DRAFT

Environmental Assessment for NorthStar Medical Technologies LLC Commercial Domestic Production of the Medical Isotope Molybdenum-99 (DOE/EA–1929)

Prepared for

U.S. Department of Energy
National Nuclear Security Administration
Defense Nuclear Nonproliferation/
Global Threat Reduction Initiative

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SUMMARY

Introduction

The majority of the world's molybdenum-99 (Mo-99) is produced at aging facilities in Europe, Canada, and South Africa, using primarily highly enriched uranium (HEU), a nuclear weapon material. Through the process of radioactive decay, Mo-99 produces the metastable isotope technetium-99m, which is used for medical diagnostic procedures. The uncertain reliability of the aging reactors currently used to produce Mo-99 and numerous statements that the Canadian National Research Universal reactor (a Mo-99-producing reactor) will cease medical isotope production in 2016 demonstrate the necessity to support establishment of a reliable supply in an accelerated timeframe. As part of its nuclear nonproliferation mission, the National Nuclear Security Administration (NNSA) is working through its Global Threat Reduction Initiative to (1) accelerate establishment of commercial Mo-99 production in the United States without the use of HEU; (2) encourage existing international producers to convert the use of HEU targets to that of low-enriched uranium targets for Mo-99 production; and (3) facilitate transition of this industry to an economically sustainable model that does not rely on Government subsidies to produce the isotope.

In March 2010, NNSA issued a funding opportunity announcement to establish cooperative agreements with commercial entities for the purpose of accelerating establishment of non-HEU-based technologies for production of the medical radioactive isotope (radioisotope) Mo-99. Based on the results of this effort, NNSA proposes to provide funding to one of its selected cooperative partners, NorthStar Medical Technologies LLC (NorthStar), for accelerator-based production of Mo-99 without the use of uranium in the town of Beloit, Wisconsin. In accordance with the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations, and U.S. Department of Energy (DOE) implementing procedures, NNSA is required to evaluate the impacts of any proposed actions that have the potential of affecting the quality of the environment. In compliance with CEQ regulations (40 CFR, Part 1500) and DOE's implementing procedures (10 CFR, Part 1021), NNSA has prepared this environmental assessment to meet its NEPA responsibilities related to the proposal to provide Federal funding to accelerate establishment of the commercial production of Mo-99 using accelerator-based technology without the use of HEU.

Purpose and Need

The overall purpose and need for NNSA action pursuant to the funding opportunity is to accelerate domestic endeavors to demonstrate and produce a reliable supply of the Mo-99 isotope using non-HEU technologies. NorthStar is one of the competitively selected companies chosen to demonstrate its technical proposal for the production of Mo-99. Following this selection and because of an existing Phase I cooperative agreement with NorthStar, NNSA has the opportunity to continue to support an accelerator-based technology to produce 3,000 6-day curies[1,2] per week of non-HEU-based Mo-99 in the United States by the end of 2014. This and other selected technologies are needed to reduce the potential for HEU proliferation and to produce a reliable domestic supply of Mo-99.

Proposed Action and Alternatives

This *Environmental Assessment for NorthStar Medical Technologies LLC Commercial Domestic Production of the Medical Isotope Molybdenum-99 (Mo-99 EA)* evaluates two alternatives. These alternatives include the proposed action and the No Action Alternative.

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1 A curie (Ci) is a unit of measurement describing the radioactive disintegration rate of a substance; 1 Ci is 3.700×10^{10} disintegrations per second (IOM 1995).

2 The term "6-day curie" ($Ci_{6\text{-day}}$) comes from producers that calibrate the sales price to the number of curies present in a shipment 6 days after it leaves the production facility (National Research Council 2009).

Proposed Action—NNSA's proposed action is to provide financial assistance to NorthStar in a cost-sharing arrangement under a cooperative agreement to accelerate establishment of the commercial production of Mo-99 using accelerator technology and without the use of HEU. The funding would help to accelerate the construction and initial operation of a linear accelerator (linac) and chemical processing facility (the NorthStar facility) in Beloit, Wisconsin, to produce Mo-99. Providing funding to NorthStar would expand NNSA's support of domestic non-HEU-based technologies to meet the U.S. commercial demand. Once NorthStar achieves the capacity to produce 3,000 6-day curies of Mo-99 per week, NNSA would no longer be financially or programmatically involved in the project. Using the funding provided by NNSA, NorthStar proposes to construct a linac and chemical processing facility in Beloit to produce Mo-99. The proposed project would provide commercial-scale production of the radioisotope Mo-99 using linac technology.

No Action Alternative— The No Action Alternative provides an environmental baseline with which impacts of the proposed project can be compared; this alternative is required by CEQ regulations and DOE NEPA implementing procedures. Under the No Action Alternative, NNSA would not provide funding for the proposed project. It is likely that, in the absence of funding, NorthStar would proceed with the project, but at a slower pace, which would delay construction of the proposed facility and establishment of the capacity to produce 3,000 6-day curies of Mo-99 per week. It is also possible that the proposed project could be canceled. Therefore, the NNSA No Action Alternative could result in one of two scenarios: (1) the proposed project would be pursued by NorthStar without the benefit of NNSA financing or (2) the proposed project would not be pursued. Under either scenario, if NNSA decided not to fund the project, there would be no continuing NNSA involvement and thus no Federal action.

For purposes of analysis and establishment of a meaningful environmental baseline in this EA, NNSA assumed that, under the No Action Alternative, NorthStar would not proceed, meaning that current environmental conditions and land uses would continue. This scenario would not contribute to NNSA's objective to accelerate establishment of a reliable U.S. supply of Mo-99 produced without the use of HEU.

Summary of Environmental Effects

This *Mo-99 EA* evaluates the potential environmental effects that could result from implementing the proposed project or the No Action Alternative. NorthStar expects that its capacity to produce 3,000 6-day curies per week would be achieved in less than 1 year following initiation of accelerator operations. NNSA's involvement with the NorthStar facility would be complete once NorthStar achieves the capacity to produce 3,000 6-day curies of Mo-99 per week. However, for purposes of evaluating potential environmental impacts of NNSA's funding action, this *Mo-99 EA* considers the requirements associated with a full year of operation.

Potential impacts of the proposed action for the resources evaluated in this *Mo-99 EA* include the following:

> **Geology and Soils—**Construction activities would include excavation and grading to prepare for building footings and foundations, construction material staging, and parking areas. Grading activities would likely affect only the upper 1.5 meters (5 feet) of surface soil and would not result in net removal of soil or additions of fill material. Excavation of the subgrade basement would result in removal of up to approximately 21,000 cubic meters (28,000 cubic yards) of soil and rock material. The excavated material would be either used on site for grading purposes (if of suitable properties) or transported off site for disposal or for use as construction fill material. The infrequent occurrence and low magnitude of previous earthquakes in the region indicate that impacts from earthquakes on the facility during operations are unlikely and are expected to be minimal.

Water Resources—Construction of the proposed facility and associated parking areas and roadways would likely involve conversion of less than 2 hectares (5 acres) of the property to impervious surface. This would result in a slight increase in potential runoff from the project site compared with the site's undeveloped state. Facility operations are not expected to require direct withdrawals of groundwater, as all required water would be obtained from municipal supplies. No impacts on wetlands or floodplains are expected.

Air Quality—Construction activities associated with the proposed facility would generate air pollutant emissions from site-disturbing activities, such as grading, filling, compacting, trenching, and operation of construction equipment. Emissions from construction activities would not affect local or regional National Ambient Air Quality Standards attainment status. Construction and operation activities would contribute directly to emissions of greenhouse gases. The maximum annual greenhouse gas emissions would be about 0.037 percent of Wisconsin's 2009 carbon dioxide emissions.

The proposed facility would produce air emissions from operation of the building's heating system. Process emissions are not expected, but the use of chemicals used to dissolve Mo-99 targets and the resulting evaporation could result in small emissions. Operations emissions under the proposed project are not expected to (1) cause or contribute to a violation of any Federal or State ambient air quality standard; (2) expose sensitive receptors to substantially increased pollutant concentrations; or (3) exceed any evaluation criteria established by a State implementation plan. In addition, operations emissions are not expected to trigger the need for a Prevention of Significant Deterioration or Title V operating permit.

Ecological Resources—Impacts on vegetation from construction of the proposed NorthStar facility would be negligible, as most of the vegetation at the project site is removed annually to allow for the growth of row crops. No impacts on federally or Wisconsin-listed species are expected from construction or operation of the proposed NorthStar facility, as these activities would occur on land that lacks suitable habitat.

Land Use—Agricultural use of the project site would cease with construction of the proposed NorthStar facility. The construction and operation of the proposed facility would be consistent with the City of Beloit's zoning for this site as limited manufacturing and future land use designation as Business Park.

Visual Resources—Exposed soils from construction would have a minor visual impact that would last for more than a year until the facility construction is complete and landscaping is installed. Heavy equipment at the project site would be consistent in appearance with other recent construction projects in the area, including Gateway Boulevard, the Alliant Energy substation, and housing units. The visual intrusion on the landscape would be similar to the disturbance for the electrical substation under construction to support the Gateway Business Park. The emissions stack for the chemical processing area would be approximately 18 meters (60 feet) tall and 0.6 meters (2 feet) in diameter. The height of this stack would be comparable to the overhead transmission power lines installed at the substation under construction north of the project site.

Noise—The closest residential area is approximately 210 meters (700 feet) to the south of the project site; populations would likely be exposed to noise levels of less than 65 decibels A-weighted from construction activities. Noise generation would last only for the duration of construction activities and would be limited to normal working hours. Noise would stem from the operation of linac and chemical processing equipment. While operations are likely to produce considerable noise, the noise would be contained within the production facility and would have no impact on the surrounding ambient noise levels. Employees working in this environment would follow best management practices, such as the use of hearing protection equipment, as necessary to limit exposure above the permissible levels defined by the Occupational Safety and Health Administration.

Infrastructure—Up to 1,000 megawatt-hours of electricity for construction would be required and supplied by Alliant Energy, the local utility; additional power for construction activities would be supplied by onsite generators, as needed. Operational power needs would be up to 144,000 megawatt-hours per year. Although demand on the existing electrical system would increase, it is not expected to exceed the existing supply or the ability to deliver it.

The proposed facility would use natural gas for heating and other building functions; however, the demand for natural gas from operation of the proposed facility is expected to be minimal and would not exceed the available supply.

Water demand would increase slightly during construction and operations; however, potential increases in water demand associated with construction and operations would be temporary and are not expected to exceed existing capacity.

Ground disturbance during construction would temporarily increase the potential for soil erosion and sediment transport during sheet-flow runoff. To minimize these impacts, an erosion control and stormwater management plan would be developed in accordance with Wisconsin Department of Natural Resources regulations. Soil compaction and increased impermeable surfaces (e.g., new structures, pavements, sidewalks) would decrease stormwater permeation into the ground and thereby permanently increase sheet-flow runoff into the stormwater drainage system.

The wastewater discharge needs of the proposed NorthStar facility would be met by connecting to the City of Beloit wastewater system. This would slightly increase the load on the system, but would be a small increment of the total system capacity.

No impacts on communications systems are expected during construction or operations of the NorthStar facility.

The level of vehicle and truck traffic on local roadways as a result of construction and operation activities is expected to be minimal and to not exceed existing design capacity. No additional transportation infrastructure or alterations to existing infrastructure would be required under the proposed project.

Human Health and Safety – Normal Operations—Construction would entail potential hazards to workers typical of any construction site. Normal construction safety practices would be employed to promote worker safety and reduce the likelihood of worker injury during construction. Nonetheless, construction accidents could occur.

Air emissions from the facility have the potential to contain radioactive material as a result of the accelerator operations and the dissolution and packaging of radioactive materials in the hotcells. However, the facility design and operation are intended to control the amount of radioactive material released to a negligible amount. Liquid waste generated during operations would be collected, temporarily stored on site, and sent off site for treatment and disposal. The proposed facility would not release any radioactive material through wastewater. No public dose from air emissions or wastewater is expected. Although radiological emissions are not expected, if any emission were to occur, impacts to the public would be negligible.

The potential sources of exposure for the workers include the activities associated with the linac irradiation of the Mo-100 targets, transfer of irradiated material into the hot cells, packaging and shipment of the Mo-99 product, and preparation of any radioactive waste for disposal. The Mo-99 production facility design and operation would include several features to limit worker dose. Only a fraction of the workers at the Mo-99 production facility are expected to receive any radiation dose; individual worker doses would not exceed the 5-rem-per-year regulatory limit.

Human Health and Safety – Accidents and Intentional Destructive Acts—A range of accidents involving radioactive Mo-99 or chemicals to be used in the process was evaluated. Risks to the public from most postulated accidents would be small. Impacts of extremely unlikely severe accidents, such as building collapse from an earthquake or explosion, could extend to members of the public. A severe accident causing release of the entire helium inventory (from the linac target-cooling system) could result in dispersion of hazardous concentrations to a distance of about 85 meters (280 feet) from the building; the distance from the building to the site boundary is about 20 meters (66 feet). A severe accident involving direct exposure to a freshly irradiated molybdenum target would result in a risk of a latent cancer fatality of 7×10^{-4} (1 chance in 1,400) to someone exposed at the site boundary for an hour. Although considered extremely unlikely, an intentional destructive act involving release of a significant portion of a freshly irradiated target would result in a risk of a latent cancer fatality of 8×10^{-5} to 3×10^{-4} (1 chance in 3,000 to 13,000) to a person at the site boundary.

Socioeconomics—Neither construction nor operations would involve any change in the number of personnel in the region of influence (ROI). The existing construction industry within the ROI is expected to adequately meet demands for the number of workers that would be required to complete construction activities. While workers in some specialized scientific disciplines may be needed from outside the ROI for facility operations, most of the operational labor force of 150 is expected to be supplied locally.

Cultural Resources—No historic properties are located within the area of potential effect for the proposed NorthStar facility. Construction impacts would be limited to the project site and are not expected to alter the current visible or audible characteristics of historic properties located in Rock County. Because no historic properties are located near the project site, operation of the proposed NorthStar facility would have no impact on cultural resources.

Waste Management—Excavation of the subgrade portion of the facility would generate up to 23,000 cubic meters (30,000 cubic yards) of soil/rock that would be disposed of off site if not used for onsite grading. The soil/rock material would be recycled/reused as construction fill for other construction or grading purposes, if the material properties are acceptable. Construction activities would generate about 160 metric tons (175 tons) of solid waste in the form of wood, metal, concrete, or other miscellaneous construction debris. Construction waste would be recycled to the extent practicable or disposed of at an appropriate licensed landfill or waste management facility.

Operation of the proposed NorthStar facility is expected to result in waste generation during the process of bombarding targets and preparing the Mo-99 product for shipment. About 10.4 cubic meters (14 cubic yards) of low-level radioactive waste, 2.4 cubic meters (3.1 cubic yards) of hazardous waste, and 45 cubic meters (59 cubic yards) of solid waste would be generated annually. No mixed low-level radioactive waste generation is expected. Existing commercial or municipal treatment and disposal facilities would be able to accommodate all projected quantities of waste generated by the proposed facility.

No process-water discharges are expected. Sanitary waste from the facility would be discharged to the sanitary sewer system; the quantity of waste, primarily from personnel water use would be a small addition to the load on the local sewer system.

Environmental Justice—Construction and operational activities are not expected to have adverse impacts on any of the local populations. Consequently, there would be no disproportionately high and adverse impacts on low-income or minority populations.

Energy Conservation, Renewable Energy, and Sustainable Design—Energy consumption would increase due to the construction and operation of the proposed NorthStar facility.

No Action Alternative—Under the No Action Alternative, NNSA would not provide funding through the Global Threat Reduction Initiative to NorthStar for the construction of a linac and chemical processing facility in Beloit, Wisconsin, to produce Mo-99. In the event the NorthStar facility is not built, as was assumed for the No Action Alternative that current environmental conditions and land uses would continue.

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ABBREVIATIONS AND ACRONYMS

AADT	annual average daily traffic
APE	area of potential effect
ALOHA	Areal Locations of Hazardous Atmospheres
AQCR	air quality control region
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	curie
CO_2	carbon dioxide
DART	days away from work, job restriction, or job transfer
dB	decibel
dBA	decibel A-weighted
DOE	U.S. Department of Energy
EA	environmental assessment
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
g	acceleration of gravity
GHG	greenhouse gas
GTRI	Global Threat Reduction Initiative
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HVAC	heating, ventilation, and air conditioning
I-	Interstate
IDA	intentional destructive act
JBWI	Rockford, Illinois–Janesville-Beloit, Wisconsin, Interstate
LCF	latent cancer fatality
linac	linear particle accelerator
MACCS	MELCOR Accident Consequence Code System
MACCS2	MELCOR Accident Consequence Code System, version 1.13.1
MEI	maximally exposed individual
MeV	million electron volts
Mo-99	molybdenum-99
Mo-99 EA	*Environmental Assessment for NorthStar Medical Technologies LLC Commercial Domestic Production of the Medical Isotope Molybdenum-99*
MVA	megavolt ampere
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Administration
NorthStar	NorthStar Medical Technologies LLC
PAC	Protective Action Criteria
PM_n	particulate matter with an aerodynamic diameter less than or equal to *n* micrometers
PSD	Prevention of Significant Deterioration
radioisotope	radioactive isotope

RCRA	Resource Conservation and Recovery Act
ROI	region of influence
SSPP	strategic sustainability performance plan
Tc-99m	metastable technetium-99
USGS	U.S. Geological Survey
WDNR	Wisconsin Department of Natural Resources

CONVERSION CHARTS

Metric to English			English to Metric		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area					
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Hectares	2.471	Acres	Acres	0.40469	Hectares
Concentration					
Kilograms/square meter	0.2048	Pounds/square foot	Pounds/square foot	4.882	Kilograms/square meter
Milligrams/liter	1 [a]	Parts/million	Parts/million	1 [a]	Milligrams/liter
Micrograms/liter	1 [a]	Parts/billion	Parts/billion	1 [a]	Micrograms/liter
Micrograms/cubic meter	1 [a]	Parts/trillion	Parts/trillion	1 [a]	Micrograms/cubic meter
Density					
Grams/cubic centimeter	62.428	Pounds/cubic feet	Pounds/cubic feet	0.016018	Grams/cubic centimeter
Grams/cubic meter	0.0000624	Pounds/cubic feet	Pounds/cubic feet	16,025.6	Grams/cubic meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F - 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cubic meters/second	2118.9	Cubic feet/minute	Cubic feet/minute	0.00047195	Cubic meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.78533	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.314	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1233.49	Cubic meters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons
English to English					
Acre-feet	325,850.7	Gallons	Gallons	0.000003046	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

a. This conversion is only valid for concentrations of contaminants (or other materials) in water.

METRIC PREFIXES

Prefix	Symbol	Multiplication factor
exa-	E	1,000,000,000,000,000,000 = 10^{18}
peta-	P	1,000,000,000,000,000 = 10^{15}
tera-	T	1,000,000,000,000 = 10^{12}
giga-	G	1,000,000,000 = 10^{9}
mega-	M	1,000,000 = 10^{6}
kilo-	k	1,000 = 10^{3}
deca-	D	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	μ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}

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1.0 INTRODUCTION

1.1 BACKGROUND

Every year, 30 million people around the world undergo medical diagnostic procedures that use the short-lived radioactive isotope (also called radioisotope)[1] metastable technetium-99 (Tc-99m); Tc-99m is the most commonly used medical radioisotope. Tc-99m is chemically attached to different carrier agents, allowing the isotope to be transported to, and concentrated in, specific parts of the body, such as the lungs, liver, heart, brain, and skeletal system. Tc-99m diagnostic procedures can enable doctors to determine how well the heart is functioning, whether cancer is present, and other critical medical information. Of the 30 million Tc-99m procedures conducted worldwide every year, over half are performed in the United States. Tc-99m is derived from another short-lived radioisotope, molybdenyum-99 (Mo-99). Today, the majority of the world's Mo-99 is produced at aging facilities in Europe, Canada, and South Africa, primarily using highly enriched uranium (HEU),[2] a nuclear weapon material. As part of its nuclear nonproliferation mission, the National Nuclear Security Administration (NNSA)[3] is working through its Global Threat Reduction Initiative (GTRI) to (1) accelerate establishment of commercial Mo-99 production in the United States without the use of HEU; (2) encourage existing international producers to convert the use of HEU targets to that of low-enriched uranium targets for Mo-99 production; and (3) facilitate transition of this industry to an economically sustainable model that does not rely on Government subsidies to produce the isotope.

In March 2010, NNSA issued a funding opportunity announcement (DE-FOA-0000323) to establish cooperative agreements with commercial entities for the purpose of accelerating establishment of non-HEU-based technologies for production of the medical radioisotope Mo-99. Based on the results of this effort, NNSA proposes to provide funding to one of its selected cooperative partners, NorthStar Medical Technologies LLC (NorthStar), for accelerator-production of Mo-99 without the use of uranium in the town of Beloit, Wisconsin (see Figure 1-1). In accordance with the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations, and U.S. Department of Energy (DOE) implementing procedures, NNSA is required to evaluate the impacts of any proposed actions that have the potential of affecting the quality of the environment. In compliance with CEQ regulations (40 CFR, Part 1500) and DOE's implementing procedures (10 CFR, Part 1021), NNSA has prepared this environmental assessment to meet its NEPA responsibilities related to the proposal to provide Federal funding to accelerate establishment of the commercial production of Mo-99 using accelerator-based technology. NorthStar is nearing completion of its requirements under the first phase of a cooperative agreement with NNSA to study the potential use of accelerators to produce Mo-99 without the use of HEU. NNSA provided funding to NorthStar for the initial studies, which adequately satisfy NEPA requirements (42 U.S.C 4321-4347). The second phase of the funding requires an analysis to examine the potential environmental impacts of NNSA's proposed action.

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1 Isotopes are forms of the same element having different numbers of neutrons and therefore having different mass numbers (like molybdenum-99 and -100). A radioisotope is "the name given to a substance in which the number of neutrons in the atom's nucleus have been increased or decreased to bring about nuclear instability manifested by the emission of radiation" (IOM 1995).

2 Uranium with an assay of the radioisotope uranium-235 equal to or more than 20 percent is called HEU (IAEA 2005).

3 NNSA is a semiautonomous agency within the U.S. Department of Energy.

Figure 1-1. Location of Beloit, Wisconsin

1.2 NNSA'S PURPOSE AND NEED

The United States is at a nexus of two related priorities—solving a health crisis arising from lack of sufficient supplies of Mo-99 and minimizing the use of nuclear proliferation–sensitive HEU in civilian applications, including in the production of medical isotopes. The approach to establishing a non-HEU-based Mo-99 production capability in the United States is to accelerate successful private-sector commercial ventures. Since fiscal year 2010, Congress has funded the Mo-99 program through the GTRI's Reactor Conversion Program, which aims to convert research reactors and isotope production facilities from using HEU to using low-enriched uranium. Since 2009, Congress has also funded the GTRI to accelerate establishment of a reliable supply of Mo-99 produced commercially in the United States without the use of HEU. Accordingly, as mentioned above, NNSA initiated a process to identify suitable projects to lead the way in producing a reliable domestic supply of Mo-99 without the use of HEU by issuing a funding opportunity announcement.

The overall purpose and need for NNSA action pursuant to the funding opportunity is to accelerate domestic endeavors to demonstrate and produce a reliable supply of the Mo-99 isotope using non-HEU technologies. NorthStar is one of the competitively selected companies chosen to demonstrate its technical proposal for the production of Mo-99. Because of an existing Phase I cooperative agreement with NorthStar, NNSA has the opportunity to pursue an accelerator-based technology to produce 3,000 6-day curies[4,5] per week of non-HEU-based Mo-99 in the United States by the end of 2014. This and other selected technologies are needed to reduce the potential for HEU proliferation and to produce a reliable domestic supply of Mo-99.

1.3 ENVIRONMENTAL ASSESSMENT SCOPE

This *Mo-99 EA* analyzes those aspects of Mo-99 medical radioisotope production that are related to NNSA's financial assistance support, through cooperative agreements, for accelerating development of the process to meet the United States' commercial demand. Once NorthStar achieves the capacity to

[4] A curie (Ci) is a unit of measurement describing the radioactive disintegration rate of a substance; 1 Ci is 3.700×10^{10} disintegrations per second (IOM 1995).

[5] The term "6-day curie" ($Ci_{6\text{-day}}$) comes from producers that calibrate the sales price to the number of curies present in a shipment 6 days after it leaves the production facility (National Research Council 2009).

produce 3,000 6-day curies per week, which is about half the historical United States' demand for Mo-99, NNSA would no longer be financially or programmatically involved in the project. NorthStar intends to pursue this venture even without the support of NNSA. This EA does not analyze the production and shipment of the raw materials used in the process, sale and shipment of the medical isotope product (radiochemical)[6] to the end-user, use of the product by the end-user medical facility. These are ongoing commercial activities that do not involve ongoing NNSA funding and for which there is no Federal decision to be made. Similarly, the ultimate disposition of the NorthStar facility is not included because it does not involve NNSA funding and would occur long after NNSA's involvement has ended.

1.4 AGENCY COORDINATION

Consultation letters were sent to the Wisconsin State Historic Preservation Office and the U.S. Fish and Wildlife Service.

1.5 PUBLIC INVOLVEMENT

NNSA sent notification letters to the following entities:

- Office of the Governor of the State of Wisconsin
- President of the Ho-Chunk Nation
- Tribal chairperson for the St. Croix Indians of Wisconsin (St. Croix Band of Lake Superior Chippewa)
- Repatriation/NAGPRA [Native American Graves Protection and Repatriation Act] committee chairperson of the Sac and Fox Nation
- NAGPRA/Special Project representative of the Peoria Tribe of Indians of Oklahoma
- Director of Environmental Services of the Iowa Tribe of Oklahoma

The letters indicated that NNSA intended to begin the NEPA process to prepare an EA on a proposal by NorthStar to establish a Mo-99 production facility in Beloit, Wisconsin (see Figure 1-2). These entities were notified that they would be afforded an opportunity to review and comment on a predecisional draft of this EA.

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[6] A radiochemical is a chemical that is a radioactive material.

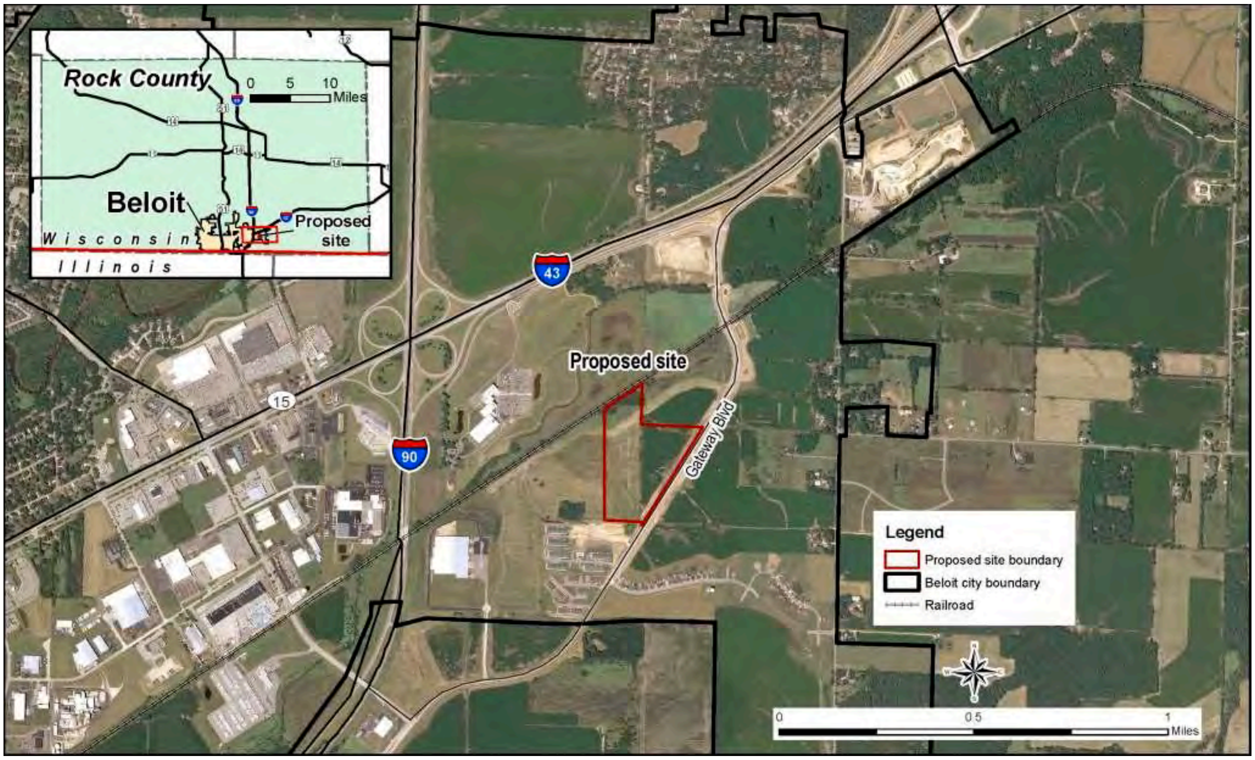


Figure 1-2. Location of NorthStar's Proposed Facility in Beloit, Wisconsin

2.0 PROPOSED ACTION AND ALTERNATIVES

This *Environmental Assessment for NorthStar Medical Technologies LLC Commercial Domestic Production of the Medical Isotope Molybdenum-99 (Mo-99 EA)* evaluates two alternatives. These alternatives are the proposed action and the No Action Alternative. The design for the Mo-99 production facility associated with the proposed action is still in the conceptual design phase. Thus, the final design and schedule as ultimately approved for construction may differ from those discussed in this *Mo-99 EA*.

2.1 NNSA's Proposed Action

NNSA's proposed action is to provide financial assistance in a cost-sharing arrangement under a cooperative agreement with NorthStar to accelerate establishment of the commercial production of Mo-99 using accelerator technology. The funding would help to accelerate the construction and initial operation of a linac[7] and chemical processing facility (the NorthStar facility) in Beloit, Wisconsin, to produce Mo-99. Providing funding to NorthStar for the accelerator production of Mo-99 would expand NNSA's support of domestic non-HEU-based technologies to meet the U.S. commercial demand. Once NorthStar achieves the capacity to produce 3,000 6-day curies per week, NNSA would no longer be financially or programmatically involved in the project.

2.2 NorthStar's Proposed Project

Using the funding provided by NNSA, NorthStar proposes to construct a linac and chemical processing facility in Beloit to produce Mo-99. The proposed project would provide commercial-scale production of the radioisotope Mo-99 using electron linac technology. Through the process of radioactive decay, Mo-99 produces Tc-99m, which is used for medical diagnostic procedures.

[7] A linac is a type of particle accelerator that substantially increases the velocity of charged subatomic particles, or ions, by subjecting the charged particles to a series of oscillating electric potentials along a linear beam.

Six steps are included in the production of Mo-99 using the technology proposed by NorthStar. These steps are (1) manufacture and shipment of the target material made of natural molybdenum or molybdenum enriched in the isotope Mo-100 (hereafter referred to as "enriched molybdenum"), (2) irradiation (also called bombardment) of the targets using linacs at the NorthStar facility, (3) processing of the targets at the NorthStar facility to produce the Mo-99 radiochemical, (4) shipment of the Mo-99 radiochemical from the NorthStar facility to the end-user medical facility, (5) return shipment of the spent/unusable portion of the radiochemical from the end-user facility, and (6) management of the spent or unusable portion of the Mo-99 radiochemical at the NorthStar facility.

This *Mo-99 EA* evaluates the NNSA-supported steps of the construction and operation of the proposed NorthStar facility for Mo-99 production. Analyses in this *Mo-99 EA* evaluate the following activities:

- Construction of a linac and chemical processing facility at Beloit for the production of the Mo-99 radiochemical
- Operation of the linac and chemical processing facility for irradiation of molybdenum targets by the NorthStar linacs and chemical dissolution of the targets
- Preparation of the Mo-99 radiochemical and packaging for shipment in the NorthStar processing facility (not including transport of the radiochemical to the end-user and not the end-user's use of the Mo-99)
- Management of waste (radioactive, hazardous, and nonhazardous) generated by the facility construction and operations, including chemical processing of targets

NorthStar expects that its capacity to produce 3,000 6-day curies of Mo-99 per week would be achieved in much less than 1 year following initiation of accelerator operations. However, for purposes of evaluating potential environmental impacts, this *Mo-99 EA* considers the requirements associated with a full year of operation.

Operations beyond meeting the production capacity of 3,000 6-day curies per week and those not funded by NNSA are not included in the *Mo-99 EA* analyses. The following activities are not within the scope of NNSA's proposed project and are not evaluated in this *Mo-99 EA*:

- Shipment of commercial products, including natural or enriched molybdenum target material, to the NorthStar linac and chemical processing facility
- Development, fabrication, procurement, or transport of Tc-99m generators used to separate Tc-99m from the Mo-99 and other components at the end-user's medical facility
- Transport of the Mo-99 radiochemical from the NorthStar facility to the end-user medical facility
- End-user use of the Mo-99
- Return transport of the spent or unusable radiochemical to the NorthStar facility
- Non-NNSA-supported activities and operations in other buildings, e.g., the Production Phase 1 Building, collocated at the Beloit facility, except for cumulative impacts (Section 5)
- Decontamination and decommissioning of the NorthStar linac and chemical processing facility in Beloit

2.2.1 Construction

NorthStar proposes to construct a linac and chemical processing production facility in Beloit to produce the Mo-99 radiochemical. The proposed 13.4-hectare (33-acre) project site is located at the north end of the Gateway Business Park (see Figure 2-1) between Interstate (I)-43 and Gateway Boulevard on property currently owned by Turtle Creek Development and NAI/MLG Commercial. This land has previously been used for agriculture, but is currently zoned for limited manufacturing and future land use designation as a business park (see Figure 2-2) (City of Beloit 2011d). Before construction would begin, the City of Beloit would purchase this property and transfer the property to NorthStar for development of the facility. It is the City's intention to include this property in Gateway Business Park.

