities

If the ESP is granted, and at EGC's discretion, EGC may perform the activities listed below:

- Preparation of the site for construction of the facility (such as clearing, grading, and construction of temporary access roads and borrow areas).
- Installation of temporary construction support facilities (such as warehouse and shop facilities, utilities, concrete mixing facilities, docking and unloading facilities, and construction support buildings).
- Excavation for facility structures.
- Construction of service facilities (such as roadways, paving, RR spurs, fencing, exterior utility and lighting systems, transmission lines, and sanitary sewerage treatment facilities).
- Construction of structures, systems, and components, which do not prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public.
- Drilling of sample/monitoring wells or additional geophysical borings.
- Construction of facility cooling tower structure(s) that are not safety-related.
- Construction of facility intake structures that are not safety-related.
- Installation of non-safety-related fire detection and protection equipment.
- Expansion of the CPS switchyard to accommodate the construction of the proposed EGC ESP Facility.
- Expansion of the CPS transmission system and substation (will not be performed by EGC).
- Modification of the CPS discharge flume to accommodate the EGC ESP Facility outflow (will not be performed by EGC and modification to the CPS NPDES permit may be required).

3.1.3 Station Layout and Appearance

The EGC ESP Facility will be a large industrial facility similar in general appearance to the CPS. The EGC ESP Facility may consist of a single reactor (unit) or multiple reactors (modules). As stated in the introduction, the EGC ESP Facility will be essentially independent of the CPS. With the exception of using the CPS UHS as a source of makeup water, no CPS safety-related systems or equipment will be shared or cross-connected. Clinton Lake will be used as a source of makeup water for the cooling water system. The CPS discharge flume will also be used for the EGC ESP Facility. Additional facilities, such as offices, a water intake structure, non-safety-related cooling tower structure(s), a security building, and miscellaneous storage buildings will also be constructed (see Figure2.1-4). The structures will be made of concrete, wood, and wood with metal siding. In addition, it will be made at a maximum height of approximately 234-ft above grade. Some structures, such as warehouse and training buildings and parking lots, may be shared with the CPS. Some support facilities, such as domestic water supply and sewage treatment, may also be shared.

Full wet or dry/wet cooling systems may not be feasible options during severe drought conditions, but were assumed for most purposes throughout this chapter because they require the most significant water usage. As such, if required by reactor design, UHS cooling towers of the mechanical draft type will be located adjacent to the plot plan area on the southeast side, and will encompass 0.5 ac of land. The estimated height of these cooling towers is 60 ft (see SSAR Table 1.4-1).

Normal heat sink (NHS) cooling towers, either mechanical draft or natural draft hyperbolic types, for the normal (non-safety) plant cooling services will be located southeast of the major facility structures and will require a maximum siting area of approximately 50 ac. The estimated dimensions of the natural draft towers are 550-ft high and 550 ft in diameter (see SSAR Table 1.4-1).

Raw water for cooling water makeup and other facility services will be provided from a new intake structure located on Clinton Lake adjacent to the CPS intake structure. Cooling tower blowdown and other facility discharges will use the CPS discharge flume as a discharge path to Clinton Lake.

The existing switchyard will be expanded to accommodate the output of the new facility and to provide the necessary off-site power. The switchyard area intended for the planned CPS Unit 2 will be utilized for this purpose. Existing transmission right-of-way will be used. Detailed information regarding this subject area is presented in Section 4.1.2.

The EGC ESP Facility footprint and layout is presented in Figure 2.1-4 and Figure 2.1-5. The figures depict the location of the new power block structure, the new intake structure, safety- and non-safety-related cooling towers, and the discharge flume to Clinton Lake.

3.1.4 Aesthetic Appearance

The EGC ESP Site will have a power block structure that could be up to 234-ft tall. The heat dissipation system could have a height of up to 550 ft, as mentioned above, and would slightly alter the visual aesthetics of the site. The CPS Site already exhibits an industrial environment; therefore, the EGC ESP Site will not substantially alter an already visually disturbed site. Any visual impacts from the visible plumes from the EGC ESP Facility will be similar to those associated with the CPS. There is the potential that an additional visible plume will result from the heat dissipation system.

The viewshed of the EGC ESP Facility is limited to a few residences and recreational users in the vicinity. Based on the fact that the EGC ESP Site will have similar visual impacts as the CPS (with the exception of the new plume from the heat dissipation system assumed for the EGC ESP Facility), the EGC ESP Site will have a minor impact on aesthetic quality for nearby residences and recreational users of Clinton Lake. Therefore, no mitigation will be provided.

3.2 Reactor Power Conversion System

Although the specific technology and design for the proposed reactor(s) have not been selected, bounding information for the reactors including the number of units, core thermal power, gross and net electrical output, and engineered safety features are provided in Table 1.4-1 of the SSAR. Provided in the following section is a generic description of the power conversion systems for the advanced reactors under consideration.

The bounding parameters indicate that the proposed reactor(s) could generate up to 6,800-MW core thermal power. In general, the ABWR (one unit) is rated at 3,926 MWt, the AP1000 (two units) is rated at 6,800 MWt, the IRIS (three units) is rated at 3,000 MWt, the GT-MHR (four modules) is rated at 2,400 MWt, the PMBR (eight modules) is rated at 3,200 MWt, the ESBWR (one unit) is rated at 4,000 MWt, and the ACR-700 (two units) is rated at 3,966 MWt.

The power conversion system utilized by the advanced reactors under consideration would include the following:

- Water cooled reactor plants, which use a steam-turbine to generate power from the reactor heat; and
- Gas cooled reactor plants, which use a gas-turbine to generate power from the reactor heat.

Both types of turbines reject exhaust heat to the normal plant cooling system.

3.3 Plant Water Use

The following paragraphs provide the anticipated and maximum plant water usage for the range of advanced reactors being considered. The design parameters presented were obtained from Table 1.4-1 of the SSAR. A water balance diagram (see Figure 3.3-1) and water balance table (see Table 3.3-1) are provided for convenience.

As described in more detail in Section 5.2, a drawdown analysis was completed to determine the capacity of the cooling water supply during dry periods. The results of the drawdown analysis, in terms of total water available or water available for new plant withdrawal, are presented in Table 5.2-3. Water requirements for the bounding plant and various cooling options is presented in Table 5.2-2. The results indicate the consumptive use limitations for the 50- and 100-yr droughts would not maintain the required minimum lake level and discharge to Salt Creek for the wet cooling system designs unless there is a short-term reduction in the plant load factor that would maintain minimum lake levels during these drought conditions. Cooling system designs that would maintain the minimum lake level and discharges to Salt Creek during the 50- and 100-yr droughts without limiting plant operations are the dry/wet cooling process (barely exceeds bounding parameter for the 100-yr drought) and the dry cooling process.

Full wet or dry/wet cooling systems may not be feasible options during severe drought conditions, but were assumed for most purposes because they require the most significant water usage.

Some cooling designs proposed may require the use of UHS cooling towers while others may utilize once-through cooling. A backup supply of emergency makeup water for the proposed UHS cooling will be provided from the submerged pond located at the bottom of Clinton Lake, which also serves as the UHS for the CPS with a failure of the dam on Clinton Lake. The CPS submerged UHS contains sufficient water inventory to provide shutdown cooling makeup water for the EGC ESP Facility for 30 days, and simultaneously provide shutdown cooling for the CPS following an accident.

Wastewater discharges from the proposed facility will be in strict compliance with an approved NPDES permit issued by the IEPA. This permit will make certain that discharges are controlled from systems (such as flumes, sewage treatment facilities, radwaste treatment systems, activated carbon treatment systems, water treatment waste systems, facility service water, stormwater runoff, etc.) to Clinton Lake. The effect on water quality in Clinton Lake due to the operation of the proposed facility will be carefully monitored in full compliance with the NPDES permit.

Additional information describing the NHS and UHS facility and emergency cooling systems is provided in Section 3.4.

3.3.1 Water Consumption

Most of the water that will be withdrawn from Clinton Lake and utilized for cooling is not consumptive as most will be returned after use as cooling tower blowdown. Values for water consumption and water supply were obtained from Table 1.4-1 of the SSAR.

3.3.1.1 Water Supply

The makeup water supply for the NHS and the UHS cooling will be taken from Clinton Lake. Pumps for the makeup water will be located in a new intake structure positioned next to the CPS intake structure.

Wet/dry cooling towers may be used to reduce makeup water consumption, if required, to match water demand with the available water supply.

3.3.1.2 Water Requirements

The raw water requirements for the EGC ESP Facility are presented in Table 3.3-2. This is the total of the water usage for potable/sanitary water supply, demineralized water production, filtered water production, and the cooling system makeup. This quantity includes the water required from Clinton Lake for the cooling tower makeup. The cooling tower makeup value presented is based on a conventional wet tower and represents the maximum expected value required during startup or adjustments to the blowdown in order to control water chemistry. Normal values presented in Table 3.3-2 are the continuous water usage requirements. The maximum values are intermittent demands that may occur during system-upset conditions or startup.

3.3.1.3 Cooling Water Discharges

The cooling water thermal discharges into Clinton Lake from the operation of the EGC ESP Facility are presented in Table 3.3-3. This is the summation of the cooling system blowdown discharges from towers.

Normal values were used to determine continuous water discharge quantities to Clinton Lake. The maximum values are intermittent flow rates that may occur during system-upset conditions, shutdown, or startup. The loss of water from Clinton Lake is the water supply requirement minus the discharges, since the discharges are returned to Clinton Lake.

The UHS for CPS is the volume of water retained by a submerged dam if Clinton Lake's main dam fails and drains. The volume of water retained in the UHS must provide shutdown cooling for the CPS. In addition, it is also the source of safety-related makeup water for the EGC ESP Facility safety-related cooling towers.

3.3.2 Water Treatment

The materials in the primary system of most of the proposed reactors will be primarily composed of austenitic stainless steel and Zircaloy cladding. For those reactors that use water as the primary coolant, reactor water chemistry limits will be established to provide an environment favorable to these materials. Design limits will be placed on conductivity and chloride concentrations. Operationally, the conductivity will be limited because it can be continuously and reliably measured, and it will give an indication of abnormal conditions and the presence of unusual materials in the coolant. Chloride limits will be specified to prevent stress corrosion cracking of stainless steel. During normal operation, condensate water will be processed through a condensate treatment system. This process consists of softening/filtration (probably some type of reverse osmosis filtration system to remove suspended particles and to purify) and demineralization (mixed resin beds or electro demineralization). The cleanup system will be provided for removal of impurities

resulting from fission products and corrosion products formed in the primary system. The cleanup process will serve to maintain a high level of water purity in the reactor coolant and to reduce contamination levels and minimize corrosion. A specific design has not been selected and the above paragraph only generically addresses the specifics of the cooling, filtration, and purification systems. Once a design is selected, more detailed information will be provided.

It is expected that chemical treatment of the cooling water and water processed through the reactor coolant cleanup system will be required on a periodic basis. This may entail the use of scale inhibitors, corrosion inhibitors (chloride), and sulfuric acid for pH adjustment.

Biological defouling of the cooling towers and the shell side of the primary heat exchangers with biocides, dispersants, and molluskicides may also be required on a periodic basis. During colder months, it may be necessary to incorporate a deicing compound into the cooling water if a wet cooling system is selected for the proposed EGC ESP Facility.

Potable water used throughout the plant will also be processed through the reverse osmosis filtration system and, if necessary, be treated with an anti-bacterial inhibitor (such as chlorine), and sampled on a monthly basis.

The chemicals used will be subject to review and approval for use by the IEPA. The total residual chemical concentrations in the discharges to Clinton Lake will be subject to discharge permit limits established by the IEPA. More detailed information regarding the specific types, quantities, and frequency of chemical addition will be provided after a specific reactor type is selected.

Estimated bounding blowdown constituents and concentrations are presented in Table 3.6-1 for the proposed EGC ESP Facility.

3.4 Cooling System

Details regarding the design of intake and discharge structures and cooling system comparison tables for the proposed reactor cooling systems will be presented at the COL phase. The design parameters presented in the following sections were obtained from Table 1.4-1 of the SSAR. The following section presents generic descriptions of the cooling system operational modes, component descriptions, NHS, UHS, and cooling system instrumentation. These design parameters help determine the environmental impacts on the EGC ESP Site and the suitability of the site for a nuclear facility. Additionally, even though the exact design for the ultimate reactor has not yet been selected, the information presented in this section is nevertheless sufficient to evaluate the impacts of the facility represented by the PPE information contained in the SSAR.

Based on the results of the drawdown analysis summarized in Section 3.3, full wet or dry/wet cooling systems may not be feasible options during severe drought conditions, but were assumed for most purposes because they require the most significant water usage.

3.4.1 Description and Operational Modes

3.4.1.1 Normal Heat Sink

The NHS provides cooling water for condensing turbine exhaust steam and cooling the turbine auxiliaries in a light water reactor plant, helium cooling in a gas cooled reactor plant, and the cooling water for other non-safety plant components.

The operation of the EGC ESP Facility will result in a significant amount of heat dissipation to the atmosphere. The cooling system options that have been conceptualized and could be incorporated into the facility design will transfer waste heat from plant components to the atmosphere, surface water, or the earth.

Described below are some of the options that are being proposed.

Proposed wet cooling systems that will utilize mechanical or natural draft cooling towers will use evaporative cooling to transfer heat from closed loop process water systems to the atmosphere. Within a wet cooling tower, hot process water will be piped through the cooling tower where non-contact cooling water is sprayed in at the top of the tower, cooling the process water. Significant amounts of cooling water can be lost by evaporation.

Proposed dry cooling systems will transfer heat to the atmosphere by pumping hot process water through a large heat exchanger or radiator, over which ambient air is passed to transfer heat from the process water to the air. This is a closed non-contact process, thus, no water is lost to evaporation, and there is no visible water vapor. The temperature of the ambient air will be elevated through the cooling process. The warm air rises naturally and dissipates into the local atmosphere, typically with no visible effects. Dry cooling is less efficient than wet cooling; therefore, dry cooling systems tend to be much larger and more costly than wet cooling systems.

Proposed hybrid wet/dry cooling systems will use a combination of the wet and dry cooling methods.

Proposed surface water cooling systems will include the use of cooling ponds, lakes, and streams. Lake cooling is the primary cooling process used by the CPS. Heated non-contact cooling water is cooled by contact with the soil and air as the water passes down the discharge flume and around the Clinton Lake cooling loop, back to the plant intake. Evaporation also occurs at an elevated rate due to the increased lake water temperature.

As stated above, full wet or wet/dry cooling processes have been assumed for most purposes because, out of the options proposed, they have the greatest consumptive water usage. As such, the NHS will provide the cooling water required for the non-safety-related facility components during normal operation and normal shutdown. The cooling water source for the NHS will be from cooling towers. Circulating water and service water pumps will take suction from the cooling tower basins and supply water to the components for cooling. The heated water from the components will be returned to the cooling towers for rejection of the heat to the atmosphere. The cooling systems that use water from the NHS are described in the reactor manufacturers' standard design documentation and the SSAR.

Blowdown, from the circulating water and service water system pumps, will be used to control the concentration of impurities in the water due to evaporation in the cooling towers.

3.4.1.2 Ultimate Heat Sink

The UHS will provide safety-related cooling water to the various reactor plant cooling water systems and components that are used for accident mitigation, safe shutdown, and maintenance of the units in a safe shutdown condition. It is assumed that safety-related cooling towers will provide the UHS function for the EGC ESP Facility; however, other options are being considered as mentioned above. Normal makeup water for the UHS cooling towers will be obtained from Clinton Lake and emergency makeup water will be supplied from the submerged pond located at the bottom of Clinton Lake. The submerged pond was constructed for the CPS in order to provide the UHS function if the Clinton Lake Dam fails.

3.4.2 Component Descriptions

Safety-related cooling towers of the mechanical draft type will be located adjacent to the EGC ESP Facility and will provide the cooling water required for the safety-related facility components during normal operation. Natural draft type or mechanical draft cooling towers will be provided for the normal (non-safety) facility cooling services. A new intake structure will be added to the Clinton Lake shoreline for use by the EGC ESP Facility while the CPS discharge flume will be modified to accommodate the new facility discharges.

3.4.2.1 EGC ESP Intake Structure

A new intake structure will be constructed to accommodate both the NHS and UHS functions for the EGC ESP Facility. The amount of shoreline and bottom that would be disturbed is an insignificant percentage of the total for Clinton Lake. The approximate intake dimension of 100-ft wide by 150-ft deep (shore to lake dimension) has been estimated based on intake velocity and flow rate.

3.4.2.2 Clinton Power Station Discharge Flume

The CPS discharge flume will have to be modified to accommodate discharges from the EGC ESP Facility. The only modification to the discharge flume will be to connect discharge pipes from the EGC ESP Facility to the discharge flume. Discharge pipe connections will be in the portion of the existing flume discharge structure that was originally provided for the circulating water discharge from the cancelled CPS Unit 2.

3.4.2.3 Normal Heat Sink

The cooling systems that use water from the NHS are either described in the reactor manufacturers, standard design documentation, or do not presently exist. Information that is available is limited to a description of the supply and discharge of the cooling water external to the standard plant package. Once the specific reactor design is selected, information will be summarized in this section.

The NHS provides the cooling water required for the non-safety-related station components during normal operation. The cooling water source for the NHS is from cooling towers. Circulating water and service water pumps take suction from the cooling tower basins and supply water to the components for cooling. The heated water from the components is returned to the cooling towers for rejection of the heat to the atmosphere.

The makeup water supply for the NHS cooling towers will be taken from Clinton Lake. Pumps for the makeup water will be located in a new intake structure, and positioned next to the CPS intake structure. The intake water for the facility will pass through bar racks or similar devices in order to remove large debris. In addition, it will also pass through traveling screens in order to remove smaller debris before entering the pump suction chamber. The approach velocity to the intake will be limited to a maximum velocity of 0.50 fps at the normal lake level elevation of 690 ft above msl. Trash collection baskets will be provided to collect trash from the screen washwater, for approved disposal, before the washwater is discharged to Clinton Lake. Strainers will be provided on the makeup pump discharges and when the strainer backwash water is returned to Clinton Lake. Several plant cooling options are being considered that may be used to reduce makeup water consumption, if required, to match water demand with the available water supply. However, for conservatism in determining impacts, either full wet or a combination wet/dry system will be used, as stated previously.

The maximum discharge flow to the NHS cooling towers is estimated to be 1,200,000 gpm during normal operation. The maximum heat load on the NHS cooling system is anticipated to be 15.08E+09 British thermal units per hour (Btu/hr) during normal operation.

As noted above, the CPS discharge flume will be modified to accommodate the EGC ESP Facility outflow. Engineering evaluations have not been performed to estimate the extent of the modifications but will be performed at the COL phase. The discharge from cooling tower blowdown will normally be 12,000 gpm with a maximum flow of 49,000 gpm (see Table 1.4-1 of the SSAR). The temperature of the blowdown discharge to the CPS discharge flume is estimated to be a maximum of 100°F. The blowdown temperature is dependent on the wet bulb temperature and will decrease with wet bulb temperatures less than 85°F.

3.4.2.4 Ultimate Heat Sink

The UHS system will pump water from the safety-related (essential service water) cooling tower basins through the components cooled by the system. The water will then be returned to the cooling towers for heat rejection to the atmosphere. Normal makeup water for the UHS cooling tower basins will be supplied from Clinton Lake. Emergency makeup water will be supplied from the submerged pond below Clinton Lake in the event that Clinton Lake dam fails. Pumps for the normal and emergency UHS makeup water will be located in a new intake structure, the same one used for the NHS cooling towers, and positioned next to the CPS intake structure. Detailed design information regarding the new intake structure is not presently available but will be provided at the COL phase. Blowdown, from the discharge of the UHS system pumps, will be used to control the concentration of impurities in the water due to evaporation in the cooling tower.

The cooling systems that use water from the UHS are either described in the reactor manufacturer’s standard design documentation or the information does not presently exist. Information that is available is limited to a description of the supply and discharge of the cooling water external to the standard plant package. Once the specific reactor design is selected, information will be summarized in this section. However, it is assumed that the UHS system will consist of a minimum of two redundant cooling divisions (trains), such that adequate cooling is provided with a single failure including a failure that renders one cooling tower inoperable. The quantity of pumps in each division (train) and the number of divisions of safety-related cooling water pumps, heat exchangers and piping, will be provided to satisfy the requirements of the reactor manufacturer’s standard plant design.

The maximum discharge flow from the UHS cooling system to the UHS cooling towers is 26,125 gpm during normal operation and 52,250 gpm during shutdown (see Table 1.4-1 of the SSAR). The maximum heat load on the UHS cooling system is 2.25E+08 Btu/hr during normal operation and 4.11E+08 Btu/hr during shutdown. The discharge from UHS cooling tower blowdown is normally 100 gpm with a maximum blowdown of 700 gpm. The maximum temperature of the UHS blowdown discharge is 95°F.

3.4.2.5 Instrumentation

Temperature monitoring instrumentation will be provided in the blowdown discharge pipe to monitor the discharge temperature.

3.5 Radioactive Waste Management Systems

Detailed information regarding the description of the liquid and gaseous radioactive waste management and effluent control systems; process/instrumentation diagrams; system process flow diagrams of the liquid and gaseous radioactive waste management and effluent control systems; identification of principal release points; identification of sources of radioactive liquid and gaseous waste materials to the environment; and identification of direct radiation sources stored on site as solid waste will be provided at the COL phase.

This section provides a list of the bounding quantity of radioactive wastes that are projected to be generated, processed, and stored or released annually in liquid and gaseous effluents, and in the form of solid waste from the EGC ESP Facility. Radioactive waste management and effluent control systems will be designed to minimize releases from active reactor operations to values as low as reasonably achievable (ALARA). The EGC ESP Facility radioactive waste systems have been evaluated against the requirements of 10 CFR 20 and 10 CFR 50, Appendix I. The systems are capable of meeting the design objectives of 10 CFR 20 and 10 CFR 50, Appendix I, and will be maintained in accordance with ALARA principles, be protective of the environment, and will minimize radiological doses to the public. Maximum individual and population doses during normal plant operations are provided in Section 5.4.

3.5.1 Liquid Radioactive Waste Management System

Radioactive isotopes are produced as a normal by-product of reactor operations. A small quantity of these radionuclides can contribute to the normal radioactive liquid effluents from the plant. The liquid radioactive waste management system supplied with any of the alternative advanced reactor concepts is designed to control, collect, process, store, and dispose of potentially radioactive liquids during the phases of plant operation. This includes startup, normal operation, shutdown, refueling, and anticipated operational occurrences. Radioactive liquid effluents can be released from the plant to the environment via waste liquid processing systems. The process systems will be designed to minimize the releases to, and impact on, the aquatic environment. Discharges will be via the existing discharge plume of the CPS.

The release of radioactive liquid effluents from the plant will be controlled in such a manner as to not exceed the average annual effluent concentration limits (ECLs) specified in 10 CFR 20.

The proposed EGC ESP Facility will be operated such that releases of radioactive liquid effluent to Clinton Lake are expected to be negligible. To provide for a bounding assessment, the maximum quantities in Table 3.5-1 for releases of radioactive liquid wastes from the proposed reactor designs were used in the evaluation of the EGC ESP Facility. The discharge quantity is taken from the bounding isotopic releases presented in the SSAR Table 1.4-4 for all isotopes except tritium, which is provided in SSAR Table 1.4-1. The liquid waste effluent concentrations are determined based on a composite of the highest activity content of the individual isotopes from the AP1000 (two units), IRIS (three units), ABWR (one unit), ESBWR (one unit), ACR-700 (two units), GT-MHR (four modules) and the PBMR (eight

modules). The discharge flow is conservatively taken as the minimum dilution value (2,400 gpm for the GT-MHR) from SSAR Table 1.4-1.

In order to provide for operating flexibility, a bounding assessment was performed to demonstrate the capability of complying with the 10 CFR 20 and 10 CFR 50, Appendix I, regulatory requirements at the EGC ESP Site. Compliance with the 10 CFR 20 criteria is based on demonstrating that average annual concentrations of radioactive material released in the liquid effluents at the boundary of the restricted area do not exceed the values specified in 10 CFR 20.

The fraction of ECL is determined by ratioing the resulting concentrations by the 10 CFR 20 ECL limits. Table 3.5-2 was obtained from Table 3.1-5 of the SSAR, which compares the releases for those radionuclides identified in Table 3.5-1 with the 10 CFR 20 ECLs and shows compliance to 10 CFR 20 requirements.

3.5.2 Gaseous Radioactive Waste Management System

Radioactive isotopes are produced as a normal by-product of reactor operation. A small portion of these radionuclides contribute to the normal radioactive gaseous effluents from the plant. The gaseous radioactive waste processing system will be designed to control, collect, process, store, and dispose of potentially radioactive gases during the phases of plant operation. The normal gaseous effluents will be released from the plant to the environment via waste gas processing systems that are designed to minimize the releases to, and the impact on, the environment. Potentially radioactive gases will also be present in the station buildings as a result of process system leakage. These gases will be released to the environment via the building ventilation systems.

The release of radioactive gaseous effluents from the plant will be controlled and monitored so that the regulatory limits specified in 10 CFR 20 and 10 CFR 50, Appendix I, are maintained.

The maximum postulated quantity of radioactive gases released from the gaseous waste processing systems and the building ventilation systems used in the evaluation of the EGC ESP Facility is shown on Table 3.5-3. Discharge quantities are taken from the bounding isotopic releases given in SSAR Table 1.4-3 for all isotopes except tritium, which is provided in SSAR Table 1.4-1. The gaseous effluent concentrations were determined based on the projected release of a composite of the highest activity content of the individual isotopes in combination with the highest sector average annual site dispersion factor at the effluent control boundary presented in Table 3.1-2 of the SSAR.

Compliance with the isotopic limits of 10 CFR 20 was based on demonstrating that the annual average concentrations of radioactive material, which would be released in the gaseous effluents at the boundary of the restricted area, would not exceed the values specified in 10 CFR 20.

Table 3.5-4 compares the releases identified in Table 3.5-3 with the 10 CFR 20 ECLs and shows compliance with the 10 CFR 20 requirements (comparison tables were obtained from Table 3.1-1 of the SSAR).

3.5.3 Solid Radioactive Waste Management System

The solid radioactive waste management system will receive, collect, and store any solid radioactive wastes received prior to their processing and packaging for shipment off site. In addition, the solid waste management system will provide storage of operations waste prior to processing or shipment. The system will be designed to collect and store radioactive wastes in a manner that will maintain radiation exposures ALARA and perform the following objectives:

- Collect, hold for decay, monitor, package, and temporarily store the wet and dry solid radioactive wastes produced by the plant during operation and maintenance prior to off-site shipment.
- Provide a means for segregating trash by radioactivity level and temporarily store the wastes.
- Minimize exposure to solid radioactive waste materials that could conceivably be hazardous to either operating personnel or the public, in accordance with 10 CFR 20 and 10 CFR 50, Appendix I.
- Minimize the volume of solidified waste requiring shipment off site.
- Take due account (through equipment selection, arrangement, remote handling, and shielding) of the necessity to keep radiation exposure of in-station personnel ALARA.

For the alternative reactor designs considered, the average total annual volume of solid radioactive waste treated within the system is not expected to exceed 15,087 ft^3/yr (see Table 1.4-1 of the SSAR). Maximum anticipated annual activity is not expected to exceed 5,900 curies per year (Ci/yr) (see Table 3.5-5). A bounding list of the principal radionuclides expected in solid radioactive wastes is presented in Table 3.5-5. The waste will be packaged and shipped in accordance with the applicable regulatory requirements.

3.6 Nonradioactive Waste Management Systems

This section generically describes the nonradioactive waste management systems and the chemical and biocidal characteristics of the nonradioactive waste stream that will be discharged from the plant.

Nonradioactive wastes from nuclear power plants may include, but are not limited to, boiler blowdown (continual or periodic purging of impurities from auxiliary boilers), water and sanitary treatment wastes, floor and equipment drains, and stormwater runoff.

If applicable, nonradioactive wastes will be collected in the wastewater treatment system. The system will be designed to stop the discharge of wastewater upon detection of high radiation in the stream to the CPS discharge flume.

Detailed information regarding the description of the nonradioactive waste management and effluent control systems, process/instrumentation diagrams, and system process flow diagrams will be provided at the COL phase.

3.6.1 Effluents Containing Biocides or Chemicals

Principal chemical, biocide, and pollutant sources that may be used or produced during the operation of the EGC ESP Facility may include, but are not limited to, the following:

- Sodium hydroxide and sulfuric acid, which are used to regenerate resins (depending on plant design);
- Phosphate in cleaning solutions;
- Biocides used for condenser defouling;
- Boiler blowdown chemicals;
- Oil and grease from plant floor drains;
- Chloride;
- Sulphates;
- Copper;
- Iron; and
- Zinc.

The estimated concentrations of impurities in the blowdown water are presented in Table 3.6-1 (values obtained from reactor vendors and values are not site specific), and were obtained from Table 1.4-2 of the SSAR.

Other small volumes of wastewater, which may be released from other station systems, are described in the SSAR. These will be discharged from sources, such as the service water and auxiliary cooling systems, water treatment, laboratory and sampling wastes, floor drains, and stormwater runoff. These waste streams will be discharged as separate point sources or will be combined with the cooling water discharges.

The chemical waste effluents may consist of the nonradioactive wastes produced from the regeneration of demineralizers, waste discharges from reverse osmosis units, filter backwash water, and wastes from laboratory and sampling processes. Drains from radioactive sources or potentially radioactive sources will not be connected to the chemical waste drain system.

Chemical waste discharges will be collected in a tank for sampling and pH adjustment before being discharged as neutralized wastes to Clinton Lake. The chemical wastes will be routed to the discharge flume of the CPS, which flows to Clinton Lake.

It is expected that chemical treatment of the cooling water systems with biocides, dispersants, molluskicides, and scale inhibitors will be required on a periodic basis. The chemicals used will be subject to review and approval for use by the IEPA and releases will be in compliance with an approved NPDES permit. The total residual chemical concentrations in the discharges to Clinton Lake will be subject to limits that will be established by the IEPA.

As discussed in Section 5.2.2.2, the water quality of Clinton Lake is presently classified as an impaired water body by the IEPA. The causes of impairment include a Confidence Level 3 (high) Excess Algal Growth, and a Confidence Level 2 (moderate) Metals. The power plant operation is not uniquely related to either of the impairments. Algal growth is related to nutrient levels in the water column that originate from the dominant agricultural land use in the vicinity. Metals concentrations in the water column and sediment have a number of sources including natural geologic formations, agricultural practices, and industrial sources. For both impairments stormwater management and erosion control practices for sediment control are the best control option. Nutrients and metals attach to sediment and are effectively controlled with control of sediment in stormwater. Industrial pollution control practices and strategic materials selection and corrosion control are also expected to be effective in reducing metals contributions from industrial sources.

3.6.2 Sanitary System Effluents

Sanitary systems installed for preconstruction and construction activities will include the use of portable toilets, which are supplied and serviced by an off-site vendor.

Sanitary system wastes that are anticipated to be discharged to Clinton Lake during actual station operations include discharges from the potable and sanitary water treatment system. The CPS sanitary sewage treatment plant will, in all likelihood, be shared and, if necessary, be upgraded to accommodate the additional sanitary waste supplied by the EGC ESP Facility. As with the CPS, these discharges will be controlled in compliance with an approved NPDES permit for the EGC ESP Facility, to be issued by IEPA. The normal and maximum amount of sanitary discharges to Clinton Lake for the selected composite reactor are presented in Table 3.6-2 and were obtained from Table 1.4-1 of the SSAR.

3.6.3 Other Effluents

3.6.3.1 Liquid Effluents

Other effluent discharges to Clinton Lake will include discharges from the chemical waste treatment system, plant drains, and storm drainage.

The total amount of anticipated discharges from the chemical waste treatment system and plant drains to Clinton Lake is presented in Table 3.6-3 and were obtained from Table 1.4-1 of the SSAR.

Plant stormwater drainage control systems will be presented at the COL phase. Erosion and sedimentation controls for preconstruction and construction activities are discussed in Section 4.6.

3.6.3.2 Gaseous Effluents

Bounding estimates of other gaseous effluents and the total quantity of sulfur oxides (SO_x), nitrogen oxides (NO_x), hydrocarbons, and suspended particulates to be discharged annually during station operations (e.g., from diesel engines, gas-turbines, heating facilities), and elevation of the release points are provided in Table 3.6-4 and Table 3.6-5. These estimates were obtained from Tables 1.4-1, 1.4-6, 1.4-7, and 1.4-8 of the SSAR.

3.7 Power Transmission System

This section generally discusses the electric transmission system construction, which would be required in conjunction with construction of the EGC ESP Facility. Detailed information regarding the impacts from construction are presented in Section 4.1.2. The proposed facility is located in the service territory of Illinois Power Company, the regional electrical transmission system owner/operator, and adjacent to the CPS, which is owned and operated by AmerGen. Discussions with service providers have furnished the general information used to determine the amount and type of new construction required. An RTO or the owner, both regulated by Federal Energy Regulatory Commission (FERC), will bear the ultimate responsibility for defining the nature and extent of system improvements, and the design and routing of connecting transmission and the impacts of such improvements. Therefore, the construction described in this section is based on the existing infrastructure, Illinois Power Company system design preferences, and best transmission practices. The guiding assumption for transmission route design is that the new construction will follow in parallel with some of the existing transmission serving the CPS, and that it is only required to reach the nearest substation providing connection to the greater area grid. Impacts to the grid will be addressed by the system owner after submission of an interconnect request. Any such request would be premature during site selection, since the design and operating capacity of the proposed facility have not yet been determined.

The system description in this chapter assumes that construction and operation of transmission lines necessary to connect a new facility to the grid will be the responsibility of the transmission system owner, and that new studies will be performed by the RTO or the owner, under FERC regulations. The assumptions developed in this section are further based on the CPS ER, which provides the most recent data available on transmission lines and corridors in the vicinity.

3.7.1 Background

3.7.1.1 Open Transmission Requirements

EGC plans to develop a merchant generator facility at the site; the proposed site will be set aside for a unit that generates power for sale on the open wholesale market. The facility owner will not be responsible for building transmission lines. Rather, it will interconnect with the transmission system owner. Under FERC regulations, an electric transmission system provider engaged in bulk power system operations must allow new generation to interconnect to its system and request transmission services across the transmission system. Illinois Power Company's Open Access Transmission Tariff identifies processes for making an interconnection request and for requesting transmission services. Once a request is received, the transmission system owner will conduct studies to determine the impacts of the generation or transmission service on the existing system, and then identify the system improvement needed. The system improvement needs are generally based on power flow studies in order to determine the thermal capacity necessary to accommodate the power flows and system stability studies in order to determine the effects the generation will have on system stability under steady state and transient conditions given various system contingencies. These studies and additional impact studies are prepared by the transmission system owner/operator under FERC regulations and guidance.

The CPS interconnects to the Illinois Power Company transmission system. The EGC ESP Facility will rely on an interconnection with Illinois Power Company, and anticipates that the configuration of the transmission system and corridor will be similar to the existing system. The construction assumptions developed in this chapter, Chapter 4, and Chapter 5, are therefore based on the existing system, described below.

3.7.1.2 Illinois Power Company Transmission System

The existing Illinois Power Company electrical transmission system in central Illinois consists of a backbone 345-kV system and an underlying 138-kV system. The Illinois Power Company system is interconnected with the systems of other utilities at numerous locations.

The CPS interconnects to the Illinois Power Company system through a 345-kV switch station. From this switch station, there are 345-kV interconnections to the following Illinois Power Company substations:

- Brokaw, about 15 mi to the north;
- Oreana, about 9 mi to the south;
- Rising, about 25 mi to the east; and
- Latham, about 25 mi to the southwest.

Based on the information available, there is no 345-kV transmission out of the Rising substation. To the extent new transmission lines are needed, they would be interconnected to the Brokaw, Oreana, or Latham substations. Reinforcements to the 138-kV or lower voltage systems are not anticipated.

3.7.1.3 Comparative Loads

An April 2002 report by the Illinois Commerce Commission, *Assessment of Retail and Wholesale Market Competition in the Illinois Electric Industry in 2001*, indicated that the noncoincident peak demand for Illinois' investor owned electric utilities was 29,465 MW (Illinois Commerce Commission, 2002). A May 2002 Illinois Power Company report to the Commission estimated the Illinois Power Company transmission system summer 2002 peak load at 4,276 MWe. The CPS has a rated capacity of 1,138.5 MWe (CPS, 2002).

From the above data, the addition of approximately 2,180 MWe in the area would be a significant increase in the power to be carried by the system, 50 percent of the estimated 2002 Illinois Power Company transmission system's peak load.

3.7.2 Transmission System Description

The existing transmission system was sized for a larger capacity than currently used and would be able to carry some new generation. However, in order to accommodate the bounding case of an output of 2,180 MWe, new lines will be required, as there is insufficient capacity on the existing system to carry the load, and the existing structures were not designed for additional circuits. Parallel lines are required in each direction because a single line can not carry the full output of both the EGC ESP Facility and CPS. Four new transmission lines will be required to connect the EGC ESP Facility to the existing transmission grid in southern Illinois. Two parallel, double circuit transmission lines will

depart the station north to an interconnect point at the Brokaw substation near Bloomington, Illinois, approximately 15 mi from the site (see Figure 2.2-4). A second pair of parallel double circuit lines will depart the station south to an interconnect point on Illinois Power Company's Latham-Rising 345-kV line (Number 4571) at Oreana, approximately 9 mi from the site (see Figure 2.2-4). As discussed above, it is assumed that any new transmission lines related to this project would be 345 kV.

Illinois Power Company has not constructed new 345-kV transmission lines for 15 to 20 yrs. However, Illinois Power Company has an engineering standard and preferred design that consists of wood pole H-Frame support structures (see Figure 3.7-1). Pole heights are typically 80 to 100 ft with 600- to 700-ft spans between poles. The right-of-way is about 130-ft wide but varies depending on the specific location. In this case, the total required right-of-way width would be 250 ft to accommodate a pair of parallel lines. The poles are typically direct buried, with engineered foundations as needed. Single steel poles with concrete footings would be used, as appropriate. The typical line clearances above ground level will be 29 ft at 60°F conductor temperature. However, a more typical design for a double circuit line would use steel structures, either lattice tower or monopole construction. Use of steel structures would reduce the required right-of-way width to about 160 ft and increase spacing to over 800 ft.

The transmission structures will carry a double circuit line, consisting of six phases of two or three bundle conductor of 1,272 kilo circular mils (kcmil) ACSR, and two shield wires. Final conductor size will be determined by the transmission system owner based on several factors, including:

- Operating voltage;
- Loads to be carried, both initially and in the future;
- Thermal capacity;
- Cost of the conductor, support structures, foundations, right-of-way, and the present value of the energy losses associated with the conductor size and expected loading; and
- Electric and magnetic field strengths, which depend on operating line voltage, conductor currents, and conductor configuration and spacing.

Transmission system design, construction, and operation will comply with the relevant local, state, and industry standards including the National Electric Safety Code (NESC) and various ANSI/Institute of Electrical and Electronics Engineers (IEEE) standards. This includes ground clearances, electro magnetic fields (EMF), radio interference (RI), television interference (TVI), audible noise, aviation safety, and other factors as appropriate.

3.7.3 Radiated Electrical and Acoustical Noises

When an electric transmission line is energized, an electric field is created in the air surrounding the conductors. If this field is sufficiently intense, it may cause the breakdown of the air in the immediate vicinity of the conductor (corona). Corona can result in audible noise or RI and TVI. Audible noise levels are usually very low and not heard, except possibly directly below the line on a quiet day.

RI and TVI can occur from corona, electrical sparking and arcing between two pieces of loosely fitting hardware or burrs or edges on hardware. RI is typically experienced as static on radio reception while TVI is a snow or hold problems on a television. Problems with TVI have diminished in recent years with the increased use of cable and satellite TV, where shielded coaxial cables and shielded receivers protect against the interference. This noise occurs at discrete points and can be minimized with good design and maintenance practices. Design practices for the proposed transmission lines include the use of extra high voltage (EHV) conductors, corona resistant line hardware, and grading rings at insulators. The effect of corona on radio and television is dependent on the radio/television signal strength, distance from the transmission line, and the transmission line noise level. In a 1972 field study, in support of the CPS ER, RI and TVI were measured at existing 345 kV lines with similar construction to those proposed here (CPS, 1973). No new transmission lines have been built in the vicinity, and the CPS ER provides the most recent available data for RI and TVI. The results were summarized as follows:

- No audible noise caused by the 345-kV power lines near Baldwin Station could be measured above prevailing ambient background noise level.
- RI measurements made on the existing 345-kV lines indicated that little or no interference would be experienced in radio receivers located outside the typical 132-ft right-of-way, providing that the strength of signal from the radio stations exceeded 500 micro volts per meter, a value that is accepted by the Federal Communications Commission as the minimum for providing good reception.
- No electrical interference was experienced in a portable television receiver having a standard rod antenna when operating near lines of similar construction to those proposed here.

3.7.4 Electro Magnetic Fields

The EMF are produced by the electrical devices including transmission lines. Electric fields are produced by voltage and are typically measured in kilo volts per meter (kV/m), while magnetic fields are produced by current and are measured in gauss (G). Some epidemiological studies have suggested a link between power-frequency EMF and some types of cancer, while others have not. Although there is no scientific consensus on the topic, the presence of EMF, especially from transmission lines, has become a greater public concern in recent years. Due to the lack of evidence supporting a health risk from EMF, there are no federal health standards for EMF. However, some states have set standards for electric and magnetic field strength at the edge of transmission right-of-ways (see Table 3.7-1); Illinois is not one of these states. The parameters having the greatest effect on EMF levels near the transmission line are operating voltage, current, conductor height, electrical phasing, and distance from the source. The EMF reduction measures will be incorporated into the line and station designs so that the EMF strengths will be minimized.

3.7.5 Induced or Conducted Ground Currents

Magnetic fields can also induce current or voltage in longer conducting objects, such as fences, RR, or pipelines. Touching the object at a point remote from an electrical ground can result in a shock. To minimize these induced ground currents and distribute ground fault

currents, the tangent or inline structure will be grounded. The tangent structure will have an electrical connection between the shield wire and ground lead, which will be connected to ground rods. Ground resistance tests will be made at the tangent structure before the shield wire is electrically connected to the ground lead. Sufficient ground rods will be installed to reduce the resistance to 10 ohms or less under normal atmospheric conditions. Angle or corner structures will have a low voltage insulator installed between the shield wire and down guys to avoid possible anchor corrosion problems.

3.8 Transportation of Radioactive Materials

This section addresses the fuel and radioactive waste transportation issues associated with siting and operating a new reactor and is divided into two main subsections. The first subsection addresses the light-water-cooled reactor (LWR) designs presently being considered. The second subsection addresses the gas-cooled reactor designs also being considered. This split addresses the regulatory distinction made in 10 CFR 51.52 for light-water-cooled reactors. In addition, the source for the information discussed in this section is from the Idaho National Engineering and Environmental Laboratory, Engineering Design File # 3747, Early Site Permit Environmental Report Sections and Supporting Documentation, May 14, 2003, Revision 0.

3.8.1 Light-Water-Cooled Reactors

As required by 10 CFR 51.52, every ER prepared for the construction permit stage of an LWR, and submitted on or after February 4, 1975, is to utilize Table S-4 "Environmental Impact of Transportation of Fuel and Waste To and From One Light-Water-Cooled Nuclear Power Reactor" and shall contain a statement concerning transportation of fuel and radioactive wastes to and from the reactor.

Table S-4 (as provided in 10 CFR 51.52(c) and repeated in Table 3.8-3) is a summary environmental impact statement concerning transportation of fuel and radioactive wastes to and from a reactor. The table is divided into two categories of environmental considerations: (1) normal conditions of transport and (2) accidents in transport. The "normal conditions of transport" considerations are further divided into environmental impact, exposed population, and range of doses to exposed individuals per reactor reference year. Under "normal conditions of transport" the environmental impacts of the heat of the fuel cask in transit, weight, and traffic density are described. Also the number and range of radioactive doses to transportation workers and the general public are described. The "accidents in transport" consideration is concerned with environmental risk. Under "accidents in transport", the environmental risk from radiological effects, and common nonradiological causes such as fatal and nonfatal injuries and property damage are described.

To demonstrate that Table S-4 adequately describes the environmental effects of the transportation of fuel and waste to and from the reactor, the reactor licensee must state that the reactor and associated transportation impacts either meet the conditions in paragraph (a) or paragraph (b) of 10 CFR 51.52. Subparagraphs 10 CFR 51.52(a)(1) through (5) delineate specific conditions the reactor must meet to use Table S-4 as part of the environmental report for the reactor. Subparagraph 10 CFR 51.52(a)(6) states "The environmental impacts of transportation of fuel and waste to and from the reactor, with respect to normal conditions of transport and possible accidents in transport, are as set forth in Summary Table S-4 in paragraph (c) of this section; and the values in the table represent the contribution of the transportation to the environmental costs of licensing the reactor." Paragraph 10 CFR 51.52(b) states that reactors not meeting the conditions of 10 CFR 51.52(a) shall make a full description and detailed analysis of the environmental impacts for their reactor.

The LWR technologies being considered have characteristics that fall within the conditions of 10 CFR 51.52 for use of Table S-4, with minor exceptions. The effect of the exceptions is addressed in the following discussion through an evaluation and comparison to the data supporting Table S-4 as provided in WASH-1238 (USNRC, 1972) and NUREG-75/038 (USNRC, 1975).

The LWR technologies being considered are identified in Section 1.1.3 of this Environmental Report and in SSAR Section 1.3. These designs include the ABWR, Economic Simplified Boiling Water Reactor (ESBWR), AP1000, IRIS, and the ACR-700. The standard configuration for these reactor technologies (assumed in this analysis) is as follows. The ABWR is a single unit, 4,300 MWt, nominal 1,500 MWe boiling water reactor. The ESBWR is a single unit, 4,000 MWt, nominal 1,390 MWe boiling water reactor. The AP1000 is a single unit, 3,400 MWt, nominal 1,117-1,150 MWe pressurized water reactor. The IRIS is a three module pressurized water reactor configuration for a total of 3,000 MWt and nominal 1,005 Mwe, and the ACR-700 is a twin unit, 3,964 MWt, nominal 1,462 MWe, LWR with a heavy water moderator. (Note that for this analysis, the ABWR is conservatively presumed to be the uprated design while other evaluations within this ESP application are based on the certified design configuration.)

10 CFR 51.52 lists several conditions that need to be addressed by these reactor technologies. If the conditions are satisfied by the reactor technologies, then the Table S-4 values are appropriate for use in ESP. These conditions are reactor core thermal power; fuel form; fuel enrichment; fuel encapsulation; average fuel irradiation; time after discharge of irradiated fuel before shipment; mode of transport for unirradiated fuel; mode of transport for irradiated fuel; and mode of transport for radioactive waste other than irradiated fuel. There are two other conditions in S-4 that require that radioactive waste, with the exception of irradiated fuel, be packaged and in solid form. Table 3.8-1 includes the referenced conditions along with the bounding values for the various reactor technologies. The information for the various reactor technologies was provided by the reactor vendors.

10 CFR 51.52(a)(1) requires that the reactor have a core thermal power level not exceeding 3,800 MW. Of the considered LWR technologies, only the two BWRs, the ABWR and the ESBWR, exceed this value. The ABWR has a core thermal power level of 4,300 MWt while the ESBWR core thermal power level is 4,000 MWt. The higher rated core power level would typically indicate the need for more fuel and therefore more fresh and irradiated fuel shipments. This is not the case in this instance due to the higher unit capacity and higher burnup for the reactors with the increased power level. The annual fuel loading for the reference reactor in Table S-4 was 35 metric tons uranium (MTU) while the expected annual fuel loading for both the ABWR and ESBWR is only 32.8 MTU. In fact, the annual MTU of fuel for these BWRs normalized to equivalent electrical generation is just slightly more than half of the reference LWR; 18.4 MTU versus 35 MTU. This reduced annual MTU requirement of fuel will mean fewer shipments and less environmental impact. Also, WASH-1238 states: "The analysis is based on shipments of fresh fuel to and irradiated fuel and solid waste from a boiling water reactor or a pressurized water reactor with design ratings of 3,000 to 5,000 MWt or 1,000 to 1,500 Mwe" (USNRC, 1972). Both the ABWR and the ESBWR fall within these bounds.

10 CFR 51.52(a)(2) requires that the reactor fuel be in the form of sintered uranium dioxide (UO_2) pellets. The LWR technologies being considered have a sintered UO_2 pellet fuel form.

10 CFR 51.52(a)(2) requires that the reactor fuel have a uranium-235 enrichment not exceeding 4 percent by weight. The NRC has subsequently concluded that enrichments up to 5 percent is also bounded by the environmental impacts considered in Table S-4. These evaluations are documented in the "NRC Assessment of the Environmental Effects of Transportation Resulting From Extended Fuel Enrichment and Irradiation" as provided in 53 FR 30555 and 53 FR 32322, and in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. The LWR technologies being considered have uranium-235 enrichments less than 5 percent by weight and therefore meet this subsequent evaluation condition.

10 CFR 51.52(a)(2) requires that the reactor fuel pellets be encapsulated in Zircaloy rods. 10 CFR 50.44 also allows use of ZIRLO™. Prior USNRC license amendments for operating reactors approving the use of ZIRLO have repeatedly indicated that the use of ZIRLO rather than Zircaloy does not involve a significant increase in the amounts or significant change in the types of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The LWR technologies being considered will use either Zircaloy or ZIRLO rods and therefore meet this subsequent evaluation condition.

10 CFR 51.52(a)(3) requires that the average burnup is not to exceed 33,000 megawatt-days per metric ton of uranium (MWd/MTU). The NRC has subsequently concluded that average burnup up to 62,000 MWd/MTU for the peak rod is also bounded by the environmental impacts considered in Table S-4. These evaluations are also documented in the "NRC Assessment of the Environmental Effects of Transportation Resulting From Extended Fuel Enrichment and Irradiation" as provided in 53 FR 30555 and 53 FR 32322, and in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. The LWR technologies being considered will have average burnup of less than or equal to 62,000 MWd/MTU for the peak rod and therefore meet this subsequent evaluation condition.

10 CFR 51.52(a)(3) requires that no irradiated fuel assemblies be shipped until at least 90 days after it is discharged from the reactor. Table S-4 assumes 150 days of decay time prior to shipment of any irradiated fuel assemblies. For the LWR technologies being considered, five years is the minimum decay time expected before shipment of irradiated fuel assemblies. The five-year minimum time is supported additionally by two practices. First, five years is the minimum cooling time specified in 10 CFR 961.11, within Appendix E of the standard DOE contract for spent fuel disposal with existing reactors. Second, the USNRC specifies five years as the minimum cooling period when it issues certificates of compliance for casks used for shipment of power reactor fuel (NUREG-1437, Addendum 1, pp 26). In addition to the minimum fuel storage time, NUREG-1555 Environmental Standard Review Plan, Section 3.8 asks for the capacity of the on-site storage facilities to store irradiated fuel. The LWR technologies being considered are designing for on-site storage of spent fuel for up to 60 years through a combination of wet (pool) and dry storage.

10 CFR 51.52(a)(4) requires that, with the exception of spent fuel, radioactive waste shipped from the reactor is to be packaged and in a solid form. The LWR technologies being considered will solidify and package their radioactive waste. Additionally, existing USNRC (10 CFR 71) and Department of Transportation (DOT) (49 CFR 173,178) packaging and

transportation regulations specify requirements for the shipment of radioactive material. The LWR technologies being considered are subject to these regulations.

10 CFR 51.52(a)(5) requires that unirradiated fuel be shipped to the reactor by truck. The LWR technologies being considered plan to ship their unirradiated fuel by truck.

10 CFR 51.52(a)(5) allows for truck, rail, or barge transport of irradiated fuel. The LWR technologies being considered will comply with this transport mode requirement. Three of the LWR reactor vendors identified rail as the shipment mode, and the vendor for the ABWR and the ESBWR stated either rail or truck. Of note, the DOE is currently (2003) responsible per the standard contract for transport of irradiated fuel from reactor sites to the storage location and, while DOE will make the decision on transport mode, it is expected that DOE will also use either truck, rail, or barge transport. NUREG-1555, Environmental Standard Review Plan, Section 3.8, also asks for the estimated transportation distance from the plant to the facility to which irradiated fuel will most likely to be sent. Recognizing the uncertainty in predicting the future destination of spent fuel in the United States, 2,500 miles is utilized as a bounding distance at this time. This length bounds the approximate average distance from typical reactor sites to potential repository locations in the U.S.

Finally, 10 CFR 51.52(a)(5) requires that low-level radioactive waste be shipped by either truck or rail. The LWR technologies being considered plan to ship their radioactive waste by truck.

In conclusion, since the LWR technologies being considered satisfy the 10 CFR 51.52(a) conditions, or subsequent USNRC evaluation conditions, for use of Table S-4, the environmental impacts of transportation of fuel and radioactive wastes for the various reactor technologies are represented and bounded by the values given in 10 CFR 51.52(c), Table S-4. Thus, the radiological and nonradiological environmental impacts of transportation of fuel to and from, and waste from, these or comparable LWRs are small and bounded by the values in Table S-4.

3.8.2 Gas-Cooled Reactors

3.8.2.1 Introduction and Background

The following assessment of the environmental impacts of the transportation of fresh and irradiated fuel to and from, and low-level waste from, the reactor for gas-cooled reactor technologies is based on a comparison of the key parameters and conditions that were used to generate the impacts listed in 10 CFR 51.52(c), Table S-4. This comparison demonstrates that the environmental impacts of these gas-cooled reactor technologies are no worse than the impacts identified in Table S-4 for the LWR technologies. The premise being that if the values of the major contributors to the health and environmental impacts that were used for the reference LWR are greater than those comparable values for the gas-cooled reactor technologies, then the reference impacts would also be greater and therefore bounding. It is important to point out that even though we are looking at the contributors individually, it is the overall cumulative impact that is of concern. That is, for purposes of comparing/evaluating cumulative impacts, there may be increases in select individual contributors that are offset by decreases in other contributors.

The parameters that have been chosen for purposes of comparison include not only the major contributors to the health and environmental impacts but also the conditions listed in 10 CFR 51.52. For example, the major contributor to transportation risk is the number of shipments. The more shipments, the greater the risk. The Table S-4 shipments include fresh fuel for both initial core loading and reloads, irradiated fuel, and low-level waste (LLW) from operations. The second main contributor to the transportation risk would be the mode of shipment. In this case, only trucks and trains are considered for the shipment of fresh fuel, irradiated fuel, and LLW. The last important risk factor relates to what kind of material is being shipped. In the category for irradiated fuel, we compared fission product inventory, krypton inventory, actinide inventory, total radioactivity, decay heat, and weight of shipment of the reference LWR to the various gas-cooled reactor technologies. For radioactive waste, we used the expected volume to determine the number of shipments. Radioactive content of the LLW was also estimated to verify that the assumption about the percentage of LLW that might require shielding was reasonable.

The 10 CFR 51.52 conditions are: reactor core thermal power; fuel form; fuel enrichment; fuel encapsulation; average fuel irradiation; time after discharge of irradiated fuel before shipment; mode of transport for unirradiated fuel; mode of transport for irradiated fuel; and mode of transport for radioactive waste other than irradiated fuel. In addition, there are two other conditions that require that radioactive waste, with the exception of irradiated fuel, be packaged and in solid form. Since existing packaging and transportation regulations already address those items and these regulations would also apply to these gas-cooled reactor technologies, these last two conditions are satisfied.

Before proceeding with the evaluation, it is important to note that the USNRC has an ongoing review of the safety of spent fuel transportation. One recent evaluation is documented in NUREG/CR-6672, "Reexamination of Spent Fuel Shipment Risk Estimates", published in March 2000. The USNRC in their discussion document "An Updated View of Spent Fuel Transportation Risk"(USNRC, 2000a) concluded that the NUREG/CR-6672 study confirmed that: 1) earlier risk estimates (NUREG-0170, "Final Environmental Statement on the Transport of Radioactive Materials by Air and Other Modes") to the public remain conservative by factors of 2 to 10 or more; 2) existing regulations governing the shipment of spent fuel are adequate; and 3) no unreasonable risk is posed to the public by the continued shipment of spent fuel. The range of conservative risk factors covers differences in assumed mode of transport (rail or truck) and the various accident scenarios.

These same USNRC conclusions support the position that environmental assessments of the transport casks do not have to be done for the Part 71 cask certifications because they meet the categorical exclusion criteria in 10 CFR 51.22(c)(13) that package designs used for the transportation of licensed materials do not require an environmental review. As discussed in 10 CFR 51.22(a), the USNRC has determined that certain categories of licensing and regulatory actions have already been determined individually or cumulatively to not have a significant effect on the human environment; thus, a separate environmental assessment is not required. As mentioned in the previous paragraph, a generic assessment of the environmental effects associated with transportation of radioactive material, including spent fuel, has already been done as provided in NUREG-0170, "Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes" dated December 1977. This environmental impact statement (EIS) provided the regulatory basis for

continued issuance of general licenses for transportation of radioactive material under 10 CFR 71. In addition, the USNRC has conducted a reexamination of the risks associated with spent fuel shipments as documented in NUREG/CR-6672. This reexamination concluded that the estimated risks for future shipments are well below those in the 1977 study. Thus, NUREG-0170 remains valid as the baseline report on which National Environmental Policy Act (NEPA) analyses of transportation risk are based.

Table 3.8-2 describes the major features of the reference LWR that were used to develop Table S-4 and compares these same features with the gas-cooled reactor technologies being considered. The reference LWR pertains to the typical 1,100 MWe light-water-cooled nuclear reactor as described in WASH-1238. The information to construct Table 3.8-2 was derived from the "Normal Conditions of Transport" portion of the 10 CFR 51.52 Summary Table S-4 "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor," WASH-1238 "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants" and Supplement 1 to WASH-1238 (NUREG-75/038) for the reference LWR. The information for the reactor technologies was provided by the reactor vendors.

3.8.2.2 Analysis

This section provides a detailed comparison of the individual LWR parameters supporting Table S-4 against the corresponding parameters for the various gas-cooled reactor technologies. The values for the reference reactor are given along with the corresponding values or range of values for the gas-cooled reactor technologies. As appropriate, additional information and/or observations are provided. Table 3.8-2 provides additional details regarding the reactor technology specific values.

There are two gas-cooled reactor technologies presently being considered (also see Environmental Report Section 1.1.3 and SSAR Section 1.3). These reactor technologies are the GT-MHR and the PBMR. The standard configuration for these reactor technologies is as follows. The GT-MHR is a four module, 2,400 MWt, nominal 1,140 MWe gas-cooled reactor. The PBMR is an eight module, 3,200 MWt, nominal 1,320 MWe gas-cooled reactor. The unit capacities for these reactors are as follows: 88 percent for the GT-MHR; 95 percent for the PBMR. These values are contrasted with the reference LWR, a single unit, 1,100 MWe plant with a unit capacity factor of 80 percent.

