Environmental Report

Renewal of Source Materials License SUB-526

Honeywell International Inc.

Metropolis Works, Metropolis, Illinois

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Acronyms, Abbreviations, and Symbols

Acronym	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
µCi/cc	microcuries per cubic centimeters
µg/g	micrograms per gram of soil, sediment, or vegetation
µg/L	micrograms per liter
µCi/ml	microcuries per milliliter
$\mu g/m^3$	microgram per cubic meter
µm	micrometer
µmhos/cm	micromhos per centimeter (standard unit of electrical conductance)
AEC	Atomic Energy Commission
AEP	American Electric Power Company
AFDD	accumulated freezing degree days
ALARA	as low as reasonably achievable
AMAD	activity median aerodynamic diameters
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASTM	American Society for Testing and Materials
bgs	below ground surface
BNSF	Burlington Northern Santa Fe
BOD	biological oxygen demand
Btu/hr	British thermal units per hour
CAA	Clean Air Act
CaF_2	calcium fluoride
CDP	census-designated place
CFR	Code of Federal Regulations
cfs	cubic feet per second
CFU/100 ml	colony forming units per 100 milliliters
cm/sec	centimeters per second
cy	cubic yard

Acronym	Definition
cysts/L	cysts per liter
dB	decibel
dBA	A-weighted decibel
DCH	designated critical habitat
DOE	U.S. Department of Energy
DUF_6	depleted uranium hexafluoride
EA	environmental assessment
EEI	Electric Energy Inc.
EF	enhanced Fujita scale (a measure of tornado severity)
EIS	environmental impact statement
ELUC	environmental land use control
EPA	U.S. Environmental Protection Agency
EPF	environmental protection facility
ER	environmental report
ERI	Energy Resources International
ESA	Endangered Species Act
F	Fujita scale (a measure of tornado severity)
F_2	fluorine
FDD	freezing degree days
FEMA	Federal Emergency Management Agency
FHA	Federal Highway Administration
FMB	feed materials building
ft^3/s	cubic feet per second
GIS	Geographic information system
H_2	hydrogen
H_2SO_4	sulfuric acid
HAP	hazardous air pollutant
HARGIS	Historic and Architectural Resources Geographic Information System
HF	hydrogen fluoride

Acronym	Definition
Honeywell	Honeywell Performance Materials & Technologies
ICRP	International Commission on Radiation Protection
IDNR	Illinois Department of Natural Resources
IDPH	Illinois Department of Public Health
IEPA	Illinois Environmental Protection Agency
IESA	Illinois Endangered Species Act
IHPA	Illinois Historic Preservation Agency
IIAS	Inventory of Illinois Archaeological Sites
IOC	inorganic compound
ISGS	Illinois State Geological Survey
ISM	Illinois State Museum
km	kilometer
KOH	potassium hydroxide
LLW	low-level waste
m^3/min	cubic meters per minute
Mb	body wave magnitude
MCL	maximum contaminant level
MEI	maximally exposed individual
MGD	million gallons per day
mg/L	milligrams per liter
mi^2	square miles
MMI	modified Mercalli intensity (earthquake scale)
mph	miles per hour
mrem	millirem
mrem/yr	millirem per year
msl	mean sea level
MTW	Metropolis Works Plant
MW	megawatt
NAC	noise abatement criteria

Acronym	Definition
NaOH	sodium hydroxide
NCDC	National Climatic Data Center
NH_3	ammonia
NHPA	National Historic Preservation Act
N_2O	nitrogen oxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
NWS	National Weather Service
O_3	ozone
oocysts/L	oocysts per liter
ORSANCO	Ohio River Valley Water Sanitation Commission
OSHA	Occupational Safety and Health Administration
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PGDP	Paducah Gaseous Diffusion Plant
PM	particulate matter
$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter
PM_{10}	particulate matter less than 10 micrometers in diameter
PMP	probable maximum precipitation
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
Qe	effective flowrate
Ra-226	Radium-226

Acronym	Definition
RCRA	Resource Conservation and Recovery Act
SLM	sound level meter
SO_2	sulfur dioxide
SOC	synthetic organic compound
STF	surface treatment facility
SU	standard unit
SWU	separative work unit
SWU/yr	separative work units per year
Tavg	average temperature
TEDE	total effective dose equivalent
Th-230	Thorium-230
TSS	total suspend solids
TVA	Tennessee Valley Authority
U-235	uranium-235
U_3O_8	triuranium octoxide
UF_4	uranium tetrafluoride
UF_6	uranium hexafluoride
UO_2	uranium dioxide
USACE	U.S. Army Corps of Engineers
USCB	U.S. Census Bureau
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USHCN	U.S. Historical Climatology Network
VOC	volatile organic compounds
VOM	volatile organic matter
WSO	weather service office

1.0 INTRODUCTION

Honeywell Performance Materials & Technologies (Honeywell) is requesting the renewal of its source material license SUB-526 for the uranium hexafluoride (UF_6) facility at the Metropolis Works Plant (MTW), in Metropolis, Illinois, for a period of up to an additional 40 years. MTW is located at 2768 North U.S. Highway 45, approximately one mile west of the city of Metropolis (Figures 1.0-1 and 1.0-2). The MTW site is located in Massac County, Illinois, across the Ohio River from McCracken County, Kentucky (Figure 1.0-2). Massac County is a predominantly agricultural area of low average population density with widely scattered villages and small cities. For the purposes of this report, the MTW site is defined as the area enclosed by U.S. Highway 45 to the north, the Ohio River to the south, an industrial coal-blending plant to the west, and privately owned developed land to the east. Additional information and description of the current facility is given in Subsection 2.1.2.1.

Honeywell has prepared this environmental report (ER) as part of MTW's license renewal application. The ER was prepared according to the guidelines contained in NUREG 1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs" (NRC 2003). The purpose of this document is to assess the environmental consequences of the proposed license renewal for this facility.

Initial construction of MTW was completed in 1958, and the first UF_6 was produced in 1959 as part of a five-year contract for conversion services with the former Atomic Energy Commission (AEC). The AEC conversion contract was completed in 1964, and the conversion process suspended. Continued increase in demand for conversion services resulted in the rehabilitation of the UF_6 facility in 1967, and commercial conversion started in 1968. In 1968–69, MTW's capacity was expanded to 9,000 metric tons. Capacity was increased again in 1975 to 11,500 metric tons and in 1995 to 12,700 metric tons. Re-engineering in 2007 increased capacity to approximately 15,000 metric tons per year.

1.1 Purpose and Need for the Proposed Action

MTW performs a necessary service for the commercial nuclear power industry by converting natural uranium ore concentrates into UF_6. The UF_6 product is shipped to various customers in the United States and worldwide for the enrichment of the uranium-235 (U-235) isotope. Following enrichment, the uranium is converted into fuel for use in commercial, governmental, and military nuclear reactors producing electricity and medical isotopes, or those supporting scientific research. MTW is the only UF_6 conversion facility operating in the United States, and as such, is a critical part of the U.S. nuclear fuel cycle and makes a significant contribution to domestic energy production.

MTW is a chemical manufacturing facility producing gaseous fluorine (F_2) and UF_6. The production process for UF_6 is the only operation at MTW licensed by the U.S. Nuclear Regulatory Commission (NRC) as required under 10 CFR Part 40. The licensed facility is designed to produce approximately 15,000 metric tons (16,535 tons) per year of uranium as UF_6 from uranium ore concentrates. The MTW feed is uranium ore concentrates of approximately 75 percent of uranium by weight, and the primary product is high purity UF_6.

The MTW operation uses the fluoride volatility process in the production of UF_6, in which the ore concentrate feed moves through the successive steps of feed preparation, reduction, hydrofluorination, fluorination, and distillation. Chemical reactions are carried out in fluidized bed reactors.

As part of UF_6 production, MTW also includes:

1) A storage area for uranium ore concentrates received from uranium mills.
2) A uranium sampling facility.
3) A bulk storage area for process chemicals such as ammonia (NH_3), sodium hydroxide ($NaOH$), potassium hydroxide (KOH), and sulfuric acid (H_2SO_4).
4) A facility for electrolytic production of gaseous F_2 from hydrogen fluoride (HF).
5) Treatment systems and storage ponds for liquid wastes.

These facilities and areas are shown on Figure 1.1-1. The feed materials building (FMB), where most of the UF_6 conversion activities occur, is located in the center of the industrialized area shown on Figure 1.1-1. The chemical manufacturing facilities are on the west side of the FMB, while settling ponds occupy the southwest portion of the industrialized area. Various types of storage pads occupy the southeastern and eastern portion of the industrialized area.

The present application for renewal of the license involves no expansion or major program changes in UF_6 production facilities since the last license renewal in May 2005. However, there have been several upgrades and modifications to the facilities, and one additional upgrade is pending. All are listed below.

- The existing environmental protection facility (EPF) was expanded in 2006 with the construction and completion of the surface treatment facility (STF). This expansion increased the capacity of the existing EPF and added an additional clarifier and sand filter. The STF is considered part of the EPF.
- Outdated oil-cooled rectifiers in the F_2 production facility were replaced with new water-cooled units.

- A new cooling tower was installed to cool the waste heat from the new rectifiers prior to discharge to the Ohio River.
- A new sewage treatment facility was put into operation in 2015.
- Seismic/tornado protection upgrades were completed in 2013.
- Treatment upgrades are planned for the EPF to comply with fluoride discharge limits and enable Pond D to be removed from service and closed per the current Resource Conservation and Recovery Act (RCRA) permit.

1.2 Proposed Action

The proposed action is the renewal of the Honeywell source material license SUB-526 for a period of up to an additional 40 years. With this renewal, MTW will continue to convert natural uranium ore concentrates into UF_6 for the nuclear industry, including commercial power reactors and medical, military, and research reactors. The production of UF_6 is one phase in the nuclear fuel cycle that results in the production of fuel elements for nuclear reactors.

1.3 Applicable Regulatory Requirements

The National Pollutant Discharge Elimination System (NPDES) permit (No. IL 0004421) for MTW has been renewed by the Illinois Environmental Protection Agency (IEPA), effective through June 30, 2020. The MTW liquid effluent is monitored in accordance with the terms and conditions of the permit.

An RCRA permit (#B-65R2-M-17) has also been issued to MTW by the IEPA for the storage and treatment of hazardous waste generated onsite. The current permit has been in effect since October 29, 2013, and regulates operation of the EPF ponds and storage of drummed hazardous waste on the waste storage pad. Some of the drummed hazardous waste is "mixed waste," in that it contains both RCRA hazardous waste and radioactive waste with low concentrations of uranium. This waste is stored onsite until shipped to a licensed facility for treatment and/or disposal. In an effort to minimize the amount of RCRA wastes, as much material as possible is reprocessed through MTW. The remaining drummed waste is periodically shipped offsite for appropriate disposal.

A Title V Clean Air Act (CAA) permit (ID No. 127854AAD) was issued to MTW by the IEPA in 2003. Honeywell submitted a permit renewal application before the current permit expired on July 14, 2008, and the State of Illinois allows MTW to operate under its existing permit until renewal is granted. Thus MTW operates in compliance with its Title V CAA permit.

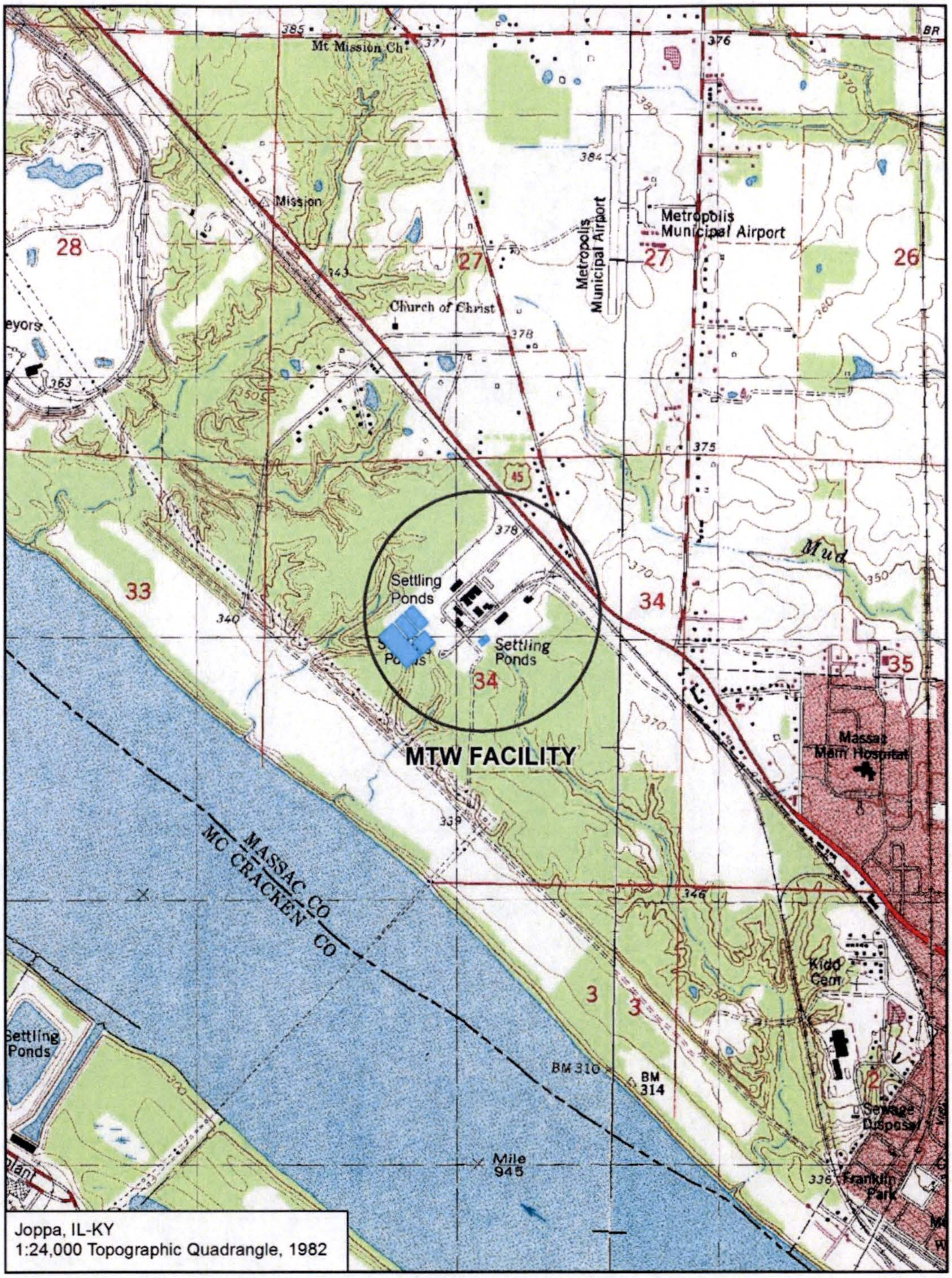


Figure 1.0-1
MTW Site Map

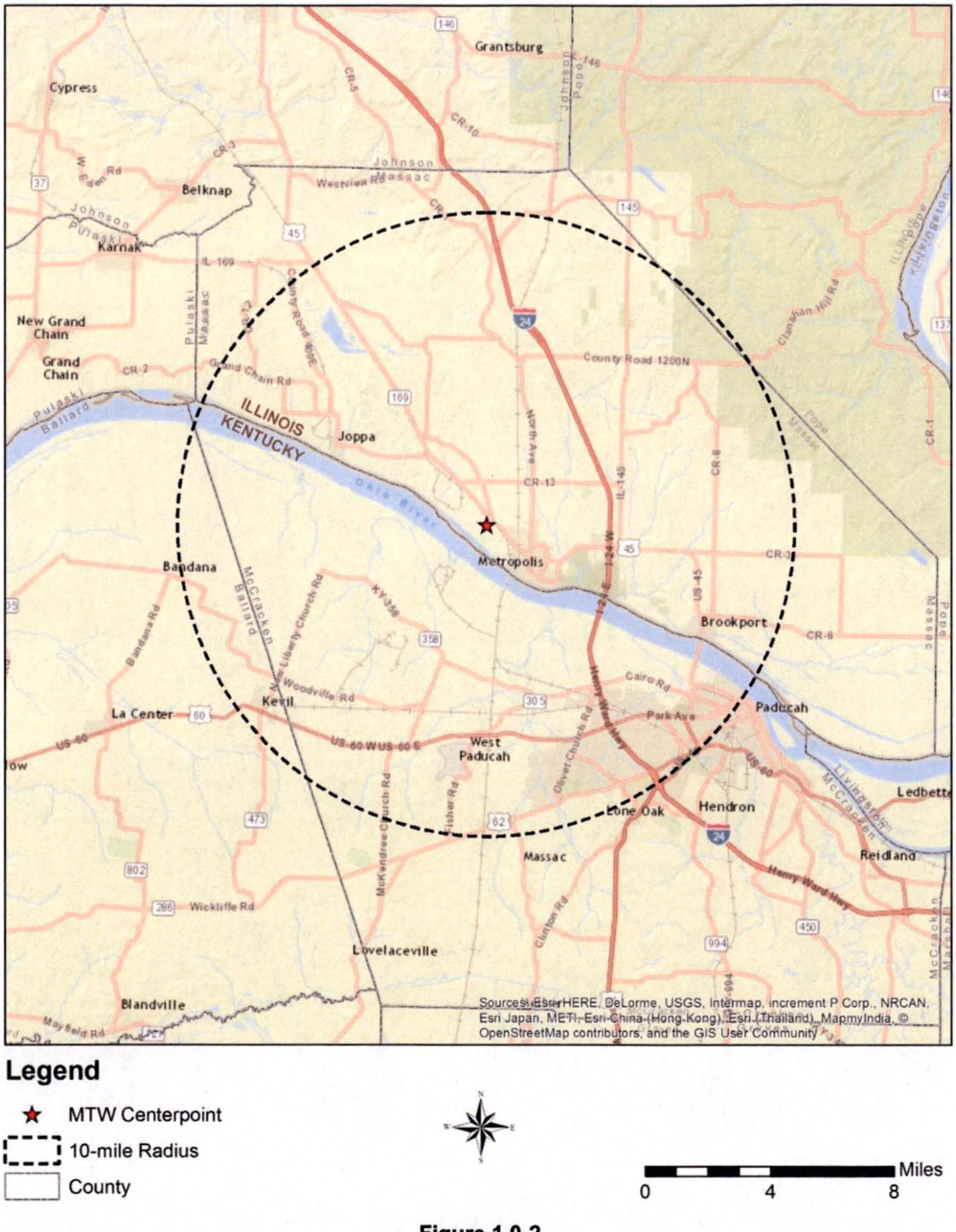


Figure 1.0-2
MTW Location Map

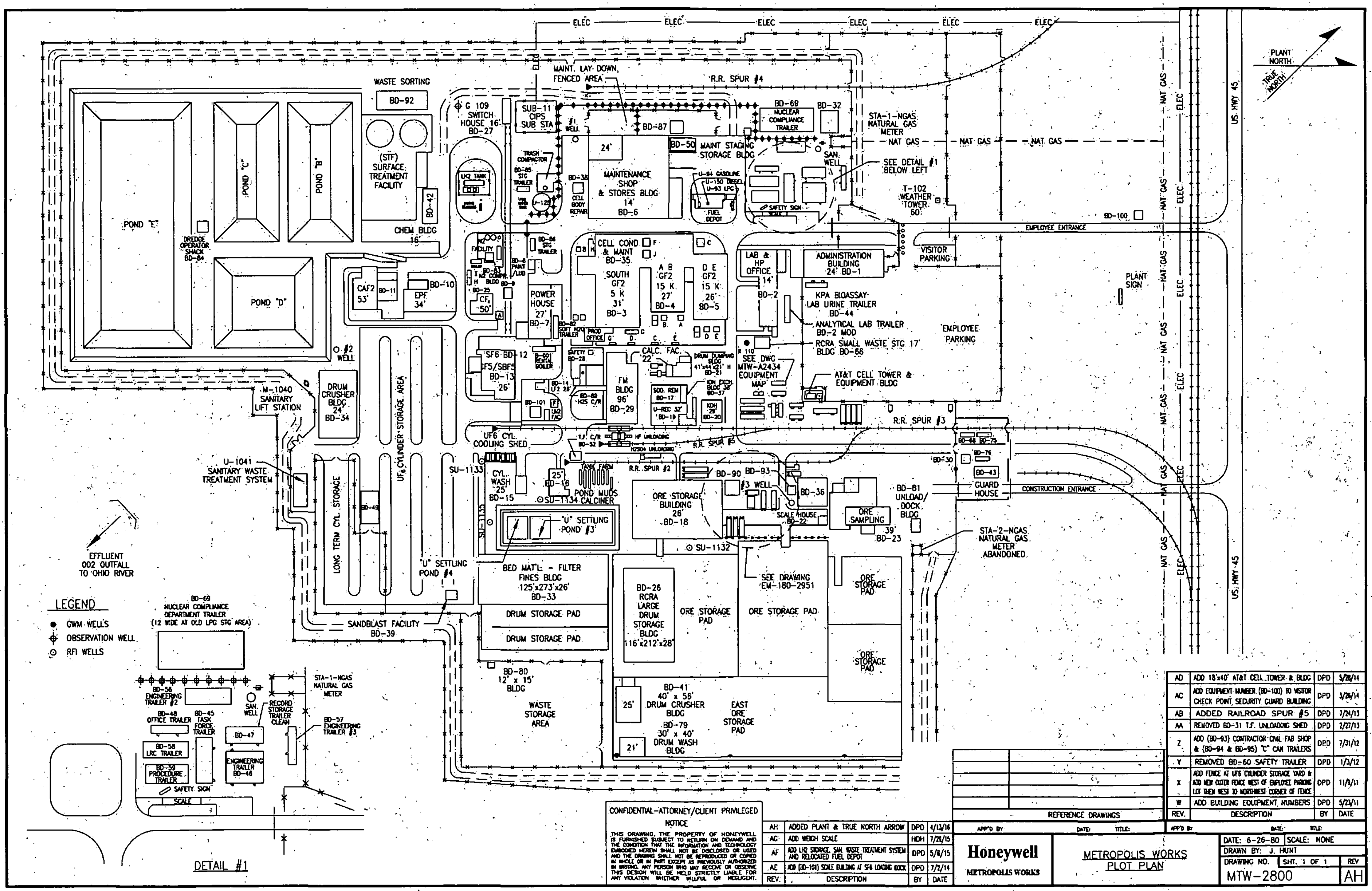


Figure 1.1-1
MTW Facility Layout

2.0 ALTERNATIVES

The purpose of this chapter is to provide a detailed description of the proposed action and the alternatives to the proposed action. In addition, planned or existing mitigating measures and any applicable decontamination and decommissioning of MTW are described. Lastly, cumulative impacts of the proposed action and a comparison of predicted environmental impacts of the proposed action and viable alternatives are provided.

2.1 Detailed Description of the Alternatives

Discussions of the proposed action, no-action alternative, and potential alternatives are provided in the following sections.

2.1.1 No-Action Alternative

The no-action alternative is that MTW's source material license SUB-526 would not be renewed. Once the current license expires on May 11, 2017, MTW would cease operations and Honeywell would begin the process of license termination in accordance with 10 CFR 40.42. MTW would eventually undergo decommissioning in accordance with NRC requirements and guidelines. The cessation of operations would also mean there would be no operating facility in the United States to convert uranium ore to UF_6, which would have a potential impact on the commercial nuclear fuel industry.

Current U.S. demand for UF_6 and enriched uranium is met in large part by importing from international sources. However, the U.S. Department of Energy (DOE) considers maintaining domestic capacity an important objective of U.S. energy security (NRC 2012a). The NRC commented on the paucity of domestic sources as follows: "...the heavy dependence on foreign sources and the lack of diversification of domestic sources of enriched uranium represent a potential reliability risk for the domestic nuclear energy industry, which supplies 20 percent of national energy" (NRC 2012a).

If the decontamination and decommissioning phase were initiated, Honeywell would do a thorough survey of the MTW grounds and buildings and develop a detailed decontamination and decommissioning plan. Decommissioning activities would involve dismantlement and removal of equipment and structures, decontamination of equipment and structures, and site remediation, with its potential for worker exposure. It is expected that these operations would result in the release of small amounts of radioactivity to the atmosphere and the Ohio River through the generation and offsite shipment of significant quantities of low-level waste (LLW). Waste volumes and dose due to decommissioning are assessed every three years as required by 10 CFR 40.36(d)(2) to prepare a detailed cost estimate for decommissioning.

The overall objective of MTW decommissioning would be to remediate MTW to an unrestricted use condition that corresponds to a calculated dose to the public that is less than 25 millirem/year (mrem/yr) from applicable pathways. The former MTW property could then be used without any restrictions. The 25 mrem/yr dose limit is codified at 10 CFR 20.1402, "Radiological Criteria for Unrestricted Use."

It is expected that decontamination and decommissioning operations would require fewer people, so there would be a negative socioeconomic impact when uranium conversion operations ceased. The short-term impacts of the no-action alternative would likely involve an increase in noise levels and vehicular traffic, and potential historical and archaeological impacts as a result of MTW decommissioning activities.

2.1.2 Proposed Action

The proposed action is renewal of MTW's source material license, SUB-526, for continued operation of the facility as described in Subsection 2.1.2.1 at the current licensed production capacity level of 15,000 metric tons per year. The up to an additional 40-year renewal term would follow the current license term, which expires May 11, 2017.

2.1.2.1 Current Facility Description and Operations

As discussed in Chapter 1, MTW is located on approximately 1,000 acres of land in Massac County in the southern tip of Illinois. The primary MTW site perimeter is formed by U.S. Highway 45 to the north, the Ohio River to the south, an industrial coal-blending plant to the west, and privately owned developed land to the east. In addition, a small portion of MTW property extends beyond Highway 45 to the northeast. MTW operations are conducted in a restricted area located on the north-central portion of the MTW site. The restricted area is defined as a 59-acre area surrounded by inner- and outer-perimeter security fences. Major facilities in the restricted area include the administration building, the laboratory, the fluorine production facility, the FMB, the sampling plant, the wastewater treatment plant, the UF_6 cylinder storage area, and the uranium ore storage yard (see Figure 1.1-1). Much of MTW, including the six-story FMB, the administration building, and the maintenance facility is visible from U.S. Highway 45, which is northeast of MTW (Honeywell 2016a). The buildings and facilities are described below, and their locations are shown in Figure 1.1-1.

2.1.2.1.1 Main Production Buildings

The main production buildings incorporate the primary processing activities and include the following:

- FMB
- FMB Pads

- Wet Process/Sodium Removal Building
- KOH Muds Building
- Sampling Plant

The ion exchange building remains onsite, but is no longer in use.

2.1.2.1.2 Miscellaneous Production Buildings

The miscellaneous production buildings incorporate support processes for the main production buildings as well as non-uranium processing activities. They include the following:

- Ore Storage Building
- Bed Material Filter Fines Building
- Pond Muds Filter Calciner Building
- Cylinder Wash Building
- Drum Dumping Building
- Gaseous F_2 Plant Building
- South Gaseous F_2 Plant
- Liquid Nitrogen Facility
- Calcium Fluoride Building
- Liquid Hydrogen System
- Powerhouse
- Drum Shredder Building
- Drum Crusher

2.1.2.1.3 Storage Facilities, Treatment Facilities, Ponds

MTW has a number of storage pads and buildings for storing materials and waste, including:

- Five (5) Ore Storage Pads
- The RCRA Waste Storage (small and large) Buildings
- The UF_6 Cylinder Storage Area
- The Long-Term Cylinder Storage Area

There are two wastewater treatment facilities: one for treating process wastewater, the EPF, and a second for sanitary wastewater, the sanitary wastewater treatment facility. The gaseous F_2 process is also supported by cooling towers. MTW has two surface impoundment facilities, uranium settling ponds 3 and 4, that facilitate the recovery of uranium for re-use in the process, and calcium fluoride (CaF_2) ponds B, C, D, and E, of which only Pond D is still in active service.

2.1.2.1.4 Outdoor Areas, Drains & Sewers

These outdoor areas include the employee parking lot, the paved roads onsite, railroad spurs #1 through #5, the land between two parallel property exclusion fences, the company-owned land outside the fenced property, the discharge ditch to the Ohio River, MTW site drains and sewers, and all other land inside the restricted area.

2.1.2.1.5 Administrative Areas

The administrative areas include the administration building, office trailers, the laboratory building, the shop/stores/office building, and the maintenance building.

2.1.2.1.6 Process Operations

Overview

The current design operating capacity of MTW is 15,000 metric tons of UF_6 annually. The feed uranium ore contains approximately 75 percent uranium by weight, generally in the form of triuranium octoxide (U_3O_8). The produced UF_6 is nearly pure, containing less than 300 parts per million (ppm) by weight of residual compounds.

The primary processing steps for licensed material are ore sampling and preparation, reduction, hydrofluorination, uranium tetrafluoride (UF_4) fluorination, and UF_6 distillation (product purification). These process steps are conducted in a sequential manner with in-process recycling used only for recovery of uranium from secondary process streams. A diagram showing the conversion process is presented in Figure 2.1-1. The chemical conversion and product purification steps take place in the FMB. Industrial chemicals required for the operations include H_2SO_4, HF, KOH, NaOH, refrigerants, glycol, hydrogen (H_2), and gaseous F_2. The balance of this section presents a more detailed description of conversion operations. Waste management operations are described in Subsection 2.1.2.2.

2.1.2.1.7 Feed Storage, Sampling, and Preparation

Uranium oxide ore concentrates are shipped to MTW via truck in 55-gallon drums and stored onsite on impervious pads. Approximately 650 feed ore shipments are received each year, and approximately 30,000 metric tons of ore are stored onsite. Each drum is transported to the sampling plant where the lid is removed and a representative sample is collected to determine the general composition of the ore and to characterize impurities. The lid is replaced and the drum is weighed, then moved to a storage area until needed as process feed.

Feed containing high levels of sodium or potassium is leached with H_2SO_4. Uranium feed is removed from the rinse solution by filtration and transferred to the ore preparation system. The filtered rinse solution is pumped to uranium settling ponds 3 and 4, and some particulates are released to the atmosphere. Feeds with acceptable purity levels are calcined, crushed, and classified to produce solid particles, which are processed in fluidized bed reactors. Ventilation air from the FMB is filtered through dust collectors before release to the atmosphere. Solid waste filter bags are produced in this operation, and a contaminated liquid stream produced during drum washing is routed to uranium settling ponds 3 and 4.

2.1.2.1.8 Reduction

The next step in the conversion process is the reduction of U_3O_8 to UO_2, which is accomplished by contacting feed U_3O_8 with H_2 gas in a fluidized bed reactor at approximately 1050°F. A liquid hydrogen system maintained by a vendor is used as a source of hydrogen. The system is located within a gated enclosure south of the maintenance building, and consists of a cryogenic storage tank with a nominal capacity of 18,000 gallons and vaporizers. Outside the liquid hydrogen system's fence, a nitrogen/hydrogen mixing station was constructed to provide the appropriate fluidizing and reactive gas mixtures to the process.

Hydrogen is flammable in air at concentrations of 4 to 75 percent. In well-ventilated areas, such as the outdoor location of the liquid hydrogen storage tank, vaporizers, and hydrogen/nitrogen mixing stations, these concentration ranges may be reached in a small region near a leak or spill. Four hydrogen gas analyzers are positioned around the liquid hydrogen storage tank and vaporization system to monitor for leaks. If two or more detectors sense a leak exceeding an action level, the hydrogen supply will be shut down. No liquid effluent stream is produced by the reduction process.

2.1.2.1.9 Hydrofluorination

Solid UO_2 is converted to solid UF_4 by contacting the UO_2 with gaseous HF in two fluidized bed reactors arranged in series. The hot (851°F) reactor off-gas is filtered and scrubbed with water, then with a KOH solution before release to the atmosphere. The spent scrubber liquid is processed through the EPF for neutralization and recovery as CaF_2. The UF_4 solids filtered from the off-gas are combined with the UF_4 product stream for transfer to fluorination reactors.

2.1.2.1.10 Fluorination

The final chemical reaction in the conversion process is fluorination of UF_4 to UF_6 using F_2 gas. The gaseous F_2 is produced by decomposition of HF in electrolytic cells located in a building near the FMB. The fluorination reaction is accomplished at a temperature of approximately 900°F in a fluidized bed containing CaF_2 bed material. The bed material gradually becomes too fine and is continuously removed, along with residual uranium deposits, from the process, while fresh bed material is continuously added. Spent bed material may either be processed onsite or shipped offsite for uranium recovery. The reactor effluent gas stream containing the UF_6 product is passed through two filters in series and three cold traps in series. The UF_6 is condensed in the cold traps and transferred to the distillation area. Gases exiting the cold traps are scrubbed with KOH solution in series-arranged spray and packed towers. Potassium fluoride mud is removed from the scrubber solution, washed, and recycled to the uranium recovery system. The spent scrubber solution is transferred to the EPF for neutralization and recovery of KOH, and recovery of CaF_2. Filtered and scrubbed off-gases are released to the atmosphere.

2.1.2.1.11 Distillation and Product Packaging

Crude UF_6 from the still feed tanks is fed into a low boiler distillation column. The UF_6 that has been stripped of low-boiling impurities is then fed into a high boiler distillation column where high boiling impurities are eliminated. The product, which meets or exceeds ASTM C787 purity requirements, is condensed and packaged into approved product cylinders. Gaseous effluents from this process are fed back to fluorination and treated along with the fluorination off-gas. The purified product UF_6 vapor is condensed and transferred as liquid to cylinders placed on load cells. Flow totalizers are used to measure the amount of UF_6 transferred to the cylinder, and the UF_6 entering the cylinder is continuously sampled. On occasion, filled cylinders are heated in a steam chest for vaporization or sampling. After filling, cylinders are moved to cooling and storage areas.

2.1.2.1.12 Uranium Recovery

Fluorinator filter fines and beds material, solids from uranium settling ponds 3 and 4, and process liquids may be processed for uranium recovery. The uranium recovery system is a series of mixing, settling, and separation tanks in which uranium is precipitated. The settled or filtered uranium solids are dried and drummed to be recycled to ore preparation. The spent liquid is transferred to the EPF for neutralization and fluoride recovery.

2.1.2.1.13 Industrial Chemical Storage

Six primary industrial chemicals used or previously used in the conversion process—H_2SO_4, KOH, NaOH, NH3, liquid hydrogen, and HF—are stored onsite. The bounding and frequently actual quantities of these chemicals are presented in Table 2.1-1.

2.1.2.2 Waste Confinement and Effluent Controls

Gaseous, liquid, and solid wastes are produced at MTW. A description of each of these waste streams and their management is presented below.

2.1.2.2.1 Gaseous Waste Management

Gaseous effluents from the UF_6 production facilities contain both radioactive and non-radioactive constituents. Uranium processing areas that produce dusts, mists, or fumes containing uranium or other toxic materials are provided with dust collectors or scrubbers to reduce employee or environmental exposure to as low as reasonably achievable (ALARA) levels. All MTW emissions that may contain significant amounts of radioactive material are monitored continuously, as described in Subsection 2.1.2.3.1. Gaseous effluent streams containing non-radioactive pollutants are discharged in accordance with IEPA operating permits.

Based on the Title V CAA permit issued by the IEPA, MTW has 53 individual stacks and exhaust fans used for release of radioactive material and 14 emission units that potentially contribute to the release of nonradioactive material. These emission sources are primarily from the 105-foot FMB and are at various elevations. Four process stacks onsite are associated with the uranium recovery system and the drum dumping building. Significant air emission units and their emission control equipment are presented in Table 2.1-2. The discharge direction, height, flow, and estimated annual release of radioactivity for most stack or exhaust fan emission points are presented in Table 2.1-3. Uranium is the primary radiological constituent released through the stacks. Fluoride (as HF) and particulates are the primary non-radiological constituents released through the FMB stacks.

The ventilation system used in the UF_6 process area consists of a series of Dravo fresh air intake units and a series of window fans for ventilating workroom air. The total airflow through the process building is sufficient to ensure a complete air change-out approximately once every five minutes. A separate air-conditioning system is used to supply fresh air to the main control room. The control room is kept under a slight positive pressure.

MTW's non-radiological emissions from 2010–2014 are summarized in Table 2.1-4.

2.1.2.2.2 Liquid Waste Management

Liquid waste streams generated at MTW are categorized as radioactive and non-radioactive waste streams, and are either recycled within the process or released. Each waste stream is recycled or treated separately. A flow diagram showing liquid waste streams and their disposition is given in Figure 2.1-2.

2.1.2.2.3 Radioactive Liquid Waste Streams and Treatment

Radioactive liquid wastes produced at MTW consist of wash water from the drum dumping building, ammonium sulfate process solutions from the preparation process, HF scrubber liquors from the hydrofluorinators, KOH scrubbing solutions from air pollution abatement equipment, NaOH leach liquors from uranium recovery and UF_6 cylinder washing, and uranium-contaminated stormwater from the FMB area. The KOH scrubbing solutions are regenerated and recycled onsite, and solids removed from the scrubber solutions are processed for CaF_2 recovery.

Wash waters from the drum dumping building and ammonium sulfate solutions from the preparation process are routed to uranium settling tanks within the wet process or uranium settling ponds. Solids that have settled out in the tanks are routed to uranium recovery, while the liquids are routed to uranium settling ponds 3 and 4, where the pH is maintained slightly basic to minimize dissolved uranium loss. Effluent flow from the ponds averages about 25 gallons per minute and is mixed with other MTW effluents before discharge at NPDES Outfall 002. Sludge from the ponds is periodically removed to maintain at least two feet of freeboard. The sludge is drummed and then processed in the ponds' mud calciner to be dried and packaged into drums for uranium recovery through introduction back into ore prep or for disposal.

Wastewaters with significant quantities of fluoride (i.e., HF scrubbing liquors and uranium recovery leach liquors) are routed to the EPF for treatment. Honeywell has completed the modifications (identified in Section 1.1) that added the STF with high capacity clarifier and new sand filters. Solids from the EPF are routed to CaF_2 recovery and solids from this process, synthetic CaF_2, are shipped offsite to industrial users as a substitute for natural fluorspar. The liquid effluent from the EPF is in the normal operating range of 11–12 pH and is sent to CaF_2 Pond D. Prior to release to Outfall 002, the pH is adjusted with H_2SO_4 to a pH range of 6–9. This stream is combined with other MTW effluents before discharge at Outfall 002. Additional modifications are planned for the EPF in accordance with its renewed NPDES permit Special Condition 26 to provide enhanced treatment to comply with fluoride discharge limits that will go into effect in 2018 (IEPA 2015a). These pending modifications will allow greater fluoride removal from the waste stream and eliminate the need for CaF_2 Pond D, allowing the pond to be removed from service. Pond D, along with ponds B, C, and E, which were removed from service previously, will be closed in accordance with MTW's RCRA permit.

2.1.2.2.4 Mixed Liquid Waste Streams and Treatment

There are no mixed (RCRA hazardous and radioactive) waste streams discharged from the UF_6 manufacturing process. Mixed waste is generated by support activities such as maintenance and laboratory activities, and is further discussed in Section 3.12.

2.1.2.2.5 Non-Radiological Aqueous Waste Streams and Treatment

Non-radiological aqueous waste streams include sanitary wastewater, non-contact cooling water, treated effluents from the EPF, and stormwater runoff. Sanitary wastewater is treated in an anaerobic water treatment system for primary treatment of sanitary wastewater before discharge to Outfall 002.

2.1.2.2.6 Liquid Waste Discharges

MTW holds NPDES permit No. IL 0004421 and has three outfalls (Outfall 2, Outfall 003, and Outfall 005) that discharge to the Ohio River. The discharge from Outfall 002 is limited to non-contact cooling water, sanitary wastewater, laundry waters, condensate, water softener regenerate, laboratory wastes, process wastewaters excluding those from the liquid hydrofluoric acid electrolysis process, UF_6 pollution control wastes, emergency discharges and test waters generated from the fluorine release mitigation system, equipment wash water, and process area stormwater free from process and other wastewater discharges. Discharges from CaF_2 Pond D and the uranium settling ponds are monitored prior to co-mingling with other waste streams for flow, total suspended solids (TSS), and fluoride. Discharges from the sanitary wastewater treatment system are also monitored prior to co-mingling for flowrate, TSS, biological oxygen demand (BOD), and coliform. The waste streams are co-mingled and monitored prior to discharge through Outfall 002 (IEPA 2015a). Monitoring results reported monthly to IEPA are further discussed in Sections 3.4 and 4.4, and are summarized in Table 2.1-5.

Stormwater is discharged via Outfalls 003 and 005, which are visually monitored quarterly per the NPDES permit. MTW also complies with the IEPA requirement for maintaining and implementing a stormwater pollution prevention plan.

2.1.2.2.7 Solid Waste Management

Solid wastes generated at MTW include radioactive, RCRA hazardous, mixed, and non-radioactive, and non-RCRA hazardous wastes. A combination of recycling and offsite disposal are used in management of these wastes. See Section 3.12 for details on the treatment and disposal of these wastes.

2.1.2.3 <u>Monitoring Programs</u>

Monitoring programs at MTW are comprised of effluent monitoring, environmental media monitoring, groundwater monitoring, and worker exposure (occupational) monitoring. Effluent monitoring of air emissions and water discharges are designed for compliance with NRC effluent and dose limits, NDPES permit limits, and air permit limits. The environmental media monitoring involves quarterly and semiannual sampling of various media (air, surface water, soil, vegetation, and direct gamma radiation) at onsite and offsite monitoring locations for uranium and fluoride. Groundwater monitoring is conducted under routine and investigatory programs. The occupational monitoring program tracks workers' radiation exposure, establishes compliance with regulations, and allows development of mitigation measures, if necessary, to maintain exposure levels ALARA.

2.1.2.3.1 Gaseous Effluent Monitoring

Gaseous effluents released from MTW contain both radiological and non-radiological constituents as described in Subsection 2.1.2.2.1. Stack monitoring is the primary method used to measure gaseous effluents containing uranium. These release points are sampled continuously at isokinetic flow conditions using particulate filters to capture the uranium. Samples are collected once or twice every 24 hours, depending on the radioactivity potential of the collection point, and counted for alpha radioactivity. If a stack release sample exceeds the administrative control level, the cause is investigated and actions are taken to decrease emissions. If three successive samples exceed an established investigation level, further actions are taken to decrease emissions, up to and including shutdown of the unit. Results for the gaseous effluent radiological monitoring from 2010–2014 are summarized in Table 2.1-3.

Gaseous emissions are also measured at the restricted area fence line and adjacent to the nearest residence. This sampling is further discussed under environmental monitoring.

Gaseous as well as liquid effluent monitoring results are reviewed weekly by the MTW Health Physics Department. The environmental information is utilized to perform trend analysis. Undesirable trends are reported to management via ALARA meetings, audits, or immediately, depending on the severity of the condition.

2.1.2.3.2 Liquid Effluent Monitoring

Compliance with NDPES effluent release limits and water quality criteria is determined by sampling the MTW effluent discharge and the Ohio River, which is the receiving stream for MTW effluents as discussed in Subsection 2.1.2.2 and in more detail in Sections 3.4 and 4.4.

In addition to the NDPES permit monitoring requirements, the main MTW effluent is continuously sampled and a daily composite is analyzed for uranium content. The daily samples are combined into a monthly composite sample, which is analyzed for uranium. Quarterly composites of the monthly samples are analyzed by a vendor laboratory for Radium-226 (Ra-226) and Thorium-230 (Th-230). Undesirable trends are reported to MTW management via ALARA meetings, audits, or immediately, depending on the severity of the condition. Appropriate information from the monitoring program is also utilized to prepare the semi-annual effluent report required by NRC regulations.

2.1.2.3.3 Environmental Monitoring Program

MTW conducts an environmental monitoring program that samples sediment, soil, vegetation, surface water, air, and measures direct gamma radiation at locations on or near the facility. The locations of sampling points are shown in Figure 2.1-3 and Figure 2.1-4. The frequency of sampling and the constituents sampled as part of this program are summarized in Table 2.1-6. Results from the radiological environmental monitoring program are reviewed by the MTW Health Physics Department. Management is made aware of undesirable trends and results that may indicate non-compliance with applicable standards. Elements of the environmental monitoring program are described in the following paragraphs.

2.1.2.3.4 Air Monitoring

The environmental air monitoring program consists of taking continuous air samples (low volume) at four points along the restricted area fence line (Stations No. 9, 10, 12, and 13). Two more samplers are located in the prevailing wind direction (Stations No. 8 and 11), and another sampler is located offsite approximately one mile downwind of the FMB (Station No. 6). An additional continuous air sampler is located at the nearest downwind residence (Station NR-7). The sample locations are further described below and depicted on Figure 2.1-3 (Distance from the FMB).

- No. 6 – 5,300 feet NNE (Metropolis Municipal Airport)
- No. 8 – 1,020 feet NE of FMB
- No. 9 – 800 feet NNW of FMB
- No. 10 – 950 feet SW of FMB
- No. 11 – 1,240 feet N of FMB
- No. 12 – 900 feet SSE of FMB
- No. 13 – 750 feet NE of FMB
- NR-7 – 1,765 feet N of FMB

Each low-volume (No. 6, 8, 9, 10, 11, 12, and 13) sample filter is changed weekly and analyzed for uranium and fluoride content. MTW's environmental sample collection procedure, MTW-SOP-HP-0209, sets the investigation limit for uranium results of the fence line sampling points at 2.0×10^{-14} µCi/ml for the average of four continuous samples. The limit for fluoride is 0.82 micrograms per cubic meter (µg/m^3) as a maximum one-month average, based on the State of Kentucky air quality standard. The NR-7 sample is also collected weekly. Additionally, a quarterly composite of the 13 weekly samples is sent to a vendor analytical laboratory for Ra-226 and Th-230 analysis. The applicable NRC license limit for the sum of uranium, Ra-226, and Th-230 at NR-7 is a quarterly average concentration of 3.0×10^{-14} µCi/ml.

Table 2.1-7 summarizes the results of the environmental air monitoring for 2010–2014 for uranium, Ra-226, Th-230, and fluoride. The results of the gaseous uranium emissions data from NR-7 are summarized in Table 2.1-8. Air quality and the results of air monitoring are further discussed in Section 4.6. MTW currently uses the CAP-88 dose modeling software issued by the EPA to calculate the dose to the public for purposes of demonstrating compliance with 40 CFR 190 (Honeywell 2013a).

2.1.2.3.5 Surface Water and Sediment Monitoring

Surface water and sediment samples are analyzed for uranium and fluoride. Seven surface water and sediment samples are collected semiannually at locations shown on Figure 2.1-4. Four locations are on the Ohio River: one sample is taken upstream and one downstream of the plant outflow, one at the point of outflow into the river, and a fourth from a location on the opposite side of the river (Figure 2.1-4). Three inland locations at lakes and ponds (see Figure 2.1-4) are also sampled. Table 2.1-9 summarizes the average annual concentrations of uranium and fluoride at the plant outflow and in offsite surface water samples for 2010–2014. In addition to the sediment sampling locations identified above, MTW collects sediment samples semiannually from the effluent ditch that conveys the plant wastewater. The ditch sediment is sampled for uranium and fluoride at 700 feet and 1,400 feet from the plant. Table 2.1-10 summarizes the average annual concentrations of uranium and fluoride from sediment samples taken from 2010–2014. Monitoring results and water quality impacts are further discussed in Section 4.4.

2.1.2.3.6 Soil and Vegetation Monitoring

Fourteen soil and vegetation samples are collected semiannually. Seven sample locations correspond with the location of the air samplers (Figure 2.1-3). Soil samples are taken within 100 feet of the air sampler, and vegetation samples are taken from the newest growth up to an elevation of four feet, which is representative of what a grazing animal might eat in close proximity of the air sampler. Seven sample locations are within an 8-mile radius covering portions of Illinois and Kentucky (Figure 2.1-4). Soil and vegetation samples analyzed for uranium and fluoride onsite for 2010–2014 are summarized in Tables 2.1-11 and 2.1-12. Soil and vegetation monitoring is further discussed in Section 3.11.

2.1.2.3.7 External Gamma Monitoring

Direct radiation is continuously monitored using environmental dosimeters at nine locations. The environmental dosimeters are located on the restricted area fence line on each side of the plant (total of four), at the nearest MTW site boundary, at the Metropolis Municipal Airport (1.6 kilometers northeast of the plant), and two at the nearest residence (NR-7 South and NR-7A North). A ninth dosimeter is a control measurement. The environmental dosimeter badges are analyzed and replaced every quarter. The 2010–2014 results of gamma monitoring at MTW are presented in Table 2.1-13.

2.1.2.3.8 Groundwater Monitoring

MTW has three groundwater monitoring programs: one monitoring the sanitary well and process well #3 for compliance with drinking water standards; a second required by the RCRA permit for CaF_2 ponds B, C, D, and E for routine compliance monitoring to detect any leaks and migration from the ponds; and a third monitoring an inactive landfill located beyond the restricted area. The numerous groundwater wells and monitoring wells are depicted on Figure 2.1-5. These groundwater monitoring programs are further discussed in Sections 3.4 and 4.4.