Figure 2-3 shows a conceptual site configuration for the NorthStar facility. The red line represents the NorthStar property boundary, as well as a south-side right-of-way for an access road for the property to the west. An Alliant Energy electrical substation that would provide electricity to the NorthStar facility is under construction directly north of the proposed facility.

As shown in Figure 2-3, the current proposed NorthStar facility would have three operational areas: the administrative area, including the facility's administrative offices; the chemical processing area; and the linac area. The current design has these three areas in one large building. The walls between the administrative area and the chemical processing and linac areas would be concrete (or other shielding material) of sufficient thickness to provide shielding for the administrative workers. Occupants and visitors to the administrative area would not be radiation workers and would not require radiation monitoring (e.g., thermoluminescent dosimeters).[8] All walls surrounding the linacs would be concrete. Other walls would be of standard industrial building construction materials and thicknesses. The primary operations and activities in the Production Phase 1 Building, also shown in Figure 2-3, would be unrelated to the NNSA-supported Mo-99 initiative evaluated in this *Mo-99 EA*.

The arrows and dashed lines in Figure 2-3 represent a possible design for the flow of commercial traffic into and through the NorthStar facility. The traffic flow would be one way, entering from Gateway Boulevard to the driveway at the north end of the property and exiting to Gateway Boulevard from the

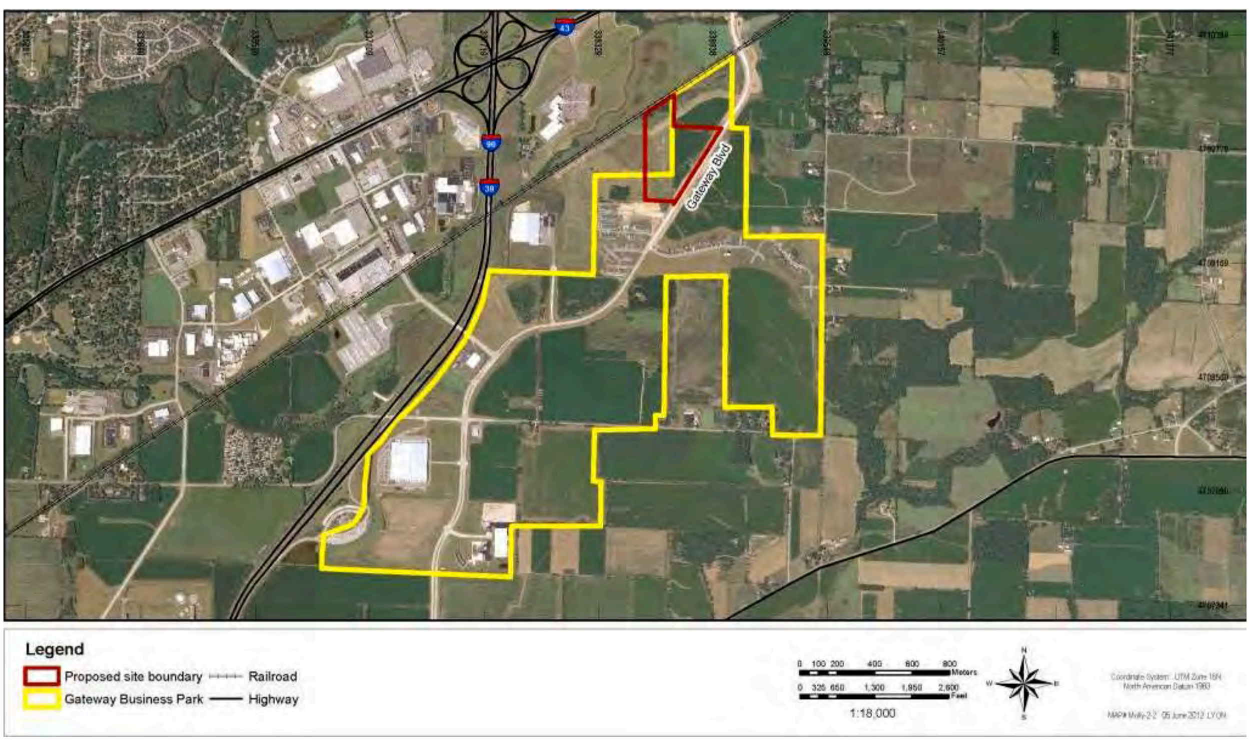


Figure 2-1. Project Location within Gateway Business Park

8 Thermoluminescent dosimeters are used to measure an individual's dose from direct exposure to external radiation.

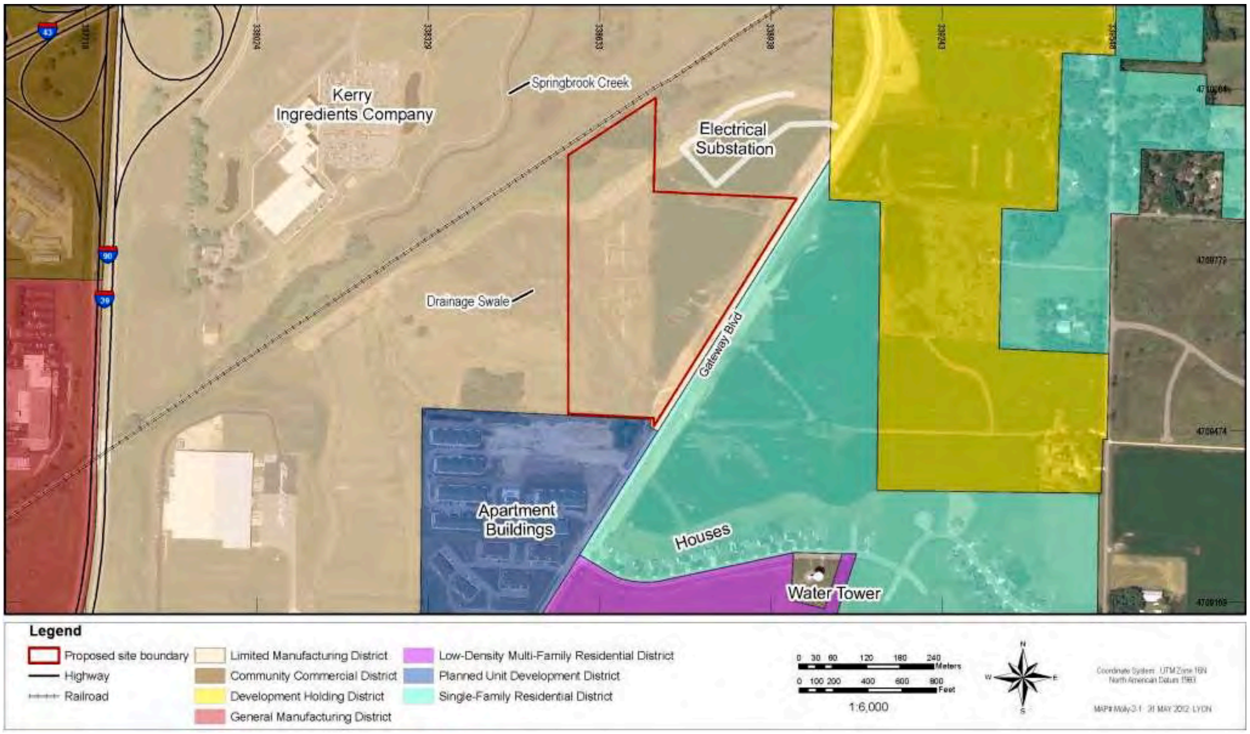


Figure 2-2. Zoning of the Lands Surrounding the Proposed NorthStar Facility Site

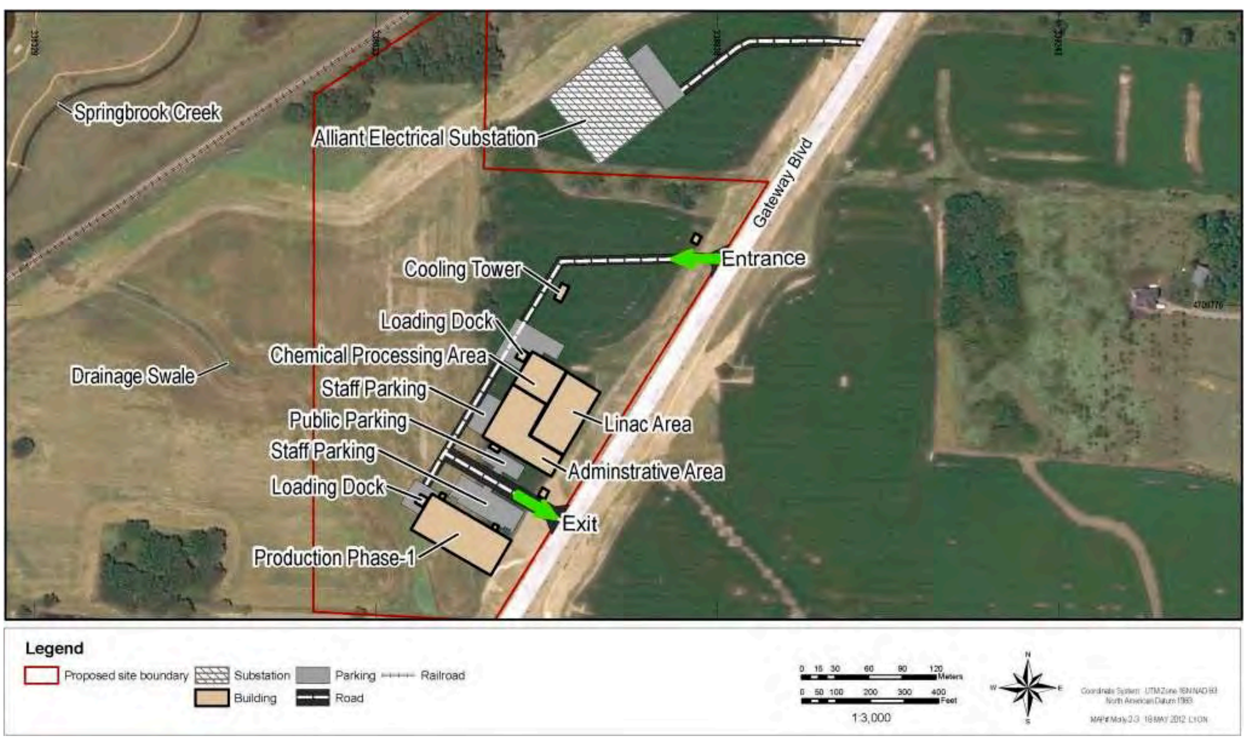


Figure 2-3. NorthStar Facility Conceptual Site Configuration

driveway south of the administrative area entrance. In this configuration, visitors to the administrative area and staff would access parking areas via the driveway south of the administrative area.

The building gross square footage estimate for the proposed NorthStar facility (excluding the Production Phase 1 Building) is 7,200 square meters (77,000 square feet). The administrative area, including quality laboratories and engineering laboratories, would be about 2,790 square meters (30,000 square feet); the chemical processing area would be about 930 square meters (10,000 square feet); and the linac area would be about 2,320 square meters (25,000 square feet).[9] The parking areas and driveways (all two-lane) would be paved, but are not included in the building gross square footage estimate. The size and configuration of the NorthStar facility described in this EA are based on early conceptual designs. Though the actual size and configuration of the buildings composing the NorthStar facility would evolve as the conceptual design matures and detailed requirements are developed, the potential environmental impacts would be comparable to those evaluated in this *Mo-99 EA*.

The NorthStar facility would house up to 16 compact linacs. NorthStar estimates that 12 of these would be needed to meet the production goals, leaving as many as 4 spares as surge capacity or to take over in the event an accelerator is down for maintenance (Harvey et al. 2011). All linacs would be of compact design and located below ground level. Figure 2-4 shows an example 20 to 35-MeV [million electron volts], 120-kilowatt-beam-power, single compact electron linac designed specifically for radioisotope production. The overall length of the machine is approximately 3 meters (10 feet). The linac requires about 650 kilowatts of electric power (Ross et al. 2010). A household microwave oven uses about 1 kilowatt of power.

Source: Ross et al. 2010.

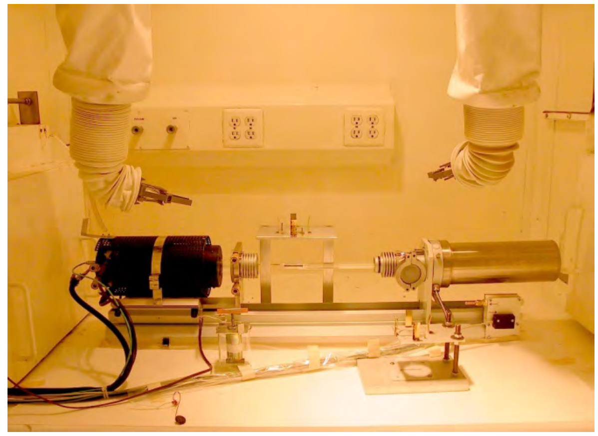
Figure 2-4. Compact Electron Linac

In its current configuration, the first floor of the NorthStar facility adjacent to the linac area would house the chemical processing area. The most notable feature of this part of the facility would be the "hot cells" where the irradiated targets would be remotely processed to produce the Mo-99 radiochemical. Each hot cell would have an in-cell workstation within the view and control of an operator. Hot cells normally include a shielded, leaded-glass window with a pair of through-the-wall master–slave manipulators; an in-cell work surface with appropriate tooling, lighting, and HVAC [heating, ventilation, and air conditioning]; and a means to transfer materials to and from other cells or access ports. Figures 2-5 and 2-6 show the elements of a hot cell operation: the operator on the outside of the hot cell uses controls to remotely operate the manipulators within the hot cell to perform a particular operation. NorthStar estimates that it would use two to four hot cell trains (hot cells linked together); each train would have four to five individual hot cells. The hot cells in a train would contain work stations for performing different steps in the process, e.g., receipt of the irradiated target assembly, dissolution of the targets, filtration, product purification/sterilization (if necessary), product packaging. Hot cell redundancy would be necessary for maintenance downtime and in the event of equipment failure. The means of transferring irradiated targets to the hot cells depends on the final configuration of the facility. As currently configured, irradiated targets would be placed in heavily shielded transfer containers referred to as "pigs" and transported by cart from the linac area to the chemical processing area. Under one design scheme, the linacs would be below the chemical processing area, with vertical access between the two levels. This configuration could allow transfer of irradiated targets from the linac area directly into the hot cells above.

9 The individual building areas are based on interior working space and thus do not total to the base gross square feet, which is based on the external dimensions of the facility.

Source: Los Alamos National Laboratory.

Figure 2-5. Hot Cell Shielded- Glass Viewing Window



Source: Oak Ridge National Laboratory.

Figure 2-6. Master-Slave Manipulators Inside Hot Cell

The chemical processing area would include shipping and receiving areas, a loading dock, utility rooms (e.g., HVAC, electrical), employee changing rooms, restrooms, research and development and quality assurance/control laboratories, and possibly a lunchroom. NorthStar expects to use natural gas for heating and for generators to provide backup electricity (if required). A stack for discharge of air emissions from the facility would be located above the chemical processing area. The stack would extend about 3 meters (10 feet) above the building roof and discharge approximately 140 cubic meters (5,000 cubic feet) of air per minute.

The construction schedule for the proposed facility has not been completed. The Production Phase 1 Building may be constructed before the Mo-99 production facility or at the same time. Construction of the Mo-99 production facility is scheduled to begin in the spring of 2013 and is expected to take about 18 months. During the construction phase, 5 to 50 workers would be on site.

NorthStar may use a closed-loop water cooling system to dissipate heat generated by their industrial equipment and the irradiation of targets. The water in the closed-loop system would be pumped to a cooling tower and through tubes with metallic fins (much like a car radiator). Fans would force air at ambient temperature past the tubes/fins to lower the temperature of the contained cooling water. Use of ambient air to remove heat is effective as long as the air temperature is at least 5 degrees Fahrenheit (^{o}F) lower than the required temperature on the downstream side of the cooling system. During the hottest parts of the year this may not be sufficient, so a hybrid system may be installed that would use limited evaporative cooling through either “wet-surface air-cooling” of the fins or direct cooling of the ambient air to achieve greater cooling capacity. In the wet-surface air-cooling mode, a mist of water is sprayed over the fins; in the direct-cooling mode, a mist of water is sprayed into the air stream before it passes over the fins. In both cases, additional cooling is achieved through evaporation. These technologies do not result in a liquid discharge because all of the added water is evaporated. As needed, one or more refrigerant-type coolers may be used where greater chilling capability is required.

Examples of dry air cooling towers, a “V-type” and flat-bed, are shown in Figure 2-7. The V-type cooling tower in Figure 2-7 has an integral wetted-surface cooling capability and provides about 2 megawatts of cooling capacity. The flat-bed cooling tower on the right has a cooling capability of about 1 megawatt. Figure 2-3 shows the approximate location and footprint of the proposed NorthStar cooling towers. The cooling tower would sit on a concrete pad about 7 by 15 meters (25 by 50 feet) and stand about 4.5 meters (15 feet) high. Any refrigerant-type cooling systems would be installed adjacent to or on top of the main facility.

Figure 2-7. Examples of Closed-Loop Dry-Air Coolers

2.2.2 Operations

2.2.2.1 Molybdenum Targets

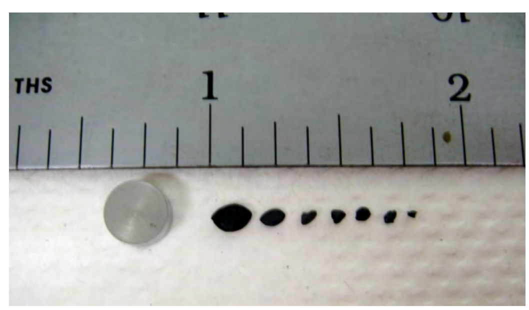
For analysis purposes, NorthStar assumes that the molybdenum targets to be used at the NorthStar facility would be coin-shaped and of small diameter and thickness, like those used in recent experiments (Dale et al. 2010). NorthStar's commercial production targets would be enriched in Mo-100. For development and testing, especially during startup, NorthStar would use natural molybdenum targets. Natural molybdenum disks typically come from cutting a metal rod, while the enriched molybdenum disks would be supplied in the form of pressed metal powder disks. The natural molybdenum disks would contain about 9.6 percent Mo-100, while the enriched disks would contain about 99.3 percent Mo-100 (see Table 2-1).

Table 2-1. Relative Isotopic Content of Natural and Enriched Molybdenum Targets

	Mo-92	Mo-94	Mo-95	Mo-96	Mo-97	Mo-98	Mo-100
Natural molybdenum	14.84	9.25	15.92	16.68	9.55	24.13	9.63
Molybdenum enriched in Mo-100	0.031	0.022	0.037	0.045	0.039	0.460	99.366

Key: Mo-99=molybdenum-99.
Source: Dale et al. 2010

While the thickness and composition of the disks are nominally relevant to the analysis in this *Mo-99 EA*, they are highly relevant to the production of Mo-99 because they affect irradiation effectiveness and, later on, target dissolution and Mo-99 production. Figure 2-8 shows the molybdenum disks before use and after bombardment in the linac and chemical processing areas. On the left is a 6-millimeter-diameter molybdenum disk prior to use and, on the right, the remnants of disks after irradiation and chemical processing.



Source: Dale et al. 2010.

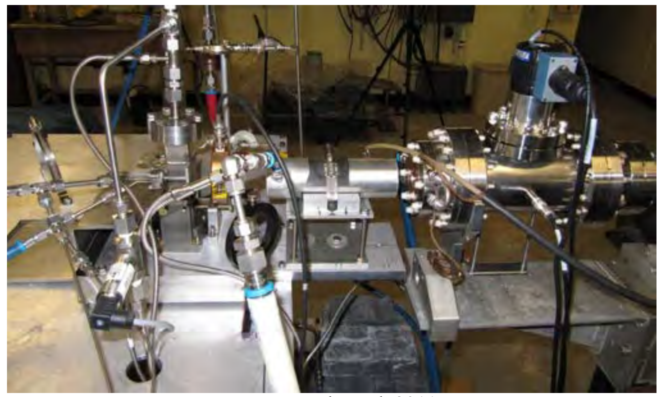
Figure 2-8. Molybdenum Disks Before and After Use

The target assembly would comprise several disks with spaces between disks to allow for a coolant to circulate between them during irradiation. NorthStar plans to use a closed-loop helium-cooling system.

2.2.2.2 Target Irradiation

NorthStar plans to use linacs in pairs to irradiate or bombard the targets from both ends. As described above, the target assembly would comprise a set of disks with spacing between, resulting in a cylindrical target assembly. The target assembly would be placed in an apparatus between a pair of linacs such that the beams would bombard opposite ends of the target assembly.

Figure 2-9 shows an experimental setup that is representative of one-half of a production assembly. The target assembly is in the apparatus shown at the left side of the figure; the linac beam is coming from the apparatus on the right. In a production setup, a second linac would be positioned to the left of the apparatus holding the target assembly. In this experimental setup, the targets were irradiated using the 20-MeV electron linac and were cooled with helium (Dale et al. 2011).



Source: Dale et al. 2011.

Figure 2-9. Molybdenum Target Testing Setup at Argonne National Laboratory

The power levels of the linacs at NorthStar would be significantly higher than those used in the experiment. The two tubes exiting to the left in the figure would be used for coolant circulation. The cylinder protruding at the upper right in the figure would hold the target disks, seen in gold and light carmine color. Activation foil would be used to determine the electron beam profile at the point just in front of the target.

The testing shown in Figure 2-9 was performed at Argonne National Laboratory with a target assembly loaded with seven disks and with the beam impinging on one end of the target (Dale et al. 2010). Modeling calculations to determine activation, heating, and exposure rates were performed at Los Alamos National Laboratory using a 25-disk target assembly with beam irradiation from each end at the same time (Kelsey 2012). These data and conditions may be more representative of the NorthStar process. To optimize production of the desired isotope, Mo-99, the target assembly would be irradiated for about 160 hours.

The linac beam can activate constituents in air (e.g., oxygen, nitrogen), producing airborne radioactive material. This would be managed by submerging the target assembly in water or paraffin. This arrangement prevents the production of activation products in the air and subsequent potential exposure to workers and release of radioactive emissions to the environment.

A large number of short-lived isotopes would be formed as a result of the irradiation (Kelsey 2012). Most of these would decay between the end of bombardment and time of target retrieval. About 2 hours after irradiation, the target assembly would be extracted from the target holder and placed into a plastic container using tongs or forceps to avoid contact radiation. The two primary isotopes produced in the irradiation would be Mo-99 and Tc-99m. Depending on whether the targets are composed of natural or enriched molybdenum, other radionuclides are expected at much lower production rates (e.g., zirconium-95, niobium-95) (Dale et al. 2010). The container with

Source: Dale et al. 2011.

Figure 2-10. Lead Transport "Pig" Container Used to Move the Irradiated Molybdenum Targets

irradiated disks would be placed inside a shielded pig (see Figure 2-10). The thick lead walls of the pig would reduce radiation levels outside the container and reduce the radiation exposure of workers who would transport the irradiated targets to the hot cells.

2.2.2.3 Cooling System

The NorthStar linacs and target irradiation generate a significant amount of heat that would need to be removed from the system. The direct cooling for the target setup was described earlier as a closed-loop system in which helium would be circulated through an enclosure around the target assembly, then pumped through piping to a cylindrical “shell and tube” heat exchanger. Inside the heat exchanger shell, the helium would pass through a tube-bundle around which cooling water would be circulated to remove heat from the helium. This circulated cooling water would be part of a closed-loop cooling system that would also be used to remove heat from the linacs and other associated equipment. The linac facility would require about 20 megawatts of total cooling capacity which would be provided by this closed-loop cooling system. For this cooling capacity and roughly a 10 ºF cooling temperature change, the estimated water flow rates in the closed-loop cooling system would be on the order of 1,600 liters (430 gallons) per minute (Dale 2012a).

The initial filling of the closed-loop water cooling system is estimated to take about 11,400 liters (3,000 gallons) of water. The water may need some pretreatment to minimize naturally existing chemical components or to adjust the acidity to within a range that would minimize the formation of scale[10] in the piping system. Over time, it may be necessary to periodically discharge and replace a portion of the cooling water to manage the scaling.

If one of the “hybrid” technologies is used, additional water use would occur during the hottest months. However, because the average high temperature in the hottest month of the year, July, is 83 ºF (TWC 2012) it is not expected that much additional water would normally be used. If water were used to augment the cooling, a vapor plume may be produced. Because the fans would be moving air at a high velocity through the system, the vapor plume would dissipate quickly.

For purposes of analysis, it is assumed that in the months of June through August, cooling capacity would be augmented by the use of water in a hybrid system. Using the average high temperatures of June (79 °F), July (83 °F) and August (81 °F), an estimated 23 liters (6 gallons) per minute of water would be needed for auxiliary cooling during the warmer parts of the day. Assuming that auxiliary cooling would be required for 8 hours per day, water usage would be about 11,000 liters (2,880 gallons) per day for a 3-month period.

Fans used would be “low-noise” fans producing no more than 60 decibels A-weighted (dBA) at a distance of about 9 meters (30 feet) from the cooling towers. Fans would not run continuously or always at the same speed as they are computer-controlled to only produce the desired temperature drop measured from the hot inlet port to the cooler outlet port.

Electricity would be used for pumps, cooling tower fans, and any auxiliary refrigerant-type coolers. Electrical usage for these systems would be about 12,600 megawatt-hours per year.

[10] Scale is caused by impurities being precipitated out of the water directly on heat transfer surfaces or by suspended matter in water settling out on the metal and becoming hard and adherent.

2.2.2.4 Radioactive Dose Information for Targets and Target Handling

Before entering the target cell area to remove target disks, sufficient decay time would be allowed so that the dose rate near the target would be at a safe level (e.g., 100 millirem[11] per hour at 30 centimeters [12 inches]). NorthStar would follow decay/delay times similar to those used in the testing at Argonne National Laboratory to allow dose rates to drop to acceptable levels. In the testing, these times included 44 minutes following the low-power enriched-target irradiation, 2.4 hours following the low-power natural-molybdenum-target irradiation, and 14 minutes following the high-power natural-target irradiation (Dale et al. 2010). Given these wait times, transferring the targets into shielded containers with 3 centimeters (1 inch) of lead shielding could result in a dose rate at the container surface of about 200 millirem per hour for the low-power enriched and high-power natural targets and about 100 millirem per hour for the low-power natural target. These data are only examples. NorthStar linacs would be operating at higher-power levels, thus the wait times would be different should manual target extraction be utilized. NorthStar could also use pigs that are more heavily shielded to provide additional worker protection during target transfer.

2.2.2.5 Chemical Processing of Molybdenum Targets

Chemical processing of the irradiated targets would take place in hot cells. The hot cells would be heavily shielded, gas-tight enclosures for the safe handling of high-dose-rate radioactive substances (see Figures 2-3, 2-4, and 2-11). Chemical processing would consist of dissolving the irradiated molybdenum metal targets.

Source: Oak Ridge National Laboratory.

Figure 2-11. Example Hot Cell Interior

NorthStar proposes to use a strong base to dissolve the molybdenum targets; which have been part of the testing, include hydrogen peroxide, sodium hydroxide, and potassium hydroxide. NorthStar may also use electrochemical methods to aid in dissolution. As NorthStar intends to use enriched-molybdenum targets, the only chemical processing necessary to produce the radiochemical to be shipped out would be dissolution. Following dissolution, the pH may be adjusted using potassium hydroxide and potassium nitrate would be used for redox control. The solution would be passed through a 0.45-micron particulate filter (Whatman™ or similar) to capture any particulates that may have entered somewhere in the process. This would take place in the chemical processing area.

2.2.2.6 Packaging for Shipment

The Mo-99 radiochemical product would be used in TechneGen™ Tc-99m generators at the user facilities. Because NorthStar would not load the Tc-99m generators at the NorthStar facility, it would only need to provide the users with vials of the molybdenum product solution. The users would place the vials in the generators at their facilities. NorthStar plans to ship the radiochemical vials in U.S. Department of Transportation–approved Type A containers (40 CFR178.350) holding no more than 20 curies each.

[11] A millirem is one-thousandth of 1 rem. A rem is a unit of radiation dose used to measure the biological effects of different types of radiation on humans. The dose in rem is estimated by a formula that accounts for the type of radiation, total dose absorbed by the body, and tissues involved.

2.2.2.7 Waste Production and Collection

Low-level radioactive waste generated from consumables used in the process, personal protective equipment, and miscellaneous materials removed from the hot cells would meet the definition of Class A wastes (10 CFR 61.55). Approximately one 208-liter (55-gallon) drum of waste would be generated per week, or about 11 cubic meters (14 cubic yards) per year. Low-level radioactive waste would be transferred to the Production Phase 1 Building for short-term storage pending shipment offsite to a licensed disposal facility.

Small quantities of hazardous materials would be generated. NorthStar estimates that it would generate about 0.2 cubic meters, or one 55-gallon drum, of hazardous waste per month. Waste would be accumulated in a 90-day storage area prior to transfer to a U.S. Environmental Protection Agency (EPA), Resource Conservation and Recovery Act (RCRA)-permitted treatment, storage, and disposal facility.

There would be no industrial discharges to the city sewer, only sanitary waste.

2.2.2.8 Staffing

Within the first year of operations, NorthStar expects a workforce of up to 150 people. Most of these workers would not be radiation workers[12] and would work in areas with no, or very low, potential for radiation exposure. About 50 full-time-equivalent workers would be classified as radiation workers and subject to a radiation dosimetry program. These workers' job duties would be primarily in the linac and chemical processing areas, operating the linacs, retrieving target assemblies, processing materials through the hot cells, packaging the Mo-99 product for shipment, and preparing radioactive materials for transfer to the Production Phase 1 Building.

2.3 NNSA'S NO ACTION ALTERNATIVE

The No Action Alternative provides an environmental baseline with which impacts of the proposed project can be compared; this alternative is required by CEQ regulations and DOE NEPA implementing procedures.

Under the No Action Alternative, NNSA would not provide funding to NorthStar for the construction of a linac and chemical processing facility in Beloit to produce Mo-99. If NNSA does not provide funding for this project, it is expected NorthStar would proceed, but at a slower pace. Therefore, constructing the facility and establishing the capacity to produce 3,000 6-day curies of Mo-99 per week would be delayed. However, it is also possible that the proposed project could be canceled. For purposes of analysis and establishment of a meaningful environmental baseline in this EA, NNSA assumed that, under the No Action Alternative, NorthStar would not proceed with the project. It is important to note that this assumption is for analytical purposes only, because if NNSA decided not to fund the project, there would be no continuing NNSA involvement and thus no Federal action. In this scenario, current environmental conditions and land uses would continue.

2.4 PERMITS AND AUTHORIZATIONS

As discussed in Section 1, NNSA issued a funding opportunity announcement indicating its intent to establish cooperative agreements with multiple commercial entities in the United States for the production of Mo-99 without the use of HEU. NNSA's decision to fund any particular cooperative agreement is based on evaluation of the individual merits of the proposed technology. As such, any other entities'

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[12] Specifically, U.S. Nuclear Regulatory Commission regulations (10 CFR, Part 19) describe radiation workers as those individuals who, in the course of their employment, are likely to receive a dose of more than 100 millirem in a year.

proposed technologies are not alternatives to the proposed project identified in this EA. As determined necessary in accordance with CEQ regulations and DOE NEPA implementing procedures, potential environmental impacts of NNSA proposals to fund other Mo-99 technologies will be evaluated in separate NEPA documents.

3.0 NORTHSTAR'S PROPOSED PROJECT – AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This section describes the existing physical, biological, and human environmental conditions of the project site and the potential environmental effects that could result from implementing the proposed project as described in Section 2. The potential impacts associated with the No Action Alternative are discussed in Section 4, and a discussion of potential cumulative effects is provided in Section 5.

3.1 PHYSICAL ENVIRONMENTAL AREAS

3.1.1 Geology and Soils

3.1.1.1 Affected Environment

The project site consists of approximately 13.4 hectares (33 acres) (Batterman et al. 2011) in Rock County, Wisconsin, located within an area of sloping upland at an elevation of about 244 meters (800 feet) above sea level (DOI 2007). The nearest surface-water body that receives existing surface drainage from the project site is Springbrook Creek, a small creek located about 400 meters (1,300 feet) north of the northern boundary and about 365 meters (1,200 feet) west of the western boundary of the parcel.

Soils

The project site includes soils of six soil map units (NRCS 2011). These soils and their approximate area percentages include Elburn silt loam (30 percent), Flagg silt loam (13 percent), Kidder silt loam (24 percent), Sogn loam (5 percent), Mahalasville silt loam (22 percent), and Pecatonica silt loam (6 percent). These soils are relatively shallow (generally less than 1.8 meters [70 inches] thick) and overlie glacial till or carbonate (limestone) bedrock (USDA-SCS 1974). The soils are slightly to moderately susceptible to erosion under conditions of low vegetative ground cover.

Geologic Setting and Mineral Resources

In the southern part of Rock County, the topography is controlled by the presence of relatively fine-grained (sandy loam) glacial till and outwash and by differential erosion of bedrock. The terrain is characterized by gently rolling prairie and low ridges underlain by dolomite (USDA-SCS 1974).

The project site is located on the Walworth Formation, a glacial till of late Pleistocene age, overlying limestone bedrock (USGS 2011a). The exact depth to bedrock is variable, but in the general vicinity of the site, bedrock is encountered at depths of less than 6 meters (20 feet). The uppermost bedrock is a sequence of Ordovician limestone about 150 meters (500 feet) thick, comprising 76 meters (250 feet) of Galena–Black River limestone overlying 76 meters (250 feet) of magnesium limestone. Cambrian sandstones underlie the limestone (Syverson et al. 2011). There are no deposits of ores or minerals of economic value in the area. Economically useful geological resources that might be present on the project site include sand and gravel in the glacial mantle and dolomite/limestone rock in the bedrock. Construction sand and gravel are the predominant economic mineral resources in southern Rock County (USGS 2011a).