Before beginning direct comparisons, it is important to note that the gas-cooled reactor technologies being considered are a different physical size, have a different electrical rating, and have a different capacity factor from the reference LWR. In order to make proper comparisons; we need to evaluate the characteristics based on equivalent criteria. For this analysis, electrical generation is the metric of choice. The electrical generation metric establishes whether the new reactor technologies, for the same electrical output, have a greater or lesser impact on the health and environment than the reference LWR. The reference LWR is a nominal 1,100 MWe plant with a capacity factor of 80 percent. Accordingly, the gas-cooled reactor technologies have been normalized to 880 MWe using their plant specific electrical ratings and capacity factors. For many of the characteristics being examined, this adjustment is not necessary. But in a few cases, specifically those dealing with the number of shipments of fuel and waste, an adjustment is appropriate.

3.8.2.3 Table S-4 Conditions

As discussed previously, 10 CFR 51.52(a) lists several conditions that need to be addressed by the new reactor technologies for the use of Table S-4. These conditions are reactor core thermal power; fuel form; fuel enrichment; fuel encapsulation; average fuel irradiation; time after discharge of irradiated fuel before shipment; mode of transport for unirradiated fuel; mode of transport for irradiated fuel; and mode of transport for radioactive waste other than irradiated fuel. Two other conditions in S-4 require that radioactive waste, with the exception of irradiated fuel, be packaged and in solid form.

10 CFR 51.52(a)(1) requires that the reactor have a core thermal power level not exceeding 3,800 MWt. The gas-cooled reactors being considered meet this condition. The GT-MHR has a core thermal power level of 600 MWt per module for a total of 2400 MWt. The PBMR has a core thermal power level of 400 MWt per module for a total of 3200 MWt.

10 CFR 51.52(a)(2) requires that the reactor fuel be in the form of sintered UO_2 pellets. The fuel forms for the gas-cooled reactors being considered are blocks of TRISO coated uranium oxycarbide fuel kernels for the GT-MHR and spheres of TRISO coated uranium dioxide fuel kernels for the PBMR.

10 CFR 51.52(a)(2) requires that the reactor fuel have a uranium-235 enrichment not exceeding 4 percent by weight. The NRC has subsequently concluded that enrichments up to 5 percent are also bounded by the environmental impacts considered in Table S-4. These evaluations are documented in the "NRC Assessment of the Environmental Effects of Transportation Resulting From Extended Fuel Enrichment and Irradiation" as provided in 53 FR 30555 and 53 FR 32322, and in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. The PBMR has an enrichment of 12.9 percent while the GT-MHR enrichment is 19.8 percent.

10 CFR 51.52(a)(2) requires that the reactor fuel pellets be encapsulated in Zircaloy rods. 10 CFR 50.44 also allows use of ZIRLO™. Per USNRC license amendments for operating reactors approving the use of ZIRLO have repeatedly indicated that the use of ZIRLO rather than Zircaloy does not involve a significant increase in the amounts or significant change in the types of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. However, the gas-cooled reactors being considered have a different reactor fuel configuration. The gas-cooled reactor fuel kernels are coated with layers of pyrolytic carbon and silicone carbide. These coatings are considered the equivalent of the fuel cladding. For the GT-MHR these TRISO fuel particles are blended and bonded together with a carbonaceous binder and are stacked within a graphite block. For the PBMR, the fuel unit is a 6-cm diameter graphite sphere containing approximately 15,000 TRISO fuel particles.

10 CFR 51.52(a)(3) requires that the average burnup is not to exceed 33,000 MWd/MTU. The NRC has subsequently concluded that average burnup up to 62,000 MWd/MTU for the peak fuel rod is also bounded by the environmental impacts considered in Table S-4. These evaluations are documented in the "NRC Assessment of the Environmental Effects of Transportation Resulting From Extended Fuel Enrichment and Irradiation" as provided in 53 FR 30555 and 53 FR 32322, and in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. The gas-cooled reactors have an expected burnup of 133,000 MWd/MTU for the PBMR and 112,742 MWd/MTU for the GT-MHR.

10 CFR 51.52(a)(3) requires that no irradiated fuel assemblies be shipped until at least 90 days after it is discharged from the reactor. Table S-4 assumes 150 days of decay time prior to shipment of any irradiated fuel assemblies with a condition of not less than 90 days. For the gas-cooled reactor technologies being considered, five years is the expected minimum decay time prior to shipment of irradiated fuel assemblies. The five-year minimum time is supported additionally by two practices. First, five years is the minimum cooling time specified in 10 CFR 961.11, within Appendix E of the standard DOE contract for spent fuel disposal with existing reactors. Second, the USNRC specifies five years as the minimum cooling period when it issues certificates of compliance for casks used for shipment of power reactor fuel (NUREG-1437, Addendum 1, pp 26). In addition to the minimum fuel storage time, NUREG-1555 Environmental Standard Review Plan, Section 3.8 asks for the capacity of the on-site storage facilities to store irradiated fuel. The gas-cooled reactor technologies being considered are designing for on-site storage of spent fuel for up to 60 years including potential modular storage expansions.

10 CFR 51.52(a)(5) requires that the unirradiated fuel be shipped to the reactor by truck. The gas-cooled reactor technologies being considered plan to ship their unirradiated fuel by truck.

10 CFR 51.52(a)(5) allows for truck, rail, or barge transport of irradiated fuel. The gas-cooled reactor technologies being considered plan to allow for irradiated fuel shipment by truck. However, the actual mode of shipment may be determined by DOE and could include barge, rail, or truck shipments.

10 CFR 51.52(a)(5) requires that the mode of transport of low-level radioactive waste is either truck or rail. The gas-cooled reactor technologies being considered plan to ship their radioactive waste by truck.

Finally, 10 CFR 51.52(a)(4) requires that, with the exception of spent fuel, radioactive waste shipped from the reactor is to be packaged and in a solid form. The gas-cooled technologies being considered will solidify and package their radioactive waste. Additionally, existing USNRC (10 CFR 71) and DOT (49 CFR 173,178) packaging and transportation regulations specify requirements for the shipment of radioactive material. The gas-cooled technologies being considered are also subject to these regulations.

In summary, the descriptions provided above indicate that the criteria of 10 CFR 51.52(a) are met with the exceptions of fuel form, cladding configuration, enrichment, and burnup. 10 CFR 51.52(b) states that reactors not meeting the conditions of 10 CFR 51.52(a) shall make a full description and detailed analysis of the environmental impacts for their reactor. As previously indicated, the risk to the environment associated with the transportation of fuel is a function of the number of shipments and the contents of the shipments. Thus, a detailed analysis of these risk contributors is provided discussed in the following sections.

3.8.2.4 Risk Contributors – Shipments

This section discusses the type and number of shipments for the gas-cooled reactor technologies and the values used for the reference LWR.

The reference LWR assumed an initial core loading of 100 MTU for a PWR and 150 MTU for a BWR. These quantities resulted in 18 truck shipments. For the new gas-cooled reactor

technologies, the numbers of shipments were 44 for the PBMR and 51 for the GT-MHR. If normalized to the equivalent electrical output, the number of shipments would be 31 and 45 respectively.

The reference LWR assumed an annual reload of 30 MTU. This quantity resulted in six truck shipments. For the new gas-cooled reactor technologies, the numbers of reload shipments ranged from three for the PBMR to 20 for the GT-MHR. The number of shipments normalized to the electrical generation changes slightly to 18 for the GT-MHR.

With respect to the number of spent fuel shipments by truck, the reference LWR assumed 60 shipments annually. For the two gas-cooled reactor technologies, the number of shipments is considerably less. The PBMR requires 16 annual shipments while the GT-MHR requires 38 truck shipments annually. Normalizing to the electrical generation lowers these numbers to 12 to 34, respectively.

The reference LWR assumed 10 rail shipments annually of spent fuel. Since the gas-cooled reactor technologies are not planning to ship their spent fuel by rail, no comparison is needed. However, based on the above comparison indicating that fewer truck shipments would be necessary, fewer than 10 rail shipments annually would also be expected for rail shipment. This could be reduced further if DOE decided to use larger and higher capacity rail transport casks for gas-reactor spent fuel.

The reference LWR also considered transporting spent fuel by barge and assumed five shipments annually. Since the gas-cooled reactor technologies are not planning to ship their spent fuel by barge, no comparison is needed.

The reference LWR assumes 46 shipments annually of low-level radioactive waste. The gas-cooled reactor technologies will make far fewer shipments. The GT-MHR will need only six shipments while the PBMR will require nine shipments annually. These results assume that 90 percent of the LLW can be shipped at 1,000 ft^3 per truck, and the remaining 10 percent can be shipped at 200 ft^3 per truck. If the numbers are normalized to electrical generation, the numbers of shipments range from six to seven.

The Table S-4 value, traffic density in trucks per day, for the reference LWR is given as less than one per day. Both the gas-cooled reactor technologies would also have less than one per day. In fact, the new gas-cooled reactor technologies would have far fewer shipments per year. The reference LWR bounding annual value for truck shipments is 112 total based on a 40-year period, while the normalized number of truck shipments for the gas-cooled reactor technologies would require as few as 18 for the PBMR and only 41 for the GT-MHR.

The rail density in cars per month for the reference LWR is given as less than three per month. Since the gas-cooled reactor technologies are not planning to make any shipments by rail, no comparison is needed. However, as noted above, if DOE decided to use rail transport for spent fuel instead of truck, fewer than three shipments per month would be expected.

3.8.2.5 Risk Contributors - Contents

This section addresses the radioactive contents of the irradiated fuel shipments and their thermal loading and compares them to the reference LWR. The radioactive and decay heat values are based on the earliest time of shipment. For the gas-cooled reactor technologies,

the five-year time was selected because it is the minimum allowed time before shipment of irradiated fuel for operating reactors per the standard DOE contract. These values are compared with the reference LWR that used a 90-day decay time. Ninety days was the minimum allowed time before shipment for Table S-4. Since we are evaluating the transportation impacts, it is the fission product inventory and associated decay heat at the time of shipment that is of interest, not the inventory and decay heat at any other particular time.

The fission product inventory at the time of shipment for the reference LWR was 6.19×10^6 curies (Ci) per MTU. The values for the fission product inventory at the time of shipment for the gas-cooled reactor technologies were both much lower, 1.55×10^6 Ci per MTU and 1.78×10^6 Ci per MTU which are ~ 25 percent and ~29 percent of the reference LWR value, respectively.

The actinide inventory at the time of shipment in Ci per MTU for the reference LWR was 1.42×10^5. Because of the longer burnup times for the new gas-cooled new reactor technologies, both of these reactor technologies have values that exceed the reference LWR. The GT-MHR and the PBMR actinide inventory values are 2.33×10^6 Ci per MTU and 2.26×10^6 Ci per MTU, exceeding the reference LWR by ~ 64 percent and ~59 percent, respectively. This comparison changes significantly for the GT-MHR if one considers the Ci per shipment, which is the principle concern. The reference LWR ships 0.5 MTU per truck cask while the GT-MHR ships about a third less, or 0.16044 MTU per truck cask. Based on this comparison, the actinide inventory per shipment is about half (~53 percent) for the GT-MHR versus the reference LWR. Since the PBMR plans to ship 0.495 MTU per cask, the PBMR comparison per shipment is essentially the same as the comparison of actinide inventory in Ci per MTU.

The total radioactive inventory in Ci per MTU at the time of shipment (90 days) for the reference LWR was 6.33×10^6. The new gas-cooled reactor technologies have much lower total radioactivity at time of shipment (five years) of 1.78×10^6 Ci per MTU and 2.01×10^6 Ci per MTU. The differences are ~ 28 percent and ~32 percent of the reference LWR value, respectively.

The krypton-85 (Kr-85) inventory in Ci per MTU at the time of shipment (90 days) for the reference LWR was 1.13×10^4. The GT-MHR and the PBMR values at the time of shipment (five years) of 2.50×10^4 Ci per MTU and 2.63×10^4 Ci per MTU both exceed the reference LWR by~ 122 percent and ~133 percent of the reference LWR value, respectively. As before, if one considers the Ci per shipment, the Kr-85 inventory for the GT-MHR would be about 71 percent of the Kr-85 reference LWR inventory partly because of the significantly smaller shipments (0.16044 MTU per truck cask versus 0.5 MTU per truck cask for the reference LWR). The PBMR comparison would remain essentially the same.

The kilowatts per MTU at the time of shipment (90 days) for the reference LWR were 27.1. This value is considerably higher than for the gas-cooled reactor technologies. At the time of shipment (five years), the decay heat for the gas-cooled reactor technologies being considered ranges from 6.36 kilowatts per MTU for the GT-MHR to 3.91 kilowatts per MTU for the PBMR. These values are ~24 percent and ~15 percent of the reference LWR value, respectively.

The decay heat (per irradiated fuel truck cask in transit) in kilowatts for the reference LWR was 10. Both the gas-cooled reactor truck casks generate much less heat (1.02 kw and 1.9 kw) per truck cask than the reference LWR. These values are ~10 percent and ~19 percent of the reference LWR value, respectively.

The decay heat (per irradiated fuel rail cask in transit) in kilowatts for the reference LWR was 70. Since the gas-cooled reactor technologies are not planning to ship their spent fuel by rail, no comparison is needed. However, should DOE elect to accept the fuel and transport it by rail, the expected decay heat would be less than 70 kw based on the above comparison for truck shipment decay heat.

At the time of the reference LWR evaluation, the road limit was 73,000 lbs. This has changed slightly through the years. 23 CFR 658.17 "Weight" states that for the Interstate and Defense Highways the maximum gross vehicle weight shall be 80,000 pounds. In all cases for the gas-cooled reactor technologies, the road limit is governed by state and federal regulations.

3.8.2.6 Discussion

Of the close to 30 characteristics/conditions that were examined, there are only eight that were exceeded by the gas-cooled reactor technologies being considered. Three of these characteristics, fuel form, U_{235} enrichment, and fuel rod cladding, have no direct transportation impact on the health and the environment. There are operational issues and fuel cycle impact issues associated with these characteristics that are addressed as part of the operating license and as part of the evaluation of Table S-3 "Uranium fuel cycle data", respectively. Two of these characteristics (number of shipments for initial core loading and number of reload shipments) are part of the overall truck transportation analysis. When one considers the total number of truck shipments (fresh fuel, irradiated fuel, and radioactive waste), the new reactor technologies have many fewer total shipments. For example, on an average annual basis, the new reactor technologies require 69 to 105 fewer total truck shipments. One characteristic, burnup, manifests its impact through other characteristics, including fuel inventory and decay heat at time of shipment, which are addressed separately. In the case of decay heat, both of the gas-cooled reactor technologies will generate fewer watts per MTU at time of shipment, and fewer kW per truck cask at time of shipment. The fuel inventory will be discussed as part of the remaining two characteristics that were exceeded: actinide inventory and Kr-85inventory.

That the actinide inventory per metric ton of spent fuel is greater for the majority of the new gas-cooled reactor technologies is not surprising, since actinide activity tends to increase with increasing burnup and both of the gas-cooled reactor technologies plan a higher burnup than the reference LWR. The increase in the actinide activity for the new reactor technologies ranges from 59 percent to 65 percent. And as discussed in the previous section, if one considers the actinide inventory per shipment, only the PBMR exceeds the reference LWR by 59 percent. From NUREG/CR-6703 "Environmental Effects of Extending Fuel Burnup Above 60 GWd/MTU", we learn that "none of the actinides contributes more than one percent of the external dose from an iron transportation cask, and as a group, the actinides do not contribute significantly to the dose from transportation accidents. In fact, increasing the activities of Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cm-242 and Cm-244 by more than a factor of 1,000 only increased the cumulative dose for a transportation accident

during shipment of 43 GWd/MTU spent fuel from the northeast to Clark County, NV from 0.0358 to 0.0359 person-mSv/shipment (3.58 x 10^{-3} to 3.59 x 10^{-3} person-rem/shipment)." There is one other area where the increased actinide activity needs to be considered and that is the corresponding increase in neutron source term. NUREG/CR-6703 states "because neutrons are effectively attenuated by low-density materials such as plastics and water, it is believed that minor modifications can be made to shipping casks to allow them to transport the higher burnup fuel at full load".

Based on the analysis performed and the conclusions drawn in NUREG/CR-6703 which show that actinides are not major contributors to the transportation risk, either incident free or accident, and with the actinide activity only 59 percent greater, the environmental impacts would still be bounded even for these higher burnups.

This leaves the Kr-85 inventory as the final characteristic to be addressed. The increase of Kr-85, a long-lived noble gas, would suggest an increase of the consequences associated with an accident that resulted in a breach of the fuel cask and fuel rods. The range of increase for the gas-cooled technologies being considered is from 121 percent to 133 percent. And as discussed in the previous section, if one considers the Kr-85 inventory per shipment, only the PBMR exceeds the reference LWR. These amounts are based on a 5-year cooling time. If this decay time were increased by about 11 years, slightly greater than the half-life of Kr-85 (10.6 years), not an unlikely scenario by the way, this increase would for the most part decay away. Another factor to consider is that transportation risk is a function of both consequences and likelihood. Because the new reactor technologies require fewer truck shipments, the likelihood would decrease approximately 37 percent for the reactor with the greatest Kr-85 inventory. Another factor to consider is that the accident rate for large trucks has steadily declined for more than the past 25 years and is less than half the rate in 1975. Thus, the likelihood of a large truck accident has decreased to about 37 percent (0.63 x 0.5) of the 1975 likelihood. A final and major factor to consider is that the cask regulations are based on allowable releases independent of the inventory. Thus, regardless of the initial source term, if the cask releases more than a specific acceptable amount, it would not be licensed. Based on these considerations, the 5-year Kr-85 quantities would still be bounded by the overall transportation risk profile provided by Table S-4.

3.8.2.7 Conclusion

In conclusion, this detailed comparison of the bases for Table S-4 show that the existing environmental and health effects are also conservative for the gas-cooled reactor technologies being considered. Of close to 30 characteristics examined, only eight were exceeded by the new technologies. In these instances, either they are independent of any impact or there are mitigating factors and controls to demonstrate that these slight increases are bounded by the impacts specified in Table S-4. This conclusion is also borne out by the observation that these new reactor technologies will be using the same transportation modes and subject to the same USNRC and DOT regulations for packaging and transportation as the original analysis that was used to develop Table S-4. Thus, the new reactor technologies under consideration and the transportation of radioactive material associated with them meet the condition in 10 CFR 51.52(b).

3.8.3 Methodology Assessment

As indicated in Section 1.1.3, the selection of a reactor design to be used for the EGC ESP Facility is still under consideration. Selection of a reactor to be used at the EGC ESP Site may not be limited to those considered above. However, the methodology utilized above is appropriate to evaluate the final selected reactor. Further, should the selected design be shown to be bounded by the above evaluation, then the selected design would be considered to be within the acceptable transportation environmental impacts considered for this ESP.

CHAPTER 3
References

Chapter Introduction

None

Section 3.1

None

Section 3.2

None

Section 3.3

None

Section 3.4

None

Section 3.5

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Section 3.6

None

Section 3.7

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Section 3.8

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CHAPTER 3

Tables

TABLE 3.3-1
Water Balance for Clinton Lake with Proposed EGC ESP

Month	Monthly Runoff (in)[a]	Runoff (million gal)	Monthly Evaporation (in)[a]	Monthly Evaporation (million gal)	CPS Forced Evaporation (gpm)[b]	CPS Annual Forced Evaporation (million gal)	ESP Cooling Tower Evaporation (gpm)[c]	ESP Annual Cooling Tower Evaporation (million gal)	Seepage (million gal)[d]	Outfall (million gal)
Jan	0.8	4,115	-	-						
Feb	1.01	5,196	-	-						
Mar	1.99	10,237	1.17	156						
Apr	1.76	9,054	3.34	444						
May	1.86	9,568	5.19	690						
Jun	1.21	6,224	6.41	852						
Jul	0.84	4,321	6.24	829						
Aug	0.5	2,572	5.26	699						
Sep	0.21	1,080	4.14	550						
Oct	0.35	1,800	2.47	328						
Nov	0.57	2,932	0.52	69						
Dec	0.87	4,475	-	-						
Total w ESP	11.97	61,575	34.74	4,618	8,292	4,358	12,000	6,307	1,451	44,841
Total w/o ESP	11.97	61,575	34.74	4,618	8,292	4,358	0	0	1,451	51,148

[a] From Table 2.3-2 of ER. The drainage area upstream of the Clinton Dam is 296 mi^2 . The surface area of the Clinton Lake is 4,855 ac or 7.64 mi^2 .

[b] From Table 5.2-1 of ER.

[c] From Table 5.2-4 of ER.

[d] Based on 6 percent annually of the total lake volume of 74,200 ac-ft.

TABLE 3.3-2
Required Raw Water Supply with Cooling Towers Used for Turbine Cycle and Safety-Related Cooling

Service	Normal	Maximum	Source
Potable/sanitary	90 gpm	198 gpm	SSAR Table 1.4-1/PPE Section 5.2.2/5.2.1
Demineralized Water	550 gpm	720 gpm	SSAR Table 1.4-1/PPE Section 6.2.2/6.2.1
Filtered Water	138 gpm	175 gpm	25% of the demineralized water flow
NHS Cooling Tower makeup from lake	43,500 gpm	43,500 gpm [a]	SSAR Table 1.4-1/PPE Section 2.5.9
UHS Cooling Tower makeup from lake	555 gpm	1,400 gpm	SSAR Table 1.4-1/PPE Section 3.3.9
Fire Protection	10 gpm	2,500 gpm	SSAR Table 1.4-1/PPE Section 7.1.2/7.1.1
Total	**44,843 gpm**	**48,493 gpm**	

[a] The vendor supplied one value for the NHS cooling tower makeup so it was conservatively assumed to be the normal makeup flow rate from Clinton Lake.

Note: The demineralizer water system is completely independent from the filtered water system.

TABLE 3.3-3
Cooling Water, Thermal Discharges to Clinton Lake

Service	Flow	Temperature	Source
NHS turbine cycle cooling tower blowdown	12,000 gpm normal, 49,000 gpm max	100°F	SSAR Table 1.4-1/PPE Section 2.5.4
UHS cooling tower blowdown	144gpm normal, 700 gpm max	95°F	SSAR Table 1.4-1/PPE Section 3.5.3
Total Discharge from Cooling Towers	**12,000 gpm normal, 49,000 gpm max**	**100°F**	

[a] Total discharge does not include UHS Tower blowdown, since the bounding plant does not require a UHS.

TABLE 3.5-1
Normal Radioactive Liquid Effluents

Isotope	Maximum Composite Release (Ci/yr)	Isotope	Maximum Composite Release (Ci/yr)
C-14	4.40E-04	Tc-99m	1.10E-03
Na-24	3.26E-03	Ru-103	9.86E-03
P-32	1.80E-04	Rh-103m	9.86E-03
Cr-51	7.70E-03	Rh-106	1.47E-01
Mn-54	2.60E-03	Ru-106	1.47E-01
Mn-56	3.81E-03	Ag-110m	2.10E-03
Fe-55	5.81E-03	Ag-110	2.80E-04
Fe-59	4.00E-04		
Ni-63	1.40E-04	Sb-124	6.79E-04
Cu-64	7.51E-03		
Co-56	5.19E-03	Te-129m	2.40E-04
Co-57	7.19E-05	Te-129	3.00E-04
Co-58	6.72E-03	Te-131m	1.80E-04
Co- 60	9.11E-03	Te-131	6.00E-05
Zn-65	8.20E-04	I-131	2.83E-02
W-187	2.60E-04	Te-132	4.80E-04
Np-239	3.11E-03	I-132	3.28E-03
Br-84	4.00E-05	I-133	1.34E-02
Rb-88	5.40E-04	I-134	1.70E-03
Rb-89	4.41E-05	Cs-134	1.99E-02
Sr-89	2.00E-04	I-135	9.94E-03
Sr-90	3.51E-05	Cs-136	1.26E-03
Sr-91	9.00E-04	Cs-137	2.66E-02
Y-90	3.11E-06	Cs-138	1.90E-04
Y-91	1.10E-04	Ba-137m	2.49E-02
Sr-92	8.00E-04	Ba-140	1.10E-02
Y-91m	2.00E-05	La-140	1.49E-02
Y-92	6.00E-04	Ce-141	1.80E-04
Y-93	9.00E-04	Ce-143	3.80E-04
Zr-95	1.04E-03	Pr-143	2.60E-04
Nb-95	1.91E-03	Ce-144	6.32E-03
Mo-99	1.14E-03	Pr-144	6.32E-03
		All Others	**4.00E-05**
		Subtotal	
		(without H-3)	**5.53E-01**
		Total Tritium (H-3)	**3.1E+03**
		Total	**3.1E+03**

TABLE 3.5-2
Comparison of Liquid Releases to 10 CFR 20 Effluent Concentration Limits (ECLs)

Isotope [a]	Release (Ci/yr)[b]	Boundary Concentration (µCi/cc)	Fraction of ECL
C-14	4.40E-04	1.15E-10	3.8E-06
Na-24	3.26E-03	8.53E-10	1.7E-05
P-32	1.80E-04	4.71E-11	5.2E-06
Cr-51	7.70E-03	2.02E-0-9	4.0E-06
Mn-54	2.60E-03	6.81E-10	2.3E-05
Mn-56	3.81E-03	9.98E-10	1.4E-05
Fe-55	5.81E-03	1.52E-09	1.5E-05
Fe-59	4.00E-04	1.02E-10	1.0E-05
Ni-63	1.40E-04	3.66E-11	3.7E-07
Cu-64	7.51E-03	1.97E-09	9.8E-06
Co-56	5.19E-03	1.36E-09	2.3E-04
Co-57	7.19E-05	1.88E-11	3.1E-07
Co-58	6.72E-03	1.76E-09	8.8E-05
Co-60	9.11E-03	2.38E-09	7.9E-04
Zn-65	8.20E-04	2.15E-10	4.3E-05
W-187	2.60E-04	6.81E-11	2.3E-06
Np-239	3.11E-03	8.14E-10	4.1E-05
Br-84	4.00E-05	1.05E-11	2.6E-08
Rb-88	5.40E-04	1.41E-10	3.5E-07
Rb-89	4.41E-05	1.15E-11	1.3E-08
Sr-89	2.00E-04	5.24E-11	6.5E-06
Sr-90	3.51E-05	9.20E-12	1.8E-05
Sr-91	9.00E-04	2.36E-10	1.2E-05
Y-90	3.11E-06	8.14E-13	1.2E-07
Y-91	1.10E-04	2.88E-11	3.6E-06
Sr-92	8.00E-04	2.09E-10	5.2E-06
Y-91m	2.00E-05	5.24E-12	2.6E-09
Y-92	6.00E-04	1.57E-10	3.9E-06
Y-93	9.00E-04	2.36E-10	1.2E-05
Zr-95	1.04E-03	2.72E-10	1.4E-05
Nb-95	1.91E-03	5.00E-10	1.7E-05
Mo-99	1.14E-03	2.98E-10	1.5E-05
Tc-99m	1.10E-03	2.88E-10	2.9E-07
Ru-103	9.86E-03	2.58E-09	8.6E-05
Rh-103m	9.86E-03	2.58E-09	4.3E-07
Ru-106	1.47E-01	3.85E-08	1.3E-02

TABLE 3.5-2
Comparison of Liquid Releases to 10 CFR 20 Effluent Concentration Limits (ECLs)

Isotope [a]	Release (Ci/yr)[b]	Boundary Concentration (μCi/cc)	Fraction of ECL
Ag-110m	2.10E-03	5.50E-10	9.2E-05
Sb-124	1.78E-03	4.67E-10	6.7E-05
Te-129m	2.40E-04	6.28E-11	9.0E-06
Te-129	3.00E-04	7.85E-11	2.0E-07
Te-131m	1.80E-04	4.71E-11	5.9E-06
Te-131	6.00E-05	1.57E-11	2.0E-07
I-131	2.83E-02	7.40E-09	7.4E-03
Te-132	4.80E-04	1.26E-10	1.4E-05
I-132	3.28E-03	8.59E-10	8.6E-06
I-133	1.34E-02	3.51E-09	5.0E-04
I-134	1.70E-03	4.45E-10	1.1E-06
Cs-134	1.99E-02	5.20E-09	5.8E-03
I-135	9.94E-03	2.60E-09	8.7E-05
Cs-136	1.26E-03	3.30E-10	5.5E-05
Cs-137	2.66E-02	6.97E-09	7.0E-03
Cs-138	1.90E-04	4.97E-11	1.2E-07
Ba-140	1.10E-02	2.89E-09	3.6E-04
L-140	1.49E-02	3.89E-09	4.3E-04
Ce-141	1.80E-04	4.71E-11	1.6E-06
Ce-143	3.80E-04	9.95E-11	5.0E-06
Pr-143	2.60E-04	6.81E-11	2.7E-06
Ce-144	6.32E-03	1.65E-09	5.5E-04
Pr-144	6.32E-03	1.65E-09	2.8E-06
Subtotal (without H-3)Pr-144	3.81E-01	---	3.73E-02
Tritium (H-3) Subtotal (without H-3)	3.10E+03	8.12E-04	8.14E-01
Total (all radionuclides)			
Tritium (H-3)	3.10E+03	---	8.50E-01

[a] Total release based on composite of the highest activity content of the individual isotopes from the AP-1000 (2 units), ABWR/ESBWR (1 unit), ACR-700 (2 units), IRIS (3 units), GT-MHR (4 modules, and the PBMR (8 modules).

[ab] Certain nuclides such as Rh-106, Ag-110, and Ba-137m are released but not included in the table. Water ECLs are not defined for these nuclides due to short half-lives.

TABLE 3.5-3
Normal Radioactive Gaseous Effluents

Isotope	Maximum Composite Release Ci/yr	Isotope	Maximum Composite Release Ci/yr
Kr-83m	8.38E-04	Sr-89	6.00E-03
Kr-85m	7.20E+01	Sr-90	2.40E-03
Kr-85	8.20E+03	Y-90	4.59E-05
Kr-87	3.00E+01	Sr-91	1.00E-03
Kr-88	9.20E+01	Sr-92	7.84E-04
Kr-89	2.41E+02	Y-91	2.41E-04
Kr-90	3.24E-04	Y-92	6.22E-04
Xe-131m	3.60E+03	Y-93	1.11E-03
Xe-133m	1.74E+02	Zr-95	2.00E-03
Xe-133	9.20E+03	Nb-95	8.38E-03
Xe-135m	4.05E+02	Mo-99	5.95E-02
Xe-135	6.60E+02	Tc-99m	2.97E-04
Xe-137	5.14E+02	Ru-103	3.51E-03
Xe-138	4.32E+02	Rh-103m	1.11E-04
Xe-139	4.05E-04	Ru-106	1.56E-04
I-131	2.59E-01	Rh-106	1.89E-05
I-132	2.19E+00	Ag-110m	2.00E-06
I-133	1.70E+00	Sb-124	1.81E-04
I-134	3.78E+00	Sb-125	1.22E-04
I-135	2.41E+00	Te-129m	2.19E-04
C-14	1.46E+01	Te-131m	7.57E-05
Na-24	4.05E-03	Te-132	1.89E-05
P-32	9.19E-04	Cs-134	6.22E-03
Ar-41	4.00E+02	Cs-136	5.95E-04
Cr-51	3.51E-02	Cs-137	9.46E-03
Mn-54	5.41E-03	Cs-138	1.70E-04
Mn-56	3.51E-03	Ba-140	2.70E-02
Fe-55	6.49E-03	La-140	1.81E-03
Co-57	1.64E-05	Ce-141	9.19E-03
Co-58	4.60E-02	Ce-144	1.89E-05
Co-60	1.74E-02	Pr-144	1.89E-05
Fe-59	8.11E-04	W-187	1.89E-04
Ni-63	6.49E-06	Np-239	1.19E-02
	1.00E-02	**Subtotal**	
Cu-64		**(without H-3)**	**2.40E+04**
Zn-65	1.11E-02	**Tritium (H-3)**	**3.53E+03**
Rb-89	4.32E-05	**Total**	**2.76E+04**

TABLE 3.5-4
Comparison of Gaseous Releases to 10 CFR 20 Effluent Concentration Limits

Isotope	Release Ci/yr	Boundary Concentration µCi/cc [a]	10 CFR 20 ECL µCi/cc	Fraction of ECL
Kr-83m	8.38E-04	6.8E-17	5.0E-05	1.4E-12
Kr-85m	7.20E+01	5.8E-12	1.0E-07	5.8E-05
Kr-85	8.20E+03	6.6E-10	7.0E-07	9.5E-04
Kr-87	3.00E+01	2.4E-12	2.0E-08	1.2E-04
Kr-88	9.20E+01	7.4E-12	9.0E-09	8.3E-04
Kr-89	2.41E+02	1.9E-11	1.0E-09	1.9E-02
Kr-90	3.24E-04	2.6E-17	1.0E-09	2.6E-08
Xe-131m	3.60E+03	2.9E-10	2.0E-06	1.5E-04
Xe-133m	1.74E+02	1.4E-11	6.0E-07	2.3E-05
Xe-133	9.20E+03	7.4E-10	5.0E-07	1.5E-03
Xe-135m	4.05E+02	3.3E-11	4.0E-08	8.2E-04
Xe-135	6.60E+02	5.3E-11	7.0E-08	7.6E-04
Xe-137	5.14E+02	4.2E-11	1.0E-09	4.2E-02
Xe-138	4.32E+02	3.5E-11	2.0E-08	1.7E-03
Xe-139	4.05E-04	3.3E-17	1.0E-09	3.3E-08
I-131	2.59E-01	2.1E-14	2.0E-10	1.0E-04
I-132	2.19E+00	1.8E-13	2.0E-08	8.9E-06
I-133	1.70E+00	1.4E-13	1.0E-09	1.4E-04
I-134	3.78E+00	3.1E-13	6.0E-08	5.1E-06
I-135	2.41E+00	1.9E-13	6.0E-09	3.2E-05
C-14	1.46E+01	1.2E-12	3.0E-09	3.9E-04
Na-24	4.05E-03	3.3E-16	7.0E-09	4.7E-08
P-32	9.19E-04	7.4E-17	1.0E-09	7.4E-08
Ar-41	4.00E+02	3.2E-11	1.0E-08	3.2E-03
Cr-51	3.51E-02	2.8E-15	3.0E-08	9.5E-08
Mn-54	5.41E-03	4.4E-16	1.0E-09	4.4E-07
Mn-56	3.51E-03	2.8E-16	2.0E-08	1.4E-08
Fe-55	6.49E-03	5.2E-16	3.0E-09	1.7E-07
Co-57	1.64E-05	1.3E-18	9.0E-10	1.5E-09
Co-58	4.60E-02	3.7E-15	1.0E-09	3.7E-06
Co-60	1.74E-02	1.4E-15	5.0E-11	2.8E-05
Fe-59	8.11E-04	6.6E-17	5.0E-10	1.3E-07
Ni-63	6.49E-06	5.2E-19	1.0E-09	5.2E-10
Cu-64	1.00E-02	8.1E-16	3.0E-08	2.7E-08
Zn-65	1.11E-02	9.0E-16	4.0E-10	2.2E-06
Rb-89	4.32E-05	3.5E-18	2.0E-07	1.7E-11
Sr-89	6.00E-03	4.9E-16	2.0E-10	2.4E-06
Sr-90	2.40E-03	1.9E-16	6.0E-12	3.2E-05
Y-90	4.59E-05	3.7E-18	9.0E-10	4.1E-09
Sr-91	1.00E-03	8.1E-17	5.0E-09	1.6E-08

TABLE 3.5-4
Comparison of Gaseous Releases to 10 CFR 20 Effluent Concentration Limits

Isotope	Release Ci/yr	Boundary Concentration µCi/cc [a]	10 CFR 20 ECL µCi/cc	Fraction of ECL
Sr-92	7.84E-04	6.3E-17	9.0E-09	7.0E-09
Y-91	2.41E-04	1.9E-17	2.0E-10	9.7E-08
Y-92	6.22E-04	5.0E-17	1.0E-08	5.0E-09
Y-93	1.11E-03	9.0E-17	3.0E-09	3.0E-08
Zr-95	2.00E-03	1.6E-16	4.0E-10	4.0E-07
Nb-95	8.38E-03	6.8E-16	2.0E-09	3.4E-07
Mo-99	5.95E-02	4.8E-15	4.0E-09	1.2E-06
Tc-99m	2.97E-04	2.4E-17	2.0E-07	1.2E-10
Ru-103	3.51E-03	2.8E-16	9.0E-10	3.2E-07
Rh-103m	1.11E-04	9.0E-18	2.0E-06	4.5E-12
Ru-106	1.56E-04	1.3E-17	2.0E-11	6.3E-07
Rh-106	1.89E-05	1.5E-18	1.0E-09	1.5E-09
Ag-110m	2.00E-06	1.6E-19	1.0E-10	1.6E-09
Sb-124	1.81E-04	1.5E-17	3.0E-10	4.9E-08
Sb-125	1.22E-04	9.9E-18	7.0E-10	1.4E-08
Te-129m	2.19E-04	1.8E-17	3.0E-10	5.9E-08
Te-131m	7.57E-05	6.1E-18	2.0E-09	3.1E-09
Te-132	1.89E-05	1.5E-18	1.0E-09	1.5E-09
Cs-134	6.22E-03	5.0E-16	2.0E-10	2.5E-06
Cs-136	5.95E-04	4.8E-17	9.0E-10	5.3E-08
Cs-137	9.46E-03	7.6E-16	2.0E-10	3.8E-06
Cs-138	1.70E-04	1.4E-17	8.0E-08	1.7E-10
Ba-140	2.70E-02	2.2E-15	2.0E-09	1.1E-06
La-140	1.81E-03	1.5E-16	2.0E-09	7.3E-08
Ce-141	9.19E-03	7.4E-16	8.0E-10	9.3E-07
Ce-144	1.89E-05	1.5E-18	2.0E-11	7.6E-08
Pr-144	1.89E-05	1.5E-18	2.0E-07	7.6E-12
W-187	1.89E-04	1.5E-17	1.0E-08	1.5E-09
Np-239	1.19E-02	9.6E-16	3.0E-09	3.2E-07
Subtotal (without H-3)	**2.40E+04**	**---**	**---**	**7.2E-02**
Tritium (H-3)	**3.53E+03**	**2.9E-10**	**1.0E-07**	**2.9E-03**
Total	**2.76E+04**	**---**	**---**	**7.5E-02**

[a] Boundary concentration values based on an average annual Chi/Q at the boundary of the restricted area (taken as the EGC ESP Site exclusion area distance of 1,025 m) in the sector with the highest value (NNE) = 2.04E-6 sec/m^3 (Table 2.7-53).

TABLE 3.5-5
Composite Principal Radionuclides in Solid Radwaste

Radionuclide	Quantity (Ci/y)r
Fe-55	1.76E+03
Fe-59	2.70E+00
Co-60	3.96E+02
Mn-54	3.47E+02
Cr-51	9.71E+01
Co-58	1.87E+02
Zn-65	5.14E+01
Nb-95	1.62E+02
Ag-110m	2.18E+00
Zr-95	7.65E+01
Ba-137m	1.01E+03
Ba-140	1.06E+00
La-140	1.21E+00
Cs-134	6.28E+02
Cs-136	6.00E-02
Cs-137	1.01E+03
Sr-89	1.77E+00
Sr-90	2.48E+00
Y-90	2.48E+00
I-131	8.19E+01
I-133	4.55E+00
Na-24	4.40E-01
Rh-106	1.20E-01
Ru-103	2.18E+00
Ru-106	1.37E+00
Sb-124	1.13E+01
Ce-141	1.40E-01
Ce-144	1.10E-01
Gd153	3.09E+00
Other	7.29E+01
Total (rounded to nearest hundred)	5.90E+03

TABLE 3.6-1
Estimated Bounding Blowdown Constituents and Concentrations

Constituents	Concentration (ppm)[a]		
	River Source	Well (Treated Water)	Bounding Estimate
Chlorine Demand	10.1	--- [b]	10.1
Free Available Chlorine	0.5	--- [b]	0.5
Copper	--- [b]	6	6
Iron	0.9	3.5	3.5
Zinc	--- [b]	0.6	0.6
Phosphate	--- [b]	7.2	7.2
Sulfate	599	3,500	3,500
Total Dissolved Solids	--- [b]	17,000	17,000
Total Suspended Solids	49.5	150	150

[a] Source: SSAR Table 1.4-2 and based on data supplied by the different reactor vendors and is not site specific
[b] Data not available

TABLE 3.6-2
Sanitary Discharges to Clinton Lake

Service	Normal	Maximum	Source
Sanitary waste discharge (This is the discharge from the potable/sanitary water system.)	60 gpm	198 gpm	SSAR Table 1.4-1/PPE Section 5.1.1

TABLE 3.6-3
Other Effluent Discharges

Service	Normal	Maximum	Source
Chemical waste discharge: This is the total of the regeneration wastes from the demineralized water system(s).	110 gpm	145 gpm	SSAR Table 1.4-1/PPE Section 6.1.1
Miscellaneous plant drains: This is the discharge from miscellaneous plant sources.	213 gpm	325 gpm	SSAR Table 1.4-1/PPE Section 8.1.1
Total	**323 gpm**	**470 gpm**	

TABLE 3.6-4
Bounding Estimates for Yearly Emissions from Auxiliary Boilers and Standby Diesel Generators for the EGC ESP Facility

Pollutant Discharged	Quantity (lbs)	Exhaust Elevation (ft)	Source
Auxiliary Boilers		110 ft above plant grade	SSAR Table 1.4-1/PPE Section 13.1
Particulates	34,500		SSAR Table 1.4-4
Sulfur Oxides	115,000		SSAR Table 1.4-4
Carbon Monoxide	1,749		SSAR Table 1.4-4
Hydrocarbons	100,200		SSAR Table 1.4-4
Nitrogen Oxides	19,022		SSAR Table 1.4-4
Note: Emissions from the operation of the auxiliary boilers is based on a 30 day/year operation			
Standby Generators		30 ft above plant grade	SSAR Table 1.4-1/PPE Section 16.1.2
Particulates	1,620		SSAR Table 1.4-5
Sulfur Oxides	5,010		SSAR Table 1.4-5
Carbon Monoxide	4,600		SSAR Table 1.4-5
Hydrocarbons	3,070		SSAR Table 1.4-5
Nitrogen Oxides	28,968		SSAR Table 1.4-5
Note: Emissions from the standby generators is based on a 4 hr/month operation for each generator			

TABLE 3.6-5

Bounding Estimates for Yearly Emissions from the Standby Power System Gas-Turbine Flue Gas for the EGC ESP Facility

Fuel: Distillate: LHV = 9,890 Btu/kWh, HHV = 10,480 Btu/kWh

96,960 lbs/hr fuel consumption rate

Release Height is 100 ft above plant grade (Table 1.4-1 of the SSAR/PPE Section 16.2.2)

Emissions are based on a 4 hour/month operating cycle for each generator

Effluent	PPMVD	Quantity (lbs)
NO_x (PPMVD @ 15% 0_2)	95	--
NO_x as NO_2	--	725
CO	25	85
UHC	10	20
VOC	5	10
SO_2	55	470
SO_3	5	30
Sulfur Mist	--	50
Particulates	--	22

Effluent	Exhaust Analysis Percent Volume
Argon	0.86
Nitrogen	72.56
Oxygen	11.2
Carbon Dioxide	5.19
Water	9.87

Source: SSAR Table 1.4-6

TABLE 3.7-1
State Transmission Line EMF Standards and Guidelines

	Electric Field		Magnetic Field	
State	**On Right-of-Way**	**Edge of Right-of-Way**	**On Right-of-Way**	**Edge of Right-of-Way**
Florida	8 kV/m[a]	2 kV/m		150 mG[a]
	10 kV/m[b]			200 mG[b]
				250 mG[c]
Minnesota	8 kV/m			
Montana	7 kV/m[d]			
New Jersey		3 kV/m		
New York	11.8 kV/m	1.6 kV/m		200 mG
	11 kV/m[e]			
	7 kVm[d]			
Oregon	9 kV/m			

[a] For line of 69-230 kV
[b] for 500-kV lines
[c] For 500-kV lines on certain existing right-of-way
[d] Maximum for highway crossings
[e] Maximum for private road crossings

TABLE 3.8-1
LWR Transportation Impact Evaluation

Reactor Technology	10 CFR 51.52(a) Condition Values	Bounding Values
Characteristic		
Reactor Power Level MWt	3,800 MWt	4,300 MWt
Fuel Form	Sintered UO_2 pellets	Sintered UO_2 pellets
U235 Enrichment	Not exceeding 4% by weight	Fuel cycle average ~4.85%; maximum assembly 4.95%; Reload up to 4.95%
Fuel Rod Cladding	Zircaloy	Zircaloy or ZIRLO
Average burnup MWd/MTU	33,000	55,200
Unirradiated fuel		
Transport mode	Truck	Truck
Irradiated fuel		
Transport mode	Truck, rail, or barge	Truck, rail, or barge
Decay time prior to shipment	At least 90 days	Five years
Radioactive waste		
Transport mode	Truck or rail	Truck or rail
Waste form	Solid	Solid
Packaged	Yes	Yes

TABLE 3.8-2

Gas-Cooled Reactor Transportation Impact Evaluation

Reactor Technology	Reference LWR (Single unit) (1,100 MWe)	GT-MHR (4 Modules) (2,400 MWt total) (1,140 MWe total)	PBMR (8 Modules) (3,200 MWt total) (1,320 MWe total)	Comments
Characteristic				
Capacity	80%	88%	95%	
Normalization factor	1	0.88	0.7	
Reactor Power Level MWt	~ 3,400	2,400 (600 MWt per module, 4 modules per plant)	3,200 (400 MWt per module, 8 modules per plant)	Not exceeding 3,800 MWt per reactor is a condition for use of Table S-4
Fuel Form	Sintered UO_2 pellets	Blocks of TRISO coated uranium oxycarbide (UCO) kernals [a]	Spheres of TRISO Coated UO_2 fuel kernels [a]	Sintered UO_2 pellets is a condition for use of Table S-4
U235 Enrichment	1% - 4%	Fissile particle 19.8%; fertile particle natural uranium [a]	Initial 4.9%; equilibrium 12.9% [a]	Not exceeding 4% is a condition for use of Table S-4; NUREG-1437 concludes that 5% is bounded
Fuel Rod Cladding	Zircaloy	Graphite [a]	Graphite [a]	Zircaloy rods are a condition for use of Table S-4; 10 CFR 50.44 allows use of ZIRLO)
Average burnup MWd/MTU	33,000	112,742 [a]	133,000 [a]	Not exceeding 33,000 is a condition for use of Table S-4; NUREG-1437 concludes 62,000 MWd/MTU for peak rod is bounded
Unirradiated fuel				
Unirradiated fuel transport mode	Truck	Truck	Truck	Shipment by truck is a condition for use of Table S-4
# of shipments for initial core loading	18	51 shipments (1020 fuel elements per module x 4 modules; 80 elements per truck) [a]	44 shipments (260,000 fuel spheres per module x 8 modules, 48,000 spheres per truck) [a]	100 MTU for PWR; 150 MTU for BWR

TABLE 3.8-2
Gas-Cooled Reactor Transportation Impact Evaluation

Reactor Technology	Reference LWR (Single unit) (1,100 MWe)	GT-MHR (4 Modules) (2,400 MWt total) (1,140 MWe total)	PBMR (8 Modules) (3,200 MWt total) (1,320 MWe total)	Comments
Characteristic				
# of reload shipments/year	6	20 shipments (520 elements per reload per 1.32 years x 4 modules; 80 elements per truck) [a]	3 shipments (18,000 fuel spheres per module x 8 modules, 48,000 spheres per truck)	30 MTU annual reload
Irradiated fuel				
Irradiated fuel transport mode	Truck, rail or barge	Truck	Truck	Shipment by truck, rail or barge is a condition for use of Table S-4
Decay time prior to shipment	150 days	Five years	Five years	Not less than 90 days is a condition for use of Table S-4; 5 years is per standard DOE contract with operating plants
Fission product inventory in Ci per MTU	6.19×10^6	1.55×10^6	1.78×10^6	LWR reference value is a 90-day decay time. Gas-cooled value is based on a 5-year decay time.
Actinide inventory in Ci per MTU	1.42×10^5	2.33×10^5 [a]	2.26×10^5 [a]	LWR reference value is a 90-day decay time. Gas-cooled value is based on a 5-year decay time.
Total radioactivity inventory in Ci per MTU	6.33×10^6	1.78×10^6	2.01×10^6	LWR reference value is a 90-day decay time. Gas-cooled value is based on a 5-year decay time.
Krypton-85 inventory in Ci per MTU	1.13×10^4	2.50×10^4 [a]	2.63×10^4 [a]	LWR reference value is a 90-day decay time. Gas-cooled value is based on a 5-year decay time.
Watts per MTU	2.71×10^4	6.36×10^3	3.91×10^3	LWR reference value is a 90-day decay time. Gas-cooled value is based on a 5-year decay time.
# of spent fuel shipments by truck	60	38 shipments (520 elements per module x 4 modules per 1.32 years, 42 elements per truck)	16 shipments (12 shipments for 1000 MWe)	0.5 MT of irradiated fuel per cask

TABLE 3.8-2
Gas-Cooled Reactor Transportation Impact Evaluation

Reactor Technology	Reference LWR (Single unit) (1,100 MWe)	GT-MHR (4 Modules) (2,400 MWt total) (1,140 MWe total)	PBMR (8 Modules) (3,200 MWt total) (1,320 MWe total)	Comments
Characteristic				
Decay heat (kW) (per irradiated fuel truck cask in transit)	10	1.02 (6.356 kW/MTU x 0.16044 MTU/shipment)	1.9 (3.9 kW/MTU x 0.495 MTU/shipment)	
# of spent fuel shipments by rail	10	0	0	3.2 – 3.5 MT of irradiated fuel per cask
Heat(per irradiated fuel rail cask in transit) kW	70	NA	NA	
# of spent fuel shipments by barge	5	0	0	
Radioactive waste				
Radioactive waste transport mode	Truck or rail	Truck	Truck	Shipment by truck or rail is a condition for use of Table S-4
# of rad waste shipments by truck	46	6 (98 m^3/yr)	9 (800 drums)	Assumed 90% of the waste shipped at 1000 ft^3 per truck, 10% at 200 ft^3 per truck
Weight per truck lbs.	73,000	Governed by state and federal regulations	Governed by state and federal regulations	Interstate gross vehicle limit is 80,000 lbs. (23 CFR 658.17)
# of rad waste shipments by rail	11	0	0	
Weight per cask per rail car tons	100	100	100	
Transport totals				
Traffic density, trucks per day	Less than 1	Less than 1	Less than 1	
Rail density, cars per month	Less than 3	0	0	

Source: 10 CFR 51.52, Table S-4 Environmental Impact of Transportation of Fuel and Waste

[a] Value larger than or different from the reference LWR.

Notes: The results for the reactor technologies have not been adjusted for their larger electrical generation or increased capacity factor.

TABLE 3.8-3

Summary Table S-4-Environmental Impact of Transportation of Fuel and Waste To and From One Light-Water-Cooled Nuclear Power Reactor

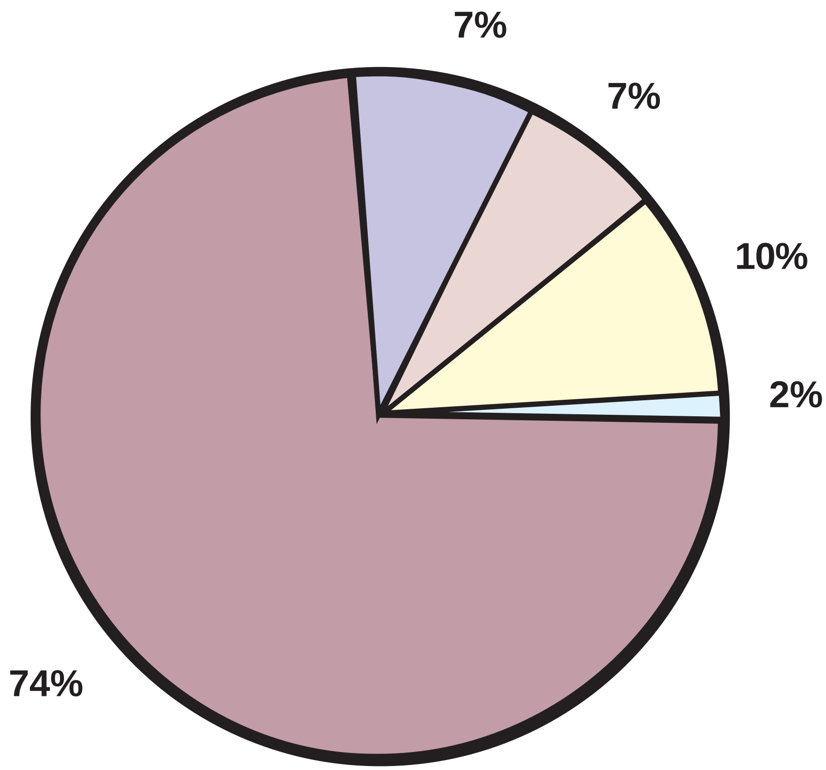
Normal Conditions of Transport			
Condition		**Value**	
Heat (per irradiated fuel cask in transit)		250,000 Btu/hr	
Weight (governed by Federal or State restrictions)		73,000 lbs. Per truck; 100 tons per cask per rail car	
Traffic Density:			
Truck		Less than 1 per day	
Rail		Less than 3 per month	
Exposed Population	**Estimated Number of Persons Exposed**	**Range of Doses to Exposed Individuals [a] (per reactor year)**	**Cumulative Dose to Exposed Population (per reactor year) [b]**
Transportation workers	200	0.01 to 300 millirem	4 man-rem.
General public:			
Onlookers	1,100	0.003 to 1.3 millirem	3 man-rem.
Along Route	600,000	0.0001 to 0.06 millirem	
Accidents in Transport			
Types of Effects		**Environmental Risk**	
Radiological effects		Small [c]	
Common (nonradiological) causes		1 fatal injury in 100 reactor years	
		1 nonfatal injury in 10 reactor years	
		$475 property damage per reactor year	

Note: Data supporting this table are given in the Commission's "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants," WASH-1238, December 1972 , and Supp. 1 NUREG-75/038 April 1975.

[a] The Federal Radiation Council has recommended that the radiation doses from the sources of radiation other than natural background and medical exposures should be limited to 5,000 millirem per year for individuals as a result of occupational exposure and should be limited to 500 millirem per year for individuals in the general population. The dose to individuals due to average natural background radiation is about 130 millirem per year.

[b] Man-rem is an expression for the summation of whole body doses to individuals in a group. Thus, if each member of a population group of 1,000 people were to receive a dose of 0.001 rem (1 millirem), or if 2 people were to receive a dose of 0.5 rem (500 millirem) each, the total man-rem dose in each case would be 1 man-rem.

[c] Although the environmental risk of radiological effects stemming from transportation accidents is currently incapable of being numerically quantified since a specific reactor has not been selected, the risk remains small regardless of whether it is being applied to a single reactor or a multireactor site.



Environmental Report for the EGC Early Site Permit

Figure 3.3-1
Annual Clinton Lake Outflows with EGC ESP Facility

Legend

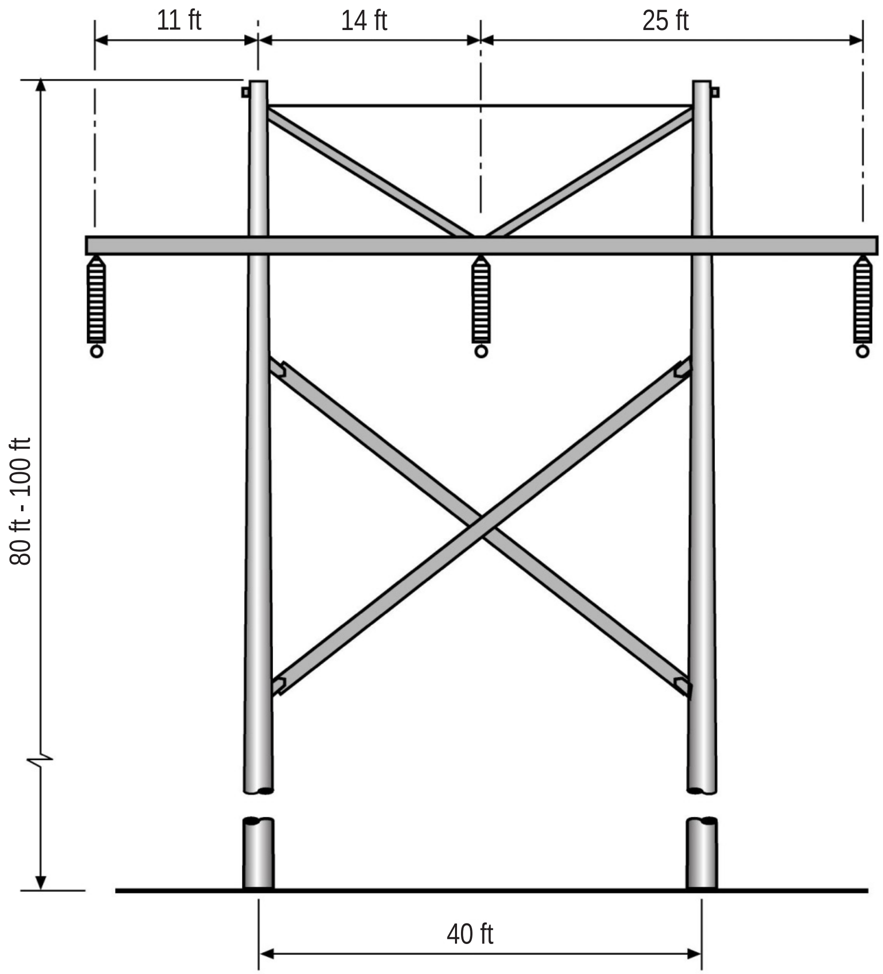
- Evaporation
- Cooling Tower Evap due to ESP
- Discharge at Clinton Lake Dam
- Forced Evap due to CPS
- Lake Bottom Seepage

Note:
Percentages are based on average annual runoff of 61,575 million gallons.

Not to Scale

Environmental Report for the EGC Early Site Permit

Figure 3.7-1
H-Frame Dimensions



Legend

Not to Scale

CHAPTER 4

Environmental Impacts of Construction

This chapter provides a description of the environmental impacts of construction to the area within and surrounding the EGC ESP Site. The chapter is organized into the following sections:

- Land Use Impacts (Section 4.1);
- Water-Related Impacts (Section 4.2);
- Ecological Impacts (Section 4.3);
- Socioeconomic Impacts (Section 4.4);
- Radiation Exposure to Construction Workers (Section 4.5); and
- Measures and Controls to Limit Adverse Impacts During Construction (Section 4.6).

For purposes of this ER, the site is defined as the property within the CPS fenceline (see Figure 2.1-3). The vicinity is the area within a 6-mi radius from the centerpoint of the site. The region of the site is the area between a 6-mi radius and a 50-mi radius from the centerpoint of the site.

