3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This section is divided into the following resource topics:

- Air Resources, *Section 3.1*
- Geology and Soils, *Section 3.2*
- Groundwater, *Section 3.3*
- Surface Water, *Section 3.4*
- Floodplains, *Section 3.5*
- Farmland, *Section 3.6*
- Land Use, *Section 3.7*
- Public Lands, Recreation and Visual Resources, *Section 3.8*
- Vegetation, *Section 3.9*
- Wetlands, Riparian Areas, and Waters of the United States, *Section 3.10*
- Fisheries and Wildlife, *Section 3.11*
- Threatened, Endangered, Proposed, and Other Special Status Species, *Section 3.12*
- Cultural Resources, *Section 3.13*
- Socioeconomics and Environmental Justice, *Section 3.14*
- Public Safety and Services, *Section 3.15*
- Noise, *Section 3.16*
- Waste Management, *Section 3.17*

The following sections are presented for each resource topic listed above:

Affected Environment – this section succinctly describes the environment of the areas to be affected by the Proposed Action (Project) or alternatives. Because resource topics are often interrelated, one section may refer to another. The Affected Environment section includes the following:

> **Region of Influence**– This is the area that the Proposed Action or alternatives may reasonably affect. Regions of influence are specific to each resource topic. Limits of regions of influence may be natural features (such as an aquifer boundary), political boundaries (such as Carroll County), or industry-accepted norms for the resource (such as 50 kilometers (km) for one aspect of air quality).
>
> **Existing Conditions**– This discussion characterizes the resource within the region of influence and provides a framework for understanding the effects described in the Environmental Consequences section; the amount of information presented is commensurate with the importance of the effects.

Environmental Consequences – This section objectively evaluates the Proposed Action and reasonable alternatives. It presents a scientific analysis of the direct and indirect environmental impacts and forms the analytic basis for the summary comparison of impacts presented in *Section 2.0, Alternatives Including the Proposed Action*. All relevant reports prepared by AECI and its consultants were reviewed to independently evaluate and verify the accuracy and comprehensiveness of the information provided by AECI, and, where necessary, supplement this information. Because resource topics are often interrelated, one section may refer to another. The Environmental Consequences section includes the following:

> **Identification of Issues** – This discussion presents the issues analyzed, which were identified during the public scoping period for this environmental impact statement (EIS) (refer to *Section 6, Consultation and Coordination*), or by lead or cooperating agency personnel during preparation of this document.
>
> **Significance Criteria** – This discussion identifies thresholds where adverse impacts become significant.

Impact Assessment Methods – The methods used to accomplish the analysis of impacts are briefly described.

Actions Incorporated Into the Proposed Action to Reduce or Prevent Environmental Impact – These are actions that AECI has committed to implementing. Impacts have been assessed assuming these measures would be implemented if the Norborne Facility is constructed. Actions presented in this section are more fully described in *Section 2.4, Description of the Proposed Action*.

Impact Assessment – The results of the impact analysis for various components of the Proposed Action and alternatives are presented.

Mitigation – This includes measures not already included in the Proposed Action. The Council on Environmental Quality (CEQ) (1981) states that mitigation measures must be considered even for impacts that would not be considered significant, and where it is feasible to develop them. Mitigation can include things such as: (1) avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action; or (5) compensating for an impact by replacing or providing substitute resources or environments.

Cumulative impacts are discussed in *Section 4, Cumulative Impacts*. A description of the Proposed Action and alternatives is presented in *Section 2, Alternatives Including the Proposed Action*.

3.1 AIR RESOURCES

This section describes the existing air quality related factors in the area where emissions from the Project would have an effect. Also described are the consequences of the Project relative to air resources. The primary factors that determine the air quality of a region are the locations of air pollution sources, the type and magnitude of pollutant emissions, existing levels of ambient air pollutants, and the local meteorological conditions. These factors are discussed in *Section 3.1.1, Affected Environment*.

AECI conducted air quality modeling as part of the air quality permit application for the Project. This study took into account factors discussed in *Section 3.1.1, Affected Environment*, and through the modeling, provided an estimate of the air impacts that would occur. These air quality impacts are discussed in *Section 3.1.2, Environmental Consequences*.

3.1.1 Affected Environment

The general location of the Proposed Action (Project) and the Alternate Site is shown in Figure 3-1. The ambient air in these areas as well as in areas downwind of the emissions that result from the Project represent the affected air quality environment.

3.1.1.1 Region of Influence

As described later in this section, the U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS) for six air pollutants.

The EPA has also established "significance levels" for nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than 10 microns in size (PM_{10}), and carbon monoxide (CO) (EPA, 2006o). Significance levels define concentrations below which an impact of an air emissions source would be considered to be insignificant for the purposes of air quality modeling. The significance levels are shown in Table 3-1 below.

Table 3-1. Air Quality Significance Levels

Pollutant	Averaging Time				
	Annual	24 hours	8 hours	3 hours	1 hour
SO_2	1 µgm/m^3	5 µgm/m^3		25 µgm/m^3	
PM_{10}	1 µgm/m^3	5 µgm/m^3			
NO_2	1 µgm/m^3				
CO			500 µmg/m^3		2000 µmg/m^3

Significance levels as used here are only related to how the air quality modeling analysis is conducted. These significance levels do not have any relationship to potential adverse impacts. Earlier in this Section, the term significance criteria is used. This term is defined as indicating thresholds where adverse impacts become significant. For air resources, these adverse impact related criteria are described in *Section 3.1.2.2, Significance Criteria*.

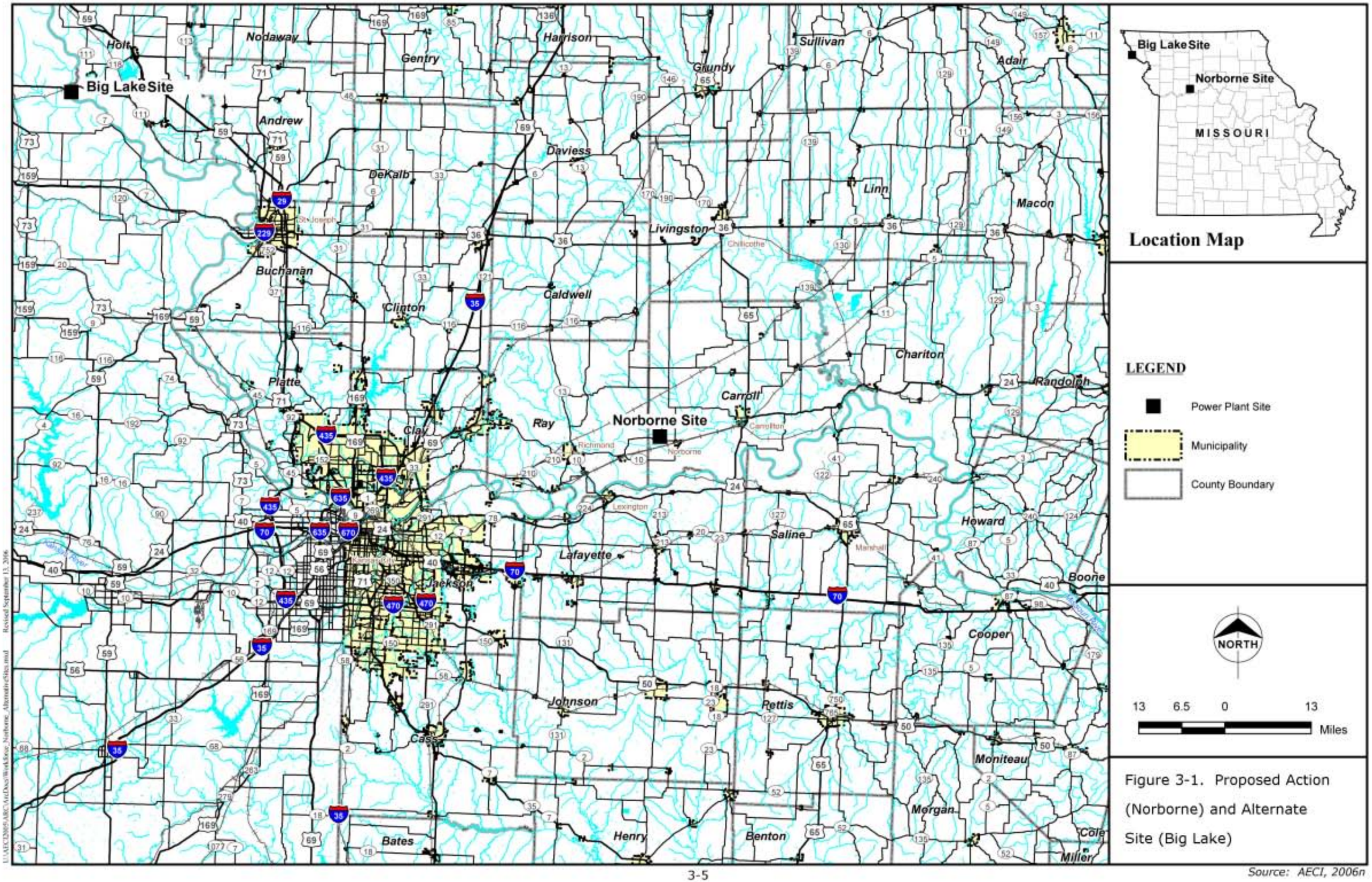


Figure 3-1. Proposed Action (Norborne) and Alternate Site (Big Lake)

Source: AECI, 2006n

Table 3-2 shows the radius of the area of influence for each pollutant modeled for the proposed source.[45]

Table 3-2. Radius of Significant Impact

Pollutant	Radius of Influence (km)
Nitrogen Oxides (NO_X)	3.1
Sulfur Dioxide (SO_2)	7.1
Particulate Matter less than 10 Microns (PM_{10})	4.2
Carbon Monoxide (CO)	Maximum modeled results for CO showed that estimated levels were less than the significance level listed in Table 3-1; therefore, the proposed project is an insignificant contributor to CO levels, the radius of influence is zero, and no further ambient air quality demonstrations are required for CO.

A second measure of the region of influence of the Proposed Action relates to the potential impact of the proposed project on air quality related values such as visibility. The federal Clean Air Act (CAA) requires that a proposed major new air pollution source such as the Proposed Action evaluate the impact of the source on specially designated areas, called Class I areas, such as national parks and wilderness areas. Typically, the EPA requires an analysis of impacts on Class I areas that are within 100 km (about 62 miles) of a major new source of air pollution. This distance can be increased for certain very large proposed sources. The term "very large" is not defined in federal guidance and in the case of the Proposed Action, AECI was required to consider the impact of the proposed project on a Class I area in Missouri even though it is further than 100 km from the Proposed Action.

How are areas classified under the Prevention of Significant Deterioration (PSD) program?
The PSD provisions of the federal CAA assign one of three classes to all areas within the United States. A Class I area is one in which visibility is protected more stringently than under the national ambient air quality standards. Class I areas include national parks, wilderness areas, monuments, and other areas of special national and cultural significance. All other areas are Class II unless a state petitions the EPA to redesignate a Class II area to Class III in order to provide added ability to accommodate emissions growth.

[45] Air Quality Permit Application, Section XX.

The Hercules Glades Wilderness Area (HGWA) in Taney County Missouri (about 295 km from the Proposed Action) is the closest Class I area (EPA, 2006r and 2006s). This area was considered to be included in the region of influence of the Proposed Action, even though it is more than 100 km distant.

3.1.1.2 Existing Conditions

3.1.1.2.1 Federal and State Laws and Regulations

The federal CAA that serves as the basis for air quality regulation was first made law in 1970. There were subsequent major amendments to the law in 1977 and 1990 (EPA, 2006a). The CAA envisions that the states will be the primary regulators of air quality and that the federal government, through the EPA, will establish the minimum set of requirements that a state must incorporate into their air quality control regulations and plans.

Section 110 of the CAA requires state and local air pollution control agencies to adopt federally approved control strategies to minimize air pollution. The resulting body of regulations is known as a State Implementation Plan (SIP). SIPs generally establish limits or work practice standards to minimize emissions of the air pollutants or their precursors. The Project must meet the requirements of the Missouri SIP. A summary of the elements of the Missouri SIP is maintained by the EPA (EPA, 2006b).

A key element of the Missouri SIP related to the Project is the requirement that the Project obtain an air quality construction permit.[46] For the air quality construction permit, the Missouri SIP refers to the federal PSD requirements.[47] Generally, this regulation requires the proponent of a proposed new air pollution source to show that the source will:

- Employ Best Available Control Technology (BACT) to reduce emissions to the ambient air,
- Not cause or significantly contribute to a violation of a NAAQS,
- Not cause or significantly contribute to exceeding a PSD increment (a cap on the amount of air quality degradation caused by new air pollution sources),

[46] Title 10 of the Missouri Code of State Regulations, Section 10-6.060 (10 CSR 10-6.060).
[47] Title 40 of the Code of Federal Regulations, Section 52.21 (40 CFR 52.21).

- Comply with all applicable New Source Performance Standards (NSPS),
- Not significantly degrade visibility in Class I areas, and
- Comply with all other applicable requirements.

Regulation of Hazardous Air Pollutants (HAPs)

Coal fired power plants emit mercury, a Hazardous Air Pollutant (HAP) listed in the CAA. When congress amended the CAA in 1990, they recognized that mercury emissions from power plants required special study in order to determine whether those emissions should be regulated as a HAP. Section 112(n) of the CAA specifies:

> "The Administrator shall perform a study of the hazards to public health reasonably anticipated to occur as a result of emissions by electric utility steam generating units of pollutants listed under subsection (b) after imposition of the requirements of this Act. The Administrator shall report the results of this study to the Congress within 3 years after the date of the enactment of the Clean Air Act Amendments of 1990. The Administrator shall develop and describe in the Administrator's report to Congress alternative control strategies for emissions which may warrant regulation under this section. The Administrator shall regulate electric utility steam generating units under this section, if the Administrator finds such regulation is appropriate and necessary after considering the results of the study required by this subparagraph."

On May 18, 2005, EPA finalized its regulatory approach to controlling mercury emissions from power plants. The rule published on that date is known as the Clean Air Mercury Rule (CAMR).

3.1.1.2.2 Criteria Air Pollutants

The EPA has established primary air quality standards to protect human health including the health of "sensitive" populations such as asthmatics, children, and the elderly by setting maximum ambient air concentrations for six common air pollutants, called criteria pollutants. The six criteria pollutants, described below, are CO, ozone (O_3), NO_X, SO_2, lead (Pb), and PM. The EPA also sets secondary air quality standards. These standards are designed to protect the public welfare. Examples of what secondary standards

are designed to protect include crops, visibility, and effects on material and coatings such as metals and paints. Collectively these standards are referred to as the National Ambient Air Quality Standards (NAAQS).

The sources and potential health effects of each of these pollutants is described below.

Carbon Monoxide (CO)

CO is a colorless, odorless, and (at high levels) poisonous gas, formed when carbon in fuels is not burned completely. It is a product of motor vehicle exhaust, which contributes about 60 percent of all CO emissions nationwide. High concentrations of CO generally occur in areas with heavy traffic congestion. In cities, as much as 95 percent of all CO emissions may emanate from automobile exhaust. Other sources of CO emissions include industrial processes such as carbon black manufacturing, non-transportation fuel combustion, and natural sources such as wildfires. Woodstoves, cooking, cigarette smoke, and space heating are sources of CO in indoor environments. Peak CO concentrations typically occur during the colder months of the year when CO automotive emissions are greater and nighttime inversion conditions are more frequent.

Ozone (O_3)

Ground-level O_3 (sometimes referred to as smog) is formed by the reaction of volatile organic compounds (VOCs) and NO_X in the atmosphere in the presence of sunlight. These two pollutants, often referred to as O_3 precursors, are emitted by many types of pollution sources, including on-road and off-road motor vehicles and engines, power plants and industrial facilities, and smaller sources, collectively referred to as area sources. O_3 is predominately a summertime air pollutant. Changing weather patterns contribute to yearly differences in O_3 concentrations from region to region. O_3 and the pollutants that form O_3 also can be transported into an area from pollution sources found hundreds of miles upwind.

O_3 is a health concern, particularly for children and people with asthma and other respiratory diseases. O_3 has also been associated with increased hospitalizations and emergency room visits for respiratory causes, school absences, and reduced activity and productivity because people are suffering from ozone-related respiratory symptoms (FR, 2004).

Nitrogen Oxides (NO_X)

NO_X is a reddish brown, highly reactive gas that is formed in the ambient air through the oxidation of nitric oxide (NO). NO_X, the generic term for a group of highly reactive gases that contain nitrogen and oxygen in varying amounts, play a major role in the formation of O_3, PM, haze, and acid rain. The major sources of man-made NO_X emissions are high-temperature combustion processes such as those that occur in automobiles and power plants. Home heaters and gas stoves can also produce substantial amounts of nitrogen dioxide (NO_2) in indoor settings.

Long-term exposures to NO_2 may lead to increased susceptibility to respiratory infection and may cause irreversible alterations in lung structure. NO_X react in the air to form ground-level O_3 and fine particle pollution, which are associated with adverse health effects.

NO_X contribute to a wide range of environmental effects directly and when combined with other precursors in acid rain and O_3. Increased nitrogen inputs to terrestrial and wetland systems can lead to changes in plant species composition and diversity. Similarly, direct nitrogen inputs to aquatic ecosystems such as those found in estuarine and coastal waters can lead to eutrophication (a condition that promotes excessive algae growth, which can lead to a severe depletion of DO and increased levels of toxins harmful to aquatic life). Nitrogen, alone or in acid rain, also can acidify soils and surface waters. Acidification of soils causes the loss of essential plant nutrients and increased levels of soluble aluminum that are toxic to plants. Acidification of surface waters creates conditions of low pH and levels of aluminum that are toxic to fish and other aquatic organisms. NO_X also contribute to visibility impairment (EPA, 2006c).

Sulfur Dioxide (SO_2)

SO_2, a colorless, reactive gas, is produced during the burning of sulfur-containing fuels such as coal and oil, during metal smelting, and by other industrial processes. Major sources include power plants, industrial boilers, petroleum refineries, smelters, and iron and steel mills. Generally, the highest concentrations of sulfur dioxide are found near large fuel combustion sources.

Acid deposition or "acid rain" occurs when SO_2 and NO_X react with water, oxygen, and oxidants to form acidic compounds. It is deposited in dry form

(gas, articles) or wet form (rain, snow, fog), and can be carried by wind hundreds of miles across state and national borders. Acid rain harms lakes and streams, damages trees, crops, historic buildings, and monuments (EPA, 2006d).

Lead (Pb)

Lead is a metal found naturally in the environment as well as in manufactured products. The major sources of lead emissions have historically been from fuels in motor vehicles (such as cars and trucks) and industrial sources. Emissions from on-road vehicles decreased 99% between 1970 and 1995 due primarily to the use of unleaded gasoline. Use of leaded gasoline in highway vehicles was prohibited on December 31, 1995. Due to the phase out of leaded gasoline, ore and metals processing is the major source of lead emissions to the air today.

The highest levels of lead in air are generally found near lead smelters. Other stationary sources are waste incinerators, utilities, and lead-acid battery manufacturers. Combustion and smelting processes operate at high temperatures and emit submicron PM lead. Material handling and mechanical operations emit larger particles of lead (EPA, 2006e).

Particulate Matter (PM)

The term "particulate matter" includes both solid particles and liquid droplets found in air. Many manmade and natural sources emit PM directly or emit other pollutants that react in the atmosphere to form PM. These solid and liquid particles come in a wide range of sizes.

Particles less than 10 micrometers in aerodynamic diameter (PM_{10}) pose a health concern because they can be inhaled into and accumulate in the respiratory system. Particles less than aerodynamic 2.5 micrometers in diameter ($PM_{2.5}$) are referred to as "fine" particles and are believed to pose the largest health risks. Because of their small size (less than one-seventh the average width of a human hair), fine particles can lodge deeply into the lungs.

Health studies have shown a significant association between exposure to fine particles and premature mortality. Other important effects include aggravation of respiratory and cardiovascular disease (as indicated by

increased hospital admissions, emergency room visits, absences from school or work, and restricted activity days), lung disease, decreased lung function, asthma attacks, and certain cardiovascular problems such as heart attacks and cardiac arrhythmia. Individuals particularly sensitive to fine particle exposure include older adults, people with heart and lung disease, and children.

While fine particulate matter is categorized as a single pollutant, fine particulates are in reality a category of pollutants. Some fine particulate matter is formed through atmospheric reactions involving other pollutants such as sulfur dioxide and nitrogen oxides. These reactions result in formation of specific categories of fine particulates such as sulfates and nitrates. In other cases, pollutants become attached to fine particulates. An example of this is organic pollutants that become attached to fine particulates. Each of these specific types of fine particulate matter has specific, sometimes different, health effects.

Sources of fine particles include all types of combustion activities (motor vehicles, power plants, wood burning, etc.) and certain industrial processes. Particles with aerodynamic diameters between 2.5 and 10 micrometers are referred to as "coarse." Sources of coarse particles include crushing or grinding operations, and dust from paved or unpaved roads (EPA, 2006f).

3.1.1.2.3 National Ambient Air Quality Standards

The primary and secondary NAAQS are presented in Table 3-3 (EPA, 2006g).

Table 3-3. National Ambient Air Quality Standards

Pollutant	Primary Standards	Averaging Times	Secondary Standards
Carbon Monoxide	9 ppm (10 mg/m^3)	8-hour[1]	None
	35 ppm (40 mg/m^3)	1-hour[1]	None
Lead	1.5 µgm/m^3	Quarterly Average	Same as Primary
Nitrogen Dioxide	0.053 ppm (100 µgm/m^3)	Annual (Arith Mean)	Same as Primary
Particulate Matter (PM_{10})	50 µgm/m^3	Annual[2] (Arith Mean)	Same as Primary
	150 µgm/m^3	24-hour[1]	
Particulate Matter ($PM_{2.5}$)	15 µgm/m^3	Annual[3] (Arith Mean)	Same as Primary
	65 µgm/m^3	24-hour[4]	

Table 3-3. National Ambient Air Quality Standards

Pollutant	Primary Standards	Averaging Times	Secondary Standards
Ozone	0.08 ppm (157 µgm/m^3)	8-hour[5]	Same as Primary
Sulfur Oxides	0.03 ppm (80 µgm/m^3)	Annual (Arith Mean)	- - - - -
	0.14 ppm (365 µgm/m^3)	24-hour[1]	- - - - -
	- - - -	3-hour[1]	0.5 ppm (1,300 µgm/m^3)

[1] Not to be exceeded more than once per year.
[2] To attain this standard, the 3-year average of the weighted annual mean PM_{10} concentration at each monitor within an area must not exceed 50 ug/m^3.
[3] To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 ug/m^3.
[4] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 65 ug/m^3.
[5] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

3.1.1.2.4 Hazardous Air Pollutants (HAPs)

The CAA Amendments of 1990 contained a list of 189 substances which were categorized as HAPs. The law also provides the EPA administrator with a procedure to add or remove substances from the list. Since the time that the list was originally published in the CAA, the EPA administrator has removed three of the original substances.