Seismology

The project site is located in a region of low local seismicity and very little Quaternary tectonic activity. A normal fault is located about 30 kilometers (19 miles) north of the City of Beloit (Mudrey et al. 1982). Mapping shows offset in the Cambrian sandstone but not in the overlying Ordovician sequence. The City of Beloit is about 560 kilometers (350 miles) north of the northern margin of the New Madrid Seismic Zone. Historic earthquakes within this zone have resulted in reports of shaking with structural damage, including broken windows and cracked plaster, in southern and central Wisconsin (USGS 1978).

In the Beloit area, the largest-magnitude recorded earthquake, with an (estimated) magnitude of 5.7 on the Richter scale, occurred on May 26, 1909. This earthquake damaged many chimneys in Aurora, Illinois, and caused Modified Mercalli Intensity VII effects from Bloomington, Illinois, to Platteville, Wisconsin (USGS 1978). Since 1972, the U.S. Geological Survey (USGS) National Earthquake Information Center has recorded four earthquakes with a magnitude of 2.5 or greater within a 100-kilometer (62-mile) radius of Beloit (USGS 2012a). The largest of these had a magnitude of 4.5 and occurred in 1972 about 50 kilometers (31 miles) southwest of Beloit.

Wisconsin and northern Illinois are located in Seismic Zone 0 on the Seismic Risk Map of the United States (Leyendecker et al. 1995). The USGS 2009 Earthquake Probability Mapping tool indicates that there is less than a 1 percent chance of a magnitude 5 or greater earthquake in the next 50 years within 50 kilometers (31 miles) of Beloit (USGS 2009). Probabilistic ground-shaking hazard maps indicate that, for an earthquake with a 10 percent probability of exceedance in 50 years, the peak horizontal acceleration would be 0.02–0.06 g [acceleration of gravity]. An earthquake with the same probability of exceedance could result in 0.2-second horizontal spectral accelerations of 0.03–0.04 g and 1.0-second horizontal spectral accelerations of 0.01–0.02 g (USGS 2008).

Prime Farmland

Prime farmland soils, as defined by the U.S. Department of Agriculture, are those soils that have the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and are also available for these uses. They have the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops. The conversion of farmland and prime farmland to industrial and other nonagricultural uses essentially precludes farming the land in the foreseeable future. The concern that continued conversion of prime farmland to nonagricultural use would deplete the Nation’s resources of productive farmland prompted creation of the 1981 Federal Farmland Protection Policy Act (7 U.S.C. 4201 et seq.). This act set guidelines that require all Federal agencies to identify prime farmland proposed to be converted to nonagricultural land use and evaluate the impact of the conversion.

The project site was formerly under cultivation as farmland but was acquired by the City of Beloit and rezoned as light commercial property to allow development of the Gateway Business Park (City of Beloit 2008; City of Beloit 2011a). Therefore, conversion of the property from farmland is not subject to review under the Farmland Protection Policy Act and is not part of the proposed project under consideration in this *Mo-99 EA*.

3.1.1.2 Construction Impacts

Construction activities would likely include excavation and grading to prepare for building footings and foundations, construction material staging, and parking areas. Grading activities would likely affect only the upper 1.5 meters (5 feet) of surface soil and would not result in net removal of soil or additions of fill material.

The northwest portion of the site (Mahalasville silt loam soil) is likely to have drainage issues resulting in saturated soil conditions. The proposed NorthStar facility would be located on the eastern portion of the project site (see Figure 2-3), where drainage is not likely to be an issue. All construction would be planned such that the wetland area on the extreme north end of the site would not be used for any facility structures and would not be disturbed during construction.

The proposed facility would include a linac area in a subgrade basement approximately 2,300 square meters (25,000 square feet) in area and up to 9 meters (30 feet) deep. Excavation of the basement would result in removal of up to approximately 21,000 cubic meters (28,000 cubic yards) of soil and rock material. The excavated material would be either used on site for grading purposes (if of suitable properties) or transported off site for disposal or for use as construction fill material.

NorthStar expects that, if the material excavated is not used on site for grading purposes, up to 11,500 cubic meters (15,000 cubic yards) of gravel would be required. If needed, gravel would be obtained from an offsite source and transported to the site, where it would remain permanently.

The site would be managed for control of potential soil erosion or stormwater impacts in accordance with the City of Beloit's General Permit to Discharge under the Wisconsin Pollutant Discharge Elimination System (WDNR 2006), which requires construction-site pollutant control and postconstruction stormwater management for construction sites over 0.4 hectares (1 acre) in size. NorthStar expects that up to 5.3 hectares (13 acres) of the project site may be disturbed during construction.

3.1.1.3 Operational Impacts

All activities at the proposed facility would be conducted within buildings or other developed areas (parking areas, driveways) within the 5.3-hectare (13-acre) area. The low seismic hazard associated with the site indicates that earthquake impacts on the facility during operations are unlikely and are expected to be minimal because of typically low earthquake magnitudes in the area. The proposed facility would be constructed in accordance with all applicable building codes, which provide for evaluation of potential earthquake effects based on potential seismic hazards.

3.1.2 Water Resources

3.1.2.1 Affected Environment

Surface Water

The project site is located within the Lower Rock River Basin in south-central Wisconsin. The predominant land use in the basin is agriculture, although urban/suburban areas have been growing in the Beloit area (NRCS 2007). Springbrook Creek, a tributary to Turtle Creek and the lower Rock River, flows from northeast to southwest about 400 meters (1,300 feet) north of the northern boundary and about 365 meters (1,200 feet) west of the western boundary of the parcel.

A small drainage swale crosses the southwest portion of the site (see Figure 2-3), draining from southeast to northwest for a distance of approximately 230 meters (750 feet), containing surface water only during and immediately after rainfall or snowmelt events. Surface runoff from the project site is expected to flow overland and eventually into Springbrook Creek to the west and northwest, although the majority of the soils have moderate infiltration rates and only low-to-moderate runoff potential.

As discussed in Section 3.1.1.2, the City of Beloit's General Permit to Discharge under the Wisconsin Pollutant Discharge Elimination System (WDNR 2006) requires construction-site pollutant control and postconstruction stormwater management for construction sites over 0.4 hectares (1 acre) in size.

Stormwater leaving the site during construction of the proposed facility would be subject to regulation by the City of Beloit.

Groundwater

According to the Wisconsin Geological and Natural History Survey, the City of Beloit has eight municipal wells in either shallow or deep aquifer systems (Gatfield et al. 2002). The shallow aquifer system is comprised of unconsolidated Quaternary sand and gravel deposits. The deep aquifer system is in the Mount Simon Formation, which consists of Cambrian-age sandstone deposits. The Wisconsin Department of Natural Resources (WDNR) indicates that the majority of the Beloit municipal wells extract groundwater from the shallow aquifer at depths between 24 and 91 meters (80 and 300 feet).

The remaining Beloit wells in the deeper sandstone are at a depth of approximately 274 meters (900 feet). The eight wells have a reported annual pumping rate between 0 and 8.1 million liters (0 and 2.14 million gallons) per day, with an average pumping rate of approximately 3.2 million liters (845,000 gallons) per day per well.

According to USGS, the total groundwater usage for all purposes within the Lower Rock River Basin (hydrologic unit code 07090002) in 2005 was 454 million liters (120 million gallons) per day. The total groundwater usage in Rock County was 174 million liters (46 million gallons) per day (USGS 2011b).

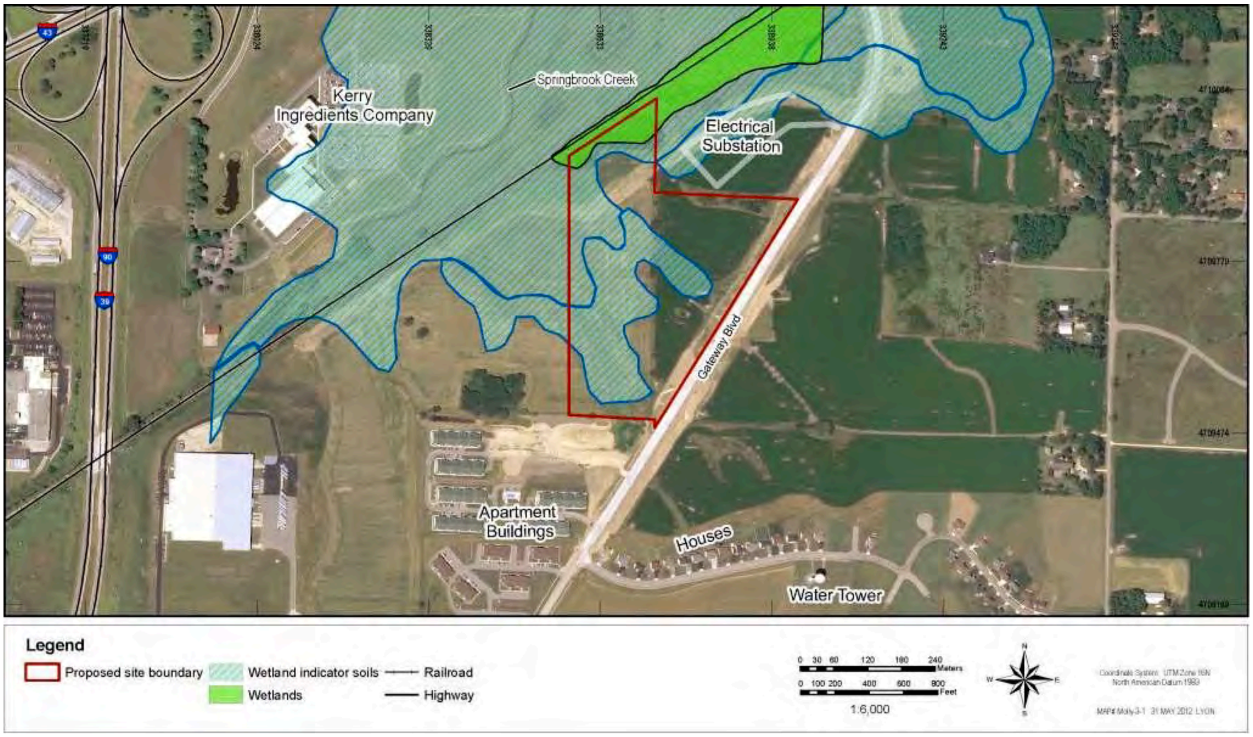
The depth to groundwater in the vicinity of the project site is expected to be approximately 12 meters (40 feet), based on historical data from the nearest known groundwater monitoring well (USGS 2012b). A wetland review in 2005 estimated the water table near the project site to be deeper than 3.4 meters (11 feet) (Strand Associates 2007).

Wetlands

Wetlands are important biological resources that perform multiple functions, including groundwater recharge, flood-flow attenuation, erosion control, and water quality improvement. They also provide habitat for many plants and animals, including threatened and endangered species. Wetlands are commonly found at the edges of creek beds and the shorelines of ponds, but can also be formed by moisture trapped in depression areas or a naturally high groundwater table. In urban areas, wetlands can be formed by manmade alterations to the landscape and sustained by stormwater runoff or the release of irrigation water, as in the case of roadside swales and agricultural ditches.

Wetlands in Wisconsin are defined by State statute as “an area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation, and which has soils indicative of wet conditions” (Wisconsin Statute 23:32(1)). WDNR maintains the Wisconsin Wetland Inventory maps, which are graphic representations of the type, size, and location of wetlands in the state. These maps have been prepared from the analysis of high-altitude imagery in conjunction with soil surveys, topographic maps, previous wetland inventories, and fieldwork. The classification system for the maps is modified from that of the U.S. Fish and Wildlife Service.

Figure 3-1 shows the status of the Wisconsin Wetland Inventory maps at the approximate location of the proposed NorthStar facility. The north edge of the project site adjacent to the railroad is mapped as wetland, with a classification as forested, broad-leaved deciduous, emergent/wet meadow (WDNR 2008). The hydrologic modifier is wet soil, palustrine, which indicates an area that does not have surface water for prolonged periods of time. The wetland was used for grazing or pasturing livestock.



Source: WDNR 2008.

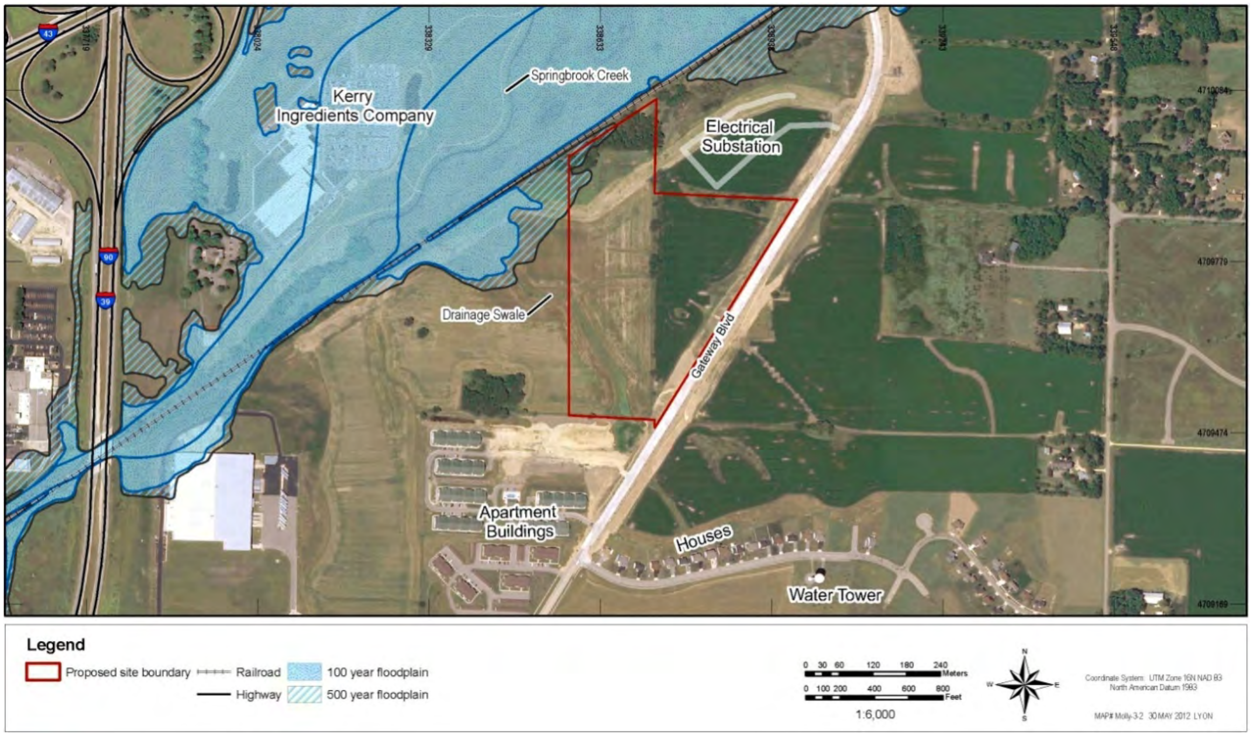
Figure 3-1. Wetlands and Wetland Indicator Soils at the Project Site

Most of the project site consists of wetland indicator soils. This designation does not confirm that regulated wetlands are present, but that soil conditions are wet or hydric. The area was surveyed in 2005 and 2007 for an alignment of Gateway Boulevard that crossed through the approximate center of the proposed site. The area surveyed at that time is consistent with the remainder of the project site, based on descriptions in the survey report compared with recent aerials, site photographs, and current land use. Other than the mapped wetland adjacent to the railroad, no other area in the road corridor was identified as wetland (Strand Associates 2007).

Floodplains

Floodplains are the lands on either side of a stream that are inundated when the capacity of the stream channel is exceeded. To provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Emergency Management Agency as the base flood for floodplain management and flood insurance purposes.

The project site is located on the fringes of the Springbrook Creek floodplain. The north edge of the property adjacent to the railroad encroaches slightly into the 500-year floodplain, as shown in Figure 3-2. This area has infrequent flooding, defined with an annual probability of occurrence of 0.2 percent (FEMA 2008).



Source: FEMA 2008.

Figure 3-2. Flood Zones Surrounding the Project Site

3.1.2.2 Construction Impacts

Surface Water

All potential construction impacts on surface water would be managed under the City of Beloit's General Permit to Discharge under the Wisconsin Pollutant Discharge Elimination System (WDNR 2006). NorthStar expects that up to 5.3 hectares (13 acres) of the site may be temporarily disturbed during construction. Stormwater leaving the site during construction of the proposed facility would be controlled in accordance with City of Beloit regulations to mitigate any potential impacts.

Groundwater

No withdrawals of, or discharges to, groundwater during construction are proposed.

Wetlands

Although most of the project site has wetland indicator soils, it is unlikely that any area meeting the statutory definition of wetlands would be impacted. One wetland was identified within the NorthStar property boundary along the south side of the railroad line (the north edge of the property) (see Figure 3-1). This area is northwest of the proposed build area and would be avoided during construction of the NorthStar facility. Any potential wetlands locations, including the drainage swale that crosses the project site, would be surveyed to confirm absence of wetlands prior to construction. Construction access to the site would be from the existing Gateway Boulevard, southeast of the project site, and would not traverse the identified wetland or its immediate vicinity. There would be no permanent or temporary impacts due to construction.

Floodplains

Changes in the floodplain, such as adding fill material or structures or limiting the natural conveyance of floodwaters, can cause a rise in the water surface and subsequently impact properties not previously affected by a storm event. The proposed NorthStar facility would not be constructed in a Federal Emergency Management Agency–designated and –regulated floodplain. Although a small portion of the property (an area not proposed for construction) encroaches into the Springbrook Creek 500-year floodplain, construction of the proposed project would not occur in this area and therefore would not impact floodplains.

3.1.2.3 Operational Impacts

Surface Water

Construction of the proposed facility and associated parking areas and roadways would likely involve the conversion of less than 2 hectares (5 acres) of the property to impervious surface (e.g., roofs, pavement), or about 15 percent of the available property. This would result in a slight increase in potential runoff from the project site compared with the site's undeveloped state. Runoff would be managed through proper design of storm drains, site contouring, or other appropriate site features in accordance with all applicable building codes and State and local ordinances.

No industrial wastewater discharges are expected from facility operations. The NorthStar facility would have normal sanitary sewer discharges. Sanitary sewer discharges would be to a City sewer line and be subject to permitting by the City of Beloit as appropriate.

Groundwater

Facility operations are not expected to require direct withdrawals of groundwater, as all required water would be obtained from municipal supplies. No discharges of open wastewater would occur, thus no potential effects of discharges on groundwater resources are expected. All facility operations would be contained inside properly constructed buildings with proper material- and waste-handling facilities and spill prevention/cleanup capabilities. No surface impoundments or other containment structures that could result in releases to groundwater are planned for the project site.

Wetlands

Operation of the proposed NorthStar facility and related activities would be contained within the buildings, adjacent parking areas, and driveways accessing the site from Gateway Boulevard. The operation of the facility would be compatible with current stormwater drainage requirements and would not impact the wetland area in the north end of the property adjacent to the railroad.

Floodplains

Operation of the proposed NorthStar facility and related activities would be contained within the buildings, adjacent parking areas, and driveways accessing the site from Gateway Boulevard. No development or activities are proposed in the northern portion of the property that extends into the 500-year floodplain. The operation of the NorthStar facility would be compatible with current stormwater drainage requirements and would not impact the Federal Emergency Management Agency floodplain designations of Springbrook Creek.

3.1.3 Air Quality

3.1.3.1 Affected Environment

In accordance with Federal Clean Air Act (CAA) requirements, the air quality in a given region or area is measured by the concentration of criteria pollutants in the atmosphere. The air quality in a region is a result of not only the types and quantities of atmospheric pollutants and pollutant sources in an area, but also the surface topography, size of the topological "air basin," and prevailing meteorological conditions.

Ambient Air Quality Standards. Under the CAA, EPA developed numerical concentration-based standards, or National Ambient Air Quality Standards (NAAQS), for pollutants that were determined to affect human health and the environment. The NAAQS represent the maximum allowable concentrations for six criteria pollutants: ozone; carbon monoxide; nitrogen dioxide; sulfur dioxide; respirable particulate matter, including PM_{10} and $PM_{2.5}$ [particulate matter with an aerodynamic diameter less than or equal to 10 and 2.5 micrometers, respectively]; and lead (40 CFR, Part 50). The CAA also gives the authority to states to establish air quality rules and regulations. The State of Wisconsin has adopted the NAAQS for federally listed criteria pollutants. No additional State ambient air quality standards have been promulgated for these criteria pollutants, but some historical NAAQS continue to be required by the State of Wisconsin. Table 3-1 presents the EPA NAAQS for federally listed criteria pollutants.

Attainment Versus Nonattainment and General Conformity. EPA classifies the air quality in an air quality control region (AQCR), or in subareas of an AQCR, according to whether the concentrations of criteria pollutants in ambient air exceed the NAAQS. Areas within each AQCR are therefore designated as either "attainment," "nonattainment," "maintenance," or "unclassified" for each of the six criteria pollutants. Attainment means that the air quality within an AQCR is better than the NAAQS; nonattainment means that criteria pollutant levels exceed NAAQS; maintenance means that an area was previously designated nonattainment but is now attainment; and unclassified means that there is not enough information to appropriately classify an AQCR, so the area is considered attainment. EPA has delegated the authority for ensuring compliance with the NAAQS in the State of Wisconsin to WDNR. In accordance with the CAA, each state with nonattainment areas must develop a state implementation plan, which is a compilation of regulations, strategies, schedules, and enforcement actions designed to move the state into compliance with all NAAQS.

The General Conformity rule applies only to significant actions in nonattainment or maintenance areas. This rule requires that any Federal action meet the requirements of a state or Federal implementation plan. More specifically, CAA conformity is ensured when a Federal action does not cause a new violation of the NAAQS; contribute to an increase in the frequency or severity of NAAQS violations; or delay the timely attainment of any NAAQS, interim progress milestones, or other milestones toward achieving compliance with the NAAQS.

Federal Prevention of Significant Deterioration. Federal Prevention of Significant Deterioration (PSD) regulations apply in attainment areas to a major stationary source, i.e., source with the potential to emit 250 tons per year of any criteria pollutant, and to a significant modification to a major stationary source, i.e., change that adds 10 to 40 tons per year, to the facility's potential to emit, depending on the pollutant. Additional PSD major source and significant modification thresholds apply for greenhouse gases (GHGs), as discussed in the GHG subsection. PSD permitting can also apply to a proposed project if all three of the following conditions exist: (1) the proposed project is a modification with a net emissions increase to an existing PSD major source, (2) the proposed site is within 10 kilometers (6.2 miles) of national parks or wilderness areas (i.e., Class I areas), and (3) regulated stationary-source pollutant emissions would cause an increase in the 24-hour average concentration of any regulated pollutant of 1 microgram per cubic meter or more in the Class I area (40 CFR 52.21(b)(23)(iii)). A Class I area includes national parks larger than 2,400 hectares (6,000 acres), national wilderness areas and national memorial parks larger

Table 3-1. National Ambient Air Quality Standards

Pollutant	Averaging Time	Primary Standard	Secondary Standard
CO	8-hour [a]	9 ppm (10 mg/m^3)	Same as primary, State only
	1-hour [a]	35 ppm (40 mg/m^3)	Same as primary, State only
Pb	Rolling 3-month average [b]	0.15 $\mu g/m^3$ [c]	Same as primary
	Quarterly average	1.5 $\mu g/m^3$ [c]	Same as primary
NO_2	Annual [d]	53 ppb (100 $\mu g/m^3$) [e]	Same as primary
	1-hour [f]	100 ppb	None
PM_{10}	24-hour [g]	150 $\mu g/m^3$	Same as primary
$PM_{2.5}$	Annual [h]	15 $\mu g/m^3$	Same as primary
	24-hour [f]	35 $\mu g/m^3$	Same as primary
O_3	8-hour [i]	0.075 ppm [j]	Same as primary
	1-hour (daily maximum)	0.12 ppm (235 $\mu g/m^3$)[10]	None
SO_2	Annual (arithmetic average)	0.03 ppm	None
	24-hour	0.14 ppm	None
	3-hour [a]	None	0.5 ppm (1300 $\mu g/m^3$)
	1-hour [k]	75 ppb[l]	None

a. Not to be exceeded more than once per year.
b. Not to be exceeded.
c. Final rule signed October 15, 2008. The 1978 Pb standard (1.5 $\mu g/m^3$ as a quarterly average) remains in effect until 1 year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved. EPA designated areas for the new 2008 standard on November 8, 2011.
d. Annual mean.
e. The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of comparison to the 1-hour standard.
f. 98th percentile, averaged over 3 years.
g. Not to be exceeded more than once per year on average over 3 years.
h. Annual mean, averaged over 3 years.
i. Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years.
j. Final rule signed March 12, 2008. The 1997 O_3 standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, EPA revoked the 1-hour O_3 standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard ("anti-backsliding"). The 1-hour O_3 standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.
k. 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
l. Final rule signed June 2, 2010. The 1971 annual (0.3 ppm) and 24-hour (0.14 ppm) SO_2 standards were revoked in that same rulemaking. However, these standards remain in effect until 1 year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved. EPA expects to designate areas for the new 2010 standard by June 2, 2012.

Note: Parenthetical values are approximate equivalent concentrations.

Key: CO=carbon monoxide; EPA=U.S. Environmental Protection Agency; $\mu g/m^3$=micrograms per cubic meter; mg/m^3=milligrams per cubic meter; NO_2=nitrogen dioxide; O_3=ozone; Pb=lead; PM_n=particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; ppb=parts per billion; ppm=parts per million; SO_2=sulfur dioxide.

Source: EPA 2011.

than 2,020 hectares (5,000 acres), and international parks. PSD regulations also define ambient air increments, limiting the allowable increases to any area's baseline air contaminant concentrations, based on the area's class designation (40 CFR 52.21(c)).

Title V Requirements. Title V of the CAA Amendments of 1990 requires states and local agencies to permit major stationary sources. A Title V major stationary source has the potential to emit criteria air pollutants and hazardous air pollutants at levels equal to or greater than major-source thresholds. These thresholds vary, depending on the attainment status of an AQCR. The purpose of the permitting rule is to establish regulatory control over large, industrial-type activities and monitor their impact on air quality. Section 112 of the CAA lists hazardous air pollutants and identifies source categories.

Greenhouse Gas Emissions. GHGs are gaseous emissions that trap heat in the atmosphere. These emissions occur from natural processes and human activities. The most common GHGs emitted from natural processes and human activities include carbon dioxide (CO_2), methane, and nitrous oxide. On September 22, 2009, EPA issued a final rule for mandatory GHG reporting from large GHG emission sources in the United States. The purpose of the rule is to collect comprehensive and accurate data on CO_2 and other GHG emissions that can be used to inform future policy decisions. In general, the threshold for reporting is 27,600 tons or more of CO_2-equivalent emissions per year, excluding mobile-source emissions. The first emissions report was due in 2011 for 2010 emissions. According to an EPA rulemaking issued on June 3, 2010 (75 FR 31514), GHG emissions will also be factors in PSD and Title V permitting and reporting. Under these permit programs, GHG potential-emission thresholds of significance for permitting of stationary sources are 75,000 and 100,000 tons per year, respectively, of CO_2-equivalent emissions.

Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, was signed in October 2009 and requires agencies to set goals for reducing GHG emissions. One requirement within this order is the development and implementation of an agency strategic sustainability performance plan (SSPP) that prioritizes agency actions based on life-cycle return on investment. Each SSPP is required to identify, among other things, "agency activities, policies, plans, procedures, and practices" and "specific agency goals, a schedule, milestones, and approaches for achieving results, and quantifiable metrics" relevant to the implementation of Executive Order 13514. On September 20, 2010, DOE released its SSPP to the public. This SSPP describes specific actions that DOE will take to achieve its individual GHG-reduction targets, reduce long-term costs, and meet the full range of goals of the order. All SSPPs segregate GHG emissions into three categories: Scope 1, 2, and 3 emissions. Scope 1 GHG emissions are those directly occurring from sources that are owned or controlled by the agency. Scope 2 emissions are indirect emissions generated in the production of electricity, heat, or steam purchased by the agency. Scope 3 emissions are other indirect GHG emissions that result from agency activities but from sources that are not owned or directly controlled by the agency. The proposed NorthStar facility, as a recipient of DOE funding, would fall under the Scope 3 emissions category. However, the Scope 3 GHG goals in the DOE SSPP do not include prime contractors not directly associated with DOE site operations. DOE's SSPP is expected to be updated in the future when GHG-reduction policy and implementation guidance is further developed. Future SSPP goals could include Scope 3 goals for these types of contracts.

Existing Conditions

The project site is located in Rock County, Wisconsin, which is within the Rockford, Illinois–Janesville-Beloit, Wisconsin, Interstate (JBWI) AQCR. The JBWI AQCR also includes all of Boone, DeKalb, Ogle, Stephenson, and Winnebago Counties in Illinois (EPA 2002). Rock County has been designated by EPA as unclassified/attainment for all criteria pollutants. According to EPA regulations (40 CFR, Part 81), no Class I areas are located within 10 kilometers (6.2 miles) of the proposed NorthStar facility (EPA 2012a).

The most recent emissions inventory for Rock County and the JBWI AQCR is shown in Table 3-2. Rock County is considered the local area of influence, and the JBWI AQCR is considered the regional area of influence for this air quality analysis. Ozone is not a direct emission; it is generated from reactions of volatile organic compounds and nitrogen oxides, which are precursors to ozone. Therefore, for purposes of this air quality analysis, volatile organic compounds and nitrogen oxide emissions are used to represent ozone generation.

Table 3-2. Local and Regional Air Emissions Inventory for the Proposed Project (tons per year)

Area	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$
Rock County, Wisconsin	5,351	6,831	36,887	234	4,704	1,447
JBWI AQCR	29,619	33,930	163,535	868	47,646	10,354

Key: AQCR = air quality control region; CO = carbon monoxide; JBWI = Rockford, Illinois–Janesville-Beloit, Wisconsin, Interstate; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compounds.

Source: EPA 2008

The project site is located in an attainment area for all criteria pollutants. Therefore, the following factors were considered in determining the significance of an increase in emissions from the proposed NorthStar facility, relative to existing conditions and ambient air quality:

- Causing or contributing to a violation of any Federal or State ambient air quality standard
- Exposing sensitive receptors to substantially increased pollutant concentrations
- Exceeding any evaluation criteria established by a State implementation plan

Impacts on ambient air quality were assessed by comparing the increase in emissions under the proposed project to the county or AQCR emissions inventory and to the General Conformity and air quality permitting criteria, discussed below.

General Conformity. The proposed NorthStar facility would not be subject to the General Conformity requirements because it is located in an attainment area for all criteria pollutants. Therefore, there is no need for a comparison to the General Conformity *de minimis* thresholds, and a General Conformity determination is not required.

PSD and Title V Permits. Air quality impacts of the emission increases under the proposed project could be subject to PSD and Title V permitting requirements. The following factors were considered in determining the significance of air quality impacts with respect to PSD permitting requirements:

- If the net increase in stationary-source emissions qualifies as a PSD major source. This includes 250 tons per year of emissions per criteria pollutant (40 CFR 52.21(a)(2) and (b)(1)) or 75,000 tons per year of GHG emissions.
- If the proposed project occurs within 10 kilometers (6.21 miles) of a Class I area and if it would cause an increase of 1 microgram per cubic meter or more in the 24-hour average concentration of any regulated pollutant in the Class I area (40 CFR 52.21(a)(2) and (b)(23)(iii)).

The following factor was considered in determining the significance of air quality impacts with respect to Title V permitting requirements (40 CFR 71.2 and 71.3):

- If the increase in stationary-source emissions under the proposed project qualifies the facility as a Title V major source. The Title V potential-to-emit thresholds are 100 tons per year of criteria pollutants; 10 tons per year of any individual hazardous air pollutant; 25 tons per year of all hazardous air pollutants combined; or 100,000 tons per year of GHGs.

Only operational emission increases were evaluated for PSD and Title V permitting impacts, as construction activity emissions typically are not subject to the above significance criteria for these permit programs.

3.1.3.2 Construction Impacts

Construction activities associated with the proposed facility would generate air pollutant emissions from site-disturbing activities, such as grading, filling, compacting, trenching, and operation of construction equipment. Related air emissions would include fugitive dust from ground-disturbing activities, as well as emissions from the combustion of fuels in construction equipment and hauling of materials to the project site. Fugitive dust emissions would be greatest during the initial site preparation activities and would vary from day to day, depending on the work phase, level of activity, and prevailing weather conditions. The quantity of uncontrolled fugitive dust emissions from a construction site would be proportional to the area of land being worked and the level of activity. Construction activities would incorporate best management practices and control measures (e.g., frequent use of water for dust-generating activities) to minimize fugitive particulate matter emissions. Additionally, the work vehicles are assumed to be well maintained, with diesel particulate filters to reduce emissions. Construction workers commuting daily to and from the job site in their personal vehicles would also generate criteria pollutant air emissions. Based on the size of the new facility and the duration of the construction activities, emissions from construction activities are not expected to contribute to or affect local or regional NAAQS attainment status.

Completion of the proposed NorthStar facility construction is estimated to take up to 18 months. Construction could be completed more quickly and the emissions from construction equipment could all occur in a shorter time. For purposes of this air quality analysis, the construction timeframe and resulting emissions are conservatively assumed to be 288 workdays, i.e., 6 days per week, 4 weeks per month, for 12 calendar months. Air emissions from construction activities are summarized in Table 3-3.

