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Ground and Surface Water Assessment
Labadie Energy Center

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I. INTRODUCTION

Union Electric Company d/b/a Ameren Missouri ("Ameren") owns and operates the Labadie Energy Center located along the south side of the Missouri River in the Town of Labadie, Franklin County, Missouri (Figure 1). This facility is coal fired and has been in operation since 1970. Ameren owns in excess of 2,300 acres of property at this location. The electric generation facility is located on the western portion of the property. The eastern portion of the property is the site of a newly constructed utility waste landfill and is surrounded by agricultural fields (Figure 2). Groundwater under the property is not used for domestic purposes. Ameren has recently prepared an Environmental Covenant[1] which permanently prohibits the installation of any future water supply wells in the geographic scope depicted in Figure 2.

In the process of burning coal, an ash is produced. That ash is sometimes referred to as Coal Combustion Residual (CCR) or simply coal ash. Beneficial uses for coal ash have been developed since the early 1960s. Such uses include encapsulation of these materials in wallboard, concrete, roofing materials, and bricks. Ameren makes a concerted effort to place its coal ash into beneficial use. For example, in year 2015, Ameren placed into beneficial use a volume of ash equal to 84% of that which it produced. The portion of the coal ash that is not beneficially used is presently stored on-site in two ponds that are operated in accordance with a permit issued by the State of Missouri. One of these ponds which contains fly ash is lined with high density polyethylene (HDPE); the other pond which contains bottom ash is unlined (Figure 3).

In August 2016, Ameren will complete the construction of a Utility Waste Landfill (UWL) for the placement of all future coal ash generated at the site that cannot be beneficially reused. The landfill has been designed to meet or exceed the requirements of the Missouri Department of Natural Resources (MDNR) utility waste landfill regulations, Franklin County's landfill ordinance and the United States Environmental Protection Agency's (USEPA's) rule on Disposal of Coal Combustion Residuals from Electric Utilities (the CCR Rule). Following the UWL's placement into service, the existing ash ponds will be phased out and permanently closed and capped,

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[1] *See Missouri Environmental Covenants Act*, Sections 260.1000 through 260.1039 RSMo.

also consistent with regulatory requirements.[2] The new landfill is located on the eastern portion of the property owned by Ameren (Figure 4).

As part of the UWL planning and regulatory process, Ameren has conducted extensive monitoring and studies of groundwater and surface water resources. This work enables the Company and MDNR to define current conditions prior to operation of the landfill. Such assessments also serve as a basis for determining whether a credible threat to public health presently or potentially exists. The results of this work are described further below and establish, unequivocally, that there is no public health risk presented by current conditions.

[2] Ameren is implementing engineering projects at the facility so as to convert the current wet sluicing of bottom ash to a dry ash handling process and to construct water treatment facilities. Such projects require major outages scheduled for 2018 and 2019. The placement of fly ash in the new utility waste landfill, however, will commence once the landfill is placed into service. Use of the bottom ash pond will be discontinued following the completion of these conveyor projects.

II. WATER RESOURCES IN THE VICINITY OF THE AMEREN LABADIE FACILITY

A. Surface Water Resources

The Labadie Energy Center lies within a relatively flat land area adjacent to the Missouri River. This area is known as the Labadie Bottoms, and it extends outward from the river where it eventually meets rising land forms known locally as the bluffs. The Labadie Bottoms are part of the Missouri River valley, an area slowly created over tens of thousands of years by the river. Above the influence of the river are the bluffs, where land elevations rise to several hundred feet higher than those in the Bottoms.

The Missouri River forms the northern boundary of Ameren's property, and it flows to the northeast at this location. Other surface waters in the vicinity of the site include Labadie Creek, Fiddle Creek and a ditch referred to as Iman Branch. Labadie Creek forms much of the western boundary of the Ameren property, and flows in a generally northerly direction to its confluence with the Missouri River. Iman Branch and Fiddle Creek lie along the southerly edge of the Labadie Bottoms area as it gives way to the bluffs. Iman Branch is a small agricultural ditch in which water flows in a generally easterly direction to its confluence with Fiddle Creek, which in turn flows in a generally northeasterly direction to its confluence with the Missouri River.

The general disposition of surface water flow in the vicinity of the Ameren property is illustrated in Figure 5. The blue arrows in Figure 5 indicate the general direction of surface water runoff to and within the waterways identified above. The basic rule regarding the flow of surface water is that it will flow from areas of higher elevation to areas of lower elevation. As can be seen, surface runoff from only a small segment (less than 120 acres, which is less than 5% of the total 2,400 acres) of the Ameren property actually drains to Labadie Creek, and that area is undeveloped. No stormwater runoff from the power plant enters Labadie Creek, and there is no direct discharge to the creek. A small portion of the property drains to a small ditch that lies just to the east of Labadie Creek and flows north to the Missouri River. The ash ponds are self-contained and controlled via the facility's NPDES permitted outfall, which discharges to this ditch. The northeasterly portion of the property drains eventually to the Missouri River. The agricultural portion of the property is very flat, and surface runoff from this area will generally flow to Iman Branch, thence to Fiddle Creek and finally to the Missouri River.

Consequently, most of the property drains eventually to the Missouri River via the ditch east of Labadie Creek and the Iman Branch – Fiddle Creek drainageways. All of the surface water features drain to the Missouri River.

B. Groundwater Resources

In the Labadie Bottoms area, the shallower subsurface has been characterized as consisting of silts and clays further underlain by sands and gravel. This zone of unconsolidated (i.e., 'loose') material extends for more than 100 feet below the ground surface. Bedrock exists below that. To the south of the site, the bedrock rises creating the bluffs area where a thinner layer of silts and clays lies over the bedrock. Figure 6 illustrates these subsurface characteristics.

As with the surface water on the land surface, groundwater likewise will always flow from areas where it is at a higher elevation to areas where it is at a lower elevation. Shallow groundwater often flows in the same general direction as local surface water. Deeper groundwater will often do the same on large regional scales, but locally may not move in the same direction as surface water.

Groundwater will flow far more easily in unconsolidated, loose material than it can in bedrock. In the Labadie Bottoms area, the shallow groundwater typically exists at depths less than 13 feet below the ground surface. In a year-long study conducted by Gredell Engineering Resources, Inc., and Reitz and Jens, Inc.[3] , the groundwater level in the vicinity of the UWL was found to be typically in the range of 460 feet above mean sea level. At any point in time, there was never more than a 4-foot change in groundwater level across the entire study area, confirming that, like the land surface, the shallow groundwater level in the Labadie Bottoms area is always relatively flat. The shallow groundwater flow in the Labadie Bottoms area generally follows surface water flow as expected. While that shallow groundwater's flow direction changes somewhat with time, it is essentially always toward the northeast flowing toward or with the Missouri River with occasional times when groundwater may actually flow toward Fiddle Creek

[3] Gredell Engineering Resources, Inc., and Reitz & Jens, Inc., *Detailed Site Investigation Report for Ameren Missouri Labadie Power Plant Proposed Utility Waste Disposal Area Franklin County, Missouri*, 2011

just after the Missouri River is at flood stage. Just as surface water flow in this area was shown to wind its way to the Missouri River, so too does the shallow groundwater.

Bedrock groundwater in this region of Missouri is relied upon by some as a source of potable water. The closest community water supply well is approximately two miles south of the Ameren property boundary. Some individual wells are located within a mile of the Ameren property boundary. However, all of these water supply wells are also located south of the Ameren property boundary, and they draw water from the bedrock beneath the bluffs. Based on detailed exploration and measurement of groundwater elevations throughout the area in both the bedrock and the Labadie Bottoms, accompanied by extensive analysis of that information including modeling of groundwater flow, it has been demonstrated that groundwater in the bedrock below the bluffs ***always, even under extreme river flood stage conditions,*** moves from the bluffs down to the river valley area, and never moves from the river valley up to the bluffs.[4] (See Appendix B.) Groundwater, in particular beneath the Ameren property and in general below the Labadie Bottoms, ***does not flow up to the bedrock aquifer below the bluffs***. Without such a reversal of flow, there is simply no physical mechanism through which groundwater from the Ameren property could conceivably travel upgradient to domestic well water supplies.