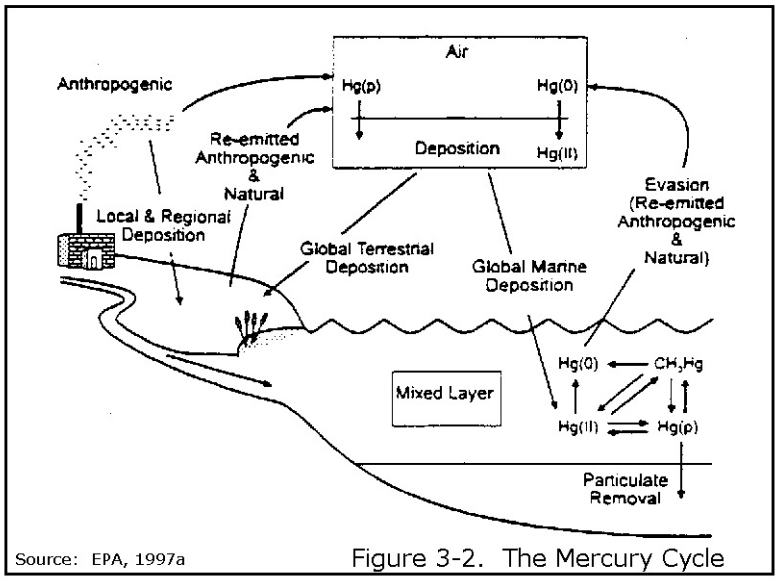
What is a Hazardous Air Pollutant?
Hazardous Air Pollutants, called HAPs, are air pollutants which are not covered by ambient air quality standards, but which, as defined in the CAA, may present a threat of adverse human health effects or adverse environmental effects. Examples of HAPs are asbestos, beryllium, mercury, benzene, hydrogen chloride, radionuclides, and vinyl chloride.

Mercury[48]

Of the entire list of HAPs, there is one HAP that is of primary concern when considering emissions impact of coal fired power plants. That HAP is mercury. (There are two other HAPs, hydrogen chloride and hydrogen fluoride that, absent the air pollution controls incorporated into the design of modern coal-fired power plants, could be emitted in significant quantities.)

[48] The majority of the discussion of mercury is taken from: Draft Environmental Impact Statement, Highwood Generating Station, Southern Montana Electric Generation and Transmissions Cooperative, Inc., June 2006. State specific portions of the text were modified to reflect the situation in Missouri.

At typical temperatures and pressures, elemental mercury (Hg) is a heavy, silver-white liquid metal (EPA, 1997a). As a chemical element common in the earth's crust (Levin, 2001), mercury can neither be created nor destroyed. However, mercury can cycle through the environment – including air, land and water – as part of both natural and human (anthropogenic) activities (Figure 3-2). Measured data and modeling results both indicate that the amount of mercury mobilized and released into the biosphere has increased since the beginning of the industrial age (EPA, 1997b). Figure 3-3 is a graph displaying a profile of historic concentrations of mercury developed from an age-dated, 160-m (530-ft) deep ice core from the Upper Fremont Glacier in Wyoming's Wind River Range (Abbott, 2004). Increasing background mercury deposition from the atmosphere is evident, with occasional spikes in concentration caused by volcanic eruptions.



Source: EPA, 1997a

Figure 3-2. The Mercury Cycle

Mercury plays an important role as a process or product ingredient in several industrial sectors. It has also been used in many household products, including thermometers, lamps, paints, batteries, electrical switches, pesticides, and even toys and shoes (Ohio EPA, 2000 and MNDR 2006). In the electrical industry, it is used in components such as fluorescent lamps, wiring devices and switches (e.g., thermostats) and mercuric oxide batteries (MNDR 2006). Furthermore, it is a component of dental amalgams used in repairing dental caries (cavities). In addition to specific products, mercury is utilized in numerous industrial processes, the largest of which in the United States (U.S.) is the production of chlorine and caustic soda by mercury cell chlor-alkali plants (EPA, 1997b).

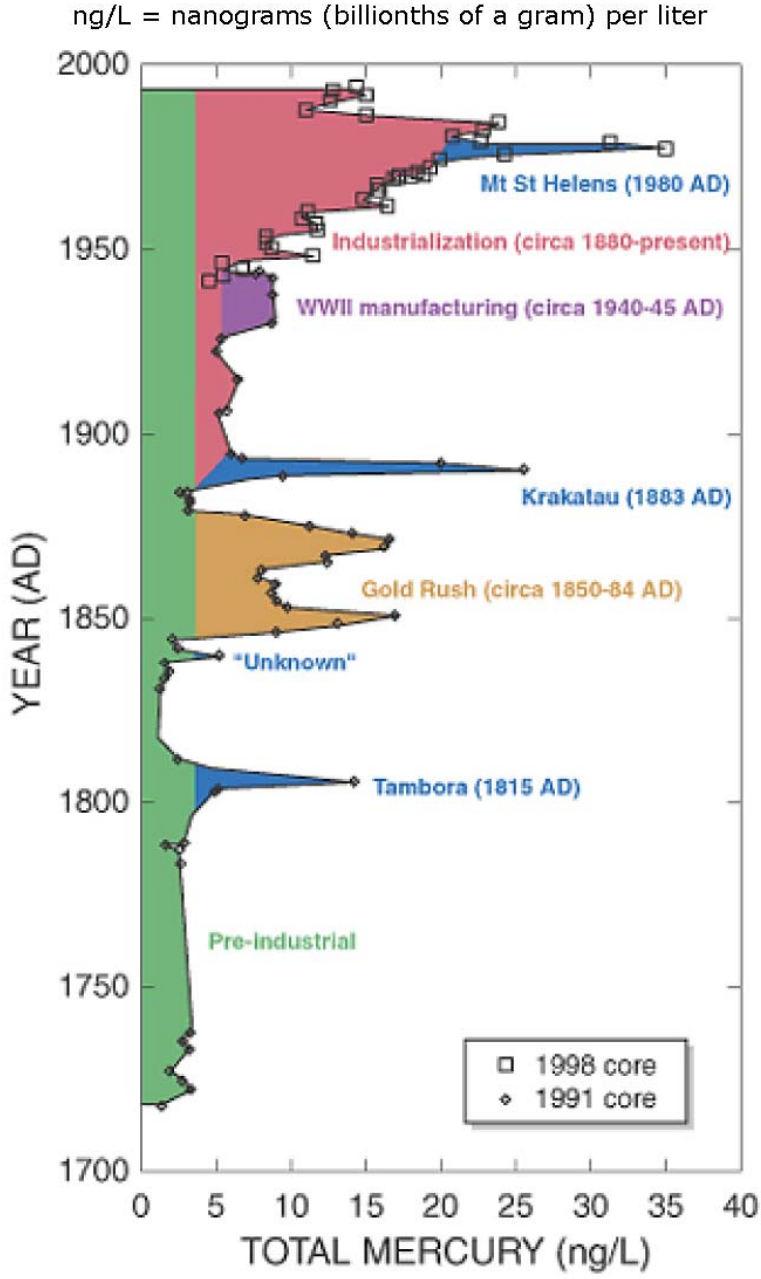


Figure 3-3. Historic Mercury Concentrations from 160-m Ice Core in Upper Fremont Glacier, Wind River Range, Wyoming

Source: Abbott, 2004

Mercury can exist in three different oxidation or valence states: Hg^0 (metallic or elemental), Hg^+ (mercurous) and Hg^{2+} (mercuric). The properties and behavior of mercury depend on its oxidation state. Elemental mercury is a liquid but also has a fairly substantial vapor pressure, meaning that mercury vapor will be present at normal environmental temperatures. The inorganic forms of mercury generally exist as solids in combination with other chemicals and do not have a measurable vapor pressure.

Mercury can also be combined with organic molecules (primarily by bacteria in sediments) to form organic mercury compounds.

The most dominant form of mercury in the atmosphere is elemental or metallic mercury (Hg^0), which is present as mercury vapor. Reactions with other chemicals and solar radiation in the atmosphere can convert elemental mercury to ionic or charged forms (Hg^{2+}, Hg^+). Most of the mercury occurring in water, soil, sediments, or biota (i.e., all environmental media except the atmosphere) is in the form of inorganic mercury salts and organic forms of mercury (EPA, 1997b).

Mercury Emissions and Deposition

Scientists estimate that natural sources of mercury – such as volcanic eruptions, forest fires, and emissions from the ocean – constitute roughly a third of current worldwide mercury air emissions (EPA, 2006h). Mercury emissions can originate from natural sources such as geysers and hot springs in Yellowstone National Park. Recent measurements have shown that Yellowstone's Norris and Mammoth thermal areas are emitting mercury to the air at the rate of 205-450 lbs/year (93-205 kg/yr) (NPS, 2005).

Anthropogenic sources account for the other two-thirds of mercury emissions. Recent estimates of annual total global mercury emissions from all sources, both natural and anthropogenic, are about 4,400 to 7,500 metric tons per year (EPA, 2006h). Much of the mercury circulating through today's environment was released years ago, when mercury was more commonly used than at present in many industrial, commercial, and residential applications. Land and water surfaces can repeatedly re-emit mercury into the atmosphere after its initial release into the environment (refer to Figure 3-2). Figure 3-4 shows that anthropogenic emissions are roughly split evenly between these re-emitted emissions from previous human activity, and direct emissions from current human activity (EPA, 2006h).

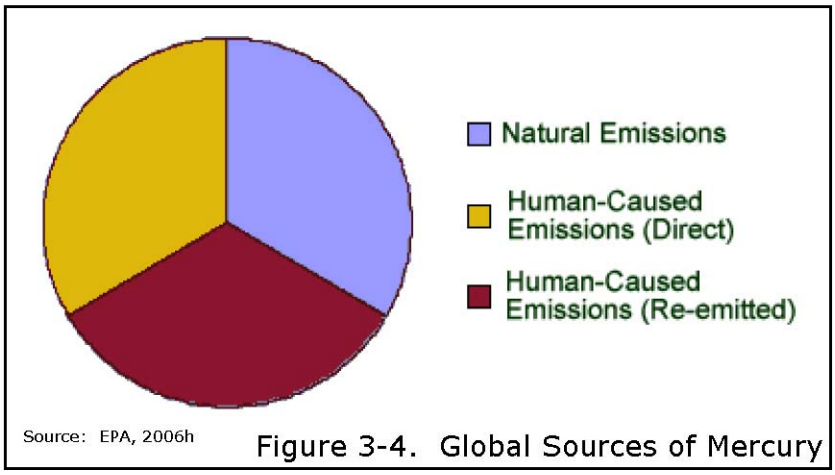


Figure 3-4. Global Sources of Mercury

U.S. anthropogenic mercury emissions are estimated to account for roughly three percent of the global total, and emissions from the U.S. power sector are estimated to account for about one percent of total global emissions (UNEP, 2002) (refer to Figure 3-5). In recent years, with increasing awareness of mercury's toxicity, increasing regulation, and technological innovation and substitution, U.S. anthropogenic emissions of mercury have decreased. They have declined 45 percent since 1990 (EPA, 2006i) (refer to Figure 3-6). The two biggest declines were in emissions from medical waste incinerators and municipal waste combustors.

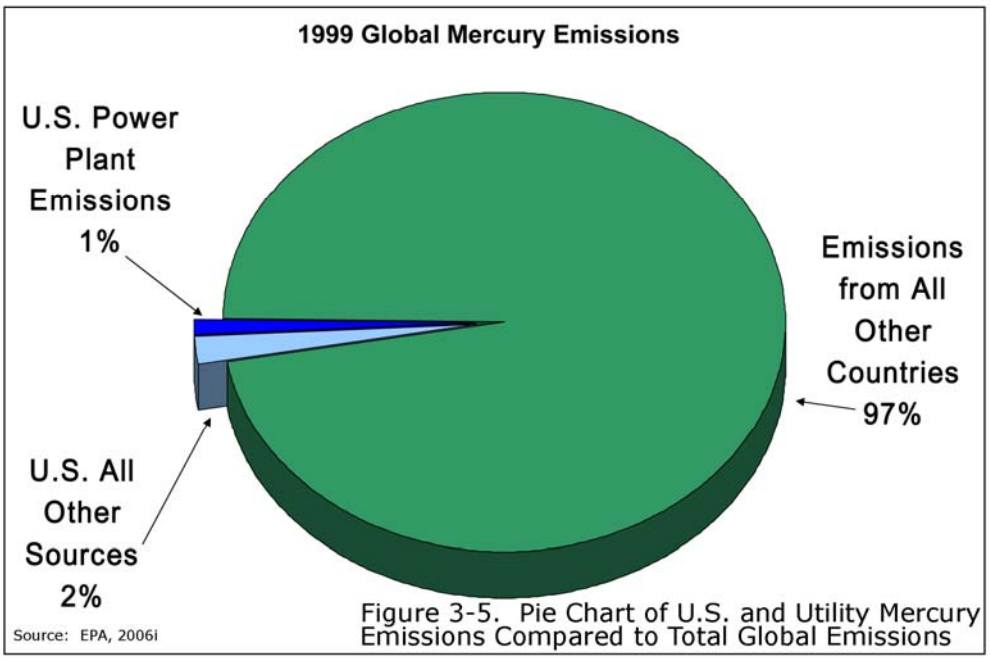


Figure 3-5. Pie Chart of U.S. and Utility Mercury Emissions Compared to Total Global Emissions

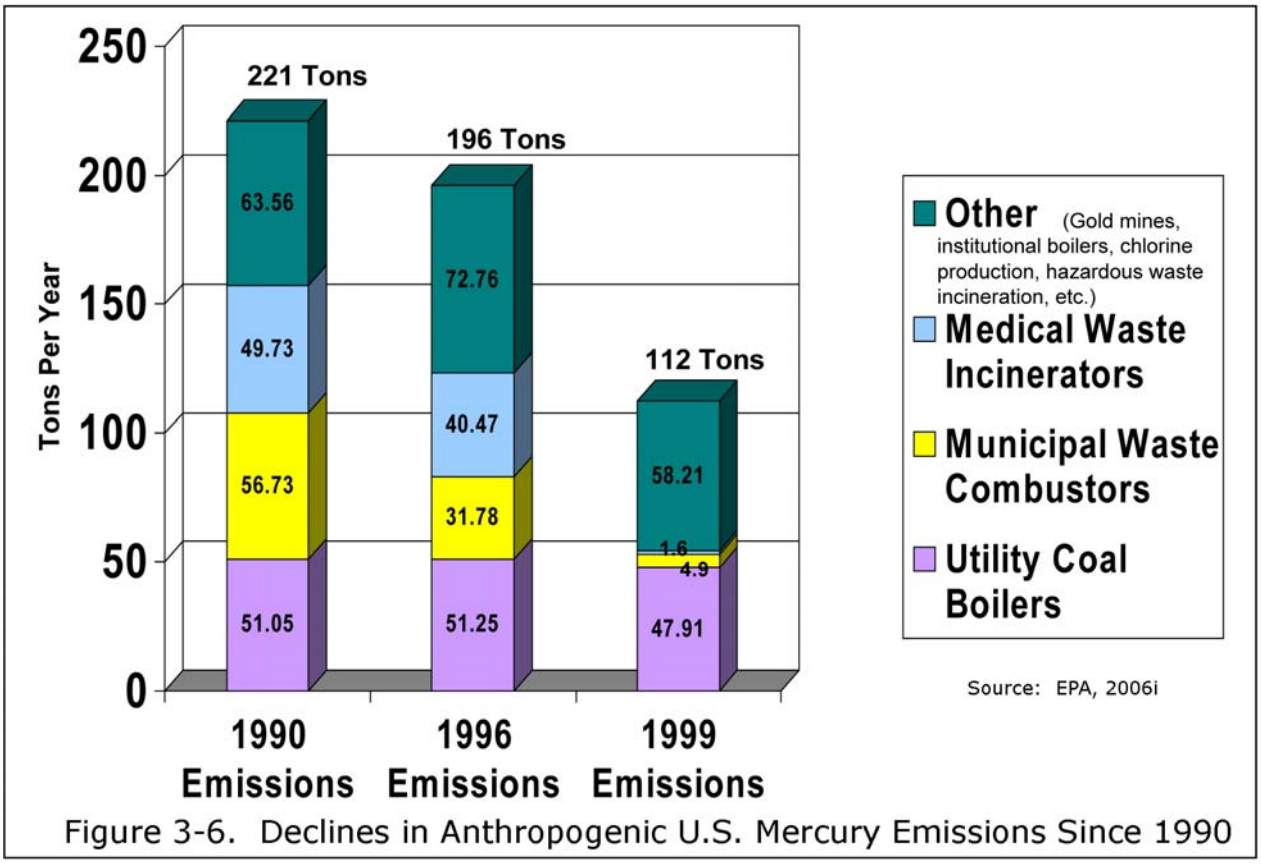


Figure 3-6. Declines in Anthropogenic U.S. Mercury Emissions Since 1990

While the overall trend in the global mercury burden since pre-industrial times appears to be increasing (by an estimated two to five times), there is some evidence that mercury concentrations in certain locations have been stable or decreasing over the past few decades. The downward trend in mercury concentrations observed in the environment in some geographic locations over the last few decades generally corresponds to declining regional mercury use and consumption patterns over the same time frame (EPA, 1997a).

Mercury occurs naturally in coal at trace amounts, and unless controlled, is released to the atmosphere when coal is burned. It is estimated that 48 tons of mercury, or about one-third of the total amount of mercury released annually by human activities in the U.S., are released into the atmosphere annually by coal-fired power plants (EPA, 2006i). Missouri power plants emitted slightly more than one and one-half tons (3,326 lbs) of mercury, or about three and one-half percent (3.52%) of total U.S. power plant emissions according the 2004 toxic release inventory data (most recent available data)

submitted to US EPA (EPA, 2006j). Current estimates are that 80 percent or more of the mercury deposited within the U.S. was emitted from sources outside the U.S. and Canada (EPA, 2006i; see Figure 3-7).

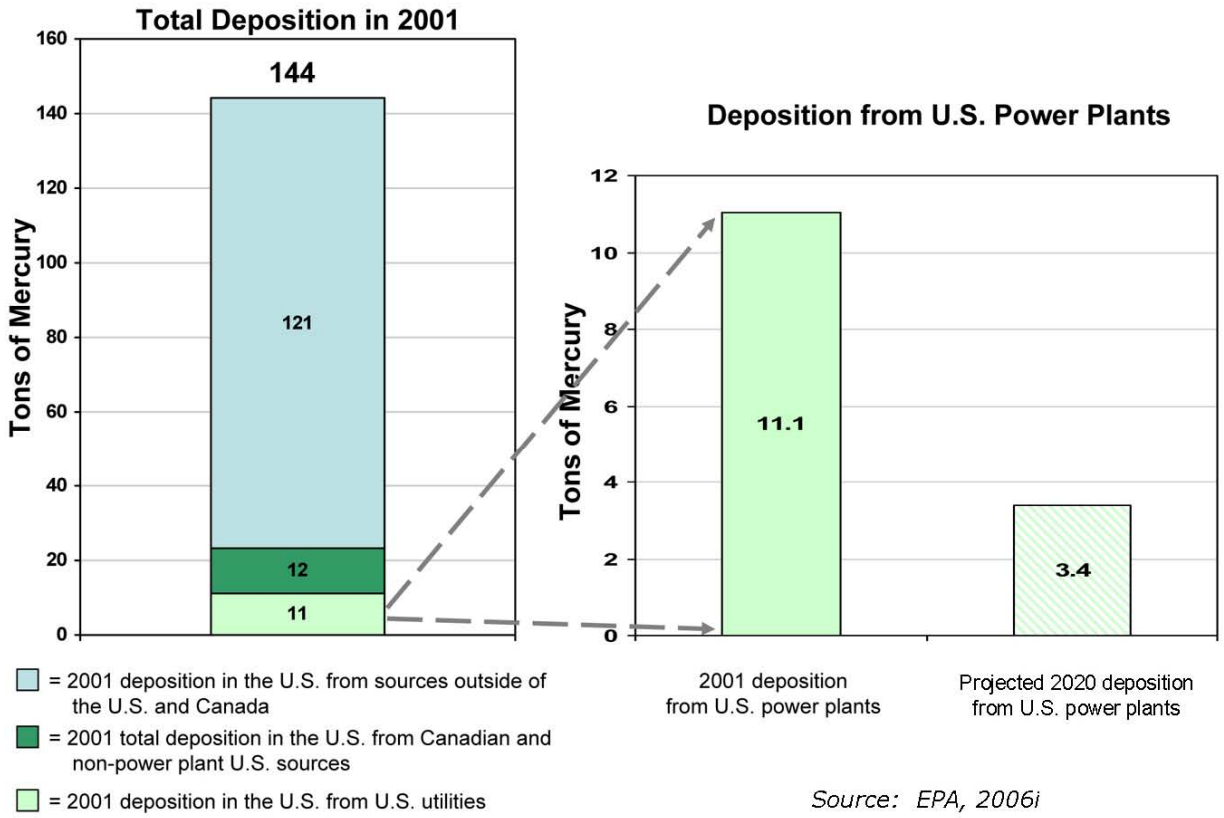


Figure 3-7. Mercury Deposition in the United States (2001) by Source

On May 18, 2005, EPA published the CAMR, which will permanently cap and reduce mercury emissions from coal-fired power plants (EPA, 2005a). This rule will reduce mercury emissions in two phases. The first will reduce emissions using currently mandated technology by 2010 and the second will reduce emissions further by 2018. Additional and updated information related to CAMR from electric generating units is available at http://www.epa.gov/mercury/. CAMR relies on markets to reduce pollution, and allows companies to buy and sell allotted pollution limits. EPA assigned most states and two Indian tribes an emissions budget for mercury, and these states must submit a SIP revision detailing when they will meet their budget for reducing mercury from coal-fired power plants (EPA, 2006k).

Missouri's statewide cap on mercury emissions will be 1.393 tons in 2010 and 0.55 tons in 2018. On October 2, 2006, the Missouri Department of Natural Resources (MDNR) filed a proposed rule, 10 CSR 10-6.368, Control of Mercury from Electric Generating Units, with the secretary of state.

