Prepared for:
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St. Louis, MO

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August 2014

Groundwater and Surface Water Data Demonstrate No Off-Site Impact from Rush Island Energy Center

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List of Acronyms

ACAA	American Coal Ash Association
AMSL	Above Mean Sea Level
AQL	Missouri State Protection of Aquatic Life Criteria
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
CARES	Center for Applied Research and Environmental System
CSM	Conceptual Site Model
DSI	Detailed Site Investigation
ft	Feet
ft bgs	Feet Below Ground Surface
GIS	Geographic Information System
GPS	Global Positioning System
HDPE	High Density Polyethylene
ICIS	Integrated Compliance Information System
MCL	Maximum Contaminant Level
MDNR	Missouri Department of Natural Resources
MEGA	Missouri Environmental Geology Atlas
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
MSDIS	Missouri Spatial Data Information System
NPDES	National Pollutant Discharge Elimination System
NRT	Natural Resource Technology
NTU	Nephelometric Turbidity Unit
ORAU	Oak Ridge Association Universities
ppm	Part per Million
PVC	Polyvinyl chloride
PWS	Public Water Supply
QA/QC	Quality Assurance/Quality Control
RAGS	Risk Assessment Guidance for Superfund
RSL	Regional Screening Levels
SMCL	Secondary Maximum Contaminant Level
STORET	Storage and Retrieval (Database)

TDS	Total Dissolved Solids
TVA	Tennessee Valley Authority
ug/L	Micrograms per Liter
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UWL	Utility Waste Landfill
WET	Whole Effluent Toxicity
WIMS	Well Information Management Systems

Groundwater and Surface Water Data Demonstrate No Adverse Human Health Impact from Coal Ash Management Practices at the Ameren Missouri Rush Island Energy Center

Executive Summary

As part of its ongoing ash management practices, Ameren Missouri intends to close its existing ash pond system and construct a landfill within the footprint of those ash impoundments. The Rush Island Energy Center has been in operation since 1976, where coal ash has been managed in an on-site impoundment for more than four decades. In conjunction with that effort, Ameren Missouri has conducted an investigation to determine if there has been an off-site impact from the existing ash pond system. This report examines groundwater samples taken in proximity to residential water wells and surface water samples taken from the river and creek which border the Rush Island Energy Center. Based on this evaluation of the data, there are **no adverse impacts on human health from either surface water or groundwater uses** resulting from current and historic coal ash management practices at the Facility. Furthermore, the groundwater flow gradient in this area demonstrates that residential wells located in the uplands along the Mississippi River bluffs are upgradient and are not and cannot be impacted from plant operations.

The conclusions expressed in this Report are based on actual data from **42 surface water** (Mississippi River and Isle Du Bois Creek) samples, and **3 bedrock groundwater** samples and water level readings taken from the bluff area west of the Facility where residential usage occurs. All samples were collected using protocols and evaluation methods that are consistent with State and Federal environmental programs.

Groundwater elevation measurements demonstrate that bedrock groundwater in the bluff areas west of the Facility flows northeast towards the Mississippi River. This groundwater flow gradient is shown in **Figure ES-1**. Such bedrock groundwater fully complies with federal and state drinking water standards. The few detections of constituents noted result from the natural characteristics of the geologic materials that make up the region.

Both upstream and downstream surface water sampling are comparable. Only a few constituents were detected in surface water at concentrations that are above ecological and human health risk-based screening levels. The detected constituent concentrations in the Creek and the River surface water are similar in both the upstream and downstream locations, indicating that the results reflect background conditions and do not indicate release due to coal ash management practices.

A critical aspect to any review of groundwater and surface water data associated with coal ash management practices generally is the presence, or lack thereof, of elevated concentrations of sulfate and boron. These “indicator parameters” will be present in elevated concentrations if a release from coal ash management practices has occurred. The focus of this Report is whether off-site impacts of coal ash indicators exist and if so, do such impacts adversely affect human health and/or the environment from either surface water or groundwater uses. Sampling results discussed in this Report reveal that neither sulfate nor boron concentrations are elevated in bedrock groundwater in the upland bluff area in the vicinity of private drinking water wells, nor in surface water and, therefore, potential off-site receptors are **not impacted** by the coal ash management practices at the Facility.

In addition, because there is no indication of coal ash impact in the Mississippi River immediately downgradient (0.25 miles) of the Facility, there can be no impact on the closest public drinking water intake located **30 miles downstream** at Chester, Illinois.

Ameren has installed groundwater wells in the immediate vicinity of the current ash pond system. Groundwater impacts relating to the ash ponds are localized and do not, and cannot, adversely impact residential wells located upgradient in the bedrock.

The results of this investigation provide Ameren Missouri and the community with the information needed to understand that this Facility’s coal ash management practices are not adversely impacting human health through current drinking water use of the Mississippi River, current drinking water use of bedrock groundwater in the bluff area west of the Facility, or recreational use of Isle Du Bois Creek or the Mississippi River.

Groundwater and Surface Water Data Demonstrate No Adverse Human Health Impact from Coal Ash Management Practices at the Ameren Missouri Rush Island Energy Center

Figure ES-1 – Bedrock Flow Direction

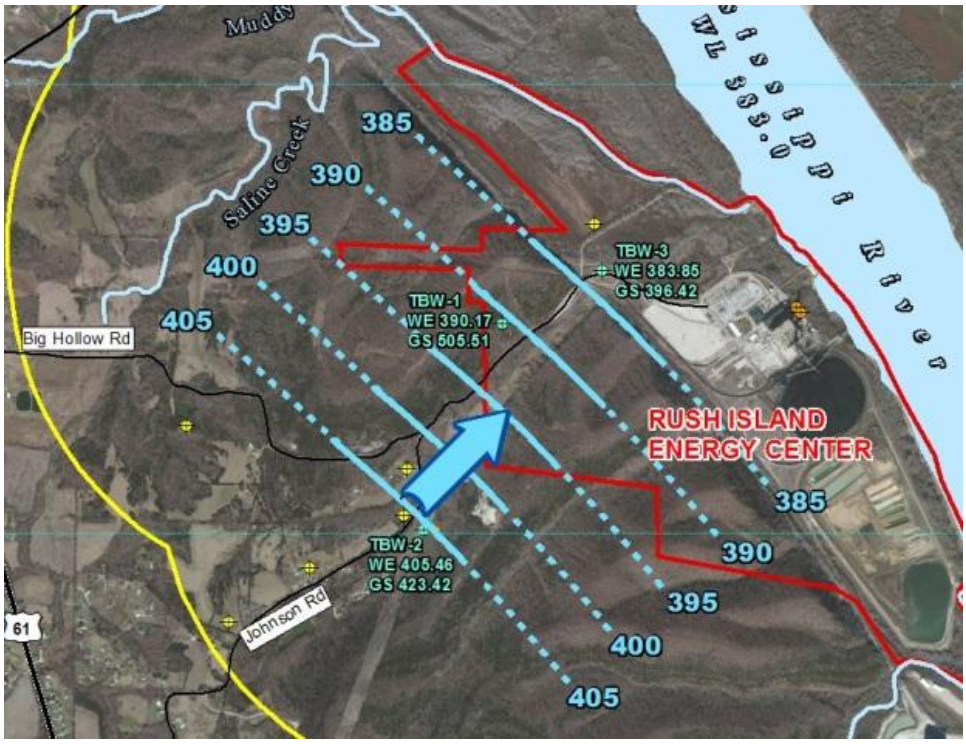
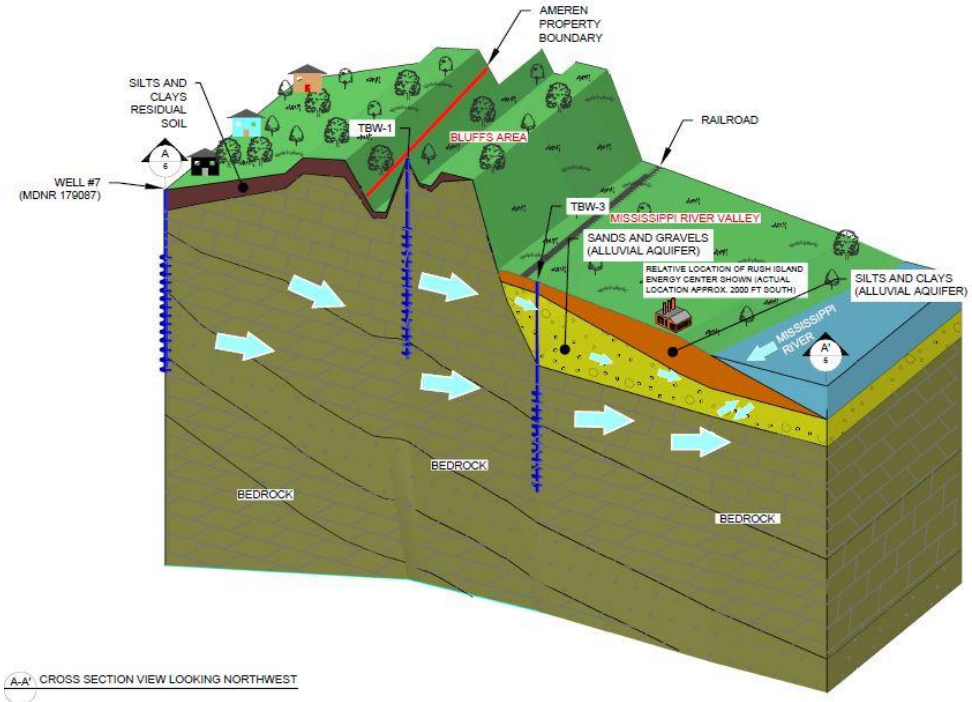


Figure ES-2 - Cross Section Bluffs, Mississippi River Valley, and Mississippi River



1.0 Introduction

Ongoing regulatory and legislative activity and media coverage regarding coal ash management, as well as ongoing opposition by environmental advocates opposed to coal fired power plants, have raised questions as to the safety of both groundwater and surface drinking water supplies near such facilities. Therefore, Ameren Missouri has retained the services of AECOM and Golder Associates Inc. (Golder) to assess whether coal ash management practices at the Rush Island Energy Center (Facility) (see **Figure 1**) has created a public health risk to water supplies. This Report evaluates analytical results for surface water samples taken at or adjacent to the Facility property and groundwater samples taken from wells installed in the upland bluff area west of the Facility (see **Figure 2**). The results of the evaluation indicate no adverse impact on human health resulting from either surface water or groundwater uses in these areas.

AECOM and Golder performed their evaluation in the context of a descriptive conceptual site model for groundwater and surface water for the Facility and its environs. Conceptual site models are used routinely by regulatory programs as the basis for gathering and evaluating environmental data. USEPA used this concept as the basis for the development of its risk assessment guidance in its authoritative document, Risk Assessment Guidance for Superfund (RAGS), Part A (USEPA, 1989). The Missouri Department of Natural Resources (MDNR) has issued regulations for assessing risk-based corrective action that are based on a conceptual site model approach (10 CSR 25-18.010), and cites to USEPA's guidance. The process used in this Report follows such methodology and evaluates constituent sources (coal ash management practices); potential releases to the environment (groundwater); potential migration of constituents in the environment (within groundwater and to surface water); and identifies where human exposure could theoretically occur (for example, use of groundwater or surface water as drinking water). Available analytical data for groundwater and surface water have been summarized and evaluated to determine whether a complete exposure pathway exists (i.e., the potential for direct exposure to coal ash-derived constituents in groundwater and surface water). In addition, a human health risk-based screening and an ecological risk-based screening have been conducted for all of the data.

This detailed analysis of the potential environmental and human health impacts of coal ash management at the Rush Island Energy Center is provided in this Report. A Questions & Answers Fact Sheet is provided as **Appendix E**, and supporting information for the Fact Sheet is provided in **Appendix F**.

1.1 Background

Coal is a type of sedimentary rock that is a natural component of the earth's crust, and the inorganic minerals and elements it contains are also naturally occurring. Coal ash is the material remaining after the combustion of coal. The organic component of coal is burned to produce energy, and the inorganic minerals and elements that remain after combustion make up the coal ash.

There are generally two kinds of coal ash, fly ash and bottom ash. Fly ash is coal ash that exits from a combustion chamber in the flue gas and is captured by air pollution control equipment. Fly ash with high calcium content is cementitious, meaning that it will harden like concrete when mixed with water; this property makes it suitable for use as a building material. Cementitious ashes are typically generated from low sulfur, western coals like that currently burned at Rush Island.

Ameren Missouri has an active program for beneficial use of the fly ash and bottom ash. Since 2010, in excess of 86% of fly and bottom ash produced at the Facility has been put into various beneficial uses. In fact, this level was above 100% in 2009, reflecting that in that year, ash was excavated from storage of previous years' production. This level of beneficial use is higher than the national average of 47% (ACAA, 2013).

The Facility currently manages the fly ash and bottom ash not put into beneficial use in an on-site 108-acre unlined impoundment. That impoundment is nearing capacity, and Ameren proposes to cap and close the impoundment and build a dry management Utility Waste Landfill (UWL) on top of the capped impoundment. The proposed sub-base grade for the UWL will be at the existing ash pond surface. As part of the landfill construction activities, the impoundment will be closed pursuant to MDNR requirements. Groundwater monitoring in the immediate vicinity of the ash impoundment is on-going and will be included as part of both the impoundment closure activities as well as the Detailed Site Investigation (DSI) activities. While the engineering design for the UWL has not yet been finalized or approved by MDNR, it is expected that the UWL will be constructed with a composite geosynthetic liner (clay and high-density polyethylene (HDPE)), and a leachate recovery system, and the design will conform to applicable regulations.

Both groundwater and surface water are used for drinking water supplies for Jefferson County residents. The City of Festus, MO obtains its drinking water from groundwater wells. A consolidated water supply district for Jefferson County sources its drinking water from the Mississippi River, upstream of the Facility. The nearest downstream drinking water intake on the Mississippi River is located approximately 30 river miles from the Facility, at City of Chester, Illinois (see **Figure 11**). This intake services Randolph County, Illinois which also supplies drinking water to other communities.

To address the issue of surface water quality, in the Spring of 2014, Ameren Missouri evaluated surface water at multiple locations on the Mississippi River and Isle Du Bois Creek. To assess off-site groundwater quality, Ameren Missouri installed monitoring wells in an area where private wells are used for drinking water. Ameren Missouri monitors the water at its permitted discharge outfalls, as part of its National Pollutant Discharge Elimination System (NPDES) permit. Permitted Outfall 002 for the impoundment is located on the Mississippi River just upgradient from the Creek. NPDES effluent data was also reviewed as part of this evaluation.

1.2 Methods Overview

A human health risk-based approach was used to identify and evaluate data needed to meet the study objective. A conceptual site model was developed to describe the process by which a potential constituent release to the environment and subsequent transport within the environment could affect environmental media (such as groundwater or surface water), and to identify locations where people could contact these environmental media. Existing data were evaluated, and data gaps were identified. Environmental sampling activities for surface water and groundwater were conducted to collect data to fill these data gaps. All of the data were summarized and used in an environmental and human health risk evaluation, and the risk evaluation results were used to evaluate the conceptual site model and derive conclusions.

2.0 Risk-Based Evaluation Methods

A conceptual site model, or CSM, is the method used to guide this risk-based evaluation of groundwater and surface water data for the Rush Island Energy Center. Because this is an important concept, this section first provides a description of the methodology for developing a conceptual site model.

2.1 CSM Introduction

A CSM is developed to evaluate the potential for human exposure to constituents that may have been released to the environment. Some of the questions posed during the CSM evaluation include:

> What is the source? How can constituents be released from the source? What environmental media may be affected by constituent release? How and where do constituents travel within a medium? Is there a point where a receptor (human or ecological) could contact the constituents in the medium? Are the constituent concentrations high enough to potentially exert a toxic effect?

The first step in developing the CSM is the characterization of the setting of the study area and surrounding area. Current and potential future uses of the study area and people who may potentially contact the environmental media of interest are then identified. Potential exposure scenarios and pathways are developed that describe how people may contact constituents released to the environment. Barriers to access including engineering and institutional controls are considered when evaluating whether a specific exposure pathway is complete.

For an exposure pathway to be complete, the following conditions must exist (as defined by USEPA (1989)):

1. A source and mechanism of chemical release to the environment;
2. An environmental transport medium (e.g., air, water, soil);
3. A point of potential contact with the medium by a receptor; and
4. A receptor exposure route at the contact point (e.g., inhalation, ingestion, dermal contact).

A receptor in this context is an organism that could hypothetically contact constituents that have been released to the environment. For the purposes of this Report, receptors will refer to people that may contact environmental media that may contain constituents that may be released as a result of the Facility's operations. Unless all of the four above conditions are met, the potential exposure pathway will be deemed incomplete. In other words, the exposure pathway is considered complete only if there are no discontinuities in or impediments to movement of a constituent from the source to the receptor. Only complete exposure pathways can result in exposure to humans.

- For example, a chemical may be spilled on the ground at an industrial facility, but if the facility is secured and members of the public are not allowed to enter the facility, there is no exposure to the public and the exposure pathway is considered to be incomplete. Alternatively, a chemical may be spilled at a location outside an industrial facility boundary in a public area. In this case, the exposure pathway would be considered to be complete –

someone could be exposed to the chemical by directly contacting the spilled material, or contacting impacted soil.

- Similarly, a large quantity of a chemical may be spilled at a facility such that it may travel down through the soil and reach groundwater and it may travel in groundwater at high enough of a concentration that it may impact a downgradient drinking water well; in this case, the drinking water exposure pathway would be considered to be complete. However, if the spilled material reaches the water table and travels in groundwater, but the concentrations in groundwater decrease such that a downgradient well is not impacted, then the exposure pathway is incomplete. Alternatively, if that same spill is contained by engineering controls such as a concrete pad or other form of impervious lining, then the chemical will not reach groundwater and will not impact any downgradient drinking water wells; in this case, the exposure pathway would also be considered to be incomplete.

Not all complete exposure pathways, however, result in a risk to human health. **For human health risk to exist, the exposure must be of a sufficient magnitude and frequency.** If the exposure pathway is complete, but the magnitude, or concentration of the chemical in the environmental medium is below health risk-based levels, then the exposure would not pose an adverse risk. Thus an exposure pathway could be complete but be insignificant on a health-risk basis.

The CSM is used to identify potentially complete exposure pathways by evaluating the source → transport → medium → exposure linkage. The CSM can then be used to identify where data gaps may exist by asking the question, what data are needed to determine if the exposure pathway is complete, and if so, is there is a risk associated with that pathway.

2.2 Risk-Based Screening Levels

Groundwater and surface water data are evaluated on a human health risk basis. Human health risk assessment is a process used to estimate the chance that contact with constituents in the environment may result in harm to people (USEPA, 1989). Generally, there are four components to the process: (1) Hazard Identification, (2) Toxicity Assessment, (3) Exposure Assessment, and (4) Risk Characterization.

One method used by USEPA in risk assessments is to develop “screening levels” of constituent concentrations in groundwater (and other media) that are considered to be protective of specific human exposures. This type of evaluation follows USEPA’s Risk Assessment Guidance for Superfund, Part B (USEPA, 1991). In this approach, a specific target risk level (component 4) is combined with an assumed exposure scenario (component 3) and toxicity information from USEPA (component 2) to derive an estimate of a concentration of a constituent in an environmental medium, for example groundwater, (component 1) that is protective of a person in that exposure scenario (for example, drinking water).

Risk-based screening levels are designed to provide a conservative estimate of the concentration to which a person (receptor) can be exposed without experiencing adverse health effects. Due to the conservative methods used to derive risk-based screening levels, it can be assumed with reasonable certainty that concentrations below screening levels will not result in adverse health effects, and that no further evaluation is necessary. Concentrations above conservative risk-based screening levels do not necessarily indicate that a potential risk exists, but indicate that further evaluation may be warranted.

Human health risk-based screening levels for groundwater are generally derived to be protective of the use of groundwater as a drinking water source. Human health risk-based screening levels for surface water are generally derived to be protective of the use of surface water as a drinking water source and the consumption of fish from a surface water body. The drinking water screening levels are also protective of recreational uses of a surface water body (such as swimming or boating) because drinking water exposure is of a higher magnitude and frequency.

The human health screening levels for groundwater and surface water used in this analysis are from federal and state sources and address the drinking water exposure pathway and the fish consumption pathway (where such values are available from the State). These sources are:

- Rules of Missouri Department of Natural Resources, Division 60 Safe Drinking Water Commission Chapter 4 Contaminant Levels and Monitoring. (MDNR, 2010a)
- 10 Missouri Code of State Regulations, Division 20, Chapter 7, Table A. Provides surface water criteria protective of human health fish consumption, drinking water supplies, and groundwater. (MO CSR, 2014)
- USEPA 2012 Edition of the Drinking Water Standards and Health Advisories, Spring 2012. (USEPA, 2012)
- USEPA Regional Screening Levels, May 2014, values for tapwater. (USEPA, 2014a)

The screening levels obtained from these sources are primary drinking water standards or maximum contaminant levels (MCLs) and secondary drinking water standards (SMCLs); Missouri has adopted the federal MCLs and SMCLs for the State. MDNR provides screening levels for the fish consumption exposure pathway. Risk-based regional screening levels (RSLs) from USEPA for tapwater (drinking water) have also been used in this evaluation. **Table 1** presents the screening levels used in this evaluation (the constituent list is discussed in Section 4.2). The screening levels are reported in units of milligrams of constituent per liter of water (mg/L).

3.0 Conceptual Site Model

This section provides the description of the preliminary site model for the Facility. The geology and hydrogeology sections are provided by Golder and are summarized in part from reports prepared for the Facility (Natural Resource Technology (NRT), 2012, 2014).

3.1 Setting

The Rush Island Energy Center includes the coal-fired power plant and the ash pond used for coal ash management, which is located approximately 300 to 400 feet from the Mississippi River at its closest approach. At its closest points, the meandering Isle Du Bois Creek is approximately 200 feet from the coal ash impoundment, and can be up to 1,000 feet away. The proposed UWL will be located within the footprint of the current impoundment, which will be closed to accommodate the landfill.

The City of Festus, Missouri, the closest municipality, is located approximately 11 miles northwest of the Facility. The City draws its drinking water supplies from groundwater wells located more than 7 miles from the Facility.

While the Facility is within the floodplain of the Mississippi River, the top of the berm of the ash impoundment is at an elevation of 410 feet above mean sea level (AMSL) and **above** the 100-year flood event elevation (406 feet AMSL). Bluffs rise over 330 feet above the floodplain and form the western border of the Facility. A rail line runs north to south along the base of the bluffs. Isle Du Bois Creek forms the southern border of the Facility and flows into the Mississippi River, separating the property from the closest neighboring industrial facility, which is located approximately 1,300 feet southwest of the impoundment. With the exception of this industrial neighbor, the Facility is bounded by woodlands. The nearest dwelling is more than 1.4 miles due west from the Facility impoundment, in the upland bluff area.

Figure 3 shows the locations of private wells within a one-mile radius of the Facility based on available State records. The majority of the wells are located in the upland hills beyond the bluffs, between Big Hollow and Johnson Roads. The area immediately west of the Facility, bounded by the railroad to the east, Johnson Road to the North, Du Bois Creek Road to the west, and Isle Du Bois Creek to the south (see **Figures 1 and 2**) is densely wooded and uninhabited, with the exception of areas in the immediate vicinity of Du Bois Creek Road. **Figure 4** shows the locations of community public water supply wells within seven miles of the Facility based on State database information. Specific discussion of the wells and locations is provided in Section 3.6.1 and **Appendix B**.

3.1.1 Geology

The Facility lies on two distinctly different geological terrains; floodplain deposits within the Mississippi River Valley and older sedimentary bedrock formations. The surficial geology in the floodplain is a result of flow and deposits of the Mississippi River. The underlying bedrock formations consist of sedimentary formations that extend across much of eastern Missouri and western Illinois. This bedrock is mainly comprised of limestone, dolomite, shale, sandstone and chert (Baker, 2001a, b, c) which are all common throughout this area. Over time, the Mississippi River has eroded the bedrock forming the Mississippi River Valley. Deposits from the sediment-laden flow of the Mississippi River

have filled the valley with clays, silts, sands, and gravels. It is these materials that make up the floodplains along the Mississippi River valley.

As a whole, the Mississippi River valley is a relatively flat area that lies between the bedrock bluffs to the northeast and southwest. The ground surface typically slopes gently from the bluffs towards the Mississippi River. Geologically, the clays, silts, sands, and gravels that make up the river valley are called floodplain alluvium or alluvial deposits (Baker, 2001d, e; Baker & Palmer, 2001; MEGA, 2007; MDNR, 2014a). This alluvium extends from bluff to bluff throughout the Mississippi River Valley with smaller alluvial deposits also present along larger streams. **Figure 5** displays the extent of the alluvial deposits and depicts where the deposits are located along larger flowing streams that flow into the Mississippi River. These alluvial deposits are Holocene in age which means that they are relatively recent in age on a geologic time scale. Baker reports that wells drilled into the floodplain alluvium encountered as much as 130 feet of alluvial deposits before bedrock was reached (Baker, 2001d, e; Baker & Palmer, 2001).

Below the sands, gravels, silts and clays of the floodplain alluvial deposits lies sedimentary bedrock. This bedrock is much older than the alluvial deposits, and was formed in the geologic Mississippian and Ordovician ages. The bedrock material is stronger and tighter (less permeable to water) than the relatively looser sands, gravels, silts and clays in the alluvial deposits that lie above the bedrock.

The bluffs on the western side of the river valley are also comprised of similar bedrock formations, but have not been as deeply eroded by the Mississippi River. The bedrock formations underneath the floodplain alluvial deposits are laterally continuous (**Figure 5**) while the alluvial deposits are limited to the river and creek floodplain areas.

3.1.2 Hydrology and Hydrogeology

The geology provides the setting for the surface water and groundwater – or hydrology and hydrogeology, respectively – in the area. Four surface water features (e.g., streams, rivers) lie in the immediate area around the Facility (**Figure 1**). The Mississippi River is on the northeastern boundary of the Facility and flows towards the southeast. Both the Muddy and Saline creeks lie north and west of the Facility. These two streams join together near the far northwestern part of the property boundary and flow towards the east-southeast where they discharge into the Mississippi River. The Isle Du Bois Creek flows along the southern boundary of the Facility property and flows towards the northeast where it discharges into the Mississippi River.

The headwaters of the Isle Du Bois Creek are about 3.5 miles to the southwest of the Facility. The Isle Du Bois Creek drains an area around Interstate 55, U.S. Route 61, and along Sawmill Hollow Lane east towards the Mississippi River. Prior to flowing into the Mississippi River, Isle Du Bois Creek drains the southern portion of the Facility.

Groundwater is present throughout this area in two distinctly different storage systems known as aquifers. Aquifers are underground layers of rock, sands, gravels, soils, etc., in which water is present and through which water can flow. A shallow aquifer consisting of sands, gravels, silts and clays of Mississippi River alluvial floodplain deposits in the Mississippi River Valley is called the alluvial aquifer. There are also aquifers within the bedrock, which are separated by confining layers. A confining layer is a geologic unit that does not readily transmit groundwater. Regionally, the aquifers within the bedrock are part of the Ozark Aquifer system.

The top elevation of the groundwater is called the water table. In general, the surface of the water table in these areas mimics the land surface elevation (topography) above it. The water table is

generally below the ground surface, except in areas such as where there are streams and rivers – in these areas the water table typically reaches the ground surface.

3.1.2.1 Groundwater Flow

Groundwater flow is described by Darcy's Law which states that the rate at which groundwater flows is equal to the product of the hydraulic conductivity multiplied by the hydraulic gradient (http://www.ngwa.org/). In simplified terms, the hydraulic gradient is the difference in groundwater elevations between two locations (or the slope of the water table) and the hydraulic conductivity can be described as a measure of how easily water flows through soil or rock. The elevation of the groundwater and how easily groundwater can flow through the materials that make up the specific aquifer are two major factors that determine the direction and velocity of groundwater flow.

3.1.2.2 Groundwater Elevation

Within an individual aquifer, groundwater flows from areas of higher water elevations (higher hydraulic pressure) to areas of lower water elevations. Groundwater flowing from a higher elevation to a lower elevation is considered to be flowing in a downgradient direction. Thus, water flows from upgradient locations to downgradient locations.

Areas of high water elevation are often associated with recharge areas, and are typically found at higher ground surface elevations. At these recharge areas, precipitation in the form of rain or melting snow percolates into the ground and reaches the aquifer. From these recharge areas, water will flow downgradient towards areas of lower water elevations where it may discharge. Discharge areas typically lie in low ground surface elevation areas and may contain surface water in the form of a lake or river.

3.1.2.3 Constraints on Groundwater Flow

Groundwater flows most easily in areas of least resistance. Water in streams and rivers is unconstrained – it can flow freely. Water will flow relatively easily through sand and gravel, and as the materials get more dense and compacted or contain more silt and clay, groundwater flow will become more constrained and consequently does not flow as easily. For example, water that is poured on more permeable sand and gravel will infiltrate or soak in quickly, whereas water poured on less permeable clayey soil or limestone bedrock will take longer to infiltrate or soak in.

The same is generally true in the subsurface. Groundwater can flow more easily in aquifers that are comprised of unconsolidated sands and gravels. Groundwater flow is typically more constrained in bedrock when compared to alluvial sand and gravel aquifers.

3.1.2.4 Groundwater Flow at Rush Island

As discussed above, groundwater flows from areas of higher water elevations (recharge areas) to areas of lower water elevations (discharge areas). In the Rush Island area, the Mississippi River under normal conditions is the lowest water level elevation towards which surface water and groundwater flow, thus it acts as a groundwater discharge location. Groundwater flow in the alluvial aquifer can generally be described as flowing from the base of the bluff areas in the west towards the Mississippi River to the east under normal river conditions (NRT, 2014). Groundwater in the bedrock under the bluffs and under the Mississippi River Valley generally flows from areas of topographic high ground, to areas of low ground, ultimately discharging into the Mississippi River (USGS, 1994). These concepts are illustrated in **Figure 6**.

The groundwater in the alluvial aquifer and underlying bedrock in the coal ash management area of the Facility will be addressed in a detailed site investigation (DSI) report. The DSI study will provide groundwater levels from different parts of the alluvial aquifer (shallow and deep), as well as groundwater flow characteristics in the uppermost bedrock. Current data collected near the coal ash management area indicates the alluvial aquifer ranges in thickness from 73 to 149 feet (NRT, 2014).

Groundwater levels within the alluvial aquifer outside of the coal ash management area range from ~356 to 376 feet above mean sea level (NRT, 2014) and fluctuate in response to changing water levels in the Mississippi River. (Between January and April of 2013, water levels within the alluvial aquifer increased by 6 to 27 feet in response to a 30 foot rise in river elevation over the same time frame (NRT, 2014)). Additionally, groundwater levels in the ash management pond are typically 20 to 30 feet higher than those in the surrounding alluvial aquifer (NRT, 2014).

Groundwater in the alluvial aquifer outside of the coal ash management area typically flows from west to east towards the Mississippi River (NRT, 2014), with a southerly component at times toward Isle Du Bois Creek. Additionally, groundwater in the deeper portions of the alluvial aquifer, beneath the coal ash management area, typically flows from west to east toward the Mississippi River (NRT, 2014).

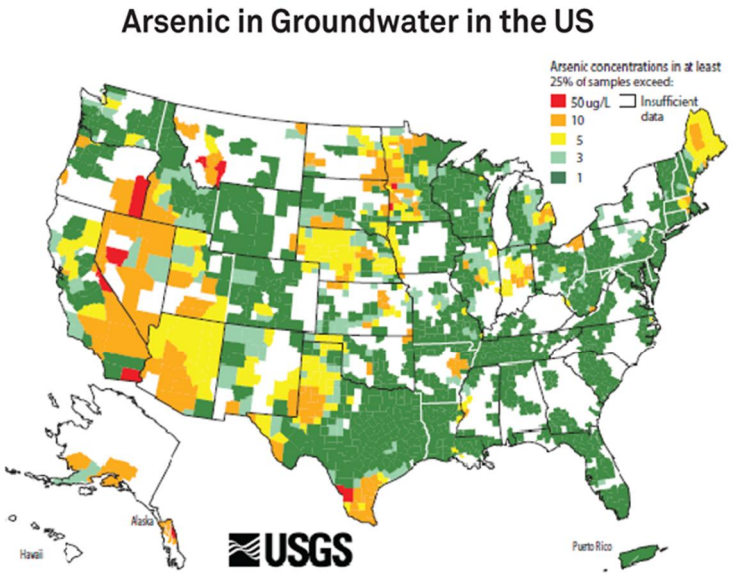
In 2014, Golder installed monitoring wells to determine the groundwater gradient, elevation and flow direction within the bedrock in the residential areas in the bluff area west of the Facility. Golder confirmed that groundwater in the bedrock locally flows towards the Mississippi River in a southwest to northeast direction (from higher areas in the bluffs to lower areas in the Mississippi River Valley). Water levels in the bedrock measured in the vicinity of the nearest private wells are approximately 20 feet or more **higher** than bedrock water levels near the Facility. The results of this study are consistent with regional descriptions of the Ozark Aquifer by the U.S. Geological Survey (USGS), where the Mississippi and Missouri Rivers are considered a major discharge area for groundwater moving north and east (USGS, 1994; USGS, 1997).

3.2 Constituents of Interest

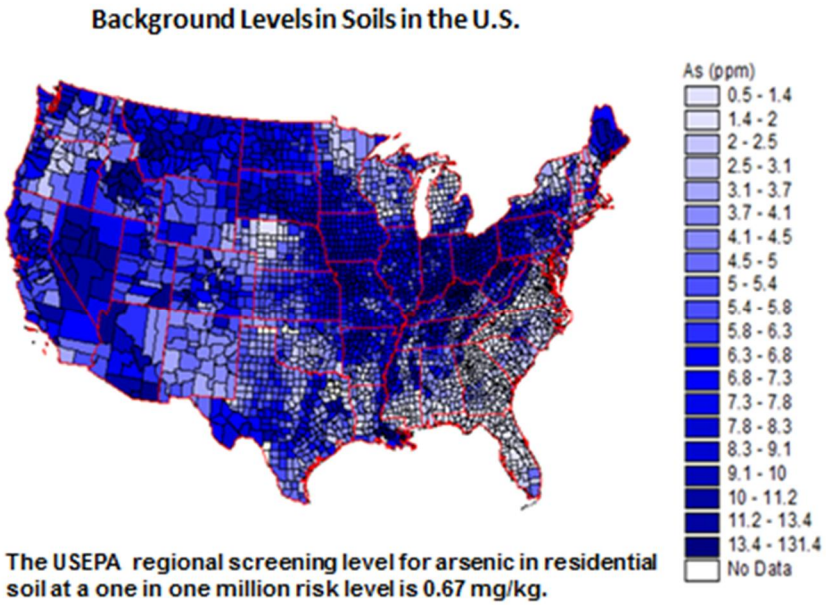
As coal ash is made up of inorganic elements and minerals left after the combustion of the organic material from the coal, the focus of this analysis is on inorganic elements and metals, including those that are mentioned most commonly in the press such as arsenic, cadmium, lead, mercury, and selenium. It is important to note that coal is a naturally occurring material in our environment, and the inorganic constituents present in coal ash are similarly naturally occurring.

The USGS has studied extensively the presence of naturally occurring inorganic constituents in our environment and in 2011 published a report titled “Trace Elements and Radon in Groundwater Across the United States” (USGS, 2011). **Figure 7** shows a map of arsenic concentrations in groundwater in the U.S. (USGS, 2001). The area around Jefferson County, and southern Missouri in general, are shown to have arsenic concentrations of 1 microgram per liter of water (ug/L) in at least 25% of groundwater samples in each county. The USEPA drinking water standard, or MCL, for arsenic is 10 ug/L (USEPA, 2012). However, the USEPA risk-based screening level for tapwater for arsenic is 0.052 ug/L (USEPA, 2014a). As can be seen from **Figure 7**, the natural concentration of arsenic in almost all groundwater in the U.S. is above this level. The presence of arsenic in groundwater is related to the fact that arsenic is also naturally occurring in soils in the U.S. Information on naturally occurring levels in soils is provided by USGS as part of their national Geochemical Survey Program (USGS, 2013c). **Figure 7** also shows a map of arsenic concentrations in soils in the U.S. (USGS, 2013b). These figures are shown below, and full page versions are provided in the figures section.

Figure 8 provides USGS maps of concentrations in soil in Missouri for a variety of constituents, and the results for Jefferson County are highlighted (USGS, 2013a). Appendix A provides more detailed information on naturally occurring levels of inorganic constituents in soils in the U.S. and levels in coal ash.



The USEPA regional screening level for arsenic in tapwater at a 1 in one million risk level is 0.045 µg/L.



The USEPA regional screening level for arsenic in residential soil at a one in one million risk level is 0.67 mg/kg.

Because all of the constituents in coal ash are naturally occurring, it is important to distinguish between the natural, or background, concentrations in the environment, and those concentrations that may be derived from releases from coal ash management locations. For this Report, these latter concentrations are referred as coal ash-derived.

Because these constituents occur naturally, their presence alone in groundwater **does not** indicate that there has been a release from a coal ash management location. Several lines of evidence must be evaluated before a conclusion can be drawn about whether a specific groundwater sample has been impacted by a coal ash management location. These considerations include:

- *Is the sample location downgradient or upgradient from the coal ash management location?* It is only possible for coal-ash derived constituents to be present if the sampled location is hydrologically downgradient of the coal ash management location.
- *Do the samples and the coal ash management unit share the same aquifer?* For example, at the Rush Island Energy Center, the coal ash management area is a pond constructed in a borrow area used to construct the Rush Island Facility. Investigations have shown that ash is present very close to the base of the alluvial aquifer in some areas of the impoundment (NRT, 2014).
- *What is the pattern of constituents present and at what concentration?* Boron and sulfate are considered to be signature indicators in groundwater of coal ash; however, both must be present at high concentrations (relative to background) (EPRI, 2006) in order for a potential release to be attributable to a coal ash management location.

3.3 Coal Ash Management Locations

There are several pathways for potential release of coal ash-derived constituents to the environment at the Facility.

3.3.1 Ash Ponds

There is one unlined ash pond at the Facility. The ash pond is located adjacent to both the Isle Du Bois Creek and the Mississippi River. Coal ash at the bottom of the pond is likely to contact groundwater as such levels fluctuate within the river basin. A groundwater monitoring program for the closure of the impoundment, and a groundwater monitoring program for the DSI have been detailed in work plans submitted to the MDNR (NRT, 2012, 2014). Surface discharge to the Mississippi River from the ash pond is monitored under the current NPDES permit and the Facility's 2009 re-application. Available data were reviewed and data gaps identified. Data collection studies for the Mississippi River, the Isle Du Bois Creek and the bluff bedrock region were conducted to assess the potential for offsite impacts from the ash pond.

3.3.2 NPDES Permitted Outfall

Surface discharges from the ash ponds are monitored under a NPDES permit to the Facility (NPDES Permit #: MO-0000043). The Facility's four outfalls are covered under the NPDES permit:

- Outfall 001 is the discharge from once-through cooling water systems. The outfall is considered a non-process waste stream.
- Outfall 002 is the discharge from the plant's wastewater treatment pond. The pond provides treatment for fly ash and bottom ash sluice water, low volume wastes, and storm water runoff. The outfall is considered a process waste stream.

- Outfall 003 is for sewage treatment plant effluent. The outfall is considered a non-process waste stream.
- Outfall 004 is for storm water runoff.

Outfall 002 is monitored and the maximum daily values for a range of inorganic constituents are reported in the 2009 NPDES permit application; the location of Outfall 002 is shown on **Figure 9**. Outfall 002 discharges to the Mississippi River, just upstream of the discharge point of Isle Du Bois Creek.

3.4 Potential Constituent Transport Pathways

Coal ash-derived constituents can move into underlying soils and to groundwater, and can be transported within groundwater as a result of groundwater flow. However, a variety of geophysical/geochemical mechanisms can occur that can serve to attenuate constituent concentrations within groundwater. The extent of attenuation is dependent upon the constituent chemistry, the initial concentration, the local geology and hydrogeology, and the distance the groundwater travels. Groundwater from the Facility ultimately will discharge to the Mississippi River, and, depending on river stage and precipitation, the Isle Du Bois Creek may function as a groundwater receptor. The discharge of NPDES Outfall 002 is to the Mississippi River, just upstream of the discharge point of Isle Du Bois Creek.

3.5 Receptors and Potential Exposure Pathways

Groundwater will flow from the coal ash management area to downgradient areas. For users of drinking water to be exposed to groundwater impacted by coal ash, water supply wells would need to be located in an aquifer both hydrologically connected and downgradient of the ash pond. Thus, while the use of groundwater as drinking water may be considered to be a *potential* exposure pathway, it can be a complete pathway if and only if coal ash-derived constituents from the Facility are impacting groundwater wells used for drinking water. Based on groundwater flow directions discussed above, the physical location of the ash pond, and the absence of private drinking water wells downgradient from the coal ash management area (i.e., between the coal ash management area and the Mississippi River), this potential exposure pathway is incomplete.

Figure 3 shows the locations of private wells within a 1-mile radius of the Facility. There are approximately 16 wells recorded in state databases within this 1-mile radius. As can be seen, these wells are located west and upgradient of the Facility; there are no wells located between the coal ash management area and the Mississippi River. As discussed in Section 3.1.2, typical groundwater flow will be in a west to east direction and away from bluff areas where residential wells are located.

The discharge from the NPDES permitted Outfall 002 is to the Mississippi River. Groundwater also may discharge to the Mississippi River and to Isle Du Bois Creek. Isle Du Bois Creek is not a source of drinking water, thus this exposure pathway is incomplete.

In additional to pathways related to drinking water usage, surface water bodies were evaluated based upon potential recreational user exposure. Since the Creek could be used for wading, the recreational user exposure pathway was considered in this evaluation as potentially complete. In addition, recreational users of the Mississippi River could have direct contact with river water. Thus, under this evaluation, the recreational user exposure pathway is treated here for evaluation purposes as potentially complete. Lastly, the Mississippi River is a source of drinking water for the City of Chester, Illinois. The drinking water intake is located approximately 30 miles downstream from the Facility at the Chester Community Water Supply. **Figure 11** shows the location of Chester, Illinois

and the Facility. Thus, under this evaluation the drinking water exposure pathway is treated here as potentially complete.

3.6 Evaluation of Groundwater CSM

Consistent with construction practices of the 1970's, the Facility's coal ash pond is unlined and, therefore, may impact underlying groundwater. Because groundwater is used as source of drinking water within Jefferson County, the use of groundwater as drinking water pathway may be considered to be a complete exposure pathway **if and only if** coal ash-derived constituents from the Facility are impacting the local drinking water well supplies.

3.6.1 Location of Wells in the Vicinity of the Facility

The locations of non-community public, private, and public-industrial wells within approximately 1 mile of the Facility property within Missouri are plotted on **Figure 3** and details of the wells (reference ID number, year of installation, owner, coordinates, screened/open interval, total depth, etc.) are displayed in **Table 2**. The figure and table were generated using six different data sources which are: 1) the University of Missouri-Columbia, Missouri Spatial Data Information Service (MSDIS, 2013), 2) the MDNR Water Resources Center (MDNR, 2013b), 3) the Missouri Environmental Geology Atlas 2007 (MEGA, 2007), 4) the MDNR Wellhead Protection Program data (MDNR, 2013a), 5) MDNR Geosciences Technical Resource Assessment Tool (GeoSTRAT) (MDNR, 2014a), and 6) Public Drinking Water System Reports, Center for Applied Research and Environmental Systems (CARES, 2013).

Based on a review of state well information, county property records, and field reconnaissance, there appear to be 16 wells in Jefferson and Ste. Genevieve counties recorded in the state databases within the 1-mile radius of the Facility property boundary as shown on **Figure 3**. As displayed in **Table 2**, eight (8) are non-community public wells, one (1) is a private irrigation well installed on plant property, and seven (7) are private wells presumably used for drinking water purposes. **Appendix B** contains a detailed review of the state database records and explanation of the locations plotted on **Figure 3**.

In addition to private wells, the locations of the community public water supply wells, public industry and large business wells are shown on **Figure 4**, and listed on **Table 3**. Within a 7-mile radius of the facility property, 15 active or emergency public wells were identified using the MEGA (2007) and CARES (2013) databases. Of these 15 wells, one is listed as being located within 1-mile of the Facility property. This well is owned by Holcim (US) Inc. (Well # 4182616101) and is listed as being an Industrial & Large Business well. One additional well is located within 3 miles of the Facility property and there are 8 total public wells within 5 miles of the Facility. These are all deep wells, with approximately half of them having total well depths in excess of 1,000 feet below ground surface.

The State of Missouri regulates the installation of drinking water wells. The MDNR regulations require that drinking water wells in this area of Ste. Genevieve and Jefferson counties that are drilled into bedrock must be installed with at least 80 feet of casing that extends a minimum of 30 feet into bedrock (*10 CSR 23-3.090* of the Missouri well construction rules). Additionally, the lowermost 30 feet of casing must be sealed with approved grout materials, and full-length grouting is preferred by the MDNR. The seal is required so that surface contaminants cannot enter the drinkable groundwater. Below the seal and casing lies the open/screened interval, where water from the surrounding aquifer can enter into the well and be pumped out for use.

The location where wells can be drilled for the purpose of obtaining water for drinking, irrigation, livestock or other uses (excluding monitoring wells and heat pumps) is discussed in section 10 CSR

23-3.010. As stated in the Missouri well construction rules pertaining to landfills and lagoons, a well shall meet the following requirements:

- *10 CSR 23-3.010(2)(A)(1):* Must be located at least three hundred feet from a storage area for commercial fertilizers or chemicals, landfill, lagoon, above ground or underground storage tank, distribution lines for liquid petroleum, petroleum products or chemicals.

- *10 CSR 23-3.010(2)(B) Waste landfill or lagoons*: The safe distance that a well should be located from a waste landfill or waste stabilization pond (lagoon) cannot be assigned a fixed number because of the varieties of hydrologic and geologic parameters associated with the undetermined types and amounts of materials that may be carried by groundwater from leachates discharged from the waste landfill or waste stabilization ponds (lagoons). Wells should not be located in an area between the landfill or lagoon sites and the point of groundwater discharge to a surface water source. Any well that may intercept leachates shall not be used for human consumption and must be plugged unless it is used for a monitoring well.

Taken together, these installation requirements effectively preclude the use of the alluvial aquifer as a residential drinking water supply source. Given Ameren's sole ownership and the fact that Ameren owns the property between the coal ash management area and the River, it is not possible for private residential wells to be located in the alluvial aquifer *downgradient* of the coal ash management area. In addition, the relatively few (15) private wells located within a 1 mile radius are upgradient of the Facility. Large areas of land to the west of the Facility between Muddy Creek to the north and Isle Du Bois Creek to the south are undeveloped as can be seen from **Figures 1 and 2**.

3.6.2 Groundwater Flow, Well Depth, and Aquifer Source

Under normal river flow conditions the groundwater within the alluvial aquifer typically flows from west to east towards the Mississippi River. Under short-term, high river conditions, groundwater could temporarily flow westward and away from the Mississippi River. These short lived changes in flow direction are typically localized and occur within the alluvium in response to high water levels in the Mississippi River, and occur due to the relative ease of groundwater flow in the unconsolidated alluvial deposits.

As shown on **Figures 5 and 6**, the alluvial aquifer thins, or pinches out, and does not extend into the bluff and hilly upland area to the west. Based on the information obtained from the State well databases (**Table 2**), all of the private wells (7) and all of the non-community public (8) wells are located on the bedrock bluffs to the west of the Facility. The exceptions are that one (1) private irrigation north of the Facility and two (2) non-community public wells, all owned by Ameren exist within the Rush Island Facility boundary.

The 7 residential wells are screened in the bedrock at depths ranging from 100-200 ft below ground surface (bgs) (three wells); between 200-300 ft bgs (two wells), and two (2) wells are between 300-400 ft bgs. The average private well depth is approximately 240 ft bgs. All of these wells are screened into bedrock, most having screened intervals beginning greater than 80 ft bgs. **Appendix B** contains copies of the State well database information and Golder's assessment of the records as plotted on **Figure 3**. None of these wells extract any water from the alluvial aquifer.

For ease of reference, the wells listed within a one-mile radius of the Facility have been numbered, as shown in **Table 2**. Based on the state database coordinates, the closest well to the coal ash management area is well #7 (Missouri Well ID 0179087), which is approximately 1.5 miles in an

upgradient location, as shown in **Figure 3**. This well has a screened interval of 80-215 ft bgs with a total depth of 215 feet and bedrock was encountered at 35 feet.

Eight (8) non-community public wells and one public/industrial and large business well are located within one mile of the Facility. Of these, six (6) have total depths greater than 1000 ft bgs, two (2) have total depths of ~425 ft bgs, and one well record has no information about its total depth. None of these wells have screening intervals that commence less than 267 ft bgs, and most wells commence screening at depths greater than 750 ft bgs. Therefore, all such wells are cased at least 267 feet into bedrock and do not extract any water from the alluvial aquifer.

In summary, based on review of the wells records in the vicinity of the Facility, private drinking wells, non-community public wells and public/industrial wells receive water from the Ozark Aquifer and not the alluvial aquifer within the Mississippi River Valley.

Furthermore, it is critical to note that the alluvial aquifer does not extend beyond the floodplain of the Mississippi River and the nearby creeks. Accordingly, any potential release of coal ash constituents at the Facility would not extend to the bedrock aquifer in the bluffs and hilly uplands area where residential wells are located.

Accordingly, from the well records alone, it is apparent that the groundwater drinking water pathway is incomplete. Any potential release of coal ash constituents from the ash pond system would result in an impact to the alluvial aquifer, and the prevailing flow of this groundwater is towards the Mississippi River and, potentially, to Isle Du Bois Creek. Based on bedrock groundwater gradients measured in the bluff and residential hilly upland areas and the strong flow direction to the east and northeast, any such constituents cannot migrate to the area of the bedrock used for drinking water west of the Facility. The ash pond system has not impacted groundwater that is used as drinking water. Furthermore, without a complete exposure pathway, there can be **no risk** to human health through use of the bedrock groundwater as a drinking water source.

3.6.3 Groundwater Data Gaps

In 2014, Ameren Missouri directed Golder to conduct a groundwater study to determine whether historic ash management practices at the Facility has resulted in off-site impacts. Golder installed three monitoring wells to collect site-specific data such as groundwater flow direction within the bedrock, and assess groundwater quality data. By examining the groundwater gradient within the bedrock at three locations (TBW-1, TBW-2 and TBW-3) (**Figure 10**) located near the closest residential wells to the Facility, Golder confirmed that groundwater within the bedrock flows in an east to northeast direction (from high areas of the bluffs to the low areas of the Facility and the Mississippi River). The groundwater sample locations were located in proximity to the closest residential wells to the Rush Island property boundary and the existing ash management area (see **Figure 10**). The groundwater quality data for these locations reflect that groundwater quality near and around such residential wells fully complies with safe drinking water standards (See Section 5).

3.7 Evaluation of Surface Water CSM

Both the Creek and the River can be used for recreational purposes. The Mississippi River is also used as source of drinking water for the City of Chester, Illinois via a water intake approximately 30 river miles downstream from the Facility (**Figure 11**). Accordingly, for purposes of this evaluation of surface water, it is assumed that an exposure pathway is potentially complete, and this potential exposure pathway is evaluated further.

3.7.1 Data Gaps – Isle Du Bois Creek

Isle Du Bois Creek is not a source of drinking water, but can be used for recreational purposes such as wading. Since there are no existing water quality data available for Isle Du Bois Creek, Golder collected surface water quality data for locations on Isle Du Bois Creek upstream, midstream, and downstream of the Facility. As the Creek forms or is very near to the southern boundary of the Facility, a downgradient location near where the Creek discharges to the Mississippi River was selected as an appropriate sample location. These sample locations are shown on **Figure 9**. These data are evaluated in the risk-based screening presented in Section 5.

3.7.2 Existing Surface Water Data – Mississippi River

3.7.2.1 NPDES Outfall 002

Analytical data are available for the Facility's NPDES Outfall 002 from 2009 "NPDES Permit MO-0000043 Renewal Application." These data are representative of the concentrations of a comprehensive list of inorganic constituents. The outfall location is shown on **Figure 9**. These data are evaluated in the risk-based screening presented in Section 5.

3.7.2.2 Surface Water Databases

The STORET (short for STOrage and RETrieval) Data Warehouse is a repository for water quality, biological, and physical data and is used by state environmental agencies, USEPA and other federal agencies (USEPA, 2014b). Locations within the Lower Missouri watershed were accessed, and **Figure 12** shows the locations of data collection points where quantitative analytical data are available within 30 miles upstream and downstream of the Facility. The data are available for a limited analytical list, and the majority of the data are for dissolved constituents. The data are shown on **Table 4**, and are discussed in Section 5.

3.7.3 Data Gaps – Mississippi River

The Mississippi River is a recreational resource as well as a source of drinking water for the City of Chester, Illinois. Although surface water data are available for the Mississippi River for various locations both upstream and downstream of the Facility (data are not available from the City of Chester drinking water intake), such data are limited to specific analytical parameters only. Golder collected surface water quality data at locations on the Mississippi River immediately upgradient and downgradient of the Facility, testing for a complete set of analytical parameters. These sample locations are shown on **Figure 9**. These data are evaluated in the risk-based screening presented in Section 5.

4.0 Data Collection

To further address the potential groundwater exposure pathway, Ameren Missouri installed monitoring wells west of the Facility and in an area where private wells are used for drinking water. To address the potential surface water exposure pathway, Ameren Missouri conducted an investigation of surface water at locations both upstream and downstream of the Facility on the Mississippi River and upstream, midstream and downstream on Isle Du Bois Creek, which is on the southern boundary of the Facility and is a tributary to the Mississippi River. These investigations are discussed below.

4.1 Groundwater Sample Collection and Analysis

As noted above, in 2014, Ameren Missouri directed Golder to conduct a groundwater study to determine groundwater flow direction within the bedrock, and to collect groundwater quality data.

Three piezometers were installed with screened intervals in bedrock at similar depths to nearby residential water wells. The piezometer locations are shown on **Figures 9 and 10**. As shown on **Figure 10**, and below, the piezometers were located in proximity to the residential wells closest to the Rush Island Energy Center property boundary (the closest private drinking water well is approximately 6000 feet from the coal ash management area). The geologic cross-section in **Figure 6** shows the location, depth, and screened interval for TBW-1 and TBW-3 and nearby residential wells. Groundwater quality data are presented and evaluated in Section 5.

The new piezometers (TBW-1, TBW-2, and TBW-3) were constructed as three-inch diameter open-hole completions in bedrock with three-inch diameter schedule 40 polyvinyl chloride (PVC) casing extending at least 80 feet bgs with a minimum of 30 feet placed into competent bedrock. The casing was grouted into bedrock using a cement bentonite grout to form a seal above the open interval. A small concrete surface pad and protective steel cover were formed in the concrete surface seal. The riser extends approximately 3 feet above the ground surface to facilitate groundwater sampling. After completion, Zahner & Associates, Inc. provided professional land survey of the three new piezometers.

New piezometers were developed using surging and purging techniques. A stainless steel bailer was lowered into each piezometer and used to surge and remove drilling sediment from the bottom of each installation. A submersible electric pump with polyethylene tubing was lowered into each piezometer and at least three well-bore volumes of groundwater were removed. Development was deemed complete when at least three consecutive reading of field parameters (pH, specific conductivity, and temperature) were within 10% of previous measurements and turbidity was less than 20 nephelometric turbidity units (NTU).

Groundwater samples were collected and submitted for laboratory analyses after three well-bore volumes were removed using a submersible electric pump, turbidity was below 15 NTU, and three consecutive sets of field parameters were stabilized within 10% of previous measurements including pH, specific conductivity, and temperature, and within 0.1 for pH.

Groundwater samples were collected into laboratory-supplied containers directly from the pump tubing discharge. Clean, new tubing was used for each sample and non-dedicated equipment such as the submersible pump were decontaminated between samples using Alconox™ solution and potable

water followed by a deionized water rinse. One duplicate groundwater sample was collected from TBW-1 for quality assurance/quality control (QA/QC) purposes. One equipment rinsate blank was collected from the submersible sampling pump using laboratory grade de-ionized water and analyzed at the laboratory. After collection in the field, groundwater samples were labeled with the sample identification number, requested analysis, collection date, and sampler's initials, and placed on ice in a cooler for shipment under chain-of-custody protocol via overnight transport to the Lancaster Laboratories – Lancaster, Pennsylvania laboratory.

4.2 Surface Water Sample Collection and Analysis

Surface water samples were collected by Golder on April 17 and 18, 2014 from Isle Du Bois Creek and the Mississippi River. Sample locations are displayed on **Figure 9**. Validated analytical results from this sampling are displayed on **Table 5** and are discussed in Section 5. Water quality parameters are shown in **Table 6**. Samples were analyzed for the inorganic analytes listed on **Table 1.** The analyte list was selected to be consistent with the NPDES permit application analyte list as the list is comprehensive and approved by the State. Because the radiological parameters included on the NPDES list do not exceed screening levels, these parameters were not included in the surface water sampling program. The following paragraphs summarize the surface water sampling effort.

Isle Du Bois Creek sampling was completed by Golder on April 17, 2014 and consisted of nine surface water sample locations accessed by wading. Three Creek locations at the far southern end of the Facility property were sampled in the following order: downstream, midstream, and upstream. Samples were collected at the following locations within the creek:

- Near bank on the side closest to the Rush Island Energy Center
- At the midway point between the center of the Creek and the bank closest to the Rush Island Energy Center
- At the center of the Creek

Surface water samples were submitted to an independent environmental laboratory (Lancaster Laboratories, Lancaster, PA) for filtered (dissolved) and unfiltered (total) analysis. For unfiltered samples, water was collected into a clean sample collection container by direct filling of the container from surface water. For filtered samples; a polyethylene bailer was filled, followed by field filtering the water out of the bailer using a 0.45 micron filter. Samples were then placed on ice and sent to Lancaster Laboratories for analytical testing under chain-of-custody procedures. Clean, new, sampling equipment (bailers, etc.) were used to collect each sample following industry standard protocols for environmental sampling.

Sampling of the Mississippi River was completed on April 18, 2014. Ten locations were sampled in the Mississippi River. The first five of these samples were collected approximately 0.25-mile downstream of the downstream Rush Island Energy Center property boundary and the second five samples were collected approximately 0.25-mile upstream of the Facility upstream property boundary. Samples were collected both at the surface and at mid-depth within the Mississippi River, where possible. Downstream and upstream samples were collected in the following places in the River:

- A surface sample near the bank of the Mississippi River on the side nearest to the Rush Island Energy Center (west side) in water less than 4 feet in depth
- A surface and mid-depth sample near the midway point between the riverbank nearest the Rush Island Energy Center and the center of the Mississippi River
- A surface and mid-depth sample collected near the center of the Mississippi River

A powered boat with sonar depth sounding equipment was used to access the Mississippi River sampling locations and measure river water depths. Unfiltered surface samples were obtained by collecting water into a clean sample collection container by direct filling of the containers from surface water. Filtered surface samples were obtained by filling a polyethylene bailer, followed by field filtering the water out of the bailer using a 0.45 micron filter. Mid-depth samples were obtained by lowering tubing attached to a 35-pound weight to the mid-depth-point of the river. Once the desired depth was reached, a peristaltic pump was attached to the tubing and used to evacuate at least three tubing-volumes of water prior to water sample collection. Following the water purge, unfiltered samples were collected directly from the tubing. For filtered samples, a 0.45 micron filter was attached to the end of the tubing and water was transferred through the filter into the sample containers. Clean, new, sample containers, tubing, and bailers were used at each sample location, as needed. Samples were immediately placed on ice and shipped to Lancaster Laboratories for analytical testing using chain-of-custody procedures.

4.3 Data Validation

The sample validation memorandum is provided in **Appendix C**.

5.0 Results and Evaluation

This section presents the results and evaluation of the screening of available data sets to the screening levels provided in Section 2. Section 5.1 presents the groundwater data evaluation, and Section 5.2 presents the surface water screening results.

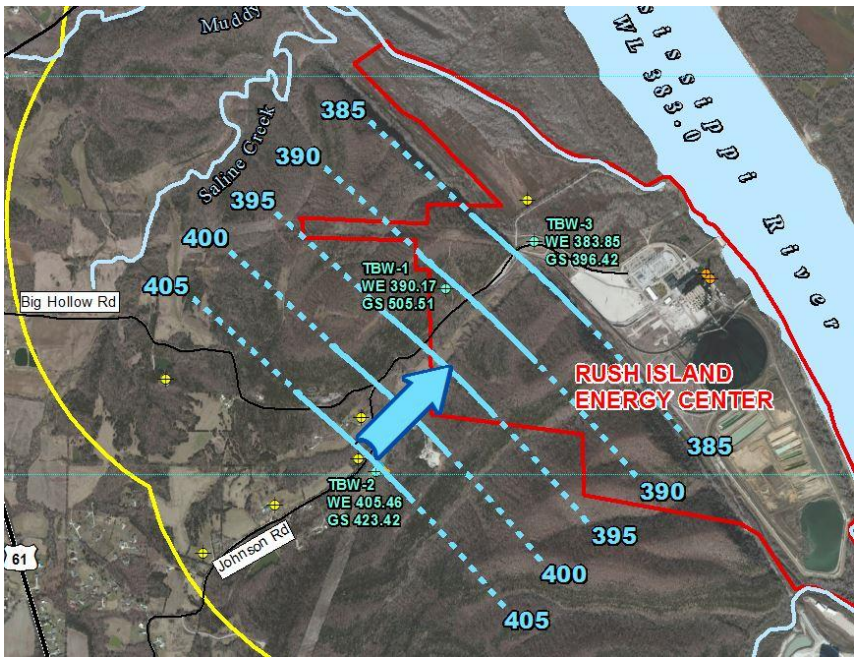
5.1 Groundwater Data

This section presents the upgradient monitoring well data evaluation.

As discussed in Section 4.1, bedrock groundwater samples were collected in April and June 2014 for laboratory analysis. The well locations are shown on **Figures 9 and 10**, and they are completed into bedrock at depths similar to nearby residential water wells within 6,000 feet of the coal ash management area. The well depths are shown in the table below.

Well Name / Date Installed	Total Depth (feet below ground surface)	Screen/Open Interval (feet below ground surf)
TBW-1 (April 21, 2014)	239.5	81.5-239.5
TBW-2 (April 11, 2014)	118.2	81.5-118.2
TBW-3 (May 28, 2014)	249.6	132.5-249.6

Evaluation of water level measurements in these three wells (TBW-1, TBW-2, and TBW-3) indicates that bedrock groundwater is flowing from the bluff area towards the Mississippi River, in a northeast direction, as shown below and in more detail on **Figure 10**.



As indicted in **Table 7**, all results are **below** federal drinking water standards and/or risk-based screening levels. Another critical aspect to any review of groundwater data associated with coal ash management units generally is the presence, or lack thereof, of elevated concentrations of sulfate and boron. These indicator parameters will be present in elevated concentrations if a release from a coal management unit has occurred (EPRI, 2006). Notably, boron and sulfate, the signature identifiers for coal ash, are present at low concentrations that are below risk-based screening levels and are consistent with background water quality. Furthermore, arsenic was not detected in these wells. Taken together, these bedrock groundwater data are consistent with groundwater that is not affected by constituents from coal ash management facilities.

5.2 Surface Water Data

Two data sets have been collected by Ameren Missouri and evaluated to address surface water:

- Rush Island Power Plant National Pollutant Discharge Elimination System 2009 Renewal Package – Outfall 002.
- Surface Water samples collected from Isle Du Bois Creek and the Mississippi River, April 2014.

5.2.1 NPDES Data

Table 8 presents a comparison of the NPDES data to the surface water surface water screening levels (presented in Section 2, and **Table 1**). The majority of constituents **did not** exhibit concentrations above surface water screening levels or were not detected, including:

- Antimony**
- Barium
- Beryllium**
- Boron
- Bromide
- Cadmium**
- Chromium
- Cobalt**
- Copper
- Cyanide**
- Lead**
- Magnesium
- Manganese
- Mercury**
- Molybdenum
- Nickel
- Nitrate-Nitrite (as N)
- Selenium
- Silver**
- Sulfate
- Sulfide
- Sulfite
- Surfactants
- Tin**
- Titanium
- Zinc

Radioactivity

- Alpha**
- Beta
- Radium (total)**
- Radium 226**

[** - Not Detected]

Constituents detected above surface water screening levels include:

- Aluminum – USEPA SMCL
- Arsenic – USEPA RSL (below MCL)
- Fluoride – USEPA RSL (below MCL)
- Iron – SMCL and Missouri state water quality value for groundwater
- Thallium – human health fish consumption, drinking water (state and federal)

The comparison of the discharge data directly to the surface water screening levels is very conservative as concentrations from the Outfall are mixed with surface water and diluted quickly. Thus, these data are not predictive of constituent concentrations in surface water. Therefore, a comparison of surface water data to screening levels is presented below.

5.2.2 Isle Du Bois Creek Surface Water Data

Surface water data for Isle Du Bois Creek are presented in **Table 9** (total/unfiltered results) and **Table 10** (dissolved/filtered results). Detected concentrations are compared to human health surface water screening levels in both tables; note that only the filtered/dissolved concentrations are compared to the human health fish consumption screening levels. Per the MDNR regulations, those screening levels are intended for use with filtered data.

A number of constituents were **not detected** in the Isle Du Bois Creek surface water samples; these are:

- Antimony
- Beryllium
- Cadmium
- Cyanide
- Fluoride
- Mercury
- Silver
- Thallium
- Tin

The following additional constituents were **not detected** in the Isle Du Bois Creek filtered samples:

- Aluminum (dissolved)
- Arsenic (dissolved)
- Cobalt (dissolved)
- Copper (dissolved)
- Iron (dissolved)
- Lead (dissolved)
- Nickel (dissolved)

As indicated in **Table 9**, the majority of constituents in the total (unfiltered) samples do not have detected concentrations above screening levels, including the following (constituents lacking screening values are not included, such as essential nutrients and hardness):

- Barium
- Boron

- Chromium
- Cobalt
- Copper
- Lead
- Molybdenum
- Nickel
- Nitrate/Nitrite
- Selenium
- Sulfate
- Zinc

As indicated in **Table 10**, with the exception of manganese, detected results for filtered samples are below human health surface water screening levels. **It is worth noting here that both boron and sulfate concentrations are low in the Isle Du Bois Creek samples.**

The following constituents have detected concentrations above risk-based screening levels in at least one total (unfiltered) sample:

- Aluminum – Total (unfiltered) aluminum concentrations in upstream, midstream, and downstream are above the SMCL, which is a secondary standard based on prevention of post-treatment precipitation in a water distribution system. All of the detected concentrations of aluminum are below the USEPA tapwater screening level. Aluminum concentrations in upstream, midstream, and downstream Isle Du Bois Creek surface water samples are above the NPDES outfall concentration for aluminum with the exception of one result. Aluminum concentrations in the downstream samples are higher than the upstream samples. However, aluminum was not detected in any of the dissolved/filtered samples. Thus, it can be concluded that the downstream total aluminum concentrations are a result of suspended particulate/sediment in the samples, and are not associated with Facility operations.
- Arsenic – Total (unfiltered) arsenic concentrations in upstream, midstream, and downstream are below the state and federal drinking water standard, but are above the USEPA tapwater screening level. Arsenic concentrations in upstream, midstream, and downstream Isle Du Bois Creek surface water samples are less than the NPDES outfall concentration for arsenic. Arsenic concentrations in the downstream samples are slightly higher than the midstream and upstream samples. However, arsenic was not detected in any of the dissolved/filtered samples. Thus, it can be concluded that the downstream total arsenic concentrations are a result of suspended particulate/sediment in the samples, and are not associated with Facility operations.
- Iron – Iron was not detected in any dissolved/filtered samples, and was detected above the SMCL in all of the total/unfiltered samples. The SMCL is a secondary standard based on aesthetic effects (unpleasant metallic taste and staining of fixtures). All of the detected concentrations are below the USEPA tapwater screening level, and are similar to or lower than the NPDES outfall concentration. The iron concentrations in the downstream samples are only slightly higher than the midstream and upstream samples. Because iron was not detected in the dissolved/filtered samples, it can be concluded that the downstream total iron concentrations are a result of suspended particulate/sediment in the samples, and are not associated with Facility operations.

- Manganese – Manganese concentrations in the co-located samples are higher in the total than in the dissolved samples, thus some component of the total manganese results are likely associated with suspended sediments. The downstream sample concentrations are approximately 10-15% higher than in the upstream samples. All detected concentrations of manganese are above the SMCL, which is based on aesthetic effects (unpleasant taste and black staining of fixtures), but the concentrations are below the USEPA tapwater screening level, and lower than the NPDES outfall concentration.

5.2.3 Mississippi River Surface Water Data

Surface water data for the Mississippi River are presented in **Table 11** (total/unfiltered results) and **Table 12** (dissolved/filtered results). Detected concentrations are compared to human health surface water screening levels in both tables; note that only the filtered/dissolved concentrations are compared to the human health fish consumption screening levels. Per the MDNR regulations, those screening levels are intended for use with filtered data.

A number of constituents **were not detected** in the Mississippi River surface water samples; these are:

- Antimony
- Beryllium
- Cadmium
- Cyanide
- Mercury
- Silver
- Thallium
- Tin

The following additional constituents were **not detected** in the Mississippi River filtered/dissolved samples:

- Chromium (dissolved)
- Cobalt (dissolved)
- Copper (dissolved)

Because these constituents listed above are not present in the dissolved form (**Table 12**), their total concentrations in unfiltered/total samples (**Table 11**) are due entirely to their association with particulates/suspended sediment in those samples and are not associated with Facility operations.

As indicated in **Table 11**, the majority of constituents in the total (unfiltered) samples do not have detected concentrations above screening levels, including the following (constituents lacking screening values are not included, such as essential nutrients and hardness):

- Barium
- Boron
- Chromium
- Cobalt
- Copper

- Fluoride
- Lead
- Molybdenum
- Nickel
- Nitrate/Nitrite
- Selenium
- Sulfate
- Zinc

Similar to the Isle Du Bois Creek results, as indicated in **Table 12**, with the exception of arsenic, detected results for filtered samples are below human health surface water screening levels.