- *Drinking water monitoring*. The sanitary well and process well # 3 are monitored for inorganic constituents, volatile organic compounds, radionuclides, and general parameters including pH, turbidity, chlorine, total coliform, and fecal coliform (see Subsection 3.4.8.1 for additional information).

- *RCRA (Part B) groundwater compliance monitoring network.* Routine compliance monitoring to detect any leaks and migration from the CaF_2 ponds consists of two upgradient and seven downgradient wells, sampled and analyzed quarterly for pH, specific conductance, fluoride, gross alpha and gross beta. A tenth well is used for groundwater surface elevation determination only (ENERCON 2010).
- *Landfill monitoring network.* Eight wells are sampled and analyzed quarterly for pH, specific conductance, other environmental constituents, gross alpha, gross beta, Ra-226, and Radium-228 (ENERCON 2010).

2.1.2.3.9 Occupational Monitoring Program

Honeywell implements an external dosimetry program. Individuals who enter an area where occupational external exposures are likely to exceed 10 percent of the applicable dose limits as established in Subpart C of 10 CFR 20 are issued a personal dosimeter.

Honeywell uses a commercial service accredited by the National Voluntary Laboratory Accreditation Program to process personal dosimeters on at least a quarterly basis. Honeywell also conducts routine gamma radiation surveys consistent with the guidance provided in Section 2.4 of NRC Regulatory Guide 8.30, e.g., quarterly within known radiation areas and semi-annually in other areas where radioactive materials are used, processed, or stored. The results of these surveys are used to identify areas requiring posting, changes in radiological conditions, and areas where personnel dosimeters may be required. Radiation survey results are also used as input to the ALARA program.

Honeywell conducts investigative beta-gamma instrument surveys when a process or procedural change is made that could result in a significant increase in employee exposure. Exposure rates and occupancy factors are appropriately utilized to determine if additional precautions are needed. Additionally, each time a radioactive material vessel is entered for inspection or repairs (confined space entry), a radiation survey is conducted by the MTW Health Physics Department and appropriate employee protection is specified utilizing time, distance, and shielding considerations. Workers who are likely to receive an intake exceeding 10 percent of the applicable adjusted annual limits on intake values derived from dose coefficients found within International Commission on Radiation Protection (ICRP) 68 are enrolled in a bioassay program providing routine and special urinalysis. For purposes of practicality, the routine bioassay program typically includes all individuals who routinely access areas where unsealed quantities of uranium are used or processed.

MTW also has a work area air sampling program that supports its respiratory protection program. Under this program, areas where radioactive materials are handled or processed are monitored when operations could expose workers, without credit for respiratory protection, to the inhalation of quantities of radioactive material exceeding 10 percent of a derived air concentration.

2.1.3 Mitigating Measures

Releases of radiological or non-radiological constituents to the air, water, and soil create an environmental impact. MTW has special processes to minimize the environmental impact associated with plant operations. Settling ponds are used to remove uranium from the effluent streams to reduce the volume of these constituents released to the Ohio River. Fluorides are chemically bound as residual solids in the EPF. The solids, which include both fluorides and uranium, are settled out in CaF_2 Pond D, and in the future will be treated with enhanced removal processes in the EPF prior to release of the effluent through Outfall 002 to the Ohio River. All surface impoundments will be closed in accordance with the RCRA permit.

To reduce gaseous emissions that could contain significant quantities of uranium or hazardous chemicals, dust collectors and scrubbers are typically operated in series. Each emission source is operated in accordance with an operating permit issued by the IEPA. In addition to the engineering control measures such as scrubbers, air filters, and waste treatment systems, MTW has set action levels for the effluent monitoring program. Exceeding an action level triggers an investigation into the cause of the exceedance and may trigger corrective actions that could include shutdown. Approaches used in reduction of contaminant sources include equipment repair, cleaning, modification, replacement, and addition of effluent control equipment. Approaches used in contaminant removal include excavation of soil and disposal in permitted offsite facilities.

2.1.4 Decontamination and Decommissioning

Prior to termination of license SUB-526, Honeywell will decommission MTW to provide for restoration of the environment and public health and safety. The overall objective of the decommissioning is to remediate MTW to an unrestricted use condition that corresponds to a calculated dose to the public that is less than 25 mrem/yr from applicable pathways. The former MTW property can then be used without any restrictions. The 25 mrem/yr dose limit is codified at 10 CFR 20.1402, "Radiological Criteria for Unrestricted Use."

Following completion of decontamination activities, a comprehensive radiological survey will be completed and a report documenting cleanup to the target levels will be produced. The complete decontamination activities and final survey will be reviewed and verified by the NRC before termination of the license.

2.1.5 Reasonable Alternatives

As discussed in Subsection 2.1.1, no other alternatives were considered reasonable.

2.2 Alternatives Considered but Eliminated

Given the need to maintain domestic production of UF_6 for its critical role in nuclear fuel production as discussed in Subsection 2.1.1, another alternative could be the transfer of conversion activities to a new area, greenfield or brownfield, located within the United States. However, the time needed to re-locate, obtain necessary permits and licenses, and construct such a plant would mean such a plant would not be operational prior to the expiration of the MTW license. Furthermore, construction impacts from a new production facility, whether utilizing a greenfield or brownfield, would be expected to be similar to other large industrial construction projects, resulting from construction activities such as land clearing, waste generation from remediation activities, emissions and noise from construction equipment, potential degradation of ecological habitat, etc. Construction impacts would not occur under the proposed action of operating license renewal, and operational impacts of a new facility would be similar to those described in Chapter 4 for the license renewal alternative. Because establishment of a new facility would result in a lapse in domestic production and additional environmental impacts from its construction, the transfer of the conversion of uranium ore to UF_6 to a new U.S.-based plant was not considered a reasonable alternative.

The demand for enriched uranium could be met by means other than the enrichment of domestically produced UF_6. Other means of meeting the demand for enriched uranium include importation of low-enriched uranium, down-blending highly-enriched uranium held by the DOE, and enrichment of U.S. supplies of high-assay depleted UF_6 (DOE 2015a). Both down-blending of highly enriched uranium and purchase of low-enriched uranium from foreign sources were not considered reasonable alternatives for uranium enrichment supplies in the NRC's environmental impact statement (EIS) for the Global Laser Enrichment facility in Wilmington, North Carolina (NRC 2012a). Although enrichment of high-assay depleted uranium (DOE 2015a) has been undertaken and the NRC acknowledged beneficial uses of depleted uranium including its re-enrichment, the NRC did not consider this an alternative to the conversion of depleted UF_6 (DUF_6) in its EIS for the depleted uranium deconversion plant in Lea County, New Mexico (NRC 2012b).

2.3 Cumulative Effects

Cumulative impacts are those impacts from past, present, and reasonably foreseeable projects or activities that could be additive to environmental impacts from MTW operations. Honeywell reviewed information on past, present, and reasonably foreseeable future projects and actions that could result in impacts over the same period and in the same general location as MTW. Past activities include uranium enrichment at the DOE's Paducah Gaseous Diffusion Plant (PGDP) across the Ohio River from MTW. Present and continuing activities include the operation of two nearby coal burning power plants, two coal barge terminals, and decommissioning activities at PGDP.

Honeywell conducted online research to identify reasonably foreseeable industrial development and other land use changes that could potentially occur near MTW. MTW is located in Massac County, which does not have land use zoning or an economic development office. The land parcel that MTW is located within is owned by Honeywell International Inc. Metropolis lies to the east of MTW, with the closest city limit approximately one-half mile from MTW. Metropolis utilizes zoning and mapped zoning districts to control land use. There are few industrial parcels on the western side of the city and the industrial park with availability is located on eastern side adjacent to I-24 (Metropolis 2016). Most of the land to the west of Metropolis within approximately two miles of MTW that is not owned by Honeywell is owned by American Electric Power Company (AEP) and supports coal operations (Massac County 2016). There are some land parcels located outside the Metropolis city limits but within the city's extra-territorial jurisdiction that are zoned residential (Metropolis 2016). The Ohio River and McCracken County, Kentucky, lie to the south of MTW; activities in McCracken County are discussed below. Current land ownership patterns and zoning districts indicate that developments leading to cumulative impacts are unlikely at this time. MTW conducts environmental monitoring in the surrounding area as discussed in Subsection 2.1.2.3, and the monitoring program will continue during the renewed license term. Analyses of the air, water, soil, and vegetation samples would detect any increasing trends in monitored parameters potentially indicating cumulative impacts.

McCracken County has industrial development properties and is part of the western Kentucky economic development partnership. Two of these properties are in close proximity of MTW: the Ohio River Triple Rail Megasite and the West KY Chemical Site (KCED 2016a). PGDP also has a Global Laser Enrichment facility pending (WNA 2016). When operational, this facility would process radioactive materials and have radioactive emissions.

An additional initiative in Kentucky is the elimination of the state's moratorium on nuclear power plants. Legislation passed Kentucky's senate and was sent to the House for consideration (Kentucky Legislature 2016). The PGDP site is seen as a potential location for a nuclear power plant (Paducah Sun 2016).

The research discussed above indicates that reasonably foreseeable projects include the Ohio River Triple Rail Megasite, the Global Laser Enrichment facility at PGDP, and the siting of a nuclear power plant at the PGDP site. These projects are further discussed below.

Activities considered for cumulative analysis include those occurring near MTW that could be added to MTW impacts, resulting in cumulative impacts. Because of their air emissions and radiological releases, activities that could contribute to existing or future impacts on MTW include continued operation of the Tennessee Valley Authority's (TVA's) Shawnee Fossil Plant, and the Joppa, Illinois, coal power plant, which are nearby industrial facilities whose operations result in air emissions that could be cumulative with those of MTW. The PGDP is in a shutdown status and is undergoing remediation and decommissioning of the facility; however, the plant has air emissions and radiological air, water, and direct radiation effluents, and also ships radioactive waste offsite.

2.3.1.1.1 Tennessee Valley Authority Shawnee Fossil Plant

The Shawnee Fossil Plant is located across from the MTW discharge point on the Ohio River (Figure 2.1-4). Shawnee has nine active coal-fired units with a total summer net generating capability of 1,206 megawatts (MW) (TVA 2016). Refer to Table 2.3-1 for a summary of 2014 air emissions from the Shawnee Fossil Plant.

2.3.1.1.2 Electric Energy, Inc. Joppa Generating Station

Electric Energy, Inc. (EEI) Joppa Generating Station, located in Joppa, Illinois, generates 802 MW of electric capacity at its coal-fired power plant, and 221 MW at its natural gas-fired facility at the same location (Dynegy 2015). The plant is on the Ohio River approximately six miles downstream from MTW. Refer to Table 2.3-1 for a summary of 2014 air emissions from the EEI plant.

2.3.1.1.3 DOE Paducah Gaseous Diffusion Plant

Located across the Ohio River and approximately four miles south of MTW, PGDP enriched uranium from 1952 to 2013 (DOE 2015b), and is now undergoing remediation planned to extend to 2040 (NCSL 2016). With uranium enrichment activities having ended, the DOE is focusing its resources and efforts at PGDP on its mission of environmental management, decontamination and decommissioning, and maintenance of remaining facilities in a safe and regulatory compliant manner. The DOE also plans to reduce the size of the site by transfer of the real property to one or more entities, but has excluded some areas from consideration for transfer, including waste burial grounds or permitted landfills, lands and supporting structures for the DUF_6 facility, and any areas that contain waste governed by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. The DUF_6 facility involves the conversion of approximately 42,000 cylinders of DUF_6 into a more stable form (an oxide) for beneficial reuse or disposal. (DOE 2015b) The operation utilizes a one-step fluidized bed process to convert DUF_6 to uranium oxide powder that is collected and packaged for reuse or disposal. This is accomplished by reacting DUF_6 gas with steam, nitrogen, and hydrogen that produces hydrofluoric acid as a saleable end product, and uranium oxide powder. (DOE 2014)

The DUF_6 conversion facility operates under a Kentucky Department of Environmental Protection air permit and has two emission points preceded by air scrubber systems. Additional sources of emissions in 2013 were two contaminated groundwater treatment systems that remove trichloroethene contamination from the groundwater by air stripping. Additional water emission sources from PGDP include wastewater treatment facilities, leachate treatment, and stormwater runoff, which are discharged to Bayou and Little Bayou Creeks through NPDES-permitted outfalls. (DOE 2014)

DOE also has an environmental monitoring program for radiation. Using emission monitoring results and annual sampling of environmental media, DOE estimates the dose to the maximally exposed individual. In 2013, the last year of enrichment operations, the worst-case combined (internal and external) dose to an individual member of the public was calculated at 0.44 mrem. This level is well below the DOE annual dose limit of 100 mrem/yr to members of the public and below the EPA limit of 10 mrem airborne dose to the public from DOE facilities (40 CFR 61.92). (DOE 2014)

DOE selected a representative industrial project to evaluate resource impacts and the potential consequences of a potential industrial reuse of the PGDP property. New industry that located in the area of land transfer would be likely to have similar types of air emissions and be minor contributors as existing air permit holders. The overall impact on air quality from industrial facilities would be minimal because new major emitters would require Kentucky air permits that would limit and control emissions and potential impacts to air quality. (DOE 2015b)

2.3.1.1.4 Future Activities

The Ohio River Triple Rail Megasite is a planned transportation infrastructure site on the Kentucky side of the river between the Shawnee Fossil Plant and PGDP. The site has 670 acres available for development (KCED 2016a). No companies have proposed to build facilities at the Ohio River Triple Rail Megasite at this time (DOE 2015b). The West KY Chemical Site has 201 acres for development (KCED 2016a). While the West KY Chemical Site is available for development, no chemical company locations or expansions in McCracken County were identified in the current report for economic development in the chemical industry sector (KCED 2016b). Industrial use of this real property could result in increased air emissions. Future users would have to obtain all applicable environmental permits, including air emission permits, so impacts to air quality would be minimized.

In 2013, the DOE selected the Global Laser Enrichment facility proposal for licensing, constructing, and operating a new laser enrichment facility at PGDP for disposition of its depleted uranium hexafluoride inventory. The estimated capacity of this facility is 0.5 to 1.0 million separative work units per year (SWU/yr). Negotiations between the DOE and Global Laser Enrichment continued in 2016 (WNA 2016). This capacity is much less than the six million SWU/yr maximum capacity for the laser enrichment facility licensed for operation in Wilmington, NC. The NRC prepared an EIS for the PGDP facility and estimated uranium and HF stack emissions and dose. The maximum uranium concentration is estimated to be 1.9 $\times 10^{-7}$ µg/m^3 and an annual effective dose of 3.2 $\times 10^{-5}$ mrem for an onsite member of the public. HF concentrations were far below the most stringent state or federal ambient air quality standards for the general public with the maximum HF concentration estimated to be 3.7 $\times 10^{-4}$ µg/m^3. (NRC 2012a) The PGDP facility would be approximately one-sixth the size of the Wilmington facility and located approximately four miles from MTW. Cumulative impacts would be negligible.

If the moratorium on nuclear power plants in Kentucky is lifted and a nuclear power plant is constructed at or near the PGDP site, that plant's operation would result in some public dose. However, the NRC's experience in regulating nuclear power plants indicates that during normal operations, nuclear power plants typically release only a small fraction of the radiation allowed by the NRC's established limits. With the potential nuclear power plant located approximately four miles away and with typical release rates, cumulative radiological impacts would be negligible.

2.3.1.1.5 Summary

The influence of past and present activities and their emissions along with MTW operations are captured in MTW's environmental monitoring program. The program is designed to ensure that MTW's environmental controls are effective, but the samples would include contributions from other nearby industrial sites if their emissions reached the sample locations. As for future activities, any future industries would operate under air and water permits and, in case of a nuclear materials facility or nuclear power plant, under NRC regulations and radiological emissions standards. The permits and emission limits would be designed to be protective of the environment and human health. Along with the continued operation of MTW in compliance with its permits and licenses, no significant cumulative impacts are expected. Cumulative impacts for environmental resources are discussed in Chapter 4.

2.4 Comparison of the Predicted Environmental Impacts

No impacts attributed to the continued operation of MTW have been identified that differ from the historical operational impacts; thus the proposed action would continue the following impacts.

- Radiological exposure to the offsite population would be well below the maximum NRC dose limit of 100 mrem/yr to the offsite maximally exposed individual (MEI) and below the limit of 25 mrem/yr specified in 40 CFR 190 for uranium fuel cycle facilities. Annual individual doses to involved workers would be monitored to maintain exposure below the regulatory limit of five rem per year.
- Continued operation of MTW would likely continue the trend of increased uranium deposition in soils and sediments both onsite and offsite in the immediate vicinity of the plant.
- Continued non-radiological air and water effluents within permitted limits.
- Continued positive, generally small socioeconomic impacts.

The alternative of no license renewal for MTW implies cessation of conversion and manufacturing of UF_6 and commencement of decontamination and decommissioning of the UF_6 production facilities. Under the no-action alternative, releases of materials associated with UF_6 production, primarily uranium would be expected to decrease over time to background levels.

MTW is the only facility operating in the United States that manufactures UF_6, a feedstock for uranium enrichment used in the production of nuclear fuel. Feedstock for uranium enrichment would have to be supplied from international sources, or from the limited opportunities of down-blending DOE stockpiles of high-enriched uranium, or de-conversion of high-assay DUF_6. Operation of an international facility would be expected to be similar to those described in Section 4 for the license renewal alternative.

Table 2.1-1
Bounding Quantities of Industrial Chemicals Used in the Conversion Process at MTW

Chemical	Maximum Storage Quantity (pounds)
29% Aqueous Ammonia (NH3)	99,461[a]
Anhydrous Hydrofluoric Acid (HF)	2,400,000[b]
45% Potassium Hydroxide (KOH)	390,850[c]
20% Sodium Hydroxide (NaOH)	164,592[d]
93% Sulfuric Acid (H2SO4)	132,145[e]
Liquid Hydrogen	9,219

(MTW 2016a)

a. 95% vol. in U-467
b. Up to seven (7) 80-ton railroad cars inside of fence; Up to eight (8) 80-ton railcars outside of fence
c. 230,850 (95% vol. in U-436) + one (1) 80-ton railcar inside of fence
d. 95% vol. in U-28
e. 95% vol. in U-440,U-852, and U-921

Table 2.1-2
Significant Air Emission Units and Emission Control Equipment

Emission Unit	Description	Emission Control Equipment
Unit 01	UF_6 manufacturing process emission, unit 1	Dust collectors
Unit 02	Fluorine plant: 5 kA, 6kA, 15kA cells (includes additional 15 kA cells and melt reactor)	Hydrogen gas scrubbers, fluorine scrubbers, maintenance booth scrubber, melt scrubber
Unit 03	Out of service	
Unit 04	Out of service	
Unit 05	Out of service	
Unit 06	Ponds mud calciner with dryer, maximum heat input 3 million British thermal units per hour (Btu/hr)	Secondary baghouse (F182) and baghouse system (F181)
Unit 07	Calcium fluoride cage–mill flash dryer (maximum heat input 4 million Btu/hr)	Dust collector
Unit 08	Lime silo (acid neutralization base regeneration)	Dust collector
Unit 09	Sandblasting recovery	Dust collector and blower
Unit 10	Waste gas incinerator	None
Unit 11	Out of service	
Unit 12	Natural gas fired boilers 1, 2, and 3; (distillate oil backup) maximum heat input capacity 18 million Btu/hr	None
Unit 13	Out of service	Scrubber
Unit 14	Fugitive emissions from exhaust fans	None

(IEPA 2003)

Table 2.1-3
Discharge Direction, Stack Height, Flow, and Annual Uranium Emissions, 2010–2014 (Sheet 1 of 3)

Stack No.	Description	Discharge Direction	Height (meters)	Flow (m^3/min)[(a)]	Uranium Emissions (curies/year)				
					2010	2011	2012	2013	2014
1-1	Wet oxide dust collector	V	30	143	1.33E-02	1.53E-03	2.48E-03	1.44E-03	6.09E-04
1-2	Dry oxide dust collector	H	32	75	8.98E-04	3.48E-04	9.34E-04	5.19E-04	9.98E-04
1-3	Decon area and retox screen	V	12	122	2.08E-04	7.37E-05	2.91E-05	3.14E-05	8.06E-05
1-4	Oxide vacuum cleaner	H	30	12	2.17E-05	7.61E-05	1.57E-05	1.56E-05	6.61E-05
1-7	UF_4 vacuum cleaner	H	4	21	2.41E-04	4.73E-05	7.61E-05	5.91E-05	1.49E-04
1-10	"B" UF_4, dust collector	V	30	12	3.34E-04	5.03E-04	3.82E-05	4.10E-05	6.05E-04
1-11	Dust collector for secondary DC	V	12	167	8.48E-06	3.89E-06	6.21E-04	4.46E-03	4.48E-03
1-12	Ash vacuum cleaner	H	26	73	4.22E-05	2.04E-03	7.03E-05	3.81E-05	7.40E-05
1-12	Ash dust collector	H	26	73	5.99E-04	6.26E-04	4.02E-05	3.37E-04	3.44E-03
1-13	"A" fluorination coke box	V	32	5	1.10E-02	4.30E-03	1.77E-03	9.41E-03	8.38E-02
1-14	"B" fluorination coke box	V	32	5	3.38E-03	2.15E-03	6.41E-04	1.35E-02	9.59E-02
1-46	"A" UF_4 dust collector	V	30	30	4.75E-05	5.89E-05	1.27E-04	4.36E-05	5.75E-05
1-48	Hydrogen sulfide incinerator stack	V	47	184	2.23E-04	1.71E-04	7.11E-05	7.25E-05	1.37E-04
1-49	Distillation multi-floor exhaust	H	27	651	1.53E-03	2.05E-03	1.16E-03	7.59E-04	1.42E-03
1-54	Drum invertor dust collector	V	6	436	4.46E-03	6.78E-04	2.21E-03	6.31E-04	8.92E-04
3-2	U-recovery dust collector	V	12	13	8.93E-05	5.32E-05	3.95E-05	3.92E-05	5.14E-05
4-2	Pond mud calciner	V	9	93	9.70E-05	6.27E-05	5.04E-04	2.69E-04	7.57E-05
17-1	Sampling plant dust collector	V	7	214	5.77E-04	1.78E-04	2.25E-04	3.90E-04	9.00E-04
17-2	Sampling plant vacuum cleaner	H	4	14	3.50E-05	4.89E-04	6.84E-04	8.21E-04	1.54E-03
1-15	"A" reductor blower	H	23	28	1.42E-04	1.95E-04	4.40E-05	4.43E-05	9.83E-05
1-16	"B" reductor blower	H	23	28	1.03E-03	5.98E-04	1.95E-04	3.82E-04	4.07E-04
1-17	"A" top hydrofluorinator blower	H	14	188	0.00E+00	1.48E-05	0.00E+00	2.81E-05	2.08E-05

Table 2.1-3
Discharge Direction, Stack Height, Flow, and Annual Uranium Emissions, 2010–2014 (Sheet 2 of 3)

Stack No.	Description	Discharge Direction	Height (meters)	Flow (m^3/min)[a]	Uranium Emissions (curies/year)				
					2010	2011	2012	2013	2014
1-18	"A" bottom hydrofluorinator blower	H	4	188	1.40E-05	2.85E-06	1.25E-06	3.10E-04	5.64E-04
1-19	"B" top hydrofluorinator blower	H	12	28	1.28E-03	1.79E-03	1.66E-04	1.36E-03	4.50E-03
1-20	"B" bottom hydrofluorinator blower	H	14	28	2.84E-03	9.54E-04	7.82E-05	3.48E-05	7.85E-05
1-21	"A" fluorinator blower	H	9	120	1.05E-03	1.38E-04	5.96E-05	6.51E-05	9.84E-05
1-22	"B" fluorinator blower	H	9	120	8.19E-04	2.74E-04	2.42E-04	6.27E-05	1.08E-04
1-26	Ore prep multifloor exhaust	V	18	400	5.77E-06	2.24E-05	1.64E-05	8.40E-06	2.18E-05
1-27	Exhaust fan first floor south	H	5	651	8.01E-04	2.91E-03	1.01E-03	1.10E-03	6.53E-04
1-28	Exhaust fan first floor west	H	5	651	0.00E+00	1.23E-03	2.94E-03	2.63E-03	5.88E-03
1-29	Exhaust fan second floor south	H	9	651	6.00E-03	6.03E-03	7.61E-04	3.21E-03	6.31E-03
1-30	Exhaust fan third floor south	H	14	651	4.14E-03	5.41E-03	2.70E-03	2.41E-03	5.10E-03
1-31	Exhaust fan third floor west	H	14	651	2.96E-05	6.24E-03	2.31E-03	2.70E-03	4.89E-03
1-32	Exhaust fan third floor south	H	14	651	3.05E-03	4.27E-03	1.58E-03	2.39E-03	4.59E-03
1-33	Exhaust fan third floor north	H	14	651	4.76E-05	4.94E-05	2.64E-05	2.91E-05	4.65E-05
1-34	Exhaust fan fourth floor south	H	18	651	3.80E-03	3.69E-03	2.53E-04	0.00E+00	5.76E-05
1-35	Exhaust fan fourth floor west	H	18	651	3.68E-03	3.44E-03	1.26E-03	1.30E-03	3.65E-03
1-36	Exhaust fan fourth floor south	H	18	651	4.17E-03	5.24E-03	1.77E-03	1.30E-03	3.09E-03
1-37	Exhaust fan fifth floor south	H	23	651	2.02E-03	3.08E-03	5.97E-04	7.62E-04	1.52E-03
1-38	Exhaust fan fifth floor south	H	23	651	2.41E-03	2.92E-03	1.41E-03	9.91E-04	2.90E-03
1-39	Exhaust fan fifth floor south	H	23	651	0.00E+00	2.18E-05	4.77E-06	0.00E+00	5.10E-05
1-41	Exhaust fan sixth floor west #2	V	27	708	1.85E-03	2.38E-03	1.62E-03	9.99E-04	3.08E-03
1-42	Exhaust fan sixth floor west #3	V	27	708	2.28E-03	2.76E-03	1.62E-03	1.24E-03	3.69E-03

Table 2.1-3
Discharge Direction, Stack Height, Flow, and Annual Uranium Emissions, 2010–2014 (Sheet 3 of 3)

Stack No.	Description	Discharge Direction	Height (meters)	Flow (m^3/min)[(a)]	Uranium Emissions (curies/year)				
					2010	2011	2012	2013	2014
1-43	Exhaust fan sixth floor south	V	27	708	2.25E-03	3.04E-03	1.73E-03	1.17E-03	3.69E-03
1-45	NH_3 vent	V	18	356	2.28E-03	2.88E-03	1.87E-03	1.41E-03	2.38E-03
1-47	"C" fluorinator blower	H	9	120	3.21E-04	5.82E-06	0.00E+00	0.00E+00	0.00E+00
1-50	"A" reductor off-gas	H	20	21	4.37E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1-51	"B" reductor off-gas	H	20	34	1.04E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1-55	Exhaust fan third floor north	H	14	242	4.20E-05	1.31E-03	1.02E-03	4.33E-04	1.31E-03
1-56	Exhaust fan distillation first floor north	H	7	747	1.53E-04	7.76E-04	5.72E-04	1.06E-06	1.69E-05
1-57	Exhaust fan first floor south	H	3	149	8.55E-05	1.87E-05	4.72E-06	1.81E-06	1.84E-06
1-58	Exhaust fan third floor east	H	29	651	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-04
Hard ore shredder dust collector		H	7	138	0.00E+00	7.96E-04	9.47E-03	1.01E-04	1.02E-03
Total Ventilation Emissions					**8.36E-02**	**7.79E-02**	**4.71E-02**	**5.94E-02**	**2.55E-01**

a. Cubic meters per minute.

Table 2.1-4
Non-radiological Air Emissions in Tons, 2010–2014

Air Emissions	2010	2011	2012	2013	2014
Carbon monoxide	11.63	15.26	5.98	3.89	16.15
Carbon dioxide	Not reported	18,700.60	7,545.14	4,913.37	20,381.58
HF	1.91	2.62	1.24	1.55	4.62
Lead	6.09E-05	6.64E-05	3.21E-05	2.31E-05	6.85E-05
Methane	Not reported	0.35	0.14	0.09	0.38
Nitrous oxide (N_2O)	Not reported	0.04	0.01	0.01	0.04
Nitrogen oxides (NO_x)	13.85	18.16	7.11	4.63	19.22
Particulates	5.54	6.46	2.81	3.27	8.74
PM_{10}[a]	5.54	6.46	2.81	3.27	8.74
$PM_{2.5}$[b]	5.54	6.46	2.81	3.27	8.74
Sulfur dioxide (SO_2)	320.71	350.59	163.04	58.67	143.31
Volatile organic matter (VOM)	1.04	1.27	0.62	0.47	1.27

(IEPA 2015b)

a. Particulate matter less than 10 micrometers in diameter.

b. Particulate matter less than 2.5 micrometers in diameter.

Table 2.1-5
Summary of Outfall 002 Monitoring

Parameter	Units	2010		2011		2012		2013		2014	
		Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.
Flow rate	MGD[a]	6.53	3.51	6.03	3.00	3.92	1.92	7.04	2.22	4.13	2.87
Uranium	mg/L[b]	25.384	1.75	25.850	1.32	13.731	1.02	9.962	0.84	17.101	1.15
pH[c]		7.74	7.47	7.49	7.17	6.26	6.61	7.72	7.03	7.67	7.11
Temperature	°C	[d]	[d]	24.2	20.34	24.8	20.54	22.00	18.28	21.90	19.73
Total fluorides	mg/L[b]	6.38	3.28	6.02	3.12	9.08	3.06	15.27	3.96	13.39	4.98
TSS	mg/L[b]	6.35	3.49	7.75	3.55	7.69	4.63	63.60	11.17	2.75	1.65
BOD	mg/L[b]	19.00	5.70	16.50	4.65	21.00	7.73	13.20	5.49	25.00	7.79

a. Millions of gallons per day.

b. Milligrams per liter.

c. Maximum deviation from pH of 7.

d. This parameter in this location not monitored until 2011.

Table 2.1-6
Summary of Effluent and Environmental Monitoring Programs

Sample Medium	# of Stations	Analytical Frequency	Sample Type	Type of Analysis
Onsite				
Air	6	Weekly for uranium; quarterly for Ra-226 and Th-230	Continuous	Uranium, Ra-226, Th-230, fluoride
Soil	6	Semiannually	Grab	Uranium, fluoride
Vegetation	6	Semiannually	Grab	Uranium, fluoride
Ambient radiation	6	Quarterly	Continuous	Gamma
Surface water	1	Monthly	Continuous	Uranium, gross alpha, gross beta
		Monthly	Continuous	Suspended solids, dissolved solids, pH, fluorides, other chemicals
Sediment	2	Semiannually	Grab	Uranium, fluoride
Offsite				
Air	2	Weekly for uranium; quarterly for Ra-226 and Th-230	Continuous	Uranium,Ra-226, Th-230, fluoride
Soil	8	Semiannually	Grab	Uranium, fluoride
Vegetation	8	Semiannually	Grab	Uranium, fluoride
Ambient radiation	2	Quarterly	Continuous	Gamma
Surface water	7	Semiannually	Grab	Uranium, fluoride
Sediment	7	Semiannually	Grab	Uranium, fluoride

Table 2.1-7
Environmental Air Sampling Annual Averages

Year	Sample Station Number							
	6	8	9	10	11	12	13	NR-7
Fluorides (µg/m^3)								
2010	0.075	0.191	0.314	0.346	0.213	0.172	0.210	NA
2011	0.000	0.001	0.000	0.003	0.000	0.000	0.002	NA
2012	0.000	0.000	0.000	0.001	0.000	0.000	0.000	NA
2013	0.000	0.000	0.002	0.080	0.000	0.000	0.000	NA
2014	0.001	0.000	0.024	0.077	0.002	0.000	0.000	NA
Uranium (µCi/ml)								
2010	8.934E-16	9.160E-15	6.212E-15	6.231E-15	6.565E-15	1.141E-14	1.071E-14	7.568E-15
2011	1.030E-15	8.944E-15	4.047E-15	6.076E-15	4.310E-15	5.622E-15	1.096E-14	5.206E-15
2012	1.539E-15	1.099E-14	4.687E-15	3.021E-14	5.506E-15	1.246E-14	1.280E-14	5.080E-15
2013	5.083E-16	5.377E-15	4.083E-15	1.156E-14	4.212E-15	6.996E-15	6.593E-15	2.358E-15
2014	2.052E-12	1.094E-14	1.027E-14	9.879E-15	8.464E-15	9.251E-15	1.692E-14	5.714E-15
Ra-226 (µCi/cc)[(a)]								
2010	6.71E-17	9.15E-17	5.69E-17	5.53E-17	6.35E-17	8.65E-17	6.34E-17	1.93E-17
2011	1.36E-07	4.53E-10	4.40E-10	1.15E-10	3.60E-10	4.85E-10	5.70E-10	6.05E-10
2012	4.16E-17	3.61E-17	3.64E-17	3.73E-17	1.57E-16	4.00E-17	3.98E-17	9.42E-18
2013	4.61E-17	4.64E-17	4.39E-17	5.38E-17	4.96E-17	1.46E-16	4.81E-17	1.96E-17
2014	3.46E-17	5.12E-17	4.99E-17	4.69E-17	5.12E-17	4.36E-17	5.14E-17	1.30E-17
Th-230 (µCi/cc)[(a)]								
2010	3.88E-17	2.57E-17	4.94E-17	5.38E-17	4.79E-17	8.45E-17	5.38E-17	5.13E-18
2011	1.21E-10	1.25E-10	1.37E-10	3.53E-10	1.88E-10	1.65E-10	2.15E-10	5.63E-11
2012	2.23E-17	2.60E-08	1.56E-17	3.01E-17	4.63E-17	2.06E-17	2.11E-17	3.02E-18
2013	2.40E-17	2.31E-17	1.89E-17	3.07E-17	1.87E-17	2.00E-17	2.48E-17	2.04E-18
2014	2.79E-17	4.96E-17	3.53E-17	5.97E-17	1.94E-17	5.12E-17	4.97E-17	6.67E-18

a. Microcuries per cubic centimeter.

Note: The detection limit for uranium is <1E^{-16} µCi/ml; minimum detection limits required in MTW's source material license SUB-526 have been met.

Table 2.1-8
Environmental Air Sampling Quarterly Results for NR-7

Year	Quarter	Concentration		
		U(NAT) µCi/ml	Ra-226 µCi/cc	Th-230 µCi/cc
2010	1Q	6.35E-15	8.61E-18	2.80E-18
	2Q	1.55E-14	3.21E-17	2.30E-18
	3Q	6.18E-15	1.67E-17	2.12E-18
	4Q	2.61E-15	1.96E-17	1.33E-17
2011	1Q	4.95E-15	1.15E-17	2.39E-18
	2Q	9.11E-15	2.44E-17	1.64E-18
	3Q	3.11E-15	2.42E-09	2.25E-10
	4Q	3.76E-15	2.36E-17	1.52E-18
2012	1Q	8.52E-15	1.93E-17	2.73E-18
	2Q	6.72E-15	1.07E-17	2.41E-18
	3Q	1.81E-15	1.31E-18	4.69E-18
	4Q	3.27E-15	6.37E-18	2.26E-18
2013	1Q	2.38E-15	2.53E-17	2.24E-18
	2Q	2.45E-15	1.49E-17	1.53E-18
	3Q	1.45E-15	2.05E-17	1.89E-18
	4Q	3.15E-15	1.75E-17	2.51E-18
2014	1Q	4.93E-15	2.78E-17	1.57E-18
	2Q	9.66E-15	1.43E-17	2.29E-18
	3Q	2.44E-15	5.13E-18	7.52E-18
	4Q	5.88E-15	4.69E-18	1.53E-17

Note: The detection limit for uranium is <1E-16 µCi/ml; minimum detection limits required in MTW's source material license SUB-526 have been met.

Table 2.1-9
Surface Water Monitoring Annual Averages, 2010–2014

	Location	2010	2011	2012	2013	2014
Uranium (ppm)	Lamb Farm Lake	0.00	0.00	0.00	0.05	0.00
	Ohio River, opposite MTW	0.02	0.00	0.00	0.00	0.00
	MTW outflow	0.01	0.01	0.13	0.02	0.14
	Brookport Dam	0.00	0.00	0.00	0.00	0.00
	Joppa boat ramp	0.00	0.00	0.00	0.00	0.00
	Lindsay Lake	0.00	0.03	0.04	0.00	0.00
	Oak Glenn Lake	0.00	0.00	0.00	0.00	0.00
Fluoride (ppm)	Lamb Farm Lake	1.73	0.13	0.12	0.76	0.12
	Ohio River, opposite MTW	1.52	0.16	0.13	0.09	0.14
	MTW outflow	4.49	0.42	1.64	0.40	1.56
	Brookport Dam	2.51	0.19	0.15	0.15	0.17
	Joppa boat ramp	3.40	0.20	0.17	0.16	0.17
	Lindsay Lake	1.98	0.16	1.12	0.20	0.19
	Oak Glenn Lake	1.63	0.18	0.16	0.19	0.19

Note: The detection limit for uranium is <0.001 ppm.

Table 2.1-10
Sediment Monitoring Annual Averages, 2010–2014

	Location	2010	2011	2012	2013	2014
Uranium (ppm)	Effluent ditch, 700 feet	12.54	69.02	343.50	439.50	28.30
	Effluent ditch, 1,400 feet	30.14	243.79	376.45	1,775.00	370.00
	Lamb Farm Lake	0.29	0.63	1.13	2.55	0.97
	Ohio River, opposite MTW	0.12	0.28	0.34	0.78	1.12
	MTW outflow	0.43	13.82	23.75	0.68	2.30
	Brookport Dam	0.07	0.19	0.71	1.00	0.57
	Joppa boat ramp	0.09	0.29	0.44	0.55	0.76
	Lindsay Lake	0.09	0.56	0.91	1.45	0.79
	Oak Glenn Lake	0.22	0.42	0.49	1.65	1.09
Fluoride (ppm)	Effluent ditch, 700 feet	817.13	7,677.08	43.50	110.00	60.50
	Effluent ditch, 1,400 feet	32,782.09	5,220.50	27.40	105.50	31.00
	Lamb Farm Lake	5.34	0.94	1.35	1.20	1.79
	Ohio River, opposite MTW	9.90	5.07	0.55	0.24	2.30
	MTW outflow	161.65	7.21	6.10	0.54	8.15
	Brookport Dam	6.83	1.62	1.19	0.50	0.84
	Joppa boat ramp	12.28	1.75	1.32	0.29	1.70
	Lindsay Lake	0.99	1.64	0.57	1.80	2.90
	Oak Glenn Lake	1.84	1.03	1.36	2.10	0.54

Note: Detection limits are fluoride, .005 mg/L; uranium, .025 micrograms per gram of soil, sediment, or vegetation (μg/g).

Table 2.1-11
Vegetation Monitoring Annual Averages, 2010–2014

	Location	2010	2011	2012	2013	2014
Uranium (ppm)	Lamb farm[a]	4.46	18.62	0.08	0.46	0.15
	Brubaker farm[a]	3.83	15.61	NR	0.25	0.36
	Texaco station[a]	3.39	11.90	0.27	0.14	0.14
	IL Power Equipment Station[a]	2.26	22.04	0.18	0.28	0.19
	Reiniking property[a]	2.17	9.76	0.07	0.21	1.00
	Metropolis Municipal Airport[a]	4.00	4.12	0.26	0.16	0.54
	Maple Grove School[a]	4.87	19.12	0.23	0.20	0.08
	North of FMB	2.40	9.72	9.85	5.40	15.40
	West of FMB	2.08	27.67	2.40	1.90	5.95
	South of FMB	3.46	23.44	3.00	5.55	4.55
	Northwest of FMB	2.23	10.64	1.72	4.60	2.25
	East of FMB	11.19	35.03	6.00	6.10	14.75
	North of FMB	8.93	11.97	7.50	4.60	7.15
	Nearest residence[a]	1.40	16.48	2.00	7.90	0.83
Fluoride (ppm)	Lamb farm[a]	23.32	4.09	694.00	34.50	177.20
	Brubaker farm[a]	12.12	7.94	1660.00	24.55	232.00
	Texaco station[a]	12.22	8.65	1665.00	43.00	232.00
	IL Power Equipment Station[a]	13.43	7.97	1640.00	1365.00	310.00
	Reiniking property[a]	13.30	7.43	696.50	9.30	214.00
	Metropolis Municipal Airport[a]	11.54	35.39	1240.00	16.80	351.00
	Maple Grove School[a]	12.76	11.53	264.00	3.65	55.48
	North of FMB	26.02	15.35	182.50	11.20	98.70
	West of FMB	13.87	16.70	289.00	153.35	49.50
	South of FMB	121.14	13.57	428.00	221.85	241.50
	Northwest of FMB	26.16	9.52	518.50	47.50	15.15
	East of FMB	37.06	15.05	85.65	6.25	8.95
	North of FMB	50.88	23.92	845.00	206.65	195.00
	Nearest residence[a]	28.42	47.24	1200.00	30.50	335.00

Note: Detection limits are fluoride, 0.005 mg/L; uranium, 0.10 μg/g.
a. Offsite sample locations.

Table 2.1-12
Soil Monitoring Annual Averages, 2010–2014

	Location	2010	2011	2012	2013	2014
Uranium (ppm)	Lamb farm[(a)]	0.96	1.36	1.09	1.45	1.07
	Brubaker farm[(a)]	1.94	0.55	1.2	1.23	1.09
	Texaco station[(a)]	1.90	0.72	1.1	1.3	1.09
	IL Power Equipment Station[(a)]	1.23	0.46	0.97	1.2	1.11
	Reiniking property[(a)]	6.65	0.70	1.17	1.35	2.15
	Metropolis Municipal Airport[(a)]	1.10	2.50	1.75	2	2.10
	Maple Grove School[(a)]	1.32	1.19	0.91	0.8	0.79
	North of FMB	12.45	11.93	25.55	21	37.5
	West of FMB	10.34	14.30	14.85	12.55	16.5
	South of FMB	7.06	6.22	8.15	8.15	12.5
	Northwest of FMB	13.80	15.36	19.35	4.35	26
	East of FMB	49.88	89.44	71.55	36.5	162.15
	North of FMB	16.89	19.52	27	23.5	27.5
	Nearest residence[(a)]	5.21	6.84	8.5	7.3	9
Fluoride (ppm)	Lamb farm[(a)]	4.49	1.61	1.85	4.95	1.31
	Brubaker farm[(a)]	37.31	1.10	0.615	1.35	0.52
	Texaco station[(a)]	3.74	24.61	0.91	0.89	0.16
	IL Power Equipment Station[(a)]	4.38	2.63	0.56	2.08	0.87
	Reiniking property[(a)]	3.55	3.88	2.35	2	1.4
	Metropolis Municipal Airport[(a)]	2.83	2.22	2.2	1.3	1.6
	Maple Grove School[(a)]	3.62	1.22	2.9	0.89	1.575
	North of FMB	1.76	4.66	8.4	15.5	8.05
	West of FMB	1.23	4.27	4.85	7.3	5.85
	South of FMB	1.67	4.78	11.6	16	8.9
	Northwest of FMB	3.59	1.81	1.75	2.85	3.2
	East of FMB	4.87	6.83	8.95	5.6	11.015
	North of FMB	5.85	5.16	4.95	11.4	7.65
	Nearest residence[(a)]	1.10	1.69	1.25	2.6	1.8

Note: Detection limits are fluoride, 0.005 mg/L; uranium, 0.025 µg/g.

a. Offsite sample locations.

Table 2.1-13
Average of External Gamma Monitoring Quarterly Results (mrem)

Location	Year				
	2010	2011	2012	2013	2014
Control	28	31	29	27	27
North fence	44	43	23	17	13
East fence	96	100	88	64	69
South fence	142	81	73	26	71
West fence	31	33	13	4	5
North MTW site boundary	38	41	20	7	10
Airport	25	28	M	M	M
NR-7 A north	26	28	10	M	M
NR-7 south	28	29	16	M	M

M = below the minimal measurable quantity.