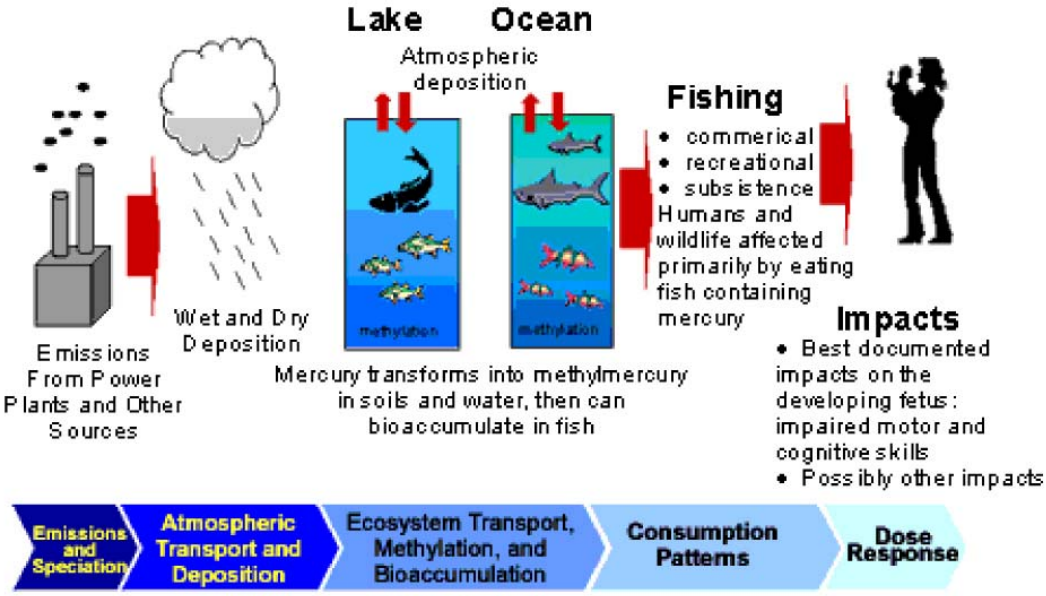
Transformation to Methylmercury and Exposure Pathways

Once in aquatic systems, mercury can exist in dissolved or particulate forms and can undergo a number of chemical transformations (Figure 3-8). Sediments contaminated with mercury at the bottom of surface waters can serve as an important reservoir of the element, with sediment-bound mercury recycling back into the aquatic ecosystem for decades or longer. Mercury also has a long retention time in soils, from which it may continue to be released to surface waters and other media for long periods of time, possibly hundreds of years (EPA, 1997b).

Mercury that enters water bodies and sediments can ultimately be transformed through "methylation" (attachment of one carbon and three hydrogen atoms) into a more toxic form, methylmercury (CH_3Hg). Methylmercury can be formed in the environment both by microbial metabolism as well as by abiotic, chemical processes, although it is generally believed that microbial metabolism is the dominant process (UNEP, 2002).

Plants, animals and humans can be exposed to mercury by direct contact with contaminated environmental media or ingestion of mercury-contaminated water and food. Unlike other forms of mercury, methylmercury is readily absorbed across biological barriers and the gastrointestinal tract. Methylmercury can build up in tissues of organisms (bioaccumulation) and increase in concentration along the food chain (biomagnification) (EPA, 1997a).

Almost all human exposure to methylmercury is through fish consumption (EPA, 1997c). Estimates developed by the World Health Organization and published by the U.S. Agency of Toxic Substances and Disease Registry (ATSDR) indicate that 99.6 percent of methylmercury intake arises from fish consumption and that 97.7 percent of inorganic mercury intake is associated with the diet (ATSDR, 1999).



Source: EPA, 2006h

Figure 3-8. Mercury Exposure Pathways

As of the 2004, forty-four (44) states (including Missouri) had issued fish consumption advisories for mercury (methylmercury) on certain water bodies, twenty-one (21) states had statewide advisories for mercury in freshwater lakes and rivers, and twelve (12) states had statewide advisories for mercury in their coastal waters (EPA, 2005b). The Missouri Department of Health and Senior Services (DHSS) provides recommendations on the amount and type of sport fish that can be safely eaten, how to prepare caught fish, and what special precautions should be taken by higher-risk individuals. These recommendations are published annually. The most recent recommendations are detailed in the 2007 Fish Advisory – A Guide to Eating Fish in Missouri (DHSS, 2007). By employing a margin of safety, the guidelines are intended to protect consumers from the first symptoms of mercury toxicity. The guidelines are generally designed to protect higher-risk segments of the population, in particular, pregnant women, women of childbearing age, children, and anglers who regularly consume fish caught in Missouri waters in larger quantities over long periods of time (DHSS, 2007, MDNR, 2006, and EPA, 2005b).

Missouri fish consumption guidelines vary substantially by fish species and size, water body, and consumer (adult men or women and children). They apply to approximately 30 water bodies in the state, all but two of which are lakes and reservoirs. The 2006 Fish Advisory – A Guide to Eating Fish in Missouri added both the Mississippi and Missouri Rivers to the advisory for mercury (DHSS, 2007).

Mercury levels in Missouri fish appear to be mostly related to their size and the type of food they consume. For example, large fish that feed on other fish exhibit higher concentrations of mercury than smaller fish or bottom feeding fish. Sampling and analysis of largemouth bass, smallmouth bass, and spotted bass greater than 12 inches in length have been found to have the highest mercury concentrations in Missouri lakes. Fish species found in the Missouri and Mississippi rivers with high mercury concentrations were flathead, channel, and blue catfish. Certain fish species and size do not contain levels that warrant concern for consumption on a frequent or prolonged basis except for sensitive populations (DHSS, 2007).

Health and Ecological Effects

The study of mercury's effects on health reflect the dose-response principle, which states that organisms respond to toxic substances according to the amount or dose of the substance that gets into their bodies. This is one of the fundamental principles of the field of toxicology – with increasing dose or exposure to a substance, there are likely to be greater effects.

Mercury Toxicity. Mercury is a well-documented human toxin at certain doses. Clinically observable neurotoxicity has been observed following exposure to large amounts of mercury (e.g., "Mad Hatters' Disease") and consumption of highly contaminated food also has induced acute mercury neurotoxicity. Generally, the most subtle indicators of methylmercury toxicity are neurological changes. These impaired motor skills and sensory ability occur at comparatively low doses, and progress to tremors, inability to walk, convulsions and death at extremely high exposures (EPA, 1997d). Mercury poisoning can also permanently damage kidneys and fetuses (EPA, 2003).

Mercury and Autism. Links between mercury exposure and autism have been suggested, but to date there is no evidence for a causal link between mercury exposure and autism.

Several studies in the early 2000s expressed a concern about a possible link between autism and a mercury-containing compound in vaccines administered to children (referenced in Nelson and Bauman, 2003). A recent study in Texas reported a positive correlation between increases in mercury emissions as reported by U.S. EPA and increases in autism at the county level, and suggested, based solely on the correlation, that there may be a link between mercury and autism (Palmer et al., 2006). (However, the authors did acknowledge that a causal association could not be determined from the data.) Some of the same researchers had earlier reported a positive correlation between school district revenue and rates of autism, but in that case, rather than speculating that money may cause autism, concluded that disadvantaged school districts may need more assistance in identifying children with special needs (Palmer et al 2005). Many trends correlate positively with one another that are not necessarily related to each other.

An article from Pediatrics, the official journal of the American Academy of Pediatrics, noted as being current as of May 2007, concluded that there is presently no evidence that mercury causes autism (Nelson and Bauman, 2003):

> Nonspecific symptoms such as anxiety, depression, and irrational fears may occur both in mercury poisoning and in children with autism, but overall the clinical picture of mercurism—from any known form, dose, duration, or age of exposure—does not mimic that of autism. No case history has been encountered in which the differential diagnosis of these two disorders was a problem. Most important, no evidence yet brought forward indicates that children exposed to vaccines containing mercurials, or mercurials via any other route of exposure, have more autism than children with less or no such exposure.

The same article notes that "There has clearly been an broadening of the criteria for autism, better case-finding, increased awareness by clinicians and by families, and an increase in referrals of children for services," but "whether the sum of these is sufficient to account for the more frequent diagnosis of autism is a matter of contention and is properly settled by careful research."

Ecological Effects. In addition to neurotoxicity from acute and chronic exposure in human beings, mercury poisoning can potentially cause adverse

health effects on individual animals and plants, up to and including mortality, and therefore may potentially affect wildlife populations and ecological communities (EPA, 1997b). Severe neurological effects were already observed in animals at Minamata, Japan, prior to the recognition of human poisonings – birds experienced severe difficulty in flying and exhibited other grossly abnormal behavior (UNEP, 2002). However, these effects occurred at levels of fish contamination that were 10 to 20 times higher than the U.S. Food and Drug Administration (FDA) limit for human consumption of 1 ppm (FDA, 2004).

Adverse effects of elevated mercury levels in fish include death, reduced reproductive success, impaired growth and development, and behavioral abnormalities. Reproductive effects are the primary concern for mercury poisoning in wildlife and can occur at dietary concentrations well below those which cause overt toxicity. Effects of mercury on birds and mammals include death, reduced reproductive success, impaired growth and development and behavioral abnormalities. Sub-lethal effects of mercury on birds and mammals include liver damage, kidney damage, and neurobehavioral effects (EPA, 1997b).

Summary. Mercury is ubiquitous in the earth's biosphere, occurring in the air, water, land, and soil, as well as in living organisms. In the industrialized era, human activities have mobilized greater amounts of mercury, thereby exposing organisms, ecosystems, and human beings to a particularly toxic form, methylmercury. Almost all human exposure to methylmecury is from ingesting contaminated fish. In low doses, methylmercury can be voided by the body and is not generally problematic; at sustained, excessive doses, it may accumulate in certain tissues and organs to concentrations that can cause a variety of adverse health effects on humans and wildlife. These negative effects may be acute or chronic, and from sub-lethal to lethal. While mercury contamination is widespread, indeed global, the incidents to date have tended to involve specific point source discharges to water rather than dispersed emissions to air.

3.1.1.2.5 Global Climate Change

This discussion is based entirely on the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, *Climate Change 2007*, the most recent and comprehensive source of information on global climate change.

IPCC authors and contributors are scientists representing hundreds of research institutes and universities around the world, and 180 member governments. The IPCC is currently finalizing its Fourth Assessment Report, *Climate Change 2007*. Parts or all of the reports from IPCC's three working groups are available on the IPCC website.

- Working Group I Report—The Physical Science Basis (final report available (including summary for policy makers), IPCC 2007a)

- Working Group II Report—Impacts, Adaptation and Vulnerability (summary for policymakers available, IPCC 2007b)

- Working Group III Report—Mitigation of Climate Change (summary for policymakers available, IPCC 2007c)

Some of the highlights of the IPCC 2007 reports:

Global Warming: "Warming of the earth's climate is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." Eleven of the last twelve years (1995-2006) rank among the 12 warmest years in the instrumental record of global surface temperature (since 1850) (IPCC, 2007a). See Figure 3-9.

Sea Level Rise. Global average sea level rose at an average rate of 1.8 mm per year over 1961 to 2003. Sea level rise is caused by thermal expansion of ocean water and by melting ice. Oceans have been absorbing more than 80 percent of the heat added to the climate system. Since 1961, the average temperature of global oceans has increased to depths of about 10,000 feet. This warming causes seawater to expand, contributing to sea level rise. "Widespread decreases in glaciers and icecaps have contributed to sea level rise." "Losses from the ice sheets of Greenland and Antarctica have very likely contributed to sea level rise over 1993 to 2003" (IPCC, 2007a).

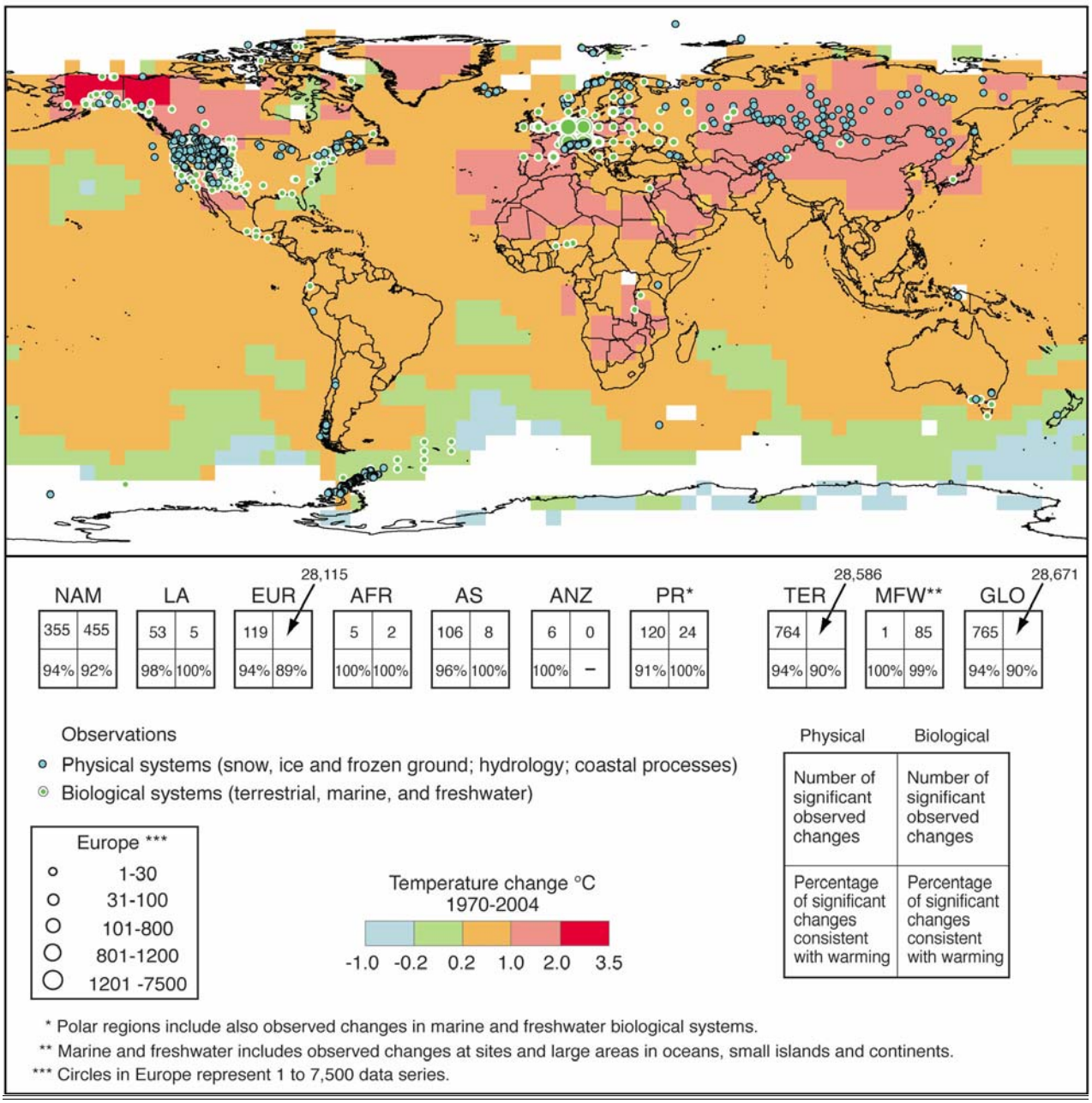


Figure 3-9. Climate Changes 1970-2004

Source: IPCC, 2007a

Increases in Greenhouse Gases: "Global atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years [Figure 3-10]. The global increases in carbon dioxide concentrations are due primarily to fossil fuel use and land use change, while those of methane and nitrous oxide are primarily due to agriculture" (IPCC, 2007a). Between 1970 and 2004 global greenhouse gas emissions increased by 70 percent (IPCC, 2007c).

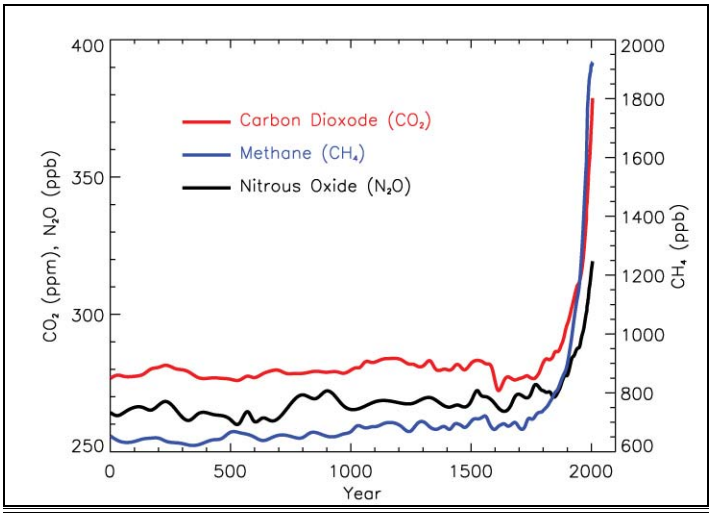


Figure 3-10. Concentrations of Greenhouse Gases from 0 to 2005

Source: IPCC, 2007a

Human Contribution to Global Warming. "The understanding of anthropogenic warming and cooling influences on climate change has improved since the TAR [IPCC Third Assessment Report, IPCC, 2001], leading to very high confidence [at least a 9 out of 10 chance of being correct] that the global average net effect of human activities since 1750 has been one of warming..." and the rate of increase in warming "is very likely [> 90 percent] to have been unprecedented in more than 10,000 years". "The carbon dioxide radiative forcing increased by 20 percent from 1995 to 2005, the largest change for any decade in at least the last 200 years." "Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations" (IPCC, 2007a).

Associated Phenomenon. An increased frequency of hot days and hot nights over most land areas is a virtual certainty. Increased heat waves and greater proportion of rainfall from heavy rains is very likely. Greater temperature extremes are likely. An increase in areas affected by drought is likely. Increased intensity of tropical cyclone activity is likely, as is an increased incidence of extreme high sea levels including tsunamis. Many plant and animal species are likely to be at increased risk of extinction. Regions relying on water supply from mountain snow melt (more than one-sixth of the world population) are projected to have reduced water availability. Increases in floods and droughts are expected. For millions of people, various adverse health effects (including death) from droughts, floods, heat, increased ozone, and changes in spatial distribution of disease vectors are likely (IPCC, 2007a).

Mitigation Potential. "Mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilized levels of greenhouse gases." "…studies indicate that there is substantial economical potential for the mitigation of global GHG emissions over the coming decades that could offset the projected growth of global emissions or reduce emissions below current levels" (IPCC, 2007c).

IPCC (2007c) identifies key mitigation technologies for the following sectors: energy supply, transport, buildings, industry, agriculture, forestry/forests, and waste. The summary of key mitigation technologies identified for the energy supply sector is as follows:

- *Key mitigation technologies and practices currently commercially available:* Improved supply and distribution efficiency; fuel switching from coal to gas; nuclear power; renewable heat and power (hydropower, solar, wind, geothermal, and bioenergy); combined heat and power; early applications of carbon capture and storage (e.g., storage of removed CO_2 from natural gas) (IPCC, 2007c).

- *Key mitigation technologies and practices projected to be commercialized before 2030:* carbon capture and storage for gas, biomass and coal-fired electricity generating facilities; advanced nuclear power; advanced renewable energy, including tidal and waves energy, concentrating solar and solar photovoltaic (IPCC, 2007c).

3.1.1.3 Existing Conditions – Meteorological Conditions

The following paragraphs present information on the meteorological conditions in the area where the new unit is proposed to be built. Information is also presented on existing ambient air quality.

Meteorological Conditions

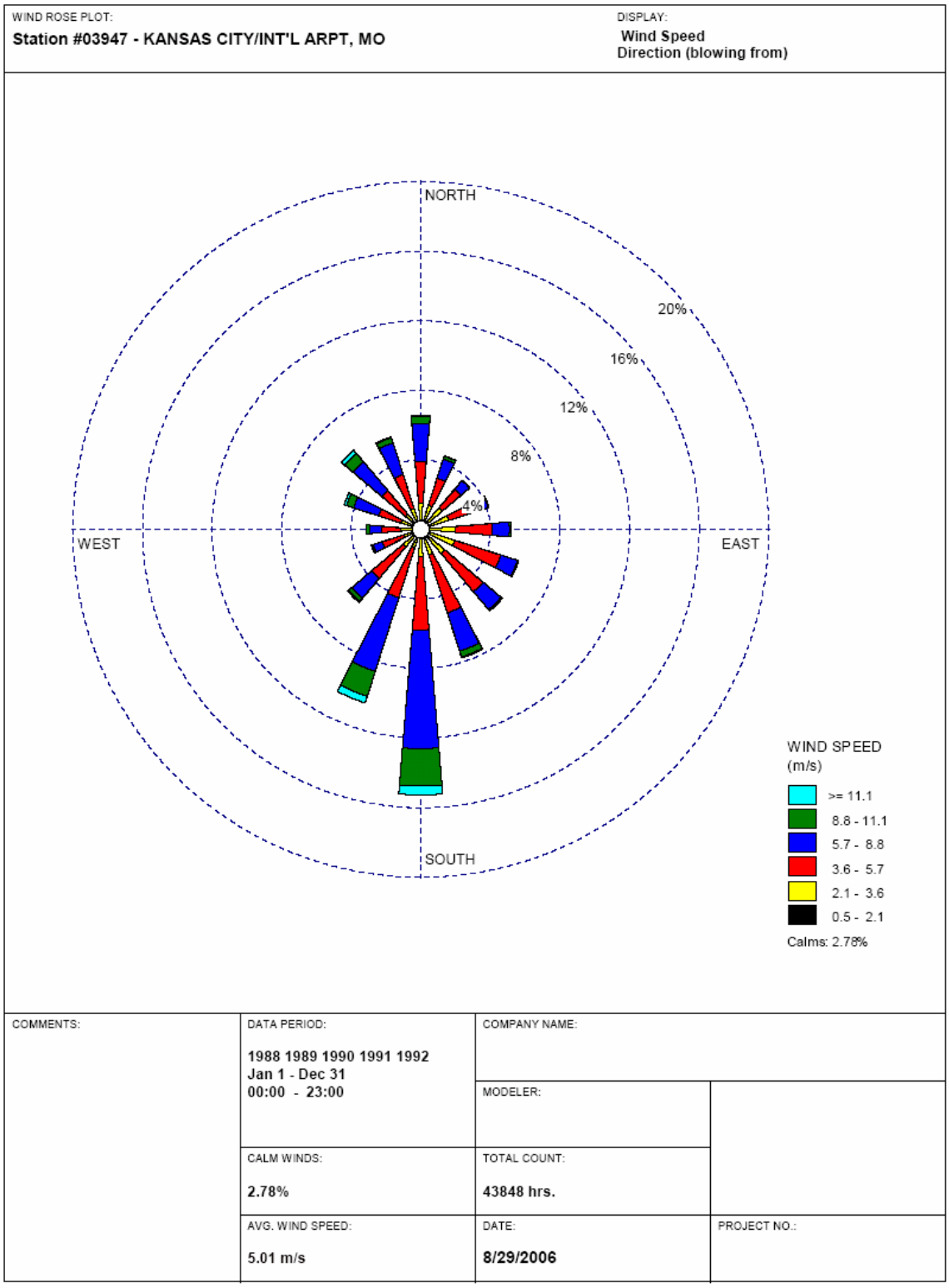
The nearest National Weather Service long term weather observation data are from the Kansas City International Airport. Table 3-4 shows a summary of temperature and precipitation data for the period 1971 through 2000 (EPA, 2006k). The annual mean temperature is 54.2°F with a monthly mean maximum temperature of 88.8°F in July and a monthly mean minimum temperature of 26.9°F in January. The annual precipitation is 37.98 inches with May being the month with the highest mean precipitation, 5.39 inches.