C. Water Quality Studies

Ameren has undertaken substantial ground and surface water quality data collection (a summary of the constituents for which testing was conducted is provided in Table 1), and groundwater modeling. Many of these studies were done by Ameren on a voluntary, proactive basis, and were above and beyond what is required by regulation. Tasks included the following:

1. *Sampling of the Missouri River* – Sampling of the river was conducted to assess water quality within the river and to determine whether historical activities at the site have had any measurable impact on water quality in the river. Sampling was conducted upstream and immediately downstream of the site on October 25, 2013.

[4] Golder Associates, Kleinfelder and CDG Engineers, *Technical Review of "Potential for Contamination of Domestic Wells, Labadie Bottoms, Franklin County, Missouri" by Dr. Robert E. Criss*, June 22, 2015.

Sampling was conducted again on November 12, 2014 at the same upstream and downstream locations, plus two additional downstream locations in an effort to expand the area of assessment, ensuring that any measureable impact that may potentially occur would indeed have been observed. Figure 7 illustrates the Missouri River sampling locations (i.e., locations beginning with designation LBD-R).

2. *Sampling of Labadie Creek* – Sampling of Labadie Creek was also conducted. That sampling was conducted on one date, October 24, 2013, at two locations in the creek, i.e., a location upstream of the Ameren facility, and a location downstream of the Ameren facility. These sampling locations are illustrated in Figure 7 (i.e., locations beginning with designation LBD-C).

3. *Background Groundwater Quality* – Ameren has conducted sampling on multiple dates at 36 locations around the perimeter of the UWL. These sampling locations are depicted in Figure 8. Thirty-three of these wells (MW-1 through MW-32 and TMW-1) are relatively shallow, sampling groundwater at depths less than 25 feet below ground surface. Three of the wells (MW-33D, MW-34D and MW-35D) are deeper at approximately 65 to 75 feet below ground surface. At all of these locations, samples are representative of groundwater in the alluvial unconsolidated soils of the Labadie Bottoms, not bedrock.

4. *Groundwater Sampling around Perimeter and Outside of Ameren Property* – Ameren has also undertaken sampling to characterize groundwater quality around the perimeter of its property as well as outside of its property in the bluffs area. These sampling locations are illustrated in Figure 9. The sampling locations beginning with designation DP used a 'one-time only' sampling method (direct push technology), whereas sampling locations beginning with designation TGP or BW are monitoring wells where sampling can be repeated. Samples collected at the DP locations are representative of groundwater in the alluvial unconsolidated soils of the Labadie Bottoms. Samples collected at the TGP and BW locations are representative of bedrock groundwater.

5. *Groundwater Modeling* – In addition to sampling existing groundwater quality conditions, Ameren also undertook a detailed groundwater level monitoring program

and groundwater modeling to evaluate whether or not groundwater in the Labadie Bottoms would have the potential to move up into the bluffs under extreme river flood conditions and potentially carry with it any constituents that might exist in the Bottoms groundwater. A report on that study is included as Appendix B. Groundwater modeling demonstrated that even during a worst case flood condition (i.e., the 1993 flood event), groundwater flow in the bluffs still moves in a northward direction toward the Bottoms and not vice versa. The modeling evaluation assumed that an extreme condition, i.e., the 1993 flood of record, lasted for 55 straight days. The modeling findings are corroborated by groundwater level data showing that even at higher river levels the flow direction of the bedrock aquifer did not change and still flowed in a northerly direction toward the Bottoms and the river. These exercises further confirmed that groundwater quality in the bluffs could not be affected by groundwater or surface water quality in the Bottoms and the river.

III. WATER QUALITY ASSESSMENT

A. Background

As a result of such efforts, a substantial database of information exists upon which an evaluation can be completed with regard to whether the Labadie facility has had or will have an impact on ground and surface water quality in the vicinity of the site. The information provided above enables an understanding of both the movement of water in and around the Labadie site, and the quality of that water.

Given the large number of parameters and sampling locations for which there is information, it is useful to consider that information in logical environmental segments (e.g., groundwater versus surface water), of course always being mindful of the potential for interaction between those segments. It is also useful to first consider key parameters for which information is available rather than attempting to consider all of the information about every parameter at the same time. The latter quickly becomes overwhelming and inconclusive.

To overcome the above dilemma, it is useful to consider, at least initially, the primary parameters for which an impact would be observed. Such constituents might be considered "indicator parameters." Many sources identify boron and sulfate as good indicators of the presence of coal ash leachate.[5] A study performed by the University of Illinois also supported the use of boron and sulfate as leading indicators of coal ash landfill leachate.[6] The Tennessee Valley Authority and the USEPA released an Interagency Energy and Environment R&D report that concluded that coal ash leachate is typically high in dissolved solids, boron, iron, calcium, aluminum and sulfate, again supporting the use of boron and sulfate as indicators of coal ash landfill leachate.[7]

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[5] For example, see case studies in the states of Montana and Indiana.

http://deq.mt.gov/mfs/ColstripSteamElectricStation/default.mcpx

http://www.hecweb.org/wp-content/uploads/2014/08/HEC-fact-sheet-IPL-coal-ash-lagoons-what-we-know-about-GW-contamination-August-20142.pdf

[6] Cerbus, John F., Sheldon Landsberger, Susan Larson. "Elemental Characterization of Coal Ash Leachates."

[7] TVA and EPA. "Effects of Coal-ash Leachate on Groundwater Quality," March 1980.

The Electric Power Research Institute (EPRI) released a study in 2006 that characterized the composition of Coal Combustion Product (CCP) leachate concentrations from 29 CCP management facilities.[8] That study found sulfate was the dominant anion in coal ash leachate. Boron was also commonly observed.

A publication by the Wisconsin Department of Natural Resources analyzed and examined groundwater monitoring well data from 12 Wisconsin coal combustion by-product (CCB) disposal sites. The study identified four compounds where the State of Wisconsin groundwater protection standards were frequently exceeded: boron, sulfate, arsenic, and selenium. Elevated levels of manganese were found in approximately half the locations, and exceedances of lead, chromium and mercury also occurred periodically.[9]

As noted above, in all cases boron and sulfate appear as common constituents in detection of impacts from coal ash leachate. It is not surprising that USEPA included these in their list of Constituents for Detection Monitoring for landfills that accept coal combustion residuals. (See USEPA's rule on *Disposal of Coal Combustion Residuals from Electric Utilities,* December 19, 2014). This list contains the leading indicators of releases of constituents associated with coal combustion residuals. They are boron, calcium, chloride, fluoride, pH, sulfate and total dissolved solids (TDS). If a statistically significant increase above background concentrations occurs, then assessment monitoring is required. In addition to the detection monitoring parameters, the constituents USEPA requires for assessment monitoring include antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

The following assessment will focus on the USEPA list of indicator parameters. The larger set of parameters for which water quality monitoring has been conducted will also be considered. A summary table of the data for these indicator parameters is provided in Appendix A.

[8] Electric Power Research Institute "Characterization of Field Leachates at Coal Combustion Product Management Sites Arsenic, Selenium, Chromium," and Mercury Speciation November 2006.

[9] PUB-WA 1174 2004 "Groundwater Impacts from Coal Combustion Ash Disposal Sites in Wisconsin."

B. Surface Water

Boron

Figure 10 provides a summary of boron data in the Missouri River and in Labadie Creek. The concentrations presented are the average of the data collected at each location. Individual data values are provided in Appendix A. As can be seen, sampling in the river was conducted on two separate dates, October 25, 2013 and November 12, 2014, at two of the locations. For the two furthest downstream locations, sampling was conducted only on the latter date. The results are compelling. Total boron concentrations are virtually identical at all locations and on all dates in the river. Clearly these data indicate that coal ash management at the Labadie facility is not having a measurable impact on the concentration of total boron in the river.

In Labadie Creek, one sampling event was completed. The creek itself is small relative to the Missouri River. Again as shown in Figure 10, the results show that coal ash management activities at Labadie are not having a measurable impact on the creek and, in fact, the downstream concentration of boron is actually lower than the upstream concentration. These data again indicate that coal ash management at the Labadie facility is not having a measurable impact on the concentration of total boron in the creek.

Consideration of filtered (i.e., dissolved) boron at these same locations leads to the same conclusions.