The following constituents have detected concentrations above risk-based screening levels in at least one total (unfiltered) sample:

- Aluminum – The concentrations of total aluminum are essentially the same in the upstream and downstream samples. While the concentrations are above the SMCL, which is based on prevention of post-treatment precipitation in a water distribution system, all concentrations are below the USEPA tapwater screening level. Aluminum was detected in one upstream dissolved/filtered sample above the SMCL but below the USEPA tapwater screening level. Aluminum was not detected in any downstream dissolved/filtered samples and was detected in the upstream dissolved/total sample at a much lower concentration than the upstream total aluminum samples. The concentrations in the river, both upstream and downstream are lower that the NPDES outfall concentration. Therefore, it can be concluded that the total aluminum concentrations are a result of suspended particulate/sediment in the samples and are not associated with Facility operations. This is not unusual for a large river that carries a large suspended sediment load.
- Arsenic – The arsenic concentrations are similar in all of the Mississippi River surface water samples, both upstream and downstream, total and dissolved and, therefore, are not associated with Facility operations. The concentrations in the river, both upstream and downstream are lower that the NPDES outfall concentration. All concentrations are below the state and federal drinking water standard, but are above the USEPA tapwater screening level.
- Iron – Iron was detected above the SMCL in all of the total/unfiltered samples and in one upstream dissolved/total sample. The SMCL is a secondary standard based on aesthetic effects (unpleasant metallic taste and staining of fixtures). All of the detected concentrations are below the USEPA tapwater screening level. The total iron concentrations are essentially the same in the upstream and downstream samples. Iron was detected in one upstream dissolved/filtered sample, but at a much lower concentration that is below the screening levels. Therefore, it can be concluded that the total iron concentrations are a result of suspended particulate/sediment in the samples and are not associated with Facility operations.
- Manganese – The concentrations of total manganese are essentially the same in the upstream and downstream samples. Manganese was detected in the filtered samples, but at a much lower concentration that is below the screening levels. Therefore, it can be concluded that the total manganese concentrations are a result of suspended particulate/sediment in the samples and are not associated with Facility operations.

Detected concentrations of constituents in surface water from the Mississippi River (total (unfiltered) and dissolved (filtered)) were also compared to the USEPA Ambient Water Quality Criteria (AWQC) Human Health Screening Levels for the Consumption of Organism Only (referred to here as Organism Only AWQC) (USEPA, 2009). The USEPA Organism Only AWQC screening levels apply to total concentrations but have been conservatively compared to dissolved concentrations as well. **Table 13** compares surface water data for the Mississippi River unfiltered (total) results to the USEPA Organism Only AWQC screening levels and **Table 14** provides the same comparison for the filtered (dissolved) results. [Note that Isle Du Bois Creek is not large enough to sustain a recreational fishery, therefore, detected concentrations of constituents in surface water samples from Isle Du Bois Creek were not compared to the USEPA Organism Only AWQC screening levels.]

As indicated in **Table 13**, the majority of constituents in the total (unfiltered) samples do not have detected concentrations above the USEPA Organism Only AWQC, including the following (constituents lacking screening values are not included):

- Nickel
- Selenium
- Zinc

As indicated in **Table 14**, the majority of constituents in the dissolved (filtered) samples do not have detected concentrations above the USEPA Organism Only AWQC, including the following (constituents lacking screening values are not included):

- Manganese (dissolved)
- Nickel (dissolved)
- Selenium (dissolved)
- Zinc (dissolved)

The following constituents have detected concentrations above risk-based screening levels in at least one sample:

- Arsenic – Arsenic was detected above USEPA AWQC Human Health for the Consumption of Organism Only in both upstream and downstream total (unfiltered) and dissolved (filtered) samples from the Mississippi River.
- Manganese – Manganese was detected above USEPA AWQC Human Health for the Consumption of Organism Only in both upstream and downstream total (unfiltered) samples from the Mississippi River.

5.3 Groundwater and Surface Water Data Summary

The detected analyte concentrations in samples of the bedrock groundwater taken from the three upgradient wells are **below** drinking water standards and/or risk-based screening levels. The concentrations of the indicator parameters, boron and sulfate, are low, thus there are no indications of potential impacts from coal ash management practices at the Rush Island Energy Center on the bedrock groundwater in the bluff and upland areas based on these data.

The low concentrations of boron and sulfate indicate that the Creek is not impacted from coal ash management practices at the Rush Island Energy Center. While boron concentrations were slightly higher midstream and downstream than upstream, the sulfate concentrations were slightly lower

downstream than upstream; thus, there is not a consistent pattern in the Creek for the indicator parameters. Both boron and sulfate concentrations are below screening levels, further indicating no adverse impact. Based on an evaluation of the available data**, no adverse health risks** are posed by coal ash-derived constituents for people who may use the Creek recreationally.

It is worth noting here that both boron and sulfate concentrations are also low in the Mississippi River samples. The Mississippi River boron and sulfate concentrations were generally slightly lower downstream than upstream and all concentrations were below the NPDES Outfall 002 concentrations for boron and sulfate, indicating that the Outfall has little if any impact on Mississippi River water quality. Concentrations are below screening levels, further indicating no adverse impact of the coal ash management practices on surface water quality based on these data.

Concentrations of aluminum, iron and manganese were higher in the upstream and downstream Mississippi River samples than in the samples measured in the NPDES Outfall 002. The concentrations of all analytes were similar in the upstream and downstream samples collected from the Mississippi River, indicating that based on these data groundwater from the Facility and the Outfall are not having a measurable effect on the Mississippi River water quality.

The low concentrations and the similarity of the constituent concentrations upstream and downstream, as well as a lack of elevated concentrations in the River for the indicator parameters boron and sulfate indicate no adverse impact of the coal ash management practices on surface water quality based on these data. The similarity of the upstream and downstream concentrations of constituents that are above screening levels in the River (aluminum, arsenic, iron, and manganese) indicate that these concentrations are not due to coal ash management practices at the Rush Island Energy Center.

This detailed evaluation of the results of the surface water investigation conducted in Isle Du Bois Creek and the Mississippi River indicate that none of the constituents with concentrations above screening levels are present due to coal ash management practices at the Rush Island Energy Center. The differences in the total and dissolved results for the River samples are consistent with what would be expected of a large river that carries a substantial sediment load. Mississippi River boron and sulfate concentrations were slightly lower downstream than upstream. Concentrations are below screening levels, further indicating no adverse impact of the coal ash management practices on surface water quality. Approximately half of the detected arsenic concentrations in the River are associated with sediments. The fact that the upstream and downstream concentrations are essentially the same indicates that the arsenic concentrations are consistent with background conditions in these water bodies. With the exception of a portion of the detected manganese concentrations, the suspended sediments in Isle Du Bois Creek also account for the concentration results. Coal ash management practices are not likely to be a potential source based on the boron and sulfate results.

Based on these results, the coal ash management practices at the Rush Island Energy Center have not adversely impacted either the Isle Du Bois Creek or the Mississippi River, and do not pose an adverse risk to human health. This conclusion applies to both recreational uses of the Creek and River, and the use of the River as a source of drinking water by the City of Chester, Illinois at the intake which is approximately 30 miles downstream from the Rush Island Energy Center.

As part of the regulatory approval process for the construction of a landfill within the ash pond system (which will be closed), Ameren Missouri has installed a groundwater monitoring network the current coal ash management area. Those results reflect that the gro8undwater in this area has been impacted by the coal ash pond. However, the investigation presented here demonstrates that such impact is localized and does not extend to bedrock groundwater in the bluffs west of the Facility, the

surface water in Isle Du Bois Creek, or the surface water in the Mississippi River. As this Report details, **there are no adverse impacts on human health or the environment due to coal ash management practices at the Facility**.

6.0 Ecological Evaluation

In addition to the human health evaluation, a comparison of surface water data for Isle Du Bois Creek and the Mississippi River, collected in April 2014, to ecological screening levels for surface water has also been conducted on a sample-by-sample basis for both total (unfiltered) and dissolved (filtered) constituents. In addition, whole effluent toxicity (WET) testing has been conducted annually as part of the Rush Island NPDES permit requirements. The results are summarized below.

6.1 Ecological Screening Levels

6.1.1 Sources of Screening Levels

Screening levels were obtained from both the State of Missouri and the U.S. Environmental Protection Agency (USEPA):

- Missouri State Water Quality Criteria (MDNR, 2014b), and
- USEPA AWQC (USEPA, 2009).

Screening levels from both sources applicable to total (unfiltered) and dissolved (filtered) results are presented in **Table 15.**

The Missouri State Water Quality Criteria for the Protection of Aquatic Life (acute and chronic) are applicable only to dissolved (filtered) forms of the constituents (with the exception of mercury, pH, and sulfate which are applicable to the total form). The Irrigation and the Livestock/Wildlife Watering criteria are applicable to the total (unfiltered) form of the constituents.

USEPA provides acute and chronic AWQC, some of which are applicable to total (unfiltered), and some of which are applicable to dissolved (filtered) results.

6.1.2 Site-Specific Adjustment for Hardness and Chloride

The Federal AWQC and the Missouri State Protection of Aquatic Life (AQL) criteria for cadmium, chromium III, copper, lead, nickel, silver, and zinc are calculated using hardness-dependent equations. The default USEPA AWQC and Missouri State AQLs are based on a hardness of 100 mg/L as $CaCO_3$, however AWQC and AQLs can be calculated with site-specific hardness values in accordance with USEPA and Missouri State guidance (USEPA, 2009 and MDNR, 2014b). The average total hardness value of 272 mg/L from the April 2014 surface water sampling event for Isle Du Bois Creek was used for the evaluation of Isle Du Bois Creek data, and the average total hardness value of 217 mg/L from the April 2014 surface water sampling event for Mississippi River was used for the evaluation of Mississippi River data.

The Missouri State AQL criterion for sulfate is calculated using site-specific hardness and chloride data. In the absence of site-specific chloride data, a default value of 25 mg/L was assumed to calculate the sulfate criteria for Isle Du Bois Creek and the Mississippi River.

6.2 Screening Level Comparisons

Detected concentrations of constituents in surface water samples from Isle Du Bois Creek and the Mississippi River were compared to the applicable ecological screening levels.

Detected concentrations of constituents in surface water for the total (unfiltered) analyses were compared to the screening levels applicable to total (unfiltered) results:

- Missouri State Water Quality Criteria (MDNR, 2014b):
  - Criteria for Protection of Aquatic Life (acute and chronic), Irrigation and Livestock and Wildlife Watering were used.
- Federal AWQCs (USEPA, 2009):
  - The acute and chronic values for freshwater aquatic life applicable to total/unfiltered results were used.

Detected concentrations of constituents in surface water for the dissolved (filtered) analyses were compared to the screening levels applicable to dissolved (filtered) results:

- Missouri State Water Quality Criteria (MDNR, 2014b):
  - Criteria for Protection of Aquatic Life (acute and chronic) were used.
- Federal AWQCs (USEPA, 2009):
  - The acute and chronic values for freshwater aquatic life applicable to dissolved (filtered) results were used.

6.3 Surface Water Screening Results

6.3.1 Isle Du Bois Creek Surface Water Data

Surface water data for Isle Du Bois Creek are presented in **Table 16** (total (unfiltered) results) and **Table 17** (dissolved (filtered) results). The USEPA AWQC and Missouri State AQL criteria for pH range from 6.5 to 9.0 for the protection of freshwater aquatic life. Field pH measurements obtained during the April 2014 Isle Du Bois Creek sampling event ranged from 7.35 to 8.08. All pH values are within the acceptable range.

A number of constituents were not detected in the Isle Du Bois Creek total (unfiltered) surface water samples (see **Table 16**); these are:

- Antimony
- Beryllium
- Cadmium
- Cyanide
- Fluoride
- Mercury
- Silver
- Thallium
- Tin

The following constituents were not detected in the Isle Du Bois Creek filtered (dissolved) samples (see **Table 17**):

- Aluminum (dissolved)
- Antimony (dissolved)
- Iron (dissolved)
- Lead (dissolved)

- Arsenic (dissolved)
- Beryllium (dissolved)
- Cadmium (dissolved)
- Cobalt (dissolved)
- Copper (dissolved)
- Mercury (dissolved)
- Nickel (dissolved)
- Silver (dissolved)
- Thallium (dissolved)
- Tin (dissolved)

As indicated in **Table 16**, the majority of detected constituents in the total (unfiltered) samples do not have detected concentrations above screening levels, including the following (constituents lacking screening values are not included):

- Arsenic
- Boron
- Chromium
- Cobalt
- Copper
- Lead
- Nickel
- Selenium
- Sulfate
- Zinc

As indicated in **Table 17**, all detected results for filtered samples from the Du Bois Creek are below ecological surface water screening levels including the following (constituents lacking screening values are not included):

- Chromium
- Selenium
- Zinc

The following constituents have detected concentrations above risk-based screening levels in at least one total (unfiltered) sample:

- Aluminum – Aluminum was detected above USEPA Acute and Chronic Aquatic Life AWQC in downstream, midstream, and upstream unfiltered samples from Isle Du Bois Creek. Aluminum was not detected in the filtered (dissolved) samples, indicating that the aluminum is particulate bound.

- Iron – Iron was detected above USEPA Chronic Aquatic Life Ambient Water Quality Criteria in downstream, midstream, and upstream unfiltered (total) samples from Isle Du Bois Creek. Iron was not detected in the filtered (dissolved) samples, indicating that the iron is particulate bound.

The use of total recoverable metals is likely to be a conservative estimate of metal bioavailability and may over-estimate potential risks to aquatic receptors.

The low concentrations of boron and sulfate in the Creek samples indicate that the coal ash management practices at the Rush Island Energy Center are not impacting the Creek. While boron concentrations were slightly higher midstream and downstream than upstream, the sulfate concentrations were slightly lower downstream than upstream; thus, there is not a consistent pattern in the Creek for the indicator parameters. Boron and sulfate concentrations are below screening levels, further indicating no adverse impact of the coal ash management practices on surface water quality. Based on an evaluation of all the data**, no adverse ecological risks** are posed by coal ash-derived constituents for the Creek.

6.3.2 Mississippi River Surface Water Data

Surface water data for the Mississippi River are presented in **Table 18** (unfiltered (total) results) and **Table 19** (filtered (dissolved) results). The USEPA AWQC and Missouri State AQL criteria for pH range from 6.5 to 9.0 for the protection of freshwater aquatic life. Field pH measurements obtained during the April 2014 Mississippi sampling event ranged from 6.14 to 8.93. Only one pH value is below the acceptable range. This low pH value does not indicate an abnormal condition and can likely be attributed to the natural Mississippi River conditions.

A number of constituents were not detected in the Mississippi River total (unfiltered) surface water samples (see **Table 18**); these are:

- Antimony
- Beryllium
- Cadmium
- Cyanide
- Mercury
- Silver
- Thallium
- Tin

The following constituents were not detected in the Mississippi River filtered (dissolved) samples (see **Table 19**):

- Antimony (dissolved)
- Beryllium (dissolved)
- Cadmium (dissolved)
- Chromium (dissolved)
- Cobalt (dissolved)
- Copper (dissolved)
- Mercury (dissolved)
- Silver (dissolved)
- Thallium (dissolved)
- Tin (dissolved)

As indicated in **Table 18**, the majority of constituents in the total (unfiltered) samples do not have detected concentrations above screening levels, including the following (constituents lacking screening values are not included):

- Arsenic
- Boron
- Chromium
- Cobalt
- Copper
- Fluoride
- Lead
- Nickel
- Selenium
- Sulfate
- Zinc

As indicated in **Table 19**, all detected results for filtered samples from the Mississippi River are below ecological surface water screening levels including the following (constituents lacking screening values are not included):

- Aluminum
- Arsenic
- Iron
- Lead
- Nickel
- Selenium
- Zinc

The following constituents have detected concentrations above risk-based screening levels in at least one total (unfiltered) sample:

- Aluminum – Aluminum was detected above USEPA Acute and Chronic Aquatic Life AWQC in upstream and downstream total (unfiltered) samples from the Mississippi River. Aluminum was detected in only one of the dissolved (filtered) samples below the ecological surface water screening levels, indicating that the aluminum is particulate bound.

- Iron – Iron was detected above USEPA Chronic Aquatic Life AWQC in upstream and downstream total (unfiltered) samples from the Mississippi River. Iron was detected in only one of the dissolved (filtered) samples below the ecological surface water screening levels, indicating that the iron is particulate bound.

Upstream and downstream constituent concentrations are essentially the same for both constituents, indicating that their presence in the samples is a result of background conditions. It is worth noting here that both boron and sulfate concentrations are also low in the Mississippi River samples. The Mississippi River boron and sulfate concentrations were generally slightly lower downstream than upstream and all concentrations were below the NPDES Outfall 002 concentrations for boron and sulfate. Concentrations are below screening levels, further indicating no adverse impact of the coal ash management practices on surface water quality. Further, the concentrations of all analytes were similar in the upstream and downstream samples collected from the Mississippi River, indicating that discharge of groundwater from the Facility is not having a measurable effect on the Mississippi River water quality.

The use of total recoverable metals is likely to be a conservative estimate of metal bioavailability and may over-estimate potential risks to aquatic receptors.

6.4 Whole Effluent Toxicity Testing

As required by the Rush Island NPDES Permit MO-0000043, an Acute WET test was performed in February 2005 for Outfall 002, the Ash Pond discharge point. To perform this test, a grab sample of the ash pond effluent stream and of the Mississippi River (representing the upstream receiving water) were collected and provided to the testing laboratory. Laboratory testing was conducted by Environmental Analysis South, Inc. using two freshwater test organisms: larval fathead minnow (*Pimephales promelas*) and water flea (*Ceriodaphnia dubia*). Testing is conducted according to USEPA guidance (2002) over a 48 hour period and measures test organism survival after exposure to a 10% effluent concentration (ash pond effluent diluted with Mississippi River water).

Mississippi River water is used to dilute the effluent in order to simulate mixing of the effluent upon discharge to the river. A Mississippi River water sample is also included in the tests to provide a site-specific baseline result.

Organism survival in the 10% effluent treatment is compared against survival in a Mississippi River water treatment (referred to as an Upstream Control) and to a laboratory water treatment (referred to as a Reconstituted Control). If the effluent treatment results are not statistically different (alpha = 0.05) from the control results, then the effluent is considered to have passed the WET test. **Table 20** presents the results of the WET tests conducted in February 2005.

A review of the February 2005 Rush Island WET test results indicates that survival of *C. dubia* in the effluent and control treatments was 100% in all cases. The WET test results indicated that the survival of *P. promelas* in the effluent and Upstream Control was 98%, and survival in the Reconstituted Control was 100%. These results indicate that the effluent treatment passed the test

conducted in February 2005 and was in compliance with the NPDES permit requirement for WET testing.

7.0 Summary

Ameren Missouri retained the services of AECOM and Golder to assess the potential for public health and ecological risks associated with coal ash management practices at the Rush Island Energy Center. This Report evaluates analytical results for surface water samples taken at or adjacent to the Facility property and bedrock groundwater samples collected from locations in the upland bluff area west of the Facility. The results of the evaluation indicate no adverse impact to the environment or human health for either surface water or bedrock groundwater in these areas.

The CSM has been used as the basis for this health risk-based evaluation of the potential impact of coal ash management practices at the Rush Island Energy Center on groundwater and surface water. The evaluation has been conducted using the source → transport → medium → exposure linkage framework. The evaluation provided in this Report has been used to refine the CSM to reflect all of the available data. The conceptual site model for this evaluation is provided in **Figure 13**.

7.1 Geology

The geology of the area is characterized by sedimentary bedrock that extends across much of eastern and southern Missouri. The bedrock in the Rush Island area is made up of sedimentary formations, mainly limestone, sandstone, and dolomite. This bedrock has eroded over the years due to the flow of the Mississippi River, and the river valley is filled in with unconsolidated alluvial deposits such as sands, gravels, silts, and clays forming the floodplain deposits in the Rush Island bottomland area. The alluvial deposits extend from bluff to bluff throughout the Mississippi River valley with smaller alluvial deposits located along larger streams. The Rush Island Energy Center is located in the bottomlands of the Mississippi River floodplain. The less-eroded bedrock makes up the bluffs and hilly uplands west of the Mississippi River.

7.2 Groundwater – Potential for Exposure and Results

The groundwater that flows through the sand, silt, clay and gravel in the Mississippi River floodplain forms the alluvial aquifer. The alluvial aquifer is on the order of 100 feet thick at the Facility, but this thickness pinches out, or generally thins, as it approaches the Mississippi bluffs to the west. The alluvial aquifer extends from the base of the bluffs east to the Mississippi River. The bedrock contains alternating continuous layers that serve as aquifers and confining units; at the Facility it extends from the Mississippi River to the west and south and underlies the alluvial aquifer and the bluffs and hilly upland areas west of the Facility. Residences are located in the bluff areas and have private wells used to supply groundwater as drinking water. These wells draw water from the bedrock, not the alluvial aquifer.

The coal ash management area of the Rush Island Energy Center is located within the Mississippi River bottomlands. Alluvial groundwater flows from the coal ash pond to downgradient areas and to the Mississippi River and the Isle Du Bois Creek. There are no users of groundwater as drinking water in those locations. Residential users of groundwater are located in the bluff and hilly upland area west of the Facility. These wells draw water from the bedrock aquifer and not the alluvial aquifer.

Any release of constituents from the coal ash pond will not flow in an upgradient direction and into the upland and bluff area bedrock where such residential wells are located. Thus, the groundwater drinking water pathway is incomplete, and where there is no exposure, there is no risk.

Data collected from the bedrock groundwater wells TBW-1, TBW-2, and TBW-3 fully comply with federal primary drinking water standards and are below risk-based screening levels. There are no indications of coal ash impacts in the bluff and upland areas. Groundwater sampling results reveal that neither sulfate nor boron, indicator parameters for coal ash, is elevated beyond background levels in the bedrock areas evaluated.

7.3 Surface Water – Potential for Exposure and Results

A detailed evaluation of the results of the surface water investigation conducted in Isle Du Bois Creek and the Mississippi River indicate that none of the constituents with concentrations above screening levels are present due to coal ash management practices at the Rush Island Energy Center. The sample locations were specifically selected such that if such impact had occurred in these water bodies, it would be evident at such locations.

The Mississippi River and the Isle Du Bois Creek are both immediately adjacent to the Facility. In both surface water bodies, constituent concentrations from nearby sample locations both upstream and downstream from the Facility were similar, indicating that the downstream location results are consistent with background. The concentrations from such sampling further reflect that there are no adverse human health or ecological impacts from coal ash management practices in either the Creek or the River. The differences in the total and dissolved results for the Mississippi River samples are consistent with what would be expected of a large river that carries a substantial sediment load. The suspended sediments in Isle Du Bois Creek also account for the concentration results. The arsenic concentrations in the River are partially associated with sediments (dissolved concentrations are approximately half of the total concentrations), and the fact that the upstream and downstream concentrations are also similar indicates that the arsenic concentrations are consistent with background conditions in these water bodies. It is worth noting here that both boron and sulfate concentrations are low in the Isle Du Bois Creek and Mississippi River samples.

7.4 Summary

In summary, there is no evidence of constituent release due to coal ash management practices at the Facility resulting in an adverse human health or ecological impact.

Separate from this off-site investigation, Ameren Missouri has installed and sampled groundwater wells located onsite and adjacent to the coal ash management area as part of regulatory process for construction of a dry-storage landfill and closure of ash impoundment. Such a network provides a framework for evaluating groundwater quality in the vicinity of the surface impoundment. Two of the four quarterly rounds of groundwater sampling and analysis have been completed and the results are provided in **Appendix G**. While concentrations of some constituents are above drinking water-based screening levels, the groundwater in this area is **not used** as a source of drinking water. As described in this Report, drinking water resources associated with the bedrock groundwater in the bluffs west and upgradient of the Facility and of surface water in Isle Du Bois Creek and the Mississippi River are not impacted. Accordingly, there are no adverse impacts on human health or the environment due to coal ash management practices at the Facility.

8.0 References

ACAA. 2013. CCP Production and Use (1990 – 2012). American Coal Ash Association. Available at: http://www.acaa-usa.org/associations/8003/files/News_Release_Coal_Ash_Production_and_Use_2012.pdf and http://www.acaa-usa.org/associations/8003/files/ACAA-Brochure-Web.pdf

Baker, H.W. 2001a. Bedrock Geologic Map of the Bloomsdale 7 ½' quadrangle, Missouri. Missouri Department of Natural Resources, Division of Geology and Land Survey, Open File Map OFM-01-378-GS. Available at: http://ngmdb.usgs.gov/Prodesc/proddesc_79851.htm

Baker, H.W. 2001b. Bedrock Geologic Map of the Danby 7 ½' quadrangle, Missouri. Missouri Department of Natural Resources, Division of Geology and Land Survey, Open File Map OFM-01-380-GS. Available at: http://ngmdb.usgs.gov/Prodesc/proddesc_79853.htm

Baker, H.W. 2001c. Bedrock Geologic Map of the Selma 7 ½' quadrangle, Missouri. Missouri Department of Natural Resources, Division of Geology and Land Survey, Open File Map OFM-01-392-GS. Available at: http://ngmdb.usgs.gov/Prodesc/proddesc_79865.htm

Baker, H.W. 2001d. Surficial material geologic map of Danby 7 ½' quadrangle, Missouri. Missouri Department of Natural Resources, Division of Geology and Land Survey, Open File Map OFM-01-381-GS. Available at : http://ngmdb.usgs.gov/Prodesc/proddesc_79854.htm

Baker, H.W. 2001e. Surficial material geologic map of Bloomsdale 7 ½' quadrangle, Missouri. Missouri Department of Natural Resources, Division of Geology and Land Survey, Open File Map OFM-01-379-GS Available at : http://ngmdb.usgs.gov/Prodesc/proddesc_79852.htm

Baker, H.W. and J.R. Palmer. 2001. Surficial material geologic map of Selma 7 ½' quadrangle, Missouri. Missouri Department of Natural Resources, Division of Geology and Land Survey, Open File Map OFM-01-393-GS. Available at : http://ngmdb.usgs.gov/Prodesc/proddesc_79866.htm

CARES. 2013. Public Drinking Water System Reports. Center for Applied Research and Environmental Systems. Available at: http://maproom.missouri.edu/swipmaps/pwssid.htm

EPRI. 2006. Characterization of Field Leachates at Coal Combustion Product Management Sites - Arsenic, Selenium, Chromium, and Mercury Speciation. Technical Report No. 1012578. Electric Power Research Institute. Available for download at www.epri.com

MDNR. 2010a. 10 CSR 60-4. Rules of Missouri Department of Natural Resources, Division 60 – Safe Drinking Water Commission, Chapter 4 – Contaminant Levels and Monitoring. 11/30/10. Missouri Department of Natural Resources. Available at: http://www.sos.mo.gov/adrules/csr/current/10csr/10c60-4.pdf

MDNR. 2010b. Rules of Missouri Department of Natural Resources, Division 20 – Clean Water Commission, Chapter 7 – Water Quality. 5/31/12. 10 CSR 10-7. Available at: http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf.

MDNR. 2013a. Missouri Well Information Management System (WIMS), Wellhead Protection Program. Missouri Department of Natural Resources. Available at: http://dnr.mo.gov/mowells/publicLanding.do

MDNR. 2013b. Geologic Well Logs of Missouri, Water Resource Center. Missouri Department of Natural Resources. Available at: http://www.dnr.mo.gov/env/wrc/logmain/

MDNR. 2013c. Census of Missouri Public Water Systems, Public Water Drinking Branch. Missouri Department of Natural Resources. Available at: http://www.dnr.mo.gov/env/wpp/pdwb/2013-census.pdf

MDNR, 2014a. Geosciences Technical Resource Assessment Tool (GeoSTRAT). Missouri Department of Natural Resources. Available at: http://www.dnr.mo.gov/geology/geostrat.htm

MDNR. 2014b. Rules of Missouri Department of Natural Resources, Division 20 – Clean Water Commission, Chapter 7 – Water Quality. 1/29/14. 10 CSR 10-7. Available at: http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf

MEGA. 2007. Missouri Environmental Geology Atlas. A Collection of Statewide Geographic Information System Data. Available at: http://www.missourigeologystore.com/product.php?productid=69

MO CSR. 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. January 29 2014. http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf

MSDIS. 2013. Missouri Spatial Data Information Service. Available at: http://www.msdis.missouri.edu/data/datalist.html#list

NRT. 2012. Detailed Site Investigation Work Plan. Ameren Missouri Rush Island Energy Center Proposed Utility Waste Disposal Area. Jefferson County, Missouri. Natural Resource Technology. October 1, 2012.

NRT. 2014. Rush Island Impoundment Pond Closure Groundwater Monitoring and Sample Plan. Ameren Missouri Rush Island Energy Center. Jefferson County, Missouri. Natural Resource Technology. March 4, 2014.

USEPA. 1989. Risk Assessment Guidance for Superfund: Volume I. Human Health Evaluation Manual (Part A). Interim Final. Office of Emergency and Remedial Response. U.S. Environmental Protection Agency, Washington, D.C. EPA 540/1-89/002. Available at: http://www.epa.gov/oswer/riskassessment/ragsa/

USEPA. 1991. Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual: (Part B, Development of Risk-based Preliminary Remediation Goals). Interim, OSWER Directive 9285.6-03. December, 1991. Available at: http://www.epa.gov/oswer/riskassessment/ragsb/index.htm

USEPA. 2002. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. Fifth Edition. EPA-821-R-02-012.

USEPA. 2009. National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Available at: http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm

USEPA. 2012. USEPA 2012 Edition of the Drinking Water Standards and Health Advisories, Spring 2012. U.S. Environmental Protection Agency. Available at: http://water.epa.gov/drink/contaminants/index.cfm

USEPA. 2014a. USEPA Regional Screening Levels. May 2014. U.S. Environmental Protection Agency. Available at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

USEPA. 2014b. Surf Your Watershed. Available at: http://cfpub.epa.gov/surf/locate/index.cfm Lower Missouri Watershed link: http://cfpub.epa.gov/surf/huc.cfm?huc_code=10300200

USGS. 1994. Geohydrology of the Ozark Plateaus Aquifer System in Parts of Missouri, Arkansas, Oklahoma, and Kansas. Imes J.L., Emmett L.F. U.S. Geological Survey Professional Paper 1414-D. Available at: http://pubs.er.usgs.gov/publication/pp1414D

USGS. 1997. Groundwater Atlas of the United States, Kansas, Missouri, and Nebraska. Miller, J.A. and Appel, C.L. U.S. Geological Survey Professional Paper HA 730-D. Available at: http://pubs.usgs.gov/ha/ha730/ch_d/index.html\

USGS. 2001. Mapping arsenic in groundwater. Geotimes 46(11):34-36. Ryker, S.J. November 2001. U.S. Geological Survey. Available at: http://water.usgs.gov/nawqa/trace/pubs/geo_v46n11/fig2.html.

USGS. 2011. Trace Elements and Radon in Groundwater Across the United States. U.S. Geological Survey. Scientific Investigations Report 2011-5059. Authors: Ayotte, J.D. Gronberg, J.M., and Apodaca, L.E. Available at: http://pubs.usgs.gov/sir/2011/5059/pdf/sir2011-5059_report-covers_508.pdf

USGS. 2013a. Average concentrations of elements in Jefferson County, Missouri. National Geochemical Survey. U.S. Geological Survey. Available at: http://mrdata.usgs.gov/geochem/county.php?place=f29071&el=As&rf=central

USGS. 2013b. Geochemical and Mineralogical Data for Soils of the Conterminous United States. Available at: http://pubs.usgs.gov/ds/801/

USGS, 2013c. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

Tables

Table 1
Groundwater and Surface Water Screening Levels
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

			Missouri State Water Quality Screening Levels			Federal Water Quality Screening Levels			
Constituent	**CAS**	**Units**	**Human Health Fish Consumption (a)**	**Drinking Water Supply (f)**	**Groundwater (f)**	**USEPA MCLs (c)**	**USEPA SMCLs (c)**	**USEPA Tapwater RSLs (d)**	**USEPA AWQC Human Health for the Consumption of Organism Only (h)**
Inorganics									
Aluminum	7429-90-5	mg/L	NA	NA	NA	NA	0.05	20	NA
Antimony	7440-36-0	mg/L	4.3	0.006	0.006	0.006	NA	0.0078	0.64
Arsenic	7440-38-2	mg/L	NA	0.05	0.05	0.01	NA	0.000052	0.00014
Barium	7440-39-3	mg/L	NA	2	2	2	NA	3.8	NA
Beryllium	7440-41-7	mg/L	NA	0.004	0.004	0.004	NA	0.025	NA
Boron	7440-42-8	mg/L	NA	NA	2	NA	NA	4	NA
Cadmium	7440-43-9	mg/L	NA	0.005	0.005	0.005	NA	0.0092	NA
Chromium	7440-47-3	mg/L	NA	0.1 (e)	0.1 (e)	0.1 (e)	NA	22 (g)	NA
Cobalt	7440-48-4	mg/L	NA	NA	1	NA	NA	0.006	NA
Copper	7440-50-8	mg/L	NA	1.3	1.3	1.3 (b)	1	0.8	NA
Cyanide	57-12-5	mg/L	NA	NA	NA	0.2	NA	0.0015	0.14
Fluoride	16984-48-8	mg/L	NA	4	4	4 (i)	2	0.8	NA
Iron	7439-89-6	mg/L	NA	NA	0.3	NA	0.3	14	NA
Lead	7439-92-1	mg/L	NA	0.015	0.015	0.015 (b)	NA	NA	NA
Manganese	7439-96-5	mg/L	NA	NA	0.05	NA	0.05	0.43	0.1
Mercury	7487-94-7	mg/L	NA	0.002	0.002	0.002	NA	0.0057	NA
Molybdenum	7439-98-7	mg/L	NA	NA	NA	NA	NA	0.1	NA
Nickel	7440-02-0	mg/L	NA	0.1	0.1	NA	NA	0.39	4.6
Nitrate-Nitrite (as N)	NA	mg/L	NA	10	10	10	NA	NA	NA
Selenium	7782-49-2	mg/L	NA	0.05	0.05	0.05	NA	0.1	4.2
Silver	7440-22-4	mg/L	NA	0.05	0.05	NA	0.1	0.094	NA
Sulfate	14808-79-8	mg/L	NA	250	NA	NA	250	NA	NA
Thallium	7440-28-0	mg/L	0.0063	0.002	0.002	0.002	NA	0.0002	0.00047
Tin	7440-31-5	mg/L	NA	NA	NA	NA	NA	12	NA
Zinc	7440-66-6	mg/L	NA	5	5	NA	5	6	26

Notes:
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
MCL - Maximum Contaminant Level.
NA - Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level. No MCL available.
USEPA - United States Environmental Protection Agency.
mg/L - Milligrams per liter.
(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. Updated January 29, 2014. http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf. Per 10 CSR 20-7.031(4)(B)(2), the criteria for Human Protection Fish Consumption apply to dissolved metals data. All other criteria apply to total concentrations.
(b) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(c) - USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. Spring 2012. http://water.epa.gov/drink/contaminants/index.cfm
(d) - USEPA Regional Screening Levels (November 2013). Values for tapwater. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. May 31, 2012. http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf.
(g) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, and the basis of which has been questioned by USEPA's Science Advisory Board. This issue is discussed in detail in Appendix A.
(h) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed May 2014. http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
(i) - Value for Soluble Fluoride used.

Table 2
Private Well Search Results from State Databases – 1-Mile Radius of Facility Boundary
Rush Island Energy Center, Jefferson County, Missouri
Ameren Missouri

Missouri Well Record ID Number	Well Number in Figure 3	Date of Installation	Owner Name	Well Type	Location (Feet, NAD 1983 StatePlane Missouri East FIPS 2401) EASTING	NORTHING	Source Used to Plot Well Location In Figure 3	Data Source	Screen/open Interval (feet)	Depth to Bedrock (feet)	Well Depth (feet)	Material at Screened/Open Interval (feet)
0307749	1	4/25/2003	Jerry Capps	Private	878200.0	843255.7	Owner Address	1,3,4,5	80-380	18	380	Bedrock
0012028	2	2/24/1989	Dan Doenges	Private	879042.0	835435.5	Owner Address	3,4	82-230	11	230	Bedrock
0017312	3	4/14/1958	O.H. England	Private	879346.9	842721.3	State Database Coordinates	2,3,5	65-195	60	195	Bedrock
0418482	4	9/12/2012	David Doenges	Private	879395.1	832133.4	Well Address	1,3,4,5	80-310	8	310	Bedrock
0006418	5	6/14/1940	Johnston	Private	880705.2	832992.8	State Database Coordinates	1,2,3,5	13.5-181	30	181	Note #9
0010685	6	11/18/1988	Joe Cook	Private	882206.7	833834.5	Owner Address (Note #10)	1,3,4,5	N/A	46	188	Note #5
0179087	7	3/23/1998	Richard Tindall	Private	882257.3	834568.4	Owner Address	1,3,4,5	80-215	35	215	Bedrock
0210636	8	10/29/1998	Bob Berthold (Note #6)	Private (Irrigation)	885256.0	838490.8	Legal Address/ Field locate	1,3,4,5	90	N/A	90	Alluvium
0263792	9	4/30/2009	Ameren	Non-community public	888482.0	837154.0	State Database Coordinates	1,4,5	730-1160	164	1160	Bedrock
0263795	10	4/30/2009	Ameren	Non-community public	888548.4	837063.2	State Database Coordinates	1,4,5	730-1160	164	1160	Bedrock
0028952	11	04/2004	Holcim (US) Inc./Lee Island Project	Non-community public	888650.9	827355.3	State Database Coordinates	2,3,5	N/A	15	1948	Note #5
0263776	12	7/12/2004	Holcim US Inc.	Non-community public	888702.7	827326.8	State Database Coordinates	1,4,5	750-1948	44	1948	Bedrock
0263779	13	7/16/2004	Holcim US Inc.	Non-community public	888702.7	827326.8	State Database Coordinates	1,4,5	750-1060	30	1060	Bedrock
0361434	14	4/2/2007	Holcim US Inc.	Non-community public	889343.1	827848.7	State Database Coordinates	1,4,5	267-423	6	423	Bedrock
0390620	15	1/22/2008	Holcim US Inc.	Non-community public	889683.9	829557.4	State Database Coordinates	1,4,5	725-1460	2	1460	Bedrock
0390618	16	9/20/2007	Holcim US Inc.	Non-community public	890818.3	829239.9	State Database Coordinates	1,4,5	725-1460	2	1460	Bedrock

Sources:
1. Data Source 1 = University of Missouri - Columbia - Department of Geography - MSDIS Database
2. Data Source 2 = MDNR - Water Resources Center - Geologic Well Logs
3. Data Source 3 = Missouri Environmental Geology Atlas 2007 (MEGA)
4. Data Source 4 = MDNR Wellhead Protection Program
5. Data Source 5 = MDNR Geosciences Technical Resources Assessment Tool (GeoSTRAT)
6. Data Source 6 = The University of Missouri and Missouri Department of Natural Resources, Center for Applied Research and Environmental System (CARES), Public Drinking Water Systems Report database

Prepared By: JSI
Checked By: MWD
Reviewed By: MNH

Notes
1.) This table displays private, non-community public and private industrial wells within approximately one mile of the property boundary based on state records; monitoring wells, soil borings, heat pumps, reconstructions, stratigraphic test holes and abandonments are not listed on this table.
2.) MDNR - Missouri Department of Natural Resources.
3.) MSDIS - Missouri Spatial Data Information Service.
4.) GeoSTRAT - Geosciences Technical Resources Assessment Tool.
5.) Material at screened depth cannot be determined because well logs do not contain data on casing depth.
6.) Well is believed to be installed on behalf of Ameren, on Ameren property.
7.) More information on the use of different sources to plot the wells is provided in Appendix B.
8.) "N/A" - Data not available.
9.) The screen interval and depth to bedrock data for well #5 appear to be in error. The well would likely not be constructed with a screen interval above bedrock.
10.) Owner address based on 2013 parcel map of Jefferson County. All other Owner/Well Addresses based on well certification forms.

Table 3
Public Well Search Results from State Databases –
7-Mile Radius of Facility Boundary
Rush Island Energy Center, Franklin County, MO
Ameren Missouri

Extended PWS Number	Status	Drill Date (Year)	Local Name	Well Name	Location		Casing Size (inches)	Ground Elevation	Casing Depth (feet)	Total Well Depth (feet)
					Latitude	Longitude				
4010079102	Active	1998	Well #2	Bloomsdale	38.0251	-90.2347	10.0	N/A	550	1490
4024544101	Active	1969	Well #1	Ste. Genevieve Co. PWSD #1 - North	38.0432	-90.2976	8.0	N/A	463	1150
4171222101	Active	1961	School Well	Bloomsdale Elem. School	38.0335	-90.2447	6.0	N/A	210	1200
4182616101	Active	2007	Well #1 - Temporary site 4	Holcim (US) Inc. - Lee Island Project	38.1065	-90.2594	6.0	460	267	425
6010198102	Active	1955	Well #2, Hospital	Crystal City	38.1964	-90.3921	8.0	N/A	175	750
6010198103	Active	1996	Well #3	Crystal City	38.1934	-90.3893	N/A	N/A	425	555
6024304101	Emergency	1957	Well #1	Jefferson Co. PWSD #12	38.1544	-90.3506	8.0	550	484	1100
6024304102	Active	1989	Well #2	Jefferson Co. PWSD #12	38.1577	-90.3709	N/A	580	450	910
6024304103	Active	2002	Well #3	Jefferson Co. PWSD #12	38.1449	-90.3622	13.0	620	550	1050
6024304104	Active	N/A	Well #4	Jefferson Co. PWSD #12	38.1544	-90.3506	12.0	N/A	505	1140
6048073101	Active	N/A	Well #1	Lakeside Manor	38.1789	-90.3934	6.0	N/A	250	435
6048142102	Active	1974	Well #2	D&J MHP	38.1452	-90.3249	6.0	N/A	250	635
6048616101	Active	1990	Well #1	Manderly MHP	38.1901	-90.3956	6.0	N/A	350	668
6180934101	Active	N/A	Well	River Cement Co.	38.1805	-90.3390	8.0	496	194	1000
6291426101	Active	N/A	Well	Festus Fuel & Food Mart	38.1574	-90.3613	N/A	N/A	N/A	N/A

Sources

1. The University of Missouri and Missouri Department of Natural Recourses, Center for Applied Research and Environmental System (CARES), Public Drinking Water Systems Report Database (CARES)
2. Missouri Environmental Geology Atlas 2007 (MEGA)

Prepared By: JSI
Checked By: MWD
Reviewed By MNH

Notes

1.) Database well locations are approximate.
2.) Table displays active and emergency public wells; proposed, inactive and plugged wells are not displayed for clarity.
3.) "N/A" - Data not available.
4.) PWSD - Public Water Supply District.
5.) Wells 4171222101 (Bloomsdale Elementary School) and 6291426101 (Festus Fuel & Food) are only listed in the MEGA database and are not found in the CARES database.
6.) Wells 4182616101 (Holcim (US) Inc.) and 6180934101 (River Cement Co.) are listed as Industrial and Large Business wells in the CARES (2013) Database.
7.) Further information on the location of wells within approximately 1-mile of the Facility boundary are available in Appendix B.
8.) MHP - Mobile home park.

Table 4
Publicly Available Surface Water Quality Monitoring Data for the Mississippi River
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Constituent	CAS	Units	Upstream (h)													
			Mississippi River Station ID: GRW04449-331 (a)		Mississippi River Station ID: J-36 (b)								Mississippi River Station ID: GRW04449-347 (c)		Mississippi River Station ID: GRW04449-316 (d)	
Approximate Distance* (miles):			21.8		21.2								14		6.6	
	Sample Collection Date:		8/9/2005		11/16/2011		8/16/2011		6/28/2011		3/16/2011		8/1/2005		9/20/2004	
Inorganics			**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**
Aluminum	7429-90-5	mg/L	--	0.0250	1.41	0.436	3.53	0.0202	5.96	ND	3.12	0.0094	--	0.0250	--	0.0250
Arsenic	7440-38-2	mg/L	--	0.0250	ND	ND	0.0046	0.0032	0.0093	0.0071	0.0010	0.0020	--	0.0250	--	0.0250
Cadmium	7440-43-9	mg/L	--	--	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Copper	7440-50-8	mg/L	--	0.0050	0.0009	0.0009	0.0017	ND	0.0054	0.0009	0.0052	0.0012	--	0.0050	--	0.0050
Iron	7439-89-6	mg/L	--	0.0050	1.64	0.515	3.66	0.0111	7.72	0.0285	4.38	0.0375	--	0.0106	--	0.0190
Lead	7439-92-1	mg/L	--	0.0250	0.0086	0.0099	0.0065	0.0071	0.01	0.0096	0.0032	ND	--	0.0250	--	0.0250
Magnesium	743-95-4	mg/L	--	19.1	23.2	22.8	24.0	20.0	25.1	21.8	22.7	21.0	--	20.7	--	18.9
Manganese	7439-96-5	mg/L	--	--	0.111	0.0380	0.203	0.0025	0.330	0.0029	0.170	0.0052	--	--	--	--
Nickel	7440-02-0	mg/L	--	0.0100	0.0045	0.0028	0.0043	0.0009	0.0058	ND	0.0045	ND	--	0.0100	--	0.0100
Nitrogen	93037-13-9	mg/L	1.83	--	--	--	--	--	--	--	--	--	1.93	--	1.43	--
Nitrate-Nitrite (as N)	NA	mg/L	--	--	2.24	--	1.73	--	4.68	--	4.06	--	--	--	--	--
Selenium	7782-49-2	mg/L	--	0.0500	--	--	--	--	--	--	--	--	--	0.0500	--	0.0500
Sulfate	7757-82-6	mg/L	--	96.4	50.6	--	71.6	--	46.8	--	32.2	--	--	83.6	--	71.4
Zinc	7440-66-6	mg/L	--	0.0050	0.0225	0.0199	0.0148	0.0042	0.0502	ND	0.0169	0.0042	--	0.0050	--	0.0149
Water Parameters (j)																
Temperature, water	NA	deg C	29.5	--	10.6	--	27.2	--	23.2	--	4.70	--	29.9	--	24.0	--
Turbidity	NA	NTU	44.7	--	33.0	--	75.0	--	140	--	95.0	--	26.9	--	30.37	--
Conductivity	NA	uS/cm	605	--	613	--	592	--	511	--	545	--	585	--	510	--
pH	NA	----	9.32	--	8.30	--	7.30	--	7.80	--	9.00	--	7.84	--	8.82	--
Dissolved oxygen (DO)	NA	mg/L	7.28	--	10.10	--	6.30	--	6.30	--	12.10	--	7.33	--	8.04	--

Notes:
CAS - Chemical Abstracts Service.
NA - Not Available.
ND - Compound Presented Below Quantification Limit.
USEPA - United States Environmental Protection Agency.
mg/L- Milligrams per liter.
-- = Data not available.
* = Approximate surface water distance, upstream or downstream, from the Rush Island Energy Center.
(a) - Data was obtained from USEPA Surf Your Watershed website at http://ofmpub.epa.gov/apex/STORETSummary/f?p=WatershedUI:1:0::::P1_ORG_CHAR,P1_HUC:1,07140101 on November 6, 2013.Water quality monitoring data from Data from EMAP-Great Rivers Ecosystems collected on August 9, 2005. Sample location Latitude: 38.409493, Longitude: -90.317478, and Generated HUC:07140101.
(b) - Data was obtained from USEPA Surf Your Watershed website at http://ofmpub.epa.gov/apex/STORETSummary/f?p=WatershedUI:1:0::::P1_ORG_CHAR,P1_HUC:1,07140101 on October 24, 2013.Water quality monitoring data from Illinois EPA and collected on November 16, August 16, June 28, and March 16, 2011. Sample location Latitude: 38.4007, Longitude: -90.3232, and Generated HUC:07140101.
(c) - Data was obtained from USEPA Surf Your Watershed website at http://ofmpub.epa.gov/apex/STORETSummary/f?p=WatershedUI:1:0::::P1_ORG_CHAR,P1_HUC:1,7140101 on October 24, 2013.Water quality monitoring data from Data from EMAP-Great Rivers Ecosystems collected on August 1, 2005. Sample location Latitude: 38.305035, Longitude: -90.371933, and Generated HUC: 07140101 .
(d) - Data was obtained from USEPA Surf Your Watershed website at http://ofmpub.epa.gov/apex/STORETSummary/f?p=WatershedUI:1:0::::P1_ORG_CHAR,P1_HUC:1,07140101 on November 4, 2013.Water quality monitoring data from EMAP-Great Rivers Ecosystems and collected on September 20, 2004. Sample location Latitude: 38.206456, Longitude: -90.347067, and Generated HUC:07140101.
(e) - Data was obtained from USEPA Surf Your Watershed website at http://ofmpub.epa.gov/apex/STORETSummary/f?p=WatershedUI:1:0::::P1_ORG_CHAR,P1_HUC: 1,7140101 on November 6, 2013.Water quality monitoring data from Data from EMAP-Great Rivers Ecosystems collected on August 3, 2005. Sample location Latitude: 38.020952, Longitude: -90.096254, and Generated HUC:07140101.
(f) - Data was obtained from USEPA Surf Your Watershed website at http://ofmpub.epa.gov/apex/STORETSummary/f?p=WatershedUI:1:0::::P1_ORG_CHAR,P1_HUC:1,7140101 on November 4, 2013.Water quality monitoring data from EMAP-Great Rivers Ecosystems and collected on September 27, 2004. Sample location Latitude: 37.966671, Longitude: -90.004191, and Generated HUC:07140101.
(e) - Data was obtained from USEPA Surf Your Watershed website at http://ofmpub.epa.gov/apex/STORETSummary/f?p=WatershedUI:1:0::::P1_ORG_CHAR,P1_HUC: 1,7140105 on October 24, 2013.Water quality monitoring data from Illinois EPA and collected on March 16, June 28, August 16, and November 16, 2011. Sample location Latitude:37.9125, Longitude: -89.8519444, and Generated HUC:10300102.
(g) - The surface water monitoring data presented was obtained from the USEPA Surf Your Watershed website at http://cfpub.epa.gov/surf/locate/index.cfm. Water quality monitoring data was accessed through the Surf Your Watershed website by selecting the watershed name, or geographic unit of interested and then selecting to view the water quality monitoring data from this watershed. The water quality monitoring data presented is from the Cahokia-Joachim and Lower Missouri Watersheds.
(h) - Where more than one value was available, the higher value was used.

Table 4
Publicly Available Surface Water Quality Monitoring Data for the Mississippi River
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Constituent	CAS	Units	Downstream (h)											
			Mississippi River Station ID: GRW04449-353 (e)		Mississippi River Station ID: GRW04449-290 (f)		Mississippi River Station ID: I-05 (g)							
Approximate Distance* (miles):			10.9		17.6		29.6							
	Sample Collection Date:		8/3/2005		9/27/2004		11/16/2011		8/16/2011		6/28/2011		3/16/2011	
Inorganics			**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**
Aluminum	7429-90-5	mg/L	--	0.0250	--	0.0250	1.50	0.0356	4.13	0.0203	6.36	ND	3.98	0.0475
Arsenic	7440-38-2	mg/L	--	0.0250	--	0.0250	--	--	0.0051	0.0031	0.0107	0.0079	0.0038	ND
Cadmium	7440-43-9	mg/L	--	--	--	--	ND	ND	ND	ND	ND	ND	0.0002	ND
Copper	7440-50-8	mg/L	--	0.0050	--	0.0050	0.0010	ND	0.0024	ND	0.0066	ND	0.0059	0.0019
Iron	7439-89-6	mg/L	--	0.0050	--	0.0226	1.69	0.0186	4.15	0.0122	8.06	0.0226	5.3600	0.0420
Lead	7439-92-1	mg/L	--	0.0250	--	0.0250	0.0106	0.00145	0.0052	0.0062	0.0081	0.0037	0.0053	0.0008
Magnesium	743-95-4	mg/L	--	23.2	--	19.5	23.4	22.1	22.7	21.8	24.8	21.5	20.3	18.9
Manganese	7439-96-5	mg/L	--	--	--	--	0.1190	0.0030	0.2270	0.0025	0.3640	0.0043	0.2040	0.0082
Nickel	7440-02-0	mg/L	--	0.0100	--	0.0100	0.0027	0.0016	0.0044	ND	0.0071	0.0004	0.0052	0.0009
Nitrogen	93037-13-9	mg/L	1.87	--	--	1.44	--	--	--	--	--	--	--	--
Nitrate-Nitrite (as N)	NA	mg/L	--	--	--	--	2.30	--	1.57	--	4.11	--	3.14	--
Selenium	7782-49-2	mg/L	--	0.0500	--	0.0500	--	--	--	--	--	--	--	--
Sulfate	7757-82-6	mg/L	--	84.2	--	61.2	64.1	--	86.4	--	77.9	--	36.1	--
Zinc	7440-66-6	mg/L	--	0.0050	--	0.0280	0.0226	0.0159	0.0160	0.0030	0.0221	ND	0.0191	0.0013
Water Parameters (j)														
Temperature, water	NA	deg C	30.0	--	23.1	--	11.0	--	27.6	--	23.6	--	5.10	--
Turbidity	NA	NTU	29.5	--	58.0	--	35.0	--	95.0	--	140	--	120	--
Conductivity	NA	uS/cm	588	--	478	--	621	--	612	--	552	--	507	--
pH	NA	----	8.53	--	7.55	--	8.7	--	7.30	--	7.70	--	8.80	--
Dissolved oxygen (DO)	NA	mg/L	7.65	--	7.57	--	10.8	--	6.20	--	6.20	--	11.70	--

Notes:
CAS - Chemical Abstracts Service.
NA - Not Available.
ND - Compound Presented Below Quantification Limit.
USEPA - United States Environmental Protection Agency.
mg/L- Milligrams per liter.
-- = Data not available.
* = Approximate surface water distance, upstream or downstream, from the Rush Island Energy Center.
(a) - Data was obtained from USEPA Surf Your Watershed website at http://ofmpub.epa.gov/apex/STORETSummary/f?p=WatershedUI:1:0::::P1_ORG_CHAR,P1_HUC:1,07140101 on November 6, 2013.Water quality monitoring data from Data from EMAP-Great Rivers Ecosystems collected on August 9, 2005. Sample location Latitude: 38.409493, Longitude: -90.317478, and Generated HUC:07140101.
(b) - Data was obtained from USEPA Surf Your Watershed website at http://ofmpub.epa.gov/apex/STORETSummary/f?p=WatershedUI:1:0::::P1_ORG_CHAR,P1_HUC:1,07140101 on October 24, 2013.Water quality monitoring data from Illinois EPA and collected on November 16, August 16, June 28, and March 16, 2011. Sample location Latitude: 38.4007, Longitude: -90.3232, and Generated HUC:07140101.
(c) - Data was obtained from USEPA Surf Your Watershed website at http://ofmpub.epa.gov/apex/STORETSummary/f?p=WatershedUI:1:0::::P1_ORG_CHAR,P1_HUC:1,7140101 on October 24, 2013.Water quality monitoring data from Data from EMAP-Great Rivers Ecosystems collected on August 1, 2005. Sample location Latitude: 38.305035, Longitude: -90.371933, and Generated HUC: 07140101 .
(d) - Data was obtained from USEPA Surf Your Watershed website at http://ofmpub.epa.gov/apex/STORETSummary/f?p=WatershedUI:1:0::::P1_ORG_CHAR,P1_HUC:1,07140101 on November 4, 2013.Water quality monitoring data from EMAP-Great Rivers Ecosystems and collected on September 20, 2004. Sample location Latitude: 38.206456, Longitude: -90.347067, and Generated HUC:07140101.
(e) - Data was obtained from USEPA Surf Your Watershed website at http://ofmpub.epa.gov/apex/STORETSummary/f?p=WatershedUI:1:0::::P1_ORG_CHAR,P1_HUC: 1,7140101 on November 6, 2013.Water quality monitoring data from Data from EMAP-Great Rivers Ecosystems collected on August 3, 2005. Sample location Latitude: 38.020952, Longitude: -90.096254, and Generated HUC:07140101.
(f) - Data was obtained from USEPA Surf Your Watershed website at http://ofmpub.epa.gov/apex/STORETSummary/f?p=WatershedUI:1:0::::P1_ORG_CHAR,P1_HUC:1,7140101 on November 4, 2013.Water quality monitoring data from EMAP-Great Rivers Ecosystems and collected on September 27, 2004. Sample location Latitude: 37.966671, Longitude: -90.004191, and Generated HUC:07140101.
(e) - Data was obtained from USEPA Surf Your Watershed website at http://ofmpub.epa.gov/apex/STORETSummary/f?p=WatershedUI:1:0::::P1_ORG_CHAR,P1_HUC: 1,7140105 on October 24, 2013.Water quality monitoring data from Illinois EPA and collected on March 16, June 28, August 16, and November 16, 2011. Sample location Latitude:37.9125, Longitude: -89.8519444, and Generated HUC:10300102.
(g) - The surface water monitoring data presented was obtained from the USEPA Surf Your Watershed website at http://cfpub.epa.gov/surf/locate/index.cfm. Water quality monitoring data was accessed through the Surf Your Watershed website by selecting the watershed name, or geographic unit of interested and then selecting to view the water quality monitoring data from this watershed. The water quality monitoring data presented is from the Cahokia-Joachim and Lower Missouri Watersheds.
(h) - Where more than one value was available, the higher value was used.

Table 5
Validated Analytical Results – Surface Water Sampling Event – April 2014
Rush Island Energy Center
Ameren Missouri

Constituent	CAS	Units	Analytical Method	Isle Du Bois Creek Creek Downstream															
				RI-C-1 Total		RI-C-1 DUP Total		RI-C-1 Filtered		RI-C-1 DUP Filtered		RI-C-2 Total		RI-C-2 Filtered		RI-C-3 Total		RI-C-3 Filtered	
Aluminum	7429-90-5	mg/L	SW846 Method 6020	3.37		3.27		0.0143	U	0.0143	U	2.95		0.0143	U	2.93		0.0143	U
Antimony*	7440-36-0	mg/L	SW846 Method 6010B	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U
Arsenic	7440-38-2	mg/L	SW846 Method 6020	0.0015	J	0.0015	J	0.00078	U	0.00078	U	0.0017	J	0.00078	U	0.0013	J	0.00078	U
Barium	7440-39-3	mg/L	SW846 Method 6010B	0.107		0.106		0.0863		0.086		0.0957		0.0854		0.0987		0.0868	
Beryllium*	7440-41-7	mg/L	SW846 Method 6010B	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U
Boron	7440-42-8	mg/L	SW846 Method 6010B	0.0395	J	0.0388	J	0.0368	J	0.0365	J	0.039	J	0.0375	J	0.0391	J	0.0374	J
Cadmium*	7440-43-9	mg/L	SW846 Method 6020	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U
Calcium	7440-70-2	mg/L	SW846 Method 6010B	67.1		67.5		67		67		65.6		66.7		65.8		68.1	
Chromium	7440-47-3	mg/L	SW846 Method 6010B	0.0033	J	0.0032	J	0.0016	U	0.0016	U	0.0016	J	0.0016	U	0.002	J	0.0016	U
Cobalt	7440-48-4	mg/L	SW846 Method 6010B	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U
Copper	7440-50-8	mg/L	SW846 Method 6010B	0.0053	J	0.0044	J	0.0027	U	0.0027	U	0.0033	J	0.0027	U	0.0036	J	0.0027	U
Total Cyanide (water)	57-12-5	mg/L	SW846 Method 9012B	0.005	U	0.005	U	NA		NA		0.005	U	NA		0.005	U	NA	
Fluoride	16984-48-8	mg/L	EPA Method 300.0	0.4	U	0.4	U	NA		NA		0.4	U	NA		0.4	U	NA	
Iron	7439-89-6	mg/L	SW846 Method 6010B	2.68		2.76		0.043	U	0.043	U	1.29		0.043	U	1.87		0.043	U
Lead	7439-92-1	mg/L	SW846 Method 6020	0.0027		0.0024		0.000085	U	0.000085	U	0.002		0.000085	U	0.002		0.000085	U
Magnesium	7439-95-4	mg/L	SW846 Method 6010B	25.6		25.7		25.3		25.3		24.6		25.2		24.8		25.6	
Manganese	7439-96-5	mg/L	SW846 Method 6010B	0.189		0.188		0.134		0.135		0.163		0.127		0.163		0.129	
Mercury*	7439-97-6	mg/L	SW846 Method 7470A	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U
Molybdenum	7439-98-7	mg/L	SW846 Method 6010B	0.002	J	0.0017	U	0.004	J	0.002	J	0.0018	J	0.0021	J	0.0017	U	0.0017	U
Nickel	7440-02-0	mg/L	SW846 Method 6010B	0.0018	J	0.002	J	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.002	J	0.0015	U
Total Nitrite/Nitrate Nitrog	7727-37-9	mg/L	EPA Method 353.2	0.42		0.43		NA		NA		0.45		NA		0.37		NA	
Selenium	7782-49-2	mg/L	SW846 Method 6020	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U
Silver*	7440-22-4	mg/L	SW846 Method 6010B	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U
Sulfate	14808-79-8	mg/L	EPA Method 300.0	40.5		41		NA		NA		40.2		NA		41.1		NA	
Thallium*	7440-28-0	mg/L	SW846 Method 6020	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U
Tin*	7440-31-5	mg/L	SW846 Method 6010B	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U
Zinc	7440-66-6	mg/L	SW846 Method 6010B	0.0205		0.0205		0.0083	J	0.0075	J	0.002	U	0.0021	J	0.002	U	0.0027	J
Total Hardness as CaCO3	471-34-1	mg/L	SM2340 Method B-1997	273		NA		NA		NA		265		NA		267		NA	

Notes:

* Constituent was not detected in any samples.

CAS - Chemical Abstracts Service.

J - Estimated value.

mg/L = Milligrams per liter.

NA - Not Analyzed.

Total - Not filtered.

U - Constituent was not detected.

Table 5
Validated Analytical Results – Surface Water Sampling Event – April 2014
Rush Island Energy Center
Ameren Missouri

				Isle Du Bois Creek																					
				Creek Midstream												Creek Upstream									
				RI-C-4 Total		RI-C-4 Filtered		RI-C-5 Total		RI-C-5 Filtered		RI-C-6 Total		RI-C-6 Filtered		RI-C-7 Total		RI-C-7 Filtered		RI-C-8 Total		RI-C-8 Filtered		RI-C-9 Total		RI-C-9 Filtered	
Constituent	**CAS**	**Units**	**Analytical Method**																								
Aluminum	7429-90-5	mg/L	SW846 Method 6020	1.59		0.0143	U	1.64		0.0143	U	1.28		0.0143	U	2.01		0.0143	U	1.89		0.0143	U	1.75		0.0143	U
Antimony*	7440-36-0	mg/L	SW846 Method 6010B	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U
Arsenic	7440-38-2	mg/L	SW846 Method 6020	0.00091	J	0.00078	U	0.0012	J	0.00078	U	0.00078	U	0.00078	U	0.0011	J	0.00078	U	0.00079	J	0.00078	U	0.0012	J	0.00078	U
Barium	7440-39-3	mg/L	SW846 Method 6010B	0.0909		0.0818		0.0935		0.0827		0.091		0.0821		0.0999		0.0845		0.0919		0.0813		0.0938		0.0829	
Beryllium*	7440-41-7	mg/L	SW846 Method 6010B	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U
Boron	7440-42-8	mg/L	SW846 Method 6010B	0.036	J	0.0351	J	0.0366	J	0.0348	J	0.0343	J	0.0334	J	0.0208	J	0.019	J	0.0195	J	0.0172	J	0.0189	J	0.018	J
Cadmium*	7440-43-9	mg/L	SW846 Method 6020	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U
Calcium	7440-70-2	mg/L	SW846 Method 6010B	67		66		66.7		67.5		66.5		66.7		70.3		67.4		65.8		64.4		66		65.6	
Chromium	7440-47-3	mg/L	SW846 Method 6010B	0.0016	U	0.0016	U	0.0016	U	0.0021	J	0.002	J	0.0016	U	0.0021	J	0.0016	U	0.0017	J	0.0016	U	0.0018	J	0.0016	U
Cobalt	7440-48-4	mg/L	SW846 Method 6010B	0.0017	J	0.0013	U	0.0018	J	0.0013	U	0.002	J	0.0013	U	0.0023	J	0.0013	U	0.0019	J	0.0013	U	0.0019	J	0.0013	U
Copper	7440-50-8	mg/L	SW846 Method 6010B	0.0039	J	0.0027	U	0.0034	J	0.0027	U	0.0037	J	0.0027	U	0.0039	J	0.0027	U	0.0031	J	0.0027	U	0.0036	J	0.0027	U
Total Cyanide (water)	57-12-5	mg/L	SW846 Method 9012B	0.005	U	NA		0.005	U	NA		0.005	U	NA		0.005	U	NA		0.005	U	NA		0.005	U	NA	
Fluoride	16984-48-8	mg/L	EPA Method 300.0	0.4	U	NA		0.4	U	NA		0.4	U	NA		0.4	U	NA		0.4	U	NA		0.4	U	NA	
Iron	7439-89-6	mg/L	SW846 Method 6010B	1.31		0.043	U	1.37		0.043	U	1.36		0.043	U	1.87		0.043	U	1.34		0.043	U	1.46		0.043	U
Lead	7439-92-1	mg/L	SW846 Method 6020	0.0013		0.000085	U	0.0013		0.000085	U	0.0012		0.000085	U	0.002		0.000085	U	0.0016		0.000085	U	0.0016		8.5E-05	U
Magnesium	7439-95-4	mg/L	SW846 Method 6010B	25.8		25.1		25.6		25.8		25.4		25.5		26.9		26		26.5		25.9		26.8		26.6	
Manganese	7439-96-5	mg/L	SW846 Method 6010B	0.115		0.0917		0.122		0.0899		0.115		0.0881		0.143		0.0933		0.136		0.0941		0.138		0.0989	
Mercury*	7439-97-6	mg/L	SW846 Method 7470A	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U
Molybdenum	7439-98-7	mg/L	SW846 Method 6010B	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U
Nickel	7440-02-0	mg/L	SW846 Method 6010B	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U
Total Nitrite/Nitrate Nitrog	7727-37-9	mg/L	EPA Method 353.2	0.44		NA		0.42		NA		0.44		NA		0.63		NA		0.48		NA		0.46		NA	
Selenium	7782-49-2	mg/L	SW846 Method 6020	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.00067	J	0.00058	J	0.0005	U	0.0005	U	0.0005	U	0.0005	U
Silver*	7440-22-4	mg/L	SW846 Method 6010B	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U
Sulfate	14808-79-8	mg/L	EPA Method 300.0	41.7		NA		40.8		NA		41.9		NA		43.2		NA		42.4		NA		43.7		NA	
Thallium*	7440-28-0	mg/L	SW846 Method 6020	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U
Tin*	7440-31-5	mg/L	SW846 Method 6010B	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U
Zinc	7440-66-6	mg/L	SW846 Method 6010B	0.0082	J	0.002	J	0.002	U	0.002	U	0.002	U	0.0023	J	0.0171	J	0.0044	J	0.0116	J	0.004	J	0.0074	J	0.002	J
Total Hardness as CaCO3	471-34-1	mg/L	SM2340 Method B-1997	273		NA		272		NA		271		NA		286		NA		273		NA		275		NA	

Notes:

* Constituent was not detected in any samples.

CAS - Chemical Abstracts Service.

J - Estimated value.

mg/L = Milligrams per liter.

NA - Not Analyzed.

Total - Not filtered.

U - Constituent was not detected.

Table 5
Validated Analytical Results – Surface Water Sampling Event – April 2014
Rush Island Energy Center
Ameren Missouri

Constituent	CAS	Units	Analytical Method	Mississippi River River Downstream																			
				RI-R-1S Total		RI-R-1S Filtered		RI-R-2S Total		RI-R-2S Filtered		RI-R-2M Total		RI-R-2M Filtered		RI-R-3S Total		RI-R-3S Filtered		RI-R-3M Total		RI-R-3M Filtered	
Aluminum	7429-90-5	mg/L	SW846 Method 6020	2.64		0.0143	U	2.43		0.0143	U	2.61		0.0143	U	2.77		0.0143	U	2.51		0.0143	U
Antimony*	7440-36-0	mg/L	SW846 Method 6010B	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U
Arsenic	7440-38-2	mg/L	SW846 Method 6020	0.0028		0.0015	J	0.0021		0.0011	J	0.0024		0.0012	J	0.0024		0.0012	J	0.0022		0.0011	J
Barium	7440-39-3	mg/L	SW846 Method 6010B	0.1		0.078		0.099		0.073		0.0947		0.0662		0.0801		0.0602		0.0911		0.0611	
Beryllium*	7440-41-7	mg/L	SW846 Method 6010B	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U
Boron	7440-42-8	mg/L	SW846 Method 6010B	0.0543		0.0527		0.0515		0.0499	J	0.0487	J	0.0442	J	0.0418	J	0.0405	J	0.0437	J	0.0412	J
Cadmium*	7440-43-9	mg/L	SW846 Method 6020	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U
Calcium	7440-70-2	mg/L	SW846 Method 6010B	53.5		52.5		54.1		52.4		53.7		51.3		52.9		50.9		53.7		51	
Chromium	7440-47-3	mg/L	SW846 Method 6010B	0.0022	J	0.0016	U	0.0032	J	0.0016	U	0.0034	J	0.0016	U	0.0021	J	0.0016	U	0.0035	J	0.0016	U
Cobalt	7440-48-4	mg/L	SW846 Method 6010B	0.0023	J	0.0013	U	0.0028	J	0.0013	U	0.0024	J	0.0013	U	0.0021	J	0.0013	U	0.0026	J	0.0013	U
Copper	7440-50-8	mg/L	SW846 Method 6010B	0.0046	J	0.0027	U	0.0055	J	0.0027	U	0.0053	J	0.0027	U	0.0052	J	0.0027	U	0.0066	J	0.0027	U
Total Cyanide (water)	57-12-5	mg/L	SW846 Method 9012B	0.005	U	NA		0.005	U	NA		0.005	U	NA		0.005	U	NA		0.005	U	NA	
Fluoride	16984-48-8	mg/L	EPA Method 300.0	0.4	U	NA		0.4	U	NA		0.4	U	NA		0.4	U	NA		0.4	U	NA	
Iron	7439-89-6	mg/L	SW846 Method 6010B	2.17		0.043	U	2.78		0.043	U	2.93		0.043	U	2.12		0.043	U	3.11		0.043	U
Lead	7439-92-1	mg/L	SW846 Method 6020	0.0025		0.000085	U	0.0025		0.000085	U	0.0024		0.000085	U	0.0022		0.000085	U	0.0022		0.000085	U
Magnesium	7439-95-4	mg/L	SW846 Method 6010B	19.5		19.2		19.9		19.2		19.8		19		19.7		19		20.3		19	
Manganese	7439-96-5	mg/L	SW846 Method 6010B	0.153		0.0031	J	0.174		0.00097	J	0.172		0.00098	J	0.159		0.0012	J	0.181		0.0012	J
Mercury*	7439-97-6	mg/L	SW846 Method 7470A	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U
Molybdenum	7439-98-7	mg/L	SW846 Method 6010B	0.0017	U	0.0019	J	0.0017	U	0.0017	U	0.0017	U	0.0017	J	0.0017	U	0.0017	U	0.0017	U	0.0017	U
Nickel	7440-02-0	mg/L	SW846 Method 6010B	0.0026	J	0.0019	J	0.003	J	0.0015	U	0.0034	J	0.0015	U	0.0027	J	0.0015	U	0.0038	J	0.0015	U
Total Nitrite/Nitrate Nitrog	7727-37-9	mg/L	EPA Method 353.2	1.5		NA		1.6		NA		1.8		NA		2.2		NA		2.2		NA	
Selenium	7782-49-2	mg/L	SW846 Method 6020	0.001	J	0.00087	J	0.00098	J	0.00075	J	0.00079	J	0.00085	J	0.00077	J	0.0008	J	0.00069	J	0.00079	J
Silver*	7440-22-4	mg/L	SW846 Method 6010B	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U
Sulfate	14808-79-8	mg/L	EPA Method 300.0	75.5		NA		70.6		NA		63.9		NA		44.1		NA		47		NA	
Thallium*	7440-28-0	mg/L	SW846 Method 6020	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U
Tin*	7440-31-5	mg/L	SW846 Method 6010B	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U
Zinc	7440-66-6	mg/L	SW846 Method 6010B	0.0117	J	0.0046	J	0.0123	J	0.0025	J	0.0136	J	0.0021	J	0.0108	J	0.0029	J	0.0206		0.0034	J
Total Hardness as CaCO3	471-34-1	mg/L	SM2340 Method B-1997	214		NA		217		NA		215		NA		213		NA		218		NA	

Notes:

* Constituent was not detected in any samples.