Figure 3-11 shows an annual windrose (five years of data) for Kansas City International Airport (EPA, 2006l). The average wind speed is 11.2 miles per hour and the predominant wind directions are from the south and the south-southwest.

Table 3-4. Average Temperature and Precipitation Data – 1971 to 2000, Kansas City Airport

	Parameter			
	Max °F	**Min °F**	**Mean °F**	**Precipitation (in)**
Jan	36	17.8	26.9	1.15
Feb	42.6	23.3	33	1.31
Mar	54.4	33.2	43.8	2.44
Apr	65.2	43.5	54.4	3.38
May	74.6	53.9	64.3	5.39
Jun	83.9	63.2	73.6	4.44
Jul	88.8	68.2	78.5	4.42
Aug	87.1	66.1	76.6	3.54
Sep	79	57.2	68.1	4.64
Oct	67.6	45.9	56.8	3.33
Nov	52	33.4	42.7	2.30
Dec	40	22.5	31.3	1.64
Ann	64.3	44	54.2	37.98

Source: Midwest Regional Climate Center
(http://mcc.sws.uiuc.edu/climate_midwest/historical/precip/mo/234358_psum.html)



Source: Data obtained from USEPA Web Site (http://www.epa.gov/scram001/surfacemetdata.htm#mo)

Figure 3-11. Annual Wind Rose – Kansas City International Airport

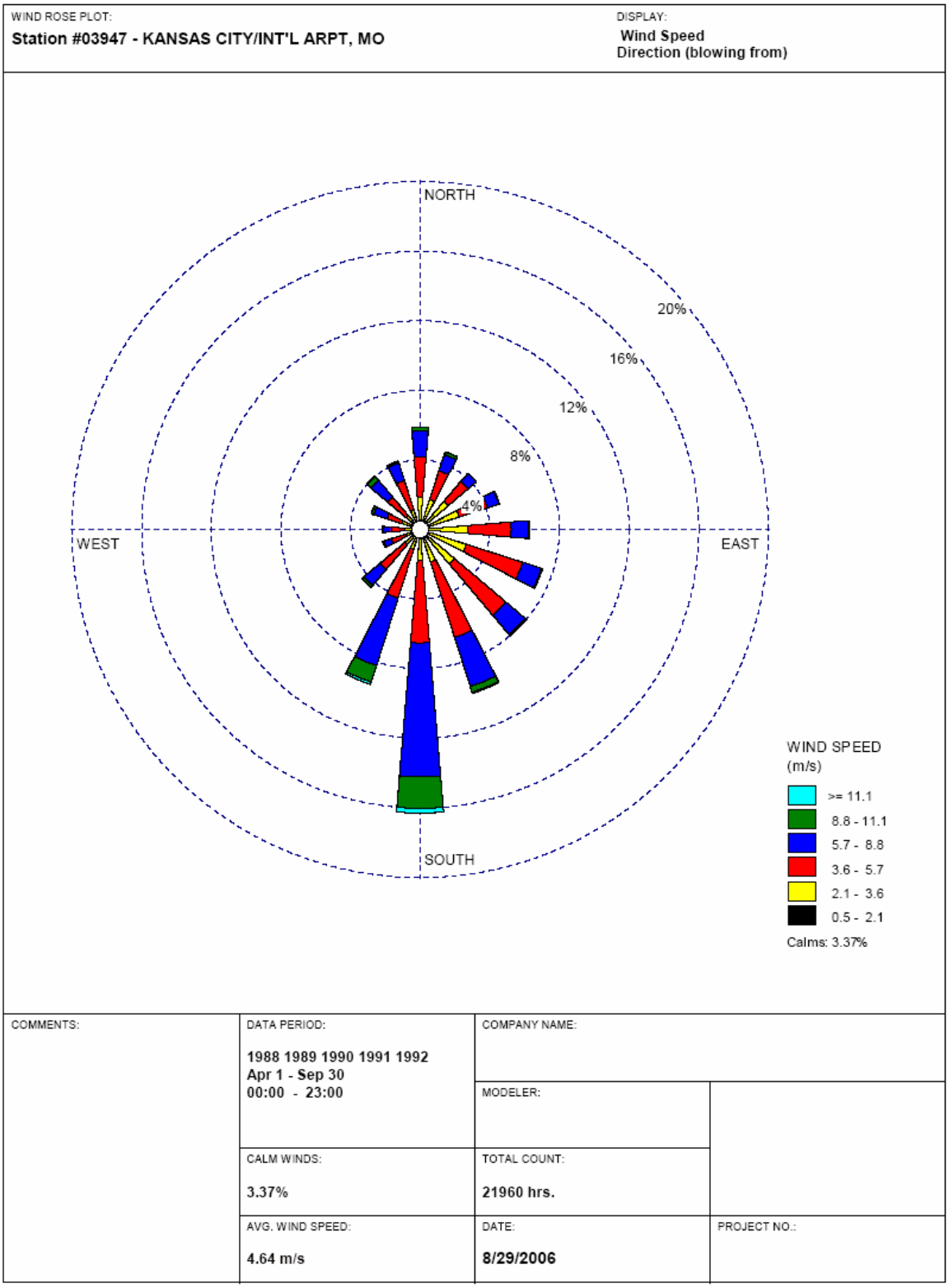
A windrose that generally corresponds to the "ozone season" is shown in Figure 3-12. The ozone season starts on April 1 and runs through October 31. In western Missouri, it is very unlikely that elevated O_3 levels would be measured outside of the ozone season and therefore, the state monitoring system measures O_3 levels in the ozone season only. Since the ozone season is the portion of the year that is most likely to have elevated O_3 levels, and since O_3 is formed in the atmosphere over a period of hours, it is important to know predominant wind directions during the ozone season to determine potential contributors to elevated O_3 levels.

The windrose shown in Figure 3-12 shows that the predominant wind directions during the ozone season are from the south, the south-southeast, and the south-southwest. This demonstrates that the proposed project, located to the northeast of Kansas City would not be expected to be a contributor to elevated O_3 levels in Kansas City.

Existing Ambient Air Quality

The existing air quality in the area around the proposed site location shows that NAAQS are being met consistently in the area. This is based on review of monitoring data collected by the MDNR (mostly in the Kansas City area) and also data that have been collected by AECI in the area near the proposed site location. MDNR monitoring site locations are shown in Figure 3-13 and AECI monitoring site locations are shown in Figures 3-14 and 3-15. Appendix C contains summary tables showing ambient air quality measured pollutant levels.

Table 3-5 summarizes the ambient air quality data collected by AECI in the vicinity of the proposed project and Table 3-6 summarizes data collected by the MDNR for the years 2002 through 2005 (EPA,2006m).



Source: Data obtained from USEPA Web Site (http://www.epa.gov/scram001/surfacemetdata.htm#mo)

Figure 3-12. Ozone Season Wind Rose – Kansas City International Airport

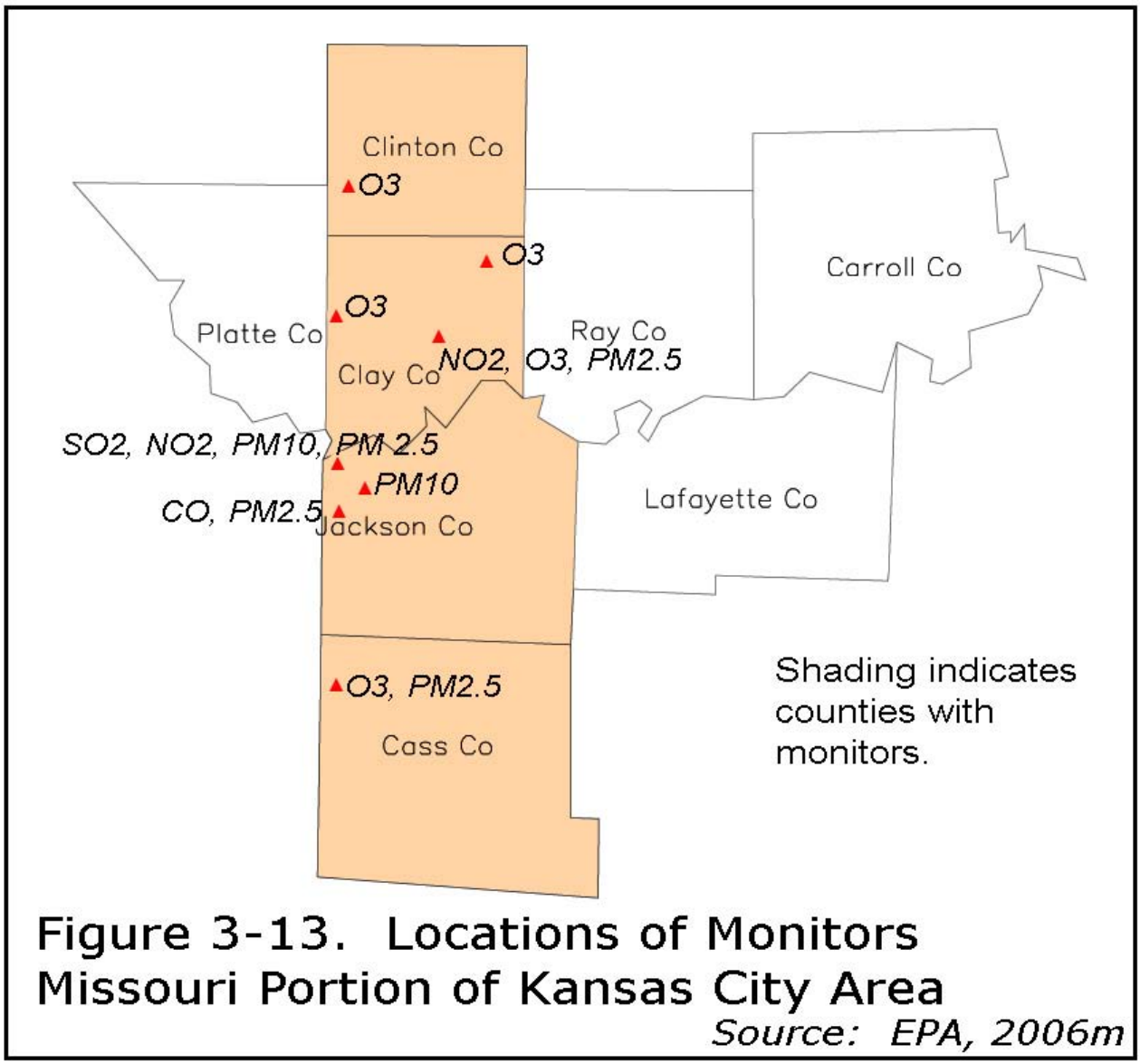
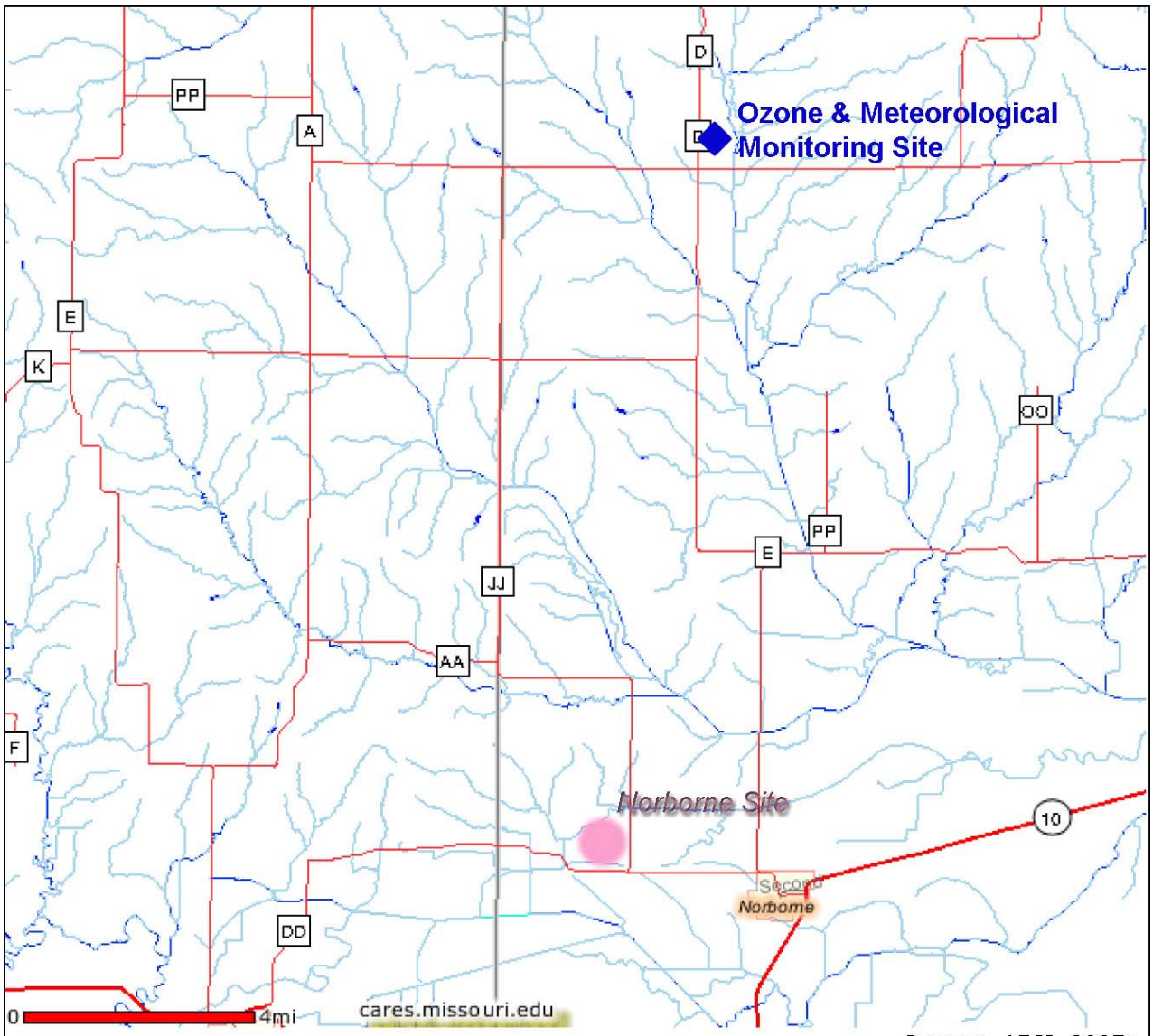


Figure 3-13. Locations of Monitors
Missouri Portion of Kansas City Area
Source: EPA, 2006m



Source: AECI, 2005g

Figure 3-14. Ozone and Meteorlogical Monitor Location

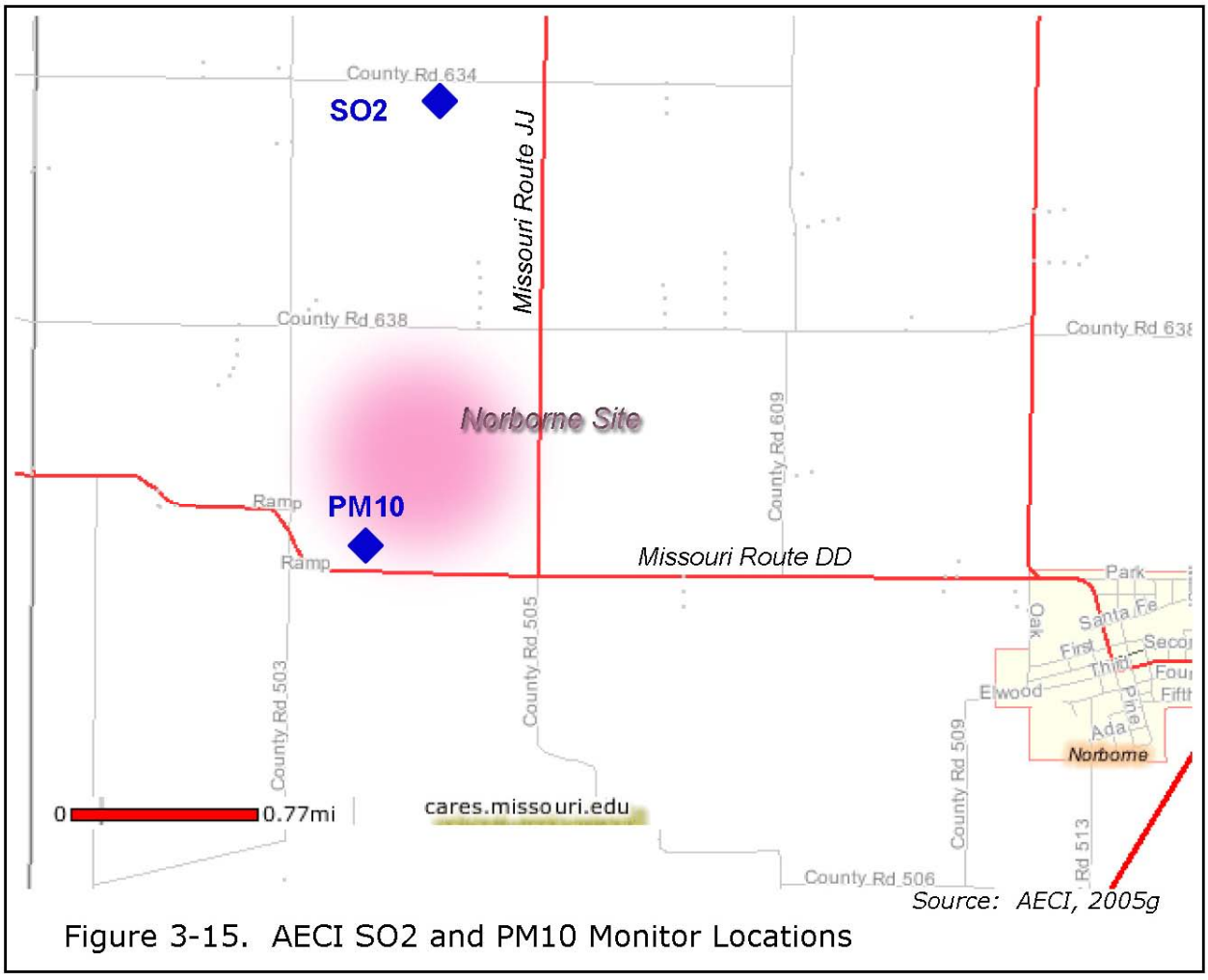


Figure 3-15. AECI SO2 and PM10 Monitor Locations

Table 3-5. Monitoring Data – Vicinity of Proposed Project

	O_3				SO_2			PM_{10}	
	8-Hour Max (ppm)	**8-Hour 2nd High (ppm)**	**8-Hour 2nd High (ppm)**	**8-Hour 2nd High (ppm)**	**3-Hour (ppm)**	**24-Hour (ppm)**	**Mean (ppm)**	**24-Hour (µgm/m³)**	**Mean (µgm/m³)**
Period / NAAQS	0.08 ppm[1]				0.5 ppm[2]	0.14 ppm[2]	0.03 ppm[3]	150 µgm/m³[2]	50 µgm/m³[4]
Aug 05	0.084	0.080	0.076	0.070	0.005	0.002	0.001	58.7	28.7
Sept 05	0.070	0.067	0.065	0.065	0.004	0.002	0.001	75.2	30.8
Oct 05	0.058	0.057	0.055	0.053	0.005	0.003	0.001	65.1	29.4
Nov 05	0.052	0.046	0.046	0.042	0.005	0.003	0.002	38.7	27.1
Dec 05	0.035	0.035	0.033	0.031	0.011	0.0052	0.002	20.2	23.6
Jan 06	0.040	0.038	0.037	0.037	0.006	0.003	0.002	30.2	12.9
Feb 06	0.055	0.050	0.050	0.046	0.008	0.004	0.003	46.9	15.5
Mar 06	0.056	0.055	0.054	0.052	0.007	0.005	0.003	55.6	15.6
Apr 06	0.063	0.063	0.061	0.060	0.006	0.004	0.003	62.0	18.3
May 06	0.069	0.064	0.064	0.062	0.007	0.005	0.003	48.4	18.9
Jun 06	0.081	0.080	0.080	0.080	0.007	0.005	0.003	42.5	19.5
Jul 06	0.087	0.072	0.072	0.068	0.006	0.005	0.004	46.7	20.2
Aug 06	0.086	0.085	0.083	0.083	(5)	(5)	(5)	(5)	(5)
Sept 06	0.062	0.062	0.059	0.056	(5)	(5)	(5)	(5)	(5)

Source: AECI Monitoring Data Summaries

Notes:

1. 3-year average of the 4th highest daily maximum 8-hour average ozone concentration
2. Not to be exceeded more than once per year.
3. Annual arithmetic mean.
4. 3-year average of the weighted annual mean concentration.
5. Monitoring ended.

Table 3-6. Maximum 2002 – 2005 Recorded Pollutant Levels Compared to NAAQS

Pollutant	Recorded Level	NAAQS	Averaging Time	Location	Year
CO	10.2 ppm	35 ppm	2nd High 1-hour	4928 Main Street Kansas City	2002
CO	3.3 ppm	9 ppm	2nd High 8-hour	4928 Main Street Kansas City	2002
O_3	0.083 ppm	0.084 ppm	Average 4th High 8-hour	13131 Highway 169 NE Kansas City	2004
NO_2	0.022 ppm	0.053 ppm	Annual Average	Kansas City	2003
SO_2	0.155 ppm	0.5 ppm	2nd High 3-hour	724 Troost, Kansas City	2003
SO_2	0.073 ppm	0.14 ppm	2nd High 24-hour	724 Troost, Kansas City	2003
SO_2	0.008 ppm	0.03	Annual Average	724 Troost, Kansas City	2003
PM_{10}	66 µgm/m^3	150 µgm/m^3	2nd High 24-hour	1517 Locust St. Kansas City	2002
PM_{10}	36 µgm/m^3	50 µgm/m^3	Annual Average	1517 Locust St. Kansas City	2002
$PM_{2.5}$	35 µgm/m^3	65 µgm/m^3	3-year Average 98%tile	Highway 33 & County Home Rd. Clay County	2004
$PM_{2.5}$	13.6 µgm/m^3	15 µgm/m^3	3-year Average Annual Mean	Highway 33 & County Home Rd. Clay County	2004

Existing Major Air Emission Sources

Major sources of an air pollutant are often defined as sources that emit more than 100 tons per year of a pollutant. Table 3-7 shows major sources of CO, VOC, NO_X, SO_2, PM_{10}, and $PM_{2.5}$ located in the Missouri portion of the Kansas City metropolitan area (EPA, 2006n). Figure 3-16 depicts the location of major air emission sources in the Missouri portion of the Kansas City area.