Sulfate

Figure 11 provides a summary of sulfate data in the Missouri River and Labadie Creek. Again, the concentrations presented are the average of the data collected at each location. For the river, sampling was conducted on October 25, 2013 at the upstream location and first downstream location, and on November 12, 2014 at the upstream location and three downstream locations. Individual data values are provided in Appendix A. As with boron, the sulfate results are virtually identical at all locations and on all dates in the river. Coal ash management at the Labadie facility is not having a measurable impact on sulfate concentration in the river.

In Labadie Creek, as shown in Figure 11, the difference between upstream and downstream concentration is also insignificant, and the data indicate that coal ash management at the Labadie facility is not having a measurable impact on the concentration of sulfate in the creek.

Total Dissolved Solids (TDS)

Figure 12 provides a summary of TDS data in the Missouri River. Testing for TDS in Labadie Creek was not conducted. Again, the concentrations presented are the average of the data collected at each location. As described above, sampling was conducted on October 25, 2013 at the upstream location and first downstream location, and on November 12, 2014 at the upstream location and three downstream locations. Individual data values are provided in Appendix A. As with boron and sulfate, the TDS results are virtually identical at all locations in the river. Coal ash management at the Labadie facility is not having a measurable impact on TDS concentration in the river.

Calcium, Chloride, Fluoride and pH

Calcium, chloride and fluoride were also included in the surface water sampling program. Testing for pH was not conducted in the river or the creek, and testing for chloride was not conducted in the creek. Figures analogous to those shown above for boron, sulfate and TDS can be created for these parameters, but the findings are the same. Differences between the concentrations at all four stations in the river and between the concentrations at the two stations in the creek are insignificant, indicating that coal ash management at the Labadie facility is not having a measurable impact in the river or the creek for these parameters.

Leading Indicators Summary

The monitoring conducted by Ameren indicates that, for the leading indicators of contamination from coal combustion residuals, the Labadie facility is not having an impact on surface waters.

Additional Parameters

Testing for many parameters was conducted in the river and creek. Data for six additional parameters (i.e., aluminum, arsenic, iron, manganese, molybdenum and sodium) are further discussed in this assessment and summarized in Appendix A. With regard to the river, none of these results indicate an impact from the Labadie facility.

In the Missouri River, one sample, LBD-R-7S indicated elevated levels of aluminum, iron and manganese. Four adjacent samples (LBD-R-8S, LBD-R-8M, LBD-R-9S and LBD-R-9M) did not indicate elevated concentrations for these parameters, and rather indicate parameter concentrations similar to those found at the other three stations in the river. Sample LBD-R-7S was located close to the river shoreline. Upon closer inspection of test results from this sample it was discerned that the sample exhibited high turbidity, and field notes indicate that during sampling, river bottom sediment was disturbed and contaminated the sample. Consequently, it is concluded that these anomalous results are not representative of the river water concentrations at this location. A filtered sample at this location did not exhibit elevated concentrations, further confirming that bottom sediment contamination of the unfiltered sample was responsible for the elevated concentrations.

Arsenic and molybdenum[10] were not impacted by the above anomaly, and are virtually identical in concentration at all Missouri River stations on each sampling date. The levels detected are not a consequence of Ameren operations, and therefore represent background ambient conditions in this section of the river.

Consequently, there is no discernable difference in concentration for these six parameters at any of the river monitoring locations.

In Labadie Creek, concentrations for aluminum, iron and manganese were noticeably higher, and molybdenum was somewhat elevated for all downstream samples as compared to the upstream samples. The filtered samples for aluminum and iron showed little difference between upstream and downstream.

[10] Testing for sodium was not conducted for surface water samples.

But the filtered sample for manganese showed higher concentrations downstream than upstream. As happened in the river sample at LBD-R-7S, it is again possible that sediment contaminated the downstream samples in the creek, although the single filtered manganese results are not yet understood. Additional sampling of the creek could resolve this. However, results in the Missouri River do not show elevated levels of manganese, and manganese is not a constituent commonly associated with releases from coal ash management areas.

Of note is that arsenic is virtually the same concentration upstream and downstream, again indicating no consequence from Ameren operations, and therefore representative of background ambient conditions in this section of the creek.

Regardless of the results in the creek, the flow of water from the creek to the river has had no measureable effect on water quality in the river.

Surface Water Conclusions

There is no evidence to suggest that coal ash management at the Ameren Labadie facility has had any impact on surface waters in the vicinity of the property. Indeed, the data confirm that it does not have an impact.[11]

With regard to the potential for future surface water impacts, the planned closure and capping of the presently used ash ponds will only further lessen the potential for surface water impact from these facilities. The design of the UWL with its stormwater collection system, elevated berm, concrete mat, landfill liner, leachate collection system, elevation above groundwater, comprehensive groundwater monitoring system and landfill cap will ensure that future management of coal combustion residuals will not adversely impact surface waters in the vicinity of this site.

[11] Two anomalies in the data have been identified, and it may be useful to repeat monitoring at the same locations previously studied to resolve these items and to further support a finding of no impact.

C. Shallow Groundwater

As previously described, Ameren has assembled a sizeable database for groundwater quality. A summary for selected parameters of interest is provided in Appendix A. Sampling has been conducted at multiple depths in the subsurface. The shallow sampling will be discussed in this section. Sampling results for deeper groundwater is discussed in the next section.

Boron

Figure 13 depicts total boron sampling results for the shallow groundwater sampling. For this figure, all monitoring well (MW) and direct push (DP) locations provide groundwater samples at elevations above 430 feet. The MW sampling locations tend to be a bit shallower than the DP sampling locations (approximately 5 to 25 feet below ground surface corresponding to elevations around 450 feet for the MW locations; approximately 25 to 30 feet below ground surface corresponding to elevations around 440 feet for the DP locations). As all of these locations are in the Labadie Bottoms area, they all sample groundwater in the alluvium and not the bedrock. For the purposes of this figure, when more than one sample result was available at a particular location (e.g., there are several samples at the MW locations), the average of the sample results is presented. The individual data can be found in Appendix A.

Boron concentrations tend to be quite low, and all sample results are below 1 mg/l and below Missouri's groundwater quality criterion for boron (2 mg/l). This information indicates that coal ash management at Labadie does not cause concern with regard to impact to shallow groundwater. Concentrations are generally in the range of 0.1 mg/l at virtually all locations. Even though the concentration of total boron proximate to the current ash ponds at location DP-5 is about an order of magnitude higher than that at the background location DP-Background-1 (i.e., 0.646 mg/l versus 0.051 mg/l, respectively), it is still well below the groundwater criterion. The difference between the concentrations at these two locations could well be due to natural variability.

Sulfate

Figure 14 depicts the analogous information for total sulfate with identical results. At all locations, sulfate concentration is below 100 mg/l, and below Missouri's groundwater quality criterion for sulfate (250 mg/l).

As with boron, the concentration of sulfate at DP-5S is higher than that at DP-Background-1S (i.e., 92.7 mg/l versus 30.8 mg/l, respectively). Again, the difference between the concentrations at these two locations could well be due to natural variability. This information again indicates that coal ash management at Labadie does not cause concern with regard to impact to shallow groundwater.

Total Dissolved Solids (TDS)

Figure 15 depicts TDS concentrations for the shallow groundwater sampling. These data suggest that shallow groundwater in the alluvium has naturally elevated TDS concentrations, since the boron and sulfate data do not indicate impact from the coal ash facility. The DP-Background-1S location had a TDS concentration of 477 mg/l, which of course is close to 500 mg/l. Only one sample was collected at this location; multiple samples would likely have revealed concentrations above and below 500 mg/l. The other locations had TDS concentrations ranging typically between 400 and 600 mg/l. DP-5S had a concentration of 682 mg/l, again a single sample. The difference in concentrations between the single samples collected at DP-5S and DP-Background-1S is within the range observed at other sampling locations and certainly could be attributed to natural variability. This information does not indicate that coal ash management at Labadie causes concern with regard to impact to shallow groundwater.

Calcium, Chloride, Fluoride and pH

Calcium, chloride and fluoride were also considered. (See summary data in Appendix A.) The results for all of these parameters do not raise any cause for concern.