It is estimated that site preparation activities (preconstruction) will take up to eighteen months to complete. Based on estimates provided by the reactor vendors, assuming that appropriate licenses are obtained, actual construction is expected to take from three to five years. The construction laydown area will be approximately 29 ac with an additional 52 ac needed for temporary construction facilities, and another 15 ac for a substation (see SSAR Table 1.4-1). To the extent possible, the CPS roads will be used for construction traffic. The site has at least one access road that can be used to transport heavy construction equipment.

Construction of the EGC ESP Facility will occur at a location approximately 700 ft to the south of the CPS. The site is comprised of impervious surfaces, crushed stone, and existing structures. In addition, land use is designated for the CPS.

4.1 Land Use Impacts

Land use impacts include any impacts to the site and the vicinity as a result of the proposed facility construction and construction in the transmission corridor. One hundred percent of the land at the site is classified as industrial, and 82 percent of land use within the vicinity is agricultural. Industrial land use within the vicinity of the site is limited to areas near the City of Clinton and Village of Weldon. As detailed below, construction activities will not significantly impact land use in nearby communities.

4.1.1 Site and Vicinity

There are two main types of land use impacts: direct impacts that affect the site and transmission corridor, and secondary impacts that affect the vicinity. To a lesser extent, impacts may affect the region. An assessment of impacts is described below. In general, because existing access roads and infrastructure will be used for construction, site and vicinity land use impacts will be negligible.

4.1.1.1 Land Directly Affected by Construction

Construction will be confined to the existing site and existing transmission corridor. The transmission corridor is discussed in Section 4.1.2. Areas that will be disturbed by site construction on either a long-term or short-term basis are located in Sections 22, 23, 26, and 27 of Township 20 North and Range 3 East (USGS, 1990).

In Section 2.2.1, Figure 2.2-1 shows the land use at the site. A total of 461 ac is located within the site boundary (fenceline), and up to approximately 96 ac will be disturbed. In addition, Table 2.2-1 lists the acres devoted to various land use categories for the site. Industrial land is the only type of land use within the site. Utility construction on this site is consistent with the DeWitt County Land Use Plan (University of Illinois, 1992).

The EGC ESP Site has no special agricultural resources (such as prime or unique farmland) because there is no land classified as agricultural within the site boundary. There are no known significant mineral resources (sand and gravel, coal oil, natural gas, and/or ores) within the site (ISGS, 1999). No construction activities within the site will take place within a floodplain (IDNR, 1986), coastal zone (USGS, 1990), or wild and scenic river (USFWS, 2002). There are four minor areas (less than 1 ac) within the site boundary that have been identified as wetland areas. They are all palustrine unconsolidated bottom (IDNR, 1987). None are within the power block footprint, cooling tower footprint, or intake areas of the EGC ESP Facility, and therefore will not be impacted by construction. Additionally, care will be taken so that these areas are not impacted by other construction activities such as construction laydown, and disposal of fill material. As defined by ESRP Section 4.1.1, since the expected disturbance of construction is less than 1,236 ac and does not have any special resources that will be affected, "it may be concluded that the expected impacts of construction on land use are not a major significance and there are no land use changes that will influence the decision on a construction permit" (USNRC, 1999).

4.1.1.2 Land Secondarily Affected by Construction

The closest communities to the primary area of construction (i.e., the site) include DeWitt, Weldon, and Clinton. DeWitt has a population of about 188, and is located approximately 3-mi east of the site. Weldon has an approximate population of 440, and is located approximately 6-mi southeast of the site. Clinton has a population of 7,485, and is located 6-mi west of the site (U.S. Census Bureau, 2001). It is anticipated that there will be no undesirable land use impacts to these communities from site preparation and construction.

Any land use impacts to nearby communities or properties will be the result of an increase in workers due to the addition of a construction labor force (up to 3,150 people) in the area (see SSAR Table 1.4-1). A small percentage of the construction labor force may opt to relocate to the vicinity. However, based on the discussion in Section 2.5.2, there is adequate property and community services to support these relocated workers. It is anticipated that minimal infrastructure and/or expanded development will be needed to accommodate their needs. As discussed in detail in Section 4.4, a significant amount of the construction labor force needed for this project would not relocate to the vicinity on a permanent basis but would commute from within the region.

In Section 2.2.1, Figure 2.2-2 shows the land use within the vicinity, and Table 2.2-1 lists the acres devoted to each land use category. The only special land use in this area is recreational, which makes up 17 percent of total land use within the vicinity (USGS, 1992). Normal recreational practices near the site will not be altered during construction. Access to the lake and camp areas will still be afforded to the recreational public.

In Section 2.2.1, Figure 2.2-3 shows the highways, RR, and utilities that cross the site and the vicinity. None of these facilities will be physically impacted by construction. Approximately 3,200 additional worktrips and 100 truck deliveries during peak hours will occur on the roads and highways during construction, but the roads and highways will not be unduly congested, except for brief periods (10 to 15 minutes) during the beginning and end of shifts. This analysis is discussed in more detail in Section 4.4.2.8.

To determine impact of additional workers on traffic, average daily traffic counts were obtained from IDOT's website for IL Route 54 and 10. Near the EGC ESP Facility, 2,750 cars and trucks and 2,000 cars and trucks travel daily on IL Route 54 and 10, respectively (IDOT, 2003). According to IDOT's *Bureau of Design and Environmental Manual*, the typical average daily traffic count for a rural 2-lane highway is 5,000 cars and trucks (IDOT, 1999). The EGC ESP Facility would add an additional 1,640 cars and trucks to each highway. Based on the addition of the average daily traffic counts and the expected number of additional trips due to construction, the additional construction workers would not put an excessive amount of burden on the roadways near the EGC ESP Facility.

There are no known significant mineral resources (sand and gravel, coal oil, natural gas, and ores) within the vicinity (ISGS, 1999). No construction activities within the vicinity will take place within a coastal zone (USGS, 1990) or wild and scenic river (USFWS, 2002). Clinton Lake is considered a 100-yr floodplain, but the area surrounding the lake is not within any floodplain (IDNR, 1986). There are minor wetland areas within the vicinity (IDNR, 1987). These will not be impacted by construction of the intake structure, and careful consideration of wetlands will take place when in the construction of the transmission corridor.

4.1.1.3 Land Use Plans

There are no federal, state, or regional land use plans for this area. However, DeWitt County published a countywide generalized land use plan in 1992. This plan guides future land use throughout the county and has designated the site for transportation and utility use. Further, the county land use plan targets expansion and spin-off development from the existing power plant as ways to realize further economic development in DeWitt County (University of Illinois, 1992). Construction of the EGC ESP Facility is compatible with existing land use, which has been developed as an operating nuclear power station.

4.1.1.4 Site Restoration and Management Actions

Mitigation measures, designed to lessen the impact of construction activities, will be specific to erosion control, controlled access roads for personnel and vehicle traffic, and restricted construction zones. The site preparation work will be completed in two stages. The first stage will consist of stripping, excavating, and backfilling the areas occupied by the structure and roadways. The second stage will consist of developing the site with the necessary facilities to support construction, such as construction offices, warehouses, trackwork, large unloading facilities, water wells, construction power, construction drainage, etc. In addition, structures will be razed and holes will be filled.

Grading and drainage will be designed to avoid erosion during the construction period. Action will be taken to restore areas consistent with existing and natural vegetation. A total of approximately 96 ac will be required for construction facilities including permanent facility structures and laydown. To the extent possible, CPS roads will be used for construction traffic. If necessary, temporary stone roads will be installed along with site grading and drainage facilities. This will permit an all weather use of the site for travel and storage of materials and equipment during construction.

Other potential environmental impacts that may be created by preconstruction and construction activities as well as associated measures and controls to limit those impacts are discussed in Section 4.6.3.

4.1.2 Transmission Corridors and Off-Site Areas

This section is divided into two parts, first a description of general construction methods, and then a description of any physical impacts or restrictions on land use in the transmission corridor. In general, construction of transmission corridor in off-site areas will have a minimal impact on land use due to the fact that it is assumed that only existing rights-of-way will be used.

As stated in Section 2.2.2, the transmission corridor is divided into two sections. The northern section will run north of the EGC ESP Facility and then turn west and run towards Bloomington, Illinois. The southern section will run southeast of the EGC ESP Facility past Clinton Lake and then turn south and run towards the southern boundary of DeWitt County. Figure 2.2-4 depicts the anticipated transmission line corridor.

As described in Section 3.7, an RTO or the owner, both regulated by FERC, will bear the ultimate responsibility for defining the nature and extent of system improvements, as well as the design and routing of connecting transmission. Therefore, the construction impacts described in this section are based on the existing infrastructure, the owner’s system design

preferences, and best transmission practices. It is anticipated the transmission corridor owner will use the existing corridor as a method to minimize the environmental impact as much as possible.

4.1.2.1 Transmission Corridor Construction Methods

This section describes the general construction methods proposed for building the new 345-kV transmission lines described in Section 3.7. The methods used in constructing the lines may vary considerably from place to place and time to time due to a number of outside influences including:

- Differing restrictions by different property owners or the right-of-way;
- Local restrictions by state and local agencies, road commissioners and RR;
- Restrictions due to weather;
- Legal requirements; and
- Land use type.

The methods proposed are based on best practices in the industry and provide a means of assuring reliable, safe, economical construction that meets applicable safety and environmental requirements. New techniques, different from the standards, are sometimes required to meet special or emergency circumstances. In both normal and special condition construction, the methods used will be selected to minimize the impact on the local environment.

The following sections describe the proposed construction methods and the possible environmental impacts associated with them. A proactive approach will be applied to minimize environmental impact.

4.1.2.1.1 Surveying and Construction Access Roads

Before construction begins, a survey will be required to identify centerline location, H-Frame locations, right-of-way boundaries and access locations. Surveys will generally be conducted well in advance of construction and will have minimum impact on the land. Most survey monuments will consist of wooden stakes and lathes that will be removed following construction.

Construction surface access will be required for both materials and equipment. However, the largely agricultural nature of the land will minimize the need to construct access roads. Maximum practical use will be made of existing right-of-way access roads, public roads, and temporary access points. Where temporary access is required, short routes of non-graded overland access will be constructed for as long as access to the site is required, after which they will be reclaimed. Standard design techniques, such as installing water bars and dips to control erosion, will be employed along with minimizing construction during wet seasons.

4.1.2.1.2 Material Laydown, Storage Yards and Field Offices

Material for the construction of the transmission lines can be described by five major categories:

- Poles for wooden H-Frame structures;
- Cross arms, braces, and other framing materials for the H-Frame structures;
- Reels of conductor;
- Insulators; and
- Conductor hardware.

Delivery method, material handling, and storage requirements will dictate the size and nature of the storage yard or yards. To the extent practical, the property already in use for the project construction and at the existing substation sites will be used for storage and laydown yards. Material will be received at a central location or locations and transported to the area under construction. Any area disturbed by the storage operations, not already in use for substation operations or construction activities, will be restored consistent with existing and natural vegetation.

Customary practices will be used for field offices during line construction in order to minimize any environmental impacts.

4.1.2.1.3 Right-of-Way Clearing

Clearing trees, brush and other vegetation from the transmission line right-of-way will be required for two primary reasons:

- To permit construction of the transmission lines, and
- To provide adequate clearance between the energized lines and any other objects.

Right-of-way clearing will result in the removal of some natural vegetation and removal or brief interruption of crops. Such clearing may temporarily affect soil stability, water runoff, wildlife habitat, and aesthetics. Waste material requiring disposal may be created by the clearing process. The effects of clearing will be minimized by applying one or more of the following guidelines:

- Restrict cutting of vegetation to the minimum necessary to satisfy construction access and clearance to energized lines.
- Remove vegetation by cutting rather than by bulldozer or other mechanical means. Restricting clearing to cutting, where possible, reduces soil disturbance, reduces waste, and allows retention of plant root systems to stabilize the earth and promote regrowth.
- Leave a screen of vegetation at junctions of the right-of-way and other linear features such as roads, railways, and watercourses, where possible.
- Taper right-of-way cutting in forested areas to minimize disturbance and eliminate clear cutting for the entire width of right-of-way.

- Limit herbicide use to those species of trees that are subject to resprouting. Maximum application rates will be restricted to minimize impacts.

Right-of-way clearing methods will be dictated in large part by the requirements of the property owner. Absent direction from the property owner, clearing will be done in accordance with industry guidelines and best practices. In some cases, special techniques may need to be used around sensitive habitats. In agricultural areas, farming will remain permissible in the right-of-way and only the H-Frame structure footprint will be taken out of normal use.

Waste material generated from clearing operations will be disposed of in a variety of ways, usually depending on the requirements of the landowner. One or more of the following methods will typically be employed:

- Haul to landfill;
- Use as a windrow along edge of right-of-way and allow to deteriorate naturally;
- Place brush and logs in runoff channels to prevent erosion; and/or
- Chip vegetation and spread evenly over the right-of-way, allowing it to deteriorate naturally.

Following clearing, disturbances caused by equipment will be repaired.

4.1.2.1.4 Temporary Improvements

Where necessary, culverts and fence openings will be installed to allow access to and along the right-of-way during clearing and construction activities. Except where requested by landowners, the culverts and fence openings will be removed following completion of construction activities.

Culverts will be installed where necessary, and sized to handle the expected flows including changes in flow brought about by right-of-way clearing or construction activities. Culverts will be covered with material borrowed from the adjacent area. If sufficient material is not available in the surrounding area it will be brought in from a commercial source. Following removal, the cover material will either be spread on the surrounding area or hauled to an approved dumpsite depending on its original source.

Fence openings will be installed in existing fences where access is required. Depending on the landowner's wishes, the openings will either be temporary or permanent. Temporary openings will be braced on either side and have a simple gate consisting of a section of fence or commercial pipe type gate. Permanent openings will consist of braced openings with one side reinforced to accommodate hanging a gate. Gates will be commercial galvanized metal or pipe type gates with a locking feature. No environmental impacts are expected from gate installation. Temporary gates will be removed and the area restored as closely as possible to original conditions while permanent gates will be left for the landowner's use.

4.1.2.1.5 H-Frame Erection

H-Frame erection will be completed in three basic steps: foundation preparation, assembly of pole sections into H-Frame assemblies, and erection of the assemblies. Figure 3.7-1 depicts the H-Frame structure and dimensions. The H-Frame structures will be direct

buried in the ground except where site conditions dictate a concrete foundation. Foundation holes will typically be excavated with rubber tire or track mounted augers, which will leave a minimum footprint of disturbed ground. Following erection of the H-Frames into the foundation holes, the holes will be backfilled with the removed soil and compacted. Excess soil will be distributed evenly around the legs and graded to match the existing ground profile. The small amount of excess soil will not require off-site disposal.

The poles, connecting hardware, insulators, and guys required for H-Frame construction will be delivered to the construction site from the storage yard on suitable rubber tire trucks and trailers. At the erection site, a rubber tire rough duty mobile crane will be used to move the sections during assembly and to install the completed H-Frames. During this operation an area approximately 100 ft-long by 40-ft wide will be required for component laydown, the preassembly of structures, and vehicle access at each H-Frame location.

As for other portions of the transmission line construction, adverse effects caused during erection of towers will primarily be the result of soil disturbance caused by construction equipment. Weather conditions will be the determining factor in how much damage is actually done. If rainy and wet weather prevails, excessive compaction and rutting could result. Dry weather construction will cause only minor compaction and disturbance. On completion of construction, the right-of-way will be restored as near as possible to its original condition. As the contractor completes the operations, the right-of-way will be backbladed with a bulldozer and the area will be graded. Customary practices for erosion prevention will then be used.

4.1.2.1.6 Conductor Installation

The conductor installation on these lines will use the tension stringing method, which requires tension pull sites the full width of the right-of-way, 3 to 4 ac in size, at intervals of approximately 1.5 mi along the route. In this method, light pilot lines will be pulled through stringing dollies on the towers by a bulldozer traversing the right-of-way between towers. The pilot line will then be used to pull in a heavy steel carrier line, which in turn will pull in the conductor. If both transmission lines are not built at the same time, the tension site will only require the width of a single right-of-way, approximately 130 ft, not the full final anticipated width of approximately 250 ft.

At the tension pulling sites, temporary anchors will be installed in the ground to support the conductor. The temporary anchors may cause some disturbance of the soil, which will be corrected upon the completion of this activity. After the conductor has been sagged and clipped in, the right-of-way restoration procedures will be carried out as described in the previous section. This work will include the removal of equipment, cribbing, packing cartons, scrap wire, etc., as well as restoration of the soil.

4.1.2.2 Potential Physical Impacts to Land Use from Construction

Physical impacts to land use from construction of transmission lines are described below. In general, these impacts are anticipated to be minor; however, steps will be taken to mitigate these minor impacts. Section 2.2.2 describes the anticipated location of transmission corridor routes, area, and land use. Figure 2.2-4 shows where highways, RR, and utilities cross the transmission corridors.

4.1.2.2.1 Long-Term Physical Changes in Land Use

No long-term physical changes in land use will result from construction in the anticipated transmission corridor.

Land uses within the transmission corridor are listed in Table 2.2-2. Highways and RR that will be crossed by the transmission corridor are listed in Section 2.2.2. There are three utility rights-of-way that will be crossed by the transmission lines in the northern section and one utility right-of-way that will be crossed in the southern section (see Figure 2.2-4).

There are no federal, state, or regional land use plans for this area (McLean, 2000). However, DeWitt County published a countywide generalized land use plan in 1992, the DeWitt County comprehensive plan, and McLean County published a countywide regional comprehensive plan in 2002. Details about these land use plans and the effects of the transmission corridors are detailed in Section 2.2.2.

The transmission corridor will not cause long-term changes to special agricultural resources, such as prime or unique farmland, since the transmission corridor will be constructed in existing right-of-way. There are no known significant mineral resources (sand and gravel, coal oil, natural gas, and ores) within the transmission corridor (ISGS, 1999). No construction activities for the transmission corridor will take place within a coastal zone (USGS, 1990) or wild and scenic river (USFWS, 2002). Clinton Lake is considered a 100-yr floodplain. There are also three other 100-yr floodplains within the transmission corridor (IDNR, 1986). There are minor wetland areas within the vicinity (IDNR, 1987). Careful consideration of these floodplains and wetlands will take place when constructing the transmission corridor. Transmission towers required for the proposed transmission system will be sited in upland areas within the existing utility corridor. Adverse impacts to watercourses, wetlands, and floodplains within the existing right-of-way will be avoided to the greatest extent possible.

4.1.2.2.2 Short-Term Changes in Land Use

Some minor impacts to the land may result from construction of the transmission corridor. These include:

- Temporary access roads, if required;
- Material laydown areas, storage areas, and field offices;
- Right-of-way clearing;
- Temporary improvements, such as culverts and fence openings;
- Minor soil disturbance from erection of H-frames; and
- Conductor installation.

A detailed description of these minor impacts and mitigation measures are described in Section 4.1.2.1.

If for any reason construction of the EGC ESP Facility license or license application is withdrawn, the procedures and practices described in the Site Redress Plan for the EGC ESP Site may be followed.

4.1.2.2.3 Construction Impacts on the Geologic Environment

The only impacts on the geologic environment will result from H-Frame erection. As described in Section 4.1.2.1.5, some soil disturbance and regrading will occur with construction of the foundations for the H-Frames. This impact is minor, and mitigation measures are discussed in Section 4.6.3.8.

4.1.3 Historic Properties

As described in Section 2.5.3, no historic standing structures have been identified within the EGC ESP Facility power block footprint, cooling tower footprint, or in the immediate vicinity of the CPS. Reviews of records show that no historic structures ever stood within the EGC ESP Facility power block or cooling tower footprint; however, the potential for historic material does exist within the site boundary. Therefore, if the power block or cooling tower footprint area was expanded or moved, there is a potential for impact to historic properties. Prehistoric remains have been identified in the vicinity of the site and, to a lesser extent, within the site boundary. Two prehistoric sites of uncertain date were identified within the EGC ESP Facility power block footprint. These two sites are small prehistoric occupations of unknown cultural affiliation that were identified during the archaeological surveys for the CPS in the early 1970s. There is no evidence in the state site files that any further study was conducted at these sites after their initial identification. It is likely that these sites were identified either through controlled surface reconnaissance or shovel testing. These sites likely were destroyed during construction of the CPS. Therefore, no further archeological investigations within the footprint of the power block appears warranted.

The cooling tower footprint of the EGC ESP Facility also may have been disturbed by previous development of the CPS, although it is unclear whether this area was surveyed prior to development of the CPS. An aerial photograph review illustrates disturbances related to roads and some stripping, possibly resulting from lay down activities. Therefore, archeological testing of this area does not appear to be warranted.

The previous archaeological studies conducted within a 2-mi radius of the CPS and map research have determined that the archaeological potential of areas around the site is high. If additional areas within the EGC ESP Site will be required for development, further evaluation will be performed to determine if additional archaeological review is necessary.

4.2 Water-Related Impacts

This section describes hydrological alterations and the potential water use impacts from preconstruction and construction phases for the EGC ESP Facility as well as the anticipated transmission corridor from the station. The scope of this evaluation is described below.

- Descriptions of proposed construction activities including preconstruction, station construction, and transmission line construction that could result in hydrologic alterations or impact water use.
- Descriptions of resulting hydrologic alterations and the effects of these alterations or construction-related effluents on physical and water quality conditions.
- Proposed controls, practices, and procedures to minimize adverse construction impacts on water use.
- Evaluation of compliance with applicable federal, state, regional, and local standards and regulations.

The construction will be confined to the station site and the existing transmission corridor. Proper mitigation and management methods implemented during construction will limit the potential water quantity and quality impacts to the surface water (e.g., Clinton Lake, stream crossings, and intermittent drainage ways) and adjacent groundwater.

4.2.1 Hydrologic Alterations

This section identifies and describes anticipated hydrologic alterations and the potential water-related impacts resulting from the proposed construction activities. Preconstruction and construction activities, which have been initially identified as possibly resulting in hydrologic alterations at the site or transmission corridor, include:

- Alteration of the existing watershed surface including buildings, structures, and paved surfaces such as parking lots and access roads;
- Temporary disturbance of the ground surface for stockpiles, materials storage, or temporary access roads;
- Construction of intake structures;
- Construction of cofferdams and storm sewers;
- Dredging operations;
- Dewatering activities and other operations affecting water levels;
- Construction activities contributing to sediment runoff; and
- Removal of woody vegetation and shrubs along the transmission corridor

The potential hydraulic alterations that may be caused by these construction activities include:

- Changes in surface water drainage characteristics;

- Erosion and sedimentation;
- Changes in groundwater levels from dewatering activities; and
- Subsidence resulting from groundwater withdrawals.

The following sections discuss the possible hydrologic alterations and impacts resulting from these construction-related activities. This discussion of potential impacts also includes a description of practices that will be implemented to minimize the impacts of hydrologic alterations and applicable federal, state, regional, and local standards and regulations that will be addressed.

Construction erosion control measures and comprehensive Stormwater Pollution Prevention Plans (SWPPP) are required under the Illinois Environmental Protection Act, the Illinois Pollution Control Rules (35 Ill. Adm. Code, Subtitle C, Chapter I), and the federal Clean Water Act (CWA). Where necessary, special erosion control measures will be implemented to minimize impacts to the lake and lake users and CPS operations. Typical stormwater control elements of a SWPPP are discussed in Section 4.6.3.3.

4.2.1.1 Freshwater Streams

There are not expected to be any hydrologic alterations of the watershed upstream of Clinton Lake on Salt Creek and North Fork of Salt Creek. There will be limited hydrologic alterations on Clinton Lake, and therefore, on Salt Creek downstream of Clinton Lake. The alterations related to site preparation or preconstruction, construction and transmission corridor improvements will generally increase the volume of runoff to the lake and may temporarily alter the quality of runoff to the lake particularly related to sediment. The impacts to Salt Creek will be reduced by lake watershed stormwater management practices and the buffering effect of the lake on the rate and volume of runoff as well as water quality.

The Clinton Lake Dam will continue to release water to Salt Creek at a minimum rate of 5 cfs in accordance with dam permit conditions. The dam operating procedures will be reviewed and revised as necessary during the construction phase, to accommodate changes in the watershed hydrology and monitoring improvements to support the minimum 5 cfs discharge.

The rate and volume of discharge to Salt Creek from Clinton Lake will be unchanged. There may be some temporary effects during construction before permanent stormwater management measures are in place. Such temporary impacts will be minimal due to the size of the contributing watershed relative to the size of the area of disturbance. Temporary impacts will be further buffered by the attenuating capacity of the lake.

The long-term quality of discharge to Salt Creek from Clinton Lake will be unchanged due to hydrologic alterations. There may be a slight increase in sediment concentrations and associated nutrients as a result of increased erosion during construction. These changes will be mitigated by incorporating construction erosion practices as required by federal and state law and stormwater best management practices following construction. Any increase in sediment load to the lake will be buffered by the sediment removal capability of the lake before water is discharged to Salt Creek. Proper safeguards will be undertaken to minimize construction-related impacts to Clinton Lake and thereby prevent long-term impacts to downstream habitats in Salt Creek.

There may be smaller streams and intermittent streams along the transmission corridor that may be impacted by corridor preparation work or transmission line construction. Such activity may include mowing and woody vegetation removal, temporary disturbance along access routes for construction equipment, and small site excavation for tower base pads. The location of these tower pads will be selected to maintain adequate separation from drainage ways and streams. Where the soil is exposed due to construction or equipment traffic, appropriate construction erosion control and revegetation methods will be applied. Disturbed areas at tower pad sites are expected to be less than federal and state minimum requirements for permanent stormwater management facilities.

4.2.1.2 Lakes and Impoundments

The most considerable hydrologic features related to the facility site and transmission corridor are Clinton Lake, the UHS, and the discharge flume. Clinton Lake provides the cooling water for the CPS. The UHS is a submerged impoundment located within Clinton Lake that provides emergency cooling water to the CPS in the event that the lake is drained. The discharge flume receives discharges from the CPS and conveys them to Clinton Lake. The proposed site is located adjacent to the shore of the North Fork of the lake.

Construction erosion control measures will be applied during the phases of site development to contain eroded soil on the construction site and remove sediment from stormwater prior to leaving the site. Design measures will be incorporated to avoid concentrated flow that has a high potential to transport sediment. Visual inspections of construction erosion control measures will be incorporated into the construction project to monitor the effectiveness of the control measures and to aid in determining if other mitigation measures are necessary. Mitigation measures will be incorporated into the requirements of the construction contracts and the SWPPP. Beyond the construction activity, stormwater management practices will be incorporated into the site design to minimize the long-term delivery of sediment to the lake.

The peak rate and volume of runoff for the permanent site will be controlled by best management practices for stormwater systems. Practices include diverting stormwater runoff from paved surfaces and buildings to vegetated areas or detention areas in order to slow down the rate of runoff, and promote infiltration in order to reduce the volume of runoff. Based on the anticipated construction activities, the resulting hydrologic alterations impacting Clinton Lake, the UHS, or the discharge flume are mainly related to increased erosion and sediment transport (i.e., quality) rather than removal of available water for use (i.e., quantity) since construction-related runoff will eventually be returned to Clinton Lake.

4.2.1.2.1 Construction Along Clinton Lake

Construction along Clinton Lake will include the building of a new intake structure to supply the cooling water needs of the new station. The proposed location of the new intake structure is next to the existing intake structure for the CPS. Additional construction for stormwater drainage outfalls from the new EGC ESP Site, and temporary drainage outfalls during construction are anticipated. No modifications to the existing discharge flume are anticipated. The new ESP discharge pipe will be connected to the CPS discharge structure that was intended for the circulating water discharge from the cancelled CPS Unit 2. At this time, additional construction related to the UHS pond is not anticipated.

The hydrologic alterations resulting from the construction of the new intake structure and outfall are mainly related to sediment. The construction area will be temporarily isolated from the lake by cofferdams, or similar structures, and dewatered. The water will be pumped to a sedimentation basin if necessary and allowed to drain back into the lake at a location away from the CPS intake structure. Construction of the intake structure will be designed to control shoreline and bank erosion and minimize impacts on Clinton Lake, the UHS, and the CPS intake structure. Special erosion and siltation control measures will be incorporated with lakeshore construction to minimize these impacts. Any sediment deposition in the vicinity of the intake structure will be removed following construction. This work will be bounded by the requirements of the SWPPP. Appropriate USACOE Section 404, IEPA 401 Water Quality Certification, and NPDES permits will be obtained for these activities.

4.2.1.2.2 Secondary Impacts to Clinton Lake from Surface Disturbance

The majority of the area that is within the footprint of the EGC ESP Facility is paved, covered with gravel, or is an existing structure. The runoff from these areas is collected and controlled by a stormwater drainage system and is eventually discharged into Clinton Lake. The construction of the new station and disturbances to the existing ground surface will potentially increase the sediment load via runoff to Clinton Lake. Site grading and drainage during construction will be designed consistent with the SWPPP to avoid erosion during the construction period.

Construction erosion and stormwater control will also be incorporated for new areas of disturbance of the EGC ESP Site that will be used for material staging, parking, or other construction-related facilities. The preparation of these areas will temporarily, or in some cases permanently, alter the existing terrain and drainage by clearing, grading, transporting dirt and spoils, and other activities. Comprehensive construction erosion control measures will be employed to minimize the effects of the runoff and minimize siltation in the adjacent drainage ways and Clinton Lake.

Runoff from construction areas will be diverted to the south or to the discharge side of the Clinton Lake cooling system in order to avoid impacts to the CPS intake and cooling system. A limited amount of silt deposition in the drainage ways and Clinton Lake will be unavoidable; however, erosion will be monitored and control measures implemented to minimize the potential for additional sediment deposition during the construction period. Proper safeguards (such as sediment basins, silt fencing, and revegetation of disturbed areas) will be used to minimize sediment and nutrient transport to Clinton Lake in order to prevent long-term effects on downstream habitats.

Surface disturbance due to construction of overhead transmission lines is expected to be limited to temporary disturbance from removal of trees and shrubs, movement of construction equipment, and excavation for the foundation of the transmission line towers. This disturbance is expected to be minimal, as the disturbances will be short-term or isolated at individual tower pads. The appropriate erosion control measures will be incorporated into the design contract documents to minimize the impacts of disturbances that occur near the lake or other surface waters. Ground disturbance will be minimized and native ground vegetation will be reestablished following construction in order to minimize erosion.

A notice of intent (NOI) will be filed with the federal and state agencies to receive authorization for land disturbance under the General Stormwater Permit. A SWPPP will also be prepared in accordance with the requirements of the general permit. A notice of termination (NOT) will be filed with the IEPA upon completion of construction and stabilization of the disturbed areas.

4.2.1.2.3 Secondary Impacts to Clinton Lake from Subsurface Excavation Activities

The facility complex will be excavated up to a depth of 140 ft (approximate elevation of 595 ft) (see SSAR Table 1.4-1). Although some of the soil may be used for backfill, the majority of the soil will be deposited in spoil and excavation areas that will be identified during the design. These spoil areas will be maintained during construction in order to minimize water and wind erosion. Spoil areas will be kept graded, reasonably flat, and compacted by normal construction traffic. Spoil areas will be surrounded by a silt fence or a vegetated buffer strip, which will be maintained in order to minimize erosion. If necessary, water will be sprayed on the bare soil to minimize wind erosion during dry periods. If stockpiles are in place for more than a specified period of time, they will be vegetated in order to prevent erosion.

4.2.1.3 Groundwater

The hydrologic alterations anticipated to result from construction activities also include the temporary changes in groundwater levels from dewatering. The potential impacts that need to be considered during the design of the excavation and dewatering activities include:

- The amount of water that will need to be removed based on the embedment depth;
- Potential slope stability and subsidence problems when water is removed from the unconsolidated materials;
- The lateral extent of the depression in the groundwater surface caused by dewatering;
- The management and handling of the water removed from the excavation and eventual discharge to Clinton Lake; and
- Potential changes in water quality.

The proposed maximum embedment depth of up to approximately 140 ft (elevation of 595 ft) is below the static water table in the surrounding glacial soils. The piezometers installed to measure the groundwater level within the proposed footprint of the new reactor have measurements ranging from approximately 10- to 17-ft below ground surface, corresponding to elevations of 720 to 730 ft.

Dewatering of the excavation for construction may be required to lower the groundwater table in the immediate vicinity of the CPS. The excavation for the main power structure of the CPS extended from grade to the Illinoian till of the Glasford Formation at depths of about 53 to 56 ft below grade (elevation of 680 to 683 ft above msl) (CPS, 2002). Construction of the CPS did not require extensive dewatering, and the existing 30-ft deep excavation for the canceled second unit at the CPS has remained dry. However, the proposed maximum excavation depth of 140 ft for the EGC ESP Facility embedment is deeper; therefore, deeper geologic deposits (glacial deposits) will be encountered. As depicted in Figure 2.3-16, glacial outwash deposits, described as containing sand and gravel

with potential hydraulic conductivities of up to 1E-02 centimeters per second (cps) (28 ft/day), were encountered at depths of approximately 50 to 100 ft (elevations of 655 ft to 695 ft) based on the boring logs included in the CPS USAR (CPS, 2002). These permeable deposits ranging in thickness of up to about 10 ft were encountered in many of the borings installed, as part of the investigations for the CPS. These outwash deposits were also encountered in the recent borings completed within the footprint proposed for the EGC ESP Facility, at depths ranging between approximately 50 and 65 ft.

The volume of water to be removed during excavation is unknown since the lateral continuity and hydraulic connection of these outwash deposits have not been defined within the proposed excavation area. However, if outwash deposits are encountered, the water within the deposit will drain into the excavation area and will need to be removed and managed appropriately. The excavation activities will be designed to minimize the amount of water to be handled as well as potential slope stability problems that may be caused by caving and dewatering of these unconsolidated materials.

Based on the depth and size of the excavation and the possible duration of the open excavation, the depression of the groundwater caused by dewatering may extend beyond the site boundary. However, the generally low permeability of the shallower glacial materials will help to minimize the extent of the potential impacts.

The dewatering effluent obtained from the station excavation will be pumped and eventually discharged to an adjacent drainage way and into Clinton Lake. Measures will be implemented, such as sedimentation or filtration, to ensure that erosion or siltation caused by the dewatering will be negligible. Existing sediment basin facilities will be considered or new facilities constructed to accommodate dewatering flows. Where possible, dewatering flows will be diverted to the south or to the discharge side of Clinton Lake in order to avoid impacts to the CPS Facility intake and cooling system. A limited amount of silt deposition in the drainage ways and Clinton Lake will be unavoidable; however, the impacts from these activities will be confined to the construction period and will be monitored and controlled using best management practices for sediment control. Proper safeguards will be implemented to prevent long-term effects on downstream habitats resulting from the construction activities.

Based on the available water quality data, the groundwater pumped out the excavation and discharged to Clinton Lake will not impact the lake water quality. The analytical results from groundwater samples collected from CPS piezometers screened in the glacial drift aquifers (see Table 2.3-20) and mean concentrations in the Illinoian aquifer (see Table 2.3-22) were compared to the Illinois Water Quality Standards (IEPA, 2002). The groundwater concentrations, except for iron, were below the General Use Standards and with a few exceptions (i.e., sulfate and iron) were also below the Public and Food Processing Water Supply Standards (IEPA, 2002). The mean iron concentration in Illinoian aquifers of 3.0 mg/L (see Table 2.3-22) exceeded the General Use Standard of 1.0 mg/L and the Public and Food Processing Water Supply Standard of 0.3 mg/L. The highest iron concentration (0.32 mg/L) from groundwater samples collected from the CPS piezometers just exceeded the standard. The maximum sulfate concentration of 325 mg/L exceeded the Food Processing Water Supply Standard of 250 mg/L.

Based on the description of the aquifer systems in the vicinity of the site, the water withdrawals and resulting changes in the water levels will not affect water quality since it does not differ substantially between aquifers (see Section 2.3.3.3). However, the potential for changes in water quality will be considered during the design.

If piezometers are encountered during foundation excavation, they will be removed and/or abandoned (depending on their depth) in accordance with applicable regulations.

4.2.2 Water Use Impacts

The construction-related impacts on water use are evaluated based on alteration in water quality and availability.

4.2.2.1 Freshwater Stream

Although there may be some private users, there are no communities upstream or downstream of Clinton Lake that draw water from Salt Creek or the North Fork for public water supply. Any users upstream of Clinton Lake will not be impacted by construction-related activities because they are upstream of the construction activity. Any users downstream of Clinton Lake are also not expected to see significant impacts in the quantity or quality of flow in Salt Creek during the construction period. The limited amount of additional sediment in stormwater related to construction activities will be first controlled by site specific practices identified in the SWPPP and significantly buffered by Clinton Lake before downstream discharge to Salt Creek.

4.2.2.2 Lakes and Impoundments

The CPS Facility is the only major water user on Clinton Lake. The anticipated short-term construction-related impacts to the CPS are temporary increases in suspended solids. The CPS uses Clinton Lake water for operational cooling and relatively smaller amounts of lake water for potable water and fire protection. The main potential water use impact is short-term, and would consist of temporary increases in the suspended solids concentration of water drawn into the plant water systems. Long-term impacts are less significant consisting of temporary increases in the sediment loading to the lake and loss of lake volume and associated ecological and cooling water storage capacity.

The limited amount of additional sediment in stormwater related to construction activities will be first controlled by sight specific practices identified in the SWPPP. During construction of the new EGC ESP intake structure, the CPS intake structure will be protected to prevent suspended sediment from entering the cooling system. Special construction techniques such as watertight sheet piling with dewatering of submerged areas to expose the construction zone will be implemented where necessary to prevent migration of suspended solids. Water collected from dewatering operations will be settled or filtered before water is allowed to return to the lake. Where appropriate stormwater runoff and treated dewatering water will be diverted to the discharge side of the lake to reduce CPS impacts.

There are no other industrial, municipal, commercial, or agricultural user of the Clinton Lake water. Recreational facilities adjacent to Clinton Lake either do not provide potable water or do not use wells as a water source. There is the potential for short-term

construction-related changes in suspended solids concentrations that may have minor impacts on fishing, swimming, or other recreational uses of the lake. The minor and short-term nature of these impacts, implementation of a site specific construction SWPPP, and the significant distance from recreational access points to the plant site effectively limit exposure to recreational users and potential impacts.

4.2.2.3 Groundwater Use

As discussed in the previous section, the construction of the EGC ESP Facility will cause localized short-term impacts to ambient groundwater levels. The CPS USAR identified one private residence approximately 0.73-mi southwest of the CPS (CPS, 2002). This residence is served by three wells. One well is 247-ft deep and is installed in the buried Mahomet Bedrock Valley Aquifer, which is not present beneath the CPS (see Section 2.3.2.3.2). The other two wells are 30-ft deep, and are estimated to be completed near the top of the unaltered Illinoian till (CPS, 2002). The CPS USAR also identified one public well about 0.9-mi south of the site that is used to supply the water for the Village of DeWitt. The production zone for this well is at a depth interval between about 300 to 340 ft and also draws water from the buried Mahomet Bedrock Valley Aquifer (CPS, 2002). Based on the distance and the well depths, the dewatering during construction of the site will not impact these deep wells. As discussed in Section 4.2.1.3, the depression of the groundwater table during construction may extend beyond the site boundary. The distance and generally low permeability of the shallow glacial materials will help to minimize impacts to the shallow wells. Impacts from construction dewatering on the shallow wells will be evaluated during the preapplication monitoring (conducted at time of the COL application) for the EGC ESP Facility (see Section 6.3.1).

4.3 Ecological Impacts

The sections below describe anticipated impacts to the ecological resources, terrestrial and aquatic, existing at the site and within the vicinity surrounding the EGC ESP Site, as described in Section 2.4.

4.3.1 Impacts to Terrestrial Ecosystems from Construction

4.3.1.1 Introduction

The following sections of this document describe the potential impacts to the terrestrial environment and biota of the site and vicinity, and off-site areas likely to be affected by the construction of the EGC ESP Facility. Descriptions of existing terrestrial habitats including important habitats, as defined by the USNRC, are presented in Chapter 2. This portion of the document has been divided into three sections describing the potential impacts to land use, wildlife resources, and important species and habitats found within the site and vicinity.

4.3.1.2 Land Use and Habitats

Construction of the EGC ESP Facility will occur adjacent to the CPS. The footprint for the facility is mainly comprised of disturbed areas (impervious surfaces, crushed stone, and existing structures) and open fields in the vicinity of the CPS.

As a result of the implementation of the proposed project, there will be a loss of some open field habitat located adjacent to the existing facility. Project construction is not anticipated to adversely affect other habitats including forested areas or wetlands at the site or in the vicinity.

As previously discussed, transmission system improvements will be required to support the EGC ESP Facility. These modifications will be located within or immediately adjacent to the existing substation at the CPS and along the existing transmission corridor. The proposed transmission line improvements will be sited within the existing utility rights-of-way to the greatest extent possible.

Construction of the proposed transmission line improvements will temporarily impact habitats within the existing rights-of-way; however, the agricultural and open field areas will be allowed to revegetate to preconstruction conditions. There will be no significant loss of agricultural or open field habitats resulting from construction of the transmission systems. Where right-of-way expansion is required in forested lands, clearing will be required. Forested habitats do not make up a significant amount of the proposed utility corridor; therefore, significant impacts to forested lands are not anticipated.

4.3.1.3 Wildlife Resources

Project construction is not anticipated to adversely affect wildlife resources (as described in Section 2.4.1) at the site or in the vicinity.

During construction of the EGC ESP Facility and transmission corridor, wildlife may be temporarily displaced as a result of minor disturbances associated with construction activities (i.e., noise and earth moving activities). However, upon completion of

construction, any species that were displaced would be expected to return to the area. Use of the existing maintained access roadway and utility corridor, and the placement of footings for the poles will not have long-term adverse impacts on wildlife resources.

4.3.1.4 Important Species and Habitats

4.3.1.4.1 Important Species

According to the USNRC, "important species" are defined as state- or federally-listed (or proposed for listing) threatened or endangered species; commercially or recreationally valuable species; species that are essential to the maintenance and survival of species that are rare and commercially or recreationally valuable; species that are critical to the structure and function of the local terrestrial ecosystem; and/or species that may serve as biological indicators to monitor the effects of the facilities on the terrestrial environment (USNRC, 1999).

4.3.1.4.1.1 Federally-Listed Threatened and Endangered Species

Based on preliminary database reviews, construction of the EGC ESP Facility is not anticipated to adversely affect federally-listed threatened or endangered species at the site or within the vicinity (IDNR, 2002). Federal wildlife agencies will be contacted at a date closer to the station construction to confirm the absence of federally-listed threatened and endangered species, since confirmation letters are valid for only one year after issuance.

4.3.1.4.1.2 State-Listed Threatened and Endangered Species

Based on preliminary database reviews, construction of the EGC ESP Facility is not anticipated to adversely affect state-listed threatened or endangered species at the site or within the vicinity (IDNR, 2002). State-listed threatened and endangered species potentially occurring within the site or vicinity are presented in Section 2.4. These species include a variety of birds that have been observed at the Clinton Lake State Recreation Area. Direct adverse impacts to these species are not anticipated as a result of construction of the proposed EGC ESP Facility.

State wildlife agencies will be contacted at a date closer to the station construction to confirm the absence of state-listed threatened and endangered species since confirmation letters are valid for only two years after issuance.

4.3.1.4.1.3 Species of Commercial or Recreational Value

Open field habitats within the EGC ESP Site may provide suitable habitat for recreationally valuable species including deer and games species; however, direct adverse impacts to terrestrial species of commercial or recreational value are not anticipated as a result of construction activities.

Construction of new transmission lines will be required to support the EGC ESP Facility. These lines will be sited within the existing maintained utility rights-of-way to the greatest extent possible. The existing corridor may already provide suitable habitat for recreationally valuable species including deer and game species; thus, the construction of any additional right-of-way is not anticipated to adversely impact these species.

It is anticipated that certain terrestrial species of commercial or recreational value may be temporarily displaced during site and transmission corridor construction activities.

However, upon completion of construction, species that were displaced would be expected to return to the vicinity.

4.3.1.4.2 Important Habitats

According to the USNRC, "important habitats" include any wildlife sanctuaries, refuges, or preserves; habitats identified by state or federal agencies as unique, rare, or of priority for protection; wetlands and floodplains; and land areas identified as critical habitat for species listed as threatened or endangered by the USFWS (USNRC, 1999).

4.3.1.4.2.1 Clinton Lake State Recreation Area

During construction, portions of the Clinton Lake State Recreation Area in the vicinity of the site may be temporarily closed as a result of minor disturbances associated with construction activities. However, upon completion of construction, it is expected that any areas that were temporarily closed would be reopened for use.

Wildlife species in Clinton Lake State Recreation Area may be temporarily displaced during construction activities. However, upon completion of construction, species that were displaced would be expected to return.

No direct adverse impacts to ecological habitats of Clinton Lake State Recreation Area are anticipated as a result of construction of the EGC ESP Facility.

4.3.1.4.2.2 Weldon Springs State Recreation Area

Weldon Springs State Recreation Area is located approximately 5.5 mi from the project. Due to the location of this area, no direct impacts to this park, including ecological habitats within the park, are anticipated as a result of the construction of the EGC ESP Facility.

4.3.1.4.2.3 Environmentally Sensitive Areas (Illinois Natural Area Inventory Sites)

The State of Illinois designates certain environmentally sensitive areas as Illinois Natural Areas. These areas are protected to varying degrees, under the jurisdiction of the Illinois Nature Preserves Commission. As discussed in Section 2.4.1, there are two environmentally sensitive areas located within 6 mi of the site. However, due to the location of the EGC ESP Facility, construction is not anticipated to adversely affect any environmentally sensitive areas within the vicinity of the site.

4.3.1.4.2.4 Wetlands and Floodplains

As discussed in Section 2.4, based on preliminary reviews of available USFWS National Wetlands Inventory (NWI) databases, wetlands, including forested, emergent, and scrub-shrub communities, exist within 6 mi of the location of the EGC ESP Facility (USFWS, 2002). These wetlands are generally associated with small tributaries to Salt Creek and North Fork of Salt Creek. However, four minor wetland resources (less than 1 ac) have been identified within the site boundaries. Construction of the EGC ESP Facility is not anticipated to have direct or permanent impacts on these or other wetlands or floodplain resources within the vicinity of the site.

The construction of the transmission line will occur along existing maintained right-of-way. The actual amount of disturbance will be contingent on construction techniques used (e.g., open cut or directional drill). These impacts will be determined by the transmission system owner or RTO during the construction process for the corridor. At this time, it is assumed that there will be a short-term disturbance of lands immediately adjacent to the existing

right-of-way. The wetlands and floodplains will be restored and there will be no net loss of wetland resources. It is assumed that any pole placement will occur outside of the designated wetland areas. Therefore, the project is not anticipated to adversely affect any wetlands or floodplains within the site or vicinity.

4.3.2 Impacts to Aquatic Ecosystems from Construction

4.3.2.1 Introduction

The following sections of this document describe the anticipated impacts to the aquatic environment of the site and vicinity, and the off-site areas likely to be affected by the construction of the EGC ESP Facility. Descriptions of aquatic habitats are presented in Section 2.4.2. This portion of the document has been divided into three sections describing the anticipated impacts to water quality and use, fisheries resources, and important species and habitats found within the site and vicinity.

4.3.2.2 Water Quality and Use

Construction of the cooling water intake structure associated with the EGC ESP Facility will impact open water and shoreline habitats including benthic ecosystems, potentially occurring within the site and vicinity of Clinton Lake. The new cooling water intake structure will be located near the CPS intake structure. Limited natural or otherwise significant habitat is present in this area. Construction of intake structures may result in displacement of open waters, disturbed shoreline habitats, or a temporary increase in sediment levels from construction activities. Overall, these impacts will be insignificant in comparison to the total amount of open water and shoreline at Clinton Lake.

Construction of new transmission lines will be required to support the EGC ESP Facility. These lines have been sited within the existing maintained utility rights-of-way to the greatest extent possible. Construction of the proposed transmission corridor will temporarily impact watercourses existing along the proposed right-of-way. These temporary impacts will be short-term and temporary in nature, and there will be no net loss of resource area.

4.3.2.3 Fisheries Resources

Project construction is not anticipated to have direct adverse effects on fisheries at the site or in the vicinity of the site. During construction of the new intake structure, fish species (described in Section 2.4.2) may be temporarily displaced as a result of minor disturbances associated with construction activities including noise, dredging, or other activities. However, upon completion of construction, species that were displaced would be expected to return to the area.

Additionally, construction in the transmission corridor is not anticipated to adversely impact fishery resources along the existing right-of-way.

4.3.2.4 Important Species and Habitats

4.3.2.4.1 Important Species

According to the USNRC, "important species" are defined as state- or federally-listed (or proposed for listing) threatened or endangered species; commercially or recreationally

valuable species; species that are essential to the maintenance and survival of species that are rare and commercially or recreationally valuable; species that are critical to the structure and function of the local terrestrial ecosystem; and/or species that may serve as biological indicators to monitor the effects of the facilities on the terrestrial environment (USNRC, 1999).

4.3.2.4.1.1 Federally-Listed Threatened and Endangered Species

Based on preliminary database reviews, construction of the EGC ESP Facility is not anticipated to adversely affect federally-listed threatened or endangered aquatic species at the site or within the vicinity (IDNR, 2002).

Federal wildlife agencies will be contacted at a date closer to the station construction to confirm the absence of federally-listed threatened and endangered species, since confirmation letters are valid for only one year after issuance.

4.3.2.4.1.2 State-Listed Threatened and Endangered Species

Construction of the EGC ESP Facility is not anticipated to adversely affect state-listed threatened or endangered aquatic species at the site or within the vicinity (as described in Section 2.4.2).

State wildlife agencies will be contacted at a date closer to the station and transmission corridor construction to confirm the absence of state-listed threatened and endangered species, since confirmation letters are valid for only two years after issuance.

4.3.2.4.1.3 Species of Commercial or Recreational Value

Construction of the EGC ESP Facility is not anticipated to adversely affect aquatic species of commercial or recreational value.

During construction of the EGC ESP Facility (including intake structures), fish species of recreational value (as described in Section 2.4.2) may be temporarily displaced as a result of minor disturbances associated with construction activities. However, upon completion of construction, any species that were displaced would be expected to return to the area.

4.3.2.4.2 Important Habitats

According to the USNRC, "important habitats" include any wildlife sanctuaries, refuges, or preserves; habitats identified by state or federal agencies as unique, rare, or of priority for protection; wetlands and floodplains; and land areas identified as critical habitat for species listed as threatened or endangered by the USFWS (USNRC, 1999).

4.3.2.4.2.1 Clinton Lake State Recreation Area

During construction, portions of the Clinton Lake State Recreation Area may be temporarily closed as a result of minor disturbances associated with construction activities. However, upon completion of construction, it is expected that any areas that were temporarily closed would be reopened.

4.3.2.4.2.2 Weldon Springs State Recreation Area

Weldon Springs State Recreation Area is located approximately 5.5 mi from the location of the EGC ESP Facility. Based on the distance from the site, no direct impacts to the park or any other adverse effects are anticipated due to construction of the EGC ESP Facility.

4.3.2.4.2.3 Wetlands and Floodplains

The construction of the modifications to any necessary water intake or discharge structures may result in a short-term disturbance of a narrow band of bank along the lakeshore and a strip of lake bottom. Any potential loss of open water or shoreline habitats that result from construction activities will be insignificant in comparison to the total amount of open water and shoreline habitats found in Clinton Lake.

4.4 Socioeconomic Impacts

There is no permanent population within the EGC ESP Site that would be impacted by construction (U.S. Census Bureau, 2001). As detailed below, socioeconomic impacts within the vicinity and region are anticipated to be minor. Except for the CPS, the Clinton Visitors Center, and the site recreational facilities, there are no industrial, commercial, or institutional structures on the site property.

4.4.1 Physical Impacts

Physical impacts are defined as noise, air, and visual quality changes. Physical impacts will be controlled by applicable regulations and, as detailed below, will not significantly impact the site, vicinity (including recreational areas), or region.

4.4.1.1 Noise

During construction activities ambient noise levels on and off site will increase; however, mitigation efforts will ease the potential adverse impact of increased ambient noise. Turbines, generators, pumps, transformers, switchyard equipment, and heavy equipment are noise producers. Noise levels will be controlled by using the following criteria:

- The Occupational Safety and Health Administration (OSHA) noise exposure limit to workers and workers' annoyance that are determined through consideration of acceptable noise levels for offices, control rooms, etc. (29 CFR 1910);
- Federal (40 CFR 204) noise pollution control regulations; and
- State regulation or local (35 Illinois Administrative Code [IAC] Subtitle H, 1987) noise pollution control rules.

The large industrial equipment that is needed for clearing, excavating, trash disposal, and land filling operations will be the source of noise pollution at the site. Standard noise control devices on trucks and other equipment are expected to be sufficient to keep off-site noise levels well below acceptable levels. Construction noise at the site is estimated to be between 76 to 101 decibels (dBa) at a distance of 50 ft from the source of the construction (see SSAR Table 1.4-1). The nearest residence is 0.73 mi from the site. The nearest campground, church, and school are 1 mi, 3.8 mi, and 4.8 mi from the site, respectively. During the construction period, additional construction traffic to and from the site will increase the level of vehicular noise for those residences along routes that access the station. It is anticipated that construction activities may take place up to 24 hours per day, 7 days per week. However, activities with significant noise impacts, such as blasting, will be limited to normal weekday business hours. Given this construction schedule, noise impacts will be minor because standard noise control devices will be used and there is a minimal number of nearby residences or other sensitive receptors.

4.4.1.2 Air

Dust, smoke, engine exhaust, and concrete facility operations are sources of air pollution. During construction, a number of controls will be imposed to mitigate air emissions from construction sources including good drainage and dry weather wetting. Bare areas will be

seeded to provide ground cover, where necessary. Applicable air pollution control regulations will be adhered to as they relate to open burning or the operation of fuel burning equipment. Permits and operating certificates will be secured where required. Fuel burning equipment will be maintained in good mechanical order to reduce excessive emissions. Reasonable precautions will be taken to prevent accidental brush or forest fires.

Overall air pollution impacts from construction are expected to be minimal. A slight increase in air emissions will result from the increase in construction vehicular traffic and the generation of dust during construction. In Illinois, dust generated as a part of construction activities is exempt from state permit requirements pursuant to 35 IAC 201.146(tt). Nevertheless, dust emissions will be mitigated to the extent possible. Additionally sensitive receptors are not proximate to the construction site. The nearest resident is 0.73 mi from the site, and the nearest campground, church, and school are 1 mi, 3.8 mi, and 4.8 mi from the site, respectively.

4.4.1.3 Temporary Aesthetic Disturbances

The proposed construction site is far removed from most of the permanent population that would view the construction activities. The closest residence is approximately 0.73 mi to the southwest (IDNR, 1998 and 1999), and the closest town is DeWitt, which is approximately 3 mi to the east (U.S. Census Bureau, 2001). Some recreational users of Clinton Lake will be able to view the construction areas. However, the construction area will not visually impact most recreational users and areas of the Clinton Lake. Therefore, overall aesthetic impacts during construction are minimal.

Mitigation measures designed to lessen the minor visual impact of construction activities include restricting construction laydown to as small of an area as possible, and removing construction debris from the site in a timely and suitable manner. Sensitive receptors are not proximate to the construction site. The nearest resident is 0.73 mi from the site, and the nearest campground, church, and school are 1 mi, 3.8 mi, and 4.8 mi from the site, respectively.

4.4.2 Social and Economic Impacts

Social and economic impacts include impacts to the economy, tax and social structure, housing, education, recreation, public services and facilities, transportation facilities, distinctive communities, and agriculture. The analysis of impacts is focused on the vicinity and region.

The construction workforce will consist of up to 3,150 people (see SSAR Table 1.4-1). It is expected that a significant amount of the workforce will already be located within the region. The proposed site is proximate to three significant population and employment centers (Bloomington-Normal, Champaign-Urbana, and Decatur) and within two additional employment centers (Springfield and Peoria). Table 2.5-8 shows that in the year 2000 there were 38,485 people employed in the construction industry; therefore, there is a significant pool of workers to draw from. Experience from the construction of the CPS indicates that a significant number of the construction workforce came from other areas; however, the construction workforce was at least three times larger than what is anticipated for the EGC ESP Facility.

4.4.2.1 Economic Characteristics

Section 2.5.2.1 describes the regional employment by industry including the construction labor force within the region and the total regional labor force (see Table 2.5-8), and the regional unemployment levels and future economic outlook (see Table 2.5-10).

The construction work will commence on receipt of a construction permit and will continue through the cleanup phase. The peak workforce will include up to 3,150 people and usually occurs during the installation of piping and electrical wiring, which usually takes place when 50 to 70 percent of construction is completed (see SSAR Table 1.4-1). It is anticipated, that the workforce will then continue to decline steadily until completion of the job. It is intended that the construction workforce be scheduled in such a manner as to avoid sharp manpower peaks and declines. Construction is estimated to take from three to five years.

Construction workforce salaries will have a multiplier effect, where money is spent and re-spent within the region. Local businesses in and around the City of Clinton may see an increase in business, especially in the retail and services sector. Worker compensation will have a positive impact on the business community. Employment may help to sustain existing businesses throughout the region as well as provide opportunities for some new businesses. The effect of the construction project will temporarily improve the unemployment levels in the area.

Annual expenditures within the region for construction materials and services cannot be ascertained at this time because the timing of construction has not yet been determined, nor has the facility design been selected.

4.4.2.2 Tax Impacts

The taxing districts, as listed in Section 2.5.2.2, will not be affected by construction since there are no additional property taxes to be paid during construction. Potential tax impacts include an increase in state income tax revenue generated by additional construction jobs and salaries that are created by construction, as well as sales tax on materials purchased for the project, and sales tax for goods and services purchased by workers.

4.4.2.3 Social Structure

The social structure for the region is described in Section 2.5.2.3. No impacts from construction on the social structure of the region are anticipated. The workforce during construction will be largely transient and will mainly commute to the site from the major metropolitan areas within the region (Bloomington-Normal, Champaign-Urbana, Decatur, and Springfield). Therefore, the social structure and patterns presently observed in the surrounding communities will not experience the effects of a rapid population increase. Thus, it is expected that the social structure will remain unchanged during construction.

4.4.2.4 Housing Information

Based on experience at the CPS, it is estimated that most of the construction force will live within a 50-mi radius of the station prior to the start of construction. Within the 20-county region surrounding the site, the population in the year 2000 was nearly 1.2 million. Most people were concentrated in the metropolitan areas of Bloomington-Normal, Champaign-

Urbana, Decatur, Lincoln, Morton, Peoria-Pekin, Pontiac, Rantoul, Springfield, and Taylorville.

It is estimated that a significant number of construction workers will commute to the site rather than move their families to the immediate area of Clinton. Some construction workers may originate from outside the 50-mi radius, and will commute to the job site (on a weekly basis). These workers will likely share trailers and/or campers parked at existing and new mobile home courts. A small number of construction workers from both within and beyond the 50-mi radius may choose to move to the Clinton area with their families. The 2000 Census indicates that there were 74 vacant, year round housing units within the vicinity and over 19,000 vacant, year round housing units within the region. Based on the available housing and the expected amount of commuters, no housing shortages are anticipated as a result of the construction. The abundance of existing housing within the surrounding area will mitigate against effects on rents or prices produced by the construction (U.S. Census Bureau, 2001; Clinton Daily Journal, 2002; Herald & Review, 2002; State Journal Register, 2002; DeWitt County, 2002; Pantagraph, 2002).