CAS - Chemical Abstracts Service.

J - Estimated value.

mg/L = Milligrams per liter.

NA - Not Analyzed.

Total - Not filtered.

U - Constituent was not detected.

Table 5
Validated Analytical Results – Surface Water Sampling Event – April 2014
Rush Island Energy Center
Ameren Missouri

				Mississippi River																							
				River Upstream																							
Constituent	CAS	Units	Analytical Method	RI-R-4S Total		RI-R-4S DUP Total		RI-R-4S Filtered		RI-R-4S DUP Filtered		RI-R-5S Total		RI-R-5S Filtered		RI-R-5M Total		RI-R-5M Filtered		RI-R-6S Total		RI-R-6S Filtered		RI-R-6M Total		RI-R-6M Filtered	
Aluminum	7429-90-5	mg/L	SW846 Method 6020	2.47		2.74		0.0143	U	0.0143	U	2.54		0.385		2.73		0.0143	U	2.77		0.0143	U	2.6		0.0143	U
Antimony*	7440-36-0	mg/L	SW846 Method 6010B	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U
Arsenic	7440-38-2	mg/L	SW846 Method 6020	0.0021		0.0028		0.001	J	0.0019	J	0.0019	J	0.0015	J	0.0025		0.0012	J	0.0023		0.0013	J	0.0021		0.0014	J
Barium	7440-39-3	mg/L	SW846 Method 6010B	0.104		0.107		0.0776		0.08		0.102		0.0796		0.101		0.0745		0.0931		0.0677		0.0932		0.0698	
Beryllium*	7440-41-7	mg/L	SW846 Method 6010B	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U
Boron	7440-42-8	mg/L	SW846 Method 6010B	0.0553		0.0593		0.053		0.0525		0.0532		0.0511		0.0532		0.0502		0.0471	J	0.0449	J	0.0468	J	0.0476	J
Cadmium*	7440-43-9	mg/L	SW846 Method 6020	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U
Calcium	7440-70-2	mg/L	SW846 Method 6010B	56.4		55		52.5		53.2		54.3		52.6		55.2		52.1		54		52		53.6		51.7	
Chromium	7440-47-3	mg/L	SW846 Method 6010B	0.0027	J	0.003	J	0.0016	U	0.0016	U	0.0027	J	0.0016	U	0.0026	J	0.0016	U	0.0029	J	0.0016	U	0.0031	J	0.0016	U
Cobalt	7440-48-4	mg/L	SW846 Method 6010B	0.0023	J	0.0013	U	0.0013	U	0.0013	U	0.0024	J	0.0013	U	0.0026	J	0.0013	U	0.0024	J	0.0013	U	0.0025	J	0.0013	U
Copper	7440-50-8	mg/L	SW846 Method 6010B	0.0047	J	0.0027	U	0.0027	U	0.0027	U	0.0053	J	0.0027	U	0.0056	J	0.0027	U	0.0056	J	0.0027	U	0.0061	J	0.0027	U
Total Cyanide (water)	57-12-5	mg/L	SW846 Method 9012B	0.005	U	0.005	U	NA		NA		0.005	U	NA		0.005	U	NA		0.005	U	NA		0.005	U	NA	
Fluoride	16984-48-8	mg/L	EPA Method 300.0	0.4	U	0.4	U	NA		NA		0.4	U	NA		0.4	U	NA		0.58		NA		0.4	U	NA	
Iron	7439-89-6	mg/L	SW846 Method 6010B	2.71		2.41		0.043	U	0.043	U	2.57		0.364		2.5		0.043	U	2.79		0.043	U	2.89		0.043	U
Lead	7439-92-1	mg/L	SW846 Method 6020	0.0025		0.0026		8.5E-05	U	0.000085	U	0.0024		0.00049	J	0.0025		0.000085	U	0.0026		0.000085	U	0.0022		0.000085	U
Magnesium	7439-95-4	mg/L	SW846 Method 6010B	20.7		20		19.2		19.8		19.6		19.2		20		19		19.7		19.2		19.7		19	
Manganese	7439-96-5	mg/L	SW846 Method 6010B	0.158		0.159		0.0032	J	0.0031	J	0.171		0.0384		0.172		0.0011	J	0.18		0.001	J	0.178		0.0011	J
Mercury*	7439-97-6	mg/L	SW846 Method 7470A	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U
Molybdenum	7439-98-7	mg/L	SW846 Method 6010B	0.0017	U	0.0021	J	0.0018	J	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U
Nickel	7440-02-0	mg/L	SW846 Method 6010B	0.0034	J	0.0041	J	0.0018	J	0.0023	J	0.0032	J	0.002	J	0.003	J	0.0021	J	0.0032	J	0.0016	J	0.0033	J	0.0015	U
Total Nitrite/Nitrate Nitrog	7727-37-9	mg/L	EPA Method 353.2	1.5		1.5		NA		NA		1.5		NA		1.5		NA		1.8		NA		1.7		NA	
Selenium	7782-49-2	mg/L	SW846 Method 6020	0.00088	J	0.001	J	0.00093	J	0.00096	J	0.00097	J	0.00079	J	0.0011	J	0.00084	J	0.00079	J	0.00069	J	0.00083	J	0.00073	J
Silver*	7440-22-4	mg/L	SW846 Method 6010B	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U
Sulfate	14808-79-8	mg/L	EPA Method 300.0	79		76.6		NA		NA		73.8		NA		73.2		NA		60.3		NA		59.3		NA	
Thallium*	7440-28-0	mg/L	SW846 Method 6020	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U
Tin*	7440-31-5	mg/L	SW846 Method 6010B	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U
Zinc	7440-66-6	mg/L	SW846 Method 6010B	0.0128	J	0.0111	J	0.0023	J	0.002	U	0.0118	J	0.0037	J	0.0117	J	0.0026	J	0.0125	J	0.003	J	0.013	J	0.0024	J
Total Hardness as CaCO3	471-34-1	mg/L	SM2340 Method B-1997	226		220		NA		NA		216		NA		220		NA		216		NA		215		NA	

Notes:

* Constituent was not detected in any samples.

CAS - Chemical Abstracts Service.

J - Estimated value.

mg/L = Milligrams per liter.

NA - Not Analyzed.

Total - Not filtered.

U - Constituent was not detected.

Table 6
Field Parameters
Surface Water Sampling Event - April 2014
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Sample ID	RI-C-1	RI-C-2	RI-C-3	RI-C-4	RI-C-5	RI-C-6	RI-C-7	RI-C-8	RI-C-9	RI-R-1S	RI-R-2S	RI-R-2M	RI-R-3S	RI-R-3M	RI-R-4S	RI-R-5S	RI-R-5M	RI-R-6S	RI-R-6M
Date Sampled	04/17/14	04/17/14	04/17/14	04/17/14	04/17/14	04/17/14	04/17/14	04/17/14	04/17/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14	04/18/14
Time Sampled	10:10	10:40	11:05	12:20	12:35	12:50	14:15	14:30	14:45	09:30	10:00	10:20	10:55	11:15	11:45	12:20	12:45	13:10	13:30
Field Parameters																			
pH (Standard Units)	7.89	7.48	7.42	7.35	7.38	7.43	7.65	8.08	7.42	8.58	8.56	8.88	7.78	8.93	6.14	7.59	8.88	8.33	8.76
Specific Conductance (µS/cm)	734	733	733	739	733	727	752	736	737	553	515	543	436	562	563	547	547	517	528
Turbidity (NTU)	50.6	51.9	51.2	30.1	28.7	35.0	39.3	38.2	NA	54.4	52.0	68.2	35.2	86.6	58.7	64.1	70.6	60.8	81.3
Temperature (˚C)	9.63	9.49	9.76	11.72	10.78	11.10	11.99	11.10	11.39	9.60	9.42	9.67	9.42	9.41	9.50	9.45	9.96	9.57	9.66
Dissolved Oxygen (mg/l)	8.38	7.92	8.07	8.14	7.89	8.22	8.94	8.32	8.85	8.33	8.86	8.95	12.59	8.80	14.15	12.32	8.93	11.40	8.46
Redox Potential (mV)	43.3	24.9	34.6	35.9	27.0	43.7	51.7	25.5	34.6	169.5	118.7	121.0	105.6	85.9	158.6	88.8	82.7	81.1	59.1

Notes:

1) pH, specific conductance, temperature, dissolved oxygen, and redox potential were measured using a YSI 556 MPS multi-parameter reading device
2) Turbidity was measured using a HACH 2100P turbidometer
3) µS/cm - micro-Siemens per centimeter
4) NTU - Nephelometric Turbidity Units
5) ˚C - degrees Celsius
6) mg/l - milligrams per liter
7) mV - millivolts
8) NA - not analyzed

Prepared by: JSI
Check by: MWD
Reviewed by: MNH

Table 7
Comparison of Bluff Area Groundwater Monitoring Results to Screening Levels – April and June 2014 Sampling Event Results (a)
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Piezometer Sample ID (d)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Total Cyanide	Fluoride	Iron	Lead	Manganese	Mercury
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MCL (b)	NA	0.006	0.01	2	0.004	NA	0.005	0.1	NA	1.3	0.2	4	NA	0.015	NA	0.002
SMCL (b)	0.05 - 0.2	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	2	0.3	NA	0.05	NA
RSL (c)	16	0.006	0.000045	2.9	0.016	3.1	0.0069	16	0.0047	0.62	0.0014	0.62	11	NA	0.32	0.0043
TBW-1	0.0596 (f)			0.0926		0.0135		0.0021						0.00028	0.0023	
DUP-1 (e)	0.068 (f)			0.0947		0.0129		0.0016						0.00028	0.0021	
TBW-2				0.106		0.0088			0.0526						0.0038	
TBW-3	0.332			0.05		0.0574		0.0051					0.322	0.00028	0.0166	

Notes:
Blank data cells indicate a non-detect value.
mg/L - Milligrams per liter.
MCL - Maximum Contaminant Level.
NA - Not Available/Not Analyzed.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level. Used if no MCL available.
USEPA - United States Environmental Protection Agency.
greater than MCL/SMCL
greater than RSL
(a) - Numerical values were obtained from the Ameren Missouri Rush Island Energy Center
Laboratory Analytical Results for Groundwater Monitoring Samples collected on April 25, 2014(TBW-1, TBW-2) and June 4, 2014 (TBW-3)
from Temporary Groundwater Piezometers Installed Near Rush Island Energy Center.
(b) - USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. Spring 2012. http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2013). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - Piezometers are screened in bedrock.
(e) - Duplicate sample from TBW-1.
(f) - Value is within the SMCL range.

Table 7
Comparison of Bluff Area Groundwater Monitoring Results to Screening Levels – April and June 2014 Sampling Event Results (a)
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Piezometer Sample ID (d)	Molybdenum	Nickel	Total Nitrite/Nitrate Nitrogen	Selenium	Silver	Sulfate	Thallium	Tin	Zinc
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MCL (b)	NA	NA	10	0.05	NA	NA	0.002	NA	NA
SMCL (b)	NA	NA	NA	NA	0.1	250	NA	NA	5
RSL (c)	0.078	0.3	NA	0.078	0.071	NA	0.00016	9.3	4.7
TBW-1		0.0023	0.12			14.6			
DUP-1 (e)		0.0015	0.15			14.3			
TBW-2		0.0092				7			
TBW-3		0.0036	0.58			28.3			0.0218

Notes:
Blank data cells indicate a non-detect value.
mg/L - Milligrams per liter.
MCL - Maximum Contaminant Level.
NA - Not Available/Not Analyzed.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level. Used if no MCL available.
USEPA - United States Environmental Protection Agency.
greater than MCL/SMCL
greater than RSL
(a) - Numerical values were obtained from the Ameren Missouri Rush Island Energy Center
Laboratory Analytical Results for Groundwater Monitoring Samples collected on April 25, 2014(TBW-1, TBW-2) and June 4, 2014 (TBW-3)
from Temporary Groundwater Piezometers Installed Near Rush Island Energy Center.
(b) - USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. Spring 2012. http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2013). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - Piezometers are screened in bedrock.
(e) - Duplicate sample from TBW-1.
(f) - Value is within the SMCL range.

Table 8
Comparison of NPDES Monitoring Results for Outfall 002 to Screening Levels
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

				Missouri State Water Quality Screening Levels			Federal Water Quality Criteria Screening Levels		
Constituent	**CAS**	**Units**	**NPDES 2009 Renewal Package – Outfall 002 (g)**	**Human Health Fish Consumption (a)**	**Drinking Water Supply (a)**	**Groundwater (a)**	**USEPA MCLs (c)**	**USEPA SMCLs (c)**	**USEPA Tapwater RSLs (d)**
Inorganics,Total									
Aluminum	7429-90-5	mg/L	1.60	NA	NA	NA	NA	0.05	16
Antimony	7440-36-9	mg/L	<0.005	4.3	0.006	0.006	0.006	NA	0.006
Arsenic	7440-38-2	mg/L	0.008	NA	0.05	0.05	0.01	NA	0.000045
Barium	7440-39-3	mg/L	0.50	NA	2	2	2	NA	2.9
Beryllium	7440-41-7	mg/L	<0.005	NA	0.004	0.004	0.004	NA	0.016
Boron	7440-42-8	mg/L	0.40	NA	NA	2	NA	NA	3.1
Bromide	24959-67-9	mg/L	2.10	NA	NA	NA	NA	NA	NA
Cadmium	7440-43-9	mg/L	<0.005	NA	0.005	0.005	0.005	NA	0.0069
Chromium	16065-83-1	mg/L	0.017	NA	0.1 (h)	0.1 (h)	0.1 (h)	NA	16 (b)
Cobalt	7440-48-4	mg/L	<0.005	NA	NA	1	NA	NA	0.0047
Copper	7440-50-8	mg/L	0.210	NA	1.3	1.3	1.3 (f)	1	0.62
Cyanide	57-12-5	mg/L	<0.005	NA	NA	NA	0.2	NA	0.0014
Fluoride	16984-48-8	mg/L	0.8	NA	4	4	4	2	0.62
Iron	7439-89-6	mg/L	1.9	NA	NA	0.3	NA	0.3	11
Lead	7439-92-1	mg/L	<0.005	NA	0.015	0.015	0.015 (f)	NA	NA
Magnesium	743-95-4	mg/L	15	NA	NA	NA	NA	NA	NA
Manganese	7439-96-5	mg/L	0.05	NA	NA	0.05	NA	0.05	0.32
Mercury	7487-94-7	mg/L	<0.001	NA	0.002	0.002	0.002	NA	0.0043
Molybdenum	7439-98-7	mg/L	0.01	NA	NA	NA	NA	NA	0.078
Nickel	7440-02-0	mg/L	0.026	NA	0.1	0.1	NA	NA	0.3
Nitrate-Nitrite (as N)	NA	mg/L	0.4	NA	10	10	10	NA	NA
Selenium	7782-49-2	mg/L	0.040	NA	0.05	0.05	0.05	NA	0.078
Silver	7440-22-4	mg/L	<0.005	NA	0.05	0.05	NA	0.1	0.071
Sulfate	7757-82-6	mg/L	90	NA	250	NA	NA	250	NA
Sulfide	NA	mg/L	2.1	NA	NA	NA	NA	NA	NA
Sulfite	NA	mg/L	1.4	NA	NA	NA	NA	NA	NA
Surfactants	NA	mg/L	0.02	NA	NA	NA	NA	NA	NA
Thallium	7440-28-0	mg/L	0.01	0.0063	0.002	0.002	0.002	NA	0.00016
Tin	7440-31-5	mg/L	<0.005	NA	NA	NA	NA	NA	9.3
Titanium	7440-32-6	mg/L	0.06	NA	NA	NA	NA	NA	NA
Zinc	7440-66-6	mg/L	0.054	NA	5	5	NA	5	4.7
Radioactivity									
Alpha total	NA	pCi/L	<3.88	NA	NA	NA	15	NA	NA
Beta Total	NA	pCi/L	8.19	NA	NA	NA	4 mrem/yr (e)	NA	NA
Radium Total (i)	NA	NA	<1.00	NA	NA	NA	5	NA	NA
Radium 226	NA	NA	<0.31	NA	NA	NA	NA	NA	9.06E-04 (j)

Notes presented on following page.

Table 8
Comparison of NPDES Monitoring Results for Outfall 002 to Screening Levels
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Notes:
CAS - Chemical Abstracts Service.
MCL - Maximum Contaminant Level.
mrem/year - millirem per year.
NA - Not Available.
NPDES - National Pollutant Discharge Elimination System.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level. No MCL available.
USEPA - United States Environmental Protection Agency.
mg/L - Milligrams per liter.
pCi/L - picocuries per liter.
NPDES 2009 Renewal Package – Outfall 002 Detected Concentration> Indicated Screening Value.
(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. Updated January 29, 2014. http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf
Per 10 CSR 20-7.031(4)(B)(2), the criteria for Aquatic Life Protection and Human Protection Fish Consumption should be compared to dissolved metals data (except for mercury). All other criteria are to be compared to total metals data. Dissolved data are not available; therefore, total data have conservatively been compared to the aquatic life and fish protection criteria.
(b) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, and the basis of which has been questioned by USEPA's Science Advisory Board. This issue is discussed in detail in Appendix A.
(c) - USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. Spring 2012. http://water.epa.gov/drink/contaminants/index.cfm
(d) - USEPA Regional Screening Levels (November 2013). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(e) - MCL of 4 mrem/year is not comparable to data in pCi/L. Therefore, no comparison has been made.
(f) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(g) - Data from Rush Island Energy Center NPDES 2009 Renewal Package – Outfall 002.
(h) - The drinking water standard or MCL for chromium is based on total chromium.
(i) - Sum of Radium 226 and Radium 228.
(j) - USEPA Preliminary Remediation Goals for Radionuclides. August 2010. http://epa-prgs.ornl.gov/radionuclides/download.html.

Table 9
Comparison of Isle Du Bois Creek Surface Water Results to Screening Levels – Total (Unfiltered) Sample Results
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Constituent	CAS	Units	Missouri State Water Quality Screening Levels		Federal Water Quality Screening Levels			Isle Du Bois Creek (g)																										
								Creek Downstream											Creek Midstream							Creek Upstream									
			Drinking Water Supply (a)	Groundwater (a)	USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)	RI-C-1		RI-C-1 DUP		RI-C-2		RI-C-3		RI-C-4		RI-C-5		RI-C-6		RI-C-7		RI-C-8		RI-C-9									
Aluminum	7429-90-5	mg/L	NA	NA	NA	0.05	20	3.37		3.27		2.95		2.93		1.59		1.64		1.28		2.01		1.89		1.75									
Antimony*	7440-36-0	mg/L	0.006	0.006	0.006	NA	0.0078	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U								
Arsenic	7440-38-2	mg/L	0.05	0.05	0.01	NA	0.000052	0.0015	J	0.0015	J	0.0017	J	0.0013	J	0.00091	J	0.0012	J	0.00078	U	0.0011	J	0.00079	J	0.0012	J								
Barium	7440-39-3	mg/L	2	2	2	NA	3.8	0.107		0.106		0.0957		0.0987		0.0909		0.0935		0.091		0.0999		0.0919		0.0938									
Beryllium*	7440-41-7	mg/L	0.004	0.004	0.004	NA	0.025	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U								
Boron	7440-42-8	mg/L	NA	2	NA	NA	4	0.0395	J	0.0388	J	0.039	J	0.0391	J	0.036	J	0.0366	J	0.0343	J	0.0208	J	0.0195	J	0.0189	J								
Cadmium*	7440-43-9	mg/L	0.005	0.005	0.005	NA	0.0092	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U								
Calcium (e)	7440-70-2	mg/L	NA	NA	NA	NA	NA	67.1		67.5		65.6		65.8		67		66.7		66.5		70.3		65.8		66									
Chromium	7440-47-3	mg/L	0.1 (d)	0.1 (d)	0.1 (d)	NA	22 (h)	0.0033	J	0.0032	J	0.0016	J	0.002	J	0.0016	U	0.0016	U	0.002	J	0.0021	J	0.0017	J	0.0018	J								
Cobalt	7440-48-4	mg/L	NA	1	NA	NA	0.006	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0017	J	0.0018	J	0.002	J	0.0023	J	0.0019	J	0.0019	J								
Copper	7440-50-8	mg/L	1.3	1.3	1.3 (f)	1	0.8	0.0053	J	0.0044	J	0.0033	J	0.0036	J	0.0039	J	0.0034	J	0.0037	J	0.0039	J	0.0031	J	0.0036	J								
Total Cyanide* (water)	57-12-5	mg/L	NA	NA	0.2	NA	0.0015	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U								
Fluoride*	16984-48-8	mg/L	4	4	4 (i)	2	0.8	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U								
Iron	7439-89-6	mg/L	NA	0.3	NA	0.3	14	2.68		2.76		1.29		1.87		1.31		1.37		1.36		1.87		1.34		1.46									
Lead	7439-92-1	mg/L	0.015	0.015	0.015 (f)	NA	NA	0.0027		0.0024		0.002		0.002		0.0013		0.0013		0.0012		0.002		0.0016		0.0016									
Magnesium (e)	7439-95-4	mg/L	NA	NA	NA	NA	NA	25.6		25.7		24.6		24.8		25.8		25.6		25.4		26.9		26.5		26.8									
Manganese	7439-96-5	mg/L	NA	0.05	NA	0.05	0.43	0.189		0.188		0.163		0.163		0.115		0.122		0.115		0.143		0.136		0.138									
Mercury*	7439-97-6	mg/L	0.002	0.002	0.002	NA	0.0057	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U								
Molybdenum	7439-98-7	mg/L	NA	NA	NA	NA	0.1	0.002	J	0.0017	U	0.0018	J	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U								
Nickel	7440-02-0	mg/L	0.1	0.1	NA	NA	0.39	0.0018	J	0.002	J	0.0015	U	0.002	J	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U								
Total Nitrite/Nitrate Nitrogen	7727-37-9	mg/L	10	10	10	NA	NA	0.42		0.43		0.45		0.37		0.44		0.42		0.44		0.63		0.48		0.46									
Selenium	7782-49-2	mg/L	0.05	0.05	0.05	NA	0.1	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.00067	J	0.0005	U	0.0005	U								
Silver*	7440-22-4	mg/L	0.05	0.05	NA	0.1	0.094	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U								
Sulfate	14808-79-8	mg/L	250	NA	NA	250	NA	40.5		41		40.2		41.1		41.7		40.8		41.9		43.2		42.4		43.7									
Thallium*	7440-28-0	mg/L	0.002	0.002	0.002	NA	0.0002	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U								
Tin*	7440-31-5	mg/L	NA	NA	NA	NA	12	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U								
Zinc	7440-66-6	mg/L	5	5	NA	5	6	0.0205		0.0205		0.002	U	0.002	U	0.0082	J	0.002	U	0.002	U	0.0171	J	0.0116	J	0.0074	J								
Total Hardness as CaCO3 (e)	471-34-1	mg/L	NA	NA	NA	NA	NA	273		NA		265		267		273		272		271		286		273		275									

Notes:
* Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - Milligrams per liter.
NA - Not Analyzed/Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level. No MCL available.
U - Constituent was not detected.
USEPA - United States Environmental Protection Agency.
Detected Concentration> USEPA Tapwater RSL.
Detected Concentration> USEPA SMCL.
Detected Concentration> Missouri Groundwater Quality Criteria.
Detected Concentration> Missouri Groundwater Quality Criteria and USEPA. SMCL.
(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. Updated January 29, 2014. http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf.
Per 10 CSR 20-7.031(4)(B)(2), the criteria for Human Protection Fish Consumption apply to dissolved metals data.
All other criteria apply to total concentrations.
(b) - USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. Spring 2012.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (May 2014). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - The drinking water standard or MCL for chromium is based on total chromium.
(e) - Screening levels from the presented sources are not available for this constituent.
(f) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(g) - Surface Water Samples collected in April 2014.
(h) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, and the basis of which has been questioned by USEPA's Science Advisory Board. This issue is discussed in detail in Appendix A.
(i) - Value for Soluble Fluoride used.

Table 10
Comparison of Isle Du Bois Creek Surface Water Results to Screening Levels – Dissolved (Filtered) Sample Results
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Constituent	CAS	Units	Missouri State Water Quality Screening Levels			Federal Water Quality Screening Levels			Isle Du Bois Creek (h)																									
									Creek Downstream																Creek Midstream							Creek Upstream					
			Human Health Fish Consumption (a)	Drinking Water Supply (a)	Groundwater (a)	USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)	RI-C-1		RI-C-1 DUP		RI-C-2		RI-C-3		RI-C-4		RI-C-5		RI-C-6		RI-C-7		RI-C-8		RI-C-9							
Aluminum*	7429-90-5	mg/L	NA	NA	NA	NA	0.05	20	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U						
Antimony*	7440-36-0	mg/L	4.3	0.006	0.006	0.006	NA	0.0078	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U						
Arsenic*	7440-38-2	mg/L	NA	0.05	0.05	0.01	NA	0.000052	0.00078	U	0.00078	U	0.00078	U	0.00078	U	0.00078	U	0.00078	U	0.00078	U	0.00078	U	0.00078	U	0.00078	U						
Barium	7440-39-3	mg/L	NA	2	2	2	NA	3.8	0.0863		0.086		0.0854		0.0868		0.0818		0.0827		0.0821		0.0845		0.0813		0.0829						
Beryllium*	7440-41-7	mg/L	NA	0.004	0.004	0.004	NA	0.025	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U						
Boron	7440-42-8	mg/L	NA	NA	2	NA	NA	4	0.0368	J	0.0365	J	0.0375	J	0.0374	J	0.0351	J	0.0348	J	0.0334	J	0.019	J	0.0172	J	0.018	J						
Cadmium*	7440-43-9	mg/L	NA	0.005	0.005	0.005	NA	0.0092	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U						
Calcium (g,e)	7440-70-2	mg/L	NA	NA	NA	NA	NA	NA	67		67		67		68		66		68		67		67		64		66						
Chromium	7440-47-3	mg/L	NA	0.1 (d)	0.1 (d)	0.1 (d)	NA	22 (i)	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0021	J	0.0016	U	0.0016	U	0.0016	U	0.0016	U						
Cobalt*	7440-48-4	mg/L	NA	NA	1	NA	NA	0.006	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U						
Copper*	7440-50-8	mg/L	NA	1.3	1.3	1.3 (f)	1	0.8	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U						
Total Cyanide (water) (e)	57-12-5	mg/L	NA	NA	NA	0.2	NA	0.0015	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA						
Fluoride (e)	16984-48-8	mg/L	NA	4	4	4 (j)	2	0.8	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA						
Iron*	7439-89-6	mg/L	NA	NA	0.3	NA	0.3	14	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U						
Lead*	7439-92-1	mg/L	NA	0.015	0.015	0.015 (f)	NA	NA	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U						
Magnesium (g)	7439-95-4	mg/L	NA	NA	NA	NA	NA	NA	25.3		25.3		25.2		25.6		25.1		25.8		25.5		26		25.9		26.6						
Manganese	7439-96-5	mg/L	NA	NA	0.05	NA	0.05	0.43	0.134		0.135		0.127		0.129		0.0917		0.0899		0.0881		0.0933		0.0941		0.0989						
Mercury*	7439-97-6	mg/L	NA	0.002	0.002	0.002	NA	0.0057	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U						
Molybdenum	7439-98-7	mg/L	NA	NA	NA	NA	NA	0.1	0.004	J	0.002	J	0.0021	J	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U						
Nickel*	7440-02-0	mg/L	NA	0.1	0.1	NA	NA	0.39	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U						
Total Nitrite/Nitrate Nitrogen (e)	7727-37-9	mg/L	NA	10	10	10	NA	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA						
Selenium	7782-49-2	mg/L	NA	0.05	0.05	0.05	NA	0.1	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.00058	J	0.0005	U	0.0005	U						
Silver*	7440-22-4	mg/L	NA	0.05	0.05	NA	0.1	0.094	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U						
Sulfate (e)	14808-79-8	mg/L	NA	250	NA	NA	250	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA						
Thallium*	7440-28-0	mg/L	0.0063	0.002	0.002	0.002	NA	0.0002	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U						
Tin*	7440-31-5	mg/L	NA	NA	NA	NA	NA	12	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U						
Zinc	7440-66-6	mg/L	NA	5	5	NA	5	6	0.0083	J	0.0075	J	0.0021	J	0.0027	J	0.002	J	0.002	U	0.0023	J	0.0044	J	0.004	J	0.002	J						
Total Hardness as CaCO3 (g,e)	471-34-1	mg/L	NA	NA	NA	NA	NA	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA						

Notes:
* Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - Milligrams per liter.
NA - Not Analyzed/Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level. No MCL available.
U - Constituent was not detected.
USEPA - United States Environmental Protection Agency.
Detected Concentration> USEPA SMCL.
Detected Concentration> Missouri Groundwater Quality Criteria.
Detected Concentration> Missouri Groundwater Quality Criteria and USEPA SMCL.
(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. Updated January 29, 2014.
http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf. Per 10 CSR 20-7.031(4)(B)(2), the criteria for Human Protection Fish Consumption apply to dissolved metals data.All other criteria apply to total concentrations but have been conservatively compared to dissolved concentrations.
(b) - USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. Spring 2012.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (May 2014). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - The drinking water standard or MCL for chromium is based on total chromium.
(e) - Constituent not analyzed.
(f) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(g) - Screening levels from the presented sources are not available for this constituent.
(h) - Surface Water Samples collected in April 2014.
(i) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, and the basis of which has been questioned by USEPA's Science Advisory Board. This issue is discussed in detail in Appendix A.
(i) - Value for Soluble Fluoride used.

Table 11
Comparison of Mississippi River Surface Water Results to Screening Levels – Total (Unfiltered) Sample Results
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Constituent	CAS	Units	Missouri State Water Quality Screening Levels		Federal Water Quality Screening Levels			Mississippi River (g)																								
								River Downstream																								
			Drinking Water Supply (a)	Groundwater (a)	USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)	RI-R-1S		RI-R-2S		RI-R-2M		RI-R-3S		RI-R-3M		RI-R-4S		RI-R-4S DUP		RI-R-5S		RI-R-5M		RI-R-6S		RI-R-6M				
Aluminum	7429-90-5	mg/L	NA	NA	NA	0.05	20	2.64		2.43		2.61		2.77		2.51		2.47		2.74		2.54		2.73		2.77		2.6				
Antimony*	7440-36-0	mg/L	0.006	0.006	0.006	NA	0.0078	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U			
Arsenic	7440-38-2	mg/L	0.05	0.05	0.01	NA	0.000052	0.0028		0.0021		0.0024		0.0024		0.0022		0.0021		0.0028		0.0019	J	0.0025		0.0023		0.0021				
Barium	7440-39-3	mg/L	2	2	2	NA	3.8	0.1		0.099		0.0947		0.0801		0.0911		0.104		0.107		0.102		0.101		0.0931		0.0932				
Beryllium*	7440-41-7	mg/L	0.004	0.004	0.004	NA	0.025	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U			
Boron	7440-42-8	mg/L	NA	2	NA	NA	4	0.0543		0.0515		0.0487	J	0.0418	J	0.0437	J	0.0553		0.0593		0.0532		0.0532		0.0471	J	0.0468	J			
Cadmium*	7440-43-9	mg/L	0.005	0.005	0.005	NA	0.0092	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U			
Calcium (e)	7440-70-2	mg/L	NA	NA	NA	NA	NA	53.5		54.1		53.7		52.9		53.7		56.4		55		54.3		55.2		54		53.6				
Chromium	7440-47-3	mg/L	0.1 (d)	0.1 (d)	0.1 (d)	NA	22 (h)	0.0022	J	0.0032	J	0.0034	J	0.0021	J	0.0035	J	0.0027	J	0.003	J	0.0027	J	0.0026	J	0.0029	J	0.0031	J			
Cobalt	7440-48-4	mg/L	NA	1	NA	NA	0.006	0.0023	J	0.0028	J	0.0024	J	0.0021	J	0.0026	J	0.0023	J	0.0013	U	0.0024	J	0.0026	J	0.0024	J	0.0025	J			
Copper	7440-50-8	mg/L	1.3	1.3	1.3 (f)	1	0.8	0.0046	J	0.0055	J	0.0053	J	0.0052	J	0.0066	J	0.0047	J	0.0027	U	0.0053	J	0.0056	J	0.0056	J	0.0061	J			
Total Cyanide* (water)	57-12-5	mg/L	NA	NA	0.2	NA	0.0015	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U			
Fluoride	16984-48-8	mg/L	4	4	4 (i)	2	0.8	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.58		0.4	U			
Iron	7439-89-6	mg/L	NA	0.3	NA	0.3	14	2.17		2.78		2.93		2.12		3.11		2.71		2.41		2.57		2.5		2.79		2.89				
Lead	7439-92-1	mg/L	0.015	0.015	0.015 (f)	NA	NA	0.0025		0.0025		0.0024		0.0022		0.0022		0.0025		0.0026		0.0024		0.0025		0.0026		0.0022				
Magnesium (e)	7439-95-4	mg/L	NA	NA	NA	NA	NA	19.5		19.9		19.8		19.7		20.3		20.7		20		19.6		20		19.7		19.7				
Manganese	7439-96-5	mg/L	NA	0.05	NA	0.05	0.43	0.153		0.174		0.172		0.159		0.181		0.158		0.159		0.171		0.172		0.18		0.178				
Mercury*	7439-97-6	mg/L	0.002	0.002	0.002	NA	0.0057	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U			
Molybdenum	7439-98-7	mg/L	NA	NA	NA	NA	0.1	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0021	J	0.0017	U	0.0017	U	0.0017	U	0.0017	U			
Nickel	7440-02-0	mg/L	0.1	0.1	NA	NA	0.39	0.0026	J	0.003	J	0.0034	J	0.0027	J	0.0038	J	0.0034	J	0.0041	J	0.0032	J	0.003	J	0.0032	J	0.0033	J			
Total Nitrite/Nitrate Nitrogen	7727-37-9	mg/L	10	10	10	NA	NA	1.5		1.6		1.8		2.2		2.2		1.5		1.5		1.5		1.5		1.8		1.7				
Selenium	7782-49-2	mg/L	0.05	0.05	0.05	NA	0.1	0.001	J	0.00098	J	0.00079	J	0.00077	J	0.00069	J	0.00088	J	0.001	J	0.00097	J	0.0011	J	0.00079	J	0.00083	J			
Silver*	7440-22-4	mg/L	0.05	0.05	NA	0.1	0.094	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U			
Sulfate	14808-79-8	mg/L	250	NA	NA	250	NA	75.5		70.6		63.9		44.1		47		79		76.6		73.8		73.2		60.3		59.3				
Thallium*	7440-28-0	mg/L	0.002	0.002	0.002	NA	0.0002	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U			
Tin*	7440-31-5	mg/L	NA	NA	NA	NA	12	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U			
Zinc	7440-66-6	mg/L	5	5	NA	5	6	0.0117	J	0.0123	J	0.0136	J	0.0108	J	0.0206		0.0128	J	0.0111	J	0.0118	J	0.0117	J	0.0125	J	0.013	J			
Total Hardness as CaCO3 (e)	471-34-1	mg/L	NA	NA	NA	NA	NA	214		217		215		213		218		226		220		216		220		216		215				

Notes:
* Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - Milligrams per liter.
NA - Not Analyzed/Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level. No MCL available.
U - Constituent was not detected.
USEPA - United States Environmental Protection Agency.
Detected Concentration> USEPA Tapwater RSL.
Detected Concentration> USEPA SMCL.
Detected Concentration> Missouri Groundwater Quality Criteria.
Detected Concentration> Missouri Groundwater Quality Criteria and USEPA. SMCL.
(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. Updated January 29, 2014. http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf.
Per 10 CSR 20-7.031(4)(B)(2), the criteria for Human Protection Fish Consumption apply to dissolved metals data.
All other criteria apply to total concentrations.
(b) - USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. Spring 2012.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (May 2014). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - The drinking water standard or MCL for chromium is based on total chromium.
(e) - Screening levels from the presented sources are not available for this constituent.
(f) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(g) - Surface Water Samples collected in April 2014.
(h) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, and the basis of which has been questioned by USEPA's Science Advisory Board. This issue is discussed in detail in Appendix A.
(i) - Value for Soluble Fluoride used.

Table 12
Comparison of Mississippi River Surface Water Results to Screening Levels – Dissolved (Filtered) Sample Results
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Constituent	CAS	Units	Missouri State Water Quality Screening Levels			Federal Water Quality Screening Levels			Mississippi River (h)																					
									River Downstream																River Upstream					
			Human Health Fish Consumption (a)	Drinking Water Supply (a)	Groundwater (a)	USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)	RI-R-1S		RI-R-2S		RI-R-2M		RI-R-3S		RI-R-3M		RI-R-4S		RI-R-4S DUP		RI-R-5S		RI-R-5M		RI-R-6S		RI-R-6M	
Aluminum	7429-90-5	mg/L	NA	NA	NA	NA	0.05	20	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.385		0.0143	U	0.0143	U	0.0143	U
Antimony*	7440-36-0	mg/L	4.3	0.006	0.006	0.006	NA	0.0078	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U
Arsenic	7440-38-2	mg/L	NA	0.05	0.05	0.01	NA	0.000052	0.0015	J	0.0011	J	0.0012	J	0.0012	J	0.0011	J	0.001	J	0.0019	J	0.0015	J	0.0012	J	0.0013	J	0.0014	J
Barium	7440-39-3	mg/L	NA	2	2	2	NA	3.8	0.078		0.073		0.0662		0.0602		0.0611		0.0776		0.08		0.0796		0.0745		0.0677		0.0698	
Beryllium*	7440-41-7	mg/L	NA	0.004	0.004	0.004	NA	0.025	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U
Boron	7440-42-8	mg/L	NA	NA	2	NA	NA	4	0.0527		0.0499	J	0.0442	J	0.0405	J	0.0412	J	0.053		0.0525		0.0511		0.0502		0.0449	J	0.0476	J
Cadmium*	7440-43-9	mg/L	NA	0.005	0.005	0.005	NA	0.0092	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U
Calcium (g,e)	7440-70-2	mg/L	NA	NA	NA	NA	NA	NA	53		52		51		51		51		53		53		53		52		52		52	
Chromium*	7440-47-3	mg/L	NA	0.1 (d)	0.1 (d)	0.1 (d)	NA	22 (i)	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U
Cobalt*	7440-48-4	mg/L	NA	NA	1	NA	NA	0.006	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U
Copper*	7440-50-8	mg/L	NA	1.3	1.3	1.3 (f)	1	0.8	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U
Total Cyanide (water) (e)	57-12-5	mg/L	NA	NA	NA	0.2	NA	0.0015	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Fluoride (e)	16984-48-8	mg/L	NA	4	4	4 (j)	2	0.8	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Iron	7439-89-6	mg/L	NA	NA	0.3	NA	0.3	14	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.364		0.043	U	0.043	U	0.043	U
Lead	7439-92-1	mg/L	NA	0.015	0.015	0.015 (f)	NA	NA	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.00049	J	0.000085	U	0.000085	U	0.000085	U
Magnesium (g)	7439-95-4	mg/L	NA	NA	NA	NA	NA	NA	19.2		19.2		19		19		19		19.2		19.8		19.2		19		19.2		19	
Manganese	7439-96-5	mg/L	NA	NA	0.05	NA	0.05	0.43	0.0031	J	0.00097	J	0.00098	J	0.0012	J	0.0012	J	0.0032	J	0.0031	J	0.0384		0.0011	J	0.001	J	0.0011	J
Mercury*	7439-97-6	mg/L	NA	0.002	0.002	0.002	NA	0.0057	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U
Molybdenum	7439-98-7	mg/L	NA	NA	NA	NA	NA	0.1	0.0019	J	0.0017	U	0.0017	J	0.0017	U	0.0017	U	0.0018	J	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U
Nickel	7440-02-0	mg/L	NA	0.1	0.1	NA	NA	0.39	0.0019	J	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0018	J	0.0023	J	0.002	J	0.0021	J	0.0016	J	0.0015	U
Total Nitrite/Nitrate Nitrogen (e)	7727-37-9	mg/L	NA	10	10	10	NA	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Selenium	7782-49-2	mg/L	NA	0.05	0.05	0.05	NA	0.1	0.00087	J	0.00075	J	0.00085	J	0.0008	J	0.00079	J	0.00093	J	0.00096	J	0.00079	J	0.00084	J	0.00069	J	0.00073	J
Silver*	7440-22-4	mg/L	NA	0.05	0.05	NA	0.1	0.094	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U
Sulfate (e)	14808-79-8	mg/L	NA	250	NA	NA	250	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Thallium*	7440-28-0	mg/L	0.0063	0.002	0.002	0.002	NA	0.0002	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U
Tin*	7440-31-5	mg/L	NA	NA	NA	NA	NA	12	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U
Zinc	7440-66-6	mg/L	NA	5	5	NA	5	6	0.0046	J	0.0025	J	0.0021	J	0.0029	J	0.0034	J	0.0023	J	0.002	U	0.0037	J	0.0026	J	0.003	J	0.0024	J
Total Hardness as CaCO3 (g,e)	471-34-1	mg/L	NA	NA	NA	NA	NA	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	

Notes:
* Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - Milligrams per liter.
NA - Not Analyzed/Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level. No MCL available.
U - Constituent was not detected.
USEPA - United States Environmental Protection Agency.
Detected Concentration> USEPA Tapwater RSL.
(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. Updated January 29, 2014. http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf.
Per 10 CSR 20-7.031(4)(B)(2), the criteria for Human Protection Fish Consumption apply to dissolved metals data.
All other criteria apply to total concentrations but have been conservatively compared to dissolved concentrations.
(b) - USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. Spring 2012.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (May 2014). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - The drinking water standard or MCL for chromium is based on total chromium.
(e) - Constituent not analyzed.
(f) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(g) - Screening levels from the presented sources are not available for this constituent.
(h) - Surface Water Samples collected in April 2014.
(i) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, and the basis of which has been questioned by USEPA's Science Advisory Board. This issue is discussed in detail in Appendix A.
(i) - Value for Soluble Fluoride used.

Table 13
Comparison of Mississippi River Surface Water Results to USEPA AWQC Human Health Consumption of Organism Only - Total (Unfiltered) Sample Results (c)
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Constituent	CAS	Units	Federal Water Quality Criteria	Mississippi River (c)																					
				River Downstream												River Upstream									
			USEPA AWQC Human Health for the Consumption of Organism Only (a)	RI-R-1S		RI-R-2S		RI-R-2M		RI-R-3S		RI-R-3M		RI-R-4S		RI-R-4S DUP		RI-R-5S		RI-R-5M		RI-R-6S		RI-R-6M	
Aluminum (b)	7429-90-5	mg/L	NA	2.64		2.43		2.61		2.77		2.51		2.47		2.74		2.54		2.73		2.77		2.6	
Antimony*	7440-36-0	mg/L	0.64	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U
Arsenic	7440-38-2	mg/L	0.00014	0.0028		0.0021		0.0024		0.0024		0.0022		0.0021		0.0028		0.0019	J	0.0025		0.0023		0.0021	
Barium (b)	7440-39-3	mg/L	NA	0.1		0.099		0.0947		0.0801		0.0911		0.104		0.107		0.102		0.101		0.0931		0.0932	
Beryllium* (b)	7440-41-7	mg/L	NA	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U
Boron (b)	7440-42-8	mg/L	NA	0.0543		0.0515		0.0487	J	0.0418	J	0.0437	J	0.0553		0.0593		0.0532		0.0532		0.0471	J	0.0468	J
Cadmium* (b)	7440-43-9	mg/L	NA	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U
Calcium (b)	7440-70-2	mg/L	NA	53.5		54.1		53.7		52.9		53.7		56.4		55		54.3		55.2		54		53.6	
Chromium (b)	7440-47-3	mg/L	NA	0.0022	J	0.0032	J	0.0034	J	0.0021	J	0.0035	J	0.0027	J	0.003	J	0.0027	J	0.0026	J	0.0029	J	0.0031	J
Cobalt (b)	7440-48-4	mg/L	NA	0.0023	J	0.0028	J	0.0024	J	0.0021	J	0.0026	J	0.0023	J	0.0013	U	0.0024	J	0.0026	J	0.0024	J	0.0025	J
Copper (b)	7440-50-8	mg/L	NA	0.0046	J	0.0055	J	0.0053	J	0.0052	J	0.0066	J	0.0047	J	0.0027	U	0.0053	J	0.0056	J	0.0056	J	0.0061	J
Total Cyanide* (water)	57-12-5	mg/L	0.140	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U
Fluoride (b)	16984-48-8	mg/L	NA	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.58		0.4	U
Iron (b)	7439-89-6	mg/L	NA	2.17		2.78		2.93		2.12		3.11		2.71		2.41		2.57		2.5		2.79		2.89	
Lead (b)	7439-92-1	mg/L	NA	0.0025		0.0025		0.0024		0.0022		0.0022		0.0025		0.0026		0.0024		0.0025		0.0026		0.0022	
Magnesium (b)	7439-95-4	mg/L	NA	19.5		19.9		19.8		19.7		20.3		20.7		20		19.6		20		19.7		19.7	
Manganese	7439-96-5	mg/L	0.1	0.153		0.174		0.172		0.159		0.181		0.158		0.159		0.171		0.172		0.18		0.178	
Mercury* (b)	7439-97-6	mg/L	NA	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U
Molybdenum (b)	7439-98-7	mg/L	NA	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0021	J	0.0017	U	0.0017	U	0.0017	U	0.0017	U
Nickel	7440-02-0	mg/L	4.6	0.0026	J	0.003	J	0.0034	J	0.0027	J	0.0038	J	0.0034	J	0.0041	J	0.0032	J	0.003	J	0.0032	J	0.0033	J
Total Nitrite/Nitrate Nitrogen (b)	7727-37-9	mg/L	NA	1.5		1.6		1.8		2.2		2.2		1.5		1.5		1.5		1.5		1.8		1.7	
Selenium	7782-49-2	mg/L	4.2	0.001	J	0.00098	J	0.00079	J	0.00077	J	0.00069	J	0.00088	J	0.001	J	0.00097	J	0.0011	J	0.00079	J	0.00083	J
Silver* (b)	7440-22-4	mg/L	NA	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U
Sulfate (b)	14808-79-8	mg/L	NA	75.5		70.6		63.9		44.1		47		79		76.6		73.8		73.2		60.3		59.3	
Thallium*	7440-28-0	mg/L	0.00047	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U
Tin *(b)	7440-31-5	mg/L	NA	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U
Zinc	7440-66-6	mg/L	26	0.0117	J	0.0123	J	0.0136	J	0.0108	J	0.0206		0.0128	J	0.0111	J	0.0118	J	0.0117	J	0.0125	J	0.013	J
Total Hardness as CaCO3 (b)	471-34-1	mg/L	NA	214		217		215		213		218		226		220		216		220		216		215	

Notes:
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - Milligrams per liter.
NA - Not Analyzed/Not Available.
U - Constituent was not detected.
USEPA - United States Environmental Protection Agency.
Detected Concentration> USEPA AWQC Human Health for the Consumption of Organism Only
(a) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed May 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.
(b) - Water quality criteria from the presented sources are not available for this constituent.
(c) - Surface Water Samples collected in April 2014.

Table 14
Comparison of Mississippi River Surface Water Results USEPA AWQC Human Health Consumption of Organism Only – Dissolved (Filtered) Sample Results (d)
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Constituent	CAS	Units	Federal Water Quality Criteria	Mississippi River (d)																					
				River Downstream										River Upstream											
			USEPA AWQC Human Health for the Consumption of Organism Only (a)	RI-R-1S		RI-R-2S		RI-R-2M		RI-R-3S		RI-R-3M		RI-R-4S		RI-R-4S DUP		RI-R-5S		RI-R-5M		RI-R-6S		RI-R-6M	
Aluminum (c)	7429-90-5	mg/L	NA	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.385		0.0143	U	0.0143	U	0.0143	U
Antimony*	7440-36-0	mg/L	0.64	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U
Arsenic	7440-38-2	mg/L	0.00014	0.0015	J	0.0011	J	0.0012	J	0.0012	J	0.0011	J	0.001	J	0.0019	J	0.0015	J	0.0012	J	0.0013	J	0.0014	J
Barium (c)	7440-39-3	mg/L	NA	0.078		0.073		0.0662		0.0602		0.0611		0.0776		0.08		0.0796		0.0745		0.0677		0.0698	
Beryllium* (c)	7440-41-7	mg/L	NA	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U
Boron (c)	7440-42-8	mg/L	NA	0.0527		0.0499	J	0.0442	J	0.0405	J	0.0412	J	0.053		0.0525		0.0511		0.0502		0.0449	J	0.0476	J
Cadmium* (c)	7440-43-9	mg/L	NA	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U
Calcium (b,c)	7440-70-2	mg/L	NA	53		52		51		51		51		53		53		53		52		52		52	
Chromium* (c)	7440-47-3	mg/L	NA	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U
Cobalt* (c)	7440-48-4	mg/L	NA	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U
Copper* (c)	7440-50-8	mg/L	NA	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U
Total Cyanide (water) (b)	57-12-5	mg/L	0.140	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Fluoride (b,c)	16984-48-8	mg/L	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Iron (c)	7439-89-6	mg/L	NA	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.364		0.043	U	0.043	U	0.043	U
Lead (c)	7439-92-1	mg/L	NA	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.00049	J	0.000085	U	0.000085	U	0.000085	U
Magnesium (c)	7439-95-4	mg/L	NA	19.2		19.2		19		19		19		19.2		19.8		19.2		19		19.2		19	
Manganese	7439-96-5	mg/L	0.1	0.0031	J	0.00097	J	0.00098	J	0.0012	J	0.0012	J	0.0032	J	0.0031	J	0.0384		0.0011	J	0.001	J	0.0011	J
Mercury* (b)	7439-97-6	mg/L	NA	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U
Molybdenum (c)	7439-98-7	mg/L	NA	0.0019	J	0.0017	U	0.0017	J	0.0017	U	0.0017	U	0.0018	J	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U
Nickel	7440-02-0	mg/L	4.6	0.0019	J	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0018	J	0.0023	J	0.002	J	0.0021	J	0.0016	J	0.0015	U
Total Nitrite/Nitrate Nitrogen (b,c)	7727-37-9	mg/L	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Selenium	7782-49-2	mg/L	4.2	0.00087	J	0.00075	J	0.00085	J	0.0008	J	0.00079	J	0.00093	J	0.00096	J	0.00079	J	0.00084	J	0.00069	J	0.00073	J
Silver* (c)	7440-22-4	mg/L	NA	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U
Sulfate (b,c)	14808-79-8	mg/L	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Thallium*	7440-28-0	mg/L	0.00047	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U
Tin* (c)	7440-31-5	mg/L	NA	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U
Zinc	7440-66-6	mg/L	26	0.0046	J	0.0025	J	0.0021	J	0.0029	J	0.0034	J	0.0023	J	0.002	U	0.0037	J	0.0026	J	0.003	J	0.0024	J
Total Hardness as CaCO3 (b,c)	471-34-1	mg/L	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	

Notes:
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - Milligrams per liter.
NA - Not Analyzed/Not Available.
U - Constituent was not detected.
USEPA - United States Environmental Protection Agency.
Detected Concentration> USEPA AWQC Human Health for the Consumption of Organism Only
(a) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed May 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations but have been conservatively compared to dissolved concentrations.
(b) - Constituent not analyzed.
(c) - Water quality criteria from the presented sources are not available for this constituent.
(d) - Surface Water Samples collected in April 2014.

Table 15
Ecological Risk-Based Screening Levels
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

			Missouri State Water Quality Criteria						Federal Water Quality Criteria							
			Site-Specific Protection of Aquatic Life Acute (a)		Site-Specific Protection of Aquatic Life Chronic (a)		Irrigation (a)	Livestock and Wildlife Watering (a)	Site-Specific USEPA Aquatic Life AWQC Freshwater Acute (b)				Site-Specific USEPA Aquatic Life AWQC Freshwater Chronic (b)			
Constituent	CAS	Units	Dissolved - Isle Du Bois Creek	Dissolved - Mississippi River	Dissolved - Isle Du Bois Creek	Dissolved - Mississippi River	Total	Total	Total - Isle Du Bois Creek	Total - Mississippi River	Dissolved - Isle Du Bois Creek	Dissolved - Mississippi River	Total - Isle Du Bois Creek	Total - Mississippi River	Dissolved - Isle Du Bois Creek	Dissolved - Mississippi River
Aluminum	7429-90-5	mg/L	0.75	0.75	NA	NA	NA	NA	0.75 (e)	0.75 (e)	NA	NA	0.087 (e)	0.087 (e)	NA	NA
Antimony	7440-36-0	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	mg/L	NA	NA	0.02	0.02	0.1	NA	0.34	0.34	0.34	0.34	0.15	0.15	0.15	0.15
Barium	7440-39-3	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	7440-41-7	mg/L	NA	NA	0.005	0.005	0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
Boron	7440-42-8	mg/L	NA	NA	NA	NA	2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	7440-43-9	mg/L	0.0126 (f)	0.0101 (f)	0.0005 (f)	0.0004 (f)	NA	NA	0.006 (f)	0.005 (f)	0.005 (f)	0.004 (f)	0.0006 (f)	0.0005 (f)	0.0005 (f)	0.0004 (f)
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	7440-47-3	mg/L	1.30 (d,f)	1.07 (d,f)	0.17 (d,f)	0.14 (d,f)	0.1 (d)	NA	4.101 (d,f)	3.397 (d,f)	1.296 (d,f)	1.073 (d,f)	0.196 (d,f)	0.162 (d,f)	0.17 (d,f)	0.14 (d,f)
Cobalt	7440-48-4	mg/L	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA
Copper	7440-50-8	mg/L	0.035 (f)	0.028 (f)	0.021 (f)	0.017 (f)	NA	0.5	0.036 (f)	0.029 (f)	0.035 (f)	0.028 (f)	0.022 (f)	0.018 (f)	0.021 (f)	0.017 (f)
Total Cyanide (water)	57-12-5	mg/L	0.022	0.022	0.005	0.005	NA	NA	0.022	0.022	0.022	0.022	0.005	0.005	0.005	0.005
Fluoride	16984-48-8	mg/L	NA	NA	NA	NA	NA	4	NA	NA	NA	NA	NA	NA	NA	NA
Iron	7439-89-6	mg/L	NA	NA	1	1	NA	NA	NA	NA	NA	NA	1	1	NA	NA
Lead	7439-92-1	mg/L	0.1888 (f)	0.1482 (f)	0.0074 (f)	0.0058 (f)	NA	NA	0.293 (f)	0.219 (f)	0.189 (f)	0.148 (f)	0.011 (f)	0.009 (f)	0.007 (f)	0.006 (f)
Magnesium	7439-95-4	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	7439-96-5	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	7439-97-6	mg/L	0.0024	0.0024	0.0005	0.0005	NA	NA	0.0016	0.0016	0.0014	0.0014	0.001	0.001	0.00077	0.00077
Molybdenum	7439-98-7	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	7440-02-0	mg/L	1.095 (f)	0.901 (f)	0.122 (f)	0.100 (f)	NA	NA	1.097 (f)	0.903 (f)	1.094 (f)	0.901 (f)	0.122 (f)	0.100 (f)	0.122 (f)	0.100 (f)
Total Nitrite/Nitrate Nitrogen	7727-37-9	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	7782-49-2	mg/L	NA	NA	0.005	0.005	NA	NA	12.820 (c)	12.820 (c)	NA	NA	0.005	0.005	NA	NA
Silver	7440-22-4	mg/L	0.018 (f)	0.012 (f)	NA	NA	NA	NA	0.021 (f)	0.014 (f)	0.018 (f)	0.012 (f)	NA	NA	NA	NA
Sulfate	14808-79-8	mg/L	NA	NA	1783 (f,g)	1582 (f,g)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	7440-28-0	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tin	7440-31-5	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	7440-66-6	mg/L	0.27 (f)	0.23 (f)	0.27 (f)	0.23 (f)	NA	NA	0.28 (f)	0.23 (f)	0.27 (f)	0.23 (f)	0.28 (f)	0.23 (f)	0.28 (f)	0.23 (f)
pH (h)	NA	--	NA	NA	6.5-9	6.5-9	NA	NA	NA	NA	NA	NA	6.5-9	6.5-9	6.5-9	6.5-9
Total Hardness as CaCO3	471-34-1	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
mg/L - Milligrams per liter.
NA -Not Available.
USEPA - United States Environmental Protection Agency.
(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. January 29, 2014
http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf
Total and dissolved (filtered) values provided separately.
Values adjusted for site-specific hardness and chloride, as applicable - see notes (f) and (g).
Missouri State Protection of Aquatic Life Acute and Chronic values apply only to dissolved results (except mercury, sulfate, and pH);
irrigation, livestock/wildlife watering, and mercury Aquatic Life Acute and Chronic values apply only to totals results.
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science
and Technology. Accessed May 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total and dissolved (filtered) values provided separately.
Values adjusted for site-specific hardness - see notes (f) and (h).
USEPA provides AWQC for both total and dissolved results.
(c) - Acute AWQC is equal to 1/[(f1/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and
CMC1 and CMC2 are 185.9 ug/L and 12.82 ug/L, respectively. Calculated assuming that all selenium is present as selenate, a likely overly conservative assumption.
(d) - Value for trivalent chromium used.
(e) - Values for pH range of 6.5-9.0.
(f) - Hardness dependent values were adjusted using the mean site-specific total recoverable hardness values, as follows:
Site-specific mean total recoverable hardness value for Isle Du Bois Creek data of 272 mg/L as CaCO3 was used to calculate values for comparison with Isle Du Bois Creek results.
Site-specific mean total recoverable hardness value for the Mississippi River data of 217 mg/L as CaCO3 was used to calculate values for comparison with Mississippi River results.
(g) - Chloride dependent value (default chloride value of 25 mg/L is assumed).
When chloride is greater than or equal to 25 and less than or equal to 500 mg/L and hardness
is between 100 and 500 mg/L, sulfate limit in mg/L = [1276.7 + 5.508 (hardness)− 1.457 (chloride)] * 0.65.
(h) - pH values were obtained during the field sampling event and were recorded at the time of sample collection. Data for pH was not provided by the laboratory.

Table 16
Comparison of Isle Du Bois Creek Surface Water Results to Ecological Risk-Based Screening Levels - Total (Unfiltered) Sample Results
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Constituent	CAS	Units	Missouri State Water Quality Criteria				Federal Water Quality Criteria		Isle Du Bois Creek (e)																								
									Creek Downstream																Creek Midstream						Creek Upstream				
									RI-C-1		RI-C-1 DUP		RI-C-2		RI-C-3		RI-C-4		RI-C-5		RI-C-6		RI-C-7		RI-C-8		RI-C-9						
			Protection of Aquatic Life Acute (a)	Protection of Aquatic Life Chronic (a)	Irrigation (a)	Livestock Wildlife Watering (a)	USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)																										
Aluminum	7429-90-5	mg/L	NA	NA	NA	NA	0.75 (e)	0.087 (e)	3.37		3.27		2.95		2.93		1.59		1.64		1.28		2.01		1.89		1.75						
Antimony* (g)	7440-36-0	mg/L	NA	NA	NA	NA	NA	NA	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U					
Arsenic	7440-38-2	mg/L	NA	NA	0.1	NA	0.34	0.15	0.0015	J	0.0015	J	0.0017	J	0.0013	J	0.00091	J	0.0012	J	0.00078	U	0.0011	J	0.00079	J	0.0012	J					
Barium (g)	7440-39-3	mg/L	NA	NA	NA	NA	NA	NA	0.107		0.106		0.0957		0.0987		0.0909		0.0935		0.091		0.0999		0.0919		0.0938						
Beryllium*	7440-41-7	mg/L	NA	NA	0.1	NA	NA	NA	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U					
Boron	7440-42-8	mg/L	NA	NA	2	NA	NA	NA	0.0395	J	0.0388	J	0.039	J	0.0391	J	0.036	J	0.0366	J	0.0343	J	0.0208	J	0.0195	J	0.0189	J					
Cadmium*	7440-43-9	mg/L	NA	NA	NA	NA	0.006 (f)	0.0006 (f)	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U					
Calcium (g)	7440-70-2	mg/L	NA	NA	NA	NA	NA	NA	67.1		67.5		65.6		65.8		67		66.7		66.5		70.3		65.8		66						
Chromium	7440-47-3	mg/L	NA	NA	0.1 (d)	NA	4.101 (d,f)	0.196 (d,f)	0.0033	J	0.0032	J	0.0016	J	0.002	J	0.0016	U	0.0016	U	0.002	J	0.0021	J	0.0017	J	0.0018	J					
Cobalt	7440-48-4	mg/L	NA	NA	NA	1	NA	NA	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0017	J	0.0018	J	0.002	J	0.0023	J	0.0019	J	0.0019	J					
Copper	7440-50-8	mg/L	NA	NA	NA	0.5	0.036 (f)	0.022 (f)	0.0053	J	0.0044	J	0.0033	J	0.0036	J	0.0039	J	0.0034	J	0.0037	J	0.0039	J	0.0031	J	0.0036	J					
Total Cyanide (water)*	57-12-5	mg/L	NA	NA	NA	NA	0.022	0.005	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U					
Fluoride*	16984-48-8	mg/L	NA	NA	NA	4	NA	NA	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U					
Iron	7439-89-6	mg/L	NA	NA	NA	NA	NA	1	2.68		2.76		1.29		1.87		1.31		1.37		1.36		1.87		1.34		1.46						
Lead	7439-92-1	mg/L	NA	NA	NA	NA	0.293 (f)	0.011 (f)	0.0027		0.0024		0.002		0.002		0.0013		0.0013		0.0012		0.002		0.0016		0.0016						
Magnesium (g)	7439-95-4	mg/L	NA	NA	NA	NA	NA	NA	25.6		25.7		24.6		24.8		25.8		25.6		25.4		26.9		26.5		26.8						
Manganese (g)	7439-96-5	mg/L	NA	NA	NA	NA	NA	NA	0.189		0.188		0.163		0.163		0.115		0.122		0.115		0.143		0.136		0.138						
Mercury*	7439-97-6	mg/L	0.0024	0.0005	NA	NA	0.0016	0.00091	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U					
Molybdenum (g)	7439-98-7	mg/L	NA	NA	NA	NA	NA	NA	0.002	J	0.0017	U	0.0018	J	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U					
Nickel	7440-02-0	mg/L	NA	NA	NA	NA	1.097 (f)	0.122 (f)	0.0018	J	0.002	J	0.0015	U	0.002	J	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U					
Total Nitrite/Nitrate Nitrogen (g)	7727-37-9	mg/L	NA	NA	NA	NA	NA	NA	0.42		0.43		0.45		0.37		0.44		0.42		0.44		0.63		0.48		0.46						
Selenium	7782-49-2	mg/L	NA	NA	NA	NA	12.820 (c)	0.005	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.00067	J	0.0005	U	0.0005	U					
Silver*	7440-22-4	mg/L	NA	NA	NA	NA	0.021 (f)	NA	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U					
Sulfate	14808-79-8	mg/L	NA	1783 (f,h)	NA	NA	NA	NA	40.5		41		40.2		41.1		41.7		40.8		41.9		43.2		42.4		43.7						
Thallium* (g)	7440-28-0	mg/L	NA	NA	NA	NA	NA	NA	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U					
Tin* (g)	7440-31-5	mg/L	NA	NA	NA	NA	NA	NA	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U					
Zinc	7440-66-6	mg/L	NA	NA	NA	NA	0.28 (f)	0.28 (f)	0.0205		0.0205		0.002	U	0.002	U	0.0082	J	0.002	U	0.002	U	0.0171	J	0.0116	J	0.0074	J					
pH (i)	NA	--	NA	NA	NA	NA	NA	NA	7.89		7.89		7.48		7.42		7.35		7.38		7.43		7.65		8.08		7.42						
Total Hardness as CaCO3 (g)	471-34-1	mg/L	NA	NA	NA	NA	NA	NA	273		NA		265		267		273		272		271		286		273		275						

Notes:
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - Milligrams per liter.
NA - Not Analyzed/Not Available.
U - Constituent was not detected.
USEPA - United States Environmental Protection Agency.
Detected Concentration> USEPA Aquatic Life AWQC Chronic.
Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.
(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. January 29, 2014
http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf. Total values provided.
Missouri State Protection of Aquatic Life Acute and Chronic values apply only to dissolved results (except mercury);
irrigation, livestock/wildlife watering, and mercury Aquatic Life Acute and Chronic values apply only to totals results.
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science
and Technology. Accessed May 2014
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (f).
USEPA provides AWQC for both total and dissolved results.
(c) - Acute AWQC is equal to 1/[(f1/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and
CMC1 and CMC2 are 185.9 ug/L and 12.82 ug/L, respectively. Calculated assuming that all selenium is present as selenate, a likely overly conservative assumption.
(d) - Value for trivalent chromium used.
(e) - Surface Water Samples collected in April 2014.
(f) - Hardness dependent value. Site-specific (Isle Du Bois Creek) total recoverable mean hardness value of 272 mg/L as CaCO3 used.
(g) - Water quality criteria from the presented sources are not available for this constituent.
(h) - Chloride dependent value (default chloride value of 25 mg/L is assumed).
When chloride is greater than or equal to 25 and less than or equal to 500 mg/L and hardness
is between 100 and 500 mg/L, sulfate limit in mg/L = [1276.7 + 5.508 (hardness)− 1.457 (chloride)] * 0.65.
(i) - pH values were obtained during the field sampling event and were recorded at the time of sample collection. Data for pH was not provided by the laboratory.

Table 17
Comparison of Isle Du Bois Creek Surface Water Results to Ecological Risk-Based Screening Levels - Dissolved (Filtered) Sample Results (h)
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Constituent	CAS	Units	Missouri State Water Quality Criteria		Federal Water Quality Criteria		Isle Du Bois Creek (e)																					
							Creek Downstream								Creek Midstream								Creek Upstream					
			Protection of Aquatic Life Acute (a)	Protection of Aquatic Life Chronic (a)	USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	RI-C-1		RI-C-1 DUP		RI-C-2		RI-C-3		RI-C-4		RI-C-5		RI-C-6		RI-C-7		RI-C-8		RI-C-9	
Aluminum*	7429-90-5	mg/L	0.75	NA	NA	NA	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U
Antimony* (g)	7440-36-0	mg/L	NA	NA	NA	NA	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U
Arsenic*	7440-38-2	mg/L	NA	0.02	0.34	0.15	0.00078	U	0.00078	U	0.00078	U	0.00078	U	0.00078	U	0.00078	U	0.00078	U	0.00078	U	0.00078	U	0.00078	U	0.00078	U
Barium (g)	7440-39-3	mg/L	NA	NA	NA	NA	0.0863		0.086		0.0854		0.0868		0.0818		0.0827		0.0821		0.0845		0.0813		0.0829			
Beryllium*	7440-41-7	mg/L	NA	0.005	NA	NA	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U
Boron (g)	7440-42-8	mg/L	NA	NA	NA	NA	0.0368	J	0.0365	J	0.0375	J	0.0374	J	0.0351	J	0.0348	J	0.0334	J	0.019	J	0.0172	J	0.018	J		
Cadmium*	7440-43-9	mg/L	0.0126 (f)	0.0005 (f)	0.005 (f)	0.0005 (f)	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U
Calcium (g)	7440-70-2	mg/L	NA	NA	NA	NA	67		67		67		68		66		68		67		67		64		66			
Chromium	7440-47-3	mg/L	1.30 (c,f)	0.17 (c,f)	1.296 (c,f)	0.17 (c,f)	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0021	J	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U
Cobalt* (g)	7440-48-4	mg/L	NA	NA	NA	NA	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U
Copper*	7440-50-8	mg/L	0.035 (f)	0.021 (f)	0.035 (f)	0.021 (f)	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U
Total Cyanide (water) (d)	57-12-5	mg/L	0.022	0.005	0.022	0.005	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA			
Fluoride (d,g)	16984-48-8	mg/L	NA	NA	NA	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA			
Iron*	7439-89-6	mg/L	NA	1	NA	NA	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U
Lead*	7439-92-1	mg/L	0.1888 (f)	0.0074 (f)	0.189 (f)	0.007 (f)	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U
Magnesium (g)	7439-95-4	mg/L	NA	NA	NA	NA	25.3		25.3		25.2		25.6		25.1		25.8		25.5		26		25.9		26.6			
Manganese (g)	7439-96-5	mg/L	NA	NA	NA	NA	0.134		0.135		0.127		0.129		0.0917		0.0899		0.0881		0.0933		0.0941		0.0989			
Mercury*	7439-97-6	mg/L	NA	NA	0.0014	0.00077	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U
Molybdenum (g)	7439-98-7	mg/L	NA	NA	NA	NA	0.004	J	0.002	J	0.0021	J	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U
Nickel*	7440-02-0	mg/L	1.095 (f)	0.122 (f)	1.094 (f)	0.122 (f)	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0015	U
Total Nitrite/Nitrate Nitrogen (d,g)	7727-37-9	mg/L	NA	NA	NA	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA			
Selenium	7782-49-2	mg/L	NA	0.005	NA	NA	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.0005	U	0.00058	J	0.0005	U	0.0005	U	0.0005	U
Silver*	7440-22-4	mg/L	0.018 (f)	NA	0.018 (f)	NA	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U
Sulfate (d,g)	14808-79-8	mg/L	NA	NA	NA	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA			
Thallium* (g)	7440-28-0	mg/L	NA	NA	NA	NA	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U
Tin* (g)	7440-31-5	mg/L	NA	NA	NA	NA	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U
Zinc	7440-66-6	mg/L	0.27 (f)	0.27 (f)	0.27 (f)	0.28 (f)	0.0083	J	0.0075	J	0.0021	J	0.0027	J	0.002	J	0.002	U	0.0023	J	0.0044	J	0.004	J	0.002	J		
pH (i)	NA	--	6.5-9	NA	NA	NA	7.89		7.89		7.48		7.42		7.35		7.38		7.43		7.65		8.08		7.42			
Total Hardness as CaCO3 (d,g)	471-34-1	mg/L	NA	NA	NA	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA			

Notes:
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - Milligrams per liter.
NA - Not Analyzed/Not Available.
U - Constituent was not detected.
USEPA - United States Environmental Protection Agency.
(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. January 29, 2014
http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf
Dissolved (filtered) values provided. Values adjusted for site-specific hardness - see note (f).
Missouri State Protection of Aquatic Life Acute and Chronic values apply only to dissolved results (except mercury);
irrigation, livestock/wildlife watering, and mercury Aquatic Life Acute and Chronic values apply only to totals results.
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology.
Accessed May 2014. http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Dissolved (filtered) values provided. Values adjusted for site-specific hardness - see note (f).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Constituent not analyzed.
(e) - Surface Water Samples collected in April 2014.
(f) - Hardness dependent value for filtered (dissolved) metals. Site-specific (Isle Du Bois Creek) mean total recoverable hardness value of 272 mg/L as CaCO3 used.
(g) - Water quality criteria from the presented sources are not available for this constituent.
(h) - No results are above the relevant screening levels.
(i) - pH values were obtained during the field sampling event and were recorded at the time of sample collection. Data for pH was not provided by the laboratory.