Leading Indicators Summary

The monitoring conducted by Ameren indicates that, for the leading indicators of contamination from coal combustion residuals, the Labadie facility does not cause any concern with respect to impact to shallow alluvial groundwater.

Additional Parameters

As with surface water, testing for many parameters was conducted in the groundwater sampling. Data for six additional parameters (i.e., aluminum, arsenic, iron, manganese, molybdenum and sodium) were considered and are summarized in Appendix A. Variability in concentration is noted from one sampling location to the next, and is greater for some parameters (e.g., iron) than others (e.g., arsenic). No discernible pattern is observed, indicating that these variations are naturally occurring. No impact from Ameren's coal ash management is observed.

D. Deeper Groundwater

For a number of the groundwater monitoring locations, Ameren has conducted sampling at multiple depths. Table 2 summarizes the characteristics of the various sampling locations. The locations where deep groundwater has been sampled include the MW-xxD, DP, BW and TGP locations. Again, a summary of the data for selected parameters of interest is provided in Appendix A. For presentation purposes below, the deep sampling has been divided into the following groupings:

1. monitoring of alluvial groundwater between elevations 370 and 430 feet (referred to below as the mid-depth monitoring);
2. monitoring of alluvial groundwater below elevation 370 feet (referred to below as the deeper monitoring);
3. monitoring of bedrock groundwater at the TGP and BW wells.

At the latter, monitoring of groundwater occurred over larger depths than at the DP or MW locations.

Boron

Figure 16 depicts total boron sampling results for the mid-depth alluvial groundwater sampling. Several locations (MW-33D, MW-34D, MW-35D, DP-3M) revealed elevated boron concentrations in the range of approximately 10 mg/l when compared to the other locations (DP-1M, DP-2M, DP-4M, DP-5M, DP-Background-1) which showed concentrations less than 1 mg/l. The locations with elevated concentrations are consistent with a groundwater flow direction to the north – northeast away from the Ameren ash ponds. Therefore, these data suggest that there may be a limited band of impact to deeper alluvial groundwater.

Figure 17 shows boron concentrations at the deeper alluvial monitoring locations. While there are fewer monitoring locations at this depth, the results are consistent with the results depicted in Figure 16. Again, these data suggest that there may be a limited band of impact to deeper alluvial groundwater.

Figure 18 shows results for the bedrock wells. These wells exhibit boron concentrations that are quite low, even less than those at the DP-Background-1 location. This is not surprising since they are located upgradient (i.e., upstream in terms of direction of groundwater flow) of the other monitoring locations that show elevated levels of boron.

Based on the above and as expected, it is safe to say that the Ameren facility has had no impact on bedrock groundwater, particularly of note in the bluffs where groundwater serves as a source of water supply. However, there may be a narrow band of impact to the deeper alluvial groundwater below the Labadie Bottoms trending in a north – northeasterly direction away from the existing ash ponds. This limited impact does not pose an imminent endangerment to the public as there is no opportunity for exposure. This impact is not evident in the shallow alluvial groundwater, or in the bedrock that is used for water supply (see Figures 13 and 18, respectively), and as has been shown above, there is no impact in the river.

Ameren intends to close the Labadie ash ponds following the construction of the UWL and completion of the dry ash handling and water treatment engineering projects which will enable the transition of ash management activities at the site to the landfill. Closure of the ash ponds will eliminate loading to groundwater that may be presently emanating from the ponds due to infiltration and percolation of rainwater into the ponds. Further investigation will be performed to delineate the nature and extent of any impact to the deeper alluvial groundwater. However, as set forth more fully below, there is no pathway of exposure and consequently no public health risk associated with such localized impact.

Sulfate

Figure 19 depicts the mid-depth alluvial monitoring information for total sulfate. Inspection of the individual data reveals that concentrations at MW-33D, MW-34D, MW-35D and DP-3M are about an order of magnitude greater than the corresponding shallow groundwater samples. The other mid-depth monitoring locations do not show the same effect. These results are consistent with the findings for boron as discussed above.

Figure 20 shows sulfate concentrations at the deeper monitoring locations. As with boron, while there are fewer monitoring locations at this depth, the results are consistent with the results depicted in Figure 19, again suggesting that there may be a limited band of impact to deeper alluvial groundwater.

Figure 21 shows sulfate results for the bedrock wells. These wells exhibit sulfate concentrations that are quite low and similar to the DP-Background-1 location. As noted above, these locations are upgradient of the other monitoring locations that show elevated levels of sulfate.

These results support the conclusion drawn from evaluation of the boron data, i.e., it is safe to say that the Ameren facility has had no impact on bedrock groundwater. However, there may be a narrow band of impact to the deeper alluvial groundwater below the Labadie Bottoms trending in a north – northeasterly direction away from the existing ash ponds. This limited impact does not pose an imminent endangerment to the public as there is no opportunity for exposure (as will be discussed further below).

Total Dissolved Solids (TDS)

Figure 22 depicts the mid-depth alluvial monitoring information for TDS. Since TDS was naturally elevated in the shallow groundwater (see above discussion), it is not apparent as to whether there may be an impact to TDS from the ash ponds in the mid-depth alluvial groundwater. The same band of monitoring locations reveals elevated levels as seen for boron and sulfate, but even the background location (DP-Background -1M) shows elevated levels of TDS (567 mg/l). Locations MW-34D and MW-35D exhibit the highest concentrations of TDS, which is consistent with the findings for boron and sulfate. But the degree of impact is not as pronounced for TDS as it was for boron and sulfate, and the TDS concentrations observed could indeed be within the range of natural variability.

Figure 23 depicts the deeper alluvial groundwater concentrations for TDS which are not significantly different from the shallow or mid-depth TDS concentrations in groundwater throughout the Labadie Bottoms area.

Finally, Figure 24 depicts TDS concentrations in the bedrock wells. Concentrations are consistently lower, in the 300 to 400 mg/l range, as compared to the other groundwater monitoring locations.

Therefore, due to naturally elevated TDS concentrations in groundwater in this area, evaluation of the TDS groundwater monitoring data cannot be relied upon to support or refute observations made from inspection of the boron and sulfate data.

Calcium, Chloride, Fluoride and pH

The calcium, chloride, fluoride and pH data in the deeper groundwater do not reveal anything particularly significant in terms of potential impact. Chloride concentrations are somewhat elevated, although still quite low, at the MW-33D, MW-34D and MW-35D locations; elevated levels are not consistently observed in the deeper DP monitoring locations. Consequently, inspection of the data for these parameters does not reveal an impact to deeper groundwater.

Leading Indicators Summary

In summary, inspection of the deeper alluvial groundwater data for boron and sulfate suggests that there may be a narrow zone of impact trending in a north – northeasterly direction away from the ash ponds in the Labadie Bottoms area. Impact is not discerned for other leading indicator parameters. Any impact that may be occurring does not extend south, is not occurring in the shallow groundwater, and certainly does not extend into the bedrock below the bluffs.

Additional Parameters

Again, testing for many additional parameters was conducted in the deeper groundwater sampling, and variability in concentration is noted from one sampling location to the next. Data for six additional parameters (i.e., aluminum, arsenic, iron, manganese, molybdenum and sodium) were considered and are summarized in Appendix A. Molybdenum and sodium show patterns similar to those described above for boron and sulfate. Aluminum, arsenic, iron and manganese do not. The findings from examination of data for these additional parameters are consistent with findings expressed above in this report.

IV. SUMMARY OF FINDINGS

The Ameren Labadie facility generates electricity by burning coal. A natural byproduct of this process is ash which is often referred to as coal ash or coal combustion residual. While Ameren has been able to beneficially reuse more than half of the ash generated at the Labadie facility, the remaining ash requires final disposal. Historically Ameren has placed that residual material in regulatory approved ponds located on its property. Ameren will replace its historical method of ash disposal with the construction of a utility waste landfill that meets or exceeds regulations, on the eastern portion of its property. The landfill provides a more secure method of disposal for the residual ash. In concert with this proposal, Ameren will permanently close and cover any residual material in the existing ash ponds. The net effect will be a better, more secure ash management and disposal program.

Some have expressed concern that the current coal ash management at the Ameren facility has impacted water resources in the vicinity of the facility, and that the placement of the new landfill poses yet another potential source of contamination. Particular concern has been expressed with regard to contamination of (a) groundwater used as a source of drinking water, and (b) surface waters to which the Ameren property drains. This report has considered those concerns.