There will be no families or households displaced by station construction because there are none on the site property.

4.4.2.5 Educational System

Since the majority of construction workers will be taken from the region, where their educational requirements are already being met, the surrounding school systems will likely not experience any major influx of students because of the construction. A survey of class size of schools in the region was performed, and 70 percent of schools have class size at or below the national average. This indicates there is sufficient capacity for a small increase in population.

4.4.2.6 Recreation

Recreational facilities within the region are described in Section 2.5.2.6. No land classified as recreational will be involved in any construction. Therefore, there are no direct impacts on recreational facilities from construction. Construction worker population will predominately reside at their existing residence; therefore, there will not be any unusual peaks at recreational facilities within the region.

4.4.2.7 Public Services and Facilities

In general, no overcrowding of public facilities is anticipated because most of the construction forces are not expected to move to the region.

The EGC ESP Site is in a rural area; therefore, no direct effect on community services is expected for the region. Also, since private security guards will be used at the site, dependence on local police forces will not be required. Public facilities will be capable of absorbing the minor increase in load due to the small influx of people that are expected. A survey was performed of water and water facilities in the region, the facilities have excess capacity to accommodate a potential increase in population in the region.

4.4.2.8 Transportation Facilities

None of the roads and highways within the vicinity of the site will be physically impacted by the construction. The roads and highways within the vicinity and region of the site will experience an increase of approximately 3,200 vehicle trips (it was estimated that each construction worker would commute individually, and 50 additional miscellaneous trips would occur throughout the day) and 100 truck deliveries during the peak hours of the workday. However, these roads and highways are two-lane rural highways that are not heavily traveled and can withstand the increase in vehicular traffic. Additionally, it is expected that the construction forces will be living in dispersed areas nearly uniform in all directions from the site, and will therefore travel relatively uniform in all directions.

To determine impact of additional workers on traffic, average daily traffic counts were obtained from IDOT's website for IL Route 54 and 10. Near the EGC ESP Facility, 2,750 cars and trucks and 2,000 cars and trucks travel daily on IL Route 54 and 10, respectively (IDOT, 2003). According to IDOT's *Bureau of Design and Environmental Manual*, the typical average daily traffic count for a rural 2-lane highway is 5,000 cars and trucks (IDOT, 1999). The EGC ESP Facility would add an additional 1,650 cars and trucks to each highway. This was estimated assuming a total of 3,200 vehicle trips, plus 100 truck deliveries, and it was assumed that traffic was divided equally between IL Route 54 and 10. Based on the addition of the average daily traffic counts and the expected number of additional trips due to construction, the additional construction workers would not put an excessive amount of burden on the roadways near the EGC ESP Facility.

During the construction of the CPS Facility, 9,000 construction workers were employed; three times the maximum amount that will be utilized for the construction of the EGC ESP Facility. During this time, congestion problems occurred entering and exiting the site at the beginning and end of shifts, and lasted approximately ten to fifteen minutes. Based on this experience, it is expected that there will be a limited amount (less than 10 minutes) of congestion during construction of the EGC ESP Facility, which will be limited to times of shift changes.

4.4.2.9 Distinctive Communities

As stated in Section 2.5.2.3, the population in the region is fairly homogeneous, largely white, and not dominated by a particular ethnic group. The only special group within the region is an Amish community located around the towns of Arthur and Arcola, approximately 40-mi southeast of the site. This area is far enough away that it will not be impacted by any construction, which is limited to the site.

4.4.2.10 Agriculture

As stated in Section 2.2, no land is designated as agricultural within the site, but 82 percent of the land is designated as agricultural within the vicinity. Further, 93 percent of the land is designated as agricultural within the region. No agricultural land will be disturbed by any construction, and construction will be limited to the site that is zoned industrial.

4.4.3 Environmental Justice

This section describes the potential for disproportionate impacts to low income and minority populations that could result due to construction of the EGC ESP Facility. An

assessment was performed that included a technical analysis to determine potential effects of construction on low income and minority populations. A disproportionate impact to these populations exists when they bear more than their "fair share." Compared to the general population, it was determined that there would be no disproportionate impact to low income populations (in accordance with Health and Human Services Poverty Guidelines) or minority populations within the region.

The detailed analysis of U.S. Census Bureau data in the region shows no disproportionate presence of minority or low income populations in the vicinity. Within the vicinity, the total population in 2000 was 2,343 people and the minority population in 2000 was only 85 people, or 3.6 percent. Within the region, the total population in 2000 was 762,022 people and the minority population in 2000 was 100,331 people, or 13 percent. DeWitt County has a 3 percent minority population. The average minority population in the State of Illinois is 39 percent, and the national average is 37 percent. Thus, the vicinity, region, and county within which the site is located have minority populations well below the state and national average. Therefore, it can be concluded that minority populations will not be disproportionately impacted from construction of the EGC ESP Facility.

Figure 4.4-1 shows the location of minority and total population within each census block. In addition, Figure 4.4-1 and Figure 2.1-3 show that the closest minority population is proximate to the site (approximately 0.73 mi). Further investigation shows that this is a Native American person that lives directly southwest of the site. Since this person is the only resident within the census block, the percent minority for this block is 100 percent (U.S. Census Bureau, 2001a and 2001b). While the site may have a disproportionate impact on minorities in one census block, it in fact involved only one person; therefore, no mitigation is required.

The detailed analysis of the region shows no disproportionate impact to low income populations. Within the vicinity, 8 percent of the population had a 1999 income below the poverty level. Within the region, 10 percent of the population had a 1999 income below the poverty level. In DeWitt County, 8 percent of the population is considered low income. The average low income population in Illinois is 10.8 percent, and the national average is 11.3 percent (U.S. Census Bureau, 2001b). The vicinity, region, and county within which the site is located have low income populations that are below the state and national average. Therefore, it can be concluded that low income populations will not be disproportionately impacted by any operation of the EGC ESP Facility. Figure 4.4-2 shows the location of low income populations within each census block (U.S. Census Bureau, 2001 and 2001a).

An assessment of environmental justice also includes considerations of other factors such as environmental health effects of air and noise pollution upon low income and minority populations. Noise and air pollution will be controlled to follow any federal, state, and local regulation. In summary, no disproportionately high or adverse impacts on minority and low income populations would result from construction.

4.5 Radiation Exposure to Construction Workers

This section presents an assessment of the potential radiological dose impacts to the construction workers of the EGC ESP Facility resulting from the operation of the CPS.

4.5.1 Site Location

The physical location of the EGC ESP Site relative to the layout of various CPS facilities is presented in Figure 2.1-4 and Figure 2.1-5. As shown, with the possible exception of the expansion of the switchyard and the installation of the EGC ESP Facility intake structure, the major construction activities are expected to take place outside the CPS protected area boundary, but inside the restricted area boundary.

4.5.2 Radiation Sources

During the construction of the EGC ESP Facility, the construction workers will be exposed to direct radiation and to the radioactive effluents emanating from the routine operation of the CPS.

The direct radiation exposure has two principal sources: (1) the cycled condensate storage tank located on the northern boundary of the protected area adjacent to the existing switchyard; and (2) the skyshine from the N-16 activity present in the reactor steam in the high pressure and low pressure turbines, the intercept valves, and the associated piping located on the main floor of the turbine building.

The design basis radiation source term for the cycled condensate storage tank is listed in the CPS USAR Table 12.2-8 (CPS, 2002).

The N-16 activity that is present in the reactor steam in the primary steam lines, turbines, and moisture separators provides an air-scattered radiation dose contribution to locations outside the CPS plant structure. The design basis radiation source inventory in these pieces of equipment is listed in the CPS USAR Table 12.2-7 (CPS, 2002). To reduce the turbine skyshine doses, radiation shielding has been provided.

The CPS Facility releases airborne effluents via two gaseous effluent release points to the environment. These are the common station heating, ventilating, and air conditioning stack and the standby gas treatment system vent. The expected radiation sources in the gaseous effluents are listed in the CPS USAR Table 11.3-8 (CPS, 2002).

The CPS Facility has achieved zero liquid radioactivity release from the plant in the past nine years. Therefore, the radiation sources expected to be present in liquid effluents in the future are considered negligible.

4.5.3 Measured Radiation Dose Rates and Airborne Concentrations

Environmental radiological monitoring data obtained from the *Annual Radiological Environmental Operating Report* (Campbell, 2002) was used to assess any radiological impact upon the surrounding environment due to the operation of the CPS Facility.

During 2001, CPS collected over 1,400 environmental samples. These samples represented direct radiation, and also atmospheric, terrestrial, and aquatic environments along with

Clinton Lake surface water and public drinking water samples. Subsequently, more than 1,800 analyses were performed on these environmental samples.

4.5.3.1 Gaseous and Liquid Releases from the Clinton Power Station Facility

As stated in the *Annual Radioactive Effluent Release Report* for the CPS Facility (Campbell, 2002a):

- Gaseous Releases – "The highest calculated off-site dose received by a member of the public due to the release of gaseous effluents from the CPS was less than 0.003 millirem (mrem)."
- Liquid Releases – "There were zero (0) radioactive liquid releases or exposures from liquid radioactive effluents from CPS during 2001."

In addition, the 2001 *Annual Radioactive Effluent Release Report* (Campbell, 2002a) calculated total body, skin, and thyroid doses to the public from CPS gaseous effluents. The doses were less than 0.003 mrem per year with the maximum doses resulting from public use of the road in the southeast sector within the CPS Site boundary.

4.5.3.2 Direct Radiation Measurements

Environmental thermoluminescent dosimeter (TLDs) are used to measure the ambient gamma radiation levels at many locations in and around the CPS. A total of 216 TLD measurements were made throughout the year 2001. The average quarterly dose from indicator location(s) was 18.1 mrem. At control locations, the average quarterly dose was 16.9 mrem. These quarterly measurements ranged from 13.1 mrem to 21.9 mrem for indicator TLDs and 15.0 mrem to 19.5 mrem for control TLDs (Campbell, 2002).

From these observations, when factoring in the statistical variances, it is concluded that there was no increase in environmental gamma radiation levels resulting from unit operations at the CPS (Campbell, 2002).

In addition, area TLD measurements during the third quarter of 2002 at the CPS protected area fenceline varied between 0.005 and 0.050 mrem/hr with an average fenceline dose rate of approximately 0.021 mrem/hr.

The average dose rate at the protected area occurs at distances ranging from 100 ft to 200 ft from the turbine building (Campbell, 2002). The EGC ESP Facility will be located more than 700 ft from the CPS turbine building. Skyshine studies for BWR plants demonstrate that the above dose rates are typically reduced by factors of 3 to 5 when accounting for the increased distance (i.e., 700 ft vs. 100 ft) from the turbine building (Campbell, 2002).

4.5.4 Annual Construction Worker Doses

The dose to construction workers considers assessment of public and occupational doses resulting from operation of the CPS.

The greatest off-site doses received by a construction worker, as a member of the public from operation of the CPS, is less than 0.003 mrem as reported in Section 4.5.3.1. Table 4.5-1 and Table 4.5-2 show the expected public dose satisfies the regulatory requirements for individual members of the public (10 CFR 20).

The occupational doses are conservatively estimated using the CPS surveys and radiation measurements described in Section 4.5.3.1 and Section 4.5.3.2. The occupational dose is based on:

- A protected area fenceline average dose rate of 0.021 mrem/hr;
- No credit for the reduction in dose rate with distance from the protected area fenceline to the EGC ESP construction areas although factors of 3 to 5 are anticipated;
- An occupational exposure period of 2,080 hrs per year; and
- A gaseous effluent contribution adjusted for worker site occupancy time based on the measurements and calculated values reported in Section 4.5.3.1.

The estimated occupational doses to an individual construction worker due to operation of CPS are compared in Table 4.5-3 to the occupational dose limits in 10 CFR 20. The annual dose per individual construction worker is less than 0.045 mrem. Table 4.5-3 shows that the expected doses are orders of magnitude less than the prescribed occupational limits. The construction worker dose is dominated by the direct dose contribution from the turbine building and skyshine.

The 10 CFR 20.1502 requires monitoring of dose exposures to radiation and radioactive effluents to demonstrate compliance with occupational dose limits. Expected doses are orders of magnitude less than the occupational limits in 10 CFR 20.1201; thus, monitoring of individual construction workers will not be required.

With an assumed work force of 3,150 people (see Table 1.4-1, Section 18.4 of the SSAR), the annual collective dose to the construction work force is estimated to be approximately 140-person rem.

The above evaluation demonstrates that the construction worker doses meet the occupational and public individual exposure limits in 10 CFR 20.1201 and 1301, respectively.

4.6 Measures and Controls to Limit Adverse Impacts During Construction

4.6.1 Regulatory Criteria

In accordance with NUREG-1555, potential adverse environmental impacts due to construction activities are identified and addressed in this section, as well as the specific measures and controls to limit those adverse impacts (USNRC, 1999). The term "construction activities" will be used generically in this section and encompasses both preconstruction and full scale construction activities.

4.6.2 Adverse Environmental Impacts

Presented below is a list of identified adverse environmental impacts that may be encountered during construction activities:

- Temporary aesthetic disturbances;
- Noise;
- Dust/air pollutants;
- Erosion and sedimentation;
- Potential pollutant sources (effluents, wastes, spills, and material handling);
- Traffic controls;
- Water-related impacts;
- Land use protection/restoration impacts;
- Water use protection/restoration impacts;
- Terrestrial ecosystem impacts;
- Aquatic ecosystem impacts;
- Socioeconomic impacts; and
- Radiation exposure to construction workers.

The identified impacts will be discussed in the following section, as well as the measures and controls that will be implemented to limit these impacts during preconstruction and construction activities, if applicable.

4.6.3 Measures and Controls to Limit Adverse Impacts

The following sections list potential adverse environmental impacts that may be created by preconstruction and construction activities, and associated measures and controls to limit those impacts.

4.6.3.1 Temporary Aesthetic Disturbances

As stated in Section 4.4.1.3, the proposed construction site is far removed from most of the permanent population that would view the construction activities. The closest residence is approximately 0.73 mi to the southwest, and the closest town is DeWitt, which is approximately 3 mi to the east. Some recreational users of Clinton Lake will be able to view the construction areas. However, the construction area will not visually impact most recreational users and areas of the Clinton Lake. Therefore, overall aesthetic impacts during construction are minimal.

Mitigation measures designed to lessen the minor visual impact of construction activities include restricting construction laydown to as small of an area as possible, and removing construction debris from the site in a timely and suitable manner. Additionally, sensitive receptors are not proximate to the construction site. The nearest resident is 0.73 mi from the site, and the nearest campground, church, and school are 1 mi, 3.8 mi, and 4.8 mi from the site, respectively.

4.6.3.2 Noise

During construction activities ambient noise levels on and off site will increase; however, mitigation efforts will ease the potential adverse impact of increased ambient noise. Turbines, generators, pumps, transformers, switchyard equipment, and heavy equipment are noise producers. Noise levels will be controlled by using the following and as described in Section 4.4.1.1:

- The OSHA noise exposure limit to workers and workers' annoyance that are determined through consideration of acceptable noise levels for offices, control rooms, etc.;
- Federal noise pollution control regulations; and
- State regulation or local noise pollution control rules.

The large industrial equipment that is needed for clearing, excavating, trash disposal, and land filling operations will be the source of noise pollution at the site. Standard noise control devices on trucks and other equipment are expected to be sufficient to keep off-site noise levels well below acceptable levels. Construction noise at the site is estimated to be between 76 to 101 decibels (dB) and at a distance of 50 ft from the source of the construction (see SSAR Table 1.4-1). The nearest residence is 0.73 mi from the site. The nearest campground, church, and school are 1 mi, 3.8 mi, and 4.8 mi from the site, respectively. During the construction period, additional construction traffic to and from the site will increase the level of vehicular noise for those residences along routes that access the station. It is anticipated that construction activities may take place up to 24 hrs per day, 7 days per week. However, activities with significant noise impacts, such as blasting, will be limited to normal weekday business hours. Given this construction schedule, noise impacts will be minor because standard noise control devices will be used and there is a minimal number of nearby residences or other sensitive receptors.

Regulatory guidance 29 CFR 1910.95 requires that a hearing conservation program be developed to control and protect on-site workers from excessive noise levels. As stipulated in 29 CFR 1910, a hearing conservation program includes the following:

- Hearing protection (earplugs or muffs) at no cost to employees;
- Noise monitoring at the work location where employees are exposed to excessive noise;
- Annual audiometric exams for noise exposed employees;
- Notification of noise monitoring and audiometric exam results to exposed employees;
- Records of noise monitoring and audiometric exams results; and
- Training on use, maintenance, and limitations of hearing protection.

Procedures and a hearing conservation program will be developed at the construction site for any employees exposed to excessive noise, which is defined as an 8-hr exposure of 85 dB or more.

4.6.3.3 Dust/Air Pollutants

Dust, smoke, engine exhaust, and concrete facility operations are sources of air pollution. During construction, a number of controls will be imposed to mitigate air emissions from construction sources including good drainage and dry weather wetting. In addition, the most traveled construction roads will be paved in order to reduce dust generated by vehicular traffic. Bare areas will be seeded to provide ground cover, where necessary. Applicable air pollution control regulations will be adhered to as they relate to open burning or the operation of fuel burning equipment. Permits and operating certificates will be secured where required. Fuel burning equipment will be maintained in good mechanical order to reduce excessive emissions. Reasonable precautions will be taken to prevent accidental brush or forest fires. The concrete facility will be equipped with dust control systems to avoid excessive releases of cement dust.

Overall air pollution impacts from construction are expected to be minimal. A slight increase in air emissions will result from the increase in construction vehicular traffic, and the generation of dust during construction. As stated in Section 4.4.1.2, dust generated in Illinois as a part of construction activities is exempt from state permit requirements. Nevertheless, dust emissions will be mitigated to the extent practical and will be in compliance with local, state, and federal air emissions standards. Additionally sensitive receptors are not proximate to the construction site. The nearest resident is 0.73 mi from the site, and the nearest campground, church, and school are 1 mi, 3.8 mi, and 4.8 mi from the site, respectively.

4.6.3.4 Erosion and Sedimentation Controls

If construction activities are not properly controlled and monitored, erosion from improperly graded or excavated areas will lead to the runoff of large amounts of sediments to nearby areas or surface waters.

Therefore, the construction activities at the EGC ESP Site will conform to the following goals and criteria, as applicable.

- Erosion and sedimentation controls will comply with the requirements specified in this section and, if appropriate, with a stormwater pollution prevention plan.

- Implement erosion and sediment controls during construction in order to retain sediment on site to the greatest extent practicable.
- Select, install, and maintain control measures in accordance with the manufacturer's specifications and good engineering practices. If periodic inspections or other information indicate that a particular erosion control measure is ineffective, the control measure will be modified or replaced as necessary.
- If practical and if required, remove off-site accumulations of sediment in order to minimize the off-site impacts in the event that sediment escapes the construction site.
- Routinely remove sediment from sediment traps or sedimentation routinely.
- Implement construction practices that prevent litter, construction debris, and construction chemicals exposed to stormwater from becoming pollutant sources for stormwater discharges.
- Control erosion and sediment runoff through the use of structural and/or stabilization practices. Structural control practices may include the use of straw bales, silt fences, earth dikes, drainage swales, sediment traps, and sediment basins. Sediment traps and basins will be designed to accommodate the large potential load from the deep excavation dewatering operations. Stabilization practices may include temporary seeding, permanent seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, and preservation of mature vegetation.

Several different structural controls may be used to regulate the quality of the stormwater running off the construction site. Table 4.6-1 lists the controls that may be instituted during construction activities. Based on site conditions, the final location of these controls will be determined just prior to the commencement of construction.

Stabilization practices that may be implemented are listed in Table 4.6-2. Final stabilization will consist of grading and revegetation areas in which potential pollutant sources are used.

In addition, the following general erosion control requirements will be implemented during construction activities, as appropriate:

- Where practical, disturbed soil areas will be reseeded with maintenance seed (if activities are temporary) or permanent seed mix (for permanent or final cover) as soon as possible after redress activities are either temporarily or permanently stopped.
- Where practical, excelsior blankets will be mulched or installed and slopes greater than 3:1 will be reseeded, depending on the length, exposure, and texture of the soils on the slope. Mulch may be natural and consist of slash, brush, manure, and vegetation previously chipped and stockpiled; clean straw, free from noxious weed seed, mold, and other harmful elements; or wood cellulose fiber. Mulch will be applied as soon as possible after seeding to reduce runoff and promote vegetation.
- Sidehill slopes will be furrow-contoured as practical. Otherwise the final grading will be performed in a manner that will result in tracks and depressions contoured across the slope instead of down the "fall-line." This will not only minimize wind erosion, but will also "roughen" the earth to provide a microclimate of wind protection for new plants,

and will help conserve precipitation for use in growth of new seed. This results in a reduction of sediment erosion.

- The time that bare soil is exposed before stabilized will be minimized.
- The disturbance to existing vegetation will be minimized.
- Where slope cuts have developed from erosion (particularly along the faces of flood detention structures), loose material will be removed, and the area will be filled with suitable soils to the original profile of the bank or slightly above the original profile. If the cut is not completely filled, the steeper area at the brow of the cut will encourage erosion and may cause redevelopment of the cut. The area upstream from the cut will be carefully inspected to determine if there is an irregularity in the ground profile that will cause stormwater to concentrate and erode the soils. Any such irregularity will be removed. This will allow the water to run off the site as sheet flow.
- No solid materials including demolition materials will be discharged to waters of the United States (U.S.), unless authorized under an approved permit.

The erosion and sediment control measures and other protection measures will be maintained in effective operating condition. Maintenance will be performed on an "as-needed" basis and as specified by state and local permits. Specific maintenance requirements include, but are not limited to:

- Routine removal of sediment and other debris collected behind silt fences or hay bales;
- Routine cleaning of sediment from detention ponds; and
- Based on visual inspection, replacement of gravel and sediment from entrances/exits.

4.6.3.5 Potential Pollutant Sources

Potential pollutant sources during construction activities and specific measures to control discharges of those pollutant sources from construction activities both on and off site are described in this section.

4.6.3.5.1 Vehicle Fueling

The fueling stations will have temporary secondary containment around the fuel tanks. For specifics, see Section 4.6.3.5.8.

4.6.3.5.2 Concrete Truck Washout/Decontamination Areas

Where concrete truck washout and decontamination areas are necessary, they will be located on the construction site. Typically, these areas are located within an impoundment where the water is contained.

Concrete can be used for fill, in many cases, once it has hardened. However, it is necessary to contain the liquid associated with the washing out of the concrete. This liquid usually has a high pH that can impact streams if released. Concrete washout areas will only be in designated locations. These areas will be established so that concrete materials are retained until hardened.

4.6.3.5.3 Loading and Unloading Areas

Areas with reduced potential for spills to become pollution sources may be designated for loading and unloading. Clean up in such designated areas may occur less frequently, but no less than once per day. Soils or other materials spilled during loading and unloading (outside of designated areas) will be cleaned up promptly, including soils on the outside of the trucks (i.e., the side rails) and on the ground or road surface.

4.6.3.5.4 Vehicle Maintenance

Vehicle and equipment maintenance activities, such as lubrication or equipment repair that could result in oil spills or grease spills, will be performed in an enclosed building, if practical, in an area designated for this purpose. Spills will be cleaned up promptly. Precautions will be taken to prevent the release of pollutants to the environment from vehicle maintenance. Precautions will include the use of drip pans, mats, and other similar methods. Oil contaminated materials will be stored in metal containers and disposed of off site in accordance with state and local regulations. Spill kits will be maintained for prompt clean up of oil spills.

4.6.3.5.5 Excavated Areas

To prevent the mobilization of contaminants in stormwater runoff from entering and/or leaving excavated areas, the following controls on erosion and sedimentation controls will be implemented.

4.6.3.5.5.1 Excavated Soil and Material Stockpile Areas

In general, excavated soils and stockpiles will be managed; management techniques are described below.

- Stockpiles of excavated soils will be placed on plastic sheeting or other suitable material, if required, near the excavation areas.
- If practical, stockpiles will be provided with liner, cover, and perimeter berm in order to prevent rupture, release or infiltration of liquids, and to prevent the re-suspension dispersion of dust. If it is not possible to cover stockpiles, it may be necessary to install a temporary sprinkler system to inhibit dust dispersion.
- Polyethylene sheeting or other suitable material will be used for liners and covers.
- A perimeter berm, typically hay bales placed beneath the liner, will be constructed to allow for collection of any free liquids draining from the stockpile.
- Accumulated free liquids will be pumped, treated, and removed, as required.
- Covers and perimeter berms will be secured in place when not in use and at the end of the workday, or will be secured as necessary in order to prevent wind dispersion or runoff from major precipitation events.

4.6.3.5.6 Off-Site Vehicle Tracking

Sediment and the generation of dust will be minimized using the methods noted in Section 4.6.3.3, thereby minimizing the amount that is tracked off site by vehicles.

4.6.3.5.7 Material Handling and Storage

The following material handling and storage practices will be implemented during construction activities, as applicable.

- Materials on the construction site will be stored in areas designated for that purpose. Suitable measures will be taken in storage areas to reduce the likelihood of a discharge, such as straw bale barriers around the storage area.
- Equipment not in use will be stored in a designated area.
- Used oil tanks will be emptied frequently as necessary to avert overflow. The area will be kept free of trash and spilled oil. Tanks containing waste will have secondary containment.
- Garbage receptacles will be equipped with covers. This includes such receptacles that contain materials that may be carried by the wind, or water soluble materials (e.g., paint).
- Storage containers, including drums and bags, will be stored away from traffic to prevent accidental spills.
- Containers will be kept closed except to add or remove material as necessary.
- Containers will be stored in such a manner as to prevent corrosion that could result from contact between the container and ground surface, resulting in a release of material.
- Containers will be appropriately labeled to show the name, type of substance, health hazards, and other appropriate information.
- Material safety data sheets (MSDSs) for substances used or stored on the construction site will be available for review and use.
- Hazardous substances such as used oil, anti-freeze, spent solvents, discarded paint cans, etc. will be controlled, stored and disposed of in accordance with the applicable MSDS.

4.6.3.5.8 Spill Prevention, Control, and Response

The NPDES permit to be issued to the site for construction will provide a description of procedures to be used for spill prevention and response. During construction, the project specific waste management and health and safety plans will contain spill prevention, control, and response procedures that address site and activity specific conditions. These plans will be maintained on site. The general procedures for addressing spill prevention, control, and response are provided below, and will be implemented for on-site construction activities.

4.6.3.5.8.1 Spill Prevention

Fuel and waste tanks located on soil will be bermed with a perimeter dike of native material, or placed inside an open tank capable of containing its' maximum capacity, in case of rupture. When practical, areas inside the dike will be covered with an oil resistant membrane to minimize soil contamination in the event of a spill.

Fuel and waste tanks located on concrete or steel foundations will be bermed with appropriate materials suitable for the application. These materials will allow for the

containment of the full capacity of the tank while minimizing contamination of the surrounding area.

Construction projects requiring fuel or waste tanks will maintain a sufficient number of spill kits to contain minor spills and leaks.

4.6.3.5.8.2 Mitigation of Spills

Fueling operations and vehicle maintenance will be performed at designated facilities, when practical.

Spill sumps will be constructed around fuel and oil tanks. Drip pans will be used underneath oil barrels and other fluids that are used during construction activities.

Spills of toxic or hazardous materials will be reported promptly to on-site authority (i.e., general contractor representative or site health and safety personnel) or their designee.

The procedure, described below, will be followed for the clean up of small spills, as applicable.

- Upon detection of any spill, personal safety is the first priority. The area of the spill and the nature of the spilled material will be evaluated in order to determine if remedial actions could result in additional health hazards, escalation of the spill, or station damage that may escalate the problem. If such conditions exist, a guard will be posted near the area (if practical), and the on-site authority or their designee will be promptly notified.
- Identify the source of the spill (if possible), and then stop the flow of pollutants if it can be done in a safe manner as described above.
- Record pertinent facts and information about the spill including type of pollutant, location, apparent source, estimated volume, and time of discovery.
- Spread absorbent materials on the area to soak up as much of the liquid as possible and prevent infiltration into the soil, and transfer the used materials to an appropriate container.
- As soon as possible, the contaminated soil and absorbent material will be excavated and transported to a designated site for collection of such material.
- If prompt transfer of the contaminated soil is not practical, the contaminated soil will be excavated and placed on polyethylene sheeting or other suitable material of sufficient thickness, and form a small berm to prevent breakout or infiltration.
- If the general contractor responds to the spill, notify the site health and safety representative of the spill and provide in writing the amount of material, type of contaminant, and the source (location of the spill).

The procedure, described below, will be followed for the clean up of medium to large spills, as applicable.

- Upon detection of any spill, personal safety will be the first priority. The area of the spill and the nature of the spilled material will be evaluated in order to determine if remedial

actions could result in additional health hazards, escalation of the spill, or facility damage that may escalate the problem. If such conditions exist, a guard will be posted near the area (if practical). In addition, the on-site health and safety personnel or their designee, and other parties will be promptly notified. The responsible on-site authority will, in turn, notify appropriate agencies (e.g., National Response Center).

- Identify the source of the spill (if possible) and stop the flow of pollutants if it can be done in a safe manner as described above.
- Record pertinent facts and information about the spill including type of pollutant, location, apparent source, estimated volume, and time of discovery.
- Promptly dispatch appropriate equipment (e.g., front-end loader) to the spill and construct a berm or berms downstream of it in order to minimize the spread.
- Mobilize additional resources as necessary to address the spill.
- Commence spill cleanup when the lateral spread has been contained and the notifications have been made.
- Bail or pump free liquid into the appropriate container.
- When the liquid has been bailed to the soil layer, apply absorbent materials to the surface, and transfer it to the appropriate container.
- The remaining contaminant soils and absorbent material will be excavated and transferred to a temporary contaminant stockpile underlaid with polyethylene sheeting or other suitable material of sufficient thickness. The edges will be bermed to provide a dam to prevent inflow of water or leakage of the liquid.
- Contaminated soil and absorbent material will be disposed, as appropriate.

4.6.3.5.8.3 National Response Center

The National Response Center will be contacted when a release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity occurs during a 24-hr period, established under either 40 CFR 110, 40 CFR 117, or 40 CFR 302.

4.6.3.6 Traffic Controls

The roads and highways within the immediate vicinity of the site will experience an increase in use, especially at the beginning and end of the workday. However, the immediate area surrounding the site is rural, and the nearby roads and highways are not heavily traveled. It is expected that the construction workforce will be living in areas dispersed nearly equally in all directions from the site, and therefore, travel will be relatively uniform from all directions. No significant congestion problems are expected due to station construction. Traffic and traffic control impacts may include, but are not limited to:

- Working adjacent to or in active roadways (day/night);
- Traffic control zones;
- Traffic control device installation and removal;

- Flagging;
- Inspection and maintenance of traffic control devices;
- Equipment; and
- General roadway traffic control zone safety.

Regulatory guidance 29 CFR 1926 contains requirements for traffic control signs, signals, and barricades. Some state OSHA and DOT plans may have requirements that are more stringent. However, local, state, and federal requirements will be adhered to regarding traffic control on and off site from construction activities.

4.6.3.7 Water-Related Impacts

Described in Section 4.2 are the hydrological alterations and the potential water use impacts from preconstruction and construction phases for the EGC ESP Facility, as well as the impacts from the anticipated transmission corridor upgrades required for the EGC ESP Facility operation. The scope of this evaluation is discussed below and in the sections that follow:

- Descriptions of proposed construction activities including preconstruction, station construction, and transmission line construction that could result in hydrologic alterations or impact water use.
- Descriptions of resulting hydrologic alterations and the effects of these alterations or construction-related effluents on physical and water quality conditions.
- Proposed controls, practices, and procedures to minimize adverse construction impacts on water use.
- Evaluation of compliance with applicable federal, state, regional, and local standards and regulations.

The construction will be confined to the EGC ESP Site and the existing transmission corridor. Proper mitigation and management methods implemented during construction will limit the potential water quantity and quality impacts to the surface water (e.g., Clinton Lake, stream crossings, and intermittent drainage ways) and adjacent groundwater.

4.6.3.7.1 Hydrologic Impacts

Preconstruction and construction activities, which have been initially identified as possibly resulting in hydrologic alterations at the site or within the transmission corridor may include:

- Alteration of the existing watershed surface including buildings, structures, and paved surfaces, such as parking lots and access roads;
- Temporary disturbance of the ground surface for stockpiles, materials storage, or temporary access roads;
- Construction of intake structures;
- Construction of cofferdams and storm sewers;

- Dredging operations;
- Dewatering activities and other operations that affect water levels;
- Construction activities that contribute to sediment runoff; and
- Removal of woody vegetation and shrubs along the transmission corridor

The potential hydraulic alterations that may be caused by these construction activities include:

- Changes in surface water drainage characteristics;
- Erosion and sedimentation;
- Changes in groundwater levels from dewatering activities; and
- Subsidence resulting from groundwater withdrawals.

Construction erosion control measures and comprehensive stormwater pollution prevention plans (SWPPP) are required under the Illinois Environmental Protection Act, the Illinois Pollution Control Rules, and the federal CWA. Where necessary, special erosion control measures will be implemented to minimize impacts to the lake and lake users and CPS operations. Typical stormwater control elements of a SWPPP are discussed in Section 4.6.3.4. A NOI will be filed with the federal and state agencies to receive authorization for land disturbance under the general stormwater permit. A SWPPP will also be prepared in accordance with the requirements of the general permit. A NOT will be filed with the IEPA upon completion of construction and stabilization of the disturbed areas.

4.6.3.7.1.1 Fresh Water Streams

There are not expected to be any hydrologic alterations of the watershed upstream of Clinton Lake on Salt Creek and North Fork of Salt Creek.

4.6.3.7.1.2 Lakes and Impoundments

Construction erosion control measures will be applied during the phases of site development to contain eroded soil on the construction site and remove sediment from stormwater prior to leaving the site. Design measures will be incorporated to avoid concentrated flow that has a high potential to transport sediment. Visual inspections of construction erosion control measures will be incorporated into the construction project to monitor the effectiveness of the control measures and to aid in determining if other mitigation measures are necessary. Mitigation measures will be incorporated into the requirements of the construction contracts and the SWPPP. Beyond the construction activity, stormwater management practices will be incorporated into the site design to minimize the long-term delivery of sediment to the lake.

4.6.3.7.1.3 Groundwater

The hydrologic alterations anticipated to result from construction activities also include the temporary changes in groundwater levels from dewatering. The potential impacts that need to be considered during the design of the excavation and dewatering activities include:

- The amount of water (dewatering) that will need to be removed based on the embedment depth;

- Potential slope stability and subsidence problems when water is removed from the unconsolidated materials;
- The lateral extent of the depression in the groundwater surface caused by dewatering;
- The management and handling of the water removed from the excavation and eventual discharge to Clinton Lake; and
- Potential changes in water quality.

Dewatering of the excavation for construction may be required to lower the groundwater table in the immediate vicinity of the CPS. The volume of water to be removed during excavation is unknown since the lateral continuity and hydraulic connection of these outwash deposits have not been defined within the proposed excavation area. However, if outwash deposits are encountered, the water within the deposit will drain into the excavation area and will need to be removed and managed appropriately. The excavation activities will be designed to minimize the amount of water to be handled as well as potential slope stability problems that may be caused by caving and dewatering of these unconsolidated materials.

Based on the depth and size of the excavation and the possible duration of the open excavation, the depression of the groundwater caused by dewatering may extend beyond the site boundary. However, the generally low permeability of the shallower glacial materials will help to minimize the extent of the potential impacts.

The dewatering effluent obtained from the station excavation will be pumped and eventually discharged to an adjacent drainage way and into Clinton Lake. Measures will be implemented, such as sedimentation or filtration, so that erosion or siltation caused by the dewatering will be negligible. Existing sediment basin facilities will be considered or new facilities constructed to accommodate dewatering flows. Where possible, dewatering flows will be diverted to the south or to the discharge side of Clinton Lake in order to avoid impacts to the CPS intake and cooling system. A limited amount of silt deposition in the drainage ways and Clinton Lake will be unavoidable; however, the impacts from these activities will be confined to the construction period and will be monitored and controlled using best management practices for sediment control. Proper safeguards will be implemented to prevent long-term effects on downstream habitats resulting from the construction activities.

Based on the available water quality data, the groundwater pumped out the excavation and discharged to Clinton Lake will not impact the lake water quality.

Based on the description of the aquifer systems in the vicinity of the site, the water withdrawals and resulting changes in the water levels will not affect water quality since it does not differ substantially between aquifers (see Section 2.3.3.3). However, the potential for changes in water quality will be considered during the design.

4.6.3.7.2 Water Use Impacts

The construction-related impacts on water use are also evaluated in Section 4.2 and are based on alteration in water quality and availability. Conclusions from that section are summarized below.

4.6.3.7.2.1 Fresh Water Streams

Although there may be some private users, there are no communities upstream or downstream of Clinton Lake that draw water from Salt Creek or the North Fork of Salt Creek for public water supply. Any users upstream of Clinton Lake will not be impacted by construction-related activities because they are upstream of the construction activity. Any users downstream of Clinton Lake are also not expected to see significant impacts in the quantity or quality of flow in Salt Creek during the construction period. The limited amount of additional sediment in stormwater related to construction activities will be first controlled by sight specific practices identified in the SWPPP and significantly buffered by Clinton Lake before downstream discharge to Salt Creek.

4.6.3.7.2.2 Lakes and Impoundments

The CPS Facility is the only major water user on Clinton Lake. The anticipated short-term construction-related impacts to the CPS are temporary increases in suspended solids. The CPS uses Clinton Lake water for operational cooling and relatively smaller amounts of lake water for potable water and fire protection. The main potential water use impact is short-term, and would consist of temporary increases in the suspended solids concentration of water drawn into the plant water systems.

The limited amount of additional sediment in stormwater related to construction activities will be first controlled by sight specific practices identified in the SWPPP. During construction of the new EGC ESP intake structure, the CPS intake structure will be protected to prevent suspended sediment from entering the cooling system. Special construction techniques, such as watertight sheet piling with dewatering of submerged areas to expose the construction zone, will be implemented where necessary to prevent migration of suspended solids. Water collected from dewatering operations will be settled or filtered before water is allowed to return to the lake. Where appropriate, stormwater runoff and treated dewatering water will be diverted to the discharge side of the lake to reduce CPS impacts.

There are no other industrial, municipal, commercial, or agricultural user of the Clinton Lake water. Recreational facilities adjacent to Clinton Lake either do not provide potable water or do not use wells as a water source. There is the potential for short-term construction-related changes in suspended solids concentrations that may have minor impacts on fishing, swimming, or other recreational uses of the lake. The minor and short-term nature of these impacts, implementation of a site specific construction SWPPP, and the significant distance from recreational access points to the plant site effectively limit exposure to recreational users and potential impacts.

4.6.3.8 Land Use Protection/Restoration

As stated in Section 4.3, construction of the EGC ESP Facility will occur adjacent to the CPS. The footprint for the facility is mainly comprised of disturbed areas (impervious surfaces, crushed stone, and existing structures) and open fields in the vicinity of the CPS.

As a result of the implementation of the EGC ESP Facility, there will be a loss of some open field habitat located adjacent to the existing facility. Project construction is not anticipated to adversely affect other habitats, including forested areas or wetlands, at the site or in the vicinity.

Transmission system improvements will be required to support the EGC ESP Facility. These modifications will be located within or immediately adjacent to the existing substation at the CPS and along the existing transmission corridor. The proposed transmission line improvements will be sited within existing utility rights-of-way to the greatest extent practical.

Construction of the proposed transmission line improvements will temporarily impact habitats within the existing rights-of-way; however, agricultural and open field areas will be allowed to revegetate to preconstruction conditions. There will be no significant loss of agricultural or open field habitats resulting from construction of the transmission systems. Where right-of-way expansion is required in forested lands, clearing will be required. Forested habitats do not make up a significant amount of the proposed utility corridor; therefore, significant impacts to forested lands are not anticipated.

4.6.3.9 Water Use Protection/Restoration

As stated in Section 4.3.2, construction of the cooling water intake structure associated with the EGC ESP Facility will impact open water and shoreline habitats including benthic ecosystems, potentially occurring within the site and vicinity of Clinton Lake. The new cooling water intake structure will be located near the CPS intake structure; as a result, limited natural or otherwise significant habitat is present in this area. Construction of intake structures may result in displacement of open waters, disturbed shoreline habitats, or a temporary increase in sediment levels from construction activities. Overall, these impacts will be insignificant in comparison to the total amount of open water and shoreline occurring at Clinton Lake.

Construction of new transmission lines will be required to support the EGC ESP Facility. These lines have been sited within the existing and maintained utility rights-of-way to the greatest extent possible. Construction of the proposed transmission corridor will temporarily impact watercourses existing along the proposed right-of-way. These temporary impacts will be short-term and temporary in nature, and there will be no net loss of resource area.

4.6.3.10 Terrestrial Ecosystem Impacts

The following discussion was taken from Section 4.3.1, and summarizes the potential impacts to the terrestrial environment and biota of the site and vicinity, and any off-site areas likely to be affected by the construction of the EGC ESP Facility. Descriptions of existing terrestrial habitats including important habitats, as defined by the USNRC, are presented in Chapter 2.

4.6.3.10.1 Wildlife Resources

Project construction is not anticipated to adversely affect wildlife resources (as described in Section 2.4.1) at the site or in the vicinity.

During construction of the EGC ESP Facility and transmission corridor, wildlife may be temporarily displaced as a result of minor disturbances associated with construction activities (i.e., noise and earth moving activities). However, upon completion of construction, any species that were displaced would be expected to return to the area. Use

of the existing maintained access roadway, utility corridor, and the placement of footings for the poles will not have long-term adverse impacts on wildlife resources.

4.6.3.10.2 Important Species

Based on preliminary database reviews, construction of the EGC ESP Facility is not anticipated to adversely affect federally- or state-listed threatened or endangered species or species of recreational or commercial value at the site or within the vicinity. Federal and state wildlife agencies will be contacted at a date closer to the station construction to confirm the absence of federally- and state-listed threatened and endangered species, since confirmation letters are only valid for a one or two year period after issuance.

4.6.3.10.3 Important Habitats

During construction, portions of the Clinton Lake State Recreation Area in the vicinity of the site may be temporarily closed as a result of minor disturbances associated with construction activities. However, upon completion of construction, it is expected that any areas that were temporarily closed would be reopened for use. Wildlife species in Clinton Lake State Recreation Area may be temporarily displaced during construction activities. However, upon completion of construction, species that were displaced would be expected to return. No direct adverse impacts to ecological habitats of Clinton Lake State Recreation Area are anticipated as a result of construction of the EGC ESP Facility.

Weldon Springs State Recreation Area is located approximately 5.5 mi from the EGC ESP Facility. Due to the location of this area, no direct impacts to this park, including ecological habitats within the park, are anticipated as a result of the construction of the EGC ESP Facility.

As discussed in Section 2.4.1, there are two environmentally sensitive areas located within 5.5 mi of the site. However, due to the location of the EGC ESP Facility, construction is not anticipated to adversely affect any environmentally sensitive areas within the vicinity of the site.

As discussed in Section 2.4, based on preliminary reviews of available USFWS NWI databases, wetlands including forested, emergent, and scrub-shrub communities exist within 6 mi of the location of the EGC ESP Facility. These wetlands are generally associated with small tributaries to Salt Creek and North Fork of Salt Creek. However, four minor wetland resources (less than 1 ac) have been identified within the site boundaries. Construction of the EGC ESP Facility is not anticipated to have direct permanent impacts on these or other wetlands or floodplain resources within the vicinity of the site.

4.6.3.10.4 Wetlands and Floodplains

The construction of the transmission line will occur along existing maintained right-of-way. The actual amount of disturbance will be contingent on construction techniques used (e.g., open cut or directional drill). These impacts will be determined during the COL phase. At this time, it is assumed that there will be a short-term disturbance of lands immediately adjacent to the existing right-of-way. Wetlands and floodplains will be restored and there will be no net loss of wetland resources. It is assumed that any pole placement will occur outside of designated wetland areas. Therefore, the EGC ESP Facility is not anticipated to adversely affect any wetlands or floodplains within the site or vicinity.

4.6.3.11 Aquatic Ecosystem Impacts

As stated in Section 4.3.2, construction of the EGC ESP Facility will occur 700-ft south of the CPS. The site is comprised of impervious surfaces, crushed stone, and existing structures. In addition, it contains no aquatic habitats.

4.6.3.11.1 Water Quality and Use

Construction of the cooling water intake structure associated with the EGC ESP Facility will impact open water and shoreline habitats including benthic ecosystems, potentially occurring within the site and vicinity of Clinton Lake. The new cooling water intake structure will be located near the CPS intake structure. As a result, limited natural or otherwise significant habitat is present in this area. Construction of intake structures may result in displacement of open waters, disturbed shoreline habitats, or a temporary increase in sediment levels from construction activities. Overall, these impacts will be insignificant in comparison to the total amount of open water and shoreline occurring at Clinton Lake.

Construction of new transmission lines will be required to support the EGC ESP Facility. These lines have been sited within the existing and maintained utility rights-of-way to the greatest extent possible. Construction of the proposed transmission corridor will temporarily impact watercourses existing along the proposed right-of-way. These temporary impacts will be short-term and temporary in nature, and there will be no net loss of resource area.

4.6.3.11.2 Fisheries Resources

Project construction is not anticipated to have direct adverse effects on fisheries at the site or in the vicinity.

During construction, fish species (described in Section 2.4.2) may be temporarily displaced as a result of minor disturbances associated with construction activities including noise, dredging, and other activities associated with the new intake structure. However, upon completion of construction, any species that were displaced would be expected to return to the area.

Therefore, construction in the transmission corridor is not anticipated to adversely impact fishery resources along the existing right-of-way.

4.6.3.11.3 Important Species

Based on preliminary database reviews, construction of the EGC ESP Facility is not anticipated to adversely affect federally- or state-listed threatened or endangered aquatic species or aquatic species of recreational or commercial value at the site or within the vicinity. Federal wildlife agencies will be contacted at a date closer to the station construction to confirm the absence of federally-listed threatened and endangered species, since confirmation letters are valid for only one year after issuance.

4.6.3.11.4 Important Habitats

During construction, portions of the Clinton Lake State Recreation Area may be temporarily closed as a result of minor disturbances associated with construction activities. However, upon completion of construction, it is expected that any areas that were temporarily closed would be reopened.

Weldon Springs State Recreation Area is located approximately 5.5 mi from the location of the EGC ESP Facility. Based on the distance from the site, no direct impacts to the park or any other adverse effects are anticipated due to construction of the EGC ESP Facility.

4.6.3.11.5 Wetlands and Floodplains

The construction of the modifications to any necessary water intake or discharge structures may result in a short-term disturbance of a narrow band of bank along the lakeshore and a strip of lake bottom. Any potential loss of open water or shoreline habitats that result from construction activities will be insignificant in comparison to the total amount of open water and shoreline habitats found in Clinton Lake.

4.6.3.12 Socioeconomic Impacts

Socioeconomic impacts include physical impacts, such as, increases in ambient noise levels; air pollution from heavy equipment, dust, and open burning; and, aesthetic disturbances from new construction. Socioeconomic impacts also include impacts to the local tax structure, housing, educational facilities, recreational areas, public service facilities, local area transportation, local community structure, agricultural areas, and impacts to low income and minority populations. As stated in Section 4.4, there is no permanent population that would be impacted from construction. Socioeconomic impacts within the vicinity and region are anticipated to be minor. Except for the CPS, the Clinton Visitors Center, and the site recreational facilities, there are no industrial, commercial, or institutional structures on the site property. Physical impacts will be controlled by applicable regulations and, as detailed below, will not significantly impact the site, vicinity (including recreational areas), or region. Summarized below in the following sections are the conclusions drawn from Section 4.4.

4.6.3.12.1 Tax Impacts

The taxing districts will not be affected by construction since there are no additional property taxes to be paid during construction. Potential tax impacts include an increase in state income tax revenue generated by additional construction jobs and salaries that are created by construction, as well as sales tax on materials purchased for the project, and sales tax for goods and services purchased by workers.

4.6.3.12.2 Social Structure

No impacts from construction on the social structure of the region are anticipated.

4.6.3.12.3 Housing

Based on experience at the CPS, it is estimated that most of the construction force will live within a 50-mi radius of the station prior to the start of construction. It is estimated that most of the construction workers will commute to the site rather than move their families to the immediate area of Clinton. A small amount of construction workers may originate from outside the 50-mi radius, and will commute to the job site (on a weekly basis). These workers will likely share trailers and/or campers parked at existing and new mobile home courts. A very small number of construction workers from both within and beyond the 50-mi radius may choose to move to the Clinton area with their families.

Additionally, there will be no families or households displaced by the EGC ESP Facility construction because there are none within the site boundaries.

4.6.3.12.4 Educational System

Since the majority of construction workers will be taken from the region, where their educational requirements are already being met, the surrounding school systems will not experience any major influx of students because of the construction.

4.6.3.12.5 Recreation

No land classified as recreational will be involved in any construction. Therefore, there are no direct impacts on recreational facilities from construction.

4.6.3.12.6 Public Services and Facilities

In general, no overcrowding of public facilities is anticipated because most of the construction forces are not expected to move to the region.

4.6.3.12.7 Transportation Facilities

None of the roads and highways within the vicinity of the site will be physically impacted by the construction.

4.6.3.12.8 Distinctive Communities

The population in the region is fairly homogeneous, largely white, and not dominated by a particular ethnic group. The only special groups within the region are two Amish communities located around the towns of Arthur and Arcola, which are 37-mi and 44-mi southeast of the site, respectively. These two areas are far enough away that they will not be impacted by construction at the site.

4.6.3.12.9 Agriculture

No agricultural land will be disturbed by the site construction, since it is zoned industrial.

4.6.3.12.10 Low Income and Minority Populations

No disproportionately high or adverse impacts on minority and low income populations would result from construction.

4.6.3.13 Radiological Protection Program

As shown in Tables 4.5-1 through 4.5-3, anticipated doses to construction workers from active CPS operations are well within the bounding criteria presented in 10 CFR 20 and 40 CFR 190. However, in order that doses to construction workers are maintained at levels below those specified in 10 CFR 20 and 40 CFR 190 and that any doses are maintained ALARA, routine radiological monitoring will be performed in and around the construction site. This will be in compliance with an established and sanctioned radiological protection program.

Section 6.2 provides information regarding the environmental radiological monitoring that will be performed in and around the construction site. Health Physics personnel will perform radiological monitoring at other selected locations when warranted and as required.

CHAPTER 4

References

Chapter Introduction

None

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CHAPTER 4

Tables

TABLE 4.5-1
Comparison of Construction Worker Public Dose to 10 CFR 20.1301 Criteria

Type of Dose	Annual Dose Limits 10 CFR 20	Estimated Dose
Whole body dose equivalent	100 mrem	<< 1 mrem
Maximum dose rate in any hour	2 mrem/hr	<< 1 mrem/hr

TABLE 4.5-2
Comparison of Construction Worker Public Dose from Clinton Power Station Gaseous Effluent Discharges to 40 CFR 190 Criteria

Type of Dose	Annual Dose Limits	Evaluated Dose
Whole body dose equivalent	25 mrem	<< 1 mrem
Thyroid doses	75 mrem	<< 1 mrem
Other organ doses	25 mrem	<< 1 mrem

Note: 10 CFR 20 requires that the dose to an individual from radioactive effluents also meet 40 CFR 190 limits.

TABLE 4.5-3
Comparison of Construction Worker Occupational Dose to 10 CFR 20.1201 Criteria

Type of Dose	Annual Dose Limits	Evaluated Dose
Whole body dose equivalent	5 rem	< 0.045 rem
Thyroid dose	50 rem	< 0.045 rem
Dose to the eye	15 rem	< 0.045 rem
Dose to skin or extremities	50 rem	< 0.045 rem

TABLE 4.6-1
Structural Control Measures

Control Measure	Location	Description of Control Measure
Silt Fencing	Along the perimeter of the excavation sites. Drainage areas should be less than 0.25 ac per 100 ft of fence length.	To protect streams or wetland areas, to prevent erosion, and to keep sediment on site. Silt fencing consists of posts with filter fabric stretched across the posts. The lower end of the fence is vertically trenched and covered with back fill. This prevents water from passing by the fence without being filtered. The fabric allows for the water to pass off site while retaining the sediment on site.
Check Dams	If applicable where the grade change is more than 2 percent or where practical.	A check dam is a small, temporary dam constructed across a drainage ditch or channel. Its purpose is to slow down the speed of the concentrated flows. The reduced runoff speed will result in less erosion and gulling in the channel and allow the sediment to settle out. The check dams can be built with materials such as straw bales, rock, timber, or other material that will retain water.
Straw Bales	Installed around areas requiring protection such as wetlands and to form a temporary containment.	Straw bales work much like silt fencing and may be used instead of a silt fence. They can be used to form a barrier or redirect water. They impede stormwater flow. Unlike silt fence, straw bales do not allow water to flow through freely; thus, they are used where detention, not just filtration, is necessary.
Limit Entrance/Exit	Designated construction site entrances/exits. The exact location will be determined by the contractor.	The purpose is to reduce tracking of soil off the site. These entrance/exits are usually constructed of fabric and large stone. The fabric is laid down on the soil; the rock is then applied on top of the fabric. The rough surface will shake and pull the soil off the tires.
Inlet Protection	Located around inlet areas to the storm sewer system.	Filtering material placed around an inlet to a receiving stream to trap sediment. It can be composed of gravel, stone with a wire mesh filter, block and gravel, or straw bales.
Sediment Basins	Sediment basins are required for drainage locations that serve 10 or more disturbed acres at one time. For drainage locations serving less than 10 ac, smaller sediment basins or sediment traps should be used.	Sediment basins are either temporary or permanent settling ponds with a controlled stormwater release structure. Their function is to collect and store sediment-laden stormwater from construction activities long enough to allow the sediment to settle. At a minimum, silt fences, vegetative buffer strips, or equivalent sediment controls are required.

TABLE 4.6-2
Stabilization Control Measures

Control Measure	Location	Description of Control Measure
Temporary Seeding	Disturbed areas where the construction activity has temporarily ceased.	Growing of a short-term vegetative cover on disturbed areas that may be in danger of erosion. Seeding is to be implemented within a reasonable time frame of the activity ceasing.
Mulching	On slopes steeper than 3:1 or on areas that have been seeded.	Temporary soil stabilization or erosion control practices where materials, such as grass wood chips, hay, etc., are placed on the soil surface. Mulching is to be implemented within a reasonable time frame of the activity ceasing.
Preservation of Natural Vegetation	Wherever practical.	Wherever practical, existing vegetation should be retained. It minimizes erosion potential and protects water quality. The preservation of natural vegetation between the silt fence and stream will provide additional water quality improvement prior to the stormwater entering state waters.
Permanent seeding	On appropriate disturbed areas once construction is complete.	Provides stabilization of the soil and reduces erosion. Permanent seeding is to be implemented within a reasonable time frame of the activity ceasing.