This information is taken from a database maintained by the EPA and is for the calendar year 2002. These are the most recent data available from the EPA database. MDNR maintains a database with more recent information. That information is forwarded to the EPA annually; however, that information is not available on EPA's emission inventory website and it is not readily accessible from the MDNR.

Table 3-7. Major Sources

Facility	Address	County	SIC	Emissions in Tons per Year						Location Number from Figure 3-16
				CO	NO_X	VOC	SO_2	$PM_{2.5}$	PM_{10}	
Aquila Inc.	1433 Lower Lake Road, St. Joseph, MO 64502	Buchanan	4911	160.9	4198.7	26.0	3563.0	56.6	70.0	1
Ag Processing Inc	900 Lower Lake Road, St. Joseph, MO 64504	Buchanan	2075	3.4	4.0	412.7	0.02	17.5	60.1	2
Silgan Containers Corp	2115 Lower Lake Road, St. Joseph, MO 64504	Buchanan	3411	9.9	11.8	231.3	0.07	0.8	0.9	3
Varco-Pruden Buildings	2250 Lower Lake Road, St. Joseph, MO 64504	Buchanan	3448	0	0	112.4	0	0	0	4
Ford Motor Co	8121 E US Highway 69, Kansas City, MO 64119	Clay	3711	80.2	96.2	2321.7	5.7	68.4	82.5	5
ADM Processing	200 West 19th Ave, North Kansas City, MO 64116	Clay	2075	30.4	36.2	288.0	0.2	6.3	18.0	6
Independence Power & Light	22225 210 Hwy, Missouri City, MO 64072	Clay	4911	4.0	259.3	0.3	1233.8	3.1	11.3	7
National Starch & Chemical Company	1001 Bedford Avenue North Kansas City, MO 64116	Clay	2046	36.1	43.0	100.6	105.0	65.2	141.1	8
Exide Technologies	111 Canon Hollow Road, Forest City, MO 64451	Holt	3341	2.9	6.3	84.5	323.5	12.3	16.0	9
Trigen Energy Corporation	115 Grand Ave, Kansas City, MO 64106	Jackson	4911	20.0	498.8	2.0	3788.2	13.6	24.6	10
Kansas City Power & Light Co	8700 Hawthorn Road, Kansas City, MO 64120	Jackson	4911	469.6	2400.2	14.4	3752.3	474.0	819.5	11
Lafarge North America Inc.	2200 North Courtney Road, Sugar Creek, MO 64050	Jackson	3241	447.0	1050.0	58.2	677.8	7.5	20.4	12
Aquila Inc.	33200 East Johnson Rd, Sibley, MO 64088	Jackson	4911	405.6	11491.4	89.2	11804.2	198.9	213.5	13
Independence Power And Light	21500 East Truman, Independence, MO 64056	Jackson	4911	29.7	547.8	3.7	4576.0	102.4	131.0	14
Cargill Inc	2306 Rochester, Kansas City, MO 64120	Jackson	2075	28.5	33.9	366.5	0.2	11.4	38.7	15
Aquila Inc.	14015 Smart Road Greenwood, MO 64034	Jackson	4911	60.3	236.4	1.8	0.5	0.0001	0.7	16

Table 3-7. Major Sources

Facility	Address	County	SIC	Emissions in Tons per Year						Location Number from Figure 3-16
				CO	NO_X	VOC	SO_2	$PM_{2.5}$	PM_{10}	
ANR Pipeline Company	33854 County Road TT, Graham, MO 64455	Nodaway	4922	243.2	981.5	82.4	0.3	2.6	10.1	17
Pittsburgh-Corning Corp	2700 West 16th Street, Sedalia, MO 65301	Pettis	3296	19.6	204.3	4.8	80.7	19.4	42.0	18
Waterloo Industries Inc	1500 Waterloo Drive, Sedalia, MO 65301	Pettis	3499	5.1	6.1	146.6	0.01	9.1	10.0	19
Panhandle Eastern Pipe Line Co	16076 Highway T, Lamonte, MO 65337	Pettis	4922	318.1	1477.5	80.4	0.35	0.04	23.6	20
Kansas City Power & Light Co	20250 Highway 45 North Weston, MO 64098	Platte	4911	575.0	7596.4	69.1	14856.3	328.5	553.0	21
Marshall Municipal Utilities	765 W North Street, Marshall, MO 65340	Saline	4911	25.6	295.7	1.6	1450.0	3.2	6.5	22

Source: USEPA Air Data (http://www.epa.gov/air/data) Data are from a 2002 EPA database.

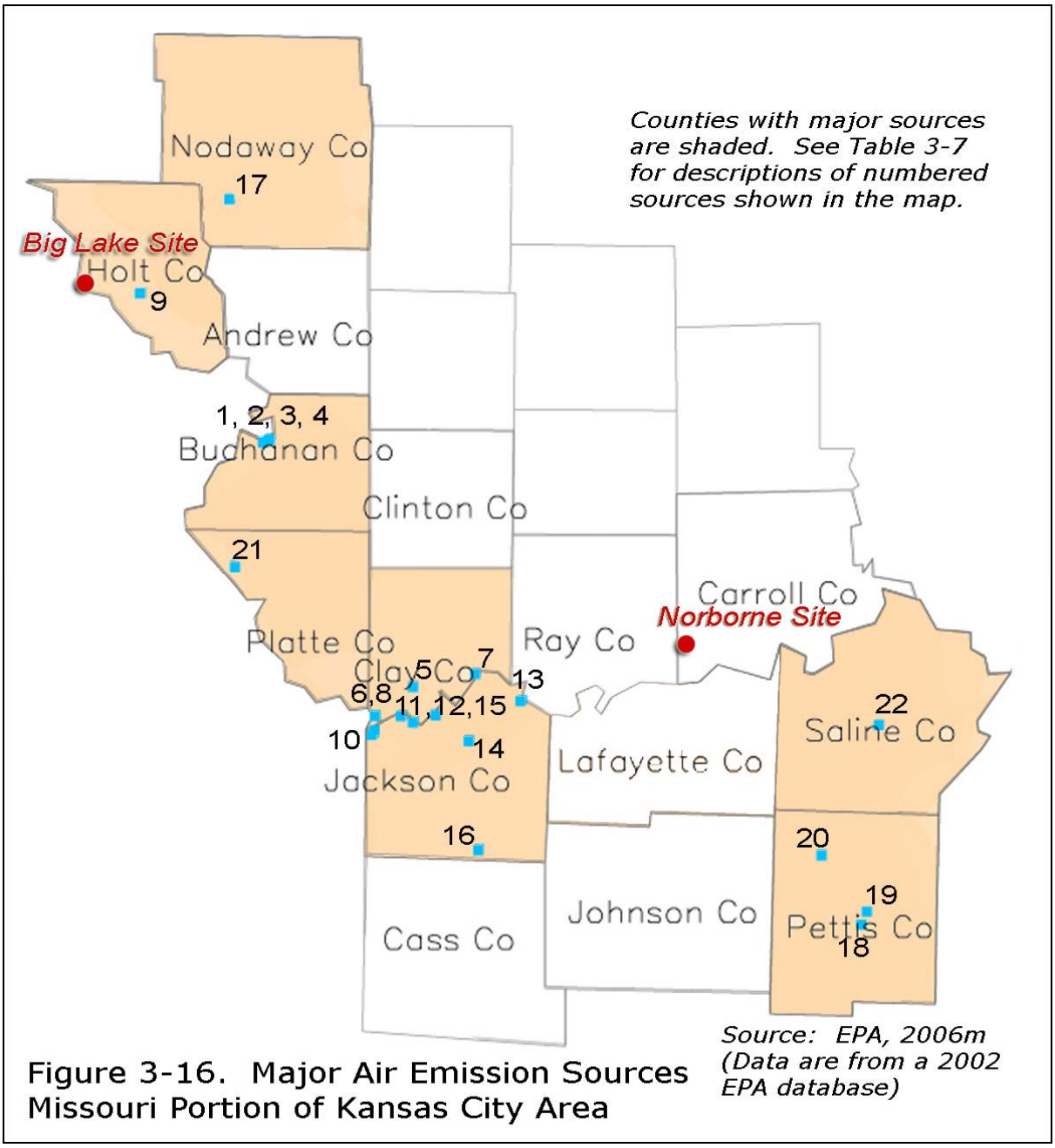


Figure 3-16. Major Air Emission Sources Missouri Portion of Kansas City Area

3.1.2 Environmental Consequences

3.1.2.1 Identification of Issues

The EIS scoping process resulted in the identification of several air quality related issues. They include:

- the addition of new emissions into the air in an area that currently does not have air quality problems
- storage of ammonia and chlorine
- acid rain
- global climate change
- mercury emissions
- impact on agricultural products grown in the area
- potential health effects
- effect of incremental emissions over those already there
- transport of emissions to the Kansas City area
- impact of emissions trading
- control of fugitive dust from plant operations

3.1.2.2 Significance Criteria

If any of the following conditions are met, the project is considered to have a significant impact on air quality:

- the ambient air quality impact of the Proposed Action on areas currently meeting NAAQS is greater than EPA allowed PSD increments
- the Proposed Action causes or significantly contributes to a violation of a health or welfare related NAAQS
- the Proposed Action significantly contributes to the health risk caused by eating mercury contaminated fish
- the Proposed Action causes deterioration in visibility in excess of EPA allowed impacts
- not incorporating appropriate controls to meet regulatory requirements related to operations, such as equipment and techniques used to store and use ammonia and chlorine
- significant increase in CO_2 emissions relative to existing emissions that may contribute to climate change

There are a number of regulatory requirements that must be met in order for the Proposed Action to receive an air quality permit. These requirements are intended to ensure that any proposed major new air pollution source does not have a significant impact on air quality. The proponent of the Proposed Action must apply for and receive such a permit prior to beginning construction. AECI has applied to the DNR for an air quality permit and the DNR is presently reviewing that application. A permit can be issued only if the DNR (and the EPA) find that on the basis of the information in the application, the project would meet all regulatory requirements designed to ensure that the project does not have a significant impact on air quality.

3.1.2.3 Impact Assessment Methods

The Proposed Action would have emission impacts that cannot be directly measured because direct measurements cannot occur until after the facility is built. However, impacts need to be assessed, and estimation methods described below were used. These methods use assumptions that are intended to overestimate impacts. This approach is consistent with historic air quality and risk assessments. The assessment methodologies require the use of either generic assumptions or site specific data to evaluate risk or impact to air quality. The generic assumptions are considered by state and federal agencies to be protective of human health and the environment under almost any circumstance. Site specific data provide more accurate assessments of an individual facility, but they are often costly and time consuming to obtain or develop. For example, in assessments to determine impact of air emissions over a year's period of time, the proposed plant is assumed to be in operation continuously for the entire year even though there would be periods of time when the plant would not be in operation in order to carry out needed maintenance activities.

Air quality and risk assessments can go through several iterations of assumptions. The first assessment combines many generic assumptions with some site specific data which result in impacts that are almost certain to be greater than those that would actually occur. If the impacts using these initial assumptions are not acceptable, then more site specific data are developed and used instead of assumptions that over-estimate impacts. The results of the assessment methods described below incorporate initial generic assumptions without any reassessment of those assumptions in order to reflect additional site specific details.

Ambient Air Quality Standards

Air quality impacts are assessed through the use of air quality dispersion models. These models use as input data the Proposed Action's emissions and the meteorological conditions that cause the emissions to disperse after they leave the plant site. The EPA has detailed requirements for the modeling that must be done in order for a new emission source to receive an air quality construction permit. The air quality permit application prepared by the project proponent must contain the results of the required modeling and a demonstration, based on those results, that the proposed source would not cause or significantly contribute to a violation of an ambient air quality standard.

Visibility, Soils, and Vegetation

The impact of the Proposed Action on visibility is assessed using EPA screening models that have been developed to estimate worst case impacts of air pollutant emitting sources. Visibility impacts were assessed for the Hercules Glades Wilderness Area (a Class I area), which is about 295 km from the proposed plant site. Typically, Class I areas that are this far distant from the Proposed Action are not evaluated using modeling techniques since available techniques tend to over estimate impacts at such long distances.

Impacts to soils and vegetation were evaluated using an EPA developed air quality model that estimates the magnitude of pollutant deposition. This model also estimates ambient air concentrations of pollutants for comparison with EPA standards set for the protection of soils and vegetation.

Mercury Emissions

The EPA has established a regulatory system to control mercury emissions from power plants that does not rely on air quality modeling. Rather, the system is based on each existing and new coal fired power plant keeping mercury emission levels below a limit that is set by state air quality regulators, working with the EPA. This system of controlling mercury emissions would result in a significant reduction in current levels of nationwide emissions from coal fired power plants.

Some people, however, have a concern that while mercury may be properly controlled on a national scale, there might be local "hotspots" where mercury levels could create a potential localized health threat.

The proponents of the Proposed Action must demonstrate, as part of their air quality permit application, that the proposed plant would meet EPA limits on mercury emissions. However, there is no requirement that the permit application demonstrate that there would be no localized "hotspots" created. For this reason, the impact of maximum allowable mercury emissions from the proposed plant was modeled to determine the maximum amount of mercury deposition that could be created by emissions from the plant.

The results of this modeling effort were then evaluated using a health risk assessment to determine the incremental health risk that would be posed by mercury deposition from the proposed plant.

Global Climate Change (Greenhouse Gas Emissions)

There are no established standards for significance for greenhouse gas emissions. The sources that contribute to global climate change are national and international in scope. For the purposes of this EIS, the impact would be considered significant if it the difference in constructing or not constructing the project would make a discernable difference in global climate change.

3.1.2.4 Actions Incorporated into the Proposed Action to Reduce or Prevent Impacts

There are a number of elements incorporated into the Proposed Action that would reduce or prevent air quality impacts. These include:

- use of operating techniques that reduce emissions
  - low sulfur coal
  - combustion techniques that reduce emissions
- air pollution emissions control equipment
  - selective catalytic reduction (SCR) to control NO_X emissions
  - scrubber to control SO_2 emissions
  - a particulate control device (baghouse) to control particulate matter emissions
- use of BACT to control potential fugitive emissions from materials handling operations

3.1.2.4.1 Impact Assessment

Ambient Air Quality Standards

The impact of the Proposed Action is described in "Prevention of Significant Deterioration Construction Permit Application, 660-MW Pulverized Coal Fired Generating Facility, Carroll County, Missouri", dated January 2006. (The initial application has been updated periodically to incorporate additional material.)

The impact of the proposed action, as described in this application, is based on estimates of potential emissions from the plant, information concerning the physical characteristics of the plant such as the height and exit diameter of the stack, and information about the meteorology in the area around the proposed plant. The projected potential emissions associated with the plant (including cooling tower emissions) are shown in Table 3-8 (AECI, 2007d).

Table 3-8. Projected Emissions, Tons per Year

Pollutant	Main Boiler	Aux. Boiler[A]	Cooling Tower	Materials Handling (Fugitive)	Haul Roads (Fugitive)	Emerg. Diesel Generator[B]	Diesel Fire Water Pump[B]	Diesel Fire Water Pump Booster[B]	Total
SO_2	2,408	21.4	--	--	--	0.24	0.04	0.015	2,430
CO	4,515	33.0	--	--	--	3.4	0.62	0.29	4,552
NO_X	1,505	41.1	--	--	--	5.9	0.66	0.75	1,553
PM_{10}	752	6.7	20.6	13.63	7.82	0.16	0.04	0.05	801
VOC	108	2.2	--	--	--	0.37	0.27	0.09	111
Lead	114	1.6	--	--	--	0.018	0.003	0.001	116
Mercury	0.226	--	--	--	--	--	--	--	0.226[49]

[A]Hours of operation limited to 2,190 per year
[B]Hours of operation limited to 500 per year
Source: AECI, 2007d

[49] EPA's New Source Performance Standard (NSPS) codified at 40 CFR 60.45Da(a)(2)(i) limits mercury emissions to 0.000066 lb/MWh. The emissions reported in Table 3-8 are based on a gross power output of 782 MW. Also, the MDNR's proposed rule to implement EPA's Clean Air Mercury Rule does not allocate any mercury budget for new units. Therefore, if the proposed project is built, a mercury emission allocation will have to be either purchased from the open market, or, the proposed project's emissions will have to be accommodated within AECI's budget for it's existing units. The actual emissions cannot be higher than what would be allowed by the NSPS; therefore, the potential emissions listed in the table are higher than what would be allowed. Actual mercury emissions would be monitored using EPA certified technology.

Based on the information described above, AECI has estimated the maximum ambient air quality impacts for the proposed action. These impacts are shown in Table 3-9.

Table 3-9. Highest Model-Predicted Concentration For All Norborne Sources

Pollutant	Averaging Time	Highest Concentration ($\mu gm/m^3$)
SO_2	3-hour	24.1
	24-hour	6.3
	annual	0.67
NO_2	annual	6.49
PM_{10}	24-hour	26
	annual	4.16
CO	one-hour	292
	8-hour	73.2

The results for SO_2, NO_2, and CO show that the maximum ambient air quality impact of the Proposed Action is well below applicable standards. Therefore, the Proposed Action would not have a significant impact on air quality for those pollutants for which there are ambient air quality standards.

Visibility, Soils, and Vegetation

The impact of the Proposed Action on visibility, soils, and vegetation was analyzed for AECI as part of the process of applying for an air quality permit. The results of that analysis are summarized in "Additional Impacts Analysis for a 688 MW Electric Generating Facility, Norborne, Missouri", November 2006.

The visibility analysis was conducted using an EPA developed model called VISCREEN. The analysis was conducted for five areas that were specified by the MDNR. Those areas are:

- Norborne R8 High School,
- Stet Xv School District,

- Carroll County memorial Hospital,
- Van Meter State Park, and
- Swan Lake National Wildlife Refuge.

The results show that visibility impacts exceeded plume perceptibility thresholds for Class I areas at each of the receptor areas with the exception of Swan Lake National Wildlife Refuge. However, none of these areas are a Class I area.

The locations where visibility criteria do have meaning are Class I areas. The closest Class I area to the Proposed Action is Hercules Glades Wilderness Area (HGWA) in southwest Missouri, about 295 km from the Proposed Action location. A visibility analysis was conducted for HGWA in response to comments from the Federal Land Manager.

The analysis was conducted using several "worst case" assumptions and showed that the greatest change in light extinction was 6.8%, less than the 10 % change that is considered to be significant. (AECI, 2006). The visibility analyses show that the Proposed Action would have no significant impact on visibility.

The impact of the Proposed Action on soils and vegetation was evaluated using an air quality model that estimated pollutant concentrations and deposition of pollutants onto soils and vegetation. The modeling showed that the estimated maximum concentrations of air pollutants would be less than secondary ambient air quality standards (standards set for the protection of materials, vegetation, and other effects that are not directly health related.

The analysis showed that emissions of SO_2 and NO_X related to the Proposed Action would be highly unlikely to cause adverse effects. (AECI, 2006). Based on these findings, the Proposed Action would not have significant adverse effects on soils and vegetation.

Mercury Emissions

The mercury emissions from the Proposed Action could pose a potentially unacceptable risk to local populations by entering the human food chain. Inorganic mercury released in power plant emissions can be converted to a toxic organic form, methylmercury, once it enters water bodies via deposition and runoff. Methylmercury is highly bioaccumulative in fish, and anglers who

catch and consume fish can be at risk if too much mercury enters a watershed, therefore a health risk assessment was performed.

The health risk evaluation addresses the emissions from the Proposed Action. The health risk posed by the cumulative impact of emissions from all power plants in the Midwest and all other sources of mercury deposition were not specifically evaluated, although the evaluation did include an element to determine whether the existing fish advisory issued by the Missouri Department of Health and Senior Services (DHSS) would be made more severe in consideration of the mercury emissions from the Proposed Action.

A number of assumptions are made throughout the evaluation process to ensure that risks are more likely to be overestimated than underestimated. The evaluation is performed using the multi-step process listed below:

1. Obtain and evaluate fish advisories issued by the DHSS. Also obtain from the MDNR mercury concentrations in fish fillets and whole fish tissue from streams within a 100-mile radius.
2. Estimate maximum allowable mercury emissions from the proposed power plant based upon New Source Performance Standards (NSPS) limits.
3. Perform air modeling to predict mercury air concentrations from the proposed power plant and subsequent deposition rates to the surrounding vicinity.
4. Identify locations of fish sampling, particularly those sampling points that lay in watersheds that are primarily within the 50-km radius of the proposed plant. Separately identify watersheds with the highest potential to be impacted by mercury deposition.
5. Calculate the total deposition of mercury for the most-impacted watersheds. Based on a review of the deposition modeling results, the Wakenda and Moss Creek watersheds were identified as the most-impacted. Additionally, fish sampling occurred in the Cooley Lake and the Lamine River watershed, which includes the Davis Creek, Salt Fork, Finney Creek, Muddy Creek, Flat Creek, and Blackwater River watersheds.
6. Calculate surface water concentrations of methylmercury in the watersheds.

7. Use the bioaccumulation factor (BAF) for methylmercury to calculate mercury concentrations in fish tissue.

8. Use fish tissue concentrations to evaluate the incremental impact on fish samples obtained from MDNR in step 1.

9. Calculate hazard indices for anglers who catch and consume fish from the evaluated watersheds.

A hazard index is a number that is calculated to determine if a combination of non-carcinogenic pollutants and/or exposure pathways create a potential health risk. Each pollutant/exposure pathway is evaluated individually. The estimated exposure is then divided by a health effects threshold value for the pollutant and/or pathway to create a ratio for each condition that was evaluated. The hazard index is the sum of the ratios calculated for each pollutant and pathway. A hazard index greater than one indicates a potential health risk.

A number of assumptions were made for this analysis which are likely to overestimate the potential impacts. In particular, the following conservative assumptions were made:

- Predicted mercury deposition rates were calculated based on worst-case historical meteorological data for the years 2001-2005 (i.e., 2005 data, which produced the highest predicted mercury deposition rates).