A. Potential for Impact to Groundwater

It is important to understand the natural occurrence of many constituents in groundwater, the dynamics of groundwater movement in this area, and whether or not there is a potential for that movement to affect the groundwater used by humans in this area. Ameren has voluntarily authorized a substantial effort to characterize groundwater conditions, monitor groundwater levels and understand where groundwater is being withdrawn for human use. The results of that effort have been summarized in this report.

All known uses of groundwater withdraw that water from the deeper bedrock, and such withdrawals are located in the bluffs, not in the Labadie Bottoms area. The aquifer that serves these water supply wells is within the bedrock that underlies a fairly thin layer of soils in the bluffs area. That bedrock also exists under the Labadie Bottoms area, but at that location there exists more than a hundred feet of overlying soil. The movement of water in the bedrock aquifer in this area is always in a north to northeasterly direction from the bluffs down to the river valley. The same is generally true of groundwater in the thicker soils of the Labadie Bottoms, although that water will be influenced by flood stage in the river and will at times flow in an easterly direction with the river. There is no potential for groundwater in (a) the Labadie Bottoms soils or (b) the Labadie Bottoms bedrock to move up into the bedrock aquifer in the bluffs. Consequently, the natural laws of physics ensure that the existing coal ash management at Ameren as well as the new landfill do not endanger the groundwater withdrawn for human use.

Extensive groundwater quality monitoring as reviewed above further demonstrates this. That monitoring has shown a limited area of impact in the alluvial groundwater within the Labadie Bottoms soils, but no impact to deeper groundwater quality on the southern portion of the Ameren property and in the bluffs outside of the property. While the concentrations of parameters indicative of impact from coal ash leachate are somewhat elevated in this limited area for alluvial groundwater, that impact does not extend south to the property line and certainly not into the bedrock beneath the bluffs. The known direction of groundwater movement prevents such from occurring, and the groundwater quality data support this. Therefore, it is safe to say that the Ameren facility has had no impact on bedrock groundwater, particularly of note in the bluffs where groundwater serves as a source of water supply. The limited impact to deeper alluvial groundwater below the Labadie Bottoms does not pose an imminent endangerment to the public as there is no opportunity for exposure. This impact is not evident in the shallow alluvial groundwater, or in the bedrock that is used for water supply. As there is no imminent endangerment associated with this limited impact, an appropriate time for any further investigation would be during preparation of the closure plan for the ash ponds after Ameren receives direction from Missouri DNR regarding the scope of such an investigation.

With regard to the potential for future groundwater contamination from the new landfill, again the laws of physics preclude that possibility. Furthermore, the secure nature of the design of the new landfill (i.e., a design that meets or exceeds regulatory requirements to protect the environment) will certainly pose a lesser risk of groundwater contamination than that existing with the presently unlined ash pond on the site.

B. Potential for Impact to Surface Water

The location of the site is such that drainage from it could potentially have an impact to surface water quality. Stormwater runoff from the site naturally drains to the surface waters surrounding the site. Groundwater beneath the site may discharge to these surface waters as well. Thus, there are opportunities for impact **only if** contaminants from the site are discharged in sufficient quantities. Consideration of the surface water quality data cited in this report does not show any impact from coal ash management at the site. The limited elevated groundwater concentrations observed below the site are not causing any measurable change to water quality in the Missouri River. The single sampling event in Labadie Creek may not fully assess whether the NPDES discharge has had an impact in the creek, but certainly that discharge is not impacting the Missouri River.

While the available surface water quality data enable a finding of no impact, collection of additional data could be useful to further support a finding of no impact. Therefore, additional sampling could be undertaken in an abundance of caution to ensure that there has been no impact. Given that these data were all collected at approximately the same time of year (late October / early November), Ameren could consider follow-up monitoring at a different time of year (e.g., early summer), and do so at all locations previously sampled. However, analysis of three separate samples at each location is not supported as no significant difference was found. Collecting a single sample, or combining the three into a single sample (i.e., a spatially composite sample) is appropriate. Ameren could consider monitoring of the ditch to which Outfall #002 discharges, assuming there is sufficient depth of flow to collect a representative sample. Two additional surface water sampling events should be sufficient.

With regard to the potential for future surface water impacts, the closure and capping of the presently used ash ponds will only further lessen the opportunity for any possible future surface water impact from these facilities. The overdesign of the UWL with its stormwater collection system, elevated berm, concrete mat, landfill liner, leachate collection system, elevation above groundwater, monitoring system and landfill cap will ensure that future management of coal combustion residuals will not adversely impact surface waters in the vicinity of this site.

C. Assessment for Current Conditions

The movement of water in the bedrock aquifer in this area is always in a north to northeasterly direction from the bluffs down to the river valley. The same is generally true of groundwater in the thicker soils of the Labadie Bottoms, although that water will be influenced by flood stage in the river and will at times flow in an easterly direction with the river. As has been demonstrated, there is no potential for groundwater in (a) the Labadie Bottoms soils or (b) the Labadie Bottoms bedrock to move up into the bedrock aquifer in the bluffs. Consequently, the natural laws of physics ensure that any constituents observed at the Ameren site do not have a potential to move south away from the site.

Extensive monitoring of groundwater and surface waters on and around the site confirms the above conclusion about groundwater movement and the potential for exposure south and away from the site. That monitoring has also revealed a limited area of impact in the alluvial groundwater within the Labadie Bottoms soils. That impact is observed at mid depth in the alluvium, not in the shallow alluvium or in the bedrock below the alluvium. Therefore, since these constituents are at mid depth and not at or near the surface, there is no potential for human or wildlife contact with the constituents observed. Furthermore, there is no impact to deeper groundwater quality on the southern portion of the Ameren property and in the bluffs outside of the property. While the concentrations of constituents indicative of impact from coal ash leachate are somewhat elevated in the limited mid depth alluvial groundwater, that impact does not extend south to the property line and certainly not into the bedrock beneath the bluffs. Furthermore, the fact that the Labadie Energy Center has been in operation for over 40 years and the observed zone of impact is quite limited confirms that any impact has developed slowly and that constituents move very slowly.

The known direction of groundwater movement prevents such from occurring, and the groundwater quality data support this. Therefore, it is safe to say that the Ameren facility has had no impact on bedrock groundwater, particularly of note in the bluffs where groundwater serves as a source of water supply. The limited impact to the mid depth alluvial groundwater in the Labadie Bottoms does not pose an imminent endangerment to the public or wildlife as there is no opportunity for exposure. This impact is not evident in the shallow alluvial groundwater, or in the bedrock that is used for water supply.

While some additional confirmatory surface water quality monitoring may be useful, the monitoring conducted by Ameren to date demonstrates that there has not been any impact to surface waters in the vicinity of the property, either directly through surface discharges from the site or indirectly through groundwater that might find its way to surface waterbodies. It is not expected that additional monitoring will reveal any findings contrary to this. Consequently, as was concluded for groundwater, the present surface water conditions at the Ameren site do not pose an unacceptable risk of exposure.

D. Assessment for the New Utility Waste Landfill

It is impossible to conceive that the proposed Utility Waste Landfill creates a greater potential for exposure to humans or the environment when compared to the current ash management facilities at the site. The UWL has been designed with a number of redundant and fail safe characteristics that make this method of ash management far superior to the current reliance on open ponds. Some of the features of the UWL include the following which are depicted in Figure 25:

1. Redundant liner system with clay and HDPE liners
2. The bottom of the UWL liner is at least five feet above the existing ground
3. Leachate collection system
4. Extensive ring of groundwater monitoring wells around the UWL
5. A berm encircling the UWL to a height exceeding the 500-year flood event
6. Fabric formed concrete mat on the exterior of the berm

There is essentially no possibility that all of the above features will simultaneously fail. Even if a pathway for exposure to constituents from coal ash management at this site presently exists, then the UWL will certainly eliminate that.

The potential pathways for exposure are as defined above for current conditions (i.e., before construction of the landfill). However, the UWL will effectively sever the connection between the coal ash and the various environmental pathways as follows:

1. In regard to groundwater, the liner system, distance between the bottom of the UWL and groundwater, the leachate collection system and the groundwater monitoring wells all contribute to an effective impenetrable barrier between coal ash and groundwater. Therefore, the pathway for exposure via groundwater is incomplete, and exposure cannot occur.