Environmental Report for the EGC Early Site Permit

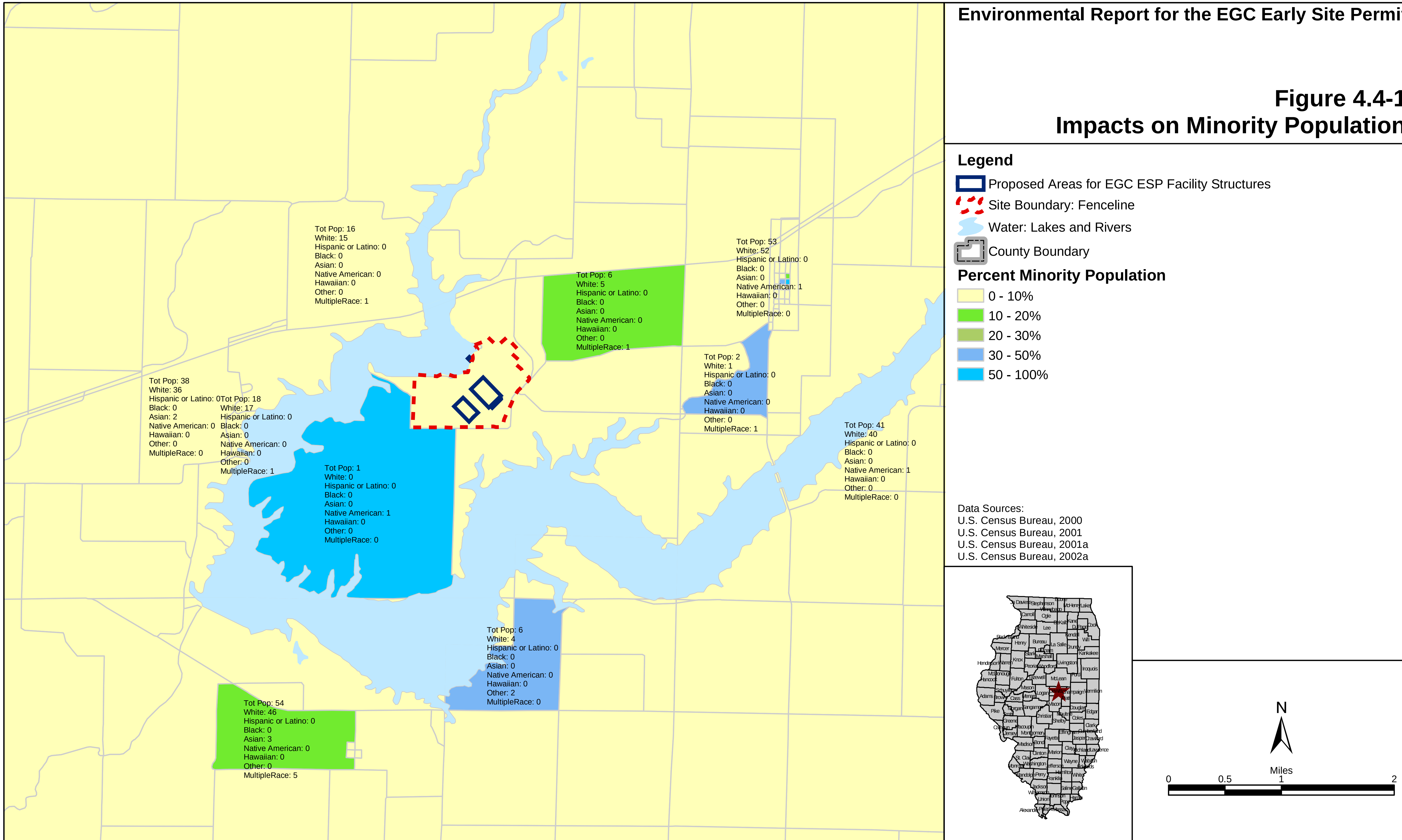
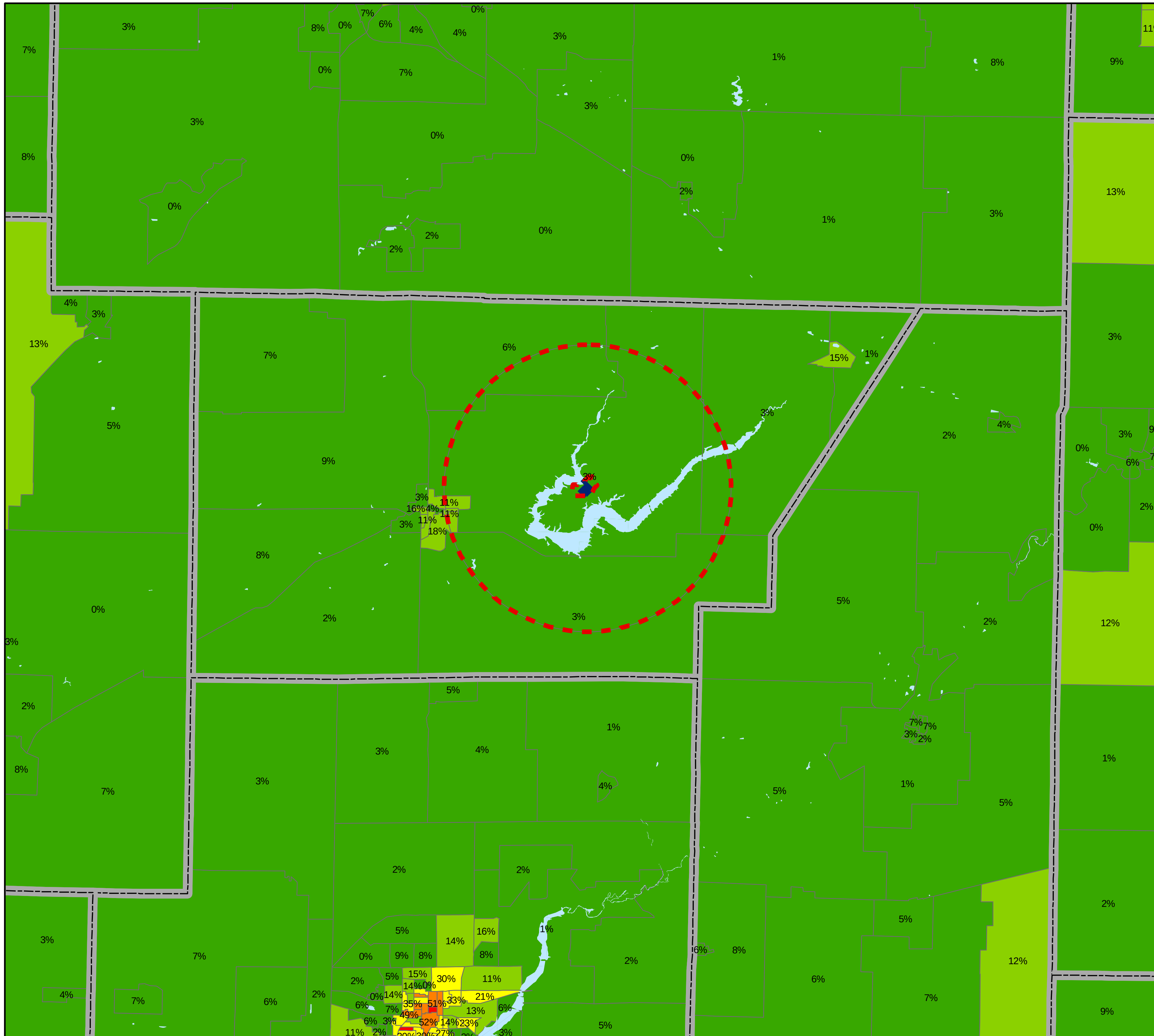


Figure 4.4-1
Impacts on Minority Population

Environmental Report for the EGC Early Site Permit

Figure 4.4-2
Impacts on Low Income Population



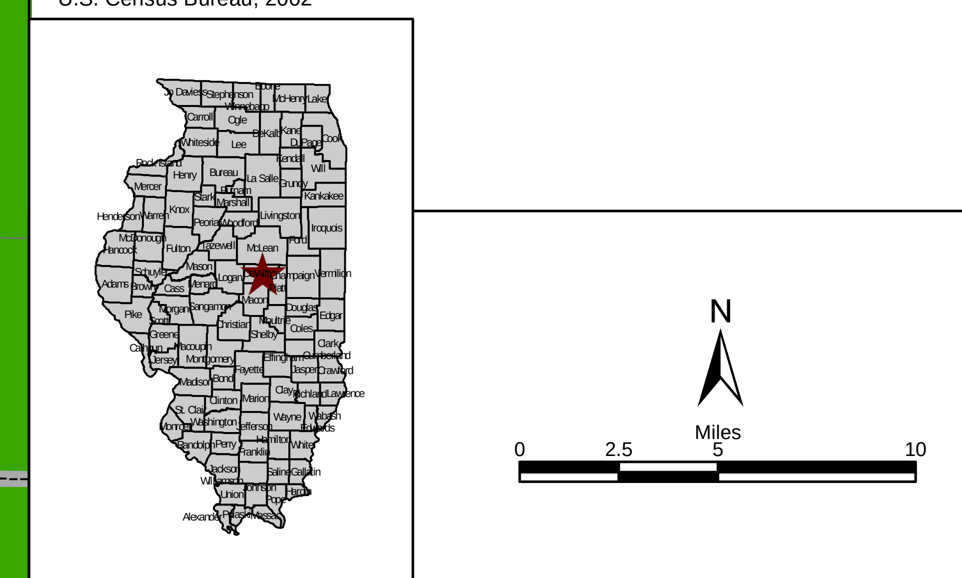
Legend

- Proposed Areas for EGC ESP Facility Structures
- Site Boundary: Fenceline
- Vicinity: 6-mi radius around site
- Water: Lakes and Rivers
- County Boundary

Percent of Population - Income Less Than the Poverty Level

- 0 - 10%
- 10 - 20%
- 20 - 40%
- 40 - 60%
- > 60% Poverty

Data Sources:
U.S. Census Bureau, 2000
U.S. Census Bureau, 2001
U.S. Census Bureau, 2001b
U.S. Census Bureau, 2002



CHAPTER 5

Environmental Impacts of Station Operation

The environmental impacts of station operation on the area within and surrounding the EGC ESP Facility are described in the following sections:

- Land Use Impacts (Section 5.1);
- Water-Related Impacts (Section 5.2);
- Cooling System Impacts (Section 5.3);
- Radiological Impacts of Normal Operations (Section 5.4);
- Environmental Impacts of Waste (Section 5.5);
- Transmission System Impacts (Section 5.6);
- Uranium Fuel Cycle Impacts (Section 5.7);
- Socioeconomic Impacts (Section 5.8);
- Decommissioning (Section 5.9); and
- Measures and Controls to Limit Adverse Impacts During Operation (Section 5.10).

For purposes of this ER, the site is defined as the property within the CPS fenceline (see Figure 2.3-1). The vicinity is the area within a 6-mi radius from the centerpoint of the power block footprint. The region of the site is the area between the 6-mi radius and the 50-mi radius from the centerpoint of the power block footprint.

Impacts evaluated in this chapter are those associated with station operation. Impacts due to operation of the EGC ESP Facility include potential impacts from operational staff, traffic from staff commutes and delivery of raw materials, storage of raw materials, waste disposal associated with operation, and water and air emissions from operation of the facility.

Section 3.1 describes the plant layout and configuration for the EGC ESP Facility. As stated in Section 3.1, the specific technology and design for the proposed reactor(s) have not been selected. However, sufficient information is available from the range of possible facilities in order to assess the potential environmental impacts to the station operation. In summary, up to 580 workers will be needed to operate the EGC ESP Facility. The power block structures will be located 700-ft south of the CPS, in an area approximately 800 ft by 1,200 ft. Additional buildings, such as offices, a water intake structure, a security building, and miscellaneous storage buildings will be located outside this area, within the site boundary.

5.1 Land Use Impacts

As described in Section 2.2.1, one hundred percent of land use within the site is identified as industrial. Within the vicinity, 82 percent of the land is identified as agricultural, and less than one percent of the land is identified as industrial. As detailed below, the operation will not have a significant adverse impact on land use in nearby communities.

5.1.1 Site and Vicinity

In general, there will be no zoning or USGS land use classification changes to the site or vicinity as a result of operation. Any physical land use changes to the site and the vicinity will be the result of facility construction and are described in Section 4.1.1. Any additional land use impacts from operation will occur as a result of operation of the heat dissipation system, and could include land use impacts from cooling tower fog or mist. These impacts are expected to be minor and are described in Section 5.1.1.2.

5.1.1.1 Summary of Land Use Impacts

Land use impacts from operation will be similar to the land use impacts from construction, which are described in Section 4.1. Operation impacts will be limited to the site and transmission corridor, and up to approximately 96 ac will be disturbed. Additional sirens are not anticipated, and no undesirable land use impacts are anticipated to affect surrounding communities. Normal recreational practices near the site are not anticipated to change as a result of the operation of the EGC ESP Facility.

Roads and highways in the vicinity will be slightly more traveled compared to existing operations, with up to 580 additional workers required (see SSAR Table 1.4-1). To determine impact of additional workers on traffic, average daily traffic counts were obtained from IDOT’s website for IL Route 54 and 10. Near the EGC ESP Facility, 2,750 and 2,000 cars and trucks travel daily on IL Route 54 and 10, respectively (IDOT, 2003). According to IDOT's Bureau of Design and Environmental Manual, the typical average daily traffic count for a rural 2-lane highway is 5,000 cars and trucks (IDOT, 1999). The EGC ESP Facility would add an additional 300 cars and trucks to each highway. This was estimated assuming that each worker commuted individually, that an extra 20 miscellaneous trips occurred throughout the day, and that the commuters will equally divided between IL Route 54 and 10. Based on the addition of the average daily traffic counts and the expected number of additional trips from facility workers, the additional workers would not put an excessive amount of burden on the roadways near the EGC ESP Facility.

As detailed in Section 4.1.1.3, there are no federal, state, or regional land use plans for the area. However, DeWitt County has published a countywide generalized land use plan, which designates the site for industrial land use. This plan guides future land use throughout the county, and has designated a site for transportation and utility use. Further, the county land use plan targets expansion and spin-off development from the CPS as a way to realize further economic development in DeWitt County (University of Illinois, 1992).

Figure 2.2-1 and Figure 2.2-2 depict the land use within the site and vicinity, and Table 2.2-1 presents the acreage of land within the site and vicinity for each land use category. In

addition, the location of roads is shown in Figure 2.1-1, and the location of major bridges in the area is shown in Figure 5.1-1.

5.1.1.2 Heat Dissipation System Impacts to Land Use

A detailed description of the heat dissipation system (or cooling system) is described in Chapter 3. If required due to reactor design, UHS cooling towers, of the mechanical draft type, will be located adjacent to the 800-ft by 1,200-ft power block area on the southeast side, and will encompass 0.5 ac of land. The estimated height of these cooling towers is 60 ft.

NHS cooling towers, either mechanical draft or natural draft hyperbolic types, for the normal (non-safety) plant cooling services will be located approximately 600-ft southeast of the major station structures and will require a siting area of approximately 50 ac. The estimated height of the mechanical draft type cooling towers is 60 ft and the estimated dimensions of the natural draft towers are 550-ft high and 550 ft in diameter.

Potential impacts to land use from cooling towers are primarily related to salt drift from a cooling tower. In addition, the potential for fogging, icing, or drift damage may also result from a cooling tower plume. Both wet and dry mechanical draft cooling technologies are being considered for the EGC ESP Facility. If wet mechanical draft cooling technology is used, there will be a mist plume from the cooling tower. While there is the potential for minor salt drift, fogging, and icing to occur, it is expected to be of such small magnitude that no land use changes will result.

As previously discussed, if wet mechanical draft cooling technology is used, there will be a mist plume from the cooling tower. The salt drift associated with this mist plume is anticipated to be minor in nature, and impacts to resident species are not expected. Quantification of impacts associated with salt drift will be reassessed, as appropriate, once the facility's cooling system configuration and design parameters have been determined. This analysis will be conducted at or before a later licensing stage.

5.1.2 Transmission Corridors and Off-Site Areas

Land use impacts from transmission corridor operations primarily fall into two broad categories: maintenance roads for access to pole structures, and vegetation control in the right-of-way. The transmission corridor for the EGC ESP Facility will, most likely, be within the existing right-of-way. No other off-site areas are proposed in association with the EGC ESP. Therefore, no conflicts are apparent between the project and the objectives of land use plans described in Section 2.2.2. Operation and maintenance of the proposed transmission system will be the responsibility of the owner. It has been assumed that operation and maintenance activities will be conducted in a similar manner to the existing transmission facilities because it is anticipated that the transmission corridor will, most likely, be within the existing right-of-way.

5.1.2.1 Maintenance Roads

A major portion, approximately 88 percent, of the transmission line right-of-way that will most likely serve the EGC ESP Facility will cross agricultural land. As part of the existing right-of-way agreements, it is assumed that farmers will continue to cultivate this land except for a small area around the H-Frame structure. Therefore, it is anticipated that

existing access to the right-of-way is adequate and no permanent roads will be built on the right-of-way for either construction or maintenance. However, road construction may become necessary if the landowner requires it as a condition of the right-of-way or for access to a switching structure.

A road will be constructed to the following general specifications:

- Aligned to avoid impacts to wetland resource areas;
- Grades will be minimized to eliminate erosion;
- Grading, ditches, cut and fill areas, or other disturbed areas will be re-vegetated to prevent erosion;
- Culverts will be installed where needed to prevent erosion and prevent flooding of the road; and
- The surface of the road will be paved with crushed rock or natural gravelly material to withstand expected loads. Once constructed, these roads will be permitted to "grass-over" for grazing, aesthetics, and minimal maintenance.

5.1.2.2 Vegetation Control

Vegetation control will be performed in accordance with customary practices. With such a high percentage of the transmission right-of-way crossing productive agricultural land, there will be a minimal amount of vegetation control required. Where the transmission line crosses wooded areas, trees with the potential to impact the lines may be removed or pruned during construction. For maintenance purposes those tree species with the potential for resprouting may be controlled with an environmentally acceptable selective basal spray herbicide. It is not customary for trees to be allowed directly under the transmission lines for approximately 50 ft on either side of the centerline. Trees outside of the 50-ft limit may be maintained through periodic trimming in order to keep them out of the danger timber zone, see Figure 5.1-2.

Where the transmission line crosses public roads, a screen of trees may be left to minimize visual impacts from the line. Any new access to the right-of-way, though not anticipated, may be constructed at oblique angles to the road in order to prevent line of sight down the right-of-way, see Figure 5.1-3.

Routine inspections of the right-of-way for vegetation control monitoring will be conducted periodically. It is assumed that inspections will be conducted by aircraft in order to determine the need for roads and minimize associated impacts. Maintenance and repair inspections required by cause, such as storms that may down timber on or near the lines, will be conducted by air, road, or foot, as required by the circumstances. These occurrences are expected to be few, and will have limited impact on the land.

5.1.3 Historic Properties

As described in Section 2.5.3, no historic standing structures have been identified within the EGC ESP Site power block footprint, cooling tower footprint, or in the immediate vicinity of the CPS. Impacts of operation of the EGC ESP Site will be no more than what is described regarding the impact from construction, see Section 4.1.3.

5.2 Water-Related Impacts

This section describes the analysis and assessment of anticipated hydrological alterations on water supply and to water users that may result from the EGC ESP Facility. The topics covered include:

- Hydrologic alterations resulting from station operations and the potential impacts on other surface and groundwater users;
- Adequacy of water sources proposed in order to supply total station water needs;
- Water quality changes and possible effects on water use;
- Engineering controls, practices, and procedures that may be used to mitigate, minimize, or avoid impacts; and
- Identification and compliance with federal, state, regional, and local regulations that are applicable to water use and water quality.

The evaluation of potential hydrological alterations was conducted relative to how they may impact the water environment and both surface water and groundwater users including domestic, commercial, municipal, agricultural, industrial, mining, recreation, navigation, and hydroelectric power.

5.2.1 Hydrologic Alterations and Plant Water Supply

The evaluation of anticipated hydrologic alterations resulting from the operation of the EGC ESP Facility, and the adequacy of water sources proposed to supply plant water needs included:

- Identification and description of proposed operational activities that could result in hydrologic alterations;
- Identification, description, and analysis of the resulting hydrologic alterations and the effects of these alterations on other water users;
- Analysis of proposed practices to minimize hydrologic alterations that could have adverse impacts;
- Analysis and comparison of plant water needs and the availability of water supplies to meet those needs; and
- Conclusions with respect to the adequacy of water supplies to meet plant water needs.

As discussed in Section 2.3.1, Clinton Lake has a storage capacity of approximately 74,200 ac-ft. The Salt Creek Watershed, upstream of the Clinton Lake Dam, delivers an average of 188,000 ac-ft of water annually to Clinton Lake, or about 2.5 times the total lake volume. According to the CPS USAR, the estimated recirculating water system requirements for the CPS are between 718,000 ac-ft (winter) and 913,000 ac-ft (summer) per year, or about 9.6 and 12.2 times the total lake volume (CPS, 2002).

The CPS draws lake water through the screen house on the northwest side and uses it as recirculating cooling water and plant service water. The bulk of this water is returned to the lake through the discharge flume (Outfall No. 2). Evaporative losses are increased (forced evaporation from the lake surface) due to increased temperature of the return flow discharge to the lake. The CPS discharge is 566,000 gpm (summer) and 445,000 gpm (winter), which represents about 84 percent (summer) and 66 percent (winter) of the permitted discharge rate of 670,000 gpm for Outfall No. 2 (IEPA, 2000). These withdrawal and discharge relationships along with the estimated consumptive use or forced evaporation are identified in Table 5.2-1.

The CPS NPDES permit allows a 90-day average maximum discharge temperature of 99°F and maximum daily allowable temperature not to exceed 110.7°F. The CPS NPDES permit also requires monitoring for flow, temperature, pH, total residual chlorine, and total residual oxidant (IEPA, 2000).

One target established for the EGC ESP Facility is to maintain a discharge rate within the CPS NPDES permit conditions. With 66 percent (winter) to 84 percent (summer) of the permitted discharge flow already used by the CPS, the EGC ESP Facility must maintain lower discharge flows by using a less consumptive cooling process to reduce the volume of water withdrawn and discharged.

The need for the selected cooling method to incorporate some form of low consumption wet/dry cooling will also depend on the water available for use during drought conditions. The following sections describe three cooling options that are generally compatible with any one of the ESP facility options being considered. These cooling options and associated water use (consumptive use) requirements are summarized in Table 5.2-2.

The potential impacts to surface water and groundwater from hydrologic alterations resulting from the operation of the EGC ESP Facility, and the adequacy of water sources proposed to supply plant water needs are discussed in the following sections.

5.2.1.1 Freshwater Streams

5.2.1.1.1 Flow Characteristics

The dam that forms Clinton Lake is operated to provide a minimum downstream release of 5 cfs from Clinton Lake to Salt Creek. This flow rate will not change under the operation of the EGC ESP Facility. The total annual discharge volume to Salt Creek downstream of the dam will be slightly reduced by the value of the consumptive use of the lake water.

5.2.1.1.2 Floods

Flooding conditions downstream of the dam have been significantly reduced as a result of initial dam construction and flow attenuation in the Clinton Lake (see Section 2.3.1.1.3). Flood conditions will continue to be attenuated and may be further reduced with additional consumptive use of lake water.

5.2.1.1.3 Temperature and Water Quality

Review of temperature data from the Rowell gauging station (12-mi downstream of the dam) indicates no measurable change in temperature from predam to preplant operation to postplant operation. Stream temperatures at Rowell are not influenced by increased

temperatures in Clinton Lake. Figure 2.3-11 presents the temperature data at the Rowell gauging station.

As part of the required monitoring for the CPS NPDES permit, the temperature data are collected continuously downstream from the dam during the months of June, July, and August of each year. These data are representative of the lake temperature due to the proximity of the monitoring point to the dam. A summary of the temperature data recorded on the 1st and 15th of each month between 1994 and 2000 is presented in Table 2.3-11. A comparison of stream temperatures immediately downstream of the dam (lake temperatures) and temperatures at the Rowell gauging station for June, July, and August of 1994, 1995, and 1996 are presented in Figures 2.3-20, 2.3-21, and 2.3-22, respectively. The comparison indicates higher temperatures near the dam than at the Rowell gauging station, as would be expected. Average temperatures at the dam were 2°F to 8°F higher than those observed at the Rowell gauging station for the summer periods monitored.

With addition of the new EGC ESP Facility, temperatures are expected to increase by a minimal level described for Clinton Lake in the following section. The minimal change will be further diminished as flow moves downstream from the Clinton Lake Dam. No change is expected at Rowell, as the temperatures at that location are under the stronger influence of natural stream temperature moderating processes.

5.2.1.2 Lakes and Impoundments

5.2.1.2.1 Floods

The operation of the EGC ESP Facility is not expected to have a significant impact on flooding. The EGC ESP Facility will take water in from the lake and discharge a smaller amount of water (intake less consumptive use) back to the lake. This results in no increase in lake levels and potentially lower lake levels during dry conditions based on water use requirements identified in Table 5.2-2.

5.2.1.2.2 Droughts

A drawdown analysis was completed to determine the capacity of the cooling water supply during dry periods. The 50- and 100-yr recurrence interval dry periods with a five-year duration were selected for the evaluation. The normal lake level of 690 ft was used as the initial water surface elevation. The lake volume at normal lake level was assumed to be 72,400 ac-ft. Inflow to the lake (in acre-feet) was computed on a monthly basis by multiplying the rainfall runoff (in feet) by the watershed area (in acres). Water loss from the lake was comprised of downstream discharge; net lake evaporation; forced evaporation due to CPS operations; seepage; and the cooling water consumed by the new facility. Forced evaporation is defined as the additional evaporation produced due to an increase in lake water temperature caused by the discharge of cooling water to the lake under the open-cycle lake cooling process employed by the existing plant.

A minimum lake discharge rate of 5 cfs was maintained at the Clinton Lake Dam when lake levels are at or below the 690-ft spill elevation. For the purpose of drought analysis calculations, the lake elevation was not allowed to exceed 690 ft. The discharge was allowed to exceed 5 cfs if inflows would increase the lake level to a level above the spillway elevation of 690 ft. The minimum allowable water level in the lake was 677 ft, which provides a 2-ft water depth over the submerged dam elevation of the UHS.

The analysis reviewed CPS plant operations and consumptive use for a 100 percent load factor on the uprated 1,138.5-MWe plant. The results of the drawdown analysis, in terms of total water available and water available for new plant withdrawal, are presented in Table 5.2-3. The results indicate the consumptive use limitations for the 50- and 100-yr droughts to maintain the required minimum lake level.

Comparing the water use requirements for the various cooling methods (see Table 5.2-2) with the water availability from the drought analysis (see Table 5.2-3), it is apparent that the maximum wet cooling method water use range exceeds the volume of water available for the 50 and 100-yr droughts. The minimum wet cooling method water use range is compatible with the volume of water available for both the 50 and 100-yr droughts. The maximum wet/dry cooling method water use range is generally compatible with the volume of water available for the 50-yr drought for the full range listed and is compatible with the volume of water available for both the 50 and 100-yr drought for the lower end of the range listed. The minimum wet/dry cooling method water use is compatible with both the 50 and 100-yr droughts. Dry cooling is compatible with both the 50-yr and 100-yr droughts as it is a non-consumptive process. If a cooling method is selected that has a consumption rate that exceeds the available water for drought conditions, it may be necessary for periods of time to reduce or curtail plant operation to protect the minimum lake level and the integrity of the UHS.

5.2.1.2.3 Temperature and Water Quality

The CPS NPDES permit allows a cooling water discharge of 670,000 gpm at a temperature that does not exceed 99°F during 90 days in a fixed calendar year and 110.7°F for any given day. The CPS discharges a summer volume of 566,000 gpm and a winter volume of 445,000 gpm, both at 99°F, leaving considerable discharge capacity (104,000 gpm in summer and 225,000 gpm in winter) under the permit for the CPS. The estimates of discharge requirements for the EGC ESP Facility using the wet and wet/dry cooling tower methods and dry cooling methods are presented in Table 5.2-4. The wet cooling tower method has a maximum water discharge value of 49,000 gpm and normal discharge value of 12,000 gpm. The wet/dry cooling towers have a reduced discharge flow of up to 70 percent of the wet cooling method or in the range of 14,700 to 3,600 gpm. There is no discharge required from the dry cooling method. The added ESP water discharge values for any of the cooling methods combined with the CPS discharge is well within the available capacity under the CPS NPDES permit.

Lake temperatures are expected to increase slightly with operation of the EGC ESP Facility. The temperature increase is expected to be proportional to the increase in flow and temperature that was observed for the CPS Facility. This conclusion can be conservatively drawn because both plant discharge temperatures are expected to be similar within the NPDES discharge permit limit of 99°F. The ESP discharge or cooling tower blowdown temperatures are based on the wet bulb temperature and the cooling tower approach temperature ,which is the basin discharge temperature minus the wet bulb temperature. The PPE gives an approach of 10°F for the normal heat sink towers (see SSAR Table 1.4-1) and gives an approach of 10°F for the UHS tower (see SSAR Table 1.4-1). Because the flow will increase between 1 to 8 percent above the CPS summer flow rate, a conservative estimate for the increase in lake temperature would be a 1 to 8 percent increase above the CPS.

With an average increase in temperature of 9°F due to the CPS Facility (see Section 2.3.3.2), the increase in temperature from the operation of the EGC ESP Facility is estimated to be 0.06°F to 0.72°F (1 to 8 percent of 9°F). The impact of any increase in temperature is expected to be most significant during the summer months where the difference between the intake water temperature and the wet bulb temperature are the smallest and when recirculating volumes are high.

Average lake temperatures are highest in July and August (see Figure 6 in *Environmental Monitoring Program Water Quality Report 1978-1991*; CPS, 1992). Review of the lake temperature data indicates increases due to operation of the CPS. The preoperational data (1978-1986) indicate average July and August epilimnion temperatures of 79°F and postplant operational data (1987-1991) show average July epilimnion temperatures of 81°F and August temperatures of 82°F.

Comparison of simulated lake temperatures and measured lake temperatures indicate similar temperature ranges. Table 2.3-10 presents simulated lake temperatures (preplant) for the years 1966, 1964, and 1954. These years were selected for simulation because they were expected to produce naturally warmer lake temperatures. Table 2.3-11 provides measured stream temperatures 100-ft downstream of the dam (postplant) for the years 1994 to 2000. These data are representative of lake temperatures because of their close proximity to the dam. Average temperatures from the two data sets for the months of June, July, and August range from 1°F cooler to 2°F warmer than the simulated preplant lake temperatures.

Review of lake water quality monitoring data between 1987 and 1991 indicates that, with the exception of the temperature and dissolved oxygen, the quality of lake water near the CPS intake structure is similar to water near the discharge flume. A comparison of intake and discharge water quality is presented in Table 2.3-19. The comparison is made by reviewing data recorded at lake monitoring Site 4 (see Figure 2.3-25), near the plant intake and lake monitoring Site 2, near the plant discharge flume. Both sites are representative of the intake and discharge water, but are also influenced by lake conditions and flow patterns in the vicinity. These locations were used because direct monitoring data of the plant intake and discharge water is not available.

Review of the temperature data indicates that average lake temperatures increase from upstream (66.7°F) to downstream (76.3°F) of the CPS. Dissolved oxygen decreased from 9.3 mg/L to 8.1 mg/L, as would be expected with an increase in temperature. There appears to be only slight changes in other constituents presented including turbidity, hardness, TDS, magnesium, chloride, orthophosphate, and sulfate.

Other conservative constituents such as hardness and TDS may increase as a result of evaporation if the wet or wet/dry cooling method is selected. For example, the TDS intake water concentration at Site 4 measured in the range of 275 mg/L. Discharge concentrations of TDS from the EGC ESP Facility (see SSAR Table 1.4-2) are estimated to be 17,000 mg/L. The combined discharge will be in the range of 380 mg/L (based on 3,600 gpm) to 620 mg/L (based on 12,000 gpm) of TDS. The discharge will be diluted by lower dissolved solids in the lake and in the base flows from Salt Creek and North Fork of Salt Creek. Dissolved solids will also be passed downstream through the dam. Over time, a rise in ambient lake dissolved solids concentration is expected to a level of equilibrium higher than the ambient level. Further discussion of dissolved solids concentration is included in Section 5.3.

5.2.1.3 Groundwater

It is anticipated that surface water (namely Clinton Lake) will be used to meet the operational water requirements of the EGC ESP Facility; groundwater will not be used as a source of water. In addition, based on the planned design of the EGC ESP Facility, no permanent groundwater dewatering system will be implemented. Thus, there are no anticipated hydrologic alteration impacts to groundwater from the operation of the EGC ESP Facility.

5.2.2 Water Use Impacts

This section discusses the predicted impacts of station operation on water use, including:

- Hydrologic alterations that could have impacts on water use including water availability;
- Water quality changes that could affect water use;
- Impacts resulting from these alterations and changes;
- Engineering controls, practices, and procedures that may be used to mitigate, minimize, or avoid impacts; and
- Identification and compliance with federal, state, regional, and local regulations applicable to water use and water quality.

5.2.2.1 Freshwater Streams

5.2.2.1.1 Water Availability

There are no significant water users either upstream or downstream of Clinton Lake that draw water from Salt Creek or the Sangamon River. The 5-cfs minimum discharge from Clinton Lake to Salt Creek will be maintained in accordance with the CPS NPDES permit requirements.

5.2.2.1.2 Water Quality

Clinton Lake is expected to buffer potential water quality impacts to Salt Creek resulting from station operations. Downstream users will not be affected, provided that the operating CPS and the EGC ESP Facility operate within the bounds of the their NPDES permits.

5.2.2.2 Lakes and Impoundments

5.2.2.2.1 Water Availability

Clinton Lake was designed and constructed to accommodate two similar sized power plants. The CPS is the first plant and the only major water user on the lake. Recreation is the secondary use of the lake, which includes camping, boating, and fishing. There are no other significant identified withdrawals of water from Clinton Lake (ISWS, 2002).

The EGC ESP Facility will be designed and operated to be compatible with the operation of the CPS and their respective NPDES permits. Incorporating wet/dry cooling rather than the more consumptive wet cooling process will minimize water consumption. Operation of the dam structure is also an important water management function. The dam outfall structure is operated in a passive manner with gate settings periodically set based on long-term weather conditions. Dam operation practices will be reviewed and revised where

appropriate in conjunction with the CPS to maintain minimum flows in Salt Creek downstream of the dam and conserve water in the lake impoundment for power plant operation and recreational purposes.

With these design considerations, there is expected to be a minimal impact on the operation of the CPS. The EGC ESP Facility operation will comply with federal laws related to hydrology and water quality. There are no regional or local regulations applicable to water use (ISWS, 2002).

5.2.2.2.2 Water Quality

The water quality of Clinton Lake is presently classified as an impaired water body by the IEPA (IEPA, 2002). The causes of impaired use include a Confidence Level 3 (high) Excess Algal Growth, and a Confidence Level 2 (moderate) Metals. Review of the impairments and possible causes are discussed in Chapter 2. The power plant operation is not uniquely related to either of the impairments. Algal growth is related to nutrient levels in the water column that originate from the dominant agricultural land use. Metals concentrations in the water column and sediment have a number of sources including natural geologic formations, agricultural practices, and industrial sources. For both impairments, stormwater management and erosion control practices for sediment control are the best control option. Nutrients and metals attach to sediment and are effectively controlled with control of sediment in stormwater. Industrial pollution control practices, strategic materials selection, and corrosion control are also expected to be effective in reducing metals contributions from industrial sources.

Lake water temperatures may be marginally increased (see Section 5.2.1.2.3) due to plant operation. The combined discharge of the two plants will be within with the limits of the NPDES permit for the CPS. There are no expected impacts to the CPS or lake recreational users.

5.2.2.3 Groundwater Use

As discussed above, it is anticipated that surface water (namely Clinton Lake) will be used to meet the operational water requirements of the EGC ESP Facility, and that groundwater will not be used as a source of water. In addition, based on the proposed design of the plant, no permanent groundwater dewatering system will be implemented. Thus, there are no anticipated groundwater use impacts resulting from the operation of the EGC ESP Facility.

5.3 Cooling System Impacts

This section describes the impacts of the cooling system intake and discharge facilities. As described in Section 3.3, either mechanical draft or natural draft hyperbolic type cooling towers will be used for normal non-safety plant cooling and for safety-related cooling. The makeup water for the normal (non-safety) plant operations will be taken up through a new intake structure located next to the CPS intake structure on the northern basin of Clinton Lake. The intake will include a screening system similar in function to the CPS intake, but for a significantly smaller flow rate. Makeup water for the safety-related cooling towers will be supplied from the same intake structure, which will draw water from the bottom of the submerged impoundment within Clinton Lake (i.e., the UHS). The cooling tower(s) blowdown will be discharged to the CPS discharge flume that flows to the southern basin of Clinton Lake.

The discussion of the cooling system impacts have been divided into the following sections:

- Intake system;
- Discharge system;
- Heat-discharge system; and
- Impacts to members of the public.

5.3.1 Intake System

This section describes the impacts of the intake system during station operation including the physical impacts caused by the flow field induced by the intake system and the potential impacts on the aquatic ecology.

The descriptions of the new intake system that will draw makeup water from Clinton Lake and the UHS, and convey it to the EGC ESP Facility NHS and the UHS cooling towers are presented in Section 3.4.2. Although the specific design details have not been finalized, it is anticipated that the new intake structure will consist of a shore structure adjacent to the existing intake structure that allows access to impounded water of Clinton Lake down to the bottom of the UHS cooling towers. The location of the intake structure will provide a secure source for makeup water to the UHS in the unlikely event of a failure at the Clinton Lake Dam. Intake water temperatures are expected to be similar to existing seasonal ambient lake temperatures of 40°F to 75°F.

5.3.1.1 Hydrodynamic Descriptions and Physical Impacts

This section describes the intake hydrodynamics and the predicted spatial and temporal alterations in the ambient flow field and physical hydrologic effects (e.g., bottom scouring, induced turbidity, silt buildup) induced by the intake system operation. In addition, design considerations and descriptions of practices or procedures to mitigate or minimize predicted adverse impacts are identified and evaluated.

5.3.1.1.1 Intake-Hydrodynamic Description

The new cooling system intake structure will increase the overall flow and velocity through the eastern end of the submerged UHS. The maximum approach velocity to the new intake structure will be limited to 0.5 fps at a normal lake level of 690 ft (see Section 3.4.2.1). Review of the cross section of the eastern end of the UHS (see Figure 5.3-1) near the CPS intake structure and existing summer intake flow rate indicates that at normal lake level, the average intake velocity is approximately 0.09 fps. The average velocity of combined flows for the CPS and EGC ESP Facility through the eastern end of the submerged UHS is estimated to be 0.10 fps. At the elevation of 675 ft, which is the full elevation of the UHS, the velocities increase from 0.33 fps to 0.35 fps. These minor changes in velocity are not expected to have an adverse impact on soil erosion near the plant intake. Velocities in this range are below the erosion velocity for structures and soils (Hjulstrom, 1935) present at this location (see Table 5.3-1). Design of the intake structure will include features that maintain an even distribution of intake flows. Where necessary, the intake area will be protected to prevent local areas of erosion.

5.3.1.1.2 Physical Impacts of Intakes

The slight increase in velocity across the intake end of the UHS is not expected to cause any change in shoreline erosion, bottom scouring, induced turbidity, or silt buildup. The increased velocity may slightly increase the suspended solids concentration drawn into the cooling system. Such a minimal change will tend to pass through the cooling system without impact.

5.3.1.1.3 Maintenance of Intake Facilities

The intake piping and screens will require cleaning to keep them free of debris, algae growth and aquatic organisms. The intake screens will be kept clean by mechanical means. The screens will be washed or scraped to remove algae, dead fish, trash, and debris that may have been drawn in. Captured material will be removed and disposed of onshore at an approved landfill site. There will be no direct discharge of these materials except for water to Clinton Lake.

In addition, the piping system will need to be kept clean of aquatic organisms such as algae and shellfish. Standard practices that have been used by the utility industry include scraping, backwash with the heated cooling water and chemical treatment including certain biocides, anti-corrosion, and anti-scaling chemicals. These chemicals will ultimately be discharged to Clinton Lake through the thermal discharge piping, as described in Section 3.6.1. If a chemical addition is required to protect the new cooling system, this same approach may be used in the intake piping. It is anticipated that there will be a minor change in the quality of the water discharged. The selection of chemicals will be done in order to minimize the impacts on water quality. It is assumed that the discharges will be comparable to those associated with the CPS as approved under their NPDES permit.

5.3.1.2 Aquatic Ecosystems

As previously discussed, Clinton Lake was constructed as a source for cooling water for the CPS. Clinton Lake is a significant resource for a variety of recreational activities including fishing, boating, swimming, and wildlife viewing. The water quality of Clinton Lake is presently classified as an impaired water body by the IEPA (CPS, 2001).

5.3.1.2.1 Fish Impingement

The ER for the CPS documented that juvenile centrarchid species (including largemouth bass, bluegill, and crappie) were not anticipated to be subject to high levels of impingement (CPS, 1973 and CPS, 1982). It was noted that any adult fish species that are drawn into the intake screens and structures would already be in a physiologically weakened state, and therefore, would not be able to avoid the intake velocities. Such fish would likely be lost due to other circumstances and would be of limited value to the fishery resource of the lake. The impacts to aquatic organisms were monitored for a 5-yr period following the startup of the CPS. Finfish populations have continued to be monitored in Clinton Lake by the IDNR.

The proposed intake facilities are of a similar nature to the CPS. Therefore, it is projected that the EGC ESP Facility will have similar effects. The total number of fish lost, both juvenile and adult, as a result of operation of the proposed EGC ESP Facility will be insignificant in comparison to the total number of fish that exist in Clinton Lake, as natural residents or through stocking programs.

5.3.2 Discharge System

This section describes the hydrothermal discharge, associated physical impacts to the CPS discharge flume, and the potential impacts to important aquatic populations in the vicinity of the point of discharge to Clinton Lake. The scope of the evaluation includes the analysis of alterations to the receiving body (i.e., the discharge flume and Clinton Lake) resulting from station thermal, physical, and chemical discharges, and potential impacts on the aquatic ecosystems.

The EGC ESP Facility cooling system will discharge cooling tower blowdown to the CPS discharge flume. The layout of the CPS discharge flume and point of connection of the cooling system discharge from the EGC ESP Facility is described in Section 3.4.2.

5.3.2.1 Thermal Description and Physical Impacts

A hydrothermal analysis of the discharge system of the EGC ESP Facility cooling system was conducted to characterize the temporal and spatial temperature distribution in Clinton Lake and potential physical impacts (e.g., increased turbidity, scouring, erosion, sedimentation) resulting from the EGC ESP Facility's thermal discharges. The EGC ESP Facility cooling system will discharge to the CPS discharge flume; therefore, the impacts of the CPS were examined to determine the incremental impact that would be attributable to the EGC ESP Facility. In addition, design considerations and descriptions of practices or procedures to mitigate or minimize predicted adverse impacts have also been identified.

5.3.2.1.1 Discharge Thermal Description

A thermal description of Clinton Lake is presented in Section 2.3. Characteristics of thermal discharges to Clinton Lake and nonradioactive wastes that may be discharged to Clinton Lake via the discharge flume are presented in Section 3.3 and Section 3.6. In general terms, the average discharge temperature is expected to remain below the NPDES permit maximum 90-day average limit of 99°F. The discharge flow rate will increase slightly, but will also fall within the NPDES permit limit of 670,000 gpm. Discharge flow will increase from a summer rate of 566,000 gpm to 615,000 gpm, increasing the total heat discharge to Clinton Lake. Flow and temperature values for existing, future, and permitted discharge are identified in Table 5.3-2.

5.3.2.1.2 Physical and Chemical Impacts of Discharge

The discharge flume is a trapezoidal section with a design water depth of 13 ft, bottom width of 120 ft, and side slopes of 3-ft horizontal to 1-ft vertical. The flume is designed to carry 1,372,077 gpm at a velocity of 1.5 fps. The existing summer discharge is less than half of the design flow capacity of the flume (CPS, 2002). The combined flow of the CPS and EGC ESP Facility system will also be less than half of the capacity of the existing flume. Therefore, the flow and velocity will be within the design capacity of the existing flume. The existing and combined system flow and velocity relationships are presented in Table 5.3-3.

The quality of water discharged will be similar to intake water and reflect changes that result from evaporative losses during the cooling process, addition of suitable chemicals to aid the cooling system such as biocides, dispersants, molluskicides, and scale inhibitors, and other compatible flow streams. These constituents are described in Section 3.6.1. The chemicals will be selected for their effectiveness and to minimize the impacts on water quality. The discharge-monitoring program will be revised, as necessary, to monitor for potential water quality impacts.

Potential chemical impacts of discharge to water quality in Clinton Lake were examined by estimating the concentration of TDS in Clinton Lake under a range of hydrologic conditions (mean runoff and drought conditions) and loading (with and without the addition of the EGC ESP Facility). The peak TDS concentrations were calculated over a 5-yr period for each scenario with an initial condition based on average TDS values observed by Illinois Power Company (CPS, 1992). The impacts to Clinton Lake water quality are conservatively examined by comparing results to IEPA's general use standard for TDS of 1,000 mg/L (IEPA, 2002). The results of the analysis indicated that additional loading from the EGC ESP Facility would not impact Clinton Lake water quality under the mean runoff or 50-yr drought conditions, but may exceed the general use standard during the 100-yr drought.

The chemicals used will be subject to review and approval for use by the IEPA, and releases will be in compliance with water quality standards and an approved NPDES permit. The total residual chemical concentrations in the discharges to Clinton Lake will be subject to limits that will be established by the IEPA.

The proposed changes in the quality, quantity, and velocity of the discharged water are not expected to cause any change to shoreline erosion, bottom scouring, induced turbidity, or silt buildup in the discharge flume or at the point of entrance to Clinton Lake. The increased velocity of the intake and discharge may slightly increase the suspended solids concentration or turbidity of discharge waters to Clinton Lake.

5.3.2.2 Aquatic Ecosystems

Several cooling alternatives are being considered for the operation of the proposed facility. The alternatives will discharge cooling waters in a similar manner to the CPS. As noted above, the discharge water temperature will continue at the NPDES permit level. Flows will increase slightly in the range of 1 to 8 percent. Under the discharge conditions, it is expected that certain fish species would migrate to other portions of Clinton Lake where temperatures are more tolerable. This condition is expected to continue with the addition of the EGC ESP Facility.

As previously mentioned, the average discharge temperature is expected to remain at the current NPDES permit temperature limit (approximately 99°F). In the event of an unexpected shutdown of the discharge system, temperatures would be expected to drop significantly, potentially resulting in adverse impacts to fish populations, consistent with impacts (due to "cold shock") that were observed after a shutdown event that occurred in December 2000. However, design alternatives being considered may lessen the potential for temperatures to drop as significantly, in the event of a shutdown.

5.3.3 Heat-Discharge System

This section describes the impacts of the heat-discharge system during station operation. The evaluation of potential impacts includes consideration of physical and aesthetic impacts attributable to vapor plumes resulting from heat dissipation to the atmosphere and the impacts to terrestrial ecosystem induced by operation of heat dissipation systems, especially cooling towers.

The CPS uses the lake and atmosphere for heat dissipation. There are no cooling towers for mechanical heat dissipation. The plant takes in water from the lake, passes it through a heat exchanger, and discharges the same volume of water at a higher temperature back into the lake. The added heat is dissipated in the discharge channel and Clinton Lake, with an exchange of heat to the atmosphere and (to a much lesser extent) to the ground as the cooling water moves through the discharge channel and Clinton Lake. Of the total volume of cooling water that is discharged from the plant, a portion of the water evaporates to the atmosphere, a portion passes over or through the Clinton Lake Dam to Salt Creek, and the remaining portion is drawn back to the plant intake to go through the heating and cooling cycle again. Discharged and evaporated water is made up from runoff from the upstream watershed.

The average discharge temperature from the CPS is in the range of the maximum 90-day average temperature limit in the NPDES permit of 99°F. The CPS discharge flow rate ranges from 566,000 gpm (summer) to 445,000 gpm (winter). The intake temperature varies seasonally with an average monthly summer temperature that ranges from 72°F (June of 1989) to 84°F (August of 1988). Average monthly temperatures measured near the CPS intake for periods 1987 through 1991 are presented in Table 5.3-4.

The EGC ESP Facility will use cooling towers for plant cooling. The facility will pump cooling water from the cooling tower basins, and after the water passes through the heat exchangers it will be returned to the cooling tower for cooling and discharge to the basin. A portion of the water will be evaporated to the atmosphere in the cooling tower and a portion of the water will be discharged as blowdown to the discharge flume in order to limit the buildup of impurities in the basin water. Water from Clinton Lake will be used for makeup to the cooling tower to replace the evaporation and blowdown losses. Blowdown water will be discharged back into the lake. This water will be combined with the CPS discharge water, and the associated heat load will be dissipated to the atmosphere in the discharge channel and Clinton Lake.

For the EGC ESP Facility, the maximum blowdown discharge temperature is expected to be below the NPDES discharge limit. The actual discharge temperature is expected to be 10°F above the ambient wet bulb temperature. The EGC ESP Facility discharge flow rate is

expected to be significantly less than what is being discharged by the CPS. For the cooling processes being considered for the EGC ESP Facility, the normal discharge flow is estimated to be 12,000 gpm, which is about 2 percent of the summer discharge flow rate from the CPS (Table 5.2-4). The incoming cooling water temperature for the EGC ESP Facility is expected to vary seasonally and be similar to the intake temperatures for the CPS.

5.3.3.1 Heat Dissipation to the Atmosphere

The operation of the EGC ESP Facility will result in significant heat dissipation to the atmosphere. Depending on the type of cooling system(s) that will be used to dissipate heat from the facility, the rejected heat will be manifested in the form of thermal and/or vapor plumes from one or more locations at the site. For wet cooling processes, resulting water vapor plumes will have the potential to result in a variety of physical or aesthetic impacts. The extent of these impacts will depend primarily on the prevailing meteorological conditions, the type of cooling tower selected (mechanical or natural draft), cooling water quality, and plant load. For dry cooling processes, dry thermal plumes are not normally expected to result in significant environmental or other impacts.

The scope of this evaluation includes a qualitative assessment of potential impacts attributable to wet cooling processes, specifically mechanical and natural draft cooling towers. The ambient impacts that are expected to be of most concern as a result of the use of these wet cooling systems include the following:

- Length and frequency of occurrence of visible plumes;
- Frequency of occurrence and spatial extent of ground level fogging and icing in the immediate vicinity of the cooling towers;
- Solids deposition (i.e., cooling tower drift droplet deposition);
- Cloud formation, cloud shadowing, and additional precipitation attributable to vapor formation downwind of wet cooling towers; and
- Interaction of the vapor plume with existing pollution sources in the area including the potential for wet deposition effects.

Wet cooling systems that utilize mechanical or natural draft cooling towers use evaporative cooling to transfer heat from the process to the atmosphere. Within a wet cooling tower, hot process water is sprayed in at the top of the tower and cooled by evaporation. Large amounts of water can be lost by evaporation. Depending on the meteorological conditions, this evaporated water vapor can produce visible plumes of varying densities and lengths.

Dry cooling systems transfer heat to the atmosphere by pumping hot process water through a large heat exchanger or radiator, over which ambient air is passed to transfer heat from the process water to the air. This is a closed non-contact process, thus, no water is lost to evaporation, and there is no visible plume. The temperature of the ambient air passing through the system is increased during the cooling process, and the warm air rises naturally and dissipates into the local atmosphere, typically with no visible effects. Dry cooling is less efficient than wet cooling; therefore, dry cooling systems tend to be much larger and more costly than wet cooling systems.

Hybrid wet/dry cooling systems are a combination of the wet and dry cooling methods. The amount of visible vapor that will result from a wet/dry cooling process will necessarily depend on the proportional mix of wet and dry cooling, as well as the meteorological conditions present at the time of operation.

Table 5.3-5 provides a qualitative assessment of the nature and extent of water vapor plumes that can be expected to occur as a result of the operation of the EGC ESP Facility, depending on the type of cooling system that is ultimately selected for use at the facility.

A quantitative assessment of the potential impact of heat dissipation to the atmosphere requires the use of mathematical and/or empirical models to simulate a cooling tower operation under a variety of meteorological conditions. Models are available that will predict the frequency of occurrence of visible plumes, fogging, icing, and drift droplet deposition as a result of the wet cooling tower operation. The EGC ESP Facility will be located on property that is owned by CPS, and the distances to the CPS property boundaries are relatively large and necessarily restricted from public access. The most significant impacts attributable to the operation of the cooling towers are expected to be limited primarily to on-site locations because of the proximity of the EGC ESP Site to the property boundaries. The nearest public roadway is more than 0.5 mi in any direction. Additionally, there is no agricultural or public land use in the immediate vicinity of the EGC ESP Site; thus, deposition effects are not expected to be a significant concern. In terms of potential interaction with conventional fossil fueled emission sources, the proposed facility will only install standby and auxiliary power systems that will be used for emergency and backup purposes. As such, their use will be very limited and, for the most part, only during periods when the EGC ESP Facility is not operational. Occasionally, during cold weather conditions, moisture plumes from the cooling towers may be visible from some off-site locations, depending on wind direction and other meteorological parameters.

The impacts attributable to the operation of the EGC ESP heat dissipation system are expected to be primarily aesthetic in nature, namely visible plumes that may be evident from on-site and some off-site locations depending on the time of day, the prevailing meteorological conditions, and the direction/orientation of the observer with regard to the ESP site. These and other impacts such as fogging, icing, and drift droplet deposition are not expected to be of significant concern at off-site locations, nor will they be inconsistent with the current heat dissipation system impacts that are attributable to the existing CPS facility, which is located adjacent to and on the same property as the EGC ESP Site.

5.3.3.2 Terrestrial Ecosystem

Impacts resulting from the proposed heat dissipation system would be consistent, if not less significant, in comparison to the CPS. As noted in the preceding sections, potential impacts to terrestrial and aquatic ecosystems were monitored for a 5-yr period following the startup of the CPS.

5.3.3.2.1 Impacts to Terrestrial Ecosystems

The following sections describe the anticipated impacts to the terrestrial environment and biota of the site and vicinity likely to be affected by operation of the proposed facility. Descriptions of existing terrestrial habitats including important habitats as defined by the USNRC, are presented in Section 2.4.

Impacts to terrestrial ecosystems associated with salt drift will be assessed once the facility's cooling system configuration and design parameters have been determined. This analysis will be conducted before or during a later licensing stage.

5.3.3.3 Impacts to Important Terrestrial Species and Habitats

5.3.3.3.1 Important Species

As previously discussed, "important species" are defined, by the USNRC, as state- or federally-listed (or proposed for listing) threatened or endangered species; commercially or recreationally valuable species; species that are essential to the maintenance and survival of species that are rare and commercially or recreationally valuable; species that are critical to the structure and function of the local terrestrial ecosystem; and/or species that may serve as biological indicators to monitor the effects of the facilities on the terrestrial environment (USNRC, 1999).

5.3.3.3.1.1 Federally-Listed Threatened and Endangered Species

Based on preliminary database reviews, operation of the proposed facility is not anticipated to adversely affect federally-listed threatened or endangered species at the site or within the site vicinity (IDNR, 2002). Federal wildlife agencies including the USFWS and National Marine Fisheries Service will be contacted at a date closer to the station construction in order to confirm the absence of federally-listed threatened and endangered species, since confirmation letters are valid for only one year after issuance.

5.3.3.3.1.2 State-Listed Threatened and Endangered Species

Based on preliminary database reviews, operation of the proposed facility is not anticipated to adversely affect state-listed threatened or endangered species at the site or in the site vicinity. According to data provided by the IDNR, no state-listed threatened or endangered terrestrial wildlife species have been documented within the site or site vicinity (IDNR, 2002). However, as discussed in Section 2.4, based on other sources, several state-listed threatened and endangered birds have been observed in the vicinity of Clinton Lake.

Some mortality of birds is expected that result from collisions with the cooling towers. However, impacts to state-listed threatened and endangered species populations are not anticipated.

State wildlife agencies will be contacted at a date closer to the station construction in order to confirm the absence of state-listed threatened and endangered species, since confirmation letters are valid for only two years after issuance.

5.3.3.3.1.3 Species of Commercial or Recreational Value

Several species of commercial or recreational value were identified in Section 2.4. These species include white-tailed deer, various species of waterfowl, and various species of small mammals.

No direct adverse impacts to species of commercial or recreational value are anticipated as a result of the implementation of the proposed project. It is assumed that any impacts on species of commercial or recreational value, resulting from the EGC ESP Facility would be consistent with or less significant than those impacts associated with the existing facility.

5.3.3.3.2 Important Habitats

According to the USNRC, "important habitats" include any wildlife sanctuaries, refuges, or preserves; habitats identified by state or federal agencies as unique, rare, or of priority for protection; wetlands and floodplains; and land areas identified as critical habitat for species listed as threatened or endangered by the USFWS (USNRC, 1999).

5.3.3.3.2.1 Clinton Lake State Recreation Area

It is not anticipated that the proposed heat dissipation system will have any adverse impacts on the terrestrial environment within the Clinton Lake State Recreation Area. The proposed system will not inhibit access to or use of the terrestrial system surrounding Clinton Lake.

Activities such as hunting, fishing, hiking, and other recreational activities that rely on the terrestrial environments of the Clinton Lake State Recreation Area are not anticipated to be impacted by operation of the proposed facility.

5.3.3.3.2.2 Weldon Springs State Recreation Area

Weldon Springs State Recreation Area is located approximately 6 mi from the location of the proposed facility. Due to the location of this area, no direct impacts to this recreation area are anticipated as a result of operation of the proposed facility.

5.3.3.3.2.3 Environmentally Sensitive Areas (Illinois Natural Area Inventory Sites)

The State of Illinois designates certain environmentally sensitive areas as Illinois Natural Areas. These areas are protected to varying degrees, under the jurisdiction of the Illinois Nature Preserves Commission. There are two environmentally sensitive areas located within 6 mi of the site. Descriptions of these areas are presented in Section 2.4.

Due to the location of these areas, operation of the proposed facility is not anticipated to adversely affect any environmentally sensitive areas within the site vicinity.

5.3.3.3.2.4 Wetlands and Floodplains

As previously discussed, the location for the proposed facility is at the site of an existing power plant, which is comprised of impervious surfaces, crushed stone, existing structures, and other facilities necessary for the operation and maintenance of the facility, in addition to small amounts of open fields.

As previously discussed, four small (less than 1 ac) wetlands are located within the site boundaries; however, these wetland areas are not anticipated to be adversely impacted as a result of the operation of the proposed cooling system.

Any aquatic vegetation existing prior to the operation of the proposed facility will likely adapt to the new conditions resulting from the additional station.

5.3.3.4 Ultimate Heat Sink

An UHS is required to provide a secure source of cooling water for a safe plant shut down. In the event that the main impounding structure of Clinton Lake is breached, the UHS for the CPS is provided in a submerged impoundment within Clinton Lake. There is a primary impounding structure for the main lake and secondary impounding structure within the main lake that makes up the UHS. This secondary structure extends across the north basin of Clinton Lake or the streambed of the now submerged North Fork of Salt Creek. This secondary structure has an overflow elevation of 675.0 ft, 15-ft below the overflow elevation

of the primary structure of 690.0 ft. The volume (see Figure 5.3-2) of the UHS is 1,022 ac-ft, a small portion of the total Clinton Lake volume of 74,200 ac-ft.

The UHS for the CPS was designed to accommodate safe plant shutdown cooling for two 992-MW BWR units. The UHS is designed to provide cooling and to safely bring two units to a cold shutdown, assuming heat loads for loss-of-coolant accident (LOCA) for one unit and a shutdown of the second unit with a loss of off-site power (LOOP) for two 992-MW plants. This UHS requirement is considered the worst case combination for two units. The minimum UHS volume to accommodate these criteria is 849 ac-ft.

The design of existing UHS was examined to evaluate if it can adequately supply emergency shutdown cooling water to both the CPS and the UHS cooling tower makeup water for the EGC ESP Facility. The analysis is based on data available on the existing UHS and previous modeling conducted for Illinois Power Company. The results of the analysis indicated the previous modeling is sufficient to evaluate the adequacy of the UHS as a supply for emergency shutdown cooling water and no additional modeling or associated analysis are necessary.

Based on the information reviewed, the UHS at a current 1,022 ac-ft, has the volumetric and heat load capacity for the 30-day shut down of the CPS and proposed EGC ESP Facility. The actual required UHS capacity for the CPS is 849 ac-ft for LOOP and LOCA failure scenarios. The required capacity for makeup cooling water for the EGC ESP Facility, under LOOP or LOCA failure scenarios, is 87 ac-ft. The worst case volume necessary to accommodate the emergency shutdown requirements of the two stations combined is 936 ac-ft. This leaves about 86 ac-ft of excess storage capacity. With an estimated annual sedimentation rate of 5 ac-ft per year, the UHS will require dredging in approximately 17 yrs. Without addition of the proposed EGC ESP Facility, dredging would be required in 34 yrs.

The volume of the UHS is measured annually to track the progress of sedimentation. These annual measurements will be continued to confirm the available volume of the impoundment.

5.3.4 Impact to Members of the Public

Impacts to members of the public from the cooling system of the proposed EGC ESP Facility might include:

- Thermophilic organisms that could negatively impact human health;
- Thermal and/or vapor plumes; and/or
- Potential for increases in ambient noise levels from the operation of the EGC ESP Facility cooling system and towers.

5.3.4.1 Thermophilic Organisms

Thermophilic organisms are microorganisms that are associated with cooling towers and thermal discharges that have a negative impact on human health. The presence and numbers of these organisms can increase due to elevated temperatures in and around the cooling tower and discharge flume (CPS, 2001). The NPDES permit for the CPS allows a 90-

day average maximum discharge temperature of 99ºF and maximum daily allowable temperature not to exceed 110.7ºF.

Thermophilic organisms may include, but are not limited to, enteric pathogens such as *Salmonella sp., Shigella sp., Pseudomonas aeriginosa,* and *thermophilic fungi.* They also include the bacteria *Legionella sp.* and free-living amoeba of the genera *Naegleria fowleri* and *Acanthomoeba*. Exposure to these microorganisms, or in some cases the endotoxins or exotoxins produced by the organism, may cause illness and death (USNRC, 1999).