Table 3-3. Estimated Annual Air Emissions Resulting from Construction of the NorthStar Facility (tons per year)

Activity	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Combustion emissions	6.11	0.686	2.68	0.459	0.4	0.4	696
Fugitive dust emissions	—	—	—	—	15	1.5	—
Haul truck on-road emissions	1.09	0.335	1.98	0.086	1.3	0.34	276
Construction commuter emissions	0.13	0.132	1.19	0.002	0.01	0.01	158
Temporary heating	0.39	0.030	0.23	0.001	0.02	0.02	375
Total Construction Emissions from Proposed Project	**7.72**	**1.18**	**6.07**	**0.547**	**16.8**	**2.3**	**1,505**
Percentage of Rock County, Wisconsin, Inventory	**0.1**	**0.02**	**0.02**	**0.2**	**0.4**	**0.2**	**0.0014**
Percentage of JBWI AQCR Inventory	**0.03**	**0.003**	**0.004**	**0.06**	**0.04**	**0.02**	**0.0014**[a]

[a.] Percentage of Wisconsin's 2009 CO_2 emissions (DOE/EIA 2011).

Key: AQCR=air quality control region; CO=carbon monoxide; CO_2=carbon dioxide; JBWI=Rockford, Illinois–Janesville-Beloit, Wisconsin, Interstate; NO_x=nitrogen oxides; PM_n=particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2=sulfur dioxide; VOC=volatile organic compounds.

3.1.3.3 Operational Impacts

The proposed facility would produce air emissions from operation of the building's heating system. Additional emissions would occur from maintenance testing and possible use of the 1,000-kilowatt emergency generator for the facility. Emissions would occur from the chemical processing of medical isotopes at the facility. Long-term emissions would be produced yearly, beginning with the year that construction of the proposed NorthStar facility is complete. Further information on the sources of long-term air emissions is summarized in the following paragraphs.

Based on available design information, the proposed facility would utilize a natural gas heating system for comfort heating. Although the design capacity of the heating system was not available, it was estimated by rough order-of-magnitude calculations. Based on Wisconsin's general climate zone; a heating requirement of 50 to 60 British thermal units per square foot of building space (AC 2011); an assumed efficiency of 80 percent; and assuming a well-insulated facility, NorthStar estimated that the building would need a boiler or heater with a capacity of approximately 4 million British thermal units per hour. Emissions from the heating system and emergency generator operations were estimated using EPA's emission-factor reference document, *AP-42* (EPA 2012b). Air emission estimates of these operations are summarized in Table 3-4.

Process operations may generate long-term air emissions from the use of chemicals, including chemical reactions and evaporation. The most significant chemical processing would occur in the hot cells in the chemical processing area of the facility. The design of the hot cells appears to be gas-tight; however, whether any air emissions would be generated, the nature of such emissions, and whether ventilation to the atmosphere would occur sometime during the chemical processing operations is unclear.

Radioactive emissions from the process operations and their impacts are addressed in Section 3.3.5 of this *Mo-99 EA*.

Table 3-4. Estimated Annual Air Emissions Resulting from Operation of the NorthStar Facility (tons per year)

Activity	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Emergency generator emissions	8.05	0.215	1.844	0.0041	0.235	0.235	38,889
Building heating systems emissions	0.11	0.012	0.186	0.0013	0.017	0.017	266
Process operations emissions	[a]	[a]	[a]	[a]	[a]	[a]	[a]
Worker commuting emissions	0.50	0.494	4.462	0.006	0.047	0.030	592
Total Operational Emissions from Proposed Project	**8.66**	**0.721**	**6.492**	**0.011**	**0.298**	**0.281**	**39,747**
PSD Permitting Thresholds	**250**	**250**	**250**	**250**	**250**	**250**	**75,000**[b]
Title V Permitting Thresholds	**100**	**100**	**100**	**100**	**100**	**100**	**100,000**[b]
Percentage of Rock County, Wisconsin Inventory	**0.2**	**0.01**	**0.02**	**0.005**	**0.006**	**0.02**	**0.0002**[c]
Percentage of JBWI AQCR Inventory	**0.03**	**0.002**	**0.004**	**0.001**	**0.0006**	**0.003**	**0.0002**[c]

a. Process operations emissions are expected to be negligible.

b. Percent of Wisconsin's 2009 CO_2 emissions (DOE/EIA 2011).

c. These thresholds include aggregated emissions of all GHGs; however, the overwhelming majority of GHGs emitted from the operational sources would be CO_2.

Key: AQCR=air quality control region; CO=carbon monoxide; CO_2=carbon dioxide; GHG=greenhouse gas; JBWI=Rockford, Illinois–Janesville-Beloit, Wisconsin, Interstate; NO_x=nitrogen oxides; PM_n=particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; PSD=Prevention of Significant Deterioration; SO_2=sulfur dioxide; VOC=volatile organic compounds

Long-term air emissions would also be produced as a result of new workers commuting to the facility. NorthStar estimates that 150 workers would commute to the facility daily. Estimates of air emissions from personnel activities and other facility operations are summarized in Table 3-4, below.

Based on the emission calculations discussed above, construction and operations emissions under the proposed project are not expected to (1) cause or contribute to a violation of any Federal or State ambient air quality standard; (2) expose sensitive receptors to substantially increased pollutant concentrations; or (3) exceed any evaluation criteria established by a State implementation plan. In addition, operations emissions are not expected to trigger the need for a PSD or Title V operating permit. Air quality construction permits may be needed for the boiler and emergency generator. Once further design information is available, the proposed NorthStar facility would comply with the *Wisconsin Administrative Code*, Chapter NR 406, air quality regulations regarding the potential requirement for air quality construction permits.

Greenhouse Gas Emissions. Construction and operation activities would contribute directly to emissions of GHGs from the combustion of fossil fuels. Because CO_2 emissions account for approximately 92 percent of all GHG emissions in the United States, they are used for analyses of GHG emissions in this EA.

The DOE Energy Information Administration estimates that, in 2009, gross CO_2 emissions in Wisconsin were 107 million tons and in the entire United States were 6.0 billion tons (DOE/EIA 2011). The proposed project would emit an estimated 1,130 tons from construction activities. Operation would generate an estimated 39,747 tons yearly from onsite activities. Construction GHG emissions would be temporary and occur for 1 year. GHG emissions from operation activities would be permanent beginning in the year that construction is complete. Total maximum annual CO_2 emissions from the proposed project would be 0.037 percent of Wisconsin's 2009 CO_2 emissions and 0.001 percent of that of the entire United States. Therefore, the proposed project would represent a negligible contribution toward statewide and national GHG inventories.

3.2 BIOLOGICAL ENVIRONMENTAL AREAS

3.2.1 Ecological Resources

3.2.1.1 Affected Environment

Vegetation

Prior to European settlement, vegetation in the general project area consisted of an oak savanna and prairie. The site was agricultural land until it was zoned for light industrial purposes as part of the Gateway Business Park (City of Beloit 2011a). During site visits, crops were observed being grown at the site in 2011, but the land was fallow in 2012 (Hull 2012).

Review of aerial photographs indicates that the site has been cultivated from at least 1955 to the present (City of Beloit 2011b). In non-crop areas, some grasses, forbs, and trees are present.

Wildlife

The project site is presently within an area that was largely agricultural, but is gradually being converted to urban uses related to the City of Beloit. Wildlife that may be observed at the site would likely be limited to those species that are adapted to agricultural settings, such as deer, some birds, and various small rodents. The site does not provide high-quality habitat for wildlife due to periodic tilling and fertilizer/pesticide application for nearly 6 decades.

Special Status Species

The Endangered Species Act (ESA) (16 U.S.C. 1531–1544) provides Federal protection for threatened and endangered species. Section 3 of the ESA defines endangered species as any animal or plant species in danger of extinction throughout all or a significant portion of its range. ESA defines threatened species as any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Under NEPA, both candidate species and species proposed for listing require analysis to the same level of detail as listed species. However, species that are Federal candidates for listing as threatened or endangered do not receive legal protection under the ESA.

Federally listed endangered, threatened, and candidate species reported in Rock County, Wisconsin, with the potential to occur at the project site were identified from the U.S. Fish and Wildlife Service Wisconsin Ecological Services Field Office website (USFWS 2012a). A list of endangered, threatened, and special concern species protected by the State of Wisconsin was obtained online for Rock County (WDNR

2012a). A letter from WDNR regarding a portion of the Gateway Business Park (about 0.8 kilometers, 0.5 miles, south of the proposed project site) in Beloit, Wisconsin, provided a list of species in very similar habitat near the project site (WDNR 2010).

Table 3-5 presents federally listed endangered, threatened, and candidate animal species reported for Rock County and Wisconsin-listed species also known or expected to be present in the county. These species are discussed below.

Table 3-5. Protected and Sensitive Species of Rock County, Wisconsin, with Potential to Occur at the Project Site

Common Name	Scientific Name	Status Federal, State	Habitat
Animals			
Whooping crane	*Grus americana*	Nonessential, experimental, population, SC/FL	Open wetlands and lakeshores
Eastern massasauga rattlesnake	*Sistrurus catenatus*	FC, SE	Open to forested wetlands and adjacent uplands
Gravel chub	*Erimystax x-punctatus*	None, SE	Strong currents of riffles in shallow medium to large rivers
Ozark minnow	*Notropis nubilus*	None, ST	Clear to medium, low-gradient streams over bottoms of cobble
Plants			
Eastern prairie fringed orchid (prairie white fringed orchid)	*Platanthera leucophaea*	FT, SE	Wet grasslands
Glade mallow	*Napaea dioica*	None, SC	Alluvial meadows, ditches, and forest margins near large rivers
Hairy wild petunia	*Ruellia humilis*	None, SE	Prairies and oak upland woods
Pale purple coneflower	*Echinacea pallida*	None, ST	Prairies and prairie remnants with dry mesic soils along roads and railroads
Pink milkwort	*Polygala incarnata*	None, SE	Moist- to dry-mesic prairies
Prairie bush-clover	*Lespedeza leptostachya*	FT, SE	Dry to mesic prairies with gravelly soil
Prairie false-dandelion	*Nothocalais (=Microseris) cuspidata*	None, SC	Dry, rock prairie bluffs and gravelly hillsides
Prairie Indian plantain	*Cacalia tuberosa*	None, ST	Variety of deep-soiled prairies
Prairie parsley	*Polytaenia nuttallii*	None, ST	Prairies and open areas that were savannahs
Snowy campion	*Silene nivea*	None, ST	Alluvial deciduous forest margins and meadows
Wafer-ash	*Ptelea trifoliata*	None, SC	Dry dolomite ledges in oak forests
Woolly milkweed	*Asclepias lanuginosa*	None, ST	Dry, sandy or gravelly hillside prairies

Key: FC=Federal candidate: Species for which the U.S. Fish and Wildlife Service has sufficient information to propose them as endangered or threatened, but for which development of a proposed listing regulation is precluded by other higher-priority listing activities.

FT=Federal threatened: Any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

SC=State special concern.

SC/FL=Federally protected as endangered or threatened, but not so designated by the Wisconsin Department of Natural Resources.

SE=State endangered: Any species whose continued existence is determined to be in jeopardy by the Wisconsin Department of Natural Resources.

ST=State threatened: Any species that appears likely within the foreseeable future, on the basis of scientific evidence, to become endangered in Wisconsin.

Source: USFWS 2012a; WDNR 2010, 2011, 2012a.

Federally Listed Endangered Species

- Whooping crane (*Grus americana*) [nonessential experimental population of a federally listed endangered species that is not so designated by WDNR]
  - Whooping cranes frequent open wetlands and lake shores and breed in freshwater marshes and prairies. Since 1999, Wisconsin has played a major role in efforts to restore a migratory whooping crane population in eastern North America, with a core breeding area at the Necedah National Wildlife Refuge in central Wisconsin (WDNR 2012b). The area at the project site proposed for the NorthStar facility and related operations is entirely on previously tilled land used for row crops and other agricultural purposes since at least 1955 and lacks suitable habitat for this species. A small (0.8-hectare [2-acre]) wetland area is located in an avoidance area that would not be developed (NorthStar 2012b).

Federally Listed Threatened Species

- Eastern prairie fringed orchid [Prairie white fringed orchid](*Platanthera leucophaea*) [federally listed threatened species, Wisconsin-listed endangered species]
  - This wildflower is found in moist, undisturbed, deep-soiled and/or calcareous prairies and rarely in tamarack fens. Blooming occurs in early June through early August, and fruiting occurs throughout August (WDNR 2012c). Decline in populations of this species has been attributed to loss of habitat from the drainage and development of wetlands (USFWS 2012b). The area of the project site proposed for the NorthStar facility is entirely on previously tilled land used for row crops and other agricultural purposes since approximately 1955 and does not provide suitable habitat for this species due to its previous conversion to cropland and pasture. A small (0.8-hectare [2-acre]) wetland area is located in an avoidance area that would not be developed (NorthStar 2012b).Woody plants, shrubs, and trees now growing in the wetlands, making it very marginal habitat for this orchid.

- Prairie bush clover (*Lespedeza leptostachya*) [federally listed threatened species, Wisconsin-listed endangered species]
  - This plant grows in gravelly or sandy hillside prairies. Blooming occurs in late July through late August, and fruiting occurs in early August through early September (WDNR 2012d). Gravelly or sandy hillside prairies are not present at the site. The area at the project site proposed for the NorthStar facility and related operations is entirely on previously tilled land used for row crops and other agricultural purposes since approximately 1955 and it lacks suitable habitat for this species.

Federally Listed Candidate Species

- Eastern massasauga rattlesnake (*Sistrurus catenatus*) [federally listed candidate species, Wisconsin-listed endangered species]
  - This snake is strongly associated with floodplain habitats along medium–to-large rivers, especially near river confluences, where the snakes occupy primarily open-canopy wetlands, such as sedge meadows, fresh wet meadows, scrub carr, and adjacent upland prairies and old fields. Overwintering usually occurs in terrestrial crayfish burrows or rotted-out root channels in open-canopy wetlands, shrub carr, and lowland hardwood forests (WDNR 2012e). Although the project site does not contain floodplain habitats along medium-to-large rivers, it does contain approximately 0.8 hectares (2 acres) of isolated wetlands. This wetlands area is not located in a part of the project site designated for construction or operations. The wetlands would provide, at best, marginal habitat for the eastern massasauga rattlesnake due

to the relative small size of the wetlands; past agricultural practices, including its use for grazing or pasturing livestock, as well as for tilling of adjacent cropland for nearly 6 decades; and the increasing presence of woody plants in the wetlands. This wetland is an avoidance area that would not be developed (NorthStar 2012b). Other factors reducing suitability of the site for the eastern massasauga rattlesnake are habitat fragmentation resulting from increasing urban development and the presence of an adjacent railroad and nearby roads.

Wisconsin-Listed Endangered Species

- Gravel Chub (*Erimystax* x-*punctatus*) [Wisconsin-listed endangered species, no Federal status in Wisconsin]
  - This fish prefers the strong currents of riffles and fast runs in shallow medium to large rivers over pea-gravel substrate (WDNR 2012f). There are no streams on the project site so it lacks suitable habitat for this species.
- Hairy wild petunia (*Ruellia humilis*) [Wisconsin-listed endangered species, no Federal status in Wisconsin]
  - This wildflower grows in prairies and oak upland woods. Blooming occurs in late May through early October, and fruiting occurs in late June through early October (WDNR 2012g). Prairies and oak upland woods are not present at the project site. The area at the project site proposed for the NorthStar facility and related operations is entirely on previously tilled land used for row crops and other agricultural purposes since approximately 1955 and it lacks suitable habitat for this species.
- Pink milkwort (*Polygala incarnata*) [Wisconsin-listed endangered species, no Federal status in Wisconsin]
  - This wildflower grows in moist- to dry-mesic prairies. Blooming occurs in early July through early August, and fruiting occurs in early August through early November (WDNR 2012h). The area at the project site proposed for the NorthStar facility and related operations is entirely on previously tilled land used for row crops and other agricultural purposes since approximately 1955 and it lacks suitable habitat for this species.

Wisconsin-Listed Threatened Species

- Ozark minnow (*Notropis nubilus*) [Wisconsin-listed threatened species, no Federal status in Wisconsin]
  - This fish prefers clear, small to medium, low-gradient streams over bottoms of cobble. There are no rivers on the project site so it lacks suitable habitat for this species (WDNR 2012i).
- Pale purple coneflower (*Echinacea pallida*) [Wisconsin-listed threatened species, no Federal status in Wisconsin]
  - This wildflower grows in prairies and prairie remnants along roads and railroads. Blooming occurs in early June through late July, and fruiting occurs in early July through late August (WDNR 2012j). Dry, sandy, or gravelly hillside prairies are not present at the project site. The area at the project site proposed for the NorthStar facility and related operations is entirely on previously tilled land used for row crops and other agricultural purposes since approximately 1955 and it lacks suitable habitat for this species.
- Prairie Indian plantain (*Cacalia tuberosa*) [Wisconsin-listed threatened species, no Federal status in Wisconsin]

- This plant is found in a variety of deep-soiled prairies. Blooming occurs in early May through late June, and fruiting occurs in late June through late July (WDNR 2012k). The area at the project site proposed for the NorthStar facility and related operations is entirely on previously tilled land used for row crops and other agricultural purposes since approximately 1955 and it lacks suitable habitat for this species.

- Prairie parsley (*Polytaenia nuttallii*) [Wisconsin-listed threatened species, no Federal status in Wisconsin]
  - This plant is found in prairies and persisting open areas that were savannahs. Blooming occurs in early May through late June, and fruiting occurs in late June through late August (WDNR 2012l). The area at the project site proposed for the NorthStar facility and related operations is entirely on previously tilled land used for row crops and other agricultural purposes since approximately 1955 and it lacks suitable habitat for this species.

- Snowy campion (*Silene nivea*) [Wisconsin-listed threatened species, no Federal status in Wisconsin]
  - This plant is found on alluvial deciduous forest margins and meadows. Blooming occurs in late June through late July, and fruiting occurs in early July through late August (WDNR 2012m). The area at the project site proposed for the NorthStar facility and related operations is entirely on previously tilled land used for row crops and other agricultural purposes since approximately 1955 and it lacks suitable habitat for this species.

- Woolly milkweed (*Asclepias lanuginosa*) [Wisconsin-listed threatened species, no Federal status in Wisconsin]
  - This plant is found in dry, sandy, or gravelly hillside prairies. Blooming occurs in late May through late June, and fruiting occurs in late June through late July (WDNR 2012n). The project site lacks suitable habitat for this species.

Wisconsin-Listed Special Concern Species

- Glade mallow (*Napaea dioica*) [Wisconsin-listed special concern species, no Federal status in Wisconsin]
  - This wildflower grows in alluvial meadows, ditches, and forest margins near large rivers. Blooming occurs in early June through early August, and fruiting occurs in early August through late September (WDNR 2012o). Alluvial meadows, ditches, and forest margins near large rivers are not present at the project site. The area at the project site proposed for the NorthStar facility and related operations is entirely on previously tilled land used for row crops and other agricultural purposes since approximately 1955 and it lacks suitable habitat for this species.
- Prairie false dandelion (*Nothocalais cuspidata*) [Wisconsin-listed special concern species, no Federal status in Wisconsin]
  - This wildflower grows on dry, rock prairie bluffs and gravelly hillsides. Blooming occurs in early May through early June, and fruiting occurs in late May through late June (WDNR 2012p). Dry, rock prairie bluffs and gravelly hillsides are not present at the project site. The area at the project site proposed for the NorthStar facility and related operations is entirely on previously tilled land used for row crops and other agricultural purposes since approximately 1955 and it lacks suitable habitat for this species.

- Wafer-ash (*Ptelea trifoliata*) [Wisconsin-listed special concern species, no Federal status in Wisconsin]
  - This plant grows on prairies and oak uplands. Blooming occurs in late May through early October, and fruiting occurs in late June through early October (WDNR 2012q). The area at the project site proposed for the NorthStar facility and related operations is entirely on previously tilled land used for row crops and other agricultural purposes since approximately 1955 and it lacks suitable habitat for this species.

3.2.1.2 Construction Impacts

Most of the vegetation at the project site has been removed annually to allow for the growth of row crops, such as corn. Agricultural practices have also eliminated biological communities at the project site. Additional loss of vegetation at the project site is unlikely, and some vegetative cover may be restored due to possible landscaping associated with the proposed project and to elimination of agricultural practices.

The project site has not provided high-quality habitat for wildlife for about 60 years due to the periodic tilling and fertilizer/pesticide application. In the past, some small wildlife species have likely been killed as a result of those agricultural practices. Site preparation could result in some wildlife deaths and temporary relocation of wildlife due to construction activity and noise. The project site is in an area that has been zoned for light industrial use and will be converted to that use sometime in the future, regardless of whether the proposed project is approved.

Construction would occur on land that lacks suitable habitat for all the federally or Wisconsin-listed species in Table 3-5. Removal of vegetation on an annual basis since at least 1955 in the area at the project site where construction for the proposed NorthStar facility would occur make that area unsuitable habitat for the eastern prairie fringed orchid, glade mallow, hairy wild-petunia, pale purple coneflower, pink milk wort, prairie bush clover, prairie false-dandelion, prairie Indian plantain, prairie parsley, snow campion, wafer-ash, and woolly milkweed. A small (0.8-hectare [2-acre]) wetland area may provide marginal habitat for the eastern prairie fringed orchid, but it is located in area at the project site where construction would not occur (NorthStar 2012b).

The eastern massasauga rattlesnake, a federally listed candidate and Wisconsin-listed endangered species, has been reported in a number of different habitats, although it generally prefers wetlands or habitat adjacent to wetlands (USFWS 2000). It does not generally frequent plowed fields, which constitute nearly the entire project site. The wetlands would provide marginal habitat for the eastern massasauga rattlesnake due to the relative small size of the wetlands; past agricultural practices, including its use for grazing or pasturing livestock, as well as for tilling of adjacent cropland for nearly 6 decades; and the increasing presence of woody plants in the wetlands. This wetland is an avoidance area that is not being developed (NorthStar 2012b). Other factors reducing suitability of the site for the eastern massasauga rattlesnake are habitat fragmentation resulting from increasing urban development and the presence of an adjacent railroad and nearby roads.

There are no rivers or streams on the project site. Therefore, there would be no impacts to the gravel chub or Ozark minnow, since suitable habitat is lacking for these species.

Impacts on a non-essential population of the whooping crane are not expected, since the area at the project site for the proposed NorthStar facility is about 210 kilometers (130 miles) from this population's core breeding area at the Necedah National Wildlife Refuge in central Wisconsin. The area at the project site for the proposed NorthStar facility is on land previously for agricultural purposes and it lacks open wetlands, lakeshores, or large rivers. A small isolated wetland that is partially enclosed from the incursions of trees and shrubs would be a very unlikely resting area during the migration of whooping cranes due to its isolated nature, small size, and incursion of woody plants. However, that wetland is an avoidance area that would not be developed (NorthStar 2012b).

The bald eagle (*Haliaeetus leucocephalus*) and the golden eagle (*Aquila chrysaetos*) are protected by the Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.). Neither of these species would be impacted by the construction of the proposed project since the area at the project site proposed for the NorthStar facility lacks large rivers or lakes that are typical of bald eagle habitat or mountainous terrain that is typical of golden eagle habitat.

To avoid impacts to migratory birds, a pre-construction survey of the area at the project site proposed for the NorthStar facility would be conducted to prevent disturbance of active nests of bird species protected by the Migratory Bird Treaty Act (16 U.S.C. 703 et seq.). Active nests of migratory birds identified during the survey would be avoided and not be disturbed. If these nests would be disturbed or destroyed by construction activities or tree cutting, a permit would be required from the U.S. Fish and Wildlife Service.

No impacts on critical habitat for federally listed species would occur from the construction of the proposed NorthStar facility, as no critical habitat exists at the project site.

3.2.1.3 Operational Impacts

Proposed project operations would occur primarily inside the linac area for the production of the Mo-99 radiochemical. Outdoor activities would be limited and would involve primarily movement of material on and off the project site. Impacts on vegetation from operation of the proposed NorthStar facility would be negligible. As mentioned in Section 3.2.1.1, agricultural practices have eliminated biological communities at the project site.

Noise associated with operations would be largely inside, so impacts on wildlife would be minimal. Noise would continue to be generated from nearby trains on the railroad track, as well as from automobiles and trucks using Gateway Boulevard and other roads in the area.

Suitable habitat for federally or Wisconsin-listed species does not currently exist at the project site. Operations for the proposed NorthStar facility would occur primarily inside the linac and chemical processing areas. NorthStar has made a decision to avoid operations in the wetlands (where marginal habitat exists for the eastern massasauga rattlesnake, and possibly the eastern prairie fringed orchid and whooping crane) so that potential impacts on these three species would be avoided (NorthStar 2012b).

Migratory birds are not likely to be impacted by operations at the proposed NorthStar facility, since operations would be largely inside. However, active bird nests need to be avoided.

3.3 HUMAN–ENVIRONMENTAL INTERACTIONS

3.3.1 Land Use

3.3.1.1 Affected Environment

Land use is described by land activities, ownership, and the governing entities' management plans and zoning that define land use types and regulate development patterns.

The project site is owned by MLG/BRC Beloit LLC and Turtle Creek Development LLC and covers parcel number 22810005 and part of parcel number 22880100 (City of Beloit 2011c). The zoning classification of these parcels is M-1 Limited Manufacturing, although the current land use is agricultural. Lands to the west and east of the proposed site are zoned Industrial and Residential, respectively, with the current use being agricultural. Land use to the north and south is consistent with the zoning of Industrial and Housing, respectively. The City of Beloit 2008 Comprehensive Plan designates the future use of this area as a business park for industrial, office, and related economic development (City of Beloit 2008).

Prime farmland is defined by Wisconsin statute as having a land capability classification of Class I or II or as being identified as prime farmland in a preservation plan (Wisconsin Statute 91) (see Section 3.1.1.1). The project site is predominantly Class III or IV and is within the corporate limits of the City of Beloit; therefore, it is not subject to the Rock County Agricultural Preservation Plan (Rock County 2005).

3.3.1.2 Construction Impacts

The agricultural use of the project site would cease with construction of the proposed NorthStar facility. Changes in land use to implement the City of Beloit's Comprehensive Plan are generally initiated by the property owner and private developers; thus, cessation of farming on the project site was planned and expected, and the construction of the proposed facility is consistent with the City of Beloit's planned land use for this site.

3.3.1.3 Operational Impacts

Operation of the proposed NorthStar facility would be compatible with the current Limited Manufacturing zoning and Business Park land use designation of the area. The proposed facility would be designed and operated in compliance with the *City of Beloit Municipal Code*. Operation of the proposed facility would not conflict with, or impact, adjacent zoning designations or land uses.

The project site is not "farmland" subject to the Farmland Protection Policy Act. The land is not prime farmland as defined by Wisconsin statute. The stated goal of the City of Beloit Comprehensive Plan is to preserve agricultural lands within the city's planning area, except in places designated for future urban development; therefore, the project site is not of local importance to agriculture.

3.3.2 Visual Resources

3.3.2.1 Affected Environment

The physical and biological features of the landscape contribute to the scenic quality of an area and the visual appeal to an observer. The project site is located in the Gateway Business Park on the eastern outskirts of the City of Beloit. The project site and surrounding area are primarily rural agricultural lands. For part of the year, the project site and surrounding parcels are devoid of vegetation after crops are harvested and the fields are plowed and left fallow. The topography rises gently with rolling hills to the east and south of the site. Other than mature trees scattered along the site boundary, the view is unobstructed in all directions. Visible features surrounding the project site (see Figure 3-3) include an electrical substation and overhead transmission lines to the north; Gateway Boulevard and cropland to the east; two-story apartment buildings, single- and double-story houses, and a water tower to the south; and cropland, overhead transmission lines, a railroad, and multistory industrial buildings to the west.

Figure 3-3. Aerial View of Visible Features Surrounding the Project Site

3.3.2.2 Construction Impacts

Exposed soils from construction would have a minor visual impact that would last for more than a year until the facility construction is complete and landscaping is installed. Heavy equipment at the project site would be consistent in appearance with other recent construction projects in the area, including Gateway Boulevard, the Alliant Energy substation, and housing units.

3.3.2.3 Operational Impacts

The project site is located in a land use area designated Business Park for industrial development. The production facility, road access, utilities, and other improvements would disturb less than half of the 13.4-hectare (33-acre) site. The visual intrusion on the landscape would be similar to the disturbance for the electrical substation under construction to support the Gateway Business Park. The emissions stack for the chemical processing area would be approximately 18 meters (60 feet) tall and 0.6 meters (2 feet) in diameter. The height of the stack would be comparable to the overhead transmission towers installed at the substation under construction north of the project site. Transmission towers generally range in height from 15 meters (50 feet) to 55 meters (180 feet) depending on transmission line voltage.

The exterior lighting design and landscaping would follow the *City of Beloit Municipal Code*. Lighting designs would not be directed toward adjacent properties or produce distracting glare. A landscape buffer would be required along Gateway Boulevard to screen the industrial character of the proposed facility from the property east of the road that is zoned Residential.

3.3.3 Noise

Sound is defined as a particular auditory effect produced by a given source; for example, the sound of rain on a rooftop. Noise and sound share the same physical aspects, but noise is considered a disturbance, while sound is defined as an auditory effect. Noise is defined as any sound that is undesirable because it interferes with communication, is intense enough to damage hearing, or is otherwise annoying. Noise can be intermittent or continuous, steady or impulsive, and can involve any number of sources and frequencies. It can be readily identifiable or generally nondescript. Human response to increased sound levels varies according to the source type, characteristics of the sound source, distance between source and receptor, receptor sensitivity, and time of day. How an individual responds to the sound source will determine if the sound is viewed as "music to one's ears" or as annoying noise. Affected receptors are specific (e.g., schools, churches, hospitals) or broad (e.g., nature preserves, designated districts) areas in which occasional or persistent sensitivity to noise above ambient levels exists.

Noise Metrics and Regulations

Sound varies by both intensity and frequency. Sound pressure levels, described in decibels (dB), are used to quantify sound intensity. The dB is a logarithmic unit that expresses the ratio of a sound pressure level to a standard reference level. The cycles from high to low pressure each second, also called Hertz, are used to quantify sound frequency. The human ear responds differently to different frequencies. The decibel A-weighted (dBA) is used to characterize sound levels that can be sensed by the human ear. "A-weighted" denotes the adjustment of the frequency range to what the average human ear can sense when experiencing an audible event. The threshold of audibility is generally within the range of 10 to 25 dBA for normal hearing. The threshold of pain occurs at the upper boundary of audibility, which is normally in the region of 135 dBA (EPA 1981a). Table 3-6 compares common sounds and shows how they rank in terms of the effects on hearing. As shown, a whisper is normally 30 dBA and considered to be very quiet, while an air-conditioning unit 6.1 meters (20 feet) away is considered an intrusive noise at 60 dBA. Noise levels can become annoying at 80 dBA and very annoying at 90 dBA. To the human ear, each increase of 10 dBA seems twice as loud (EPA 1981b).

Table 3-6. Sound Levels and Human Response

Noise Level (dBA)	Common Sounds	Effect
10	Just audible	Negligible[a]
30	Soft whisper (4.6 meters)	Very quiet
50	Light automobile traffic (30.5 meters)	Quiet
60	Air-conditioning unit (6.1 meters)	Intrusive
70	Noisy restaurant or freeway traffic	Telephone use difficult
80	Alarm clock (0.61 meters)	Annoying
90	Heavy truck (15.2 meters) or city traffic	Very annoying hearing damage (8 hours)
100	Garbage truck	Very annoying[a]
110	Pile drivers	Strained vocal effort[a]
120	Jet takeoff (61 meters) or automobile horn (0.91 meters)	Maximum vocal effort
140	Carrier deck jet operation	Painfully loud

a. Extrapolated effect.

Note: To convert meters to feet, multiply by 3.2808.

Key: dBA=decibels A-weighted.

Source: EPA 1981b.

Federal Regulations. The Federal Government has established noise guidelines and regulations for the purpose of protecting citizens from potential hearing damage and from various other adverse physiological, psychological, and social effects associated with noise. Under the Noise Control Act of 1972, the Occupational Safety and Health Administration established workplace standards for noise. The minimum requirement states that constant noise exposure must not exceed 90 dBA over an 8-hour period. The highest allowable sound level to which workers can be constantly exposed is 115 dBA, and exposure to this level must not exceed 15 minutes within an 8-hour period. The standards limit instantaneous exposure, such as impact noise, to 140 dBA. If noise levels exceed these standards, employers are required to provide hearing protection equipment that will reduce sound levels to acceptable limits (29 CFR 1910.95).

State Regulations. The State of Wisconsin does not have comprehensive noise control regulations (State of Wisconsin 2011). Therefore, the sound-level limits contained in the *City of Beloit Municipal Code* would apply to the proposed project.

Local Regulations. The project site is located within the City of Beloit corporate limits, therefore the *City of Beloit Municipal Code* would apply to the construction and operation of the facility. Chapter 19, Article 8-800, of the code includes sound-level limits for land that is zoned Industrial. The maximum permitted sound level varies, depending on the frequency of the industrial equipment; however, the maximum noise level of any operation cannot exceed 72 dBA as measured at the boundary of a residential zoning district, or 79 dBA as measured at the boundary of a commercial zoning district (City of Beloit 2011e). The *City of Beloit Municipal Code* does not include other provisions that would apply to the proposed project, such as restrictions on construction noise (City of Beloit 2011e).

3.3.3.1 Affected Environment

The ambient sound environment at the project site is affected mainly by automobile and railroad traffic. Vehicles traveling southeast of the site on Gateway Boulevard, west of the site on I-90, and north of the site on I-43 are the main contributors to the ambient noise environment. The railroad directly north of the site is operated by Union Pacific Railroad and is used for freight services (Wisconsin DOT 2011). The project site is currently rural agricultural land; therefore, ambient noise levels are low (approximately 50 dBA day–night average sound level [FHWA 1980]) during offpeak traffic hours. During peak traffic hours, the ambient noise level is increases slightly (approximately 55 to 60 dBA day–night average sound level [FHWA 1980]).