Table 18
Comparison of Mississippi River Surface Water Results to Ecological Risk-Based Screening Levels - Total (Unfiltered) Sample Results
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Constituent	Missouri State Water Quality Criteria				Federal Water Quality Criteria		Mississippi River (e)																					
							River Downstream										River Upstream											
	Protection of Aquatic Life Acute (a)	Protection of Aquatic Life Chronic (a)	Irrigation (a)	Livestock Wildlife Watering (a)	USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	RI-R-1S		RI-R-2S		RI-R-2M		RI-R-3S		RI-R-3M		RI-R-4S		RI-R-4S DUP		RI-R-5S		RI-R-5M		RI-R-6S		RI-R-6M	
Aluminum	NA	NA	NA	NA	0.75 (e)	0.087 (e)	2.64		2.43		2.61		2.77		2.51		2.47		2.74		2.54		2.73		2.77		2.6	
Antimony* (g)	NA	NA	NA	NA	NA	NA	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U
Arsenic	NA	NA	0.1	NA	0.34	0.15	0.0028		0.0021		0.0024		0.0024		0.0022		0.0021		0.0028		0.0019	J	0.0025		0.0023		0.0021	
Barium (g)	NA	NA	NA	NA	NA	NA	0.1		0.099		0.0947		0.0801		0.0911		0.104		0.107		0.102		0.101		0.0931		0.0932	
Beryllium*	NA	NA	0.1	NA	NA	NA	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U
Boron	NA	NA	2	NA	NA	NA	0.0543		0.0515		0.0487	J	0.0418	J	0.0437	J	0.0553		0.0593		0.0532		0.0532		0.0471	J	0.0468	J
Cadmium*	NA	NA	NA	NA	0.005 (f)	0.0005 (f)	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U
Calcium (g)	NA	NA	NA	NA	NA	NA	53.5		54.1		53.7		52.9		53.7		56.4		55		54.3		55.2		54		53.6	
Chromium	NA	NA	0.1 (d)	NA	3.397 (d,f)	0.162 (d,f)	0.0022	J	0.0032	J	0.0034	J	0.0021	J	0.0035	J	0.0027	J	0.003	J	0.0027	J	0.0026	J	0.0029	J	0.0031	J
Cobalt	NA	NA	NA	1	NA	NA	0.0023	J	0.0028	J	0.0024	J	0.0021	J	0.0026	J	0.0023	J	0.0013	U	0.0024	J	0.0026	J	0.0024	J	0.0025	J
Copper	NA	NA	NA	0.5	0.029 (f)	0.018 (f)	0.0046	J	0.0055	J	0.0053	J	0.0052	J	0.0066	J	0.0047	J	0.0027	U	0.0053	J	0.0056	J	0.0056	J	0.0061	J
Total Cyanide (water)*	NA	NA	NA	NA	0.022	0.005	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U	0.005	U
Fluoride	NA	NA	NA	4	NA	NA	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.4	U	0.58		0.4	U
Iron	NA	NA	NA	NA	NA	1	2.17		2.78		2.93		2.12		3.11		2.71		2.41		2.57		2.5		2.79		2.89	
Lead	NA	NA	NA	NA	0.219 (f)	0.009 (f)	0.0025		0.0025		0.0024		0.0022		0.0022		0.0025		0.0026		0.0024		0.0025		0.0026		0.0022	
Magnesium (g)	NA	NA	NA	NA	NA	NA	19.5		19.9		19.8		19.7		20.3		20.7		20		19.6		20		19.7		19.7	
Manganese (g)	NA	NA	NA	NA	NA	NA	0.153		0.174		0.172		0.159		0.181		0.158		0.159		0.171		0.172		0.18		0.178	
Mercury*	0.0024	0.0005	NA	NA	0.0016	0.001	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U
Molybdenum (g)	NA	NA	NA	NA	NA	NA	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0021	J	0.0017	U	0.0017	U	0.0017	U	0.0017	U
Nickel	NA	NA	NA	NA	0.903 (f)	0.100 (f)	0.0026	J	0.003	J	0.0034	J	0.0027	J	0.0038	J	0.0034	J	0.0041	J	0.0032	J	0.003	J	0.0032	J	0.0033	J
Total Nitrite/Nitrate Nitrogen (g)	NA	NA	NA	NA	NA	NA	1.5		1.6		1.8		2.2		2.2		1.5		1.5		1.5		1.5		1.8		1.7	
Selenium	NA	NA	NA	NA	12.820 (c)	0.005	0.001	J	0.00098	J	0.00079	J	0.00077	J	0.00069	J	0.00088	J	0.001	J	0.00097	J	0.0011	J	0.00079	J	0.00083	J
Silver*	NA	NA	NA	NA	0.014 (f)	NA	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U
Sulfate	NA	1582 (f,h)	NA	NA	NA	NA	75.5		70.6		63.9		44.1		47		79		76.6		73.8		73.2		60.3		59.3	
Thallium* (g)	NA	NA	NA	NA	NA	NA	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U
Tin* (g)	NA	NA	NA	NA	NA	NA	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U
Zinc	NA	NA	NA	NA	0.23 (f)	0.23 (f)	0.0117	J	0.0123	J	0.0136	J	0.0108	J	0.0206		0.0128	J	0.0111	J	0.0118	J	0.0117	J	0.0125	J	0.013	J
pH (i)	NA	NA	NA	NA	NA	NA	8.58		8.56		8.88		7.78		8.93		6.14		6.14		7.59		8.88		8.33		8.76	
Total Hardness as CaCO3 (g)	NA	NA	NA	NA	NA	NA	214		217		215		213		218		226		220		216		220		216		215	

Notes:
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - Milligrams per liter.
NA - Not Analyzed/Not Available.
U - Constituent was not detected.
USEPA - United States Environmental Protection Agency.

(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. January 29, 2014
http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf. Total values provided.
Missouri State Protection of Aquatic Life Acute and Chronic values apply only to dissolved results (except mercury); irrigation, livestock/wildlife watering, and mercury Aquatic Life Acute and Chronic values apply only to totals results.
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed May 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (f).
USEPA provides AWQC for both total and dissolved results.
(c) - Acute AWQC is equal to 1/[(f1/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMC1 and CMC2 are 185.9 ug/L and 12.82 ug/L, respectively. Calculated assuming that all selenium is present as selenate, a likely overly conservative assumption.
(d) - Value for trivalent chromium used.
(e) - Surface Water Samples collected in April 2014.
(f) - Hardness dependent value for total metals. Site-specific (Mississippi River) total recoverable mean hardness value of 217 mg/L as CaCO3 used.
(g) - Water quality criteria from the presented sources are not available for this constituent.
(h) - Chloride dependent value (default chloride value of 25 mg/L is assumed).
When chloride is greater than or equal to 25 and less than or equal to 500 mg/L and hardness is between 100 and 500 mg/L, sulfate limit in mg/L = [1276.7 + 5.508 (hardness) − 1.457 (chloride)] * 0.65.
(i) - pH values were obtained during the field sampling event and were recorded at the time of sample collection. Data for pH was not provided by the laboratory.

Table 19
Comparison of Mississippi River Surface Water Results to Ecological Risk-Based Screening Levels - Dissolved (Filtered) Sample Results (h)
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Constituent	CAS	Units	Missouri State Water Quality Criteria		Federal Water Quality Criteria		Mississippi River (e)																					
							River Downstream										River Upstream											
							RI-R-1S		RI-R-2S		RI-R-2M		RI-R-3S		RI-R-3M		RI-R-4S		RI-R-4S DUP		RI-R-5S		RI-R-5M		RI-R-6S		RI-R-6M	
			Protection of Aquatic Life Acute (a)	Protection of Aquatic Life Chronic (a)	USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)																						
Aluminum	7429-90-5	mg/L	0.75	NA	NA	NA	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.0143	U	0.385		0.0143	U	0.0143	U	0.0143	U
Antimony* (g)	7440-36-0	mg/L	NA	NA	NA	NA	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U	0.0053	U
Arsenic	7440-38-2	mg/L	NA	0.02	0.34	0.15	0.0015	J	0.0011	J	0.0012	J	0.0012	J	0.0011	J	0.001	J	0.0019	J	0.0015	J	0.0012	J	0.0013	J	0.0014	J
Barium (g)	7440-39-3	mg/L	NA	NA	NA	NA	0.078		0.073		0.0662		0.0602		0.0611		0.0776		0.08		0.0796		0.0745		0.0677		0.0698	
Beryllium*	7440-41-7	mg/L	NA	0.005	NA	NA	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U	0.00067	U
Boron	7440-42-8	mg/L	NA	NA	NA	NA	0.0527		0.0499	J	0.0442	J	0.0405	J	0.0412	J	0.053		0.0525		0.0511		0.0502		0.0449	J	0.0476	J
Cadmium*	7440-43-9	mg/L	0.0101 (f)	0.0004 (f)	0.004 (f)	0.0004 (f)	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U	0.00023	U
Calcium (g)	7440-70-2	mg/L	NA	NA	NA	NA	53		52		51		51		51		53		53		53		52		52		52	
Chromium*	7440-47-3	mg/L	1.07 (c,f)	0.14 (c,f)	1.073 (c,f)	0.14 (c,f)	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U	0.0016	U
Cobalt* (g)	7440-48-4	mg/L	NA	NA	NA	NA	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U
Copper*	7440-50-8	mg/L	0.028 (f)	0.017 (f)	0.028 (f)	0.017 (f)	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U
Total Cyanide (water) (d)	57-12-5	mg/L	0.022	0.005	0.022	0.005	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Fluoride (d)	16984-48-8	mg/L	NA	NA	NA	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Iron	7439-89-6	mg/L	NA	1	NA	NA	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.043	U	0.364		0.043	U	0.043	U	0.043	U
Lead	7439-92-1	mg/L	0.1482 (f)	0.0058 (f)	0.148 (f)	0.006 (f)	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.000085	U	0.00049	J	0.000085	U	0.000085	U	0.000085	U
Magnesium (g)	7439-95-4	mg/L	NA	NA	NA	NA	19.2		19.2		19		19		19		19.2		19.8		19.2		19		19.2		19	
Manganese (g)	7439-96-5	mg/L	NA	NA	NA	NA	0.0031	J	0.00097	J	0.00098	J	0.0012	J	0.0012	J	0.0032	J	0.0031	J	0.0384		0.0011	J	0.001	J	0.0011	J
Mercury*	7439-97-6	mg/L	NA	NA	0.0014	0.00077	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U	0.00006	U
Molybdenum (g)	7439-98-7	mg/L	NA	NA	NA	NA	0.0019	J	0.0017	U	0.0017	J	0.0017	U	0.0017	U	0.0018	J	0.0017	U	0.0017	U	0.0017	U	0.0017	U	0.0017	U
Nickel	7440-02-0	mg/L	0.901 (f)	0.100 (f)	0.901 (f)	0.100 (f)	0.0019	J	0.0015	U	0.0015	U	0.0015	U	0.0015	U	0.0018	J	0.0023	J	0.002	J	0.0021	J	0.0016	J	0.0015	U
Total Nitrite/Nitrate Nitrogen (d,g)	7727-37-9	mg/L	NA	NA	NA	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Selenium	7782-49-2	mg/L	NA	0.005	NA	NA	0.00087	J	0.00075	J	0.00085	J	0.0008	J	0.00079	J	0.00093	J	0.00096	J	0.00079	J	0.00084	J	0.00069	J	0.00073	J
Silver*	7440-22-4	mg/L	0.012 (f)	NA	0.012 (f)	NA	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U	0.0021	U
Sulfate (d,g)	14808-79-8	mg/L	NA	NA	NA	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
Thallium* (g)	7440-28-0	mg/L	NA	NA	NA	NA	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U
Tin* (g)	7440-31-5	mg/L	NA	NA	NA	NA	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U	0.0029	U
Zinc	7440-66-6	mg/L	0.23 (f)	0.23 (f)	0.23 (f)	0.23 (f)	0.0046	J	0.0025	J	0.0021	J	0.0029	J	0.0034	J	0.0023	J	0.002	U	0.0037	J	0.0026	J	0.003	J	0.0024	J
pH (i)	NA	--	6.5-9	NA	NA	NA	8.58		8.56		8.88		7.78		8.93		**6.14**		**6.14**		7.59		8.88		8.33		8.76	
Total Hardness as CaCO3 (d,g)	471-34-1	mg/L	NA	NA	NA	NA	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	

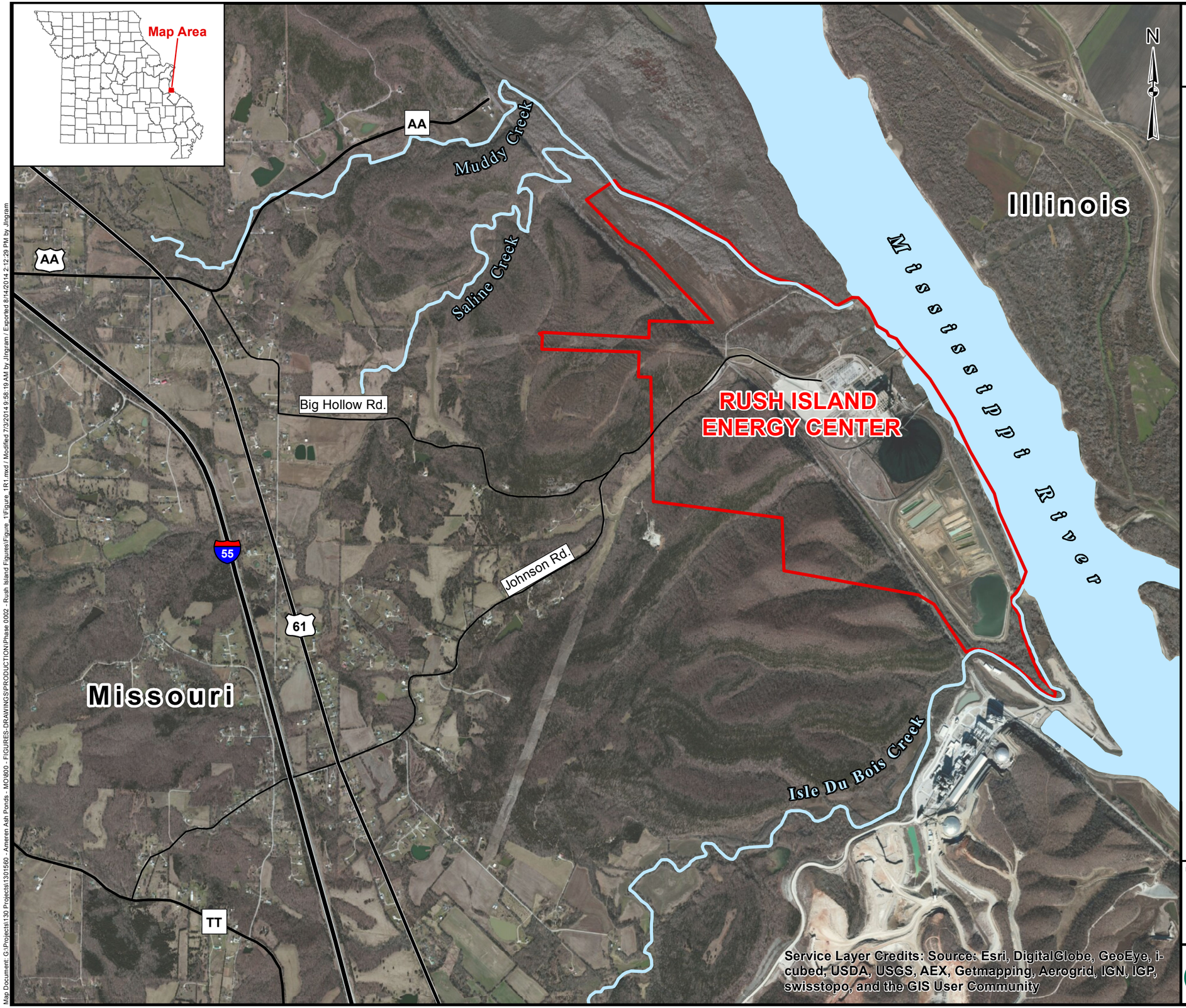
Notes:
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - Milligrams per liter.
NA - Not Analyzed/Not Available.
U - Constituent was not detected.
USEPA - United States Environmental Protection Agency.
BOLD indicates pH reading outside of the criteria range.
(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A. January 29, 2014
http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf
Dissolved (filtered) values provided. Values adjusted for site-specific hardness - see notes (c) and (f).
Missouri State Protection of Aquatic Life Acute and Chronic values apply only to dissolved results (except mercury); irrigation, livestock/wildlife watering, and mercury Aquatic Life Acute and Chronic values apply only to totals results.
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology.
Accessed May 2014. http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Dissolved (filtered) values provided. Values adjusted for site-specific hardness - see notes (c) and (f).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Constituent not analyzed.
(e) - Surface Water Samples collected in April 2014.
(f) - Hardness dependent value for filtered (dissolved) metals. Site-specific (Mississippi River) mean total recoverable hardness value of 217 mg/L as CaCO3 used.
(g) - Water quality criteria from the presented sources are not available for this constituent.
(h) - No results are above the relevant screening levels.
(i) - pH values were obtained during the field sampling event and were recorded at the time of sample collection. Data for pH was not provided by the laboratory.

Table 20
Summary of Whole Effluent Toxicity Testing Results for NPDES Outfall 002
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Sampling Event	Treatment	Percent Survival at 48 hours	
		Pimephales promelas	***Ceriodaphnia dubia***
February 2005	10% Effluent	98%	100%
	Reconstituted Control	100%	100%
	Upstream Control	98%	100%

Notes:
No significant difference (alpha = 0.05) between effluent and control survival data for the above test.
Effluent passes the test conducted in 2005.
10% Effluent - Outfall 002 effluent mixed with Mississippi River water.
Reconstituted Control - Laboratory reconstituted water.
Upstream Control - Mississippi River water.
Effluent samples collected on February 8, 2005.

Figures



TITLE

SITE LOCATION AERIAL MAP

LEGEND

Rush Island Property Boundary

NOTES

1.) All boundaries and locations are approximate.

REFERENCES

1.) Ameren, 2012. Ameren Missouri Rush Island Energy Center, Rush Island Property Control Map, January 2012.
2.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 2,000 4,000 Feet

August 2014

PROJECT

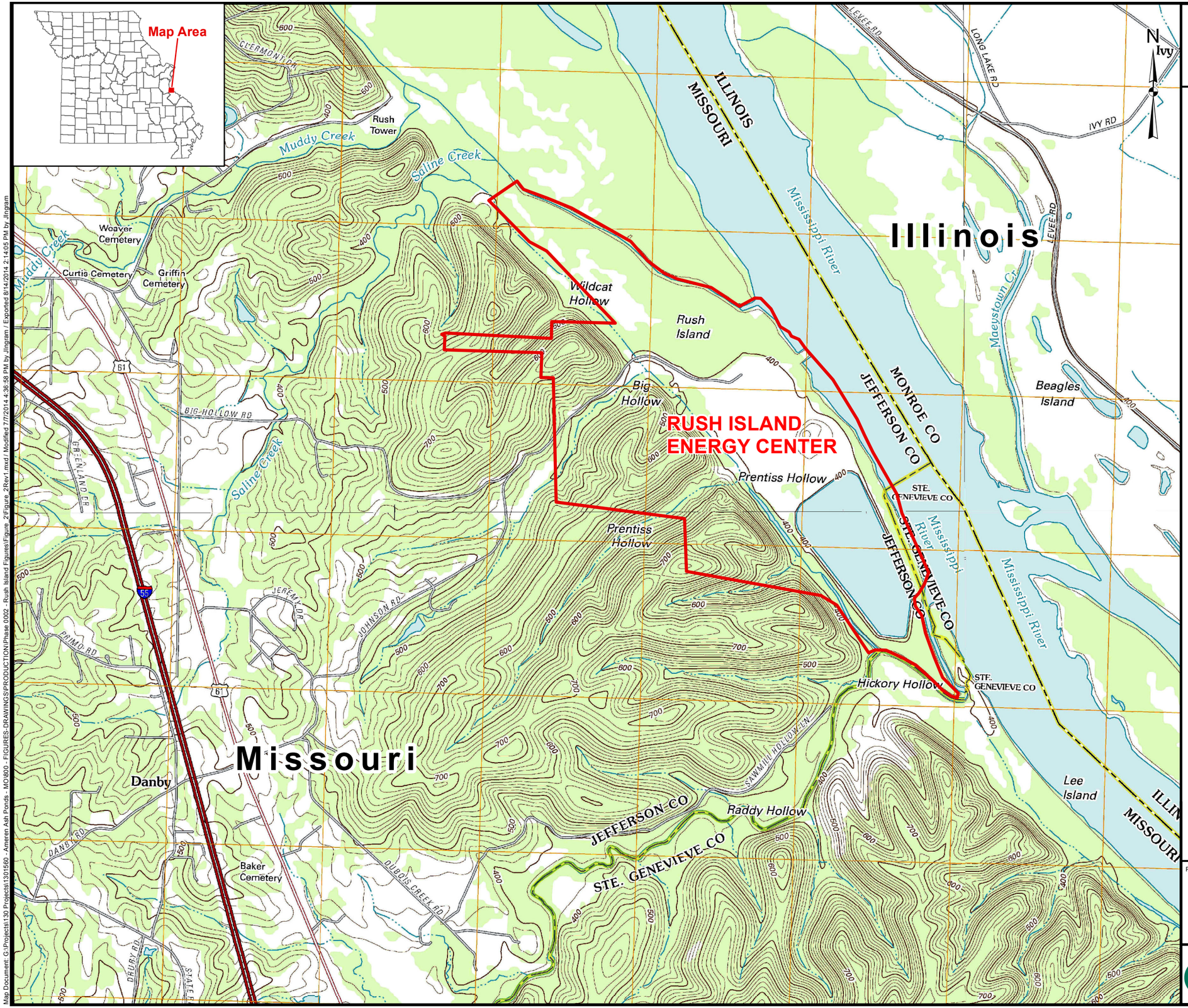
Ameren

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
JEFFERSON COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Figure_1R1.mxd
DESIGN	-	-	SCALE: AS SHOWN / REV. 1
GIS	JSI	1/27/14	
CHECK	MWD	1/30/2014	
REVIEW	MNH	6/15/2014	

FIGURE 1



TITLE

SITE LOCATION TOPOGRAPHIC MAP

LEGEND

Rush Island Property Boundary

NOTES

1.) All boundaries and locations are approximate.
2.) Contour Interval is 20 feet.

REFERENCES

1.) Ameren, 2012. Ameren Missouri Rush Island Energy Center, Rush Island Property Control Map, January 2012.
2.) USGS, 2012a. USGS 2012 Bloomsdale Quadrangle, Missouri-Illinois 7.5-Minute Series.
3.) USGS, 2012b. USGS 2012 Danby Quadrangle, Missouri 7.5-Minute Series.
4.) USGS, 2012c. USGS 2012 Renault Quadrangle, Missouri-Illinois 7.5-Minute Series.
5.) USGS, 2012d. USGS 2012 Selma Quadrangle, Missouri-Illinois 7.5-Minute Series.
6.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 2,000 4,000 Feet

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JEFFERSON COUNTY, MISSOURI

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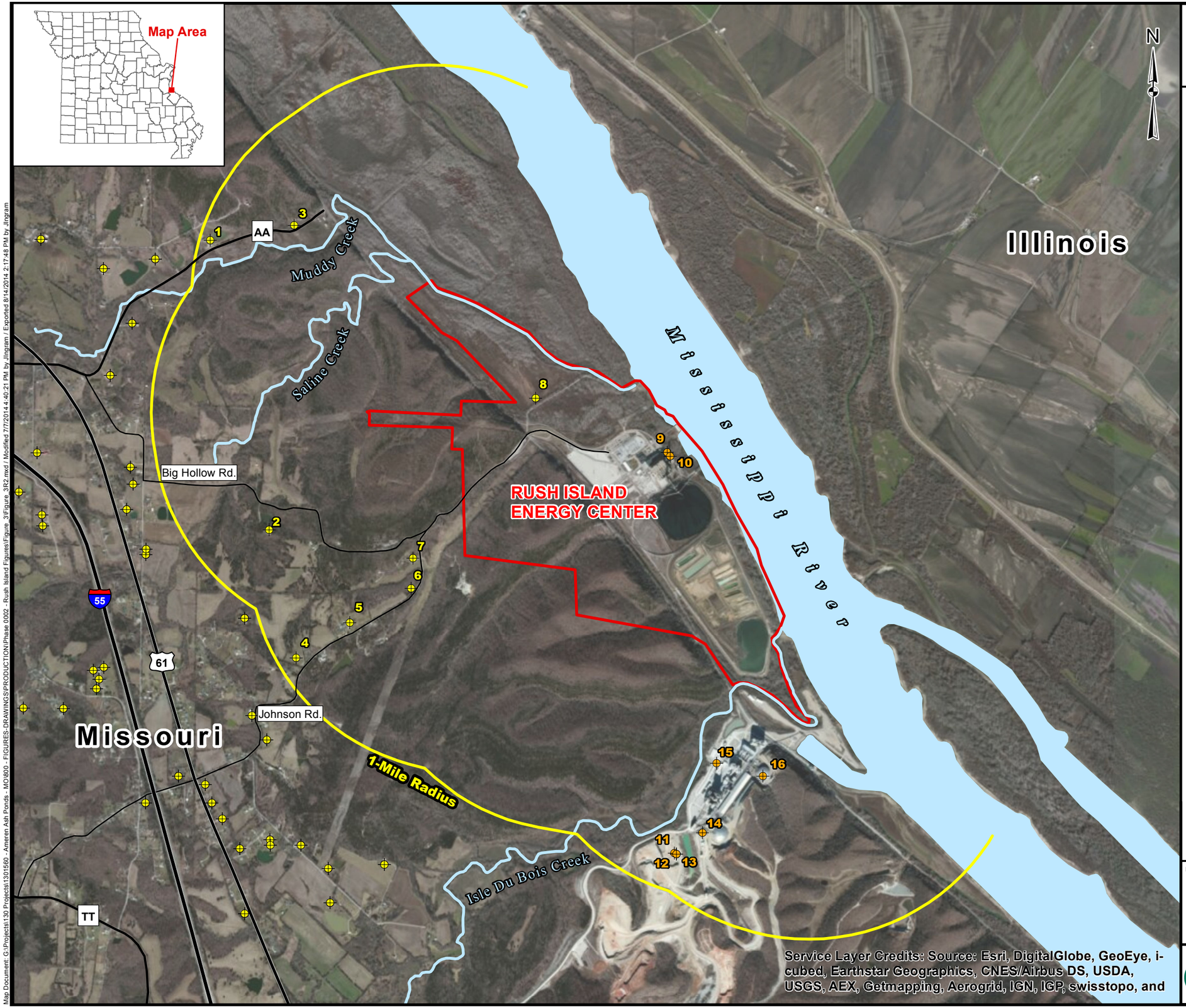
PROJECT No. 130-1560			Figure_2Rev1.mxd
DESIGN	-	-	SCALE: AS SHOWN / REV. 1
GIS	JSI	1/27/2014	FIGURE 2
CHECK	MWD	1/29/2014	
REVIEW	MNH	6/15/2104	



TITLE

PRIVATE WELL LOCATIONS WITHIN 1-MILE RADIUS OF FACILITY BOUNDARY

LEGEND

- Rush Island Property Boundary
- Approximate 1-Mile Radius
- Non-Community Public Well
- Private Well

NOTES

1.) All locations and boundaries are approximate.
2.) Figure displays all non-community public and private wells located near the Rush Island Energy Center property boundary in Jefferson and Ste. Genevieve Counties, Missouri, based on state well records.
3.) See Table 2 and Appendix B for more information on the wells located within one mile of the Rush Island Energy Center Property Boundary.
4.) Wells displayed outside of the 1-mile radius are plotted based on the address of the well from the MDNR well certification forms.
5.) MDNR - Missouri Department of Natural Resources.
6.) MSDIS - Missouri Spatial Data Information Service.
7.) GeoSTRAT - Geosciences Technical Resources Assessment Tool.

REFERENCES

1.) Ameren, 2012. Ameren Missouri Rush Island Energy Center, Rush Island Property Control Map, January 2012.
2.) CARES. 2013. Public Drinking Water System Reports. Center for Applied Research and Environmental Systems.
3.) MDNR. 2013a. Missouri Well Information Management System (WIMS), Wellhead Protection Program. Missouri Department of Natural Resources.
4.) MDNR. 2013b. Geologic Well Logs of Missouri, Water Resource Center. Missouri Department of Natural Resources.
5.) MDNR, 2014a. Geosciences Technical Resource Assessment Tool (GeoSTRAT). Missouri Department of Natural Resources.
6.) MEGA. 2007. Missouri Environmental Geology Atlas. A Collection of Statewide Geographic Information System Data.
7.) MSDIS. 2013. Missouri Spatial Data Information Service.
8.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 3,000 6,000 Feet

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JEFFERSON COUNTY, MISSOURI

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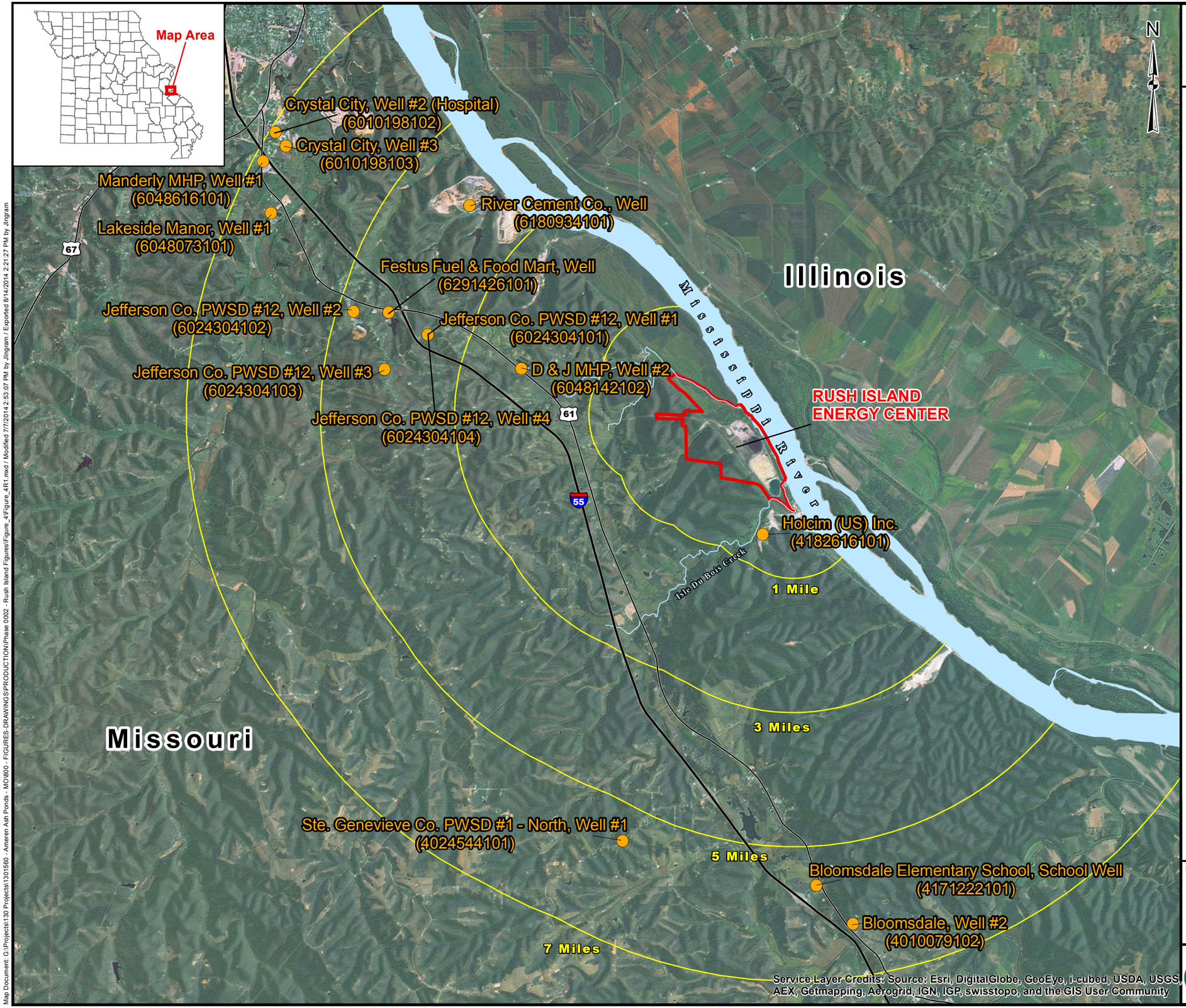
PROJECT No. 130-1560			Figure_3R2.mxd
DESIGN	-	-	SCALE: AS SHOWN / REV. 2
GIS	JSI	6/6/2014	FIGURE 3
CHECK	MWD	6/7/2014	
REVIEW	MNH	6/15/2014	



TITLE

PUBLIC WELL LOCATIONS WITHIN 7-MILE RADIUS OF FACILITY BOUNDARY

LEGEND

- Rush Island Energy Center Property Boundary
- Approximate Distance from Property Boundary
- Public Wells

NOTES

1.) Wells are labeled with state issued well names, local names and extended public water supply (PWS) numbers.
2.) See Table 3 for details of wells listed in this figure.
3.) Figure displays active and emergency public wells near the Ameren Missouri Rush Island Energy Center within the state of Missouri. Non-community public wells, proposed public wells, inactive public wells, abandoned public wells and wells in Illinois are not shown.
4.) All boundaries and locations are approximate. Wells are plotted according to database coordinates.
5,) PWSD - Public water supply district.
6.) MHP - Mobile home park.
7.) See Appendix B for further information on wells located within approximately 1-mile of the Facility boundary.

REFERENCES

1.) Ameren, 2012. Ameren Missouri Rush Island Energy Center, Rush Island Property Control Map, January 2012.
2.) CARES. 2013. Public Drinking Water System Reports. Center for Applied Research and Environmental Systems.
3.) MEGA. 2007. Missouri Environmental Geology Atlas. A Collection of Statewide Geographic Information System Data.
4.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 10,000 20,000
Feet

August 2014

PROJECT

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
JEFFERSON COUNTY, MISSOURI

PROJECT No. 130-1560			Figure_4R1.mxd	
DESIGN	-	-	SCALE: AS SHOWN	REV. 1
GIS	JSI	1/29/2014	FIGURE 4	
CHECK	MWD	1/31/2014		
REVIEW	MNH	6/15/2014		

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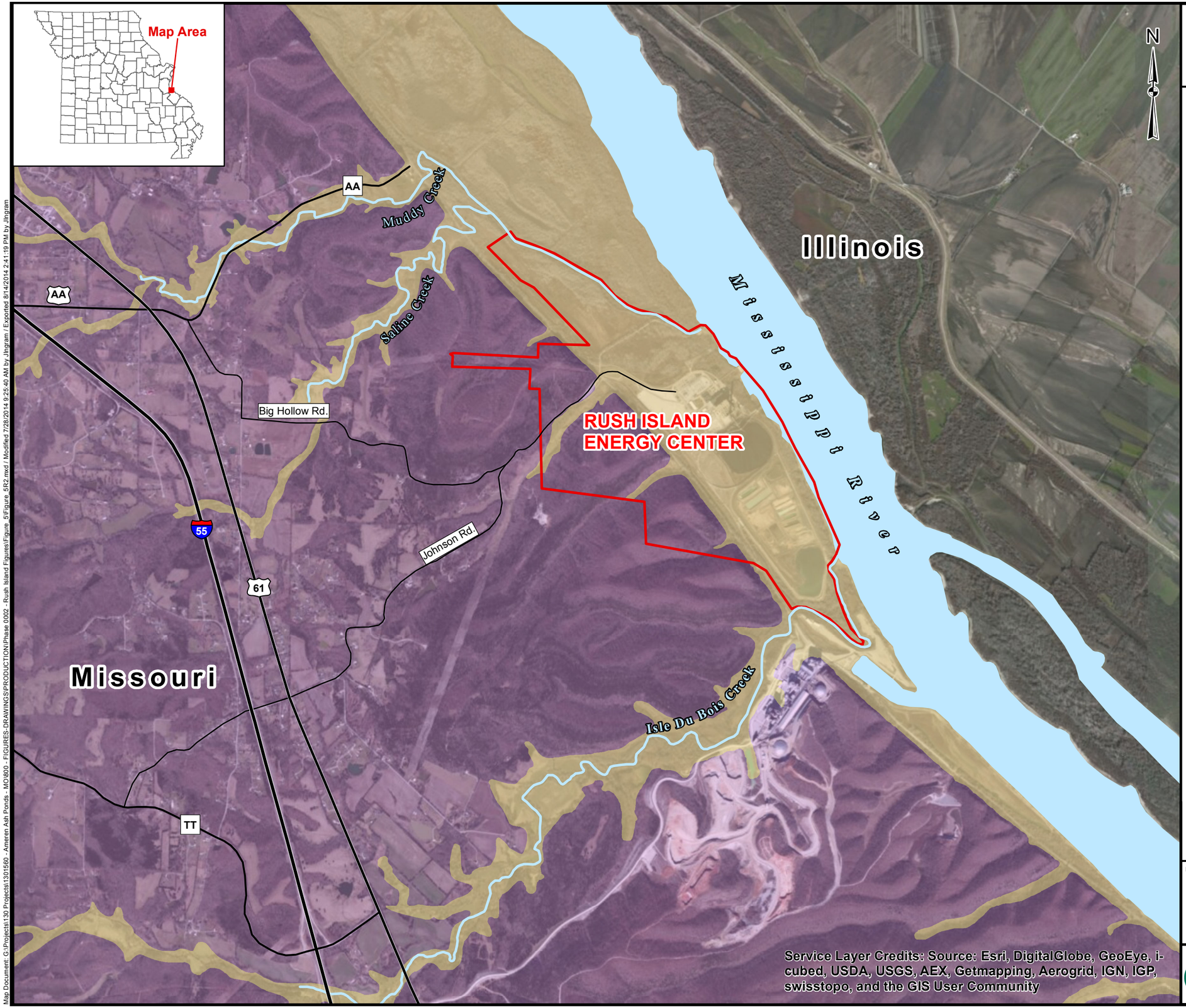
Map Document: G:\Projects\130 Projects\1301560 - Ameren Ash Ponds - MO\800 - FIGURES-DRAWINGS\PRODUCTION\Phase 0002 - Rush Island Figures\Figure_4\Figure_4R1.mxd / Modified 7/7/2014 2:53:07 PM by Jingram / Exported 8/14/2014 2:21:27 PM by Jingram



TITLE

REGIONAL GEOLOGY AND UPPERMOST AQUIFER MAP

LEGEND

- Rush Island Energy Center Property Boundary
- Sand, Gravel, Silt, and Clay (Alluvial Deposits)
- Bedrock

NOTES

1.) This figure illustrates the uppermost groundwater aquifer. The bedrock consists of many geologic formations and is continuous and underlies the alluvial deposits.
2.) Alluvial deposit is a general term for sand, gravel, silt, and clay materials deposited by streams and rivers.
3.) All boundaries and locations are approximate.

REFERENCES

1.) Ameren, 2012. Ameren Missouri Rush Island Energy Center, Rush Island Property Control Map, January 2012.
2.) MEGA. 2007. Missouri Environmental Geology Atlas. A Collection of Statewide Geographic Information System Data.
3.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 3,000 6,000
Feet

August 2014

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JEFFERSON COUNTY, MISSOURI

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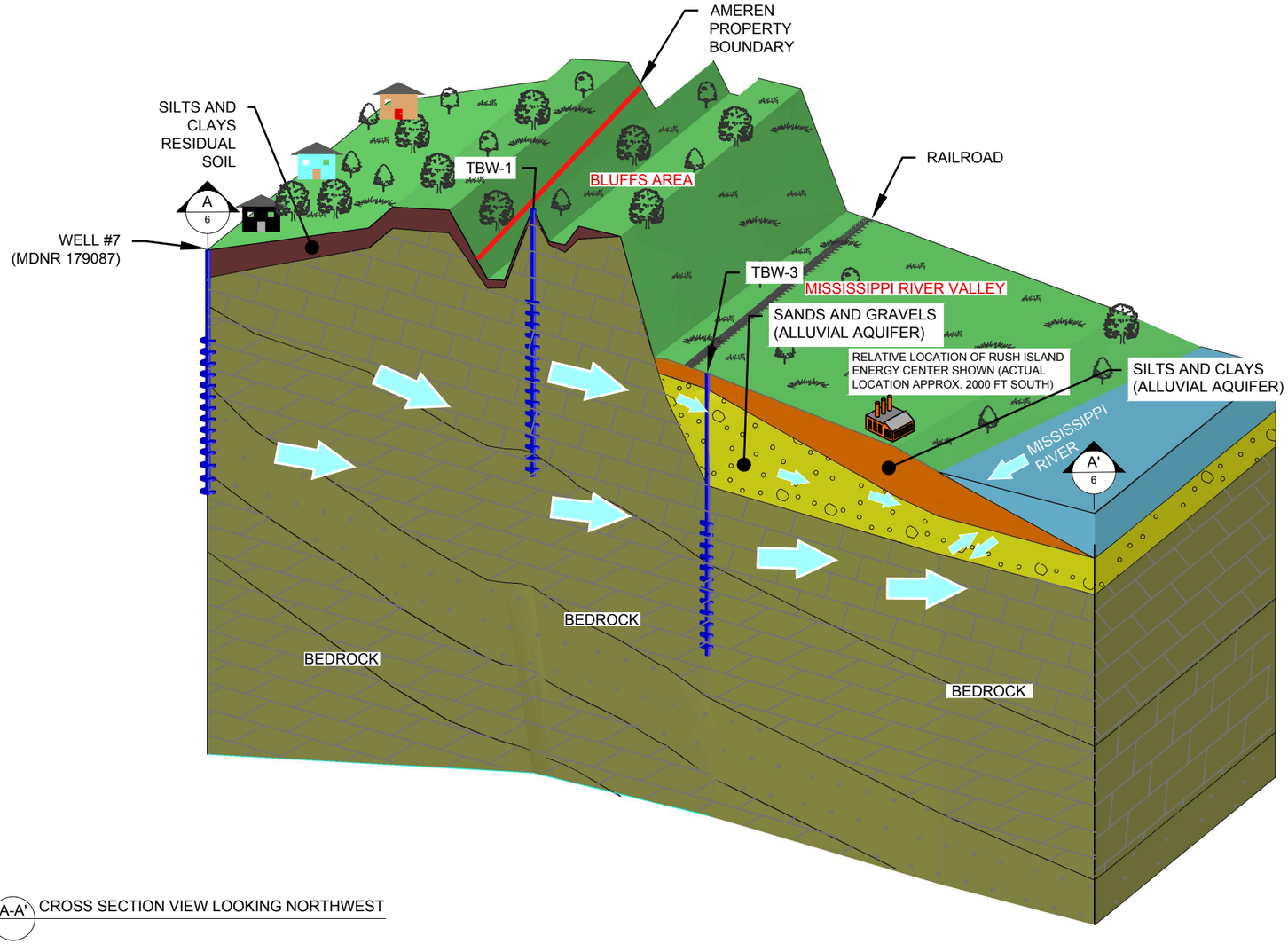
PROJECT No. 130-1560			Figure_5R2.mxd
DESIGN	-	-	SCALE: AS SHOWN / REV. 2
GIS	JSI	1/28/14	
CHECK	MWD	1/30/14	FIGURE 5
REVIEW	MNH	6/15/2014	

Map Document: G:\Projects\130 Projects\1301560 - Ameren Ash Ponds - MO\800 - FIGURES-DRAWINGS\PRODUCTION\Phase 0002 - Rush Island Figures\Figure_5\Figure_5R2.mxd / Modified:7/28/2014 9:25:40 AM by JIngram / Exported 8/14/2014 2:41:19 PM by JIngram

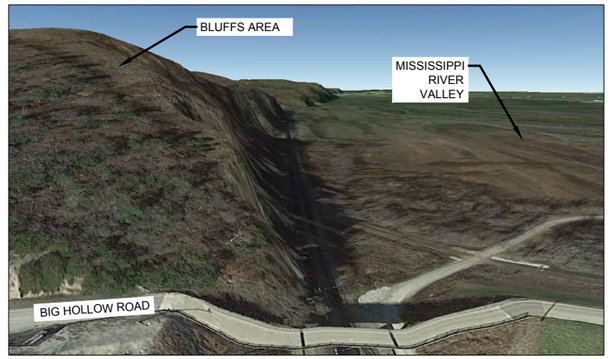
TITLE

CROSS SECTION OF BLUFFS, MISSISSIPPI RIVER VALLEY, AND MISSISSIPPI RIVER



HORIZ. SCALE 1" = 1200'
VERT. SCALE 1" = 120'

A-A' CROSS SECTION VIEW LOOKING NORTHWEST



RELIEF BETWEEN BLUFFS AND MISSISSIPPI RIVER VALLEY LOOKING NORTHWEST
FROM GOOGLE EARTH IMAGE

LEGEND

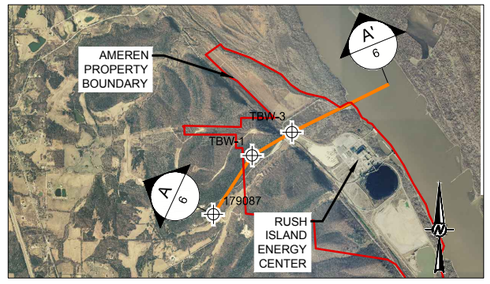
- BH — Available well and boring records located along section line
- Groundwater flow direction
- Well screen interval
- Limestone
- Dolomite
- Sandstone

NOTES

1.) Depth and composition of subsurface materials shown in cross section are approximate and conceptualized based on available borehole logs and well record forms.
2.) Ground surface topography was interpolated from USGS topographic contours.
3.) Cross section displays a 10x vertical exaggeration.
4.) Mississippi River elevation was taken as 369 ft. above mean sea level based on April 1, 2014 Ameren measurements at Rush Island Energy Center.
5.) Elevations are feet above mean sea level using the navd88 datum.
6.) Locations are in the state plane coordinate system wgs84 datum. US survey feet. zone 2401 - Missouri East.
7.) The bedrock consists of multiple rock types including dolomite, sandstone, and limestone.

REFERENCES

1.) USGS, 2012d. USGS 2012 Selma Quadrangle, Missouri-Illinois 7.5-Minute Series.
2.) MDNR, 2013a. Missouri Well Information Management System (WIMS), Wellhead Protection Program. Missouri Department of Natural Resources.
3.) USGS high resolution orthoimagery dated March 7, 2007 (earthexplorer.usgs.gov).



0 3000 6000 9000
SCALE FEET

CROSS SECTION LOCATION

August 2014

PROJECT

Ameren

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
JEFFERSON COUNTY, MISSOURI

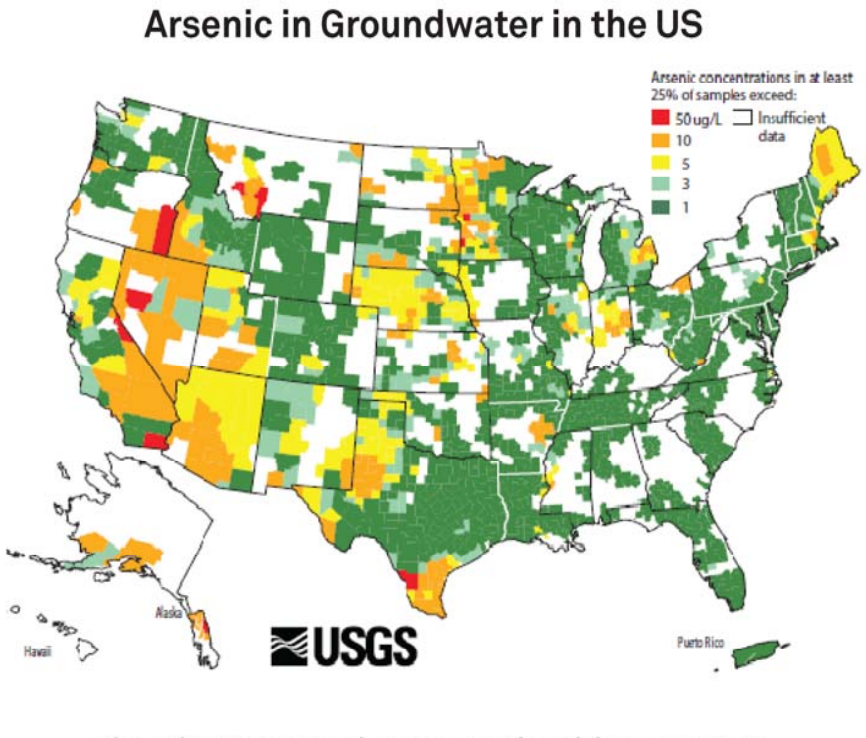
Golder Associates

PROJECT No.		1301560.0002	FILE No.	13015600001F01_REV7
DESIGN	MWD	06/12/14	SCALE	AS_SHOWN
CADD	MWD	06/28/14		
CHECK	JSI	06/28/14		
REVIEW	MNH	06/28/14		

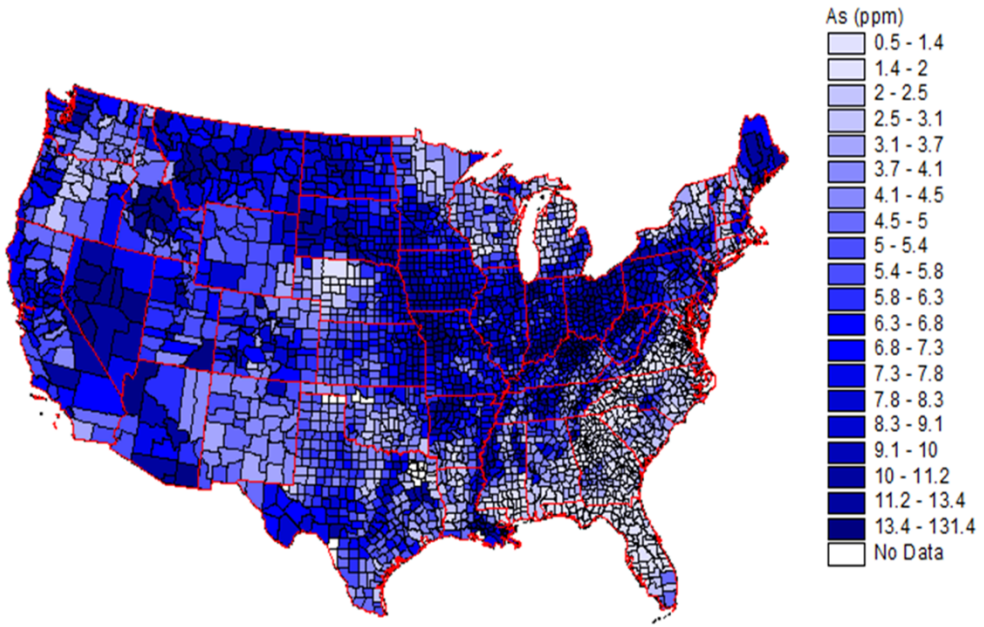
FIGURE 6

FILENAME\LAYOUT\MOD\FIED\PLOTTED\OFFICE

Figure 7
Arsenic is Present in our Natural Environment –



The USEPA regional screening level for arsenic in tapwater at a 1 in one million risk level is 0.052 µg/L.



The USEPA regional screening level for arsenic in residential soil at a one in one million risk level is 0.67 mg/kg. Thus the arsenic concentration in the majority of the soils in the U.S. are above the one in one million risk level.

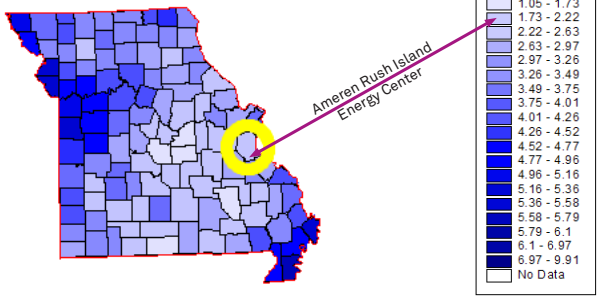
Sources:

- **Groundwater. USGS, 2001. Trace Elements National Synthesis Project. http://water.usgs.gov/nawqa/trace/pubs/geo_v46n11/fig2.html**
- **USEPA, 2014. Regional Screening Level Table. May 2014. http://www.epa.gov/region09/superfund/prg/index.html**
- **USGS. National Geochemical Survey**. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

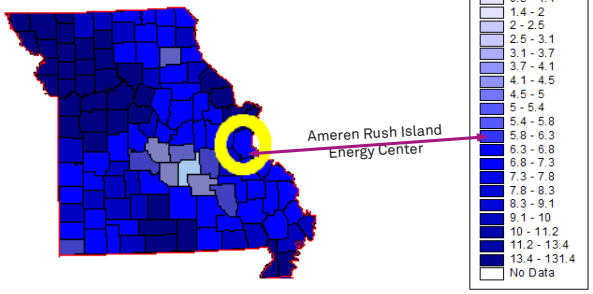
Metals are Present in our Natural Environment

Average Concentrations in Soil in Jefferson County Compared to the Range of Concentrations in Missouri and in the U.S. - All Data from the U.S. Geological Survey (USGS)

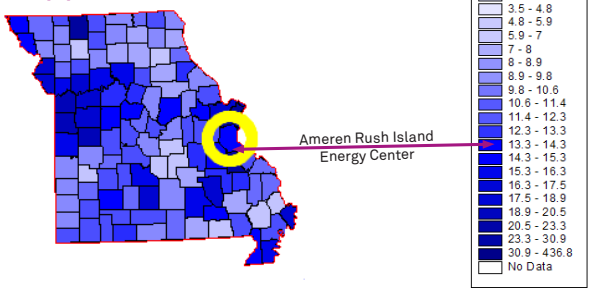
Aluminum



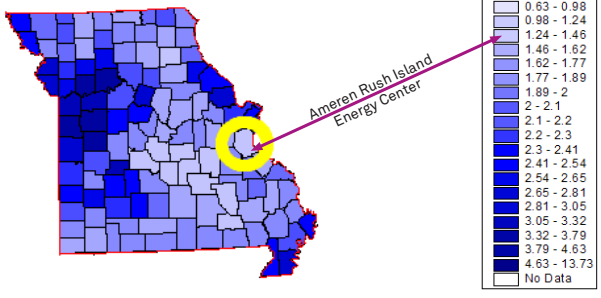
Arsenic



Copper



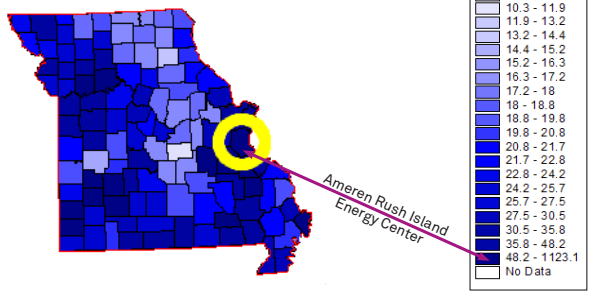
Iron



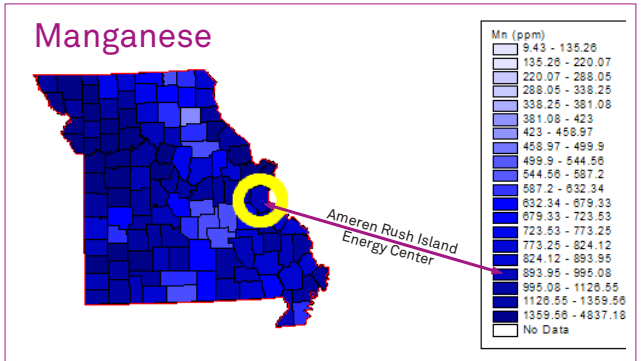
Constituent	Jefferson County, Missouri	United States
	Range (mg/kg)	Range (mg/kg)
Aluminum	3,590 - 37,030	200 - 153,000
Arsenic	1.4 - 14	<0.6 - 830
Copper	1.8 - 36	<0.5 - 996
Iron	2,620 - 26,440	<100 - 133,000
Lead	6.8 - 519	<0.5 - 12,400
Manganese	167 - 1,383	<5 - 7,780
Selenium	0.1 - 0.3	<0.2 - 6.9
Zinc	11 - 499	<1 - 11,700

NOTES: < - Not detected above detection limit.

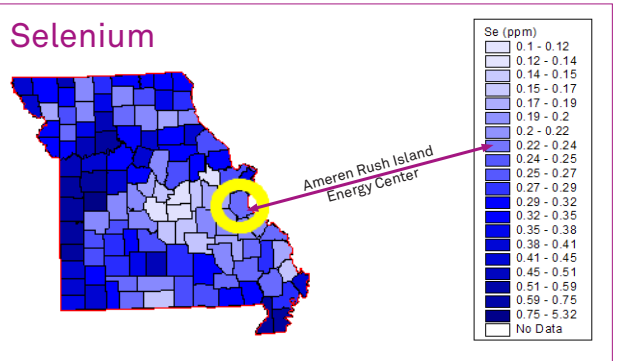
Lead



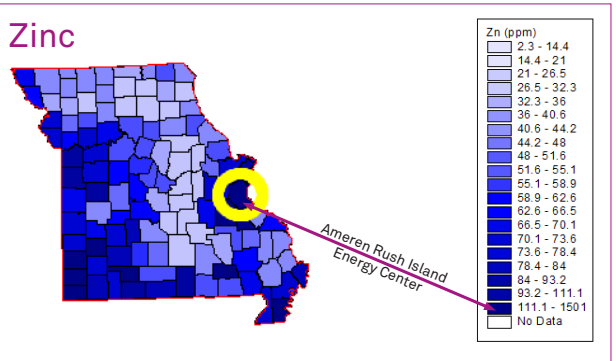
Manganese



Selenium



Zinc



Graphics Source: United States Geological Service (USGS). National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

Table Sources: Jefferson County, Missouri Data: USGS. 2008. National Geochemical Survey. U.S. Geological Survey Open-File Report 2004-1001. http://mrdata.usgs.gov/geochem/county.php?place=f29099&el=As&rf=central

United States Data: USGS. 2013. Geochemical and Mineralogical Data for Soils of the Conterminous United States. Table 2. Statistical summary for chemical analyses of surface soil samples collected from a depth of 0 to 5 centimeters, conterminous United States. http://pubs.usgs.gov/ds/801

mg/kg = milligrams per kilogram
ppm = Parts per Million (1 ppm = 1 mg/kg)
wt% = Percent weight

August 2014

Figure 8

TITLE

GROUNDWATER AND SURFACE WATER SAMPLING LOCATIONS

LEGEND

- Rush Island Property Boundary
- Surface Water Sample Location
- Bedrock Groundwater Well and Sample Location
- Ameren NPDES Outfall

NOTES

1.) All boundaries and locations are approximate.
2.) Sample locations for surface water samples were obtained during sampling using a Trimble GeoXH GPS unit.
3.) Bedrock groundwater wells surveyed by Zahner & Associates.
4.) NPDES outfall location based on MEGA database.

REFERENCES

1.) Ameren, 2012. Ameren Missouri Rush Island Energy Center, Rush Island Property Control Map, January 2012.
2.) MEGA. 2007. Missouri Environmental Geology Atlas. A Collection of Statewide Geographic Information System Data.
3.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 2,000 4,000 Feet

August 2014

PROJECT

Ameren

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
JEFFERSON COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Figure_9rev2.mxd
DESIGN	-	-	SCALE: AS SHOWN / REV. 2
GIS	JSI	6/4/2014	
CHECK	MWD	6/5/2014	FIGURE 9
REVIEW	MNH	6/15/2014	

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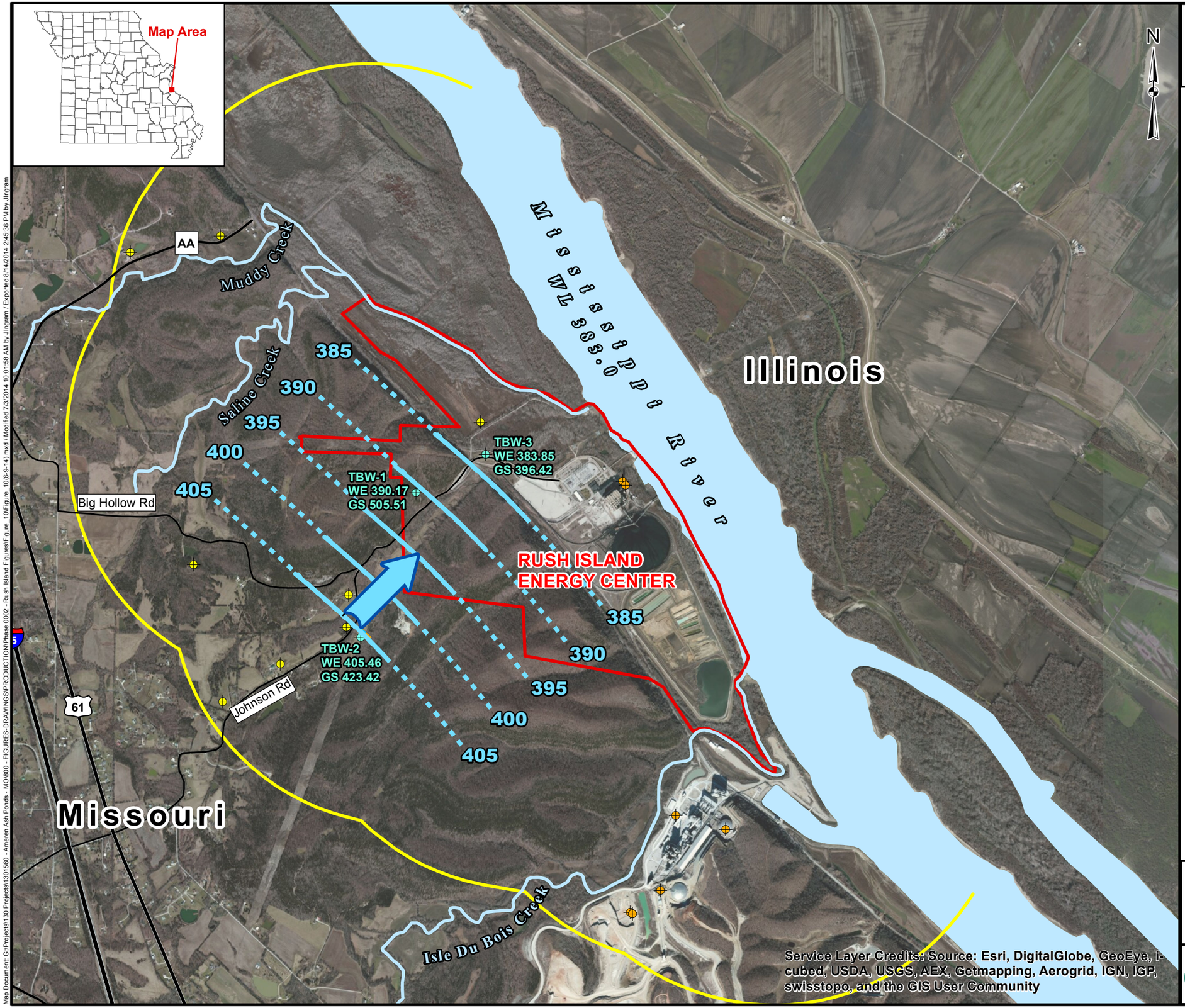

TITLE

BEDROCK GROUNDWATER INVESTIGATION - MAP OF WELLS AND GROUNDWATER FLOW DIRECTION

LEGEND

- Rush Island Property Boundary
- Approximate 1-Mile Radius
- Non-Community Public Well
- Private Well
- TBW-1 / WE 390.17 / GS 505.51 — Well Location with Groundwater Elevation (WE) and Ground Surface (GS) Elevation (Feet Above MSL)
- Groundwater Potentiometric Surface Contour (Feet Above MSL) (Dashed Where Inferred)
- Groundwater Flow Direction

NOTES

1.) All boundaries and locations are approximate.
2.) Well locations were surveyed by Zahner & Associates.
3.) Groundwater elevations measured on June 9th, 2014 by Golder.
4.) MSL - mean sea level.
5.) WE - groundwater elevation (feet above MSL).
6.) GS - ground surface elevation (feet above MSL).
7.) Ft - feet.
8.) See Figure 3 and Table 2 for more information on the wells within approximately 1-mile of the Rush Island Energy Center.
9.) Wells outside of the approximate 1-mile radius and those outside of Missouri are not shown.

REFERENCES

1.) Ameren, 2012. Ameren Missouri Rush Island Energy Center, Rush Island Property Control Map, January 2012.
2.) CARES. 2013. Public Drinking Water System Reports. Center for Applied Research and Environmental Systems.
3.) MDNR. 2013a. Missouri Well Information Management System (WIMS), Wellhead Protection Program. Missouri Department of Natural Resources.
4.) MDNR. 2013b. Geologic Well Logs of Missouri, Water Resource Center. Missouri Department of Natural Resources.
5.) MDNR, 2014a. Geosciences Technical Resource Assessment Tool (GeoSTRAT). Missouri Department of Natural Resources.
6.) MEGA. 2007. Missouri Environmental Geology Atlas. A Collection of Statewide Geographic Information System Data.
7.) MSDIS. 2013. Missouri Spatial Data Information Service.
8.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 2,000 4,000 Feet

August 2014

PROJECT

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JEFFERSON COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Figure_10(6-9-14).mxd
DESIGN	-	-	SCALE: AS SHOWN / REV. 1
GIS	JSI	6/10/2014	
CHECK	LAB	6/10/2014	FIGURE 10
REVIEW	MNH	6/15/2014	

TITLE

NEAREST DOWNSTREAM DRINKING WATER INTAKE

LEGEND

- Water Intake
- Approximate River Miles
- Rush Island Energy Center Property Boundary

NOTES

1.) Water intakes labeled with the Illinois Public Water Supply Intake Name and Identification Number (Intake ID).
2.) All boundaries and locations are approximate.