2. Similarly with regard to surface water, the UWL's berm exceeding the 500-year flood elevation, the fabric formed concrete exterior on the berm and the leachate collection system all contribute to an effective impenetrable barrier between coal ash and surface water. Furthermore, the proposed closure and capping of the presently used ash ponds will only further lessen the opportunity for surface water impact from those facilities. Therefore, the pathway for exposure via surface water is incomplete, and exposure cannot occur.

Given the above, it is apparent that the superior design of the UWL is protective of human health and the environment.

FIGURES

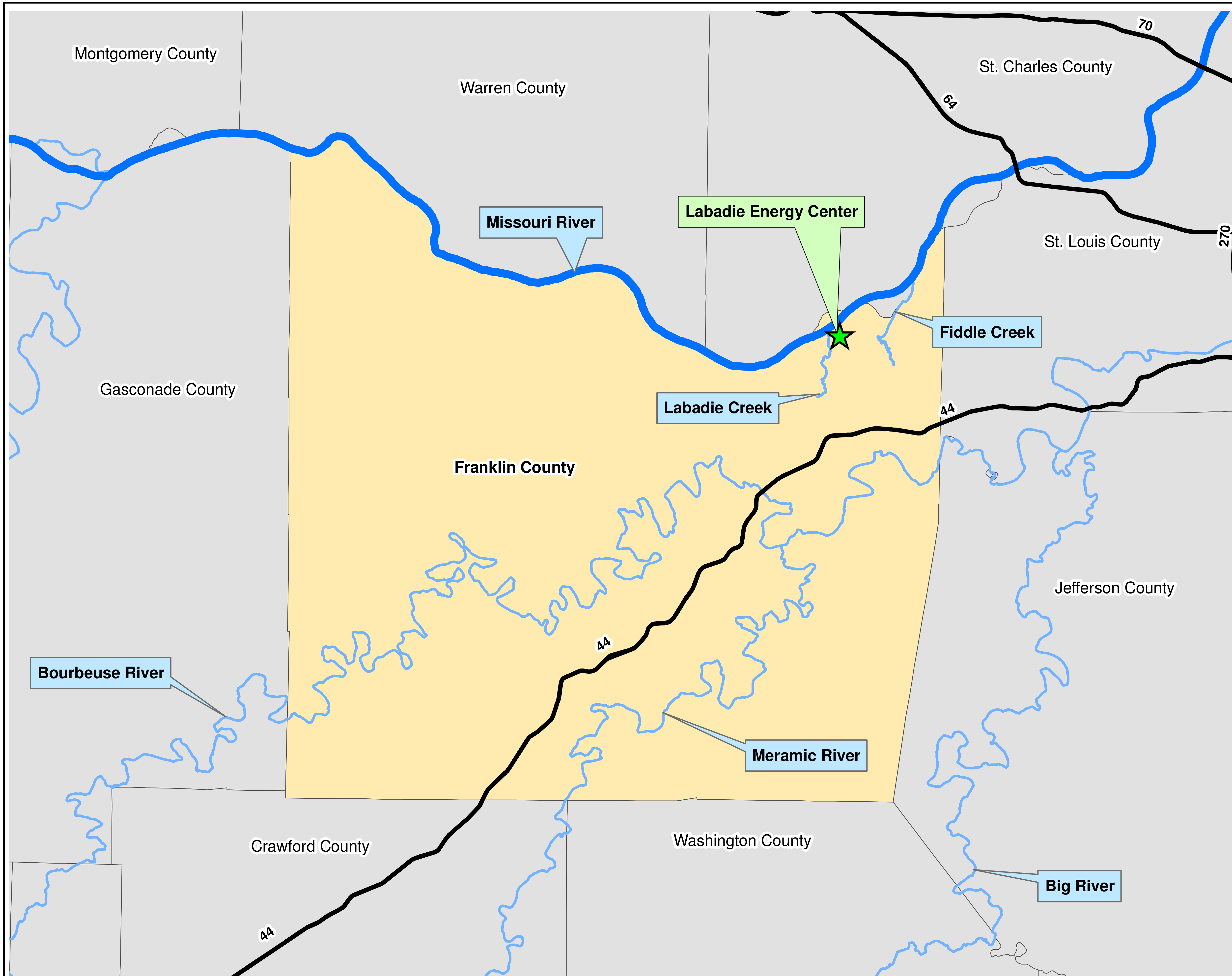

Figure 1
Site Location Map

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

Labadie Energy Center
Major Roads
Missouri River
Streams and Rivers

County Boundary
County Boundaries
Franklin County

2012 MoDOT Roads
2005 NHD Rivers and Streams
2009 Mo County Boundaries

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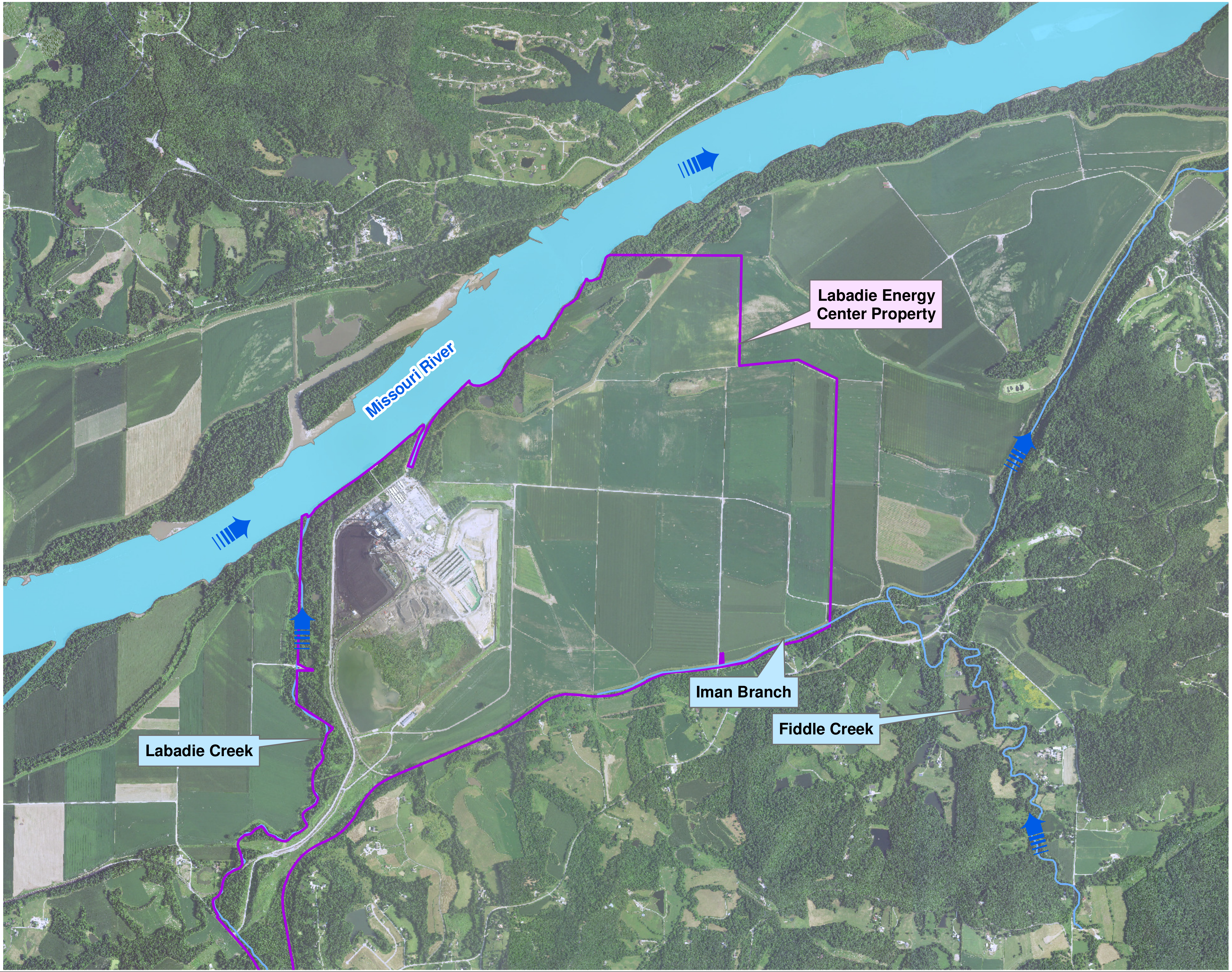