Table 2.3-1
Air Emissions (in Tons) from the Shawnee Fossil and EEI Power Plants

Air Emission	Shawnee 2014[a]	EEI 2014[b]	MTW 2014[c]
Carbon monoxide	Not reported	Not reported	16.15
Carbon dioxide	8,000,000	7,910,000	20,381.58
HF	125	31.21	4.62
Lead	0.049	0.111	6.85E-05
Methane	Not reported	Not reported	0.38
N_2O	Not reported	Not reported	0.04
NO_x	12,331	4,024	19.22
Particulates	Not reported	Not reported	8.74
PM_{10}	Not reported	Not reported	8.74
$PM_{2.5}$	Not reported	Not reported	8.74
SO_2	30,000	18,281	143.31
VOM	Not reported	Not reported	1.27

a. (TVA 2016)

b. (EPA 2015)

c. (IEPA 2015b)

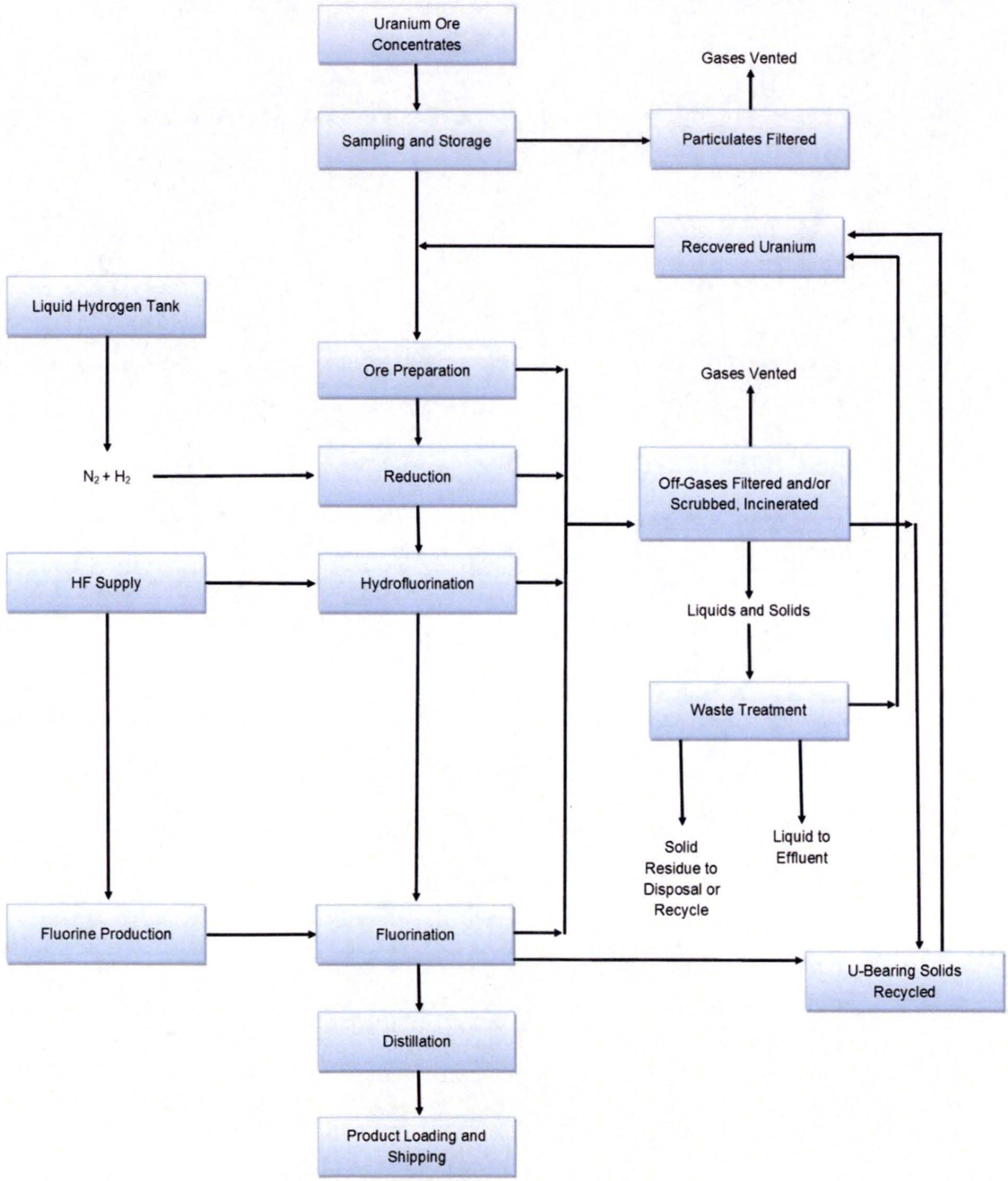


Figure 2.1-1
Flow Schematic of the Uranium Oxide to UF_6 Conversion Process at MTW

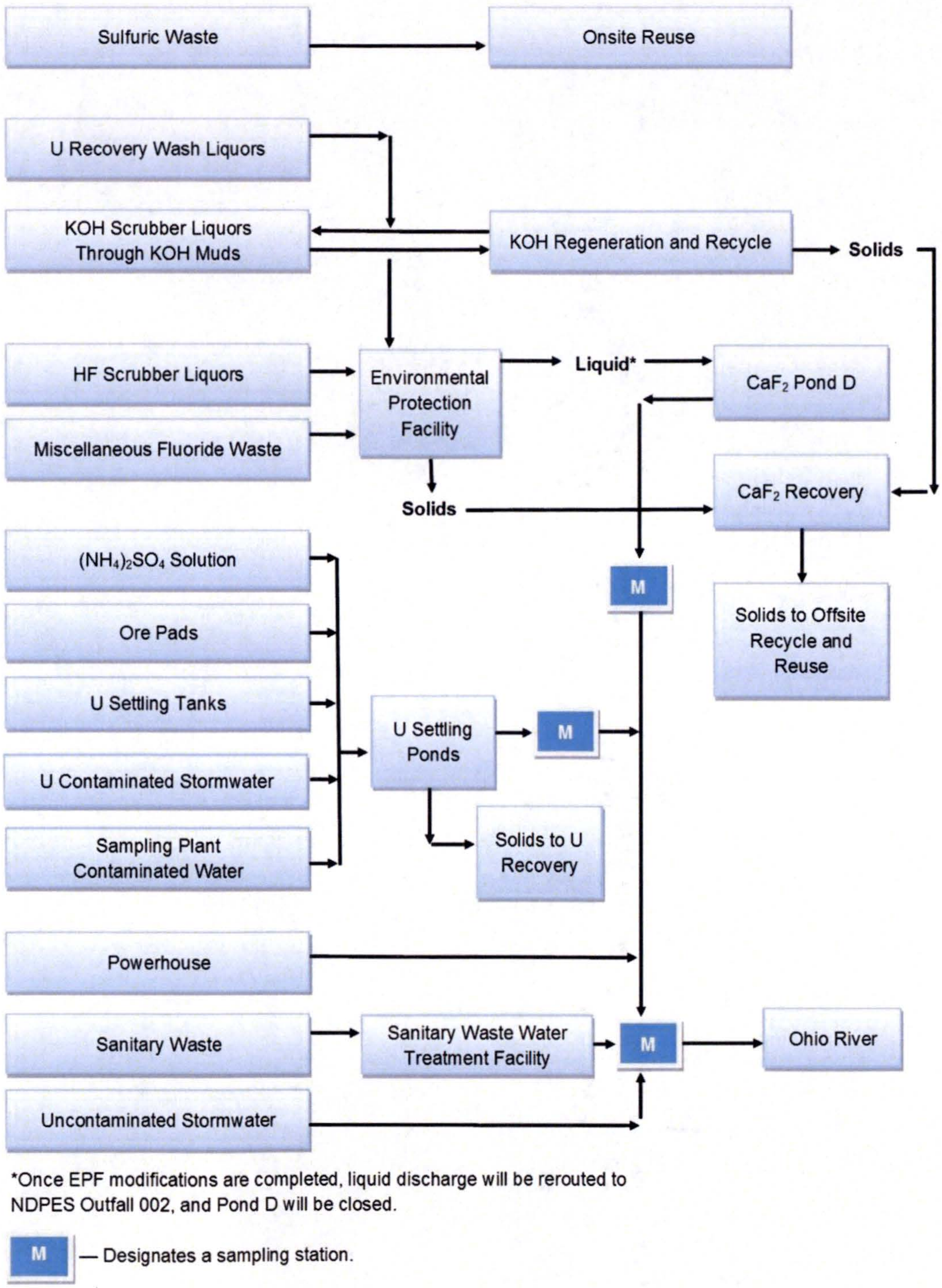


Figure 2.1-2
Flow Diagram for Wastewater Disposition

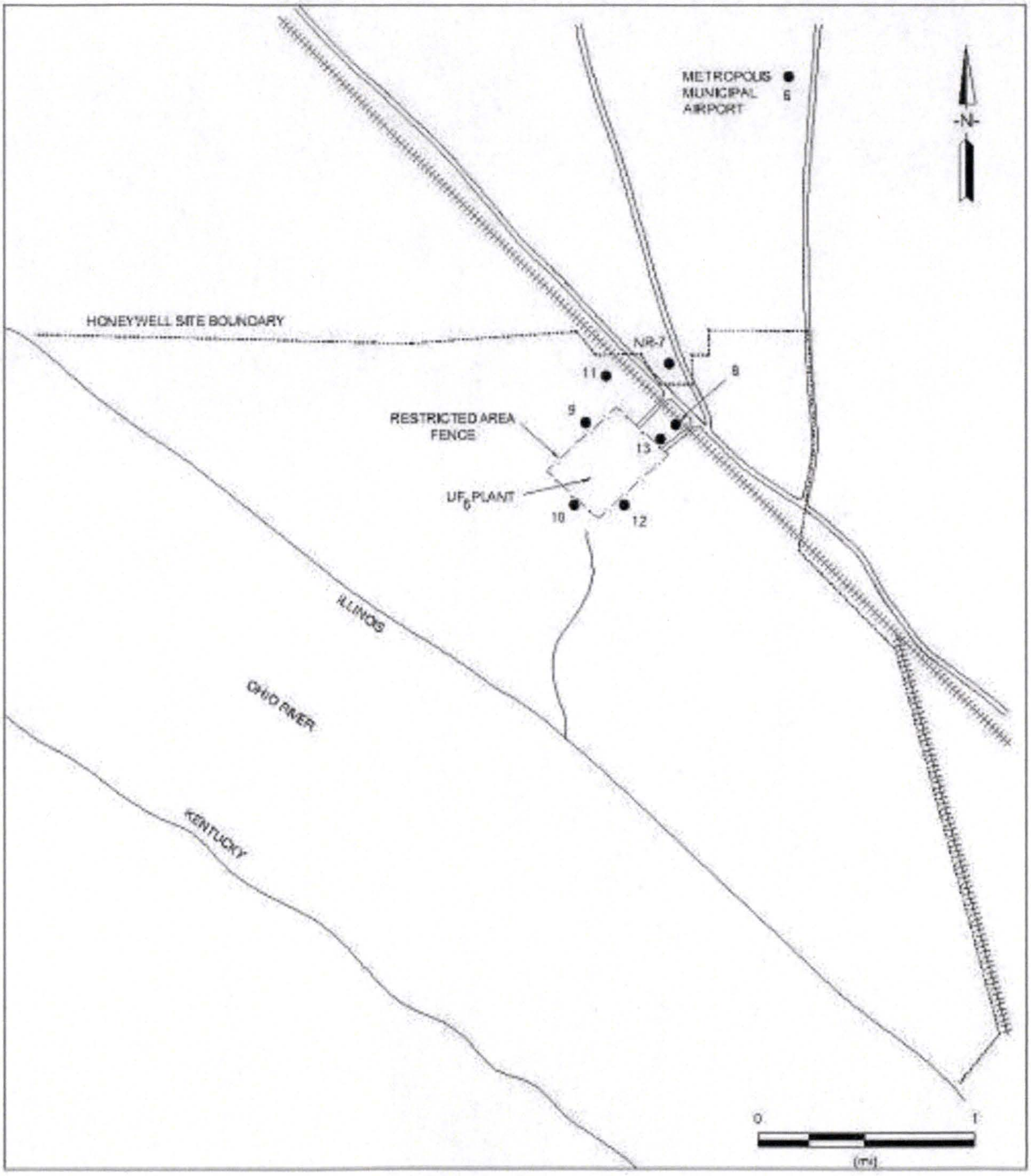
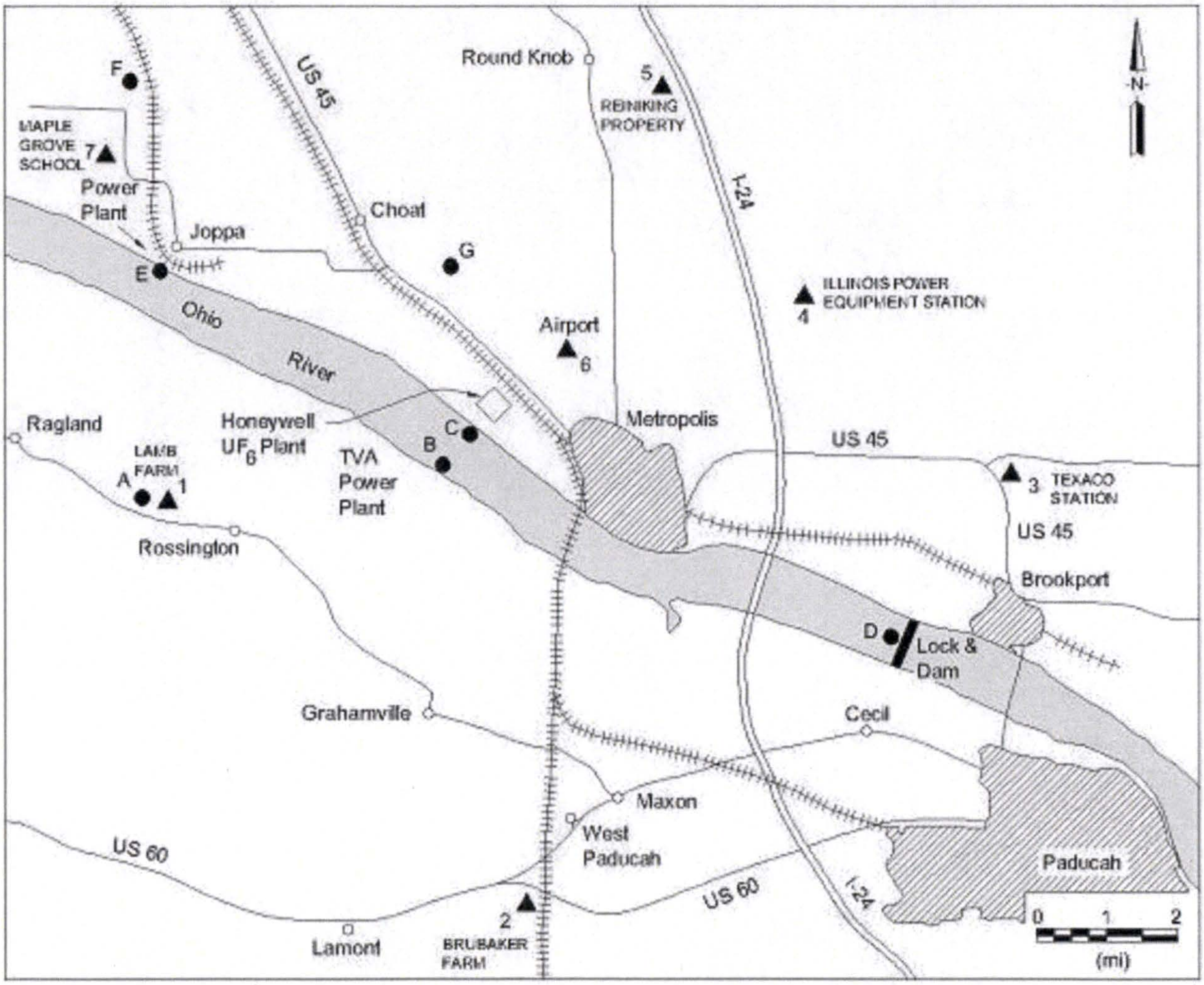


Figure 2.1-3
Environmental Air Sampling Stations



● Surface Water and Sediment (Mud) Samples

▲ Soil and Vegitation Samples

A	Lamb Farm	1	Lamb Farm
B	TVA	2	Brubaker Farm
C	Plant Site Outflow	3	Texaco Station
D	Bookport Dam	4	Illinois Power Equipment Station
E	Joppa Power Plant	5	Reiniking Property
F	Lindsay Lake	6	Metropolis Airport
G	Oak Glenn Lake	7	Maple Grove School

Figure 2.1-4
Environmental Monitoring Sample Locations for Surface Water, Sediment, Soil, and Vegetation

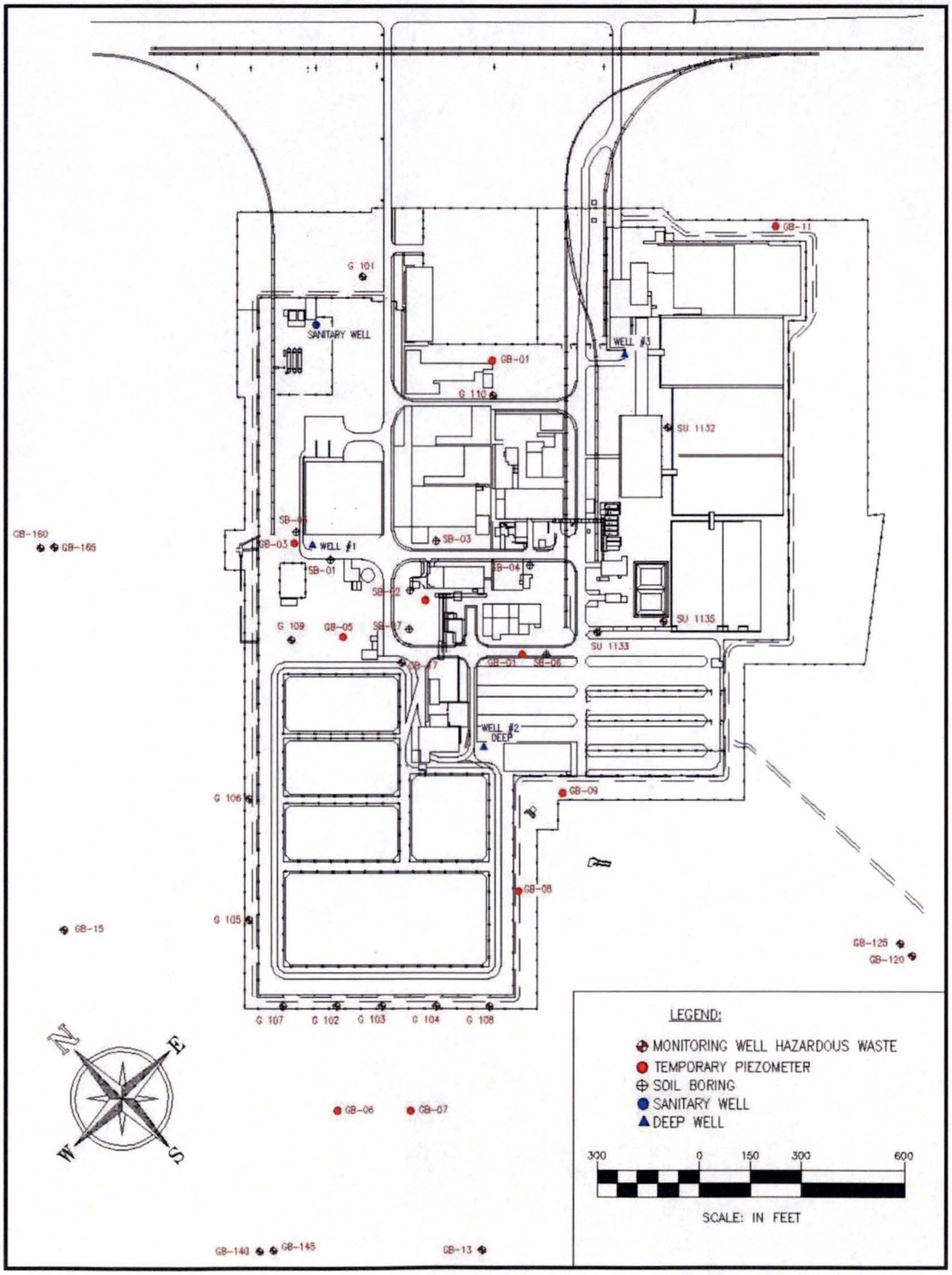


Figure 2.1-5
Monitoring Well Locations

3.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Land Use

Anderson, et al. (1976) define five major land use categories. They are cropland, grassland pasture and range, forest, special (including urban areas, transportation areas, rural parks, wildlife refuges, and others), and miscellaneous (typically unoccupied and unused areas such as tundra, glaciers, ice fields, wetlands, and others). Using the latest available data set with slightly different categories, open water, cultivated crops, pasture and grassland, forest, developed land, wetlands, and barren land occur on or in close proximity (two miles) to MTW. Land use on the MTW site is primarily developed, with the remainder forest and cropland (USGS 2016a).

Wetlands, refuges, and wildlife conservation areas are discussed in greater detail in Subsection 3.5.2.

3.1.1 Site Vicinity

Land use within a two-mile radius of MTW is summarized in Table 3.1-1.

This analysis is based on interpretation of the U.S. Geological Survey (USGS) National Land Cover Database 2011 (USGS 2016a). As tabulated, MTW lies in a mainly undeveloped, rural region of extreme southern Illinois. Dominant undeveloped land uses within a two-mile radius of MTW are forest, planted and cultivated areas, and open water, which combined cover 67 percent of the area (Table 3.1-1). Most of the MTW property outside the restricted area remains forested.

In the 2005 Honeywell ER, a comparison using the 1982 USGS topographic map and an aerial photograph from 1998 was done. With the exception of a small expansion of MTW, no obvious or significant trends or changes in the land use were noted. The floodplain within the MTW site, between the restricted area and the Ohio River, was cultivated in the past. It is no longer farmed and is returning to a more natural vegetation stand. Cropland on the MTW site is restricted to the approximately 100 acres north of U.S. Highway 45. A comparison between the 2006 and 2011 land use-land cover datasets reveals no obvious differences in land use in the immediate area of MTW (USGS 2011; USGS 2016a).

About 102,249 acres of the land in Massac County were used for agricultural purposes in 2012, with corn and soybeans as principal cash crops and cattle and hogs as principal livestock (USDA 2012). The nearest pastureland was located approximately 1.5 miles northeast of MTW and was used to graze beef cattle. The nearest dairy cattle were grazed approximately eight miles east of MTW. (Honeywell 2016a)

3.1.2 Site

Major facilities in the 59-acre restricted area include the administration building, the laboratory, the fluorine production facility, the FMB, the sampling plant, the wastewater treatment plant, the UF_6 cylinder storage area, and the uranium ore storage yard (see Figure 1.1-1). These facilities are surrounded by inner- and outer-perimeter security fences. Much of MTW, including the six-story FMB, the administration building, and the maintenance facility is visible from U.S. Highway 45. (Honeywell 2016a)

3.1.3 Transportation and Transmission

U.S. Highway 45 and the Burlington Northern Santa Fe (BNSF) railroad right-of-way bisects the MTW site to the northeast. The Metropolis Municipal Airport is north of MTW (USDOT 2015). An electrical transmission line crosses the property about halfway between the Ohio River and the southwestern border of the restricted area (Honeywell 2005). The transmission line corridor is maintained in grasses and low-growing shrubs (Honeywell 2016a). A buried natural gas pipeline, crossing the property about 18 meters (60 feet) north of the administration building, provides gas to MTW and continues east to serve the City of Metropolis (Honeywell 2005)..

3.1.4 Other Nearby Development

Major nearby industrial development includes the TVA Shawnee Fossil Plant and the DOE's PGDP (a former uranium enrichment facility), both located across the Ohio River in Kentucky (DOE 2016; TVA 2016).

The AEP Cook Coal Terminal is located immediately northwest of MTW (AEP 2016), and a coal-fired power plant is located in Joppa, Illinois, about six miles northwest of MTW.

3.1.5 Archaeologically or Historically Significant Sites

The National Park Service (NPS) maintains the National Register of Historic Places (NRHP) based on authorization from the National Historic Preservation Act (NHPA) of 1966. For this ER, the search for NRHP sites at MTW was set at a five-mile radius of the facility to account for potential adverse effects on historic properties, including their viewsheds. Viewshed refers to the area that is visible from a specified location. In general, there is no set distance to consider for possible adverse effects to NRHP-listed properties, but likely anything over five miles would only be discussed in special circumstances.

Based on this search, two sites listed on the NRHP are located within five miles of MTW (NPS 2016). The Elijah P. Curtis House is within the City of Metropolis, about one mile southeast of MTW (NRHP 1978). This site is a two-story brick home constructed in 1870 by a local Civil War veteran. The structure now houses the Massac County Historical Society. The other site is Fort Massac, for which the county was named. It lies about four miles upriver in Fort Massac State

Park on the banks of the Ohio River (NRHP 1971). Fort Massac is the oldest state park in Illinois, and the fort itself was ordered restored by George Washington when he became president of the United States. Based on an examination of topographic maps and aerial photographs, MTW is outside the viewsheds of both of these NRHP-listed properties.

To evaluate potential impacts on architectural resources, the Historic and Architectural Resources Geographic Information System (HARGIS) was consulted. HARGIS is a resource of the Illinois Historic Preservation Agency (IHPA) and includes all architectural resources that have been listed in the NRHP, determined eligible for listing to the NRHP, or surveyed without an NRHP determination. No state-listed historic sites within the MTW site are listed in HARGIS. Of the 10 standing structures within one mile of MTW that are listed in HARGIS, none have been evaluated for NRHP eligibility. (IHPA 2016)

To evaluate potential impacts on archaeological resources, the Inventory of Illinois Archaeological Sites (IIAS) geographic information system (GIS) database was consulted. This database is maintained by the Illinois Department of Natural Resources (IDNR) and the Illinois State Museum (ISM). A search of IIAS found no address-restricted previously recorded sites within the MTW site, while there are eight previously recorded archaeological sites within one mile of MTW. These sites include five prehistoric period sites and three historic period sites. Seven of the sites have not been assessed for NRHP eligibility, but one has been determined as not eligible. (IDNR and ISM 2016)

3.1.6 Mineral Use

The nearest active mineral extraction operations are sand and gravel extractions along the Ohio River (dredging). Commodities mined within 50 miles are bail clay, crushed stone, Fuller's earth, silica, and silicon (USGS 2016b).

Table 3.1-1
Major Land Use Categories Within a Two-Mile Radius of the MTW Site Center

Land Use Category	Approximate Total Acreage	Percentage of Total
Water		
Open water	1,790.74	22.27
Developed		
Developed, open space	1,011.69	12.58
Developed, low intensity	736.49	9.16
Developed, medium intensity	261.39	3.25
Developed, high intensity	150.64	1.87
Barren		
Barren land (rock/sand/clay)	80	0.99
Forest		
Deciduous forest	1,806.34	22.46
Herbaceous		
Grassland/herbaceous	4.68	0.06
Planted/Cultivated		
Pasture/hay	740.72	9.21
Cultivated crops	1,037.99	12.91
Wetlands		
Woody wetlands	345.4	4.30
Emergent herbaceous wetlands	74.65	0.93
Total	**8,040.73**	**99.99**

(USGS 2016a)

Figure 3.0-1
Aerial Photograph of MTW and Surrounding Area

3.2 Transportation

MTW is located approximately two miles west of Metropolis, Illinois. U.S. Highway 45 and the BNSF railroad border the facility to the northeast, and the Ohio River bounds MTW to the south. Interstate 24 is located approximately 4.5 miles east of MTW and provides access from Paducah, Kentucky, across the Ohio River into Metropolis, Illinois (see Figure 3.2-1). (USDOT 2015)

Illinois Department of Transportation traffic counts for locations on U.S. Highway 45 northwest and southeast of the MTW entrance indicate that traffic has decreased on the route since 2005. (IDOT 2016a) Although the State of Illinois created the Massac-Metropolis Port District in 2009 to construct new river ports along the Ohio River and expand an existing airport in Massac County, to date no Ohio River ports are located in Massac County, Illinois, nor in McCracken County, Kentucky. (MMPD 2016; WPS 2016)

There are two small airports located near MTW. These are the Metropolis Municipal Airport, located approximately 0.7 miles north, and the Barkley Regional Airport, located 6.7 miles south.

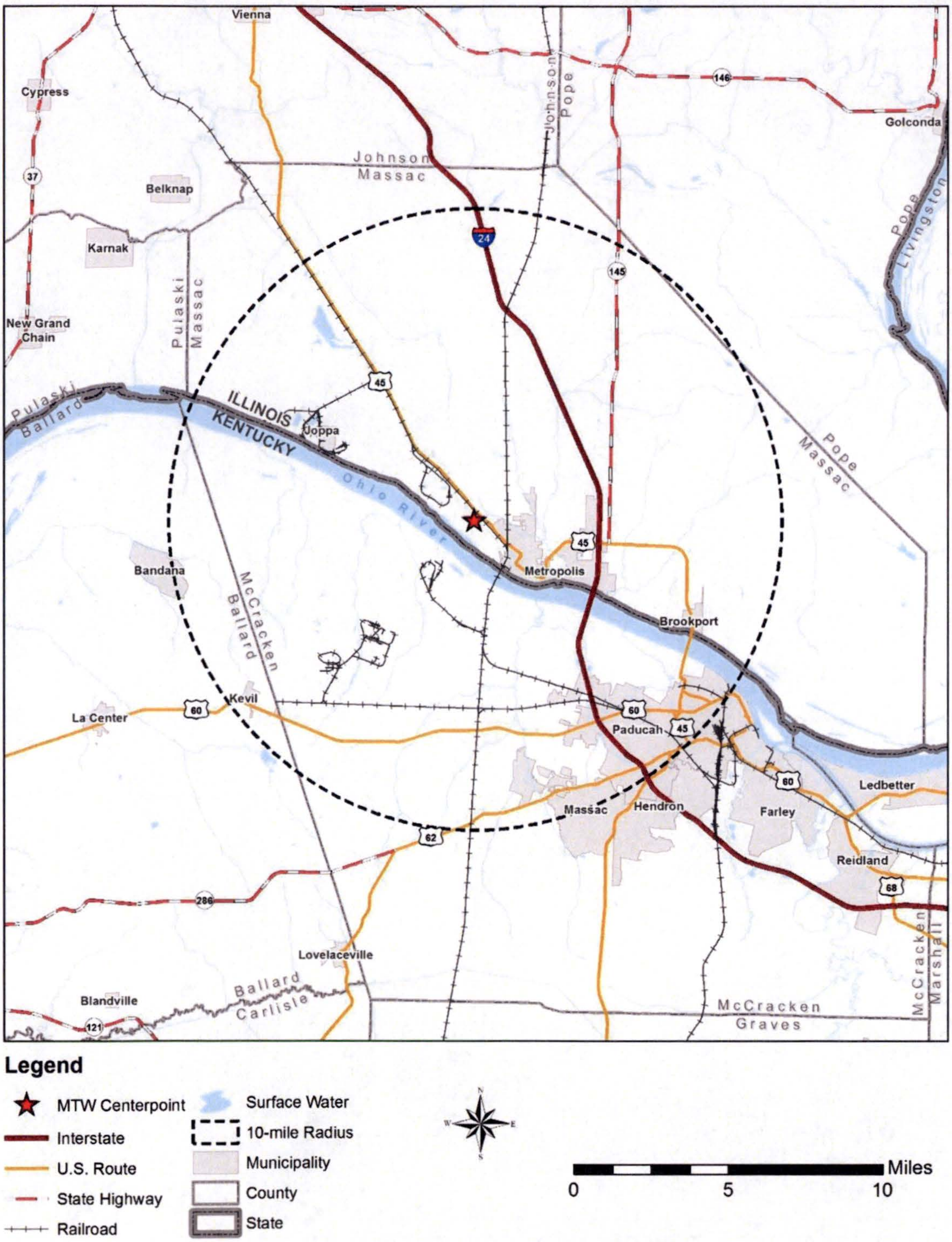


Figure 3.2-1
Transportation Routes & Cities Within the Vicinity of MTW

3.3 Geology and Soils

3.3.1 Regional Geology

The MTW site is located in the northern section of the Coastal Plains physiographic province and is underlain by deposits of Mesozoic age and younger. Although the area was not glaciated, it was subject to glacial processes such as aeolian and meltwater deposition and erosion. (Honeywell 2015)

The restricted area is situated on a bluff overlooking the Ohio River and is between 370 and 380 feet above mean sea level (msl). The bluff is dissected by multiple ravines with an average depth of 30 to 40 feet. These ravines grade into a terrace located between 20 and 40 feet above the river elevation. (Honeywell 2015)

The river terrace is underlain by Cahokia alluvium composed primarily of poorly sorted sand, silt, or clay with sandy gravel locally. The upper 10 to 20 feet of the bluff may contain Peoria loess and Roxanna silt, under which the Carmi Member of the Equality Formation is found. The Carmi Member is composed of quiet-water lake sediments dominated by well-bedded silts and clays. Below the Carmi Member is the Mackinaw Member of the Henry Formation, which is a glacial outwash deposit made up of well-sorted sand and gravel with lenses of clay. (Honeywell 2015)

The first bedrock unit encountered is the McNairy sand. It is a poorly to moderately indurated, white to light gray sandstone approximately 150 to 200 feet in thickness with a 70-foot gray to black lignitic shale or siltstone sequence known as the Levings Member. This formation is unconformably underlain by a limestone of Mississippian age, believed to be the St. Louis limestone. (Honeywell 2015)

As shown in Figure 3.3-1, MTW is located within the northern portion of the New Madrid seismic zone. A large number of earthquakes have occurred in northeastern Arkansas and southeastern Missouri in association with the New Madrid seismic zone. The major historic earthquakes felt in this area were from the 1811–1812 series of New Madrid earthquakes, whose epicenter was approximately 97 kilometers (60 miles) southwest of MTW. The strongest of these earthquakes was estimated to have produced a modified Mercalli Intensity (MMI) IX earthquake (i.e., a seismic event capable of causing considerable damage to well-built buildings, moving houses off their foundations, breaking some underground pipes, cracking the ground and causing serious damage to reservoirs) at Metropolis, Illinois. (Honeywell 2005)

3.3.2 Local Geology and Terrain

The topography of the MTW site is relatively flat. Southern Illinois has gently rolling hills, with MTW site terrain between 300 and 380 feet (91 and 116 meters) above msl. Within the restricted area, the maximum variation in elevation is about 10 feet. (Figure 1.0-1).

The bedrock unit beneath the MTW site is a sandstone deposit correlating with the McNairy Formation. This formation is encountered at a depth between 90 and 95 feet and contains interbedded shale. The McNairy Formation extends to a depth of 240 to 260 feet below ground surface (bgs). No groundwater investigation boring/well encountered the bedrock formation. The bedrock contact was based on boring information from the installation of onsite production wells, which are screened in bedrock. Figures 3.3-2a, 3.3-2b, and 3.3-2c present geologic cross sections running from MTW north to near the Ohio River, showing the various geologic deposits observed. (Honeywell 2015)

Overlying bedrock is a sand deposit approximately 35 to 65 feet thick with multiple lenses of silty clay. In some locations the sand deposit is more gravelly. This sand deposit is believed to be outwash from a distal valley train of the Mackinaw Member of the Henry Formation. These sediments are generally thinner and finer grained inland than towards the edge of the river. Laboratory data indicated this unit was 70 to 80 percent fine sand, 5 to 30 percent medium sand, and 5 to 25 percent silt. The coefficients of uniformity ranged from 2 to 5, with the coarser-grained samples tending to be better sorted. Based on these grain size characteristics, the hydraulic conductivities should be approximately 1 x 10^{-3} centimeters per second (cm/sec) to 2 x 10^{-2} cm/sec. These conductivities are consistent with slug test results previously submitted to the IEPA. (Honeywell 2015)

The uppermost geologic unit on which MTW is located is a deposit of clayey silt to silty clay that ranges from 20 to 40 feet in thickness, with the bottom of the unit located at approximately 345 to 350 feet msl. This material is believed to be the Carmi Member of the Equality Formation, but may include Peoria loess and Roxanna silt. It also grades into fluvial/floodplain deposits near the river. Distinguishing between the aeolian and lacustrine deposits was not possible with the available data. These sediments were found to be thicker towards the center of the bluff than towards its edges. (Honeywell 2015)

Laboratory data revealed the silty deposits contain from 0 to 40 percent sand, 40 to 80 percent silt, and 15 to 35 percent clay. Most of the samples analyzed had less than 20 percent sand, 55 to 80 percent silt, and 15 to 35 percent clay. Atterberg limits indicate these soils are a mix of low plasticity clays, clay-silts and silts, with liquid limits ranging from 30 to 35 and plasticity indices from 4 to 12. (Honeywell 2015)

Additional samples obtained from borings drilled in May 2010 on the berms between the ponds were found to have similar ranges of grain sizes, but higher liquid limits, ranging from 34 to 50, and higher plasticity indices, ranging from 19 to 36 (Honeywell 2015).

As shown in geologic cross-sections (see Figures 3.3-2a, 3.3-2b, and 3.3-2c), there is an unsaturated zone greater than 50 feet thick beneath the regulated units. Saturation values within the fine-grained soils (including the zone in which the in-situ soil liner is located) range between 57 and 98 percent. The deeper, sandier soils had much lower saturation values, ranging between 27 and 63 percent. Fluid movement in the unsaturated zone depends on matric potentials, hydraulic conductivities, and moisture contents. Hydraulic conductivities of unsaturated soil conditions are generally orders of magnitude lower than saturated conditions and must be calculated for different moisture contents as fluid moves through the unsaturated zone. (Honeywell 2015)

3.3.3 Soils

3.3.3.1 Regional Soils

Gently rolling hills are the predominant surface feature of the area surrounding MTW. Drainage is directly or indirectly through secondary watersheds into the Ohio River. Bottomland and light-colored terrace soils are found along the Ohio River, which forms the southern boundary of the MTW site. These soils were developed primarily from outwash or alluvium under forest vegetation. Soils in the remainder of the area are light colored silt learns, with moderately slow to slowly permeable subsoils developed primarily under forest vegetation from loess. (Honeywell 2005)

3.3.3.2 Site Soils

Based on a review of the Massac County soil survey, the soils on and surrounding the MTW site include Stoy silt loam, 0-2 percent slopes; Stoy silt loam, 2-5 percent slopes; and Weir silt loam, 0-2 percent slopes. The distribution of these dominant soil types is provided in Figure 3.3-3.

The Weir silt loam is considered a hydric soil and the Stoy silt loam is prime farmland. These silt loam and silty clay loam soils (CL, CL-ML, ML) exhibit a variable water table, a high to medium surface runoff rate, and a slow permeability. They are not prone to flooding, although Weir soils exhibit frequent ponding. The soils offer very limited conditions for dwellings, dwellings with basements, and commercial buildings due to the depth to soil saturation, shrink-swell, and ponding issues. Due to low permeability and depth to saturation, these soils are very limited in use for septic tank absorption fields. The MTW site soils also exhibit a high potential for frost action and a high risk of corrosion to uncoated steel and concrete. The soil structure in the area of MTW may exhibit a viscous or visco-elastic response to earthquake loading and may be susceptible to ground wave motion from distant earthquakes; however, severe ground motion tends to be reduced due to the soil structure present. (Honeywell 2005)

3.3.4 Mineral Resources

The nearest active mineral extraction operations are sand and gravel extractions along the Ohio river (dredging). Commodities mined within 50 miles are bail clay, crushed stone, Fuller's earth, silica, and silicon (USGS 2016b).

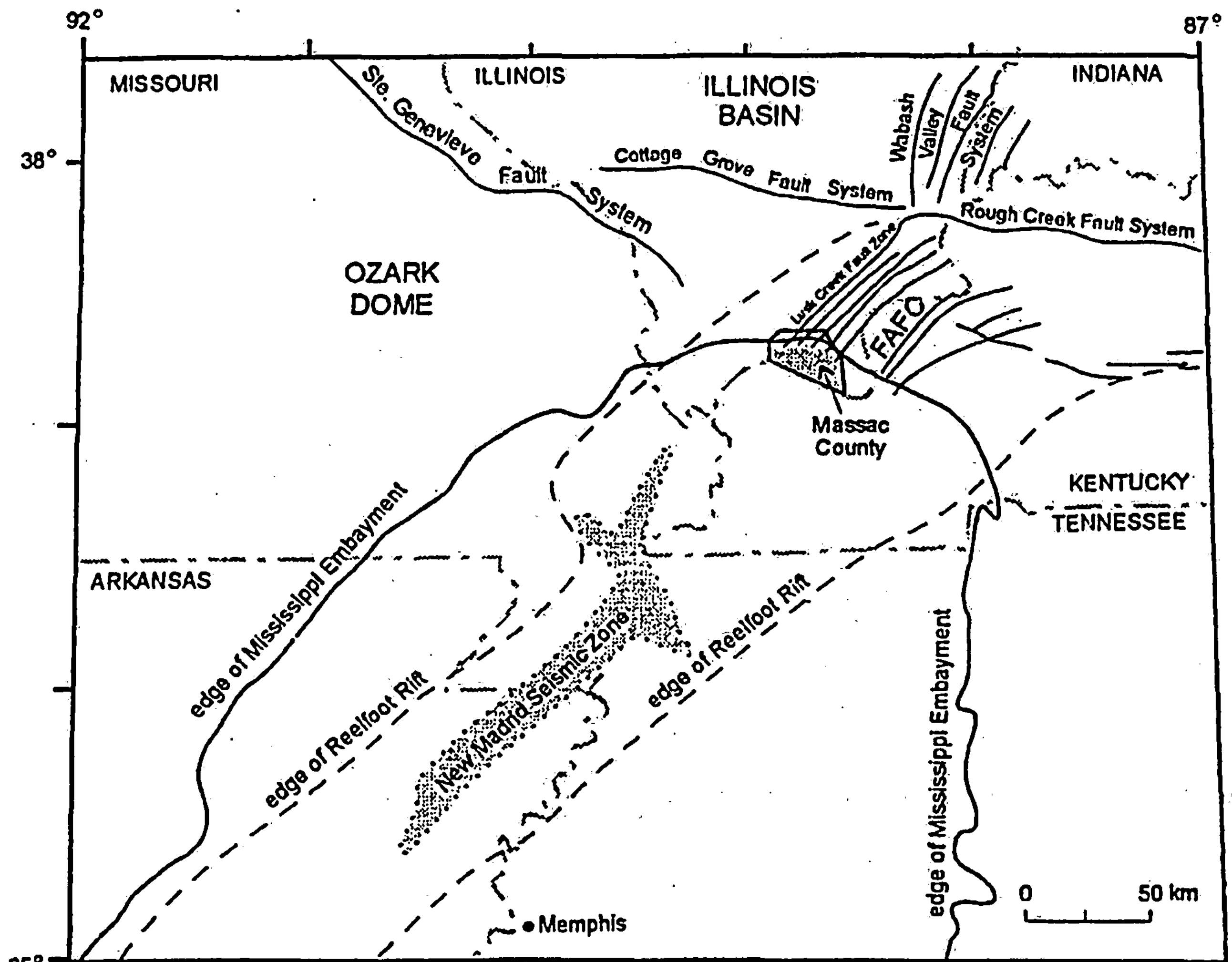
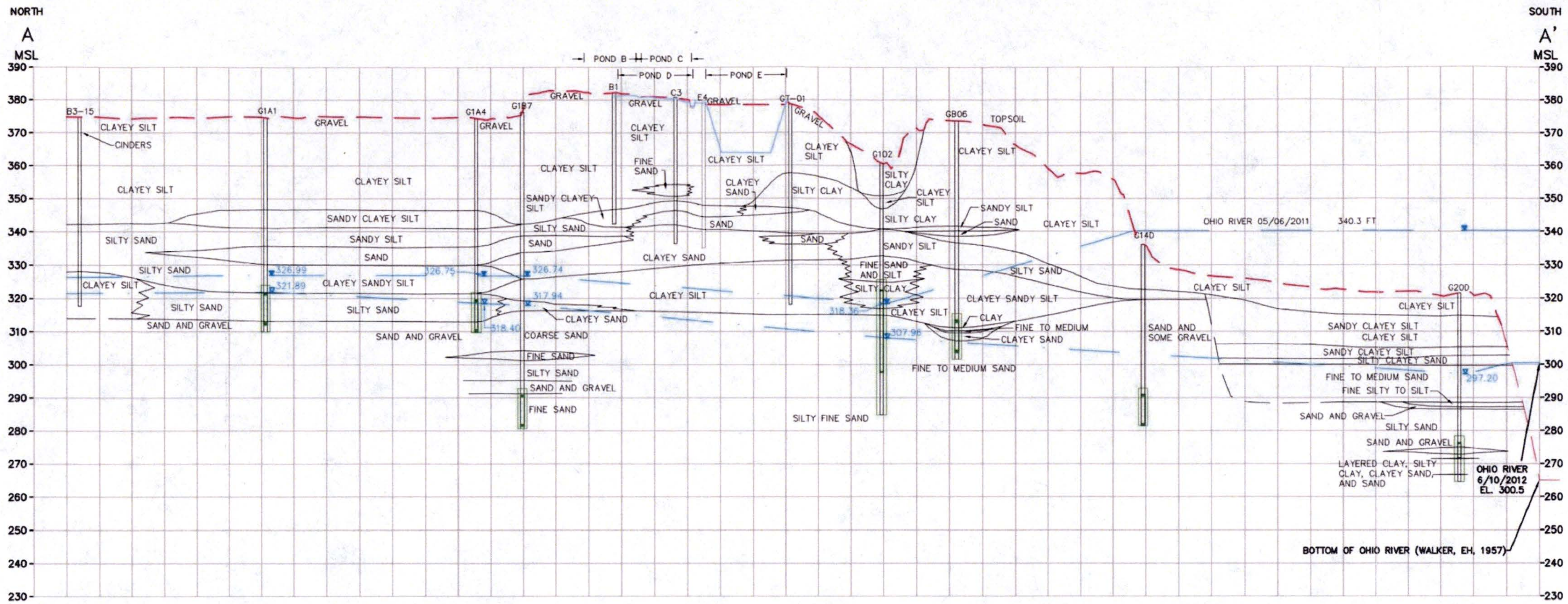
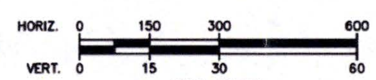


Figure 3.3-1
Regional Geologic Setting



NOTES:

1. OHIO RIVER AT BROOKPORT LOCK AND DAM (BRKI 2) "GAGE 0" DATUM: 283.3 FT MSL. RECENT HISTORIC CREST; 57.00 FT ON 05/06/2011. RECENT HISTORIC LOW: 17.20 FT ON 06/10/2012.
2. MAXIMUM GROUNDWATER ELEVATIONS OCCURED DURING SECOND QUARTER 2011.
3. MINIMUM GROUNDWATER ELEVATIONS OCCURED DURING FOURTH QUARTER 2011.
4. WALKER, EH, 1957. THE DEEP CHANNEL AND ALLUVIAL DEPOSITS OF THE OHIO RIVER VALLEY IN KENTUCKY: U.S. GEOL. SURVEY WATER-SUPPLY PAPER 1411, 25p.



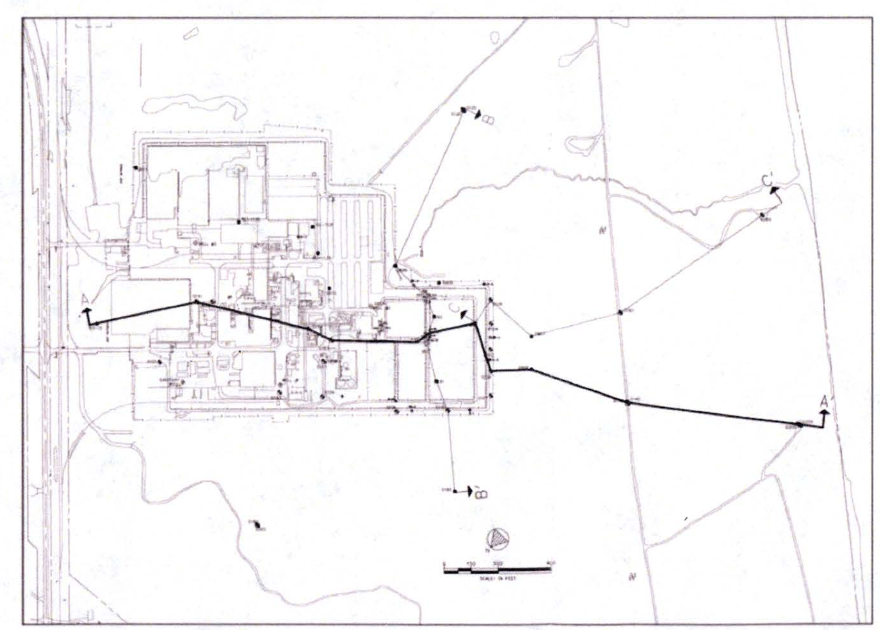
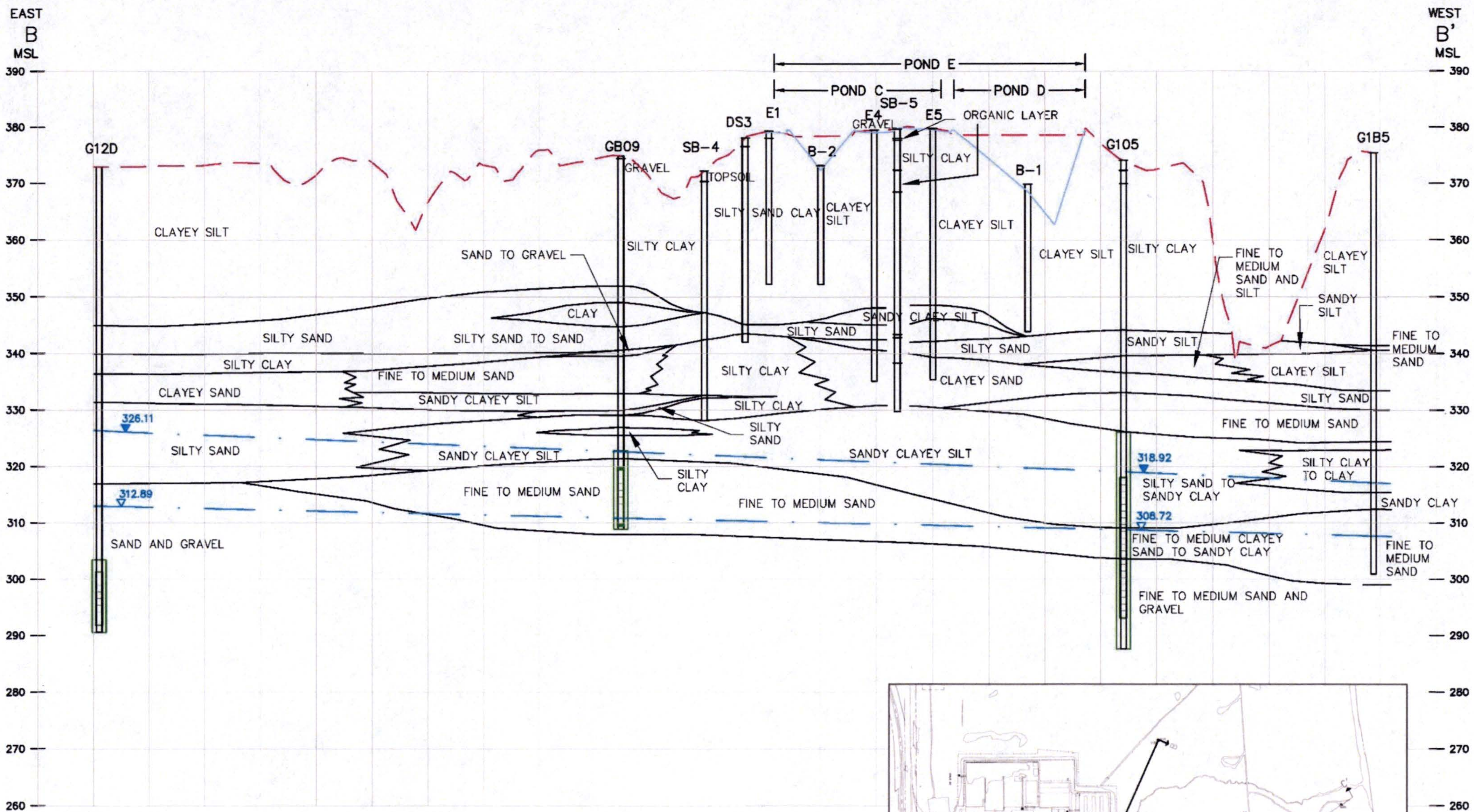
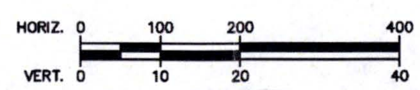


Figure 3.3-2a
Cross Section A-A'



NOTES:
1. OHIO RIVER AT BROOKPORT LOCK AND DAM (BRKI 2) "GAGE 0" DATUM: 283.3 FT MSL. RECENT HISTORIC CREST; 57.00 FT ON 05/06/2011. RECENT HISTORIC LOW: 17.20 FT ON 06/10/2012.
2. MAXIMUM GROUNDWATER ELEVATIONS OCCURED DURING SECOND QUARTER 2011.
3. MINIMUM GROUNDWATER ELEVATIONS OCCURED DURING FOURTH QUARTER 2011.
4. NO MAXIMUM AND MINIMUM DATA FOR G14D FOR THE SECOND AND FOURTH QUARTER 2011.