REFERENCES

1.) Ameren, 2012. Ameren Missouri Rush Island Energy Center, Rush Island Property Control Map, January 2012.
2.) IDNR, 2014. Illinois Resource Management Mapping Service (RMMS).
3.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 2 4 Miles

August 2014

PROJECT

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JEFFERSON COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Figure 11R1.mxd	
DESIGN	-	-	SCALE: AS SHOWN	REV. 1
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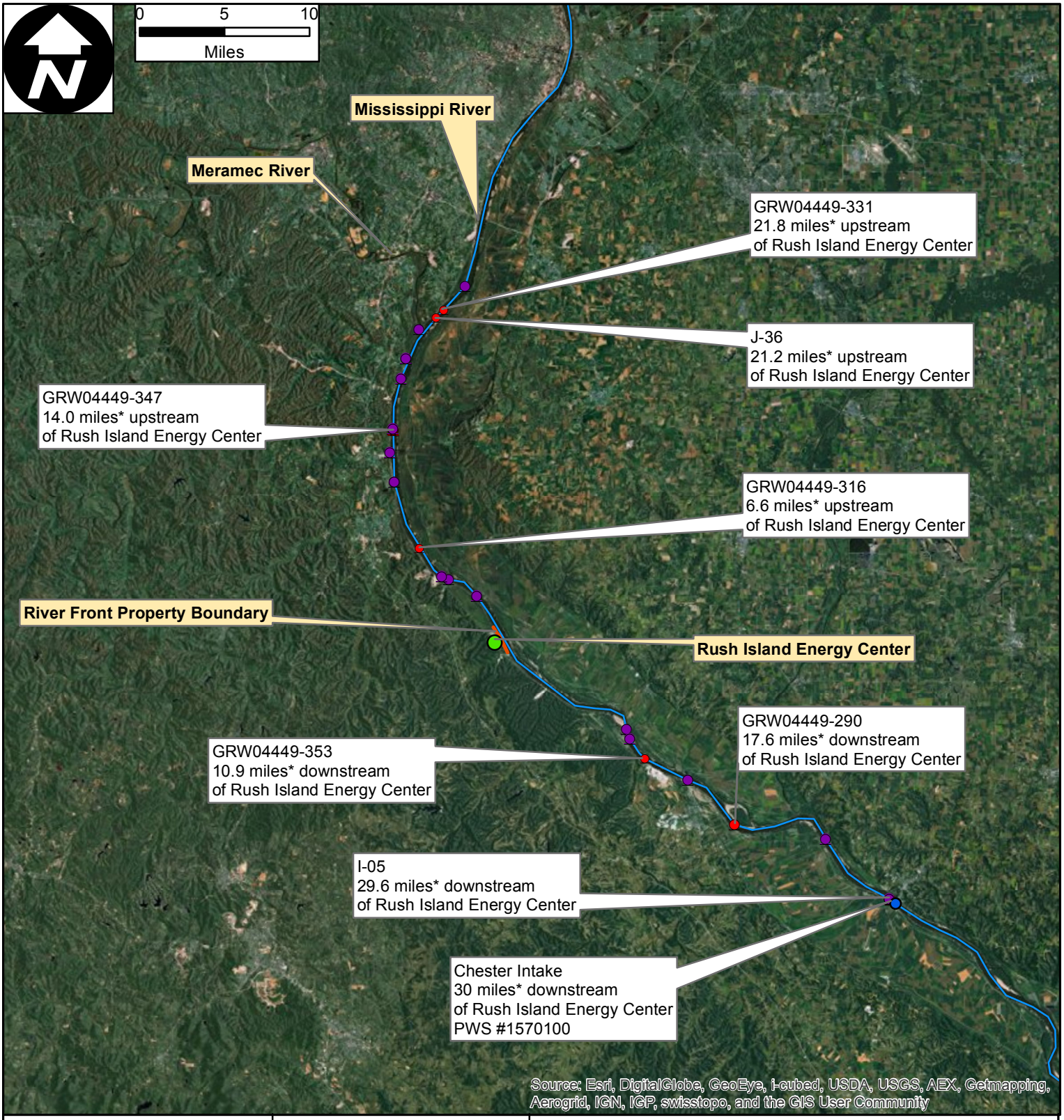
CHECK	MWD	1/30/14		
REVIEW	MNH	6/15/2014		

Map Document: G:\Projects\130 Projects\1301560 - Ameren Ash Ponds - MO\800 - FIGURES-DRAWINGS\PRODUCTION\Phase 0002 - Rush Island Figures\Figures\Figure_11\Figure 11R1.mxd / Modified 8/14/2014 4:14:10 PM by Jingram / Exported 8/14/2014 4:14:23 PM by Jingram



AECOM

Created On: 6/9/2014

Created by: C. Puopolo

Project #: 60307162.1

Figure 12

Mississippi River Water Quality Monitoring Stations

Rush Island Energy Center
Jefferson County, MO
Ameren Missouri

Legend

- Rush Island Energy Center
- Mississippi River
- River Front Property Boundary

Notes:
1.) * Approximate distance measured. STORET locations are measured from the most upstream or downstream property boundary point.
2.) Water Monitoring Locations GIS shapefile is available from USEPA Surf Your Watershed via http://epamap32.epa.gov.
3.) Imagery - Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

August 2014

Figure 13
Conceptual Site Model – Coal Ash Management Area
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Source	Transport medium	Environmental Contact Medium	Potential Receptors	Data Used for Evaluation	Is Pathway Complete?	Rationale
Ameren Rush Island Energy Center Potential release of inorganic constituents derived from coal and coal ash to the environment, specifically groundwater. Sources include coal ash ponds, NPDES Outfall, and historical ash pond seeps.	**Groundwater and Surface Water** Transport of coal- and coal ash-derived constituents in groundwater to downgradient locations, including discharge to surface water, and NPDES and seep discharge to surface water.	**Groundwater**				
		Groundwater in locations hydrologically downgradient of the Facility	Drinking water wells (if located downgradient and screened in the same aquifer)	Data from wells installed in the bluff area to the west and northwest of the Facility	Drinking water pathway incomplete	Direct water quality monitoring in the bedrock aquifer in the area of the closest private drinking water wells has demonstrated that the groundwater used by private wells in the area is upgradient of the Facility and is not impacted by the coal ash management practicies at the Facility; evaluation of analytical data in the bedrock aquifer indicates that constituent concentrations are consistent with background conditions, do not exhibit evidence of coal ash-derived constituent indicators boron and sulfate, and concentrations are below drinking water screening levels
		Surface Water				
		Isle Du Bois Creek	Recreational users of Isle Du Bois Creek	Data from upstream, midstream, and downstream locations.	Recreational pathway may be complete but is insignificant (a)	Constituent concentrations in the creek are similar upstream and downstream; most concentrations are associated with suspended sediments; concentrations of "indicator parameters" boron and sulfate are low; thus, no impact on surface water quality is evident and coal ash managment practices at the Facility do not pose an adverse risk to human health.
			Drinking water intakes	Drinking water pathway incomplete	Drinking water pathway incomplete (a)	There are no drinking water intakes on Isle Du Bois Creek.
		Mississippi River	Recreational users of the Mississippi River	Data from location 1/4 mile downstream of Facility boundary (and downstream of Isle Du Bois Creek discharge), and from a location 1/4 mile upstream of the Facility; data are available for NPDES permitted outfall; limited water quality data available for Mississippi River from USEPA STORET database	Recreational pathway may be complete but is insignificant (a)	Constituent concentrations in the river are similar upstream and downstream; most concentrations are associated with suspended sediments; concentrations of "indicator parameters" boron and sulfate are low and do not exhibit a consistent pattern upstream and downstream; thus, no impact on surface water quality is evident and coal ash managment practices at the Facility do not pose an adverse risk to human health
			Downgradient/down river municipal drinking water intakes	Data from above (no downstream drinking water intake data available)	Drinking water pathway may be complete but is insignificant (a)	

Notes:

(a) - An exposure pathway is complete only if there is a source → transport → medium → exposure linkage. If an exposure pathway is complete, but the magnitude, or concentration of the chemical in the environmental medium is below health risk-based levels, then the exposure would not pose an adverse risk. Thus an exposure pathway could be complete but be insignificant on a health-risk basis.

Appendix A

Constituents Present in Coal Ash and in Our Natural Environment

Appendix A

Constituents Present in Coal Ash and in Our Natural Environment

It is important to understand what constituents are present in coal ash, which can be released to the environment, and to understand the natural occurrence of these constituents in our environment.

Coal is a type of sedimentary rock that is a natural component of the earth's crust and the inorganic minerals and elements it contains are also naturally occurring. It is the organic component of coal that burns and produces energy, and it is the inorganic minerals and elements that remain after combustion the make up the coal ash, or coal combustion products (CCPs).

A.1 Major, Minor and Trace Constituents in Coal Ash

All of the inorganic minerals and elements that are present in coal ash are also present in our natural environment. This is one fact that that the public seems either not to understand or will not acknowledge. **Figure A-1** shows the major and minor components of fly ash, bottom ash, volcanic ash, and shale. It is important to understand that the constituents that are the focus of many of the concerns expressed by the public about the toxicity of coal ash (e.g., lead, arsenic, mercury, cadmium, selenium, etc.) are trace elements, so called because they are present in such low concentrations (in the mg/kg or part per million (ppm) range). Together, the trace elements generally make up less than 1 percent of the total mass of these materials. To put these concentrations into context, a mg/kg or ppm is equivalent to:

- 1 penny in a large container holding $10,000 worth of pennies, or
- 1 second in 11.5 days, or
- 1 inch in 15.8 miles

These trace elements have been referred to by the public and even in the popular press as "toxic"—without any context provided for what this means. Moreover, claims have been made that there is no safe level of exposure to any of these elements.

This is simply not true, and there are two important facts that must be understood to put this in context. The first relates to background levels of constituents in our environment and the second relates to toxicity.

A.2 Background Levels in Soils

The first fact that must be understood is that all of the constituents present in coal ash occur naturally in our environment. U.S. Geological Survey (USGS) data demonstrate the presence of these constituents in the soils across the U.S. Prime examples include arsenic, lead, mercury and selenium. With respect to arsenic, **Figure A-2** shows the range of background levels of arsenic in soils across the U.S., as published by the USGS. The USGS is conducting a "national geochemical survey" to identify background levels of elements in soils in the U.S. (USGS, 2013). **Figures A-3 – A-6** provide maps prepared by the USGS demonstrating the naturally-occurring presence of other trace elements in soils in the U.S., including aluminum and copper (**Figure A-3**), iron and lead (**Figure A-4**), manganese and mercury (**Figure A-5**), and selenium and zinc (**Figure A-6**).

These soils are found in our backyards, schools, parks, etc., and because of their presence in soil, these constituents are also present in the foods we eat. Some of these constituents are present in

our vitamins, such as manganese and selenium. Thus, we are exposed to these trace elements in our natural environment every day, and in many ways.

A.3 Toxicity and Risk

The second fact is that all constituents and materials that we encounter in our natural environment can be toxic, but what determines whether a toxic effect actually occurs is how one is exposed to the constituent, the amount of material to which one may be exposed, and the timing and duration of that exposure. Without sufficient exposure the science tells us that there are no toxic effects. Put another way, when a toxic effect is demonstrated by a particular constituent, it is generally caused by high levels of exposure over a long-term duration. The fundamental principles here are:

- All constituents can exert toxic effects (from aspirin[1] to table salt to water to minerals).
- For such toxic effects to occur, exposure must occur at a sufficiently high level for a sufficiently long period of time.
- If there is no exposure, there is no risk.

A.4 Risk-Based Screening Levels

The U.S. Environmental Protection Agency (USEPA) uses information on the potential toxicity of constituents to identify concentrations of trace elements in soil in a residential setting that are considered by USEPA to be protective for humans (including sensitive groups) over a lifetime (USEPA, 2014c). Specifically, residential soil screening levels are levels that are protective of a child and adult's daily exposure to constituents present in soil or a solid matrix over a residential lifetime. In the context of regulatory decision making, at sites where constituent concentrations fall below these screening levels, no further action or study is warranted under the federal Superfund program. Missouri Department of Natural Resources also applies this concept to the development of screening levels in its Risk-Based Corrective Action program (MDNR, 2006).

Figure A-7 shows USEPA's residential soil screening levels for a variety of trace elements that are present in coal ash. USEPA considers it to be safe for children to be exposed to these concentrations of each of these trace elements in soils on a daily basis, throughout their lifetime. What this tells us is that by developing these residential soil screening levels, USEPA considers the presence of these levels of these constituents in soils to be safe for humans, even for exposure on a daily basis. It is, therefore, simply not true that there are no safe levels of exposure to these constituents.

A.5 Comparison of Coal Ash Constituent Concentrations to Risk-Based Screening Levels and Background

A comparison of constituent concentrations in coal ash, as reported by the USGS (USGS, 2011a) to USEPA's risk-based screening levels for residential soil indicates that with only a few exceptions, constituent concentrations in coal ash are below screening levels developed by the USEPA for residential soils, and are similar in concentration to background U.S. soils. Details of this evaluation are provided in the report titled "Coal Ash Material Safety: A Health Risk-Based Evaluation of USGS

[1] For example, if one takes two aspirin every four hours as directed, aspirin is not toxic. If one takes the entire bottle at once, the aspirin is very toxic.

Coal Ash Data from Five US Power Plants" (AECOM, 2012). The study is available at: http://www.acaa-usa.org/associations/8003/files/ACAA_CoalAshMaterialSafety_June2012.pdf.

Figure A-8 is an updated chart from this study comparing ranges of trace element concentrations in fly ash produced from coal from the Powder River Basin in Wyoming (the same type of coal used at Rush Island Energy Center) to USEPA screening levels, and to background levels in soils in the U.S. The USEPA screening levels for residential soils (USEPA, 2014c) are shown as the green vertical bars, the ranges for the Wyoming coal fly ash are shown in purple on top of the green vertical bars, and the ranges of background levels in U.S. soils are shown in the grey bars. What this figure shows is that all but one of the constituents are present in the Wyoming fly ash at concentrations that are below the USEPA residential soil screening levels; and for cobalt, the concentration range is only marginally above the screening level. As noted in detail in the report itself, the toxicity value upon which the USEPA soil screening level for cobalt is based is two levels of magnitude lower than what has been derived by other regulatory agencies; thus a much higher health protective soil screening level for cobalt exists. What the data also show is that constituent concentrations in coal ash are not that different from concentrations in soils in the U.S.

The results are similar for all of the coal ashes evaluated in the report (AECOM, 2012). The evaluation in the report included not only the simple comparison of constituent concentrations in coal ash to USEPA screening levels, but also provided a detailed cumulative risk screen for each coal ash data set to account for potential additive effects of combined exposures to the trace elements in coal ash. The results confirm the simple screening results, which indicate that no significant risk would be posed by direct exposure to coal ash in a residential setting.

Thus, by considering the levels of trace elements in coal ash in comparison to the background levels in soils in the U.S., and in comparison to the USEPA screening levels for these constituents in residential soil, screening levels that are protective of daily exposure to soils by children and adults, including sensitive subgroups, it is concluded that even daily direct contact to trace elements in coal ash would not pose a significant risk to human health.

A.6 Background Levels in Groundwater

Because these constituents are naturally present in soils and rocks, they are also naturally present in our groundwaters and surface waters. The USGS has published a report titled "Trace Elements and Radon in Groundwater Across the United States" (USGS, 2011b). Just as for soil, it is important to understand that there are background levels of constituents in groundwater. Constituent concentrations in groundwater that is upgradient of a source represent background conditions. To demonstrate a release to groundwater by a source, concentrations downgradient of the source must be greater than the background/upgradient concentrations at a statistically significant level for a consistent period of time.

The same concept applies to surface water. These same constituents are naturally present in surface water due to discharge of groundwater to surface water and the effect of erosion of soil into our surface waters. To demonstrate an effect of a source on surface water, the concentrations downgradient/downstream of the source must be greater than the background/upstream concentrations at a statistically significant level for a consistent period of time.

Constituents in groundwater and surface water can be in a dissolved form, or they can be adhered to or part of a soil or sediment particle. Movement of these particles in groundwater is generally more difficult because of the presence of the soil and rock that the groundwater must move through. Surface water is constantly impacted by erosion of soils, thus in surface water, it is much more

common for constituents to be bound to particles rather than dissolved in the water. For this reason, it is important to evaluate both total concentrations of constituents in water (which represents constituents dissolved in the water and as part of a soil or sediment particle) and the dissolved component (by filtering out the soil/sediment particles).

A.7 Toxicity Evaluation for Cobalt and Chromium

A.7.1 Cobalt

Cobalt is the only constituent in the Powder River Basin coal ash (the coal that is used at the Rush Island Energy Center) with concentrations above the USEPA screening level for residential soils. There is much uncertainty associated with the USEPA dose-response value for cobalt, and with the resulting screening level for residential soil. The World Health Organization (WHO) indicates that "there are no suitable data with which to derive a tolerable intake for chronic ingestion of cobalt" (WHO, 2006). Agency for Toxic Substances and Disease Registry (ATSDR, 2004) states that "adequate chronic studies of the oral toxicity of cobalt or cobalt compounds in humans and animals are not presently available." However, using a short-term study in six human volunteers, ATSDR (2004) derived an intermediate-term (15–364 days) minimal risk level (MRL) of 0.05 mg/kg-day. The "adverse" effect was identified as increased red blood cell count, although it is also noted that cobalt is used as a treatment for anemia (low red blood cell count). ATSDR also notes that "Since cobalt is naturally found in the environment, people cannot avoid being exposed to it. However, the relatively low concentrations present do not warrant any immediate steps to reduce exposure." WHO notes that the largest source of exposure to cobalt for the general population is the food supply; the estimated intake from food is 5–40 ug/day, most of which is inorganic cobalt (WHO, 2006). Expressed on a mg/kg-day basis, this is 0.00007–0.0005 mg/kg-day from the diet.

USEPA however has derived a Provisional Peer-Reviewed Toxicity Value (PPRTV) for cobalt of 0.0003 mg/kg-day, this is two orders of magnitude lower than the ATSDR intermediate term MRL, and is higher that most dietary intake estimates. Thus the RSL for cobalt for residential soil is much lower than values derived by other regulatory bodies.

A.7.2 Hexavalent Chromium

The data provided by USGS (2011a) for chromium is for total chromium in the samples; the Ameren data for groundwater and surface water are also based on analysis of total chromium. Many metals can exist in different oxidation states; for some metals, the oxidation state can have different toxicities. This is the case for chromium. Chromium exists in two common oxidation states: trivalent chromium (chromium-3, Cr(III) or Cr+3), and hexavalent chromium (chromium-6, Cr(VI) or Cr+6). Trivalent chromium is essentially nontoxic, as evidenced by its RSL of 120,000 mg/kg. It can be bought over-the-counter as a supplement, and is included in most vitamins. Hexavalent chromium has been concluded to be a human carcinogen by the inhalation route of exposure (USEPA, 2014a).

Currently on USEPA's toxicity database, the Integrated Risk Information System (IRIS) (USEPA, 2014a), the primary source of dose-response information for risk assessment and for the RSL tables, an oral reference dose is available for trivalent chromium, and IRIS provides an inhalation IUR for potential inhalation carcinogenic effects and an oral reference dose and inhalation reference concentration for hexavalent chromium. The oral noncancer dose-response value for hexavalent chromium is based on a study where no adverse effects were reported; thus the target endpoint is identified as "none reported."

Recent studies by the National Toxicology Program (NTP) have shown that when present in high concentrations in drinking water, hexavalent chromium can cause gastrointestinal tract tumors in mice (NTP, 2008). IRIS does not present an oral CSF for hexavalent chromium; a value developed by the New Jersey Department of Environmental Protection (NJDEP, 2009) was used in the development of the RSLs. USEPA developed a draft oral cancer dose-response value for hexavalent chromium, based on the same study and was the same as the NJDEP value. However, it should be noted that USEPA's Science Advisory Board (SAB) provided comments in July 2011 on the draft USEPA derivation of the oral CSF for hexavalent chromium and indicated many reservations with the assumptions of mode of action, and in the derivation itself. The SAB review can be accessed at http://cfpub.epa.gov/ncea/iris_drafts/recordisplay.cfm?deid=221433. Thus, the value used to develop the RSLs for hexavalent chromium has been called into question by USEPA's peer review panel. Currently there is much scientific debate about whether the mode of action of hexavalent chromium in very high concentrations in drinking water is relevant to the low concentrations most likely to be encountered in environmental situations (Proctor, et al., 2012).

Therefore, for this evaluation of chromium in the Powder River Basin coal ash, total chromium is evaluated assuming the total concentration is hexavalent chromium and using RSLs calculated using USEPA's on-line RSL calculator (USEPA, 2014b), based on the primary dose-response values provided in the IRIS database (USEPA, 2014a) for both potential carcinogenic and noncarcinogenic endpoints.

The assumption that all chromium in CCPs is in the hexavalent form is very conservative, and in fact unrealistic. Data for the Alaska Power Plant indicate that hexavalent chromium comprises 0.25% of the total chromium concentration in the combined fly ash/bottom ash material from that facility. Literature data for analyses of CCPs from US coals (total CCPs) indicate that hexavalent chromium can comprise up to 5% of the total chromium (Huggins, et al., 1999); thus over 95% of the total chromium is present in the nontoxic trivalent form. This is consistent with data from USEPA, though there are some single higher results (USEPA, 2009).

A.8 Summary

Constituents present in coal ash are also present in our natural environment, and we are exposed to them every day, in the soils that we contact and the food that we eat. All of these constituents have USEPA-derived risk-based screening levels for residential soils. The constituent concentrations in coal ash from the Powder River Basin, the source of the coal used at the Rush Island Energy Center, are below risk-based screening levels for residential soils (with one exception) and the concentrations are similar to background levels in U.S. soils.

A.9 References

AECOM. 2012. Coal Ash Material Safety: A Health Risk-Based Evaluation of USGS Coal Ash Data from Five US Power Plants. Prepared for the American Coal Ash Association. Available at: http://www.acaa-usa.org/associations/8003/files/ACAA_CoalAshMaterialSafety_June2012.pdf

ATSDR. 2004. Toxicological Profile for Cobalt. Agency for Toxic Substances and Disease Registry. Available at: http://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=373&tid=64

Huggins, FE, M Najih, and GP Huffman. 1999. Direct speciation of chromium in coal combustion by-products by X-ray absorption fine-structure spectroscopy. Fuel 78:233–242.

MDNR. 2006. Missouri Risk-Based Correction Action (MRBCA) Technical Guidance. April, 2006. Available at: http://www.dnr.mo.gov/env/hwp/mrbca/docs/mrbca-sections6-06.pdf

NJDEP. 2009. Derivation of Ingestion-Based Soil Remediation Criterion for Cr+6 Based on the NTP Chronic Bioassay Data for Sodium Dichromate Dihydrate. Division of Science, Research and Technology New Jersey Department of Environmental Protection. Risk Assessment Subgroup of the NJDEP Chromium Workgroup. April 8, 2009.

NTP. 2008. NTP technical report on the toxicology and carcinogenesis studies of sodium dichromate dihydrate (CAS No. 7789-12-0) in F344/N rats and B6C3F1 mice (drinking water studies), NTP TR 546. NIH Publication No. 08-5887. National Toxicology Program.

Proctor, DM, M Suh, LL Aylward, CR Kirman, MA Harris, CM Thompson, H Gurleyuk, R Gerads, LC Haws, SM Hays. 2012. Hexavalent chromium reduction kinetics in rodent stomach contents. Chemosphere 89(5): 487–493. Available at: http://www.sciencedirect.com/science/article/pii/S0045653512005978

USEPA. 2009. Characterization of Coal Combustion Residues from Electric Utilities – Leaching and Characterization Data. U.S. Environmental Protection Agency. EPA-600/R-09/151. December 2009.

USEPA. 2014a. Integrated Risk Information System (IRIS). Environmental Criteria and Assessment Office. U.S. Environmental Protection Agency, Cincinnati, OH. Available at: http://cfpub.epa.gov/ncea/iris/index.cfm

USEPA. 2014b. Regional Screening Levels (RSLs) Calculator. U.S. Environmental Protection Agency. Available at: http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search

USEPA. 2014c. USEPA Regional Screening Levels. May 2014. U.S. Environmental Protection Agency. Available at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

USGS. 2011a. Geochemical Database of Feed Coal and Coal Combustion Products (CCPs) from Five Power Plants in the United States. Data Series 635. U.S. Geological Survey. Available at: http://pubs.usgs.gov/ds/635/

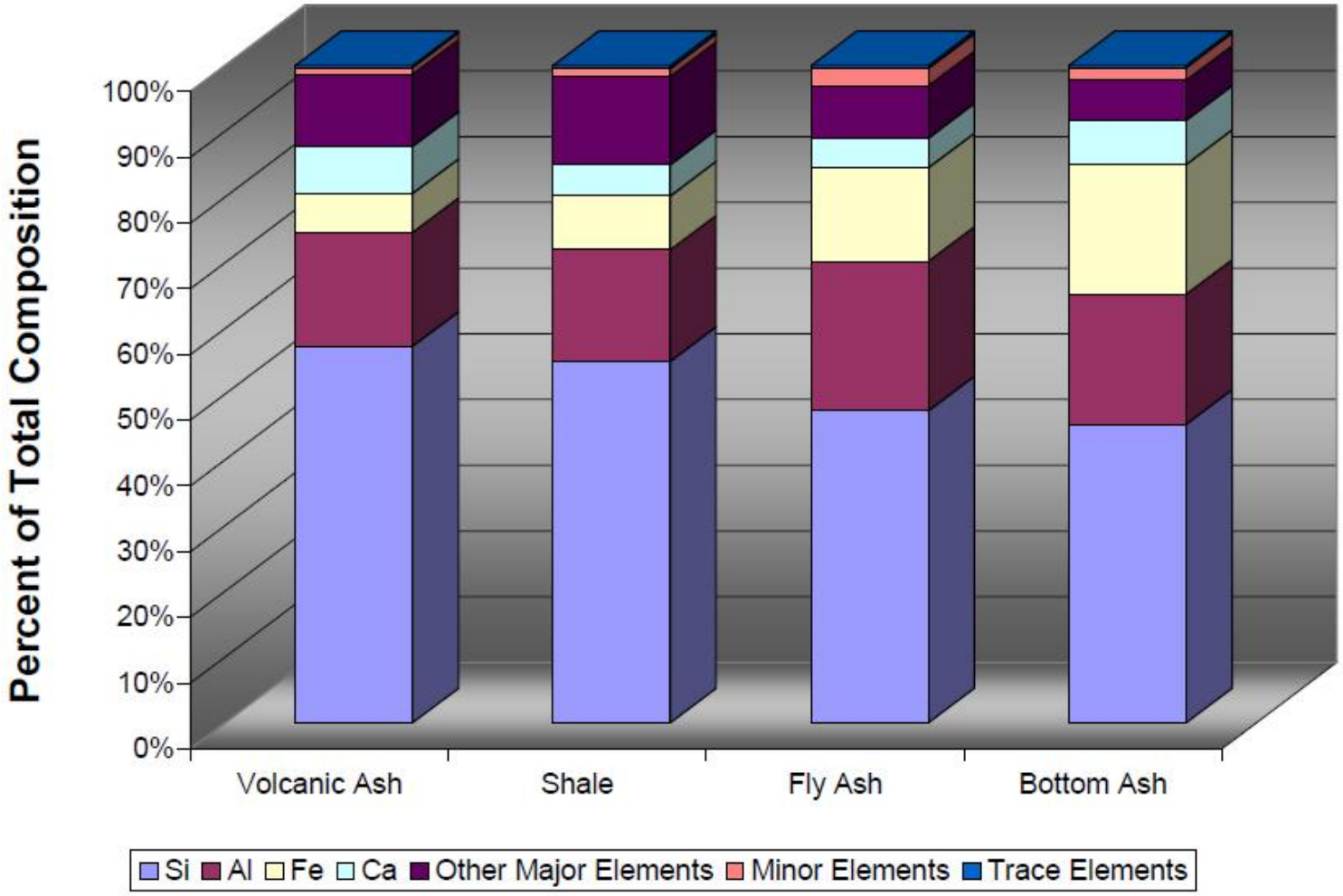
USGS. 2011b. Trace Elements and Radon in Groundwater Across the United States. U.S. Geological Survey. Scientific Investigations Report 2011-5059. Authors: Ayotte, J.D. Gronberg, J.M., and Apodaca, L.E. Available at: http://pubs.usgs.gov/sir/2011/5059/pdf/sir2011-5059_report-covers_508.pdf

USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

WHO. 2006. Cobalt and Inorganic Cobalt Compounds. Concise International Chemical Assessment Document 69. World Health Organization.

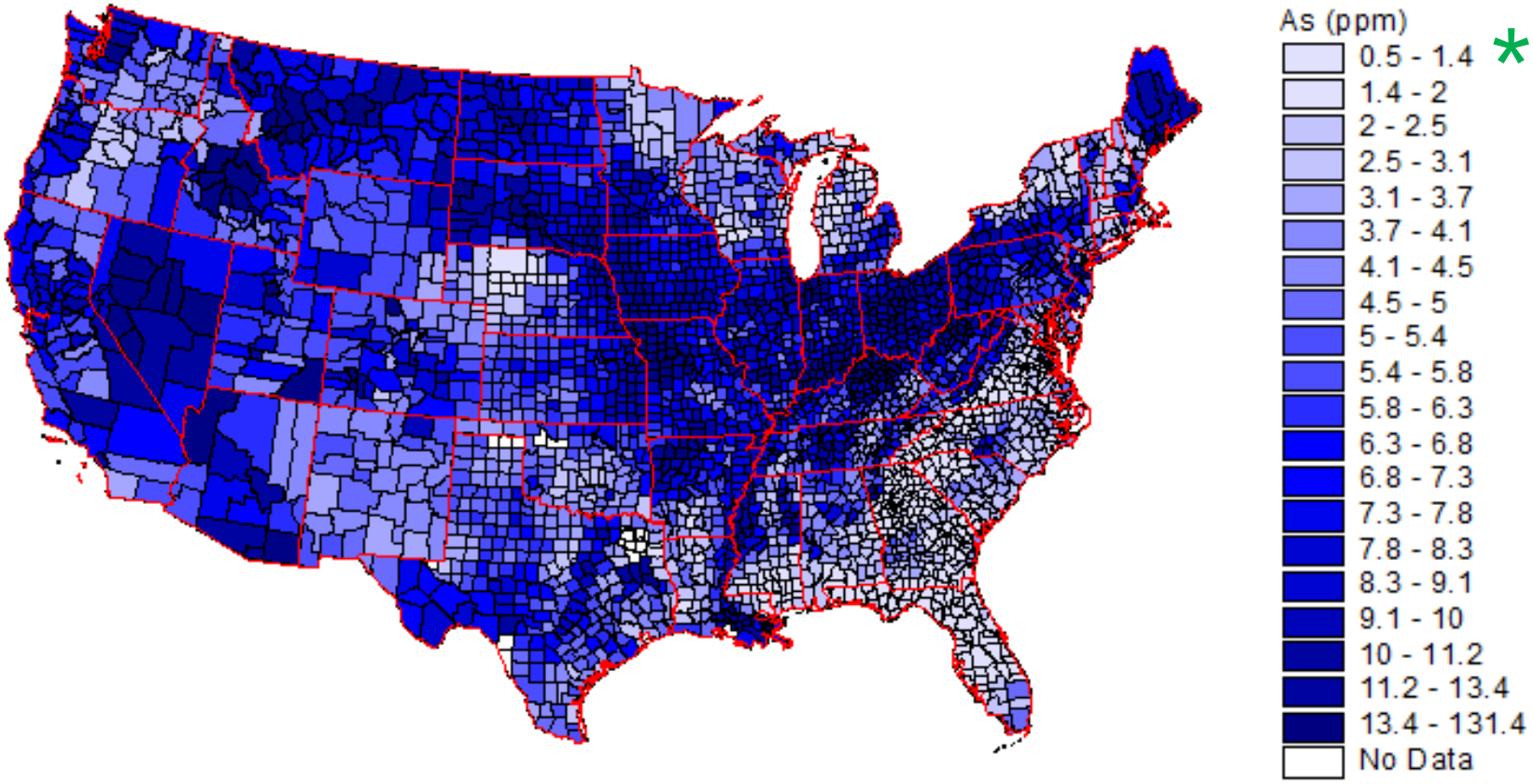
Appendix A – Figures

Figure A-1
Composition of Coal Ash and Other Natural Materials



Source: EPRI. 2010. Comparison of Coal Combustion Products to Other Common Materials – Chemical Characteristics. Report No. 1020556. Available for download at www.epri.com.

Figure A-2
Arsenic is Present in our Natural Environment –
Background Levels in Soils in the U.S.



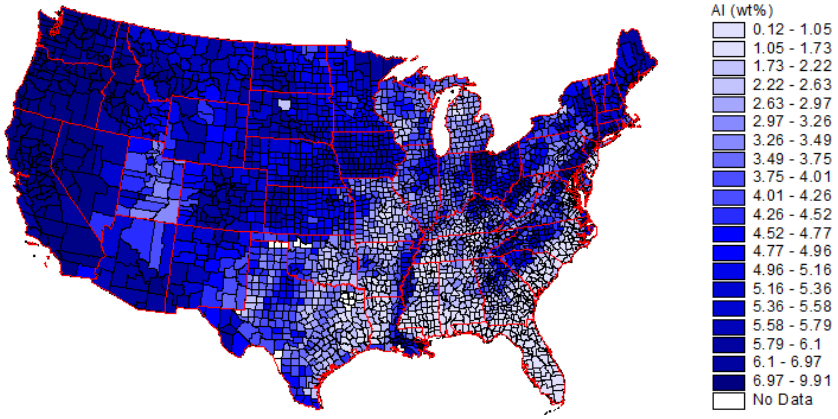
* **The USEPA regional screening level for arsenic in residential soil at a one in one million risk level is 0.67 mg/kg. USEPA. 2014c.** http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
Thus the arsenic concentration in the majority of the soils in the U.S. are above the one in one million risk level.

Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

Figure A-3

Aluminum is Present in our Natural Environment – Background Levels in Soils in the U.S.

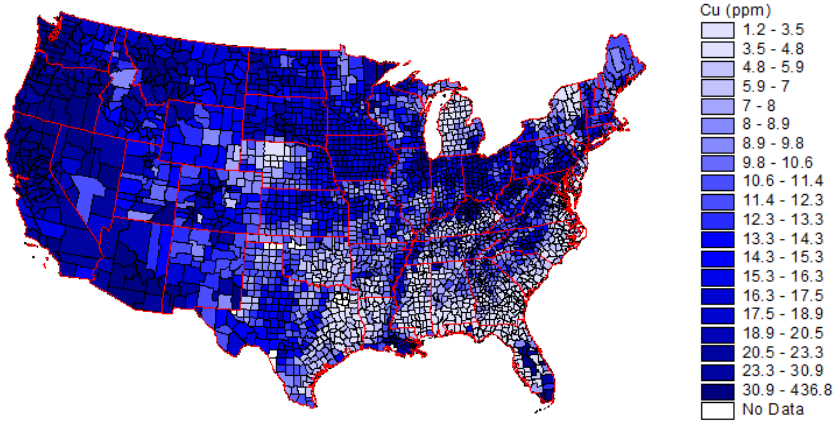
AECOM



Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

Copper is Present in our Natural Environment – Background Levels in Soils in the U.S.

AECOM

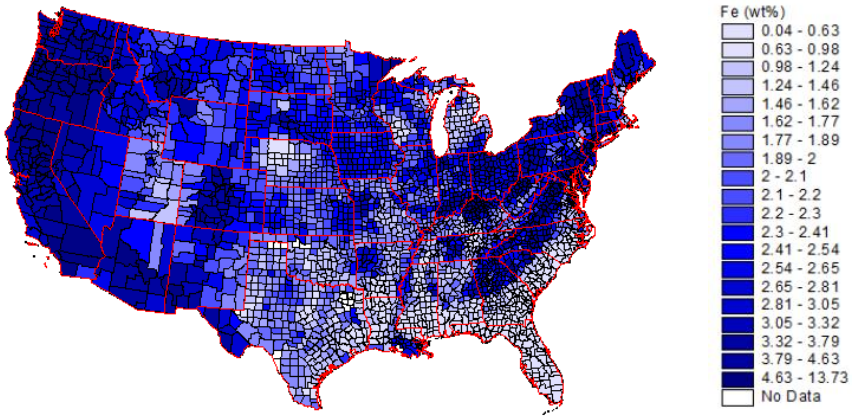


Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

Figure A-4

AECOM

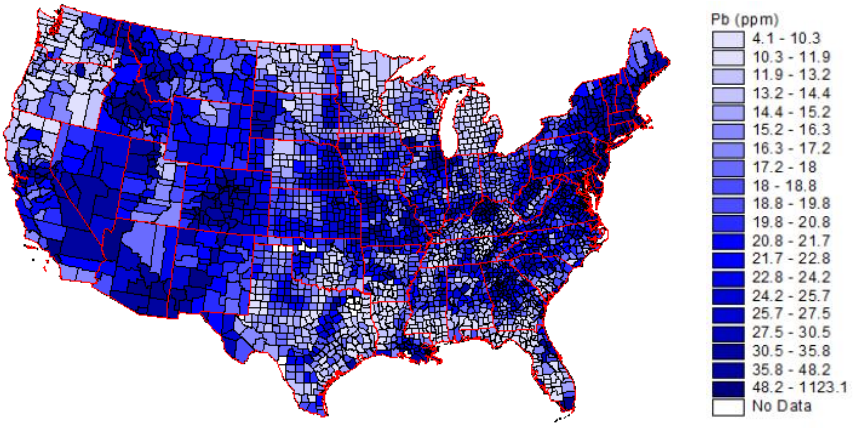
Iron is present in our natural environment –
Background levels in soils in the U.S.



Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

AECOM

Lead is present in our natural environment –
Background levels in soils in the U.S.

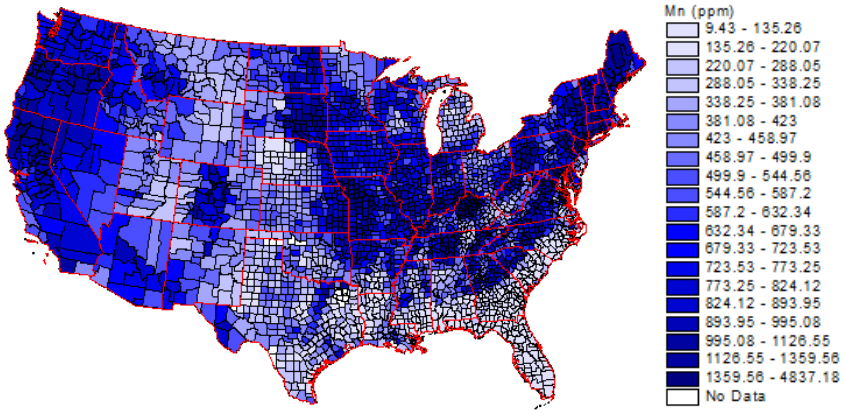


Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

Figure A-5

AECOM

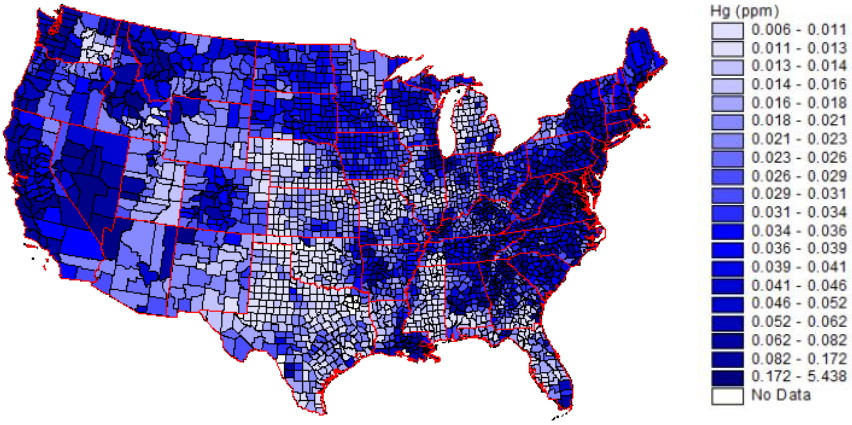
Manganese is present in our natural environment –
Background levels in soils in the U.S.



Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

AECOM

Mercury is present in our natural environment –
Background levels in soils in the U.S.

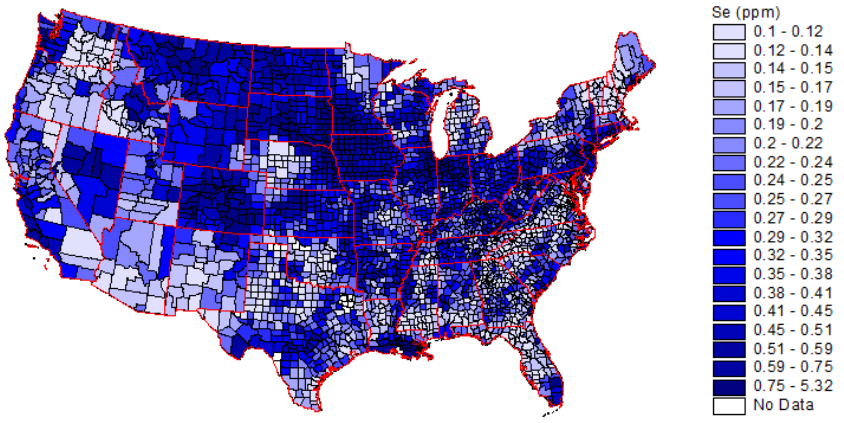


Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

Figure A-6

AECOM

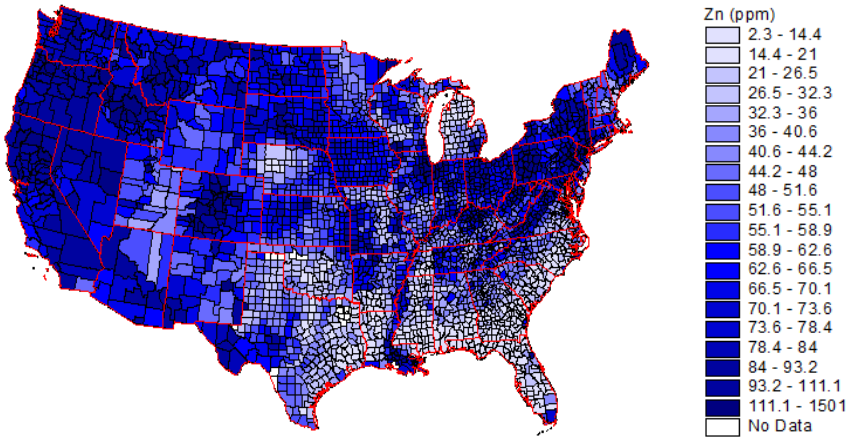
Selenium is present in our natural environment –
Background levels in soils in the U.S.



Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

AECOM

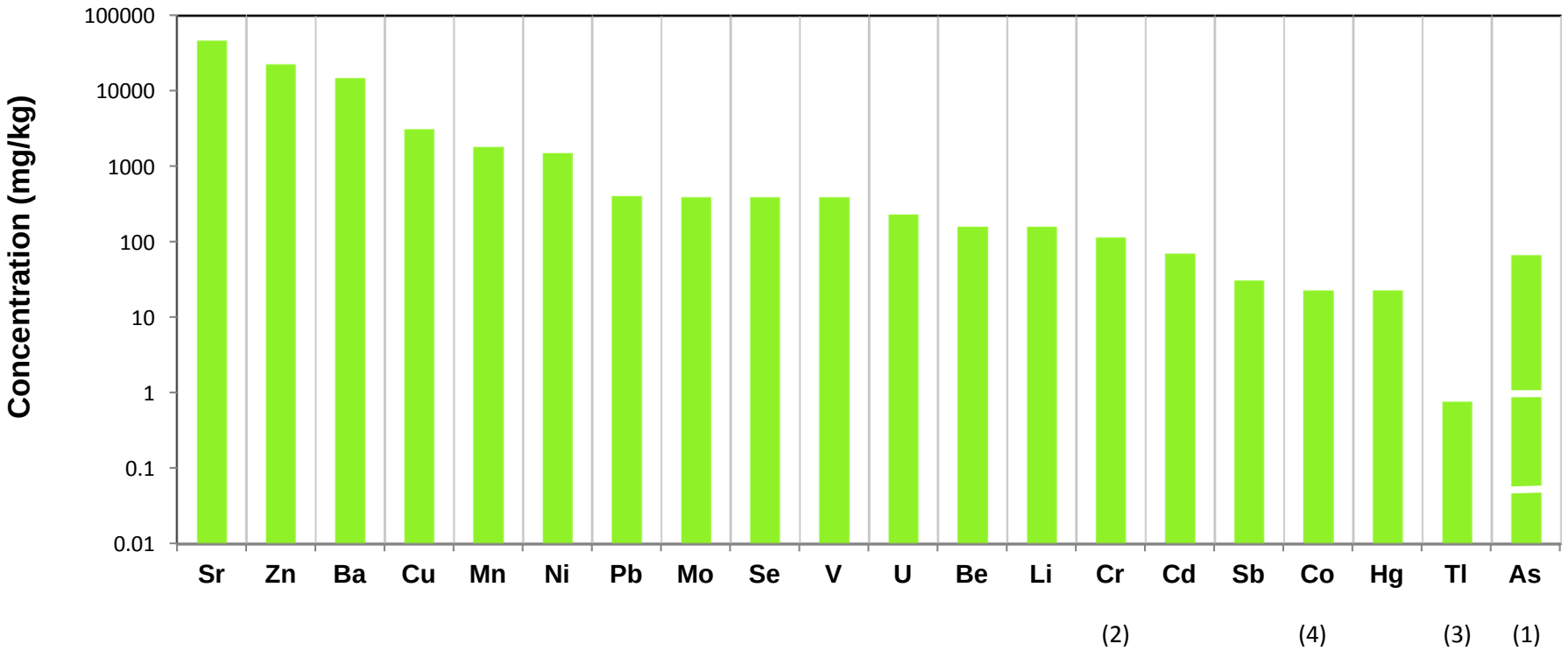
Zinc is present in our natural environment –
Background levels in soils in the U.S.



Source: USGS. 2013. National Geochemical Survey. http://mrdata.usgs.gov/geochem/doc/averages/countydata.htm

Figure A-7

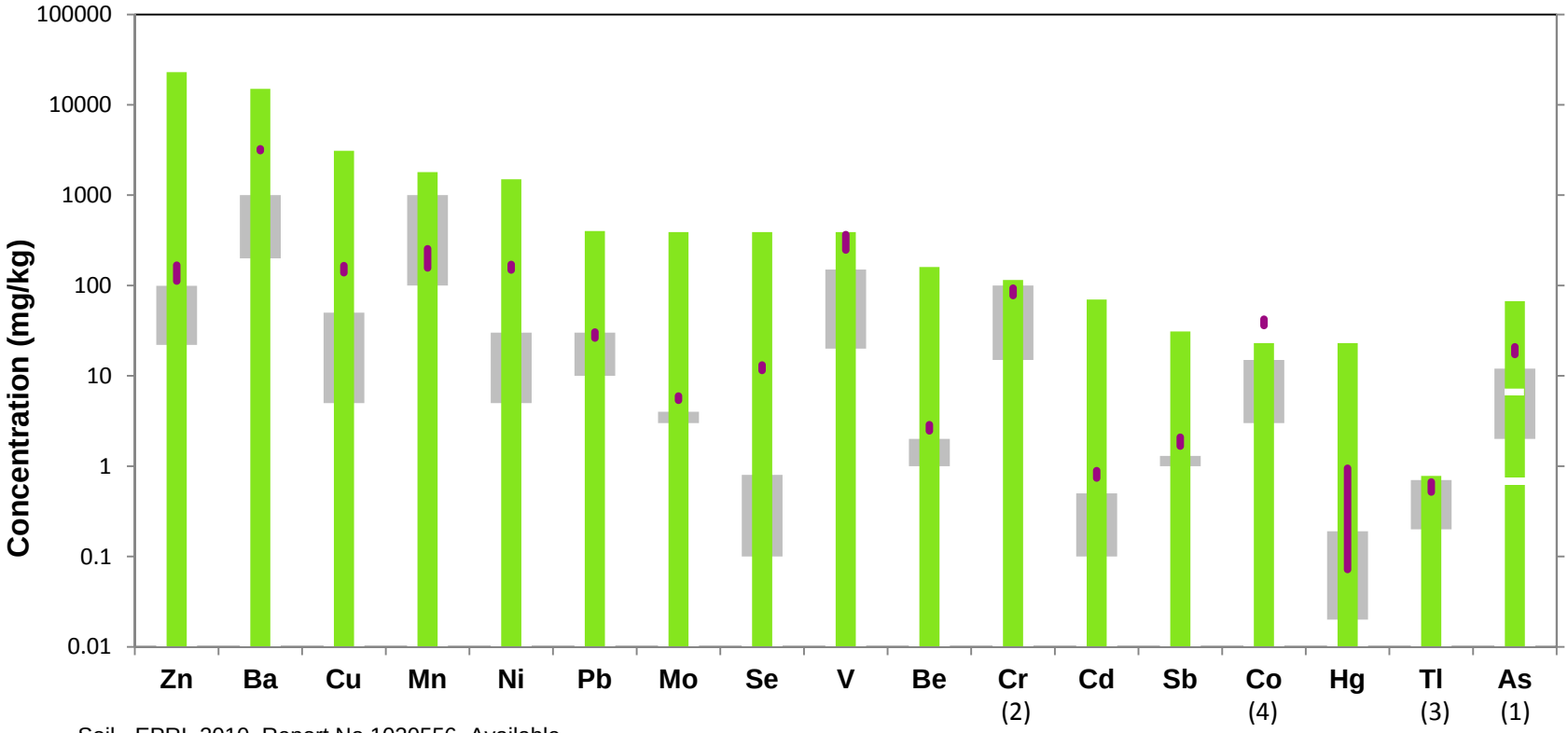
USEPA Regional Screening Levels for Residential Soils - Coal Ash Constituents



Top of bar corresponds to the USEPA Regional Screening Level (RSL) - Residential Soil (May 2014)
http://www.epa.gov/region9/superfund//prg/index.html

Notes:
(1) Arsenic RSLs for target risk level of 10^{-4} (top of green bar), 10^{-5} (middle white bar), 10^{-6} (lower white bar.
(2) The screening level shown for chromium is the value calculated using toxicity information for hexavalent chromium currently available on USEPA's IRIS database [http://www.epa.gov/iris/subst/0144.htm]. The screening level for trivalent chromium is 120,000 mg/kg.
(3) The RSL for thallium is identified by USEPA as a "provisional value" of "limited usefulness" that was developed for information purposes although USEPA states "it is inappropriate to derive a provisional subchronic or chronic [toxicity value] for thallium" [http://hhpprtv.ornl.gov/issue_papers/ThalliumandCompounds.pdf]
(4) The RSL for cobalt is based on a provisional dose-response value that is two orders of magnitude lower than values from other regulatory sources, and higher than most dietary intake estimates. Thus, a more realistic RSL could be more than an order of magnitude higher than the value shown here.

Figure A-8 **Comparison of 10th and 90th percentile USGS Database Constituent Concentrations in Fly Ash from the Wyoming Coal Power Plant and Background Levels in US Soils to the USEPA Regional Screening Levels for Residential Soils**



Soil - EPRI, 2010. Report No.1020556. Available for download at www.epri.com.

USEPA Regional Screening Level (RSL) - Residential Soil (May 2014)
http://www.epa.gov/region9/superfund//prg/index.html

Concentration Range (10th - 90th Percentile) in Wyoming Fly Ash; USGS, 2011.
http://pubs.usgs.gov/ds/635/

Notes:
(1) Arsenic RSLs for target risk level of 10^{-4} (top of green bar), 10^{-5} (middle white bar), 10^{-6} (lower white bar).
(2) The screening level shown for chromium is the value calculated using toxicity information for hexavalent chromium currently available on USEPA's IRIS database [http://www.epa.gov/iris/subst/0144.htm]. The screening level for trivalent chromium is 120,000 mg/kg.
(3) The RSL for thallium is identified by USEPA as a "provisional value" of "limited usefulness" that was developed for information purposes although USEPA states "it is inappropriate to derive a provisional subchronic or chronic [toxicity value] for thallium" [http://hhpprtv.ornl.gov/issue_papers/ThalliumandCompounds.pdf]
(4) The RSL for cobalt is based on a provisional dose-response value that is two orders of magnitude lower than values from other regulatory sources, and higher than most dietary intake estimates. Thus, a more realistic RSL could be more than an order of magnitude higher than the value shown here.

Appendix B

Evaluation of Misreported Well Locations

Appendix B

Evaluation of Well Locations Within 1-mile of the Rush Island Energy Center

Information on wells in the vicinity of the Rush Island Energy Center was obtained from the following sources:

- The University of Missouri-Columbia, Missouri Spatial Data Information Service (MSDIS, 2013),
- The MDNR Water Resources Center (MDNR, 2013b),
- The Missouri Environmental Geology Atlas 2007 (MEGA, 2007),
- The MDNR Wellhead Protection Program Data (MDNR, 2013a),
- MDNR Geosciences Technical Resource Assessment Tool (GeoSTRAT) (MDNR, 2014a), and
- Public Drinking Water System Reports, Center for Applied Research and Environmental Systems (CARES, 2013).

As with any large database of records, some errors exist in the database. While most wells appear to be located in somewhat close proximity (within ½ mile) to where they are identified as being located in the databases, some of the wells in this area do not appear to be located near to their state database coordinate location. The summaries below discuss the likely location of the wells within a 1-mile radius of the Rush Island Energy Center property boundary based on state database coordinates, field observation, review of the well certification forms from the MDNR (Missouri Department of Natural Resources) Well Information Management Systems (WIMS) database, as well as a review of the Jefferson County Assessors information and property plat maps. Wells not included in this discussion are believed to be correctly located. **Figure B-1** displays the well location as provided in state records, and the likely location of the well (if different) based on this review. **Figure 3** of the main text presents the likely locations of the wells. **Table 2** of the main text provides a list of the wells.

- Well #0307749 (**Well #1**) is a private well owned by Jerry Capps, that was installed in 2003. According to state database coordinates, this well is plotted approximately 1-mile northwest of the Rush Island Energy Center (Facility) property boundary. A review of the well certification form displays an owner address of 272 Clevemont Dr. and no address is provided in the "address of well (If different than above)" section. According to Google Earth™ and field observations of the area, there are no streets named Clevemont Dr. However, the location where the well is plotted is near a Clermont Dr. A review the Jefferson County plat map displayed that Jerry Capps owns property at 284 Clermont Dr, Festus, MO. This address is approximately 0.25 miles to the southwest of the state plotted location. Therefore, based on the proximity between the state database location and the address of the area owned by Jerry Capps, this well is believed to be near the house at 284 Clermont Dr, Festus, MO and is located within the 1-mile radius of the Facility property boundary.

- Well #0012028 (**Well #2**) is a private well owned by Dan Doenges that was installed in 1989. According to state database coordinates, this well is plotted about 1.25 miles west of the Facility property boundary to the west. A review of the well certification form displays an owner address of 924 Big Hollow Rd, and no address is listed in the "address of well (If different than above)" section. This address is also listed as being owned by Dan Doenges in the Jefferson County Assessor's records. Therefore, based on the owner's address of

well and the assessor's office information, this well is believed to be located near the house at 924 Big Hollow Rd. and is within the 1-mile radius of the Facility property boundary.

- Well #0418482 (**Well #4**) is a private well owned by David Doenges (listed as Doenoes in well certification, but is likely a spelling error), and was installed in 2012. A review of the well certification form displays an owner address of 774 Big Hollow Road, Festus, MO, and an address of well of 777 Johnson Road, Bloomsdale, MO. The state database location of this well places the well in an open field approximately 0.9 miles from the Facility boundary. This location is between two houses with addresses of 763 and 841 Johnson Road. During field reconnaissance, no address of 777 Johnson Road was identified, however, the state database location of the well is likely near where 777 Johnson Road would exist. Also, according to the Jefferson County Assessor's office, this area is owned by David & Patricia Doenges. Google Earth™ imagery displays that the location where this well is plotted is near a small building that could house a well. Therefore, this well is believed to be correctly located in the state database due to the addresses on either side of the plotted location, information from the county assessor and due to the structure that can be seen in Google Earth™.

- Well #0010685 (**Well #6**) is a private well owned by Joe Cook that was installed in 1988. According to the state database coordinates, this well is located approximately 0.5 miles west of the Facility boundary. The well certification form displays an owner address of 215 Chestnut, Crystal City, MO with no address listed in the "Address of well (If different than above)" section. Based on information from the Jefferson County Assessor, an area approximately 0.25 miles east of the state database location is owned by a James J. & Denise L. Cook. This property address is 653 Johnson Road, Festus, MO. Therefore, based on the county assessor's information and the well certification form, this well is believed to be located near the house at 653 Johnson Road, Festus, MO.

- Well #0179087 (**Well #7**) is a private well owned by Richard Tindall and was installed in 1998. According to state database coordinates, this well is located approximately 0.35 miles west of the Facility in a heavily wooded area. The well certification form displays an owner address of 641 Johnson Road, Festus, MO. This address is also listed as being owned by Richard & Jean Tindall according to the Jefferson County Assessor's office. Therefore, based on the owner address and the county assessor this well is believed to be located approximately 0.4 miles south of its state database location near the house at 641 Johnson Road.

- Well #0210636 (**Well #8**) is listed as being a private irrigation well owned by Bob Berthold. According to state database records, this well plots approximately 0.4 miles west of the Facility in a heavily wooded area within the bluffs at a surface elevation of approximately 610ft above mean sea level (AMSL). The well certification form displays an owner address of 16 Sunnen Drive Suite 165, St. Louis, MO. According to the MDNR WIMS website, the business address for this well is listed as the Rush Island Conservation Area. Additionally, the well is listed as having a surface elevation of 390 ft AMSL and a total depth of 90 ft, all of which is in unconsolidated silts, sands, and gravels. These characteristics are much more consistent with wells that are drilled into the Mississippi River Valley and not those in the bluffs to the west. The legal address for the well is the southwest ¼ of the southwest ¼ of the northwest ¼ of section 5, township 39 north, range 7 east (SW ¼ SW ¼ NW ¼ S5 T39N R7E). Field reconnaissance studies located a well in the northern part of the Facility property, in the conservation area that lies in the area described by the legal address. The well found is believed to be this irrigation well. Therefore, based on the legal address,

business owners name, well characteristics and field observation this well is believed to be located within the northern part of the Facility property. Golder believes this well was installed for Ameren for irrigation purposes but is no longer being used.

- Wells #0263792 and #0263795 (**Wells #9 and #10**) are reported as being non-community public wells, owned by Ameren, and were installed in 2009. According to state database coordinates, these wells are located within the bedrock bluffs along the far western margin of the Rush Island Energy Center property at an elevation of approximately 500 ft AMSL. Both of these wells have been reconstructed and the reconstruction forms associated with them (MO reference #0020350 and #20351) have state database coordinates that plot near the Rush Island Energy Center plant. The certification forms for these wells display that bedrock is not encountered until 164 ft bgs, with a surface elevation of 410 feet AMSL. These characteristics are consistent with wells that are drilled in the Mississippi River Valley. Therefore, based on the well characteristics, the geology, and the location in the reconstruction forms, these wells are believed to be located at the Rush Island Energy Center plant where the reconstruction wells are plotted.

- Wells #0017312 and #0006418 (**Wells #3 and #5**) were installed prior to 1987. Wells drilled prior to 1987 are not available in the MDNR WIMS database. Additionally, no address is provided for either of these wells. The location of these wells is based on quarter-quarter sections that are available on the well logs (MDNR, 2013b). Also, when comparing locations to aerial photos, these wells look to be near houses that do not have other wells in state databases. Therefore, based on the provided locations of these wells and the use of aerial photographs, the wells are believed to be plotted correctly according to state database coordinates.

- Well #0007728 is a private well owned by Bill Hempel that was installed in 1987. According to state database coordinates it is located approximately 0.6 miles south of the Facility boundary near the Holcim (US) INC Facility (Holcim). The owner address of this well is 426 N. Fifth, Festus, Mo with no address listed in the “address of well (if different than above) section.” According to the Jefferson County Assessor, the area where the well is located according to the state databases is owned by Holcim. Additionally, no results for Bill Hempel appear in the Jefferson County Assessor’s online records. This well is listed as being installed at an elevation of 400 ft AMSL and encounters white sandstone at 5ft bgs. Well #0390620 (**Well #15**) is located 0.3 miles south of this well on Holcim property at an elevation of 405 ft AMSL. In well #0390620 (**Well #15**) the St. Peter Sandstone (white sandstone) is not encountered until 391 ft bgs. Therefore, based on the land ownership and the geology of the location, this well is believed to be incorrectly located. At this time, a likely location for this well is unknown, but not believed to be within 1-mile of the Facility boundary.

- Well #4182616101 is a public industrial and large business well that is owned by Holcim, and was installed in 2007. According to the MEGA database, this well is plotted within the 1-mile radius of the Facility boundary and lies on the eastern edge of the bluffs. The CARES 2013 database displays a location of the well which is very similar to that of well #0361434 (**Well # 14**). The MEGA public drinking water database lists this well as pending whereas the CARES database lists it as active. It is likely that the location of this well is identical to Well #14 and that it was plotted incorrectly prior to being installed and is therefore incorrectly plotted in the MEGA database. In addition, this well (#4182616101) and #0361434 (**Well #14)** have nearly identical constructions and are likely the same well. Both have identical casing lengths, date (year) drilled, locations according to the state database, pump depth, pump rate, casing material, pumping rates, and elevations. The only difference between the

well certification form for #0361434 (**Well #14)** and the CARES record for #4182616101 is the total depth is 2 feet shorter at 423 ft bgs instead of 425 ft bgs in the MDNR well certification forms. Therefore, based on the well characteristics and the location in the CARES database, well #4182616101 is believed to be the same well as #0361434 (**Well #14)**.

- Well #0052006 is listed as being a private well, owned by Stella M England Estate's and was installed in 1988. According to state database locations this well is listed as being located 0.6 miles north of the Facility property. The owner address of this well is 3700 Rouggly-Kiepe Road, Festus, MO and no address is listed in the "Address of well (If different than above)" section. The Jefferson County Assessor's office does not have any properties in the name of Stella England. Therefore, according to the owner address, this well is likely located near the house at 3700 Rouggly-Kiepe Road which is outside of the 1-mile radius of the Facility property boundary.

- Well #0179059 is listed as being a private well, owned by Jeff Beckemeyer, and was installed in 1997. According to state database coordinates, this well is located approximately 0.75 mile west of the Facility boundary in a heavily wooded area not near any houses. The location of this well and well #0186309 are identical according to state database coordinates. The owner address of the well is 737 Jeremy, Festus, MO and no address is provided in the "address of well (if different than above)" section. This address is located approximately 0.32 miles to the southwest of the state database location for the well. When searching Jeff Beckemeyer in the Jefferson County Assessors information, the only property owned is near De Soto Missouri. Therefore, based on the owner address of the well, this well is believed to be located near the house at the 737 Jeremy address and not in the woods. This address, lies outside of the 1-mile radius of the Facility property boundary.

- Well #0186309 is a private well, owned by David Rose, and was installed in 1997. According to state database coordinates, this well plots in an identical location to well #0179059, which is approximately 0.75 mile west of the Facility boundary in a heavily wooded area not near any houses. The owner address of this well is 870 Johnson Rd, Bloomsdale MO and no address is provided in the "address of well (if different than above)" section. The Jefferson County Assessor's office displays this address as the "Rose Acres" on the plat map and the area is owned by David P. and Yvonne M. Rose. Therefore, based on the owner address of this well and the county assessor's information, this well is believed to be located near the house at 870 Johnson Road. This address lies outside of the 1-mile radius of the Facility property boundary.

- Well #0173730 is a private well, owned by Brent Kemp, and was installed in 1998. According to state database coordinates, this well is located within the Facility property boundary along the far western margin. The owner address of this well is 1755 Harness Road, Festus, MO and no address is listed in the "address of well (if different than above)" section. The legal address provided in the well certification form is Section 5, Township 39 North, Range 7 East. 1755 Harness Road is located approximately 5 miles west of the location plotted in the state database records. According to the Jefferson County Assessor's office, this address (1755 Harness Road) is owned by Brent & Sandra Kemp and is located in Section 5, Township 39 North, Range 6 East. Therefore, this well is believed to be plotted incorrectly due to an error in the legal address, and is believed to be located near the house at 1755 Harness Road which is outside of the 1-mile radius of the plant Facility.

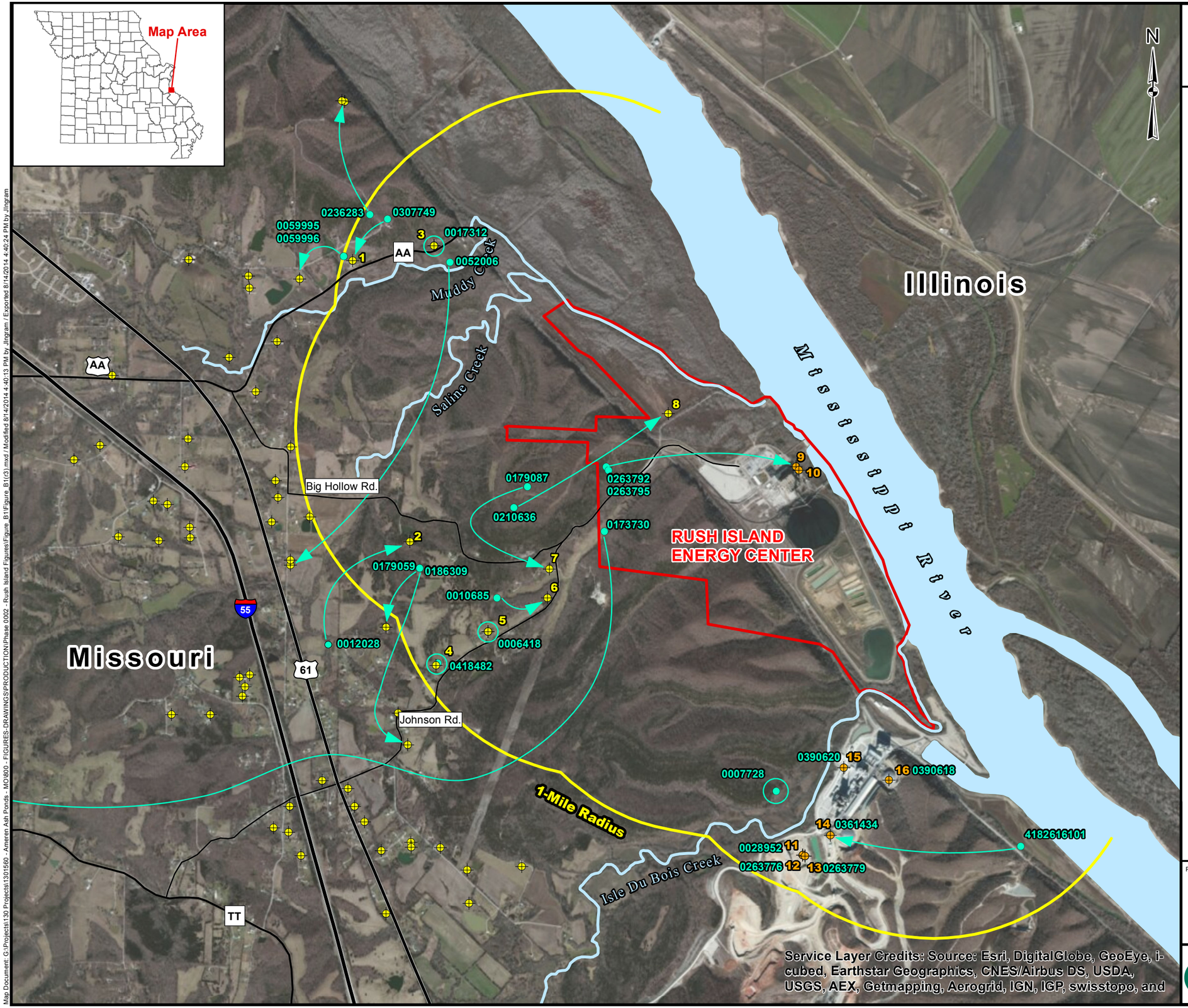
- Wells #0059995 and #0059996 are private wells, owned by Gary Surdyke, and were installed in 1991. According to state database records these wells are plotted approximately 1 mile northwest of the Facility property boundary in an identical location. The well certification forms display an Owner address of 1305 Highway 61, Crystal City, MO and no address is provided in the "address of well (If different than above)" section. However, a review of Jefferson county plat map indicates that the property approximately 1300 ft to the east of where these wells are plotted is owned by Gary & Linda Surdyke. Therefore, based on the county assessor's office information and the owner's name, these wells are believed to be located on the Surdyke's property, east of the state database location. This location lies outside of the 1-mile radius of the Facility property boundary.

- Well #0236283 is listed as being private pump installation in 2000 on a well owned by Shelia Reese. According to state database records, this well is located approximately one mile north of the Facility property boundary. A review of the well certification form indicates that this pump installation was for another well (MO Reference #0226300). The well installation log (#0226300) plots to the north of the 1-mile radius of the Facility boundary and about 1800 feet to the northeast of the corresponding pump installation (#0236283). Both of these forms have an owner address of 201 Clermont Dr, Festus, MO, however, both display slightly different addresses in the address of well section. The well installation (#0226300) has an address of well of Lot 12 Clevemont, and the pump installation (#0236283) has an address of well of Estates of Clairmont. The owner's address also matches the Jefferson County Assessor's information with 201 Clermont Dr. being owned by Jeffrey and Sheila Reese. When plotted based on the address of owner, the well and pump installation plot north of the Facility, approximately 3500 feet north of where these wells plot according to the state database records. Therefore, based on owner address and county assessor's information, this well and pump installation is believed to be located near the home at the owners address of 201 Clermont Dr., which lies outside of the 1-mile radius of the Facility property boundary.

- Wells #0263776, #0263779, #0361434, #0390620, and #0390618 (**Wells #12, #13, #14, #15, and #16**) are all owned by Holcim US INC. According to state database locations, these wells all lie south of the Facility in an area less that 1-mile from the Facility property boundary. All of these wells have an owner address of 2942 US highway 61, Bloomsdale, MO and no address is listed in the "address of well (If different than above)" section. The owner address is the correct address for that Holcim Facility. Therefore, based on owner well address, these wells are believed to be plotted correctly in the state databases and all lie within the 1-mile radius of the Facility property boundary.

- Well #0028952 (**Well #11**), is not listed in the MDNR WIMS database (MDNR, 2013a). Well #11 is listed in MDNR's Water resource center geologic well logs of Missouri (MDNR, 2013b). This well is listed as being a Non-community public well that was drilled in April, 2004. No well log is available for this well, however, the owner is listed as being "Holcim (US) Inc. Lee Island Project," and the legal address is 39N, 7E, Section 9. This matches the location where the well is plotted. Therefore, based on owner name and the legal address of the well, this well is believed to be plotted correctly in the state database and lies within the 1-mile radius of the Facility property boundary.

Appendix B – Figure



TITLE

WELL LOCATIONS BASED ON AVAILABLE INFORMATION

August 2014

LEGEND

- Rush Island Property Boundary
- Approximate 1-Mile Radius
- Non-Community Public Well
- Private Well
- Original State Database Well Locations
- Arrow points from the original state database location to the interpreted well location based on information provided in Appendix B.

NOTES

1.) All locations and boundaries are approximate.
2.) Figure displays all non-community public and private wells located near the Rush Island Energy Center property boundary in Jefferson and Ste. Genevieve Counties, Missouri, based on state well records.
3.) See Appendix B for information on relocation of the wells.
4.) Wells displayed outside of the 1-mile radius are plotted based on the address of the well from the MDNR well certification forms.
5.) MDNR - Missouri Department of Natural Resources.
6.) MSDIS - Missouri Spatial Data Information Service.
7.) GeoSTRAT - Geosciences Technical Resources Assessment Tool.
8.) More information on the wells is provided in Appendix B.