Recent IDNR studies on Clinton Lake indicate that these elevated water temperatures may be increasing the risk of the presence of pathogenic amoeba (*Naegleria fowleri*) in the thermal discharge zone and at the beach. Although the IDNR has expressed concern about the presence of *Naegleria fowleri* in Clinton Lake, they also have concluded that the risk to human health is very small and decided to allow swimming and water-skiing in the lake (CPS, 2001). The increase in heat rejected to the lake due to the uprate would be greater than the increase due to the EGC ESP Facility; therefore, the EGC ESP Facility logically would not increase the risk significantly. Additionally, the EGC ESP Facility thermal discharges will comply with the approved CPS NPDES permit, and therefore, operations will not increase the risk of the presence of *Naegleria fowleri* in Clinton Lake.

5.3.4.2 Cooling Tower Thermal and/or Vapor Plumes

As discussed in Section 5.3.3.1, the operation of the EGC ESP Facility will result in significant heat dissipation to the atmosphere. Depending on the type of cooling system(s) used to dissipate this heat, the rejected heat will be manifested in the form of thermal and/or vapor plumes on and around the site.

Quantification of these ambient impacts will necessarily require a more in depth assessment once the facility's cooling system configuration and design parameters have been determined. This analysis will be conducted at or before a later licensing stage.

5.3.4.3 Noise Impacts

There are basically two types of cooling systems that are being considered for use in the EGC ESP Facility and are described below.

- Wet cooling systems utilize mechanical or natural draft cooling towers for evaporative cooling to transfer heat from closed loop process water systems to the atmosphere.
- Hybrid wet/dry cooling systems are a combination of the wet and dry cooling methods.

According to the PPE data gathered, for both the natural draft cooling towers and the mechanical draft cooling towers, the anticipated noise levels from cooling tower operations is anticipated to be 55 dB at 1,000 ft. The Department of Housing and Urban Development uses a day-night average sound level recommended by the USEPA as guidelines or goals for ambient noise levels outdoors in residential areas. Noise levels are deemed acceptable if the day-night average sound level outside in a residential area is less than 65 dB (24 CFR 51). Based on anticipated noise levels being less than USEPA guidelines and Illinois noise requirements, no noise mitigation will be required.

5.4 Radiological Impacts of Normal Operations

The following section identifies and describes the environmental pathways and impacts by which radiation and radiological effluents can be transmitted to the living organisms in and around the EGC ESP Facility. The scope of this section encompasses the pathways by which gaseous and liquid radiological effluents can be transported to and expose individual receptors as well as biota. It also assesses exposure to operations to living organisms in and around the station from increased ambient background radiation levels from plant.

5.4.1 Exposure Pathways

A radiological exposure pathway is the vehicle by which a receptor may become exposed to radiological releases from nuclear facilities. The major pathways of concern are those that could cause the highest calculated radiological dose. These pathways are determined from the type and amount of radioactivity released, the environmental transport mechanism, and how the station environs are used (e.g., residence, gardens, etc.). The environmental transport mechanism includes the historical meteorological characteristics of the area that are defined by wind speed and wind direction. This information is used to evaluate how the radionuclides will be distributed within the surrounding area. The most important factor in evaluating the exposure pathway is the use of the environment by the residents in the area around the proposed EGC ESP Facility. Factors such as location of homes in the area, use of cattle for milk, and the growing of gardens for vegetable consumption are considerations when evaluating exposure pathways.

Routine radiological effluent releases from the EGC ESP Facility are a potential source of radiological exposure to man and biota. The potential exposure pathways include aquatic (liquid) and gaseous particulate effluents. The radioactive gaseous effluent exposure pathways include direct radiation, deposition on plants and soil, and inhalation by animals and humans. The radioactive liquid effluent exposure pathways include fish consumption and direct exposure from radionuclides that may be deposited in Clinton Lake. An additional exposure pathway is the direct radiation from the facility equipment and structure during normal operation of the EGC ESP Facility.

The description of the exposure pathways and the calculational methods utilized to estimate doses to the maximally exposed individual and to the population surrounding the EGC ESP Site are based on Regulatory Guides 1.109 and 1.111 (USNRC, 1977 and 1977a). The source terms used in estimating exposure pathway doses are based on the bounding values provided in Chapter 3.

5.4.1.1 Liquid Pathways

Small amounts of liquid radioactive effluents (below regulatory limits) may be mixed with the cooling water and discharged to Clinton Lake. It is expected that the EGC ESP Facility will be operated in a similar fashion to the CPS, which in nine years has not discharged any liquid radiological effluents to the environment. However, since the release of small amounts of radioactive liquid effluents is permitted at the CPS and is expected to be permitted at the EGC ESP Facility as long as releases comply with the requirements specified in 10 CFR 20, the following analyses are provided in order to bound the doses from liquid pathways.

The important exposure pathways include:

- Internal exposure from ingestion of water or contaminated food chain components;
- External exposure from the surface of contaminated water or from shoreline sediment; and
- External exposure from immersion in contaminated water.

Water from Clinton Lake is utilized for potable water at the CPS, and will be used at the EGC ESP Facility, but it will not be utilized in any way for public consumption.

Population dose estimates out past 50 mi will not be calculated based on the conclusions presented in the CPS ER (OLS), Section 5.2.1.2.2, where it is stated that the liquid pathway is not very significant for the 50-mi population dose estimate. There are no municipal or industrial water intakes within 50-mi downstream of the station. Commercial fishing is not allowed on Salt Creek, but is allowed on the Sangamon River. Per the CPS ER (OLS), Section 2.1.3.2.1, Salt Creek joins the Sangamon River 56-mi west of the station. Therefore, the only possible aquatic pathway is due to sport fishing on Clinton Lake and on Salt Creek. However, without detailed dilution and statistics on number of fish caught by sport fishermen, the calculation is not meaningful. In any case, this is not considered to be a significant contribution to the annual population dose within 50 mi, and is therefore, not included in the liquid effluent pathway (CPS, 1982).

The LADTAP II computer program, as described in NUREG/CR-4013, and the liquid pathway parameters presented in Table 5.4-1 and Table 5.4-2 were used to calculate the maximally exposed individual dose from this pathway (USNRC, 1986). This program implements the radiological exposure models described in Regulatory Guide 1.109, Revision 1, for radioactivity releases in liquid effluent (USNRC, 1977).

A discussion pertaining to doses calculated for liquid pathways is presented in Section 5.4.2.1.

5.4.1.2 Gaseous Pathways

The methodology contained in the GASPAR II program (described in NUREG/CR-4653) was used to determine the doses for gaseous pathways (USNRC, 1987). This program implements the radiological exposure models described in Regulatory Guide 1.109, Revision 1, for radioactivity releases in gaseous effluent. The code calculates the radiation exposure to man from:

- External exposure to airborne radioactivity;
- External exposure to deposited activity on the ground;
- Inhalation of airborne activity; and
- Ingestion of contaminated agricultural products.

Table 5.4-3 and Table 5.4-4 present the gaseous pathway parameters used by the code to calculate doses for both the maximally exposed individual and for the population. A

discussion pertaining to doses calculated for this gaseous pathways is presented in Section 5.4.2.2.

5.4.1.3 Direct Radiation from Station Operation

Contained sources of radiation at the EGC ESP Facility will be shielded as was done at the CPS. It is assumed that the direct radiation from any of the EGC ESP Facility designs remains bounded by the CPS direct and skyshine dose from the turbine building.

5.4.2 Radiation Doses to Members of the Public

The following discussion is based on the cumulative impacts from both active CPS and EGC ESP facility operations.

5.4.2.1 Liquid Pathways Doses

Maximum dose rate estimates to man due to liquid effluent releases were determined in the following ways:

- Eating fish or invertebrates caught near the point of discharge;
- Using the shoreline for activities, such as sunbathing or fishing; and
- Swimming and boating on Clinton Lake near the point of discharge.

The estimates for whole-body and critical organ doses from these interactions are presented in Table 5.4-5. These dose rates would only occur under conditions that maximize the resultant dose. It is unlikely that any individual would receive doses of the magnitude calculated.

5.4.2.2 Gaseous Pathways Doses

Dose rate estimates were calculated for hypothetical individuals of various ages exposed to gaseous radioactive effluents through the following pathways:

- Direct radiation from immersion in the gaseous effluent cloud and from particulates deposited on the ground;
- Inhalation of gases and particulates;
- Ingestion of milk contaminated through the grass-cow-milk pathway; and
- Ingestion of foods contaminated by gases and particulates.

Table 5.4-6 provides the estimated whole-body and critical organ doses for the identified gaseous effluent pathways.

5.4.3 Impacts to Members of the Public

5.4.3.1 Impacts from Liquid Pathways

The maximally exposed individual dose calculated was compared to 10 CFR 50, Appendix I criteria and is presented in Table 5.4-7. The maximally exposed individual dose calculated was also compared to 40 CFR 190 criteria and is presented in Table 5.4-8.

5.4.3.2 Impacts from Gaseous Pathways

The following section provides a comparison between the calculated maximally exposed individual dose and 10 CFR 50, Appendix I criteria (see Table 5.4-9). In addition, the maximally exposed individual dose calculated was also compared to 40 CFR 190 criteria (see Table 5.4-10).

The population dose due to gaseous effluents to individuals living within a 50-mi radius of the EGC ESP Facility was also calculated. For these doses, the population data were projected to the year 2010. The population dose for the various pathways (immersion, inhalation, ingestion, and ground deposition) is provided in Table 5.4-11.

5.4.3.3 Direct Radiation Doses from the EGC ESP Facility

It is assumed that the direct radiation from any of the EGC ESP Facility designs remains bounded by the CPS direct and skyshine dose from the turbine building provided in the CPS ER (see Table 5.2-10). The data are reproduced in Table 5.4-12.

Population doses resulting from natural background radiation to individuals living within a 50-mi radius of the EGC ESP Facility is presented in Table 5.4-13 for comparison.

5.4.4 Impacts to Biota Other than Members of the Public

Radiation exposure pathways to biota other than man or members of the public are examined to determine if the pathways could result in doses to biota greater than those predicted for man. This assessment uses surrogate species that provide representative information on the various dose pathways potentially affecting broader classes of living organisms. Surrogates are used since important attributes are well defined and are accepted as a method for judging doses to biota.

Important biota considered are state-or federally-listed species that are endangered, threatened, commercial, recreationally valuable, or important to the local ecosystem. Table 5.4-14 identifies important biota from Section 2.4 and the assigned surrogates in this assessment. Surrogate biota used includes algae (also taken as aquatic plants), invertebrates (taken as fresh water mollusks and crayfish), fish, muskrat, raccoon, duck, and heron.

This assessment uses dose pathway models adopted from Regulatory Guide 1.109 (USNRC, 1977). Pathways included are:

- Ingestion of aquatic foods including fish, invertebrates, and aquatic plants;
- Ingestion of water;
- External exposure water immersion or surface effect;
- External exposure to shoreline residence;
- Inhalation of airborne nuclides;
- External exposure to immersion in gaseous effluent plumes; and
- Surface exposure from deposition of iodine and particulates from gaseous effluents.

Internal exposures to biota from the accumulation of radionuclides from aquatic food pathways are determined using element-dependent bioaccumulation factors. The terrestrial doses are calculated as total body doses resulting from the consumption of aquatic plants, fish, and invertebrates. The terrestrial doses are the result of the amount of food ingested, and the previous uptake of radioisotopes by the "living" food organism. The total body doses are calculated using the bioaccumulation factors corresponding to the "living" food organisms and dose conversion factors for adult man modified for terrestrial animal body mass and size. The use of the adult factors is conservative since the full 50-yr dose commitment predicted by the adult ingestion factors would not be received by biota due to their shorter life spans. These models show that the largest contributions to biota doses are from liquid effluents via the food pathway.

5.4.4.1 Liquid Effluents

The concentrations of radioactive effluents in Clinton Lake are estimated using a partially mixed impoundment model (USNRC, 1978). The impoundment (Clinton Lake) receives plant effluents and allows additional time for radiological decay before release of effluents to the receiving water body. Dilution of the impoundment occurs due to flow from Salt Creek. Mixing occurs due to drawing water from the impoundment for discharge of the plant's liquid effluents. The model used for estimating nuclide concentrations is similar to that used in the analysis for doses to man described in Section 5.4.2. Table 5.4-1 summarizes parameters used in the calculation of nuclide concentrations in the lake.

The calculation of biota doses in nontidal rivers and near lakeshore environments was performed using LADTAP II (USNRC, 1986). Doses to biota are estimated at Clinton Lake (within the impoundment), and no credit is taken for dilution or transit time from the outflow. Downstream of the Clinton Lake Dam, additional credit for dilution and radio decay occur, resulting in lower nuclide concentrations and doses to biota. This assessment, however, is made for the higher doses occurring in or near Clinton Lake.

Food consumption, body mass, and effective body radii used in the dose calculations are shown in Table 5.4-15. Residence times for the surrogate species are shown in Table 5.4-16 (USNRC, 1986). Table 5.4-17 summarizes parameters used in the pathways dose models. Surrogate biota doses from liquid effluents are shown in Table 5.4-18.

5.4.4.2 Gaseous Effluents

Doses from gaseous effluents also contribute to terrestrial total body doses. External doses occur due to immersion in a plume of noble gases and deposition of radionuclides on the ground. The inhalation of radionuclides followed by the subsequent transfer from the lung to the rest of the body also contributes to total body doses. Inhaled noble gases are poorly absorbed into the blood and do not contribute significantly to the total body dose. The noble gases do contribute to a lung organ dose, but do not make a contribution via this path to the total body dose.

Immersion and ground deposition doses are largely independent of organism size and the doses for the maximally exposed individual, described in Section 5.4.2, can be applied. The external ground doses, described in Section 5.4.2, and calculated by GASPAR II are increased to account for the closer proximity to ground of terrestrials (USNRC, 1987). This approach is similar to the adjustments made for biota exposures to shoreline sediment

performed in LADTAP II. Doses from gaseous effluents to terrestrials are also adjusted for site residency times and are based on Table 5.4-16. The inhalation pathway doses for biota are the internal total body doses calculated by GASPAR II for man, as described in Section 5.4.2. The total body inhalation dose (rather than organ specific doses) is used since the biota doses are assessed on a total body basis. Table 5.4-17 summarizes some of the parameters used in the gaseous effluent dose models.

5.4.4.3 Biota Doses

The following discussion is based on the cumulative impacts from both active CPS and EGC ESP facility operations. Doses to biota from liquid and gaseous effluents are shown in Table 5.4-18. Table 5.4-19 shows those doses meeting the whole body dose equivalent criterion in 40 CFR 190. Dose criteria are applicable to man and are considered conservative when applied to biota. The criteria in 40 CFR 190 for thyroid and next highest organ doses are not used in this analysis since doses are based on total body doses. The total body dose is taken as the sum of the internal and external dose. In man, the internal dose from individual organs is weighted by factors less than unity to arrive at the whole body dose equivalent. Thus, a unity factor is assumed for the entire internal dose. Table 5.4-19 shows that annual doses to five of the seven surrogates can meet the requirements of 40 CFR 190.

Use of exposure guidelines, such as 40 CFR 190, which apply to members of the public in unrestricted areas, is considered very conservative when evaluating calculated doses to biota. The International Council on Radiation Protection states that "...if man is adequately protected then other living things are also likely to be sufficiently protected," and uses human protection to infer environmental protection from the effects of ionizing radiation (ICRP, 1977 and ICRP, 1991). This assumption is appropriate in cases where humans and other biota inhabit the same environment and have common routes of exposure. It is less appropriate in cases where human access is restricted or pathways exist that are much more important for biota than for humans. Conversely, it is also known that biota with the same environment and exposure pathways as man can experience higher doses without adverse effects.

Species in most ecosystems experience dramatically higher mortality rates from natural causes than man. From an ecological viewpoint, population stability is considered more important to the survival of the species than the survival of individual organisms. Thus, higher dose limits could be permitted. In addition, no biota have been discovered that show significant changes in morbidity or mortality to radiation exposures predicted for nuclear power plants.

An international consensus has been developing with respect to permissible dose exposures to biota. The International Atomic Energy Agency (IAEA, 1992) evaluated available evidence including the *Recommendations of the International Commission on Radiological Protection* (ICRP, 1977). The IAEA found that appreciable effects in aquatic populations would not be expected at doses lower than 1 unit of absorbed dose (100 ergs/gm) per day (rad/day) and that limiting the dose to the maximally exposed individual organisms to less than 1 rad/day would provide adequate protection of the population. The IAEA also concluded that chronic dose rates of 0.1 rad/day or less do not appear to cause observable changes in terrestrial animal populations. The assumed lower threshold occurs for terrestrials rather than for aquatic animals primarily because some species of mammals and

reptiles are considered more radiosensitive than aquatic organisms. The permissible dose rates are considered screening levels and higher species-specific dose rates could be acceptable with additional study or data.

The calculated total body doses for biota are compared in Table 5.4-20 to the dose criteria evaluated in the *Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards* (IAEA, 1992). The biota doses meet the dose guidelines by a large margin. In these cases, the annual dose to biota is much less than the daily allowable doses to aquatic and terrestrial organisms.

5.5 Environmental Impacts of Waste

Presented in the following sections is a generic discussion regarding the environmental impacts of waste, nonradioactive and mixed waste (a matrix of low-level radioactive and hazardous waste), as they pertain to the EGC ESP Facility operation. Regulations for generating, management, handling, storage, treatment, protection requirements and disposal of these types of waste are contained in 10 CFR series managed by the USNRC and the 40 CFR series managed by the USEPA.

5.5.1 Nonradioactive Waste-System Impacts

This section describes the nonradioactive waste management systems and associated impacts from the generation of nonradioactive and non-hazardous solid, liquid, and gaseous waste from EGC ESP Facility operations. A more detailed description of these nonradioactive waste management and effluent systems is provided in Chapter 3.

5.5.1.1 Nonradioactive Solid Waste

Solid nonradioactive and non-hazardous waste may include office waste, aluminum cans, laboratory waste, glass, metals, paper, etc., and will be collected from several on-site locations and deposited in dumpsters located throughout the site. Segregation and recycling of waste will be practiced to the greatest extent practical. The material will either be disposed of on site or the Applicant will contract with an outside vendor who will perform weekly collections and disposal at area landfills. If collected and disposed of off site, it is not expected that the amount of solid waste generated will significantly contribute to the total amount of household waste disposed of weekly by area residents.

5.5.1.2 Nonradioactive Liquid Effluents

Nonradioactive liquid wastes from the site may include, but are not limited to, boiler blowdown (continual or periodic purging of impurities from auxiliary boilers), water treatment wastes, floor and equipment drains, sanitary sewer systems, and stormwater runoff.

5.5.1.2.1 Liquid Effluents Containing Biocides or Chemicals

The chemical waste effluents may consist of the nonradioactive wastes produced from the regeneration of demineralizers and blowdown; waste discharges from reverse osmosis units and filter backwash water; and wastes from laboratory and sampling processes. Drains from radioactive sources or potentially radioactive sources will not be connected to the chemical waste drain system. Chemical waste discharges will be collected in a tank for sampling and pH adjustment before being discharged as neutralized wastes to Clinton Lake. The chemical wastes will be routed to the discharge flume of the CPS, which flows to Clinton Lake.

Based on the evaluation of PPE bounding data (see SSAR Tables 1.4-1 and 1.4-2), a generic list of principal chemical, biocide, and pollutant sources that may be used or produced during the operation of the EGC ESP Facility may include, but are not limited to, the following:

- Sodium hydroxide and sulfuric acid, which are used to regenerate resins (depending on plant design);
- Phosphate in cleaning solutions;
- Biocides used for condenser defouling;
- Boiler blowdown chemicals;
- Oil and grease from plant floor drains;
- Chloride;
- Sulphates;
- Copper;
- Iron; and
- Zinc.

The estimated concentration of impurities in the blowdown water is presented in Chapter 3. The total amount of anticipated discharges from the chemical waste and demineralizer treatment system to Clinton Lake is also presented in Chapter 3.

Other small volumes of wastewater, which may be released from other station sources, are described in the SSAR for the EGC ESP Facility. These will be discharged from sources such as the service water and auxiliary cooling systems, water treatment, laboratory and sampling wastes, floor drains, and stormwater runoff. These waste streams will be discharged as separate point sources or will be combined with the cooling water discharges.

It is expected that chemical treatment of the safety-related cooling water system with biocides, dispersants, molluskicides, and scale inhibitors will be required on a periodic basis. The chemicals used will be subject to review and approval for use by the IEPA, and releases will comply with an approved NPDES permit. The total residual chemical concentrations in the discharges to Clinton Lake will be subject to limits that will be established by the IEPA. These limits will be protective of the water quality of Clinton Lake.

5.5.1.2.2 Sanitary System Effluents

Sanitary system wastes that are anticipated to be discharged to Clinton Lake during actual station operations include discharges from the potable and sanitary water treatment system. It is anticipated that the sanitary system effluents will receive tertiary treatment consisting of presettling, filtration, and chlorination prior to release to the environment via the circulating water discharge flume. The normal and maximum amount of sanitary discharges to Clinton Lake based on PPE data for the composite reactor (see SSAR Table 1.4-1) is presented in Chapter 3. These discharges will comply with the approved NPDES permit for the EGC ESP Facility.

5.5.1.2.3 Other Effluents

Other small volumes of wastewater will be discharged from additional sources, such as the service water and auxiliary cooling systems, water treatment, laboratory and sampling

wastes, floor drains, and stormwater runoff. Some of these waste streams will be discharged as separate point sources or will be combined with the cooling water and discharged to Clinton Lake. The normal and maximum amount of miscellaneous discharges to Clinton Lake based on PPE data (see SSAR Table 1.4-1) is presented in Chapter 3.

Facility stormwater drainage control systems will be presented at the COL phase to the appropriate permitting agency.

A Storm Water Pollution Prevention Plan (SWPPP) will be written, if deemed appropriate, that will meet the requirements of a permit for stormwater discharges from the EGC ESP Facility. The plan will include aspects of stormwater pollution prevention common to areas of the EGC ESP Facility that have a potential to discharge stormwater to waters of the U.S. The aspects common to activities will include site description and assessment, erosion and sediment control, stormwater management, identification and control of potential sources of pollution, implementation, maintenance, inspection, and stabilization.

Stormwater discharges are a significant source of pollutants and a major cause of water use impairment in receiving streams. Stormwater runoff becomes polluted as it flows over surfaces picking up soil particles and other pollutants. The USEPA's goal of stormwater management is to improve water quality by reducing pollutants in stormwater discharges.

A SWPPP primary purpose is to prevent discharges from facilities that cause, or have reasonable potential to cause or contribute to, violations of water quality standards. The USEPA determined the best approach to stormwater management for facilities is through self-designed stormwater pollution prevention plans based on the use of control measures. There are three types of control measures: those that prevent erosion, those that trap pollutants before they can be discharged, and those that prevent contact between pollutants and stormwater runoff. The plans are designed to prevent or minimize the pollution of stormwater before it has a chance to affect receiving streams. Erosion and sedimentation controls for preconstruction and construction activities are discussed in Section 4.6.

5.5.1.2.4 Mitigation

The nonradioactive liquid wastes will be checked for proper pH and the presence of radiological and hazardous constituents, discharged as a separate point source or combined with plant circulating water prior to discharge to Clinton Lake. These discharges comply with the approved NPDES permit for the EGC ESP Facility issued by the IEPA.

5.5.1.3 Gaseous Effluents

Bounding estimates for gas releases are provided in Chapter 3.

Air emissions will be in compliance with the limits that will be established and imposed by state and local regulations. These limits will be protective of the air quality in and around the EGC ESP Facility.

5.5.2 Mixed Waste Impacts

In regulatory parlance, the term "mixed waste" refers specifically to waste that is regulated as both radioactive and hazardous waste. Mixed wastes are dually regulated for their radioactive materials and hazardous waste constituents. The radioactive materials are

regulated by the USNRC or an Agreement State (states that have entered into an Agreement with the USNRC to regulate facilities, other than Federal facilities and nuclear power plants) under the AEA; and the hazardous wastes are regulated by the USEPA or an Authorized State (a state authorized by the USEPA to regulate those portions of the Federal act) under the Resource Conservation and Recovery Act (RCRA).

Most low-level mixed wastes consist of low-level radioactive wastes combined with hazardous materials in the same matrix. It exists throughout the commercial, industrial, and government sectors. Mixed waste falls into two basic waste forms, liquids and solids.

The hazardous component of mixed waste presents the major regulatory treatment challenge in meeting the USEPA regulations for land disposal. The radioactive component of mixed waste, while posing a challenge from a health, safety, and environmental protection standpoint, is usually not the controlling factor for treatment.

These tend to be difficult waste streams to manage and facilities with the proper technology and permits are not ubiquitous; thus, the technology required to process the waste is the most influential factor in deciding where the waste will be sent for treatment, storage, and disposal. Transportation costs are a minimal factor when selecting treatment options.

As a general practice, EGC ESP Facility personnel will strive not to generate mixed waste at the EGC ESP Facility. It is expected that with the implementation of proper chemical handling techniques, prejob planning, and compliance with an approved facility waste minimization plan, only small quantities of mixed waste will be generated. It is almost impossible to project the types and quantities of mixed waste that may be generated without knowing specific design details about the plant. However, if mixed waste is generated, the volume may be reduced or eliminated by one or more of the following basic types of treatment prior to disposal: decay, stabilization, neutralization, filtration, and chemical or thermal destruction by an off-site vendor. If required, programs will be implemented and mixed waste storage facilities constructed to store mixed waste for decay or for storage prior to shipment to an approved off-site treatment or disposal area. It is not the Applicant's intention to dispose of mixed waste on site.

There will be no environmental impacts from storage or shipment activities if both activities are performed in compliance with approved facility procedures, storage requirements, and regulatory requirements. In the event of a spill, emergency procedures will be implemented to limit any on-site impacts. Emergency response personnel will be properly trained and will be routinely provided with a facility inventory, which will include types, volumes, locations, hazards, control measures, and precautionary measures to be taken in the event of a spill.

If generated on site, mixed waste will be assessed based on the following regulatory guidance. Mixed waste (low level radioactive and hazardous waste) is waste that satisfies the definition of low level radioactive waste in the Low-Level Radioactive Waste Policy Amendments Act of 1985 (LLRWPAA) and contains hazardous waste that either: 1) is listed as a hazardous waste in 40 CFR 261(d); or 2) causes the waste to exhibit any of the hazardous waste characteristics identified in 40 CFR 261(c). Persons who generate, treat, store, or dispose of mixed wastes are subject to the requirements of the AEA, as amended, the Solid Waste Disposal Act (SWDA) as amended by the RCRA, and the Hazardous and

Solid Waste Amendments of 1984 (HSWA). The federal agencies responsible for ensuring compliance with the implementing regulations of these two statutes are the USNRC and the IEPA. In October of 1992, Congress enacted the Federal Facilities Compliance Act (FFCA), which, among other things, added a definition of mixed waste to RCRA. Mixed waste is defined in the FFCA as "waste that contains both hazardous waste and source, special nuclear, or byproduct material subject to the Atomic Energy Act of 1954."

Since there is presently no information available regarding the generation of mixed waste during operations of the proposed composite reactor, information was obtained from a preliminary survey performed for the USNRC. It identified two potential types of generated mixed low-level waste (LLW) at reactor facilities:

- LLW containing organic liquids, such as scintillation liquids and vials; organic lab liquids; sludges; and cleaning, degreasing, and miscellaneous solvents.
- LLW containing heavy metals, such as discarded lead shielding, discarded lined containers, and lead oxide dross containing uranium oxide; light-water reactor (LWR) process wastes containing chromate and LWR decontamination resins containing chromium; and mercury amalgam in trash.

Mixed waste is sometimes generated during routine maintenance activities, refueling outages, health physics activities, and radiochemical laboratory activities. The vast majority of mixed waste that is stored at nuclear power plants is chlorinated fluorocarbons (CFCs) and waste oil. Other sources may include liquid scintillation fluids, and other types of organic materials including lead, chromium, and aqueous corrosives (USNRC, 1999).

Mixed waste is commonly stored on site due to the lack of treatment and disposal sites. For this reason, impacts resulting from the chemical hazards and occupational exposures to radiological material may be somewhat higher than would otherwise be expected. In addition, occupational chemical and radiological exposures may occur during the testing of mixed wastes in order to determine if the constituents are chemically hazardous.

The EGC ESP Facility personnel will place primary importance on source reduction efforts to prevent pollution, and eliminate or reduce the generation of mixed waste. Potential pollutants and wastes that cannot be eliminated or minimized will be evaluated for recycling. Treatment to reduce the quantity, toxicity, or mobility of the mixed waste before storage or disposal will be considered only when prevention or recycling is not possible or practical. Environmentally safe disposal will be the last option (USNRC, 1999).

A Pollution Prevention and Waste Minimization Program (PPWMP) will be developed, if deemed appropriate, and implemented before initial reactor operations. Elements of a successful program are described in the following sections.

5.5.2.1 Pollution Prevention and Waste Minimization Program

5.5.2.1.1 Inventory Management

Inventory management or control techniques will be used to reduce the possibility of generating mixed waste resulting from excess or out-of-date chemicals and hazardous substances. Where necessary, techniques will be implemented to reduce inventory size of

hazardous chemicals, size of containers, and amount of chemicals, while increasing inventory turnover.

A chemical management system, if required, will be established, prior to initial operation, and acquisition of new chemical supplies will be documented in a controlled process that addresses, as appropriate, the following:

- Need for the chemical;
- Availability of non-hazardous or less hazardous substitutes or alternatives; and
- Amount of chemical required and the on-site inventory of the chemical.

Excess chemicals will be managed in accordance with the station's chemical management procedures. Excess chemicals that are deemed usable will be handled through an excess chemical program. Material control operations will be revised or expanded to reduce raw material and finished product loss, waste material, and damage during handling, production, and storage. The inventory management procedures will be periodically assessed and updated, as appropriate, using criteria that include the following considerations:

- If existing inventory management techniques are in accordance with existing pollution prevention and waste minimization guidelines, and regulatory guidelines;
- How existing inventory management procedures can be applied more effectively;
- Whether new techniques will be added to or substituted for current procedures;
- If the review and evaluation approval procedures for the purchase of materials will be revised;
- If additional employee training in the principles of inventory management is needed;
- How specifications for the review and revision of procurement limit the purchase of environmentally sound products; and
- How to increase the purchase of recycled products.

5.5.2.1.2 Maintenance Program

Equipment maintenance programs will be periodically reviewed to determine whether improvements in corrective and preventive maintenance can reduce equipment failures that generate mixed waste. The methods for maintenance cost tracking and preventive maintenance scheduling and monitoring will be examined. Maintenance procedures will be reviewed in order to determine which are contributing to the production of waste in the form of process materials, scrap, and cleanup residue. In addition, the need for revising operational procedures, modifying equipment, and source segregation and recovery will be determined.

5.5.2.1.3 Recycling and Reuse

Recycling of the waste types will be considered. Opportunities for reclamation and reuse of waste materials will be explored whenever feasible. Decontamination of tools, equipment,

and materials for reuse or recycle will be used whenever possible to minimize the amount of waste for disposal. Impediments to recycling, whether regulatory or procedural, will be challenged to enable generators to recycle whenever possible.

5.5.2.1.4 Segregation

When radiological or hazardous waste is generated, proper handling, containerization, and separation techniques will be employed, as applicable. This will be done to minimize cross contamination resulting in the generation of unnecessary mixed waste.

5.5.2.1.5 Decay-In-Storage of Mixed Waste

Some portion of the generated mixed waste will, most probably, contain radionuclides with relatively short half-lives. The USNRC generally allows facilities to store waste containing radionuclides with half-lives of less than 65 days until 10 half-lives have elapsed and the radiation emitted from the unshielded surface of the waste, as measured with an appropriate survey instrument, is indistinguishable from background levels. The waste can then be disposed of as a nonradioactive waste. Radioactive waste can also be stored for decay under certain circumstances in accordance with 10 CFR 20. For mixed waste, storage for decay is particularly advantageous, since the waste can be managed solely as a hazardous waste after the radionuclides decay to background levels. Thus, the management and regulation of these mixed wastes are greatly simplified by the availability of storage for decay.

5.5.2.1.6 Work Planning

Prejob planning will be completed to determine what materials and equipment are needed to perform the anticipated work. One objective of this planning is to prevent pollution and minimize the amount of mixed waste that may be generated and to use only what is absolutely necessary to accomplish the work. Planning will also be completed to prevent mixing of materials or waste types.

5.5.2.1.7 Pollution Prevention Tracking Systems

A tracking system will be developed, if required, to identify waste generation data and PPWMP opportunities. This will provide essential feedback to successfully guide future efforts. The data collected by the system will be used for internal reporting. The tracking system will provide feedback on the progress of the PPWMP including the results of the implementation of pollution prevention technologies. In addition, it will facilitate reporting pollution prevention data and accomplishments to the USNRC and IEPA.

The system will track waste from point of generation to point of final disposition (cradle to grave). The system will also permit the tracking of hazardous substances from the point of site entry to the final disposition in order to comply with environmental regulations and reporting requirements. The system will collect data on input material, material usage, type of waste, volume, hazardous constituents, generating system, generation date, waste management costs, and other relevant information.

5.5.2.1.8 Implement Pollution Prevention and Waste Minimization Awareness Programs

A successful PPWMP requires employee commitment. By educating employees in the principles and benefits of a PPWMP, solutions to current and potential environmental management problems can be found. The broad objective of the PPWMP is to educate employees in the environmental aspects of activities occurring at the EGC ESP Facility, in their community, and in their homes. A PPWMP will be developed and implemented, as required, that incorporates the following:

- A waste minimization plan that will be routinely reviewed, revised, and implemented during the phases of the EGC ESP Facility construction and operation;
- Educate employees of general environmental activities and hazards at the EGC ESP Facility and pollution prevention program and waste minimization requirements, goals, and accomplishments;
- Inform employees of specific environmental issues;
- Train employees on their responsibilities in pollution prevention and waste minimization;
- Recognize employees for efforts to improve environmental conditions through pollution prevention and waste minimization; and
- Encourage employees to participate in pollution prevention and waste minimization.

5.5.2.1.9 Implement Environmentally Sound Pollution Prevention Procurement Practices

The EGC ESP Facility will implement procurement practices that comply with regulatory guidance, and other requirements for the purchase of products with recovered materials. This includes the elimination of the purchase of ozone depleting substances and the minimization of the purchase of hazardous substances.

5.5.2.1.10 Assure Consistent Policies, Orders, and Procedures

Policies and procedures will be developed, as applicable, to reflect a focus on integrating PPWMP objectives into EGC ESP Facility activities. The Environmental, Health, and Safety departments will review new procedures for EGC ESP Facility activities. The procedures will determine whether the elimination or revision of procedures can contribute to the reduction of waste (hazardous, radiological, or mixed). This will include incorporating PPWMP into the appropriate on-site work procedures. Changes to procurement procedures to require affirmative procurement of IEPA-designated recycled products, and reduction of procurement of ozone-depleting substances will also be completed.

5.5.2.2 Mixed Waste Impacts

5.5.2.2.1 Chemical Hazards Impacts

Generation and storage of mixed waste on site has the potential to expose workers to hazards associated with the chemical component of the mixed waste matrix from leaks and spills. Mixed waste can, and usually does, exhibit one of the following hazardous characteristics: ignitability, corrosivity, reactivity, or toxicity, as well as exhibiting the characteristics of a radiological hazard (i.e., contamination and radiation). Even though

personnel may be properly trained, handling and storage accidents do occur where acids are stored with bases and may become reactive during a spill. Thus, it potentially exposes workers and emergency response personnel during subsequent cleanup efforts both from the standpoint of the chemical hazard, but also based on the radiological hazards that may be present. Another example might include the improper storage of oxidizers (nitric acid, nitrates, peroxides, chlorates) and organics with inorganic reducing agents (metals).

The EGC ESP Facility Environmental Health and Safety management will implement and enforce the following guides if it is necessary to store mixed wastes on site:

- Use the area only for storage of mixed waste and not for storing unrelated materials or equipment, or for other functions;
- Follow proper storage protocols for different kinds of mixed waste;
- Label the containers properly and in accordance with regulatory requirements;
- Follow the container label requirements;
- Post applicable material safety data sheets, emergency spill response procedures, and have a spill kit in the area;
- Install fire detection and suppression equipment (if required), alternate water supply, telephone, and alarm at the area;
- Make an emergency shower/eyewash station immediately available, where it is tested weekly and functioning;
- Fence and lock the gate to the accumulation area or long-term storage area when authorized personnel are not present;
- Post “MIXED HAZARDOUS WASTE AREA” and “DANGER—UNAUTHORIZED PERSONNEL—KEEP OUT” signs at the entrance;
- Provide secondary containment for liquid mixed hazardous waste;
- Conduct weekly inspections; and
- Post “NO SMOKING OR OPEN FLAME” signs.

The EGC ESP Facility management will also develop and implement contingency plans, emergency preparedness, and prevention procedures that will be utilized in the event of a mixed waste spill. The EGC ESP Facility personnel who are designated to handle mixed waste or whose job function it is to provide emergency response to mixed waste spills will receive appropriate training in order to perform their work properly and safely.

If mixed waste is generated and shipped for treatment and disposal rather than stored, EGC ESP Facility management will identify potential disposal facilities considering the following selection criteria:

- The desired method of treatment or disposal (e.g., incineration vs. land disposal);

- The disposal facility's permit (e.g., can they accept polychlorinated biphenyls (PCBs), hazardous waste, or radioactive waste);
- The disposal facility's turnaround time on approvals;
- The form of waste, (e.g., is it soil, debris, semi-solid, or liquid);
- The mass or volume of waste; and
- The cost of transportation and disposal.

The EGC ESP Facility management will also identify one disposal facility as the primary facility, and a second facility will be identified as an alternate in the event that laboratory testing or other observations prove the waste to be different than initially determined.

5.5.2.2.2 Radiological Hazards Impacts

If mixed waste is generated, it must either be stored on site or shipped off site for treatment and subsequent disposal. Off-site shipment, treatment, and disposal will depend on the toxicity levels and radiological characteristics of the mixed waste. Personnel performing packaging and shipping operations have the potential to be exposed to increased ambient radiation levels from the containers and may exceed their yearly ALARA goals. If stored at the facility, the USEPA mandates that waste storage containers must be inspected on a weekly basis, and certain aboveground portions of waste storage tanks must be inspected on a daily basis. The purpose of these inspections is to detect leakage from, or deterioration of, containers (40 CFR 264). The USNRC recommends that waste in storage be inspected on at least a quarterly basis (10 CFR 20). The methods used for these inspections may include direct visual monitoring or the use of remote monitoring devices for detecting leakage or deterioration. The remote methods would reduce exposures due to direct visual inspections. Additionally, measures will be provided to promptly locate and segregate or remediate leaking containers.

5.6 Transmission Systems Impacts

This section describes the potential impacts on terrestrial and aquatic ecosystems induced by the operation and maintenance of transmission systems including operation and maintenance of applicable rights-of-way. The impacts described in this section were developed by the applicant. However, operation of transmission lines and corridors necessary to connect a new plant to the grid will generally be the responsibility of the transmission system operator, and the applicant assumes that the transmission system operator will perform new impact studies under FERC regulations.

Proposed transmission systems will be sited within existing Illinois Power Company rights-of-way to the greatest extent possible. The proposed transmission line enhancements will require dual transmission lines and encompass an area approximately 250 ft in width (see Section 3.7).

Transmission systems are typically maintained using a combination of mechanical trimming and mowing and selective use of herbicides. Trees and shrubs that obstruct access along the transmission line right-of-way or pose a safety concern to the lines and pole structures will be removed. The right-of-way will periodically be maintained to control vegetative growth using mechanical mowing (e.g., brush hogs) and selective use of herbicides to control noxious species such as vines that climb poles. It has been assumed that the transmission line will be operated and maintained in accordance with existing approved Illinois Power Company plans and procedures.

5.6.1 Terrestrial Ecosystems

This section describes the potential impacts to terrestrial ecosystems as a result of operation and maintenance of transmission system corridors required to support the EGC ESP Facility. The proposed transmission corridor (see Figure 2.2-4) will be sited within an existing utility corridor to the greatest extent possible.

Land uses traversed by the proposed transmission corridor are predominantly agricultural. Operation and maintenance activities in agricultural areas are typically minimal as the vegetative growth is under control.

Periodic maintenance of the proposed transmission rights-of-way will result in the cutting of any trees, shrubs, or other vegetation observed. Rights-of-way will be maintained in accordance with the transmission corridor owner or operators plans and procedures.

Towers required for the transmission system may eliminate a small amount of productive agricultural lands, but the overall amount of land used will be insignificant in comparison to the total amount of agricultural lands along the proposed transmission corridor.

5.6.1.1 Important Species

According to the USNRC, "important species" are defined as state- or federally-listed (or proposed for listing) threatened or endangered species; commercially or recreationally valuable species; species that are essential to the maintenance and survival of species that are rare and commercially or recreationally valuable; species that are critical to the structure and function of the local terrestrial ecosystem; and/or species that may serve as biological

indicators to monitor the effects of the facilities on the terrestrial environment (USNRC, 1999).

5.6.1.1.1 Federally-Listed Threatened and Endangered Species

Based on preliminary database reviews, operation and maintenance of the proposed transmission systems are not anticipated to impact federally-listed threatened or endangered species (IDNR, 2002).

The USFWS will be contacted in order to discuss any federally-listed (or proposed for listing) threatened or endangered terrestrial species within the proposed transmission system corridor.

5.6.1.1.2 State-Listed Threatened and Endangered Species

Based on preliminary database reviews, operation of the EGC ESP Facility is not anticipated to impact state-listed threatened or endangered species (IDNR, 2002). Transmission towers and lines will be located in the vicinity of existing towers and lines; therefore, mortality to any state-listed species of concern (including a variety of birds species discussed in Section 2.4) is not anticipated to increase significantly over current levels.

5.6.1.1.3 Species of Commercial or Recreational Value

As previously mentioned, “important species” include those terrestrial species that present value in a commercial or recreational manner. Species that are commercially or recreationally valuable that can be found within the site vicinity include white-tailed deer, several species of waterfowl, and a variety of small mammals commonly hunted along the proposed transmission system corridor. Detailed descriptions of these species can be found in Section 2.4.1.

It is anticipated that construction of the proposed transmission system may temporarily displace certain recreationally valuable species including deer, small mammals, game birds, and waterfowl. However, operation and maintenance activities are not anticipated to have adverse effects on species of commercial or recreational value.

5.6.1.2 Important Habitats

According to the USNRC, “important habitats” include any wildlife sanctuaries, refuges, or preserves; habitats identified by state or federal agencies as unique, rare, or of priority for protection; wetlands and floodplains; and land areas identified as critical habitat for species listed as threatened or endangered by the USFWS (USNRC, 1999).

5.6.1.2.1 Clinton Lake State Recreation Area

The proposed transmission system corridor will be sited within an existing utility corridor to the greatest extent possible. Periodic maintenance of the right-of-way will be required; however, no adverse impacts to the Clinton Lake State Recreation Area are anticipated as a result of the operation and maintenance of the proposed transmission systems.

5.6.1.2.2 Weldon Springs State Recreation Area

Weldon Springs State Recreation Area is located approximately 5.5 mi from the location of the EGC ESP Facility. The proposed transmission system corridor is not located within the Weldon Springs State Recreation Area, and therefore, will have no direct impacts to the area.

5.6.1.2.3 Environmentally Sensitive Areas

The State of Illinois designates certain environmentally sensitive areas as Illinois Natural Areas. These areas are protected to varying degrees under the jurisdiction of the Illinois Nature Preserves Commission.

The proposed transmission systems will be located within existing utility rights-of-way to the greatest extent possible. Towers required to support the proposed transmission system would be sited in upland areas to the greatest extent possible. Appropriate best management practices will be utilized so that adverse impacts to any environmentally sensitive areas potentially occurring along the proposed corridor are avoided during periodic maintenance activities.

5.6.1.2.4 Other Important Habitats

As previously mentioned, the proposed transmission system will be located within existing utility rights-of-way to the greatest extent possible. Appropriate best management practices will be utilized so that adverse impacts to any important habitats potentially occurring along the proposed corridor are avoided during periodic maintenance activities.

5.6.1.2.5 Wetlands and Floodplains

The proposed transmission system corridor has been located within existing utility rights-of-way to the greatest extent possible. Towers required to support the proposed transmission system will be sited within upland areas within the existing utility corridor. There will be no net loss of wetland or floodplain resources resulting from operation or maintenance of the proposed transmission system corridor.

5.6.1.3 Maintenance

Required maintenance activities will be consistent with maintenance practices being utilized for the existing utility corridor. It is anticipated that there will be no adverse effects to terrestrial ecosystems resulting from maintenance activities including applicable roadway maintenance and required periodic mechanical clearing.

5.6.1.4 Indirect Impacts

The proposed transmission system will be located within an active transmission right-of-way. Therefore, it is assumed that any projected indirect impacts associated with such issues as EMF and bird strikes along transmission lines will be minimal. Approximately 88 percent of the right-of-way is active agricultural land, and it is assumed that any residential development will occur outside of the utility corridor (see Section 3.7). Active agricultural lands typically have low quality habitat for bird nesting and roosting. Given the length of time the existing transmission towers and lines have been in the area, it is presumed that bird strike potential will not significantly increase.

5.6.2 Aquatic Ecosystems

This section describes the impacts to aquatic ecosystems as a result of operation and maintenance of transmission system corridor required to support the EGC ESP Facility.

The proposed transmission corridor (see Figure 2.2-4) has been sited along an existing utility corridor.

Transmission towers required for the proposed transmission system will be sited in upland areas within the existing utility corridor to the greatest extent possible. An effort will be made to avoid adverse impacts to watercourses, wetlands, and floodplains.

Appropriate construction procedures and best management practices will be used to minimize disturbances to existing wetlands, floodplains, and other aquatic ecosystems located within or along the existing corridor, during operation and maintenance activities. In marsh and emergent growth, wetlands vegetation maintenance is typically not required. In shrub and forested wetland areas, mowing and trimming is periodically required to keep growth outside of the line areas and away from poles. Periodic maintenance will be performed in accordance with the transmission corridor owner or operators plans and procedures.

5.6.2.1 Important Species

According to the USNRC, "important species" are defined as state- or federally-listed (or proposed for listing) threatened or endangered species; commercially or recreationally valuable species; species that are essential to the maintenance and survival of species that are rare and commercially or recreationally valuable; species that are critical to the structure and function of the local terrestrial ecosystem; and/or species that may serve as biological indicators to monitor the effects of the facilities on the terrestrial environment (USNRC, 1999).

5.6.2.1.1 Federally-Listed Threatened and Endangered Species

Based on preliminary database reviews, operation and maintenance of the proposed transmission system is not anticipated to impact federally-listed threatened or endangered species (IDNR, 2002). The USFWS will be contacted in order to confirm the absence of any federally-listed (or proposed for listing) threatened or endangered fish or other aquatic species. In addition, the National Marine Fisheries Service will be contacted in order to confirm the presence or absence of any federally-listed (or proposed for listing) threatened or endangered species under their jurisdiction.

5.6.2.1.2 State-Listed Threatened and Endangered Species

Based on preliminary database reviews, operation and maintenance of the EGC ESP Facility is not anticipated to impact state-listed threatened or endangered aquatic species (IDNR, 2002). Appropriate state wildlife agencies will be contacted to confirm the absence of state-listed threatened or endangered species along the proposed transmission system corridor.

5.6.2.1.3 Species of Commercial or Recreational Value

As previously mentioned, "important species" include those aquatic species that present value in a commercial or recreational manner. Species that are commercially or recreationally valuable that can be found within the vicinity include channel catfish, striped bass, largemouth bass, and walleye. Detailed descriptions of these species can be found in Section 2.4.2.

No direct impacts to watercourses, including Clinton Lake and other streams and tributaries along the proposed transmission system corridor, are anticipated as a result of operation and maintenance. Therefore, impacts to commercially or recreationally valuable aquatic species are not anticipated as a result of the operation and maintenance of the proposed transmission system corridor.

5.6.2.2 Important Habitats

According to the USNRC, "important habitats" include any wildlife sanctuaries, refuges, or preserves; habitats identified by state or federal agencies as unique, rare, or of priority for protection; wetlands and floodplains; and land areas identified as critical habitat for species listed as threatened or endangered by the USFWS (USNRC, 1999).

5.6.2.2.1 Clinton Lake State Recreation Area

The proposed transmission system corridor has been sited within an existing utility corridor to the greatest extent possible. No adverse impacts to the Clinton Lake State Recreation Area are anticipated as a result of the operation and maintenance of the proposed transmission systems.

5.6.2.2.2 Weldon Springs State Recreation Area

Weldon Springs State Recreation Area is located approximately 5.5 mi from the site. The proposed transmission system corridor is not located within the Weldon Springs State Recreation Area, and therefore, will have no direct impacts to the area.

5.6.2.2.3 Environmentally Sensitive Areas

The State of Illinois designates certain environmentally sensitive areas as Illinois Natural Areas. These areas are protected to varying degrees under the jurisdiction of the Illinois Nature Preserves Commission.

The proposed transmission system will be located within the existing utility rights-of-way to the greatest extent possible. Appropriate construction procedures and best management practices will be utilized so that adverse impacts to any environmentally sensitive areas along the proposed corridor are avoided.

5.6.2.2.4 Other Important Habitats

As previously mentioned, the proposed transmission system will be located within existing utility rights-of-way to the greatest extent possible. Appropriate construction procedures and best management practices will be utilized so that adverse impacts to any important habitats along the proposed corridor are avoided.

5.6.2.2.5 Wetlands and Floodplains

The proposed transmission system corridor has been located within upland habitats and within the existing utility rights-of-way to the greatest extent possible. Towers required to support the proposed transmission system will be sited within upland areas and within the existing utility corridor. Adverse impacts to wetland and floodplain resources along the existing right-of-way will be avoided to the greatest extent possible. There will be no net loss of wetland or floodplain resources resulting from operation or maintenance of the proposed transmission system corridor.

5.6.2.3 Maintenance

Required maintenance activities will be consistent with maintenance practices being utilized for the existing utility corridor. It is anticipated that there will be no adverse effects on aquatic ecosystems resulting from maintenance activities including applicable roadway maintenance and required periodic mechanical clearing. Periodic maintenance activities will be performed in accordance with the transmission corridor owner or operators plans and procedures.

5.6.3 Impacts to Members of the Public

5.6.3.1 Design Parameters

It is assumed that only two 345-kV transmission lines will need to be constructed. The first will span 15 mi from the plant to the Brokaw substation, located to the north. The second line will span 9 mi from the plant to Oreana substation, located to the south. The transmission lines will be constructed on existing rights-of-way; thus, there will be minimal disruption of land. Wood pole H-Frames, which are an Illinois Power Company standard, will be approximately 80-ft to 100-ft high and be spaced approximately 600-ft to 700-ft apart.

5.6.3.2 Maintenance Practices

A major portion, approximately 88 percent, of the transmission line right-of-way proposed to serve the EGC ESP Facility will cross agricultural land. As part of the existing right-of-way agreements, it is assumed that farmers will continue to cultivate this land except for a small area around the H-Frame structure. Therefore, it is anticipated that existing access to the right-of-way is adequate, and that no permanent roads will be built on the right-of-way for either construction or maintenance. If access roads need to be constructed, these roads will be permitted to "grass-over" for grazing, aesthetics, and minimal maintenance.

Where the transmission lines cross public roads, a screen of trees will be left to minimize visual impacts from the lines. Any new access to the right-of-way, though not anticipated, will be constructed at oblique angles to the road to prevent line of sight down the right-of-way, see Figure 5.1-3.

5.6.3.3 Electric Field Gradient

Although there are no standards to limit EMF levels in Illinois, EMF reduction measures will be incorporated into the design of the transmission lines and facility. Since there are no local criteria, the NESC guideline of a 5 milliamperes (mA) maximum EMF will be maintained.

5.6.3.4 Communication System Reception

Audible noise or RI and TVI can occur from corona, from electrical sparking and arcing between two pieces of loosely fitting hardware, or from burrs or edges on hardware. Design practices for the proposed transmission lines include use of EHV conductors, corona resistant line hardware, and grading rings at insulators. The effect of corona on radio and television is dependent on the radio/television signal strength, distance from the transmission line, and the transmission line noise level.

In a 1972 field study, in support of the CPS ER, RI and TVI were measured at existing 345-kV lines with similar construction to those proposed in this report. This study found that little or no interference would be experienced in radio receivers located outside the typical 132-ft right-of-way, providing that the strength of the signal from the radio stations exceeded 500 micro volts per meter, a value that is accepted by the Federal Communications Commission as the minimum for providing good reception. No electrical interference was experienced in a portable television receiver having a standard rod antenna when operating near lines of similar construction to those proposed in this report.

5.6.3.5 Grounding Procedures

Ground faults will be installed to limit induced currents from the EMF given off by the lines. Sufficient ground rods will be installed to reduce the resistance to 10 ohms or less under normal atmospheric conditions. With these construction operational measures taken into consideration, no impacts to members of the public are expected.

5.6.3.6 Noise Levels

During the construction of the H-Frame structures, there will only be slight noise impacts, if any, to members of the public.

When an electric transmission line is energized, an electric field is created in the air surrounding the conductors. If this field is sufficiently intense, it may cause the breakdown of the air in the immediate vicinity of the conductor (corona); corona can result in RI and TVI. This noise occurs at discrete points and can be minimized with good design and maintenance practices. Design practices for the proposed transmission lines will include use of EHV conductors, corona resistant line hardware, and grading rings at insulators.

Audible noise levels are usually very low and not heard, except possibly directly below the line on a quiet day. In a 1972 field study, in support of the CPS ER, RI and TVI were measured at existing 345-kV lines with similar construction to those proposed in this report. This study found that no audible noise caused by the 345-kV power lines near Baldwin Station could be measured above prevailing ambient background noise level.

5.7 Uranium Fuel Cycle Impacts

This section addresses the uranium fuel cycle environmental impacts and is divided into two main subsections. The first subsection addresses the light-water-cooled reactor (LWR) designs presently being considered. The second subsection addresses the gas-cooled reactor designs also being considered. This split addresses the regulatory distinction made in 10 CFR 51.51 for LWRs. In addition, the source for the information discussed in this section is from the Idaho National Engineering and Environmental Laboratory, Engineering Design File # 3747, Early Site Permit Environmental Report Sections and Supporting Documentation, May 14, 2003, Revision 0.

5.7.1 Light-Water-Cooled Reactors

10 CFR 51.51(a) states that "Every environmental report prepared for the construction permit stage of a light-water-cooled nuclear power reactor, and submitted on or after September 4, 1979, shall take Table S-3, *Table of Uranium Fuel Cycle Environmental Data*, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low level waste and high level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power plant. Table S-3 shall be included in the environmental report and may be supplemented by a discussion of the environmental significance of the data set forth in the table as weighed in the analysis for the proposed facility."

Table S-3 of 10 CFR 51.51 is reproduced in its entirety herein as Table 5.7-3. Specific categories of natural-resource use included in the table relate to land use, water consumption and thermal effluents, radioactive releases, burial of transuranic and high- and low-level wastes, and radiation doses from transportation and occupational exposures. The contributions in the table for reprocessing, waste management, and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle); that is, the cycle that results in the greater impact is used.

Descriptions of the environmental impact assessment of the uranium fuel cycle as related to the operation of LWRs are well documented by the USNRC. The environmental impact of a LWR on the U.S. population from radioactive gaseous and liquid releases (including radon and technetium) due to the uranium fuel cycle is small when compared with the impact of natural background radiation. In addition, the nonradiological impacts of the uranium fuel cycle are acceptable (10 CFR 51).

The LWR technologies being considered in this analysis are identified in Section 1.1.3 of this Environmental Report and in SSAR Section 1.3. These LWR designs include the ABWR (Advanced Boiling Water Reactor), the ESBWR (Economic Simplified Boiling Water Reactor), the AP1000 (Advanced Passive PWR), the IRIS (International Reactor Innovative and Secure), and the ACR-700 (Advanced light-water-cooled version of the CANDU Reactor). The standard configuration for each of these reactor technologies is as follows. The ABWR is a single unit, 4,300 MWt, nominal 1,500 MWe boiling water reactor. The ESBWR is a single unit, 4,000 MWt, nominal 1,390 MWe boiling water reactor. The AP1000

is a single unit, 3,400 MWt, nominal 1,117-1,150 MWe pressurized water reactor. The IRIS is a three module pressurized water reactor configuration for a total of 3,000 MWt and nominal 1,005 Mwe, and the ACR-700 is a twin unit, 3,964 MWt, nominal 1,462 MWe, light-water-cooled CANDU reactor. (Note that for this analysis, the ABWR is conservatively presumed to be the uprated design while other evaluations within this ESP application are based on the certified design configuration.)

These reactor technologies are all light-water-cooled nuclear power reactors with uranium dioxide fuel and therefore Table S-3 of paragraph (b) of 10 CFR 51.51 provides the environmental effects from the uranium fuel cycle for these reactor technologies.

5.7.2 Gas-Cooled Reactors

5.7.2.1 Introduction and Background

This section provides an assessment of the environmental impacts of the fuel cycle, as related to the operation of the gas-cooled reactor technologies, based on a comparison of the key parameters that were used to generate the impacts listed in 10 CFR 51.51 Table S-3 (and repeated in Table 5.7-3). The key parameters are energy usage, material involved, number of shipments, etc. associated with the major fuel cycle activities. These activities are mining and milling, uranium hexafluoride conversion, enrichment, fuel fabrication, and radioactive waste disposal. This analysis assumes that, for the gas-cooled reactor fuel cycle, if less energy is needed, if fewer shipments are required, and if less material is involved, then the overall environmental impacts are less than or equal to the impacts identified as acceptable for the LWR fuel cycle.

There are two gas-cooled reactor technologies being considered at this time (also see Section 1.1.3 of this Environmental Report and SSAR Section 1.3). The GT-MHR is a four module, 2,400 MWt, nominal 1,140 MWe reactor that operates at a unit capacity of 88 percent. The PBMR is an eight module, 3,200 MWt, nominal 1,320 MWe reactor operating at a 95 percent unit capacity.

A key reference for this analysis is NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants,* May 1996, which provides a detailed review of the impacts to the environment from the LWR nuclear fuel cycle. The document also looks at the sensitivity of the changes to the nuclear fuel cycle on the impacts to the environment. As these changes are much more representative of the current and future situation than what was considered in the WASH-1248 *Environmental Survey of the Uranium Fuel Cycle* report (the basis for Table S-3), the conclusions of NUREG-1437 will be used in the following discussion.

Table 5.7-1 describes the major features of the reference LWR fuel cycle that were used to develop Table S-3 and compares these same features with the gas-cooled reactor technologies being considered. This comparison demonstrates that the previously accepted environmental impacts identified in Table S-3 are comparable to the impacts for these gas-cooled technologies. The premise being that if the values of the major contributors to the health and environmental impacts that were used for the reference LWR fuel cycle are greater than those comparable values for the gas-cooled reactor technologies, then the published, previously accepted impacts for LWRs would also be greater than the impacts from the new reactor technologies. It is important to point out that even though we are

looking at the contributors individually, it is the overall impact that is of concern. As such, there can be increases in individual contributors, yet the total impacts can still be bounded, if offset by decreases in other contributors.