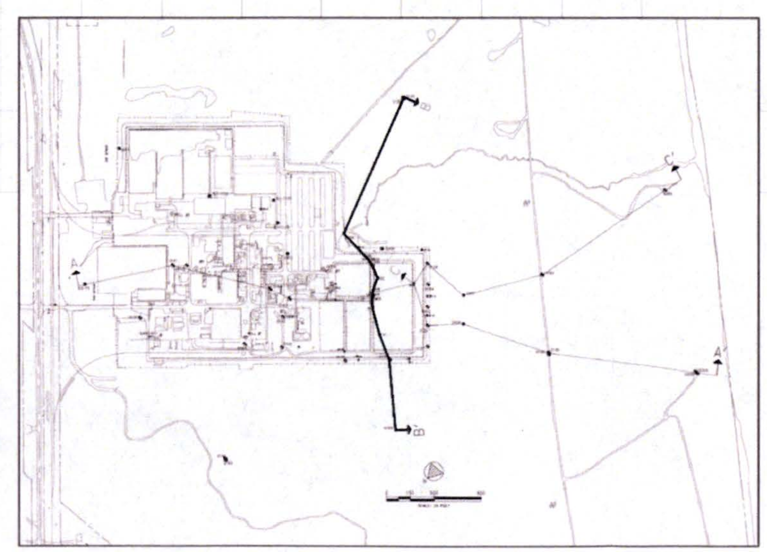
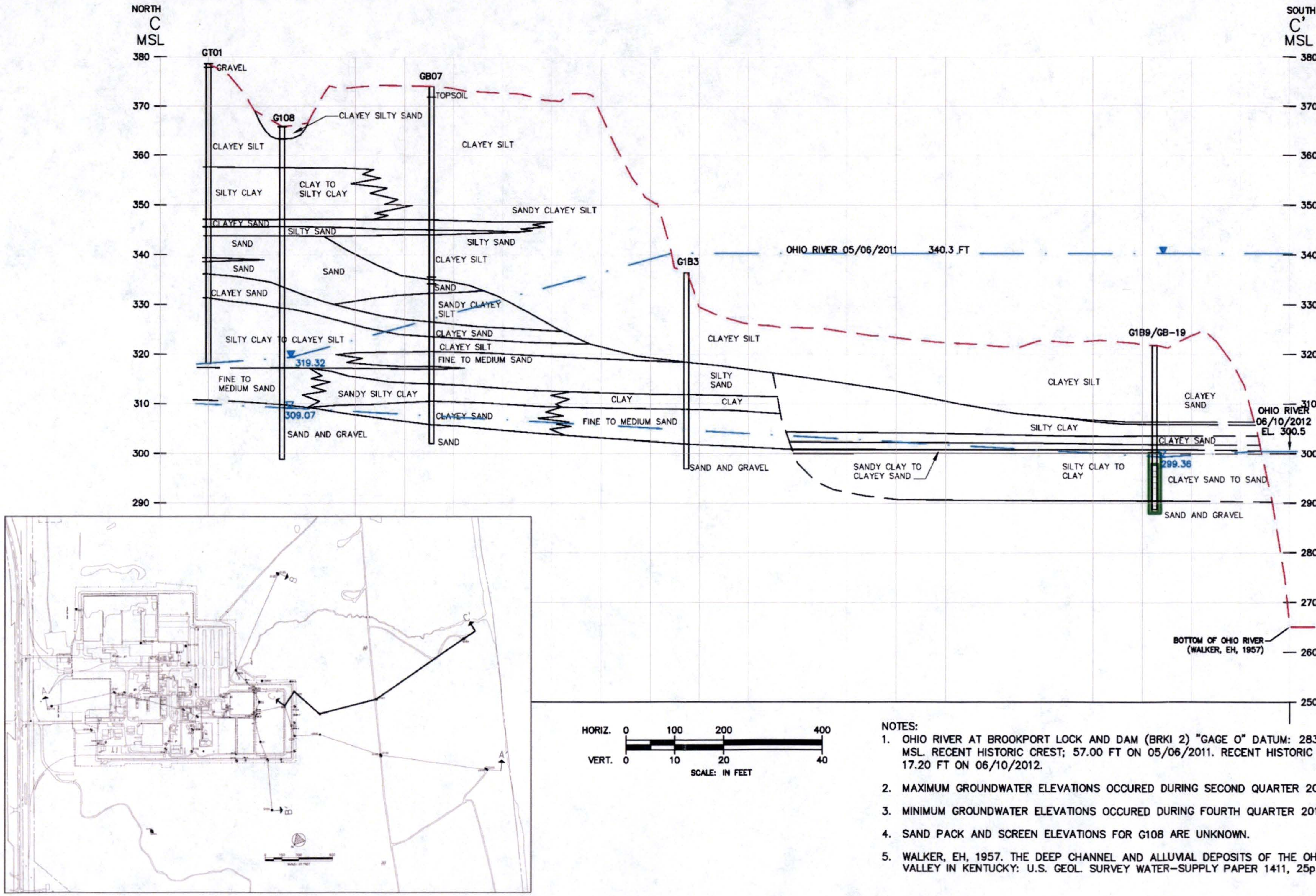


Figure 3.3-2b
Cross Section B-B'



NOTES:
1. OHIO RIVER AT BROOKPORT LOCK AND DAM (BRKI 2) "GAGE O" DATUM: 283.3 FT MSL. RECENT HISTORIC CREST; 57.00 FT ON 05/06/2011. RECENT HISTORIC LOW: 17.20 FT ON 06/10/2012.
2. MAXIMUM GROUNDWATER ELEVATIONS OCCURED DURING SECOND QUARTER 2011.
3. MINIMUM GROUNDWATER ELEVATIONS OCCURED DURING FOURTH QUARTER 2011.
4. SAND PACK AND SCREEN ELEVATIONS FOR G108 ARE UNKNOWN.
5. WALKER, EH, 1957. THE DEEP CHANNEL AND ALLUVIAL DEPOSITS OF THE OHIO RIVER VALLEY IN KENTUCKY: U.S. GEOL. SURVEY WATER-SUPPLY PAPER 1411, 25p.

Figure 3.3-2c
Cross Section C-C'

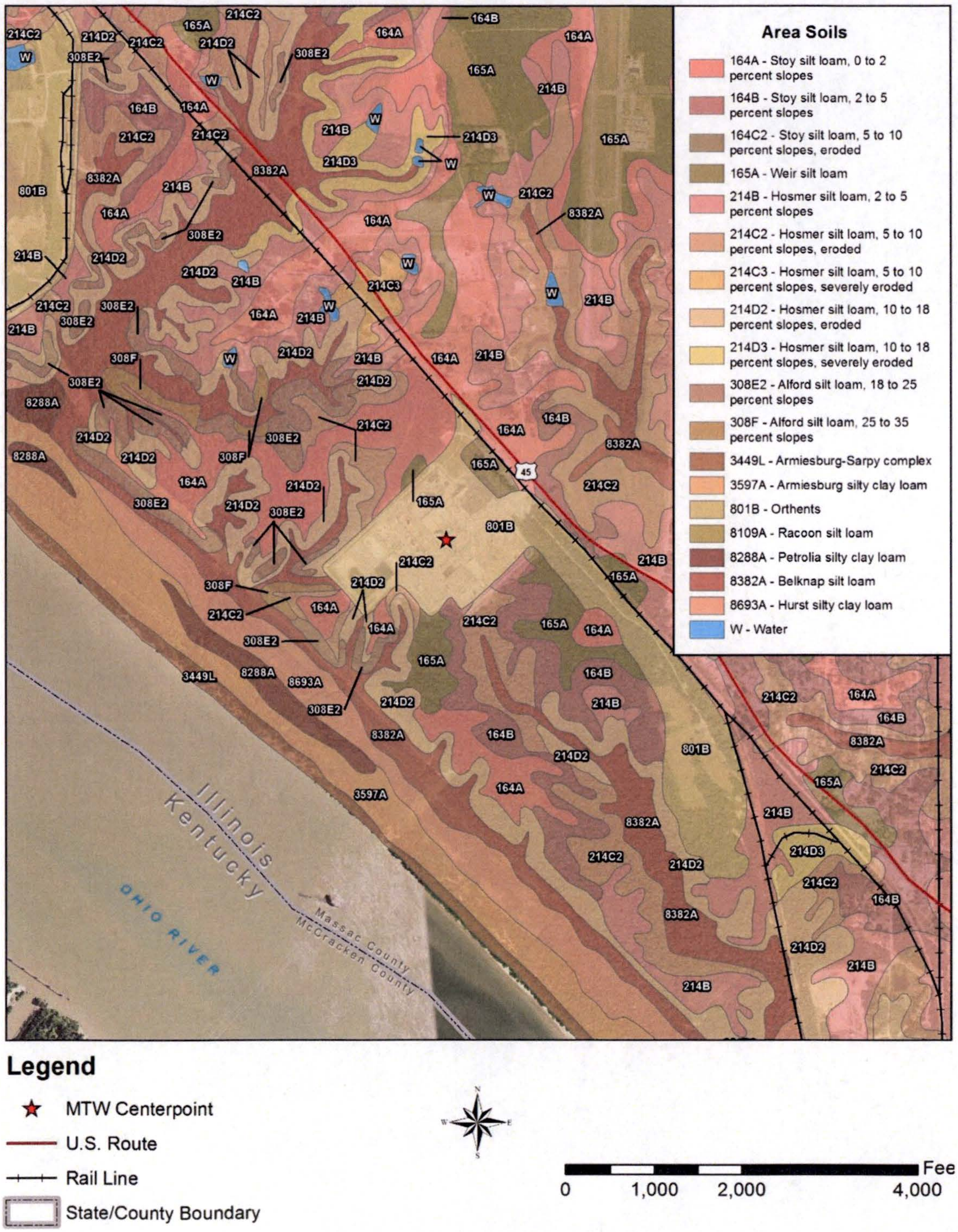


Figure 3.3-3
Area Soil Types

3.4 Water Resources

3.4.1 Surface Water

The MTW site is bound on the south by the Ohio River in the vicinity of river mile 946, approximately 35 miles upstream from its confluence with the Mississippi River. The Ohio River at the MTW site is about 910 meters (3,000 feet) wide with a normal pool elevation of 88 meters (290 feet) above msl. (Honeywell 2005) Over its 981-mile course, the Ohio River drains 203,940 square miles (ORSANCO 2016a).

There are four intermittent creeks that drain the MTW site property to the Ohio River. Surface water features are illustrated in Figure 1.0-1. The intermittent creeks enter the MTW site on the north side, and there are no other downstream properties between MTW and the Ohio River.

MTW's wastewater treatment system utilizes one surface impoundment, Pond D. Effluent from Pond D is mixed with other MTW effluents before discharge at Outfall 002. Outfall 002, which is used to discharge MTW's treated sanitary, process wastewaters, non-contact cooling water, and stormwater, is located on one of the onsite drainages about 2,000 feet from the Ohio River. (Honeywell 2005) According to the current NPDES permit (IL0004421), Outfall 002 is located at 37° 09' 52" north latitude, 88° 45' 45" west longitude (IEPA 2014a).

There are no downstream receptors for the intermittent drainage channel that receives MTW effluent. This water body has no downstream uses for potable water, fishing, recreation, or irrigation prior to discharge to the Ohio River. (Honeywell 2005)

3.4.2 Streamflow and Flood Characteristics

Numerous flood control dams regulate the flow of the Ohio River and have reduced the threat of flooding. The nearest flood control structure is lock and dam No. 52 at Brookport, Illinois, which is about seven miles upstream from MTW. (USACE 2014)

Ohio River discharge records have been maintained since 1928. The maximum recorded discharge on the Ohio River at Metropolis, Illinois, was 1,850,000 cubic feet per second (ft^3/s) and occurred on February 1, 1937 (USGS 2014). Although flooding is an annual event, MTW has reportedly never been reached by flood waters. While the 2011 flood recorded the maximum peak stage at an elevation of 338 feet NAVD88 (USGS 2014), the probable elevation of a 100-year flood (1 in 100 chance of occurring in a given year) in the area is approximately 337 feet (Honeywell 2005). The MTW site elevation is 375 feet, which is considerably higher than the most extreme flood level projected for the Ohio River. The distance from the restricted area to the 100-year floodplain is approximately 650 feet. (Honeywell 2005)

MTW's effluent flow is insignificant compared to the annual mean Ohio River flow, which has ranged from 120,300 ft^3/s (1931) to 436,600 ft^3/s (1979) (USGS 2014). Table 3.4-1 summarizes effluent flow rates from NPDES monitoring data.

3.4.3 Water Use

MTW does not utilize surface water as a source for potable water or for process water. There are no fishing, recreational, irrigation, or other agricultural uses of the onsite intermittent streams.

The Ohio River in the area is used for barge transportation, commercial and sport fishing, musseling, and a source of water supply. The nearest public drinking water intake is located at Paducah, Kentucky, about eleven miles upstream. There are no upstream or downstream public drinking water intakes on the Illinois side of the river within Massac County. The nearest downstream public drinking water intake is located in Cairo, Illinois, about 32 miles away (Honeywell 2005).

Most surface streams outside the MTW site are used for recreation and watering livestock. Numerous farm ponds and lakes are found throughout the area.

Total surface water withdrawals for 2010 for Massac County, Illinois, and McCracken County, Kentucky (the adjoining county to the south), are presented in Table 3.4-2.

3.4.4 Water Quality

NPDES Outfall 002 effluent is sampled to produce a daily composite, which is analyzed for uranium. In addition, a weekly composite is also analyzed for numerous non-radiological constituents. Effluent limits are stipulated in NPDES permit number IL0004421. (Honeywell 2015)

In general, the effluent has not had any significant adverse trending in required monitoring parameters. MTW's effluent flow has remained consistent to slightly decreased between 2010–2014 due to the installation of water-cooled rectifiers and a cooling tower in 2006. Concentrations of NPDES-monitored contaminants in MTW's effluent have not had adverse trends within the past five years. NPDES monitoring data are summarized in Tables 3.4-3a through 3.4-3f. Excursions related to MTW's NPDES permit since 2010 are summarized in Table 3.4-4. There were no consequences from these excursions.

The 2014 Clean Water Act (CWA) Section 303 (d) list of impaired water bodies was reviewed (IEPA 2014b) for locations within the vicinity of MTW. The impaired water bodies are summarized in Table 3.4-5 and Figure 3.4-1.

Water quality data for the Ohio River at the confluence of the Tennessee River (Ohio River mile 934.5, Paducah, Kentucky, upstream of MTW) are presented in Table 3.4-6 (ORSANCO 2016b).

Radiological monitoring of surface water is routinely conducted by Honeywell, and is described in detail in Sections 6.0 and 6.1.

Every two years, the Ohio River Valley Water Sanitation Commission (ORSANCO) completes an assessment of Ohio River designated uses in cooperation with the Ohio River 305(b) coordinators work group, which is composed of representatives from each of the main stem states. This biennial assessment reports the conditions of Ohio River water quality and the ability to which the river supports each of its four designated uses: warm-water aquatic life, public water supply, contact recreation, and fish consumption. (ORSANCO 2014). Table 3.4-7 describes attainment of designated uses for the 55.2-mile segment of the Ohio River that includes the MTW site (between Ohio River miles 925.8 and 981.0) (ORSANCO 2014).

3.4.5 Wetlands and Floodplain Characteristics

The southern portion of the MTW site is located within the floodplain of the Ohio River; however, no MTW facilities are located in this area (FEMA 1983). The floodplain areas mapped on the Federal Emergency Management Agency (FEMA) floodplain map are illustrated in Figure 3.4-2. Flood hazard areas (Zone A18) indicated on Figure 3.4-2 are identified as special flood hazard areas (SFHAs). SFHAs are defined as areas that will be inundated by the flood event having a one percent chance of being equaled or exceeded in any given year. The one percent annual chance flood is also referred to as the base flood or 100-year flood. Moderate flood hazard areas (Zone B) are the areas between the limits of the base flood and the 0.2 percent annual chance (or 500-year) flood. The areas of minimal flood hazard, which are the areas outside the SFHA and higher than the elevation of the 0.2 percent annual chance flood, are labeled Zone C.

The restricted area of the facility contains no wetlands. There are areas on the MTW site that have been identified as wetlands, primarily in the floodplain of the Ohio River, south of MTW. Section 3.5 provides additional discussion concerning wetlands.

3.4.6 Regional Groundwater

Total groundwater withdrawals for Massac County, Illinois, and McCracken County, Kentucky (the adjoining county to the south) are presented in Table 3.4-8.

No designated sole source aquifers are located in Illinois, and Massac County has no community water supplies identified by the IEPA as potentially exceeding the arsenic standard. The City of Metropolis utilizes three municipal water supply wells, each completed in Mississippian limestone, to provide for its population. The city's water treatment plant is designed to treat and pump up to four million gallons per day (MGD). (Honeywell 2005)

3.4.7 Local Groundwater

Within the MTW site, the overlying loess deposits do not yield enough water for domestic use. When saturated by precipitation, these formations transmit water to the underlying aquifers. The mixed gravel, sand, and clay of the Pliocene series (the Mounds Gravel Formation) are the first unconfined aquifer encountered. Domestic wells may be bored to a depth of 120 feet before encountering the Porter's Creek Clay Formation. The Porter's Creek clay is an aquitard, slowing groundwater movement between the Pliocene gravel and the sand in the McNairy Formation. The McNairy Formation may yield enough water for domestic use, but the high iron content and fine-grained matrix make the groundwater quality generally unattractive. The shallowest aquifer adequate for most industrial needs is the Mississippian limestone, which occurs at a depth of 300 to 500 feet. The yield of an industrial well penetrating the Mississippian limestone often exceeds one thousand gallons per minute, but usually the water is hard. The lower units of the McNairy Formation and the Mississippian limestone are confined aquifers (Honeywell 2005).

Public water use for the region is provided by the Massac County Water District and the City of Metropolis. Both of these sources withdraw their water from wells in the Mississippian limestone aquifer. (Honeywell 2005)

The MTW site water is supplied by groundwater from the Mississippian limestone. Process wells No.1, No. 2, and No. 3 are drilled to depths of 455 feet, 520 feet, and 500 feet, respectively. The sanitary well is 412 feet deep. A 72-hour pumping test was performed on process well No. 2 in October 1971. The drawdown was measured in all four wells during the test, with a drawdown of 1.5 feet observed in the sanitary well, two feet in process well No. 1, and no apparent drawdown experienced in well No. 3. It was concluded that significant hydrologic connections exists between the sanitary well and process wells No. 1 and No. 2, but this system has no apparent interconnection with process well No. 3. (Honeywell 2005) Only the sanitary well and process well No. 3 are used for potable water supply and are sufficient for MTW's needs.

The Illinois Department of Public Health (IDPH) administers the drinking water regulations of the U.S. Environmental Protection Agency (EPA). The analyses required and frequency of testing for the sanitary well is determined by the IDPH based on the results obtained from previous analyses, and are listed in Table 3.4-9.

Results of the IDPH-required sampling are provided in Table 3.4-10a and Table 3.4-10b which show the results were below federal maximum contaminant levels (MCLs) or other regulatory thresholds. Sampling events are scheduled for all parameters for between 2016 and 2019.

3.4.8 Groundwater Monitoring

The facility has several means of monitoring for leaks from the surface impoundments. Each pond is equipped with a two-part liner system. The first part is a 60-mil synthetic liner, and the second is a minimum of 15 feet of in-situ clay. To monitor for leaks or determine if a leak is present in the synthetic liner, each pond has a leachate collection system (gravel trench with perforated pipe) that gravity flows to sumps. Ponds B, C, and D have one sump; Pond E has two. The sump liquors are monitored for pH and fluorides; if the liquors exceed certain thresholds, it is considered in leak status (for the synthetic liner). In addition, all ponds are equipped with lysimeters. A lysimeter is a monitoring device drilled on an angle below the 15-foot in-situ soil liner. The lysimeters are positioned in areas where suspected or known leaks in the synthetic liner may be present, and are monitored quarterly for pH, fluorides, and potassium. If the lysimeter results exceed certain thresholds, MTW must implement measures to investigate the extent and significance of the exceedance. Lastly, MTW has groundwater monitoring wells along the perimeter of the facility that are monitored for pH, fluorides, gross alpha, and gross beta. (Honeywell 2005)

There are numerous additional groundwater monitoring wells on the MTW site. Locations of the monitoring wells are shown on Figure 2.1-5.

3.4.8.1 Sanitary and Process Well Monitoring

Two of the four deep wells, the sanitary well and process well # 3 are monitored for inorganic constituents, volatile organic compounds (VOCs), radionuclides, and general parameters including pH, turbidity, chlorine, total coliform, and fecal coliform. Analytical results between 2010–2014 are attached as Table 3.4-11a and Table 3.4-11b. In comparison to groundwater quality standards, no significant impact on these parameters is indicated in the deep Mississippian limestone aquifer.

3.4.8.2 RCRA Groundwater and Compliance Monitoring

The routine RCRA groundwater compliance monitoring network for MTW consists of eleven wells: two upgradient and nine downgradient. The eleven monitoring wells are sampled and analyzed quarterly for pH, specific conductance, fluoride, gross alpha, and gross beta, and historical analytical results are provided in Tables 3.4-12 and 3.4-13. The quarterly results from each well are statistically compared to historical upgradient groundwater quality. Results are routinely reported to IEPA. A review of the data from 2010–2014 suggests no significant impact on these parameters to the first water zone in the Mounds Gravel aquifer.

3.4.8.3 RCRA Corrective Action

In accordance with its RCRA permit, MTW has worked with the IEPA on a number of corrective action areas. Two of the areas are located within the restricted area; these areas are discussed below.

3.4.8.3.1 Chlorinated Solvent/Arsenic Area

In April 2001, the IEPA identified the presence of dissolved arsenic, total arsenic, chloroform, trichloroethene, tetrachloroethene, and trichlorofluoromethane in groundwater from onsite monitoring wells. The IEPA issued a violation notice to Honeywell, which prompted the development of a groundwater investigation plan to investigate the source and extent of the groundwater exceedances. Various phases of soil and groundwater investigation concluded the RCRA ponds were not the source of the groundwater exceedances.

According to maps prepared by Illinois State Geological Survey (ISGS), the affected media is groundwater in the Pliocene Mounds Gravel Formation. The *RCRA Groundwater Investigation Report,* dated January 2005, states that groundwater migration is southwest toward the Ohio River at a rate ranging from 0.052 to 2.36 feet per day (Honeywell 2005).

In October 2006, the IEPA acknowledged the contamination was from historic activities and not the result of ongoing contaminant releases with all soil sample results reported below the IEPA's remedial objectives. Therefore, the IEPA indicated the soil investigation activities were complete.

In August 2014, the IEPA approved an evaluation indicating the risks associated with the residual groundwater impacts were below regulatory thresholds and no additional investigation or remediation was necessary. In March 2016, the IEPA approved an environmental land use control (ELUC) for portions of MTW. The ELUC will be attached to the property deed and places the limitations listed below on the property.

a) Property use is limited to industrial/commercial uses.

b) Groundwater cannot be used as a potable water supply within the ELUC area. The ELUC area does not encompass the entire MTW property. The existing potable water supply wells (sanitary well and process well No. 3) may still be used as potable water supply wells.

c) All existing or potential buildings must have a full concrete slab on-grade or a full concrete basement floor and walls.

No current groundwater monitoring is being performed in this area. The investigation has been completed and Honeywell is working with the IEPA to obtain regulatory closure for the area.

3.4.8.3.2 Underground Process Sewers

Under its RCRA permit, MTW is investigating the condition of its underground process sewers and structures. MTW has identified two areas where liquids may have migrated out of the underground process sewers. These areas include:

- Cell rooms D and E in the gaseous F_2 building, and
- A sump located on the Green Salt South Pad.

Honeywell submitted, and the IEPA approved, a work plan to complete groundwater sampling at the areas listed above. Honeywell is working with the IEPA to identify the extent and significance of potential releases.

Table 3.4-1
NPDES Monitoring Data – Outfall 002 Average Monthly Flow Rate (MGD)

Month	2010	2011	2012	2013	2014
January	3.4375	2.5364	2.4791	1.3572	2.7716
February	3.3088	3.1195	2.4480	1.1875	2.8234
March	3.5261	3.2832	2.7096	1.2729	2.8486
April	3.6345	3.0319	2.7434	1.3780	2.9841
May	4.1281	3.3244	2.5821	2.0151	2.8388
June	4.2874	3.1911	1.7928	1.4359	2.8979
July	3.7621	3.0774	1.6265	2.0460	2.8617
August	3.5447	3.1892	1.2233	2.8478	2.9286
September	3.4376	3.1825	1.5296	2.8170	2.8042
October	3.1392	2.6728	1.3583	4.2575	2.8045
November	3.1151	2.5726	1.2276	3.0487	2.8651
December	2.8004	2.5274	1.2596	2.8556	3.0083

(Honeywell 2016b)

Table 3.4-2
Surface Water Withdrawal, 2010

Usage	Surface Water Withdrawal Quantity (MGD)	
	Massac County, IL	McCracken County, KY
Public supply	0.00	7.96
Domestic self-supply	0.00	0.00
Industrial self-supply	0.00	15.63
Irrigation	0.00	0.07
Livestock	0.00	0.09
Mining	0.00	0.00
Aquaculture	0.00	0.00
Thermoelectric, once through	652.89	755.00
Thermoelectric, closed loop	0.00	0.00
Total Withdrawals	**652.89**	**770.79**

(USGS 2016c; USGS 2016d)

Table 3.4-3a
NPDES Monitoring Data – Outfall 002 BOD

Monitoring Period	Maximum Quantity[a]	Annual Average Quantity[a]	Maximum Concentration[b]	Annual Average Concentration[b]
2010	1356.841	187.966	37.00	6.22
2011	517.964	118.187	18.00	4.65
2012	487.083	112.384	29.00	7.73
2013	428.453	96.596	21.00	5.49
2014	748.808	184.252	33.00	7.79

(Honeywell 2016b)

a. BOD in pounds per day is based on the following formula: (($BOD_{(mg/L)}$ / 453592.4) / 0.2641721) * ($Qe_{(MGD)}$ * 1,000,000).

b. Quantities in mg/L.

Qe = effective flowrate

Table 3.4-3b
NPDES Monitoring Data – Outfall 002 pH

Monitoring Period	Maximum	Average
2010	8.21	7.47
2011	8.22	7.17
2012	7.07	6.61
2013	8.22	7.03
2014	7.86	7.11

(Honeywell 2016b)

Table 3.4-3c
NPDES Monitoring Data – Outfall 002 TSS (Combined Effluent)

Monitoring Period	Maximum Quantity[a]	Annual Average Quantity[a]	Maximum Concentration[b]	Annual Average Concentration[b]
2010	441.701	101.904	15.00	3.49
2011	316.534	88.859	11.00	3.55
2012	652.724	73.818	72.00	4.63
2013	3241.713	206.966	149.00	11.17
2014	140.703	38.339	6.00	1.65

(Honeywell 2016b)

a. TSS in pounds per day is based on the following formula: $((TSS_{(mg/l)} / 453592.4) / 0.2641721) * (Qe_{(MGD)} * 1,000,000)$.

b. Quantities in mg/L.

Qe = effective flowrate

Table 3.4-3d
NPDES Monitoring Data – Outfall 002 TSS (Process Location)

Monitoring Period	Maximum Quantity[a]	Annual Average Quantity[a]	Maximum Concentration[b]	Annual Average Concentration[b]
2010	791.215	209.822	26.87	7.08
2011	586.641	150.957	20.39	5.96
2012	681.161	95.465	49.21	5.33
2013	4579.078	302.712	210.47	14.44
2014	225.681	62.126	9.62	2.58

(Honeywell 2016b)

a. TSS in pounds per day is based on the following formula: $((TSS_{(mg/l)} / 453592.4) / 0.2641721) * (Qe_{(MGD)} * 1{,}000{,}000)$.

b. Quantities in mg/L.

Qe = effective flowrate

Table 3.4-3e
NPDES Monitoring Data – Outfall 002 Total Fluoride

Monitoring Period	Maximum Quantity[a]	Annual Average Quantity[a]	Maximum Concentration[b]	Annual Average Concentration[b]
2010	432.623	97.234	15.96	3.28
2011	204.157	76.766	8.90	3.12
2012	287.003	63.394	11.60	3.06
2013	172.937	86.674	26.00	3.96
2014	654.981	117.555	28.00	4.98

(Honeywell 2016b)

a. Quantities in pounds per day.

b. Quantities in mg/L.

Table 3.4-3f
NPDES Monitoring Data – Outfall 002 Total Uranium (U_3O_8)

Monitoring Period	Annual Average Quantity[a]	Maximum Concentration[b]	Annual Average Concentration[b]	Minimum Concentration[b]
2010	55.173	17.052	1.754	0.590
2011	46.080	12.613	1.324	0.493
2012	18.671	6.138	1.025	0.342
2013	26.751	8.270	0.843	0.332
2014	30.919	8.999	1.147	0.368

(Honeywell 2016b)

a. Quantities in pounds per day.

b. Quantities in mg/L.

Table 3.4-4
NPDES Excursions 2010–2014

Date	Description
May 2014 August 2014	TSS excursions: The TSS excursions were attributed to stormwater runoff mixing with sediment entering the storm sewers. Controls such as additional sediment filters and discharging wastewater to ponds 3 and 4 were enacted to minimize the potential for additional excursions.
January 2014 February 2014	Fluoride excursions: The fluoride excursions were attributed to leaking trenches and the associated sump in GF2, cell rooms D and E. The trenches and sump were replaced in February 2014.
November 2013	Fluoride excursions: The fluoride excursions were attributed to leaking trenches and the associated sump in GF2, cell rooms D and E. The trenches and sump were replaced in February 2014.
August 2012	TSS excursions: The TSS excursions were attributed to stormwater runoff mixing with sediment entering the storm sewers. Controls such as additional sediment filters and discharging wastewater to ponds 3 and 4 were enacted to minimize the potential for additional excursions.
April to August 2010	Temperature excursions: Several temperature excursions were reported in 2010. In the current NPDES permit, the IEPA indicated MTW's discharge will not impact the temperature of the Ohio River and the requirement to monitor for temperature at the river was deleted.

(Honeywell 2016c)

Table 3.4-5
Clean Water Act, Section 303(d) Information on the Ohio River in Massac County, IL

Site Name	Hydrologic Unit Code	Assessment ID	Water Size	Designated Uses	Cause
Ohio River	514020607	IL_A-920-981	60.13	Fish consumption Primary contact recreation	Dioxin Mercury Polychlorinated biphenyls Fecal coliform
New Columbia Ditch	None listed	IL_ADCD-01	10.12	None listed	Alteration in stream-side or littoral vegetative covers Changes in stream depth and velocity patterns Loss of instream cover

(IEPA 2014b)

Table 3.4-6
Upstream Water Quality Sampling Data, Paducah, KY (Sheet 1 of 2)

Date	Flow (cfs)[a]	TSS (mg/L)	Sulfate((mg/L)	Hardness (mg/L)	Phosphorus (mg/L)	TOC (mg/L)	Nitrogen			Chlorides (mg/L)	Phenolics (µg/L)[b]
							Ammonia (mg/L)	Nitrate/Nitrite (mg/L)	TKN (mg/L)		
1/12/2010	45,000	7	16	68	0.074	2.59	0.04	0.502	0.521	10	<5
3/24/2010	30,000	7.4	12	76	1.12	2.7	<0.03	0.378	0.606	10	<5
5/12/2010	140,000	10.7	7	40	0.193	4.33	0.05	0.231	0.668	6	<5
7/14/2010	25,000	6.5	10.2	52	0.05	2.64	0.03	<0.1	0.247	2	<5
9/8/2010	25,000	5.2	12.2	56	0.012	3.55	0.04	<0.1	1.02	10	<5
11/3/2010	27,000	8	15.6	64	0.1	2.49	0.04	0.169	0.48	18	<5
1/27/2011	58,000	8.8	15.9	76	0.086	2.2	0.04	0.409	0.568	16	<5
3/16/2011	134,000	11	14.5	76	0.07	1.6	0.05	0.475	0.552	12	<5
5/24/2011	50,000	8.25	11.8	68	0.054	2.18	0.05	0.324	0.567	8	<5
7/13/2011	25,000	10	9.2	46	0.06	2.49	0.11	0.11	0.29	9	<5
9/8/2011	46,000	10	9.91	56	0.056	2.38	0.03	0.13	0.09	13.5	<5
11/16/2011	47,000	5	12.4	66	0.079	2.79	0.04	0.42	0.19	11.9	7
1/10/2012	66,000	6	11.3	79.5	0.083	2	0.099	0.58	0.15	12.4	<5
3/8/2012	94,000	15	28	104	0.04	1.8	0.14	0.41	0.36	4.6	7.5
5/24/2012	14,000	8	20.3	66.4	0.029	1.7	<0.03	0.09	<0.1	11.6	<0.01
7/12/2012	18,000	<5	17.7	56.5	0.073	2.1	0.047	0.12	0.24	12.9	6.5
9/12/2012	18,000	<5	14.7	66.3	0.049	2.3	0.035	0.17	<0.1	13.8	<0.01
11/14/2012	32,000	7	15.6	75.9	<0.01	2.5	<0.03	0.31	<0.1	14.6	<0.01
1/29/2013	176,000	17	16.1	63.8	0.073	2.6	<0.03	0.43	<0.1	7.6	<0.01
3/26/2013	70,000	<5	11.6	69.1	0.024	2.2	<0.03	0.45	0.45	8.2	<0.01

Table 3.4-6
Upstream Water Quality Sampling Data, Paducah, KY (Sheet 2 of 2)

Date	Flow (cfs)[a]	TSS (mg/L)	Sulfate (mg/L)	Hardness (mg/L)	Phosphorus (mg/L)	TOC (mg/L)	Nitrogen			Chlorides (mg/L)	Phenolics (µg/L)[b]
							Ammonia (mg/L)	Nitrate/Nitrite (mg/L)	TKN (mg/L)		
5/7/2013	173,000	6	12.4	64	0.043	2.1	<0.03	0.32	0.26	6	<0.01
7/24/2013	77,000	14	14	67.7	0.057	2.1	<0.03	0.15	0.27	6.8	<0.01
9/25/2013	42,000	11	12.3	55.2	0.074	2.4	<0.03	0.15	0.48	9.1	<0.01
11/19/2013	38,000	<5	13.3	71.1	0.046	1.8	<0.03	0.25	0.4	12.8	<0.01
1/21/2014	121,000	10	13.9	65	0.031	2	<0.03	0.4	0.42	7.6	<0.01
3/18/2014	59,000	22	11.9	69.5	0.018	2.5	0.036	0.37	0.39	7.9	<0.01
5/28/2014	15,000	14	10.4	58.3	0.033	2.1	<0.03	0.13	0.35	8.1	<0.01
7/16/2014	36,000	9.6	67.8	152	0.068	2.61	0.04	1.35	0.624	11.4	<5
9/18/2014	31,000	6.25	13.8	62.5	0.092	2.46	0.05	0.183	0.427	16.2	<5
11/18/2014	49,000	4.25	13.8	80	0.081	2.49	0.04	0.42	0.302	12.5	<5

(ORSANCO 2016a)

a. Cubic feet per second

b. Micrograms per liter.

Table 3.4-7
Number of Miles Within the 55.2-Mile Segment Attaining Designated Uses

Criteria	Fully Supporting (Good Water Quality)	Not Supporting (Poor Water Quality)	Unassessed	Partially Supporting (Fair Water Quality)	Cause of Impairment
Aquatic life use	55.2	0.0	0.0	0.0	
Public water supply use	55.2	0.0	0.0	0.0	
Contact recreation use	55.2	0.0	0.0	0.0	
Fish consumption	0.0	55.2	0.0	0.0	Polychlorinated biphenyls Dioxin

(ORSANCO 2014)

Note: The river stream segment is between Ohio River miles 925.8 to 981.0.

Table 3.4-8
Groundwater Withdrawals, 2010

Usage	Groundwater Withdrawal Quantity (MGD)	
	Massac County, IL	McCracken County, KY
Public supply	2.80	0.40
Domestic self-supply	0.07	0.08
Industrial self-supply	3.79	0.43
Irrigation	4.44	0.09
Livestock	0.12	0.01
Mining	0.00	0.00
Aquaculture	0.00	0.00
Thermoelectric, once through	1.40	0.00
Thermoelectric, closed loop	0.00	0.00
Total Withdrawals	12.62	1.01

(USGS 2016c; USGS 2016d)

Table 3.4-9
Required IDPH Drinking Water Monitoring

Analysis	Number of Sample Sites Required	Frequency	Due Date
Bacteria	1	Annually	6/2016
Copper and lead	5	Every three (3) years	12/31/2016
Arsenic	1	Annually	12/31/2016
Inorganic compounds (IOCs)	1	Every nine (9) years	12/31/2019
Synthetic organic compounds (SOCs)	1	Every nine (9) years	12/31/2019
Volatile organic compounds (VOCs)	1	Annually	12/31/2016

(IDPH 2015)

Table 3.4-10a
Laboratory Analysis of Groundwater at the Taps (Radiological)

Sample Location	Date	Alpha Activity[a]	Alpha Error[a]	Beta Activity[a]	Beta Error[a]
MCL		**15**	**NS**	**15**	**NS**
Lunch Room (LUNCH)					
	7/21/2010	< 1.2	2.1	< 0.7	1.9
	4/6/2011	< 3.16	2.07	< 4.16	2.65

(Honeywell 2016d; IEPA 2016)

a. Quantities in picocuries per liter (pCi/L).

NS = not specified.

Table 3.4-10b
Laboratory Analysis of Groundwater at the Taps, IOCs and Microbial (Sheet 1 of 2)

Sample Location	Date	Arsenic (mg/L)	Copper (mg/L)	Lead (mg/L)	Cryptosporidum (oocysts/L)[(a)]	Giardia Lamblia (cysts/L)[(b)]	Total Coliform (CFU/100 mL)[(c)]
MCL		**0.01**	**1.3**	**0.015**	**NS**	**NS**	**NS**
Administration Building (ADMIN)							
	9/24/2010	ND	0.131 J	0.0074 J			
	7/9/2014	0.00037	0.032	0.00046			
Feed Materials Building (FMB)							
	9/24/2010	ND	0.0124 J	0.0081 B J			
	9/17/2013	ND	0.0057	0.00089			
Laboratory Building (LAB)							
	9/24/2010	ND	0.034 J	0.0024 B J			
	7/11/2014	0.00037	0.0005	0.000063			
Lunch Room (LUNCH)							
	7/21/2010				ND	ND	ND
	9/24/2010	ND	0.145 J	0.0021 B J			
	4/6/2011						ND
Fluorine Plant (GF)							
	9/24/2010	ND	0.221 J	0.0039 J			
	9/17/2013	ND	0.150	0.0033			
	7/9/2014	0.00037	0.100	0.00025			

Table 3.4-10b
Laboratory Analysis of Groundwater at the Taps, IOCs and Microbial (Sheet 2 of 2)

Sample Location	Date	Arsenic (mg/L)	Copper (mg/L)	Lead (mg/L)	Cryptosporidum (oocysts/L)[a]	Giardia Lamblia (cysts/L)[b]	Total Coliform (CFU/100 mL)[c]
MCL		**0.01**	**1.3**	**0.015**	**NS**	**NS**	**NS**
Nuclear Compliance Trailer (NCT)							
	3/17/2011	ND	0.0048	0.00018 J			
	9/17/2013	ND	0.27	0.0014			
Maintenance Building (MAINT)							
	9/17/2013	ND	0.045	0.00055			
Environmental Protection Facility (EPF)							
	9/17/2013	ND	0.0067	0.00028			

(Andrews 2013; Honeywell 2016d; Honeywell 2016e; IEPA 2016; TAL 2011a)

J = The associated method blank contains the target analyte at a reportable level.

B = Estimated result. Result is less than the reporting limit.

ND = none detected; NS = not specified; Shaded = not analyzed.

a. Oocysts per liter.

b. Cysts per liter.

c. Colony forming units per 100 milliliters.

Table 3.4-11a
Analysis of Compliance Parameters in Deep Water Wells (Radiological)

Sample Location	Date	Alpha Activity[a]	Alpha Error[a]	Beta Activity[a]	Beta Error[a]
MCL		15	NS	15	NS
Sanitary Well					
	2/9/2010	< 1.3	< 1.4	< 1.2	< 1.1
	5/13/2010	< 0.6	1.5	< 2.8	2.3
	7/21/2010	< 1.3	1.8	< 0.3	2.4
	10/7/2010	< 0.6	1.2	< 0.32	0.59
	4/6/2011	< 3.09	1.68	< 3.93	2.52
	9/6/2011	< 2.25	1.41	< 3.23	2
	10/5/2011	< 1.7	1.28	< 3.04	1.85
Process Well No. 3					
	4/8/2011	< 3.07	1.67	< 4.06	2.53
	9/6/2011	< 2.37	1.47	< 2.37	1.47
	10/5/2011	< 1.59	1.19	< 3.27	2.05

(Honeywell 2016d; IEPA 2016)

NS = not specified

a. Quantities in pCi/L.

Table 3.4-11b
Analysis of Compliance Parameters in Deep Water Wells (IOCs and Microbial)

Sample Location	Date	Arsenic (mg/L)	Copper (mg/L)	Lead (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Cryptosporidum (oocysts/L)	Giardia Lamblia (cysts/L)	Total Coliform (CFU/100 mL)
MCL		**0.01**	**1.3**	**0.015**	**10**	**1**	**NS**	**NS**	**NS**
Sanitary Well									
	2/9/2010				0.50	ND	ND	ND	ND
	5/13/2010				0.43	ND	ND	ND	
	7/21/2010						ND	ND	2
	10/7/2010								4
	4/6/2011								ND
	9/6/2011				0.45	ND	ND	ND	3
	10/5/2011						ND	ND	ND
	2/9/2012				0.5	ND			ND
	11/28/2012				0.4	ND			
Process Well No. 3									
	3/17/2011	0.00093 J	< 0.001	0.000085 J	0.47	ND	ND	ND	1
	4/7/2011								0
	9/6/2011				0.37	ND	ND	ND	23
	10/5/2011						ND	ND	0
	2/9/2012								0
	8/28/2014	ND	0.0016	0.0046					

(Honeywell 2014a; Honeywell 2016d; IDPH 2012; IEPA 2016; TAL 2011a; TAL 2011b; TAL 2012; Teklab 2011; Teklab 2012)
J = The associated method blank contains the target analyte at a reportable level.
ND = none detected; NS = not specified; Shaded = not analyzed.

Table 3.4-12
Historical RCRA Compliance Monitoring Data – Alpha and Beta Activity (Sheet 1 of 3)

Well ID	Year	Average Alpha Activity[(a)]	Maximum Alpha Activity[(a)]	Alpha Error[(a)]	Average Beta Activity[(a)]	Maximum Beta Activity[(a)]	Beta Error[(a)]
G101 (Background Well)							
	2010	3.986	6.400	2.600	2.414	5.000	1.700
	2011	1.900	2.890	1.590	4.201	5.970	1.240
	2012	1.109	1.480	0.578	3.099	4.170	0.863
	2013	0.869	0.869	0.557	2.619	3.340	0.898
	2014	< 2.29	< 2.29	1.550	2.630	3.070	2.020
G102							
	2010	3.770	5.500	2.800	2.307	3.300	1.800
	2011	2.687	4.170	1.960	3.570	6.020	1.370
	2012	1.050	1.050	0.571	2.752	3.600	0.971
	2013	< 2.49	< 2.49	1.470	2.440	3.390	0.907
	2014	< 2.28	< 2.28	1.330	2.877	3.500	1.130
G103							
	2010	6.320	10.000	4.400	2.230	3.400	1.900
	2011	2.018	3.040	1.870	3.216	3.710	1.300
	2012	1.191	1.400	0.646	3.121	5.690	1.130
	2013	< 0.98	< 0.98	0.622	2.759	3.680	0.953
	2014	< 2.99	< 2.99	2.140	2.999	3.930	1.590
G105							
	2010	4.000	6.200	2.400	2.199	3.900	1.500
	2011	4.941	8.020	3.160	5.857	8.270	1.270
	2012	1.501	3.980	0.968	4.567	10.600	1.330
	2013	1.372	1.790	0.719	3.537	6.220	0.983
	2014	< 1.94	< 1.94	1.610	2.586	4.040	1.210

Table 3.4-12
Historical RCRA Compliance Monitoring Data – Alpha and Beta Activity (Sheet 2 of 3)

Well ID	Year	Average Alpha Activity[a]	Maximum Alpha Activity[a]	Alpha Error[a]	Average Beta Activity[a]	Maximum Beta Activity[a]	Beta Error[a]
G106							
	2010	3.267	4.700	2.200	2.448	5.200	1.500
	2011	1.506	1.960	0.724	3.824	5.350	0.988
	2012	2.366	3.600	1.060	4.223	10.300	1.270
	2013	< 1.02	< 1.02	0.618	2.477	3.960	0.837
	2014	< 1.98	< 1.98	1.080	2.311	3.370	1.340
G107							
	2010	5.250	8.200	3.000	3.810	6.000	1.300
	2011	< 2.91	< 2.91	2.390	2.377	2.820	0.910
	2012	< 1.32	< 1.32	0.693	2.664	3.620	1.090
	2013	< 0.951	< 0.951	0.645	2.292	2.950	0.863
	2014	< 3.36	< 3.36	1.710	2.738	3.840	1.370
G108							
	2010	9.567	15.100	3.600	3.698	7.700	1.400
	2011	< 2.77	< 2.77	1.880	2.041	2.470	0.893
	2012	< 1.15	< 1.15	0.631	2.038	2.770	0.846
	2013	< 0.851	< 0.851	0.555	1.972	3.000	0.848
	2014	< 1.97	< 1.97	1.010	2.097	2.810	1.160
G109							
	2013	1.463	2.200	0.813	3.706	5.950	1.030
	2014	< 2.23	< 2.23	1.230	3.205	4.320	1.400
G1B7							
	2013	1.443	2.140	0.837	3.898	4.890	2.870
	2014	< 2.27	< 2.27	1.380	3.433	3.740	1.270

Table 3.4-12
Historical RCRA Compliance Monitoring Data – Alpha and Beta Activity (Sheet 3 of 3)

Well ID	Year	Average Alpha Activity[a]	Maximum Alpha Activity[a]	Alpha Error[a]	Average Beta Activity[a]	Maximum Beta Activity[a]	Beta Error[a]
R104							
	2010	10.175	21.200	5.300	4.253	10.300	3.100
	2011	3.787	4.790	1.950	3.940	5.840	1.860
	2012	1.098	1.200	0.686	3.373	5.400	0.737
	2013	< 1.28	< 1.28	0.809	3.078	4.960	0.948
	2014	< 1.96	< 1.96	1.140	2.678	3.550	1.320
R110 (Background Well)							
	2010	5.700	11.500	3.500	5.750	14.700	2.300
	2011	< 3.07	< 3.07	1.920	1.649	2.000	0.815
	2012	< 0.979	< 0.979	0.595	2.311	3.100	0.988
	2013	< 0.904	< 0.904	0.565	1.727	2.200	0.865
	2014	0.653	0.653	0.616	2.325	2.540	1.080

(Honeywell 2016f)
a. Quantities in pCi/L.