The land is zoned for light industrial use, as it is located at the north end of the Gateway Business Park, adjacent to the Alliant Energy electrical substation. Southwest of the project site (approximately 210 meters [700 feet]) is residential land use; this includes apartment buildings and single-family homes along Eagles Ridge Road. No other noise-sensitive receptors are adjacent to the project site.

Construction Sound Levels

Building demolition and construction work can cause an increase in sound that is well above the ambient level. A variety of sounds are emitted from loaders, trucks, saws, and other work equipment. Table 3-7 lists noise levels associated with common types of construction equipment. Construction equipment usually exceeds the ambient sound levels by 20 to 25 dBA in an urban environment and by up to 30 to 35 dBA in a quiet suburban area.

3.3.3.2 Construction Impacts

Noise from construction activities varies, depending on the type of construction equipment being used, the area that the project would occur in, and the distance from the noise source. To predict how construction activities would impact adjacent populations, noise from the probable construction was estimated. For example, as shown in Table 3-7, construction usually involves several pieces of equipment (e.g., trucks, bulldozers) that can be used simultaneously. Under the proposed project, the combined noise from the construction equipment during the busiest day was estimated to determine the total impact of noise from construction activities at a given distance. Examples of expected combined construction noise during daytime hours at specified distances are shown in Table 3-8.

Table 3-7. Predicted Noise Levels for Construction Equipment

Construction Category and Equipment	Predicted Noise Level at 15.2 meters (50 feet) (dBA)
Clearing and Grading	
Bulldozer	80
Grader	80–93
Truck	83–94
Roller	73–75
Excavation	
Backhoe	72–93
Jackhammer	81–98
Building Construction	
Concrete mixer	74–88
Welding generator	71–82
Pile driver	91–105
Crane	75–87
Paver	86–88

Key: dBA=decibels A-weighted.

Source: EPA 1971.

The noise from construction equipment would be localized, short term, and intermittent during machinery operations. Heavy construction equipment would be used periodically during construction; therefore, noise levels from the equipment would fluctuate throughout the day. The construction is expected to result in noise levels comparable to those indicated in Table 3-8.

Table 3-8. Predicted Noise Levels from Construction Activities

Distance from Noise Source (meters)	Predicted Noise Level (dBA)
15	89
30	83
61	77
122	71
244	65
366	61

Note: To convert meters to feet, multiply by 3.2808.

Key: dBA=decibels A-weighted.

The closest residential area is approximately 210 meters (700 feet) to the south of the project site; populations would likely be exposed to noise levels of less than 65 dBA from construction activities. Noise generation would last only for the duration of construction activities (approximately 18 months) and would be isolated to normal working hours (i.e., between 7:00 a.m. and 5:00 p.m.). NorthStar does not expect that the short-term increase in noise levels from construction would cause significant adverse impacts on the surrounding populations.

Construction vehicles are expected to access the site from Gateway Boulevard. The additional traffic resulting from construction vehicles would likely cause short-term, minor increases in noise levels on adjacent populations.

3.3.3.3 Operational Impacts

The proposed project is expected to require approximately 150 employees, and 10 to 20 trucks are expected daily for shipments to and from the site. The additional employee and shipping traffic would likely cause minor, long-term increases in noise levels on populations adjacent to the roadways. It could be necessary for vehicles to drive past the adjacent residential neighborhoods off Gateway Boulevard.

Noise would stem from the operation of linac and chemical processing equipment. While this equipment is likely to produce considerable noise levels, the noise would be contained within the production facility and would have no impact on the surrounding ambient noise levels. Employees working in this environment would follow best management practices, such as the use of hearing protection equipment, to limit exposure above the permissible noise exposure level as defined by the Occupational Safety and Health Administration.

The proposed cooling system would contribute slightly to the noise environment. The cooling system fans would produce no more than 60 dBA at a distance of about 9 meters (30 feet) from the cooling towers. The fans would run as needed to control the temperature from the hot inlet port to the cooler outlet port; therefore, they would run intermittently.

The use of a backup electric generator could produce noise levels above existing ambient levels; however, backup generator use is expected to be limited to emergency situations involving the loss of grid-supplied power. Generators used to produce electricity are driven by internal combustion engines that run on diesel fuel. Their electric power capacity ranges in size from a few hundred to several thousand kilowatts. Generators are commonly used for electricity and emergency power generation in central utility facilities and industrial applications. Noise levels from generators vary, depending on the type of generator and how it is installed; however, an average noise level at 15 meters (49 feet) is 72 dBA (University of Washington 2005). As the generators would be used for only emergency situations, short-term, minor, adverse effects are expected.

3.3.4 Infrastructure

Infrastructure consists of the systems and physical structures that enable a population in a specified area to function. Infrastructure is wholly manmade, with a high correlation between the type and extent of infrastructure and the degree to which an area is characterized as “urban,” or developed. The availability of infrastructure and its capacity to support growth are generally regarded as essential to the economic growth of an area. Utilities and infrastructure include systems for electric power, gas, and water supply and for stormwater, sewer and wastewater, solid waste management, communications, and transportation. The analysis to determine potential impacts on infrastructure considers primarily whether a proposed project would exceed capacity or place unreasonable demand on a specific utility.

3.3.4.1 Affected Environment

Power Supply

Power supply at the proposed NorthStar facility would be furnished by Alliant Energy. Two substations are located near the project site: the East Beloit substation, which has a 25-MVA [megavolt ampere] transformer and is 2.4 kilometers (1.5 miles) from the project site, and a substation currently under construction adjacent to the project site that will have a capacity load of 42 MVAs. The current load on the existing substation is 10.6 MVAs, which leaves 14.4 MVAs, or 57 percent, of the capacity unused. No power interruptions of greater than 1 minute have been reported at the East Beloit substation. Once completed, the initial load at the new substation is expected to be 21 MVAs, which is 50 percent of the total capacity. If the new substation reaches 80 to 85 percent of total capacity, a second transformer is planned for installation at the new substation site (Kepner 2012**).** The proposed NorthStar Facility would connect to existing electric-power transmission lines that are located along the Gateway Boulevard right-of-way adjacent to the project site (GBEDC 2010).

Natural Gas

Natural gas at the proposed NorthStar facility would be furnished by Alliant Energy. The project site is served by a 10.2-centimeter (4-inch) line along the east side of the Gateway Boulevard right-of-way. The natural gas system is an on-demand system in which the gas is delivered to customers when they need it. As such, as long as a steady supply of natural gas is available to customers, the system would operate at capacity (MLG Commercial Inc. Undated).

Water Supply

Water would be supplied to the proposed NorthStar facility by the City of Beloit. The City currently operates seven groundwater wells, with depths ranging from 34 to 366 meters (113 to 1,200 feet) (City of Beloit 2010a). The wells are the sole source of water for the city. The overall capacity of the water system in 2009 was 5.6 million liters (15.5 million gallons) per day, and the average daily use was 24.6 million liters (6.5 million gallons) per day (MLG Commercial Inc. Undated). An existing 20.4-centimeter (8.0-inch) water main line is located along the Gateway Boulevard right-of-way adjacent to the project site and would serve as the interconnection point for the proposed NorthStar facility (GBEDC 2010).

Stormwater

Management of stormwater in the vicinity of the proposed NorthStar facility falls under the purview of the City of Beloit stormwater utility. The City of Beloit is authorized by WDNR to discharge stormwater under a municipal separate stormwater system permit. The project site is undeveloped and does not have any stormwater management infrastructure currently in place.

Wastewater

Sanitary sewer and wastewater treatment would be provided by the City of Beloit. A 20.4-centimeter (8-inch) sanitary sewer line is located along the Gateway Boulevard right-of-way adjacent to the proposed site (GBEDC 2010). This line would carry wastewater to a sewage treatment plant located approximately 3.1 kilometers (1.9 miles) southwest of the proposed facility. The City of Beloit's treatment system has an allotted capacity of approximately 4.5 million liters (12 million gallons) per day. Currently, the system is treating approximately 2.3 million liters (6 million gallons) per day (MLG Commercial Inc. Undated).

Communications

The proposed NorthStar facility site is serviced by AT&T for communications infrastructure. The project site has not yet been wired for telephone and fiber-optic service; however, telecommunication lines would be extended to the project site once the need arises (MLG Commercial Inc. Undated). Existing fiber-optic and telephone lines are located along the Gateway Boulevard right-of-way adjacent to the project site (GBEDC 2010).

Transportation

The project site is immediately west of Gateway Boulevard, south of I-43, and east of I-39/90. The main access to the proposed facility would be via Gateway Boulevard, which is a four-lane, north–south, median-divided roadway owned and maintained by the City of Beloit. I-39/90 is a north–south interstate in the vicinity of the project site that heads south into Illinois toward Rockford, Illinois, and north to Janesville, Wisconsin. In Rockford, I-39 continues south toward Bloomington, Illinois, and I-90 turns east toward Chicago. I-43 runs northeast to Milwaukee and turns into Milwaukee Road (Wisconsin State Route 81) west of I-39/90 on the way into Beloit, Wisconsin.

Annual average daily traffic (AADT) counts for roadways near the proposed facility ranged from 1,500 to 50,100 vehicles per day in 2010. The intersection of Gateway Boulevard and Cranston Road, south of the project site, had an AADT of 1,500 to 2,100 vehicles per day. At the intersection of Gateway Boulevard and I-43 north of the project site, I-43 had an AADT of 15,700 vehicles per day. I-39/90 west of Gateway Boulevard and southwest of the site had an AADT of 50,100 vehicles per day (Wisconsin DOT 2010).

The proposed facility would be located near one bus stop on the City of Beloit's bus transit system. The Aldrich Tripper route is a limited-service route operating only during the week on school days, with service in the mornings and afternoons. It has a stop near the intersection of Gateway Boulevard and Colley Road (City of Beloit 2010b).

3.3.4.2 Construction Impacts

Power Supply

Up to 1,000 megawatt-hours of electricity would be required and supplied by Alliant Energy for construction of the proposed facility by connecting to existing transmission lines adjacent to the proposed project site; additional power for construction activities would be supplied by onsite generators, as needed. Although demand on the existing electrical system would increase, it is not expected to exceed supply.

Natural Gas

Construction of the proposed NorthStar facility would not require the use of natural gas.

Water Supply

Water demand would increase slightly during construction; however, potential increases in water demand associated with construction and demolition activities would be temporary and are not expected to exceed existing capacity. Water for construction would be supplied by connecting to the existing main lines adjacent to the project site.

Stormwater

Ground disturbance during construction would temporarily increase the potential for soil erosion and sediment transport during sheet-flow runoff. To minimize these potential effects, an erosion control and stormwater management plan would be developed in accordance with WDNR regulations. This plan would reduce potential impacts by outlining best management practices that would minimize soil and sediment runoff into local bodies of water during construction.

Wastewater

Wastewater systems would not be affected during construction of the NorthStar facility.

Communications

Communications systems would not be affected during construction of the NorthStar facility.

Transportation

The level of vehicle and truck traffic on local roadways as a result of construction activities is expected to be minimal and to not exceed existing design capacity. No additional transportation infrastructure or alterations to existing infrastructure would be required under the proposed project.

3.3.4.3 Operational Impacts

Power Supply

The constructed facility would require up to 144,000 megawatt-hours of electricity per year, which would be supplied by Alliant Energy through a connection to existing transmission lines adjacent to the project site. Although the demand on the existing electrical system would increase, it is not expected to exceed the available supply of the nearby substations; therefore, a long-term, minor, adverse impact is expected from the increase in demand.

Natural Gas

The proposed facility would connect to existing gas lines along Gateway Boulevard and would use natural gas for heating and other building functions. The demand for natural gas from operation of the proposed facility is expected to be minimal and is not expected to exceed the available supply.

Water Supply

Demand for water would increase during operation of the proposed NorthStar Facility. The constructed facility would utilize a closed-loop cooling system; the initial water requirement would be approximately 11,400 liters (3,000 gallons). This water would circulate internally and would need to be periodically replenished; however, the water required for replenishment would be minimal. Use of a hybrid cooling system using evaporative cooling, would require up to 11,000 liters (2,880 gallons) of water per day during the hotter summer months. Under either scenario, the existing supply of water would be adequate to meet facility needs and would not be overburdened. Water for operations would be supplied by connecting to the existing main lines adjacent to the project site.

Stormwater

The constructed facility would result in soil compaction and increased impermeable surfaces (e.g., new structures, pavements, sidewalks). This would decrease stormwater permeation into the ground and thereby permanently increase sheet-flow runoff into the stormwater drainage system.

Wastewater

The wastewater discharge requirements from the proposed NorthStar facility would be met by connecting to the City of Beloit wastewater lines adjacent to Gateway Boulevard. This would slightly increase the demand on the system, but would not overburden existing capacity.

Communications

Communications systems would not be affected during operations of the NorthStar facility.

Transportation

The level of vehicle traffic on local roadways as a result of operations of the proposed facility is expected to be minimal and is not expected to exceed existing design capacity. No additional transportation infrastructure or alterations to existing infrastructure would be required under the proposed project.

3.3.5 Human Health and Safety – Normal Operations

3.3.5.1 Affected Environment

The human health and safety environment is composed of the operating environment to which workers are exposed. Because the proposed NorthStar facility would be new, there is no existing environment with regard to workers. The public health and safety environment reflects the exposure of members of the public to potential additional impacts resulting from the operating facility.

The average American receives a total radiation dose of approximately 620 millirem per year from all radiation sources, both natural and manmade, of which approximately 311 millirem per year are from natural sources. Radiation sources can be divided into six categories: (1) cosmic radiation, (2) terrestrial radiation, (3) internal radiation, (4) consumer products, (5) medical diagnosis and therapy, and (6) other sources (e.g., commercial nuclear power, aviation) (NCRP 2009). Major sources and levels of background radiation exposure to an average individual in the United States are shown in Table 3-9. Annual background radiation doses to individuals are expected to remain constant over time and are unrelated to NorthStar's linac operations.

Table 3-9. Sources of Radiation Exposure to Individuals: U.S. Average

Source[a]	Effective Dose Equivalent[b] (millirem per year)
Natural Background Radiation	
External cosmic	33
External terrestrial	21
Internal terrestrial and global cosmogenic	29
Radon (in homes)	228
Subtotal Natural Background Radiation	**311**
Medical	
Computed tomography	147
Fluoroscopy and other radiography	76
Nuclear medicine	77
Subtotal Medical	**300**
Consumer and Industrial Products	**13**
Other	**<1**
Total (Rounded)	**620**

a. Averages for an individual in the United States population.

b. Lifetime doses are the conventional measure of detriment used for radiological protection. These are 50-year dose commitments to a weighted sum of tissue doses defined by the International Commission on Radiological Protection and referred to as "effective dose equivalent."

Source: NCRP 2009.

3.3.5.2 Construction Impacts

No radioactive material would be brought to the facility or generated at the facility prior to operation. Therefore, no radiological impacts are expected during construction of the NorthStar facility. Construction activities are not expected to impact members of the public.

Construction would entail potential hazards to workers typical of any construction site. Normal construction safety practices would be employed to promote worker safety and reduce the likelihood of worker injury during construction. Nonetheless, construction accidents could occur. Over the 18-month construction period, the number of workers at the site would range from 5 to 50. The number of recordable cases and days away from work, job restriction, or job transfer (DART) cases were estimated using U.S. Bureau of Labor Statistics data for total recordable cases (4.0 per 200,000 hours) and DART cases (2.1 per 200,000 hours) (DOL 2011). Conservatively assuming that the peak number of workers would be involved during the entire construction period, there would be 3 total recordable cases, 1.6 of which would be DART cases.

3.3.5.3 Operational Impacts

Public Impacts

Members of the public could be potentially impacted by normal operational releases of radioactive material. These releases could be of two types: releases to the atmosphere and releases through wastewater to surface water.

Liquid waste generated during operations would be collected and stored (see Section 3.3.8, Waste Management). The proposed facility would not release any radioactive material through wastewater; therefore, no public dose from wastewater is expected.

Air emissions from the facility have the potential to contain radioactive material. However, the facility design and operation are intended to control the amount of radioactive material released to a negligible amount. The generation of Mo-99 using linacs would produce very little radioactive material other than the target. As discussed in Section 2, the target assembly would likely be submerged in water, or encased in paraffin, to prevent the activation of air, thereby eliminating gaseous radioactive air emissions. The dissolution processing of the Mo-99 targets in the hot cells is not expected to generate any airborne contaminants. Because any potential particulate or aerosol air emissions would come from the linac rooms or the hot cells, they would be processed through high-efficiency particulate air (HEPA)[13] filters prior to release to the atmosphere; however, the emissions are not expected to contain radioactive material.

Worker Impacts

Radiation workers at the proposed NorthStar facility would receive the same dose as the general public from background radiation, but they also would receive an additional dose from working in a facility with radioactive material. The potential sources of exposure for the workers include the activities associated with the linac irradiation of the natural and enriched Mo-100 targets, transfer of irradiated material into the hot cells, packaging and shipment of the Mo-99 product, and preparation of any radioactive waste for disposal. Specifically, these activities include the following:

- Loading the molybdenum target assembly into the linac target position
- Irradiation of molybdenum targets by the linacs
- Removal of the irradiated targets and target assembly from the target position
- Loading the targets into the transfer pig
- Transfer of the irradiated targets between the linacs and hot cells
- Processing of the molybdenum targets, including chemical dissolution and filtration
- Packaging and handling of the Mo-99 radiochemical product for shipment
- Management of radioactive process materials and waste streams
- Maintenance, calibration, testing, measurement, and research and development activities

The Mo-99 production facility design and operation include several features to limit worker dose. Some of the more significant features include the following:

[13] A HEPA filter removes 99.97 percent of particles greater than 0.3 micrometers from the air that passes through the filter.

- Use of water or paraffin around the targets during irradiation to limit production of air activation radionuclides
- Delay time in approaching the target assembly and handling irradiated targets to allow for a reduction in dose rate
- Use of tongs or other target-handling devices to eliminate contact dose
- Remote handling of materials in hot cells during target processing and product packaging
- Remote handling of material between the linac and chemical processing areas and/or the use of shielded transfer containers
- HVAC systems designed to pass air from the linacs and hot cells through HEPA filters
- Physical barriers (e.g., concrete walls) that act as radiation shielding between areas handling radioactive material and other areas

About one-third of the workers at the Mo-99 production facility are expected to receive any radiation dose. Most of the workers would work in areas that would be exposed to no more radiation than that from normal background levels. Approximately 50 workers are expected to be considered radiation workers. The maximum dose to be allowed for any radiation worker at the Mo-99 production facility (workers in the linac and chemical processing areas) would be 5 rem per year. This is equivalent to the radiation worker dose limit established by the Wisconsin Department of Health Services' Regulation 157.22 (WISREG 2012). Using this regulatory limit, the maximum impact on the 50 radiation workers at the linac and chemical processing areas would be 250 person-rem per year. Using a risk estimator of 0.0006 latent cancer fatalities (LCFs) per person-rem (ISCORS 2002), the calculated number of latent fatal cancers[14] among workers from normal operations would be 0.15 per year. An individual worker who receives a dose of 5 rem in 1 year would have an increased risk of a latent fatal cancer of 0.003.

Operations of the NorthStar facility would entail risks to workers typical of light industrial, warehouse, and office settings. The Bureau of Labor Statistics incident rates for all industries for total recordable cases (3.8 per 200,000 hours) and DART cases (1.9 per 200,000 hours) were used to estimate injury rates for operations (DOL 2011). Assuming a workforce of 150, there would be 5.7 total recordable cases and 2.9 DART cases in 1 year of operations.

3.3.6 Human Health and Safety – Accidents and Intentional Destructive Acts

3.3.6.1 Facility Accidents

The analysis of accidents and intentional destructive acts (IDAs) at the NorthStar facility was performed using the following multistep process: (1) obtain design and operating parameters relevant to accident and IDA scenarios; (2) develop accident and IDA scenarios that are representative of the range of human health impacts associated with radioactive and hazardous-chemical inventories identified in step 1; and (3) select and apply appropriate methods to calculate the human health impacts of scenarios developed in step 2. Both radiological and hazardous-chemical human health impacts were calculated for the nearest location, assumed to be 20 meters (66 feet), of a member of the public, denoted as the maximally exposed individual (MEI).[15] In addition, for radiological airborne-release scenarios, the human health impacts on the population within 80 kilometers (50 miles) of the facility were also calculated. Chemical impacts were not calculated for this population because the dispersion and dilution of chemicals beyond MEI distances

[14] A latent fatal cancer is a cancer that results in death that develops sometime after the exposure to ionizing radiation or other carcinogen.

[15] The MEI is a hypothetical individual whose location and habits result in the highest total exposure (and thus dose) from a particular source for all relevant exposure routes (e.g., inhalation, ingestion, direct exposure).

do not typically affect human health, whereas even small concentrations of radionuclides out to larger distances are a long-term source of cumulative or chronic radiation dose and concomitant long-term health impacts on the public in terms of an increased likelihood of an LCF. For any hazardous-chemical accidents in which serious health impacts were calculated for the MEI, the distance beyond the MEI location where these health impacts would occur was also calculated.

3.3.6.1.1 Chemical Health Effects

NorthStar proposes to use the following three hazardous chemicals in quantities above those associated with routine analytical laboratory applications: hydrogen peroxide (30 percent solution), potassium hydroxide (for pH adjustment), and potassium nitrate (for redox[16] control). These chemicals would be used in processing the solid target molybdenum disks after end of bombardment in the linac to produce the end product Mo-99 solution for shipment. Assuming that a 4-week supply of these chemicals is stored on site, there would be a maximum onsite inventory of 60 liters (16 gallons) of hydrogen peroxide, 20 kilograms (44 pounds) of potassium hydroxide, and 0.4 kilograms (0.9 pounds) of potassium acetate. In addition, the Mo-99 targets would be cooled by a helium system that involves the storage and transfer of pressurized helium from gas bottles. The total volume of helium that could be present at the facility is estimated to be the equivalent of 2,100 cubic feet (58.4 cubic meters) at atmospheric pressure (Dale 2012b). A helium release could affect human health by displacing oxygen in an enclosed space or in the immediate vicinity of the accident and causing asphyxiation.

The DOE Protective Action Criteria (PAC) database was used to determine airborne concentration values that would result in serious and/or fatal health effects (DOE 2012). Two methods were used to calculate human health impacts of postulated accidents involving hazardous chemicals. For hydrogen peroxide and helium, the ALOHA [Areal Locations of Hazardous Atmospheres] computer code (version 5.4.1.2, April 2009) was used to calculate the consequences of postulated accidents involving liquid and gaseous chemical releases and associated airborne dispersion. ALOHA was developed jointly by the National Oceanic and Atmospheric Administration and EPA and has been used extensively to model the atmospheric dispersion of chemical releases to the environment (DOE 2012). For potassium hydroxide and potassium nitrate (both in solid form), a particulate dispersion calculation was performed using the methodology in the MACCS [MELCOR Accident Consequence Code System] computer code, version 1.13.1 (MACCS2) (Chanin and Young 1998), which was also used in this EA to calculate radiological accident human health impacts. A detailed description of the MACCS model is provided in the *Code Manual for MACCS2* (Chanin and Young 1998). The enhancements incorporated in MACCS2 are described in the MACCS2 user's guide (Chanin and Young 1998). Four conservative hazardous-chemical accident scenarios were postulated in which 100 percent of each of the 4-week inventories of the aforementioned chemicals and of the helium cooling system is assumed to be released. The accident scenario evaluated for stored helium assumes an aircraft impact, explosion, earthquake, or tornado causing failure of all bottles and interconnected systems containing helium. For hydrogen peroxide, the accident scenario assumes that the 4-week inventory is spilled at the delivery dock by a replenishment vehicle during unloading. A fire-induced dispersion of solid potassium hydroxide or potassium nitrate is the accident scenario analyzed for these hazardous chemicals. ALOHA was used to calculate the air concentrations of hydrogen peroxide and helium for different distances, and the MACCS2 particulate dispersion equation was used to calculate the airborne concentration of respirable[17] particles of the potassium hydroxide and potassium acetate at the MEI location. All accidents were calculated using both the arithmetic mean and 95th percentile statistical meteorology.

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[16] A chemical reaction in which an atom or ion loses or gains electrons to another atom or ion.

[17] Respirable particulate fraction is that fraction of inhaled airborne particles that can penetrate beyond the terminal bronchioles into the gas-exchange region of the lungs.

The results of the chemical accident analyses were compared to the specific chemical's PAC value (DOE 2012). The hydrogen peroxide spill accident, assumed to occur when a replenishment shipment arrives at the facility, results in the MEI concentration reaching the PAC-1 level (nondisabling temporary discomfort), but no serious public or worker health effects are expected from this accident. The potassium hydroxide and potassium nitrate fire accidents do not result in any exceedance of PAC levels at the MEI distance or for workers. A postulated accident resulting in release of the entire onsite helium inventory causes no health effects on the MEI under the statistical mean meteorology, but exceeds the PAC-3 concentration (life threatening) under 95th percentile meteorology conditions. The PAC-3 concentration is exceeded out to 35 meters (115 feet) for the 95th percentile meteorology conditions, thus affecting any person out to this distance. Depending on their locations with respect to the accident, workers could experience health impacts similar to those of the MEI or more severe. Table 3-10 presents the results of the hazardous-chemical accident analysis.

Table 3-10. Hazardous-Chemical Accident Scenario Consequences

Accident Scenario	Chemical (volume)	MEI[a] Concentration: Mean Meteorology and 95th Percentile Meteorology (ppm)	PAC-1 (ppm)	PAC-2 (ppm)	PAC-3 (ppm)
Failure of storage container during delivery	Hydrogen peroxide (60 liters)	7.94 55.5	30	170	330
Explosion-, fire-, earthquake-, or tornado-induced release of entire inventory	Helium (2,100 cubic feet)	37,100 1,240,000[b]	65,000	230,000	400,000

a. The MEI is assumed to be located 20 meters (66 feet) from the accident.

b. PAC-3 reached at 35 meters (115 feet); PAC-2 reached at 45.5 meters (150 feet); PAC-1 reached at 85.5 meters (282 feet).

Note: To convert cubic feet to cubic meters, multiply by 0.0283; liters to gallons, by 0.264.

PAC-**1** is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic, nonsensory effects. However, these effects are not disabling and are transient and reversible.

PAC-**2** is the airborne concentration above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting, adverse health effects or an impaired ability to escape.

PAC-**3** is the airborne concentration above which it is predicted that the general population, including susceptible individuals, could experience life-threatening adverse health effects or death.

Key: MEI=maximally exposed individual; PAC-Protective Action Criteria; ppm=parts per million; ft^3 = cubic feet

Source of PAC values: DOE 2012.

3.3.6.1.2 Radiological Health Effects

The health consequences from exposure to radionuclides due to accidental releases were calculated. Total effective dose equivalents were calculated and converted to estimates of LCFs using dose conversion factors recommended by the International Commission on Radiological Protection. For individuals, the estimated probability of an LCF occurring was determined for the MEI. The nominal values of lifetime cancer risk for low-dose or low-dose-rate exposure (less than 20 rem to an individual) used in this *Mo-99 EA* are 0.0006 LCFs per person-rem for a population of all ages, including workers, and 0.0006 LCFs per rem for individual dose (ISCORS 2002). The lifetime cancer risk of an individual dose or dose-rate exposure that is 20 rem or greater is two times the low-dose value, or 0.0012 LCFs per rem. An acute dose (received over less than 24 hours) of 600 rem or greater was assumed to result in a fatality (PNNL 2003). In the following radiological accident analyses, doses were calculated for the worker (for direct-radiation accident scenarios), MEI, and population within 80 kilometers (50 miles). Population distributions were based on U.S. Department of Commerce state population 2010 census numbers (USCB 2011). The population was spatially distributed on a circular grid with 16 directions and 10 radial distances up to 80 kilometers (50 miles). The grid was centered at the location from which the radionuclides were assumed to be released. The 2010 census total population from the NorthStar facility out to 80 kilometers (50 miles) was about 2,381,000 (USCB 2011). Although the production of Mo-99 by linac high-energy electron bombardment does produce other radionuclides, analyses have shown that the dominant radionuclide contributor to human health impacts is Mo-99 (Kelsey 2012).

Accident Scenarios

Potential facility radiological accidents could occur in the linac and chemical processing areas of the proposed NorthStar facility. Production of Mo-99 is expected to use pairs of linacs aiming high-energy, collimated[18] electron beams at a stack of enriched Mo-100 metallic disks. The disks would be enclosed in a target assembly that would be immersed in water or other air-excluding media to preclude the generation of air activation products. During electron bombardment, the target disks in the assembly would be cooled by a closed-loop pressurized-helium system. After electron bombardment, the target (containing up to 2,500 curies of Mo-99) would be transferred to a series of hot cells, where it would be processed to create batches of solution of up to 20 curies of Mo-99 each, which would be subsequently shipped in Type A packages to customers. Several of these packages would be shipped in batches each day. Liquid-process-loss material and contaminated solid material would be transferred to the Production Phase 1 Building in a package that may contain up to 100 curies of Mo-99. The maximum Mo-99 activity expected to be in the linac and chemical processing areas at any one time is 10,000 curies. Because Mo-99 is a gamma radiation–emitting radionuclide (Stanford 2012), it can affect human health from both direct unshielded exposure as well as inhalation of respirable airborne particles. Therefore, accidents were postulated and analyzed that involved both of these exposure pathways.

Direct-Exposure Accident Scenarios—Two direct-exposure accident scenarios were postulated in which the integrity of shielded packages or structures enclosing the Mo-99 was compromised, resulting in direct gamma radiation streaming from the exposed Mo-99 to workers and members of the public. Mo-99 emits a spectrum of gamma radiation up to a maximum energy of 0.778 MeV (Stanford 2012). Mo-99 also emits beta radiation (average energy of 0.398 MeV and peak energy of 1.215 MeV), but this radiation has a range of 3 to 10 feet in air and would therefore be absorbed before reaching the public receptors; in the event of an accident, workers would not be remain within this distance so no significant dose contribution to workers would be expected. For each of these scenarios, gamma dose rates were calculated assuming a point source and no intervening shielding for distances of 1 to 50 meters (3.3 to 165 feet). The calculated dose rates were based on the inverse square law[19] of radiation attenuation without accounting for air absorption or air/ground scatter effects. Workers are assumed to be within 1 to 3 meters (3.3 to 10 feet) of the accident, while the MEI is assumed to be at a nearby, offsite location 20 meters (66 feet) from the exposed Mo-99 material.

The first direct-exposure accident scenario was postulated to involve the structural failure on the loading dock of one of the Type A packages containing 20 curies of Mo-99, which exposes the package contents without shielding. This accident could occur due to mishandling or other types of human error. The resulting unshielded direct-streaming radiation doses as a function of distance are presented in Table 3-11. No doses that are immediately life threatening would occur to workers or the public, but significant worker dose could occur. A 1-hour exposure to workers at 1 meter (3.3 feet) from the accident and to an MEI was calculated to result in LCF risks of 2×10^{-3} and 5×10^{-6}, respectively.

A second direct-exposure accident scenario was postulated to involve an aircraft impact, severe seismic event, or tornado that destroys the linac area of the facility when a target set is at the end of bombardment

18 A collimated beam of electrons is a beam whose rays or particles are nearly parallel so that it does not converge or diverge appreciably.

19 The inverse square law applies when energy is radiated outward radially in three-dimensional space from a point. As the emitted radiation gets farther from the source, it spreads out over a spherical area that is increasing in proportion to the square of the distance (sphere radius) from the source. Because the surface area of a sphere (which is $4\pi r^2$) is proportional to the square of the radius, the intensity of radiation passing through any unit area is inversely proportional to the square of the distance from the point source.

Table 3-11. Direct-Exposure Accident Scenario Radiological Consequences[a]

Distance (meters)	Shipping-Package Failure (20 curies of Mo-99)		End-of-Bombardment Target Exposed (2,500 curies of Mo-99)	
	Dose Rate (rem/hr)	LCF Risk from 1 Hour of Exposure	Dose Rate (rem/hr)	LCF Risk from 1 Hour of Exposure
1	3.6	2×10^{-3}	450	1 (0.5 calculated)
3	0.4	2×10^{-4}	50	6×10^{-2}
10	0.036	2×10^{-5}	4.5	3×10^{-3}
20 (MEI)	0.009	5×10^{-6}	1.1	7×10^{-4}
30	0.004	2×10^{-6}	0.5	3×10^{-4}
40	0.0023	1×10^{-6}	0.28	2×10^{-4}
50	0.0014	9×10^{-7}	0.18	1×10^{-4}

a. Mo-99 gamma direct-dose rates (including effect of metastable technetium-99 daughter radioisotope) is based on 1.8 rem per hour at 1 centimeter from 1 millicurie (0.001 curie) (Stanford 2012). LCFs are based on 0.0006 LCFs per rem (ISCORS 2002); for dose rates above 20 rem per hour, the factor increases to 0.0012 LCFs per rem. An acute dose of 600 rem is assumed to result in fatality (PNNL 2003).

Note: To convert centimeters to inches, multiply by 0.3937; meters to feet, by 3.2808.

Key: LCF=latent cancer fatality; MEI=maximally exposed individual; Mo-99=molybdenum-99.

and is being transferred to a hot cell, thus exposing a total Mo-99 activity of 2,500 curies. The resulting unshielded direct-streaming radiation doses as a function of distance are presented in Table 3-11. Workers within about 1 meter (3 feet) of the exposed Mo-99 would receive a large dose, which could be fatal after 1 hour of exposure. Beyond this distance, workers would receive significant, but not fatal, doses. The MEI would receive a measurable, but not fatal, dose, depending on exposure time. A 1-hour exposure to workers and to the MEI was calculated to result in LCF risks of 1 (calculated to be 0.5) and 7×10^{-4}, respectively.