The information to conduct the comparison was taken from 10 CFR 51.51 Table S-3 "Uranium Fuel Cycle Environmental Data," WASH-1248 *Environmental Survey of the Uranium Fuel Cycle*, and Supplement 1 to WASH-1248 (also known as NUREG-0116) *Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle*. The "reference LWR" refers to the model 1,000 MWe light-water-cooled nuclear reactor used as a basis for studying annual fuel related requirements as described in WASH-1248. For the gas-cooled reactor technologies, information was gathered from the reactor vendors, United States Enrichment Corporation (USEC) and ConverDyn.

5.7.2.2 Analytic Approach

The major activities of the reference LWR fuel cycle that were considered in the WASH-1248 report were uranium mining, uranium milling, uranium hexafluoride production, uranium enrichment, fuel fabrication, irradiated fuel reprocessing, radioactive waste management which includes decontamination and decommissioning, and transportation. Three comments pertinent to this analysis are: 1) the WASH-1248 report and this evaluation only address the uranium fuel cycle (other fuel cycles such as thorium and plutonium are not part of this effort), 2) irradiated fuel reprocessing is not being considered by any of the new reactor technologies and is not included in this analysis, and 3) the transportation impacts are addressed based on the following premise - if the quantity of material required by the new gas-cooled reactor technologies at each major step of the fuel cycle is less than the reference plant, then the transportation impacts are also less.

The main features of the major activities of the reference LWR fuel cycle that were identified as being the primary contributors to the health and environmental impacts are as follows. For the mining operation, annual ore supply is the major determinant of environmental and health impacts. Less ore will necessitate less energy, fewer emissions, less water usage, and less land disturbed. Secondarily, the mining technique can play a significant role in any impacts. Open pit mining has by far the most environment impact, followed by underground mining, with *in situ* leaching being the most environmentally benign. Recent practice has been primarily *in situ* leaching (USNRC, 1996).

For the milling operation, annual yellowcake (U_3O_8) production is the metric of interest. If a plant requires less U_3O_8 than the reference plant, then there will be less energy needed, fewer emissions, and less water usage. This is especially true if *in situ* leaching was used to obtain the ore, because the major milling steps of crushing and grinding are not required.

For the uranium conversion process, annual uranium hexafluoride (UF_6) production is the primary determinant of environmental impacts. If the new technology requires less UF_6 than the reference plant, then there will be less energy required, fewer emissions and less water used. As with the mining step, the conversion process (wet versus dry) is also a consideration. However, NUREG-1437 states that in either case "the environmental releases are so small that changing from 100 percent use of one process to 100 percent of the other would make no significant difference in the totals given in Tables S-3 or S-4."

For the enrichment operation, there are two quantities of interest. The first quantity is the separative work units (SWU) needed to enrich the fuel, and the second quantity is the amount of enriched UF_6. The SWU is a measure of energy required to enrich the fuel. More SWUs would by itself indicate not only more energy required but also more emissions associated with the production of the energy needed and with that more water usage. However, this assumes the same technology is used to achieve the enrichment. As discussed in NUREG-1437, the centrifuge process uses 90 percent less energy than the gaseous diffusion process. Since the major environmental impacts for the entire fuel cycle are from the emissions from the fossil fueled plants needed to supply the energy demands of the gaseous diffusion plant, this reduction in energy requirements results in a fuel cycle with much less environmental impact. With regard to the amount of enriched UF_6 produced, the major effect would be the number of shipments. More UF_6 would necessitate more shipments, while less UF_6 would require fewer shipments. Slight increases or decreases would probably result in the same number of shipments.

For the fuel fabrication process, the quantity of UO_2 produced is the value of interest. This is equivalent to the annual fuel loading in MTU, which will also be evaluated. Here again, the production of more UO_2 would require more energy, greater emissions, and increased water usage. New reactor technologies with an annual fuel loading less than the reference LWR plant would have less environmental impact, requiring less energy, fewer emissions and less water usage.

The last activity to be addressed is radioactive waste management. There are two aspects of radioactive waste that are considered as part of Table S-3: operations and reactor decontamination and decommissioning (D&D). For these activities, curies (Ci) of low-level waste (LLW) from annual operations and Ci of LLW from reactor D&D are the measures to consider. Curies by themselves are not a direct indicator of the potential environmental impacts. The radionuclide, its half-life and type of emission, and its physical and chemical form are the main contributors to risk. While we recognize this distinction, for this bounding analysis we will use curies as was done in the WASH-1248. More curies generally indicate the potential for greater impacts, while fewer curies indicate lesser impacts.

This comparison between the reference LWR and the gas-cooled reactor technologies begins with the annual fuel loading in MTU for each of the gas-cooled reactor technologies. Using annual fuel loading as the starting point, the analysis will proceed in the reverse direction for the fuel cycle until the mining has been addressed, then the radioactive waste will be addressed. Before beginning this comparison, it is important to recognize that the gas-cooled reactor technologies being considered are a different size, have a different electrical rating and have a different capacity factor from the reference LWR. The reference LWR is a 1,000 MWe plant with a capacity factor of 80 percent. In order to make a proper comparison, we need to evaluate the activities based on the same criterion. For this analysis, electrical generation is the metric of choice. The electrical generation is the metric that establishes whether the new reactor technologies, for the same electrical output, have a greater or lesser impact on human health and environment. Based on this, the reactor technologies have been normalized to 800 MWe using plant specific electrical ratings and capacity factors.

5.7.2.3 Analysis and Discussion

5.7.2.3.1 Fuel Fabrication/Operations

The reference LWR required 35 MTU of new fuel on an annual basis. This is equivalent to 40 MT of enriched UO_2, the annual output needed from the fuel fabrication plant. In comparison, the normalized annual fuel needs for the new gas-cooled reactor technologies ranged from 4.3 MTU to 5.3 MTU, approximately 88 percent to 85 percent lower than the reference plant. Similarly, the annual output needed from the fuel fabrication plant range from a low of 4.89 MT of UO_2 to 6.0 MT of UO_2, again approximately 88 percent to 85 percent lower than the reference plant. The specific breakdowns are shown on Table 5.7-1.

One important distinction is that the fuel form for the gas-cooled reactors is also different. For the GT-MHR, the fuel is a two-phase mixture of enriched UO_2 and UC_2, usually referred to as UCO. For the PBMR, the fuel kernel is UO_2. Both fuels are then TRISO coated. For the GT-MHR these TRISO fuel particles are blended and bonded together with a carbonaceous binder. These fuel compacts are then stacked within a graphite block. For the PMBR, the fuel unit is a 6 cm diameter graphite sphere containing approximately 15,000 fuel particles. As a result, the gas-cooled reactors require a different fuel fabrication process and a different type of fuel fabrication facility. Ideally, to verify that the environmental impacts of this change in the fabrication process are bounded by the reference LWR fuel fabricationprocess, a comparison of the land use, energy demand, effluents, etc., would be in order. However, because there are no planned or currently operating gas-cooled reactor fuel fabrication plants in the United States, a direct comparison cannot be made at this time. Therefore, we have provided information on the reference fuel fabrication plant along with conceptual design information for a TRISO fabrication plant that was planned for the New Production Reactor and conceptual design information received from one of the gas-cooled reactor vendors.

From WASH-1248, the reference LWR fuel fabrication plant produced fuel for 26 plants (~910 MTU), was located on a site of about 100 acres, required 5.2 million gallons of water per annual fuel requirement of 35 MTU, and required 1,700 MW-hours of electricity per 35 MTU. The WASH-1248 report also states that nearly all of the airborne chemical effluents resulted from the combustion of fossil fuels to produce electricity to operate the fabrication plant. These numbers represented a very small portion of the overall fuel cycle. For example, the electrical usage represented less than 0.5 percent of that needed for the enrichment process, and the water use was less than 2 percent of the overall fuel cycle.

The fuel fabrication facility for the New Production Reactor was for a modular high temperature gas reactor (MHTGR) design and was sized for just one plant. The dimensions for the fuel fabrication building were 230 ft x 150 ft. The annual production was about 2 MTU. The plant required 960 kW of electrical power and 45 liters per minute of water. Effluents consisted of 60 m^3/yr of miscellaneous non-combustible solids and filters; 50 m^3/yr of combustible solids; 50 m^3/yr of process off-gas and HVAC filters; 2.0 m^3/yr of tools and failed equipment; and process off-gases of 900,000 m^3/yr. The process off-gases consisted of 74 percent N_2, 12 percent O_2, 7.2 percent Ar, 6.4 percent CO_2, 0.2 percent CO, and 0.02 percent CH_3CCl_3. The activity associated with this off-gas was 0.01 pCi alpha/m^3, and 0.01 pCi beta/m^3.

The information gathered from one of the current reactor vendors was for a plant producing 6.3 MTU, about 19 percent more than the annual reload of 5.31 MTU for its reactor. Again this plant was sized for just one reactor. This plant would require 10 MW of electrical power with an annual electrical usage of 35,000 MW-hr. The gaseous emissions consist of 80 MT of nitrogen, 52 MT of argon, 22.4 MT of CO, 22 MT of hydrogen and 3.7 MT of CO_2. The solid waste totals about 84 m^3 of LLW, 3 m^3 of intermediate level waste, and the remainder sanitary/industrial wastes. The liquid processing system would generate an additional 3.8 m^3 of LLW, would discharge about 3,700 m^3 of low activity aqueous effluent, and would discharge about 45,000 m^3 of industrial cooling water.

Because of the differences in scale and the state of design of the LWR and gas-cooled reactor facilities, it is not possible or appropriate to make a direct comparison of the impacts. Further, there are economies of scale and design improvements that will naturally occur for a plant comparable in size to the reference plant. Regardless, the projected impacts of a TRISO fuel plant based on the two conceptual designs are not inconsistent with the reference plant and would be operated within existing air, water, and solid waste regulations. Further, like the impacts associated with the sintered UO_2 pellet plant, the impacts from a TRISO fuel plant would still be a minor contributor to the overall fuel cycle impacts. By characterizing the impacts as "not inconsistent," we mean that while certain parameters such as electrical usage for fuel fabrication might be higher for the gas-cooled plants on an annual fuel loading basis, the environmental impacts from the TRISO plants as conceptualized would still be bounded by the overall LWR fuel cycle impacts.

5.7.2.3.2 Uranium Enrichment

In order to produce the 40 MT of enriched UO_2 for the reference LWR, the enrichment plant needed to produce 52 MT of UF_6, which required 127 MT of SWU (USNRC, 1976). The normalized enriched UF_6 needs for the new gas-cooled reactor technologies ranged from 6.38 MT of UF_6 to 7.9 MT of UF_6, approximately 88 percent to 85 percent lower. To produce these quantities of UF_6 requires (due to the higher enrichment requirements) from 124 MT of SWU to 163 MT of SWU, slightly lower to 28 percent higher. The enrichment SWU calculation for the new reactor technologies was performed using the USEC SWU calculator and assumes a 0.30 percent tails assay, the same value as for the NUREG-0116 reference plant. Using this calculator for the reference LWR plant yielded 126 MT of SWU versus the NUREG value of 127. This is very close indicating that this latest version of the USEC SWU calculator is appropriate for use in this computation. Table 5.7-2 gives the details of the computations.

The 28 percent increase in the MTU of SWU would by itself indicate greater environmental impacts. However, a close look at the original WASH-1248 analysis shows that the environmental impacts are almost totally from the electrical generation needed for the gaseous diffusion process. These impacts result from the emissions from the electrical generation that is assumed to be from coal plants and from the associated water to cool the plants. Today, and in the future, the enrichment process is and will be different. A significant fraction of the enrichment services to US utilities today is provided from European facilities using centrifuge technology rather than the fifty-year-old gaseous diffusion technology. For the future, two private companies, United States Enrichment Corporation and Louisiana Energy Services, are currently (2003) planning to develop centrifuge technology in the US. In fact, USNRC has just recently accepted United States

Enrichment Corporation's centrifuge license application for technical review. Centrifuge technology requires less than 10 percent of the energy needed for the gaseous diffusion process and as such the environmental impacts associated with the electrical generation will be correspondingly less. This tremendous reduction in energy and the associated environmental impacts more than offsets a 28 percent increase in SWU. Only a portion of the SWU would have to be expended via centrifuge technology to obtain an impact equivalent to that for the reference LWR using only the gaseous diffusion process.

5.7.2.3.3 Uranium Hexafluoride Production

In order to provide the feed needed for the reference LWR to the enrichment plant, the uranium hexafluoride plant needed to produce 360 MT of UF_6. The normalized feed needed for the new gas-cooled reactor technologies, the output from the uranium hexafluoride plant, ranged from 241 to 303 MT of UF_6, well below the reference plant. The feed calculations were performed using the USEC SWU calculator. Using this calculator for the reference LWR yielded 353 MT of UF_6 versus the NUREG value of 360. Again this value is very close (less than 2 percent) to the published value (USNRC, 1976).

5.7.2.3.4 Uranium Milling

To produce the 360 MT of UF_6 for the reference LWR, 293 MT of yellowcake (U_3O_8) from the mill was required (USNRC, 1976). The normalized new gas-cooled reactor technologies needs ranged from 193 MT of U_3O_8 to 243 U_3O_8, well below the reference plant. These yellowcake numbers were generated using the relationship 2.61285 lbs of U_3O_8 to 1 kg of UF_6. This conversion factor was obtained from ConverDyn.

5.7.2.3.5 Uranium Mining

The raw ore needed to produce the 293 MT of yellowcake (U_3O_8) for the reference LWR was 272,000 MT. Now assuming a 0.1 percent ore body and a 90 percent recovery efficiency, the normalized new gas-cooled reactor technologies ore requirements ranged from 215,000 to 270,000 MT of ore, both below the reference plant. Of note, the NUREG table value of 272,000 should be about 325,600 using the same assumptions. It is not clear why this number is different, but in any case, the gas-cooled reactor technologies are below the published reference plant value (USNRC, 1976).

Uranium mining completes the front end of the fuel cycle. However, there are two areas on the down stream cycle to be considered. These are the LLW generated by operations and the LLW generated as part of the D&D process. As mentioned earlier, spent fuel reprocessing is not germane to this analysis, and therefore, not discussed.

5.7.2.3.6 Solid Low-Level Radioactive Waste – Operations

For the reference LWR, 10 CFR 51.51, Table S-3, Table of Uranium Fuel Cycle Environmental Data, states that there are 9,100 Ci of LLW generated annually from operations. The range of activity of LLW generated annually projected by the new gas-cooled reactor technologies is 65.4 Ci to 1,100 Ci, far below the reference LLW. This decrease would also suggest many fewer shipments to the disposal facility and less worker exposure.

5.7.2.3.7 Solid Low-Level Radioactive Waste – Decontamination and Decommissioning

10 CFR 51.51, Table S-3, states 1,500 Ci per Reactor Reference Year (RRY) "comes from reactor decontamination and decommissioning – buried at land burial facilities." Based on this small quantity and the modifying phrase "buried at land burial facilities" it is clear that

only waste suitable for shallow land burial was being considered as a basis for the Table S-3 line item. At this time, only general conclusions can be drawn to indicate these gas-cooled reactor technologies would generate less D&D LLW than the reference plant. The new plants will operate much cleaner than the reference LWR as evidenced by the annual generation of much less LLW. Improvements in fuel integrity and differences in fuel form as well as the use of the chemically and radiologically inert helium as the coolant are responsible for this reduction and also should contribute to both a lower level and less overall contamination to be managed during the D&D process. The plants higher thermal efficiency and higher fuel burnup would produce less heavy metal radioactive waste. Lastly, the plants are typically more compact than the reference LWR contributing to less D&D waste. For these reasons it is expected that the D&D LLW generation from the gas-cooled reactor designs would be comparable or less than that associated with the reference LWR.

The key areas of impact from D&D LLW for the gas-cooled reactor are expected to be identical to those of the reference LWR, namely, transportation and land use supporting waste disposal. As discussed in WASH-1248, the largest portion of D&D LLW transportation and land use is associated with the mining, milling, and enrichment steps. Relative contributions of D&D are quite small. WASH-1248 also points out that other areas of impact are dominated by the these “front-end” phases of the nuclear fuel cycle, e.g., land use and power consumption to support enrichment, related water usage, and power plant emissions.

As noted above, the D&D LLW impacts related to the gas-cooled reactor designs are expected to be comparable or less than that of the reference LLW.

5.7.2.4 Summary and Conclusion

To recap, there are only two instances where any part of the uranium fuel cycle is/might be exceeded by the new gas-cooled reactor technologies. These fuel cycle steps are enrichment, with a 28 percent increase, and possibly D&D. As discussed above, the enrichment requirement for SWU, while slightly larger, can be conducted, in full or in part, in a much more environmentally benign manner, centrifuge versus gaseous diffusion, from current overseas sources or expected new domestic facilities. The net effect will be that the environmental and health impacts will be not more than those identified in Table S-3. The second area, D&D, is a minor contributor to the overall fuel cycle impacts. While definitive D&D LLW information was not readily available for the gas-cooled reactor technologies, for the numerous reasons set forth above, the impacts are expected to be comparable or less than the reference LLW. However, while not expected, even an increase in the D&D LLW impacts would be more than offset by the significant decreases in the impacts due to reduction in fuel needs and changes in the enrichment process and mining technique.

In conclusion, this detailed comparison of the underpinnings of Table S-3 show qualitatively that the existing WASH-1248 environmental and health effects are conservative and appropriate for use by these new gas-cooled reactor technologies. Collectively, improvements in both methods and technology have resulted in a fuel cycle with lower environmental impact.

5.7.3 Methodology Assessment

As indicated in Section 1.1.3, the selection of a reactor design to be used for the EGC ESP Facility is still under consideration. Selection of a reactor to be used at the EGC ESP Site may not be limited to those considered above. However, the methodology utilized above is appropriate to evaluate the final selected reactor. Further, should the selected design be shown to be bounded by the above evaluation, then the selected design would be considered to be within the acceptable fuel cycle environmental impacts considered for this ESP.

5.8 Socioeconomic Impacts

Within the site, there is no permanent population that would be impacted from station operation (U.S. Census Bureau, 2001). As detailed below, socioeconomic impacts to the vicinity and the region are anticipated to be minor.

The operation workforce will consist of up to 580 people (see SSAR Table 1.4-1). It is expected that while some of the workforce will relocate from other areas, a significant amount of the workforce will already be located within the region. The proposed site is proximate to three significant population and employment centers (Bloomington-Normal, Champaign-Urbana, and Decatur) and within two additional employment centers (Springfield and Peoria). The population of the region is approximately 1.2 million, and it is typical in this part of Illinois for workers to commute up to 50 mi one-way to work. Additionally, a significant number of employees at the CPS already lived within the region before operation began; these employees have not moved to the vicinity but have remained in their community. A similar experience is anticipated for the EGC ESP Facility.

5.8.1 Physical Impacts of Station Operation

The physical impacts are defined as noise, air, and aesthetic disturbances. Physical impacts will be controlled as specified by applicable regulations and will not significantly impact the site, vicinity, or region.

5.8.1.1 Site and Vicinity

Within the vicinity, the population is approximately 2,343 people. The two largest cities within the vicinity include DeWitt, with a population of 188, and Weldon, with a population of 440 (U.S. Census Bureau, 2001). These two cities are small rural communities that include small businesses, houses, and farm buildings. These communities will not experience any physical impact from station operation. No impacts to structures, including residences on the site or vicinity, are anticipated. No significant impacts to hospitals or other institutional facilities are anticipated; this is described in more detail in Section 5.8.2.

Roads within the vicinity are described in Section 2.2. The roads and highways within the immediate vicinity of the site will experience an increase in use, especially at the beginning and the end of the workday. However, the road network has sufficient capacity to accommodate a substantial increase in volume, as detailed in Section 5.1.1.1. Thus, no significant congestion problems are expected from station operation.

Clinton Lake State Recreation Area and Weldon Springs State Recreation Area are the only major recreational facilities within the vicinity. As described above, it is not anticipated that a significant number of workers will move to the region to work at the EGC ESP Facility; therefore, these facilities would not experience any abnormal influx in use due to station operation.

Outside of the 6-mi radius of the vicinity of the site, there will be no physical (noise, air, and aesthetic disturbances) impacts from station operation.

5.8.1.2 Noise

Turbines, generators, pumps, transformers, and switchyard equipment are noise producers. Noise levels will be controlled in accordance with the following regulations:

- OSHA noise exposure limit to workers, and workers' annoyance determined through consideration of acceptable noise levels for offices, control rooms, etc. (29 CFR 1910);
- Federal (40 CFR 204) noise pollution control regulations; and
- State or local (35 IAC Subtitle H) noise pollution control regulations.

Equipment that exceeds the noise abatement criteria will use noise control devices. Equipment manufacturers will be required to guarantee that specifications on allowable octave bands will be met. Most equipment will be located inside structures; therefore, building walls will reduce outside noise levels as much as 15 dB. Further, reduction will be achieved as the noise travels to the property line (CPS, 1982). The heat dissipation system is anticipated to have a noise level of up to 55 dB at a distance of 1,000 ft from the system (see SSAR Table 1.4-1). This level is below the typical outside noise criterion, 65 dB, for residential areas (24 CFR 51).

There are few rural families close to the site that may be affected by an increase in traffic noise generated by station employees, delivery trucks, and off-site shipments (CPS, 1982). It is anticipated that most vehicle trips will occur during normal weekday business hours. Additional traffic from the operation workforce, to and from the site, will increase the level of vehicular noise for those residents living along routes that access the EGC ESP Facility. However, the low volume highway, even with the added traffic, is expected to be below the noise criteria for residential areas.

Noise impacts are anticipated to be minor for several reasons: noise levels from operation are not expected to exceed 60 dB, 1,000 ft from the system; traffic noise will be limited to normal weekday business hours; and noise control devices will be used when necessary. The nearby Clinton Lake State Recreation Area will not be impacted by noise, since recreational facilities are well beyond 1,000 ft from the facility. The nearest campground is approximately 1 mi from the EGC ESP Facility.

5.8.1.3 Air

The annual average exposure at the site boundary from gaseous sources will not exceed applicable regulations during normal operation. Additionally, it is anticipated that air emission levels at the site boundary will be insignificant, as defined by USEPA. Depending on the reactor technology selected, air pollution control devices may be needed and will be used to meet applicable regulations. Additional air emissions from the increased vehicular traffic from the new operation workforce will have a negligible effect on the area. This is because central Illinois is considered by USEPA to be either an attainment or unclassifiable area for criteria pollutants (CO, PM_{10}, NO_X, TSP, SO_2, and ozone) (40 CFR 81.314). This indicates good overall air quality in the region.

5.8.1.4 Aesthetic Disturbances

The closest residence is approximately 0.73 mi to the southwest of the site (IDNR, 1998 and 1999), and the closest town is DeWitt, which is approximately 3 mi to the east (U.S. Census

Bureau, 2001). Many recreational users of the Clinton Lake State Recreation Area will be able to view the operation areas.

The CPS has a power block structure that is approximately 200-ft tall. The EGC ESP Site will have a power block structure that could be up to 234-ft tall. The heat dissipation system could have a height of up to 550 ft (see SSAR Table 1.4-1). An off-gas structure may be required; however, the height of this structure is unknown. The off-gas structure will likely be the same height as the power block structure and shorter than the height of the heat dissipation system. The CPS Site already exhibits an industrial environment; therefore, the EGC ESP Site will not substantially alter an already visually disturbed site. Any visual impacts from the visible plumes from the EGC ESP Facility will be similar to those associated with the CPS. There is a potential that an additional visible plume will result from the heat dissipation system.

The viewshed of the EGC ESP Facility is limited to only a few residences and recreational users in the vicinity. Based on the fact that the EGC ESP Site will have similar visual impacts as the CPS (with the exception of the new plume from the heat dissipation system), the EGC ESP Site will have a minor impact on aesthetic quality for nearby residences and recreational users of Clinton Lake. Therefore, no mitigation will be provided.

5.8.2 Social and Economic Impacts of Station Operation

Social and economic impacts include impacts to the economy, tax and social structure, housing, educational, recreation, public services and facilities, transportation facilities, distinctive communities, and agriculture.

5.8.2.1 Economic Characteristics

Section 2.5.2.1 describes the regional employment by industry (see Table 2.5-8), the construction labor force within the region (see Table 2.5-8), the total regional labor force (see Table 2.5-8), and the regional unemployment levels and future economic outlook (see Table 2.5-10).

The operation workforce will consist of up to 580 people (see SSAR Table 1.4-1). Operation workforce salaries will have a multiplier effect, where money is spent and re-spent within the region. Local businesses in and around Clinton may see an increase in business, especially in the retail and services sector during normal business hours. The additional employment, although not expected to be significant, may help to sustain existing businesses throughout the region, as well as provide opportunities for some new businesses. The effect of the EGC ESP Site may slightly improve the unemployment levels in the area, which in 2000 were at about 5 percent (see Table 2.5-10). In addition, the increase in tax revenue (described in Section 5.8.2.2) and the slight increase in workforce may provide opportunities for further development in the area.

Finally, the EGC ESP Facility will provide a new source of reliable electricity for the region, which may result in the siting of new industries into the region or expansion of existing industries.

5.8.2.2 Tax Impacts

The taxing districts, as listed in Section 2.5.2.2, will benefit from the EGC ESP Facility. Any property taxes paid in connection with the EGC ESP Facility are expected to be a benefit to the local community. Other potential tax impacts will include an increase in state income tax revenue generated from the additional operation jobs and indirect salaries created by operation.

5.8.2.3 Social Structure

The social structure for the region is described in Section 2.5.2.3. No impacts from operation to the social structure of the region are anticipated. The operation workforce will largely be from the region (see Section 5.8) and is expected to commute to the site from the major metropolitan areas (Bloomington-Normal, Champaign-Urbana, Decatur, and Springfield) within the region. Therefore, the social structure and patterns observed in the surrounding communities will not experience the effects of a rapid population increase. It is expected that the social structure will remain unchanged during operation.

5.8.2.4 Housing Information

Within the 20-county region surrounding the site, the population in the year 2000 was nearly 1.2 million, with most people concentrated in the metropolitan areas of Bloomington-Normal, Champaign-Urbana, Decatur, Lincoln, Morton, Peoria-Pekin, Pontiac, Rantoul, Springfield, and Taylorville *(*U.S. Census Bureau, 2001*).*

It is estimated that most of the operation workers will commute to the site rather than move their families to the immediate area of Clinton. A very small number of the operation workers from both within and beyond the 50-mi radius may choose to move to the Clinton area with their families. The 2000 Census indicated that there were 74 vacant, year round housing units within the vicinity and over 19,000 vacant, year round housing units within the region (U.S. Census Bureau, 2001). Based on the housing available and the commuting expected, no housing shortages are anticipated as a result of operation.

The abundance of existing housing within the surrounding area will mitigate against effects on rents or prices produced by the operation.

5.8.2.5 Educational System

Since the majority of the operation workers will be from the region (see Section 5.8) where their educational requirements are already being met, the surrounding school systems will not likely experience any major influx of students because of the operation of the EGC ESP Facility. A survey of class size of schools in the region was performed, and 70 percent of schools have class size at or below the national average. This indicates there is sufficient capacity for a small increase in population.

5.8.2.6 Recreation

Recreational facilities within the region are described in Section 2.5.2.6. The operation worker population will predominately reside at their existing residences (see Section 5.8). Therefore, it is not anticipated that there will be any unusual peaks at recreational facilities within the region.

5.8.2.7 Public Services and Facilities

In general, public facilities are not anticipated to be overcrowded because most of the operation workforce is not expected to move to the area (see Section 5.8). The EGC ESP Site is in a rural area; therefore, community services are not expected to be directly affected. Also, since private security guards will be used, dependence on local police forces will not be required. Public facilities will be able to absorb the minor increase in load due to the small influx of people expected. In the vicinity of the site, residences have private septic systems and obtain water through individual wells or individual city water well systems. The EGC ESP Site will use their own on-site water and septic facilities. A survey was conducted to assess availability of water supply and wastewater facilities in the region. This assessment indicated that the facilities have excess capacity to accommodate a potential increase in population in the region.

5.8.2.8 Transportation Facilities

The roads and highways within the vicinity of the site will experience an increase in use of approximately 580 additional vehicle trips during the peak hours of the workday. However, these roads and highways are 2-lane rural routes that are not heavily traveled and can withstand the increase in vehicular traffic (see Section 5.1.1.1). It is expected that the operation workforce will live in dispersed areas nearly uniform in all directions from the site, and will travel relatively uniformly in all directions. Thus, no significant congestion problems are expected due to the operation.

5.8.2.9 Distinctive Communities

As stated in Section 2.5.2.3, the population in the region is fairly homogeneous, largely white, and not dominated by a particular ethnic group. The only special groups within the region are two Amish communities located around the towns of Arthur and Arcola, which are 37-mi and 44-mi southeast of the site, respectively. These two areas are far enough away from the site that they will not be impacted by station operations.

5.8.2.10 Agriculture

As stated in Section 2.2, no land is designated as agricultural land within the site. However, 82 percent is designated as agricultural land within the vicinity, and 93 percent is designated as agricultural land within the region. Since the land impacted by station operations will be limited to the site and transmission corridor, only minor impacts to agriculture is anticipated at some locations of the transmission towers, and therefore, no mitigation will be provided.

5.8.3 Environmental Justice

This section describes the potential for disproportionate impacts to low-income and minority populations that could result due to the operation of the EGC ESP Facility. The environmental justice assessment includes a technical analysis in order to determine the potential effects of the operation on low-income and minority populations. A disproportionate impact to these populations exists when they endure more than their "fair share" of industrial facilities.

Compared to the general population, it was determined that there would be no disproportionate impact to low-income populations (in accordance with Health and Human Services Poverty Guidelines (Federal Register, 2000)) or minority populations within the region due to the operation of the EGC ESP Facility.

The detailed analysis of the region shows no disproportionate impact to minority populations. Within the vicinity of the site, the total population was 2,343 and the minority population was only 85, or 3.6 percent, in the year 2000. Within the region, the total population was 762,022 and the minority population was 100,331, or 13 percent, in the year 2000. The minority population in DeWitt County is approximately 3 percent. In the State of Illinois, the minority population is 39 percent, while the national average is 37 percent. The vicinity, region, and county, in which the site is located, have minority populations that are below the state and national average. Therefore, it can be concluded that minority populations will not be disproportionately impacted by any adverse impacts from the operation of the EGC ESP Facility. Figure 4.4-1 shows the location of minority populations and the total population within each census block. This figure, as well as Figure 2.1-3, shows that the closest minority population is proximate to the site (approximately 0.6 mi). Further investigation shows that this is a Native American person that lives directly southwest of the site. Since this person is the only resident within the census block, the percent minority is 100 percent for this block (U.S. Census Bureau, 2001 and 2001a). While the site may have a disproportionate impact on minorities in one census block, it in fact involved only one person, therefore, no mitigation is required.

The detailed analysis of the region shows no disproportionate impact to low-income populations. Within the vicinity, 8 percent of the population had a 1999 income below the poverty level. Within the region, 10 percent of the population had a 1999 income below the poverty level. In DeWitt County, 8 percent of the population is considered low-income. The average low-income population in Illinois is 10.8 percent, and the national average is 11.3 percent (U.S. Census Bureau, 2001b). The vicinity, region, and county, in which the site is located, have low-income populations that are below the state and national average. Therefore, it can be concluded that low-income populations will not be disproportionately impacted by operation of the EGC ESP Facility. Figure 4.4-2 shows the location of low-income populations within each census block (U.S. Census Bureau, 2001 and 2001a).

An assessment of environmental justice also includes considerations of other factors, such as environmental health effects of air and noise pollution on low-income and minority populations. Noise and air pollution will be controlled by following any federal, state, and local regulation. In summary, no disproportionately high or adverse impacts on minority and low-income populations would result from operation.

5.9 Decommissioning

This section reviews the environmental impacts of decommissioning the EGC ESP Facility. This ER supports an ESP; therefore, USNRC regulations do not require the applicant to inform the USNRC of its plans for decommissioning the facility. Consequently, no definite plan for the decommissioning of the plant has been developed (USNRC, 1999). Additionally, no financial assurances for decommissioning are required at the ESP stage. The general environmental impacts are summarized in this section, since the decommissioning plans and reports (and consequently detailed analyses of alternatives) are not prepared until cessation of operations.

The USNRC defines decommissioning as the safe removal of a nuclear facility from service and the reduction of residual radioactivity to a level that permits release of the property for unrestricted use and termination of the license (10 CFR 50). Decommissioning must occur because regulations do not permit an operating license holder to abandon a facility after ending operations.

Although this section does not evaluate the impacts of decommissioning on the proposed site, studies of social and environmental effects of decommissioning other nuclear generating facilities have not identified any significant impacts beyond those considered in the USNRC's Generic Environmental Impact Statement (GEIS) on decommissioning (USNRC, 2002). According to the USNRC, decommissioning of a nuclear power plant has certain environmental consequences. The impacts on the proposed site will be discussed in detail at the COL stage. Generally, expected impacts may include minor radiological impacts to the public, but is expected to remain ALARA. Experience at decommissioned power plants has shown that the occupational exposures during the decommissioning period are comparable to those associated with refueling and routine maintenance of the plant when it is operational (USNRC, 1996 and 2002). Socioeconomic impacts of decommissioning would result from the demands on, and contributions to, the community by the workers employed to decommission a power plant. The air quality, water quality, and ecological impacts of decommissioning are expected to be substantially smaller than those of power plant construction or operation because the level of activity and the releases to the environment are expected to be smaller during decommissioning than during construction and operation (USNRC, 2002).

The applicant does not anticipate developing decommissioning plans until termination of operations. As decommissioning plans are developed, efforts will be made to minimize or mitigate any adverse impacts from decommissioning. Additionally, large portions of the site may be available for redevelopment under various regulatory schemes (USNRC, 2002).

5.10 Measures and Controls to Limit Adverse Impacts During Operation

5.10.1 Regulatory Criteria

In accordance with NUREG-1555, *Environmental Standard Review Plan*, potential adverse environmental impacts due to active EGC ESP Facility operations are identified and addressed in this section as well as the specific measures and controls to limit those impacts (USNRC, 1999). Some of the measures and controls to limit the impacts from active EGC ESP Facility operations are discussed in other sections of this chapter.

5.10.2 Adverse Environmental Impacts

The following presents a list of the identified potential adverse environmental impacts that may be encountered during operational activities:

- Noise;
- Dust/Air Pollutants;
- Erosion and Sedimentation Controls;
- Effluents and Wastes;
- Traffic Control;
- Land Use Impacts;
- Water-related Impacts;
- Water Use Impacts;
- Cooling System Impacts;
- Radiological Impacts from Normal Operations;
- Environmental Impacts of Waste;
- Transmission System Impacts;
- Uranium Fuel Cycle Impacts;
- Socioeconomic Impacts; and
- Decommissioning Impacts.

5.10.3 Measures and Controls to Limit Adverse Impacts

The identified impacts will be discussed in the following section as well as the measures and controls that will be implemented to limit these impacts from active EGC ESP Facility operations, if applicable.

5.10.3.1 Noise

During operational activities, ambient noise levels on and off site will increase. Cooling towers, turbines, generators, pumps, transformers, switchyard equipment, and heavy equipment are noise producers. Noise levels will be controlled by an engineering design using the following criteria:

- OSHA noise exposure limit to workers and workers' annoyance determined through consideration of acceptable noise levels for offices, control rooms, etc. (29 CFR 1910);
- Federal noise pollution control regulations (24 CFR 51); and
- State or local noise pollution control regulations, as applicable (35 IAC 1987).

The many pieces of large industrial equipment needed for EGC ESP Facility operations (freight trucks, forklifts, construction equipment, locomotives, etc.) will be the source of noise pollution. Standard noise devices on trucks and other equipment are expected to be sufficient to keep off-site noise levels well-below acceptable levels. In addition, activities requiring the use of heavy equipment will be limited on weekends.

Hearing protection programs for station workers will comply with the requirements specified in 29 CFR 1910.95. This requires that a Hearing Conservation Program be developed to control and protect on-site workers from excessive noise levels. As stipulated in 29 CFR 1910, a Hearing Conservation Program will include the following:

- Provide hearing protection (earplugs or muffs) at no cost to employees;
- Conduct noise monitoring at the work location where employees are exposed to excessive noise;
- Provide annual audiometric exams for noise-exposed employees;
- Notify exposed employees of noise monitoring and audiometric exam results;
- Keep records of noise monitoring and audiometric exams results; and
- Provide training on use/maintenance and limitations of hearing protection.

Procedures and a Hearing Conservation Program will be developed for any employees exposed to excessive noise, which is defined as an 8-hr exposure of 85 dB or more.

5.10.3.2 Dust/Air Pollutants

Dust and engine exhausts represent air pollution potentials, which can be controlled, as appropriate. Good drainage and dry-weather wetting or the paving of the most traveled roads and parking lots will reduce dust generated by vehicular traffic. Bare areas will be seeded, if possible, to provide a ground cover where necessary. Care will be taken to control smoke or other undesirable emissions. Applicable air pollution control regulations will be adhered to as they relate to the operation of fuel-burning equipment. Permits and operating certificates will be secured where required. Fuel-burning equipment will be maintained in good mechanical order to reduce excessive emissions.

5.10.3.3 Erosion and Sedimentation Controls

If the areas around the EGC ESP Facility are not properly graded and seeded, erosion will lead to the runoff of large amounts of sediments to nearby residential areas or surface waters.

The following goals and criteria will be applied, as applicable:

- Erosion and sedimentation controls will be implemented in order to retain sediment on site to the greatest extent practicable.
- In accordance with the manufacturer's specifications and good engineering practices, control measures will be selected, installed, and maintained. If periodic inspections or other information indicate that a particular erosion control measure is ineffective, the control measure will be modified or replaced as necessary.
- If possible and if required, off-site accumulations of sediment will be removed in the event that sediment escapes the construction site in order to minimize the off-site impacts.
- Sediment from sediment traps or sedimentation ponds will be routinely removed when design capacity, as a general rule, has been reduced by approximately 50 percent. This will limit the potential for trap or pond failure.
- Housekeeping practices will be implemented that prevent litter, debris, and chemicals exposed to stormwater from becoming a pollutant source for stormwater discharges.
- Erosion and sediment runoff will be controlled through the use of structural and/or stabilization practices. Structural control practices may include the use of straw bales, silt fences, earth dikes, drainage swales, sediment traps, and sediment basins. Sediment traps and basins will be designed to accommodate the large potential load from the deep excavation dewatering operations. Stabilization practices may include temporary seeding, permanent seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, and preservation of mature vegetation.

Several different structural controls may be used to control the quality of the stormwater running off the site. Table 5.10-1 lists the controls that may be instituted during EGC ESP Facility operations. Based on site conditions, the final location of these controls will be determined just prior to the commencement of operation.

5.10.3.4 Effluents and Wastes

Contained in the following sections is a list of possible pollutant sources that may occur during EGC ESP Facility operations, and specific measures to control discharges of those pollutant sources on and off site.

5.10.3.4.1 Vehicle Fueling

The fueling stations, as appropriate, will have secondary containment structures installed around the fuel tanks with a leak detection system to alert personnel in the event a tank leaks fuel to the secondary containment.

5.10.3.4.2 Vehicle Maintenance

Regular vehicle maintenance will be performed in an area designated for that purpose. Any spills will be cleaned up promptly. Precautions will be taken to prevent the release of pollutants to the environment from vehicle maintenance. Precautions will include the use of drip pans, mats, and other similar methods. No vehicle washwater will be allowed to run off the EGC ESP Site or enter local, state, or federal waters.

5.10.3.4.3 Excavated Areas and Stockpile Management

To prevent the mobilization of contaminants in stormwater runoff from entering and/or leaving excavated areas, the following controls on erosion and sedimentation controls will be implemented, as applicable and as found appropriate to control the material.

- Stockpiles of excavated soils will be placed on plastic sheeting near the excavation areas.
- Stockpiles will be provided with liner, cover, and perimeter berm to prevent rupture and release or infiltration of liquids.
- Polyethylene sheeting will be used for liners and covers.
- A perimeter berm, typically hay bales placed beneath the liner, will be constructed to allow for collection of any free liquids draining from the stockpile.
- Accumulated free liquids will be pumped or otherwise removed to a sanctioned area or container.
- Covers and perimeter berms will be secured in place when not in use and at the end of the workday, or as necessary to prevent wind dispersion or runoff from major precipitation events.

5.10.3.4.4 Material Handling

The following material handling and housekeeping practices described below will be implemented during EGC ESP Facility operations, as applicable and as found appropriate.

- Auxiliary fuel tanks will have secondary containment. The area will be kept free of trash and spilled fuel.
- Garbage receptacles will be equipped with covers. This includes such receptacles that contain materials that may be carried by the wind or contain water-soluble materials, (e.g., paint).
- Empty storage containers including drums and bags will be stored inside a designated storage building or area.
- Containers will be kept closed except as necessary to add or remove material.
- Containers will be stored in such a manner to prevent corrosion that could result from contact between the container and ground surface, and in a release of material.
- The containers will be appropriately labeled to show the name, type of substance, health hazards, and other appropriate information, if applicable.
- MSDSs for chemical substances used or stored on site will be available for review and use.

5.10.3.5 Traffic Control

The roads and highways within the immediate vicinity of the site will experience an increase in use, especially at the beginning and end of the workday. However, the immediate area surrounding the site is now rural, and the nearby roads and highways are not heavily traveled. It is expected that EGC ESP Facility personnel will be living in areas dispersed nearly uniformly in all directions from the site, and will travel relatively uniformly in all directions. Thus, no significant congestion problems are expected due to EGC ESP Facility operations.

Traffic and traffic control impacts may include, but are not limited to:

- Working adjacent to or in active roadways (day/night);
- Traffic control zones;
- Traffic control device installation;
- Flagging, if applicable;
- Inspection and maintenance of traffic control devices;
- Equipment; and
- General roadway traffic control zone safety.

Some local, state, and Department of Transportation (DOT) plans may have requirements that are more stringent. However, the local, state, and federal requirements regarding traffic control on and off site from active facility operations will be adhered to.

5.10.3.6 Land Use Impacts

Section 5.1 presents a discussion of the land use impacts incurred from siting a reactor at the EGC ESP Site.

Presented in the following sections are selected excerpts from Section 5.1 and associated conclusions.

5.10.3.6.1 Site and Vicinity

Operation will be limited to the operation of facility structures and transmission corridors. In addition, up to approximately 96 ac will be disturbed at the EGC ESP Site. No undesirable land use impacts are anticipated to affect surrounding communities. Normal recreational practices near the site are not anticipated to change as a result of the operation of the EGC ESP Facility. Roads and highways in the vicinity of the site will be less traveled compared to during construction.

As detailed in Section 4.1.1.3, there are no federal, state, or regional land use plans for the area. However, DeWitt County has published a countywide generalized land use plan, which designates the site for industrial land use. This plan guides future land use throughout the county and has designated the site for transportation and utility use. Further, the county land use plan targets expansion and spin-off development from the existing power plant as ways to realize further economic development in DeWitt County.

5.10.3.6.2 Heat Dissipation System Impacts to Land Use

Potential impacts to land use from cooling towers would primarily be related to drift from a cooling tower plume. In addition, the potential for fogging, icing, or drift damage may also result from a cooling tower plume. Both wet and dry mechanical draft cooling are being considered for the EGC ESP Facility. If dry mechanical draft cooling technology is used, there will be no cooling tower plume. Thus, there will be no impact to land use from the plume. If wet mechanical draft cooling technology is used, there will be a mist plume from the cooling tower. While there is the potential for minor drift, fogging, and icing to occur, it is expected to be of such small magnitude that no land use changes will result.

5.10.3.6.3 Transmission Corridor Impacts and Impacts to Off-Site Areas

Land use impacts from transmission corridor operations primarily fall into two broad categories including maintenance roads for access to pole structures and vegetation control in the right-of-way. The transmission corridor for the EGC ESP Facility will be within the existing right-of-way. No other off-site areas are proposed in association with the EGC ESP Facility. Therefore, no conflicts are apparent between the project and the objectives of land use plans described in Section 2.2.2. Operation and maintenance of the proposed transmission system will be the responsibility of the RTO. It has been assumed that operation and maintenance activities will be conducted in a similar manner to the existing transmission facilities.

5.10.3.6.4 Historic Properties

No historic standing structures have been identified within the EGC ESP Site power block footprint or in the immediate vicinity of the CPS Facility. Impacts of the operation of the EGC ESP Site will be no more than what is described regarding the impact from construction.

5.10.3.7 Water-Related Impacts

Section 5.2 describes the analysis and assessment of anticipated hydrological alterations on water supply and to water users that may result from the EGC ESP Facility. The topics covered include:

- Hydrologic alterations resulting from station operations and the potential impacts on other surface and groundwater users;
- Adequacy of water sources proposed in order to supply total station water needs;
- Water quality changes and possible effects on water use;
- Engineering controls, practices, and procedures that may be used to mitigate, minimize, or avoid impacts; and
- Identification and compliance with federal, state, regional, and local regulations that are applicable to water use and water quality.

The evaluation of potential hydrological alterations was conducted relative to how they may impact the water environment and both surface water and groundwater users including domestic, commercial, municipal, agricultural, industrial, mining, recreation, navigation, and hydroelectric power.

The CPS NPDES permit allows a 90-day average maximum discharge temperature of 99°F and a maximum daily allowable temperature not to exceed 110.7°F. The CPS NPDES permit also requires monitoring for flow, temperature, pH, total residual chlorine, and total residual oxidant (IEPA, 2000).

One target established for the EGC ESP Facility is to maintain a discharge rate within the CPS NPDES permit conditions. With 66 percent (winter) to 84 percent (summer) of the permitted discharge flow already used by the CPS, the EGC ESP Facility must maintain lower discharge flows by using a less consumptive cooling process to reduce the volume of water withdrawn and discharged.

The need for the selected cooling method to incorporate some form of low consumption wet/dry cooling will also depend on the water available for use during drought conditions.

5.10.3.7.1 Fresh Water Streams

5.10.3.7.1.1 Flow Characteristics

The dam that forms Clinton Lake is operated to provide a minimum downstream release of 5 cfs from Clinton Lake to Salt Creek. This flow rate will not change under the operation of the EGC ESP Facility. The total annual discharge volume to Salt Creek downstream of the dam will be slightly reduced by the value of the consumptive use of the lake water.

5.10.3.7.1.2 Floods

Flooding conditions downstream of the dam have been significantly reduced as a result of initial dam construction and flow attenuation in the Clinton Lake (see Section 2.3.1.1.3). Flood conditions will continue to be attenuated and may be further reduced with additional consumptive use of lake water.

5.10.3.7.1.3 Temperature Variations

With addition of the new EGC ESP Facility, temperatures are expected to increase by a minimal level described for Clinton Lake in the following section. The minimal change will be further diminished as flow moves downstream from the Clinton Lake Dam. No change is expected at Rowell, as the temperatures at that location are under the stronger influence of natural stream temperature moderating processes.

5.10.3.7.2 Lakes and Impoundments

5.10.3.7.2.1 Floods

The operation of the EGC ESP Facility is not expected to have a significant impact on flooding. The EGC ESP Facility will obtain cooling water from the lake and discharge a smaller amount of water (intake less consumptive use) back to the lake. This results in no increase in lake levels and potentially lower lake levels during dry conditions based on the increased consumptive use identified.

5.10.3.7.2.2 Droughts

A drawdown analysis was completed to determine the capacity of the cooling water supply during dry periods. The 50- and 100-yr recurrence interval dry periods with a 5-yr duration were selected for the evaluation. Comparing the water use requirements for the various cooling methods (see Table 5.2-2) with the water availability from the drought analysis (see Table 5.2-3), it is apparent that several of the cooling methods analyzed have a consumption rate that exceeds the available water for severe drought conditions. If one of these cooling methods is selected then it may be necessary for periods of time to reduce or curtail plant

operation in order to protect the minimum lake level and the integrity of the UHS during severe drought conditions.

5.10.3.7.2.3 Temperature and Water Quality

Lake temperatures are expected to increase slightly with operation of the EGC ESP Facility. The temperature increase is expected to be proportional to the increase in flow and temperature that was observed for the CPS Facility. Both plant discharge temperatures are expected to be within the CPS NPDES permit limit of 99°F. The impact of any increase in temperature is expected to be most significant during the summer months where the difference between the intake water temperature and the wet bulb temperature are the smallest and when recirculating volumes are high.

Similar minimal impacts on dissolved oxygen are expected. Other conservative constituents, such as hardness and total dissolved solids, may increase as a result of evaporation if the wet or wet/dry cooling method is selected. The discharge will be diluted by lower dissolved solids in the lake and in the base flows from Salt Creek and North Fork of Salt Creek. Dissolved solids will also be passed downstream through the dam. Over time, a rise in ambient lake dissolved solids concentration is expected to a level of equilibrium higher than the current ambient level. Further discussion of dissolved solids concentration is included in Section 5.3.

5.10.3.7.3 Groundwater Use

It is anticipated that surface water (namely Clinton Lake) will be used to meet the operational water requirements of the EGC ESP Facility; groundwater will not be used as a source of water. In addition, based on the planned design of the EGC ESP Facility, no permanent groundwater dewatering system will be implemented. Thus, there are no anticipated hydrologic alteration impacts to groundwater from the operation of the EGC ESP Facility.

5.10.3.8 Water Use Impacts

Section 5.2.2 discusses the predicted impacts of station operation on water use including:

- Hydrologic alterations that could have impacts on water use including water availability;
- Water quality changes that could affect water use;
- Impacts resulting from these alterations and changes;
- Engineering controls, practices, and procedures that may be used to mitigate, minimize or avoid impacts; and
- Identification and compliance with federal, state, regional, and local regulations applicable to water use and water quality.

Presented in the following sections are the conclusions drawn from Section 5.2.2.

5.10.3.8.1 Fresh Water Streams

5.10.3.8.1.1 Water Availability

There are no major water users either upstream or downstream of Clinton Lake that draw water from Salt Creek or the Sangamon River. The 5-cfs minimum discharge from Clinton Lake to Salt Creek will be maintained in accordance with the CPS NPDES requirements.

5.10.3.8.1.2 Water Quality

Clinton Lake is expected to buffer potential water quality impacts to Salt Creek resulting from EGC ESP Facility operations. Downstream users will not be affected because the operating CPS and the EGC ESP Facility are expected to operate in compliance with their NPDES permits.

5.10.3.8.2 Lakes and Impoundments

5.10.3.8.2.1 Water Availability

Clinton Lake was designed and constructed to accommodate two similar sized power plants. The CPS is the first plant and the only major water user on the lake. Recreation is the secondary use of the lake, and includes camping, boating, and fishing. There are no other major identified withdrawals of water from Clinton Lake.

The EGC ESP Facility will be designed and operated to be compatible with the operation of the CPS and its NPDES permit. Incorporating wet/dry cooling rather than the more consumptive wet cooling process will minimize water consumption. Operation of the dam structure is also an important water management function. The dam outfall structure is operated in a passive manner with gate settings periodically set based on long-term weather conditions. Dam operation practices will be reviewed and revised in conjunction with the CPS, as appropriate. This will provide for maintenance of minimum flows in Salt Creek downstream of the dam and conservation of water in the lake impoundment for power plant operation and recreational purposes.

With these design considerations, there is expected to be a minimal impact on the operation of the CPS. The EGC ESP Facility operation will comply with federal laws related to hydrology and water quality.

5.10.3.8.2.2 Water Quality

The water quality of Clinton Lake is classified as an impaired water body by the IEPA. The causes of impairment include excess algal growth and metals. The power plant operation is not uniquely related to either of the impairments. Algal growth is related to nutrient levels in the water column that originate from the dominant agricultural land use in the vicinity. Metals concentrations in the water column and sediment have a number of sources including natural geologic formations, agricultural practices, and industrial sources. For both impairments, stormwater management and erosion control practices for sediment control are the best control option. Nutrients and metals attach to sediment and are effectively controlled with control of sediment in stormwater. Industrial pollution control practices, strategic materials selection, and corrosion control are also expected to be effective in reducing metals contributions from industrial sources.

5.10.3.8.3 Groundwater

It is anticipated that surface water (namely Clinton Lake) will be used to meet the operational water requirements of the EGC ESP Facility, and groundwater will not be used

as a source of water. In addition, based on the proposed design of the plant, no permanent groundwater dewatering system will be implemented. Thus, there are no anticipated groundwater use impacts resulting from the operation of the EGC ESP Facility.

5.10.3.9 Cooling System Impacts

Section 5.3 describes the impacts of the cooling system intake, discharge facilities, and the proposed measures and controls used to limit those impacts.

It is assumed that either mechanical draft or natural draft hyperbolic type cooling towers will be used for normal non-safety plant cooling, and mechanical draft type cooling towers will be used for safety-related cooling. The makeup water for the normal (non-safety) plant operations will be obtained through a new intake structure located next to the CPS intake structure on the North Fork basin of Clinton Lake. The intake will include a screening system similar in function to the CPS intake, but for a significantly smaller flow rate. Makeup water for the safety-related cooling towers will be supplied from the same intake structure, which will draw water from the bottom of the submerged impoundment within Clinton Lake (i.e., the UHS). The cooling tower(s) blowdown will be discharged to the CPS discharge flume that flows to the Salt Creek basin of Clinton Lake.

The discussion of the cooling system impacts have been divided into the following sections:

- Intake System;
- Discharge System;
- Heat-Discharge System; and
- Impacts to Members of the Public.

The conclusions drawn from these impacts are presented in the following sections.

5.10.3.9.1 Intake System

Although the specific design details have not been finalized, it is anticipated that the new intake structure will consist of a shore structure adjacent to the existing intake structure that allows access to the impounded water of Clinton Lake, down to the bottom of the UHS. The location of the intake structure will provide a secure source for makeup water to the UHS in the unlikely event of the failure of the Clinton Lake Dam.

5.10.3.9.1.1 Physical Impacts from Intake System

The slight increase in velocity across the intake end of the UHS is not expected to cause any change in the shoreline erosion, bottom scouring, induced turbidity, or silt buildup. The increased velocity may slightly increase the suspended solids concentration drawn into the cooling system. Suspended solids will tend to pass through the cooling system without impact.

5.10.3.9.1.2 Impacts on Aquatic Ecosystems from Intake System

The proposed intake facilities are of a similar nature to the CPS. The total number of fish lost, both juvenile and adult, as a result of operation of the proposed EGC ESP Facility, will be insignificant in comparison to the total number of fish that exist in Clinton Lake, as natural residents or through stocking programs.

5.10.3.9.2 Discharge System

The EGC ESP Facility cooling system will discharge to the CPS discharge flume. The layout of the CPS discharge flume and point of connection of the cooling system discharge from the EGC ESP Facility will be discussed at the COL phase when plant design information is available.

5.10.3.9.2.1 Thermal Impacts from Discharge

A thermal description of Clinton Lake is presented in Section 2.3. In general terms, the combined average discharge temperature from both the EGC Facility and the CPS is expected to be below the CPS NPDES permit maximum 90-day average limit of 99°F. The combined discharge flow rate will increase slightly, but will also fall within the CPS NPDES permit limit of 670,000 gpm. The combined discharge flow will increase from the CPS summer rate of 566,000 gpm to 615,000 gpm, increasing the total heat-discharge to Clinton Lake.

5.10.3.9.2.2 Chemical and Physical Impacts from Discharge

The EGC ESP cooling system may include certain chemicals to limit biological growth, deicing compounds, and anti-scaling materials that will ultimately be discharged to Clinton Lake. The chemical will be selected for their effectiveness and ability to minimize the impacts on water quality. The discharge-monitoring program will be revised, as necessary, to monitor for potential water quality impacts.

The chemicals used will be subject to review and approval for use by the IEPA and releases will be in compliance with water quality standards and an approved NPDES permit. The total residual chemical concentrations in the discharges to Clinton Lake will be subject to limits that will be established by the IEPA.

The proposed changes in the quality, quantity, and velocity of the discharged water are not expected to cause any change to shoreline erosion, bottom scouring, induced turbidity, or silt buildup in the discharge flume or at the point of entrance to Clinton Lake. The increased velocity of the intake and discharge may slightly increase the suspended solids concentration or turbidity of discharge waters to Clinton Lake. Observations will be made at the point of discharge to identify any impediment to the existing flow or cause any local erosion or scour of the existing flume.

5.10.3.9.2.3 Impacts to Aquatic Ecosystems from Discharge

Several cooling alternatives are being considered for the operation of the proposed facility. The alternatives will discharge cooling waters in a similar manner to the CPS flume. The discharge water temperature will continue at the NPDES permit level. Flows will increase slightly in the range of 1 to 8 percent. Under the discharge conditions, it is expected that certain fish species would migrate to other portions of Clinton Lake where temperatures are more tolerable. This condition is expected to continue with addition of the EGC ESP Facility.

5.10.3.9.3 Heat-Discharge System

The EGC ESP Facility will depend less on Clinton Lake for heat dissipation because the facility will use a mechanical cooling system of wet cooling or wet/dry cooling for the bulk of the plant cooling. The facility will pump cooling water from the cooling tower basins. After the water passes through the heat exchangers, it will be returned to the cooling tower

for cooling and discharge to the basin. A portion of the water will be evaporated in the cooling tower process, and a portion of the water will be discharged as blowdown to the discharge flume to limit the concentration of impurities in the basin water. The lake water will be used for make-up to the cooling tower in order to replace the evaporation and blowdown losses. The blowdown water will be discharged at an elevated temperature back into the lake. This water will be combined with the CPS discharge water, and the associated heat load will be dissipated through the lake cooling loop.

5.10.3.9.3.1 Heat Dissipation to the Atmosphere

The operation of the EGC ESP Facility will result in significant heat dissipation to the atmosphere in the immediate vicinity of the site. Depending on the type of cooling system(s) used to dissipate this heat, the rejected heat will be manifested in the form of thermal and/or vapor plumes from one or more locations at the site. The presence of water vapor plumes, associated with wet cooling processes, have the potential to result in a variety of physical or aesthetic impacts. The extent of impacts will depend on the increased moisture content of the air and the prevailing meteorological conditions. The presence of thermal plumes in the atmosphere, associated with dry cooling options, are not expected to have significant environmental or other impacts because the EGC ESP Facility will be located on property that is owned by the CPS. The CPS property boundaries are restricted from public access; any significant impacts attributable to the operation of the cooling towers for plant heat dissipation are expected to be limited to on-site locations. The nearest public roadway is more than 0.5 mi in any direction, and no significant impacts attributable to cooling tower operation are anticipated at or beyond these distances. Additionally, there is no agricultural or public land use in the immediate vicinity of the cooling towers, so salt deposition effects are not expected to be a concern. In terms of potential interaction with conventional fossil fueled emission sources, the proposed facility will only be installing standby and auxiliary power systems that will be used for emergency and backup purposes. As such, their use will be very limited and, for the most part, used only during periods when the EGC ESP Facility is not operational. Occasionally, during cold weather conditions, vapor/moisture plumes from the towers may be visible from some off-site locations depending on wind direction and other meteorological parameters.