Table 3.4-13
Historical RCRA Compliance Monitoring Data – Fluoride, pH, and Specific Conductivity (Sheet 1 of 3)

Well ID	Year	Average Fluoride[a]	Maximum Fluoride[a]	Average pH[b]	Maximum pH[b]	Average Specific Conductivity[c]	Maximum Specific Conductivity[c]
G101 (Background Well)							
	2010	0.28	0.33	6.59	7.22	575	905
	2011	0.30	0.35	7.09	8.01	542	659
	2012	0.28	0.32	6.48	6.76	464	519
	2013	0.25	0.29	6.33	6.60	508	555
	2014	0.30	0.38	6.66	6.74	594	831
G102							
	2010	0.28	0.37	6.77	7.83	520	574
	2011	0.28	0.40	7.06	7.92	550	622
	2012	0.25	0.30	6.46	6.75	529	610
	2013	0.25	0.40	6.48	6.90	525	553
	2014	0.25	0.29	6.52	6.65	574	640
G103							
	2010	0.27	0.30	6.50	6.95	701	929
	2011	0.27	0.33	7.18	8.09	708	820
	2012	0.24	0.31	6.43	6.74	674	856
	2013	0.23	0.29	6.29	6.54	613	749
	2014	0.27	0.35	6.66	6.79	704	861
G105							
	2010	0.18	0.21	6.04	6.32	427	462
	2011	0.16	0.21	6.76	7.79	407	462
	2012	0.16	0.20	6.02	6.51	388	459
	2013	0.13	0.15	6.16	6.38	360	429
	2014	0.16	0.25	6.31	6.50	367	384

Table 3.4-13
Historical RCRA Compliance Monitoring Data – Fluoride, pH, and Specific Conductivity (Sheet 2 of 3)

Well ID	Year	Average Fluoride[a]	Maximum Fluoride[a]	Average pH[b]	Maximum pH[b]	Average Specific Conductivity[c]	Maximum Specific Conductivity[c]
G106							
	2010	0.26	0.28	6.54	6.72	474	482
	2011	0.23	0.28	6.95	7.22	491	513
	2012	0.22	0.27	6.15	6.69	487	499
	2013	0.21	0.24	6.43	6.63	490	508
	2014	0.25	0.31	6.52	6.75	490	546
G107							
	2010	0.24	0.28	6.25	6.63	561	709
	2011	0.21	0.24	6.88	7.55	578	695
	2012	0.21	0.25	6.51	6.71	610	754
	2013	0.20	0.23	6.26	6.53	549	686
	2014	0.24	0.31	6.47	6.67	569	663
G108							
	2010	0.19	0.21	6.47	7.07	513	578
	2011	0.19	0.27	7.02	8.04	549	617
	2012	0.17	0.20	6.00	6.62	525	589
	2013	0.16	0.20	6.12	6.50	494	503
	2014	0.20	0.31	6.50	6.63	538	626
G109							
	2013	0.19	0.22	6.35	6.53	519	569
	2014	0.22	0.26				
G1B7							
	2013	0.21	0.23				
	2014	0.24	0.26				

Table 3.4-13
Historical RCRA Compliance Monitoring Data – Fluoride, pH, and Specific Conductivity (Sheet 3 of 3)

Well ID	Year	Average Fluoride[a]	Maximum Fluoride[a]	Average pH[b]	Maximum pH[b]	Average Specific Conductivity[c]	Maximum Specific Conductivity[c]
R104							
	2010	0.22	0.25	6.45	6.88	558	596
	2011	0.21	0.24	6.91	7.98	568	600
	2012	0.20	0.24	6.39	6.63	549	599
	2013	0.19	0.22	6.25	6.51	590	622
	2014	0.26	0.34	6.48	6.53	545	564
R110 (Background Well)							
	2010	0.15	0.20	6.01	6.52	536	613
	2011	0.15	0.22	6.91	7.88	511	577
	2012	0.15	0.20	6.32	6.80	543	622
	2013	0.11	0.12	5.99	6.20	576	610
	2014	0.13	0.16	6.23	6.34	621	660

(Honeywell 2016f)
a. Quantities in mg/L.
b. Quantities in SU.
c. Quantities in micromhos per centimeter (µmhos/cm).
Shaded = not analyzed.

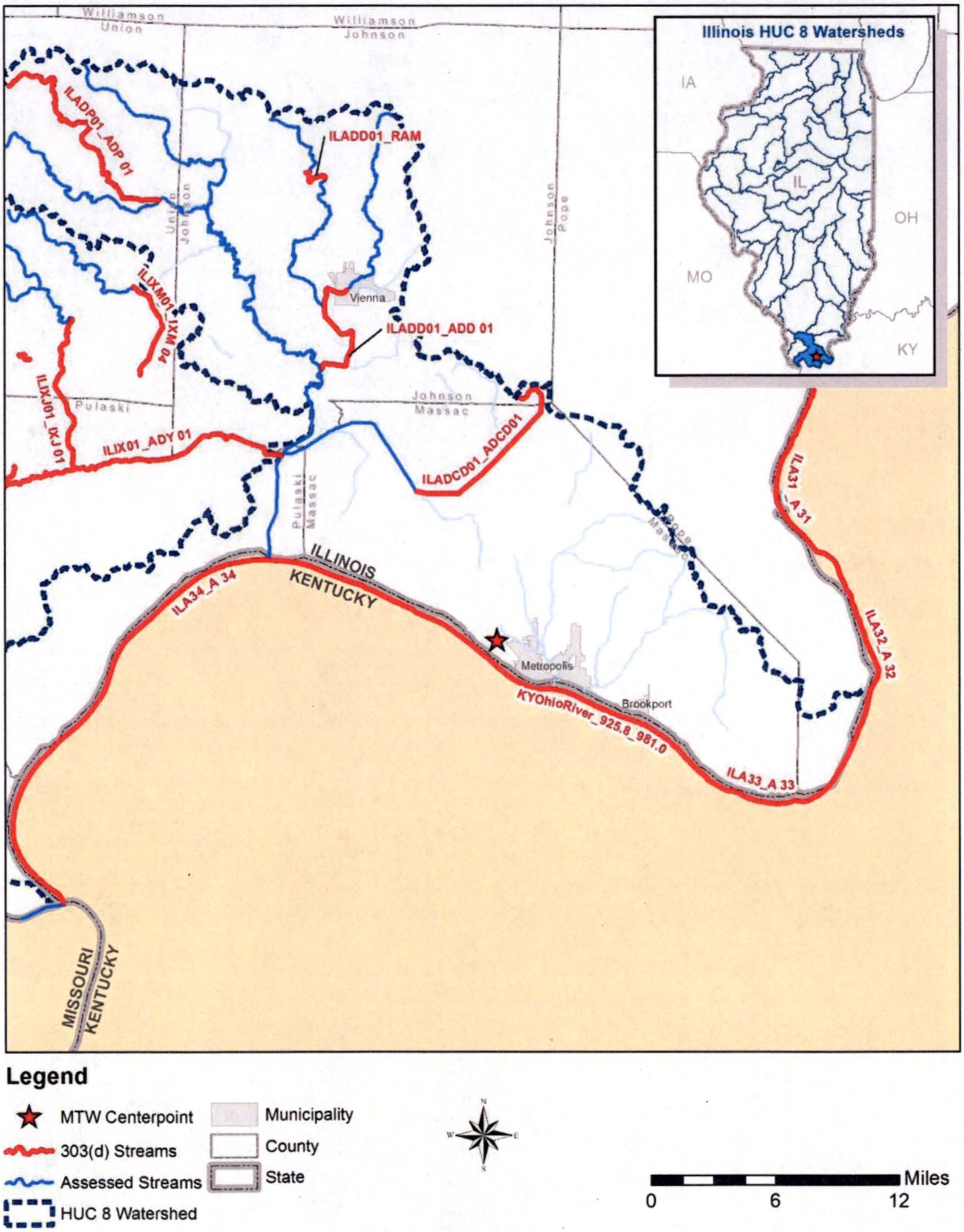
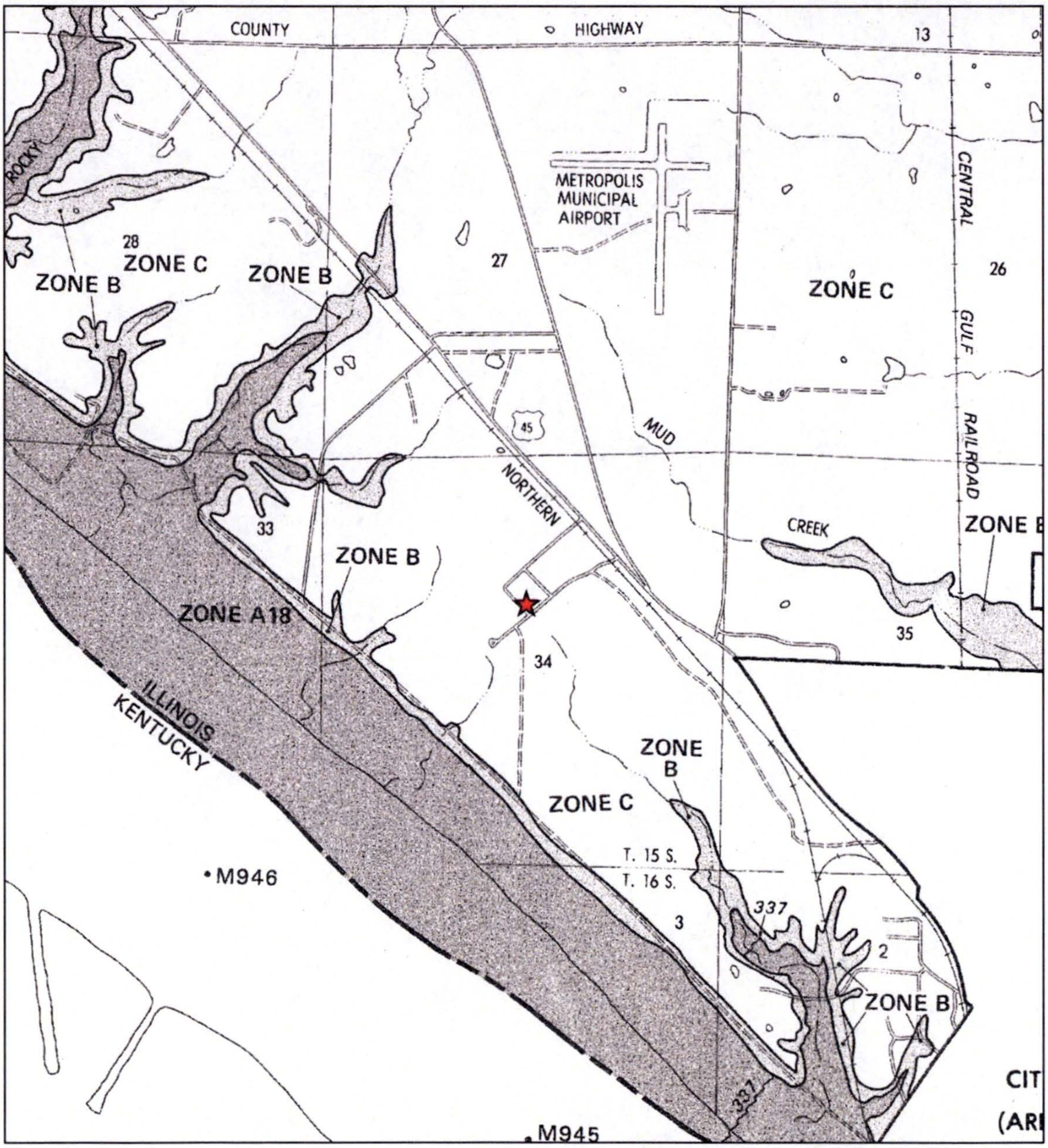


Figure 3.4-1
Current 303(d) Listed Waters



Legend

★ MTW Centerpoint

Feet
0 2,000 4,000

Figure 3.4-2
FEMA Map

3.5 Ecological Resources

In characterizing ecological resources for the purposes of this application, it is important to differentiate between resources in the general area of the MTW site and those that actually occur within the restricted area.

When MTW was built, all natural vegetation was cleared within the restricted area to permit the construction of buildings, waste ponds, and other plant-related facilities. However, MTW occupies only about five percent of applicant's property, which has otherwise remained mostly undeveloped through the years.

Additionally, review of topographic maps suggests that the MTW site was historically devoid of aquatic features of interest, including ephemeral streams. Accordingly, like terrestrial habitats and biota, MTW has had little or no effect on the area's aquatic biotic resources. The following discussions, therefore, focus on characterizing the ecological features of the general area that, unless otherwise noted, are universally absent from the restricted area.

3.5.1 General Description

Massac County is located in the coastal plain natural division of extreme southern Illinois. This division is characterized by swampy, forested bottomlands and low clay and gravel hills. It is the northernmost extension of the Gulf of Mexico plain province of North America. Bald cypress-tupelo swamps are a unique feature of the area, as are many southern animals such as bird-voiced tree frog and cottonmouth. The floodplain at the confluence of the Mississippi and Ohio rivers and Cache and Ohio rivers host rich bottomland forests, while the "Cretaceous Hills" section is a steep to rolling area of unconsolidated sand, gravel, and clay hosting Cretaceous period fossil beds. (IDNR 2005)

Illinois forests are typically assigned to the eastern broadleaf forest ecoregion as defined by Bailey (1980) that extends westward from the Appalachian Mountains to northwestern Minnesota on the north and the northeastern corner of Oklahoma to the south. Tall broadleaf deciduous trees dominate most of the landscape, interspersed with mixed evergreen/deciduous forests in the northern and southern regions of Illinois.

The MTW site is located in the EPA's Level IV Ecoregion 72a, the Wabash-Ohio bottomlands, which is a sub-region of Ecoregion 72, interior river valleys and hills. Ecoregion 72 in Illinois is comprised of old till plains, hills, forested river bluffs, major rivers, and valleys containing levees, oxbow lakes, islands, and scattered sand sheets and dunes. The interior river valleys and hills ecoregion is a transitional area between the more forested Ozark highlands, and the flatter, less dissected, more extensively cropped, and much less forested central corn belt plains. Within and between the major river systems of Ecoregion 72, considerable variability in water quality, stream conditions, and aquatic biota occur, and fish species can be limited to certain river systems. Today, less than half of Ecoregion 72 is in cropland, whereas about 30 percent is in pastureland, and the remainder is in forest. Forests are now most commonly found on steeper slopes. Patterns of land use are more varied in Ecoregion 72 than in adjacent ecoregions to the north, east, and west, where corn and soybean farming is extensive. Nearly all of the flat, cultivated uplands in Ecoregion 72 have been tiled and tied into the stream system to improve drainage. (Omernik and Griffith 2008)

The Wabash-Ohio bottomlands sub-region is found along the lower Wabash and Ohio rivers. Ecoregion 72a is composed of poorly drained floodplains, low terraces, oxbow lakes, meander scars, sloughs, and scattered low dunes, and was once covered by bottomland forests, wet and mesic prairies, marshes, and swamps. Bottomland forests contain pin oak (*Quercus palustris)*, bur oak (*Q. macrocarpa*), Shumard oak (*Q. shumardii*), swamp white oak (*Q. bicolor*), and other species with affinities to more southerly ecoregions. Today, some woodlands, marshes, and swamps remain, but most have been cleared and drained for agriculture. Land use is affected by seasonally high water tables and localized flooding. (Omernik and Griffith 2008) Floodplain forests generally support a relatively sparse understory due to frequent inundation (NRC 2006).

The electrical transmission line corridor crossing the MTW site southwest of MTW is artificially maintained and supports only grasses such as brome (*Bromus* sp.), broom sedge (*Andropogon virginicus),* and bluegrass (*Poa pratensis*), and low-growing shrubs like sumac (*Rhus* sp.) and Allegheny blackberry (*Rubus allegheniensis)* (NRC 2006).

3.5.2 Important Species

NUREG-1748 (NRC 2003) defines "important species." Included are those that are rare (i.e., listed as threatened or endangered at either the state or federal level, or proposed or a candidate for listing). Also included are those that are commercially or recreationally valuable, essential to the maintenance or survival of the above, or that serve as biological indicators.

Important habitats include wildlife sanctuaries and refuges, habitats identified by state or federal agencies as rare or unique, wetlands and floodplains, and "critical habitats" for listed species.

3.5.2.1 <u>Endangered and Threatened Species</u>

The Endangered Species Act of 1973 (ESA) prohibits any person from taking (harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, relocating, or collecting or attempting to engage in any such conduct) any federally listed threatened or endangered species. Significant habitat modification or degradation that results in death or injury to federally protected species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering is also prohibited. Administration and enforcement of the ESA are the responsibilities of the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service.

Chapter 8, Part 341 of the Illinois Endangered Species Act (IESA) sets protections for state-listed species. The take, possession, transportation, or sale of any animal species designated by Illinois state law as endangered or threatened is prohibited without issuance of a permit. The listing and recovery of state-listed endangered species is the responsibility of the IDNR wildlife division. Unlike the ESA, which sets protections for federally protected species habitats, the IESA only prohibits impacts to designated essential habitats for state-listed species. Habitat for state-listed species only receives special protections under these regulations if it has been specifically designated as essential habitat.

The IDNR's Office of Realty and Environmental Planning administers the endangered and threatened species consultation program. Consultation with the IDNR is only required when the proposed action will change existing environmental conditions; for instance, anything that disturbs the land, water, or air. The State of Illinois lists 480 plant and animal species as endangered or threatened (IESPB 2015). Of these, 356 are classified as endangered and 124 are classified as threatened (see Table 3.5-1).

Table 3.5-2 lists all federally listed threatened and endangered species and all state-listed species documented as occurring in Massac County.

A total of eight federally listed species are documented to occur in Massac County, Illinois. Of these, one endangered species, the least tern, is a transitory migrant; six species are mussels: the federally endangered spectaclecase, pink mucket pearlymussel, orangefoot pimpleback, sheepnose, fat pocketbook pearlymussel, and the federally threatened rabbitsfoot (IDNR 2014; USFWS 2015). None of these species are located on the MTW site. The remaining species, the federally threatened northern long-eared bat, is listed by the USFWS as potentially occurring in Massac County (USFWS 2015), but the IDNR has no record of occurrence for this species in Massac County (IDNR 2014). The northern long-eared bat has designated critical habitat (DCH) in Illinois, although no DCH is located in Massac County.

3.5.2.2 Other Important Species

Other important species include recreational game animals and sport fish regulated by the IDNR. Note that scientific names are not included in this description because the species named are generically grouped. In the area of the MTW site, regulated species potentially include small game such as rabbits, squirrels, and woodchucks, and resident game birds like pheasant, dove, and quail (IDNR 2015).

Examples of important woodland game species are white-tailed deer and wild turkeys. While also federally protected, state hunting regulations cover migratory game birds like dove, ducks, geese, woodcock, and crows. Finally, furbearers like raccoon, opossum, weasel, mink, and muskrat are probably also hunted and trapped recreationally in the project area.

Protected aquatic life in Illinois includes recreationally important fish such as bass, muskies, northern pike, walleye, and sauger. Statewide sport fishing regulations also cover bullfrogs and turtles, excluding those protected by federal or state endangered species regulations (IDNR 2015).

Commercial fishing has been largely abandoned in the Ohio River (NRC 2006). Thus, there are no known important commercial species in the area, nor are there any references to designated biological indicators.

3.5.2.3 Important Habitats

Two natural areas occur within a five-mile radius of MTW. The first is the Mermet Lake Conservation Area, which contains the Mermet Swamp Nature Preserve. Under the jurisdiction of the Illinois Department of Conservation, it is about 3.5 miles northwest of MTW. The second is the West Kentucky Wildlife Management Area located across the Ohio River from MTW, approximately two miles southwest of MTW and adjacent to PGDP in Kentucky. (NRC 2006)

There are no other wildlife sanctuaries, refuges, or habitats identified by state or federal agencies as rare or unique in this area.

3.5.2.4 Floodplains and Wetlands

Wetlands and other waters of the United States are under the jurisdictional control of the U.S. Army Corps of Engineers (USACE), which regulates all activity resulting in discharge to and fill in jurisdictional waters. Wetlands are defined by the USFWS in Cowardin et al. 1992. Specific wetland criteria for the MTW area are identified in the *Corps of Engineers Wetlands Delineation Manual* (USACE 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plains Region* (USACE 2010). Areas meeting the criteria to be classified as wetlands are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation adapted for life in saturated soil conditions. Wetlands typically include swamps, marshes, bogs, and similar areas. No onsite wetland delineation per the manual or regional supplement has been conducted. No wetlands occur within the restricted area (NRC 2006).

Based on a review of USFWS National Wetland Inventory (NWI) maps, only one wetland is mapped on the MTW site: an approximately 150-foot wide wetland located on the banks of the Ohio River. This wetland is classified as a PFO1Ah (palustrine, forested, broad-leaved deciduous, temporary flooded, diked/impounded). No other wetlands are mapped by the NWI as occurring on the MTW site. (USFWS 2016a)

The MTW restricted area is situated atop a low bluff approximately 60 feet above the floodplain of the Ohio River. Based on a review of FEMA panel number 1704670075B, effective July 5, 1983, one portion of the MTW site is located in a FEMA-designated floodplain (FEMA 1983). An area measuring approximately 1,000 feet wide and located to the north of the Ohio River is in Zone B, the 500-year floodplain. However, no portion of the restricted area is located within a FEMA-designated floodplain. There is no record of flooding occurring on the MTW restricted area. Numerous flood control dams that regulate the flow of the Ohio River have reduced the threat of flooding. The nearest flood control structure is Lock and Dam No. 52 at Brookport, Illinois, about seven miles upstream from MTW.

Inspection of available aerial photographs (Figure 3.0-1) suggests that the area of the floodplain owned by Honeywell is largely cleared of natural vegetation. Although this area was farmed in the past, it is no longer farmed and is being allowed to return to more natural vegetation. In its original condition, this area likely supported a typical bottomland hardwood forest. Bottomland hardwood forests qualify as palustrine, forested, seasonally flooded wetlands.

3.5.2.5 Waters of the United States

Waters of the United States are broadly defined as waters that are, were, or could be used in interstate or foreign commerce. They include all waters subject to the ebb and flow of the tide, the territorial sea, interstate waters and wetlands, and all other waters (such as intrastate lakes, rivers, streams, and wetlands) if their use, degradation, or destruction could affect interstate or foreign commerce. Also included are tributaries to waters or wetlands identified above, and wetlands adjacent to these waters (40 CFR 230.3).

The Ohio River, which forms the southern boundary of the MTW site and is approximately 1,800 feet south of the restricted area, is a jurisdictional traditional navigable water and subject to regulation by the USACE. The MTW site is drained by four creeks that flow to the Ohio River. These creeks would be considered to have a significant nexus with a jurisdictional water of the U.S., and would be subject to the regulatory jurisdiction of the USACE. However none of the four creeks located on the property are located within the restricted area. These creeks are located in the undeveloped areas outside of the restricted area and would not be impacted from MTW activities that would fall under the purview of the USACE.

3.5.2.6 Critical Habitat

Three federally listed species are identified as having DCH in the State of Illinois: the rabbitsfoot mussel, Hine's emerald dragonfly, and the Indiana bat (USFWS 2015). The Indiana bat is not listed by the USFWS as potentially occurring in Massac County (USFWS 2015). Neither the Hine's emerald dragonfly nor the Indiana bat have DCH located within five miles of the MTW site.

Critical habitat for the rabbitsfoot, a federally threatened freshwater mussel, is located within the section of the Ohio River that borders the undeveloped portion of the property southwest of the restricted area. The rabbitsfoot usually occurs in shallow water areas along the bank and adjacent runs and shoals with reduced water velocity. Relicensing MTW with minor modifications to existing systems within the restricted area requires no additional destruction or modification of aquatic habitat. MTW will continue with its existing activities and not impact surrounding waters. All materials exiting the MTW site are regulated under MTW's existing NPDES permit.

3.5.3 Terrestrial Ecology

Typical animal species on the MTW site are those of old field and secondary-growth forests in Illinois. Birds and mammals associated with open habitat such as the transmission line corridors and the cultivated fields include bobwhite quail (*Colinus virginianus*), mourning dove (*Zenaidura macroura*), horned lark (*Eremophila alpestris*), groundhog (*Marmota monax*), deer mouse (*Peromyscus maniculatus*), and the eastern cottontail rabbit (*Sylvilagus floridanus*). (NRC 2006)

Common forest dwellers include the cardinal (*Richmondena cardinalis*), chickadee (*Parus* sp.), woodpeckers, eastern gray squirrel (*Sciurus carolinensis*), white-footed mouse (*Peromyscus leucopus*), and opossum (*Didelphis marsupialis*). As discussed in greater detail in Section 3.5.2.2, game animals, including white-tailed deer, wild turkey, cottontail rabbit, and doves, are considered important species for their value as recreational game animals and are regulated by the IDNR. Other common animals associated with the banks of the Ohio River include muskrats (*Ondatra zibethica*), raccoon (*Procyon lotor*), and a variety of turtles, water snakes, salamanders, and frogs. (NRC 2006)

The MTW site is located in a predominantly agricultural area. Approximately 65 percent of the land in Massac County is used for agricultural purposes, with corn, soybeans, and wheat as the principal cash crops, and beef cattle and hogs as principal livestock (NRCS 2009). The remaining lands are occupied by woodlands, idle farms, or urban areas. The nearest pastureland is located approximately 1.5 miles northeast of MTW and is used to graze beef cattle. The nearest dairy cattle are grazed approximately eight miles east of MTW. Much of the Ohio River floodplain in the vicinity of MTW is cultivated.

3.5.4 Aquatic Ecology

The aquatic biota of the Ohio River include algal plankton communities comprised of yellow-green (diatoms), green, and blue-green algae. Zooplankton communities consist primarily of rotifers. Benthic communities in the Ohio River are characterized by species adapted to both flowing and restricted circulation conditions, with crustaceans found in greater abundance in pooled areas behind dams than in the open river. Benthic invertebrate communities are not well-developed in the Ohio River, possibly because of the lack of suitable substrates, high turbidity, or unfavorable chemical environment. Chironomid larvae and turbificids often dominate the community in terms of numbers, and the asiatic clam (*Corbicula manilensis*) occurs in large quantities. Other common organisms include snails and leeches. (NRC 2006)

Forage fish that feed largely on detritus, plant material, and bottom-dwelling invertebrates are abundant in the Ohio River. These include the emerald shiner (*Notropis atherinoides*), gizzard shad (*Dorosoma cepedianum*), and common carp (*Cyprinus carpio*). Although commercial fishing has largely been abandoned on the Ohio River, sport fishing is still fairly popular. Commonly caught species include channel catfish, white bass, and bluegill. Invasive species, including Asian carp and Zebra mussels, have invaded the Ohio River in recent years. (NRC 2006)

The Ohio River Basin has changed greatly in the past 100 years due to the construction of locks and dams and the degradation of water quality associated with industrial and municipal discharges and agricultural runoff. Large-scale damming has changed the habitat and hindered the migration of fish. Water quality changes have also produced adverse changes in fish populations. (NRC 2006)

No natural aquatic habitats occur within the restricted area.

Table 3.5-1
Summary of Illinois Threatened, Endangered, and Candidate Species

Taxa	State: E	State: T	Fed: E	Fed: T	Fed: C	Massac: E[(a)]	Massac: T[(a)]
Plants	251	73	1	8	0	0	0
Fish	19	16	1	0	0	0	0
Amphibians	3	6	0	0	0	0	0
Reptiles	10	8	0	0	1	0	0
Birds	24	7	2	1	0	2	0
Mammals	5	4	2	1	0	0	1
Invertebrates	44	10	13	1	1	7	1
Total	**356**	**124**	**19**	**11**	**2**	**9**	**2**

(IDNR 2014)

E = endangered; T= threatened; C = candidate

a. E= federally endangered confirmed in Massac County; T = federally threatened confirmed in Massac County.

Table 3.5-2
State and Federally Listed Threatened, Endangered, & Candidate Species in Illinois (Sheet 1 of 3)

Scientific Name	Common Name	Status[a]	Possible Occurrence in Massac County
Amphibians			
Cryptobranchus alleganiensis	Eastern hellbender	S-E	Extirpated
Hyla avivoca	Bird-voiced treefrog	S-T	Confirmed
Pseudemys concinna	River cooter	S-E	Confirmed
Birds			
Calidris canutus rufa	Rufa red knot	F-T	Unlikely
Charadrius melodus	Piping plover	F-E	Seasonal migrant
Gallinula chloropus	Common moorhen	S-E	Confirmed
Ictinia mississippiensis	Mississippi kite	S-T	Confirmed
Ixobrychus exilis	Least bittern	S-T	Confirmed
Lanius ludovicianus	Loggerhead shrike	S-E	Confirmed
Pandion haliaetus	Osprey	S-E	Confirmed
Nyctanassa violacea	Yellow-crowned night heron	S-E	Confirmed
Sternula antillarum	Least tern	F-E; S-E	Seasonal migrant
Tyto alba	Barn owl	S-E	Confirmed
Crustaceans			
Gammarus acherondytes	Illinois cave amphipod	F-E	Unlikely
Orconectes placidus	Bigclaw crayfish	S-E	Confirmed
Fish			
Lepomis miniatus	Redspotted sunfish	S-E	Confirmed
Notropis maculatus	Taillight shiner	S-E	Confirmed
Scaphirynchus albus	Pallid sturgeon	F-E	Unlikely
Noturus stigmosus	Northern madtom	S-E	Confirmed
Insects			
Lycaeides melissa samuelis	Karner blue butterfly	F-E	Extirpated
Ellipsaria lineolata	Butterfly (no common name)	S-T	Confirmed
Papaipema eryngii	Rattlesnake-master borer moth	F-C	Unlikely
Somatochlora hineana	Hine's emerald dragonfly	F-E; CHD	Unlikely

Table 3.5-2
State and Federally Listed Threatened, Endangered, & Candidate Species in Illinois (Sheet 2 of 3)

Scientific Name	Common Name	Status[a]	Possible Occurrence in Massac County
Mammals			
Myotis austroriparius	Southeastern myotis	S-E	Confirmed
Myotis grisescens	Gray bat	F-E	Unlikely
Myotis septentrionalis	Northern long-eared bat	F-T	Likely
Myotis sodalis	Indiana bat	F-E; DCH	Unlikely
Oryzomys palustris	Rice rat	S-T	Confirmed
Mussels			
Cumberlandia monodonta	Spectaclecase	F-E; S-E	Confirmed
Cyclonaias tuberculata	Purple wartyback	S-T	Confirmed
Cyprogenia stegaria (=C. irrorata)	Fanshell mussel	F- E	Unlikely
Elliptio crassidens	Elephant-ear	S-T	Confirmed
Epioblasma triquetra	Snuffbox	F-E	Unlikely
Fusconaia ebena	Ebonyshell	S-T	Confirmed
Lampsilis abrupta	Pink mucket pearlymussel	F-E	Confirmed
Lampsilis higginsi	Higgins eye pearlymussel	F-E	Unlikely
Ligumia recta	Black sandshell	S-T	Confirmed
Plethobasus cooperianus	Orangefoot pimpleback	F-E	Confirmed
Plethobasus cyphyus	Sheepnose	F-E; S-E	Confirmed
Pleurobema clava	Clubshell	F-E	Unlikely
Pleurobema cordatum	Ohio pigtoe	S-E	Confirmed
Potamilus capax	Fat pocketbook	F-E; S-E	Confirmed
Quadrula cylindrica	Rabbitsfoot	F-T; S-E, DCH	Confirmed
Plants			
Apios priceana	Price's potato bean	F-T	Unlikely
Asclepias meadii	Mead's milkweed	F-T	Unlikely
Boltonia decurrens	Decurrent false aster	F-T	Unlikely
Carex gigantea	Large sedge	S-E	Confirmed
Carex reniformis	Sedge (no common name)	S-E	Confirmed
Chamaelirium luteum	Fairy wand	S-E	Confirmed
Cimicifuga rubifolia	Appalachian bugbane	S-T	Confirmed
Cirsium pitcheri	Pitcher's thistle	F-T	Unlikely
Cyperus lancastriensis	Galingale	S-T	Confirmed

Table 3.5-2
State and Federally Listed Threatened, Endangered, & Candidate Species in Illinois (Sheet 3 of 3)

Scientific Name	Common Name	Status[a]	Possible Occurrence in Massac County
Plants (continued)			
Dalea foliosa	Leafy prairie clover	F-E	Unlikely
Eryngium prostratum	Eryngo	S-E	Confirmed
Euonymus americanus	American strawberry bush	S-E	Confirmed
Galactia mohlenbrockii	Boykin's dioclea	S-E	Confirmed
Halesia Carolina	Silverbell tree	S-E	Confirmed
Helianthus angustifolius	Narrow-leaved sunflower	S-T	Confirmed
Hymenopsis herbacea	Lakeside daisy	F-T	Unlikely
Iresine rhizomatosa	Bloodleaf	S-E	Confirmed
Isotria medeoloides	Small whorled pogonia	F-T	Unlikely
Lespedeza leptostachya	Prairie bush clover	F-T	Unlikely
Melanthera nivea	White melanthera	S-E	Confirmed
Melica mutica	Two-flowered melic grass	S-E	Confirmed
Nemophila triloba	Baby blue-eyes	S-E	Confirmed
Phaeophyscia leana	Lea's bog lichen	S-T	Confirmed
Planera aquatica	Water elm	S-T	Confirmed
Platanthera flava var. flava	Tubercled orchid	S-E	Confirmed
Platanthera leucophaea	Eastern prairie fringed orchid	F-T	Unlikely
Quercus phellos	Willow oak	S-T	Confirmed
Rhexia mariana	Dull meadow beauty	S-E	Confirmed
Styrax americana	Storax	S-T	Confirmed
Talinum parviflorum	Small flower-of-an-hour	S-T	Confirmed
Tilia heterophylla	White basswood	S-E	Confirmed
Reptiles			
Nerodia fasciata	Broad-banded watersnake	S-E	Confirmed
Sistrurus catenatus	Eastern massasauga	F-C	Unlikely
Thamnophis sauritus	Eastern ribbon snake	S-T	Confirmed
Snails			
Discus macclintocki	Iowa pleistocene snail	F-E	Unlikely

(IDNR 2014; USFWS 2015)

a. E = endangered: T = threatened; C = candidate; CHD = State of Illinois DCH; F = federal; S= state

3.6 Meteorology, Climatology, and Air Quality

The meteorology and climate of MTW near Metropolis, IL, was summarized in a 1995 environmental assessment (EA) (NRC 1995), and again in a 2006 EA (NRC 2006) Those reports used meteorological data from the National Weather Service (NWS) at Paducah, Kentucky, which is on the far bank of the Ohio River, just 6.8 miles south of the MTW site. It is reasonable to assume that the climate at Paducah adequately describes the weather at MTW. In this report, additional, more recent, data have been collected to ensure that the general climate remains consistent with that described in both the 1995[1] and 2006 EAs.

3.6.1 Description of the General Climate of the Region

The general description of the climate has not changed since either the 1995 or 2006 EAs were written. Borrowing from the text of the 2006 EA, the climate of the area can be described as characteristic of the humid continental zone, where the primary source of heat and moisture for western Kentucky and southern Illinois is the Gulf of Mexico.

The region has two predominant weather patterns that define the winter and summer circulation regimes. Winter is characterized by evenly distributed precipitation events and moderate diurnal changes in temperature. During the summer, frontal and pressure systems generally pass north of the region, resulting in a more tranquil weather pattern over the area.

Changes in the recent 20-year database (1995–2014) compared to the EA 30-year database (1951–1980) are modest. There is an increase in average temperature (+0.1°F) and annual rainfall (+9 percent). Extreme events in the 1951–1980 database (maximum and minimum temperatures, maximum rainfall, etc.) are comparable to the extreme events in the 1995–2014 database. No design basis impact is suggested by weather changes in the past few decades, but the slight increase in temperature and precipitation is consistent with other sources that evaluate global warming trends (IPCC 2001).

3.6.2 Temperatures

3.6.2.1 Dry Bulb Temperature

General measures of the 1995–2014 (new data) temperature data (NCDC 2016a) show values consistent with those evident from 1951–1980 (EA data). The average annual temperature in the new data was 58.0°F, little changed from the EA data value of 57.9°F. In the new data, the warmest month continues to be July (78.6°F in the new data, 79.3°F in the EA data) and the coolest, January (35.4°F in the new data, 34.3°F in the EA data). The maximum and minimum temperatures in the new data set (108°F and -8°F) are comparable to the temperature extremes of the EA data (106°F in 1952, and –12°F in 1951). In the EA data, it was reported that Paducah

[1] All references to the EA refer to the 1995 EA unless specified otherwise.

recorded 55 days per year on average with a high temperature above 32.2°C (approximately 90°F) in the years 1951 through 1980. The new data recorded the annual number of days with a high temperature equal to or exceeding 90°F as 47 days per year, on average. In the new data, the area had on average 12 days per year when the daily high temperature did not exceed freezing, which is the same as the 12 days per year in the EA data.

The conclusion is that the new data (NCDC 2016a) are not significantly different from the temperature data of the EA. Thus, Table 3.1 of the EA was updated by merging the 30-year EA dataset with the new 20-year dataset from the National Climatic Data Center (NCDC) to create Table 3.6-1 in this ER. For mean values, the value reported in Table 3.6-1 is the EA value multiplied by 30/50 plus the newer value multiplied by 20/50. For extreme values, both data sets were examined to find the limiting value. The result is not significantly different from the EA data.

Table 3.6-1 also includes heating days and cooling days. Heating days are defined as the sum in each month of all days with the average temperature (Tavg) below 65. This measure has been shown to be directly proportional to heating costs. Similarly, cooling days is the sum of all days (Tavg-65), and is proportional to air conditioning costs. The mean value for heating obtained with the new data was 4,044, compared to 4,130 in the EA data, giving a total mean for the 50 years of data of 4,096. This value is consistent with 30-year data available from the Kentucky Climate Center (KCC 2016), which is reproduced here as Figure 3.6-1.

To evaluate the possibility of ice formation in ponds and on rivers, the dry bulb data are used to calculate the accumulated freezing degree days (AFDD). AFFD is calculated using the method described in USACE report ERDC/CRREL TN-04-3 (USACE 2004). Freezing degree days (FDD) are first calculated for each day of the winter season as 32 degrees minus the average daily air temperature (in degrees Fahrenheit). A negative freezing degree day value represents a temperature warmer than freezing, while a positive freezing degree day represents temperatures below freezing. The FDD values for each day of the winter are summed to determine the net AFDD. The AFDD for each cold season are given in Table 3.6-2 (these data extend from January 1, 1995, to December 31, 2014, to capture 20 years). The 100-year recurrence was calculated by fitting the 20 years of data to the Gumbel distribution. Parameters for the Gumbel distributions were developed according to the method of moments as suggested by Wilks (1995) to develop the 100-year return value for AFDD shown in the table.

3.6.2.2 Wet Bulb Temperature and Humidity

Wet bulb and dew point data were obtained from the NCDC. These measures are not meaningful unless they are given along with the coincident dry bulb temperature. Table 3.6-3 contains the maximum wet bulb temperature along with its coincident dry bulb temperature from the NCDC database (NCDC 2016a).

Another common resource for wet bulb temperatures, dew points, and relative humidity data is the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Fundamentals Handbook (ASHRAE 2005). ASHRAE data for the years 1982–1993 at Paducah are provided in Table 3.6-3. Data for Cape Girardeau, Missouri, which is located alongside the Mississippi River 50 miles west of Metropolis, Illinois, are also presented for comparison purposes.

3.6.3 Winds and Atmospheric Stability

The EA contains a wind rose (EA Figure 3.3) based on data collected at Paducah in the years 1985 through 1992. Similar data were collected at Paducah for the years 1993 through 2012 (WRCC 2012). When the recent data are collected into a wind rose, the result is similar to that of the EA figure with a small exception. The recent data show winds primarily from the south rather than the south and south-southwest. This small shift may be due to instrument change, or data manipulation. Figure 3.6-2 was developed from data expressed in terms of the nearest 10 degrees. These data were converted to the standard 16 points of the compass by weighted distribution. For example, the southward direction was assigned 62.5 percent of the 170° winds, plus 100 percent of the 180° winds, plus 62.5 percent of the 190° winds. The mode of the wind direction data (most common angle) was 180° measured clockwise from the north. The average wind speed for this period was 5.8 knots.

Data necessary to generate a clean air assessment package – 1988 model (CAP-88) compatible wind file for estimating impacts from airborne radiological emission discussed in Section 4.6 need to contain distribution of winds across stability classes and frequency of winds in each cardinal direction. To support the CAP-88 estimates, hourly wind data were obtained from the NCDC for the nearest weather service office (WSO) located at Barkley Regional Airport near Paducah, Kentucky, for the most recent 15-year period.

The wind data were first processed to generate wind rose statistics and plots to study the variability of meteorology in the Metropolis, Illinois, area. Figure 3.6-3 provides wind rose plots (flow vectors showing wind blowing to) for periods between 2000–2004, 2005–2008, 2009–2013, and for time between 2014–2015. Inspection of these plots reveals that the meteorology between each of these time periods have remained largely similar with small variability in the predominant wind direction and associated wind speeds.

Based on the data in Figure 3.6-3, meteorological data available in the 15-year time period are expected to provide representative variability in the wind speed, direction and associated stability classes for the Metropolis area. Figure 3.6-4 provides the 15-year summary of wind direction and speed used for the analysis discussed in Section 4.6.

The meteorological data used in the CAP-88 model contain average and harmonic average wind speed by stability class (A to G), and wind direction and stability class frequencies where data for stability class G may be left with zeroes.

Hourly wind data obtained, as discussed above, from NCDC for years 2000–2015 were used to prepare an updated meteorological data file for use in CAP-88. Stability class was determined using the cloud ceiling data. It was assumed that a cloud ceiling <22,000 indicated cloud cover (slight insolation in day, >50% cloud at night) and equal to 22,000 indicated clear conditions (moderate insolation in day, <50% cloud at night); night was assumed to occur from 8 PM to 8 AM and when the resulting class was a range (for example A-B) the lower letter (in the previous example, A) was chosen. Table 3.6-4 provides the stability classes assigned based on the wind speeds and cloud ceiling height measured in the 15-year meteorological data collected by the NCDC at the Barkley Regional Airport WSO. Calm conditions were excluded and the arithmetic and harmonic means across each direction/stability class combination were computed. Frequencies of wind direction and stability class were also computed for the meteorological data file for the present work.

With the above methods, a wind file was created using the 15-year average meteorological data for air impacts modeling using CAP-88.

3.6.4 Precipitation

The MTW site has a fairly constant level of rain throughout the year. In the 20 years of recent Paducah weather records, the monthly means of precipitation varied from 2.91 inches in August to 5.21 inches in April. The EA variation previously reported in licensing submittals was a range of 2.49 inches in October to 4.92 inches in March. The recent data have a nine percent wetter average (49.8 inches versus 45.8 inches).

Snowfall is a common winter occurrence at the MTW site, with a record monthly maximum of 22.6 inches in January of 1978. The new data show slightly less snowfall compared to the EA data, with an annual mean of 8.7 inches versus 9.9 inches.

Table 3.6-5 summarizes precipitation data in a format identical to that of the EA. As in the case of Table 3.6-1, the data were time-averaged so that the earlier and longer dataset (EA data) contributes (30/50) 60 percent to the mean values. The new data contribute (20/50) 40 percent to the mean values. This does not impact the rain values much due to the consistency of the data.

3.6.5 Severe Weather Phenomena

3.6.5.1 Temperature Extremes

Although the ASHRAE reference quoted in Table 3.6-3 is an industry standard source for heating, ventilation, and air-conditioning design, the Paducah data tend to predict greater extremes, and it is more conservative to use those data. Using the Gumbel distribution for Paducah COOP Station 156110, a 100-year temperature extreme can be calculated from the 20 years of Paducah data plus a twenty-first year using the historic extremes from the EA dataset, as shown in Table 3.6-6.

To check on the reasonableness of these 100-year values, the long-term record at Owensboro, Kentucky, was consulted. Owensboro has data from 1932 through 1998 in the U.S. Historical Climatology Network (USHCN). Owensboro is seen on Figure 3.6-1 to be similarly situated on the river, but 100 miles northeast in a region of greater heating days. The maximum recorded temperature at Owensboro in this database is 107°F in 1936 and 1944. Like Paducah, Owensboro reached 106°F in 1952. The minimum recorded at Owensboro was -23°F in 1993, but Owensboro recorded -21°F in 1951, the same year Paducah hit -12°F.

3.6.5.2 Wind Speed Extremes

A typical design value for high winds is the three-second gust at 33 feet of elevation, as recommended in SEI/ASCE 7-02 (ASCE 2002). This value is identified using the methodology of SEI/ASCE 7-02 to have a 50-year return value of 90 miles per hour (mph) for Metropolis, Illinois. This is converted to a 100-year value by the factor 1.07, obtained from Table C6-3 of SEI/ASCE 7-02 (ASCE 2002). That is, the 100-year value for a three-second gust at this location is 96 mph. The maximum gust recorded at Paducah-Barkley Regional Airport from 1995 through 2014 was 84 mph in 1995 (NCDC 2016a).

3.6.5.3 Tornados

At Metropolis, Illinois, the risk of F2 and larger tornados has been estimated in days with at least one F2 or larger tornado touching down per century. Based on data from 1921–1995, the risk has been determined to be one tornado per 10,000 square miles annually, or 20 days per 2,000 square miles per century (Concannon et al. 2000).

The NCDC severe weather database was queried for all tornados in seven counties around the MTW site from 1950–2014. The counties selected were Massac, Pope, and Pulaski in Illinois (MTW is in the center-south of Massac County, with the other two counties on either side of Massac up and down the river), and McCracken, Livingston, Ballard, and Graves in Kentucky (McCracken County is across the river from MTW, with Ballard and Livingston counties on either side up and down the river. Graves County is directly south of McCracken County in the direction of common winds). These counties total 2,194 square miles. There are 19 days with tornados of F2 or greater listed, converting to a frequency of 1.33 tornado-days annually per

10,000 square miles (mi^2), which is slightly higher than the estimate from Concannon et al. (2000). There was one F4 tornado, converting to a frequency of 0.07 annually per 10,000 mi^2 for an F4 tornado. Individual tornados are listed in Table 3.6-7. (NCDC 2016b)

The single F4 event day occurred May 6, 2003. The tornado began near Grand Chain in Pulaski County, 20 miles west-northwest of MTW, and traveled six miles into Massac County. Its peak wind speed was 210 mph. (NWS 2016)

3.6.5.4 Hurricanes

MTW is well inland and not subject to hurricanes. No record of a hurricane occurring in the seven counties of Massac, Pope, Pulaski, McCracken, Livingston, Ballard, or Graves exists in the NCDC severe weather database (NCDC 2016b).

3.6.5.5 Thunderstorms and Lightning

Thunderstorms and lightning occur with moderate frequency in the MTW area. The National Lightning Safety Institute estimated a frequency of 70 thunderstorm days per year and four to eight flashes of lightning per square kilometer per year, respectively (NLSI 2016). However, these storms tend to be of lower energy and involve less lightning than regions better known for storm intensity, such as the Rocky Mountains and Florida.

Table 3.6-8 lists the greatest property-damaging storms in the NCDC's severe weather database for the seven counties described in Section 3.6.5.3. It is noted that the storms are all of recent occurrence, which is believed to be due to more thorough reporting and cost assignation. Evaluation of the storms indicates that while damaging storms occur, they are not on a large scale relative to other parts of the United States.

3.6.5.6 Probable Maximum Precipitation

Probable maximum precipitation (PMP) is defined by Hansen (1982) as the maximum theoretical rainfall that is physically possible over a given area. This value is often used for probable maximum flood risk evaluation. Other reports present similar data for longer time periods, and are of use in reviewing site characteristics (Ho and Riedel 1980; Schreiner and Riedel 1978). In general, a contour map of PMP values in the eastern United States shows roughly horizontal isohyets of decreasing values as one moves north from the Gulf of Mexico. Although 500 miles from the Gulf of Mexico, MTW is still close enough to potentially receive significant precipitation from storms.

The values and sources of PMPs are shown in Table 3.6-9.

3.6.6 Regional Emission Inventory

The IEPA maintains a statewide air monitoring network of more than 300 monitors measuring air pollutants and other toxic compounds (IEPA 2013a). The Illinois annual air quality report for

2013 provided an estimate for stationary point source emissions in Massac County, Illinois. A summary of these estimated emissions is provided in Table 3.6-10.

The Kentucky Division of Air Quality maintains a network of 39 monitors in 27 counties to monitor air quality in the state, with monitoring locations for $PM_{2.5}$, PM_{10}, SO_2, nitrogen dioxide (NO_2), and ozone (O_3) in McCracken County, Kentucky (KDEP 2014). The Kentucky ambient air quality annual report for 2014 provided data relating to the ambient air quality in McCracken County. Summaries of the ambient air quality monitoring data are provided in Tables 3.6-11, 3.6-12, 3.6-13, and 3.6-14.