REFERENCES

1.) Ameren, 2012. Ameren Missouri Rush Island Energy Center, Rush Island Property Control Map, January 2012.
2.) CARES. 2013. Public Drinking Water System Reports. Center for Applied Research and Environmental Systems.
3.) MDNR. 2013a. Missouri Well Information Management System (WIMS), Wellhead Protection Program. Missouri Department of Natural Resources.
4.) MDNR. 2013b. Geologic Well Logs of Missouri, Water Resource Center. Missouri Department of Natural Resources.
5.) MDNR, 2014a. Geosciences Technical Resource Assessment Tool (GeoSTRAT). Missouri Department of Natural Resources.
6.) MEGA. 2007. Missouri Environmental Geology Atlas. A Collection of Statewide Geographic Information System Data.
7.) MSDIS. 2013. Missouri Spatial Data Information Service.
8.) SEMOGIS. 2013. South East Missouri GIS, Jefferson County Plat Maps.
9.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 3,000 6,000 Feet

PROJECT

Ameren

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
JEFFERSON COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Figure_B1(r3).mxd	
DESIGN	-	-	SCALE: AS SHOWN	REV. 3
GIS	JSI	6/6/2014	FIGURE B-1	
CHECK	MNH	6/15/2014		
REVIEW	MNH	6/15/2014		

Map Document: G:\Projects\130 Projects\1301560 - Ameren Ash Ponds - MO800 - FIGURES-DRAWINGS\PRODUCTION\Phase 0002 - Rush Island Figures\Figure_B1\Figure_B1(r3).mxd / Modified 8/14/2014 4:40:13 PM by Jingram / Exported 8/14/2014 4:40:24 PM by Jingram

Attachment B-1

Copies of Missouri DNR Well Records

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
DOMESTIC/MULTIFAMILY WELL RECORD AND PUMP INFORMATION DATA

OFFICE USE ONLY

REF NO	DATE RECEIVED
00307749	06/09/2003
CR NO	CHECK NO. 4322

ROUTE	APPROVED	DATE	ENTERED	STATE CERT NO	REVENUE NO.
PCD	NRFRYS	06/18/2003	NRFRYS	A114860	060903

OWNER NAME	TELEPHONE WITH AREA CODE	VARIANCE NUMBER	CASING DEPTH LETTER
JERRY CAPPS	636-931-9161		[ ] YES [ ] NO

OWNER ADDRESS	CITY	STATE	ZIP
272 CLEVEMONT DR	FESTUS	MO	63028

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
		MO	

USE OF WELL
[X] DOMESTIC
[ ] MULTI-FAMILY

OWNERS SIGNATURE (Water Use Information Verified by Owner Signature)

DATE

CASING DETAILS	CASING LENGTH	O.D. OF CASING	WEIGHT (LB) SDR#, SCH#	DIAMETER OF DRILL HOLE	CASING MATERIAL	POSITION OF GROUT SEAL	SURFACE CASING (IF USED)
	80.0 FT.	6.5 IN.		8.75 IN.	[ ] STEEL [X] PLASTIC [ ] CONCRETE	[X] BOTTOM [ ] TOP [ ] FULL LENGTH	LENGTH FT. OUTSIDE DIAMETER IN.

SCREEN (UNCONSOLIDATED MATERIAL WELLS)	SCREEN LENGTH	SCREEN TYPE/SLOT SIZE
	FT.	

CASING GROUT MATERIAL	GROUT TYPE (CHOOSE ONE)	NO. OF BAGS OR	METHOD OF GROUT INSTALLATION (CHOOSE ONLY ONE)	DRIVE SHOE	DRILLING
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [ ] CHIPS [X] GRANULAR [ ] PELLETS [ ] SLURRY	CUBIC YARDS 4.0 LBS PER BAG	[X] GRAVITY [ ] TREMIE [ ] AS DRIVEN [ ] PRESSURE THROUGH CASING [ ] PRESSURE THROUGH TREMIE [ ] OPEN HOLE [ ] POS. DISPLACEMENT	USED? [ ] YES [ ] NO	SUSPENDED? [ ] YES [X] NO HRS

LINER DETAILS	LENGTH	DEPTH TO TOP OF LINER	O.D. OF LINER	LINER MATERIAL	WEIGHT (LB)SDR#, SCH#	POSITION OF SEAL	PERFORATED INTERVAL
	370.0 FT.	FT.	4.0 IN.	[ ] STEEL [ ] PLASTIC		[ ] FULL LENGTH [ ] BOTTOM	FROM TO

LINER GROUT MATERIAL	GROUT TYPE	NO. OF BAGS OR USED	METHOD OF GROUT INSTALLATION	LINER USE	ABANDONED WELL
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [ ] SLURRY [ ] GRANULAR [ ] CHIPS [ ] PELLETS	PER BAG 100	[ ] GRAVITY [ ] TREMIE [ ] AS LINER INSTALLED	[ ] HOLD BACK FORMATION [ ] PREVENT RUST [ ] SEAL OUT UNDESIRABLE CONDITIONS	ON SITE? [ ] YES WAS THE WELL PLUGGED? [ ] YES [ ] NO

DEPTH PACKERS SET
FT.

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	13.0	DIRT/CLY
13.0	18.0	CLY/RX
18.0	119.0	LS
119.0	312.0	ALT LS/SHALE
312.0	313.0	FRACTURE
313.0	380.0	SS
380.0	0.0	SEE ORIGINAL RECORD

DEPTH TO BEDROCK FT.

TOTAL DEPTH 380.0 FT.

LOCATION OF WELL OR PUMP

LAT. 38 ° 8' 58.9"

LONG. 90 ° 17' 54.3"

DRILL AREA A1

ELEVATION

LEGAL LOCATION

SECTION LG003017 TOWNSHIP N RANGE

COUNTY

JEFFERSON

WELL COMPLETION DATE	PUMP INFORMATION REQUIRED (IF INSTALLED)
04/25/2003	
WELL YEILD 25.0 GPM	PUMP INSTALLATION DATE
STATIC WATER LEVEL FT.	DEPTH PUMP SET 320.0 FT.
DEPTH TO FIRST GROUND WATER FT.	PUMP RATE 10.0 GPM

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

	PERMIT#	DATE
PRIMARY CONTRACTOR SIGNATURE RICKY COLEMAN	001057	
WELL DRILLER SIGNATURE RICKY COLEMAN	001057	
PUMP INSTALLER SIGNATURE RICKY COLEMAN	001057	
APPRENTICE DRILLER SIGNATURE		
APPRENTICE PUMP SIGNATURE		

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
DOMESTIC/MULTIFAMILY WELL RECORD AND PUMP INFORMATION DATA

OFFICE USE ONLY

REF NO	DATE RECEIVED
00012028	04/10/1989
CR NO	CHECK NO.
	12758

ROUTE	APPROVED	DATE	ENTERED	STATE CERT NO	REVENUE NO.
	IMPORT		CONVERT	A009278	456181

OWNER NAME	TELEPHONE WITH AREA CODE	VARIANCE NUMBER	CASING DEPTH LETTER
DAN DOENGES			☐ YES ☐ NO

OWNER ADDRESS	CITY	STATE	ZIP
924 BIG HOLLOW RD	FESTUS	MO	63028

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
		MO	

USE OF WELL
☒ DOMESTIC
☐ MULTI-FAMILY

OWNERS SIGNATURE (Water Use Information Verified by Owner Signature)

DATE

CASING DETAILS	CASING LENGTH	O.D. OF CASING	WEIGHT (LB) SDR#, SCH#	DIAMETER OF DRILL HOLE	CASING MATERIAL	POSITION OF GROUT SEAL	SURFACE CASING (IF USED)
	82.0_FT.	6.0__IN.		0.0__IN.	☐ STEEL ☒ PLASTIC ☐ CONCRETE	☐ BOTTOM ☐ TOP ☐ FULL LENGTH	LENGTH FT. OUTSIDE DIAMETER IN.

SCREEN (UNCONSOLIDATED MATERIAL WELLS)	SCREEN LENGTH	SCREEN TYPE/SLOT SIZE
	FT.	

CASING GROUT MATERIAL	GROUT TYPE (CHOOSE ONE)	NO. OF BAGS OR	METHOD OF GROUT INSTALLATION (CHOOSE ONLY ONE)	DRIVE SHOE	DRILLING
	CEMENT ☐ TYPE 1 ☐ HI EARLY **BENTONITE** ☐ CHIPS ☐ GRANULAR ☐ PELLETS ☐ SLURRY	CUBIC YARDS 0.0_____ LBS PER BAG _____	☐ GRAVITY ☐ TREMIE ☐ OPEN HOLE ☐ POS. DISPLACEMENT ☐ AS DRIVEN ☐ PRESSURE THROUGH CASING ☐ PRESSURE THROUGH TREMIE	USED? ☐ YES ☐ NO	SUSPENDED? ☐ YES ☒ NO _____HRS

LINER DETAILS	LENGTH	DEPTH TO TOP OF LINER	O.D. OF LINER	LINER MATERIAL	WEIGHT (LB)SDR#, SCH#	POSITION OF SEAL	PERFORATED INTERVAL
	FT.	FT.	IN.	☐ STEEL ☐ PLASTIC		☐ FULL LENGTH ☐ BOTTOM	FROM TO

LINER GROUT MATERIAL	GROUT TYPE	NO. OF BAGS OR USED PER BAG	METHOD OF GROUT INSTALLATION	LINER USE	ABANDONED WELL
	CEMENT ☐ TYPE 1 ☐ HI EARLY **BENTONITE** ☐ SLURRY ☐ GRANULAR ☐ CHIPS ☐ PELLETS	_____	☐ GRAVITY ☐ TREMIE ☐ AS LINER INSTALLED	☐ HOLD BACK FORMATION ☐ PREVENT RUST ☐ SEAL OUT UNDESIRABLE CONDITIONS	ON SITE? ☐ YES WAS THE WELL PLUGGED? ☐ YES ☐ NO

DEPTH PACKERS SET
FT.

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	11.0	CLY&SDYCLY0-8,SS
11.0	68.0	LS
68.0	143.0	SS
143.0	148.0	SDYLS 169&230 8&45GPM
148.0	230.0	SS,LS161-200

DEPTH TO BEDROCK FT.

TOTAL DEPTH 230.0 FT.

LOCATION OF WELL OR PUMP

LAT. 38 ° 7' 15.2" **DRILL AREA** A1_____

LONG. 90 ° 18' 13.8" **ELEVATION** 450

LEGAL LOCATION

SECTION 6 TOWNSHIP 39N RANGE 7 E

COUNTY

JEFFERSON

WELL COMPLETION DATE	PUMP INFORMATION REQUIRED (IF INSTALLED)
02/24/1989	
WELL YEILD	PUMP INSTALLATION DATE
45.0 GPM	
STATIC WATER LEVEL	DEPTH PUMP SET
FT.	180.0 FT.
DEPTH TO FIRST GROUND WATER	PUMP RATE
FT.	10.0 GPM

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

	PERMIT#	DATE
PRIMARY CONTRACTOR SIGNATURE EARL W BUECHTING	001595	
WELL DRILLER SIGNATURE EARL W BUECHTING	001595	
PUMP INSTALLER SIGNATURE EARL W BUECHTING	001595	
APPRENTICE DRILLER SIGNATURE		
APPRENTICE PUMP SIGNATURE		

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
DOMESTIC/MULTIFAMILY WELL RECORD AND PUMP INFORMATION DATA

OFFICE USE ONLY

REF NO	DATE RECEIVED
00418482	10/29/2012
CR NO	CHECK NO.
	7865

ROUTE	APPROVED	DATE	ENTERED	STATE CERT NO	REVENUE NO.
PCD1	NRSMITK4	11/01/2012	NRSMITK4	A187001	102912

OWNER NAME	TELEPHONE WITH AREA CODE	VARIANCE NUMBER	CASING DEPTH LETTER
DAVID DOENOES			[ ] YES [ ] NO

OWNER ADDRESS	CITY	STATE	ZIP
774 BIG HOLLOW ROAD	FESTUS	MO	63028

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
777 JOHNSON ROAD	BLOOMSDALE	MO	

USE OF WELL
[X] DOMESTIC
[ ] MULTI-FAMILY

OWNERS SIGNATURE (Water Use Information Verified by Owner Signature)

DATE

CASING DETAILS	CASING LENGTH	O.D. OF CASING	WEIGHT (LB) SDR#, SCH#	DIAMETER OF DRILL HOLE	CASING MATERIAL	POSITION OF GROUT SEAL	SURFACE CASING (IF USED)
	80.0 FT.	6.5 IN.		9.0 IN.	[ ] STEEL [X] PLASTIC [ ] CONCRETE	[X] BOTTOM [ ] TOP [ ] FULL LENGTH	LENGTH FT. OUTSIDE DIAMETER IN.

SCREEN (UNCONSOLIDATED MATERIAL WELLS)	SCREEN LENGTH	SCREEN TYPE/SLOT SIZE
	FT.	

CASING GROUT MATERIAL	GROUT TYPE (CHOOSE ONE)	NO. OF BAGS OR CUBIC YARDS	METHOD OF GROUT INSTALLATION (CHOOSE ONLY ONE)	DRIVE SHOE USED?	DRILLING SUSPENDED?
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [X] CHIPS [ ] PELLETS [ ] GRANULAR [ ] SLURRY	7.0 LBS PER BAG 50	[X] GRAVITY [ ] TREMIE [ ] OPEN HOLE [ ] POS. DISPLACEMENT [ ] AS DRIVEN [ ] PRESSURE THROUGH CASING [ ] PRESSURE THROUGH TREMIE	[ ] YES [ ] NO	[ ] YES [X] NO ____HRS

LINER DETAILS	LENGTH	DEPTH TO TOP OF LINER	O.D. OF LINER	LINER MATERIAL	WEIGHT (LB)SDR#, SCH#	POSITION OF SEAL	PERFORATED INTERVAL
	300.0 FT.	FT.	4.5 IN.	[ ] STEEL [X] PLASTIC		[ ] FULL LENGTH [ ] BOTTOM	FROM TO

LINER GROUT MATERIAL	GROUT TYPE	NO. OF BAGS OR USED	METHOD OF GROUT INSTALLATION	LINER USE	ABANDONED WELL
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [ ] SLURRY [ ] GRANULAR [ ] CHIPS [ ] PELLETS	PER BAG	[ ] GRAVITY [ ] TREMIE [ ] AS LINER INSTALLED	[X] HOLD BACK FORMATION [ ] PREVENT RUST [ ] SEAL OUT UNDESIRABLE CONDITIONS	ON SITE? [ ] YES WAS THE WELL PLUGGED? [ ] YES [ ] NO
	DEPTH PACKERS SET FT.				

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	8.0	CLY
8.0	109.0	LS
109.0	181.0	SS
181.0	183.0	FRAC LM CLY
183.0	259.0	LS
259.0	298.0	SS
298.0	310.0	LS

DEPTH TO BEDROCK 8.0 FT.

TOTAL DEPTH 310.0 FT.

LOCATION OF WELL OR PUMP

LAT. 38 ° 7' 8.2"

LONG. 90 ° 17' 38.8"

DRILL AREA A1

ELEVATION

LEGAL LOCATION

SECTION 6 TOWNSHIP 39N RANGE 7 E

COUNTY

JEFFERSON

WELL COMPLETION DATE	PUMP INFORMATION REQUIRED (IF INSTALLED)
09/12/2012	
WELL YEILD	PUMP INSTALLATION DATE
30.0 GPM	09/15/2012
STATIC WATER LEVEL	DEPTH PUMP SET
FT.	260.0 FT.
DEPTH TO FIRST GROUND WATER	PUMP RATE
183.0 FT.	10.0 GPM

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

	PERMIT#	DATE
PRIMARY CONTRACTOR SIGNATURE RICKY COLEMAN	001057	
WELL DRILLER SIGNATURE RICKY COLEMAN	001057	
PUMP INSTALLER SIGNATURE RICKY COLEMAN	001057	
APPRENTICE DRILLER SIGNATURE		
APPRENTICE PUMP SIGNATURE		

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
DOMESTIC/MULTIFAMILY WELL RECORD AND PUMP INFORMATION DATA

OFFICE USE ONLY

REF NO	DATE RECEIVED
00010685	12/20/1988
CR NO	CHECK NO.
	12390

ROUTE	APPROVED	DATE	ENTERED	STATE CERT NO	REVENUE NO.
PCD	IMPORT		CONVERT	A007763	456161

OWNER NAME	TELEPHONE WITH AREA CODE	VARIANCE NUMBER	CASING DEPTH LETTER
JOE COOK			☐ YES ☐ NO

OWNER ADDRESS	CITY	STATE	ZIP
215 CHESTNUT	CRYSTAL CITY	MO	63019

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
		MO	

USE OF WELL
☒ DOMESTIC
☐ MULTI-FAMILY

OWNERS SIGNATURE (Water Use Information Verified by Owner Signature)

DATE

CASING DETAILS	CASING LENGTH	O.D. OF CASING	WEIGHT (LB) SDR#, SCH#	DIAMETER OF DRILL HOLE	CASING MATERIAL	POSITION OF GROUT SEAL	SURFACE CASING (IF USED)
	____FT.	____IN.		____IN.	☐ STEEL ☐ PLASTIC ☐ CONCRETE	☐ BOTTOM ☐ TOP ☐ FULL LENGTH	LENGTH FT. OUTSIDE DIAMETER IN.

SCREEN (UNCONSOLIDATED MATERIAL WELLS)	SCREEN LENGTH	SCREEN TYPE/SLOT SIZE
	FT.	

CASING GROUT MATERIAL	GROUT TYPE (CHOOSE ONE)	NO. OF BAGS OR CUBIC YARDS	METHOD OF GROUT INSTALLATION (CHOOSE ONLY ONE)	DRIVE SHOE USED?	DRILLING SUSPENDED?
	CEMENT ☐ TYPE 1 ☐ HI EARLY **BENTONITE** ☐ CHIPS ☐ GRANULAR ☐ PELLETS ☐ SLURRY	_____ LBS PER BAG _____	☐ GRAVITY ☐ TREMIE ☐ OPEN HOLE ☐ POS. DISPLACEMENT ☐ AS DRIVEN ☐ PRESSURE THROUGH CASING ☐ PRESSURE THROUGH TREMIE	☐ YES ☐ NO	☐ YES ☐ NO ____HRS

LINER DETAILS	LENGTH	DEPTH TO TOP OF LINER FT.	O.D. OF LINER	LINER MATERIAL	WEIGHT (LB)SDR#, SCH#	POSITION OF SEAL	PERFORATED INTERVAL
	____ FT.		____ IN.	☐ STEEL ☐ PLASTIC		☐ FULL LENGTH ☐ BOTTOM	FROM TO

LINER GROUT MATERIAL	GROUT TYPE	NO. OF BAGS OR USED PER BAG	METHOD OF GROUT INSTALLATION	LINER USE	ABANDONED WELL
	CEMENT ☐ TYPE 1 ☐ HI EARLY **BENTONITE** ☐ SLURRY ☐ GRANULAR ☐ CHIPS ☐ PELLETS	_____ _____	☐ GRAVITY ☒ TREMIE ☐ AS LINER INSTALLED	☐ HOLD BACK FORMATION ☐ PREVENT RUST ☐ SEAL OUT UNDESIRABLE CONDITIONS	ON SITE? ☐ YES WAS THE WELL PLUGGED? ☐ YES ☐ NO

DEPTH PACKERS SET
FT.

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	46.0	CLY<9<LS:SOME SHLY
46.0	78.0	BRKN YLW LS<47<YLW,WHT LS
78.0	99.0	SHLY LS<86<YLW LS
99.0	152.0	GLS<151<FRAC LS&SS
152.0	188.0	SS

DEPTH TO BEDROCK FT.
TOTAL DEPTH ____188.0 FT.

LOCATION OF WELL OR PUMP

LAT. 38 ° 7' 24.3" **DRILL AREA** A1

LONG. 90 ° 17' 20.1" **ELEVATION**

LEGAL LOCATION

SECTION 6 TOWNSHIP 39N RANGE 7 E

COUNTY

JEFFERSON

WELL COMPLETION DATE	PUMP INFORMATION REQUIRED (IF INSTALLED)
11/18/1988	
WELL YEILD GPM	PUMP INSTALLATION DATE
STATIC WATER LEVEL FT.	DEPTH PUMP SET 160.0 FT.
DEPTH TO FIRST GROUND WATER FT.	PUMP RATE 10.0 GPM

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

PRIMARY CONTRACTOR SIGNATURE EARL W BUECHTING	PERMIT# 001595	DATE
WELL DRILLER SIGNATURE EARL W BUECHTING	PERMIT# 001595	DATE
PUMP INSTALLER SIGNATURE EARL W BUECHTING	PERMIT# 001595	DATE
APPRENTICE DRILLER SIGNATURE	PERMIT#	DATE
APPRENTICE PUMP SIGNATURE	PERMIT#	DATE

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
DOMESTIC/MULTIFAMILY WELL RECORD AND PUMP INFORMATION DATA

OFFICE USE ONLY

REF NO	DATE RECEIVED
00179087	03/27/1998
CR NO	CHECK NO.
	1825

ROUTE	APPROVED	DATE	ENTERED	STATE CERT NO	REVENUE NO.
PCD / PLT	IMPORT	04/10/1998	CONVERT	A067090	784094

OWNER NAME	TELEPHONE WITH AREA CODE	VARIANCE NUMBER	CASING DEPTH LETTER
RICHARD TINDALL	314-937-0395		[ ] YES [ ] NO

OWNER ADDRESS	CITY	STATE	ZIP
641 JOHNSTON RD	FESTUS	MO	63028

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
		MO	

USE OF WELL
[X] DOMESTIC
[ ] MULTI-FAMILY

OWNERS SIGNATURE (Water Use Information Verified by Owner Signature)

DATE

CASING DETAILS	CASING LENGTH	O.D. OF CASING	WEIGHT (LB) SDR#, SCH#	DIAMETER OF DRILL HOLE	CASING MATERIAL	POSITION OF GROUT SEAL	SURFACE CASING (IF USED)
	80.0_FT.	6.62_IN.		9.0__IN.	[ ] STEEL [X] PLASTIC [ ] CONCRETE	[X] BOTTOM [ ] TOP [ ] FULL LENGTH	LENGTH FT. OUTSIDE DIAMETER IN.

SCREEN (UNCONSOLIDATED MATERIAL WELLS)	SCREEN LENGTH	SCREEN TYPE/SLOT SIZE
	FT.	

CASING GROUT MATERIAL	GROUT TYPE (CHOOSE ONE)	NO. OF BAGS OR	METHOD OF GROUT INSTALLATION (CHOOSE ONLY ONE)	DRIVE SHOE	DRILLING
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [X] CHIPS [ ] PELLETS [ ] GRANULAR [ ] SLURRY	CUBIC YARDS 4.0_____ LBS PER BAG _____	[X] GRAVITY [ ] TREMIE [ ] AS DRIVEN [ ] PRESSURE THROUGH CASING [ ] PRESSURE THROUGH TREMIE [ ] OPEN HOLE [ ] POS. DISPLACEMENT	USED? [ ] YES [ ] NO	SUSPENDED? [ ] YES [X] NO _____HRS

LINER DETAILS	LENGTH	DEPTH TO TOP OF LINER	O.D. OF LINER	LINER MATERIAL	WEIGHT (LB)SDR#, SCH#	POSITION OF SEAL	PERFORATED INTERVAL
	FT.	FT.	IN.	[ ] STEEL [ ] PLASTIC		[ ] FULL LENGTH [ ] BOTTOM	FROM TO

LINER GROUT MATERIAL	GROUT TYPE	NO. OF BAGS OR USED	METHOD OF GROUT INSTALLATION	LINER USE	ABANDONED WELL
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [ ] SLURRY [ ] GRANULAR [ ] CHIPS [ ] PELLETS	PER BAG 100_____	[ ] GRAVITY [ ] TREMIE [ ] AS LINER INSTALLED	[ ] HOLD BACK FORMATION [ ] PREVENT RUST [ ] SEAL OUT UNDESIRABLE CONDITIONS	ON SITE? [ ] YES WAS THE WELL PLUGGED? [ ] YES [ ] NO
	DEPTH PACKERS SET FT.				

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	25.0	DRT,CLY<15;LS
25.0	35.0	BRKN ROCK
35.0	120.0	LS
120.0	200.0	SS
200.0	215.0	LS

DEPTH TO BEDROCK FT.

TOTAL DEPTH 215.0 FT.

LOCATION OF WELL OR PUMP

LAT. 38 ° 7' 52.1"

LONG. 90 ° 17' 10.4"

DRILL AREA A1_____

ELEVATION _____

LEGAL LOCATION

SECTION 5 TOWNSHIP 39N RANGE 7 E

COUNTY

JEFFERSON

WELL COMPLETION DATE	PUMP INFORMATION REQUIRED (IF INSTALLED)
03/23/1998	
WELL YEILD 40.0 GPM	PUMP INSTALLATION DATE
STATIC WATER LEVEL FT.	DEPTH PUMP SET 160.0 FT.
DEPTH TO FIRST GROUND WATER FT.	PUMP RATE 10.0 GPM

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

PRIMARY CONTRACTOR SIGNATURE RICKY COLEMAN	PERMIT# 001057	DATE
WELL DRILLER SIGNATURE TIM R HAMPTON	PERMIT# 001613	DATE
PUMP INSTALLER SIGNATURE RICKY COLEMAN	PERMIT# 001057	DATE
APPRENTICE DRILLER SIGNATURE	PERMIT#	DATE
APPRENTICE PUMP SIGNATURE	PERMIT#	DATE

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY
(573) 368-2165

HIGH YIELD AND PUBLIC WELL RECORD AND PUMP INFORMATION DATA

REF NO 00210636	DATE RECEIVED 11/12/1998	
CR NO		
STATE CERT NO APPROVED DATE A073169 12/17/1998	CHECK NO. 6775	
DATE ENTERED PHASE 1 PHASE 2 PHASE 3 11/17/1998 01/01/1000 12/28/2005	ROUTE PCD / PLT	REVENUE NO. 756242

INFORMATION SUPPLIED BY WELL OR PUMP INSTALLATION CONTRACTOR

DNR VARIANCE NUMBER _____
CASING DEPTH NUMBER _____
Applicable only if casing depth or variance were obtained from DNR

OWNER NAME	TELEPHONE (OPTIONAL)		
BOB BERTHOLD			
OWNER ADDRESS	**CITY**	**STATE**	**ZIP**
16 SUNNEN DRIVE SUITE 165	ST LOUIS	MO	63143
ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	**CITY**	**STATE**	**ZIP**
		MO	

PROPOSED USE OF WELL **SEE BACK OF FORM FOR WELL CLASSIFICATIONS**

- [X] Water Supply for Irrigation (capable of producing more than 70 gpm to surface)
  - Unconsolidated Material Well [ ] Bedrock Well [ ]
- [ ] Water Supply for a High-Capacity Well capable of producing more than 70 gpm to surface - get casing depth from GSRAD before start
- [ ] Open Loop Heat Pump
  - Supply Well [ ] Return Well [ ]
- [ ] Water Supply to a Public Facility (convenience store, restaurant, church, business, condo, mobile home park, rural or urban water supply)

CONTACT THE DNR REGIONAL OFFICE to get instructions for water supply to a PUBLIC FACILITY

CASING DETAILS

CASING LENGTH 90.0 FT. | O.D. OF CASING 12.88 IN. | DIAMETER OF DRILL HOLE 36.0 IN.

CASING MATERIAL: [ ] STEEL [X] PLASTIC [ ] CONCRETE

POSITION OF GROUT SEAL: [ ] BOTTOM [ ] FULL LENGTH [X] TOP

CASING GROUT MATERIAL

CEMENT	BENTONITE		METHOD OF GROUT INSTALLATION		PRESSURE GROUT	DRILLING SUSPENDED
[ ] TYPE 1	[ ] SLURRY	[ ] GRANULAR	[X] GRAVITY	[ ] POS. DISPLACEMENT	[ ] THROUGH CASING	[X] NO
[ ] HI-EARLY	[X] CHIPS	[ ] PELLETS	[ ] OPEN HOLE	[ ] TREMIE	[ ] THROUGH TREMIE	[ ] YES ____ HRS

NO. OF SACKS USED 30.0 POUNDS PER SACK _____

LINER DETAILS

LENGTH FT. | O.D. OF LINER IN. | LINER MATERIAL [ ] STEEL [ ] PLASTIC | POSITION OF SEAL [ ] FULL LENGTH [ ] BOTTOM [ ] TOP

LINER GROUT MATERIAL

CEMENT	BENTONITE		METHOD OF GROUT INSTALLATION		LINER USED TO:
[ ] TYPE 1	[ ] SLURRY	[ ] GRANULAR	[ ] GRAVITY	[ ] POS. DISPLACEMENT	[ ] HOLD BACK FORMATION
[ ] HI-EARLY	[ ] CHIPS	[ ] PELLETS	[ ] OPEN HOLE	[ ] TREMIE	[ ] SEAL OUT UNDESIREABLE AQUIFER CONDITIONS
					[ ] PREVENT RUST

NO. OF SACKS USED POUNDS PER SACK 50 ABANDONED WELL ON SITE? [ ] YES PLUGGED? [ ] YES

LOCATION OF WELL

LAT. 38 ° 7' 46.9"
LONG. 90 ° 17' 14.7"
COUNTY JEFFERSON

Please be aware that we do not guarantee the accuracy of the data. It is submitted to us by a third party and has not been field verified.

DEPTH TO FIRST GROUNDWATER FEET	PUMP RATE 900.0 GPM
WELL YIELD GPM	PUMP SET DEPTH 63.0 FEET
STATIC WATER LEVEL 13.0 FEET	PUMP INSTALLATION DATE
WELL COMPLETION DATE 10/29/1998	pump info required this record or on pump card

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	16.0	SILTY CLY SANDY
16.0	19.0	SND
19.0	24.0	CLY,SOME SDY
24.0	27.0	SND
27.0	51.0	SILTY CLY,SND
51.0	69.0	CLY
69.0	90.0	SND,SOME CRSE

DEPTH TO BEDROCK FEET

TOTAL DEPTH 90.0 FEET

(OPTIONAL) ELEVATION 390 FT.

LEGAL LOCATION (OPTIONAL) ____SW 1/4 ____SW 1/4 ____NW 1/4
SEC. 5 TWN. 39 RNG. 7 E

AREA A1

C DATA REQ'D [ ]

OTHER INFORMATION OR LOCATION DATA (OPTIONAL)

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

PRIMARY CONTRACTOR SIGNATURE LINDELL LINDSEY	PERMIT NUMBER 002602	DATE
WELL DRILLER SIGNATURE GERALD BUECHTING	PERMIT NUMBER 001596	DATE
PUMP INSTALLER SIGNATURE LINDELL LINDSEY	PERMIT NUMBER 002602	DATE
APPRENTICE DRILLER SIGNATURE	PERMIT NUMBER	DATE
APPRENTICE PUMP SIGNATURE	PERMIT NUMBER	DATE

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY
(573) 368-2165

HIGH YIELD AND PUBLIC WELL RECORD AND PUMP INFORMATION DATA

REF NO	DATE RECEIVED
00263792	05/21/2009
CR NO	
STATE CERT NO APPROVED DATE	CHECK NO.
A159524 06/17/2009	17912
DATE ENTERED	ROUTE / REVENUE NO.
PHASE 1 PHASE 2 PHASE 3	PCD2 / 052109
05/26/2009 05/26/2009 05/26/2009	

INFORMATION SUPPLIED BY WELL OR PUMP INSTALLATION CONTRACTOR

DNR VARIANCE NUMBER _____
CASING DEPTH NUMBER _____
Applicable only if casing depth or variance were obtained from DNR

OWNER NAME	TELEPHONE (OPTIONAL)
RAMON MIRAFLORES	314-957-3231

OWNER ADDRESS	CITY	STATE	ZIP
3700 S LINDBERGH BLVD	ST LOUIS	MO	63127

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
RUSH ISLAND POWER PLANT	FESTUS	MO	

PROPOSED USE OF WELL **SEE BACK OF FORM FOR WELL CLASSIFICATIONS**

- [ ] Water Supply for Irrigation (capable of producing more than 70 gpm to surface)
  Unconsolidated Material Well [ ] Bedrock Well [ ]
- [ ] Water Supply for a High-Capacity Well capable of producing more than 70 gpm to surface - get casing depth from GSRAD before start
- [ ] Open Loop Heat Pump
  Supply Well [ ] Return Well [ ]
- [X] Water Supply to a Public Facility (convenience store, restaurant, church, business, condo, mobile home park, rural or urban water supply)
  CONTACT THE DNR REGIONAL OFFICE to get instructions for water supply to a PUBLIC FACILITY

CASING DETAILS

CASING LENGTH 730.0 FT. | O.D. OF CASING 8.0 IN. | DIAMETER OF DRILL HOLE 12.0 IN.

CASING MATERIAL: [X] STEEL [ ] PLASTIC [ ] CONCRETE

POSITION OF GROUT SEAL: [ ] BOTTOM [X] FULL LENGTH [ ] TOP

CASING GROUT MATERIAL
CEMENT: [X] TYPE 1 [ ] HI-EARLY
BENTONITE: [ ] SLURRY [ ] CHIPS [ ] GRANULAR [ ] PELLETS
METHOD OF GROUT INSTALLATION: [ ] GRAVITY [ ] OPEN HOLE [ ] POS. DISPLACEMENT [ ] TREMIE
PRESSURE GROUT: [X] THROUGH CASING [ ] THROUGH TREMIE
DRILLING SUSPENDED: [ ] NO [X] YES 72 HRS

NO. OF SACKS USED 530.0 POUNDS PER SACK _____

LINER DETAILS

LENGTH FT. | O.D. OF LINER IN. | LINER MATERIAL: [ ] STEEL [ ] PLASTIC | POSITION OF SEAL: [ ] FULL LENGTH [ ] BOTTOM [ ] TOP

LINER GROUT MATERIAL
CEMENT: [ ] TYPE 1 [ ] HI-EARLY
BENTONITE: [ ] SLURRY [ ] CHIPS [ ] GRANULAR [ ] PELLETS
METHOD OF GROUT INSTALLATION: [ ] GRAVITY [ ] OPEN HOLE [ ] POS. DISPLACEMENT [ ] TREMIE
LINER USED TO: [ ] HOLD BACK FORMATION [ ] SEAL OUT UNDESIREABLE AQUIFER CONDITIONS [ ] PREVENT RUST

NO. OF SACKS USED POUNDS PER SACK 94 ABANDONED WELL ON SITE? [ ] YES PLUGGED? [ ] YES

LOCATION OF WELL

LAT. 38 ° 7' 57.0"
LONG. 90 ° 16' 45.5"
COUNTY JEFFERSON

Please be aware that we do not guarantee the accuracy of the data. It is submitted to us by a third party and has not been field verified.

DEPTH TO FIRST GROUNDWATER FEET	PUMP RATE 60.0 GPM
WELL YIELD GPM	PUMP SET DEPTH 500.0 FEET
STATIC WATER LEVEL FEET	PUMP INSTALLATION DATE 04/30/2009
WELL COMPLETION DATE 04/30/2009	pump info required this record or on pump card

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	164.0	SND GRVL
164.0	185.0	JOACHIM
185.0	358.0	ST PETERS
358.0	433.0	EVERTON
433.0	548.0	POWELL
548.0	697.0	COTTER
697.0	860.0	JEFF CITY
860.0	1110.0	ROUBIDOUX
1110.0	1160.0	UPPER GASCONADE

DEPTH TO BEDROCK FEET

TOTAL DEPTH 1160.0 FEET

(OPTIONAL) ELEVATION 410 FT.

LEGAL LOCATION (OPTIONAL) _____ 1/4 _____ 1/4 _____ 1/4 SEC. 5 TWN. 39 RNG. 7 E

AREA A1

C DATA REQ'D [ ]

OTHER INFORMATION OR LOCATION DATA (OPTIONAL)

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

	PERMIT NUMBER	DATE
PRIMARY CONTRACTOR SIGNATURE PHILIP LUTHER	001036	
WELL DRILLER SIGNATURE PHILIP LUTHER	001036	
PUMP INSTALLER SIGNATURE PHILIP LUTHER	001036	
APPRENTICE DRILLER SIGNATURE		
APPRENTICE PUMP SIGNATURE		

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY
(573) 368-2165

HIGH YIELD AND PUBLIC WELL RECORD AND PUMP INFORMATION DATA

REF NO	DATE RECEIVED
00263795	05/21/2009
CR NO	
STATE CERT NO APPROVED DATE	CHECK NO.
A159525 06/17/2009	17912
DATE ENTERED	ROUTE / REVENUE NO.
PHASE 1 PHASE 2 PHASE 3	PCD2 / 052109
05/26/2009 05/26/2009 05/26/2009	

INFORMATION SUPPLIED BY WELL OR PUMP INSTALLATION CONTRACTOR

DNR VARIANCE NUMBER _____
CASING DEPTH NUMBER _____
Applicable only if casing depth or variance were obtained from DNR

OWNER NAME	TELEPHONE (OPTIONAL)
RAMON MIRAFLORES	314-957-3231

OWNER ADDRESS	CITY	STATE	ZIP
3700 S LINDBERGH BLVD	FESTUS	MO	63127

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
100 BIG HOLLOW RD	FESTUS	MO	

PROPOSED USE OF WELL **SEE BACK OF FORM FOR WELL CLASSIFICATIONS**

- [ ] Water Supply for Irrigation (capable of producing more than 70 gpm to surface)
  Unconsolidated Material Well [ ] Bedrock Well [ ]
- [ ] Water Supply for a High-Capacity Well capable of producing more than 70 gpm to surface - get casing depth from GSRAD before start
- [ ] Open Loop Heat Pump
  Supply Well [ ] Return Well [ ]
- [X] Water Supply to a Public Facility (convenience store, restaurant, church, business, condo, mobile home park, rural or urban water supply)
  CONTACT THE DNR REGIONAL OFFICE to get instructions for water supply to a PUBLIC FACILITY

CASING DETAILS

CASING LENGTH 730.0 FT. | O.D. OF CASING 8.0 IN. | DIAMETER OF DRILL HOLE 12.0 IN.

CASING MATERIAL: [X] STEEL [ ] PLASTIC [ ] CONCRETE

POSITION OF GROUT SEAL: [ ] BOTTOM [X] FULL LENGTH [ ] TOP

CASING GROUT MATERIAL
CEMENT: [X] TYPE 1 [ ] HI-EARLY
BENTONITE: [ ] SLURRY [ ] CHIPS [ ] GRANULAR [ ] PELLETS
METHOD OF GROUT INSTALLATION: [ ] GRAVITY [ ] OPEN HOLE [ ] POS. DISPLACEMENT [ ] TREMIE
PRESSURE GROUT: [X] THROUGH CASING [ ] THROUGH TREMIE
DRILLING SUSPENDED: [ ] NO [X] YES 72 HRS

NO. OF SACKS USED 454.0 POUNDS PER SACK _____

LINER DETAILS

LENGTH FT. | O.D. OF LINER IN. | LINER MATERIAL: [ ] STEEL [ ] PLASTIC | POSITION OF SEAL: [ ] FULL LENGTH [ ] BOTTOM [ ] TOP

LINER GROUT MATERIAL
CEMENT: [ ] TYPE 1 [ ] HI-EARLY
BENTONITE: [ ] SLURRY [ ] CHIPS [ ] GRANULAR [ ] PELLETS
METHOD OF GROUT INSTALLATION: [ ] GRAVITY [ ] OPEN HOLE [ ] POS. DISPLACEMENT [ ] TREMIE
LINER USED TO: [ ] HOLD BACK FORMATION [ ] SEAL OUT UNDESIREABLE AQUIFER CONDITIONS [ ] PREVENT RUST

NO. OF SACKS USED POUNDS PER SACK 94 ABANDONED WELL ON SITE? [ ] YES PLUGGED? [ ] YES

LOCATION OF WELL

LAT. 38 ° 7' 56.1"
LONG. 90 ° 16' 44.7"
COUNTY JEFFERSON

Please be aware that we do not guarantee the accuracy of the data. It is submitted to us by a third party and has not been field verified.

DEPTH TO FIRST GROUNDWATER FEET	PUMP RATE 60.0 GPM
WELL YIELD GPM	PUMP SET DEPTH 500.0 FEET
STATIC WATER LEVEL FEET	PUMP INSTALLATION DATE 04/30/2009
WELL COMPLETION DATE 04/30/2009	pump info required this record or on pump card

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	164.0	SND GRVL
164.0	185.0	JOACHIM
185.0	360.0	ST PETER
360.0	435.0	EVERTON
435.0	550.0	POWELL
550.0	600.0	COTTER
600.0	865.0	JEFF CITY
865.0	1120.0	ROUBIDOUX
1120.0	1160.0	UPPER GASCONADE

DEPTH TO BEDROCK FEET

TOTAL DEPTH 1160.0 FEET

(OPTIONAL) ELEVATION 410 FT.

LEGAL LOCATION (OPTIONAL) _____ 1/4 _____ 1/4 _____ 1/4 SEC. 5 TWN. 39 RNG. 7 E

AREA A1

C DATA REQ'D [ ]

OTHER INFORMATION OR LOCATION DATA (OPTIONAL)

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

	PERMIT NUMBER	DATE
PRIMARY CONTRACTOR SIGNATURE PHILIP LUTHER	001036	
WELL DRILLER SIGNATURE PHILIP LUTHER	001036	
PUMP INSTALLER SIGNATURE PHILIP LUTHER	001036	
APPRENTICE DRILLER SIGNATURE		
APPRENTICE PUMP SIGNATURE		

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
RECONSTRUCTION RECORD

OFFICE USE ONLY	
REF NO 00020350	DATE RECEIVED 07/02/2009

ROUTE	APPROVED	DATE	ENTERED	STATE CERT NO	CHECK NO.	REVENUE NO.
PCD4	NRWIEBC	09/24/2009	NRWIEBC	R006302		

INFORMATION SUPPLIED BY WELL OR PUMP INSTALLATION CONTRACTOR

OWNER NAME		TELEPHONE	
RAMON MIRAFLORES		314-957-3231	
OWNER ADDRESS	**CITY**	**STATE**	**ZIP CODE**
3700 SOUTH LINDBERGH BLVD	ST LOUIS	MO	63127
ADDRESS OF WELL SITE (IF DIFFERENT THAN ABOVE)	**CITY**	**STATE**	**ZIP CODE**
100 BIG HOLLOW ROAD	FESTUS	MO	

SITE NAME	WELL NUMBER	ORIGINAL DRILLER	DATE ORIGINALLY DRILLED
RUSH ISLAND	RUSH ISLAND WELL 1		

TYPE OF REPAIR	DATE WELL WAS RECONTRUCTED	WELL CERTIFICATION NUMBER OR REFERENCE NUMBER	VARIANCE NUMBER
☐ RAISED CASING ☐ LINING OF WELL ☐ DEEPENING OF WELL ☐ MONITORING	06/10/2009	R006302	

LOCATION OF WELL
LAT. 38 ° 7' 57.0"
LONG 90 ° 15' 45.5"
AREA A5
ELEV 0
LEGAL LOCATION
1/4 1/4 1/4 SEC. 5 TWN. 39 RNG. 7 E
COUNTY JEFFERSON

DRILLER NOTES

RECONSTRUCTION INFORMATION

USE OF WELL	CASING DIAMETER	STATIC WATER LEVEL	WELL CHLORINATED AFTER RECONSTRUCTION
☐ DOMESTIC ☐ IRRIGATION BEDROCK ☐ IRRIGATION UNCONONSOLIDATED ☐ MONITORING ☐ MULTI-FAMILY ☒ PUBLIC WATER SUPPLY ☐ OPEN LOOP WATER	8.0		☐ YES ☒ NO

MONITORING WELL INFORMATION

TYPE OF REPAIR	LENGTH OF RISER ADDED	RISER MATERIAL	ORIGINAL RISER MATERIAL	METHOD OF ATTACHMENT	TYPE OF SURFACE COMPLETION
☐ OVER-DRILL AND RECONSTRUCTED*				☐ THREADED ☐ WELD	
☐ INSTALL OR REPLACE SURFACE COMPLETION		☐ PLASTIC	☐ PLASTIC	☐ COUPLE ☐ FUSE	☐ ABOVE GROUND
☐ RAISE OR LOWER SURFACE ELAVATION	FT.	☐ STAINLESS STEEL	☐ STAINLESS STEEL	☐ GLUE ☐ OTHER	☐ FLUSH MOUNT

LINER INFORMATION

PURPOSE OF LINER	LENGTH	OUTSIDE DIAMETER	WEIGHT OR SDR #	MATERIAL
☐ USED ONLY TO HOLD BACK THE FORMATION ☐ USED TO SEAL OUT CONTAMINATION OR OTHER CONDITIONS ☐ USED TO SEAL OUT RUST	FT.	IN.		☐ STEEL ☐ PLASTIC

DEPTH TO TOP OF LINER	PACKER USED ON PVC LINER	DEPTH PACKERS SET
FT.	☐ NONE ☐ RUBBER BOOT	

POSITION OF SEAL	GROUT TYPE	NUMBER OF SACKS USED LBS PER SACK	METHOD OF GROUT INSTALLATION
☐ FULL LENGTH ☐ BOTTOM	CEMENT ☐ TYPE 1 ☐ HI-EARLY BENTONITE ☐ CHIPS ☐ GRANULAR ☐ PELLETS ☐ SLURRY		☐ AS LINER IS INSTALLED ☐ TREMIE

RAISED CASING INFORMATION

LENGTH ADDED	CASING MATERIAL	ORGINAL CASING MATERIAL	METHOD OF ATTACHMENT
FT.	☐ PLASTIC ☐ STEEL	☐ PLASTIC ☐ STEEL	☐ THREADED ☐ WELD ☐ COUPLE ☐ GLUE

I HEREBY CERTIFY THAT THE WELL HEREIN DESCRIBED WAS RECONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE RECONSTRUCTION OF WELLS.

	PERMIT NUMBER	DATE
PRIMARY CONTRACTOR SIGNATURE x PHILIP LUTHER	001036	
CONTRACTOR SIGNATURE x PHILIP LUTHER	001036	
APPRENTICE SIGNATURE x		

DEEPENING OF WELL INFORMATION

DEPTH FROM	DEPTH TO	FORMATION AND YIELD DESCRIPTION
0.0	164.0	SAND AND GRAVEL
164.0	185.0	JOACHIM
185.0	258.0	ST PETERS
358.0	433.0	EVERTON
433.0	548.0	POWELL
548.0	697.0	COTTER
697.0	860.0	JEFF CITY
860.0	982.0	ROUBIDOUX

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
RECONSTRUCTION RECORD

OFFICE USE ONLY	
REF NO 00020351	DATE RECEIVED 07/02/2009

ROUTE	APPROVED	DATE	ENTERED	STATE CERT NO	CHECK NO.	REVENUE NO.
PCD4	NRWIEBC	09/24/2009	NRWIEBC	R006301		

INFORMATION SUPPLIED BY WELL OR PUMP INSTALLATION CONTRACTOR

OWNER NAME		TELEPHONE	
RAMON MIRAFORES		314-957-3231	
OWNER ADDRESS	**CITY**	**STATE**	**ZIP CODE**
3700 SOUTH LINDBERGH BLVD	ST LOUIS	MO	63127
ADDRESS OF WELL SITE (IF DIFFERENT THAN ABOVE)	**CITY**	**STATE**	**ZIP CODE**
100 BIG HOLLOW RD	FESTUS	MO	

SITE NAME	WELL NUMBER	ORIGINAL DRILLER	DATE ORIGINALLY DRILLED
RUSH ISLAND WELL 2	263795		

TYPE OF REPAIR	DATE WELL WAS RECONTRUCTED	WELL CERTIFICATION NUMBER OR REFERENCE NUMBER	VARIANCE NUMBER
☐ RAISED CASING ☐ LINING OF WELL ☐ DEEPENING OF WELL ☐ MONITORING	06/11/2009	R006301	

LOCATION OF WELL
LAT. 38 ° 7' 56.1" AREA A5
LONG 90 ° 15' 44.7" ELEV 0
LEGAL LOCATION
1/4 1/4 1/4 SEC. 5 TWN. 39 RNG. 7 E
COUNTY JEFFERSON

DRILLER NOTES

RECONSTRUCTION INFORMATION

USE OF WELL	CASING DIAMETER	STATIC WATER LEVEL	WELL CHLORINATED AFTER RECONSTRUCTION
☐ DOMESTIC ☐ IRRIGATION BEDROCK ☐ IRRIGATION UNCONONSOLIDATED ☐ MONITORING ☐ MULTI-FAMILY ☒ PUBLIC WATER SUPPLY ☐ OPEN LOOP WATER	8.0		☐ YES ☒ NO

MONITORING WELL INFORMATION

TYPE OF REPAIR	LENGTH OF RISER ADDED	RISER MATERIAL	ORIGINAL RISER MATERIAL	METHOD OF ATTACHMENT	TYPE OF SURFACE COMPLETION
☐ OVER-DRILL AND RECONSTRUCTED*				☐ THREADED ☐ WELD	
☐ INSTALL OR REPLACE SURFACE COMPLETION		☐ PLASTIC	☐ PLASTIC	☐ COUPLE ☐ FUSE	☐ ABOVE GROUND
☐ RAISE OR LOWER SURFACE ELAVATION	FT.	☐ STAINLESS STEEL	☐ STAINLESS STEEL	☐ GLUE ☐ OTHER	☐ FLUSH MOUNT

LINER INFORMATION

PURPOSE OF LINER	LENGTH	OUTSIDE DIAMETER	WEIGHT OR SDR #	MATERIAL
☐ USED ONLY TO HOLD BACK THE FORMATION ☐ USED TO SEAL OUT CONTAMINATION OR OTHER CONDITIONS ☐ USED TO SEAL OUT RUST	FT.	IN.		☐ STEEL ☐ PLASTIC

DEPTH TO TOP OF LINER	PACKER USED ON PVC LINER	DEPTH PACKERS SET
FT.	☐ NONE ☐ RUBBER BOOT	

POSITION OF SEAL	GROUT TYPE	NUMBER OF SACKS USED LBS PER SACK	METHOD OF GROUT INSTALLATION
☐ FULL LENGTH ☐ BOTTOM	CEMENT ☐ TYPE 1 ☐ HI-EARLY BENTONITE ☐ CHIPS ☐ GRANULAR ☐ PELLETS ☐ SLURRY		☐ AS LINER IS INSTALLED ☐ TREMIE

RAISED CASING INFORMATION

LENGTH ADDED	CASING MATERIAL	ORGINAL CASING MATERIAL	METHOD OF ATTACHMENT
FT.	☐ PLASTIC ☐ STEEL	☐ PLASTIC ☐ STEEL	☐ THREADED ☐ WELD ☐ COUPLE ☐ GLUE

I HEREBY CERTIFY THAT THE WELL HEREIN DESCRIBED WAS RECONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE RECONSTRUCTION OF WELLS.

	PERMIT NUMBER	DATE
PRIMARY CONTRACTOR SIGNATURE x PHILIP LUTHER	001036	
CONTRACTOR SIGNATURE x PHILIP LUTHER	001036	
APPRENTICE SIGNATURE x		

DEEPENING OF WELL INFORMATION

DEPTH FROM	DEPTH TO	FORMATION AND YIELD DESCRIPTION
0.0	164.0	SAND AND GRAVEL
164.0	185.0	JOACHIM
185.0	360.0	ST PETER
360.0	435.0	EVERTON
435.0	550.0	POWELL
550.0	600.0	COTTER
600.0	865.0	JEFF CITY
865.0	979.0	ROUBIDOUX

WL-36 Spls

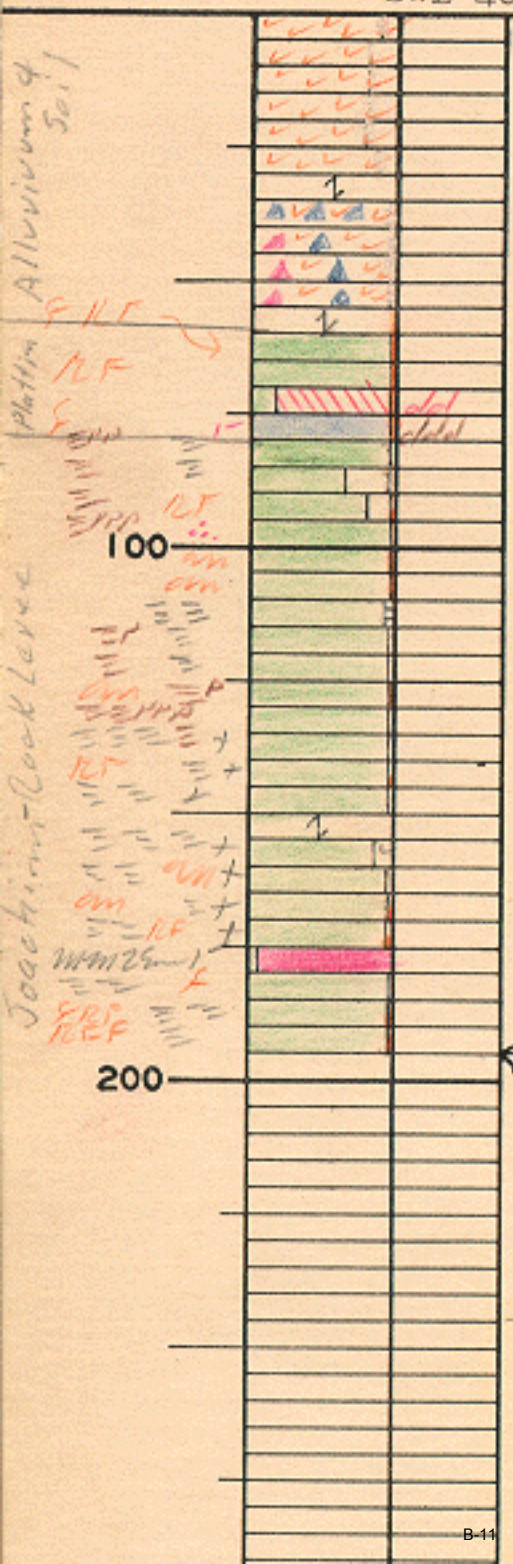
STATE OF MISSOURI
DIVISION OF
GEOLOGICAL SURVEY AND WATER RESOURCES

LOG NO.	OWNER	
17,312	Mrs. O. H. England	
COUNTY	**FARM**	**WELL NO.**
Jefferson		
T 40 **R** 7E	**DRILLER** Bloomsdale Exc. Co.	
	DATE 4-14-58	
	ELEV. Butterfield 402	**PROD.** 5 GPM
	LOGGED BY R.D. Knight 7/24/58	

INDEX SHEET NO. 51

REMARKS 65' csg.
Water @ 155'. Rushtower, Mo. - 1 Mi.
E of 61 & AA Junction.
SWL 40

SAMPLES SAVED



W. L. 25'

MISSOURI BUREAU OF GEOLOGY & MINES, ROLLA, MO.

MO SURVEY Nº	OWNER	
6418	JOHNSTON, Danby, Mo	
COUNTY	FARM	WELL Nº
JEFFERSON		
T 39	R 7E	DRILLER Lentzinger for W. Haas
		DATE June 7-14, 1940
		ELEVATION 540TM (VanKley) PRODUCTION 5 G. P. M
		SAMPLES STUDIED Mc Cracken

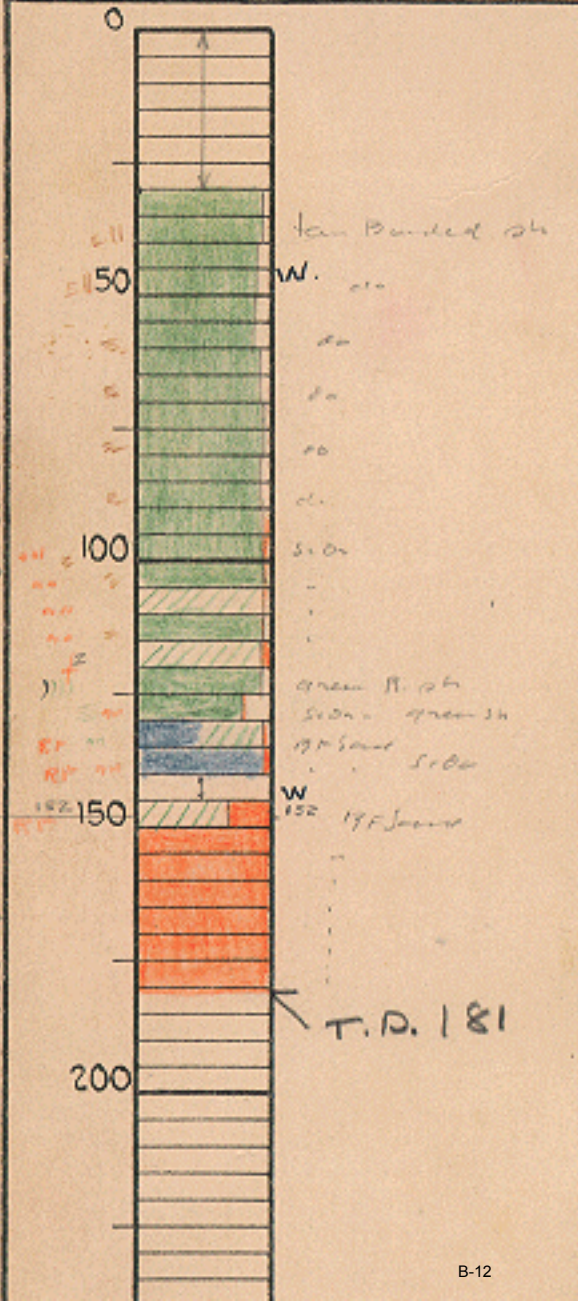
REMARKS

13½ ft of csg

Near Danby

SWL. 135

Index Sh 1941



MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
DOMESTIC/MULTIFAMILY WELL RECORD AND PUMP INFORMATION DATA

OFFICE USE ONLY

REF NO	DATE RECEIVED
00007728	08/26/1988
CR NO	CHECK NO.
	3408

ROUTE WC2 / PCD / WBA	APPROVED	DATE	ENTERED	STATE CERT NO	REVENUE NO.
	IMPORT	03/22/1991	CONVERT	A005775	456140

OWNER NAME	TELEPHONE WITH AREA CODE	VARIANCE NUMBER	CASING DEPTH LETTER
BILL HEMPEL			[ ] YES [ ] NO

OWNER ADDRESS	CITY	STATE	ZIP
426 N FIFTH	FESTUS	MO	63028

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
		MO	

USE OF WELL
[X] DOMESTIC
[ ] MULTI-FAMILY

OWNERS SIGNATURE (Water Use Information Verified by Owner Signature)

DATE

CASING DETAILS	CASING LENGTH	O.D. OF CASING	WEIGHT (LB) SDR#, SCH#	DIAMETER OF DRILL HOLE	CASING MATERIAL	POSITION OF GROUT SEAL	SURFACE CASING (IF USED)
	84.0_FT.	6.0__IN.		0.0__IN.	[X] STEEL [ ] PLASTIC [ ] CONCRETE	[ ] BOTTOM [ ] TOP [X] FULL LENGTH	LENGTH FT. OUTSIDE DIAMETER IN.

SCREEN (UNCONSOLIDATED MATERIAL WELLS)	SCREEN LENGTH	SCREEN TYPE/SLOT SIZE
	FT.	

CASING GROUT MATERIAL	GROUT TYPE (CHOOSE ONE)	NO. OF BAGS OR CUBIC YARDS	METHOD OF GROUT INSTALLATION (CHOOSE ONLY ONE)	DRIVE SHOE USED?	DRILLING SUSPENDED?
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [X] CHIPS [ ] GRANULAR [ ] PELLETS [ ] SLURRY	0.0_____ LBS PER BAG _____	[ ] GRAVITY [ ] TREMIE [ ] OPEN HOLE [ ] POS. DISPLACEMENT [ ] AS DRIVEN [ ] PRESSURE THROUGH CASING [ ] PRESSURE THROUGH TREMIE	[ ] YES [ ] NO	[ ] YES [X] NO _____HRS

LINER DETAILS	LENGTH	DEPTH TO TOP OF LINER	O.D. OF LINER	LINER MATERIAL	WEIGHT (LB)SDR#, SCH#	POSITION OF SEAL	PERFORATED INTERVAL
	FT.	FT.	IN.	[ ] STEEL [ ] PLASTIC		[ ] FULL LENGTH [ ] BOTTOM	FROM TO

LINER GROUT MATERIAL	GROUT TYPE	NO. OF BAGS OR USED PER BAG	METHOD OF GROUT INSTALLATION	LINER USE	ABANDONED WELL
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [ ] SLURRY [ ] GRANULAR [ ] CHIPS [ ] PELLETS	_____	[ ] GRAVITY [ ] TREMIE [ ] AS LINER INSTALLED	[ ] HOLD BACK FORMATION [ ] PREVENT RUST [ ] SEAL OUT UNDESIRABLE CONDITIONS	ON SITE? [ ] YES WAS THE WELL PLUGGED? [ ] YES [ ] NO

DEPTH PACKERS SET
FT.

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	5.0	OB
5.0	50.0	WHT SS
47.0	49.0	MUD HOLE
50.0	160.0	GRY LS
160.0	235.0	FRACT,GRY&TANLS190-210

DEPTH TO BEDROCK FT.
TOTAL DEPTH 235.0 FT.

LOCATION OF WELL OR PUMP

LAT. 38 ° 6' 36.0" **DRILL AREA** A1_____

LONG. 90 ° 15' 52.0" **ELEVATION** 400

LEGAL LOCATION

SECTION 9 TOWNSHIP 39N RANGE 7 E

COUNTY

JEFFERSON

WELL COMPLETION DATE	PUMP INFORMATION REQUIRED (IF INSTALLED)
05/13/1987	
WELL YEILD	PUMP INSTALLATION DATE
11.0 GPM	
STATIC WATER LEVEL	DEPTH PUMP SET
FT.	FT.
DEPTH TO FIRST GROUND WATER	PUMP RATE
FT.	GPM

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

	PERMIT#	DATE
PRIMARY CONTRACTOR SIGNATURE		
WELL DRILLER SIGNATURE		
PUMP INSTALLER SIGNATURE		
APPRENTICE DRILLER SIGNATURE		
APPRENTICE PUMP SIGNATURE		

Holcim US Inc. - Lee Island Project

PWSS No. 4182616

1 Well, Ste. Genevieve County

Prepared by:

CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS
UNIVERSITY OF MISSOURI

Missouri Department of Natural Resources

Map Update: Dec 18, 2013

Well System

System Well

SWAP Delineation Boundary

20-year time of travel

Half-mile buffer

N

Feet

0 1,400 2,800

SWAP - Source Water Assessment Plan -- http://drinkingwater.missouri.edu/swap/
Aerial photos: USDA National Agriculture Inventory Program (NAIP), 2012.

Holcim US Inc. - Lee Island Project

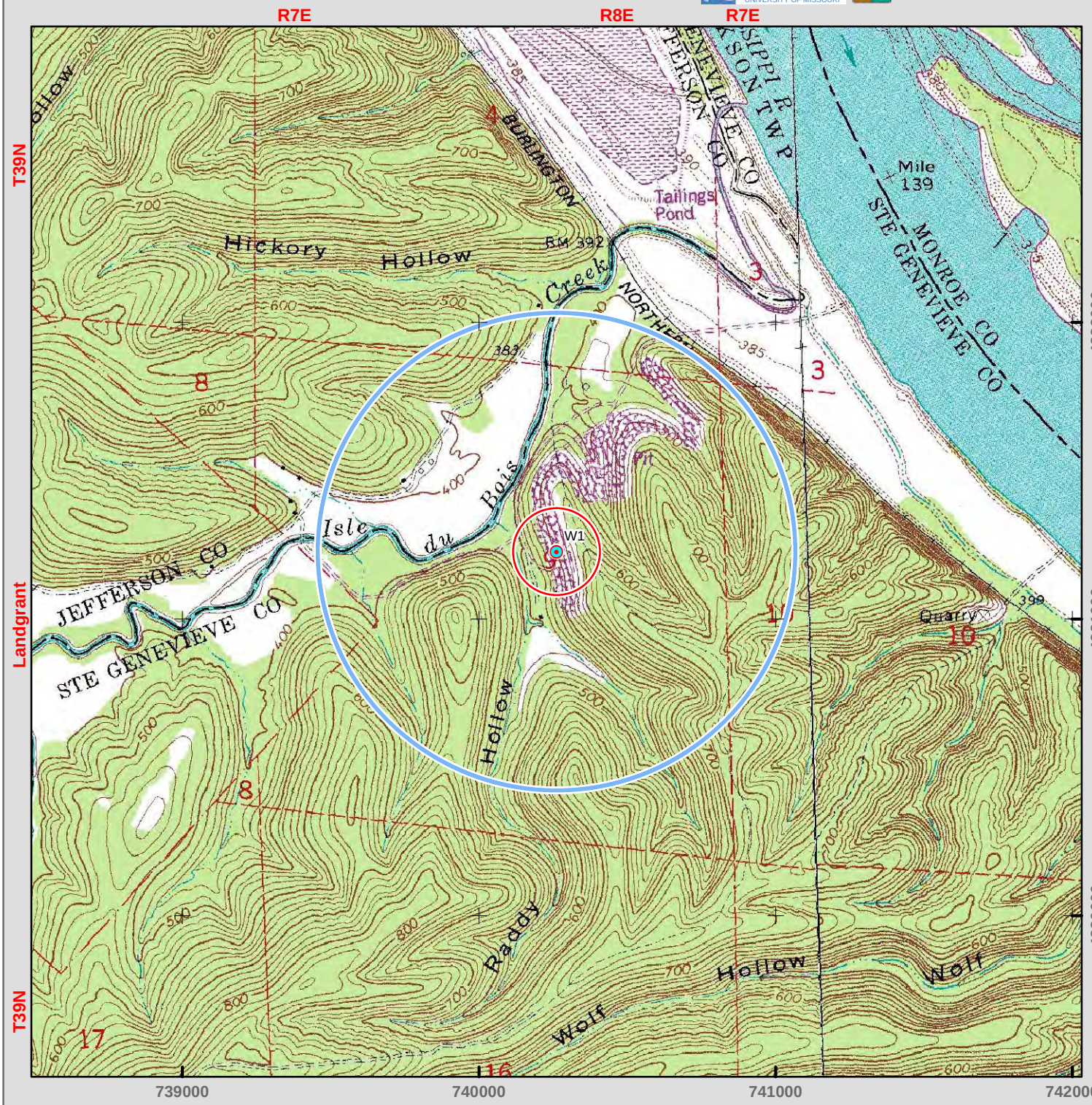
PWSS No. 4182616

1 Well, Ste. Genevieve County

Prepared by:
CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS
UNIVERSITY OF MISSOURI

Missouri Department of Natural Resources

Map Update: Dec 18, 2013



Well System

- System Well

SWAP Delineation Boundary

- 20-year time of travel
- Half-mile buffer

Feet

0 1,400 2,800

SWAP - Source Water Assessment Plan --
http://drinkingwater.missouri.edu/swap/
For basemap symbols, see the U.S. Geological Survey (USGS) publication: Topographic Map Symbols.

Holcim US Inc. - Lee Island Project

Well #1-Temporary site 4 (W1)

PWSS No. 4182616, Well 1 of 1, 0 potential contaminant sources

Prepared by:

CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS UNIVERSITY OF MISSOURI

Missouri Department of Natural Resources

Map Update: Dec 10, 2013

Well System

- System Well

SWAP Delineation Boundary

- 20-year time of travel
- Half-mile buffer

SWAP boundaries for individual wells indicated by dashed line.

SWAP - Source Water Assessment Plan -- http://drinkingwater.missouri.edu/swap/

Aerial photos: USDA National Agriculture Inventory Program (NAIP), 2012.

Potential Contaminant Source

- Database Source (Location Confirmed)
- Database Source (Location Unconfirmed)
- SWIP Field Data

N

Feet

0 800 1,600

Holcim US Inc. - Lee Island Project

Well #1-Temporary site 4 (W1)

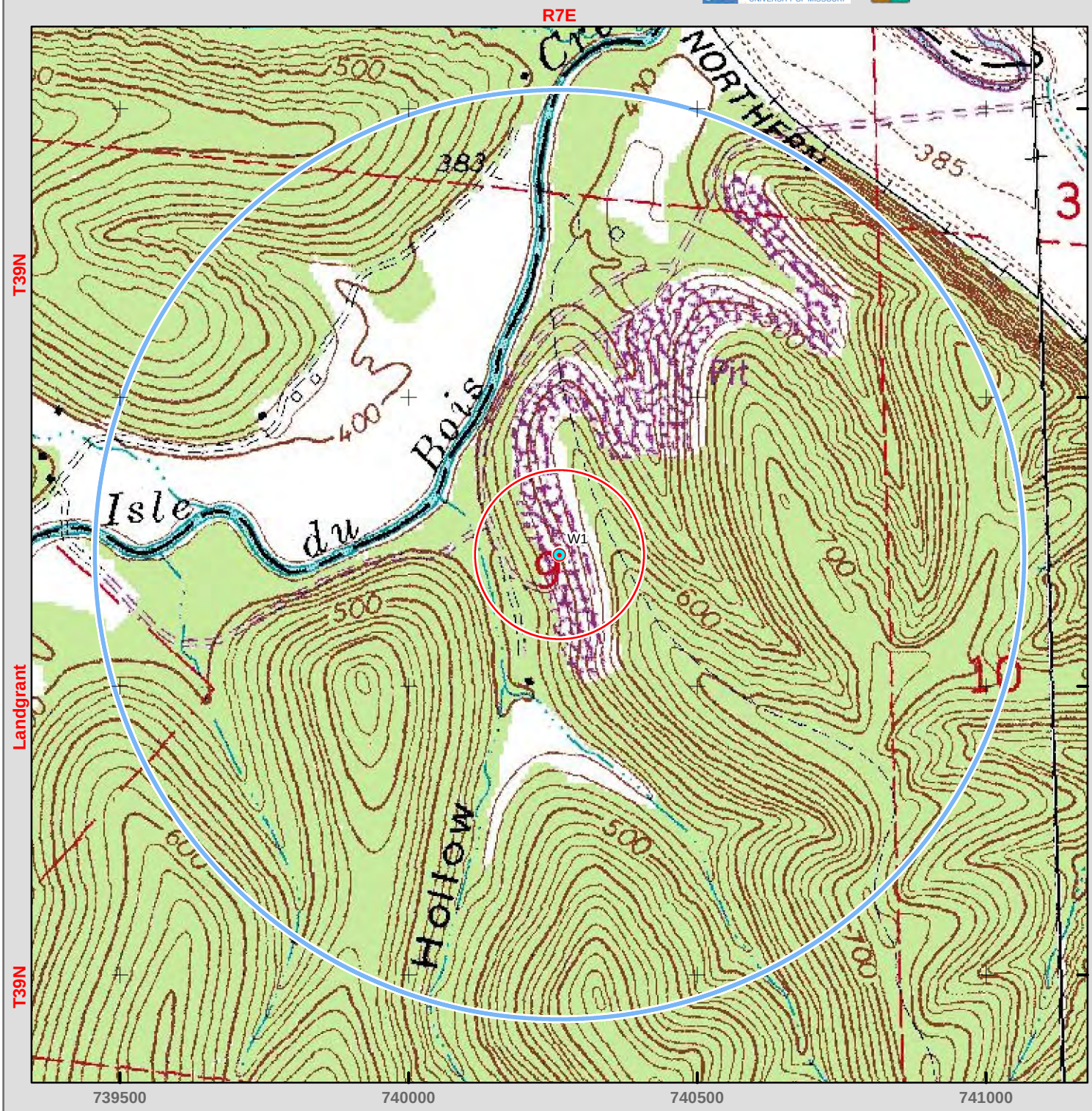
PWSS No. 4182616, Well 1 of 1, 0 potential contaminant sources

Prepared by:

CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS UNIVERSITY OF MISSOURI

Missouri Department of Natural Resources

Map Update: Dec 10, 2013



Well System

- System Well

SWAP Delineation Boundary

- 20-year time of travel
- Half-mile buffer

SWAP boundaries for individual wells indicated by dashed line.