- All mercury deposited in a watershed ends up in surface water. In reality, much of the mercury would be either lost from the watershed from subsequent volatilization, leach to the subsurface, or be sequestered in soils and sediments, where it would not be available for bio-uptake into fish.

- The ingestion rates used in the risk calculations are based on the assumption that an adult eats an average of 5.4 fish portions (4 ounces each) per week, and that all of that fish originates from the impacted watershed (i.e., that individuals do not eat fish from any other source). Likewise, the assumption is made that a very young child, aged 0-6, eats an average of 0.8 fish portions (4 ounces each) per week from the impacted watershed. In reality, most anglers consume fish that originate from a variety of sources.

- The bioaccumulation factor used to estimate representative methylmercury concentrations in fish was based on species with the highest bioaccumulation potential, Trophic Level 4 fish (i.e., it was assumed that only large individuals of top predator species such as large mouth bass were consumed). This is a worst-case scenario, as most anglers could be expected to eat a variety of fish from different trophic levels, with a lower overall methylmercury concentration.

- The reference dose used in the risk calculations includes a 10X uncertainty factor (similar in concept to a safety factor) to ensure that the hazard index is not underestimated.

In combination, these assumptions likely resulted in a substantial overestimation of the potential health impacts from mercury emissions. Even with the use of these conservative assumptions, the predicted hazard indices were well below the threshold value of 1.0, indicating that mercury emissions from the proposed power plant should not pose any health threat to the surrounding community due to the proposed power plant alone. However, due to mercury levels in fish from other sources, the MHSS Fish Advisory is applicable.

This evaluation considered the current mercury levels in fish samples taken by the MDNR, Missouri Department of Conservation (MDC), and EPA within 50 km of the proposed plant and the incremental effect the mercury released by the proposed plant would have on mercury levels in those fish. Based on this evaluation, the Proposed Action would result in no change in the current MHSS Fish Advisory due to the incremental increase in mercury in the fish.

The mercury health risk analysis is described in more detail in *Appendix D, Mercury Risk Evaluation*.

GHG Emissions

The primary GHG related emission from the Proposed Action is carbon dioxide Carbon dioxide emissions can be estimated using the type and amount of coal being fired and an emission factor. Emissions (in tons) of CO_2 are estimated by the formula:

% carbon in the coal[50] X 72.6 X amount of coal used in tons / 2000 (EPA, 2006q)

(49.72) X (72.6) X 3,762,420 tons coal per year / 2000 = 6.8 million tons

This compares to total US power plant emissions of CO_2 in 2005 of 2,474 millions tons and total US emissions of 5,912 million tons in 2004 (EIA, 2006m).

Total worldwide emissions in 2004 were 24,528 million tons. The proposed project's CO_2 emissions would be 0.1% of total US emissions and 0.03% of worldwide CO_2 emissions. Constructing or not constructing the proposed project would not make a discernable difference in global climate change, and thus the impacts are not considered significant.

Acid Rain Related Emissions

The federal CAA requires control of power plant emissions of SO_2 and NO_X in order to address potential acid rain impacts. The EPA recently issued final rules (the Clean Air Interstate Rule) that list limits for total SO_2 and NO_X emissions for each state. The limits for total power plant emissions in Missouri in 2015 are shown in Table 3-10 below together with the estimates of emissions from the Proposed Action.

Table 3-10. Acid Rain Related Emissions

	SO_2 Emissions	**NO_X Emissions**
Missouri Total	245,000	58,000
Proposed Action[51]	3,100	2,500

Potential Ammonia and Chlorine Releases

Both ammonia and chlorine would be stored and used in accordance with DNR and EPA requirements that are intended to prevent the accidental escape of these gases.

[50] This analysis used the design coal for the plant.
[51] From AECI Air Quality Permit Application, 2006. Basis of the estimate is maximum allowable emissions.

No Action Alternative

If the Proposed Action were not constructed, there still may be similar air quality impacts since the Proposed Action is intended to meet electricity demand that will exist whether or not the Proposed Action is built. The air quality impacts of the No Action Alternative would vary depending on the alterative source of the electricity. *Section 2, Alternatives Including the Proposed Action*, outlines alternative sources of electricity. Except for nuclear power, those alternatives that would have little or no air quality impact (e.g., hydro, solar, wind), are generally not suitable to provide for the base load needs that the Proposed Action is intended to meet. A coal-fired plant with carbon capture and sequestration would prevent most carbon dioxide emissions, but that technology will not be available in time to meet the needs the Proposed Action is intended to address. Energy conservation and efficiency measures would not offset the need for a new plant (see discussion in Section 2.2.13 *Energy Conservation and Efficiency*).

Big Lake Alternate Site

The air quality impacts and their significance at the Big Lake Alternate Site would be similar to those at the proposed Norborne site. If the project were developed at the Big Lake Site, it would be subject to all of the same regulatory requirements as at the Norborne site.

Integrated Gasification Combined Cycle (IGCC) Alternative

The IGCC alternative has the potential of having somewhat different impacts than the Proposed Action.

- Emissions of pollutants for which there are NAAQS would be similar to those from the Proposed Action, though SO_2 emissions could be somewhat lower. The range of SO_2 emission rates is from about 1/3 of that of the Proposed Action to a rate equal to that of the Proposed Action (EPA, 2005d).

- As with the Proposed Action, ambient air quality impacts would not cause or significantly contribute to a violation of the NAAQS.

- Emissions of CO_2 could be ten to twenty percent lower than from the Proposed Action, based on EPA estimation methodologies (EPA, 2005d).

However, because SCPC is more efficient, based on unit of CO_2 emissions per unit of net energy generated, CO_2 emissions are expected to be essentially the same for IGCC and SCPC (MIT, 2007).

- Emissions of mercury and mercury deposition would be similar to that related to the Proposed Action.

3.1.2.4.2 Mitigation and Residual Impacts

The Proposed Action incorporates Best Management Practices (BMPs) such as use of dust control measures during construction. While achievement of mercury emissions limits is a requirement and is therefore part of the Proposed Action, the specific means of achievement have not been identified. AECI would install a system for injection of activated carbon to control mercury emissions, but may not use it if standards can be met without it.

3.2 GEOLOGY AND SOILS

This section describes the affected environment and environmental consequences as they apply to geological and soil resources.

3.2.1 Affected Environment

The following sections describe the current geological and soil environment. The description of current conditions represents the baseline for the assessment of impacts and environmental consequences.

3.2.1.1 Region of Influence

The region of influence for assessing impacts on geological and soil resources includes the proposed power plant site and alternate, proposed well field and water line site, railroad corridors, rights-of-way where ground-disturbing activities could occur, proposed transmission lines, and the adjacent parcels of land. For the transmission lines, soil disturbance would occur only at locations of line support structures and substation structures.

3.2.1.2 Existing Conditions

3.2.1.2.1 Regional Setting

Missouri Natural Sections

All parts of the project and alternate site are located within the Glaciated Plains Natural Section, except for part of the Norborne to Sedalia/Mt. Hulda transmission line, which is located partly in the Osage Plains and partly along the edge of the Ozarks (Figure 3-17).

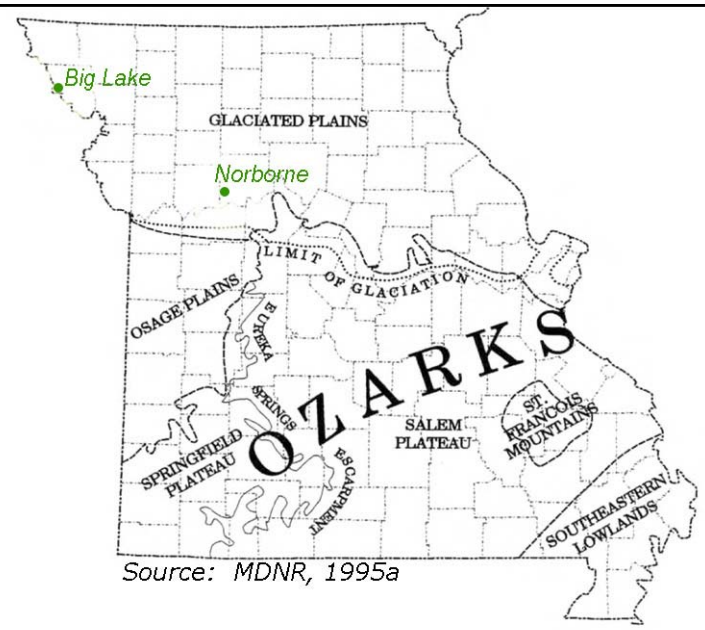


Figure 3-17. Natural Sections of Missouri

Continental glaciers were present in the glaciated plain area tens of thousands of years ago. The glaciers smoothed out the landscape and, when they melted, left thick deposits of unsorted clay, silt, sand and gravel, called glacial till. The present course of the Missouri River within Missouri was determined by glaciation. Flowing from the west, the Missouri River encountered the western edge of these great ice sheets and the course of the river was deflected southward. The southern extent of these ice sheets in Missouri was near Kansas City and at that point the river was able to turn and continue flowing eastward (MDNR, undated1). This ancient Missouri River was a larger stream of glacial meltwater that scoured and eroded the bedrock river

channel, then left thick deposits of sand, gravel and cobbles. Later, after the glaciers had melted, the calmer Missouri River deposited finer-grained sand, silt, and clay. These river deposits are called alluvium. Silt that was later blown in from drier western regions tended to deposit along river channels where vegetation was more dense, forming thick beds of what is termed loess. Thus all of Missouri north and east of the Missouri River was subject to glaciation and has been covered with deposits of glacial till. The glacial till is tens of feet thick, and locally, where ancient bedrock river valleys were filled, it may be up to 200 feet thick.

In west central Missouri, an area of unglaciated flat land referred to as the Osage Plains (Figure 3-17) lies between Kansas City on the north and Joplin on the south and stretches eastward to Osceola, Warsaw and Sedalia. In this area, thin deposits of loess overlie bedrock (MDNR, undated1).

Both the Norborne and the Big Lake plant sites are located within the Missouri River Alluvial Plains Natural Subsection (Figure 3-18), as is the rail corridor for the Big Lake Site, and the southern rail corridor for the Norborne Site, the proposed well field, and the proposed water line for the Norborne site. The alluvial plains are the broad, relatively flat floodplain lands along major rivers. As shown in Figure 3-18, the alluvial plains are especially wide at both Big Lake and Norborne.

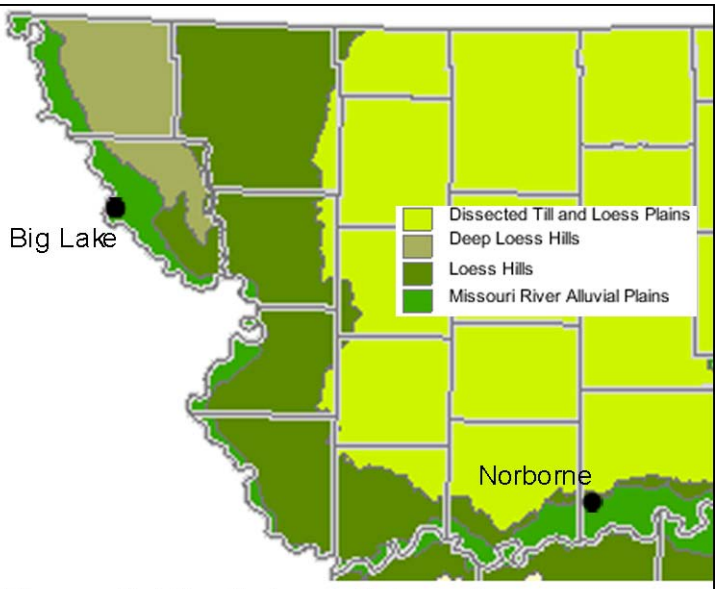


Figure 3-18. Natural Subsections
Source: cares.missouri.edu

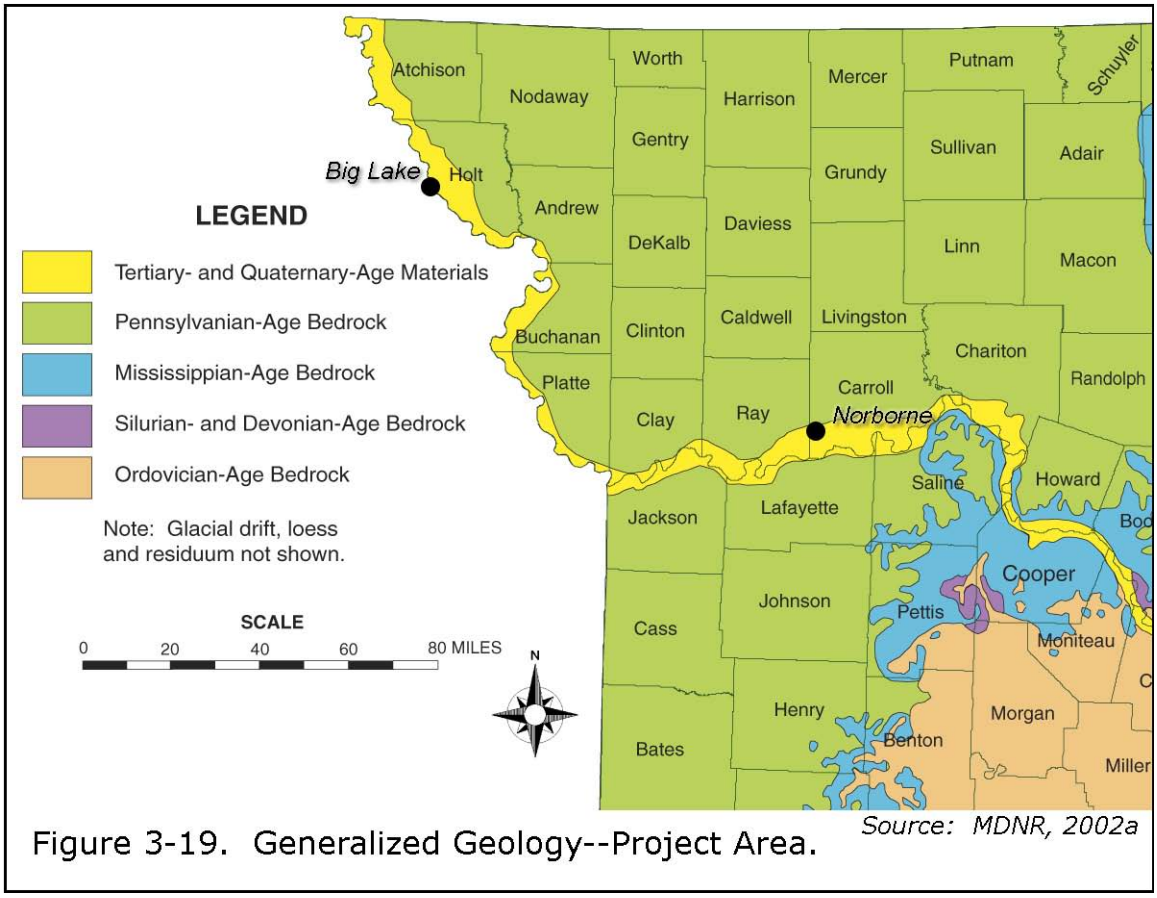
The northern rail corridor for Norborne crosses the Loess Hills Natural Subsection, which at the Norborne site forms a narrow border at the north edge of the alluvial plain along the Missouri River bluff. Much thicker and broader loess deposits lie to the east and north of the Big Lake site. These deposits, the thickest in the state, are up to 100 feet thick and form prominent bluffs. These Deep Loess Hills extend north along the east side of

the Missouri River, through Iowa and into Nebraska. A part of the Deep Loess Hills in Iowa has been designated by the National Park Service as a National Natural Landmark for the unique geology and associated native vegetation. There is only one other place on earth where loess deposits of comparable thickness have been formed: along the Yellow River in China (NPS, 2004a). In Missouri, a 112-acre portion of the Jamerson C. McCormack Conservation Area (CA) has been designated as the McCormack Loess Mound Natural Area (NA). It is located near the southern end of Squaw Creek National Wildlife Refuge (NWR), east of the Big Lake Site. The McCormack NA preserves the unique geology and associated native vegetation of a small part of the Deep Loess Hills. The goal of the natural areas system "is to designate, manage and restore high quality examples of every extant natural community in each of Missouri's natural sections" (MDC, 1996). Natural Areas are designated by the Missouri Natural Areas Committee and they are permanently protected and managed for the purpose of preserving their natural qualities. The McCormack Loess Mound NA is jointly owned by the MDC and The Nature Conservancy. The Squaw Creek NWR also protects a part of the Deep Loess Hills (USFWS, 2006a).

Bedrock Geology

Figure 3-19 shows the general bedrock underlying the surface deposits of till, loess, or, in the case of the limestone/dolomite bedrock south of the Missouri River, underlying the residual soil formed from the bedrock. Most of the bedrock in the project area is Pennsylvanian in age (about 300 million years old) and consists of cyclic deposits of shale, sandstone, and limestone, with some coal.

The Mississippian-, Silurian-, Devonian-, and Ordovician-Age (300 to 500 million years ago) bedrock shown in the figure consists mainly of limestone and dolomite. Limestone and dolomite are subject to dissolution by slightly acidic rainwater, and areas underlain by limestone and dolomite tend to develop karst features from dissolution of the bedrock along joints and other cracks: cave, sinkholes, losing streams and springs.



Source: MDNR, 2002a

Figure 3-19. Generalized Geology--Project Area.

Figure 3-20 shows sinkholes in Missouri, which occur in areas of massive limestone/dolomite bedrock, but not in the Pennsylvanian deposits of northwest, north central and west central Missouri, where the limestone is in thin layers between other rock types. Caves occur in the same geologic environment as sinkholes, as do springs (Figure 3-21). There are some springs outside the limestone/dolomite bedrock areas, but these springs are generally small and do not flow year-round (although there is reportedly a perennial spring about two miles from the proposed plant site). Losing streams, which have special protection in Missouri[52], are another characteristic feature of karst areas. Generally stream flow increases downstream, as tributaries feed into a main stream. A losing stream loses flow over some stretches, when all or part of the stream flow moves to an underground conduit. Sometimes the flow reappears further down the channel. There are many losing streams in the karst areas of Missouri, but none within the project area.

[52] 10 CSR 20-7.031

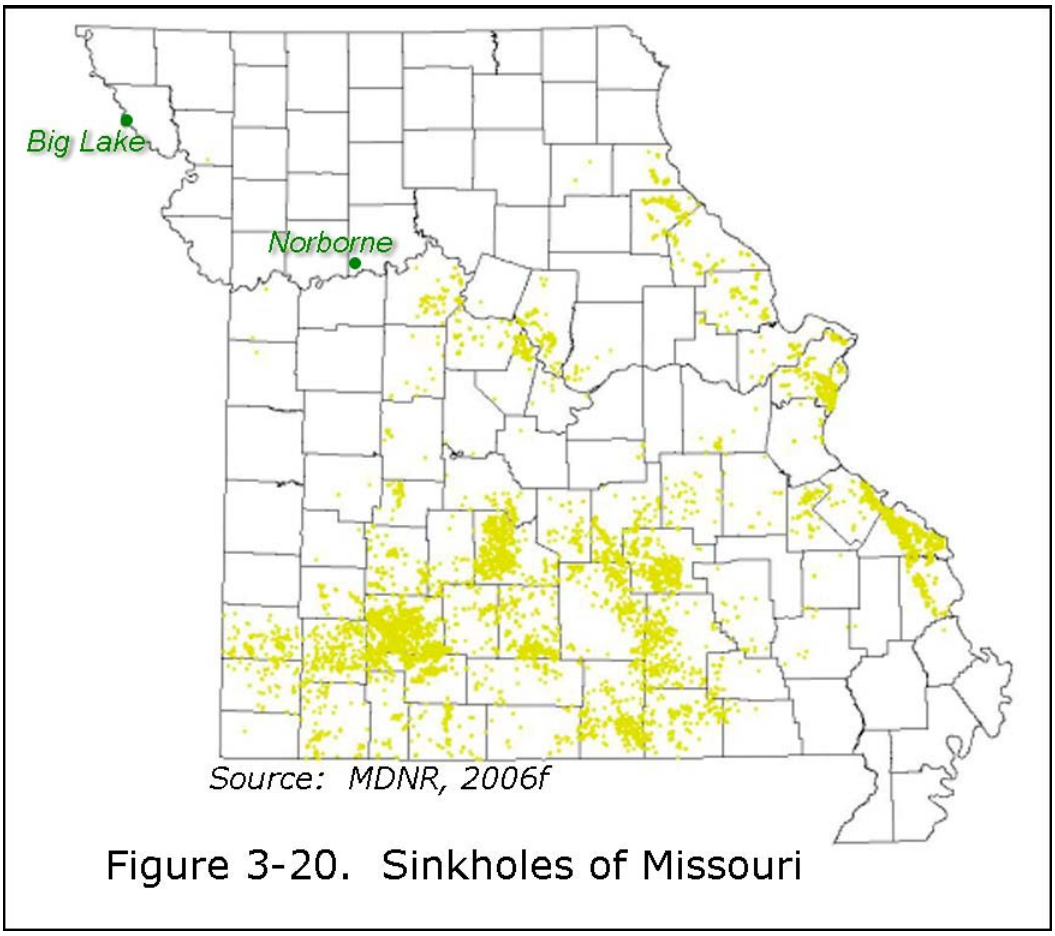


Figure 3-20. Sinkholes of Missouri

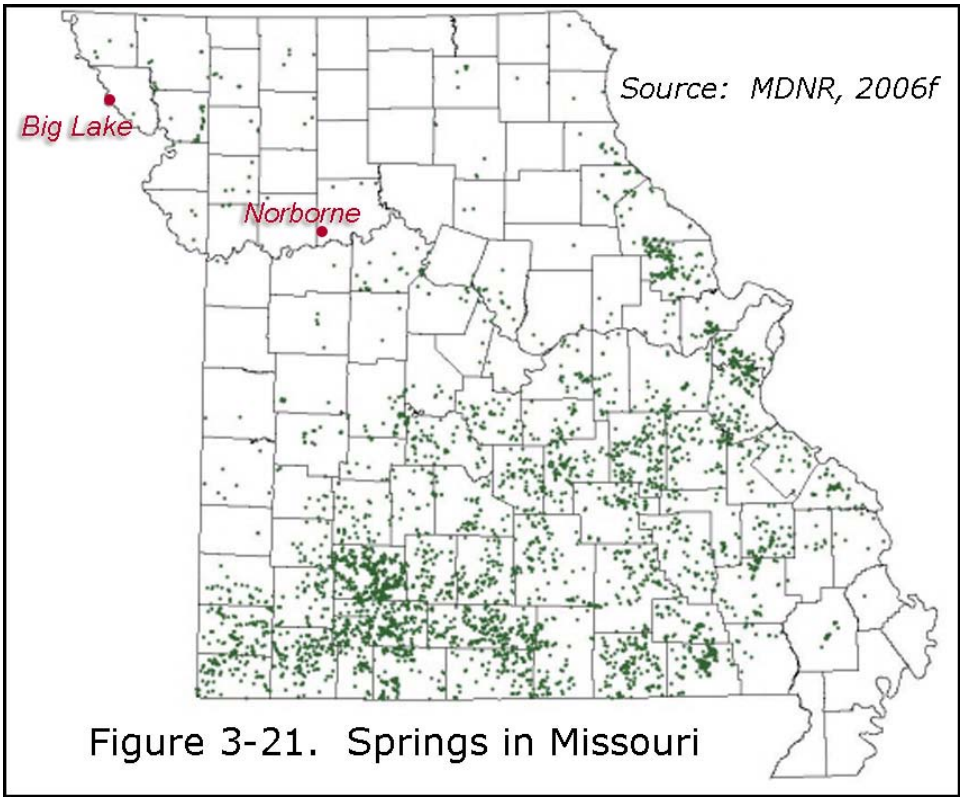


Figure 3-21. Springs in Missouri

3.2.1.2.2 Norborne Site

The Norborne site is located at the edge of, and almost entirely within, the Missouri River alluvial floodplain. Only the proposed landfill is outside the floodplain. The extent of the Missouri River alluvial deposits are evident on the topographic maps, contrasting with the bluffs that rise to either side.