Airborne-Release Accident Scenarios—Airborne-release accident scenarios involve an event in which one or more radioisotopes are released to the ambient air. The initiating event or driving force for this category of accident could be a drop, impact, fire, explosion, or external natural hazard, such as an earthquake, tornado, or flood.

The MACCS2 computer code (Chanin and Young 1998) was used to estimate the radiation doses and health effects that could result from postulated accidental releases of radioactive materials to the atmosphere. The radioactive materials released are modeled as being dispersed in the atmosphere while being transported by the prevailing wind. Atmospheric conditions during an accident scenario's radioactive material release and subsequent plume transport were assumed to be either arithmetic mean or 95th percentile, based on DOE MACCS2 recommendations (DOE 2004). For arithmetic mean meteorology, a "D" stability class[20] and 4.5 meters per second (10 miles per hour) windspeed were assumed, while, for 95th percentile meteorology, an "F" stability class and 1 meter per second (2.2 miles per hour) windspeed were assumed.

Lifetime doses are the conventional measure of detriment used for radiological protection. These are 50-year dose commitments to a weighted sum of tissue doses defined by the International Commission on Radiological Protection and referred to as "effective dose equivalent." MACCS2 uses Federal Guidance Report 11 (EPA 1988) inhalation dose conversion factors to calculate doses from airborne concentrations

[20] Atmospheric turbulence is divided into six stability classes designated as A, B, C, D, E, and F, with class A being the most unstable or most turbulent class and class F, the most stable or least turbulent class.

of specific radionuclides. Lifetime doses may be used to calculate the stochastic[21] health effect risk resulting from exposure to radiation. The calculated lifetime dose was used in cancer risk calculations in this *Mo-99 EA*.

Three airborne-release accident scenarios were developed for the proposed NorthStar facility. These scenarios represent a range of initiating events, frequencies of occurrence, and types of release plumes. As the irradiated target disks would be in the form of solid molybdenum metal or in solution during and after processing, airborne releases with respirable particles were postulated under conditions of a fire at the linac area, chemical processing area hot cells, or loading dock. Each of these accident scenarios assumes a 1-hour-duration fire as the mechanism by which respirable particles of Mo-99 are released to the atmosphere from either its liquid solution or solid form at the proposed NorthStar facility.

The first airborne-release accident scenario was postulated to involve 10 Type A packages of 20 curies of Mo-99 each (total of 200 curies of Mo-99) awaiting shipment at the loading dock. In this accident scenario, a truck impact at the loading dock causes structural failure of the transportation packages, and a subsequent fire from the fuel in the truck results in a release of respirable particles. The fire results in an airborne-release fraction[22] of 3×10^{-5} (DOE 1994) for a 1-hour release from ground level. The source term was calculated to be 0.006 curies of Mo-99. Because a fire from the combustion of fuel in a truck can result in a range of fire plume energies, a sensitivity study was performed for this accident in which the plume energy was varied between 1×10^{4} and 1×10^{10} watts. The results presented in Table 3-12 are for the plume energy with the highest MEI and population consequences.

The second airborne-release accident scenario was postulated to involve failure of the natural gas pipeline within the facility, resulting in a fire that engulfs one target set at the end of bombardment. In this scenario, the fire does not damage the HVAC system inline HEPA filters because they are assumed to be located far enough downstream in the HVAC system where the air temperature is below a value that would degrade their performance. In accordance with current accepted practice, the HEPA filters are assumed to have 99.95 percent particulate-removal efficiency (equivalent to a 5×10^{-4} reduction factor) for respirable particles (DOE 1997). The source term for this accident is 0.00125 curies of Mo-99 released over 1 hour from an elevated stack at 18 meters (60 feet) above ground level (3 meters [10 feet] above the building roof). Because a fire from the combustion of natural gas can result in a range of fire plume energies, a sensitivity study was performed for this accident in which the plume energy was varied between 1×10^{4} and 1×10^{10} watts. The results presented in Table 3-12 are for the plume energy with the highest MEI and population consequences.

The third airborne-release accident scenario was postulated to involve the impact of a beyond-design-basis natural phenomenon, such as a severe earthquake or tornado. The proposed NorthStar facility would be constructed in accordance with applicable building codes and would use commercial off-the-shelf hot cell, glovebox, HVAC, and filter designs, which could fail if subjected to external events that are beyond their design capacities. Structural failure of the linac and chemical processing areas is assumed, with 10,000 curies of Mo-99 within these areas undergoing various phases of bombardment in the linacs and processing in the hot cells. Following structural failure, a natural-gas-fed fire occurs that results in a ground-level release of Mo-99 without HEPA filter particulate removal. The source term for this accident, assuming a 1×10^{-3} release fraction for the combined solid and solution Mo-99 inventory, is 10 curies of Mo-99. The source term is released at ground level in 1 hour. Because a fire from the combustion of natural gas can result in a range of fire plume energies, a sensitivity study was performed for this accident

21 Stochastic effects are associated with long-term, low-level (chronic) exposure to radiation. "Stochastic" refers to the likelihood that something will happen. Increased levels of exposure make these health effects more likely to occur, but do not influence the type or severity of the effect.

22 The airborne-release fraction is the coefficient used to estimate the amount of a radioactive material that can be suspended in air and made available for airborne transport under a specific set of induced physical stresses (DOE 1994).

in which the plume energy was varied between 1×10^4 and 1×10^{10} watts. The results presented in Table 3-12 are for the plume energy with the highest MEI and population consequences.

Table 3-12. Radiological Accident Consequences

Accident Scenario	Annual Frequency	MEI[a] Dose[c] (rem)	MEI[a] LCF Risk[c]	MEI[a] Annual Risk[c]	Population[b] Dose[c] (person-rem)	Population[b] LCFs[c]	Population[b] Annual Risk[c]
Shipment impact – fire at loading dock	1×10^{-2}	1.5×10^{-6} 6.8×10^{-6}	9×10^{-10} 4×10^{-9}	9×10^{-12} 4×10^{-11}	2.2×10^{-5} 2.1×10^{-4}	1×10^{-8} 1×10^{-7}	1×10^{-10} 1×10^{-9}
Activated-target fire with HEPA filters intact	1×10^{-4}	3.1×10^{-7} 1.4×10^{-6}	2×10^{-10} 8×10^{-10}	2×10^{-14} 8×10^{-14}	4.5×10^{-6} 4.3×10^{-5}	3×10^{-9} 3×10^{-8}	3×10^{-13} 3×10^{-12}
BDB earthquake or tornado – building failure and fire	1×10^{-7}	2.5×10^{-3} 1.1×10^{-2}	2×10^{-6} 7×10^{-6}	2×10^{-13} 7×10^{-13}	3.6×10^{-2} 3.5×10^{-1}	2×10^{-5} 2×10^{-4}	2×10^{-12} 2×10^{-11}

a. For the MEI, the reported dose and LCF risk are those calculated to result if the accident were to occur; the annual risk is the LCF risk multiplied by the estimated annual frequency.

b. For the population, the dose and LCFs are those calculated to result if the accident were to occur; the annual risk is the LCFs multiplied by the estimated annual frequency.

c. The top number in each cell reflects the mean (average) meteorology results from the MACCS2 modeling; the bottom number reflects the 95th percentile meteorology results.

Note: LCFs are based on 0.0006 LCFs per rem or person-rem (ISCORS 2002). BDB events are those that exceed the facility's original design and ability to remain functional both during and after the event

Key: BDB=beyond-design-basis; HEPA=high-efficiency particulate air; LCF=latent cancer fatality; MACCS2=MELCOR Accident Consequence Code System, version 1.13.1; MEI=maximally exposed individual

The accident annual frequencies shown in Table 3-12 were developed using information on the nature and initiating event of each specific scenario, coupled with engineering judgment and experience from previous NEPA accident analyses. For example, the highest accident frequency of 1×10^{-2} per year was assigned to a shipment impact fire at the loading dock, based on the expected large number of annual shipments, handling controls, and presence of flammable fuel in the commercial shipping trucks that would be used.

3.3.6.2 Intentional Destructive Acts

The NorthStar facility is not judged to be a likely target for an IDA, based on its remote location from a large metropolitan area and the fact that it produces and handles the nonfissile,[23] short-half-life radionuclide Mo-99. However, as a significant inventory of Mo-99 (i.e., up to 10,000 curies) may be present at this facility, an IDA scenario was developed and analyzed to evaluate the potential human health and safety impacts in the unlikely event of such an act. The initiating event for an IDA is not limited to operational or human errors, equipment failure, or external hazards. An IDA scenario is postulated that involves intentional actions by individuals inside or outside the NorthStar facility who gain access to radioactive materials and devise a means for releasing significant quantities to the environment. This scenario could result in either an elevated or ground-level plume of 500 curies of respirable Mo-99. The plume-release time for the IDA event is assumed to be 60 seconds. There is no frequency-of-occurrence estimate associated with this event because the very nature of the IDA precludes calculating such a parameter. Table 3-13 presents the calculated human health consequences of this postulated IDA event. This IDA scenario, which results in a release of 50 times the respirable Mo-99 source term of any of the accident scenarios, would result in a maximum LCF risk of 0.0003 to the MEI and no (0.01 calculated) LCFs in the 80-kilometer (50-mile) population.

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23 The term "fissile" refers to the ability of a radionuclide to support the nuclear fission reaction that is used in reactors and nuclear weapons.

Table 3-13. Airborne-Release Intentional Destructive Act Scenario

Maximally Exposed Individual: Mean Meteorology and 95th Percentile Meteorology		Population: Mean Meteorology and 95th Percentile Meteorology	
Dose[a] (rem)	LCF Risk[a]	Dose[a] (person-rem)	Number of LCFs[a,b]
0.13 0.56	0.00008 0.0003	1.8 17	0 (0.0001) 0 (0.01)

a. The top number in each cell reflects the mean (average) meteorology results from the MACCS2 modeling; the bottom number reflects the 95th percentile meteorology results.

b. The number of LCFs would be a whole number. The value in parentheses is the calculated value.

Note: LCFs are based on 0.0006 LCFs per rem or person-rem (ISCORS 2002).

Key: LCF=latent cancer fatality; MACCS2=MELCOR Accident Consequence Code System, version 1.13.1.

3.3.7 Socioeconomics

Socioeconomics is defined as the basic attributes and resources associated with the human environment, particularly characteristics of population and economic activity. Regional birth and death rates and immigration and emigration affect population levels. Economic activity typically encompasses employment, personal income, and industrial or commercial growth. Changes in these fundamental socioeconomic indicators typically result in changes to additional socioeconomic indicators, such as housing availability and the provision of public services. Socioeconomic data at county and state levels permit characterization of baseline conditions in the context of regional and state trends.

Demographics and employment characteristics data provide key insights into socioeconomic conditions that might be affected by a proposed project. Demographics identify the population levels and the changes in population levels in a region over time. Data on employment characteristics identify gross numbers of employees, employment by industry or trade, and unemployment trends. Data on personal income in a region can be used to compare the “before” and “after” effects of any jobs created or lost as a result of a proposed project.

Socioeconomic data shown in this section are presented at county and state levels to characterize baseline socioeconomic conditions in the context of regional and state trends.

3.3.7.1 Affected Environment

The project site is located in Beloit, Wisconsin, within Rock County. The socioeconomic region of influence (ROI) associated with the proposed NorthStar facility consists of Dane and Rock Counties, Wisconsin, and Winnebago County, Illinois, because this is where most of the socioeconomic impacts are likely to occur. The State of Wisconsin serves as the respective baseline.

Demographics

Dane County underwent a significant population increase between 2000 and 2010. The ROI’s population increase is higher than that of Wisconsin due to the comparably high population of Dane County and the magnitude of its population increase. Dane County also has the largest workforce and the lowest unemployment rate in Wisconsin. Rock and Winnebago Counties have average incomes (per capita) comparable to those of Wisconsin. Dane County has a considerably higher average income (per capita) compared with the other analyzed regions. Table 3-14 shows population and employment data for the vicinity of the proposed NorthStar Facility.

Table 3-14. Population and Employment Data for the Vicinity of the Proposed NorthStar Facility

Demographic	Rock County, Wisconsin	Dane County, Wisconsin	Winnebago County, Illinois	ROI	Wisconsin
Population	160,331	488,073	295,266	943,670	5,686,986
Percentage population change from 2000–2010[a]	5.3	14.4	6.1	10.1	6.0
Percentage of population 16 years and over in the labor force	68.6	74.4	65.1	70.6	69.0
Total jobs in 2009[b]	76,699	382,379	125,265	584,343	3,444,310
Average income per capita	$23,926	$32,392	$24,008	N/A	$26,624

a. USCB 2010a.

b. BEA 2009.

Note: The U.S. Bureau of Economic Analysis employment series for states and local areas comprises estimates of the number of jobs, full-time plus part-time, by place of work. Full-time and part-time jobs are counted at equal weight. Employees, sole proprietors, and active partners are included, but unpaid family workers and volunteers are not included.

Key: N/A=not applicable; ROI=region of influence.

Source: USCB 2011a.

Employment Characteristics

As of October 2011, the ROI had a total labor force of 522,934 people and 39,850 unemployed people. The unemployment rates between the three counties vary considerably. Rock County had an unemployment rate of 8.7 percent, but this was down from 2010's annual average of 11.1 percent. Dane County had a significantly lower unemployment rate of 4.4 percent, down from 2010's annual average of 5.6 percent. Winnebago County had the highest unemployment rate, 12.7 percent, as of October 2011. Winnebago County suffered a large spike of unemployment in 2009. The average unemployment rate in 2009 was 14.6 percent, compared with 7.6 percent in 2008. The average unemployment rate for the ROI was 7.6 percent. For comparison, the Wisconsin unemployment rate (as of October 2011) was 7.3 percent (BLS 2011). Table 3-15 summarizes the unemployment characteristics as of October 2010 in the vicinity of the proposed NorthStar facility.

Table 3-15. Unemployment Rates in the Vicinity of the Proposed NorthStar Facility

Geographic Area	Unemployment Rate (percentage)
Rock County, Wisconsin	8.7
Dane County, Wisconsin	4.4
Winnebago County, Illinois	12.7
Region of influence	7.6
Wisconsin	7.3

Source: BLS 2011.

The labor force breakdown by industry for the ROI is comparable to, and representative of, Wisconsin. The most common occupations are in the educational services, health care and social assistance, manufacturing, and retail trade industries, in that order. Table 3-16 shows the industry breakdown of the civilian workforce over the age of 16 as of 2010 in the vicinity of the proposed NorthStar facility.

Table 3-16. Percentages of Employed Persons by Industry

Employment Types	Rock County, Wisconsin	Dane County, Wisconsin	Winnebago County, Illinois	ROI	Wisconsin
Construction	6.1	5.0	5.3	5.2	6.0
Manufacturing	21.7	9.4	22.0	14.8	18.7
Wholesale trade	4.0	2.6	3.0	2.9	3.0
Retail trade	12.4	10.2	11.2	10.8	11.5
Transportation and warehousing; utilities	4.9	3.0	5.8	4.1	4.5
Arts, entertainment, recreation, accommodation, and food services	8.5	8.4	7.8	8.3	8.3
Other services (except public administration)	4.2	4.1	4.9	4.3	4.0
Public administration	2.9	5.4	2.6	4.3	0.1
Agriculture, forestry, fishing and hunting, and mining	1.8	1.1	0.3	1.0	2.5
Information	2.3	3.1	2.1	2.7	2.0
Finance, insurance, real estate, and rental and leasing	4.2	8.8	5.1	7.0	6.4
Professional, scientific, management, administrative, and waste management services	6.1	11.3	8.1	9.6	7.6
Educational services; health care and social assistance	21.0	27.6	21.8	25.0	22.0
Total Employed Civilian Labor Force	**77,427**	**272,016**	**133,606**	**483,049**	**2,869,310**

Key: ROI=region of influence.
Source: USCB 2011a.

3.3.7.2 Construction Impacts

Demographics

The ROI contains approximately 25,100 construction workers, which should meet the demands of the proposed facility construction. Therefore, short-term population increases during construction are not expected to occur because construction workers would likely be existing local residents. The construction phase would not involve any change in the number of personnel in the ROI.

Employment Characteristics

The existing construction industry within the ROI is expected to adequately meet demands for the number of workers that would be required to complete construction activities. The number of construction workers required is estimated to be less than 1 percent of all construction workers in the ROI, which would not be enough to outstrip the supply of the industry.

Construction costs are estimated to be $194 million. Building materials would be procured locally, when practical; purchase of the materials would result in short-term, direct, minor, beneficial increases in the local economy. Because construction workers from the surrounding area would be used, there would be beneficial impacts on the local construction industry. The use of local construction workers would result in increases in payroll taxes and in indirect increases in local sales volumes and the purchases of goods and services, resulting in short-term, indirect, minor, beneficial increases in the local economy. Additional short-term, minor, indirect, beneficial effects on the local economy are expected due to the purchase of approximately 13.4 hectares (33 acres) of land from Turtle Creek Development and NAI/MLG Commercial.

3.3.7.3 Operational Impacts

Demographics

The ROI contains approximately 46,400 workers in professional, scientific, management, administrative, and waste management services, which should be able to meet most of the operational demands. While workers in some specialized scientific disciplines may be needed from outside the ROI, the majority of the labor force is expected to be supplied locally. Therefore, there would not be any appreciable population increases during the hypothetical production year because the majority of new employees at the NorthStar facility would likely be existing local residents. Operation of the NorthStar facility is not expected to involve any change in the number of personnel in the ROI. Therefore, no effects on demographics are expected. The number of employees relocating to the ROI would likely be negligible compared with the ROI's current population of 943,670. Therefore, no potential effects on social conditions, including property values, school enrollment, county and municipal expenditures, and crime rates, due to population increases are expected.

Employment Characteristics

Except for some specialized scientific disciplines, the existing professional, scientific, management, administrative, and waste management services industries within the ROI would adequately meet the demands for the number of workers required to complete operational activities.

The additional jobs created by operation of the proposed NorthStar facility would result in long-term, minor, direct and indirect, beneficial impacts on the local economy. Operations of the Mo-99 production facility would result in 150 full-time-equivalent workers. Because workers from the surrounding area would be used, there would be beneficial impacts on the local professional, scientific, management, administrative, and waste management services industries. The use of local workers would result in increases in payroll taxes and in indirect increases in local sales volumes and the purchases of goods and services, resulting in short-term, indirect, minor, beneficial increases in the local economy.

3.3.8 Cultural Resources

Cultural resources are defined as any prehistoric or historic district, site, building, structure, or object, including any location that is associated with cultural practices and beliefs rooted in the history of a community. Cultural resources can be prehistoric or historic archaeological sites associated with American Indian or European settlement or activity. In addition, cultural resources can include architectural resources, such as buildings, structures, landscapes, and objects associated with the historic-period settlement and land use of an area.

Authorized by the National Historic Preservation Act of 1966, the National Register of Historic Places provides the standards and methods for identifying and evaluating cultural resources by age, integrity, and significance. A property must maintain an adequate level of historical integrity for it to be eligible for inclusion in the National Register. Some level of integrity must be present in terms of location, design, setting, materials, workmanship, association, and feeling. A minimum 50-year age threshold is required for properties to be considered for listing in the National Register. A resource less than 50 years of age must be of exceptional historical importance to be considered for listing.

3.3.8.1 Affected Environment

To evaluate the potential impact of an undertaking on cultural resources, an area of potential effect (APE) is established. A radius of 0.8 kilometers (0.5 miles) around the project site was established as the APE for the proposed NorthStar facility (see Figure 3-4). A records search at the Wisconsin Office of Historic Preservation was conducted to identify previously recorded cultural resources and previously conducted

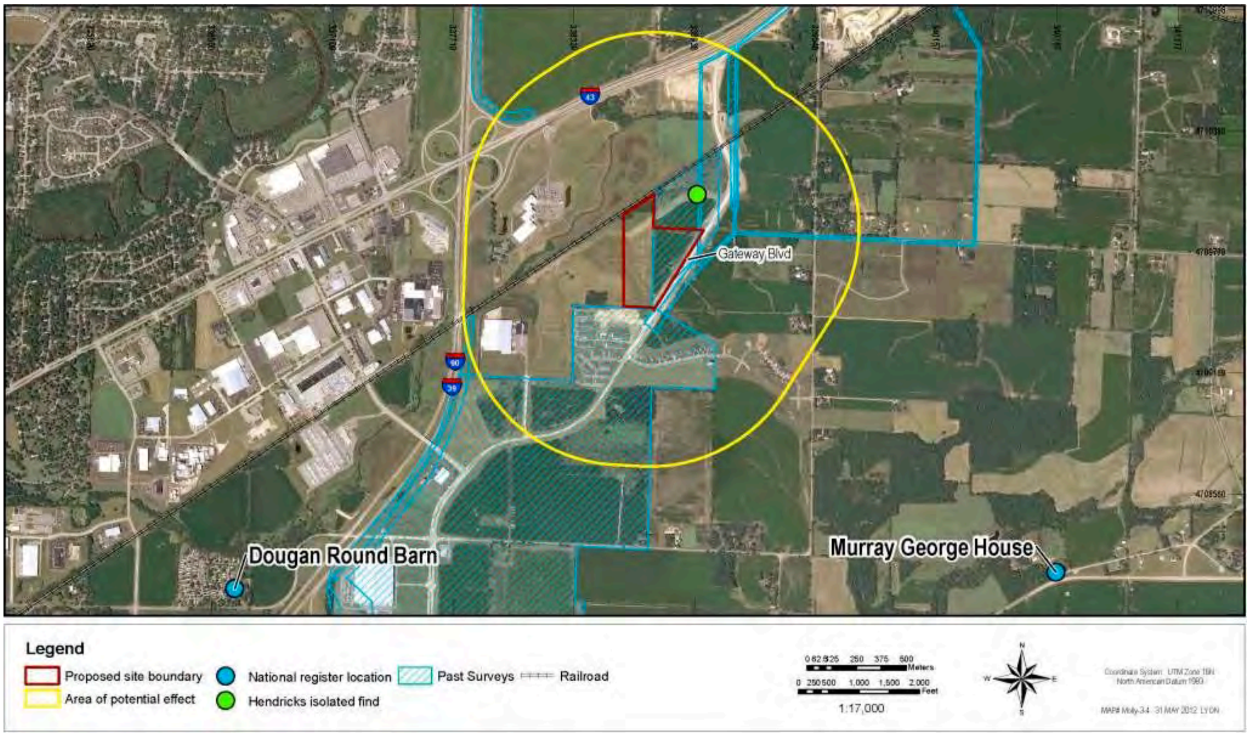


Figure 3-4. Cultural Resources Area of Potential Effect

cultural studies within the project APE. In addition, a search of the National Register database and the City of Beloit's historic properties list was conducted to locate historic properties, sites, or structures within the APE (NPS 2012; City of Beloit 2005).

The searches identified one previously recorded archaeological resource located within the APE: an isolated find consisting of a prehistoric projectile point fragment. Isolated finds are considered not eligible for listing in the National Register. No other resources were identified within the APE.

The database searches identified one previously conducted cultural resources study that included a portion of the proposed NorthStar site. This study was conducted in 2001 for the Gateway Business Park project (Salkin 2001) and included approximately 13.4 acres of the 33-acre NorthStar property. The remainder of the NorthStar site has not been surveyed for archaeological resources.

Under the National Historic Preservation Act, NNSA is required to consult with the State Historic Preservation Office regarding potential impacts on cultural resources. A request for consultation regarding the proposed action was submitted on May 15, 2012, requesting the State Historic Preservation Office's concurrence with NNSA's determination that the proposed action would have no effect on cultural resources and providing notice that the predecisional draft *Mo-99 EA* would be provided for their review.

Under the National Historic Preservation Act, NNSA is also required to consult with American Indian tribes with an interest in the NorthStar site. The following 5 tribes were sent a letter notifying them of the project and that they will be forwarded a copy of the predecisional draft EA for review: Ho-Chunk Nation of Wisconsin, Iowa Tribe of Oklahoma, Peoria Tribe of Indians of Oklahoma, Sac and Fox Nation, and St. Croix Band of Lake Superior Chippewa. An additional 21 tribes with potential interests in Rock County will be notified of the availability of the predecisional draft EA for review.

3.3.8.2 Construction Impacts

No historic properties are located within the APE for the proposed NorthStar facility. Construction impacts would be limited to the project site and are not expected to alter the current visible or audible characteristics of historic properties located in Rock County.

Because only a portion of the project area has been surveyed for archaeological resources, the possibility exists for previously unidentified cultural resources to be encountered during excavation. If no additional archaeological surveys of the project site are conducted prior to construction, it is recommended that a cultural resources worker environmental awareness training program be provided to construction supervisors and crew to ensure their awareness of requirements regarding the protection of cultural resources and procedures to be implemented in the event resources are encountered by ground-disturbing activities. Should further surveys or other information indicate a likelihood of encountering cultural materials during construction, a monitoring plan would be developed, including provision for a qualified cultural resources monitor to be present during all ground-disturbing activities.

3.3.8.3 Operational Impacts

Because no historic properties are located near the project site, operation of the proposed NorthStar facility would have no impact on cultural resources.

3.3.9 Waste Management

3.3.9.1 Affected Environment

The terms “hazardous materials” and “hazardous waste” refer to substances defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. 9601 et seq.) and the Solid Waste Disposal Act, as amended by RCRA (42 U.S.C. 6901 et seq.). In general, hazardous materials include substances that, because of their quantity; concentration; or physical, chemical, or infectious characteristics, may present substantial danger to public health or the environment when released into the environment.

Storage and usage of hazardous materials are regulated by a variety of statutes, including the Emergency Planning and Community Right-to-Know Act (42 U.S.C. 116 et seq.) and RCRA. Hazardous wastes that are regulated under RCRA are defined as any solid, liquid, contained gaseous, or semisolid waste or any combination of wastes that exhibits one or more of the hazardous characteristics of ignitability, corrosivity, toxicity, or reactivity or is listed as a hazardous waste under EPA regulations (40 CFR, Part 261).

The proposed site is vacant; consequently, no hazardous material or waste is currently used, stored, or generated at the project site. There are no known historical releases of hazardous waste or hazardous material at the proposed site. The prior use of the site was as farmland, and any use of agricultural chemicals (herbicides, pesticides) would have been for the intended use of those chemicals and therefore not considered releases or waste material.

The closest municipal solid waste landfill that could service the proposed NorthStar facility is the Rock County/City of Janesville Landfill. The Rock County/City of Janesville Landfill is a publicly owned landfill operating in Janesville, Wisconsin, about 24 kilometers (15 miles) north of the project site (DOI 2007).

3.3.9.2 Construction Impacts

Excavation of basements or subgrade facilities would potentially generate up to 23,000 cubic meters (30,000 cubic yards) of soil/rock waste that may be disposed of off site if not used for onsite grading purposes. The soil/rock material could potentially be recycled/reused as construction fill for other construction or grading purposes, depending on the material properties.

Construction activities are expected to generate approximately 160 metric tons (175 tons) of solid waste in the form of wood, metal, concrete, or other miscellaneous construction debris, based on the estimated 7,150 square meters (77,000 square feet) of building construction at the project site, and an average rate of 21 kilograms per square meter (4.34 pounds per square foot) for nonresidential construction (EPA 2009). Construction debris generation rate estimates for 2003 ranged from 7.8 to 42 kilograms per square meter (1.6 to 8.6 pounds per square foot). Construction solid waste would be recycled to the extent practicable or disposed of at an appropriate licensed landfill or waste management facility.

Solid waste requiring disposal in local facilities is expected as a result of construction of the NorthStar facility. Solid wastes would be recycled to the extent feasible. The remaining waste would be disposed of at Rock County/City of Janesville Landfill, which is anticipated to have the capacity to meet the increased demand associated with the proposed project.

3.3.9.3 Operational Impacts

Operation of the proposed NorthStar facility is expected to result in waste generation during the process of bombarding targets, dissolving the targets, and preparing the Mo-99 product for shipment. The expected waste quantities include the following wastes (NorthStar 2012):

- Hazardous waste—approximately 0.2 cubic meters (one 55-gallon drum) per month, or 2.4 cubic meters (3.1 cubic yards) per year, generated on an occasional basis.
- Class A low-level radioactive waste (per U.S. Nuclear Regulatory Commission regulations)—approximately 0.2 cubic meters (one 55-gallon drum) per week, or 10.4 cubic meters (14 cubic yards) per year, primarily materials contaminated with Tc-99 during processing and equipment cleaning. This waste would be temporarily stored on site in suitable storage containers (e.g., 208-liter [55-gallon] drums) prior to shipment to an offsite waste treatment and disposal facility.
- Solid waste—up to 45 cubic meters (59 cubic yards) per year, primarily consumables, personal protective equipment, and returned technetium generator components.

Mixed low-level radioactive waste generation at the proposed NorthStar facility is not expected. No process water or liquid discharges to the sanitary sewer system, other than sanitary waste, are expected.

Operations would slightly increase the amount of common commercial solid waste collected. Solid wastes would be recycled to the extent feasible, and the remaining waste would be disposed of at Rock County/City of Janesville Landfill, which is anticipated to have the capacity to meet the increased demand associated with the proposed project. Solid wastes would be collected and disposed of off site in accordance with relevant State and Federal regulations.

Sanitary waste would be generated commensurate with a workforce of up to 150 full-time-equivalent employees. Sanitary waste would be disposed of through normal discharges to the City of Beloit sanitary sewer system as permitted through applicable building codes and State and local ordinances.

3.3.10 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, states that, "Each Federal agency shall conduct its programs, policies, and activities that substantially affect human health or the environment, in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons (including populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination under, such programs, policies, and activities, because of their race, color, or national origin."

Executive Order 12898 also requires each Federal agency to identify and address whether its proposed project would result in disproportionately high and adverse human health or environmental effects on low-income or minority populations. Evaluation of these environmental justice concerns includes consideration of race, ethnicity, and the poverty status of populations in the vicinity of a proposed project. Minority persons are considered those who self-identify as Hispanic or Latino origin and those who self-identify as Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, or multiracial. The term "nonminority" represents non–Hispanic or Latino Caucasian. Low-income persons are those whose income is below the Federal poverty threshold, which, for a family of four with two related children in 2010 was $22,113 (USCB 2011c).

Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, states that each Federal agency "(a) shall make it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children; and (b) shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks."

3.3.10.1 Affected Environment

To provide a baseline measurement for environmental justice, an area around the proposed facility must be established to examine the impacts on minority and low-income populations. For analysis purposes, the ROI for activities occurring at the proposed NorthStar facility consists of Dane and Rock Counties, Wisconsin, and Winnebago County, Illinois, because this is where most of the impacts are likely to occur. The State of Wisconsin and the United States serve as the respective baseline.

Table 3-17 presents race, ethnicity, and poverty characteristics for populations within the ROI, the State of Wisconsin, and the United States. In 2010, the aggregate percentage of all racial minorities within the ROI was approximately 13 percent. This is slightly higher than the 11.4 percent in the State of Wisconsin, but less than the 21.4 percent in the United States. Persons of Hispanic or Latino origin made up about 8.1 percent within the ROI, 5.9 percent in the State of Wisconsin, and 16.3 percent in the United States (USCB 2010b). The project site is in the City of Beloit, which had a population in 2010 that was approximately 68.9 percent white. Approximately 17.1 percent of the City of Beloit population was of Hispanic or Latino origin (USCB 2010b). The percentage of individuals under the age of 5 in the ROI is very similar to that of the State of Wisconsin and the United States (USCB 2010b).

In 2010, approximately 8.8 percent of the population in the ROI lived below the poverty level, slightly more than the approximate 7.7 percent for the State of Wisconsin, but less than the 9.9 percent for the United States (USCB 2010b). The project site is located in an area zoned as M-1 (Restricted Industrial) by the City of Beloit Neighborhood Planning Division. The nearest residential area is approximately 0.8 kilometers (0.5 mile) southwest of the project site.

Table 3-17. Racial, Ethnic, and Poverty Data in the Region of Influence and Wisconsin

Race and Origin	Rock County, Wisconsin	Dane County, Wisconsin	Winnebago County, Illinois	ROI	Wisconsin	United States
Total population	160,331	488,073	295,266	943,670	5,686,986	308,745,538
Percentage under 5 years of age	6.5	6.2	6.7	6.5	6.3	6.5
Percentage over 65 years of age	13.6	10.3	13.8	12.6	13.7	13.0
Percentage White	87.6	84.7	77.4	83.2	86.2	72.4
Percentage Black or African American	5.0	5.2	12.2	7.5	6.3	12.6
Percentage American Indian and Alaska Native	0.3	0.4	0.3	0.3	1.0	0.9
Percentage Asian	1.0	4.7	2.3	2.7	2.3	4.8
Percentage Native Hawaiian and Other Pacific Islander	0.0	0.0	0.0	0.0	0.0	0.2
Percentage Two or More Races	2.3	2.5	2.8	2.5	1.8	2.9
Percentage Hispanic or Latino[a]	7.6	5.9	10.9	8.1	5.9	16.3
Estimated median household income	$49,716	$60,519	$47,198	$52,478	$51,598	$51,425
Estimated percentage of families living below poverty threshold	9.4	5.5	11.5	8.8	7.7	9.9

[a.] Persons of Hispanic or Latino origin can be of any race and thus are also included in applicable race categories.

Key: ROI=region of influence.

Source: USCB 2010b, 2010c.

3.3.10.2 Construction Impacts

Disproportionate impacts on low-income or minority populations are not expected during construction activities. The ROI contains slightly elevated minority and low-income populations in comparison to the State of Wisconsin, but similar to those of the United States. As noted in Section 3.3.7.2, population increases during the proposed NorthStar facility construction phase are not expected because construction workers would likely be local residents. Therefore, there would be no changes in public services or other socioeconomic factors.