Figure 2
Site Overview

Ameren Missouri Labadie Energy Center Franklin County, Missouri

- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

Declaration of Environmental Restrictive Covenant created under the Missouri Environmental Covenants Act, Sections 260.1000 through 260.1039 RSMo

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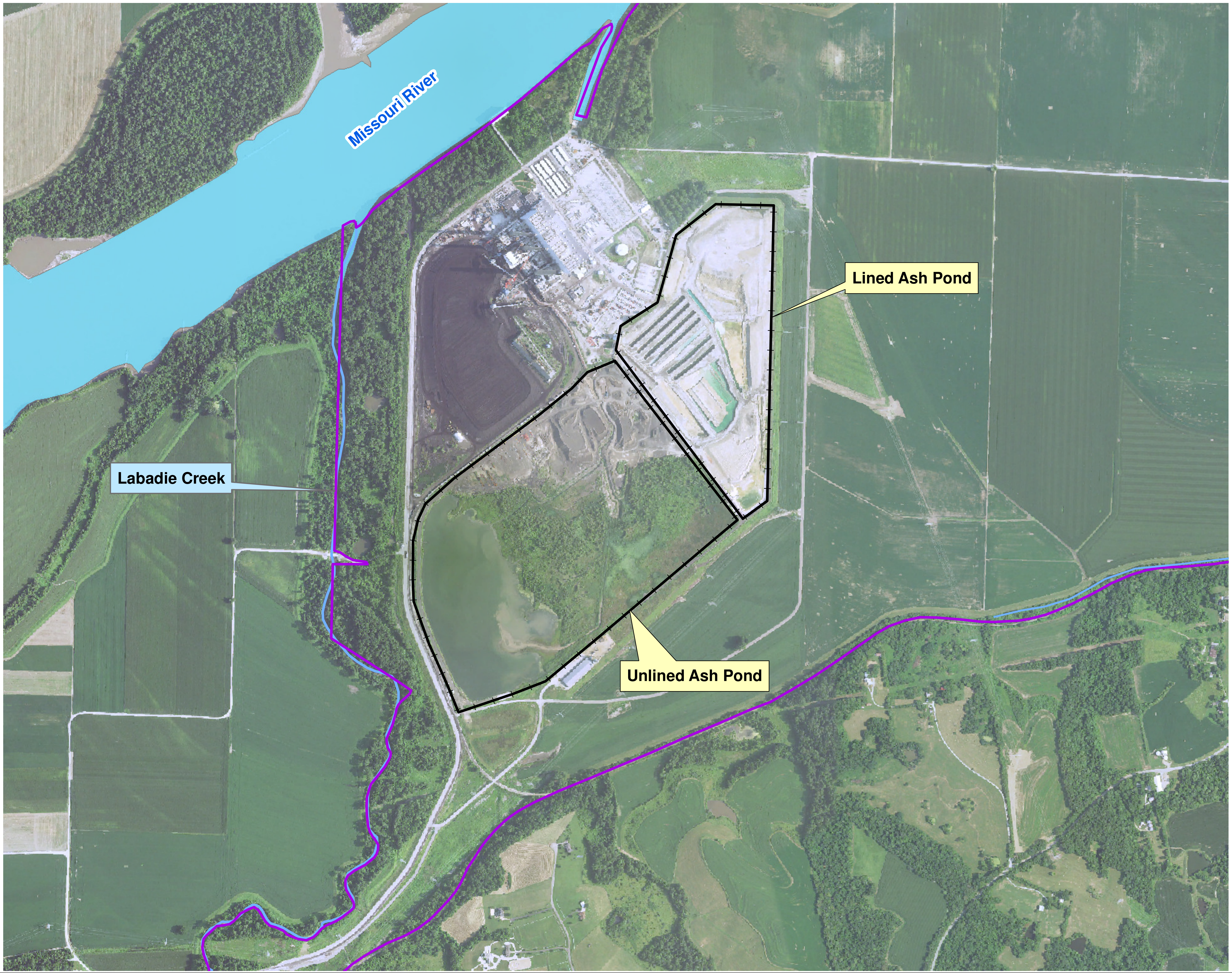

Figure 3
Facility Overview

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

- Streams
- Labadie Energy Center Property Boundary
- Missouri River
- Fence

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

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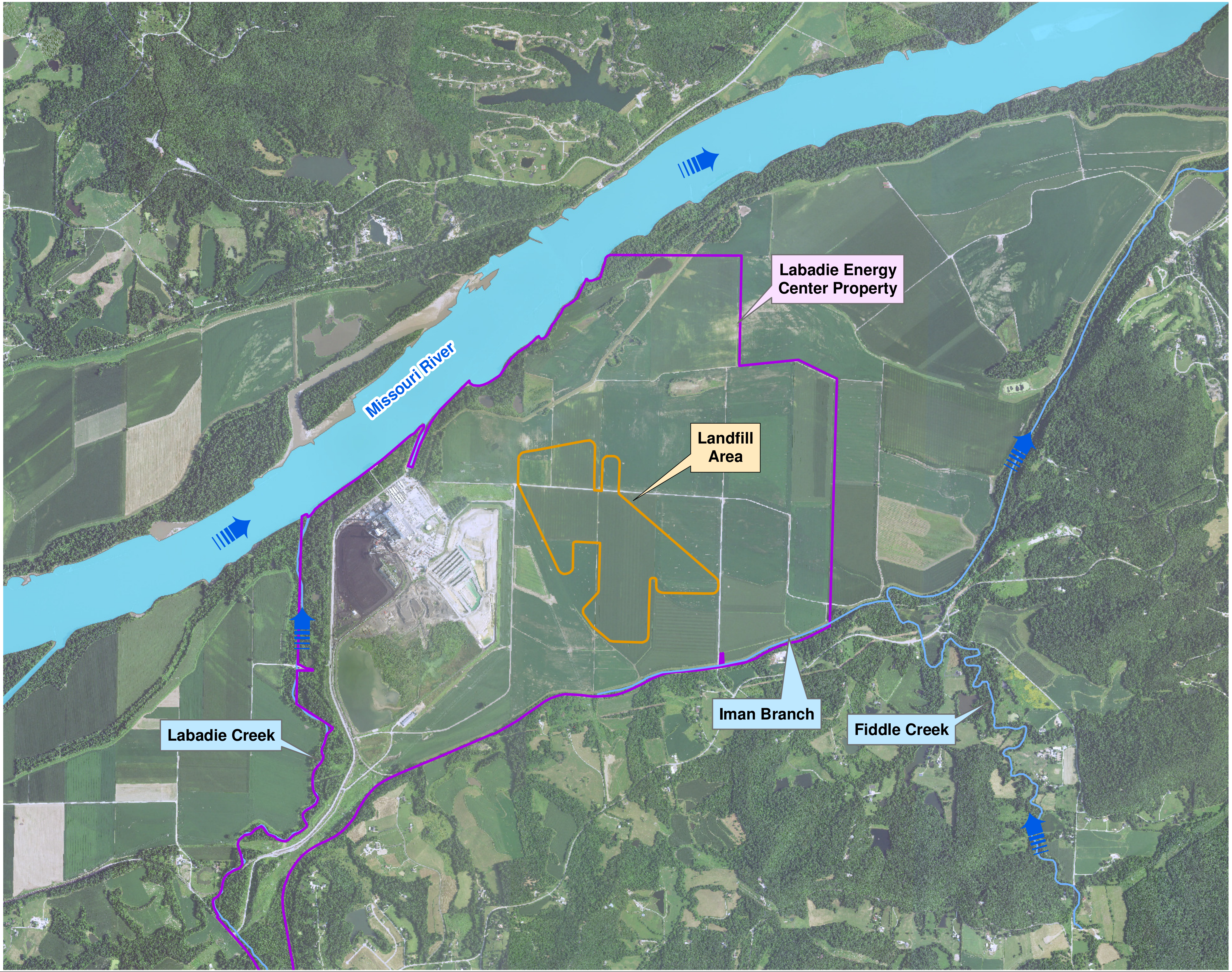