5.10.3.9.3.2 Impacts to Terrestrial Ecosystems

Impacts resulting from the proposed heat dissipation system would be consistent, if not less significant, in comparison to the CPS. As noted in the preceding sections, potential impacts to terrestrial and aquatic ecosystems were monitored for a 5-yr period following the startup of the CPS.

5.10.3.9.3.3 Important Species

Operation of the proposed facility is not anticipated to adversely affect federally-listed, state-listed, threatened or endangered species at the site or within the site vicinity.

Several species of commercial or recreational value in the vicinity of the site include white-tailed deer, various species of waterfowl, and various species of small mammals. It is not anticipated that operation of the proposed facility will have significant adverse impacts to terrestrial species of commercial or recreational value.

5.10.3.9.3.4 Important Habitats

It is not anticipated that the proposed heat dissipation system will have any adverse impacts on the terrestrial environment within the Clinton Lake State Recreation Area. The proposed system will not inhibit access to or use of the terrestrial system surrounding Clinton Lake. Activities such as hunting, fishing, hiking, and other recreational activities that rely on the terrestrial environments of the Clinton Lake State Recreation Area are not anticipated to be impacted by operation of the EGC ESP Facility.

Weldon Springs State Recreation Area is located approximately 6 mi from the location of the proposed facility. Due to the location of this area, no direct impacts to this park are anticipated as a result of operation of the EGC ESP Facility.

Operation of the proposed facility is not anticipated to adversely affect any environmentally sensitive areas within the site vicinity and is not anticipated to have significant adverse effects on wetlands and floodplains. Any aquatic vegetation existing prior to the operation of the EGC ESP Facility will likely adapt to the new conditions.

5.10.3.9.4 Impacts to Members of the Public

Impacts to members of the public from the cooling system of the proposed EGC ESP Facility might include:

- Thermophilic organisms that could negatively impact human health;
- Thermal and/or vapor plumes; and/or
- Potential for increases in ambient noise levels from the operation of the EGC ESP Facility cooling system and towers.

5.10.3.9.4.1 Impacts from Thermophilic Organisms

Thermophilic organisms are microorganisms that are associated with cooling towers, and thermal discharges that may have a negative impact on human health. The presence and numbers of these organisms can be increased due to elevated temperatures in and around the cooling tower and discharge flume.

To reiterate the conclusions from Section 5.3.4, recent IDNR studies on Clinton Lake indicate that elevated water temperatures may be increasing the risk of the presence of pathogenic amoeba (*Naegleria fowleri*) in the thermal discharge zone and at the beach. Although the IDNR has expressed concern about the presence of *Naegleria fowleri* in Clinton Lake, they also have concluded that the risk to human health is very small and decided to allow swimming and water-skiing in the lake. In addition, the USNRC decided to approve the CPS uprate. The increase in heat which was proposed to be rejected to the lake due to the uprate is greater than the increase due to the EGC ESP Facility. Therefore, the EGC ESP Facility would not pose a significant increase of risk. Additionally, the EGC ESP Facility thermal discharges will be within the approved CPS NPDES permit, the limits on which are intended to minimize risks to human health.

Monitoring will be performed, as appropriate and if required, for the presence of thermophilic organisms, and the potential health risk will be evaluated during preapplication monitoring. If the health risk is judged to be significant, the EGC ESP Facility may choose to use an alternate cooling process that will add no heat to the lake, and therefore, not change the existing degree of risk.

If wet cooling is selected, the cooling tower water will be treated with biocides to prevent the growth of dangerous organisms. Monitoring programs will be established to test for the presence of thermophilic microorganisms once the EGC ESP Facility is operational, both to protect on-site workers and the public.

5.10.3.9.4.2 Cooling Tower(s) Thermal and/or Vapor Plumes

The EGC ESP Facility will be located on property that is owned by the CPS. The distances to the CPS property boundaries are large and necessarily restricted from public access; therefore, any significant impacts attributable to the operation of the cooling towers for plant heat dissipation are expected to be limited to on-site locations. The nearest public roadway is more than 0.5 mi in any direction, and no significant impacts attributable to cooling tower operation are anticipated at or beyond these distances. Additionally, there is no agricultural or public land use in the immediate vicinity of the cooling towers, so salt deposition effects are not expected to be a concern. In terms of potential interaction with conventional fossil fueled emission sources, the proposed facility will only install standby and auxiliary power systems that will be used for emergency and backup purposes. As such, their use will be very limited and, for the most part, used only during periods when the EGC ESP Facility is not operational. Occasionally, during cold weather conditions, vapor/moisture plumes from the towers may be visible from some off-site locations depending on wind direction and other meteorological parameters.

5.10.3.9.4.3 Noise Impacts

The PPE data presented in Table 1.4-1 of the SSAR provides information on the amount of noise generated during operations if cooling towers are chosen as the preferred cooling method. For both the natural draft cooling towers and the mechanical draft cooling towers, the anticipated noise levels from cooling tower operations is anticipated to be 55 dB at 1,000 ft. The Department of Housing and Urban Development uses a day-night average sound level recommended by the USEPA as guidelines or goals for ambient noise levels outdoors in residential areas. Noise levels are deemed acceptable if the day-night average sound level outside in a residential area is less than 65 dB (24 CFR 51). Therefore, no additional noise monitoring is anticipated to be required.

5.10.3.10 Radiological Impacts from Normal Operation

Section 5.4 presents the radiological impacts from normal operations. Specifically addressed are the following topics:

- Exposure pathways;
- Radiation doses to members of the public and measures and controls to limit those impacts;
- Impacts to members of the public and measures and controls to limit those impacts; and
- Impacts to biota other than members of the public, and measures and controls to limit those impacts.

Conclusions drawn from Section 5.4 are presented in the sections that follow.

5.10.3.10.1 Doses and Impacts to Members of the Public

5.10.3.10.1.1 Impacts from the Liquid and Gaseous Pathways

Calculated doses to members of the public from active plant operations were compared to 10 CFR 50, Appendix I and 40 CFR 190 criteria. In all cases, calculated doses were well within the established criteria.

5.10.3.10.1.2 Direct Radiation

It is assumed that the direct radiation from any of the proposed EGC ESP Facility designs remains bounded by the CPS direct and skyshine dose from the turbine building.

5.10.3.10.2 Impacts to Biota

Radiation exposure pathways to biota other than man or members of the public were examined to determine if the pathways could result in doses to biota greater than those predicted for man.

Calculated doses to biota from liquid and gaseous effluents were compared to the doses provided in 40 CFR 190 and are considered conservative when applied to biota. In all cases, calculated doses were well within the established criteria.

5.10.3.10.3 Radiological Environmental Monitoring Program

To establish confidence and credibility that any radiological environmental monitoring data collected and reported are accurate and precise, monitoring activities will be incorporated into the construction phase quality assurance program established pursuant to 10 CFR 50, Appendix B, in concurrence with COL activities.

The EMP will utilize 10 CFR 50, Appendix B, compliant quality programs and processes to:

Provide that personnel are trained and qualified to perform radiological monitoring;

Create and approve procedures for sample collection, packaging, shipment, and receipt of samples for analysis, and prepare and analyze samples at the lab;

Document lab processes such as maintenance, storage, and use of radioactivity reference standards, and document the calibration and checks of radiation, radioactivity measurement systems, and sample tracking and control;

Document the processes and procedures of the monitoring program;

Conduct periodic audits of analysis laboratory functions and their facilities;

Maintain records of sample collection, shipment, and receipt. Lab activity records will also be maintained including sample description, receipt, lab identification, coding, sample preparation and radiochemical processing, data reduction, and verification.

In addition, the following activities will be performed:

- Perform duplicate analysis of the samples (excluding TLDs) to check laboratory precision;
- Routinely count quality indicator and control samples; and
- Participation in inter-comparison programs, such as the Environmental Resource Associates (ERA) cross-check program.

The analytical results provided by the laboratory will be reviewed monthly to validate that the required minimum sensitivities have been achieved and the correct analyses have been performed.

5.10.3.11 Environmental Impacts of Waste

Section 5.5 presents the environmental impacts of waste and measures and controls to limit those impacts. Specifically addressed are the following topics:

- Nonradioactive waste system impacts and measures and controls to limit those impacts; and
- Mixed waste impacts and measures and controls to limit those impacts

5.10.3.11.1 Nonradioactive Waste Systems

5.10.3.11.1.1 Solid Waste

Solid nonradioactive and non-hazardous waste may include office waste, aluminum cans, laboratory waste, glass, metals, paper, etc., and will be collected from several on-site locations and deposited in dumpsters located throughout the site. Segregation and recycling of waste will be practiced to the greatest extent practical. An outside vendor will perform weekly collections and disposal.

5.10.3.11.1.2 Liquid Waste

The nonradioactive liquid wastes will be combined with plant circulating water and checked for proper pH and the presence of radiological and hazardous constituents prior to discharge to Clinton Lake. These discharges will comply with an approved NPDES permit for the EGC ESP Facility issued by the IEPA.

5.10.3.11.1.3 Gaseous Waste

The nonradioactive air emissions will be in compliance with the limits that will be established and imposed by the IEPA. These limits will be protective of the air quality in and around the EGC ESP Facility.

5.10.3.11.2 Mixed Waste

As a general practice, mixed waste will not be generated at the EGC ESP Facility, if at all possible.

The EGC ESP Facility personnel will place primary importance on source reduction efforts to prevent pollution and eliminate or reduce the generation of mixed waste. Potential pollutants and wastes that cannot be eliminated or minimized will be evaluated for recycling. Treatment to reduce the quantity, toxicity, or mobility of the mixed waste before storage or disposal will be considered only when prevention or recycling is not possible or practical. Environmentally safe disposal is the last option.

A PPWMP will be developed and implemented before initial reactor operations.

5.10.3.12 Transmission System Impacts

Section 5.6 describes the potential impacts on terrestrial and aquatic ecosystems induced by the operation and maintenance of transmission systems including operation and maintenance of rights-of-way. Operation of transmission lines and corridors necessary to connect a new plant to the grid will generally be the responsibility of the regional

transmission system operator, and EGC assumes that the transmission system operator will perform new impact studies.

5.10.3.12.1 Impacts to Terrestrial Ecosystems

There will be no construction of new right-of-way or access roadways required for the proposed transmission system. Land uses traversed by the proposed transmission corridor are predominantly agricultural. There may be temporary disturbances to agricultural activities during construction of the proposed transmission system, but following construction, the disturbed areas will be restored to preconstruction activities. Operation and maintenance activities in agricultural areas are typically minimal as the vegetative growth is under control.

Towers required for the transmission system may eliminate a small amount of productive agricultural lands, but the overall amount of land used will be insignificant in comparison to the total amount of agricultural lands along the proposed transmission corridor.

5.10.3.12.1.1 Important Species

Operation and maintenance of the proposed transmission system is not anticipated to impact federally-listed, state-listed, threatened or endangered species, or species of commercial or recreational value.

It is anticipated that construction of the proposed transmission system may temporarily displace certain recreationally valuable species including deer, small mammals, game-birds, and waterfowl. However, operation and maintenance activities are not anticipated to have adverse effects on species of commercial or recreational value.

5.10.3.12.1.2 Important Habitats

No adverse impacts to the Clinton Lake State Recreation Area are anticipated as a result of the operation and maintenance of the proposed transmission system.

Weldon Springs State Recreation Area is located approximately 6 mi from the location of the EGC ESP Facility. The proposed transmission system corridor is not located within the Weldon Springs State Recreation Area, and therefore, will have no direct impacts to the area.

Towers required to support the proposed transmission system will be sited in upland areas to the greatest extent possible. Appropriate construction procedures and best management practices will be utilized to make certain that the adverse impacts to any environmentally sensitive areas or important habitats potentially occurring along the proposed corridor are avoided.

5.10.3.12.2 Impacts to Aquatic Ecosystems

Transmission towers required for the proposed transmission system will be sited in upland areas within the existing utility corridor. Adverse impacts to watercourses, wetlands, and floodplains within the existing right-of-way will be avoided to the greatest extent possible.

Appropriate construction procedures and best management practices will be used to make certain that minimal disturbances occur to existing wetlands, floodplains, and other aquatic ecosystems located within or along the existing corridor. In marsh and emergent growth wetlands, vegetation maintenance is typically not required. In shrub and forested wetland

areas, mowing and trimming is periodically required to keep growth outside of the line areas and away from poles.

5.10.3.12.2.1 Important Species

Operation and maintenance of the proposed transmission system is not anticipated to impact federally-listed, state-listed, threatened or endangered aquatic species, or aquatic species of commercial or recreational value.

Appropriate federal and state wildlife agencies will be contacted to confirm the absence of federally-listed, state-listed, and threatened or endangered aquatic species along the proposed transmission system corridor.

No direct impacts to watercourses including Clinton Lake and other streams and tributaries along the proposed transmission system corridor are anticipated as a result of operation and maintenance. Therefore, impacts to commercially or recreationally valuable aquatic species are not anticipated as a result of the operation and maintenance of the proposed transmission system corridor.

5.10.3.12.3 Impacts to Members of the Public

5.10.3.12.3.1 Maintenance Practices

A major portion, approximately 88 percent, of the transmission line right-of-way proposed to serve the EGC ESP Facility will cross agricultural land. As part of the existing right-of-way agreements, it is assumed that farmers will continue to cultivate this land except for a small area around the H-Frame structure. Therefore, it is anticipated that existing access to the right-of-way is adequate, and that no permanent roads will be built on the right-of-way for either construction or maintenance. If access roads need to be constructed, these roads will be permitted to "grass-over" for grazing, aesthetics, and minimal maintenance.

Where the transmission lines cross public roads, a screen of trees will be left to minimize visual impacts from the lines. Any new access to the right-of-way, though not anticipated, will be constructed at oblique angles to the road in order to prevent line of sight down the right-of-way.

5.10.3.12.3.2 Electric Field Gradient

Although there are no standards to limit EMF levels in Illinois, EMF reduction measures will be incorporated into the design of the transmission lines and facility. Since there are no local criteria, a guideline of 5 mA maximum EMF will be maintained.

5.10.3.12.3.3 Communication System Reception

Audible noise or RI and TVI can occur from corona, from electrical sparking and arcing between two pieces of loosely fitting hardware, or from burrs or edges on hardware. Design practices for the proposed transmission lines include use of EHV conductors, corona resistant line hardware, and grading rings at insulators. The effect of corona on radio and television is dependent on the radio/television signal strength, distance from the transmission line, and the transmission line noise level.

5.10.3.12.3.4 Grounding Procedures

Ground faults will be installed to limit induced currents from the EMF given off by the lines. Sufficient ground rods will be installed to reduce the resistance to 10 ohms or less under

normal atmospheric conditions. With these construction operational measures taken into consideration, no impacts to members of the public are expected.

5.10.3.12.3.5 Noise Levels

During the construction of the H-Frame structures, there will only be slight noise impacts, if any, to members of the public.

When an electric transmission line is energized, an electric field is created in the air surrounding the conductors. If this field is sufficiently intense, it may cause the breakdown of the air in the immediate vicinity of the conductor (corona); corona can result in RI and TVI. This noise occurs at discrete points and can be minimized with good design and maintenance practices. Design practices for the proposed transmission lines will include use of EHV conductors, corona resistant line hardware, and grading rings at insulators.

Audible noise levels are usually very low and not heard, except possibly directly below the line on a quiet day.

5.10.3.13 Uranium Fuel Cycle Impacts

Section 5.7 addresses the uranium fuel cycle impacts associated with operations. As required by 10 CFR 51.51, every ER prepared for an LWR, and submitted on or after September 4, 1979, will take Table S-3, Table of Uranium Fuel Cycle Environmental Data, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials, and management of low-level wastes and high-level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor.

Table S-3 was originally promulgated in the early 1970s to generically address the environmental impacts of the uranium fuel cycle for LWRs that were to be considered in environmental analyses for construction permits. The LWR technologies being considered are all light-water-cooled nuclear power reactors with uranium dioxide fuel and therefore Table S-3 of paragraph (b) of 10 CFR 51.51 provides the environmental effects from the uranium fuel cycle for these reactor technologies. The detailed comparison in Section 5.7, of the underpinnings of Table S-3 shows qualitatively that the existing WASH-1248 environmental and health effects are conservative and appropriate for use by the new gas-cooled reactor technologies included in this ER.

5.10.3.14 Socioeconomic Impacts

Section 5.8 presents the impacts, and measures and controls to limit the socioeconomic impacts. The following topics discussed include:

- Physical impacts from EGC ESP Facility operations, and measures and controls to limit those impacts; and
- Social and economic impacts from EGC ESP Facility operations, and measures and controls to limit those impacts.

Conclusions drawn from Section 5.8 are presented in the sections that follow.

5.10.3.14.1 Physical Impacts from EGC ESP Facility Operation

Physical impacts are defined as noise, air, and aesthetic disturbances. Physical impacts will be controlled as specified by applicable regulations and will not significantly impact the site, vicinity, or region. As summarized in Section 5.8, local communities will not experience any physical impact from station operation. The road network has sufficient capacity to accommodate a substantial increase in volume. Thus, no significant congestion problems are expected from station operation.

Clinton Lake State Recreation Area and Weldon Springs State Recreation Area are the only major recreational facilities within the site vicinity. Since it is not anticipated that a significant number of workers will move to the region to work at the station, these facilities would not experience any abnormal influx in use due to station operation. Outside of the 6-mi radius of the site vicinity, there will be no physical (noise, air, and aesthetic disturbances) impacts from station operation.

5.10.3.14.1.1 Noise

Any equipment that exceeds the noise abatement criteria will use noise control devices. Equipment manufacturers will be required to guarantee that specifications on allowable octave bands will be met. Most equipment will be located inside structures; therefore, building walls will reduce outside noise levels. Further, reduction will be achieved as the noise travels to the property line. The heat dissipation system is anticipated to have a noise level of up to 55 dB and at a distance of 1,000 ft from the system. This level is below the typical outside noise criterion, 65 dB, for residential areas.

There are few rural families close to the site that may be affected by an increase in traffic noise generated by station employees, delivery trucks, and off-site shipments. It is anticipated that most vehicle trips will occur during normal weekday business hours. Additional traffic from the operation workforce, to and from the site, will increase the level of vehicular noise for those residents living along routes that access the EGC ESP Facility. However, the low volume highway, even with the added traffic, is expected to be below the noise criteria for residential areas.

Noise impacts from operation are anticipated to be minor for several reasons: noise levels are not expected to exceed 55 dB, 1,000 ft from the system; traffic noise will be limited to normal weekday business hours; and noise control devices will be used when necessary. The nearby Clinton Lake State Recreation Area will not be impacted by noise, since recreational facilities are well beyond 1,000 ft from the facility. The nearest campground is approximately 1 mi from the EGC ESP Facility.

5.10.3.14.1.2 Air Emissions

The annual average exposure at the site boundary from gaseous sources will not exceed applicable regulations during normal operation. Additional air emissions from the increased vehicular traffic from the new operation workforce will have a negligible effect on the area.

5.10.3.14.1.3 Aesthetics

The viewshed of the station is limited to only a few residences and recreational users in the vicinity. Based on the fact that the EGC ESP Site will have similar visual impacts as the CPS Facility (with the exception of the new plume from the heat dissipation system), the EGC

ESP Site will have a minor impact on aesthetic quality for nearby residences and recreational users of Clinton Lake.

5.10.3.14.2 Social and Economic Impacts from EGC ESP Facility Operations

Social and economic impacts include impacts to the economy, tax and social structure, housing, education, recreation, public services and facilities, transportation facilities, distinctive communities, and agriculture.

The operation workforce will consist of up to 580 people. Operation workforce salaries will have a multiplier effect, where money is spent and respent within the region. Local businesses in and around the City of Clinton may see an increase in business, especially in the retail and services sector during normal business hours. Though not expected to be significant, the additional employment may help to sustain existing businesses throughout the region, as well as provide opportunities for some new businesses. The effect of the EGC ESP Site may slightly improve the unemployment levels in the area.

In addition, the taxing districts will benefit from the EGC ESP Facility. The assessed value of the EGC ESP Facility will be substantial; therefore, the taxes paid to local jurisdictions will be sizeable. Other potential tax impacts will include an increase in state income tax revenue generated from the additional operation jobs and indirect salaries created by operation.

The abundance of existing housing within the surrounding area will mitigate against effects on rents or prices produced by the operation. Additionally, the majority of the operation workers will be from the region, where their educational requirements are already being met. The surrounding school systems will not experience any major influx of students because of the operation of the EGC ESP Facility.

The operation worker population will predominately reside within the region, and will commute to the facility. Therefore, it is not anticipated that there will be any additional peaks at recreational facilities within the region.

In general, no overcrowding of public facilities is anticipated because most of the operation workforce is not expected to move to the area. The EGC ESP Site is in a rural area; therefore, community services are not expected to be directly affected. Also, since private security guards will be used at the site, dependence on local police forces will not be required. Public facilities will be capable of absorbing the minor increase in load due to the small influx of people expected. The population in the region is fairly homogeneous, largely white, and not dominated by a particular ethnic group. The only special group within the region are two Amish communities located around the towns of Arthur and Arcola, which are 37-mi and 44-mi southeast of the site, respectively. These two areas are far enough away from the site that they will not be impacted by station operations.

No land is designated as agricultural land within the site. However, 82 percent is designated as agricultural land within the vicinity, and 93 percent is designated as agricultural land within the region. Since the land impacted by station operations will be limited to the site, no impact to agriculture is anticipated.

5.10.3.15 Decommissioning

Section 5.9 provides a brief discussion about decommissioning plans and impacts. The following information is provided for the reviewer and more detailed information is presented in Section 5.9.

This section reviews the environmental impacts of decommissioning the EGC ESP Facility. This ER supports an ESP; therefore, USNRC regulations do not require the applicant to inform the USNRC of its plans for decommissioning the facility. Consequently, no definite plan for the decommissioning of the plant has been developed (USNRC, 1999). Additionally, no financial assurances for decommissioning are required at the ESP stage. The general environmental impacts are summarized in Section 5.9, since the decommissioning plans and reports (and consequently detailed analyses of alternatives) are not prepared until cessation of operations.

CHAPTER 5

References

Chapter Introduction

None

Section 5.1

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CHAPTER 5

Tables

TABLE 5.2-1
Clinton Power Station Discharge Permit and Plant Cooling Flows

	Intake (gpm)	Discharge (gpm)	Consumptive Use (gpm)
NPDES Permit [a]	-- [d]	670,000	-- [d]
Clinton Power Station (Lake Cooling Loop)	566,000 (summer) 445,000 (winter) [b]	566,000 (summer) 445,000 (winter) [b]	8,292 [b, c]
Capacity Remaining (under current NPDES permit)	-- [d]	104,000 (summer) 225,000 (winter)	-- [d]

[a] IEPA, 2000
[b] CPS, 2002
[c] Evaporative loss in lake cooling loop
[d] Not applicable

TABLE 5.2-2
Water Use Requirements (Consumptive Use) for Plant Options and Cooling Methods

Bounding Plant Requirement	Wet Cooling Tower	Wet/Dry Cooling Tower[a]	Dry Cooling
Maximum	31,500 gpm	16,000 to 9,450 gpm	0 gpm
Minimum	8,000 gpm	8,000 to 2,400 gpm	0 gpm

Source: SSAR Table 1.4-1
[a] Assumes up to 70 percent of cooling is accomplished in the dry cooling process
Note: Additional forced evaporation due to these cooling methods is insignificant

TABLE 5.2-3
Lake Water Available for Use During Drought Events

Water Use	50-yr Drought	100-yr Drought
Total Water Available For Withdrawal	24,100 gpm	18,514 gpm
Water Consumed By Existing Uprated Plant	8,292 gpm	8,292 gpm
Water Available For Additional Use	15,808 gpm	10,222 gpm

TABLE 5.2-4
Water Discharge Requirements for Plant Options and Cooling Methods

Bounding Plant Requirement	Wet Cooling Tower	Wet/Dry Cooling Tower[a]	Dry Cooling
Maximum	49,000 gpm	14,700 gpm	0 gpm
Normal	12,000 gpm	3,600 gpm	0 gpm

Source: SSAR Table 1.4-1
[a] Assumes up to 70 percent of cooling is accomplished in the dry cooling process

TABLE 5.3-1
Flow and Velocity through a Cross-Section of the Ultimate Heat Sink

	Flow (summer)	Section Area (Elevation 690 ft)	Velocity (Elevation 690 ft)	Section Area (Elevation 675 ft)	Velocity (Elevation 675 ft)
Existing CPS System	566,000 gpm	13,580 ft^2	0.09 ft/sec	3,868 ft^2	0.33 ft/sec
Combined CPS and EGC ESP Facility Systems	615,000[a] gpm	13,580 ft^2	0.10 ft/sec	3,868 ft^2	0.35 ft/sec

[a] Includes the CPS summer flow (566,000 gpm) plus the ESP maximum discharge requirement using a wet cooling tower (49,000 gpm.)

TABLE 5.3-2
Average and Maximum Plant Discharge Values

	Flow (summer)	Temperature (Maximum 90-Day Average)	Temperature (Maximum Daily)
Existing CPS System	566,000 gpm	99°F	110.7°F
Combined CPS and EGC ESP Facility Systems	615,000[a] gpm	99°F	110.7°F
NPDES Permit	670,000 gpm	99°F	110.7°F

Source: IEPA, 2000
[a] Includes the CPS summer flow plus the ESP maximum water use requirement using a wet cooling tower.

TABLE 5.3-3
Velocity in the Discharge Flume

	Flow Depth	Cross Sectional Area	Flow	Velocity
Design Capacity	13 ft	2,038 ft^2	1,372,077 gpm	1.5 ft/sec
Existing CPS System	-- [a]	-- [a]	566,000 gpm	1.5 ft/sec
Combined CPS and EGC ESP Facility Systems	-- [a]	-- [a]	615,000 gpm	1.5 ft/sec

Source: CPS, 2002

[a] Data on the depth of the flow in the discharge flume and the corresponding cross sectional area are not available.

TABLE 5.3-4
Average Monthly Temperatures at Monitoring Point 4 (Near Plant Intake) from 1987 to 1991

Month	1987 (°F)	1988 (°F)	1989 (°F)	1990 (°F)	1991 (°F)
April	50.0	55.4	46.4	59.0	57.2
May	55.4	57.2	57.2	64.4	75.2
June	80.6	75.2	71.6	78.8	78.8
July	77.0	80.6	80.6	78.8	80.6
August	80.6	84.2	80.6	82.4	78.8
September	71.6	73.4	73.4	73.4	-- [a]

Source: CPS, 1992

[a] Data not available

TABLE 5.3-5
Qualitative Assessment of the Magnitude and Extent of Visible Vapor Plumes

Review Element	Wet Cooling	Dry Cooling	Wet/Dry Cooling
Visible Plumes	Visible plumes of significant length can be observed during cold, moist conditions. During moderate to high wind conditions, vapor plumes can result in a "fumigation" of the area in the immediate vicinity of the cooling towers.	No visible plume	Similar to the wet cooling option; however, the extent of visible plumes will be directly proportional to the ratio of wet/dry cooling.
Ground level fogging and icing	Fogging can occur during cool/cold weather, high humidity, and light or windy conditions. Icing can occur during sub-freezing conditions, or during high winds when drift droplet deposition can accumulate and freeze at ground level or on nearby structures. Most significant impacts will be in the immediate vicinity of cooling towers.	No fogging or icing impacts	Similar to the wet cooling option; however, the extent of fogging and icing impacts will be directly proportional to the ratio of wet/dry cooling.
Solids deposition	Solids deposition results from the entrainment of suspended solids in the circulated cooling water. The extent will depend on the number of cycles of cooling water concentration prior to blowdown. The majority of deposition typically occurs in the immediate vicinity of the tower(s), but can also occur, to a limited extent, farther downwind.	No solids deposition	Similar to the wet cooling option; however, the extent of solids deposition impacts will be directly proportional to the ratio of wet/dry cooling.
Cloud formation, shadowing and precipitation	Cloud formation and precipitation is a very rare occurrence and only occurs for large cooling towers and during very cool/cold temperatures and high humidity conditions.	No cloud formation	Similar to the wet cooling option; however, the extent of cloud formation potential will be directly proportional to the ratio of wet/dry cooling.
Interaction with existing pollution sources	No significant pollution sources are known to exist in the immediate vicinity of the EGC ESP Site. Very low potential for plume interaction is anticipated.	None	Similar to the wet cooling option; however, the extent of interaction potential will be directly proportional to the ratio of wet/dry cooling.
Humidity Increase	An increase in humidity levels would only be expected in the immediate vicinity of the towers.	No increase in humidity	Limited local increase in humidity downwind.

TABLE 5.4-1
Liquid Pathways Parameters

Description	Parameter
Effluent Discharge [a]	2,400 gpm
Source Term [b]	Isotope Maximum Composite Releases
Lake Volume [c]	74,200 ac-ft

[a] SSAR Table 1.4-1
[b] See Table 3.5-1
[c] CPS, 2002

TABLE 5.4-2
Liquid Pathways Consumption Factors for the Maximum Exposed Individual

Pathway	Adult	Teen	Children	Infant
Fish consumption	21 kg/yr	16 kg/yr	6.9 kg/yr	NA
Shoreline usage	12 hr/yr	67 hr/yr	14 hr/yr	NA
Swimming exposure (assumed same as shoreline)	12 hr/yr	67 hr/yr	14 hr/yr	NA
Boating (assumed)	100 hr/yr	67 hr/yr	14 hr/yr	NA

Source: USNRC, 1977
Note: Consumption factors from Regulatory Guide 1.109 Table E-5 in lieu of site specific values.

TABLE 5.4-3
Gaseous Pathways Parameters

Description	Value
Population Data	Tables presented in Chapter 2 of this report
Milk Production	Tables contained in Chapter 2 of this report
Vegetable Production	Tables contained in Chapter 2 of this report
Meat Production	Tables contained in Chapter 2 of this report
Source Term	Tables contained in Chapter 3 of this report
Meteorological Data	Tables contained in Chapter 2 of this report
Annual Average χ/Q	Tables contained in Chapter 2 of this report
Annual Average D/Q	Tables contained in Chapter 2 of this report
Annual Average Decayed χ/Q	Tables contained in Chapter 2 of this report
Annual Average Decayed D/Q	Tables contained in Chapter 2 of this report

TABLE 5.4-4
Gaseous Pathways Consumption Factors for the Maximum Exposed Individual

Pathway	Adult	Teen	Children	Infant
Leafy Vegetables	64 kg/yr	42kg/yr	26 kg/yr	NA
Meat	110 kg/yr	65 kg/yr	41 kg/yr	NA
Milk	310 L/yr	400 L/yr	330 L/yr	330 L/yr
Vegetable	520 kg/yr	630 kg/yr	520 kg/yr	NA

Source: USNRC, 1977
Note: Consumption factors from Regulatory Guide 1.109 Table E-5 in lieu of site specific values.

TABLE 5.4-5
Liquid Pathways – Maximum Exposed Individual Dose Summary

Case	Location	Organ Receiving Maximum Dose	Dose (mrem/yr)	Total Body Dose (mrem/yr)
Maximum Composite	Clinton Lake	Liver	1.33 (Teen)	0.95 (Adult)

TABLE 5.4-6
Gaseous Pathways - Maximum Exposed Individual Dose Summary

		Dose Rate (mrem/year)		
Location [b]	**Pathway**	**Total Body**	**Skin**	**Thyroid**[a]
Nearest Residence (0.73 mi SW)	**Plume**	3.9E-01	1.4E-0	NA
	Inhalation			
	Adult	1.2E-01	NA	4.8E-01
	Teen	1.2E-01	NA	6.0E-01
	Child	1.1E-01	NA	7.0E-01
	Infant	6.3E-02	NA	6.0E-01
Nearest Garden (0.93 mi N)	**Vegetables**			
	Adult	2.7E-01	NA	2.6E+0
	Teen	3.6E-01	NA	3.6E+0
	Child	6.8E-01	NA	7.0E+0
Nearest Meat Animal (0.93 mi N)	**Meat**			
	Adult	6.1E-02	NA	NA
	Teen	4.5E-02	NA	NA
	Child	7.3E-02	NA	NA
Nearest Milk Cow [c] (5.0 mi N)	**Cow Milk**			
	Adult	9.7E-03	NA	1.5E-01
	Teen	1.4E-02	NA	2.4E-01
	Child	2.7E-02	NA	4.7E-01
	Infant	5.0E-02	NA	1.1E+0
Nearest Milk Goat (4.4 mi SE)	**Goat Milk**			
	Adult	1.5E-02	NA	1.7E-01
	Teen	2.0E-02	NA	2.7E-01
	Child	3.4E-02	NA	5.4E-01
	Infant	5.9E-02	NA	1.3E+0

[a] Thyroid is the maximum organ for maximum exposed individual dose due to pathway and location shown.

[b] Locations are based on Tables 2.7-53 to 2.7-56.

[c] The nearest milking cow for human consumption is located beyond 5 miles.

TABLE 5.4-7
Liquid Pathways – Comparison of Maximum Individual Dose Compared to 10 CFR 50, Appendix I Criteria

Type of Dose	Appendix I Criteria Dose Objective	Point of Dose Evaluation [a]	Calculated Doses (mrem/yr)
Liquid Effluents			
Dose to total body from all pathways	3 mrem/yr each unit	Clinton Lake	0.95 Adult
Dose to any organ from all pathways	10 mrem/yr each unit	Clinton Lake	1.33 Teen Liver

Source: 10 CFR 50
[a] Location of the highest dose off site.

TABLE 5.4-8
Liquid Pathways Comparison of Maximum Individual Dose Compared to 40 CFR 190 Criteria

Type of Dose (Annual)	Design Objective	Calculated Dose
Whole body dose equivalent	25 mrem	0.95 mrem
Dose to thyroid	75 mrem	0.03 mrem
Dose to another organ	25 mrem	1.33 mrem (Liver)

Source: 40 CFR 190

TABLE 5.4-9
Gaseous Pathways – Comparison of Maximum Individual Dose Compared to 10 CFR 50, Appendix I Criteria

Type of Dose	Design Objective	Point of Evaluation	Calculated Dose
Gaseous Effluents (Noble Gases Only)			
Gamma Air Dose	10 mrad	Exclusion area boundary	1.35 mrad
Beta Air Dose	20 mrad	Exclusion area boundary	2.89 mrad
Total Body Dose	5 mrem	Exclusion area boundary	0.875 mrem
Skin Dose	15 mrem	Exclusion area boundary	2.94 mrem
Radioiodines and Particulates			
Dose to any organ from all pathways	15 mrem	Varies [a]	9.44 mrem (thyroid)

Source: 10 CFR 50
[a] Locations of highest pathway doses offsite.
Note: mrad = millirad

TABLE 5.4-10
Gaseous Pathways Comparison of Maximum Individual Dose Compared to 40 CFR 190 Criteria

Type of Dose (Annual)	Design Objective	Calculated Dose
Whole Body Dose Equivalent	25 mrem	2.26 mrem
Dose To Thyroid	75 mrem	9.44 mrem
Dose To Another Organ	25 mrem	3.71 mrem (bone)

Source: 40 CFR 190

TABLE 5.4-11
Gaseous Pathways – Annual Population Dose Results

Pathway	Calculated Doses (Person rem)	
	Total Body	**Thyroid (worst case organ)**
Plume	0.403	0.403
Ground	0.145	0.145
Inhalation	0.480	1.530
Vegetable Ingestion	0.108	0.109
Cow Milk Ingestion	0.392	3.350
Meat Ingestion	0.298	0.420
Total	1.830	5.950

TABLE 5.4-12
Direct Radiation – Estimated Annual Population Dose

Location	Estimated Dose (mrem)	Estimated Population Dose (person rem)
Nearest residence	0.9	2.7E-03
Recreation site	7.2E-02	4.8E-02
Nearest site boundary	0.8	NA

Source: CPS, 1982

TABLE 5.4-13
Natural Background – Estimated Whole Body Dose to the Population within 50 mi of the EGC ESP Facility

Source	Annual Individual Dose (mrem/yr)	Annual Population Dose [a] (person-rem/yr)
Terrestrial dose	140	3.6E+04
Man-made source dose	100	8.0E+04
Total background radiation dose	285	2.3E+05

Source: CPS, 1982
[a] Annual population dose based on projected residential population in year 2010 from Tables 2.5-2 and 2.5-4.

TABLE 5.4-14
Identified Important Species and Analytical Surrogates

Basis	Identified Species	Remarks	Surrogate Species
Aquatic Ecology			
Federally threatened	None identified		
State threatened	Spike (freshwater mussel)	Located 10 mi from EGC ESP Site, or about 4 mi from site vicinity	Freshwater invertebrae
Commercial or recreation	Channel catfish Hybrid striped bass Largemouth bass Walleye	Sport fishing. Hybrid striped bass and walleye are restocked in Clinton Lake	Freshwater fish; comparable size
Terrestrial Ecology			
Federally threatened	None identified		
State threatened	None identified	None within site or site vicinity	
Commercial or recreation	Whitetail deer and small game incl. turkey, rabbit, squirrel, raccoon	Hunted near EGC ESP Site	Raccoon, muskrat
	Waterfowl incl. ducks (various species), teal, coot, Canada goose, etc.	Hunted near EGC ESP Site	Duck
	Migratory shorebirds incl. sandpipers and heron	Not hunted	Heron

Note: See Section 2.4, Ecology

TABLE 5.4-15
Terrestrial Biota Parameters

Terrestrial Biota	Food Intake (g/d)	Body Mass (g)	Effective Body Radius (cm)	Food Organism
Muskrat	100	1,000	6	Aquatic Plants
Raccoon	200	12,000	14	Invertebrates
Heron	600	4,600	11	Fish
Duck	100	1,000	5	Aquatic Plants

Source: USNRC, 1986

TABLE 5.4-16
Shoreline (Sediment) and Swimming Exposures

Biota	Shoreline Exposure (hr/yr)	Swimming Exposure (hr/yr)
Fish	4,380	8,760
Invertebrates	8,760	8,760
Algae	NA	8,760
Muskrat	2,922	2,922
Raccoon	2,191	NA
Heron	2,922	2,920
Duck	4,383	4,383

Source: USNRC, 1986

TABLE 5.4-17
Parameters Used in Biota Dose Assessments

Parameter	Source or Bases
Freshwater aquatic plant elemental bioaccumulation factors	NUREG/CR-4013, Table 3.1.
Freshwater fish and invertebrate bioaccumulation factors	Regulatory Guide 1.109, Table A-1
Committed total body dose factors from ingestion of biota	Regulatory Guide 1.109, Table E-11
Tritium dose factor	NUREG/CR-4013, Table 3.8
Effective absorbed energies for internal doses.	NUREG/CR-4013, Appendix B
Total body water immersion dose factors	NUREG/CR-4013, Appendix B
Shoreline and sediment external dose factors	Regulatory Guide 1.109, Table E-6
Increase factor (2) factor for ground exposure	NUREG/CR-4013, Section 3.2.5
Noble gas total body immersion dose factors	Regulatory Guide 1.109, Table B-1
Total body inhalation dose factors	Regulatory Guide 1.109, Table E-7

TABLE 5.4-18
Total Body Dose to Biota from Liquid and Gaseous Effluents

	Liquid Effluents		Gaseous Effluents	
Biota	Internal Dose (mrem/yr)	External Dose (mrem/yr)	Internal Dose (mrem/yr)	External Dose (mrem/yr)
Fish	2.43E+00	3.82E+00	NA	NA
Invertebrate	6.11E+00	7.63E+00	NA	NA
Algae	2.78E+01	7.18E-03	NA	NA
Muskrat	1.34E+01	2.55E+00	1.66E-01	1.06E+00
Raccoon	4.57E+00	1.91E+00	1.66E-01	1.44E+00
Heron	6.63E+01	2.55E+00	8.30E-02	6.27E-01
Duck	1.20E+01	3.82E+00	1.66E-01	1.16E+00

TABLE 5.4-19
Comparison of Biota Doses to 40 CFR 190 Whole Body Dose Equivalent of 25 mrem/yr

Biota Meeting 40 CFR 190	Biota Exceeding 40 CFR 190
Fish	Algae
Invertebrate	Heron
Muskrat	
Raccoon	
Duck	

Source: 40 CFR 190

TABLE 5.4-20
Comparison of Biota Doses to IAEA 1992 Evaluated Daily Limits

Aquatic Biota 1,000 mrad/day [a]	Terrestrial Biota 100 mrad/day
Fish – 6.3 mrem/yr	Muskrat – 17 mrem/yr
Invertebrate – 14 mrem/yr	Raccoon – 8.1 mrem/yr
Algae – 28 mrem/yr	Heron – 70 mrem/yr
	Duck – 17 mrem/yr

[a] A dose equivalent of 1 mrem is approximately the same as 1 mrad of absorbed dose in tissue (man).

TABLE 5.7-1
Gas-Cooled Fuel Cycle Impact Evaluation

Reactor Technology Facility/Activity	Reference LWR (Single unit) (~1,000 MWe) 80% Capacity	GT-MHR (4 Modules) (2,400 MWt total) (~1,140 MWe total) 88% Capacity	PBMR (8 Modules) (3,200 MWt total) (~1,320 MWe total) 95% Capacity
Mining Operations			
Annual ore supply MT	272,000	337,140	337,140
Normalized annual ore supply MT	272,000	269,712	214,739
Fraction of reference LWR	1	0.99	0.79
Calculated number	314,011	269,712	214,739
Milling Operations			
Annual yellowcake MT	293	303	303
Normalized annual yellowcake MT	293	243	193
Fraction of reference LWR	1	0.83	0.66
Calculated number	283	243	193
UF_6 Production			
Annual UF_6 MT	360	379	379
Normalized annual UF_6 MT	360	303	241
Fraction of reference LWR	1	0.84	0.67
Calculated number	353	303	241
Enrichment Operations			
Enriched UF_6 MT	52	8.0	12.3
Normalized enriched UF_6 MT	52	6.38	7.9
Fraction of reference LWR	1	0.12	0.15
Calculated number	52	6.38	7.9
Annual SWU MT	127	204	194
Normalized annual SWU MT	127	163[a]	124
Fraction of reference LWR	1	1.29[a]	0.97
Calculated number	126	163	124
Fuel Fabrication Plant Operations			
Enriched UO_2 MT	40	6.11	9.5
Normalized enriched UO_2 MT	40	4.89	6.0
Fraction of reference LWR	1	0.12	0.15
Calculated number	40	4.89	6.0

TABLE 5.7-1
Gas-Cooled Fuel Cycle Impact Evaluation

Reactor Technology Facility/Activity	Reference LWR (Single unit) (~1,000 MWe) 80% Capacity	GT-MHR (4 Modules) (2,400 MWt total) (~1,140 MWe total) 88% Capacity	PBMR (8 Modules) (3,200 MWt total) (~1,320 MWe total) 95% Capacity
Annual Fuel Loading MTU	35	5.39	8.34
Normalized annual fuel loading MTU	35	4.3	5.31
Fraction of reference LWR	1	0.12	0.15
Reprocessing Plant Operations			
Annual spent fuel reprocessing MTU	35	0	0
Solid Radioactive Waste			
Annual LLW from reactor operations Ci	9,100	1,100 Ci; 98 m^3	65.4 Ci; 800 drums
Fraction of reference LWR	1	0.12	0.01
LLW from Reactor Decontamination & Decommissioning Ci per RRY	1,500	--[b]	2.2E+04 (5.30E+05 Ci after 24 years operation and 2 years decay)[a]
TRU and HLW Ci	1.1E+07	NA [c]	NA [c]

Source: 10 CFR 51.51, Table S-3 Table of Uranium Fuel Cycle Environmental Data

[a] Value larger than Table S-3.

[b] Data not available.

[c] Reprocessing is not considered in this evaluation.

Notes: The enrichment SWU calculation was performed using the USEC SWU calculator and assumes a 0.30% tails assay. The information on the reference reactor (mining, milling, UF_6, enrichment, fuel fabrication values) taken from NUREG-0116, Table 3.2, no recycling. The information on the reference reactor (solid radioactive waste) taken from 10 CFR 51.51, Table S-3. The calculated information on the reference reactor uses the same methodology as for the reactor technologies. The normalized information is based on 1,000 MWe and the reactor vendor supplied unit capacity factor. For the new reactor technologies, the annual fuel loading was provided by the reactor vendor. The USEC SWU calculator also calculated the kgs of Uranium feed. This number was multiplied by 1.48 to obtain the necessary amount of UF_6. The annual yellowcake number was generated using the relationship 2.61285 lbs of U_3O_8 to 1 kg U of UF_6; 1.185 kgs of U_3O_8 to 1.48 kg of UF6. The annual ore supply was generated assuming a 0.1 percent ore body and a 90 percent recovery efficiency. Co-60 with a 5.26 year half-life and Fe-55 with a 2.73 year half-life are the main nuclides listed for the PBMR D&D waste.

TABLE 5.7-2

Gas-Cooled Reactor SWU and Feed Calculation Results

Reactor Technology	Kgs Uranium Product	Weight Percent U235	SWU Quantity (MTU)	Kgs of U Feed Required	Tails Assay
GT-MHR	5,394	19.80%	204.373	255,918	0.30%
PBMR	8,340	12.90%	194.414	255,679	0.30%
NUREG-0116	35,000	3.10%	126.175	238,455	0.30%
WASH-1248	35,000	3.20%	147.280	223,965	0.25%

Notes: The reactor vendors supplied the “Kgs uranium product” and “weight percent U235.” The tails assay was assumed to be 0.3 percent to match NUREG-0116 with the exception of WASH-1248, which used a tail assay of 0.25 percent. The “SWU Quantity” and “Kgs of U Feed Required” were calculated using the USEC SWU Calculator. The results have not been normalized to equivalent electrical generation.

TABLE 5.7-3
10 CFR 51.51 Table S-3- of Uranium Fuel Cycle Environmental Data [a]
Normalized to Model LWR Annual Fuel Requirement [WASH-1248] or Reference Reactor Year [NUREG-0116])

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1,000 MWe LWR
Natural Resource Use		
Land (acres)		
Temporarily committed [b]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 110 MWe coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to 95 MWe coal-fired power plant.
Water (millions of gallons)		
Discharged to air	160	=2 percent of model 1,000 MWe LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1,000 MWe LWR with once through cooling.
Fossil Fuel:		
Electrical energy (thousands of MW-hour)	323	<5 percent of model 1,000 MWe output
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45 MWe coal-fired power plant.
Natural gas (millions of scf)	135	<0.4 percent of model 1,000 MWe energy output.
Effluents-Chemical (MT)		
Gases (including entrainment) [c]		
SO_x	4,400	
NO_x [d]	1,190	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	
Other gases		
F	0.67	Principally from UF_6, production, enrichment, and reprocessing. Concentration within range of state standards- below level that has effects on human health.
HCl	0.014	
Liquids:		

TABLE 5.7-3
10 CFR 51.51 Table S-3- of Uranium Fuel Cycle Environmental Data [a]
Normalized to Model LWR Annual Fuel Requirement [WASH-1248] or Reference Reactor Year [NUREG-0116])

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1,000 MWe LWR
SO_4^-	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3-600cfs., NO_3-20cfs., Fluoride-70cfs.
NO_3^-	25.8	
Fluoride	12.9	
CA^{++}	5.4	
$C1^-$	8.5	
Na^+	12.1	
NH_3	10.0	
Fe	0.4	
Tailings Solutions (thousands of MT)	240	From mills only-- no significant effluents to environment.
Solids	91,000	Principally from mills-- no significant effluents to environment.
Effluents-- Radiological (curies)		
Gases (including entrainment):		
Rn-222		Presently under reconsideration by the Commission.
Ra-226	0.02	
Th-230	0.02	
Uranium	0.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85(thousands)	400	
Ru-106	0.14	Principally from fuel reprocessing plants.
I-129	1.3	
I-131	0.83	
Tc-99		Presently under consideration by the Commission
Fission products and transuranics	0.203	
Liquids:		
Uranium and daughters	2.1	Principally from milling-- included tailings liquor and returned to ground -- no effluents; therefore, no effect on the environment.
Ra-226	0.0034	From UF_6 production.
Th-230	0.0015	

TABLE 5.7-3
10 CFR 51.51 Table S-3- of Uranium Fuel Cycle Environmental Data [a]
Normalized to Model LWR Annual Fuel Requirement [WASH-1248] or Reference Reactor Year [NUREG-0116])

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1,000 MWe LWR
Th-234	0.01	From fuel fabrication plants-- concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.
Fission and activation products	5.9E-06	
Solids (buried on site):		
Other than high level (shallow)	11,300	9,100 Ci comes from low level reactor wastes and 15,000 Ci comes from reactor decontamination and decommissioning -- buried at land burial facilities. 600 Ci comes from mills -- included in tailing returned to ground. Approximately 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1E+07	Buried at Federal Repository
Effluents-- thermal (billions of British thermal units)	4,063	<5 percent of model 1,000 MWe LWR.
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure	22.6	From reprocessing and waste management.

[a] In some cases where no entry appears it is clear from the background documents that the matter was addressed and that, in effect, the Table, should be read as if a specific zero entry had been made. However there are other areas that are not addressed at all in the Table. Table S-3 does not include health effects from the effluents described in the Table, or estimates of releases of Radon-222 from the uranium fuel cycle or estimates of Technetium-99 released from waste management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings.

Data supporting this table are given in the Environmental Survey of the Uranium Fuel Cycle," WASH-1248, April 1974; the "Environmental Survey of Reprocessing and Waste Management Portion of the LWR Fuel Cycle," NUREG-0116 (Supp. 1 to WASH-1248); the "Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG-0216 (Supp.2 to WASH-1248): and in the record of final rulemaking pertaining to Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive Waste Management, Docket RM-50-3. The contributions from reprocessing, waste management and transportation of wastes are maximized for either of the two fuel cycles (uranium only and fuel recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor which are considered in Table S-4 of §51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S-3A of WASH-1248.

[b] The contributions to temporarily committed land from reprocessing are not prorated over 30 years, since the complete temporary impact accrues regardless of whether the plant services one reactor for one year or 57 reactors for 30 years.

[c] Estimated effluents based upon combustion of equivalent coal for power generation.

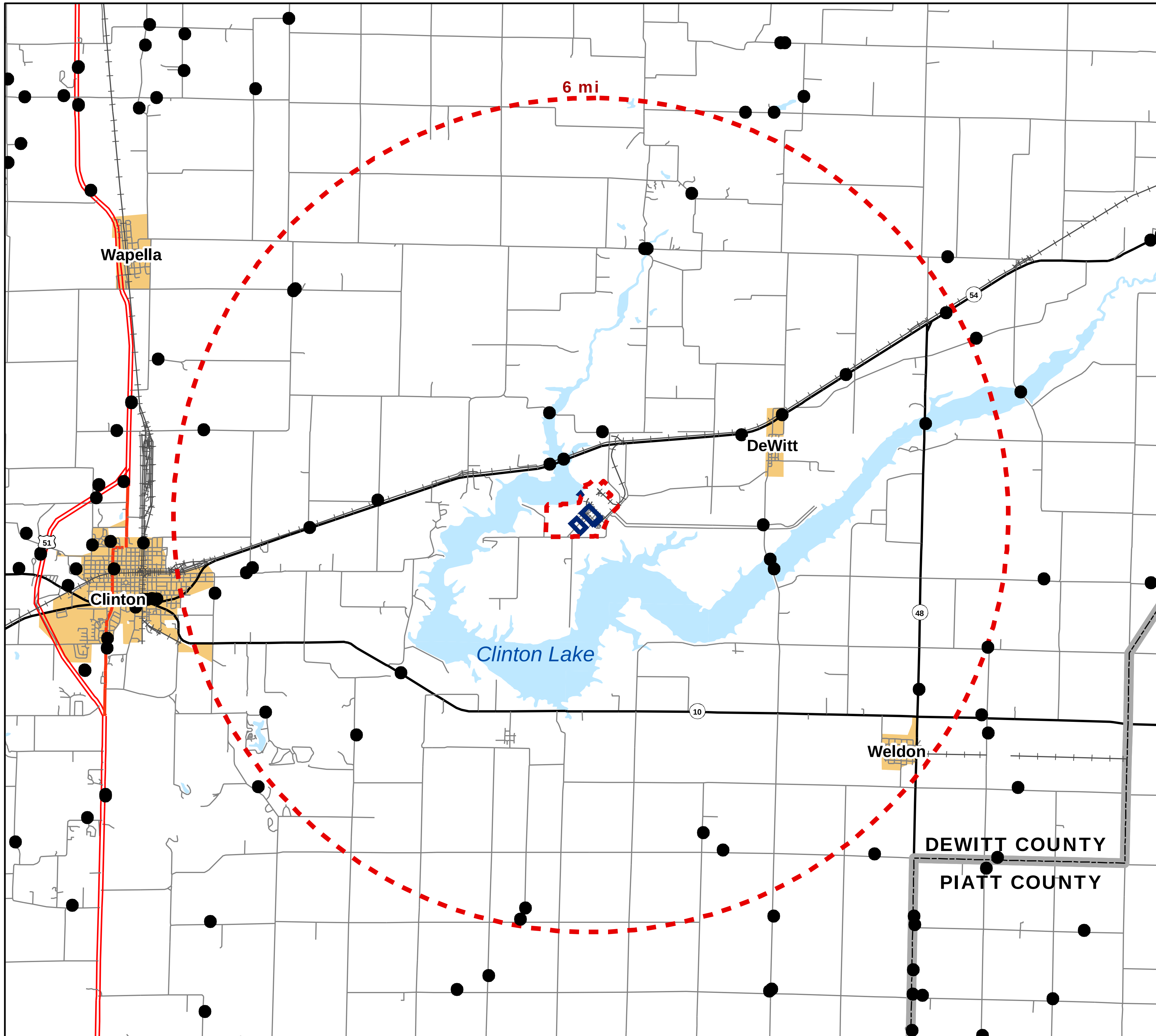
[d] 1.2 percent from natural gas use and process.

TABLE 5.10-1
Structural Control Measures

Control Measure	Location	Description of Control Measure
Silt Fencing	Along the perimeter of the site. Drainage areas should be less than 0.25 ac per 100 ft of fence length.	To protect streams or wetland areas, to prevent erosion, and to keep sediment on site. Silt fencing consists of posts with filter fabric stretched across the posts. The lower end of the fence is vertically trenched and covered with backfill. This prevents water from passing by the fence without being filtered. The fabric allows for the water to pass off site while retaining the sediment on site.
Check Dams	If applicable where the grade change is more than 2 percent or where practical.	A check dam is a small dam constructed across a drainage ditch or channel. Its purpose is to slow down the speed of the concentrated flows. The reduced runoff speed will result in less erosion and gulling in the channel and allow the sediment to settle out. The check dams can be built with materials such as straw bales, rock, timber, or other materials that will retain water.
Limit Entrance/Exit	Designated paved site entrances/exits.	The purpose is to reduce tracking of soil off the site.
Inlet Protection	Located around inlet areas to the storm sewer system.	Filtering material placed around an inlet to a receiving stream to trap sediment. It can be composed of gravel, stone with a wire mesh filter, block and gravel, or straw bales.
Sediment Basins	Sediment basins are required for drainage locations that serve 10 or more disturbed acres at one time. For drainage locations serving less than 10 ac, smaller sediment basins or sediment traps should be used.	Sediment basins are either temporary or permanent settling ponds with a controlled stormwater release structure. Their function is to collect and store sediment-laden stormwater from construction activities long enough to allow the sediment to settle. At a minimum, silt fences, vegetative buffer strips, or equivalent sediment controls are required.

Environmental Report for the EGC Early Site Permit

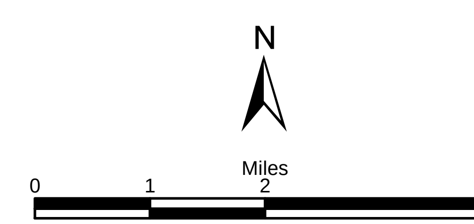
Figure 5.1-1
Location of Major Bridges in the Vicinity



Legend

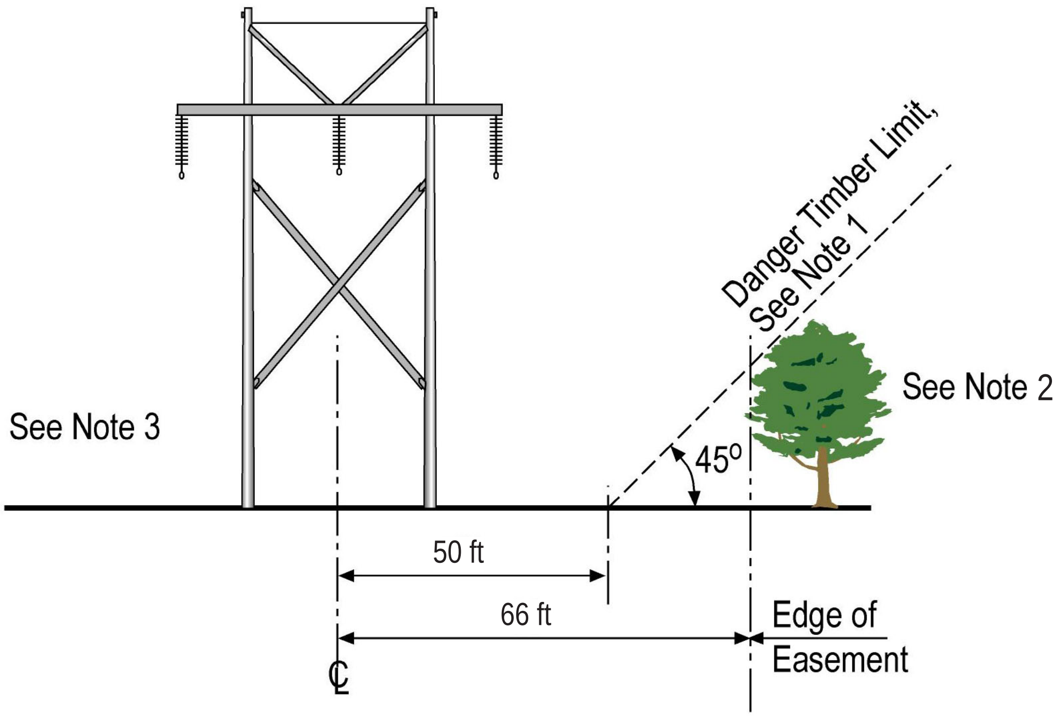
- Highway Bridges
- Proposed Areas for EGC ESP Facility Structures
- Site Boundary: Fenceline
- Vicinity: 6-mi radius around site
- U.S. Highway, Multilane divided
- U.S. Highway
- State Route
- County or other minor road
- Railroads
- Water: Lakes and Rivers
- Incorporated/Designated Places
- County Boundary

Data Sources:
IDOT, 2000
U.S. Census Bureau, 2000
U.S. Census Bureau, 2002
U.S. Census Bureau, 2002a



Environmental Report for the EGC Early Site Permit

Figure 5.1-2
345-kV H-Frame Structure



Notes:
1. Danger timber includes all timber extending above the danger timber limit.
2. If only the limbs of a tree extend into the easement strip, and it is not danger timber, do not cut.
3. Both sides of the clearing diagram are identical. On sloping ground, horizontal measurements must be used.

Not to Scale