3.3.10.3 Operational Impacts

Operational activities would not disproportionately affect low-income or minority populations, as activities would occur in an industrial area in the City of Beloit. As noted in Section 3.3.7.3, the number of employees relocating to the ROI would likely be negligible compared with the ROI's current population. Therefore, no significant impacts on public services or other socioeconomic factors are expected.

3.3.11 Energy Conservation, Renewable Energy, and Sustainable Design

Sustainability represents both short- and long-term resource stability. Therefore, planning, energy conservation, renewable resources, and sustainable design are essential aspects of facilitating and maintaining sustainability. The affected environment in this case encompasses the current energy and sustainability indicators, opportunities, and barriers in relation to planning goals. This serves as the context in which to analyze the effects of the proposed project on achieving incremental improvements toward sustainability.

3.3.11.1 Affected Environment

NorthStar does not currently have a published sustainability plan, nor does it publically document incremental sustainability improvements. The Federal Government has established a series of sustainability goals and executive orders. In addition, DOE, including NNSA, has established its own set of incremental commitments and goals. However, in general, commercial operations that receive funding or support from DOE are not required to adhere to DOE's sustainability goals (DOE 2011). Therefore, the resulting impacts of commercial operations supported by DOE are not required to be included on DOE scorecards or emission inventories.

The proposed site is serviced by Alliant Energy. Wisconsin Power and Light Company is the subsidiary of Alliant Energy that serves Wisconsin. Alliant Energy is currently building a new power substation based on NorthStar's design requirements. Electrical consumption is currently expected to be approximately 15 megawatts (NorthStar 2012). Because the proposed NorthStar facility would be a major consumer of energy, it is appropriate to consider the sustainability measures undertaken by Alliant Energy.

Alliant Energy focuses on energy efficiency, not only as a means to provide sustainable and environmentally sound electric power services, but also as a significant aspect of its business model. The company's energy efficiency portfolio consists of a variety of policies and programs aimed to reduce peak demand and total energy usage. As a result, Alliant Energy saved over 192,000 megawatt-hours of electricity in 2010 and approximately 3 million megawatt-hours of electricity since 1996. In addition to its performance, Alliant Energy also invests an average of $3.84 million per year (since 2006) on research and development for improving environmental performance. In 2010, 46 percent of that sum was directed toward energy efficiency and renewable energy, and 9 percent was directed toward climate change (Alliant 2011).

The State of Wisconsin's commercial building codes adopt the guidance of the 2009 International Code Council and the International Energy Conservation Code; however, there are no Wisconsin amendments relevant to the requirements for sustainable design (Wisconsin Department of Safety and Professional Services Undated). Construction of the proposed NorthStar facility would comply with all applicable Federal, State, and local regulations.

3.3.11.2 Construction Impacts

No effects on sustainability planning and progress are expected to result from the construction of the proposed NorthStar facility. Approximately 1,100 tons of GHGs are expected to result from the facility construction. However, this would likely be the responsibility of the contractor and would not be incorporated into DOE's or NNSA's GHG inventory.

It is assumed that practical efforts to utilize energy-efficient construction methods would be implemented; however, none have been identified. Because no effort to utilize renewable energy during construction activities has been identified, it is assumed that the majority of the construction activities would consume diesel fuel derived from nonrenewable fossil fuels. However, the amount of diesel fuel that would be consumed is expected to be negligible.

3.3.11.3 Operational Impacts

The operation of the proposed NorthStar Facility would result in 36,000 metric tons per year (39,800 tons per year) of CO_2 emissions which would be required to be recorded on the DOE's Scope 3 GHG emissions inventory. This would represent an increase of 4.3 percent compared to the DOE's 2010 Scope 3 GHG emissions, making achieving their 2020 goal more difficult. Energy consumption would be expected to the increase approximately 1 MW. The majority of which is assumed to be from nonrenewable sources.

4.0 NNSA'S NO ACTION ALTERNATIVE – ENVIRONMENTAL CONSEQUENCES

As described in Section 2.3, under the No Action Alternative, NNSA would not provide funding through its GTRI to NorthStar for the construction of a linac and chemical processing facility in Beloit, Wisconsin, to produce Mo-99. For purposes of this *Mo-99 EA*, NNSA assumes that the project would therefore not proceed. If the NorthStar facility is not built, current environmental conditions and land uses as described in the Affected Environment paragraphs of Section 3 would continue.

5.0 CUMULATIVE IMPACTS

Cumulative impacts are those impacts on the environment that result from the incremental impacts of the proposed action when added to other past, present, and reasonably foreseeable future public or private-sector actions (40 CFR 1508.7).

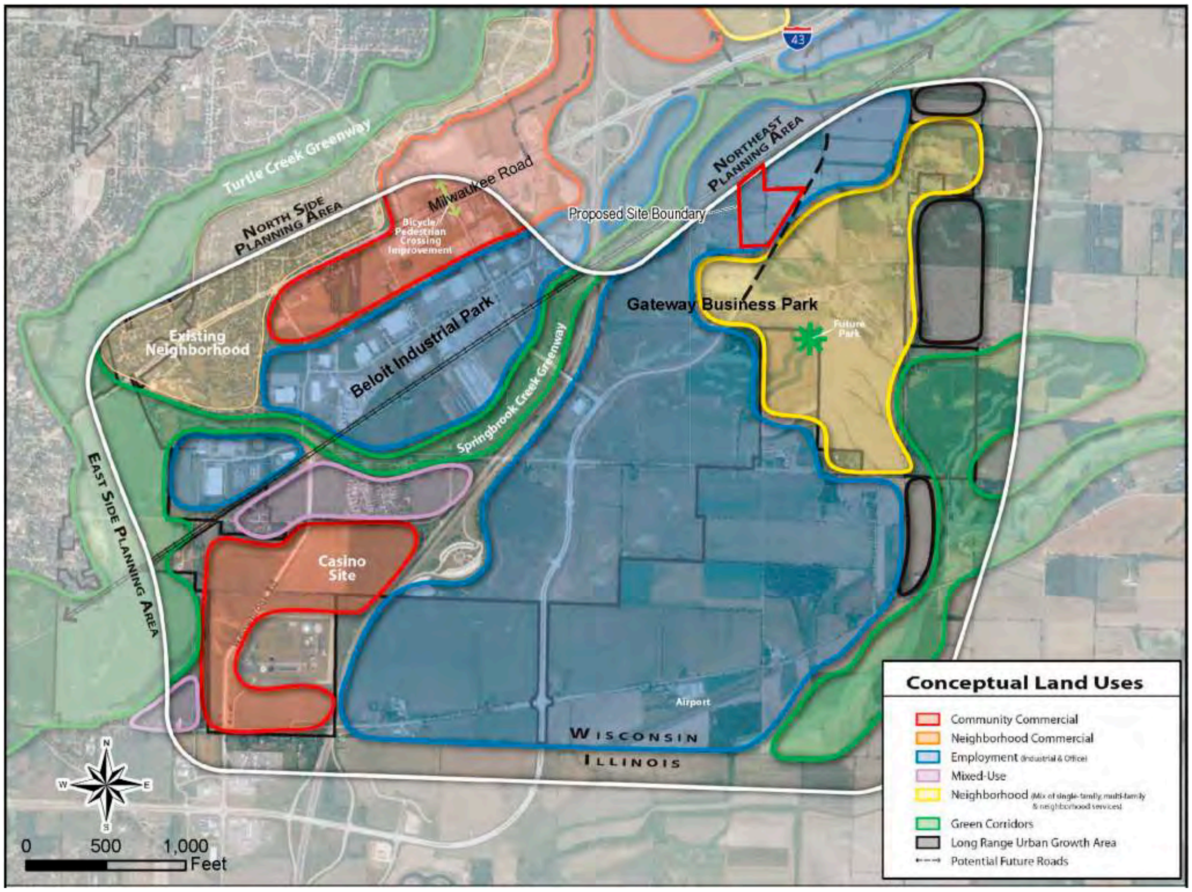
The projects used as the basis for evaluating cumulative impacts are the current and planned Gateway Business Park properties; the existing Beloit Industrial Park; activities outlined in the City of Beloit's Comprehensive Plan (City of Beloit 2008) and in the Rock County Comprehensive Plan (Rock County 2009b); other NorthStar activities to occur within the Production Phase 1 Building to be constructed at the project site; and the Alliant Energy substation currently under construction. While other land is zoned and available for development in the area, the Gateway Business Park and Beloit Industrial Park are the only projects that have been announced and therefore would be considered existing or reasonably foreseeable development activities.

The proposed NorthStar facility is part of a larger development, the Gateway Business Park. The Gateway Business Park, a mixed-use development located at the intersection of I-90 and I-43 (see Figure 2-1), would include approximately 72 hectares (177 acres) of single-family residential, 26 hectares (65 acres) of multifamily residential, and 151 hectares (374 acres) of industrial development. The Gateway Business Park is expected to develop over a 20-year time period, from 2003 to 2023. The City of Beloit planning officials have projected a straight-line rate of development over that time period. Residential development in the Gateway Business Park is expected to have 300 multifamily units and 438 single-family units. Industrial development in the Gateway Business Park is expected to create 4,550 jobs (DOI 2007).

The Beloit Industrial Park, located immediately west of I-90 from the Gateway Business Park, is largely developed but has some vacant lots available and has a goal of attracting a variety of businesses within the manufacturing, distribution, and food processing industries (DOI 2007).

The Gateway Business Park and the Beloit Industrial Park are of separate and distinct character. The industrial park is a commercial venture, while the Gateway Business Park is a mixed-use development, including residential and business. Lots in the Beloit Industrial Park are zoned Industrial, while portions of the Gateway Business Park are zoned as Residential. The two developments are within approximately 300 meters (1,000 feet) of each other, but are separated by an interstate highway (I-90).

The City of Beloit's Comprehensive Plan (City of Beloit 2008) provides the likely development patterns for land throughout the City of Beloit, including the area surrounding the project site (see Figure 5-1). The project site is within the Milwaukee Road/Gateway Planning Area in a land use area identified as Employment (Industrial and Office). An area to the south and east of the project site is identified as Neighborhood (mix of single-family, multifamily, and neighborhood services). An existing apartment complex is located immediately south of the project site. Additional industrial and office development



Source: City of Beloit 2008

Figure 5-1. Potential Land Use Near Project Site

will also likely occur at the Gateway Business Park and other areas in the vicinity of the project site. Increases in development of both residential and industrial/office areas could result in cumulative impacts in addition to the direct impacts of construction and operation of the NorthStar facility.

The Rock County Comprehensive Plan 2035 (Rock County 2009b) also provides guidelines and general patterns for future development in the area. In general, the Rock County and City of Beloit Comprehensive Plans are consistent and state similar goals and direction for development. The Rock County plan incorporates the City of Beloit future land use map.

Some resource areas are dismissed from cumulative impacts evaluation because it has been determined they would not be substantially affected by the proposed project and therefore would not contribute collectively to existing or reasonably foreseeable impacts. Resource areas not evaluated for cumulative impacts are geology and soils, water resources, ecological resources, infrastructure (power supply, natural gas, water supply, communications, and solid waste only), and cultural resources.

5.1 EXISTING AND REASONABLY FORESEEABLE IMPACTS

Air Quality

Construction of the proposed NorthStar facility is expected to impact air quality for 18 months from the start of construction. Air quality effects for the immediate area would be increased if other developments (industrial/office or residential) were under construction during the same time period as the proposed NorthStar facility construction. All estimated air emissions from the proposed NorthStar facility construction would be less than or equal to 0.4 percent of the annual Rock County emissions inventory (see Table 3-3). Additional construction in the area surrounding the project site is expected to have similarly low air emissions and would have a cumulative effect only for the period of construction that overlaps with the proposed NorthStar facility construction.

Operational air quality impacts of the NorthStar facility would include emissions from facility processes, heating system operation, emergency generator operation, truck traffic, and worker commuting. Emergency generator operations would be limited in duration and would occur only when emergency power is needed for safe operation of the facility or testing of the generator system. Expected levels of all emissions sources are well below PSD or Title V permitting thresholds. Residential and industrial/office development in the surrounding area, including the Beloit Industrial Park to the west, would contribute additional emissions through heating and commuting. The quantity of these additional emissions is not currently known, but would be proportional to the number of housing units, offices, and industrial facilities developed. In addition, the electricity demand of the NorthStar facility, i.e. 144,000 megawatt-hours per year, is anticipated to result in an increase in utility power plant emissions, including an estimated 114,599 tons per year of CO_2. This increase is a very small percent, i.e. 0.487 percent, of the 2009 level of utility power plant CO_2 emissions for the region. The overall increase in operational CO_2 emissions from the NorthStar facility and from utility power plants is estimated at 154,345 tons per year, which is approximately 0.14 percent of Wisconsin's 2009 CO_2 emissions inventory and 0.003 percent of the entire U.S. 2009 CO_2 emissions inventory. These CO_2 emissions increases represent a negligible contribution toward statewide and national GHG inventories.

No radioactive emissions from operation of the proposed NorthStar facility are projected. Future activities in the NorthStar Production Phase 1 Building could involve radioactive materials, but have not been well-enough defined at this time to quantify emissions. Additional industrial/office and housing developments in the surrounding area would be unlikely to contribute additional radioactive emissions.

Land Use

The 13.4-hectare (33-acre) project site would be converted from farmland to industrial use. As discussed in Section 3.3.1, the parcel is not classified as prime farmland and is not subject to the Rock County Agricultural Preservation Plan (Rock County 2005). The industrial use of this property is consistent with the City of Beloit Comprehensive Plan (City of Beloit 2008) and with the Rock County Comprehensive Plan (Rock County 2009b). Similarly, other properties in the surrounding area would be developed in ways consistent with the City of Beloit and Rock County Comprehensive Plans. Therefore the cumulative impacts on land use for this area would be consistent with stated goals and would represent the desired land use distribution of both the City of Beloit and Rock County.

Visual Resources

The proposed NorthStar facility would be industrial in nature and in appearance, but would be buffered by landscaping on the east side of the property to screen the industrial nature of the facility from residential areas. Additional industrial development in the surrounding area would increase the industrial appearance of the area as viewed from residential areas to the east and southwest of the proposed NorthStar facility. However, development of residential properties would mitigate to some extent the increase in the industrial appearance of the area. Such visual changes are an expected consequence of land use designations in the City of Beloit Comprehensive Plan (City of Beloit 2008).

Noise

During the 18-month construction period for the proposed NorthStar facility, additional impacts are expected if construction is occurring on other properties in the surrounding area. Noise levels of less than

65 dBA are currently expected at existing residential locations during construction of the proposed NorthStar facility (see Section 3.3.3). Additional construction at other properties (if concurrent with construction of the proposed project) would likely increase the noise levels, but only for limited time periods while construction is occurring.

Operational noise levels due to equipment at the proposed NorthStar facility would largely impact only workers inside the facility and would have little or no impact outside the buildings. Use of the emergency generator would result in short-term noise impacts outside the facility, but only for brief periods of emergency generator use. Vehicular noise would be generated by employees driving to the facility and by trucks carrying shipments to and from the facility. Employee vehicular noise would be limited to relatively brief periods before and after shift changes, while truck noise would be generated periodically during all working hours (approximately 10–20 trucks per day for shipments to and from the facility). It is likely that truck traffic would be routed near some residential units. Cumulative impacts would result from additional vehicular traffic related to nearby industrial/office and residential developments. Actual noise levels from vehicular traffic related to the proposed NorthStar facility operations are not currently known.

Infrastructure

Infrastructure requirements for the proposed NorthStar facility and other developments in the surrounding area are anticipated in the City of Beloit Comprehensive Plan (City of Beloit 2008). NorthStar facility requirements for communications lines; solid waste collection; and supplies of electric power, natural gas, and water would have minimal impacts and would be well within the capacity of those systems to meet all needs. Nearby development would increase the aggregate demand for those infrastructure elements, but those increases are anticipated in the City of Beloit Comprehensive Plan (City of Beloit 2008) and would not exceed supply capacity.

Stormwater drainage requirements would increase as development increases the area of impervious surfaces, such as roofs, parking areas, and roads. Stormwater discharges are regulated by local and State ordinances, and stormwater drainage capacity is incorporated in the City of Beloit Comprehensive Plan (City of Beloit 2008) such that drainage capacity would not be exceeded by anticipated new developments.

Wastewater infrastructure requirements for the NorthStar facility would include only connection to the City of Beloit sanitary sewer system. Those requirements, combined with requirements of other developments in the surrounding area, would increase the load on the sewer system. The increased sewage flows associated with these developments were considered in the comprehensive plan. New sewer lines would be installed as required by the growing demand, but current capacity is considered sufficient for the projected growth (City of Beloit 2008). At this time, NorthStar projects that another 25 employees may be associated with the Production Phase 1 Building operations, for a total of 175 NorthStar facility employees. The greatest increase in sewer demand would likely be due to the increasing residential population, with the proposed NorthStar facility contributing a relatively minor component due to 175 onsite employees.

Transportation infrastructure includes roadways and traffic control devices. Construction and operation of the proposed NorthStar facility would result in increased vehicular traffic in the form of commuting workers and truck shipments to and from the facility. As industrial and residential development continues in the area, this increased traffic related to the NorthStar facility would merge with increasing residential and business traffic. Current infrastructure is likely sufficient to handle the projected growth, but traffic monitoring as development progresses would identify potential problem areas and could point to traffic control modifications to alleviate episodic or peak traffic congestion if it arises.

Power supply at the proposed NorthStar facility would be furnished by Alliant Energy. A new substation is under construction for the Gateway Business Park, near the proposed NorthStar facility site (see Figure 3-3). This substation would have a capacity load of 42 MVAs and is expected to be in place by the end of 2012 (MLG Commercial Inc. Undated). The new substation's capacity is expected to exceed all supply needs for the NorthStar facility so that, in conjunction with other supply pathways, electrical supply needs of current and future industrial and residential users in the area would be met.

Health and Safety

The proposed Production Phase 1 Building (see Figure 2-3) would house various other NorthStar activities, including the processing of returned/spent technetium generator vial solutions; potential recovery of Mo-100; and collection, storage, and management of waste (e.g., preparing waste containers for shipment off site). Activities in the Production Phase 1 Building would involve an additional 25 radiation workers and result in additional collective radiation dose. All workers would be subject to dose restrictions of 5 rem per year, as discussed in Section 3.3.5. If the 50 radiation workers associated with the proposed project and the 25 additional Production Phase 1 Building workers all received an annual dose at the regulatory limit, the collective dose would be 375 person-rem; the annual risk of a single LCF in the worker population would be 0.22.

Potential future activities at the proposed NorthStar facility could include production of other medical radioisotopes, including actinium-225, actinium-227, and tungsten-188 (GBEDC 2011). Production of additional isotopes at the project site would potentially result in additional radiation dose to workers at the facility if the additional production involves increases in the total curies of radioisotopes generated, staged, handled, or shipped from the facility in a given time period. Additional production could also result in increased air emissions of radioactivity. However, current plans are intended to minimize or completely eliminate gaseous and particulate radioactive air emissions through shielding and HEPA filtration, and operations to produce additional radioisotopes would be subject to similar engineering controls. Therefore, the cumulative impact of the production of other medical radioisotopes through either revised or expanded operations would be negligible.

5.2 SUMMARY OF CUMULATIVE ENVIRONMENTAL IMPACTS

Construction and operation of the proposed NorthStar facility in proximity to the other projects and plans considered in this cumulative impacts analysis would result in incremental increases in impacts on various resource areas; specifically, air quality, visual resources, noise, stormwater, wastewater, and transportation. These changes are identified in the City of Beloit Comprehensive Plan (City of Beloit 2008) and Rock County Comprehensive Plan (Rock County 2009) and are not expected to exceed current or planned infrastructure capacities or result in violations of regulations regarding these resources. Zoning enforcement and adherence to applicable building codes and other ordinances would mitigate the limited adverse effects. Therefore, the effects of the NorthStar project, when combined with those effects of other actions defined in the scope of this section, do not result in cumulatively significant impacts.

6.0 REGULATORY COMPLIANCE

This section identifies the Federal, tribal, State, and local environmental regulatory requirements, permits, and authorizations potentially applicable to the proposed NorthStar facility in Beloit, Wisconsin. According to CEQ regulations for implementing NEPA, the significance of an impact is in part based on whether an action threatens violation of Federal, tribal, state, or local law or requirements imposed for the protection of the environment (40 CFR 1508.27(b)(10)). Confirmation that the proposed action and alternatives comply with environmental regulatory requirements provides a threshold level for evaluating environmental impacts.

As part of environmental impact analysis requirements under NEPA, NNSA evaluated the proposed action and alternatives in terms of compliance with laws, regulations, and licensing and permitting protocols and requirements. CEQ regulations (40 CFR 1506.2) require Federal agencies to cooperate with state and local agencies to the fullest extent possible to reduce duplication between NEPA and comparable state and local requirements. Specifically, in the case of land use, CEQ regulations (40 CFR 1502.16) state that an environmental consequences discussion should include possible conflicts between the proposed project and the objectives of Federal, regional, state, local, and tribal land use plans, policies, and controls.

Major Federal laws, regulations, and executive orders and DOE orders that may be applicable to the proposed NorthStar facility are summarized in Table 6-1, along with a brief description of each. These requirements are organized into three general resource areas: physical environment, biological environment, and human–environmental interactions. Regulatory requirements and compliance are addressed in the context of each applicable resource area in Section 3.

State of Wisconsin statutes and implementing rules related to environmental protection are summarized in Table 6-2. Rock County ordinances are summarized in Table 6-3, and relevant sections of the *City of Beloit Municipal Code* are listed in Table 6-4. These tables are organized into the same three general resource areas and also include some local-level plans and guidance. Particularly at the city level, applicability of many codes and ordinances (such as waste disposal rules and plumbing codes) will depend upon the specific details of the facility design.

Table 6-1. Potentially Applicable Federal Statutes, Regulations, and Orders

Statute/Regulation/Order	Description
Physical Environment	
Executive Order 12699, *Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction*	Each agency is independently responsible for ensuring appropriate seismic design and construction standards are applied to new construction under its purview, including newly constructed buildings in which a Federal agency assisted in the financing through a grant.
Farmland Protection Policy Act (7 U.S.C. 4201 et seq.)	This act set guidelines that require all agencies to identify prime farmland proposed to be converted to nonagricultural land use and to evaluate the impact of the conversion.
Clean Air Act of 1970, as amended (42 U.S.C. 7401 et seq.)	EPA requires sources to meet standards and obtain permits to satisfy National Ambient Air Quality Standards, State implementation plans, Standards of Performance for New Stationary Sources, National Emission Standards for Hazardous Air Pollutants, and Prevention of Significant Deterioration.
Prevention of Significant Deterioration (PSD) regulations (40 CFR 52.21)	Requires permitting for modifications to major sources in attainment areas.
State Operating Permit Programs under Title V of the Clean Air Act (40 CFR Part 70)	Requires states and local agencies to permit major stationary sources.
Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring (40 CFR Parts 51, 52, 70, et seq.)	This rule sets thresholds for greenhouse gas emissions that define when new and existing industrial facilities are subject to the permitting requirements under the PSD and Title V operating permit programs.
General Conformity Regulations (40 CFR Part 93, Subpart B)	Requires determination that the proposed action is in compliance with the general conformity requirements of Section 176(c) of the Clean Air Act.
Standards of Performance for New Stationary Sources (42 U.S.C. 7411)	Establishes emission standards and recordkeeping requirements for new or modified air emission sources specifically addressed by a standard.
National Emission Standards for Hazardous Air Pollutants (42 U.S.C. 7412)	Requires sources to comply with air emission levels of carcinogenic or mutagenic pollutants; may require preconstruction approval depending on the process being considered and the level of emissions that will result from the new or modified source.
Section 401 Certification (Section 401 of the Clean Water Act)	Requires applying for a Federal permit or license to conduct any activity that might result in a discharge of dredge or fill material into water or non-isolated wetlands or excavation in water or non-isolated wetlands.
National Pollutant Discharge Elimination System (Section 402 of the Clean Water Act) (33 U.S.C. 1342)	Requires permit to discharge effluents and stormwater to surface waters; permit modifications are required if discharge effluents are altered.
U.S. Army Corps of Engineers Regulatory Program (33 CFR 320–334)	Requires permits to, among other things, discharge dredged or fill material in wetlands and to authorize certain work in or structures affecting wetlands or waters of the United States.
National Flood Insurance Act of 1968 (42 U.S. C. 4014)	Establishes the National Flood Insurance Program.
Policies and Procedures of FEMA (44 CFR Part 1)	FEMA regulations for floodplain management and analysis, identification, and mapping of floodplains for flood insurance purposes.
Executive Order 11988, *Floodplain Management*	Assists in furthering NEPA, the National Flood Insurance Act of 1968 (amended), and the Flood Disaster Protection Act of 1973. Requires consultation for projects impacting a floodplain. Directs Federal agencies to avoid the adverse impacts associated with occupancy and modification of floodplains.

Table 6-1. Potentially Applicable Federal Statutes, Regulations, and Orders *(continued)*

Statute/Regulation/Order	Description
Executive Order 11990, *Protection of Wetlands*	Requires Federal agencies to avoid the long- and short-term adverse impacts associated with the destruction or modification of wetlands.
Compliance with Floodplain/Wetlands Environmental Review Requirements (10 CFR Part 1022)	Requires DOE to comply with all applicable floodplain/wetlands environmental review requirements.
Biological Environment	
Bald and Golden Eagle Protection Act of 1973, as amended (16 U.S.C. 668 et seq.)	Consultations should be conducted to determine if any protected birds are found to inhabit the area. If so, a permit is required prior to moving any nests due to construction or operation of project facility.
Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703 et seq.)	Requires consultation to determine if there are any impacts on migrating bird populations due to construction or operation of project facility. If so, mitigation measures must be developed to avoid adverse effects or a permit obtained if nests must be moved or destroyed.
Endangered Species Act of 1973 (16 U.S.C. 1531-1544 et seq.) and Interagency Cooperation, Endangered Species Act of 1973, as amended (50 CFR Part 402)	Requires consultation to identify endangered or threatened species and their habitats, assess Federal agency impacts thereon, obtain necessary biological opinions, and, if necessary, develop mitigation measures to reduce or eliminate adverse effects of construction or operations.
Human–Environmental Interactions	
Occupational Safety and Health Act of 1970 (5 U.S.C. 651)	Requires compliance with all applicable worker safety and health legislation (including guidelines of 29 CFR Part 1960).
Hazard Communication Standard (29 CFR 1910.1200)	Requires that all workers are informed of, and trained to handle, all chemical hazards in the workplace.
Standards for Protection against Radiation (10 CFR Part 20)	Establishes standards for protection against ionizing radiation resulting from activities conducted under licenses issued by the U.S. Nuclear Regulatory Commission.
Worker Safety and Health Program (10 CFR Part 851)	Establishes requirements for a worker safety and health program.
Occupational Radiation Protection (10 CFR Part 835)	Establishes limits for worker exposure to radioactivity.
Rules of General Applicability to Domestic Licensing of Byproduct Material (10 CFR Part 30)	Requires license to manufacture, produce, transfer, receive, acquire, own, possess, or use byproduct material. Wisconsin is an agreement state. States with agreement-state status can maintain authority over byproduct material (see "Wisconsin rules on radiation protection" in Table 6-2).
Energy Policy Act of 2005 (42 U.S.C. 13201 et seq.)	Expanded the definition of "byproduct material" to include "any material that has been made radioactive by use of a particle accelerator and is produced, extracted, or converted after extraction, before, on, or after the date of enactment of the Energy Policy Act for use for a commercial, medical, or research activity."
Emergency Planning and Community Right-To-Know Act of 1986 (42 U.S.C. 11001 et seq.)	Requires development of emergency response plans and reporting requirements for chemical spills and other emergency releases, and imposes right-to-know reporting requirements covering storage and use of chemicals that are reported in toxic chemical release forms.

Table 6-1. Potentially Applicable Federal Statutes, Regulations, and Orders *(continued)*

Statute/Regulation/Order	Description
Resource Conservation and Recovery Act (RCRA) / Hazardous and Solid Waste Amendments of 1984 (42 U.S.C. 6901 et seq.)	Requires notification and permits for operations involving hazardous waste treatment, storage, or disposal facilities. EPA hazardous waste regulations (40 CFR Parts 260 through 262) include RCRA regulations governing hazardous waste identification, classification, generation, management, and disposal. EPA delegates the primary responsibility of implementing the RCRA hazardous waste program to individual states through a state authorization process. In addition to the base RCRA program, the State of Wisconsin has been granted authority to implement numerous additional parts of the RCRA program, as listed in EPA's state authorization tracking program data (see Table 6-2).
Toxic Substances Control Act of 1976 (15 U.S.C. 2601 et seq.)	Requires inventory reporting and chemical control provisions to protect the public from the risks of exposures to chemicals. Strict limitations on use and disposal are imposed on polychlorinated biphenyls, lead-based paint, and asbestos-contaminated equipment and material.
Low-Level Radioactive Waste Policy Act of 1954 (42 U.S.C. 2021b– 2021d)	Requires disposal of low-level radioactive wastes in accordance with the requirements of the state in which it operates (see Table 6-2).
Pollution Prevention Act of 1990, under the provision of the Superfund Amendments and Reauthorization Act (SARA) (42 U.S.C. 13101 et seq. and Section 313 of SARA)	Establishes a national policy that pollution should be reduced at the source and requires a toxic chemical source reduction and recycling report from owners or operators of facilities who are required to file an annual toxic chemical release form under Section 313 of SARA.
Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*	Requires Federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. Amended by Executive Order 12948.
Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks*	Prioritizes identification and assessment of environmental health and safety risks that may disproportionately affect children and ensures those risks are addressed.
Noise Control Act of 1972, as amended (42 U.S.C. 4901 et seq.)	Requires facilities to maintain noise levels that do not jeopardize public health or safety.
Occupational Safety and Health Administration occupational noise exposure regulations (29 CFR 1910.95)	Establishes workplace standards for noise.
National Historic Preservation Act of 1966, as amended (U.S.C. 470 et seq., 36 CFR Part 800)	Requires consultation with State and Tribal Historic Preservation Officers and interested parties prior to construction to ensure that no historic properties will be affected. The Advisory Council on Historic Preservation may choose to participate in the consultation and any subsequent agreements.
Archaeological and Historical Preservation Act of 1974 (16 U.S.C. 469 et seq.)	Requires Federal agencies to provide for the preservation of historical and archeological data that might otherwise be lost or destroyed as the result of any federally licensed activity or program causing an alteration of terrain.

Key: DOE=U.S. Department of Energy; EPA=U.S. Environmental Protection Agency; FEMA=Federal Emergency Management Agency; NEPA=National Environmental Policy Act; PSD=Prevention of Significant Deterioration; RCRA=Resource Conservation and Recovery Act; SARA=Superfund Amendments and Reauthorization Act

Table 6-2. Potentially Applicable Wisconsin State Requirements

Statute/Regulation/ Order	Citation	Responsible Agency	Description
Physical Environment			
Wisconsin Statutes on Groundwater Protection Standards	Wisconsin Statutes Chapter 160	Department of Natural Resources	Establishes numerical standards for contaminants in groundwater.
Wisconsin Statutes on Pollution Discharge Elimination	Wisconsin Statutes Chapter 283	Department of Natural Resources	Defines effluent limitations and permit and enforcement programs.
Wisconsin Floodplain Management Program	*Wisconsin Administrative Code* Chapter NR 116	Department of Natural Resources	Establishes floodplain zones. NR116.21 directs municipalities to issue permits for uses in floodplain areas through a zoning administrator.
Wisconsin rules pertaining to wetlands	*Wisconsin Administrative Code* Chapter NR 350–353	Department of Natural Resources	Wetland compensatory mitigation, exemptions from water quality certification in non-federal wetlands, wetland delineation, and wetland conservation activities.
Wisconsin Statutes on Wetland Mapping	Wisconsin Statutes Chapter 23.32	Department of Natural Resources	Defines wetlands.
Wisconsin Air Pollution Statutes	Wisconsin Statutes Chapter 285	Department of Natural Resources, Air Management Program	Defines air quality standards, permits and fees, and enforcement and penalties.
Wisconsin Air Pollution Control Rules	*Wisconsin Administrative Code* Chapters NR 400–499	Department of Natural Resources, Air Management Program	State air pollution control rules. See NR 406 and NR 407 for construction permit and operation permit rules. Greenhouse gases are covered in NR 407.075.
Biological Environment			
Endangered and Threatened Species	*Wisconsin Administrative Code* Chapter NR 27	Department of Natural Resources	Establishes rules that govern the taking, transportation, possession, processing, or sale of any wild animal or wild plant specified by the department's lists of endangered and threatened wild animals and wild plants.
Wisconsin Statutes on Wild Animals and Plants Subchapter IX, Miscellaneous Provisions, Endangered and Threatened Species Protected	Wisconsin Statutes Chapter 29.604	Department of Natural Resources	Department of Natural Resources maintains list of endangered and threatened Wisconsin species.
Human Environmental Interactions			
Wisconsin rules on radiation protection	*Wisconsin Administrative Code* Chapter DHS 157 under authority of Wisconsin Statutes Chapter 254, Subchapter III,	Department of Health Services	Licensing of radioactive material, standards of protection from radiation including waste management and radiation safety requirements. Wisconsin is an agreement state with authority to regulate radioactive materials (10 CFR Part 30)(see Table 6-1). A "Type A specific license of broad scope" is required (DHS 157.13 (3)).
Requirements for Transfer of Low-level Radioactive Waste for Disposal at Land Disposal Facilities and Manifests	*Wisconsin Administrative Code* Chapter DHS 157, Appendix G	Department of Health Services	Requirements for manifests, certification, and control and tracking of low-level radioactive waste, including Class A waste.
Wisconsin rules on radiation protection—occupational dose limits	*Wisconsin Administrative Code* Chapter DHS 157.22	Department of Health Services	Sets radiation worker dose limits.
Wisconsin Statutes on Solid Waste Reduction, Recovery, and Recycling	Wisconsin Statutes Chapter 287	Department of Natural Resources	Establishes solid waste reduction, reuse, recycling, composting, and resource recovery policy. Details material-specific programs.