Table 3.6-1
Dry Bulb Temperature Data (°F), NWS at Paducah, KY, Combined Periods 1951–1980 and 1995–2014

	Means			Extremes						Mean # Days				Degree Days	
Month	**Max**	**Min**	**Mean**	**Record High**	**Year**	**Day**	**Record Low**	**Year**	**Day**	**Max >=90**	**Max <=32**	**Min <=32**	**Min <=0**	**Heat**	**Cool**
January	43.9	25.6	34.8	79	1952	1	-8	1963	24	0	7	24	1	935	0
February	48.2	28.5	38.4	81	1962	13	-12	1951	3	0	3	18	0	746	0
March	58.2	36.9	47.6	84	1967	13	2	1960	5	0	1	11	0	548	11
April	70.2	47.3	58.8	90	1977	17	21	2007	8	0	0	1	0	217	33
May	78.8	56.2	67.5	96	1974	20	34	1963	1	2	0	0	0	66	146
June	86.8	64.5	75.7	108	2012	29	44	1972	1	11	0	0	0	1	327
July	89.9	68.1	79.0	107	2012	6	50	1962	27	17	0	0	0	0	437
August	89.2	65.9	77.7	105	2007	16	46	2004	14	15	0	0	0	0	397
September	82.9	58.2	70.7	105	1954	6	35	1995	24	6	0	0	0	21	197
October	72.0	46.6	59.3	95	1953	1	24	1957	28	0	0	2	0	213	39
November	58.2	36.8	47.5	84	1955	13	8	1964	30	0	0	11	0	522	1
December	47.3	29.3	38.3	75	1970	1	-8	2004	25	0	3	20	0	826	0
Annual	**68.8**	**47.0**	**58.0**	**108**	**2012**	**29**	**-12**	**1951**	**3**	**52**	**13**	**87**	**1**	**4,096**	**1,589**

(NRC 1995; NCDC 2016a)

Table 3.6-2
Accumulated Freezing Degree Days

1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	100 Year
222	338	220	99	137	301	147	125	228	241	474
2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	
137	90	162	193	199	365	177	40	152	348	

(NCDC 2016a)

Table 3.6-3
Dew Point Temperature, Dry Bulb Temperature, and Wet Bulb Temperature Extremes

Parameter	ASHRAE Data for Paducah, KY 1982–1993[a]			NCDC Data for Paducah, KY 1995–2014			
	Dry Bulb (F)	Wet Bulb (F)	Dew Point (F)	Dry Bulb (F)	Wet Bulb (F)	Dew Point (F)	Date
99.6 percent dry bulb	96 (96)	77 (77)		Not reported			
Dry bulb extreme	98 (100)			107 106[b]	75	59	6/29/12 7/29/52[b]
99.6 percent wet bulb	90 (92)	80 (80)		Not reported			
Wet bulb extreme	Not reported			96 98	84[c] 84[c]	80 79	7/11/11 8/3/2011
99.6 percent dew point	86 (86)		77 (77)	Not reported			
Dew point extreme	Not reported			88	83	82	8/23/14
99.6 percent dry bulb minimum	7 (6)			Not reported			
Dry bulb minimum extreme	-1 (-1)			-12[b]			2/3/1951

(ASHRAE 2005; MRCC 2016; NCDC 2016a)

a. Data in parentheses are for Cape Girardeau, MO, 1982–1993.

b. These values are from the EA database covering 1951–1980 (from Table 3.6-1).

c. The wet bulb extreme value of 84 degrees occurred twice from the years 1996–2014. The extreme wet bulb had different associated dry bulb and dew point temperatures.

Table 3.6-4
Pasquill Stability Class Assigned by Wind Speed and by Day/Night Cloud Cover

Wind Speed (meters/second)	Non-Cloud Day	Cloud Day	Non-Cloud Night	Cloud Night
0	A	B	F	E
2	B	C	F	E
3	B	C	E	D
5	C	D	D	D
6	C	D	D	D

(EPA 2000)

Table 3.6-5
Precipitation Data, NWS at Paducah, Kentucky, Combined Periods 1951–1980 and 1995–2014

Month	Rain						Snow			Mean # Days of Precipitation		
	Mean (in)	Max (in)	Year	Daily Max (in)	Year	Day	Mean (in)	Monthly Max (in)	Year	<0.1"	<0.5"	<1"
January	3.72	8.05	2013	3.97	2000	3	3.12	22.6	1978	6	2	1
February	3.25	7.35	1962	3.20	2011	24	2.98	16.0	1979	5	2	1
March	4.61	17.73	1966	8.00	1964	4	1.7	18.3	1960	7	3	1
April	4.74	15.91	2011	3.87	2011	24	0.06	1.5	1951	7	3	2
May	4.73	9.83	1957	3.62	1967	14	0	0	–	7	3	1
June	4.51	10.98	1998	5.58	2013	1	0	0	–	6	3	1
July	4.00	11.18	1958	4.43	2000	29	0	0	–	6	3	1
August	3.14	7.85	2014	4.55	2014	30	0	0	–	5	3	1
September	3.45	11.65	2006	5.90	1962	14	0	0	–	5	2	1
October	3.07	10.55	2009	4.19	2013	5	0	0	–	5	2	1
November	4.03	13.23	1957	4.9	1996	7	0.27	4.0	1958	6	3	1
December	4.13	9.24	1978	5.26	2013	21	1.68	14.2	2004	6	3	1
Annual	**47.39**	**17.73**	**1966**	**8.00**	**1964**	**4**	**9.8**	**22.6**	**1978**	**72**	**32**	**13**

– indicates no data available.

(NRC 1995; NCDC 2016a)

Table 3.6-6
Data and Development of 100-year Return Temperature (°F) Extremes

T	1951-52	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Tmin	-12	2	-3	-3	11	7	4	5	10	-3	-8
Tmax	106	100	95	100	96	101	99	99	99	97	96

T	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	100-yr
Tmin	8	6	7	7	3	1	-4	17	9	2	-18
Tmax	96	96	105	96	98	104	99	108	96	97	111

(NCDC 2016a)

Table 3.6-7
All Tornado-day Records, F2 or Greater, in the NCDC Severe Weather Database

Number	Date	Time	Intensity[a]	Deaths	Injury	Property Damage ($)	County[b]
1	4/3/1957	14:08	F2	0	0	250K	Pulaski
2	6/12/1958	18:08	F3	0	3	25K	Ballard
3	6/6/1966	12:00	F2	0	2	25K	McCracken
4	6/21/1967	19:00	F2	0	0	25K	Pulaski
	6/21/1967	19:00	F2	0	0	25K	McCracken
5	4/24/1970	01:00	F3	0	5	0	Livingston
6	12/15/1971	03:40	F2	0	0	25K	McCracken
	12/15/1971	03:50	F2	0	0	25K	Graves
7	4/21/1972	17:03	F2	0	2	25K	Pulaski
	4/21/1972	17:20	F2	3	0	25K	Pope
	4/21/1972	19:00	F2	0	0	25K	Livingston
8	4/19/1973	15:30	F2	0	0	25K	McCracken
9	10/3/1990	21:20	F2	0	0	250K	Pope
10	1/22/1999	01:15	F2	0	0	800K	Pope
11	4/28/2002	00:59	F3	0	1	400K	Pope
	4/28/2002	01:10	F2	0	0	40K	Livingston
12	5/6/2003	21:14	F3	0	0	2.5M	Pope
	5/6/2003	20:32	F4	1	13	3.5M	Pulaski
	5/6/2003	20:40	F4	1	20	10M	Massac
	5/6/2003	21:41	F2	0	0	0	Ballard
	5/6/2003	21:55	F2	0	0	80K	Massac
13	10/18/2004	18:55	F2	0	0	150K	Pope
14	9/22/2006	14:20	F3	0	2	500K	Massac
15	4/4/2011	09:20	EF2	0	1	700K	Ballard
16	5/25/2011	17:59	EF2	0	0	150K	Massac
17	2/29/2012	05:00	EF2	0	0	0	Pulaski
	2/29/2012	05:07	EF2	0	0	100K	Ballard
	2/29/2012	05:17	EF2	0	5	150K	McCracken
	2/29/2012	05:35	EF2	0	0	50K	Massac
18	1/12/2013	15:18	EF2	0	0	100K	Livingston
19	11/17/2013	14:05	EF2	0	1	350K	McCracken
	11/17/2013	14:26	EF2	0	0	500K	Pope
	11/17/2013	14:20	EF3	3	33	5.5M	Massac
	11/17/2013	14:29	EF2	0	0	400k	Livingston

(NCDC 2016b)

a. EF = enhanced Fujita scale. The NWS replaced the Fujita scale (F) with the EF scale in 2006.

b. Some of the same tornados tracked over several counties.

Table 3.6-8
Ten Worst Severe Weather Events by Property Damage in NCDC Database, 1950–2014

Date	Time[a]	Type[b]	Magnitude	Death	Injury	Property Damage ($)	County
1/26/2009	20:00	Ice Storm	1.5"-2" thick ice	0	0	>100M	All seven counties[c]
9/14/2008	6:10	High Wind	68 knots	0	1	38M	All seven counties[c]
3/2/1997	10:00	Flood	1"-10" rainfall	0	0	28M	Ballard Pulaski Livingston
5/1/2011	00:00	Flood	Ohio River crests at 55.3 feet at Paducah	0	0	21M	All seven counties[c]
5/4/2003	10:58	Hail	2.5" inch diameter	0	1	20M	McCracken
2/11/2008	11:00	Winter storm	1/4" to 1/2" thick ice	0	0	7M	Pulaski Pope Massac McCracken Ballard Livingston
3/18/2008	7:00	Flood	Record 24-hour rainfall at Cape Girardeau 12"+	0	0	3.75M	Pulaski Pope Massac
6/1/2013	3:39	Flash flood	2"-6" rainfall	0	0	1.6M	McCracken Ballard
1/3/2000	14:45	Flash flood	Heavy rain	0	0	800K	Ballard

(NCDC 2016b)

a. Time is relative to central standard time and noted in 24-hour format.

b. Damages from tornados are not included in this table.

c. "All seven counties" refers to Ballard County, Illinois (IL), Pulaski County, IL, Graves County, Kentucky (KY), Pope County, IL, Massac County, IL, McCracken County, KY, and Livingston County, KY.

Table 3.6-9
Probable Maximum Precipitation (PMP) Values for the Eastern U.S.

Duration	Area	PMP (in)	Source
5-min	1-mi^2	6.1	HMR 52
15-min	1-mi^2	9.7	HMR 52
30-min	1-mi^2	13.9	HMR 52
1-hr	1-mi^2	18.6	HMR 52
1-hr	10-mi^2	15.25	HMR 52
6-hr	10-mi^2	28.75	HMR 51
12-hr	10-mi^2	34	HMR 51
24-hr	10-mi^2	36.5	HMR 51
48-hr	10-mi^2	40	HMR 51
72-hr	10-mi^2	42	HMR 53

(Hansen 1982; Ho and Reidel 1980; Schreiner and Reidel 1978)

Table 3.6-10
Massac County, IL – Stationary Point Source Emissions, 2013 (Tons/Year)

Carbon Monoxide	NO_x	Particulate Matter	SO_2	VOM
1,430.4	8,026.2	818.3	17,666.8	300.3

(IEPA 2013a)

Table 3.6-11
McCracken County, KY – $PM_{2.5}$ and PM_{10} Monitoring, 2014

$PM_{2.5}$ 24-hour Average[a]					PM_{10} 24-hour Average[a]				
Mean	1st Max	2nd Max	3rd Max	4th Max	Mean	1st Max	2nd Max	3rd Max	4th Max
10.03[b]	23.0	21.0	17.5	16.8	17.6[b]	33.0	28.0	28.0	28.0

(KDEP 2014)

a. Quantities in µg/m³.

b. AQS-ID 21-145-1004 incomplete data set. The mean does not satisfy summary criteria.

Table 3.6-12
McCracken County, KY – SO_2 Monitoring, 2014

1-hour Average[a]		Annual Maximum 3-hour Block Average[a]	
1st Max	2nd Max	1st Max	2nd Max
20	19	3.6	3.0

(KDEP 2014)

a. Quantities in parts per billion (ppb).

Table 3.6-13
McCracken County, KY – NO_2 Monitoring, 2014

Annual Mean	1-hour Daily Maximum (ppb)	
	1st Max	2nd Max
5.68	41	36

(KDEP 2014)

Table 3.6-14
McCracken County, KY – O_3 Monitoring, 2014

Daily Maximum 8-hour Average (ppm)			
1st Max	2nd Max	3rd Max	4th Max
0.070	0.067	0.065	0.064

(KDEP 2014)

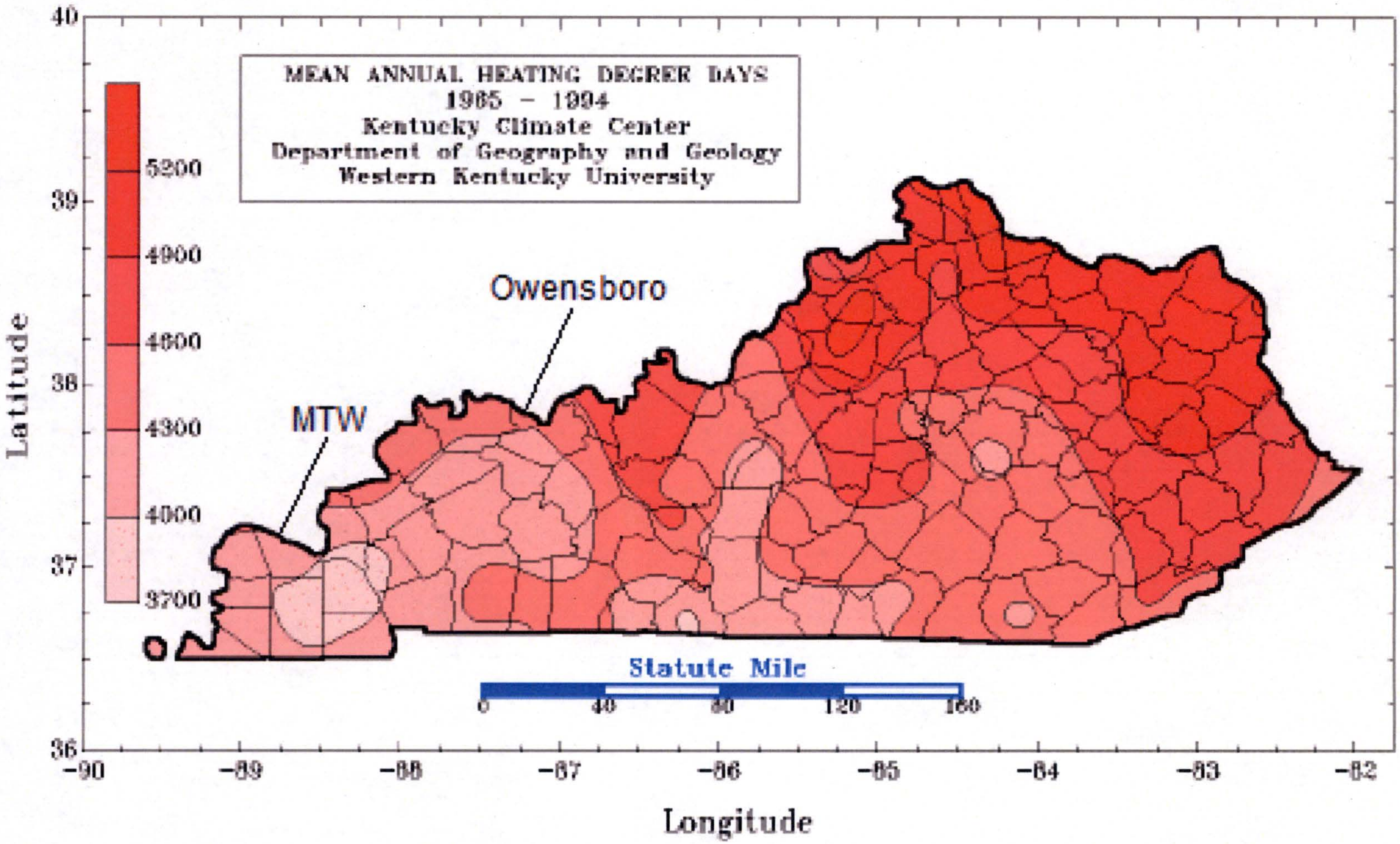


Figure 3.6-1
Mean Annual Heating Degree Days, 1965–1994, Kentucky

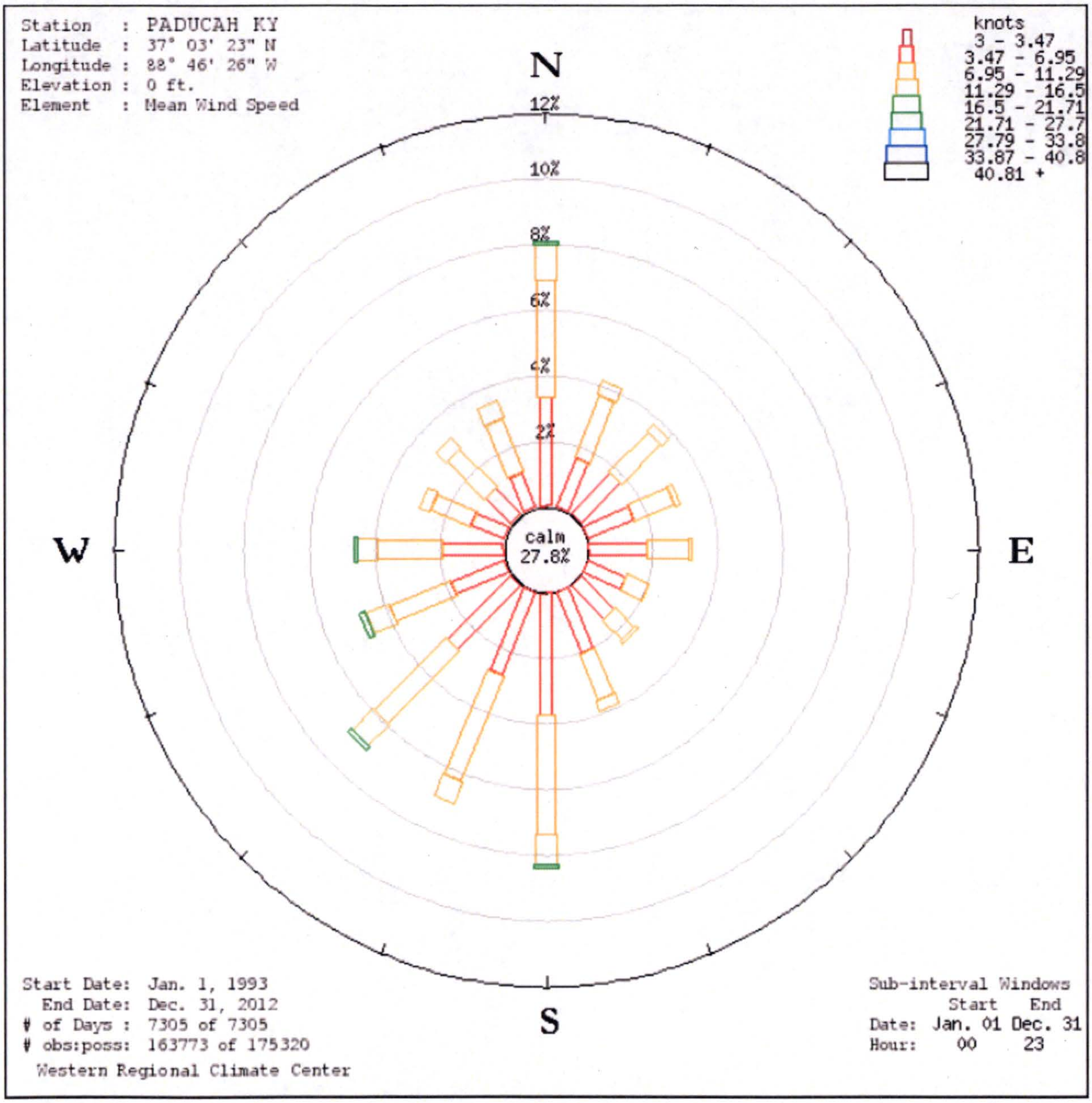


Figure 3.6-2
Paducah, Kentucky, Wind Rose

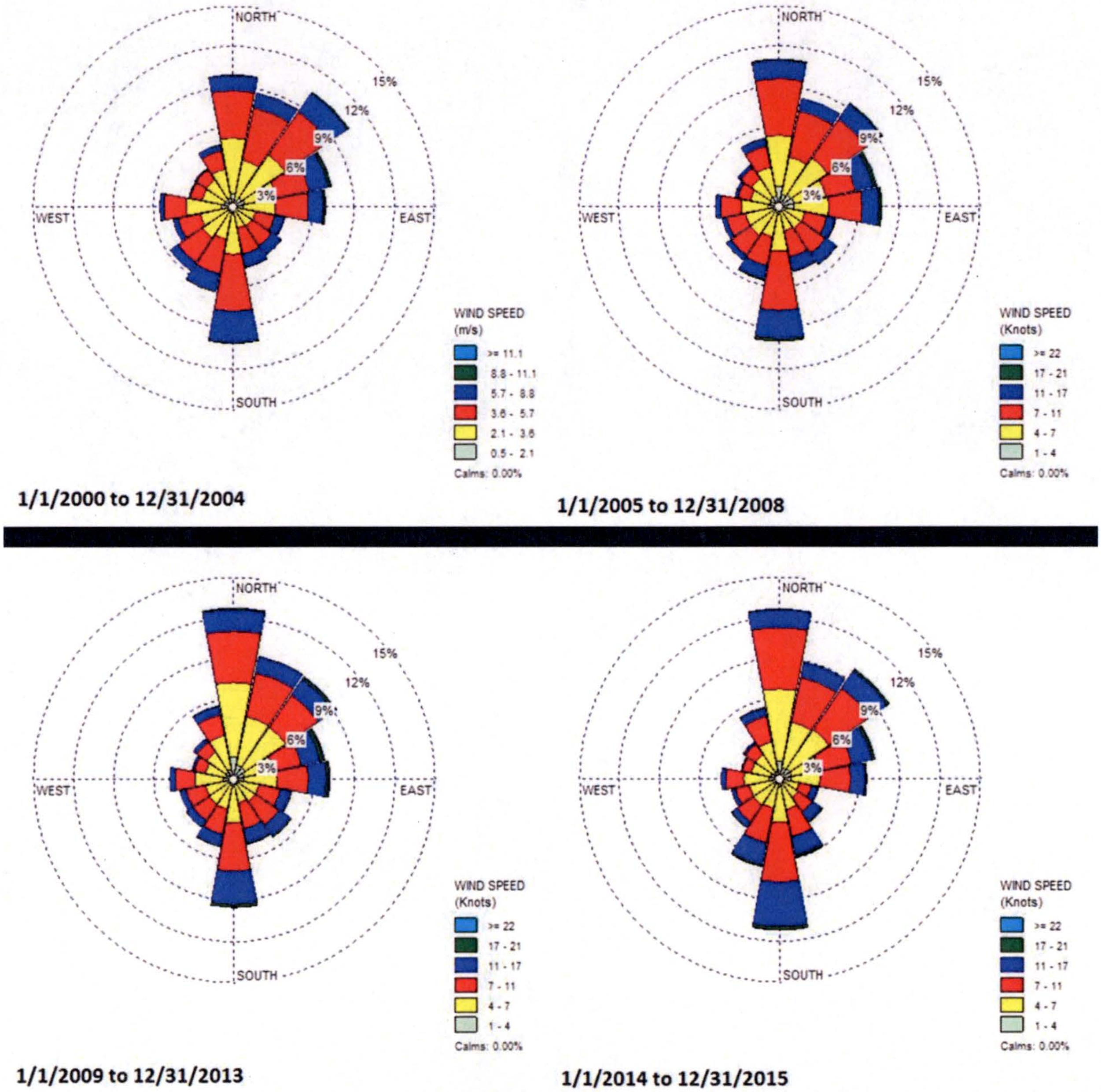


Figure 3.6-3
Wind Rose Plots from Meteorological Data Collected at Barkley Regional Airport Showing Flow Vectors (blowing to)

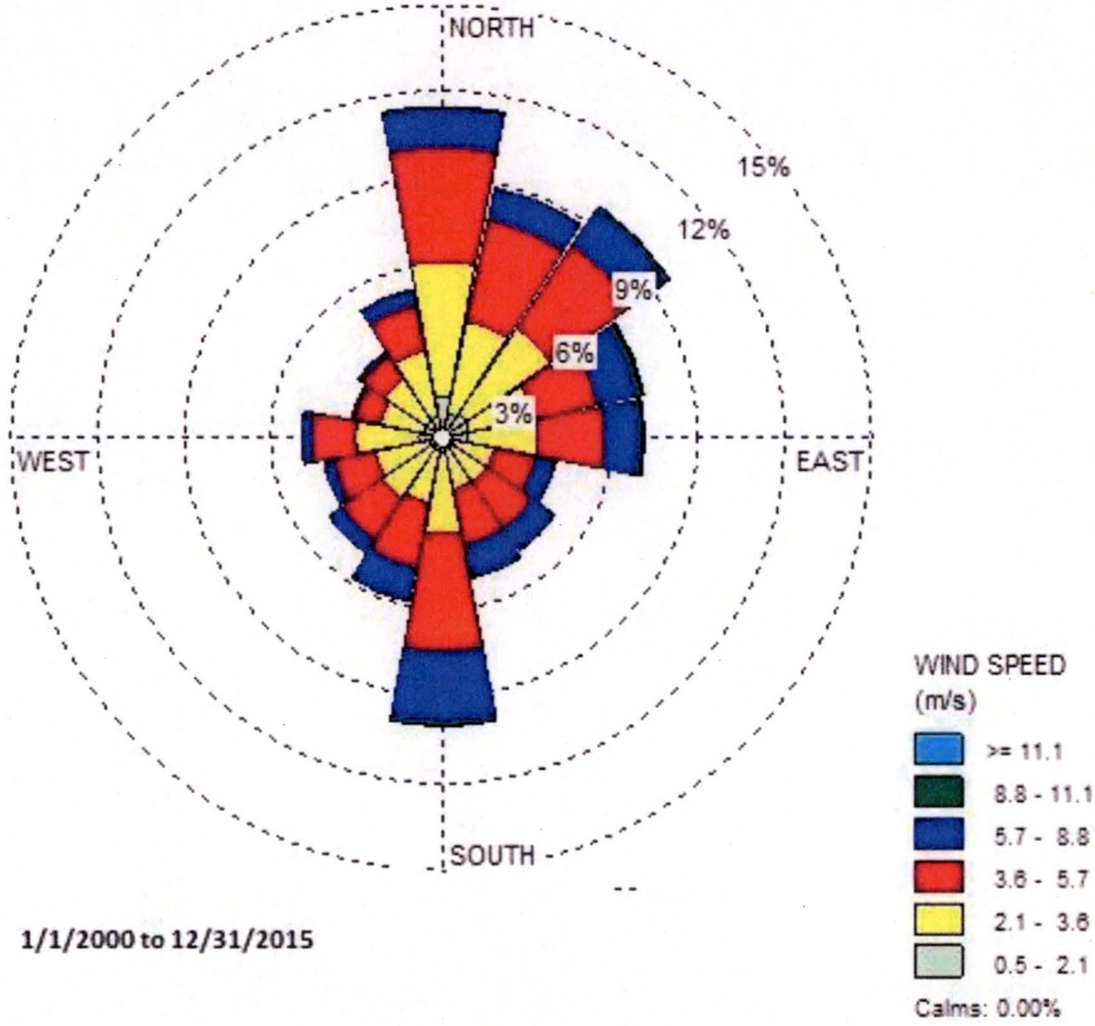


Figure 3.6-4
15-year Wind Rose Plots from Meteorological Data Collected at Barkley Regional Airport Showing Flow Vectors (blowing to)

3.7 Noise

Noise is generally defined as unwanted or undesirable sound. Scientists measure ambient or background noise in the field at selected sampling locations using sound level meters (SLMs) adjusted to accurately reflect the way humans typically hear sound. Sound is described in units called decibels (dB), and sound adjusted to human hearing is referred to as the "A-weighted scale" or dBA.

Especially important in assessing the impact of noise is an understanding of the sound environment at noise-sensitive receptors. The Federal Highway Administration (FHA) codified noise abatement criteria levels for noise-sensitive receptors based on categories of land use and human activity; noise-sensitive receptors are categorized from A to E depending on the level of human activity normally associated with each (Table 3.7-1).

Category A noise-sensitive receptors are places or lands where serenity and quiet are of special importance and where the preservation of those qualities is essential if the place or area is to continue to serve its intended purpose. Category C noise-sensitive receptors are commercial and industrial areas, office buildings, and other developed lands. Noise abatement criteria (NAC) are more stringent for Category A (hourly A-weighted sound levels of 57dBA or less) than Category C (hourly A-weighted sound levels of 72dBA or less) noise-sensitive receptors. The noise levels of common outdoor activities are heavy highway traffic at 300 feet (60 dBA) and a gas-powered lawn mower at 100 feet (70 dBA). (ADOT 2008)

There are no ambient noise survey data available for the area around the MTW site, nor has the operator performed any noise surveys at the boundary of the restricted area. However, there are also no known noise-sensitive receptors in close proximity to the MTW site, with the exception of Category B rural residences typically assigned an NAC of 67 dBA. The nearest noise-sensitive receptor (a rural home) is 1,765 feet north-northeast of the FMB.

In addition to MTW, other sources of noise in the vicinity include U.S. Highway 45 and the BNSF railroad to the northeast, and the Ohio River to the southwest.

Table 3.7-1
FHA Noise Abatement Criteria in Hourly dBA

Activity Category	Description of Activities	Hourly dBA
A	Lands or places where preservation of serenity and quiet is essential to continue to serve the intended purpose.	57 (Exterior)
B	Picnic, sports, and recreation areas, playgrounds, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.	67 (Exterior)
C	Cemeteries, commercial and industrial areas, office buildings, and other developments.	72 (Exterior)
D	Undeveloped land including roadside facilities and dispersed recreation.	None
E	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, auditoriums.	52 (Interior)

(Source: 23 CFR, Part 772, Table 1)

3.8 Historic and Cultural Resources

Based on the IIAS GIS database, which is maintained by IDNR and ISM, no known records of archeological or cultural surveys are available for the previous development at the MTW site (IDNR and ISM 2016). Based on the NRHP, which is maintained by the NPS and IIAS databases, no registered federal or state archaeological sites were identified within the boundaries of the MTW site (IHPA 2016; NPS 2016). An examination of the IIAS GIS database found no address-restricted previously recorded sites within the MTW site boundaries (IDNR and ISM 2016). A detailed description of the sites located near MTW which are listed on state and federal registries is provided in Subsection 3.1.5 of this report.

3.9 Visual and Scenic Resources

As described in Section 3.1, the MTW site lies in a rural region of extreme southern Illinois adjacent to the Ohio River. Generally, southern Illinois is an area of swampy, forested bottomlands and low clay and gravel hills. Away from well-traveled roadways, the area affords pastoral viewsheds where rural residences, undeveloped agricultural land, and deciduous forests are the dominant visual features.

U.S. Highway 45 and the BNSF railroad right-of-way border MTW to the northeast, except for a small portion of MTW that extends beyond U.S. Highway 45. Viewed from the air, MTW has the typical appearance of an industrial complex with interconnected industrial-looking buildings, open-air storage of raw material, exhaust stacks with pollution control equipment, parking lots, railroad spurs, and a number of large waste management ponds. Open space on the property is minimal (see Figure 1.1-1).

The complex of buildings, ponds, and storage areas is surrounded by two nine-foot high chain-link and barbed wire security fences. Much of MTW, including the six-story FMB, the administration building, and the maintenance facility, is visible from U.S. Highway 45 northeast of MTW, as seen in Figure 3.9-1.

While Massac County is mainly rural, the area in the immediate vicinity of the MTW site contains other substantial industrial and urban development on both sides of the Ohio River. The TVA Shawnee Fossil Plant in Kentucky is located on the west bank of the Ohio River, with smoke stacks potentially visible from U.S. Highway 45. Also located across the river in Kentucky is the DOE's PGDP (a former uranium enrichment facility).

On the Illinois side of the Ohio River, the AEP Cook Coal Terminal immediately northwest of the MTW site and a coal-fired power plant near Joppa, Illinois (approximately six miles northwest), are also potentially visible to travelers on U.S. Highway 45. The industrial area transitions into the Metropolis, Illinois, urban area approximately two miles southeast of the MTW site.

The Illinois Department of Transportation has designated portions of U.S. Highway 45 as part of the Ohio River Scenic Byway, including the segment bordering MTW (IDOT 2016b). Throughout the MTW vicinity, high value scenic views are found within historical sites located on the banks of the Ohio River. Nearby sites like Fort Massac State Park in Metropolis, Illinois, offer views of the river from numerous picnic areas and pavilions.

Figure 3.9-1
Aerial View Looking Southwest across U.S. Highway 45 at MTW

3.10 Socioeconomics

The MTW vicinity is located in a predominantly agricultural area of low average population density with widely scattered villages and small cities in Massac County, Illinois, and McCracken County, Kentucky. Population data for Massac and McCracken counties, obtained from the U.S. Census Bureau's (USCB's) 2010 census, are provided below in Table 3.10-1. Population data for communities within the 10-mile vicinity of the MTW site (as shown in Figure 3.2-1) are provided in Table 3.10-2.

3.10.1 Economic Analysis

As of February 2016, MTW employs 237 people (Honeywell 2016g). The two counties most influenced by MTW operations are Massac County, Illinois, and McCracken County, Kentucky, because the highest percentage of MTW employees resides in these two counties. In total, 34 percent of MTW's employees reside in eight counties in Illinois, with 27 percent living in Massac County in Brookport and Metropolis. Another 62 percent of employees reside in 11 counties in Kentucky, with 37 percent living in McCracken County, specifically the cities of Paducah and West Paducah. The remaining four percent of MTW employees are scattered amongst several states.

As reported in Subsection 3.10.6, the populations of both Massac County, Illinois, and McCracken County, Kentucky, are expected to increase during the license renewal period. Low-income populations and poverty thresholds for these counties are described in Subsection 3.10.6.

The estimated employed population in Massac County, Illinois, decreased from 6,047 persons in 2010 to 5,368 persons in 2014. In 2014, the leading occupation was the government and government enterprises sector, with approximately 18.8 percent, or 1,011 persons employed. This was followed by the health care and social assistance sector, with approximately 9.5 percent, or 511 persons employed; and the retail trade sector, with approximately 8.0 percent, or 430 persons employed. The manufacturing sector was sixth largest in the county with 4.0 percent, or 218 persons employed. The annual payroll in Massac County was reported to be approximately $506 million in 2014, and the average wage per job was $46,217. (BEA 2016) In 2014, per capita personal income was $33,923 (BEA 2016), and the annual unemployment rate decreased from 9.5 percent in 2010 to 8.0 percent in 2014 (BLS 2016).

The estimated employed population in McCracken County, Kentucky, increased from 45,798 persons in 2010 to 47,118 persons in 2014. In 2014, the leading occupation was the health care and social assistance sector, with approximately 16.2 percent, or 7,621 persons employed. This was followed by the retail trade sector with approximately 15.3 percent, or 7,222 persons employed; and the government and government enterprises sector with approximately 10.1 percent, or 4,741 persons employed. The manufacturing sector was seventh largest in the county with 5.3 percent, or 2,520 persons employed. The annual payroll in McCracken County was reported to be approximately $2.8 billion in 2014, and the average wage was $40,533. (BEA 2016) In 2014, per capita personal income was $42,532 (BEA 2016), and the annual unemployment rate decreased from 9.1 percent in 2010 to 7.1 percent in 2014 (BLS 2016).

MTW is not planning or expecting a significant employment expansion within the next licensing period; therefore, local employment trends will be unaffected by the licensing action.

3.10.2 Health and Social Services

NRC licensing requires Honeywell to maintain agreements and working relationships with specific state and local emergency agencies to ensure proper response in the event of an emergency at MTW. The following agencies are currently part of a mutual assistance agreement with MTW: Massac County Emergency Services and Disaster Agency, City of Metropolis Office of Emergency Management, Massac County and City of Metropolis Fire Departments, Massac County Sheriff, City of Metropolis Police Department, Massac Memorial Hospital (Metropolis, Illinois), Lourdes Hospital (Paducah, Kentucky), and Baptist Health Hospital (Paducah, Kentucky). Agreements with local agencies are reviewed and renewed annually unless specified otherwise within the respective agreements.

As part of the mutual assistance agreement, Honeywell agrees to provide general awareness training and MTW-specific hazards training to emergency responders in Massac County and the City of Metropolis. In exchange, local emergency responders in Massac County and the City of Metropolis agree to provide law enforcement, fire and emergency services, and coordination of efforts to protect the health and safety of the public during any plant emergency at MTW.

MTW has separate agreements with Massac Memorial Hospital, Lourdes Hospital, and Baptist Health Hospital. In these agreements, Honeywell offers training with regard to injured Honeywell employees, and assistance with chemical/radiological decontamination procedures in the event of exposure during the treatment of an injured employee. Massac Memorial Hospital, located in Metropolis, Illinois, is the nearest medical facility to MTW. When necessary, patients are transferred to either Lourdes Hospital (approximately 14 miles from MTW) or Baptist Health Hospital (approximately 14 miles from MTW), located in Paducah, Kentucky. (Honeywell 2016h)

3.10.3 Education

Massac County, Illinois, has two public school districts (pre-kindergarten through 12th grade). Based on the 2013–2014 school year, Joppa-Maple Grove Unit District 38 has a total of 281students in the two public schools located in Joppa, Illinois. The Joppa-Maple Grove student/teacher ratio for the district was 13.71:1. The Massac Unit District 1 has a total of 2,186 students in the five public schools located in Metropolis, Illinois, and two public schools located in Brookport, Illinois. The Massac County student/teacher ratio for the district was 16.06:1. There are no private schools in Massac County. (NCES 2016)

McCracken County, Kentucky, has two public school districts (pre-kindergarten through 12th grade). Based on the 2013–2014 school year, the McCracken County School District has a total of 6,929 students located in 14 public schools in Paducah and West Paducah, Kentucky. The student/teacher ratio for the district was 17.62:1. The Paducah Independent School District has a total of 2,920 students in seven public schools in Paducah, Kentucky. The student/teacher ratio for the district was 15.35:1. There are three private schools in Paducah, Kentucky, including the Community Christian Academy K-12, with 154 students; St. Mary Elementary (pre-kindergarten through 5th grade), with 183 students; and the St. Mary School System (pre-kindergarten through 12th grade), with 421 students. (NCES 2016)

Scattered throughout the counties within a 50-mile radius from Metropolis, Illinois, are eight public two-year and four-year higher education institutions. In the same region there are five private higher education institutions. (NCES 2016)

3.10.4 Transportation Resources

As seen in Figure 3.2-1, MTW is located approximately two miles west of Metropolis, Illinois. U.S. Highway 45 and the BNSF railroad border the facility to the northeast, and the Ohio River bounds MTW to the south. A small portion of the MTW property extends beyond Highway 45 to the northeast. Interstate 24 is approximately 4.5 miles east of the facility and provides access from Paducah, Kentucky, across the Ohio River into Metropolis, Illinois.

3.10.5 Cities

Metropolis, Illinois, is the closest community, located approximately two miles southeast of MTW. Paducah, Kentucky, is located approximately 11 miles southeast of MTW on the south side of the Ohio River. In addition, several communities and census-designated places (CDPs) are located immediately adjacent to Paducah, including: Massac, Kentucky; Hendron, Kentucky; Farley, Kentucky; Reidland, Kentucky; and Ledbetter, Kentucky. Table 3.10-2 provides population data for communities located within the 10-mile vicinity of the MTW facility. The population of Metropolis, Illinois, grew by 0.85 percent between 2000 and 2010. An evaluation of 2010 population data indicates Paducah and the immediately surrounding communities represent approximately 69 percent of the permanent population for McCracken County. The remaining 31 percent of the population is located throughout the county in low-density farming communities. While the city of Paducah's population slightly declined between 2000 and 2010, Massac, Hendron, and Reidland CDPs all increased in population. (USCB 2016a). A map depicting the location of the listed communities is included as Figure 3.2-1.

3.10.6 Demographics

Using census blocks, the most recent decennial census data were used to estimate the population within a 50-mile radius of the center of MTW. The 50-mile radius was broken into 160 sectors defined by 16 "cardinal" directions, each 22.5 degrees wide and various radial distances. The 2010 population and population projections within these sectors for 0 to 5 miles in one-mile increments are provided in Table 3.10-3. The 2010 population from 5 to 50 miles is provided in Table 3.10-4. The total permanent population within 50 miles of MTW is 528,404 (USCB 2016b). Figures 3.10-1 and 3.10-2 illustrate the 2010 population distribution relative to the MTW facility.

3.10.6.1 Population Projections

A radial distance of five miles from the center of MTW was selected as the area of potential impact. Population projections were calculated to 2057 to include up to a 40-year MTW re-licensing period.

The State of Illinois data portal provided Massac County population projections in five-year increments to 2025. According to Illinois population projection data, the population of Massac County is expected to grow during the reported time frame. The population projections were extended to 2057 using the 2015, 2020, and 2025 values and linear interpolation. (IDPH 2016) There were 15,429 persons reported living in Massac County in 2010 (USCB 2016c) and 15,487 persons projected to live in the county as of 2057.

The McCracken County population projections were provided in five-year increments by the Kentucky State Data Center through the year 2050. McCracken County's population is expected to grow through 2025, and then decline between the years 2030 and 2050. There were 65,565 persons reported as living in McCracken County in 2010 (USCB 2016c). The state projects there will be 66,781 persons living in McCracken County in 2025, and that the county population will decline thereafter (KSDC 2016). To provide conservative population values, the 2025 projected county population (66,781) was extended out to 2057 for this analysis.

These population projection values were applied as appropriate to the individual sectors within five miles of MTW. The 2010 population and the population projections for 2017, 2027, 2037, 2047, and 2057 are provided in Table 3.10-3. The table provides population values for each sector, sums of population by direction, and total population projections for 2010, 2017, 2027, 2037, 2047, and 2057.

3.10.6.2 Environmental Justice Evaluation

A "minority" is defined as one of the following categories listed within the U.S. census: Black or African-American, American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, some other race, two or more races, and Hispanic or Latino (of any race) (USCB

2016d). For the purpose of this analysis, low-income populations are defined as "individuals or households who have incomes below the poverty level" (USCB 2016e). Two additional minority categories consisting of an aggregate of all races and an aggregate of all races and Hispanic were created to be thorough. A four-mile radius from the MTW site centerpoint was used as the appropriate geographic area for the evaluation as defined in NUREG-1748 (NRC 2003).

Demographic data from the 2010 U.S. census was collected for census block groups within a four-mile radius of the MTW site, which includes portions of the state of Kentucky and the state of Illinois. Income data from the American Community Survey (2010–2014) were collected for the same 12 block groups. The populations in each census block group were then compared to minority and low-income populations within their respective states. (USCB 2016b; USCB 2016d; USCB 2016e) If the population in a block group exceeded the state's average plus 20 percent or the block group exceeded 50 percent for any minority or low-income population, the block group was considered to contain an identified minority or low-income population (NRC 2003).

None of the census block groups within four miles of the MTW facility contain minority populations that exceed the criteria derived from their respective state's averages for any of the minority categories. Two census block groups containing populations that exceed the criteria for low-income individuals and households were identified within a four-mile radius of the MTW facility (see Figure 3.10-3). Block group 171279702004 contains 66 households, out of a total of 168; and 203 people, out of a total of 398, living at or below the poverty level. That corresponds to 39.3 percent of the households and 51.0 percent of individuals living at or below the poverty level. Block group 171279704001 contains 151 households, out of a total of 404; and 280 people, out of a total of 780, living at or below the poverty level. That corresponds to 37.4 percent of the households and 35.9 percent of individuals living at or below the poverty level. (USCB 2016b; USCB 2016d; USCB 2016e)

Table 3.10-1
Population Density within a 50-mile Radius of MTW

Geographic Area	2010 Population	Density (People/Square Mile)
Massac County, IL	15,429	64
McCracken County, KY	65,565	245
50-mile Radius	528,404	67

(USCB 2016b; USCB 2016c)

Table 3.10-2
Communities in the Vicinity of MTW

City	County/State	Distance from MTW (miles)	Direction from MTW	2000 Population	2010 Population
Metropolis (city)	Massac, IL	2.0	SE	6,482	6,537
Joppa (village)	Massac, IL	5.5	WNW	409	360
Brookport (city)	Massac, IL	7.5	ESE	1,054	984
Kevil (city)	Ballard, KY	9	SW	574	376
Bandana (CDP)	Ballard, KY	11	West	Null	203
Paducah (city)	McCracken, KY	11	SE	26,307	25,024
Massac (CDP)[a]	McCracken, KY	10	SSE	3,888	4,505
Hendron (CDP)[a]	McCracken, KY	11	SE	4,239	4,687
Farley (CDP)[a]	McCracken, KY	14	SE	Null	4,701
Woodlawn-Oakdale (CDP)[a]	McCracken, KY	14	SE	4,937	Null
Reidland (CDP)[a]	McCracken, KY	16	SE	4,353	4,491
Ledbetter (CDP)[a]	Livingston, KY	18	ESE	1,700	1,683

a. Communities adjacent to Paducah, Kentucky.

Distances are approximate and calculated using the MTW centerpoint and USDOT 2015 and USCB 2016b "place" geography.

Null: no available data.