SWAP - Source Water Assessment Plan -- http://drinkingwater.missouri.edu/swap/

For basemap symbols, see the U.S. Geological Survey (USGS) publication: Topographic Map Symbols.

Potential Contaminant Source

- Database Source (Location Confirmed)
- Database Source (Location Unconfirmed)
- SWIP Field Data

Feet

0 800 1,600

Holcim US Inc. - Lee Island Project

PWSS No. 4182616

Ste. Genevieve County

1 well

Prepared by:

CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS UNIVERSITY OF MISSOURI

Missouri Department of Natural Resources

Sheet Update: Dec 18, 2013

Well Number	W1
Extended PWS #	4182616101
Local Well Name	Well #1-Temporary site 4
Well ID #	16881
DGLS ID #	0029228
Facility Type	Indus. & Lg. Business
Status	Active
Latitude	38.106944
Longitude	-90.259722
Location Method	GPS
Method Accuracy (ft)	100
USGS 7.5 Quadrangle	Danby
County	Ste. Genevieve
MoDNR Region	Southeast
Date Drilled (year)	2007
Material (C/U)	Consolidated
Base of Casing Formation	Joachim/Dutchtown
Total Depth Formation	Everton
Total Depth	425
Ground Elevation (ft)	460
Top Seal	Pressure Grout
Bottom Seal	Pressure Grout
Casing Depth (ft)	267
Casing Size (in)	6
Casing Type	Steel
Elev. of Casing Top (ft)	
Outer Casing Depth (ft)	
Outer Casing Size (in)	
Screen Length (ft)	No Screen
Screen Size (in)	No Screen
Static Water Level (ft)	60
Well Yield (gpm)	48
Head (ft)	
Draw Down (ft)	74
Pump Test Date (year)	2007
Pump Type	Submersible
Pump Manufacturer	
Pump Depth (ft)	315
Pump Capacity (gpm)	40
Pump Meter (Y/N)	
VOC Detection (Y/N)	
Nitrate Detection (Y/N)	
Chlorination (Y/N)	
Filtration (Y/N)	
GWUDISW (Y/N)	
Surface Drainage	
State Approved(Y/N)	
Date Abandoned (year)	
Date Plugged (year)	

Holcim US Inc. - Lee Island Project

PWSS No. 4182616

Susceptibility Determination Sheet

1 well

Prepared by:

CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS UNIVERSITY OF MISSOURI

Missouri Department of Natural Resources

Sheet Update: Apr 01, 2013

The Missouri Department of Natural Resources (MoDNR) has assembled this information to assess the susceptibility of drinking water sources to contamination. There are many unforseen and unpredictable factors that may cause a source to be contaminated. MoDNR routinely monitors all public supplies to ensure public health is protected. Public water systems and local communities are encouraged to take all measures possible to reduce the susceptibility of their drinking water source to chemical contamination. For more information, call 1-800-361-4827.	Not Susceptible	Moderately Susceptible	Highly Susceptible	Incomplete Data
A system is highly susceptible because of construction deficiencies if:				
A well was not constructed according to plans approved by MoDNR-PDWB,				X
A well was not cased to a depth approved by MoDNR,				X
A well casing is not of sufficient weight,	X			
A well is not sufficiently sealed (grouted) around the casing, or A well has developed holes in the casing or other flaws that compromise its integrity.	X			
A system is highly susceptible due to direct influence of surface water if:				
A well has tested positive for surface water indicators such as algae or high turbidity.				X
A system is highly susceptible to surface contaminants if:				
A well casing does not extend 12 inches above the well house floor, or 18 inches above the ground surface,				X
A well casing does not extend four feet above the 100-year flood level, or four feet above the highest known flood elevation,				X
A well is not provided with a properly screened vent, or				X
All openings in a well casing are not properly sealed.				X
A system is highly susceptible based on detection histories if:				
Volatile Organic Chemicals (VOCs) have been detected in a well,				X
Synthetic Organic Chemicals (SOCs) have been detected in a well,				X
Inorganic Chemicals (IOCs) have been detected in a well above naturally occurring levels,				X
Nitrates have been detected at or above one-half the MCL,				X
Bacteria has been consistently detected in a well, or				X
Viruses or microbiological contaminants are detected in a well.				X
A system is highly susceptible to weather, vandalism, and sabotage if:				
A well is not in a locked well house of adequate construction.				X (1)
A system is moderately susceptible due to local geology if:				
A producing aquifer is less than 100 feet below the surface,	X			
A producing aquifer has conduit flow conditions due to surficial karst topography,				X
A producing aquifer is not overlain by an impermeable confining layer,				X
A producing aquifer is overlain by a conductive (>5X10e-4) formation (including soil), or				X
A producing aquifer is confined, but there are open wells nearby penetrating that layer.				X
A system is moderately susceptible to contaminants if:				
Any contaminants listed in Appendix F-a are found in the source water area,	X			
Septic systems are present in the source water area,				X
A well is indirectly connected to a surface water body,				X
A submersible well pump cannot be ruled out from containing PCBs or PHAs, or				X
There is a high density of transportation corridors in the source water area.				X
A system is highly susceptible to contamination if:				
Any contaminant sites identified in the source water area are known to have contaminated groundwater that may migrate toward a well.				X

(1) This system was not assessed to determine if adequate security devices such as padlocks, gates, and lighting are in place to deter vandals and saboteurs. All water systems should have this type of protection in place.

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
DOMESTIC/MULTIFAMILY WELL RECORD AND PUMP INFORMATION DATA

OFFICE USE ONLY

REF NO	DATE RECEIVED
00052006	02/18/1993
CR NO	CHECK NO.
	1654

ROUTE	APPROVED	DATE	ENTERED	STATE CERT NO	REVENUE NO.
PCD	IMPORT	03/19/1993	CONVERT	A029528	775617

OWNER NAME	TELEPHONE WITH AREA CODE	VARIANCE NUMBER	CASING DEPTH LETTER
STELLA M ENGLAND ESTATE'S	314-937-3327		[ ] YES [ ] NO

OWNER ADDRESS	CITY	STATE	ZIP
3700 ROUGGLY-KIEPE RD	FESTUS	MO	63028
ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
		MO	

USE OF WELL
[X] DOMESTIC
[ ] MULTI-FAMILY

OWNERS SIGNATURE (Water Use Information Verified by Owner Signature)

DATE

CASING DETAILS	CASING LENGTH	O.D. OF CASING	WEIGHT (LB) SDR#, SCH#	DIAMETER OF DRILL HOLE	CASING MATERIAL	POSITION OF GROUT SEAL	SURFACE CASING (IF USED)
	106.0FT.	6.62_IN.		8.0__IN.	[X] STEEL [ ] PLASTIC [ ] CONCRETE	[ ] BOTTOM [ ] TOP [X] FULL LENGTH	LENGTH FT. OUTSIDE DIAMETER IN.

SCREEN (UNCONSOLIDATED MATERIAL WELLS)	SCREEN LENGTH	SCREEN TYPE/SLOT SIZE
	FT.	

CASING GROUT MATERIAL	GROUT TYPE (CHOOSE ONE)	NO. OF BAGS OR	METHOD OF GROUT INSTALLATION (CHOOSE ONLY ONE)	DRIVE SHOE	DRILLING
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [X] CHIPS [ ] GRANULAR [ ] PELLETS [ ] SLURRY	CUBIC YARDS 0.0_____ LBS PER BAG _____	[ ] GRAVITY [ ] TREMIE [ ] OPEN HOLE [ ] POS. DISPLACEMENT [ ] AS DRIVEN [ ] PRESSURE THROUGH CASING [ ] PRESSURE THROUGH TREMIE	USED? [ ] YES [ ] NO	SUSPENDED? [ ] YES [X] NO _____HRS

LINER DETAILS	LENGTH	DEPTH TO TOP OF LINER	O.D. OF LINER	LINER MATERIAL	WEIGHT (LB)SDR#, SCH#	POSITION OF SEAL	PERFORATED INTERVAL
	FT.	FT.	IN.	[ ] STEEL [ ] PLASTIC		[ ] FULL LENGTH [ ] BOTTOM	FROM TO

LINER GROUT MATERIAL	GROUT TYPE	NO. OF BAGS OR USED PER BAG	METHOD OF GROUT INSTALLATION	LINER USE	ABANDONED WELL
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [ ] SLURRY [ ] GRANULAR [ ] CHIPS [ ] PELLETS	_____	[ ] GRAVITY [ ] TREMIE [ ] AS LINER INSTALLED	[ ] HOLD BACK FORMATION [ ] PREVENT RUST [ ] SEAL OUT UNDESIRABLE CONDITIONS	ON SITE? [ ] YES WAS THE WELL PLUGGED? [ ] YES [ ] NO
	DEPTH PACKERS SET FT.				

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	20.0	MD
20.0	90.0	SND, GRVL
90.0	228.0	LS 20GPM@97, 40GPM@179
228.0	261.0	SS 60GPM@241

DEPTH TO BEDROCK FT.

TOTAL DEPTH 261.0 FT.

LOCATION OF WELL OR PUMP

LAT. 38 ° 8' 48.1" **DRILL AREA** A1_____

LONG. 90 ° 17' 34.7" **ELEVATION** _____

LEGAL LOCATION

SECTION 31 TOWNSHIP 40N RANGE 7 E

COUNTY

JEFFERSON

WELL COMPLETION DATE	PUMP INFORMATION REQUIRED (IF INSTALLED)
05/18/1988	
WELL YEILD 60.0 GPM	PUMP INSTALLATION DATE
STATIC WATER LEVEL FT.	DEPTH PUMP SET 164.0 FT.
DEPTH TO FIRST GROUND WATER FT.	PUMP RATE 10.0 GPM

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

	PERMIT#	DATE
PRIMARY CONTRACTOR SIGNATURE DARRIEL COLEMAN	001056	
WELL DRILLER SIGNATURE DARRIEL COLEMAN	001056	
PUMP INSTALLER SIGNATURE DARRIEL COLEMAN	001056	
APPRENTICE DRILLER SIGNATURE		
APPRENTICE PUMP SIGNATURE		

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
DOMESTIC/MULTIFAMILY WELL RECORD AND PUMP INFORMATION DATA

OFFICE USE ONLY

REF NO	DATE RECEIVED
00179059	09/19/1997
CR NO	CHECK NO.
	1562

ROUTE	APPROVED	DATE	ENTERED	STATE CERT NO	REVENUE NO.
PCD / PLT	IMPORT	10/23/1997	CONVERT	A062220	784060

OWNER NAME	TELEPHONE WITH AREA CODE	VARIANCE NUMBER	CASING DEPTH LETTER
JEFF BECKEMEYER	314-933-2332		☐ YES ☐ NO

OWNER ADDRESS	CITY	STATE	ZIP
737 JEREMY	FESTUS	MO	63028

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
		MO	

USE OF WELL
- [X] DOMESTIC
- [ ] MULTI-FAMILY

OWNERS SIGNATURE (Water Use Information Verified by Owner Signature)

DATE

CASING DETAILS	CASING LENGTH	O.D. OF CASING	WEIGHT (LB) SDR#, SCH#	DIAMETER OF DRILL HOLE	CASING MATERIAL	POSITION OF GROUT SEAL	SURFACE CASING (IF USED)
	169.0FT.	6.62_IN.		9.25_IN.	[X] STEEL ☐ PLASTIC ☐ CONCRETE	[X] BOTTOM ☐ TOP ☐ FULL LENGTH	LENGTH FT. OUTSIDE DIAMETER IN.

SCREEN (UNCONSOLIDATED MATERIAL WELLS)	SCREEN LENGTH	SCREEN TYPE/SLOT SIZE
	FT.	

CASING GROUT MATERIAL	GROUT TYPE (CHOOSE ONE)	NO. OF BAGS OR	METHOD OF GROUT INSTALLATION (CHOOSE ONLY ONE)	DRIVE SHOE	DRILLING
	CEMENT ☐ TYPE 1 ☐ HI EARLY **BENTONITE** ☐ CHIPS ☐ GRANULAR ☐ PELLETS [X] SLURRY	CUBIC YARDS 10.0 LBS PER BAG	☐ GRAVITY ☐ TREMIE ☐ AS DRIVEN ☐ PRESSURE THROUGH CASING ☐ PRESSURE THROUGH TREMIE ☐ OPEN HOLE [X] POS. DISPLACEMENT	USED? ☐ YES ☐ NO	SUSPENDED? ☐ YES [X] NO ____HRS

LINER DETAILS	LENGTH	DEPTH TO TOP OF LINER	O.D. OF LINER	LINER MATERIAL	WEIGHT (LB)SDR#, SCH#	POSITION OF SEAL	PERFORATED INTERVAL
	FT.	FT.	IN.	☐ STEEL ☐ PLASTIC		☐ FULL LENGTH ☐ BOTTOM	FROM TO

LINER GROUT MATERIAL	GROUT TYPE	NO. OF BAGS OR USED	METHOD OF GROUT INSTALLATION	LINER USE	ABANDONED WELL
	CEMENT ☐ TYPE 1 ☐ HI EARLY **BENTONITE** ☐ SLURRY ☐ GRANULAR ☐ CHIPS ☐ PELLETS	PER BAG 100	☐ GRAVITY ☐ TREMIE ☐ AS LINER INSTALLED	☐ HOLD BACK FORMATION ☐ PREVENT RUST ☐ SEAL OUT UNDESIRABLE CONDITIONS	ON SITE? ☐ YES WAS THE WELL PLUGGED? ☐ YES ☐ NO

DEPTH PACKERS SET

FT.

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	50.0	DRT,CLY,SS
50.0	60.0	BRKN ROCK
60.0	120.0	LS
120.0	125.0	BRKN ROCK
125.0	210.0	LS

DEPTH TO BEDROCK FT.

TOTAL DEPTH 210.0 FT.

LOCATION OF WELL OR PUMP

LAT. 38 ° 7' 31.8"

LONG. 90 ° 17' 44.5"

DRILL AREA A1

ELEVATION

LEGAL LOCATION

SECTION 6 TOWNSHIP 39N RANGE 7 E

COUNTY

JEFFERSON

WELL COMPLETION DATE	PUMP INFORMATION REQUIRED (IF INSTALLED)
08/12/1997	
WELL YEILD 30.0 GPM	PUMP INSTALLATION DATE
STATIC WATER LEVEL FT.	DEPTH PUMP SET 180.0 FT.
DEPTH TO FIRST GROUND WATER FT.	PUMP RATE 10.0 GPM

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

PRIMARY CONTRACTOR SIGNATURE RICKY COLEMAN	PERMIT# 001057	DATE
WELL DRILLER SIGNATURE RICKY COLEMAN	PERMIT# 001057	DATE
PUMP INSTALLER SIGNATURE RICKY COLEMAN	PERMIT# 001057	DATE
APPRENTICE DRILLER SIGNATURE	PERMIT#	DATE
APPRENTICE PUMP SIGNATURE	PERMIT#	DATE

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
DOMESTIC/MULTIFAMILY WELL RECORD AND PUMP INFORMATION DATA

OFFICE USE ONLY

REF NO	DATE RECEIVED
00186309	10/27/1997
CR NO	CHECK NO.
	1052

ROUTE	APPROVED	DATE	ENTERED	STATE CERT NO	REVENUE NO.
PCD / PLT	IMPORT	12/11/1997	CONVERT	A062984	784069

OWNER NAME	TELEPHONE WITH AREA CODE	VARIANCE NUMBER	CASING DEPTH LETTER
DAVID ROSE	314-937-9163		[ ] YES [ ] NO

OWNER ADDRESS	CITY	STATE	ZIP
870 JOHNSON RD	BLOOMSDALE	MO	63627

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
		MO	

USE OF WELL
[X] DOMESTIC
[ ] MULTI-FAMILY

OWNERS SIGNATURE (Water Use Information Verified by Owner Signature)

DATE

CASING DETAILS	CASING LENGTH	O.D. OF CASING	WEIGHT (LB) SDR#, SCH#	DIAMETER OF DRILL HOLE	CASING MATERIAL	POSITION OF GROUT SEAL	SURFACE CASING (IF USED)
	120.0FT.	6.0__IN.		8.62_IN.	[ ] STEEL [X] PLASTIC [ ] CONCRETE	[X] BOTTOM [ ] TOP [ ] FULL LENGTH	LENGTH FT. OUTSIDE DIAMETER IN.

SCREEN (UNCONSOLIDATED MATERIAL WELLS)	SCREEN LENGTH	SCREEN TYPE/SLOT SIZE
	FT.	

CASING GROUT MATERIAL	GROUT TYPE (CHOOSE ONE)	NO. OF BAGS OR	METHOD OF GROUT INSTALLATION (CHOOSE ONLY ONE)	DRIVE SHOE	DRILLING
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [ ] CHIPS [X] GRANULAR [ ] PELLETS [ ] SLURRY	CUBIC YARDS 7.0_____ LBS PER BAG _____	[X] GRAVITY [ ] TREMIE [ ] OPEN HOLE [ ] POS. DISPLACEMENT [ ] AS DRIVEN [ ] PRESSURE THROUGH CASING [ ] PRESSURE THROUGH TREMIE	USED? [ ] YES [ ] NO	SUSPENDED? [ ] YES [X] NO _____HRS

LINER DETAILS	LENGTH	DEPTH TO TOP OF LINER	O.D. OF LINER	LINER MATERIAL	WEIGHT (LB)SDR#, SCH#	POSITION OF SEAL	PERFORATED INTERVAL
	FT.	FT.	IN.	[ ] STEEL [ ] PLASTIC		[ ] FULL LENGTH [ ] BOTTOM	FROM TO

LINER GROUT MATERIAL	GROUT TYPE	NO. OF BAGS OR USED	METHOD OF GROUT INSTALLATION	LINER USE	ABANDONED WELL
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [ ] SLURRY [ ] GRANULAR [ ] CHIPS [ ] PELLETS	PER BAG 50_____	[ ] GRAVITY [ ] TREMIE [ ] AS LINER INSTALLED	[ ] HOLD BACK FORMATION [ ] PREVENT RUST [ ] SEAL OUT UNDESIRABLE CONDITIONS	ON SITE? [ ] YES WAS THE WELL PLUGGED? [ ] YES [ ] NO
	DEPTH PACKERS SET FT.				

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	60.0	SND
60.0	300.0	LS
300.0	345.0	WT SND

DEPTH TO BEDROCK FT.

TOTAL DEPTH 345.0 FT.

LOCATION OF WELL OR PUMP

LAT. 38 ° 7' 31.8"

LONG. 90 ° 17' 44.5"

DRILL AREA A1_____

ELEVATION _____

LEGAL LOCATION

SECTION 6 TOWNSHIP 39N RANGE 7 E

COUNTY

JEFFERSON

WELL COMPLETION DATE	PUMP INFORMATION REQUIRED (IF INSTALLED)
10/03/1997	
WELL YEILD 30.0 GPM	PUMP INSTALLATION DATE
STATIC WATER LEVEL FT.	DEPTH PUMP SET 320.0 FT.
DEPTH TO FIRST GROUND WATER FT.	PUMP RATE 12.0 GPM

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

PRIMARY CONTRACTOR SIGNATURE WILLIE PATTERSON	PERMIT# 002476	DATE
WELL DRILLER SIGNATURE JOHNNY PATTERSON	PERMIT# 003033	DATE
PUMP INSTALLER SIGNATURE JOHNNY PATTERSON	PERMIT# 003033	DATE
APPRENTICE DRILLER SIGNATURE	PERMIT#	DATE
APPRENTICE PUMP SIGNATURE	PERMIT#	DATE

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
DOMESTIC/MULTIFAMILY WELL RECORD AND PUMP INFORMATION DATA

OFFICE USE ONLY

REF NO	DATE RECEIVED
00173730	07/06/1998
CR NO	CHECK NO.
	1632

ROUTE	APPROVED	DATE	ENTERED	STATE CERT NO	REVENUE NO.
PCD / PLT	IMPORT	07/30/1998	CONVERT	A069133	756216

OWNER NAME	TELEPHONE WITH AREA CODE	VARIANCE NUMBER	CASING DEPTH LETTER
BRENT KEMP			☐ YES ☐ NO

OWNER ADDRESS	CITY	STATE	ZIP
1755 HARNESS RD	FESTUS	MO	63028

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
		MO	

USE OF WELL
☒ DOMESTIC
☐ MULTI-FAMILY

OWNERS SIGNATURE (Water Use Information Verified by Owner Signature)

DATE

CASING DETAILS	CASING LENGTH	O.D. OF CASING	WEIGHT (LB) SDR#, SCH#	DIAMETER OF DRILL HOLE	CASING MATERIAL	POSITION OF GROUT SEAL	SURFACE CASING (IF USED)
	81.0_FT.	6.0__IN.		8.62_IN.	☐ STEEL ☒ PLASTIC ☐ CONCRETE	☒ BOTTOM ☐ TOP ☐ FULL LENGTH	LENGTH FT. OUTSIDE DIAMETER IN.

SCREEN (UNCONSOLIDATED MATERIAL WELLS)	SCREEN LENGTH	SCREEN TYPE/SLOT SIZE
	FT.	

CASING GROUT MATERIAL	GROUT TYPE (CHOOSE ONE)	NO. OF BAGS OR	METHOD OF GROUT INSTALLATION (CHOOSE ONLY ONE)	DRIVE SHOE	DRILLING
	CEMENT ☐ TYPE 1 ☒ HI EARLY **BENTONITE** ☐ CHIPS ☐ GRANULAR ☐ PELLETS ☐ SLURRY	CUBIC YARDS 5.0_____ LBS PER BAG _____	☒ GRAVITY ☐ TREMIE ☐ AS DRIVEN ☐ PRESSURE THROUGH CASING ☐ PRESSURE THROUGH TREMIE ☐ OPEN HOLE ☐ POS. DISPLACEMENT	USED? ☐ YES ☐ NO	SUSPENDED? ☐ YES ☒ NO _____HRS

LINER DETAILS	LENGTH	DEPTH TO TOP OF LINER	O.D. OF LINER	LINER MATERIAL	WEIGHT (LB)SDR#, SCH#	POSITION OF SEAL	PERFORATED INTERVAL
	FT.	FT.	IN.	☐ STEEL ☐ PLASTIC		☐ FULL LENGTH ☐ BOTTOM	FROM TO

LINER GROUT MATERIAL	GROUT TYPE	NO. OF BAGS OR USED	METHOD OF GROUT INSTALLATION	LINER USE	ABANDONED WELL
	CEMENT ☐ TYPE 1 ☐ HI EARLY **BENTONITE** ☐ SLURRY ☐ GRANULAR ☐ CHIPS ☐ PELLETS	PER BAG 94_____	☐ GRAVITY ☐ TREMIE ☐ AS LINER INSTALLED	☐ HOLD BACK FORMATION ☐ PREVENT RUST ☐ SEAL OUT UNDESIRABLE CONDITIONS	ON SITE? ☐ YES WAS THE WELL PLUGGED? ☐ YES ☐ NO

DEPTH PACKERS SET
FT.

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	10.0	RED CLAY SOIL
10.0	292.0	WHITE LS
292.0	313.0	TAN LS

DEPTH TO BEDROCK FT.

TOTAL DEPTH 313.0 FT.

LOCATION OF WELL OR PUMP

LAT. 38 ° 7' 40.9"

LONG. 90 ° 16' 46.1"

DRILL AREA A1_____

ELEVATION _____

LEGAL LOCATION

SECTION 5 TOWNSHIP 39N RANGE 7 E

COUNTY

JEFFERSON

WELL COMPLETION DATE	PUMP INFORMATION REQUIRED (IF INSTALLED)
05/17/1998	
WELL YEILD	PUMP INSTALLATION DATE
20.0 GPM	
STATIC WATER LEVEL	DEPTH PUMP SET
FT.	280.0 FT.
DEPTH TO FIRST GROUND WATER	PUMP RATE
FT.	10.0 GPM

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

PRIMARY CONTRACTOR SIGNATURE COLBY SCOTT	PERMIT# 002365	DATE
WELL DRILLER SIGNATURE COLBY SCOTT	PERMIT# 002365	DATE
PUMP INSTALLER SIGNATURE MARK L MICHAEL	PERMIT# 001535	DATE
APPRENTICE DRILLER SIGNATURE	PERMIT#	DATE
APPRENTICE PUMP SIGNATURE	PERMIT#	DATE

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
DOMESTIC/MULTIFAMILY WELL RECORD AND PUMP INFORMATION DATA

OFFICE USE ONLY

REF NO	DATE RECEIVED
00059995	05/24/1991
CR NO	CHECK NO.
	15364

ROUTE	APPROVED	DATE	ENTERED	STATE CERT NO	REVENUE NO.
PCD	IMPORT		CONVERT	A018920	661601

OWNER NAME	TELEPHONE WITH AREA CODE	VARIANCE NUMBER	CASING DEPTH LETTER
GARY SURDYKE	314-937-9166		[ ] YES [ ] NO

OWNER ADDRESS	CITY	STATE	ZIP
1305 HWY 61	CRYSTAL CITY	MO	63019

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
		MO	

USE OF WELL
[X] DOMESTIC
[ ] MULTI-FAMILY

OWNERS SIGNATURE (Water Use Information Verified by Owner Signature)

DATE

CASING DETAILS	CASING LENGTH	O.D. OF CASING	WEIGHT (LB) SDR#, SCH#	DIAMETER OF DRILL HOLE	CASING MATERIAL	POSITION OF GROUT SEAL	SURFACE CASING (IF USED)
	160.0FT.	6.63_IN.		8.63_IN.	[ ] STEEL [X] PLASTIC [ ] CONCRETE	[ ] BOTTOM [ ] TOP [X] FULL LENGTH	LENGTH FT. OUTSIDE DIAMETER IN.

SCREEN (UNCONSOLIDATED MATERIAL WELLS)	SCREEN LENGTH	SCREEN TYPE/SLOT SIZE
	FT.	

CASING GROUT MATERIAL	GROUT TYPE (CHOOSE ONE)	NO. OF BAGS OR	METHOD OF GROUT INSTALLATION (CHOOSE ONLY ONE)	DRIVE SHOE	DRILLING
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [X] CHIPS [ ] PELLETS [ ] GRANULAR [ ] SLURRY	CUBIC YARDS 0.0_____ LBS PER BAG _____	[ ] GRAVITY [ ] TREMIE [ ] OPEN HOLE [ ] POS. DISPLACEMENT [ ] AS DRIVEN [ ] PRESSURE THROUGH CASING [ ] PRESSURE THROUGH TREMIE	USED? [ ] YES [ ] NO	SUSPENDED? [ ] YES [X] NO _____HRS

LINER DETAILS	LENGTH	DEPTH TO TOP OF LINER	O.D. OF LINER	LINER MATERIAL	WEIGHT (LB)SDR#, SCH#	POSITION OF SEAL	PERFORATED INTERVAL
	FT.	FT.	IN.	[ ] STEEL [ ] PLASTIC		[ ] FULL LENGTH [ ] BOTTOM	FROM TO

LINER GROUT MATERIAL	GROUT TYPE	NO. OF BAGS OR USED PER BAG	METHOD OF GROUT INSTALLATION	LINER USE	ABANDONED WELL
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [ ] SLURRY [ ] GRANULAR [ ] CHIPS [ ] PELLETS		[ ] GRAVITY [ ] TREMIE [ ] AS LINER INSTALLED	[ ] HOLD BACK FORMATION [ ] PREVENT RUST [ ] SEAL OUT UNDESIRABLE CONDITIONS	ON SITE? [ ] YES WAS THE WELL PLUGGED? [ ] YES [ ] NO

DEPTH PACKERS SET
FT.

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	65.0	DRT
65.0	205.0	LS
0.0	0.0	50GPM@205

DEPTH TO BEDROCK FT.
TOTAL DEPTH 205.0 FT.

LOCATION OF WELL OR PUMP

LAT. 38 ° 8' 49.7" **DRILL AREA** A1_____

LONG. 90 ° 18' 8.2" **ELEVATION** _____

LEGAL LOCATION

SECTION LG003017 TOWNSHIP _____N RANGE _____

COUNTY

JEFFERSON_____

WELL COMPLETION DATE	PUMP INFORMATION REQUIRED (IF INSTALLED)
04/15/1991	
WELL YEILD 50.0 GPM	PUMP INSTALLATION DATE
STATIC WATER LEVEL FT.	DEPTH PUMP SET 100.0 FT.
DEPTH TO FIRST GROUND WATER FT.	PUMP RATE 15.0 GPM

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

	PERMIT#	DATE
PRIMARY CONTRACTOR SIGNATURE JAMES KLINKHARDT	001242	
WELL DRILLER SIGNATURE JAMES KLINKHARDT	001242	
PUMP INSTALLER SIGNATURE JAMES KLINKHARDT	001242	
APPRENTICE DRILLER SIGNATURE		
APPRENTICE PUMP SIGNATURE		

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
DOMESTIC/MULTIFAMILY WELL RECORD AND PUMP INFORMATION DATA

OFFICE USE ONLY

REF NO	DATE RECEIVED
00059996	05/24/1991
CR NO	CHECK NO.
	15364

ROUTE	APPROVED	DATE	ENTERED	STATE CERT NO	REVENUE NO.
PCD	IMPORT		CONVERT	A018919	661601

OWNER NAME	TELEPHONE WITH AREA CODE	VARIANCE NUMBER	CASING DEPTH LETTER
GARY SURDYKE	314-937-9166		[ ] YES [ ] NO

OWNER ADDRESS	CITY	STATE	ZIP
1305 HWY 61	CRYSTAL CITY	MO	63019

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
		MO	

USE OF WELL
[X] DOMESTIC
[ ] MULTI-FAMILY

OWNERS SIGNATURE (Water Use Information Verified by Owner Signature)

DATE

CASING DETAILS	CASING LENGTH	O.D. OF CASING	WEIGHT (LB) SDR#, SCH#	DIAMETER OF DRILL HOLE	CASING MATERIAL	POSITION OF GROUT SEAL	SURFACE CASING (IF USED)
	100.0FT.	6.63_IN.		8.63_IN.	[ ] STEEL [X] PLASTIC [ ] CONCRETE	[ ] BOTTOM [ ] TOP [X] FULL LENGTH	LENGTH FT. OUTSIDE DIAMETER IN.

SCREEN (UNCONSOLIDATED MATERIAL WELLS)	SCREEN LENGTH	SCREEN TYPE/SLOT SIZE
	FT.	

CASING GROUT MATERIAL	GROUT TYPE (CHOOSE ONE)	NO. OF BAGS OR	METHOD OF GROUT INSTALLATION (CHOOSE ONLY ONE)	DRIVE SHOE	DRILLING
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [X] CHIPS [ ] GRANULAR [ ] PELLETS [ ] SLURRY	CUBIC YARDS 0.0_____ LBS PER BAG _____	[ ] GRAVITY [ ] TREMIE [ ] OPEN HOLE [ ] POS. DISPLACEMENT [ ] AS DRIVEN [ ] PRESSURE THROUGH CASING [ ] PRESSURE THROUGH TREMIE	USED? [ ] YES [ ] NO	SUSPENDED? [ ] YES [X] NO _____HRS

LINER DETAILS	LENGTH	DEPTH TO TOP OF LINER	O.D. OF LINER	LINER MATERIAL	WEIGHT (LB)SDR#, SCH#	POSITION OF SEAL	PERFORATED INTERVAL
	FT.	FT.	IN.	[ ] STEEL [ ] PLASTIC		[ ] FULL LENGTH [ ] BOTTOM	FROM TO

LINER GROUT MATERIAL	GROUT TYPE	NO. OF BAGS OR USED PER BAG	METHOD OF GROUT INSTALLATION	LINER USE	ABANDONED WELL
	CEMENT [ ] TYPE 1 [ ] HI EARLY **BENTONITE** [ ] SLURRY [ ] GRANULAR [ ] CHIPS [ ] PELLETS	_____	[ ] GRAVITY [ ] TREMIE [ ] AS LINER INSTALLED	[ ] HOLD BACK FORMATION [ ] PREVENT RUST [ ] SEAL OUT UNDESIRABLE CONDITIONS	ON SITE? [ ] YES WAS THE WELL PLUGGED? [ ] YES [ ] NO
	DEPTH PACKERS SET FT.				

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	60.0	DRT
60.0	120.0	LS
120.0	164.0	SS
0.0	0.0	100GPM@164

DEPTH TO BEDROCK FT.

TOTAL DEPTH 164.0 FT.

LOCATION OF WELL OR PUMP

LAT. 38 ° 8' 49.7" **DRILL AREA** A1_____

LONG. 90 ° 18' 8.2" **ELEVATION** _____

LEGAL LOCATION

SECTION LG003017 TOWNSHIP _____N RANGE _____

COUNTY

JEFFERSON_____

WELL COMPLETION DATE	PUMP INFORMATION REQUIRED (IF INSTALLED)
04/15/1991	
WELL YEILD 100.0 GPM	PUMP INSTALLATION DATE
STATIC WATER LEVEL FT.	DEPTH PUMP SET 100.0 FT.
DEPTH TO FIRST GROUND WATER FT.	PUMP RATE 15.0 GPM

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

	PERMIT#	DATE
PRIMARY CONTRACTOR SIGNATURE JAMES KLINKHARDT	001242	
WELL DRILLER SIGNATURE JAMES KLINKHARDT	001242	
PUMP INSTALLER SIGNATURE JAMES KLINKHARDT	001242	
APPRENTICE DRILLER SIGNATURE		
APPRENTICE PUMP SIGNATURE		

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
DOMESTIC/MULTIFAMILY WELL RECORD AND PUMP INFORMATION DATA

OFFICE USE ONLY

REF NO	DATE RECEIVED
00226300	06/02/2000
CR NO	CHECK NO.
00236283	2939

ROUTE	APPROVED	DATE	ENTERED	STATE CERT NO	REVENUE NO.
WO1 / WCP / WCP	NRGSWSTU	11/09/2000	NRWENDP	A092363	060200

OWNER NAME	TELEPHONE WITH AREA CODE	VARIANCE NUMBER	CASING DEPTH LETTER
JEFF REESE	636-937-6479		[ ] YES [ ] NO

OWNER ADDRESS	CITY	STATE	ZIP
201 CLERMONT DR	FESTUS	MO	63028

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
LOT 12 CLEVEMONT		MO	

USE OF WELL
[X] DOMESTIC
[ ] MULTI-FAMILY

OWNERS SIGNATURE (Water Use Information Verified by Owner Signature)

DATE

CASING DETAILS	CASING LENGTH	O.D. OF CASING	WEIGHT (LB) SDR#, SCH#	DIAMETER OF DRILL HOLE	CASING MATERIAL	POSITION OF GROUT SEAL	SURFACE CASING (IF USED)
	190.0FT.	6.63_IN.		8.75_IN.	[X] STEEL [ ] PLASTIC [ ] CONCRETE	[ ] BOTTOM [ ] TOP [X] FULL LENGTH	LENGTH FT. OUTSIDE DIAMETER IN.

SCREEN (UNCONSOLIDATED MATERIAL WELLS)	SCREEN LENGTH	SCREEN TYPE/SLOT SIZE
	FT.	

CASING GROUT MATERIAL

GROUT TYPE (CHOOSE ONE)
CEMENT
[ ] TYPE 1 [ ] HI EARLY
BENTONITE
[ ] CHIPS [ ] GRANULAR
[ ] PELLETS [X] SLURRY

NO. OF BAGS OR CUBIC YARDS
29.0_____
LBS PER BAG
_____

METHOD OF GROUT INSTALLATION (CHOOSE ONLY ONE)
[X] GRAVITY [ ] OPEN HOLE
[ ] TREMIE [ ] POS. DISPLACEMENT
[ ] AS DRIVEN
[ ] PRESSURE THROUGH CASING
[ ] PRESSURE THROUGH TREMIE

DRIVE SHOE USED?
[ ] YES [ ] NO

DRILLING SUSPENDED?
[X] YES [ ] NO
12___HRS

LINER DETAILS	LENGTH	DEPTH TO TOP OF LINER	O.D. OF LINER	LINER MATERIAL	WEIGHT (LB)SDR#, SCH#	POSITION OF SEAL	PERFORATED INTERVAL
	FT.	FT.	IN.	[ ] STEEL [ ] PLASTIC		[ ] FULL LENGTH [ ] BOTTOM	FROM TO

LINER GROUT MATERIAL

GROUT TYPE
CEMENT
[ ] TYPE 1 [ ] HI EARLY
BENTONITE
[ ] SLURRY [ ] GRANULAR
[ ] CHIPS [ ] PELLETS

DEPTH PACKERS SET
FT.

NO. OF BAGS OR USED
PER BAG
100_____

METHOD OF GROUT INSTALLATION
[ ] GRAVITY
[ ] TREMIE
[ ] AS LINER INSTALLED

LINER USE
[ ] HOLD BACK FORMATION
[ ] PREVENT RUST
[ ] SEAL OUT UNDESIRABLE CONDITIONS

ABANDONED WELL
ON SITE?
[ ] YES
WAS THE WELL PLUGGED?
[ ] YES
[ ] NO

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	12.0	SURF/CLY
12.0	58.0	LS
58.0	86.0	TN SS
86.0	112.0	LS
112.0	148.0	SH
148.0	156.0	LM/SH MIX
156.0	545.0	LS
545.0	600.0	SS

DEPTH TO BEDROCK FT.
TOTAL DEPTH 600.0 FT.

LOCATION OF WELL OR PUMP

LAT. 38 ° 9' 17.1"
LONG. 90 ° 17' 54.9"
DRILL AREA A1_____
ELEVATION _____

LEGAL LOCATION
SECTION 36 TOWNSHIP 40N RANGE 6 E

COUNTY
JEFFERSON

WELL COMPLETION DATE	PUMP INFORMATION REQUIRED (IF INSTALLED)
04/03/2000	
WELL YEILD	PUMP INSTALLATION DATE
45.0 GPM	
STATIC WATER LEVEL	DEPTH PUMP SET
FT.	500.0 FT.
DEPTH TO FIRST GROUND WATER	PUMP RATE
FT.	25.0 GPM

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

	PERMIT#	DATE
PRIMARY CONTRACTOR SIGNATURE RICKY COLEMAN	001057	
WELL DRILLER SIGNATURE RICKY COLEMAN	001057	
PUMP INSTALLER SIGNATURE		
APPRENTICE DRILLER SIGNATURE		
APPRENTICE PUMP SIGNATURE		

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
DOMESTIC/MULTIFAMILY WELL RECORD AND PUMP INFORMATION DATA

OFFICE USE ONLY

REF NO	DATE RECEIVED
00236283	04/27/2000
CR NO	CHECK NO.
00226300	

ROUTE	APPROVED	DATE	ENTERED	STATE CERT NO	REVENUE NO.
PO1	NRFRYS		CONVERT		

OWNER NAME	TELEPHONE WITH AREA CODE	VARIANCE NUMBER	CASING DEPTH LETTER
SHELIA REESE		_____	☐ YES ☐ NO

OWNER ADDRESS	CITY	STATE	ZIP
201 CLERMONT DR	FESTUS	MO	63028

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
ESTATES OF CLAIRMONT		MO	

USE OF WELL

☒ DOMESTIC

☐ MULTI-FAMILY

OWNERS SIGNATURE (Water Use Information Verified by Owner Signature)

DATE

CASING DETAILS	CASING LENGTH	O.D. OF CASING	WEIGHT (LB) SDR#, SCH#	DIAMETER OF DRILL HOLE	CASING MATERIAL	POSITION OF GROUT SEAL	SURFACE CASING (IF USED)
	FT.	IN.		IN.	☐ STEEL ☐ PLASTIC ☐ CONCRETE	☐ BOTTOM ☐ TOP ☐ FULL LENGTH	LENGTH FT. OUTSIDE DIAMETER IN.

SCREEN (UNCONSOLIDATED MATERIAL WELLS)	SCREEN LENGTH	SCREEN TYPE/SLOT SIZE
	FT.	

CASING GROUT MATERIAL	GROUT TYPE (CHOOSE ONE)	NO. OF BAGS OR CUBIC YARDS	METHOD OF GROUT INSTALLATION (CHOOSE ONLY ONE)	DRIVE SHOE USED?	DRILLING SUSPENDED?
	CEMENT ☐ TYPE 1 ☐ HI EARLY **BENTONITE** ☐ CHIPS ☐ GRANULAR ☐ PELLETS ☐ SLURRY	LBS PER BAG	☐ GRAVITY ☐ TREMIE ☐ OPEN HOLE ☐ POS. DISPLACEMENT ☐ AS DRIVEN ☐ PRESSURE THROUGH CASING ☐ PRESSURE THROUGH TREMIE	☐ YES ☐ NO	☐ YES ☐ NO HRS

LINER DETAILS	LENGTH	DEPTH TO TOP OF LINER	O.D. OF LINER	LINER MATERIAL	WEIGHT (LB)SDR#, SCH#	POSITION OF SEAL	PERFORATED INTERVAL
	FT.	FT.	IN.	☐ STEEL ☐ PLASTIC		☐ FULL LENGTH ☐ BOTTOM	FROM TO

LINER GROUT MATERIAL	GROUT TYPE	NO. OF BAGS OR USED	METHOD OF GROUT INSTALLATION	LINER USE	ABANDONED WELL
	CEMENT ☐ TYPE 1 ☐ HI EARLY **BENTONITE** ☐ SLURRY ☐ GRANULAR ☐ CHIPS ☐ PELLETS	PER BAG	☐ GRAVITY ☐ TREMIE ☐ AS LINER INSTALLED	☐ HOLD BACK FORMATION ☐ PREVENT RUST ☐ SEAL OUT UNDESIRABLE CONDITIONS	ON SITE? ☐ YES WAS THE WELL PLUGGED? ☐ YES ☐ NO

DEPTH PACKERS SET

FT.

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION

DEPTH TO BEDROCK FT.

TOTAL DEPTH 0.0 FT.

LOCATION OF WELL OR PUMP

LAT. 38 ° 9' 0.0"

LONG. 90 ° 18' 0.0"

DRILL AREA CODE TEXT NOT FOUND

ELEVATION _____

LEGAL LOCATION

SECTION 36 TOWNSHIP 40N RANGE 6 E

COUNTY

JEFFERSON

WELL COMPLETION DATE	PUMP INFORMATION REQUIRED (IF INSTALLED)
WELL YEILD GPM	PUMP INSTALLATION DATE 03/31/2000
STATIC WATER LEVEL FT.	DEPTH PUMP SET 500.0 FT.
DEPTH TO FIRST GROUND WATER FT.	PUMP RATE 25.0 GPM

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

	PERMIT#	DATE
PRIMARY CONTRACTOR SIGNATURE		
WELL DRILLER SIGNATURE		
PUMP INSTALLER SIGNATURE GERALD BUECHTING	001596	
APPRENTICE DRILLER SIGNATURE		
APPRENTICE PUMP SIGNATURE		

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY
(573) 368-2165

HIGH YIELD AND PUBLIC WELL RECORD AND PUMP INFORMATION DATA

REF NO	DATE RECEIVED
00263776	07/30/2004
CR NO	

STATE CERT NO	APPROVED DATE	CHECK NO.
A138612	01/31/2006	17107

DATE ENTERED	ROUTE	REVENUE NO.
PHASE 1 PHASE 2 PHASE 3 07/30/2004 12/24/2005 01/31/2006	PCD	073004

INFORMATION SUPPLIED BY WELL OR PUMP INSTALLATION CONTRACTOR

DNR VARIANCE NUMBER _____
CASING DEPTH NUMBER _____
Applicable only if casing depth or variance were obtained from DNR

OWNER NAME	TELEPHONE (OPTIONAL)
HOLCIM US INC	636-933-8184

OWNER ADDRESS	CITY	STATE	ZIP
2942 US HWY 61	BLOOMSDALE	MO	63627

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
		MO	

PROPOSED USE OF WELL **SEE BACK OF FORM FOR WELL CLASSIFICATIONS**

- [ ] Water Supply for Irrigation (capable of producing more than 70 gpm to surface)
  Unconsolidated Material Well [ ] Bedrock Well [ ]
- [ ] Water Supply for a High-Capacity Well capable of producing more than 70 gpm to surface - get casing depth from GSRAD before start
- [ ] Open Loop Heat Pump
  Supply Well [ ] Return Well [ ]
- [X] Water Supply to a Public Facility (convenience store, restaurant, church, business, condo, mobile home park, rural or urban water supply)

CONTACT THE DNR REGIONAL OFFICE to get instructions for water supply to a PUBLIC FACILITY

CASING DETAILS

CASING LENGTH	O.D. OF CASING	DIAMETER OF DRILL HOLE
750.0 FT.	6.0 IN.	12.0 IN.

CASING MATERIAL: [X] STEEL [ ] PLASTIC [ ] CONCRETE

POSITION OF GROUT SEAL [ ] BOTTOM [X] FULL LENGTH [ ] TOP

CASING GROUT MATERIAL

CEMENT	BENTONITE		METHOD OF GROUT INSTALLATION		PRESSURE GROUT	DRILLING SUSPENDED
[X] TYPE 1	[ ] SLURRY	[ ] GRANULAR	[ ] GRAVITY	[ ] POS. DISPLACEMENT	[ ] THROUGH CASING	[X] NO
[ ] HI-EARLY	[ ] CHIPS	[ ] PELLETS	[ ] OPEN HOLE	[ ] TREMIE	[ ] THROUGH TREMIE	[ ] YES ____ HRS

NO. OF SACKS USED 680.0 POUNDS PER SACK _____

LINER DETAILS

LENGTH FT. O.D. OF LINER IN. LINER MATERIAL [ ] STEEL [ ] PLASTIC POSITION OF SEAL [ ] FULL LENGTH [ ] BOTTOM [ ] TOP

LINER GROUT MATERIAL

CEMENT	BENTONITE		METHOD OF GROUT INSTALLATION		LINER USED TO:
[ ] TYPE 1	[ ] SLURRY	[ ] GRANULAR	[ ] GRAVITY	[ ] POS. DISPLACEMENT	[ ] HOLD BACK FORMATION
[ ] HI-EARLY	[ ] CHIPS	[ ] PELLETS	[ ] OPEN HOLE	[ ] TREMIE	[ ] SEAL OUT UNDESIREABLE AQUIFER CONDITIONS
					[ ] PREVENT RUST

NO. OF SACKS USED POUNDS PER SACK 94 ABANDONED WELL ON SITE? [ ] YES PLUGGED? [ ] YES

LOCATION OF WELL

LAT. 38 ° 6' 20.1"
LONG. 90 ° 15' 43.6"
COUNTY STE GENEVIEVE

Please be aware that we do not guarantee the accuracy of the data. It is submitted to us by a third party and has not been field verified.

DEPTH TO FIRST GROUNDWATER FEET	PUMP RATE GPM
WELL YIELD GPM	PUMP SET DEPTH FEET
STATIC WATER LEVEL FEET	PUMP INSTALLATION DATE
WELL COMPLETION DATE 07/12/2004	pump info required this record or on pump card

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	3.0	TOPSOIL,OB
3.0	44.0	BRKN LS
44.0	45.0	SH
45.0	400.0	LS
400.0	501.0	SS,LS
501.0	1386.0	DOL
1386.0	1948.0	DOL,CHT PLUGGED HOLE TO 1672

DEPTH TO BEDROCK FEET

TOTAL DEPTH 1948.0 FEET

(OPTIONAL) ELEVATION _____ FT.

LEGAL LOCATION (OPTIONAL) _____ 1/4 _____ 1/4 _____ 1/4 SEC. 9 TWN. 39 RNG. 7 E

AREA A1

C DATA REQ'D [ ]

OTHER INFORMATION OR LOCATION DATA (OPTIONAL)

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

	PERMIT NUMBER	DATE
PRIMARY CONTRACTOR SIGNATURE PHILIP LUTHER	001036	
WELL DRILLER SIGNATURE PHILIP LUTHER	PERMIT NUMBER 001036	DATE
PUMP INSTALLER SIGNATURE	PERMIT NUMBER	DATE
APPRENTICE DRILLER SIGNATURE	PERMIT NUMBER	DATE
APPRENTICE PUMP SIGNATURE	PERMIT NUMBER	DATE

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY
(573) 368-2165

HIGH YIELD AND PUBLIC WELL RECORD AND PUMP INFORMATION DATA

REF NO	DATE RECEIVED
00263779	07/30/2004
CR NO	

STATE CERT NO	APPROVED DATE	CHECK NO.
A138613	01/31/2006	17107

DATE ENTERED	ROUTE	REVENUE NO.
PHASE 1 PHASE 2 PHASE 3 07/30/2004 12/24/2005 01/31/2006	PCD	073004

INFORMATION SUPPLIED BY WELL OR PUMP INSTALLATION CONTRACTOR

DNR VARIANCE NUMBER _____

CASING DEPTH NUMBER _____
Applicable only if casing depth or variance were obtained from DNR

OWNER NAME	TELEPHONE (OPTIONAL)
HOLCIM US INC	636-933-8184

OWNER ADDRESS	CITY	STATE	ZIP
2942 US HWY 61	BLOOMSDALE	MO	63627

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
		MO	

PROPOSED USE OF WELL **SEE BACK OF FORM FOR WELL CLASSIFICATIONS**

- [ ] Water Supply for Irrigation (capable of producing more than 70 gpm to surface)
  Unconsolidated Material Well [ ] Bedrock Well [ ]
- [ ] Water Supply for a High-Capacity Well capable of producing more than 70 gpm to surface - get casing depth from GSRAD before start
- [ ] Open Loop Heat Pump
  Supply Well [ ] Return Well [ ]
- [X] Water Supply to a Public Facility (convenience store, restaurant, church, business, condo, mobile home park, rural or urban water supply)

CONTACT THE DNR REGIONAL OFFICE to get instructions for water supply to a PUBLIC FACILITY

CASING DETAILS

CASING LENGTH	O.D. OF CASING	DIAMETER OF DRILL HOLE	CASING MATERIAL
750.0 FT.	6.62 IN.	12.0 IN.	[X] STEEL [ ] PLASTIC [ ] CONCRETE

POSITION OF GROUT SEAL [ ] BOTTOM [X] FULL LENGTH [ ] TOP

CASING GROUT MATERIAL

CEMENT	BENTONITE		METHOD OF GROUT INSTALLATION		PRESSURE GROUT	DRILLING SUSPENDED
[X] TYPE 1	[ ] SLURRY	[ ] GRANULAR	[ ] GRAVITY	[ ] POS. DISPLACEMENT	[ ] THROUGH CASING	[X] NO
[ ] HI-EARLY	[ ] CHIPS	[ ] PELLETS	[ ] OPEN HOLE	[ ] TREMIE	[ ] THROUGH TREMIE	[ ] YES ____ HRS

NO. OF SACKS USED 628.0 POUNDS PER SACK _____

LINER DETAILS

LENGTH	O.D. OF LINER	LINER MATERIAL	POSITION OF SEAL
FT.	IN.	[ ] STEEL [ ] PLASTIC	[ ] FULL LENGTH [ ] BOTTOM [ ] TOP

LINER GROUT MATERIAL

CEMENT	BENTONITE		METHOD OF GROUT INSTALLATION		LINER USED TO:
[ ] TYPE 1	[ ] SLURRY	[ ] GRANULAR	[ ] GRAVITY	[ ] POS. DISPLACEMENT	[ ] HOLD BACK FORMATION
[ ] HI-EARLY	[ ] CHIPS	[ ] PELLETS	[ ] OPEN HOLE	[ ] TREMIE	[ ] SEAL OUT UNDESIREABLE AQUIFER CONDITIONS
					[ ] PREVENT RUST

NO. OF SACKS USED POUNDS PER SACK 94 ABANDONED WELL ON SITE? [ ] YES PLUGGED? [ ] YES

LOCATION OF WELL

LAT. 38 ° 6' 20.1"
LONG. 90 ° 15' 43.6"
COUNTY STE GENEVIEVE

Please be aware that we do not guarantee the accuracy of the data. It is submitted to us by a third party and has not been field verified.

DEPTH TO FIRST GROUNDWATER FEET	PUMP RATE GPM
WELL YIELD GPM	PUMP SET DEPTH FEET
STATIC WATER LEVEL FEET	PUMP INSTALLATION DATE
WELL COMPLETION DATE 07/16/2004	pump info required this record or on pump card

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	28.0	TOPSOIL BRKN
28.0	30.0	RD CLY SND
30.0	44.0	LS
44.0	45.0	SH
45.0	400.0	LS,CHT
400.0	421.0	GRY CHT,LS
421.0	498.0	SS,LS
498.0	501.0	BRKN CHT
501.0	1060.0	DOL,CHT

DEPTH TO BEDROCK FEET

TOTAL DEPTH 1060.0 FEET

(OPTIONAL) ELEVATION _____ FT.

LEGAL LOCATION (OPTIONAL) _____ 1/4 _____ 1/4 _____ 1/4 SEC. 9 TWN. 39 RNG. 7 E

AREA A1

C DATA REQ'D [ ]

OTHER INFORMATION OR LOCATION DATA (OPTIONAL)

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

	PERMIT NUMBER	DATE
PRIMARY CONTRACTOR SIGNATURE PHILIP LUTHER	001036	
WELL DRILLER SIGNATURE PHILIP LUTHER	PERMIT NUMBER 001036	DATE
PUMP INSTALLER SIGNATURE	PERMIT NUMBER	DATE
APPRENTICE DRILLER SIGNATURE	PERMIT NUMBER	DATE
APPRENTICE PUMP SIGNATURE	PERMIT NUMBER	DATE

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY
(573) 368-2165

HIGH YIELD AND PUBLIC WELL RECORD AND PUMP INFORMATION DATA

REF NO	DATE RECEIVED
00361434	05/23/2007
CR NO	

STATE CERT NO	APPROVED DATE	CHECK NO.
A150498	08/31/2007	5044504

DATE ENTERED	ROUTE	REVENUE NO.
PHASE 1 PHASE 2 PHASE 3 05/24/2007 05/24/2007 05/24/2007	PCD	052307

INFORMATION SUPPLIED BY WELL OR PUMP INSTALLATION CONTRACTOR

DNR VARIANCE NUMBER _____

CASING DEPTH NUMBER _____
Applicable only if casing depth or variance were obtained from DNR

OWNER NAME	TELEPHONE (OPTIONAL)
HOLCIM US INC	

OWNER ADDRESS	CITY	STATE	ZIP
2942 HWY 61	BLOOMSDALE	MO	63627

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
		MO	

PROPOSED USE OF WELL **SEE BACK OF FORM FOR WELL CLASSIFICATIONS**

- [ ] Water Supply for Irrigation (capable of producing more than 70 gpm to surface)
  Unconsolidated Material Well [ ] Bedrock Well [ ]
- [ ] Water Supply for a High-Capacity Well capable of producing more than 70 gpm to surface - get casing depth from GSRAD before start
- [ ] Open Loop Heat Pump
  Supply Well [ ] Return Well [ ]
- [X] Water Supply to a Public Facility (convenience store, restaurant, church, business, condo, mobile home park, rural or urban water supply)

CONTACT THE DNR REGIONAL OFFICE to get instructions for water supply to a PUBLIC FACILITY

CASING DETAILS

CASING LENGTH 267.0 FT. | O.D. OF CASING 6.63 IN. | DIAMETER OF DRILL HOLE 11.5 IN.

CASING MATERIAL: [X] STEEL [ ] PLASTIC [ ] CONCRETE

POSITION OF GROUT SEAL: [ ] BOTTOM [X] FULL LENGTH [ ] TOP

CASING GROUT MATERIAL

CEMENT	BENTONITE	METHOD OF GROUT INSTALLATION	PRESSURE GROUT	DRILLING SUSPENDED
[X] TYPE 1	[ ] SLURRY	[ ] GRAVITY	[ ] THROUGH CASING	[ ] NO
[ ] HI-EARLY	[ ] CHIPS	[ ] OPEN HOLE	[X] THROUGH TREMIE	[X] YES 72 HRS
	[ ] GRANULAR	[ ] POS. DISPLACEMENT		
	[ ] PELLETS	[ ] TREMIE		

NO. OF SACKS USED 110.0 POUNDS PER SACK _____

LINER DETAILS

LENGTH FT. | O.D. OF LINER IN. | LINER MATERIAL [ ] STEEL [ ] PLASTIC | POSITION OF SEAL [ ] FULL LENGTH [ ] BOTTOM [ ] TOP

LINER GROUT MATERIAL

CEMENT	BENTONITE	METHOD OF GROUT INSTALLATION	LINER USED TO:
[ ] TYPE 1	[ ] SLURRY	[ ] GRAVITY	[ ] HOLD BACK FORMATION
[ ] HI-EARLY	[ ] CHIPS	[ ] OPEN HOLE	[ ] SEAL OUT UNDESIREABLE AQUIFER CONDITIONS
	[ ] GRANULAR	[ ] POS. DISPLACEMENT	[ ] PREVENT RUST
	[ ] PELLETS	[ ] TREMIE	

NO. OF SACKS USED POUNDS PER SACK 90 ABANDONED WELL ON SITE? [ ] YES PLUGGED? [ ] YES

LOCATION OF WELL

LAT. 38 ° 6' 25.0"
LONG. 90 ° 15' 35.0"
COUNTY STE GENEVIEVE

Please be aware that we do not guarantee the accuracy of the data. It is submitted to us by a third party and has not been field verified.

DEPTH TO FIRST GROUNDWATER 170.0 FEET	PUMP RATE 40.0 GPM
WELL YIELD 48.0 GPM	PUMP SET DEPTH 315.0 FEET
STATIC WATER LEVEL 60.0 FEET	PUMP INSTALLATION DATE 04/16/2007
WELL COMPLETION DATE 04/02/2007	pump info required this record or on pump card

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	6.0	RX FILL
6.0	49.0	HARD GRY LS
49.0	130.0	LS
130.0	134.0	GRN SH
134.0	145.0	DRK GRY DOL
145.0	325.0	DOL W/SOME SH BEDS
325.0	412.0	SS
412.0	414.0	DOL
414.0	417.0	BRN SS
417.0	423.0	GRN SH

DEPTH TO BEDROCK 6.0 FEET

TOTAL DEPTH 423.0 FEET

(OPTIONAL) ELEVATION 460 FT.

LEGAL LOCATION (OPTIONAL) _____ 1/4 SW 1/4 NE 1/4
SEC. 9 TWN. 39 RNG. 7 E

AREA A1

C DATA REQ'D [ ]

OTHER INFORMATION OR LOCATION DATA (OPTIONAL)

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

	PERMIT NUMBER	DATE
PRIMARY CONTRACTOR SIGNATURE		
WELL DRILLER SIGNATURE WILLIAM PINSON	PERMIT NUMBER 001792	DATE
PUMP INSTALLER SIGNATURE WILLIAM PINSON	PERMIT NUMBER 001792	DATE
APPRENTICE DRILLER SIGNATURE	PERMIT NUMBER	DATE
APPRENTICE PUMP SIGNATURE	PERMIT NUMBER	DATE

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY
(573) 368-2165

HIGH YIELD AND PUBLIC WELL RECORD AND PUMP INFORMATION DATA

REF NO	DATE RECEIVED
00390620	02/11/2008
CR NO	
00405137	

STATE CERT NO	APPROVED DATE	CHECK NO.
A159616	02/17/2010	16773

DATE ENTERED	ROUTE	REVENUE NO.
PHASE 1 PHASE 2 PHASE 3 02/13/2008 02/13/2008 02/13/2008	PCD2	021108

INFORMATION SUPPLIED BY WELL OR PUMP INSTALLATION CONTRACTOR

DNR VARIANCE NUMBER _____

CASING DEPTH NUMBER _____
Applicable only if casing depth or variance were obtained from DNR

OWNER NAME	TELEPHONE (OPTIONAL)
HOLCIM US INC	

OWNER ADDRESS	CITY	STATE	ZIP
2942 US HWY 61	BLOOOMSDALE	MO	63627

ADDRESS OF WELL (IF DIFFERENT THAN ABOVE)	CITY	STATE	ZIP
		MO	

PROPOSED USE OF WELL **SEE BACK OF FORM FOR WELL CLASSIFICATIONS**

- [ ] Water Supply for Irrigation (capable of producing more than 70 gpm to surface)
  Unconsolidated Material Well [ ] Bedrock Well [ ]
- [ ] Water Supply for a High-Capacity Well capable of producing more than 70 gpm to surface - get casing depth from GSRAD before start
- [ ] Open Loop Heat Pump
  Supply Well [ ] Return Well [ ]
- [X] Water Supply to a Public Facility (convenience store, restaurant, church, business, condo, mobile home park, rural or urban water supply)

CONTACT THE DNR REGIONAL OFFICE to get instructions for water supply to a PUBLIC FACILITY

CASING DETAILS

CASING LENGTH 725.0 FT. | O.D. OF CASING 16.0 IN. | DIAMETER OF DRILL HOLE 22.0 IN.

CASING MATERIAL: [X] STEEL [ ] PLASTIC [ ] CONCRETE

POSITION OF GROUT SEAL: [ ] BOTTOM [X] FULL LENGTH [ ] TOP

CASING GROUT MATERIAL

CEMENT	BENTONITE		METHOD OF GROUT INSTALLATION		PRESSURE GROUT	DRILLING SUSPENDED
[X] TYPE 1	[ ] SLURRY	[ ] GRANULAR	[ ] GRAVITY	[ ] POS. DISPLACEMENT	[X] THROUGH CASING	[ ] NO
[ ] HI-EARLY	[ ] CHIPS	[ ] PELLETS	[ ] OPEN HOLE	[ ] TREMIE	[ ] THROUGH TREMIE	[X] YES 72 HRS

NO. OF SACKS USED 1780.0 POUNDS PER SACK _____

LINER DETAILS

LENGTH FT. | O.D. OF LINER IN. | LINER MATERIAL [ ] STEEL [ ] PLASTIC | POSITION OF SEAL [ ] FULL LENGTH [ ] BOTTOM [ ] TOP

LINER GROUT MATERIAL

CEMENT	BENTONITE		METHOD OF GROUT INSTALLATION		LINER USED TO:
[ ] TYPE 1	[ ] SLURRY	[ ] GRANULAR	[ ] GRAVITY	[ ] POS. DISPLACEMENT	[ ] HOLD BACK FORMATION
[ ] HI-EARLY	[ ] CHIPS	[ ] PELLETS	[ ] OPEN HOLE	[ ] TREMIE	[ ] SEAL OUT UNDESIREABLE AQUIFER CONDITIONS
					[ ] PREVENT RUST

NO. OF SACKS USED _____ POUNDS PER SACK 94 _____ ABANDONED WELL ON SITE? [ ] YES PLUGGED? [ ] YES

LOCATION OF WELL

LAT. 38 ° 6' 41.9"
LONG. 90 ° 15' 30.7"
COUNTY STE GENEVIEVE

Please be aware that we do not guarantee the accuracy of the data. It is submitted to us by a third party and has not been field verified.

DEPTH TO FIRST GROUNDWATER	FEET	PUMP RATE	625.0 GPM
WELL YIELD	650.0 GPM	PUMP SET DEPTH	485.0 FEET
STATIC WATER LEVEL	14.0 FEET	PUMP INSTALLATION DATE	
WELL COMPLETION DATE 01/22/2008		pump info required this record or on pump card	

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	2.0	LS GRVL
2.0	31.0	KIMMSWICK
31.0	391.0	PLATTIN
391.0	443.0	ST PETERS
443.0	590.0	EVERTON
590.0	682.0	POWELL
682.0	717.0	COT
717.0	1067.0	COT JEFF CITY
1067.0	1225.0	ROUBIDEAU
1225.0	1340.0	GASCONADE
1340.0	1420.0	GASCONADE
1420.0	1434.0	GUNTER
1434.0	1460.0	EMINENCE

DEPTH TO BEDROCK 2.0 FEET

TOTAL DEPTH 1460.0 FEET

(OPTIONAL) ELEVATION 405 FT.

LEGAL LOCATION (OPTIONAL) _____ 1/4 _____ 1/4 _____ 1/4 SEC. 9 TWN. 39 RNG. 7 E

AREA A1

C DATA REQ'D [ ]

OTHER INFORMATION OR LOCATION DATA (OPTIONAL)

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

	PERMIT NUMBER	DATE
PRIMARY CONTRACTOR SIGNATURE PHILIP LUTHER	001036	
WELL DRILLER SIGNATURE PHILIP LUTHER	001036	
PUMP INSTALLER SIGNATURE		
APPRENTICE DRILLER SIGNATURE		
APPRENTICE PUMP SIGNATURE		

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY
(573) 368-2165

HIGH YIELD AND PUBLIC WELL RECORD AND PUMP INFORMATION DATA

REF NO 00390618	DATE RECEIVED 10/19/2007
CR NO 00405138	
STATE CERT NO APPROVED DATE A159617 02/17/2010	CHECK NO. 16472
DATE ENTERED PHASE 1 PHASE 2 PHASE 3 10/19/2007 10/19/2007 10/19/2007	ROUTE PCD2 / REVENUE NO. 101907

INFORMATION SUPPLIED BY WELL OR PUMP INSTALLATION CONTRACTOR

DNR VARIANCE NUMBER _____
CASING DEPTH NUMBER _____
Applicable only if casing depth or variance were obtained from DNR

OWNER NAME	TELEPHONE (OPTIONAL)	CITY	STATE	ZIP
HOLCIM US INC		BLOOMSDALE	MO	63627
OWNER ADDRESS 2942 US HWY 61				
ADDRESS OF WELL (IF DIFFERENT THAN ABOVE) WELL #1		CITY	STATE MO	ZIP

PROPOSED USE OF WELL **SEE BACK OF FORM FOR WELL CLASSIFICATIONS**

- [ ] Water Supply for Irrigation (capable of producing more than 70 gpm to surface)
  Unconsolidated Material Well [ ] Bedrock Well [ ]
- [ ] Water Supply for a High-Capacity Well capable of producing more than 70 gpm to surface - get casing depth from GSRAD before start
- [ ] Open Loop Heat Pump
  Supply Well [ ] Return Well [ ]
- [X] Water Supply to a Public Facility (convenience store, restaurant, church, business, condo, mobile home park, rural or urban water supply)
  CONTACT THE DNR REGIONAL OFFICE to get instructions for water supply to a PUBLIC FACILITY

CASING DETAILS

CASING LENGTH 725.0 FT. | O.D. OF CASING 16.0 IN. | DIAMETER OF DRILL HOLE 22.0 IN.

CASING MATERIAL: [X] STEEL [ ] PLASTIC [ ] CONCRETE

POSITION OF GROUT SEAL: [ ] BOTTOM [X] FULL LENGTH [ ] TOP

CASING GROUT MATERIAL
CEMENT: [X] TYPE 1 [ ] HI-EARLY
BENTONITE: [ ] SLURRY [ ] CHIPS [ ] GRANULAR [ ] PELLETS
METHOD OF GROUT INSTALLATION: [ ] GRAVITY [ ] OPEN HOLE [ ] POS. DISPLACEMENT [ ] TREMIE
PRESSURE GROUT: [X] THROUGH CASING [ ] THROUGH TREMIE
DRILLING SUSPENDED: [ ] NO [X] YES 72 HRS

NO. OF SACKS USED 1440.0 POUNDS PER SACK _____

LINER DETAILS

LENGTH FT. | O.D. OF LINER IN. | LINER MATERIAL [ ] STEEL [ ] PLASTIC | POSITION OF SEAL [ ] FULL LENGTH [ ] BOTTOM [ ] TOP

LINER GROUT MATERIAL
CEMENT: [ ] TYPE 1 [ ] HI-EARLY
BENTONITE: [ ] SLURRY [ ] CHIPS [ ] GRANULAR [ ] PELLETS
METHOD OF GROUT INSTALLATION: [ ] GRAVITY [ ] OPEN HOLE [ ] POS. DISPLACEMENT [ ] TREMIE
LINER USED TO: [ ] HOLD BACK FORMATION [ ] SEAL OUT UNDESIREABLE AQUIFER CONDITIONS [ ] PREVENT RUST

NO. OF SACKS USED POUNDS PER SACK 94 ABANDONED WELL ON SITE? [ ] YES PLUGGED? [ ] YES

LOCATION OF WELL

LAT. 38 ° 6' 38.7"
LONG. 90 ° 15' 16.5"
COUNTY STE GENEVIEVE

Please be aware that we do not guarantee the accuracy of the data. It is submitted to us by a third party and has not been field verified.

DEPTH TO FIRST GROUNDWATER FEET	PUMP RATE 625.0 GPM
WELL YIELD 800.0 GPM	PUMP SET DEPTH 485.0 FEET
STATIC WATER LEVEL 22.0 FEET	PUMP INSTALLATION DATE
WELL COMPLETION DATE 09/20/2007	pump info required this record or on pump card

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	2.0	LS GRVL
2.0	31.0	KIMMSWICK
31.0	390.0	PLATTIN
390.0	442.0	ST PETERS
442.0	589.0	EVERTON
589.0	680.0	POWELL
680.0	715.0	COTTER
715.0	1065.0	COTTER JEFF CTY
1065.0	1215.0	ROUBIDEAU
1215.0	1330.0	GAS
1330.0	1410.0	GAS
1410.0	1422.0	GUNTER
1422.0	1460.0	EMINENCE

DEPTH TO BEDROCK 2.0 FEET
TOTAL DEPTH 1460.0 FEET

(OPTIONAL) ELEVATION 405 FT.
LEGAL LOCATION (OPTIONAL) _____ 1/4 _____ 1/4 _____ 1/4 SEC. 9 TWN. 39 RNG. 7 E
AREA A1
C DATA REQ'D [ ]

OTHER INFORMATION OR LOCATION DATA (OPTIONAL)

I HEREBY CERTIFY THE WELL/PUMP INFORMATION DESCRIBED HEREIN IS TRUE AND ACCURATE

PRIMARY CONTRACTOR SIGNATURE PHILIP LUTHER	PERMIT NUMBER 001036	DATE
WELL DRILLER SIGNATURE PHILIP LUTHER	PERMIT NUMBER 001036	DATE
PUMP INSTALLER SIGNATURE	PERMIT NUMBER	DATE
APPRENTICE DRILLER SIGNATURE	PERMIT NUMBER	DATE
APPRENTICE PUMP SIGNATURE	PERMIT NUMBER	DATE

LOG ID: 028952

WELL TYPE
Noncommunity Public Well

DRILL DATE: 2004/04/

DRILL DEPTH: 1,948FT

DEPTH TO BED: 15FT

S.W.L. (BEFORE CASING):

S.W.L. (AFTER CASING):

TOWNSHIP	RANGE	SECTION
39N	7E	9

ELEVATION:

UTM X	UTM Y
740,054.39	4,221,071.52

ZONE 15

REMARKS: Observation Well #1

Appendix C

Golder Associates Inc., Data Validation Memorandum

MEMORANDUM

Date:	May 6, 2014	**Project No.:**	1301560
To:	File	**Company:**	Golder Associates
From:	Amanda W. Derhake, Ph.D., PE		
cc:		**Email:**	aderhake@golder.com
RE:	**DATA VALIDATION SUMMARY**		

Level 2 data validation was carried out on the laboratory analytical data for the Rush Island water samples collected in April 2014. Analytical testing and reporting was performed by Eurofins Lancaster Laboratories Environmental.