A subsurface investigation at the site (AECI, 2005c) found the following general stratigraphy below the alluvial floodplain part of the site (Table 3-11).

Table 3-11. Generalized Subsurface Stratigraphy, Norborne Site

Depth BGS, Feet	Average Elevation, Feet MSL	Description
0-2	684-682	Organic clay (topsoil)
2-25	682-659	Soft to medium stiff, high plasticity clay
25-76	659-608	Loose to medium dense, poorly graded, fine to medium sand
76+	Below 608	Limestone and sandstone, fresh, hard

Because the site is several miles from the present-day river channel, the more recent deposits (the clay to a depth of 25 feet) have occurred in a backwater environment—well away from the flowing channel, in fairly still water at the edges of large floods. The deeper sand was probably deposited during glacial times. The bedrock limestone and sandstone are the cyclic Pennsylvanian deposits.

Three borings were installed in the loess bluff part of the site, where the landfill would be located. Two of these borings extended to 25 feet, and encountered 18 inches of topsoil, then a silty clay typical of loess to the bottom of the borings. A third boring was extended to 30 feet; the upper 25 feet encountered the same material as the other two borings. The bottom five feet of the boring was in sand, from approximately elevation 664 to 659 feet MSL. This sand is probably part of the glacial river deposits from the ancestral Missouri River.

Figures 3-22 and 3-23 show highly erodible soils in the area of the Norborne Plant and the proposed rail corridor north of the plant (referred to as Alternative 2 in the alternatives evaluation). The erodible soils map is based on Natural Resource Conservation Service (NRCS) soil association maps and erodibility classifications. Essentially, the alluvial soils are not considered erodible, the loess soil is considered highly erodible, and till soils are considered potentially highly erodible. As shown, most of the plant site is not in soil classified as highly erodible. The proposed well field and water line, located to the south of the proposed plant site (not shown in the figures) are located entirely in alluvial soil, which is not classified as highly erodible. Part of the rail corridor is in highly erodible soil, and the cut that would be needed to get from the plant to the Wakenda Creek Valley would be in highly erodible soil.

Locations of transmission lines are not shown in the figure. These are also located mostly in soils classified as highly erodible, except for the areas around drainages where alluvial soils and some till occur.

3.2.1.2.3 Big Lake Site

The Big Lake Site is located in a large bend in the Missouri River, where the flow direction locally changes from south to east (Figure 3-24). At the location of the bend, the Missouri River floodplain is contiguous with the floodplain of the Big Nemaha River, which flows into the Missouri River from

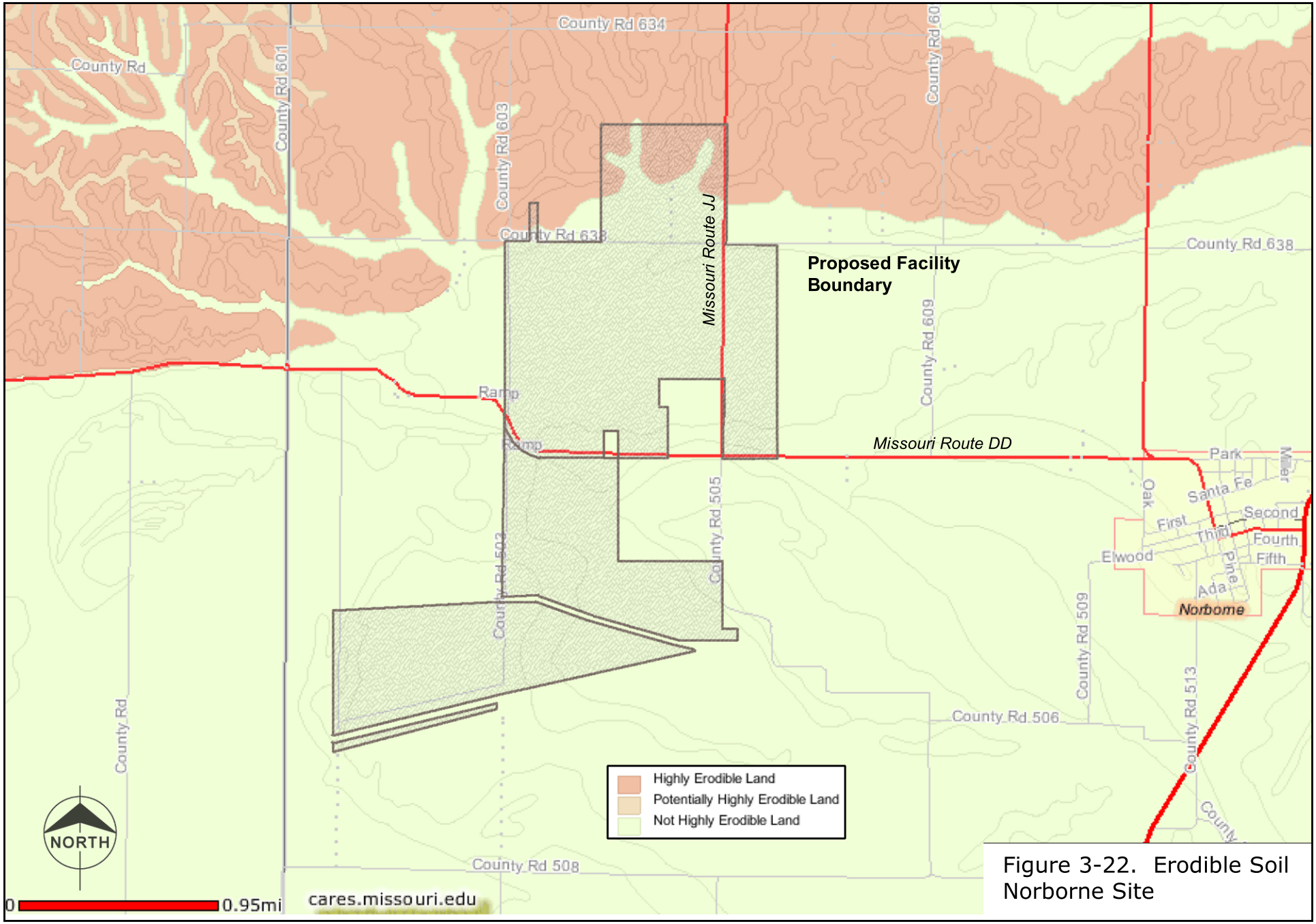


Figure 3-22. Erodible Soil Norborne Site

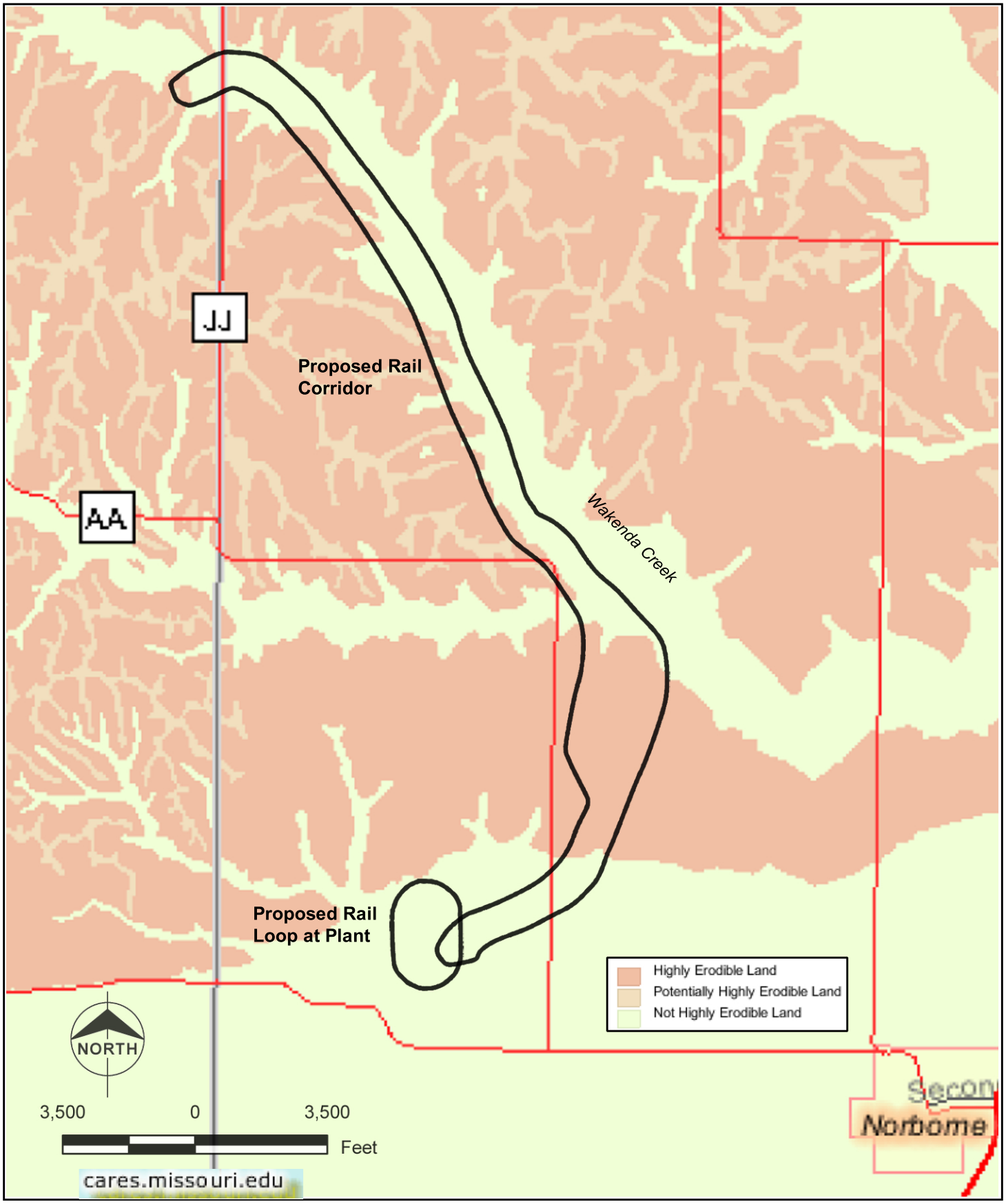
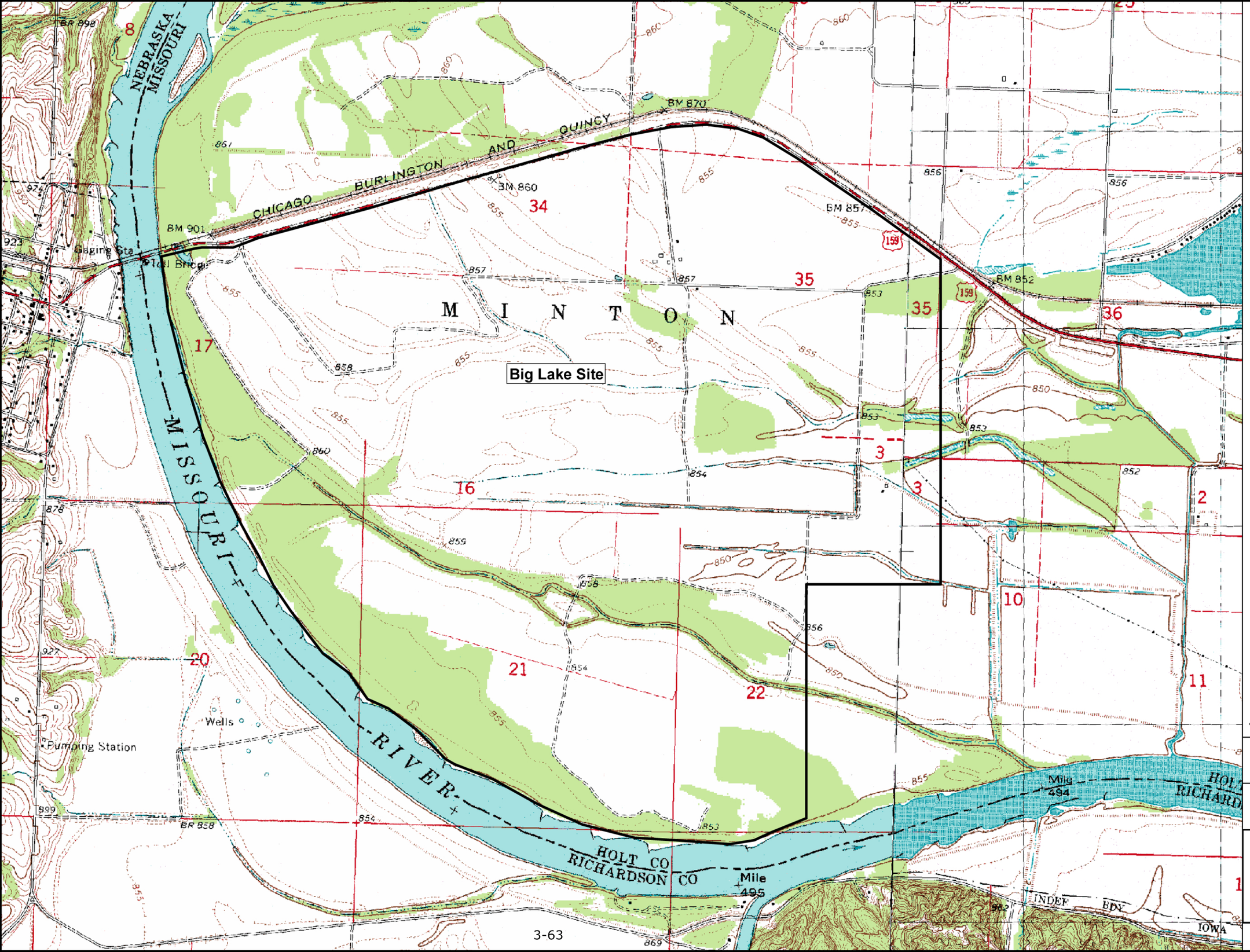


Figure 3-23 Erodible Soil
Norborne North Rail Corridor



Legend

Big Lake Facility Boundary

Big Lake and Rulo (NE)
7.5 Minute Quadrangles

1 : 18,000

0 0.25 0.5 Miles

Figure 3-24.

Big Lake Site

Source(s): Missouri Spatial Data Information Service, U.S. Geological Survey, and URS Corporation

Nebraska just south of the site. The Big Lake Site is underlain by alluvial deposits overlying Pennsylvanian bedrock, the same as the Norborne Site.

The Big Lake Site is several miles from any soil classified as highly erodible. As with the Norborne Site, the alluvial soils are not classified as highly erodible, but the bluffs to the east are.

3.2.2 Environmental Consequences

3.2.2.1 Identification of Issues

The following is a list of issues that were identified as relating to geology and soils; these issues form the basis for the assessment of potential impacts:

- potential impacts on areas of regional geological importance
- source of fill; concerns about fill being taken from Loess Hills (Big Lake Site)
- potential for creation of sinkholes caused by pumping groundwater (addressed in *Section 3.3, Groundwater*)
- potential for soil erosion

3.2.2.2 Significance Criteria

Listed below are the significance criteria established for the identified issues. Impacts would be considered significant if they would result in the following:

- destruction of areas of regional geological importance
- activities that would result in creation of sinkholes that would be safety hazards and/or cause property damage
- soil erosion sufficient to cause damage to soil resources outside the areas directly impacted by construction

3.2.2.3 Impact Assessment Methods

In order to assess potential impacts on geological and soil resources within the region of influence, available information was compiled related to geology, soils and geologic hazards. All relevant reports prepared by AECI and its consultants were reviewed to independently evaluate and verify the accuracy and comprehensiveness of the information provided by AECI, and, where necessary, supplement this information.

After data were compiled and reviewed, and the information provided was verified, potential direct and indirect impacts on geological and soil resources were assessed. Particular consideration was given to the identified issues, and the significance criteria described above were used to assess whether significant impacts potentially could occur.

3.2.2.4 Actions Incorporated Into the Proposed Action to Reduce or Prevent Impacts

The Proposed Action includes the following measures to reduce or prevent potential adverse environmental impacts on geological resources:

- Both permanent and temporary erosion control measures (silt fences, straw bale checks, riprap, revegetation)

3.2.2.4.1 Impact Assessment

The assessment of impacts on geological and soil resources is described below in terms of the criteria outlined in *Section 3.2.2.2, Significance Criteria*.

Proposed Action

Geologic Resources

There are no areas of geological importance within the region of influence of the Proposed Action. Therefore, no areas of geological importance would be destroyed by the Proposed Action.

Soil Resources

There are areas of highly erodible soil within the region of influence. Construction of the landfill would occur partly within highly erodible soils, and this material would be re-used for fill at the plant site. The cuts for the north rail connector would be made in highly erodible soils. Implementation of erosion control measures during construction and operation as incorporated into the Proposed Action as required by Missouri regulation would prevent significant adverse impacts to soil resources.

Big Lake Alternate Site

The McCormack Loess Mound CA and any comparable areas in the Deep Loess Hills Natural Subsection that have been geologically and biologically preserved but are unprotected would be considered areas of regional geologic importance. Using such areas for fill sources or constructing within such areas could result in significant impacts. The McCormack Loess Mound CA and the Deep Loess Hills Natural Subsection in which it is located are a few miles east of the Big Lake Site. The landfill and borrow areas for the Big Lake Site have not been determined; if this site is selected, care would need to be taken in identifying locations for borrow and for the landfill so as not to impact the McCormack Loess Mound CA and any comparable resources that may be present in the Deep Loess Hills east of the site.

IGCC Alternative

Impacts would be the same for the IGCC alternative as for the Proposed Action.

No Action Alternative

Under the No Action Alternative, the Project would not be constructed and there would be no change or disturbance of geological or soil resources within the project area.

3.2.2.4.2 Mitigation and Residual Impacts

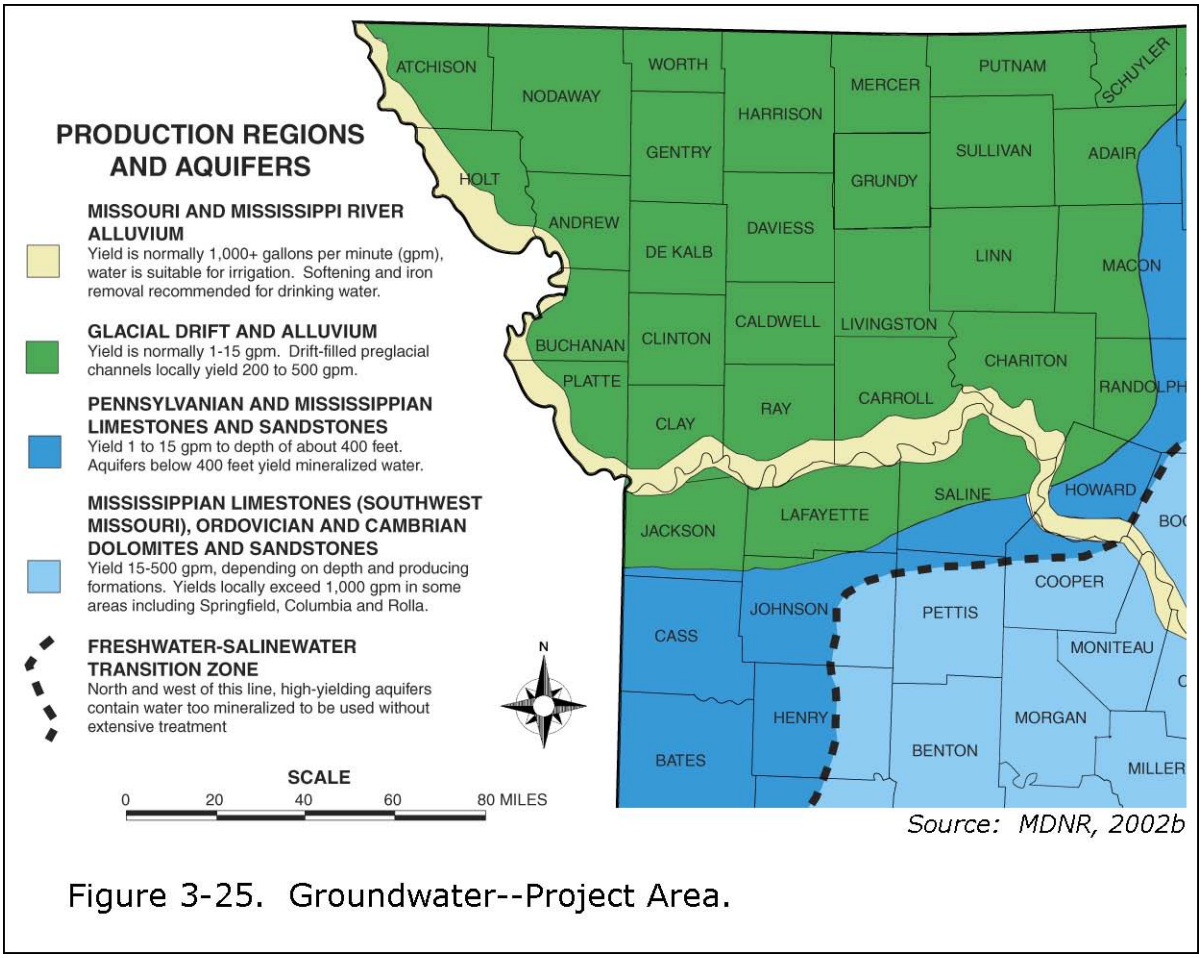
No mitigation measures have been identified because impacts are not anticipated.