(USCB 2016a; USCB 2016b; USDOT 2015)

Table 3.10-3
2010 Population and Projected Population 0 to 5 Miles from MTW (Sheet 1 of 4)

Sector/Years	Distance (miles)					
	0-1	1-2	2-3	3-4	4-5	Total
North						
2010	21	59	74	56	42	252
2017	21	59	74	56	42	252
2027	21	59	74	56	42	252
2037	21	59	74	56	42	252
2047	21	59	74	56	42	252
2057	21	60	74	56	42	253
NNE						
2010	18	58	55	37	84	252
2017	18	58	55	37	84	252
2027	18	58	55	38	84	253
2037	18	58	55	38	84	253
2047	18	58	55	38	84	253
2057	18	58	55	38	84	253
NE						
2010	37	185	255	112	74	663
2017	37	185	255	112	74	663
2027	37	185	256	112	75	665
2037	37	185	256	112	75	665
2047	37	185	256	112	75	665
2057	37	185	256	112	75	665
ENE						
2010	62	151	85	124	63	485
2017	62	151	85	124	63	485
2027	62	151	85	124	63	485
2037	62	151	85	124	63	485
2047	62	151	85	124	63	485
2057	62	151	86	124	63	486
East						
2010	188	449	130	164	118	1049
2017	188	449	130	164	118	1049
2027	188	450	130	164	118	1050
2037	188	450	130	164	118	1050
2047	189	451	130	164	118	1052
2057	189	451	130	164	118	1052

Table 3.10-3
2010 Population and Projected Population 0 to 5 Miles from MTW (Sheet 2 of 4)

Sector/Years	Distance (miles)					
	0-1	1-2	2-3	3-4	4-5	Total
ESE						
2010	327	1986	740	127	66	3246
2017	327	1986	740	127	66	3246
2027	327	1988	740	128	66	3249
2037	328	1990	741	128	66	3253
2047	328	1992	742	128	66	3256
2057	328	1993	742	128	66	3257
SE						
2010	15	1016	1944	3	6	2984
2017	15	1016	1948	3	6	2988
2027	15	1017	1952	3	6	2993
2037	15	1018	1954	3	6	2996
2047	15	1019	1955	3	6	2998
2057	15	1020	1957	3	6	3001
SSE						
2010	1	46	9	32	119	207
2017	1	46	9	33	120	209
2027	1	46	9	33	121	210
2037	1	46	9	33	121	210
2047	1	46	9	33	121	210
2057	1	46	9	33	121	210
South						
2010	0	9	44	106	250	409
2017	0	9	44	107	253	413
2027	0	9	45	108	255	417
2037	0	9	45	108	255	417
2047	0	9	45	108	255	417
2057	0	9	45	108	255	417
SSW						
2010	1	17	34	71	270	393
2017	1	17	34	72	273	397
2027	1	17	34	72	275	399
2037	1	17	34	72	275	399
2047	1	17	34	72	275	399
2057	1	17	34	72	275	399

Table 3.10-3
2010 Population and Projected Population 0 to 5 Miles from MTW (Sheet 3 of 4)

Sector/Years	Distance (miles)					
	0-1	1-2	2-3	3-4	4-5	Total
SW						
2010	1	0	1	1	2	5
2017	1	0	1	1	2	5
2027	1	0	1	1	2	5
2037	1	0	1	1	2	5
2047	1	0	1	1	2	5
2057	1	0	1	1	2	5
WSW						
2010	1	0	2	7	25	35
2017	1	0	2	8	26	37
2027	1	0	2	8	26	37
2037	1	0	2	8	26	37
2047	1	0	2	8	26	37
2057	1	0	2	8	26	37
West						
2010	3	0	1	3	5	12
2017	3	0	1	3	5	12
2027	3	0	1	3	5	12
2037	3	0	1	3	5	12
2047	3	0	1	3	5	12
2057	3	0	1	3	5	12
WNW						
2010	7	5	23	29	43	107
2017	7	5	23	30	44	109
2027	7	5	23	30	44	109
2037	8	5	23	30	44	110
2047	8	5	23	30	44	110
2057	8	5	23	30	44	110
NW						
2010	10	7	58	67	89	231
2017	10	7	58	67	89	231
2027	10	7	58	67	89	231
2037	10	7	58	67	89	231
2047	10	7	58	67	89	231
2057	10	7	58	67	90	232

Table 3.10-3
2010 Population and Projected Population 0 to 5 Miles from MTW (Sheet 4 of 4)

Sector/Years	Distance (miles) 0-1	1-2	2-3	3-4	4-5	Total
NNW						
2010	11	77	163	110	65	426
2017	11	77	163	110	65	426
2027	11	77	163	110	65	426
2037	11	77	163	110	65	426
2047	11	77	164	110	65	427
2057	11	77	164	110	65	427

Total 2010	**10,756**
Total Projected 2017	**10,774**
Total Projected 2027	**10,793**
Total Projected 2037	**10,801**
Total Projected 2047	**10,809**
Total Projected 2057	**10,816**

(USCB 2016b, IDPH 2016, KSDC 2016)

Table 3.10-4
2010 Population 5 to 50 Miles from MTW

Direction	Distance (miles)					
	5-10	10-20	20-30	30-40	40-50	5-50
North	179	2580	1994	5656	12794	23,203
NNE	398	769	883	7,462	15,495	25,007
NE	329	1,277	2,633	1,895	3,167	9,301
ENE	367	366	2,094	6,135	4,450	13,412
East	486	978	1,704	4,879	9,715	17,762
ESE	1,554	2,822	7,621	6,618	3,177	21,792
SE	12,837	24,125	9,159	13,898	7,471	67,490
SSE	6,542	13,918	5,638	10,008	25,596	61,702
South	2,500	3,207	6,093	12,221	9,074	33,095
SSW	1,673	2,030	2,436	3,482	5,001	14,622
SW	1,904	1,446	2,803	868	5,443	12,464
WSW	516	3,007	3,916	7,012	14,605	29,056
West	378	979	3,492	2,865	16,059	23,773
WNW	557	856	3146	1907	45529	51,995
NW	401	1,398	2,140	12,281	12,605	28,825
NNW	127	2,553	3,650	15,866	61,953	84,149
5–50 Total 2010		**517,648**				
0–5 Total 2010		**10,756**				
0–50 Total 2010		**528,404**				

(USCB 2016b)

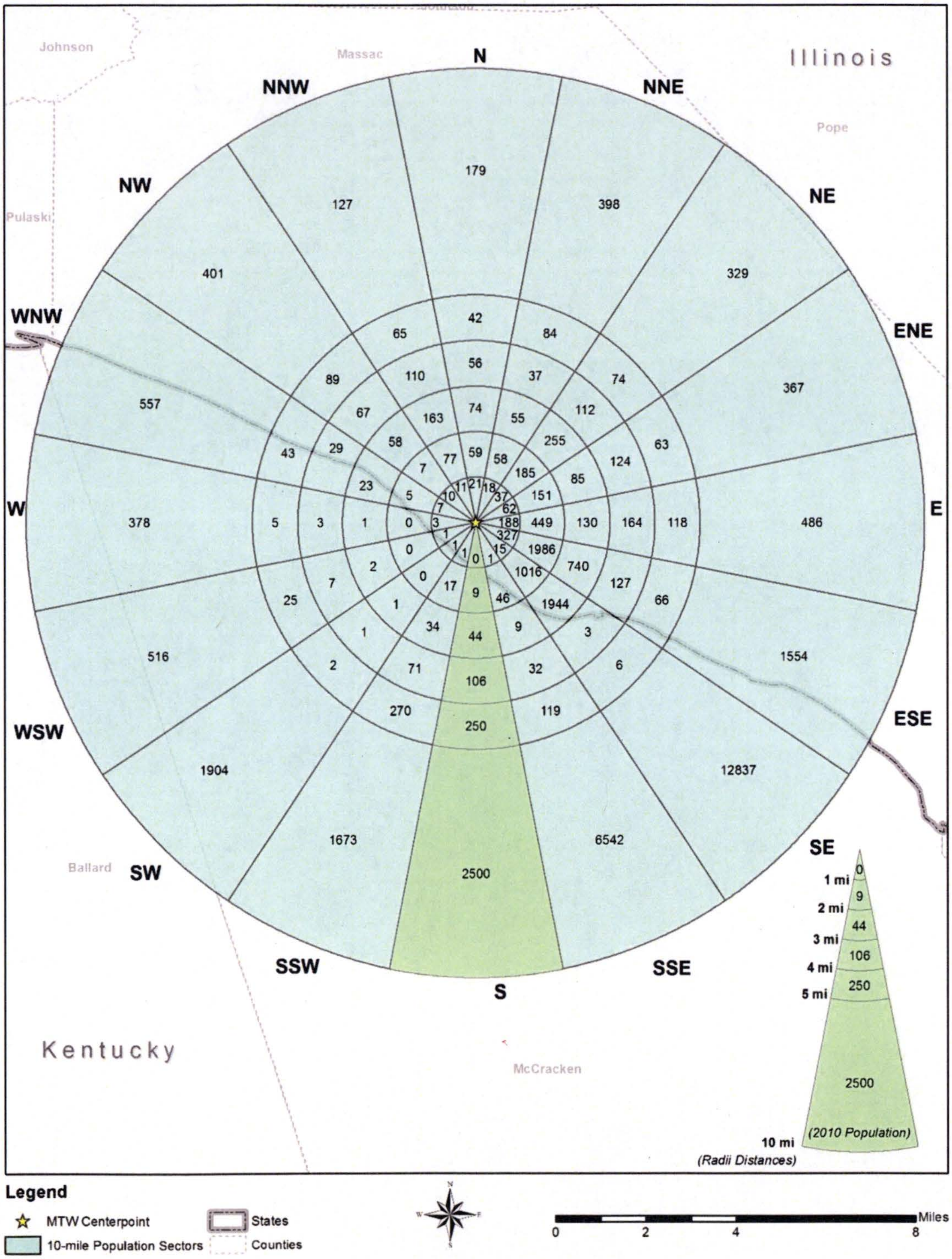


Figure 3.10-1
Population 0 to 10 Miles from MTW

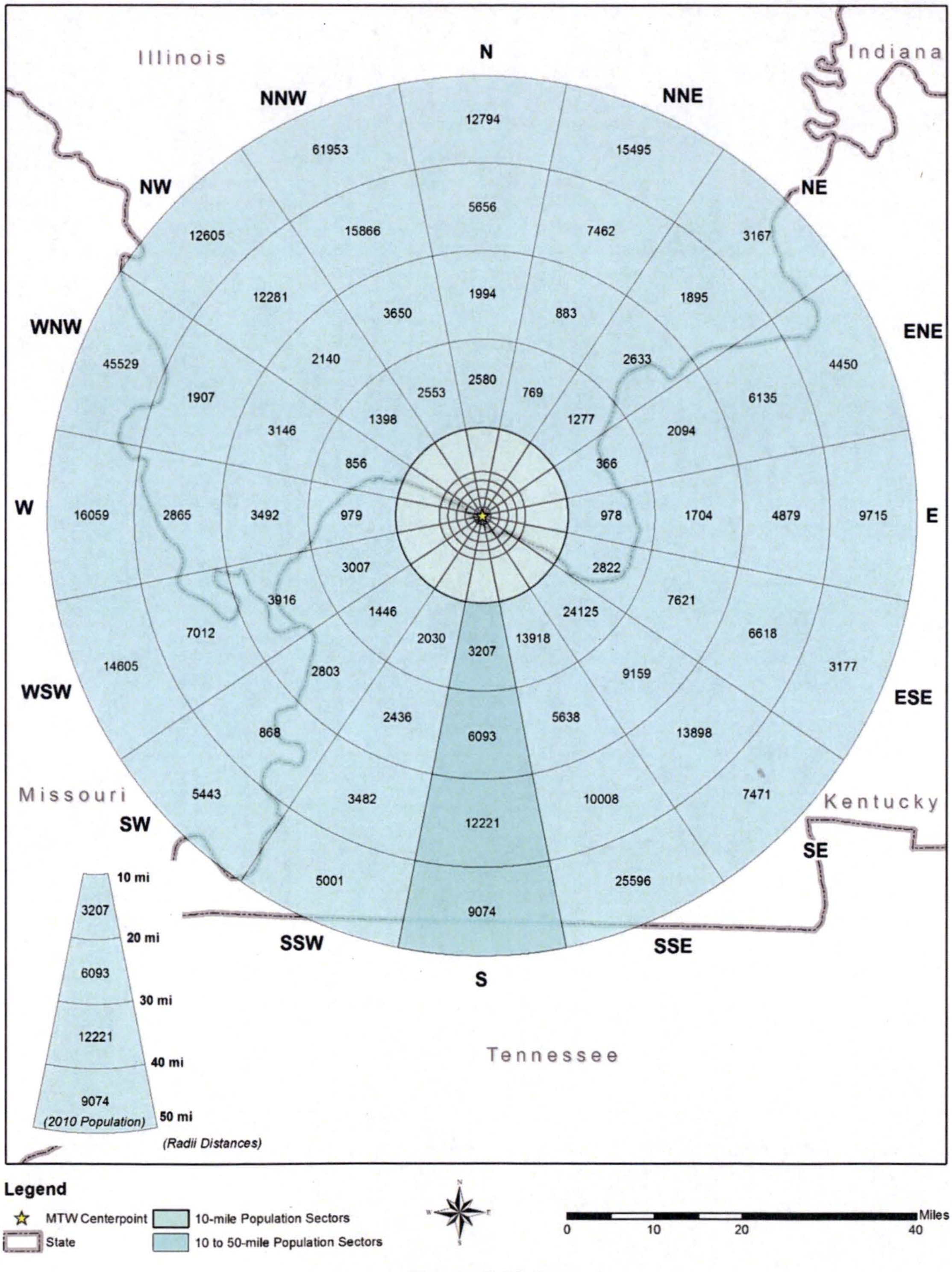


Figure 3.10-2
Population 10 to 50 Miles from MTW

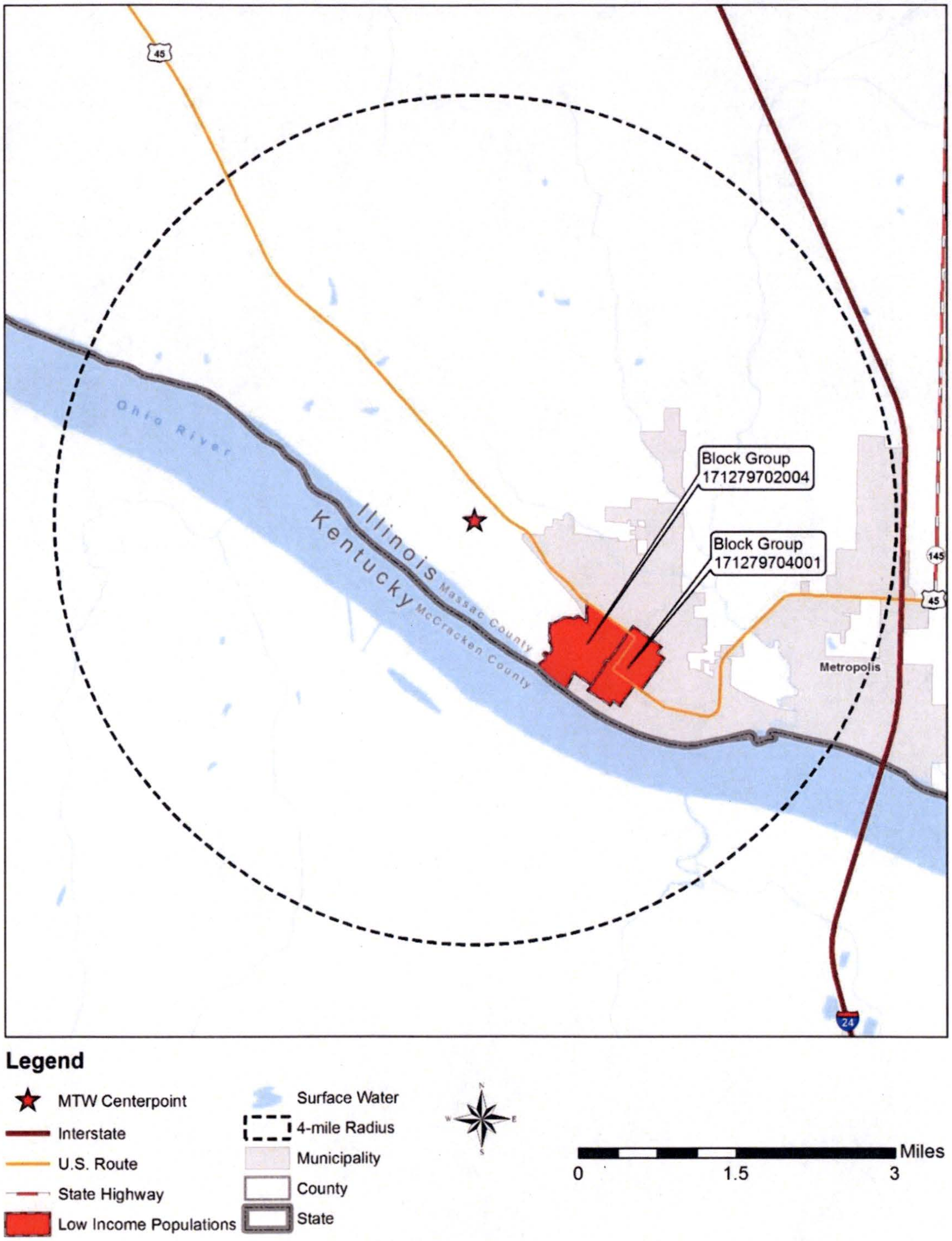


Figure 3.10-3
Low-Income Populations

3.11 Public and Occupational Health

3.11.1 Major Sources and Levels of Background Radiation Exposure

Background radiation is primarily from natural sources of cosmic and terrestrial origin. Additional sources of radiation dose from background consist of radionuclides within the body (e.g., potassium-40) and cosmogenic radionuclides (e.g., carbon-14). Man-made sources of radiation include radiation arising from medical diagnoses and treatment, incorporation of radioactive material in consumer products, and activities and effluents from industrial facilities using radioactive materials. The current estimate of cumulative individual annual dose in the United States is 620 mrem, with 50 percent each coming from background radiation and man-made sources. Of the exposure due to man-made sources, 96 percent is due to medical procedures. (NRC 2015)

As mentioned above, activities and effluents from industrial facilities using radioactive materials would also contribute to an individual's dose. MTW's surrounding vicinity also includes the DOE's PGDP, which is no longer in production but is undergoing remediation activities, some of which involve radiological releases. PGDPs emissions and effluents are controlled so that releases are maintained ALARA. To confirm that doses to the public and biota are below established limits, the DOE calculates annual dose estimates using effluent release data, direct radiation monitoring data, and environmental monitoring data. The DOE estimated the maximum individual exposure for 2013 at 0.44 mrem (DOE 2014).

3.11.2 Sources and Levels of Exposures to Radioactive Materials

In addition to the background radiation exposures discussed in Subsection 3.11.1, MTW employees and members of the public in the immediate vicinity of MTW may be exposed to low levels of radiation and radioactive materials as a result of MTW operations. For MTW employees, sources of radiation exposure include external exposure resulting from: 1) working in proximity to natural uranium, its daughter products, and other licensed materials in storage and in the plant process; and 2) internal exposures resulting from inhalation or ingestion of process materials. Members of the public in the immediate vicinity of MTW may be exposed to radiation and radioactive materials as a result of liquid and airborne MTW effluents and external gamma radiation. The monitoring results for these effluents and gamma radiation are summarized in Subsection 2.1.2.3.

The resulting occupational and non-occupational doses are controlled to levels that are within regulatory limits and ALARA. MTW monitors occupational exposure and performs environmental monitoring. The occupational exposure for 2010–2014 in average and maximum total effective dose equivalent (TEDE) is given in Table 3.11-1. Dose coefficients from ICRP 68 are used in conjunction with measured releases of airborne uranium. The dose factors assumed a particle size of 1 micrometer (μm) activity median aerodynamic diameters (AMAD) and vary by solubility. Ra-226 is taken to be Type M and Th-230 is assumed to be Type S. For dose calculation purposes, 100 percent occupancy is assumed for the nearest residence. The estimated annual dose to the nearest resident for 2010–2014 is presented in Table 3.11-2.

Some exposures to members of the public are also likely to result from the transportation of process materials, products, and waste materials in the public arena. During normal transportation operations, radioactive material and chemicals would be contained within their transport packages. Health impacts to crew members (i.e., workers) and members of the general public along the routes could occur if they were exposed to low-level external radiation in the vicinity of uranium material shipments. In addition, exposure to vehicle emissions (engine exhaust and fugitive dust) could potentially cause adverse health effects from inhalation. All transportation activities are conducted in accordance with U.S. Department of Transportation regulations. In comparison to doses resulting from natural background radiation, the doses resulting from transportation activities are expected to be negligible.

3.11.3 Major Sources and Levels of Chemical Exposure

MTW employees and members of the public in the immediate vicinity of MTW may be exposed to chemicals used in MTW processes. For MTW employees, sources of chemicals include routine exposures due to controlled system drainage, venting, leakage points, and non-routine exposures resulting from unplanned excursions. Controls in the work areas monitored include a combination of local exhaust ventilation, general ventilation, process enclosure, and personal protective equipment (PPE). Employees who work in the process areas of MTW have been trained and approved to use respiratory protection and participate in a medical surveillance program. Employees wear full body coveralls that are laundered onsite.

To control emissions from its processes and meet regulatory and permit limits, Honeywell employs a variety of emissions controls as discussed in Subsection 2.1.2.2. Members of the public in the immediate vicinity of MTW may be exposed to chemicals used at MTW as a result of routine controlled effluents and non-routine releases due to unplanned events. Honeywell monitors the emissions as well as conducts environmental monitoring at onsite and offsite sampling points as discussed in Subsection 2.1.2.3 and as shown in Figures 2.1-3 and 2.1-4. The samples are analyzed for uranium and fluoride. Tables 2.1-7 through 2.1-12 present the sample results for 2010–2014, and the results are summarized below in Subsection 3.11.4.

3.11.4 Public and Occupational Health Impacts

As mentioned in Subsection 3.11.3, Honeywell conducts environmental monitoring at onsite and offsite sampling points to ensure that emissions are within regulatory, permit, and license limits designed to be protective of human health. The environmental monitoring program is introduced in Subsection 2.1.2.3 and Tables 2.1-7 through 2.1-12 present the sample results for 2010–2014. The sampling points are shown in Figures 2.1-3 and 2.1-4, and the program is summarized in Table 2.1-6. The samples are collected weekly, quarterly, or semi-annually, and analyzed for uranium and fluoride. Sample results for 2010–2014 are discussed below.

Environmental air sample results for fluoride (µg/m^3) are presented in Table 2.1-7. The environmental air monitoring program consists of taking continuous air samples (low volume) at four points along the restricted area fence line (Stations No. 9, 10, 12, and 13). Two samplers are located in the prevailing wind direction (Stations No. 8 and 11). One sampler is located offsite, approximately one mile downwind of the FMB (Station No. 6). An additional continuous air sampler is situated at the location of the nearest residence (Station NR-7). During 2010–2014, the annual average concentration at the sampling points along the restricted area fence line ranged from not detected to 0.346 µg/m^3 at Station 10. The maximum annual concentration near the MTW site was 0.213 µg/m^3 during 2010 at Station No. 11. The State of Illinois does not have an ambient air quality standard for fluoride; however, the State of Kentucky, which adjoins the MTW site on the south, has an established secondary standard of 0.82 µg/m3 as a maximum one-month average. Kentucky's primary standard for gaseous F2 measured as HF is 400 µg/m^3 annual average (KAR 53.010 Appendix A). The CAA established primary standards to protect public health and secondary standards to protect public welfare, such as damage to crops and vegetation. There are no sampling points offsite or near the MTW site boundary in the direction of Kentucky. The maximum monthly average concentration at the sample point nearest to the Kentucky border, which is along the restricted area fence line (Station 10), exceeded the secondary standard in May and June 2010. The annual average for Station 10 was 0.346 µg/m^3 in 2010, a fraction of the Kentucky primary standard.

The applicable standard for radioactivity in environmental air samples applies to the samples collected at the nearest residence. The NRC license limit for the sum of uranium, Ra-226, and Th-230 at NR-7 is a quarterly average concentration of 3.0 x 10-14 µCi/ml. The sampling results are shown in Table 2.1-8. During 2010–2014, the sampling results were under this limit with only one exception: the third quarter of 2011.

Excursions or permit violations related to MTW's NPDES permit during 2010–2014 are summarized in Table 3.4-4. Monitoring for NPDES permit conditions is summarized in Table 2.1-5 and discussed in greater detail in Section 3.4. From Table 3.4-3e, the maximum y fluoride concentration was 28.00 mg/l.

Environmental water and mud samples are taken semi-annually from four locations on the Ohio River and at three area lakes and ponds (Figure 2.1-4). These samples are analyzed for uranium and fluoride content to determine any potential impact of MTW's operation. Environmental water samples collected from the Ohio River during 2010–2014 are shown in Table 2.1-9. The river's concentration of uranium and fluoride upstream of the MTW discharge (Brookport Dam) ranged from 0.15 to 2.51 ppm fluoride, and the yearly average of uranium was 0.00 ppm uranium with the highest sample being 0.01 ppm in June 2011. Downstream concentrations at Joppa, Illinois, ranged from an annual average of 0.16 to 3.40 ppm fluoride and 0.000 ppm for 2010–2014 samples analyzed for uranium. Joppa is the nearest downstream municipality that could (but does not) use river water for drinking purposes. The State of Kentucky, which has legal ownership of the Ohio River along its border with Ohio, Indiana, and Illinois, limits allowable instream concentrations of fluoride to 4,000 µg/L or 4 ppm (401 KAR 10:03). The current EPA drinking water standard for uranium is 30 µg/L or 0.03 ppm (40 CFR 141.66(e)).

Analysis of mud samples (bottom sediment) for uranium and fluoride as summarized in Table 2.1-10 indicate there is some deposition of both uranium and fluoride in river sediment at the point of effluent discharge into the river. With the exception of the area around the MTW effluent discharge point, results for uranium appear fairly uniform for all sampling stations (see Table 4.4-2). Fluoride concentrations in sediment are higher downstream compared to upstream, with the exception of 2013. There are no established standards for uranium or fluoride in stream sediments. Typical concentrations of Uranium-238 in soil is 3 ppm (ORISE 2011); typical concentrations of fluoride in soil in the United States are on the order of 300-430 ppm (National Research Council 2006).

Additional environmental soil and vegetation samples are also collected semi-annually. Table 2.1-12 summarizes the results for uranium and fluoride 2010–2014 soil sampling. The results for the offsite sampling points, with the exception of the nearest residence and the 2010 average for one other offsite sample location, fell below the 3 ppm typical concentration in soil. The Reiniking property 2010 average was 6.65 ppm; the 2011 average for this same property was 0.70 ppm. The concentration of uranium at the nearest residence averaged 7.37 ppm for samples collected in 2010–2014. The fluoride results do not approach the typical concentrations of fluoride in soil in the U.S.

Table 2.1-11 provides annual averages of semi-annual sample concentrations of fluoride and uranium in vegetation for the years 2010–2014. The offsite concentrations (Stations No. A through No. G and No. 1 through 7, shown on Figure 2.1-4) of uranium were on a downward trend from 2011, with the exception of 2013 at the nearest residence. The fluoride concentrations in onsite and offsite samples varied widely, as shown in Table 2.1-11, with concentrations sharply up in 2012 and continued higher concentrations in 2013 and 2014. The 2013–2014 average for fluoride was 215 ppm offsite and 105 onsite. The fluoride concentration in vegetation can result from uptake from the soil, watering/irrigating with fluorinated water, uptake from the air, fertilizers, and the use of pesticides.

The control, onsite, and offsite environmental dosimeter monitoring results from 2010–2014 are summarized in Table 2.1-13. The maximum annual average of the direct gamma radiation consistently occurs at the eastern or southern restricted area fences. This is attributed to the large ore concentrate storage area immediately adjacent to the sampling stations. The maximum annual average environmental dosimeter dose occurred at the south fence dosimeter monitoring point in 2010 and was 142 mrem. Background annual average radiation doses at the airport have varied from 31 mrem to below the minimal measureable quantity and averaged 28 mrem in 2010. Radiation doses at the nearest residence were similar to background ranging from 29 mrem to below the minimal measureable quantity. Table 3.11-1 presents the occupational dose for the Average and Maximum individuals and Table 3.11-2 presents the nearest resident dose as compared with regulatory limits, indicating compliance with the limits during 2010–2014.

3.11.5 Occupational Injury and Fatality Rates

Honeywell conducts its operations in accordance with U.S. Occupational Safety and Health Administration's (OSHA's) applicable requirements, particularly 29 CFR 1910. MTW's total recordable injury rate averaged 2.5 from 2010–2014 (Honeywell 2010; Honeywell 2011; Honeywell 2012; Honeywell 2013b; Honeywell 2014b). The chemical manufacturing sector as a whole also had a 2.3 rate in 2014 and ranged from 2.0 to 3.4 across the various subsectors (BLS 2015). There have been no work-related fatalities at MTW.

Table 3.11-1
Occupational Dose

Year	Average Individual Occupational Dose in TEDE (rem)	Maximum Individual Occupational Dose in TEDE (rem)
2010	0.155	1.642
2011	0.228	2.459
2012	0.131	1.827
2013	0.057	0.866
2014	0.062	0.591
10 CFR 20.1201(a)(1)(i)	5 rem	

(MTW 2016b)

Table 3.11-2
Nearest Residence Dose (in mrem)

Year	Comply CAP-88	Liquid	External	Annual Dose to Nearest Resident[a]
2010	3.6	0.002	12	15.6
2011	6.1	0.002	4	10.1
2012	2	0	3	5.0
2013	2	0	0	2.0
2014	4	0	0	4.0

(Honeywell 2016i)

a. These values are the sum of the annual dose to the public prepared using compliance modeling programs (COMPLY in 2010 and 2011, and CAP-88-PC 2012–2014) + the annual environmental dosimeter dose at the MTW site boundary + liquid effluent offsite dose sensitivity study (dose to the maximally exposed individual). CAP-88 runs for 2012–2014 were estimated using meteorological data from 1988–1992 at Barkley Regional Airport WSO.

3.12 Waste Management

The MTW uranium conversion process discussed in Section 2.1.2 and illustrated in Figures 2.1-1 and 2.1-2 generates effluents and residues which are captured, treated, and re-introduced into the manufacturing process or discharged as liquid or gaseous effluents or solids suitable for offsite reclamation/reuse.

The liquid and gaseous effluents are summarized in Section 2.1 and discussed in detail in Sections 3.4, 4.4, and 4.6.

MTW generates solid waste from production activities, radiation protection, maintenance, housekeeping, administration, and laboratory activities. Solid wastes include low-level radioactive, hazardous, mixed, and nonradioactive and non-RCRA hazardous wastes. A combination of recycling and offsite disposal are used in the management of these wastes and are discussed below.

MTW also has two byproduct streams, synthetic CaF_2 and filter fines, that are sent offsite for reclamation/reuse and are not considered waste streams nor managed as such. At the EPF, calcium hydroxide is used to remove chemical pollutants (primarily fluoride) from the effluent stream. The resulting synthetic CaF_2 is shipped to offsite industrial users, who use it as a substitute for naturally occurring CaF_2 (fluorspar). Filter fines from the fluorination process which have sufficient quantities of uranium for reclamation are shipped offsite for reclamation of uranium. The recovered uranium is returned to MTW for re-introduction into the manufacturing process.

3.12.1 Radiological Solid Waste Streams and Treatment

MTW generates waste contaminated with uranium residuals from its process. This waste includes environmental control filters, maintenance and housekeeping wastes, PPE, and equipment removed from service. These dry active waste and debris waste streams are collected in marked containers, segregated by radioactivity, drummed or bagged, and shipped to a disposal facility permitted to manage such waste. The annual generation rate has varied from 2010–2014, as shown in Table 3.12-1. In addition, MTW generates drums that held uranium feedstock and process intermediates that are also disposed. The drums are crushed onsite and shipped offsite to a disposal facility. Approximately 2,000 cubic yards (cy) of crushed drums were shipped offsite for disposal from 2010–2014.

Currently, Honeywell ships its unimportant source quantity waste to US Ecology's Grandview, Idaho, facility for disposal. This facility holds an RCRA Part B permit and is permitted to dispose of waste that includes residuals of source material in permitted levels (IDEQ 2015). The facility's remaining capacity as of July 2011 was 11.75 million cubic yards (IDEQ 2012). There are two NRC-licensed LLW disposal facilities that would also be available to receive MTW's unimportant source quantity waste (NRC 2016). Waste Control Specialists is the Andrews, Texas, 1,338-acre facility currently licensed for disposal of Class A, B, and C waste, including mixed waste of these classes with a permitted capacity of 5.4 million cy (WCS 2013). Energy Solutions in Clive, Utah, is currently licensed for disposal of Class A waste with a capacity of 8.72 million cy and 1.35 million cy Class A mixed waste (UDEQ 2013).

3.12.2 Nonradioactive Solid Waste and Treatment

Nonradioactive, non-hazardous waste streams include certain cleaning compounds, antifreeze, floor sweep, and compressed gases, etc., that are sent offsite for disposal or recycling; debris/trash from operations collected in roll-off containers suitable for a municipal landfill; and office waste/trash collected in frontload dumpsters. The waste is screened for radioactivity and segregated as indicated by detected radioactivity levels. Universal waste is managed in accordance with Illinois regulations. In 2014, MTW generated approximately 8,600 pounds of universal waste, 120,000 pounds of non-hazardous waste, and 188 tons of debris/trash. Additionally, office waste is collected in four 2-cy and two 8-cy dumpsters and generally dumped once to twice weekly. The recycling and disposal companies used by MTW in 2014 included Clean Harbors (various facility locations), Safety-Kleen (various facility locations), and Spring Grove Resource Recovery in Cincinnati, Ohio. Debris/trash and office waste is sent to a local or regional landfill, which is currently the Southern Illinois Regional Landfill. MTW also generated approximately 580 tons of soil from non-routine remediation activities in 2014 that was disposed of at the Southern Illinois Regional Landfill.

The IEPA annually assesses the state's remaining landfill disposal capacity. As of 2015, the remaining disposal capacity was more than 900 million cy, with 39 million cy available at the Southern Illinois Regional Landfill (IEPA 2015c). A number of Illinois companies are involved in universal waste recycling (IEPA 2015d).

3.12.3 RCRA Hazardous Waste

MTW is a large quantity generator operating under RCRA ID ILD006278170. Hazardous waste is generated by production activities and the EPF residuals as well as laboratory and maintenance activities. Some of the laboratory and maintenance wastes are mixed waste and are further discussed below. The facility has been issued an RCRA permit (#B-65R2-M-17) by the IEPA for two hazardous waste container storage areas for these wastes. This permit is in effect from December 3, 2013, until December 3, 2023. (IEPA 2015e) Annual hazardous waste generation for 2010–2014 ranged from approximately 13,000 to 27,000 pounds (MTW 2011; MTW 2012; MTW 2013; MTW 2014; MTW 2015b). In 2014, the waste was shipped offsite for recycling or disposal to various permitted facilities, including Clean Harbors (various facility locations), Safety-Kleen (various facility locations), and Veolia ES Technical Solutions in Texas.

Illinois has 13 commercial hazardous waste management companies. These companies managed approximately 400,000 tons of hazardous waste in 2013. (IEPA 2013b) MTW's annual generation of hazardous waste is a very small percentage of the overall amount of hazardous waste managed in Illinois.

The RCRA permit also covers four surface impoundments, Ponds B, C, D, and E. Three of the surface impoundments, CaF2 Ponds B, C, and E, are full and do not receive effluent. The fourth surface impoundment, Pond D, receives flow from the EPF for additional clarification prior to discharge at NPDES permitted Outfall 002. Under the terms of the RCRA permit, the ponds are scheduled to be closed by 2020. (IEPA 2015e)

3.12.4 Mixed Waste

Mixed waste is generated by support activities such as maintenance and laboratory activities. Typical mixed wastes include items such as radiologically contaminated xylene paint thinner, used lubricating oils and waste naphtha from maintenance or cleaning activities, and waste acetone, tributylphosphate, freon, etc.

The quantity of mixed waste generated at MTW is quite variable, with the generation for 2010 to 2014 ranging from none in 2012 to 15,000 pounds in 2013 (MTW 2011; MTW 2012; MTW 2013; MTW 2014; MTW 2015b). Mixed waste is stored at one of the two RCRA-permitted storage facilities onsite pending the availability of offsite facilities to either treat or dispose of these wastes. Approximately 14,000 pounds of mixed waste were shipped offsite in 2013 (MTW 2014), leaving 18 containers, mostly 55-gallon drums, in storage in 2014.

Honeywell previously was under an interim consent order with the Illinois Attorney General's Office and the IEPA. The order was the result of the unauthorized storage of drums of KOH mud, a mixed waste. (EPA 2011) Most of this material was recovered through wet process, and in 2012 the residuals were shipped offsite to Energy Solutions in Utah (MTW 2013).

As mentioned above, both, Energy Solutions, which was previously used by Honeywell for mixed waste disposal, and Waste Control Solutions are permitted to dispose of mixed waste. Energy Solutions has a permitted capacity of Class A mixed waste of 1.35 million cy (UDEQ 2013). Waste Control Specialists has a permitted capacity of 5.4 million cy (WCS 2013).

Table 3.12-1
Radioactive Waste Generation

Year	Cubic Yards
2010	4,766.66
2011	4,259.26
2012	1,296.30
2013	241.15
2014	1,399.7

4.0 ENVIRONMENTAL IMPACTS

4.1 Land Use Impacts

As discussed in Section 3.1, land uses in Massac County are predominantly pasture, cropland, and forestland. Undeveloped land uses within a two-mile radius of MTW are generally forest, planted and cultivated areas, and open water, which combined cover 67 percent of the area.

Honeywell proposes to relicense its existing facility with minor modifications to onsite systems. Relicensing or system modification would not change any current use of the land outside the restricted area. Thus, the proposed action has no beneficial or adverse impact on current land use in the vicinity.

4.2 Transportation Impacts

The NRC evaluated the potential impacts of the transportation of radioactive materials and documented its findings in the 1977 *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes*. This analysis concluded that "the average radiation dose to the population at risk from normal transportation is a small fraction of the limits recommended for members of the public from all sources of radiation other than natural and medical sources and is a small fraction of natural background dose." (NRC 1977) This earlier environmental analysis considered the types of activities conducted at MTW. There have been no substantive changes in MTW transportation procedures in the time since this evaluation and none are planned. Thus, the conclusion remains valid for the proposed license renewal.

4.3 Geology and Soils Impacts

MTW is located in a region of recognized seismic activity caused by the New Madrid seismic zone, the locus of one of the highest intensity earthquakes in North American history. The USGS seismic hazard website shows a 15 percent probability of exceeding a magnitude of five within 50 years and a 15 percent probability of exceeding a magnitude of seven within 100 years (USGS 2016e).

Historic earthquake data for the area between latitude 36.608° to 37.648° north and longitude 89.534° to 88.011° west were reviewed. The MTW site lies within a region of infrequent and minor seismic activity, with only 26 small (between 3.0 body wave magnitude [Mb] and 4.3 Mb) earthquakes within the search area between 1970 and 2014. Only six small (between 3.0 Mb and 3.9 Mb) earthquakes were reported since 2005, with the last reported earthquake occurring in February 2012 (3.9 Mb, 8 kilometers south of Charleston, Missouri) (USGS 2016f). Little evidence exists concerning the behavior of the surficial geological materials or MTW site subsurface strata during these earthquakes; however, MTW has not reported any damage or interruption of operations due to seismic events since its opening. The effect of another seismic event similar to the 1811–1812 earthquakes could potentially result in damage to onsite buildings, containments, and piping. No geological features (e.g., structural faults or karstic depressions) were identified onsite that would increase the likelihood of a local seismic event (Honeywell 2005).

Continued operations at MTW are not expected to have any significant impact to geological features such as soil compaction, soil erosion, subsidence, landslides, or disruption of natural drainage patterns. Honeywell proposes to relicense its existing facility with minor modifications to onsite systems (Honeywell 2005).

Neither relicensing nor system modification will change the existing geological or soil conditions at or surrounding MTW.

4.4 Water Resources Impacts

4.4.1 Surface Water

4.4.1.1 System

The MTW site is located along the Ohio River at a point approximately 35 miles upstream from its confluence with the Mississippi River (Honeywell 2005). Draining 203,940 square miles (ORSANCO 2016b), the Ohio River provides the southern boundary of the MTW site in the vicinity of River Mile 946 (USACE 2014) and is the receiving water for MTW effluent (Honeywell 2005).

There are four intermittent creeks that drain the MTW site to the Ohio River. These creeks enter the MTW site on the north side, and there are no other downstream properties between MTW and the Ohio River. A detailed discussion of the surface hydrological systems and a discussion of the Ohio River water quality are provided in Section 3.4.

4.4.1.2 Alterations

Continued operation of existing processes will require no additional uses or modifications of natural surface water bodies. Process and potable water for the facility will continue to be provided by groundwater wells, as discussed in Section 3.4.

Honeywell proposes to re-license its facility with only minor modifications, as discussed in Section 2.0. Some of the modifications will include phasing out the use of the onsite CaF2 settling ponds except ponds #3 and #4. Settling ponds are currently used to remove particulate contaminants from MTW effluent. Settling Pond A was closed in 2001 (Honeywell 2005). Currently, no material is discharged to Ponds B, C, and E. Pond D only receives flow from MTW's NPDES-permitted wastewater treatment system prior to discharge at permitted Outfall 002. All four remaining ponds are scheduled to be closed by the year 2020 (Honeywell 2010).

The MTW effluent flow (Table 3.4-1) has remained consistent to slightly decreased between 2010 to 2014. As discussed in Section 3.4, concentrations of NPDES-monitored constituents in the effluent from MTW have not had adverse trends within the past five years. Effluent limits stipulated in the NPDES permit are intended to minimize impacts to the receiving water.

4.4.1.3 Impacts

The MTW effluent flow rate is insignificant compared to the annual mean discharge rate for the Ohio River; therefore, the flow rate should have no significant impact on the Ohio River's flow rate.

Tables 4.4-1, 4.4-2, and 4.4-3 provide information on surface water and sediment sampling locations for uranium and fluoride (annual averages from 2010–2014). Sediment sample analyses for MTW's effluent ditch (Table 4.4-1) show no overall increasing trends, with the exception of an increase in uranium and fluoride concentrations in 2013 for both MTW effluent ditch sample locations. Higher concentrations in 2010 and 2011 are due to the use of different analysis probes starting with samples collected in the second half of 2011.

Comparing sediment sample analyses (Table 4.4-2) for the Ohio River at the MTW outflow, Brookport Dam (seven miles upstream), and the Joppa Power Plant (five miles downstream), there is a slight increase in the five-year average fluoride concentrations between 2010–2014. Analyses for the upstream and downstream sample locations show a slight increasing trend in uranium over the period, and the fluoride concentration has an overall decreasing trend. The MTW outflow location uranium and fluoride concentrations generally decrease over the monitoring period and are generally higher than the concentrations at the upstream and downstream locations in all years.

Comparing surface water sample analyses (Table 4.4-3) for the Ohio River at the MTW outflow seven miles upstream and five miles downstream, the uranium and fluoride concentrations are generally variable at all three sample locations over the period. The uranium and fluoride concentrations are generally higher for the MTW outflow location than for the upstream and downstream sample locations in all years.

Continued operation of MTW will likely have similar impacts to the local hydrological systems with no expected change over the licensing period.

4.4.2 Other Surface Water Users and Compatibility of Water Use

Some nearby water users in the vicinity of MTW also utilize the Ohio River. Nearby industrial use of the river is primarily limited to effluent discharge and/or cooling water make-up. The nearest downstream city, Joppa, Illinois, located approximately eight miles to the northwest, does not utilize the Ohio River for drinking water supply (Honeywell 2005).

Table 4.4-1
Environmental Sediment Samples Effluent Ditch Uranium and Fluoride Annual Average

Location		2010[(a)]	2011[(a)]	2012	2013	2014	5-Year Average
Uranium (ppm)	700 feet	12.54	69.02	343.50	439.50	23.80	177.67
	1,400 feet	30.14	234.79	376.45	1,775.00	370.00	557.28
Fluoride (ppm)	700 feet	817.13	7,677.08	43.50	110.00	60.50	1,741.64
	1,400 feet	32,782.09	5,220.50	27.40	105.50	31.00	7,633.30

a. Following the 2010 and June 2011 analysis, the fluoride analysis probe was changed.
(Honeywell 2016j)

Table 4.4-2
Environmental Sediment Samples Uranium and Fluoride Annual Average

	Location	2010	2011	2012	2013	2014	5-Year Average
Uranium (ppm)	Lamb Farm Lake	0.29	0.63	1.13	2.55	0.97	1.11
	Ohio River, Opposite MTW	0.12	0.28	0.34	0.78	1.12	0.53
	Brookport Dam	0.07	0.19	0.71	1.00	0.57	0.51
	MTW Outflow	0.43	13.82	23.75	0.68	2.30	8.20
	Joppa Boat Ramp	0.09	0.29	0.44	0.55	0.76	0.43
	Lindsay Lake	0.09	0.56	0.91	1.45	0.79	0.76
	Oak Glenn Lake	0.22	0.42	0.49	1.65	1.09	0.77
Fluoride (ppm)	Lamb Farm Lake	5.34	0.94	1.35	1.20	1.79	2.12
	Ohio River, Opposite MTW	9.90	5.07	0.55	0.24	2.30	3.61
	Brookport Dam	6.83	1.62	1.19	0.50	0.84	2.20
	MTW Outflow	161.65	7.21	6.10	0.54	8.15	36.73
	Joppa Boat Ramp	12.28	1.75	1.32	0.29	1.70	3.47
	Lindsay Lake	0.99	1.64	0.57	1.80	2.90	1.58
	Oak Glenn Lake	1.84	1.03	1.36	2.10	0.54	1.37

Sample locations:

Lamb Farm Lake: Pond 1/4-mile from original Lamb Farm pond (filled in Fall 1989).

Ohio River, Opposite MTW: TVA Shawnee Fossil Plant discharge.

MTW Outflow: Ohio River at MTW outflow.

Brookport Dam: Ohio River, 7 miles upstream at Lock and Dam No. 52.

Joppa Power Plant Boat Ramp: Ohio River, 5 miles downstream at Joppa, IL.

Lindsay Lake: Lake located 6.4 miles northeast of the MTW facility.

Oak Glenn Lake: Lake located 1.7 miles northeast of the MTW facility.

(Honeywell 2016j)

Table 4.4-3
Environmental Surface Water Samples Uranium and Fluoride Annual Average

	Location	2010	2011	2012	2013	2014	5-Year Average
Uranium (ppm)	Lamb Farm Lake	0.001	0.002	0.002	0.050	0.001	0.011
	Ohio River, Opposite MTW	0.015	0.001	0.001	0.000	0.003	0.004
	Brookport Dam	0.001	0.004	0.001	0.001	0.001	0.002
	MTW Outflow	0.011	0.014	0.131	0.019	0.140	0.063
	Joppa Boat Ramp	0.001	0.004	0.003	0.001	0.002	0.002
	Lindsay Lake	0.001	0.028	0.042	0.001	0.001	0.014
	Oak Glenn Lake	0.001	0.003	0.001	0.001	0.001	0.001
Fluoride (ppm)	Lamb Farm Lake	1.734	0.751	0.115	0.755	0.120	0.695
	Ohio River, Opposite MTW	1.519	0.633	0.126	0.087	0.143	0.502
	Brookport Dam	2.513	0.591	0.145	0.150	0.165	0.713
	MTW Outflow	4.486	0.763	1.640	0.400	1.555	1.769
	Joppa Boat Ramp	3.401	0.545	0.170	0.155	0.165	0.887
	Lindsay Lake	1.975	0.480	1.120	0.200	0.190	0.793
	Oak Glenn Lake	1.628	0.586	0.160	0.185	0.185	0.549

Sample locations:

Lamb Farm Lake: Pond 1/4-mile from original Lamb Farm pond (filled in Fall 1989).

Ohio River, Opposite MTW: TVA Shawnee Fossil Plant discharge.

MTW Outflow: Ohio River at MTW outflow.

Brookport Dam: Ohio River, 7 miles upstream at Lock and Dam No. 52.

Joppa Power Plant Boat Ramp: Ohio River, 5 miles downstream at Joppa, IL.

Lindsay Lake: Lake located 6.4 miles northeast of the MTW facility.

Oak Glenn Lake: Lake located 1.7 miles northeast of the MTW facility.

(Honeywell 2016j)

4.5 Ecological Resources Impacts

Honeywell proposes to relicense its existing facility with minor modifications to onsite systems. Relicensing MTW with modifications to existing systems within the restricted area does not require any additional destruction or modification of terrestrial and aquatic habitat. Therefore, no potential adverse impact on the species that might inhabit existing adjacent habitats as residents or migrants will occur as a result of the proposed relicensing.

Critical habitat for the rabbitsfoot mussel is located in the section of the Ohio River adjacent to the MTW site; however, this habitat is not impacted by existing MTW activities, nor would the rabbitsfoot mussel critical habitat be adversely affected by proposed relicensing. Relicensing MTW will not require destruction or modification to the Ohio River or adjacent aquatic habitats, as all proposed modifications are minor and will occur within the restricted area. All discharge exiting MTW is regulated under the facility's existing NPDES permit, which maintains thresholds for pollutants exiting the MTW site through stormwater runoff and effluent resulting from MTW activities. All wastewater resulting from MTW activities is processed through the MTW's environmental protection facility to meet effluent limitations specified in the MTW's NPDES permit. Compliance with this permit prevents discharge exiting MTW from degrading the Ohio River and rabbitsfoot mussel critical habitat.

No other wildlife sanctuaries, nature preserves, refuges, conservation areas, or rare, unique, or critical habitats are located on or within close proximity to MTW. Informal consultation with the USFWS was initiated on March 1, 2016, proposing that relicensing of MTW will not result in impacts to federally listed threatened or endangered species or their habitat. The USFWS responded on July 22, 2016, with no objection to facility relicensing (USFWS 2016b).

One approximately 150-foot wide forested wetland is located on the MTW site, approximately 1,700 feet southwest of the restricted area, in the floodplain of the Ohio River. This wetland was once cultivated, but is being allowed to return to its natural state. No impacts to wetlands are proposed to result from MTW relicensing, as the wetland is located outside of the restricted area, and no modifications are proposed.

Honeywell does not allow any recreational hunting, fishing, or trapping on its property and has posted signs to that effect. Therefore, the proposed license renewal would neither increase nor decrease harvest pressure on recreationally important fish or wildlife species. No impacts to the Ohio River will result from the proposed relicensing, as no modification on or abutting the Ohio River is proposed. Therefore, commercial and recreational fishing will not be impacted by the proposed license renewal.

Four creeks drain undeveloped portions of the MTW site to the Ohio River, which forms the southern boundary of the MTW site, approximately 1,800 feet southwest of the restricted area. The Ohio River is classified as a jurisdictional traditional navigable water and subject to regulation by the USACE. The proximity of the creeks located on the MTW site to the Ohio River would be considered a significant nexus with a jurisdictional water of the U.S. and would subject the creeks to the regulatory jurisdiction of the USACE as well. However, the proposed license renewal is not subject to review by the USACE because it does not require the discharge of dredge or fill material into the Ohio River or adjacent tributaries or wetlands.

4.6 Air Quality Impacts

4.6.1 Permits

MTW currently operates under a Title V CAA permit (ID Number 127854AAD) issued by the IEPA, Division of Air Pollution Control, on July 14, 2003, which expired July 14, 2008. An administratively complete renewal application was submitted in September of 2007, and the facility continues to operate under Permit #127854AAD pending review and reissuance by the IEPA. The permit grants Honeywell permission to operate a facility classified within the Industrial Organic Chemicals Group. The permit contains terms and conditions which address applicability of Title I of the CAA, including federal prevention of significant deterioration goals and Illinois Administrative Code 35 IAC Part 203 – Major Stationary Sources Construction and Modification. The permit describes various terms and conditions; MTW is subject to NRC regulations for emissions of radionuclides, but is not subject to National Emissions Standard for Hazardous Air Pollutants for radionuclides (40 CFR 61, Subpart I).

4.6.2 Facility Gaseous Effluents

Based on the Title V CAA permit issued by the IEPA, MTW has 53 individual stacks and exhaust fans used for release of radioactive material and 14 emission units that potentially contribute to the release of nonradioactive material.

4.6.3 Gaseous Effluent Control Systems

Similarly, a detailed description of the facility gaseous effluent control systems is provided in Subsection 2.1.2.2. Many of the process operations have primary, secondary, and tertiary controls to minimize or eliminate air effluents. Gaseous effluent control systems include baghouse dust collectors with filter fabric and metal or carbon filters for control of particulate emissions, and scrubbing systems using water or potassium hydroxide for control of F_2, HF, UF_4, and UF_6.

4.6.4 Non-Radiological Air Quality Impacts

Normal operation of MTW is not expected to have any significant effect on offsite non-radiological air quality. An application for a Title V CAA permit was initially filed with the IEPA in March of 1996, and was issued in July 2003. As noted above, an administratively complete renewal application has been filed with IEPA and is awaiting review. The currently effective permit includes emission limitations for volatile organic material (VOM); sulfur dioxide (SO_2); particulate matter (PM); nitrogen oxides (NOx); and hazardous air pollutants (HAPs), excluding VOM and PM. Estimates of release rates for these emissions are generally below levels required by the Title V permit. Honeywell reports semi-annually to the IEPA on any minor upsets experienced in that reporting period. In addition, the permit establishes operating conditions for many of the process units to minimize or eliminate impact to local and regional air quality.