Sample analytical data for all samples from sample groups 1468462 and 1470070, matrix spike/matrix spike duplicate (MS/MSD), laboratory control sample (LCS) recoveries, method blanks, hold times, and dilutions were reviewed during the validation. The USEPA National Functional Guidelines for validating inorganic data were used as guidance when evaluating results and raw data.

The following notes and qualifications are applicable to Sample Group 1468462:

- Zinc was qualified as non-detect (U) in samples RI-C-2, RI-C-3, RI-C-5, and RI-C-6 because the detections in the samples were not five times greater than the detections in the method blank.
- The associated sample with the duplicate sample RI-DUP is RI-R-4S.
- The associated sample with the duplicate sample RI-DUP Filtered is RI-R-4S Filtered.
- The associated sample with the duplicate sample R-C-1 DUP is R-C-1.
- The associated sample with the duplicate sample R-C-1 Filtered DUP is R-C-1 Filtered.

The following notes and qualifications are applicable to Sample Group 1470070:

- Separate, Site-specific MS/MSD and duplicate were not submitted for analysis.
- Zinc detections were qualified as non-detect (U) in samples TBW-1, TBW-2 and DUP-1 because the detections in the sample were not five times greater than the detections in the field blank.
- Calcium was qualified as non-detect (U) in sample RB-1 because the detection in the sample were not five times greater than the detections in the method blank.
- Copper detections were qualified as estimated values (J) for samples TBW-2 because the detections were less than five times the limit of quantitation (LOQ) and the absolute value of the relative percent difference (RPD) in the MS/MSD was greater than the LOQ.
- The associated sample with the duplicate sample DUP-1 is TBW-1.

No items in either Sample Group required the rejection of data results.

Appendix D

Resumes

Lisa J. N. Bradley, Ph.D., DABT
Senior Toxicologist and Vice President

Professional History

AECOM (formerly ENSR)
Massachusetts Institute of Technology
University of Idaho

Education

PhD (Toxicology) Massachusetts Institute of Technology, 1991
BS (Zoology) University of Idaho, 1983
BS (Chemistry) University of Idaho, 1983

Years of Experience 25

Technical Specialties

Toxicology
Risk Assessment
Environmental Communication
Regulatory Negotiation
Site Strategy Development

Professional Affiliations

Diplomate, American Board of Toxicology, 1994
Society of Toxicology
Phi Beta Kappa

Dr. Lisa Bradley is a Senior Toxicologist/Risk Assessor and Vice President with AECOM. She has a Ph.D. in toxicology from the Massachusetts Institute of Technology. She has 21 years of experience in risk assessment and toxicology, and is certified by the American Board of Toxicology. She has managed risk assessments for hazardous waste sites in many EPA Regions, and under many state programs. Dr. Bradley is experienced in agency negotiations, as well as public speaking and environmental communications, and she has published articles in peer reviewed scientific journals based on both her laboratory and risk assessment work.

Dr. Bradley is the project manager for the Pines Area of Investigation in Indiana, a coal ash site being managed under the Superfund Alternative program in USEPA Region 5. She has also conducted risk assessments for coal ash landfills, environmental communications for proposed landfills, and has worked with clients to evaluate and comment on state groundwater standards for coal ash related constituents. Dr. Bradley is the manager and technical lead for AECOM's coal combustion product (CCP) initiative, and has been active with utilities and industry trade groups in responding to EPA's proposed rulemaking. She has published and given many talks on various aspects of CCP risk assessment issues and the proposed rules. She has been active with ACAA and with the Government Relations Committee, and was recently elected to the ACAA Executive Committee by the Board of Directors. She is a global risk practice technical lead for AECOM, and leads the Environment Innovation Council for AECOM.

Representative Coal Combustion Product Experience

Pines Area of Investigation, Indiana. Serving as project manager for a multi-disciplinary team conducting the Remedial Investigation/Feasibility Study for the Respondents of an Administrative Order on Consent (AOC) being administered under the Superfund Alternative program in USEPA Region 5. The AOC addresses the placement of coal combustion by-products (CCBs) within a local permitted landfill and allegedly used as fill in other locations within the Area of investigation. Activities to date include agency negotiations on the AOC and scope of work; submission of a Site Management Strategy document, and subsequent approval by the Agency; submittal of the RI/FS Work Plan (including a Field Sampling Plan, Human Health and Ecological Risk Assessment Work Plans, HASP, QAPP, and a Quality Management Plan), and subsequent approval by the agency; submission of additional Sampling and Analysis Plans; and communications activities (including a website and regular mailings of information updates to the community: www.pinesupdate.com). Regular communications with the agency is also a cornerstone of the project. As the site covers not a facility, but a town and surrounding area, executing access agreements with the land owners for sampling and well installation was a critical task. Four rounds of sampling and analysis have been successfully completed. The Final RI Report has been approved and posted to USEPA's website, and the Human Health Risk Assessment Report and the Ecological Risk Assessment Report have been approved. The Draft Feasibility Study has been submitted to the agency. Approved project documents to date are available on USEPA's website: http://www.epa.gov/region5/sites/pines/index.htm.

Aurora Energy, Fairbanks, AK. Providing consulting services for an EPA HRS scoring investigation of the coal-fired power plant. Activities have included fact sheet preparation, frequently asked questions and answers, document review, strategy development, and risk-based evaluation of detailed coal and coal ash data sets for the facility.

Utility Solid Waste Activities Group (USWAG), Washington, DC. Worked with USWAG on developing comments on USEPA's October 2011 Notice of Data Availability (NODA), specifically on the risk assessment aspects of the NODA. Comments were submitted to EPA under USWAG cover, November 2011.

Utility Solid Waste Activities Group (USWAG), Washington, DC. Worked with USWAG on developing comments on USEPA's June 2010 proposed rule for the regulation of the disposal of coal combustion residuals (CCR). Reviewed and developed comments on the USEPA's revised risk assessment, on the USEPA's draft fugitive dust report, and developed comments on the Subtitle C listing criteria provided by USEPA in the proposed rule. Comments were submitted to EPA under USWAG cover, November 2010.

Utility Solid Waste Activities Group (USWAG), Washington, DC. Reviewed and developed comments on the USEPA's risk assessment for

coal combustion wastes. The risk assessment was released in 2007, and comments were submitted under USWAG cover in January 2008. AECOM addressed all aspects of the risk assessment including human health, ecological risk and fate and transport. Provided oral comments during a national teleconference.

Electric Power Research Institute. Developed the report "Comparison of Risks for Leachate from Coal Combustion Product Landfills and Impoundments with Risks for Leachate from Municipal Solid Waste Landfill Facilities," EPRI Report Number 1020555, available at www.epri.com.

Utility Solid Waste Activities Group (USWAG), Washington, DC. Developed information sheet on "What is Coal Ash" for use by the USWAG membership for community relations.

Prairie State Energy Campus, Washington County, IL. Provided presentation to county board on coal ash composition and health risk issues as part of a coal ash landfill siting matter. Provided similar presentation to the public in an informational meeting.

We Energies, Milwaukee, WI. Reviewed the basis of the state and USEPA screening levels and toxicity values for molybdenum, and demonstrated the over-conservatism used in their derivation. Provided the review to the state agency, and developed a fact sheet on molybdenum in groundwater for communications with a local community.

We Energies, Milwaukee, WI. Reviewed the basis of the state screening levels and toxicity values for aluminum as part of review of the Wisconsin Department of Natural Resources proposed groundwater standards under NR 140. Provided testimony for a board hearing, and met with the state regulators, and demonstrated the over-conservatism used in their derivation.

Ameren UE, St. Louis, MO. Developed a human health and ecological risk assessment to support the regulatory closure under the state agency of a former ash impoundment located along a major river at the Hutsonville, IL Power Station. Boron and molybdenum were constituents of interest. Pathways evaluated in the risk assessment included use of groundwater for irrigation purposes and the migration of groundwater to the river and potential impact on the benthic community. Work included negotiation meeting with the local agency.

Ameren UE, St. Louis, MO. Serving as an expert for a landfill siting project in Missouri, for issues related to exposure, toxicity and risk assessment. Provided public testimony at a county board meeting as well as written comments that have been submitted into the record.

Ameren UE, St. Louis, MO. Serving as an expert for the development of site-specific regulation for the closure of Ameren coal ash impoundments in Illinois. Participated in the development of a risk-based system for prioritization closure of the impoundments and developed a white paper on

the program that was submitted to the State as part of the rule-making process.

Ameren UE, St. Louis, MO. Providing toxicology and risk assessment support for various coal ash related projects in Illinois and Missouri.

AES, New York. Provided expert testimony on the lack of human health effects of ammonia in groundwater associated with coal ash landfills. Developed expert opinion, reviewed and critiqued opposing opinions, and testified at hearing.

AES, Puerto Rico. Provided review and synthesis of data associated with a beneficial use product, AGREMAX™ manufactured by AES Puerto Rico using bottom ash and fly ash from the coal-fired power plant. Specifically, evaluation of data on metals content, leaching of metals, and radionuclides were shown not to pose a human health or environmental risk based on the beneficial uses of AGREMAX™. Testified twice at Puerto Rico Senate hearings on potential coal ash legislation.

South Carolina Electric & Gas, Columbia, SC. Provided presentation materials for use in a landfill siting and zoning process. Materials addressed the comparison of arsenic and other metals and radionuclides in coal ash and in our natural environment, and background levels of arsenic in foods and background levels of exposure to radioactivity in our natural environment.

South Carolina Electric & Gas, Columbia, SC. Provided a risk-based review of data related to closure of a former coal storage facility.

Confidential Client. Provided a review of a state's beneficial use regulations and standards as they relate to coal ash.

Confidential Client. Evaluation of Imminent and Substantial Endangerment Claim. Conducted an evaluation of surface water, sediment, and soil data used by USEPA to support an Imminent and Substantial Endangerment (ISE) claim in a draft Administrative Order on Consent. The evaluation included a review of USEPA's approach to evaluating the risks associated with the placement of fill material containing fly ash in a wetland and the potential for downstream impacts. The review concluded that the data did not support USEPA's ISE claim.

Charah, Inc. Louisville, KY. Developed a Safety Data Sheet (SDS) for a flue gas desulfurization (FGD) gypsum project for commercial use.

Committees

Leader, AECOM's Risk Assessment Technical Practice Group including practitioners internationally within AECOM with specialties in human health and ecological risk assessment and other supporting disciplines.

Leader, AECOM's Coal Combustion Products Management Initiative, which

includes engineers, scientists, and related professionals across the national AECOM community.

Leader, AECOM's Environment Innovation Council, that seeks to foster innovation at all levels of the Environment business line.

Elected member of the American Coal Ash Association (ACAA) Executive Committee, and member of the Government Relations Committee, and the Women's Leadership Forum.

Relevant Publications

Bradley, L.J.N., G.M. Fent, and S.W. Casteel. "In Vivo Bioavailability of Arsenic in Coal Combustion By-Products." Poster presented at the Society of Toxicology 2008 annual meeting in Seattle, WA; and the World of Coal Ash 2009 meeting in Lexington, KY.

Bradley, L.J.N., A.E. Perry, K.A.S. Vosnakis, and C. Archer. "PAHs and Dioxins are not Present in Fly Ash at Levels of Concern." Poster presented at the Society of Toxicology 2010 annual meeting in Salt Lake City, UT; and the World of Coal Ash 2009 meeting in Lexington, KY.

Bradley, L.J.N., "Comparison of Risks for Leachate from Coal Combustion Product Landfills and Impoundments with Risks for Leachate from Municipal Solid Waste Landfill Facilities." EPRI Report Number 1020555, available at www.epri.com.

"Coal Ash in Context: Separating Science from Sound Bites As Regulatory and News Media Debates Continue." LJN Bradley and J Ward. Ash at Work, Issue 1, 2011. Available at www.acaa-usa.org.

"Management of Coal Ash Disposal and Household Trash – Do They Need to be Different?" LJN Bradley. Energeia, Volume 22, No. 4, 2011. Available at: http://www.caer.uky.edu/energeia/enerhome.shtml.

"Coal Ash Material Safety: A Health Risk-Based Evaluation of USGS Coal Ash Data from Five US Power Plants." June 2012. Report prepared for the American Coal Ash Association. Available at: www.acaa-usa.org.

"Coal Ash Material Safety: A Health Risk-Based Evaluation of USGS Coal Ash Data from Five US Power Plants." LJN Bradley. Ash at Work, Issue 1, 2012. Available at www.acaa-usa.org.

Presentations

"Conceptual Site Models for Coal Ash Use and Disposal, and Putting Toxicity and Risk into Context." Invited presentation at the World of Coal Ash (WOCA) Short Course on The Science of Ash Utilization, Lexington, KY, April 2013.

"Health Hazards and Risk Issues: Sorting Fact from Fear." Invited presentation at the Coal Combustion Products Utilization & Management: A Practical Workshop. Lexington, KY. October 9-10, 2012.

"Is this Risk for Real? Putting Risk Results into Context." Invited presentation at the Midwest Energy Association meeting, Minneapolis, MN. September 2012.

"Coal Ash Material Safety: A Health Risk-Based Evaluation of USGS Coal Ash Data from Five US Power Plants."

American Coal Ash Association Summer Meeting, Portsmouth, VA. June 2012; and webinar July 2012 with ACAA.

Technical Focus Group, Environmental & Energy Committee Meetings, Council of Industrial Boiler Owners (CIBO), Washington, DC, December 2012.

World of Coal Ash (WOCA), Lexington, KY, April 2013.

National Ready Mix Concrete Association (NRMCA), Redwood City, CA, May 2013.

Electric Power 2013, Chicago, IL, May 2013.

Fluid Bed & Stoker Fired Boiler Operations And Performance Conference, CIBO, Louisville, KY, May 2013.

Air & Waste Management Association (AWMA), Chicago, IL, June 2013.

"Coal Ash Material Safety: A Health Risk-Based Evaluation of USGS Coal Ash Data from Five US Power Plants." Press Conference, National Press Club, Washington, DC. June 6, 2012.

"Health Risk of CCPs: Is Coal Ash Toxic?" Presentation at the South Carolina SWANA Meeting. Myrtle Beach, SC, May 2012.

"Health Risk of CCPs: Is Coal Ash Toxic?" Presentation at Electric Power 2012. Baltimore, MD, May 2012.

"Health Risk of CCPs." Invited presentation at the Coal Ash Consortium, Scottsdale, AZ, March 28, 2012.

"Health Risk of CCPs." Presented at the EUCI conference on CCR Management: Impacts of Regulations and Technological Advances. , Nashville, TN, February 28-29, 2012.

"Risk Assessment: How the EPA Looks at Coal Combustion Products." Presented at the ACAA Fall meeting, Indianapolis, IN, September 27, 2011.

"Risk assessment: An overview of how the U.S. Environmental Protection Agency looks at coal combustion residuals." Presented at the American Chemical Society meeting in Denver, CO, August 28, 2011.

"Is Coal Ash Toxic?" Keynote Presentation at the World of Coal Ash May 10-12, 2011, and invited presentation at The Coal Institute/NCCI meeting July 11, 2011.

"Potential Effect of Proposed Coal Combustion Residuals Regulation and Alternative Leach Testing on Beneficial Reuse." World of Coal Ash May 10-12, 2011.

"Comparison of Risks for Leachate from Coal Combustion Product Landfills and Impoundments with Risks for Leachate from Municipal Solid Waste Landfill Facilities." World of Coal Ash May 10-12, 2011, and poster at Society of Toxicology, March 6-10, 2011.

"Overview of Coal Ash Regulatory Issues." NCASI Northern Regional Meeting May 18-19, 2011.

"Perspectives on Health Risks Associated with Beneficial Re-Use of Byproducts of Coal Combustion." McIlvaine Hot Topic Hour. April 28, 2011.

"Risk Assessment: How the EPA Looks at Coal Combustion Products." Presented at the EUCI conference on Future of Coal Combustion Products (CCPs): Regulatory, Legal, Technical, and New Markets, March 2011, Denver, CO.

"Coal Ash Business Planning and Management: Addressing Risks and Liabilities in a Changing Regulatory Environment." Workshop presented at the EUCI Conference on the Future of Coal Combustion Products, March 2010, Houston, TX.

"Overview of a CCP Site Investigation Conducted Under the Superfund Alternative Program." Presented at the ACAA spring meeting, March 2010, Nashville, TN.

"USEPA's Proposed Rule for Coal Combustion Residuals (CCRs): Beneficial Use Aspects." Presented at the ACAA summer meeting, June 2010, Baltimore, MD.

Education

M.S. Geological Engineering - Graduate research focused on insitu geotechnical testing, University of Missouri-Rolla, Rolla, Missouri, 1996

B.S. Geological Engineering, University of Missouri-Rolla, Rolla, Missouri, 1995

Certifications

Professional Engineer, Missouri, Illinois P.E.

Registered Professional Geologist, Missouri R.G.

OSHA 40-Hour Hazardous Waste Training Certification

OSHA 10-Hour Construction Training Certification

MSHA Part 46, Part 48 Training Certification

Golder Associates Inc. – St. Louis

Employment History

Golder Associates Inc – St. Louis, Missouri

Associate and Senior Geological Engineer / Senior Consultant (2008 to Present)

Responsible for management, preparation, and review of project work plans, hydrogeological characterization, engineering design and construction of geo environmental and geotechnical engineering projects. Project manager for multiple environmental monitoring programs and remediation systems at CERCLA, RCRA, and waste containment facilities and impoundments working with State and USEPA regulators. Project manager and regulatory liaison for investigation, risk assessment, and remediation of petroleum, solvent, and waste impacted sites. Prepared assessment monitoring plans for solid waste facilities, remedial investigation reports, feasibility studies, site closure reports, hydrogeological characterization reports, geotechnical characterization reports, design specifications, bid documents, and remediation design documents. Designed hydrogeological characterization programs for waste landfill siting in Missouri and Illinois and prepared conceptual site models. Certifying engineer for design and construction of corrective action remedies applied to contaminated sites and solid waste facilities. Prepared Remedial Action Plans for on-site disposal of impacted soil and sediments. Project manager and technical lead for preparation of mine and solid waste closure plans.

Golder Associates Inc. – St. Louis, Missouri

Staff then Project then Senior Geological/Geotechnical Engineer (1997 to 2007)

Responsible for preparing project work plans, managing field investigation projects, analyzing project data, making design recommendations, performing construction management, and preparing comprehensive reports. Performed extensive field work for geotechnical and environmental projects including geotechnical and hydrogeological characterization, contaminant transport modeling, seepage analysis, foundation inspection and shallow foundation design. Assessed geotechnical stability of soil and rock slopes; designed embankments and containment systems; performed seepage studies at dams and embankments; and performed and oversaw field quality assurance for soil and groundwater testing. Engineer of Record for final cap and closure of a solid waste landfill and toe drain system for leachate collection.

University of Missouri - Rolla – Rolla, Missouri

Graduate Research Assistant/Teaching Assistant (1995 to 1996)

Researched the use of mined-land for municipal solid waste landfill applications in southwest Missouri as a graduate research assistant. Research work involved field mapping and focused on geotechnical characterization of mine spoil derived soils utilizing plate load testing and insitu geotechnical methods. Instructed several laboratory sections throughout graduate school including Subsurface Exploration and Geomorphic Terrain Analysis.

SELECTED PROJECT EXPERIENCE – WASTE AND HYDROGEOLOGICAL

Landfill Hydrogeological Characterization
Illinois, USA

Designed hydrogeological characterization study for new landfill siting in Illinois. Managed data collection, soil and rock logging, well installation, and hydrogeological characterization activities and developed site conceptual monitoring for new landfill development. Prepared summary reports and plans for submittal to regulatory agencies.

Ash and Surface Impoundment Inspections
Indiana, USA

Performed engineering and environmental inspections of ash impoundment integrity for a power utility company. Reviewed operation and maintenance records and performed detailed inspections of all ash landfills and impoundments. Prepared summary reports and made recommendations to the utility company for rehabilitation of structures, where needed.

TSCA Waste Containment Cell
Illinois, USA

Project manager and engineer for operation and maintenance inspection, landfill leachate and groundwater sampling, groundwater and leachate monitoring plans, and statistical analysis plan for on-going operation of a hazardous waste TSCA containment cell. Prepared summary reports and plans for submittal to regulatory agencies.

Waste Properties
Illinois, USA

Managed day-to-day activities of numerous environmental investigation and remediation projects at several CERLCA, RCRA, and containment cell waste sites at a large clean-up property. Managed and coordinated on-site project work for a two year period including TSCA landfill construction, soil remediation, leachate collection and treatment, groundwater extraction and monitoring system installation, groundwater remediation and treatment, surface water sampling and creek restoration. Prepared bid documents and made contractor selection recommendations for key components of remediation activities. Oversaw and coordinated the work of numerous environmental contractors on behalf of the site ownership group. Reviewed remediation plans and worked with a management team to develop remediation alternatives for approval by state and federal regulatory agencies.

Quad Cities Landfill, Backridge Landfill, Prairie View Landfill and Orchard Hills Landfill
Missouri & Illinois, USA

Installed numerous groundwater monitoring wells and landfill gas monitoring probes at several landfill sites in Illinois and Missouri. Activities included extensive soil sampling and logging using multiple drilling methods and technologies, geologic interpretation for proper well screen placement, monitoring well and gas monitoring probe construction and abandonment of monitoring wells and piezometers. Prepared summary reports, groundwater monitoring reports, and construction documentation for submittal to regulatory agencies.

TSCA Waste Containment Cell
Illinois, USA

Project manager and engineer for operation and maintenance inspection, landfill leachate and groundwater sampling, groundwater and leachate monitoring plans, and statistical analysis plan for on-going operation of a hazardous waste TSCA containment cell. Prepared summary reports and plans for submittal to regulatory agencies.

Northside Landfill
Missouri, USA

Engineer of Record for the certification of an engineered cap system and closure of an existing solid waste landfill. Oversaw and reviewed CQA testing and prepared CQA reports for submittal to MDNR SWMP. Guided the site through the corrective action process for groundwater impacts in site monitoring wells and led public meetings to discuss and defend selected remedies. Performed a Corrective Action Assessment and served as the lead engineer on the design of an interceptor trench and leachate collection system (toe drain) to collect shallow groundwater impacts at the site. Prepared and certified stormwater diversion plans for the final grades at the site. Prepared closure plan and closure report for the site.

Zion Landfill
Illinois, USA

Responsible for the installation of an extensive groundwater and gas monitoring system which was installed in conjunction with new waste cell construction. Activities included geologic logging and sampling of glacial soils, geologic interpretation and sieve analysis for well screen design and depth selection, installation of 14 groundwater monitoring wells and 10 gas probes, abandonment of 17 wells and oversight of all field activities.

Proposed Ste. Genevieve Landfill
Missouri, USA

Performed hydrogeological characterization to create a hydrogeologic model for a potential landfill site in southeastern Missouri. The results of numerous geologic and hydrogeologic investigations at the site were incorporated into a detailed hydrogeologic model of the site. Analyses were performed on slug test data, packer testing data, potentiometric data and geologic and geophysical data to characterize the hydrogeologic setting at the site. Particle travel times and migration pathways were calculated from the results. A hydrogeologic characterization report was written and submitted to the State of Missouri.

City of Lamar Landfill
Missouri, USA

Prepared an assessment monitoring plan for submittal to MDNR SWMP for an active landfill site. Activities included review of existing site data including geologic and hydrogeologic information, statistical groundwater quality data, and landfill monitoring system details. A supplemental evaluation of the landfill monitoring system and its relation to natural geologic conditions was performed in conjunction with the compilation of the assessment monitoring plan.

Gasoline Fuel Release Site
Missouri, USA

Project manager for characterization, risk assessment and remediation of a 20,000 gallon subsurface fuel release. Worked closely with the site owner, stakeholders, regulators and insurance fund personnel to delineate the gasoline impacts to soil and groundwater and guide the project to risk assessment and remediation.

Chemical Plant
Sauget, Illinois

Worked with a team of engineers and hydrogeologists in the design and construction of a groundwater extraction system to pump and treat impacted groundwater from an alluvial aquifer system at a CERCLA site. Responsibilities included layout, geotechnical design, and hydraulic design review of a temporary pipeline. Performed oversight of the installation of telescoping 12-inch diameter extraction wells installed using cable-tool methods. Prepared a summary report and construction documentation for submittal to regulatory agencies.

Industrial Property Remediation
St. Louis, Missouri

Conducted a soil and groundwater investigation at a manufacturing facility to confirm the nature and extent of impacts. Developed remedial alternatives for the site and coordinated with excavation and hauling contractors to remove impacted soil from the property. Work included delineation of impacts, waste profiling, and evaluation of remedial alternatives, coordination and oversight of source and impact removal, and contracting with nearby landfill and hazardous waste facilities for proper disposal. Risk assessment and redevelopment interests were integral to the selection of the final remedy.

Smelting and Chemical Processing Facility
Illinois

Responsible for field activities for a remedial investigation at a listed NPL CERCLA site. Activities included drilling and sampling of soil and water in borings and the installation of shallow, intermediate and deep groundwater monitoring wells. Field activities required stringent sample collection and handling practices and involved continuous oversight by regulatory agency personnel and private consultant representatives.

Industrial Property Remediation
Sterling, Illinois

Conducted a Phase III soil sampling investigation at a manufacturing facility in northern Illinois to confirm the nature and extent of impacted soil. Developed remedial alternatives for the site and coordinated with excavation and hauling contractors to remove the impacted soil from the property. Work included construction management, waste profiling and contracting with a nearby Subtitle D landfill for proper disposal. The excavated soil was replaced with clean granular backfill and the site was restored to pre-impact conditions. Prepared a summary report and construction documentation for submittal to regulatory agencies.

Manufacturing Plant
Illinois

Performed an environmental field investigation to determine the nature and extent of free-product impact at an active manufacturing plant. Oversaw soil and groundwater sampling using direct-push and conventional drilling methods. Work included delineation of impacts and calculation of free-product and groundwater gradients at the site. Involved in the selection process of remediation methods to contain and remediate free-product impacts and minimize operational impact to the facility.

Chemical Plant
Wichita, Kansas

Coordinated field investigation activities and provided oversight of multiple site investigation activities at an active chemical plant. Directed soil and groundwater sampling using direct-push and conventional drilling methods. Coordinated the work of multiple subcontractors to achieve investigation goals within a short timeframe.

Wichita Public Schools
Wichita, Kansas

Coordinated soil and groundwater investigation activities and provided oversight of multiple site investigation and sampling activities. Coordinated source removal as part of the interim remedial measure. Removal action included delineation of impacts, waste profiling, evaluation of remedial alternatives, coordination and oversight of removal, and contracting with nearby landfill and hazardous waste facilities for proper disposal. Refined site hydrogeological model with the use of direct-push methods and geophysical logging. Conductivity logs were compared with conventional geologic data and used to refine remedial alternatives to treat groundwater impacts. Involved in the design and application of bioremediation methods to treat groundwater impacts.

Fenton Creek Dump Site
Fenton, Missouri

Conducted a comprehensive field investigation at a USEPA regulated hazardous waste site. Field activities included installation, development and slug testing of monitoring wells, excavation of numerous test pits and extensive sampling and logging of site soils, water and wastes for geotechnical and environmental chemical testing.

Limestone Mine Hydrogeological Characterization
Missouri, USA

Designed a hydrogeologlical characterization study to assess groundwater and aquifer conditions for development of an underground limestone mine. Study included detailed rock coring, insitu aquifer testing, deep well installation, and preparation of a hydrogeological site conceptual model.

City of Fulton Landfill
Fulton, Missouri

Responsible for sampling groundwater monitoring wells for quarterly analytical testing at a central Missouri landfill in accordance with MDNR solid waste guidelines. Prepared reports and data for submittal to State agency.

Industrial Property Site Closure
Burlington, Iowa

Evaluated a former leaking underground storage tank site and conducted a risk-based site closure under Iowa DNR regulation. Work included upgrading the existing groundwater monitoring system at the site and collecting additional groundwater and soil samples for the purposes of obtaining site closure and delisting from the State's LUST program.

LUST Phase II Investigation
St. Louis, Missouri

Responsible for field investigation at a listed Leaking Underground Storage Tank site. Activities included drilling and sampling of soil borings and the installation, development, slug testing and sampling of groundwater monitoring wells to determine the nature and extent of migration of waste oil contamination.

PROFESSIONAL AFFILIATIONS

American Society of Civil Engineers

Association of State Dam Safety Officials

Society of American Military Engineers

Association of Engineering Geologists

Appendix E

Questions and Answers Fact Sheet

Questions & Answers

Environmental Investigations at the Rush Island Energy Center

July 2014

As part of its ongoing ash management practices at its coal-fired power plant at the Rush Island Energy Center located in Jefferson County, Missouri, Ameren Missouri intends to close the existing ash impoundment system and construct a landfill within the footprint. In conjunction with this effort, Ameren Missouri has conducted an environmental study of groundwater in the upland bluff area and surface water adjacent to the Facility. Based on this study, we have found that there are no adverse impacts on human health from either surface water or groundwater uses that would result from current or historic coal ash management practices at the Facility. This Fact Sheet provides responses to common questions the community may have about this project.

What type of environmental monitoring does Ameren Missouri perform at the Rush Island Energy Center?

Ameren Missouri monitors surface water discharge from the ash impoundment under conditions and requirements set forth in a National Pollutant Discharge Elimination System (NPDES) Permit issued by Missouri Department of Natural Resources (DNR). As also required by the NPDES Permit, Ameren performs Whole Effluent Toxicity tests to evaluate the potential environmental toxicity of the discharge to aquatic life.

Further, Ameren has conducted an environmental study of bedrock groundwater in the upland bluff area and surface water adjacent to the Facility. For this study, Ameren Missouri has collected and analyzed samples of:

- Bedrock groundwater collected from the upland bluff area west of the Facility,
- Surface water from Isle Du Bois Creek from locations upstream, midstream and downstream of the Facility, and
- Surface water from the Mississippi River from locations upstream and downstream of the Facility.

The results of the environmental study are presented in AECOM's Risk Assessment Report. Analysis of the data as presented in the Report indicate no adverse impacts on human health or the environment for either surface water or bedrock groundwater in the upland bluff area west of the Facility as a result of coal ash management practices at the Rush Island Energy Center.

What type of environmental monitoring will Ameren Missouri perform at the Rush Island Energy Center in the future?

The proposed landfill (referred to as the Utility Waste Landfill or "UWL") will be located within the footprint of the current ash impoundment, which will be closed to accommodate the landfill. Ameren will be conducting groundwater monitoring in the immediate vicinity as part of the impoundment closure activities. However, it should be noted that based on the results of the environmental study (discussed above), no matter what the new groundwater data from the immediate vicinity of the impoundment may show, the results for the samples of bedrock groundwater in the bluffs west of the Facility and of surface water in Isle Du Bois Creek and the Mississippi River indicate that there are no adverse impacts on human health or the environment due to coal ash management practices at the Facility; thus, any new groundwater monitoring data will not change this conclusion.

Have public or private water supplies in Jefferson County been adversely impacted by the facilities operations?

No. Drinking water wells used by Jefferson County residents are located *upgradient* of the Facility and are installed at deep levels within the bedrock aquifer (typically in excess of 150 feet).

In 2014, Ameren Missouri installed groundwater monitoring wells near the closest residential wells to the existing coal ash management area to confirm the direction of groundwater flow and to assess the quality of drinking water used by such residents. These wells are located approximately 1 mile west of the Facility. That testing confirmed that the closest residential wells are *upgradient* of the Facility, and therefore groundwater will flow *from* the residential area *towards* the Facility and the Mississippi River and *not* towards the residential wells. Furthermore, Ameren Missouri tested water from the bedrock groundwater in this area, and confirmed compliance with State drinking water standards and/or risk-based levels.

Can the Mississippi River be safely used as a public drinking water supply?

Yes. The closest drinking water intake (City of Chester, Illinois) on the Mississippi River is located 30 miles downstream from the Facility. Surface water sampling performed adjacent to the Rush Island Energy Center as part of this Report evaluation, demonstrates the lack of adverse impact from coal ash management practices on Mississippi River water quality.

Why is the presence or absence of boron and sulfate so critical in determining whether an impact from an ash management area has occurred?

Elevated concentrations of boron and sulfate are considered to be the primary indicators of releases from coal ash management areas. This is because these constituents are more soluble than the other constituents in coal ash, thus they will be the first to be detected in groundwater, and because they are more mobile in groundwater than other constituents in coal ash.

The analytical results for boron and sulfate for the samples of groundwater and surface water collected during the environmental study show that the concentrations are low, and do not indicate an impact from the coal ash management area to the bedrock groundwater in the bluff area to the west of the Facility or in Isle Du Bois Creek or the Mississippi River.

Is it true that EPA has suggested that coal ash will be treated as non-hazardous under rules to be proposed by EPA governing ash management and disposal?

Yes. We believe EPA will continue to treat coal ash as "non-hazardous." EPA in the preamble to the proposed Effluent Limitation Guideline rule (June 7, 2013) states:

> "Although a final risk assessment for the CCR rule has not yet been completed, reliance on the data and analyses discussed above may have the potential to lower the CCR rule risk assessment results by as much as an order of magnitude. If this proves to be the case, EPA's current thinking is that, the revised risks, coupled with the ELG requirements that the Agency may promulgate, and the increased Federal oversight such requirements could achieve, could provide strong support for a conclusion that regulation of CCR disposal under RCRA Subtitle D would be adequate."

Are Ameren's coal ash management units in compliance with applicable environmental rules and regulations?

Yes. The ash management units are regulated as water treatment devices and are operated pursuant to requirements set forth in the Facility's NPDES Permit. The ash pond is inspected regularly to confirm structural integrity. Unlike the Tennessee Valley Authority (TVA) at the Kingston, TN site where an ash pond failed, Ameren has never permitted the stacking of wet ash at heights well above the berms. Accordingly, the safety issues posed at Kingston cannot and will not occur here (see below).

Is it safe to eat fish from the Mississippi River?

Yes. The Missouri Department of Health and Senior Services (DHSS) provides fish consumption information for the Mississippi River. In their current report for all sections of the Missouri and Mississippi Rivers, DHSS has only one "do not eat" advisory, which is for sturgeon eggs. Some limitations on consumption of specific fish exist for the entire Missouri and Mississippi Rivers and are detailed in the *DHSS – 2013 Fish Advisory*.

http://health.mo.gov/living/environment/fishadvisory/pdf/fishadvisory.pdf

Background Information About the TVA Kingston, TN Ash Pond Release

The ash pond release from the Tennessee Valley Authority (TVA) Kingston, Tennessee Fossil Plant, which occurred in December 2008), still receives wide media attention today. Certainly, the Kingston release had an immediate catastrophic impact to the local environment. Recovery efforts have been conducted over the last several years, and today, the area has been restored (see photographs below).




As part of the recovery process, local, State and Federal officials performed numerous studies on the local population and the environment, the results of which can be summarized as follows:

- Studies by the Tennessee Department of Health in conjunction with the Federal Agency for Toxic Substances and Disease Registry (ATSDR) issued a report indicating little or no adverse health impacts from the release. An official fact sheet describing the evaluation is available on-line at: http://health.state.tn.us/coalashspill.htm.
- The Oak Ridge Association Universities (ORAU) and Vanderbilt University Medical Center conducted a study of the health of residents in the county surrounding the TVA Kingston Fossil Plant. The study authors concluded, "Based on our medical evaluation and the current levels of exposure for these residents, we did not see any effects on their physical health." The press release for this study is available on-line at: http://www.orau.org/media-center/news-releases/2010/fy10-53-kingston-plant-medical-screening-results.aspx.
- A human health risk assessment conducted under the Federal EPA Superfund program did not indicate human health risks above regulatory targets (see the TVA project website for further information: http://www.tva.gov/kingston/reports_papers_presentations/index.htm).
- An extensive ecological risk assessment was also conducted, and has covered a several-year period of investigation. The results indicate:
  - No long-term impacts on the benthic community, fish community, or fish health;
  - No observable impacts on reproductive competence of fish, birds, or turtles;
  - No significant sublethal effects; and,
  - No apparent long term effects on mammals, amphibians, periphyton, birds, and fish

  The only ecological risks identified for residual ash in the river were a potential moderate risk to benthic invertebrates and a potential low-to moderate risk to insectivorous birds feeding primarily on aquatic insects. The primary factors driving those potential risks were sediment toxicity tests which showed toxicity for sediments containing >40% ash and a dietary exposure model for the birds that assumed their diets consisted entirely of aquatic insects.

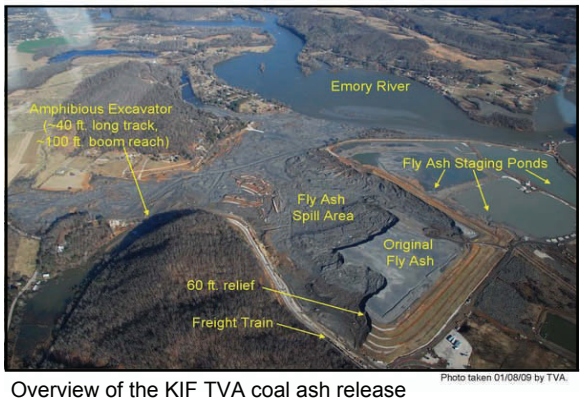
Appendix F

TVA Kingston Health Study Information

TVA Coal Ash Release Public Health Assessment Final Release

What is a Public Health Assessment?

A public health assessment is a formal government report. It is a review of available information about hazardous substances at a site. It evaluates whether exposure to chemicals might harm people. A public health assessment considers all environmental issues related to actual or possible human exposure. It is not the same thing as a medical exam or a community health study. A public health assessment can be prepared by either the Tennessee Department of Health's Environmental Epidemiology Program (EEP) or the federal Agency for Toxic Substances and Disease Registry (ATSDR). TDH ha prepared this PHA, with review and certification by ATSDR.



Overview of the KIF TVA coal ash release

What does a Public Health Assessment consider?

A public health assessment considers how much of a hazardous substance is present at a site or in the community; whether people have been or might become exposed to the hazardous substance; and what exposure pathways, such as breathing, touching, eating, or drinking, are present at the site or in the community.

What is exposure?

Exposure means that you have come into contact with a chemical and it has gotten into your body. You may be exposed to a hazardous substance by breathing, touching, eating or drinking it.

Air samplers at sample location 07. *Source: TDH*

How can a chemical get into your body?

If you come into contact with a chemical, there are three ways it can get into your body:

1. **Inhalation** – breathing air that has a chemical in it. Some chemicals come in the form of dusts, mists, or gases.
2. **Ingestion** – eating or drinking something with a chemical in it. Chemicals can be accidentally ingested by swallowing dust or soil.
3. **Contact** – touching a chemical or something that has the chemical in or on it. Some chemicals can pass through your skin and enter your bloodstream. Other chemicals cannot pass through your skin.

Can coal ash be harmful?

When coal is burned, the metals in the coal become concentrated in the ash. The metals in the coal ash have the potential to cause harm to the environment and to people. For this reason, the Tennessee Valley Authority (TVA), the Environmental Protection Agency (EPA), the Tennessee Department of Environment and Conservation (TDEC), and the Tennessee Department of Health (TDH) immediately began sampling and analysis of the ash itself, surface water, groundwater, drinking water and air. TDH reviewed all analytical results to make sure that public health was protected.

Source: TDEC

Compared with local soil sampled by TDEC, the coal ash at the Kingston Fossil Plant (KIF) is enriched in some metals and not in other metals. Aluminum, arsenic, barium, cadmium, calcium and iron concentrations in KIF's coal ash were higher than in soil. On average, concentrations of copper, magnesium and manganese were lower in KIF's coal ash than in soil. Concentrations of antimony, chromium, lead, mercury, nickel, selenium, silver, thallium and zinc were not much different in KIF's coal ash than in soil.

What have TVA, EPA and TDEC done to protect public health?

TVA, EPA and TDEC have all taken environmental samples for a variety of reasons. All agencies sampled the ash to find out what is in it, and completed analysis to make sure it was not a hazardous waste as defined by EPA. TDEC sampled the municipal drinking water from the Kingston and Rockwood Water Treatment Plants every day, and they continue to sample every week. TDEC samples the river water going into the plants and the water going out for distribution to customers to make sure that the water is not affected by the coal ash. EPA and TDEC sampled well water and spring water to find out if the metals in the coal ash had gotten into the groundwater. TDEC will continue to take samples of the groundwater. TVA, EPA and TDEC have done exhaustive sampling of the Emory, Clinch and Tennessee Rivers to find out how the coal ash is affecting the Watts Bar Reservoir. They continue to sample the rivers. TVA, EPA and TDEC have sampled the air for PM10, PM2.5, and metals in the air at monitors surrounding the coal ash release. TVA and TDEC continue to take air samples. TVA continues to take daily instantaneous air readings at many locations in the wider community.

What data sources did TDH use?

For ash:
TVA, EPA and TDEC

For surface water:
TVA, EPA and TDEC

For public drinking water:
EPA and TDEC

For private wells and springs:
EPA and TDEC

For ambient air:
TVA, EPA and TDEC

For radiological:
TDEC

All data were verified and validated.

What other data sources did TDH consider?

TVA's instantaneous air readings

Environmental sampling done by:

- Duke University
- Appalachian State University
- Appalachian Voices
- Tennessee Aquarium
- Wake Forest University
- United Mountain Defense
- Environmental Integrity Project
- Waterkeeper Alliance's Upper Watauga Riverkeeper Program

TDH's Syndromic Surveillance

TDH's Community Health Survey

TVA's Community Involvement Center

What are the public health implications of the ash spill?

Based on the sampling results by all agencies, TDH is confident that:

- No harm to health should have occurred from touching the coal ash. People had an opportunity to be exposed to the coal ash for about one month before TVA either relocated families or fenced off the coal ash. While coal ash might cause skin irritation, the irritation will stop as soon as the coal ash is washed off.
- Although arsenic was found at concentrations above health comparison values for chronic exposure to children, no harm is expected from a child accidentally eating the coal ash. Chronic health effects from exposure to arsenic require exposures more long term than the type of exposure experienced in this setting. The period of exposure to the coal ash was very short. Small children had little opportunity for direct contact with the coal ash because of the cold, wet weather and the fencing of the ash to prevent contact, as well as the diligence of parents in keeping their children away from the coal ash. The exposure frequency and exposure duration were not long enough to cause harm to the health of children or adults.
- Except in the immediate vicinity of the coal ash release, the coal ash or the metals in the coal ash have not affected surface water in the Watts Bar Reservoir. TVA and TDEC have an advisory for use of the Emory River in the area near the coal ash release. The Army Corps of Engineers and the Coast Guard are patrolling this area to prevent any harm to people. The Emory River from mile marker 1.5 to mile marker 3 is closed to river traffic until February 15, 2010.
- Municipal drinking water from the Kingston and Rockwood water treatment plants has not shown any contamination from the coal ash release since sampling began on December 23, 2008. TDEC is continuing to monitor the drinking water.
- Private well and spring water within 4 miles of the coal ash release have not shown any contamination from the coal ash. TDEC will continue to take periodic samples of private well water in the area.

(continued on page 4)

continued from page 3

What are the public health implications of the ash spill?

- Concentrations of PM10 and PM2.5 have consistently been below EPA regulatory limits since air sampling began on December 31, 2008. Metals in air have consistently been within background levels of metals in the U.S. or below any health comparison values.
- EEP could not determine whether breathing dust near the quarry and along the routes of the quarry trucks has or will harm people's health.
- Concentrations of radionuclides are below the regulatory limits for concentrations of radionuclides in air and water that are protective of public health.

The only way people could have been exposed to the coal ash from late December 2008 through the middle of January 2009 was through direct contact with the coal ash or by accidentally eating some of the coal ash.

The airborne coal ash could affect people exposed to higher concentrations of particulate matter, especially those with pre-existing respiratory or heart conditions. Such effects could include upper airway irritation and aggravation of pre-existing conditions such as asthma, emphysema and other respiratory conditions.

TVA, EPA and TDEC are working to make sure that does not happen. Examples of measures that TVA is taking include:

- applying Flexterra/hydroseed to coal ash where activity is not occurring;
- spraying of water on coal ash where activity is occurring;
- washing cars leaving the site; and
- establishing a central drop off point for delivery of materials that is off site.

What has happened since the Public Health Assessment began?

All conclusions remain valid and unchanged as of April 2010. The Tennessee Department of Health has reviewed data continually as it has become available to make sure the public health of the community near the Tennessee Valley Authority spill site is protected.

The Tennessee Department of Health will continue to follow all sampling and analysis activities and will inform the Tennessee Department of Environment and Conservation and the U.S. Environmental Protection Agency immediately if any results might be a cause of health concern. The Tennessee Department of Health, the Agency for Toxic Substances and Disease Registry, the U.S. Environmental Protection Agency, the Tennessee Department of Environment and Conservation, the Tennessee Valley Authority, Oak Ridge Associated Universities and the Tennessee Poison Center will continue to work together to ensure that public health is protected during the long cleanup process.

If you have comments or questions , please call TDH's Environmental Epidemiology Program at 615-741-7247 or 1-800-404-3006 or write them at:

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

1st Floor Cordell Hull Building
425 5th Avenue North
Nashville, TN 37243

TENNESSEE DEPARTMENT OF HEALTH

You may email comments or questions to EEP.Health@tn.gov.

Medical evaluations reveal no adverse health effects caused by coal fly ash spill at TVA's Kingston Fossil Plant

FOR IMMEDIATE RELEASE:

August 17, 2010

FY10-53

OAK RIDGE, Tenn. — No adverse health effects were found among those Roane County residents who elected to participate in medical evaluations following the December 2008 fly ash spill at TVA's Kingston Fossil Plant. Medical experts at Oak Ridge Associated Universities and Vanderbilt University Medical Center released their findings today.

"Over an eight-month period, we conducted independent comprehensive evaluations of more than 200 residents who opted to undergo a medical evaluation at no cost to the resident," said Donna Cragle, a Ph.D. epidemiologist and vice president of Occupational Exposure and Worker Health for ORAU. "The evaluation was available to any Roane County resident who had health concerns about the fly ash spill."

At the time of the evaluation, the participants ranged in age from less than a year old to 89 years old. The majority of the population (56 percent) was between the ages of 18 and 65 and nearly equally divided between male and female. Approximately half of the participants lived within two miles of the spill.

Overall, the demographics of those participating in the evaluation process mirrored the demographics for the general Roane County population, with the exception that a higher number of participants were over the age of 65. This may be the result of a higher than average number of retirees living in the area.

The medical evaluation included health history, physical examination, a breathing test (spirometry), chest x-ray, routine urinalysis, complete blood count, blood chemistry and biological monitoring tests.

Some residents initially reported symptoms related to upper airway irritation, such runny nose, cough and congestion. The physical examination conducted as part of the medical evaluation found that most participants were normal and that abnormalities or variations were due primarily to preexisting medical conditions.

Urine and/or blood tests were performed for levels of aluminum, arsenic, barium, beryllium, chromium, cobalt, copper, nickel, selenium, thallium and vanadium.

"We chose these agents (with the exception of selenium and thallium) for testing because they were found to be in high concentrations in fly ash-contaminated soil as compared to non-fly ash-contaminated soil in Roane County," said Dr. Cragle. "While selenium and thallium did not exceed regional background soil measurement, they were included in the screening due to their potential health risks."

"Based on our medical evaluation and the current levels of exposure for these residents, we did not see any effects on their physical health," said John Benitez, M.D., medical toxicologist at VUMC.

"Because there are no studies on the long-term health effects of fly ash exposure, results of the evaluation provide a valuable baseline for future medical evaluations," said Dr. Cragle. "A repeat evaluation of the people who participated in the program could determine whether there has been any change in their health that may be related to the fly ash spill."

The December 2008 spill at TVA's Kingston Fossil Plant released approximately 5.4 million cubic yards of fly ash. TVA funded the independent health screening conducted by ORAU and VUMC.

Vanderbilt University Medical Center (VUMC) Tennessee Poison Center is a program of Vanderbilt University Medical Center, a national leader in patient care, medical education, nursing education and research. Tennessee Poison Center is the statewide poison control center and the sixth busiest poison center in the U.S.

Oak Ridge Associated Universities (ORAU) is a university consortium leveraging the scientific strength of 98 major research institutions to advance science and education by partnering with national laboratories, government agencies, and private industry. ORAU manages the Oak Ridge Institute for Science and Education for the U.S. Department of Energy.

Related Links

- ORAU Kingston Project
- Kingston Project Resources

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Appendix G

Groundwater Monitoring of the Rush Island Energy Center Coal Ash Impoundment

Appendix G

Groundwater Monitoring of the Rush Island Energy Center Coal Ash Impoundment

Ameren Missouri has installed and sampled groundwater wells in the immediate vicinity of the current coal ash management area at the Rush Island Energy Center to provide a framework for evaluating groundwater quality in the vicinity of the surface impoundment. Figure G-1 shows the locations of the 23 wells. The results for the February 2014 sampling event are presented on Table G-1 and the results for the June 2014 sampling event are presented on Table G-2.

While the groundwater in this area is not used as a source of drinking water (as determined by the detailed file review of wells located in the vicinity of the Facility; see Section 3.6.1 of the Report), to provide a conservative screening evaluation, detected concentrations are compared to Federal primary and secondary drinking water standards (MCLs and SMCLs), which have been adopted by the State, and human health risk-based screening levels for tap water (RSLs, see Section 2 of the Report).

A total of 27 constituents and pH were measured for each well. The tables indicate that some concentrations of TDS, arsenic, boron, iron, manganese and molybdenum are above the screening levels. Sulfate, chloride, aluminum, antimony, hexavalent chromium, and pH each have only one or two results above screening levels in each round.

While concentrations of some constituents are above drinking water-based screening levels, this groundwater is not used as a source of drinking water, and the investigation presented in this Report has demonstrated that the results for the samples of bedrock groundwater in the bluffs west of the Facility and of surface water in Isle Du Bois Creek and the Mississippi River indicate that there are no adverse impacts on human health or the environment due to coal ash management practices at the Facility.

Table G-1
Comparison of Coal Ash Impoundment Groundwater Monitoring Results to Screening Levels – February 2014 Sampling Event (a)
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Monitoring Well ID	Depth to Top of Screen (ft bgs)	Depth to Bottom of Screen (ft bgs)	pH	Chloride	Fluoride	Sulfate	TDS	Aluminum	Antimony	Arsenic	Boron	Barium	Beryllium	Cadmium	Cobalt	Trivalent Chromium	Hexavalent Chromium	Chromium
			S.U.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	MCL (b)		NA	NA	4	NA	NA	NA	0.006	0.01	NA	2	0.004	0.005	NA	NA	NA	0.1
	SMCL (b)		6.5-8.5	250	2	250	500	0.05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	RSL (c)		NA	NA	0.8	NA	NA	20	0.0078	0.000052	4	3.8	0.025	0.0092	0.006	22	0.000035 (d)	22 (e)
P03D	69.1	74.1	7.16	11			430				0.336	0.454						
P03S	29.0	49.0	7.03	15	0.24		520			0.27	0.742	0.275						
P05I	56.1	61.1	7.16	5	0.12		342			0.0011	0.0552	0.522						
P05S	24.5	44.5	7.00	27	0.8	120	468			0.0566	3.76	0.105						
P08D	70.0	75.0	7.15	15	0.21	135	528			0.0011	2.96	0.104						
P08S	40.0	60.0	6.98	26	0.27	14	474			0.181	1.67	0.26						
P13D	138.0	143.0	7.39	59	0.29	292	728				5.23	0.0638						
P13I	76.0	81.0	7.74	22	0.97	191	462	0.0281		0.0133	8.1	0.049						
P13S	37.0	57.0	7.30	27	0.46	217	726			0.0016	4.11	0.0647						
P17D	125.3	130.3	7.54	32	0.63	57	496			0.0025	4.34	0.0868						
P17I	58.9	63.9	7.97	27	2.6	254	552	0.0298		0.0075	5.1	0.0731						
P17S	19.0	39.0	7.03	39	1.89	195	850			0.0133	2.57	0.0925						
P19D	120.0	125.0	7.45	19	0.43	60	390				5.27	0.151						
P19I	59.5	64.5	10.60	32	1.87	240	872	0.0416	0.0063	0.332	8.83	0.0233						0.001
P19S	22.0	42.0	7.00	29	0.38	77	436			0.0428	2.37	0.215						
P21D	119.2	124.2	7.37	135	1.35	74	686				8.72	0.0753						
P21I	57.8	62.8	7.68	31	1.58	71	252	0.157		0.0034	1.46	0.0303						
P21S	20.0	40.0	6.76	29	0.18		652			0.0162	0.876	0.34						
P22D	105.0	110.0	7.65	26	2.65	46	456	0.0362		0.0034	12.3	0.0318						0.0014
P22I	59.0	64.0	7.54	32	0.72	167	502			0.0065	0.791	0.149						
P22S	19.0	39.0	6.93	27	0.54	178	602			0.003	0.5	0.141			0.002			
P29D	95.3	100.3	7.50	337	0.17	26	828				0.156	0.253						
P29S	30.0	50.0	7.03	26	0.14		496			0.0211	0.0917	0.316						

Notes:
Blank data cells indicate a non-detect value.
MCL - Maximum Contaminant Level.
mg/L - Milligrams per liter.
NA - Not available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level. Value used if no MCL available.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.
(a) - Numerical values were obtained from the Ameren Missouri Rush Island Energy Center, Jefferson County, Missouri. Samples collected on February 26-28, 2014.
(b) - USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. Spring 2012. http://water.epa.gov/drink/contaminants/index.cfm; adopted as Missouri state values at 10 CSR 60-4.
(c) - USEPA Regional Screening Levels (May 2014). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - The hexavalent chromium RSL is derived using a USEPA draft oral cancer dose-response value for hexavalent chromium.
The value used to develop the RSL for hexavalent chromium has been called into question by USEPA's peer review panel, the Science Advisory Board (SAB).
(e) - A tapwater RSL not available for chromium (total). Therefore, the tapwater RSL for chromium (trivalent) is used.
greater than MCL and/or SMCL
greater than MCL/SMCL and RSL
greater than RSL

Table G-1
Comparison of Coal Ash Impoundment Groundwater Monitoring Results to Screening Levels – February 2014 Sampling Event (a)
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Monitoring Well ID	Depth to Top of Screen (ft bgs)	Depth to Bottom of Screen (ft bgs)	Copper mg/L	Iron mg/L	Manganese mg/L	Mercury mg/L	Molybdenum mg/L	Nickel mg/L	Nitrate-N mg/L	Lead mg/L	Selenium mg/L	Silver mg/L	Thallium mg/L	Zinc mg/L
MCL (b)			1.3	NA	NA	0.002	NA	NA	10	0.015	0.05	NA	0.002	NA
SMCL (b)			1	0.3	0.05	NA	NA	NA	NA	NA	NA	0.1	NA	5
RSL (c)			0.8	14	0.43	0.0057	0.1	0.39	NA	NA	0.1	0.094	0.0002	6
P03D	69.1	74.1		14.1	0.476		0.0034							
P03S	29.0	49.0		17.3	0.268		0.0089							
P05I	56.1	61.1		13.9	0.35		0.0471							
P05S	24.5	44.5	0.001	3.06	0.392		0.0957	0.0023						0.01
P08D	70.0	75.0		0.392	0.11		0.078	0.0031						
P08S	40.0	60.0		18.6	0.43		0.0219							
P13D	138.0	143.0		2.24	0.298		0.675	0.0011						
P13I	76.0	81.0	0.0014	0.162	0.0553		0.231	0.002						
P13S	37.0	57.0	0.0024		0.0041		0.05	0.0018	0.138		0.0017			
P17D	125.3	130.3		5.8	0.842		0.146	0.0033						
P17I	58.9	63.9	0.0029	0.808	0.106		0.264	0.0024		0.0021	0.0013			
P17S	19.0	39.0	0.0258	0.101	0.257		0.129	0.026		0.0012	0.0081			
P19D	120.0	125.0		5.18	0.422		0.516	0.0015						
P19I	59.5	64.5	0.0101	0.088	0.0026		0.861	0.0123		0.0113	0.0042			
P19S	22.0	42.0	0.0013	8.6	0.548		0.0234	0.0015						0.017
P21D	119.2	124.2	0.0016	0.547	0.233		0.422	0.0034						
P21I	57.8	62.8		0.397	0.0993		0.0547	0.0022			0.0012			
P21S	20.0	40.0		23.1	1.33		0.0063	0.0012						
P22D	105.0	110.0	0.0015	0.707	0.119		0.408	0.0048			0.0013			
P22I	59.0	64.0		3.03	0.524		0.0327							
P22S	19.0	39.0	0.0013	0.057	0.516		0.0233	0.0077						
P29D	95.3	100.3		9.44	0.31		0.0279	0.0012						
P29S	30.0	50.0		5.7	0.962		0.0114	0.0013						

Notes:
Blank data cells indicate a non-detect value.
MCL - Maximum Contaminant Level.
mg/L - Milligrams per liter.
NA - Not available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level. Value used if no MCL available.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
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(c) - USEPA Regional Screening Levels (May 2014). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - The hexavalent chromium RSL is derived using a USEPA draft oral cancer dose-response value for hexavalent chromium.
The value used to develop the RSL for hexavalent chromium has been called into question by USEPA's peer review panel, the Science Advisory Board (SAB).
(e) - A tapwater RSL not available for chromium (total). Therefore, the tapwater RSL for chromium (trivalent) is used.
greater than MCL and/or SMCL
greater than MCL/SMCL and RSL
greater than RSL

Table G-2
Comparis
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Monitoring Well ID	Depth to Top of Screen (ft bgs)	Depth to Bottom of Screen (ft bgs)	pH S.U.	Chloride mg/L	Fluoride mg/L	Sulfate mg/L	TDS mg/L	Aluminum mg/L	Antimony mg/L	Arsenic mg/L	Boron mg/L	Barium mg/L	Beryllium mg/L	Cadmium mg/L	Cobalt mg/L	Trivalent Chromium mg/L	Hexavalent Chromium mg/L	Chromium mg/L
	MCL (b)		NA	NA	4	NA	NA	NA	0.006	0.01	NA	2	0.004	0.005	NA	NA	NA	0.1
	SMCL (b)		6.5-8.5	250	2	250	500	0.05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	RSL (c)		NA	NA	0.8	NA	NA	20	0.0078	0.000052	4	3.8	0.025	0.0092	0.006	22	0.000035 (d)	22 (e)
P03D	69.1	74.1	7.22	22	0.18		508				0.457	0.451					0.009	
P03S	29.0	49.0	7.14	37	0.27		484	0.0311		0.196	1.04	0.229					0.007	
P05I	56.1	61.1	7.19	23	0.19		390			0.002	0.0446	0.446						
P05S	24.5	44.5	6.98	31	0.77	112	560			0.0565	3.9	0.121						
P08D	70.0	75.0	7.30	10	0.32	76	394			0.001	1.9	0.0855						
P08S	40.0	60.0	7.07	17	0.56		446			0.152	3.44	0.209						
P13D	138.0	143.0	7.38	43	0.37	271	684				4.72	0.0618						
P13I	76.0	81.0	7.77	21	1.2	190	472	0.028		0.0156	8.57	0.0459						
P13S	37.0	57.0	6.87	24	0.43	181	746			0.0011	3.6	0.077						
P17D	125.3	130.3	7.67	32	0.82	40	486			0.0026	4.95	0.0743						
P17I	58.9	63.9	8.07	26	3.22	190	558	0.0433		0.0104	5.16	0.0429						
P17S	19.0	39.0	7.26	33	1.99	217	850			0.084	3.4	0.082			0.002			
P19D	120.0	125.0	7.48	22	0.6	62	406				5.95	0.144						
P19I	59.5	64.5	10.70	30	2.23	264	1010	0.0371	0.0069	0.365	9.43	0.0204						
P19S	22.0	42.0	7.10	34	0.54	106	516			0.044	3.12	0.195						
P21D	119.2	124.2	7.49	131	1.8	93	674				9.43	0.0484						
P21I	57.8	62.8	7.78	28	1.86	68	272	0.163		0.0037	1.61	0.0236						
P21S	20.0	40.0	6.93	44	0.46	22	562			0.0278	1.59	0.23						
P22D	105.0	110.0	7.60	28	2.86	69	522	0.0333		0.0038	12.7	0.031						0.0013
P22I	59.0	64.0	7.58	36	0.99	163	496			0.0063	1.07	0.146						
P22S	19.0	39.0	6.84	36	0.66	204	612	0.807		0.0021	0.567	0.147			0.003			0.0019
P29D	95.3	100.3	7.54	218	0.27	14	686				0.117	0.222						
P29S	30.0	50.0	7.16	20	0.22		428			0.0478	0.0986	0.321						

Notes:
Blank data cells indicate a non-detect value.
btor - below top of riser.
MCL - Maximum Contaminant Level.
mg/L - Milligrams per liter.
NA - Not available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level. Value used if no MCL available.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.
(a) - Numerical values were obtained from the Ameren Missouri Rush Island Energy Center, Jefferson County, Missouri. Samples collected on June 9-11, 2014.
(b) - USEPA 2012 Edition of the Drinking Water Standards and Health Advisories. Spring 2012. http://water.epa.gov/drink/contaminants/index.cfm; adopted as Missouri state values at 10 CSR 60-4.
(c) - USEPA Regional Screening Levels (May 2014). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - The hexavalent chromium RSL is derived using a USEPA draft oral cancer dose-response value for hexavalent chromium.
The value used to develop the RSL for hexavalent chromium has been called into question by USEPA's peer review panel, the Science Advisory Board (SAB).
(e) - A tapwater RSL not available for chromium (total). Therefore, the tapwater RSL for chromium (trivalent) is used.
greater than MCL and/or SMCL
greater than MCL/SMCL and RSL
greater than RSL

Table G-2
Comparison of Coal Ash Impoundment Groundwater Monitoring Results to Screening Levels – June 2014 Sampling Event (a)
Rush Island Energy Center, Jefferson County, MO
Ameren Missouri

Monitoring Well ID	Depth to Top of Screen (ft bgs)	Depth to Bottom of Screen (ft bgs)	Copper mg/L	Iron mg/L	Manganese mg/L	Mercury mg/L	Molybdenum mg/L	Nickel mg/L	Nitrate-N mg/L	Lead mg/L	Selenium mg/L	Silver mg/L	Thallium mg/L	Zinc mg/L
MCL (b)			1.3	NA	NA	0.002	NA	NA	10	0.015	0.05	NA	0.002	NA
SMCL (b)			1	0.3	0.05	NA	NA	NA	NA	NA	NA	0.1	NA	5
RSL (c)			0.8	14	0.43	0.0057	0.1	0.39	NA	NA	0.1	0.094	0.0002	6
P03D	69.1	74.1		14.7	0.513		0.0011	0.001						
P03S	29.0	49.0		13.8	0.264		0.0053	0.0013						
P05I	56.1	61.1		14.5	0.38		0.0023	0.001						
P05S	24.5	44.5		4.79	1.16		0.0626	0.0027	0.136					
P08D	70.0	75.0		0.051	0.073		0.0303	0.0023						
P08S	40.0	60.0		12.5	0.314		0.0288							
P13D	138.0	143.0		2.63	0.363		0.799	0.0092						
P13I	76.0	81.0		0.224	0.061		0.222	0.0017	0.059		0.0012			
P13S	37.0	57.0	0.0065		0.0832		0.029	0.0028						
P17D	125.3	130.3		4.5	0.595		0.0897	0.0015						
P17I	58.9	63.9	0.0055	0.624	0.0767		0.256	0.0023		0.0045	0.0025			
P17S	19.0	39.0	0.002	0.622	0.617		0.162	0.012			0.0021			
P19D	120.0	125.0		5.97	0.442		0.455	0.0015						
P19I	59.5	64.5	0.0099	0.07	0.0021		0.729	0.0123		0.0093	0.0063			
P19S	22.0	42.0		8.25	0.382		0.0339							
P21D	119.2	124.2		0.245	0.244		0.42	0.0017						
P21I	57.8	62.8		0.379	0.08		0.0578	0.0016			0.0013			
P21S	20.0	40.0		15.9	0.866		0.0095							
P22D	105.0	110.0	0.0016	0.459	0.102		0.391	0.0058			0.0013			
P22I	59.0	64.0		2.73	0.436		0.0343	0.0021						
P22S	19.0	39.0	0.0026	1.59	1.06		0.016	0.0112			0.0015			0.0222
P29D	95.3	100.3		10.1	0.331		0.0048							
P29S	30.0	50.0	0.002	15.1	0.413		0.0057	0.0014						0.0348

Notes:
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MCL - Maximum Contaminant Level.
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RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level. Value used if no MCL available.
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http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
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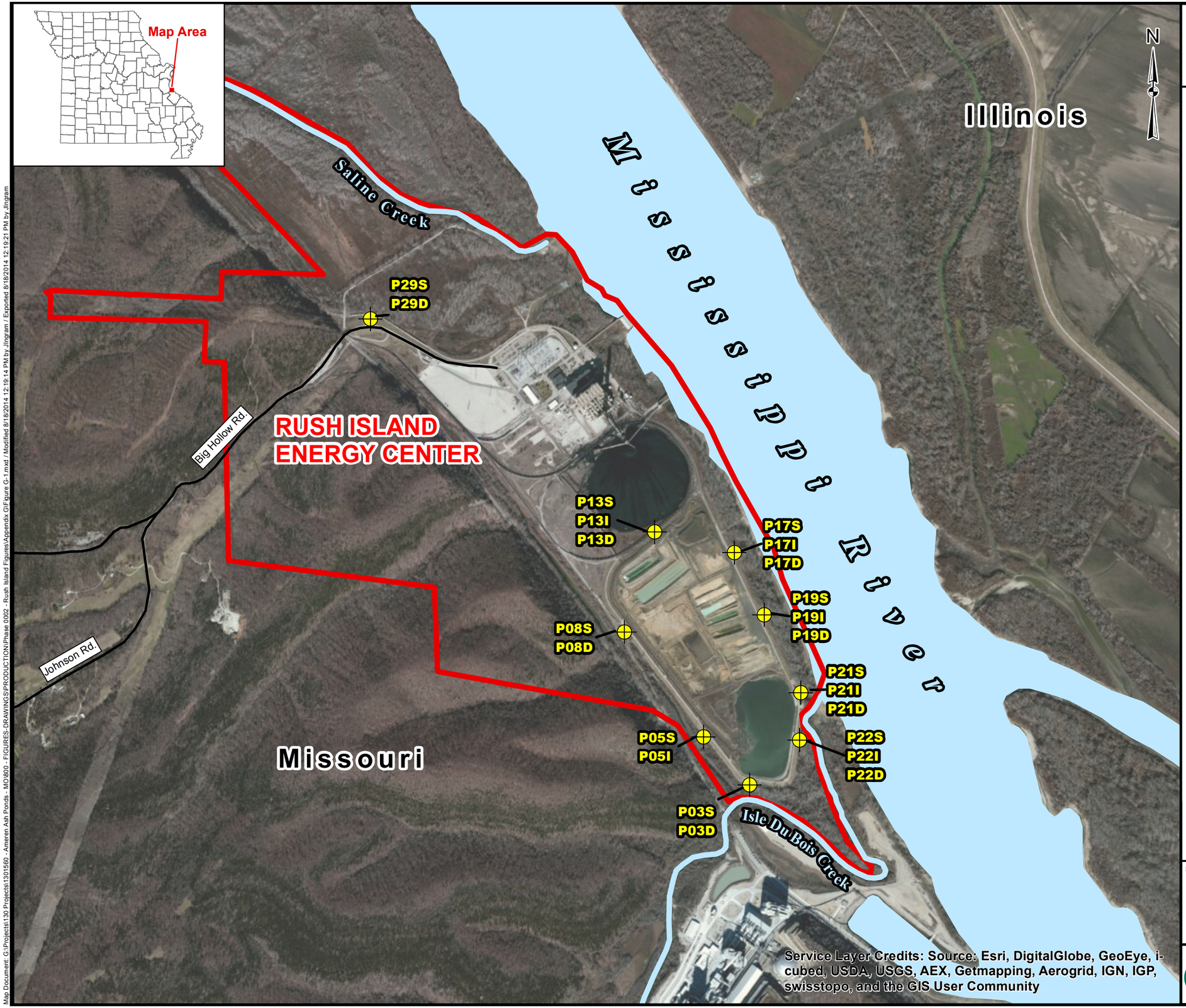
greater than MCL and/or SMCL
greater than MCL/SMCL and RSL
greater than RSL



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TITLE

COAL ASH IMPOUNDMENT MONITORING WELL LOCATIONS

LEGEND

- Rush Island Property Boundary
- Coal Ash Impoundment Monitoring Well Location

NOTES

1.) All boundaries and locations are approximate.
2.) Groundwater wells surveyed by Zahner & Associates.

REFERENCES

1.) Ameren, 2012. Ameren Missouri Rush Island Energy Center, Rush Island Property Control Map, January 2012.
2.) NRT, 2014. UWL landfill Table X.1, Site Survey Data.
3.) COORDINATE SYSTEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 1,000 2,000 3,000 Feet

August 2014

PROJECT

Ameren

AMEREN MISSOURI RUSH ISLAND ENERGY CENTER
JEFFERSON COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Figure G-1.mxd
DESIGN	-	-	SCALE: AS SHOWN / REV. 0
GIS	JSI	08/14/2014	
CHECK	MNH	08/14/2014	FIGURE G-1
REVIEW	MNH	08/14/2014	