Table 6-2. Potentially Applicable Wisconsin State Requirements *(continued)*

Wisconsin Statutes on Hazardous Waste Management	Wisconsin Statutes Chapter 291	Department of Natural Resources	Establishes policy to ensure that hazardous wastes are properly managed according to RCRA and under the authority granted to the State of Wisconsin by EPA (see Table 6-1). Directs the Department of Natural Resources to promulgate rules regarding hazardous waste management.
Wisconsin Rules on Hazardous Waste Management	*Wisconsin Administrative Code* Chapter NR 660–669	Department of Natural Resources	Rules for hazardous waste management including identification of solid wastes subject to regulation, standards for generators of hazardous wastes, and storage and accumulation requirements.
Notification of Hazardous Waste Activities	*Wisconsin Administrative Code* Chapter NR 660.07	Department of Natural Resources	Requires any person who generates or transports hazardous waste, or owns or operates a facility for the treatment, storage or disposal of hazardous waste, to notify the Department of Natural Resources using EPA Form 8700-12.
Wisconsin Statutes on Pollution Prevention	Wisconsin Statutes Chapter 299.13	Department of Natural Resources	Establishes pollution prevention policy.
Wisconsin Statutes on Farmland Preservation	Wisconsin Statutes Chapter 91	Department of Agriculture, Trade and Consumer Protection	Defines prime farmland.

Key: DHS=Department of Health Services; EPA=U.S. Environmental Protection Agency; NR=Department of Natural Resources; RCRA=Resource Conservation and Recovery Act.

Table 6-3. Rock County, Wisconsin, Ordinances and Plans

Ordinance or Plan	Responsible Agency	Description
Physical Environment		
Rock County Hazard Mitigation Plan[a]	Rock County Local Emergency Planning Committee	Includes risk assessments for all types of hazards. Includes earthquakes, landslides, subsidence, and sinkholes.
Rock County Land and Water Resource Management Plan[b]	Rock County Land Conservation Department	Provides information on water resources. The plan is intended to guide the activities of the Land Conservation Department in its efforts to protect and improve the natural resources in Rock County.
Rock County Storm Water Management Ordinance (*Code of Ordinances*, Chapter 28)	Rock County Land Conservation Department	Requires use of best management practices in stormwater management. Requires stormwater management permit.
Rock County Construction Site Erosion Control Ordinance (*Code of Ordinances*, Chapter 27)	Rock County Land Conservation Department	Requires erosion control permit. Requires a permit and best management practices to reduce sediment and other pollutants leaving sites of land-disturbing activities.
Rock County Construction Floodplain Zoning Ordinance (*Code of Ordinances*, Chapter 32)	Rock County Planning, Economic & Community Development Agency, Development Review, Land Divisions & Enforcement Division	Regulates floodplain development.
Biological Environment		
Rock County Land and Water Resource Management Plan[b]	Rock County Land Conservation Department	Provides information on local environment. The plan is intended to guide the activities of the Land Conservation Department in its efforts to protect and improve the natural resources in Rock County.
Human–Environmental Interactions		
Rock County Local Emergency Planning Committee Administrative Procedure for HR 2005 (SARA, Title III) Section 311 and 312	Rock County Local Emergency Planning Committee	Applicability depends upon nonradioactive hazardous substances to be used. This procedure provides guidance for the reporting of extremely hazardous substances.
Rock County Local Emergency Planning Committee Administrative Procedure for HR 2005 (SARA, Title III) Section 304	Rock County Local Emergency Planning Committee	Applicability depends upon nonradioactive hazardous substances to be used. This policy describes how the Rock County Local Emergency Planning Committee expects releases of hazardous materials to be handled in Rock County.
Rock County Hazard Mitigation Plan[a]	Rock County Local Emergency Planning Committee	Includes risk assessments for all types of hazards.
Rock County Comprehensive Plan 2035[c]	Rock County Planning, Economic & Community Development Agency	Guides long-term economic development; sets policies and goals for cultural and historic resource conservation (Rock County Planning, Economic & Community Development Agency, Strategic & Comprehensive Planning Division).

a. Rock County 2010.
b. Rock County 2009a.
c. Rock County 2009b.
Key: SARA=Superfund Amendments and Reauthorization Act.

Table 6-4. City of Beloit Ordinances and Guidelines by General Resource Area

City Ordinance or Guideline	Description
Physical Environment	
City of Beloit's General Permit to Discharge under the Wisconsin Pollutant Discharge Elimination System Permit No. WI-S050075-1.[a]	The permit requires construction site pollutant control and postconstruction stormwater management for construction sites over 0.4 hectares (1 acre) in size.
Beloit, Wisconsin, Code of Ordinances, Chapter 24 - Storm Water Management	Section 24.07 includes requirements for new construction. Property owner shall be responsible for submitting a stormwater utility service application with building permit application. Also includes discharge rules.
Beloit, Wisconsin, Code of Ordinances, Chapter 29 - Wastewater Treatment System	Section 29.30 includes wastewater discharge permit requirements.
Beloit, Wisconsin, Code of Ordinances, Chapter 8 - Plumbing Code	Chapter 8 includes plumbing permit requirements.
Human–Environmental Interactions	
Beloit, Wisconsin, Code of Ordinances, Chapter 6, "Fire Prevention Code"	Permit required for storage tanks.
Beloit, Wisconsin, Code of Ordinances, Chapter 17.06 - Waste Management Including Recycling	The purpose of this section is to promote the management, recycling and composting of solid waste in accordance with Section 287.11 of the Wisconsin Statutes and Chapter NR 544 of the *Wisconsin Administrative Code*. Establishes mandatory recycling program.
Beloit, Wisconsin, Code of Ordinances, Chapter 27, "City Water Utility"	Permits required for connection to City water. Permits are also required for wells.
Beloit, Wisconsin, Code of Ordinances, Chapter 19, zoning code, Article 8-800, Industrial Performance Standards	Sets sound level limits for land that is zoned industrial.
Beloit, Wisconsin, Code of Ordinances, Chapter 32, "Historic Preservation"	Regulates construction and demolition of historic landmarks, landmark sites, and historic districts.
City of Beloit 2008 Comprehensive Plan[b]	Designates the future use of the proposed project area as a business park for industrial, office, and related economic development.
Resolution adopting Eco-Municipality Sustainable Guidelines for the City of Beloit[c]	The City has site review and landscaping standards for all new construction or reconstruction projects. Architectural review standards also apply to private development.
Beloit, Wisconsin, Code of Ordinances, Chapter 34, "Architectural Review and Landscape Code"	Sets regulations for architectural and landscape quality and requires review, fees, and certification.
Beloit, Wisconsin, Code of Ordinances, Chapter 34.10, "Lighting Requirements"	Sets lighting standards for buildings, off-street parking, and other exterior lighting. Requires lighting schemes to be approved by the City Engineer and the Community Development Director
Beloit, Wisconsin, Code of Ordinances, Chapter 34.02, "Applicability of Landscape Regulations" and 34.21(2)(d) "Landscape Buffers"	Describes applicability of landscape buffer regulations, types of landscape buffers, and the requirements for each.

a. WDNR 2006.
b. City of Beloit 2008.
c. City of Beloit 2007.

7.0 AGENCIES AND PERSONS CONSULTED

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8.0 REFERENCES

AC (AC4 Life), 2011, System Sizing Help, accessed through http://www.acdirect.com/systemsize.php in December.

Alliant Energy, 2011, *Alliant Energy Environmental Report*, Madison, Wisconsin, October 2011.

Batterman, R.H., 2011, Certified Survey Map of Part of the S.E. ¼ of the S.W. ¼ of Section 21, and Part of the N.E. ¼ of the N.W. ¼ and Part of the N.W. ¼ of the N.E. ¼ and Part of the S.W. ¼ of the N.E. ¼ of Section 28, all situated in T. 1N., R 13E. of the Fourth P.M., City of Beloit, Rock County, Wisconsin, December.

BEA (U.S. Bureau of Economic Analysis), 2009, "CA25-N - Total Full-time and Part-time Employment by NAICS Industry," Local Area Personal Income, CA25, CA25N NAICS (2001-2009), Wisconsin 2009, accessed through http://www.bea.gov/regional/reis/default.cfm?selTable=CA25 on January 4, 2012.

BLS (U.S. Bureau of Labor Statistics), 2011, Unemployment, accessed through http://www.bls.gov/data/#unemployment on January 2012.

Chanin, D. and M.L. Young, 1998, *Code Manual for MACCS2: Volume 1, User's Guide*, NUREG/CR-6613, SAND97-0594, Vol. 1, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Division of Systems Technology, Washington, D.C., May.

City of Beloit, 2005, *City of Beloit Historic Districts and Individual Historic Landmarks*, Beloit, Wisconsin, August 18, accessed through http://www.ci.beloit.wi.us/vertical/Sites/%7B4AECD64A-01FA-4C24-8F53-D3281732C6AB%7D/uploads/%7BE8B3265C-AAC4-4DFE-97CF-8C09FB2E59E0%7D.PDF on May 3, 2012

City of Beloit, 2007, *Resolution Adopting Eco-Municipalities Sustainability Guidelines*, December 17, accessed through http://www.ci.beloit.wi.us/vertical/Sites/%7B4AECD64A-01FA-4C24-8F53-D3281732C6AB%7D/uploads/%7BF1C00861-CBB4-40EB-B3F4-AB9744074E1F%7D.PDF on May 10, 2012.

City of Beloit, 2008, *City of Beloit Comprehensive Plan 2008*, Adopted March 17, accessed through http://www.ci.beloit.wi.us/index.asp?Type=B_LIST&SEC={759663D0-9855-48BC-A4F5-63A1689478B4} on May 10, 2012.

City of Beloit, 2010a, *2010 Consumer Confidence Report: Annual Drinking Water Quality*, Department of Public Works, Beloit, Wisconsin.

City of Beloit, 2010b, *City of Beloit Transit Routes*, Transit System Department, August 16.

City of Beloit, 2011a, "Map 10: Future Land Use," *City of Beloit Comprehensive Plan 2008*, Revised April 16, 2010.

City of Beloit, 2011b, Phase I Environmental Site Assessment, Agricultural Property, Area 2 of the Gateway Business Park, Beloit, WI, 53511, Prepared for the City of Beloit by Free Flow Technologies, Ltd., Machesny Park, Illinois. May 2011.

City of Beloit, 2011c, City of Beloit, Reports and Presentations to City Council, Resolution authorizing City Manager to enter into development agreement with NorthStar Medical Radioisotopes, LLC., July 5 and September 19.

City of Beloit, 2011d, Aerial Photography and Maps, Property Information and Maps, Assessor's Property Information, accessed through http://cityofbeloitwi.mygisonline.com/ on December 16, 2011.

City of Beloit, 2011e, *Municipal Code, City of Beloit, Wisconsin*, Beloit, Wisconsin, Adopted 3 October 2011, accessed through http://library.municode.com/index.aspx?clientId=12549 on January 10, 2012.

Dale, G., S. Chemerisov, P.T. Vandegrift, K. Woloshun, H. Bach, C. Heath, C. Kelsey, D. Bowers, A. Guelis, C. Jonah, R. McCrady, E. Olivas, K. Hurtle, E. Pitcher, F. Romero, W. Tuzel, J. Gioia, T. Tomei, R. Wheat, Jr., M. DeCroix, D. Warren, D. Dalmas, B. Romero, and J. Harvey, 2010, *Global Threat Reduction Initiative (GTRI) Accelerator Production of* ^{99}*Mo, FY 10 Report*, LA-UR-11-10486, Los Alamos National Laboratory, September.

Dale, G., K. Woloshun, C. Kelsey, C. Heath, M. Holloway, E. Olivas, D. Dalmas, F. Romero, K. Hurtle, and J. Harvey, 2011, *Target Design, Cooling, and Diagnostics for Electron Accelerator Production of* ^{99}*Mo*, National Nuclear Security Administration, Mo-99 Topical Meeting, Santa Fe, New Mexico, December.

Dale, G., 2012a, Los Alamos National Laboratory, Los Alamos, New Mexico, personal communication (telephone conversation) with R. Hull, Los Alamos Technical Associates, Los Alamos, New Mexico, "NorthStar accelerator cooling," July 3.

Dale, G., 2012b, Los Alamos National Laboratory, Los Alamos, New Mexico, personal communication (email) to S. Mirsky, Science Applications International Corporation, Germantown, Maryland, "RE: corrected volumes," May 22.

DOE (U.S. Department of Energy), 1994, *DOE Handbook: Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities, Volume 1- Analysis of Experimental Data*, DOE HDBK 3010-94, Washington, D.C., December.

DOE (U.S. Department of Energy), 1997, *DOE Standard: Specification for HEPA Filters used by DOE Contractors*, DOE-STD-3020-97, Washington, D.C., January.

DOE (U.S. Department of Energy), 2002, *Recommendations for Analyzing Accidents Under the National Environmental Policy Act*, July.

DOE (U.S. Department of Energy), 2004, *MACCS2 Computer Code Application Guidance for Documented Safety Analysis*, DOE-EH-4.2.1.4-MACCS2-Code Guidance, Washington, D.C., June.

DOE (U.S. Department of Energy), 2012, Protective Action Criteria (PAC): Chemicals with AEGLs, ERPGs, and TEELSs, Database Revision 27; February, 2012", accessed through http://www.atlintl.com/DOE/teels/teel/result.asp on May 15

DOE (U.S. Department of Energy), 2011, *2011Strategic Sustainability Performance Plan*, Washington, D.C., May.

DOE/EIA (U.S. Department of Energy, Energy Information Administration), 2011, *Table 1. State Emissions by Year (Million Metric Tons of Carbon Dioxide)*, Environment, State CO_2 Emissions, By Summary, accessed through http://www.eia.gov/environment/emissions/state/state_emissions.cfm in October.

DOI (U.S. Department of the Interior), 2007, Preliminary Final Environmental Impact Statement for Proposed Beloit Casino Project, Bureau of Indian Affairs, February.

DOL (U.S. Department of Labor), 2011, *News Release: Workplace Injuries and Illnesses – 2010*, USDL-11-1502, Bureau of Labor Statistics, October 20.

EPA (U.S. Environmental Protection Agency), 1971, *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances*, Office of Noise Abatement and Control, Washington, D.C., December 31.

EPA (U.S. Environmental Protection Agency), 1981a, *Noise and its Measurement*, Washington, D.C., January, accessed through http://nonoise.org/epa/Roll19/roll19doc49.pdf on March 3, 2010.

EPA (U.S. Environmental Protection Agency), 1981b, *Noise Effects Handbook: A Desk Reference to Health and Welfare Effects of Noise*, Office of Noise Abatement and Control, Washington, D.C., October 1979, Revised July 1981, accessed through http://nonoise.org/epa/Roll7/roll7doc27.pdf on March 3, 2010.

EPA (U.S. Environmental Protection Agency), 1988, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*, EPA-520/1-88-020, Office of Radiation Programs, Washington, D.C., September.

EPA (U.S. Environmental Protection Agency), 2002, *Part 81 – Designation of Areas for Air Quality Planning Purposes – Table of Contents, Subpart B – Designation of Air Quality Control Regions, Sec. 81.71 Rockville (Illinois)-Janesville-Beloit (Wisconsin) Interstate (JBWI) Air Quality Control Region,* accessed through http://edocket.access.gpo.gov/cfr_2002/julqtr/40cfr81.71.htm on July 1.

EPA (U.S. Environmental Protection Agency), 2008, The National Emissions Inventory, NEI Browser Search by State and County, accessed through http://www.epa.gov/ttn/chief/net/2008inventory.html in January.

EPA (U.S. Environmental Protection Agency), 2009, *Estimating 2003 Building-Related Construction and Demolition Materials Amounts*, EPA530-R-09-002, March.

EPA (U.S. Environmental Protection Agency), 2011, National Ambient Air Quality Standards, Air and Radiation, accessed through http://www.epa.gov/air/criteria.html in October.

EPA (U.S. Environmental Protection Agency), 2012a, *Mandatory Class I Areas*, accessed through http://www.epa.gov/ttn/oarpg/t1/fr_notices/classimp.gif on May 11.

EPA (U.S. Environmental Protection Agency), 2012b, *AP-42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources,* Chapter 3.2 – Natural Gas-Fired Reciprocating Engines, accessed through http://www.epa.gov/ttn/chief/ap42/ch03/final/c03s04.pdf on May 11.

FEMA (Federal Emergency Management Agency), 2008, *Flood Insurance Rate Map, Rock County, Wisconsin,* http://map1.msc.fema.gov/idms/IntraView.cgi?KEY=22955309&IFIT=1, December

FHWA (Federal Highway Administration), 1980, *Caltrans Noise Manual*, California Department of Transportation, March.

Gatfield, S., M. Gotkowtiz, and K. Bradbury, 2002, *Delineation of Zones of Contribution for Municipal Wells in Rock County, Wisconsin: Final Report*, Open-File Report 2002-02, Wisconsin Geological and Natural History Survey, Madison, Wisconsin.

GBEDC (Greater Beloit Economic Development Corporation), 2010, Gateway Business Park Utility Information, accessed through http://www.greaterbeloitworks.com/LinkClick.aspx?fileticket=46gg2-KrCBA%3d&tabid=850.

GBEDC (Greater Beloit Economic Development Corporation), 2011, *Greater Beloit Economic Development Corporation Announces Plans for New NorthStar Medical Radioisotopes, LLC Production Facility*, press release, June 22.

Harvey, J., G. Isensee, G. Messina, and S. Moffatt, 2011, *Domestic Production of Mo99*, National Nuclear Security Administration, Mo-99 Topical Meeting, Santa Fe, New Mexico, December.

Hull, R., 2012, Los Alamos Technical Associates, personal communication (conversation) to G. Pratt, Los Alamos Technical Associates, regarding general conditions observed at the proposed NorthStar Project Site, May 8.

IAEA (International Atomic Energy Agency), 2005, *Management of High Enriched Uranium for Peaceful Purposes: Status and Trends*, IAEA-TECDOC-1452, Nuclear Fuel Cycle Material Section, Vienna, Austria, June.

IOM (Institute of Medicine), 1995, *Isotopes for Medicine and the Life Sciences*, Committee on Biomedical Isotopes, Division of Health Sciences Policy, National Academy Press.

ISCORS (Interagency Steering Committee on Radiation Standards), 2002, *A Method for Estimating Radiation Risk from Total Effective Dose Equivalents,* ISCORS Technical Report No. 1, U.S. Department of Energy, Office of Environmental Policy and Guidance, July.

Kelsey IV, C.T., 2012, *Activation, Heating and Exposure Rates for Mo-99 Experiments with 25-Disk Targets*, LA-UR-12-21228, Los Alamos National Laboratory, February.

Kepner, B., 2012, Alliant Energy, personal communication (email) to A. Teepe, HDR, Inc., Seattle, Washington, June 20.

Leyendecker, E.V., D.M. Perkins, S.T. Algermissen, P.C. Thenhaus, and S.L. Hanson, 1995, *USGS Spectral Response Maps and Their Relationship with Seismic Design Forces in Building Codes*, USGS Open-File Report 95-596, U.S. Department of the Interior, Geological Survey, 1995.

MLG Commercial Inc., Undated, *The Gateway Business Park: A Joint Development between MLG & the City of Beloit*, accessed through http://www.mlgcommercial.com/services/ourServices.cfm?page=BizParkDetail&BPPrefix=GAT on May 30, 2012.

Mudrey Jr., M.G., B.A. Brown, and J.K. Greenberg, 1982, *Bedrock Geologic Map of Wisconsin*, University of Wisconsin-Extension, Geological and Natural History Survey.

NCRP (National Council on Radiation Protection and Measurements), 2009, *Ionizing Radiation Exposure of the Population of the United States,* NCRP Report No. 160, Bethesda, Maryland, March 3.

NorthStar (NorthStar Medical Technologies, LLC), 2012a, Accelerator Production of Molybdenum-99, Data Request 01 Responses, April 27.

NorthStar (NorthStar Medical Technologies, LLC), 2012b, Letter from NorthStar to Robert Hull (LATA) indicating that construction and operations at the NorthStar facility will avoid a small 0.8-hectare (20acre) wetlands.

NPS (National Park Service), 2012, National Register of Historic Places Database, U.S. Department of the Interior, accessed through http://nrhp.focus.nps.gov/natreghome.do?searchtype=natreghome on May 10.

National Research Council, 2009, *Medical Isotope Production Without Highly Enriched Uranium*, Committee on Medical Isotope Production Without Highly Enriched Uranium, Nuclear and Radiation Studies Board, Division of Earth and Life Sciences, National Research Council of the National Academies, The National Academies Press, Washington, D.C.

NRCS (U.S. Department of Agriculture-Natural Resources Conservation Service), 2007, *Rapid Watershed Assessment, Lower Rock River*, U.S. Department of Agriculture, Wisconsin, October.

NRCS (Natural Resources Conservation Service) 2011, Web Soil Survey, U.S. Department of Agriculture, accessed through http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx on January 9.

PNNL (Pacific Northwest National Laboratory), 2003, *Health Impacts from Acute Radiation Exposure*, PNNL-14424, U.S. Department of Energy, September.

Reindl, D.T., Gansler, R.A., and Jekel, T.B., 1995, *Simulation of Source Energy Utilization and Emissions for HVAC Systems*, A report ASHRAE TC 6.9 in response to the 991-TRP workstatement, University of Wisconsin-Madison.

Rock County 2005, *Rock County Agricultural Preservation Plan, 2005 Update*, Rock County Planning, Economic and Community Development Agency, December 15.

Rock County, 2009a, *Land and Water Resource Management Plan*, Rock County Land Conservation Department, July, accessed through http://www.co.rock.wi.us/images/web_documents/departments/land_conservation/land_water_preservation_plan.pdf on May 10, 2012.

Rock County, 2009b, *Rock County Comprehensive Plan 2035*, Planning, Economic, and Community Development Agency, Adopted September 10, accessed through http://www.co.rock.wi.us/index.php/plancomprehensive2035 on May 10, 2012.

Rock County, 2010, *Rock County Hazard Mitigation Plan*, prepared by Vierbicher in cooperation with the Rock County Emergency Management and The Rock County Planning, Economic and Community Development Agency, September 2004, Updated September 2010, accessed through http://clintonpd.us/Documents/hazard_mitigation_plan.pdf on May 10, 2012.

Ross, C., R. Galea, P. Saull, W. Davidson, P. Brown, D. Brown, J. Harvey, G. Messina, R. Wassenaar, and M. de Jong, 2010, "Using the ^{100}Mo Photoneutron Reaction to Meet Canada's Requirement for ^{99m}Tc," *Physics in Canada*, Vol. 66, No. 1, Jan-Mar.

Salkin, P., 2001, An Archaeological Survey of the Proposed Gateway Business Park in Beloit, Rock County, Wisconsin, Archaeological Consulting and Services, Inc., June.

Stanford (Stanford University) 2012, "Radionuclide Safety Data Sheet: Mo-99", accessed through http://www.stanford.edu/dept/ehs/prod/researchlab/radlaser/rsds_sheets/mo-99.pdf on May 17.

State of Wisconsin, 2011, "The Updated Wisconsin Statutes & Annotations," Updated through Wisconsin Act 44 and 31 August 2011, accessed through http://legis.wisconsin.gov/rsb/stats.html on January, 10 2012.

Strand Associates, Inc., 2007, Wetland Review Memorandum: *Gateway Boulevard – Eagles Ridge Drive to Hart Road, City of Beloit,* updated December 28.

Syverson, K.M., L. Clayton, J.W. Attig, and D.M. Mickelson, 2011, *Lexicon of Pleistocene Stratigraphic Units of Wisconsin*, Wisconsin Geological and Natural History Survey Technical Report 1, Madison, Wisconsin.

TWC (The Weather Channel), 2012, accessed through http://www.weather.com/ on July 10.

University of Washington, 2005, Department of Environmental and Occupational Health Sciences. Rick Neitzel, July.

USCB (U.S. Census Bureau), 2010a, State and County Quickfacts, accessed through http://quickfacts.census.gov/qfd/index.html on 4 January 2012.

USCB (U.S. Census Bureau), 2010b, Profile of General Population and Housing Characteristics: 2010, DP01, American FactFinder 2, accessed through http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml on May 17, 2012.

USCB (U.S. Census Bureau), 2010c, Poverty Status in the Past 12 Months. 2006-2010 American Community Survey 5-Year Estimates, S1701, American FactFinder 2, accessed through http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml on May 17, 2012.

USCB (U.S. Census Bureau), 2011a, American Fact Finder 2, accessed through http://factfinder2.census.gov on January 4, 2012.

USCB (U.S. Census Bureau), 2011b, 2010 Decennial Census Summary File 1, Table P1: Total Population for all block groups in Illinois and Wisconsin, accessed through http://www2.census.gov/census_2010/04-Summary_File_1/ on August 4.

USCB (U.S. Census Bureau), 2011c, Poverty Thresholds for 2010 by Size of Family and Number of Related Children Under 18 Years, Revised September 13, 2011, accessed through http://www.census.gov/hhes/www/poverty/data/threshld/ on May 17, 2012.

USDA-SCS (U.S. Department of Agriculture Soil Conservation Service) 1974, Soil Survey of Rock County, Wisconsin.

USFWS (U.S Fish and Wildlife Service), 2000, *The Eastern Massasauga Rattlesnake: A Handbook for Land Managers 2000*, Eastern Massasauga Management Working Group, accessed through http://www.fws.gov/midwest/endangered/reptiles/pdf/eama-mgmt-guide.pdf on May 9, 2012.

USFWS (U.S Fish and Wildlife Service), 2012a, *Wisconsin County Distribution of Federally-listed Endangered, Threatened, Proposed and Candidate Species*, List Revised March 2012, accessed through http://www.fws.gov/midwest/endangered/lists/pdf/WisconsinCtyListMarch2012.pdf on May 2.

USFWS (U.S Fish and Wildlife Service), 2012b, Eastern Prairie Fringed Orchid [Prairie white-fringed orchid] (Platanthera leucophaea), Fact Sheet, accessed through http://www.fws.gov/midwest/endangered/plants/epfo.html on May 11.

USGS (U.S. Geological Survey), 1978, Wisconsin, Earthquake History, U.S. Department of the Interior http://earthquake.usgs.gov/earthquakes/states/wisconsin/history.php.

USGS (U.S. Geological Survey), 2008, National Seismic Hazard Map Figures, U.S. Department of the Interior, access through http://earthquake.usgs.gov/hazards/products/conterminous/2008/maps/.

USGS (U.S. Geological Survey), 2009, Earthquake Probability Mapping, U.S. Department of the Interior, accessed through https://geohazards.usgs.gov/eqprob/2009/index.php on May 14.

USGS (U.S. Geological Survey), 2011a, 2009 Mineral Yearbook (Advance Release), U.S. Department of the Interior, July.

USGS (U.S. Geological Survey) 2011b, *Water Use in Wisconsin, 2005*; USGS Open-File Report 2009-1076, U.S. Department of the Interior, November.

USGS (U.S. Geological Survey), 2012a, Earthquake Search, U.S. Department of the Interior, accessed through http://earthquake.usgs.gov/earthquakes/eqarchives/epic/ on May 14.

USGS (U.S. Geological Survey), 2012b, Groundwater for Wisconsin: Water Levels, National Water Information System, U.S. Department of the Interior, accessed through http://waterdata.usgs.gov/wi/nwis/gw on May 25.

WDNR (Wisconsin Department of Natural Resources), 2006, General Permit to Discharge under the Wisconsin Pollutant Discharge Elimination System WPDES Permit No. WI-S050075-1, January.

WDNR (Wisconsin Department of Natural Resources), 2008, Wisconsin Wetlands Inventory, accessed through http://dnr.wi.gov/wetlands/inventory.html, Revised September 25.

WDNR (Wisconsin Department of Natural Resources), 2010, Letter from Angela White (Endangered Resources Program) to Angela Jevremovic (Free Flow Technologies, Ltd.), May 17, 2010, Subject: Endangered Resources Review (ERR Log # 10-177) Proposed Gateway Business Park Project – 239 acre industrial park in Rock County, WI.

WDNR (Wisconsin Department of Natural Resources), 2011, *Wisconsin Endangered and Threatened Species Laws & List*, PUBL-ER-001 2004, Revised June 2011, accessed through http://dnr.wi.gov/topic/endangeredresources/documents/WIETList.pdf on May 8, 2012.

WDNR (Wisconsin Department of Natural Resources), 2012a, *Endangered Resources. Endangered, Threatened, and Special Concern Plants and Animals and Native Natural Communities in Rock County*, Wisconsin, accessed through http://dnr.wi.gov/org/land/er/nhi/countyelements/pdfs/rock.pdf on June 20.

WDNR (Wisconsin Department of Natural Resources), 2012b, Migratory Whooping Crane Reintroduction, accessed through http://dnr.wi.gov/org/land/er/birds/wcrane/ on May 9.

WDNR (Wisconsin Department of Natural Resources), 2012c, Prairie White-fringed Orchid [=Eastern Prairie Fringed Orchid] (*Platanthera leucophaea*) Species Account, accessed through http://dnr.wi.gov/topic/EndangeredResources/Plants.asp?mode=detail&SpecCode=PMORC1Y0F0 on May 9.

WDNR (Wisconsin Department of Natural Resources), 2012d, Prairie Bush-clover (*Lespedeza leptostachya*) Species Account, accessed through http://dnr.wi.gov/topic/EndangeredResources/Plants.asp?mode=detail&SpecCode=PDFAB27090 on May 9.

WDNR (Wisconsin Department of Natural Resources), 2012e, Eastern Massasauga (*Sistrurus catenatus catenatus*) Species Account, accessed through http://dnr.wi.gov/topic/EndangeredResources/Animals.asp?mode=detail&SpecCode=ARADE03011 on May 9.

WDNR (Wisconsin Department of Natural Resources), 2012f, Gravel chub (*Erimystax x-punctatus*) Species Account, accessed through http://dnr.wi.gov/topic/endangeredresources/animals.asp?mode=detail&speccode=afcjb50050 on June 20.

WDNR (Wisconsin Department of Natural Resources), 2012g, Hairy Wild Petunia (*Ruellia humilis*) Species Account, accessed through http://dnr.wi.gov/topic/EndangeredResources/Plants.asp?mode=detail&SpecCode=PDACA0J080 on May 9.

WDNR (Wisconsin Department of Natural Resources), 2012h, Pink Milkwort (*Polygala incarnata*) Species Account, accessed through http://dnr.wi.gov/topic/endangeredresources/plants.asp?mode=detail&speccode=pdpgl020p0 on June 20.

WDNR (Wisconsin Department of Natural Resources), 2012i, Ozark minnow (*Notropis nubilus*) Species Account, accessed through http://dnr.wi.gov/topic/endangeredresources/animals.asp?mode=detail&speccode=afcjb28680 on June 20.

WDNR (Wisconsin Department of Natural Resources), 2012j, Pale Purple Coneflower (*Echinacea pallida*) Species Account, accessed through http://dnr.wi.gov/topic/EndangeredResources/Plants.asp?mode=detail&SpecCode=PDAST38040 on May 9.

WDNR (Wisconsin Department of Natural Resources), 2012k, Prairie Indian Plaintain (*Cacalia tuberosa*) Species Account, accessed through http://dnr.wi.gov/topic/endangeredresources/plants.asp?mode=detail&speccode=pdastd7060 on June 20.

WDNR (Wisconsin Department of Natural Resources), 2012l, Prairie Parsley (*Polytaenia nuttallii*) Species Account, accessed through http://dnr.wi.gov/topic/endangeredresources/plants.asp?mode=detail&speccode=pdapi1u010 on June 20.

WDNR (Wisconsin Department of Natural Resources), 2012m, Snowy Campion (Silene nivea) Species Account, accessed through http://dnr.wi.gov/topic/endangeredresources/plants.asp?mode=detail&speccode=pdcar0u120 on June 20.

WDNR (Wisconsin Department of Natural Resources), 2012n, Woolly Milkweed (*Asclepias lanuginosa*) Species Account, accessed through http://dnr.wi.gov/topic/EndangeredResources/Plants.asp?mode=detail&SpecCode=PDASC022A0 on May 9.

WDNR (Wisconsin Department of Natural Resources), 2012o, Glade Mallow (*Napaea dioica*) Species Account, accessed through http://dnr.wi.gov/topic/EndangeredResources/Plants.asp?mode=detail&SpecCode=PDMAL0X010 on May 9.

WDNR (Wisconsin Department of Natural Resources), 2012p, Prairie False-dandelion (*Nothocalais cuspidata*) Species Account, accessed through http://dnr.wi.gov/topic/EndangeredResources/Plants.asp?mode=detail&SpecCode=PDAST6P020 on May 9.

WDNR (Wisconsin Department of Natural Resources), 2012q Wafer-ash (*Ptelea trifoliata*) Species Account, accessed through http://dnr.wi.gov/topic/endangeredresources/plants.asp?mode=detail&speccode=pdrut0f020 on June 20.

Wisconsin Department of Safety and Professional Services, Undated, Safety and Buildings, accessed through http://dsps.wi.gov/sb/SB-CommercialBuildingsProgram.html, on January 12, 2012.

Wisconsin DOT (Wisconsin Department of Transportation), 2010, Annual Average Daily Traffic Counts for Rock County Wisconsin 2010, accessed through http://www.dot.wisconsin.gov/travel/counts/rock.htm.

Wisconsin DOT (Wisconsin Department of Transportation), 2011, *Wisconsin Railroads & Harbors 2011*, Bureau of Planning and Economic Development, January, accessed through http://www.dot.wisconsin.gov/localgov/docs/railmap.pdf on January 12, 2012.

Wisconsin Administrative Code

WISREG, 2012, Department of Health Services, Chapter DHS 157: Radiation Protection; Subchapter III - Standards for Protection from Radiation, April.