3.3 GROUNDWATER

3.3.1 Affected Environment

3.3.1.1 Regional Setting

The general groundwater conditions within the overall project area are shown in Figure 3-25.



Source: MDNR, 2002b

Figure 3-25. Groundwater--Project Area.

The major groundwater source in the general project area is the Missouri River Alluvium. The Pennsylvanian bedrock that underlies most of this area is not considered an aquifer for water supply. The glacial deposits generally have low yields, but with some localized buried channels with higher yields. The limestones and dolomites that further south and east yield large quantities of usable groundwater are deep underground in the project area, but the water is highly mineralized. North and west of the dashed line shown in the figure, these bedrock aquifers are too highly mineralized to be used for drinking water sources (MDNR, 2005a).

3.3.1.2 Region of Influence

The two main potential types of impacts on groundwater that could result from the project are impacts on aquifers due to withdrawal of water for plant

use, and impacts due to migration of contaminants through the soil to the groundwater. There also may be temporary construction impacts due to the need to dewater the excavation for the hopper for the rotary car unloading system at the coal unloading area.

The region of influence for potential impacts from withdrawal of groundwater is the region over which groundwater levels may fall as a result of pumping water for the plant, and for construction, as a result of the temporary dewatering of the hopper excavation.

The region of influence for the potential contaminant impacts to groundwater is the general area where potential contaminants are stored or disposed of. This would primarily be the proposed waste disposal facility at the Norborne Site; a similar facility would be constructed at the Big Lake Site if it were selected. In either case, the general plant area would also be of some concern because of the storage of chemicals and fuels that, if released, could impact groundwater.

Construction and operation of the water line, discharge line, rail connections, and transmission lines are not expected to impact groundwater.

3.3.1.3 Existing Conditions

As shown in Figure 3-26, a generalized cross section at the location of the proposed well field, the depth to bedrock is about 75 feet (elevation 610 feet MSL), and the high-water-yielding sand and gravel layer is present in about a 30-foot layer above the bedrock. Finer grained sand, silt and clay material overlies the coarse-grained deposits. While the overall alluvial profile is similar to that described above for the plant site in that the thickness is similar and the material becomes coarser with depth, the deposits near the river are overall coarser grained. As described above, the waste storage facility is located in silty clay loess deposits overlying alluvial sand.

No borings were made at the Big Lake Site, but conditions would be expected to be similar.

Existing water supply wells in the vicinity of the proposed well field for the Norborne Plant are summarized in Table 3-12.

WEST
A

EAST
A'

TB-06-1
TB-06-5
TB-06-2
PW
TB-06-4
SUPPLY WELL
TB-06-3

ELEVATION (FEET)
690
680
670
660
650
640
630
620
610
600

SILT, SILTY SAND AND CLAY
SILTY SAND
SAND
SAND AND SAND & GRAVEL
BEDROCK

0.030
0.024
0.082
0.028
0.012
0.052
0.035
0.021
0.092
0.058
0.046
0.026
0.043
0.076
0.009
0.029
0.062
0.063
0.187
0.009
0.059
0.024
0.033
0.052

LEGEND:

CLAY	SILTY SAND	GRAVEL AND SAND
SILT	SANDY SILT	LIMESTONE
SAND	CLAY AND SILT	SHALE

APPROXIMATE WATER LEVEL ON 05/23/06

SCREENED INTERVAL

0.036 SIEVE SAMPLE D_{50} IN INCHES, GRAIN DIAMETER AT WHICH 50% OF SAMPLE PASSES SIEVES

Figure 3-26. Generalized Geologic Cross Section at Location of Proposed Well Field.

Source: AECI, 2006j

Table 3-12. Summary of Existing Wells in Vicinity of Proposed Well Field

MDNR Reference No.	Owner	Usage	Depth, feet	Location	Yield, gallons per minute (gpm)
00069983	Beckemeier	Unknown	70	Sec7,T51N,R25W	50
00336666	Don Heil Farms	Domestic	50	NW¼SE¼NE¼ Sec7,T51N,R25W	10
00343852	Don Heil Farms	Domestic	22	NW¼SE¼NE¼ Sec7,T51N,R25W	2
00232272	Peters Orchard	Irrigation	61	SW¼NW¼SW¼ Sec11,T51N,R25W	500
00336665	Durham	Domestic	70	NW¼NW¼NW¼ Sec11,T51N,R25W	15
00083852	Elis	Unknown	60	NW¼NE¼NS¼ Sec11,T51N,R26W	Not reported
00008548	Edmond	Irrigation	80	SW¼NE¼NE¼ Sec12,T51N,R25W	600
00099436	Elis	Irrigation	61	NW¼SE¼, Sec11,T51N,R26W	Not reported
00255556	Lester	Irrigation	72	NE¼NE¼SW¼ Sec12,T51N,R26W	1,500

Source: MDNR, 2006b

3.3.2 Environmental Consequences

3.3.2.1 Identification of Issues

The major issues identified during scoping were potential impacts from large withdrawals of groundwater and potential for groundwater contamination, especially from the landfill. Other issues were concern about development of sinkholes from overpumping, drainage of wetlands from pumping, and poor water quality.

Potential long-term groundwater impact is associated primarily with plant operation. There would be short-term construction impacts associated with the dewatering of the coal unloading hopper. There is also potential for fuel spills associated with construction activities. Proper containment as required by law results in minimal potential for groundwater impacts from spills during construction.

Groundwater Withdrawal

The water level in any well that is pumped will drop in response to pumping. This "drawdown" of the water table is greatest at the well and decreases away from the well. All else being equal, the higher the pumping rates the greater the drawdown will be and the more widespread its effects will be. Large groundwater withdrawals can potentially affect other users by lowering the overall groundwater level. There are no state laws, regulations or policies that specify the quantity of water that any groundwater diverter may use. Missouri is a riparian water law state, which means that all landowners touching or lying above water sources have a right to a reasonable use of those water resources. Recent case law has established the reasonable use criteria that the State Supreme Court has been following. Reasonable use requires that other users and landowners not be overly adversely impacted (MDNR, 2006a).

Potential Contamination of Groundwater

Chemicals and fuels that have the potential to impact groundwater would be used at the plant; and waste ash, if not properly disposed of, has the potential to impact groundwater. Chemicals and fuels can cause contamination by spillage that then migrates downward through soil to groundwater, or is carried by surface water that then infiltrates through soil to groundwater. Current laws and regulations governing storage of chemicals and fuels that can harm groundwater, and required action for spills of those materials, are intended to prevent groundwater impact from storage and use of those chemicals and fuels. As described in *Section 2.4, Description of the Proposed Action*, surface water runoff from potentially contaminated areas would be treated prior to discharge. Because of the higher potential for landfills to result in groundwater contamination, long-term monitoring is required by state regulations.

3.3.2.2 Significance Criteria

Impacts would be considered significant for the groundwater pumping if other users would be overly adversely impacted. Impacts would be considered significant for contamination if impacts from the waste disposal facility occurred that resulted in exceedances of groundwater protection standards that would be established as part of the waste disposal facility permitting.

Impacts would be considered significant for contamination if chemical or fuel spills resulted in exceedances of groundwater protection standards.

3.3.2.3 Impact Assessment Methods

Groundwater Withdrawal-Well Field

In April and May 2006, AECI conducted detailed aquifer tests at the proposed well site for the purpose of assessing whether adequate water could be produced, and what the impacts would be (*Appendix E, Hydrogeologic Investigation Report of Findings*). Task 1 of the work included installing three test borings to bedrock, collecting samples for characterization testing, and conducting a hydraulic interval test in one of the borings. The purpose of the hydraulic interval testing was to determine the hydraulic conductivity of the selected intervals and evaluate groundwater quality. Task 2 included the installation of a test well capable of pumping at least 1,000 gpm and four additional observation wells, and conducting aquifer testing. Task 3 included compilation of the data collected to determine the feasibility and preliminary design of the collector wells (AECI, 2006j).

The generalized profile shown in Figure 3-26 is based on the data collected. The boring and well locations are shown in Figure 3-27. "PW" indicates the location of the production well used for aquifer testing in Task 2. The approximately 30-foot sand and gravel layer between depths of about 45 and 75 feet is the aquifer from which the groundwater would be extracted for the plant. The hydraulic conductivity of this layer was estimated at 3,000 gallons per day per square foot (gpd/ft^2), based on the hydraulic interval testing.

Projecting the aquifer response to pumping at this site is complicated by fluctuating levels of the Missouri River, which impact the groundwater levels. Small river-stage fluctuations of short duration as might occur daily or weekly have a relatively small impact on groundwater levels. The larger impact on ground-water levels occurs from larger river-stage changes of longer duration that arise from seasonal changes in river flow or river management flow releases. Well yields would be less under low river flow conditions, and water demand would be highest during summer.

Source: AECI, 2006j

Figure 3-27. Boring and Well Locations for Aquifer Testing

Selected daily stream flow statistics from a U.S. Geological Survey gage at Waverly, Missouri, about 12 miles east of the site (Figure 3-28) were used to estimate low flow and median summer flow conditions. Shown in the figure are the median daily flow values, i.e. the flow that is equaled or exceeded for 50% of the records for a given day of the year, and also shown are the flow values that are equaled or exceeded for 90% of the records for a given day of the year. These records indicate that the lowest stream flows on this stretch of the Missouri River typically occur during the winter months. In winter, the groundwater would have a somewhat lower temperature than in summer, which would make it more viscous and effectively reduce the hydraulic conductivity. Therefore, worst-case conditions for pumping would be low flow in winter. Water needs would be higher in summer, so low-flow summer conditions were also modeled.

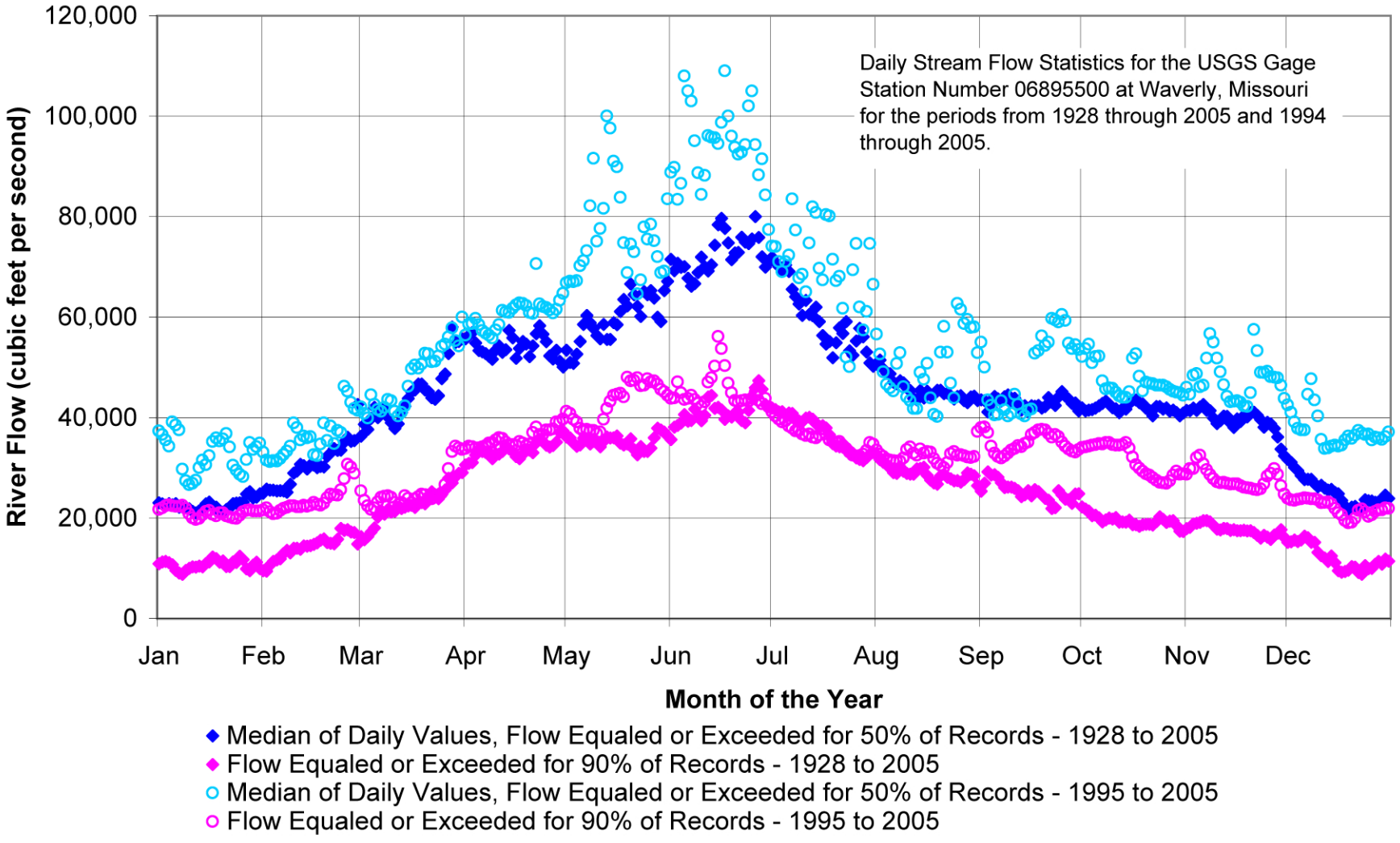
For the purposes of estimating the potential collector well yield, the winter low flow conditions were assumed to be represented by the daily flows during the months of December and January that are equaled or exceeded for 90% of the records at the Waverly gage. A model simulation with two collector wells with each pumping 3,700 gpm for a total of 7,400 gpm under assumed winter low river conditions showed that there would be approximately 5 feet or more drawdown extending nearly to the property boundaries of the well field area, and an area that would have a projected drawdown of approximately 0.5 feet or more extending to approximately 2.2 miles north of the well field area (Figure 3-29).

The simulation with low river levels during the summer (Figure 3-30) showed that summer impacts would be less than winter. Projected drawdown would be less at higher river levels (AECI, 2006j).

Groundwater Withdrawal—Construction Dewatering

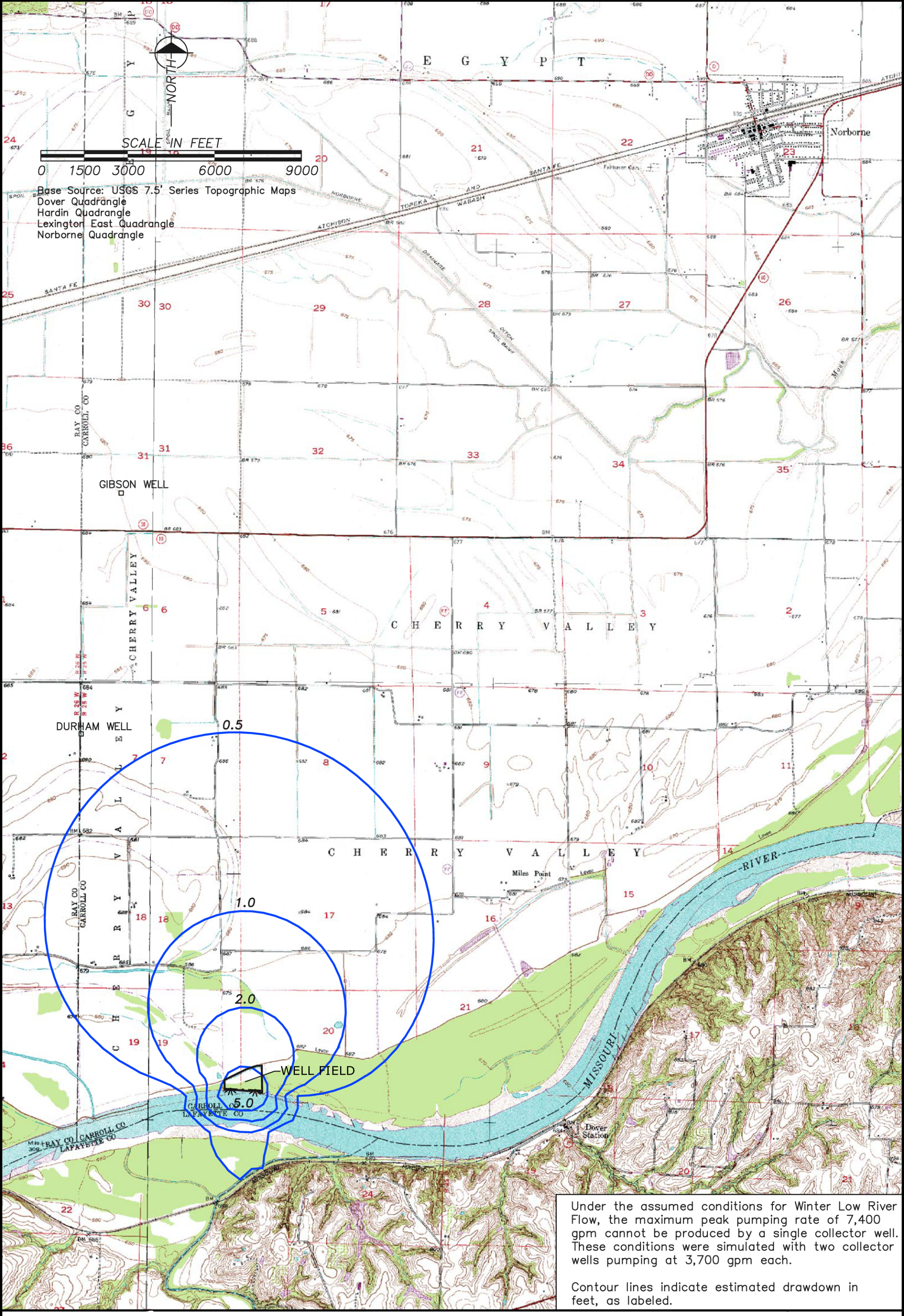
Construction of the proposed power plant would require deep excavations for construction of coal unloading and coal handling equipment. The deepest excavation required would be for the rotary coal car unloading system which would require an excavation approximately 80 feet deep. The bottom of the excavation would be well below the water table elevation in the Missouri River alluvial aquifer.

In order to safely and economically construct the facility, the groundwater level would have to be lowered, a process known as dewatering, to enable



Source: AECI, 2006j

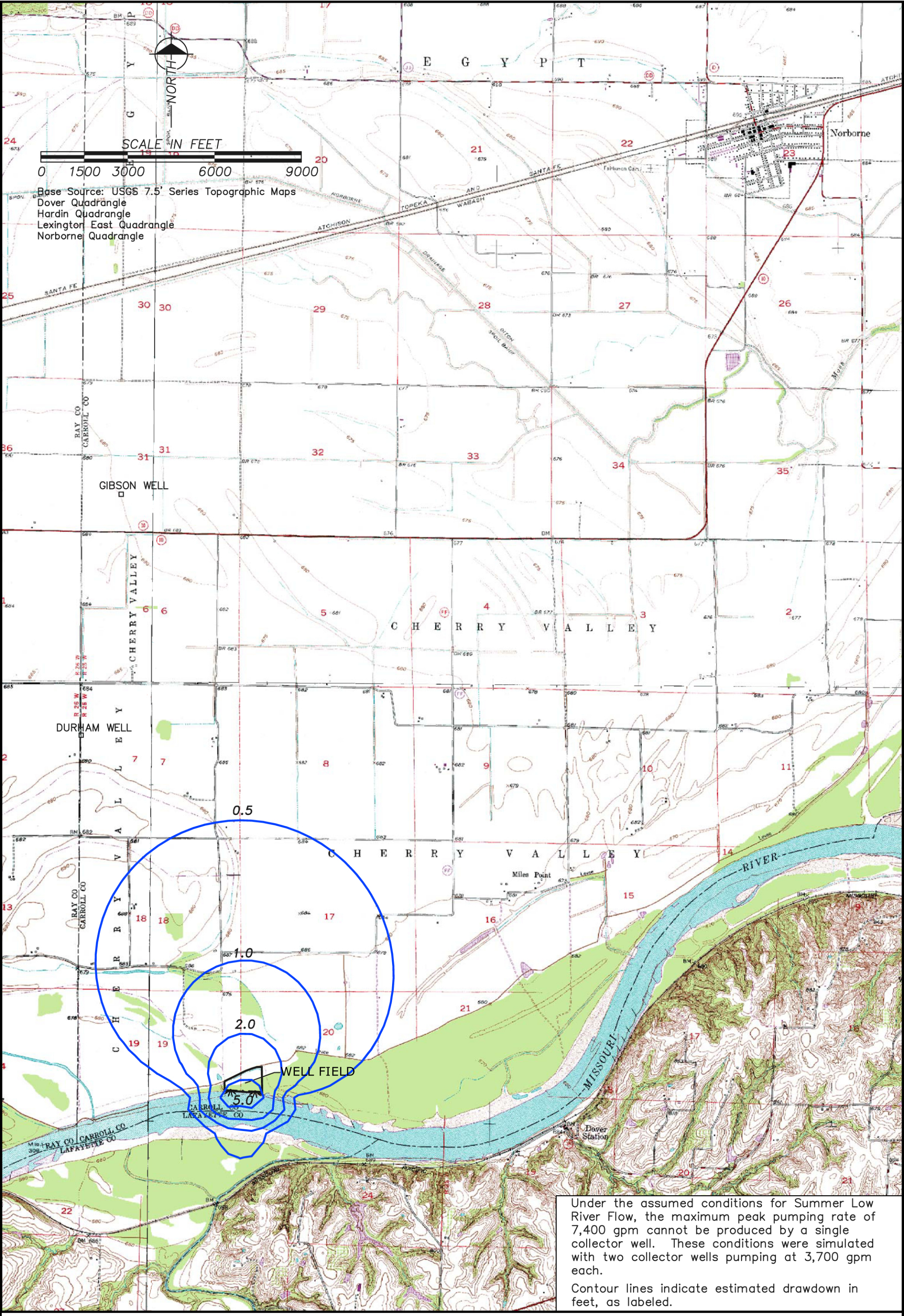
Figure 3-28. Missouri River Daily Stream Flow Statistics for the US Geological Survey Gage Station at Waverly, Missouri



Scale: 1" = 3000'

Figure 3-29. Model Estimated Drawdown for Two Collector Wells Pumping 3,700 gpm Each, Winter Low River Conditions

Source: AECI, 2006j



Under the assumed conditions for Summer Low River Flow, the maximum peak pumping rate of 7,400 gpm cannot be produced by a single collector well. These conditions were simulated with two collector wells pumping at 3,700 gpm each.

Contour lines indicate estimated drawdown in feet, as labeled.

Scale: 1" = 3000'

Figure 3-30. Model Estimated Drawdown for Two Collector Wells Pumping 3,700 gpm Each, Summer Low River Conditions

Source: AECI, 2006j