With the single exception discussed below, process operations affecting air emissions have not changed substantially since the preparation of the ER for the prior license renewal. The exception is the retirement of the process to generate H_2 by catalytic cracking of NH_3. The H_2 required for the U_3O_8 reduction is now purchased as liquid H_2 and stored onsite as described in Subsection 2.1.2.1. This process modification had the effect of eliminating an emission source (the incineration of the off-gas from the NH_3 cracking) of non-radioactive emissions.

The Title V CAA permit issued by IEPA addresses the non-radiological emissions from MTW. When developing the emission limits for the Title V permit, the IEPA considered the impacts of MTW's emissions on ambient air quality and established the limits to be protective of ambient air quality. Table 4.6-1 provides a comparison of MTW's non-radiological emissions to the permitted Title V emission limits. Inspection of Table 4.6-1 provides ample evidence that MTW's emissions are well below the permitted Title V emission limits and expected to cause no significant impact to regional ambient air quality.

4.6.5 Radiological Air Quality Impacts

Prior to 2012, the radiological impacts of the continued operation of MTW were assessed by calculating the radiation dose to the maximally exposed individual located at the nearest residence and the collective radiation dose to the local population living within 50 miles of MTW using the modeling software COMPLY. A detailed description of the methodology was provided in Appendix A of the 1995 EA. Beginning in 2012, following an amendment to MTW's license, Honeywell began using CAP-88 as the dose modeling software. Like COMPLY, CAP-88 was issued by the EPA for estimating the dose from radionuclide emissions to air. CAP-88 differs from COMPLY in the use of up to six stack heights rather than the parameters of a single building emission point, increasing the accuracy of the estimated dose. Also, all nuclides except Th-230 (considered to be Type S) are assumed to be class M (moderate rate of absorption) to better correlate with absorption into the bloodstream from the respiratory tract than the previous methodology. (Honeywell 2013a)

Throughout this section, the generic term "radiation dose" is used, meaning the TEDE, which is the sum of (1) the effective dose equivalent from exposure to external radiation for a period of one year, and (2) the 50-year committed effective dose equivalent from internal exposure from the intake of radionuclides for a period of one year. The generic term "radiation dose" may be applied to an individual, in which case it is measured in units of mrem/yr, or to populations, in which case it is measured as the collective radiation dose with units of person-rem per year.

4.6.5.1 Doses from Routine Airborne Releases

To predict the air impacts of MTW's up to a 40-year licensing term, projected demand for uranium enrichment services was used as a basis for emission rates for future years. The projections were used for impacts analysis to bound dose rates from routine airborne radiological emissions through the final year of the license renewal and is not intended to be a request for an increase in license capacity. Any request for increasing licensed capacity would be made in a license amendment request as required.

Several documents were reviewed to determine future demand for UF_6 production. The Energy Resources International (ERI) 2012 Fuel Cycle Report (ERI 2012) was selected as the best dataset for developing growth factors to be used in CAP-88 modeling. ERI predicted growth in U.S. demand for enriched uranium through 2035, as summarized in Table 4.6-2. MTW is the only UF_6 production facility in the United States and 100 percent of the projected U.S. demand was assumed as being met by MTW.

Annual growth multipliers were calculated by annualizing the five-year predicted growth in enrichment demand (Table 4.6-2) to one-year growth (Table 4.6-3). Growth beyond 2035, the last year covered under the report, was assumed to continue at a rate equal to the weighted average of the annualized growth rate from 2011–2035 and the 2030–2035 growth rate.

Table 4.6-3 summarizes the growth multiplier for each year as a multiple of the base value (with a base value for year 2011). Values derived from both the reference case and high nuclear growth case are included. However, the high nuclear growth case was used for emissions assessment and air impacts modeling because the higher nuclear growth case provides the worst-case radiological exposure within the requested licensing renewal term.

The most recent radionuclide emission data provided were for 2014, and the 2057 growth multiplier was re-indexed to a base year of 2014. The projected emission rates for year 2057 can be used as inputs in CAP-88 to estimate dose and risk from radionuclide emissions to air.

MTW releases radioactive material to the atmosphere through 53 monitored release points, and reports releases to the NRC on a semi-annual basis. However, CAP-88 can only model six sources. Therefore, the 53 sources were grouped together into source emission points based on release height. The 2057 projected radionuclide emissions were computed using the growth factors presented in Table 4.6-3 for the year 2057. Table 4.6-4 provides the base year 2014 actual radionuclide emissions data. Since the emissions in year 2014 is known, the growth rate (high nuclear growth) was re-indexed to 2014 providing a 65.6 percent increase in 2057 emissions from the 2014 base year. The 65.6 percent increase in the radiological species emissions does not imply that MTW can produce 65.6 percent more UF_6 in its current design/configuration. The growth factor was estimated simply to place an upper bound on the radiological species emissions from MTW during the up to 40-year licensing term. Table 4.6-5 provides the projected radionuclide emissions for year 2057.

4.6.5.2 Dose to the Maximally Exposed Individual

The maximally exposed individual is located at the nearest residence northeast of MTW. Figure 4.6-1 provides the location of the ore sampling plant, ore storage building, and the FMB. Distance to each of these locations to the nearest receptor (NR-7) is approximately 0.5 kilometers (km). Projected emissions for year 2057, as shown in Table 4.6-5, were entered into the CAP-88 model along with the wind data file discussed in Section 3.6.6. The exposure 0.5 km north of MTW was calculated to be 2.17 mrem/yr using model runs computed for an individual (exposure) located at the nearest receptor (NR-7). This exposure is calculated using the assumption that all the radionuclides were emitted from a source at MTW located 1,765 feet from the NR-7 receptor, which is the distance to the FMB, which emits the majority of MTW's emissions.

The radiation dose (TEDE) at 0.8 km north of MTW is estimated to be 1.42 mrem/yr for projected emission rates in year 2057. This location, which is 240 meters beyond the nearest receptor (NR-7), demonstrates that the radiation dose continues to decline beyond NR-7. Dose predicted at these two distances include exposure from all radionuclides and all pathways. The estimated radiation dose is less than the limit of 25 mrem/yr established by the EPA in 40 CFR Part 190. The resident closest to MTW is expected to receive radiation doses less than the 25 mrem/yr level established by the EPA. The highest organ dose is to the lungs from moderately soluble forms of uranium. The estimated lung dose of 11.9 mrem/yr, at 540 meters from MTW, is less than the 25 mrem/yr dose limit established in 40 CFR Part 190; the thyroid doses are also an insignificant fraction of the 75 mrem/yr thyroid dose limit established in 40 CFR Part 190. The estimated radiation dose of 2.17 mrem/yr is also less than the limit of 100 mrem/yr established by the NRC in 10 CFR Part 20.

Almost 72 percent of the radiation dose is through the inhalation pathway and from radionuclides released as solubility type M. Uranium-234 contributed 42 percent of the dose, U-238 contributed 35 percent of the dose, and U-235 contributed 3 percent of the dose.

4.6.5.3 Dose to the Surrounding Population

The projected population for year 2057 within a 50-mile radius of MTW was estimated to be 574,948, as noted in Subsection 3.10.6.1. As with the maximally exposed individual, the collective radiation dose to the population was estimated using CAP-88 software. In contrast to the maximally exposed individual dose assessment, the ingestion pathway was included in the population dose assessment.

The collective radiation dose to the population surrounding MTW is estimated to be 4.52 person-rem per year. Based on an average background radiation dose of 0.62 rem per year for individuals in the United States from natural sources (as noted in Subsection 3.11.1), the same population would receive about 356,468 person-rem per year from background radiation; the collective radiation dose associated with atmospheric releases from MTW is a small percentage of the collective radiation dose from background radiation for these same people.

Population Input

Population projection values were obtained from Illinois, Kentucky, Missouri, and Tennessee (IDPH 2016; KSDC 2016; MOA 2016; TSDC 2016). Where necessary, the population projection values were extended through 2057. The data were apportioned as appropriate to individual sectors defined by distance and direction within 50 miles of MTW. The population data were configured consistently with the data format requirements of the ".POP" file used in the CAP-88 model runs.

4.6.6 Visibility Impacts

MTW currently has a Title V CAA permit issued by the IEPA. Subsection 5.2.2 (a) of the permit requires that no emission of fugitive particle matter from any process, including any material storage handling or storage activity, be visible by an observer looking generally overhead at a point beyond the property line of the source unless wind speeds are greater than 25 miles per hour. In addition, Subsection 5.2.2 (b) of the permit requires that no emission of smoke or other particulate matter be allowed or emitted to the atmosphere from a regulated process in excess of 30 percent opacity. The facility complies with these permit conditions during normal operation.

No significant process modifications or construction activities which would alter aesthetic or visibility impacts have been completed since the 2005 license renewal. Closure of the existing settling ponds by 2020 is required under the current RCRA permit. The closure plan will describe measures necessary to control dust and other emissions from pond decommissioning activities.

4.6.7 Mitigative Measure for Air Quality Impacts

Many of the process operations have primary, secondary, and tertiary controls functioning to minimize or eliminate air effluents. In addition, a Title V CAA permit issued by the IEPA establishes limitations on emissions, control of effluent sources, and general operating requirements for the facility. No additional mitigative measures to reduce air quality impacts are contemplated.

4.6.8 Description of Cumulative Air Quality Impacts

MTW conducts a comprehensive environmental monitoring program designed to assess impacts to the environment from both short-term and long-term emissions and resulting cumulative impacts. The facility environmental monitoring programs are detailed in Section 6.0 of this ER. These programs include soil, vegetation, and external gamma monitoring, which is specifically designed to assess cumulative impacts, especially from air effluent emissions. The results of this monitoring program from 2010–2014 are presented in Table 2.1-11 for vegetation monitoring, Table 2-1.12 for soil monitoring, and Table 2.1-13 for gamma radiation monitoring.

4.6.8.1 Soil Monitoring

Table 2-1.12 provides data related to soil monitoring annual averages for years 2010–2014. The offsite sampling locations, with the exception of the Reiniking property and the Maple Grove School, show no significant trend over the 2010–2014 period in the soil uranium concentration. Those two sampling locations show a significantly declining trend over that timeframe. The onsite sampling locations all show modest but significant increasing trends across the five-year period. The average onsite uranium soil concentration is 27.4 ppm, while the offsite concentrations average 2.2 ppm.

The offsite soil fluoride levels all show significant declining trends over the 2010–2014 timeframe, averaging 3.4 ppm for the five-year period. The onsite soil fluoride concentrations exhibit increasing trends over that time, averaging 6.3 ppm for the five-year period.

4.6.8.2 Vegetation Monitoring

Table 2-1.11 provides data related to vegetation monitoring for annual averages 2010–2014. The onsite and offsite uranium concentrations in vegetation show two different tendencies. The offsite concentrations trend down over the 2010–2014 period, while the onsite concentration trends vary between increases, flat-line, and modest decreases. The average onsite uranium concentration in vegetation is 8.6 ppm for 2010–2014, while the offsite concentration averages 4.1 ppm for the same time period.

Fluoride vegetation monitoring from 2010–2014 show a markedly different pattern from uranium. The offsite samples generally show a modestly increasing trend from 2010–2014, while the onsite samples show mixed results with some trending up while others trend down.

The five-year average for onsite samples is 132 ppm and the average for offsite samples is 319 ppm.

4.6.8.3 External Gamma Monitoring

Table 2-1.13 provides data related to external gamma monitoring annual averages in mrems for years 2010–2014. Direct radiation is continuously monitored using environmental dosimeters at nine locations. The environmental dosimeters are located on the restricted area fence line on each side of MTW (total of four), at the nearest MTW site boundary, at the Metropolis Municipal Airport one mile northeast of MTW, and two at the nearest residence (NR-7 South and NR-7A North). A ninth dosimeter is a control measurement. The environmental dosimeters are analyzed and replaced every quarter.

The control, onsite, and offsite environmental dosimeter monitoring results from 2010–2014 are summarized in Table 2.1-13. The maximum annual average of the direct gamma radiation generally occurs at the eastern restricted area fence. This is because of a large ore concentrate storage area immediately adjacent to the sampling station. The average annual environmental dosimeter dose at the east fence is 83.4 mrem, approximately 83 percent of the 0.1 rem (100 mrem) limit specified in 10 CFR 20.1301(a)(1) for dose in any unrestricted area from external sources. Because the shortest distance from the eastern restricted area fence to the MTW site boundary is approximately 0.6 miles, the direct dose to any potential offsite individual would be substantially less than regulatory limit since the dose will decrease as the square of the distance. (At 0.6 miles, the dose will be reduced by at least four orders of magnitude.) Background annual average radiation doses at the airport have varied from below the minimally measurable quantity to 28 mrem. Radiation doses at the nearest residence are similar to background and range from below the minimally measurable quantity to 29 mrem from 2010–2014.

Table 4.6-1
Annual MTW Gaseous Emissions Compared to Title V Clean Air Act Permit Limits

Emission	Permit Limit	2010	2011	2012	2013	2014
Volatile organic material (VOM)	43.69	1.04	1.27	0.62	0.47	1.27
Sulfur dioxide (SO_2)	424.37	320.71	350.59	163.04	58.67	143.31
Particulate matter (PM)	47.86	5.54	6.46	2.81	3.27	8.74
Nitrogen oxides (NO_x)	57.63	13.85	18.16	7.11	4.63	19.22
HAP, not included in VOM or PM	20.21	1.91	2.62	1.24	1.55	4.62

Note: All values are in tons per year.

Table 4.6-2
Five-Year Predicted Increase in Enriched Uranium Production

Year Range	Reference	High
2016–2020	1.0277	1.0291
2021–2025	1.0051	1.0183
2026–2030	1.0098	1.0211
2031–2035	0.9988	1.0021
Thereafter	1.0036	1.0058

(ERI 2012)

Table 4.6-3
Growth Multiplier for Each Year as a Multiple of the Base Value

Year	Reference Case	High Nuclear Growth	Year	Reference Case	High Nuclear Growth
2011	1.000	1.000	2035	1.369	1.590
2012	1.028	1.029	2036	1.374	1.599
2013	1.056	1.059	2037	1.379	1.609
2014	1.085	1.090	2038	1.384	1.618
2015	1.115	1.122	2039	1.389	1.627
2016	1.146	1.154	2040	1.394	1.637
2017	1.178	1.188	2041	1.399	1.646
2018	1.211	1.223	2042	1.404	1.656
2019	1.244	1.258	2043	1.409	1.665
2020	1.279	1.295	2044	1.414	1.675
2021	1.285	1.319	2045	1.419	1.684
2022	1.292	1.343	2046	1.424	1.694
2023	1.298	1.368	2047	1.429	1.704
2024	1.305	1.393	2048	1.434	1.714
2025	1.311	1.418	2049	1.439	1.724
2026	1.324	1.448	2050	1.445	1.734
2027	1.337	1.478	2051	1.450	1.744
2028	1.350	1.510	2052	1.455	1.754
2029	1.364	1.541	2053	1.460	1.764
2030	1.377	1.574	2054	1.465	1.774
2031	1.375	1.577	2055	1.471	1.784
2032	1.374	1.580	2056	1.476	1.794
2033	1.372	1.584	2057	1.481	1.805
2034	1.370	1.587	2057(re-index)	1.365	1.656

Note: Compounded annual growth was computed as shown in the equation below (Equation 1), where EndingYearSWU and BeginningYearSWU are the annual enrichment requirements in million separative work units (SWU). One SWU is the equivalent of one kilogram of separative work necessary to separate U235 and U238. (ERI 2012)

$$CAGR = \left[\frac{EndingYearSWU}{BeginningYearSWU} \right]^{1/n} \qquad \text{Equation (1)}$$

Table 4.6-4
Base Year 2014 Actual Radionuclide Emission Data

Group ID	Avg. Height (meters)	2014 Release Data (curies/year)				
		U-238	U-234	U-235	Th-230	Ra-226
1	5	8.45E-03	8.45E-03	3.88E-04	2.93E-05	6.30E-06
2	10.4	6.36E-03	6.36E-03	2.92E-04	2.21E-05	4.74E-06
3	13.72	9.48E-03	9.48E-03	4.36E-04	3.29E-05	7.07E-06
4	18.29	4.97E-03	4.97E-03	2.28E-04	1.72E-05	3.70E-06
5	23.82	6.65E-03	6.65E-03	3.05E-04	2.31E-05	4.96E-06
6	30.67	9.87E-02	9.87E-02	4.53E-03	3.42E-04	7.36E-05

Table 4.6-5
Projected 2057 Radionuclide Emission Data

Group ID	Avg. Height (meters)	Projected 2057 Release Data (curies/year)				
		U-238	U-234	U-235	Th-230	Ra-226
1	5	1.40E-02	1.40E-02	6.42E-04	4.85E-05	1.04E-05
2	10.4	1.05E-02	1.05E-02	4.83E-04	3.66E-05	7.85E-06
3	13.72	1.57E-02	1.57E-02	7.22E-04	5.45E-05	1.17E-05
4	18.29	8.23E-03	8.23E-03	3.78E-04	2.85E-05	6.13E-06
5	23.82	1.10E-02	1.10E-02	5.05E-04	3.82E-05	8.21E-06
6	30.67	1.63E-01	1.63E-01	7.50E-03	5.66E-04	1.22E-04

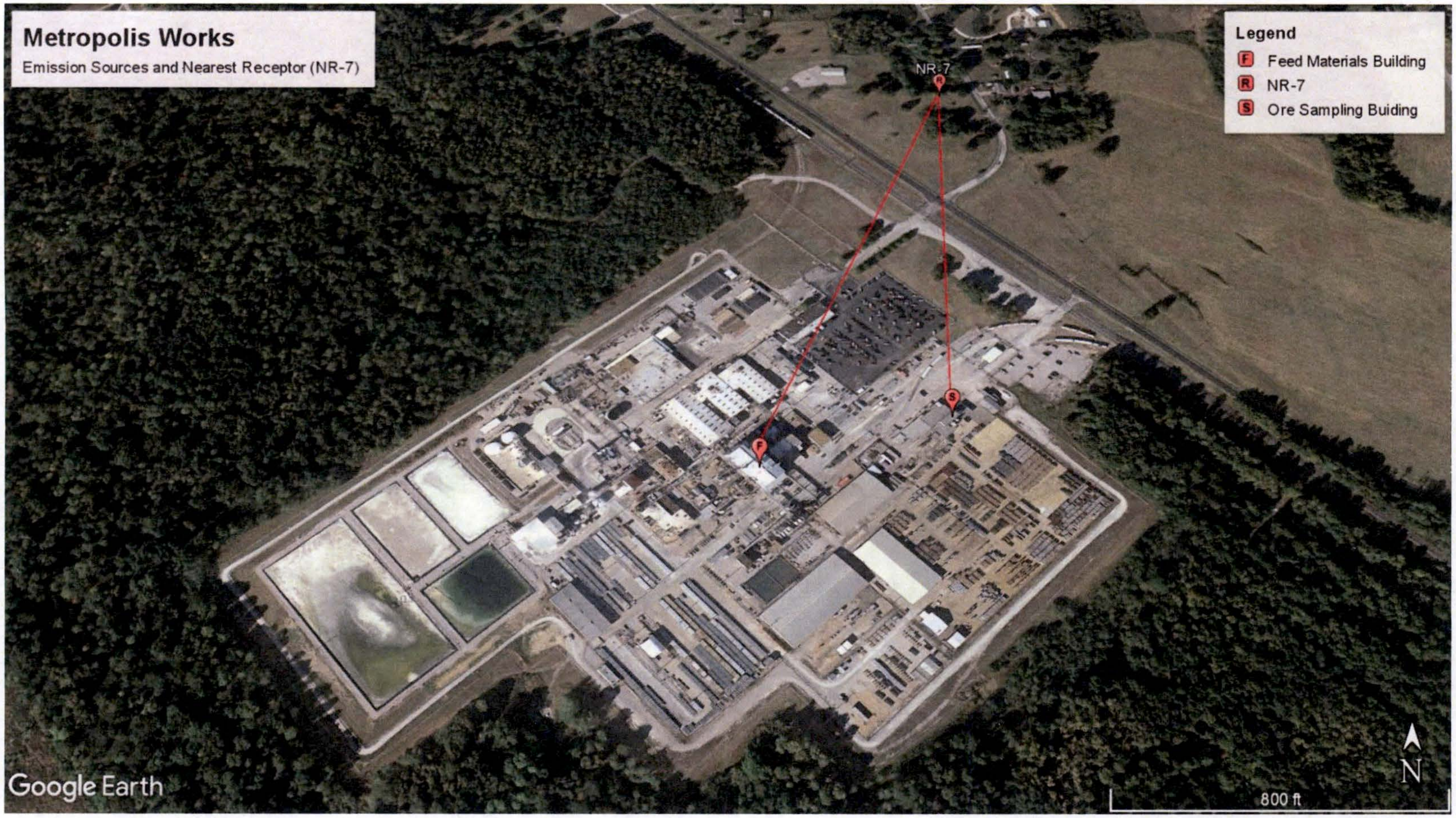


Figure 4.6-1
Locations of MTW Buildings Relative to the Nearest Offsite Receptor (NR-7)

4.7 Noise Impacts

Honeywell MTW has not performed any noise surveys at the boundary of the restricted area; however, noise surveys for occupational health purposes have been conducted within the property, primarily within buildings (Honeywell 2016k). An outdoor noise source that has been added to MTW since 2005 is the two cooling towers located near the center of the restricted area with multiple buildings surrounding the towers (see Figure 1.1-1). The noise level three feet from the cooling towers was measured at 76.8 dBA (Honeywell 2016k). The noise attenuates with distance and is also attenuated by structures.

The nearest noise-sensitive receptor to MTW is a rural residence 1,765 feet north-northeast of the FMB. Title 23 of the Code of Federal Regulations, Part 772 (23 CFR 772) defines adverse noise impact as "impacts which occur when predicted noise levels approach or exceed" the noise abatement criteria at a specific location, and sets the noise abatement criteria for residential land use, Category B (see Table 3.7-1) as 67dBA. MTW activities create intermittent noise outside the restricted area fence at the railroad siding adjacent to MTW. As needed to support operations, MTW workers move rail cars to and from the siding for receiving shipments of materials and shipping products and waste. These railroad siding activities take place during daylight hours.

As mentioned above, MTW has performed noise surveys for occupational health purposes. Using the maximum noise levels from the FMB near the center of MTW and the standard attenuation of 6 dBA for each doubling of distance, noise from MTW will hypothetically attenuate to well below Category B levels by distance alone.

The proposed license renewal will result in no significant increase in noise. Therefore, it is unlikely that continued operation of MTW would have any adverse impact on environmental noise in the area or on the nearest noise-sensitive receptor.

4.8 Historic and Cultural Resources Impacts

No impacts are expected to cultural or historical resources within the MTW site boundaries because no known historic properties are present. In addition, the proposed action is an administrative/procedural action, and as such, lacks the potential to impact historic properties. Therefore, no further consultation is required under Section 106 of the NHPA, as this action is not considered an undertaking. Archaeological surveys must be undertaken prior to initiation of new construction projects planned for areas outside of the current development footprint or that would take place in a previously undeveloped area.

4.9 Visual and Scenic Resources Impacts

The dominant visual features on the MTW site and immediate vicinity are rural and pastoral in nature, with scattered areas of industrial development. While the Illinois Department of

Transportation has designated portions of U.S. Highway 45 as a scenic byway, the high value scenic views are located along the banks of the Ohio River.

Honeywell proposes to relicense the existing facility with minor modifications to onsite systems. Relicensing or system modifications would not alter the current perception of the facility, nor would it alter or adversely affect existing visual features or scenic views. Therefore, there would be minimal to no impact on the area's visual or scenic resources.

4.10 Socioeconomic Impacts

MTW is not planning or expecting a significant employment expansion or new construction outside of the current MTW footprint (Honeywell 2005). Therefore, local socioeconomic trends would be unaffected by continued operation of MTW. Continued operation ensures the annual renewal of "mutual assistance agreements" between MTW and local emergency responders in Massac County and the City of Metropolis. Emergency response agencies within the immediate vicinity currently benefit from training, emergency drills, and emergency response equipment provided by Honeywell. Coordination and emergency response training/radiological contingency planning is a condition of NRC licensing.

4.11 Environmental Justice

None of the census block groups within four miles of MTW contain minority populations that exceed the criteria derived from their respective state's averages for any of the minority categories (USCB 2016b). Two census block groups were identified within a four-mile radius of MTW that contain populations that exceed the criteria for low-income individuals and households (USCB 2016b). These block groups are located east of MTW.

It has been determined that no significant offsite environmental impacts will be created by the license renewal of MTW. Therefore, there can be no disproportionately high and adverse impacts or effects on members of the public, including minority and, low-income and subsistence populations, resulting from the license renewal.

4.12 Public and Occupational Health Impacts

Analysis of the projected public and occupational health impacts includes consideration of a wide range of process materials, effluents, and other hazards and their potential effects. These effects include the potential for causation of disease, disability, untimely death, or other effects upon the workforce or local populace.

Honeywell implements a stringent program of effluent monitoring to identify any failures in the effluent clean-up systems and, should any such failure be detected, imposes operational controls to ensure effluents remain within established limits. Honeywell also implements an environmental monitoring program addressing radiological and non-radiological hazards. The program analyzes for uranium and fluoride concentrations in onsite and offsite environmental media to provide verification that the established controls are effectively limiting offsite releases. Section 3.11 discusses the 2010–2014 results of the environmental monitoring program. Total gaseous effluent loss is used to model and estimate an offsite dose from inhalation and ingestion. The estimated dose for 2010–2014 is presented in Table 3.11-2. The radiation dose to the offsite population has been well below the regulatory limits established by NRC in 10 CFR 20.1301 and EPA at 40 CFR 190. Therefore, the radiation effects on public health are expected to be negligible.

As shown in Table 3.11-1, individual occupational radiation doses are also maintained well below the limits established in 10 CFR 20, which are designed to be protective of worker's health. MTW's radiation protection program uses the ALARA process, committing sufficient manpower, resources, and equipment to assure an effective radiation protection program. Honeywell also uses NRC regulatory guides to identify program elements that are appropriate for a uranium conversion plant radiation protection program. As discussed in Subsection 2.1.2.3, Honeywell's radiation protection program routinely surveys work spaces to identify and mitigate radiation hazards and monitors individual worker's exposure with dosimeters and a bioassay program. Therefore, any potential health effects are expected to be within the range of those effects for comparable licensed facilities and other industrial concerns.

Continued operation of MTW is likely to result in continued low-level deposition of uranium in soils both on- and offsite. However, uranium has a low specific activity and is relatively benign in a radiological sense. Any potential health effects are bounded by maintenance of the stipulated effluent controls, which limit exposures to individuals within established limits (see above). Therefore, these effects are considered negligible.

The health effects resulting from occupational exposures to onsite chemicals, noise, and industrial safety hazards are limited by Honeywell's implementation of safety programs that meet OSHA requirements and more stringent corporate standards. In particular, Honeywell implements a process safety management program consistent with the requirements of 29 CFR 1910.119 which provides a comprehensive assessment of chemical safety hazards and specific processes and programs to mitigate these hazards. This program also implements a process of periodic review and feedback to allow continuous improvement of administrative and engineering controls. Honeywell implements engineering controls to limit workplace concentrations of hazardous and radioactive constituents. Equipment in the UF_6 process that produces dusts, mists, or fumes containing uranium or other toxic materials is provided with dust collectors and scrubbers or other ventilation equipment designed to reduce employee or environmental exposure to levels that are as low as is reasonably achievable. Honeywell established a system to sample operating exhaust points to determine uranium content. Honeywell also implements a respiratory protection program consistent with the requirements of

10 CFR 20, 29 CFR 1910.134, and Regulatory Guide 8.15. These measures limit employees' exposures to both hazardous chemicals and radioactive materials. Honeywell has conducted detailed air and noise sampling processes to characterize the workplace hazards and provide for establishment of appropriate controls, consistent with applicable regulatory requirements and good industrial practice. Therefore, the health effects related to operation of the facility are expected to be consistent with those resulting from operation of similar chemical processing facilities.

The proposed action is to continue operation of MTW during a renewed license term at current licensed levels of production. MTW emissions during a renewed license term are expected to be similar to those discussed in Subsection 2.1.2, and are compared to applicable environmental and health standards in Section 3.11. Therefore, the impacts to public and occupational health are expected to be within regulatory limits and ALARA.

It is possible that accidents could release radioactive materials or chemicals to the environment, potentially affecting workers and members of the public. The MTW Integrated Safety Analysis Summary provides details on Honeywell's analyses of the hazards arising from accident sequences identified using the criteria provided in 10 CFR 70.61. MTW has developed, in conjunction with the NRC, IEPA, and the local emergency response agencies, the protective action and supporting notification plans to minimize the potential of any adverse consequences to the workers and members of the public in the unlikely event that such a release occurs.

4.12.1 Mitigative Measures

For MTW workers, protection from health effects resulting from exposures is provided primarily by engineering controls – system design and maintenance to ensure integrity and adequate ventilation. These controls are augmented by administrative controls (primarily written procedures), augmented work controls for specified evolutions, and PPE (e.g., acid suits, respiratory protection). Chemical operators receive initial training in the areas listed below. Honeywell also provides continuing training to maintain and enhance the ability of chemical operators to perform job assignments and to ensure facility safety and reliability.

- Process operational procedures
- Temporary and emergency operations
- Alarm response and abnormal conditions
- Operating limits and safety features
- Safety and health hazards related to assigned work area(s)
- Emergency response and shutdown
- Chemical and radiological safe work

For members of the public residing in the immediate vicinity of MTW, protection is achieved primarily through system design and operational controls that limit chemical releases within established standards. For unforeseen events that may lead to unplanned releases, these controls are augmented by the measures incorporated in MTW's emergency response plan, which establishes requirements for activation of public warning systems and protective action recommendations (e.g., for specified conditions, sheltering in place within 1.3 miles of the FMB).

4.13 Waste Management Impacts

Solid wastes generated at MTW include radioactive, nonradioactive hazardous, and mixed wastes. The wastes are shipped offsite for recycling or disposal. MTW also ships other non-waste materials to be processed offsite for recovery of materials or sent to a commercial facility as a byproduct. A detailed description of the sources, types, quantities, and composition of solid, hazardous, and mixed wastes has been provided in Section 3.12 of this ER. Effluents are discussed in Sections 3.4, 4.4, and 4.6.

Personnel at MTW continually search for new and innovative ways to minimize or eliminate waste generated by the facility. Recycling materials such as the CaF_2 for use as a replacement for natural fluorspar at other commercial facilities and recovering uranium from waste streams are prime examples. Currently, however, no other feasible (economic or technical) plans for waste minimization are being contemplated.

The proposed action would continue the generation of the waste streams discussed in Section 3.12 in similar quantities; no new waste streams are anticipated. The waste streams will be managed as discussed in Section 3.12. Section 3.12 also discusses the availability and capacity of the various recycling and disposal facilities available for treatment and disposal of MTW waste. Given the available capacity and continuation of current generation rates, management and disposal of MTW waste of all types would have small to no impact on available capacity. Given the available capacities of waste management facilities, treatment and disposal of the MTW waste would result in small to no cumulative impacts when considered with the disposal needs of other regional non-radioactive waste generators and national radioactive waste generators.

5.0 MITIGATION MEASURES

Releases of radiological or non-radiological constituents to the air, water, and soil create environmental impacts. MTW has implemented mitigation measures to minimize the environmental impacts associated with MTW operations. Settling ponds and treatment processes have been used to lower the level of contaminants in the effluent streams released to the Ohio River. In addition to a sanitary wastewater treatment system, processes to mitigate uranium releases and fluoride releases are utilized at MTW. The process for mitigating fluoride liquid releases is being upgraded. This upgrade will increase the efficiency of removing contaminants in accordance with the pending NDPES permit discharge limits, remove the CaF_2 Pond D surface impoundment from service and close it, along with the other surface impoundments (Ponds B, C, and E) previously removed from service upon the expiration of a waiver from minimum technology requirements as required by Condition II.F of the current RCRA permit (#B-65R2-M-17). The wastewater stream is monitored prior to release through a permitted NPDES outfall. (IEPA 2015a; IEPA 2015e)

Honeywell also operates a series of settling tanks at MTW to recover uranium whose liquid is transferred to a settling pond for additional settling of uranium solids. The further clarified liquid is monitored prior to release through a permitted NPDES outfall (IEPA 2015a).

To reduce gaseous emissions that could contain significant quantities of uranium or hazardous chemicals, dust collectors and scrubbers are operated in series. Each emission source is operated in accordance with an operating permit issued by the IEPA. Operational and administrative controls are used to shut down and repair the emission source to prevent violation of the air permit or excessive concentrations.

In addition to the engineering control measures such as scrubbers, air filters, and waste treatment systems, MTW has set action levels for the effluent monitoring program. Exceeding an action level triggers an investigation into the cause of the exceedance and may trigger corrective actions that could include shutdown of the process. Approaches used in reduction of contaminant sources may include equipment repair, cleaning, modification, replacement, and addition of effluent control equipment.

6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

6.1 Radiological Monitoring

6.1.1 Sampling and Monitoring Locations

The fixed environmental sampling and monitoring locations and liquid effluent release points associated with MTW are illustrated in Figure 2.1-3 and Figure 2.1-4.

There are currently 53 airborne release stacks and exhaust fans associated with the facility. Due to their number and distribution, these have not been illustrated in the figures. Characteristics of these stacks are presented in Table 2.1-3.

6.1.2 Principal Radiological Exposure Pathways

6.1.2.1 Pathways to Site Workers

Internal exposure from inhalation of airborne emissions and external exposure from radioactive material entrained in MTW systems are the primary exposure pathways for MTW workers because they directly handle radioactive materials and/or may be in close proximity to radiation sources. These exposure pathways are less likely for MTWemployees not directly working in ore processing areas; however, exposure to airborne and deposited radioactive particulates would be possible. Internal exposures can occur through inhalation and incidental ingestion of radioactive particulates. Operations that could result in potential airborne emissions are confined and controlled through the use of administrative and engineering controls.

The use of appropriate PPE further minimizes the potential for worker exposure to airborne emissions. In addition, MTW implements an aggressive ALARA program to identify additional measures to minimize the exposure of workers to radiation.

6.1.2.2 Pathways to the General Public

Radiation exposures to members of the offsite general public are primarily from airborne and waterborne pathways. The directions and approximate distances from the FMB to the following features are given:

- US Highway 45 – 1,185 feet northeast
- Nearest resident – 1,765 feet north-northeast
- Nearest commercial establishment – 2,850 feet southeast
- Nearest lodging – 11,950 feet southeast
- Nearest hospital – 5,020 feet southeast

- Nearest nursing home – 3,850 feet southeast
- Nearest police station – 8,700 feet southeast
- Nearest school – 9,850 feet southeast

For locations of liquid and gaseous releases, refer to Section 4.4 and Section 2.1. No cattle grazing is allowed on the property.

Section 3.4 of this report provides additional information regarding water use for the area. Most surface streams outside the MTW site boundary are used for recreation and for watering livestock. Numerous farm ponds and lakes are found throughout the area. Subsection 2.1.2, Section 4.4, and Section 4.6 of this report provide additional details regarding radioactive discharges to water and air.

The airborne pathways include inhalation of radioactive particulates, external radiation from deposited radionuclides, incidental ingestion of deposited radionuclides, and ingestion of contaminated food products (plants, meat, and dairy products). Plants grown in the area where a potential emission plume passed could become contaminated by deposition of radionuclides on leaves or ground surfaces. Radionuclides deposited on leaves could subsequently translocate to the edible portions of plants; those deposited on ground surfaces could subsequently be absorbed by plant roots. Livestock and livestock products could become contaminated if the livestock ingest contaminated surface soil and plants.

The waterborne pathways include possible ingestion of surface water and groundwater, and possible ingestion of contaminated plant foods, fish, meat, and dairy products. Plant foods and fodder could be contaminated from irrigation with contaminated water, and the livestock and their products could become contaminated if the livestock drank contaminated water and ate contaminated fodder.

Each of the above-described pathways is recognized and accounted for in the MTW monitoring program which, as described in Subsection 6.1.4, ensures that levels remain within regulatory limits.

6.1.3 Locations and Characteristics of Radiation Sources and Radioactive Effluent

In addition to the background radiation exposures discussed in Subsection 3.11.1, MTW employees and members of the public in the immediate vicinity of MTW may be exposed to low levels of radiation and radioactive materials as a result of MTW operations. For MTW employees, sources of radiation exposure include external exposure resulting from: 1) working in proximity to natural uranium, its daughter products, and other licensed materials in storage and in the MTW process; and 2) internal exposures resulting from inhalation or ingestion of process materials. Members of the public in the immediate vicinity of MTW may be exposed to radiation and radioactive materials as a result of liquid and airborne MTW effluents. The resulting occupational and non-occupational doses are controlled to levels that are within regulatory limits and as low as is reasonably achievable. Table 2.1-13 summarizes dosimeter readings from onsite and offsite sample locations, and Table 3.11-1 and Table 3.11-2 provide an overview of the current and historical radiation doses of both MTW employees and members of the public in the immediate vicinity as a result of MTW's operations. Water resource impacts are discussed in Section 4.4, and air quality impacts are discussed in Section 4.6 of this report. Principal effluent pathways are continuously monitored or sampled to assure effective MTW operations. Refer to Table 2.1-3 for a summary of monitoring results from the exposure pathways discussed in Section 6.1.2.

6.1.4 Monitoring for Radiological Emissions and Impacts

The proposed action is to continue operation at the current licensed production level during the renewal term. The current processes for production, emission controls, and waste management, as described in Subsection 2.1.2, would continue in the renewed term. Following license renewal, MTW would continue the existing monitoring programs described below. The programs were designed to quantify emissions, identify any failures in the effluent clean-up systems, and, should any such failure be detected, impose operational controls to ensure effluents remain within established limits. The environmental monitoring program analyzes for uranium concentrations in onsite and offsite environmental media to provide verification that the established controls are effectively limiting offsite releases.

6.1.4.1 Nearest Resident Inhalation Dose

Analytical data collected at the nearest residence sampling station (NR-7) from 2010–2014 are shown in Table 2.1-8. A one (1) micron particle size is assumed, and dose conversion factors from the ICRP Publication 68 are used to calculate the annual dose from one year of intake for the nearest residence. The dose calculated for the nearest resident is provided in Table 3.11-2.

6.1.4.2 Stack Emissions

MTW's stack emissions during the five-year period from 2010–2014 have been modeled using EPA's COMPLY computer code through 2011 and CAP-88 thereafter to predict the inhalation and ingestion dose at the location of the nearest resident. As shown in Table 3.11-2, the highest annual dose calculated using the COMPLY program was 6.1 mrem in 2011. When using the CAP-88 program, the highest calculated dose was 4.0 mrem in 2014. Both computer programs assume that 100 percent of the food source is locally grown; however, the nearest residents do not produce vegetables, meat, or milk for personal consumption.

6.1.4.3 Direct Radiation Monitoring

Direct radiation is continuously monitored using environmental dosimeters. An environmental dosimeter is located on the restricted area fence on each side of MTW, one dosimeter is located at the nearest MTW site boundary, one is located at the Metropolis Municipal Airport approximately one mile northeast of MTW, and two are located at the nearest residence. These locations are depicted on Figure 2.1-3. The dosimeters are exchanged quarterly for analysis by a vendor laboratory. The environmental dosimeter monitoring results for 2010–2014 are shown in Table 2.1-13, and the results are discussed in Section 3.11.

6.1.4.4 Environmental Air Monitoring

The environmental air monitoring program consists of taking continuous air samples at four points along the restricted area fence line (Stations No. 9, 10, 12, and 13). Two samplers are located in the prevailing wind direction (Stations No. 8 and No. 11). One sampler is located offsite approximately one mile downwind of the FMB at the municipal airport (Station No. 6). An additional continuous air sampler is located at the nearest residence (NR-7). Refer to Figure 2.1-3 for locations.

The concentrations of uranium found in environmental air samples during the years 2010–2014 are shown in Table 2.1-7. The quarterly air sample concentrations of uranium, Ra-226, and Th-230 for samples collected at the nearest residence are shown in Table 2.1-8. The air sampling results are discussed in Section 3.11.

6.1.4.5 Wastewater Monitoring

Wastewater treatment and deposition are discussed in Subsection 2.1.2, and a flow diagram showing liquid waste streams and their disposition is given in Figure 2.1-2. Analytical data are presented and discussed in Section 3.4 and Section 4.4. Compliance with applicable effluent release limits and water quality criteria is determined by sampling MTW's t effluent discharge and the Ohio River, which is the receiving stream for MTW's effluents.

6.1.4.6 Environmental Water and Mud Sampling

Environmental water and mud samples are taken semi-annually from four locations on the Ohio River and at three area lakes and ponds. These samples are analyzed for uranium content to determine any potential impacts from MTW operations. Refer to Figure 2.1-4 for the location of water and mud sampling locations. The results of the sampling are summarized in Table 2.1-9 and Section 3.11, and detailed in Section 3.4 and Section 4.4.

6.1.4.7 Environmental Soil and Vegetation Samples

Additional environmental soil and vegetation samples are collected semi-annually. Seven sample stations are located onsite at the same location of the air samplers. Seven additional stations are located offsite in the surrounding areas of Illinois and Kentucky, covering a radius of about eight miles from MTW. Refer to Figure 2.1-3 and Figure 2.1-4, respectively, for location of onsite and offsite stations. Each sample is analyzed for uranium content. Table 2.1-11 and Table 2.1-12 show the results for uranium in soil and vegetation during the years 2010–2014. The results are discussed in Section 3.11.

6.2 Physiochemical Monitoring

Monitoring programs at MTW are comprised of effluent monitoring of air and water and environmental monitoring of air, surface water, soil, and vegetation. The programs are described in Subsection 2.1.1.3. Water effluent monitoring is discussed in Section 3.4 and Section 4.4, and air emissions monitoring is discussed in Section 4.4. The environmental monitoring sampling locations and timing correspond to that of uranium sampling discussed above in Section 6.1, and the samples are analyzed for fluoride. Table 2.1-6 also summarizes the program. The analytical results for 2010–2014 are presented in Tables 2.1-7 through 2.1-12, and discussed in Section 3.11.

MTW would continue the monitoring programs following license renewal. No new programs are planned.

6.3 Ecological Monitoring

Honeywell's environmental monitoring programs at MTW are composed of monitoring the effluents emitted from the facilities and the monitoring of various environmental media including air, surface water, soil, vegetation, and direct gamma radiation. No direct monitoring of terrestrial or aquatic fauna or wildlife is conducted. The monitoring program and a summary of results for the time period of 2010–2014 are described in Subsection 2.1.2.3.

MTW would continue its monitoring programs following license renewal. No new programs are planned.

7.0 COST BENEFIT ANALYSIS

The following discussion provides an overview of the qualitative costs and benefits of the proposed action and no-action alternative.

7.1 Proposed Action

The proposed action is continued operation of the facility under current production levels with the production process currently used. There are pending facility upgrades at the EPF in accordance with MTW's current NPDES permit special condition 26 to provide enhanced treatment to comply with fluoride discharge limits that are scheduled to go into effect in 2018 (IEPA 2015a). These pending modifications will allow greater fluoride removal from the waste stream.

The EPF upgrade will allow CaF_2 Pond D to be removed from service. Pond D, along with ponds B, C, and E, which were removed from service previously, will be closed in accordance with MTW's RCRA permit, a regulatory compliance activity not tied to MTW's source material license SUB-526 which would occur under both the proposed action and the no-action alternative.

Under the proposed action, MTW would continue to provide benefits to the U.S. nuclear power industry and U.S. energy security, as well as socioeconomic benefits to the local economy through continued employment of its workforce, property taxes, and sales taxes on local purchases. MTW's operation would continue to result in small environmental impacts within permit and regulatory limits as summarized in Section 2.4 and detailed in Sections 3 and 4. MTW would continue its effluent monitoring programs to ensure effective control of effluents, utilizing action levels that if exceeded would trigger investigations and corrective actions. The following points summarize the benefits and costs of renewing MTW's operating license:

- MTW is the only facility in the U.S. producing the feed material (UF6) for uranium enrichment. Enriched uranium is the key component of fuel for U.S. nuclear power generating plants.
- The president's energy policy includes nuclear energy as an important component of clean energy strategy, and the DOE has been directed to ensure that both currently operating nuclear power plants and new and advanced nuclear technologies remain a vital component of the U.S. clean energy strategy (White House 2015).
- Increasing reliance on foreign sources for enriched uranium would be counter to U.S. energy security. The NRC considered that "the heavy dependence on foreign sources and the lack of diversification of domestic sources of enriched uranium represent a potential reliability risk for the domestic nuclear energy industry" (NRC 2012a).

- The environmental impacts on air, water, soil, and biota associated with continued operation of MTW are small and within permit and regulatory limits.
- The socioeconomic benefits of MTW to the local area, including job opportunities and tax revenues, are important. The socioeconomic costs with respect to noise, traffic congestion, public health and safety, use of public works and facilities, and other land use conflicts are minor.

7.2 No-Action Alternative

The no-action alternative is no renewal of MTW's operating license with shutdown and decommissioning of the facility following the current operating term ending on May 11, 2017. In the absence of a domestic UF_6 production facility, the U.S. nuclear power industry would have to rely solely on foreign suppliers of feed material for uranium enrichment outside of the potential for limited supplies provided by the down-blending of DOE highly enriched stockpiles available for energy production. Thus, the no-action alternative would be counter to U.S. energy security and would not be supportive of ensuring the vitality of the U.S. nuclear power industry as a component of the U.S. clean energy strategy.

Upon shutdown, emissions from operations would cease, but emissions from stored materials and residual contamination would continue at decreasing levels until completion of decommissioning. Decommissioning activities would result in the release of small amounts of radioactivity to the atmosphere and the Ohio River, and the generation and offsite shipment of significant quantities of radioactive waste. As required by 10 CFR 40.36(d)(2), Honeywell assesses decommissioning waste volumes every three years and submits the results to the NRC. Decommissioning activities could result in short-term socioeconomic benefits due to decommissioning workforce needs and the demand for local services. However, upon completion of decommissioning, the benefits of employment of the MTW workforce and property tax value of an operating facility would cease.

7.3 Overall Cost-Benefit Conclusions

While there are national energy security and socioeconomic benefits, there are also direct costs and environmental impacts due to MTW's effluents associated with the proposed action. However, these impacts are estimated to be small in magnitude and small in comparison to the local and national benefits of the proposed action.

The proposed action would promote national energy security and support the continued vitality of the nuclear power industry as part of the U.S. clean energy strategy. Therefore, in comparison to the no-action alternative, the proposed action would be associated with net positive benefits.

8.0 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

8.1 Unavoidable Adverse Environmental Impacts

Unavoidable adverse environmental impacts are those that remain after all practical means to avoid or mitigate the impact have been taken. The action discussed in this ER is renewal of a license allowing continued operation of MTW. The action includes no new development or other land-disturbing activities outside the restricted area. No land or aquatic features of the natural environment occur within the restricted area because of previous construction and ongoing operations. There are no significant adverse impacts to mitigate or avoid and, accordingly, no unavoidable impacts on the natural environment.

8.2 Irreversible and Irretrievable Commitment of Resources

During a renewed license term MTW would continue to convert uranium ore to UF_6, resulting in an irreversible and irretrievable commitment of the ore. MTW reclaims uranium from its byproducts as discussed in Section 3.12, and the UF_6 product is a valuable resource to the nuclear power fuel cycle. Other than the use of uranium ore, there will be no significant irreversible and irretrievable commitments of either environmental or material resources due to license renewal because there will be no significant commitment of land due to new construction or physical enlargement of the existing MTW facility. In accordance with MTW's NPDES permit, the EPF's treatment process will be modified to enhance the removal of fluoride and allow CaF_2 Pond D to be removed from service. Pond D and the other inactive CaF_2 ponds will then be remediated and closed in accordance with MTW's RCRA permit and applicable closure plans approved by IEPA.

8.3 Relationship Between Short-Term Uses and Long-Term Productivity of the Human Environment

Short-term use generally refers to the time between the start of construction of a facility and the end of its useful life as an operating plant. Long-term use generally refers to the period after cessation of operations and decommissioning.

Operation of an industrial facility at the MTW site began in 1958. Renewal of the license in this proceeding is consistent with the intended short-term use of the MTW site for the manufacture of UF_6 as nuclear fuel. Renewal would further extend the short-term preemption of the MTW site from other uses. However, the overall economic and societal benefits of supporting the nuclear fuel cycle are considerable. As stated elsewhere, MTW is the only facility of its type operating in the United States today. The benefits are undoubtedly greater than those that could now be derived from other likely uses of the property in forestry or agriculture during this period.

Continuing the current short-term use of the land does not preclude other uses once the existing facility realizes its useful life. The overall objective of decommissioning MTW would be to remediate the MTW site to an unrestricted use condition in accordance with 10 CFR 20.1402 "Radiological Criteria for Unrestricted Use." The MTW site would be available to alternative uses in the future; therefore no conflict exists.

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