Figure 4
Landfill Area

Ameren Missouri Labadie Energy Center Franklin County, Missouri

- Landfill Area
- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

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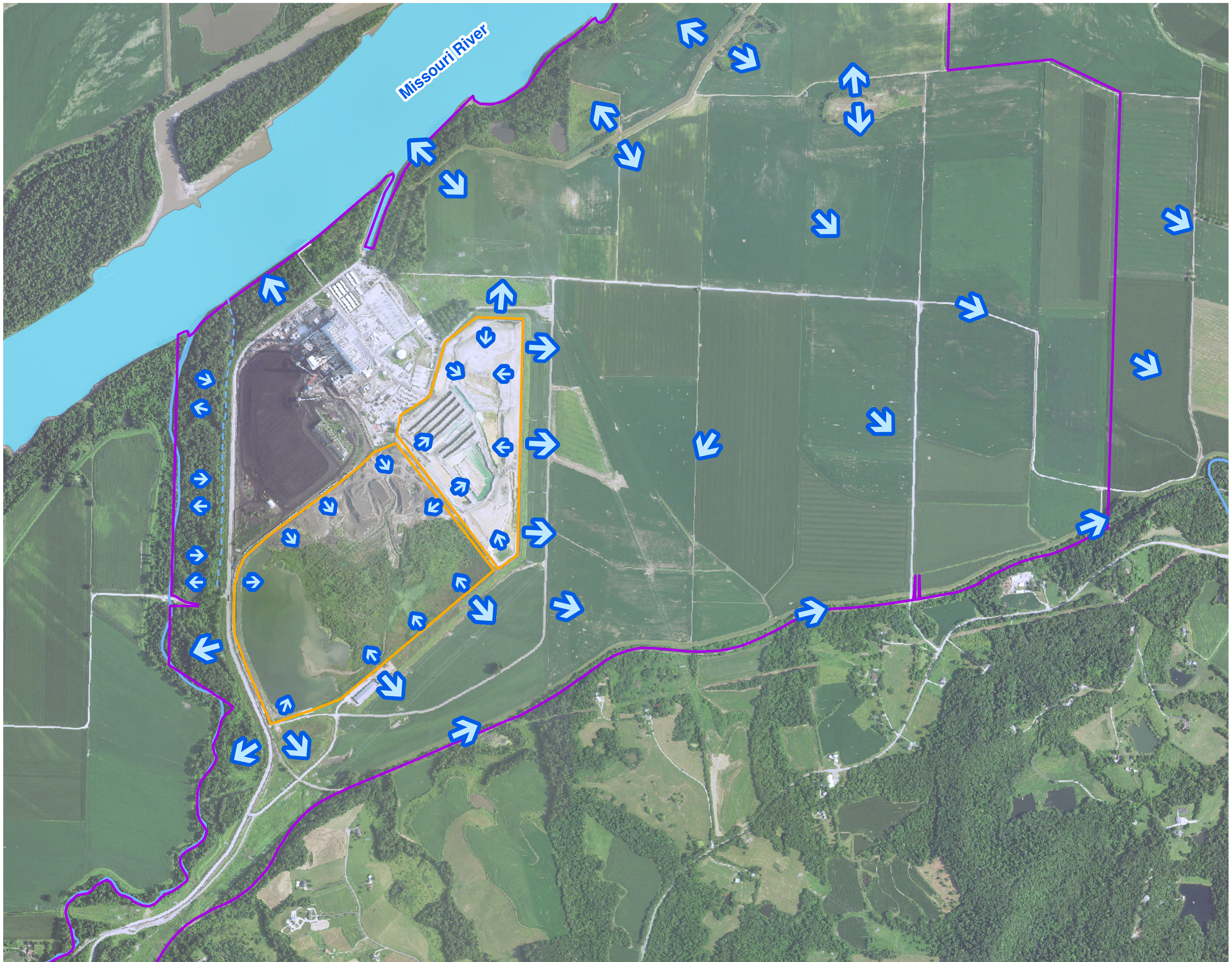

Figure 5 Overland Flow Map

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

Drainage Ditch
Labadie Energy Center Property Boundary
Streams
Ash Ponds
Missouri River
Surface Water Flow Direction

2014 USDA Orthoimagery
2005 NHD Rivers and Streams
2012 NRCS HUC 12

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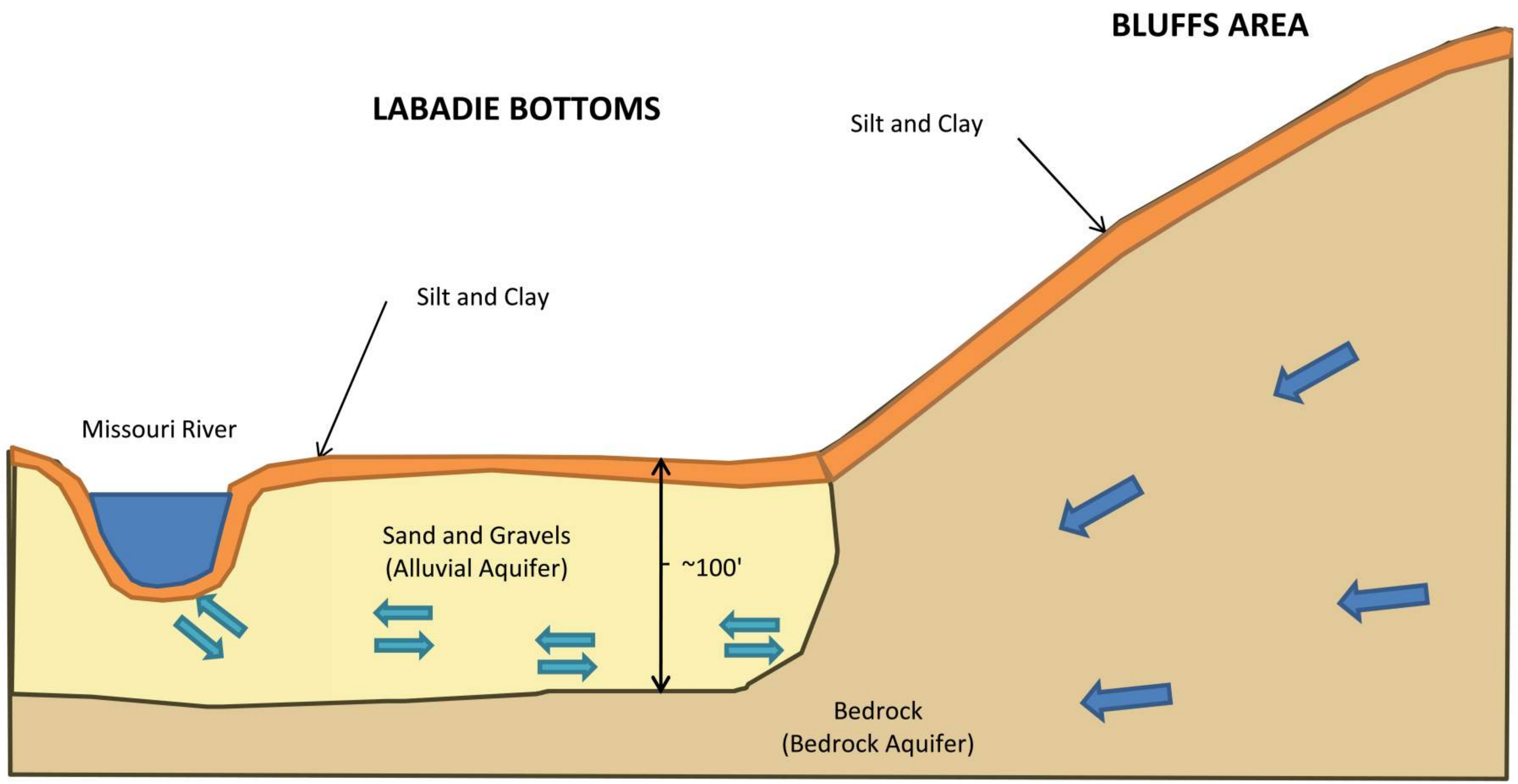

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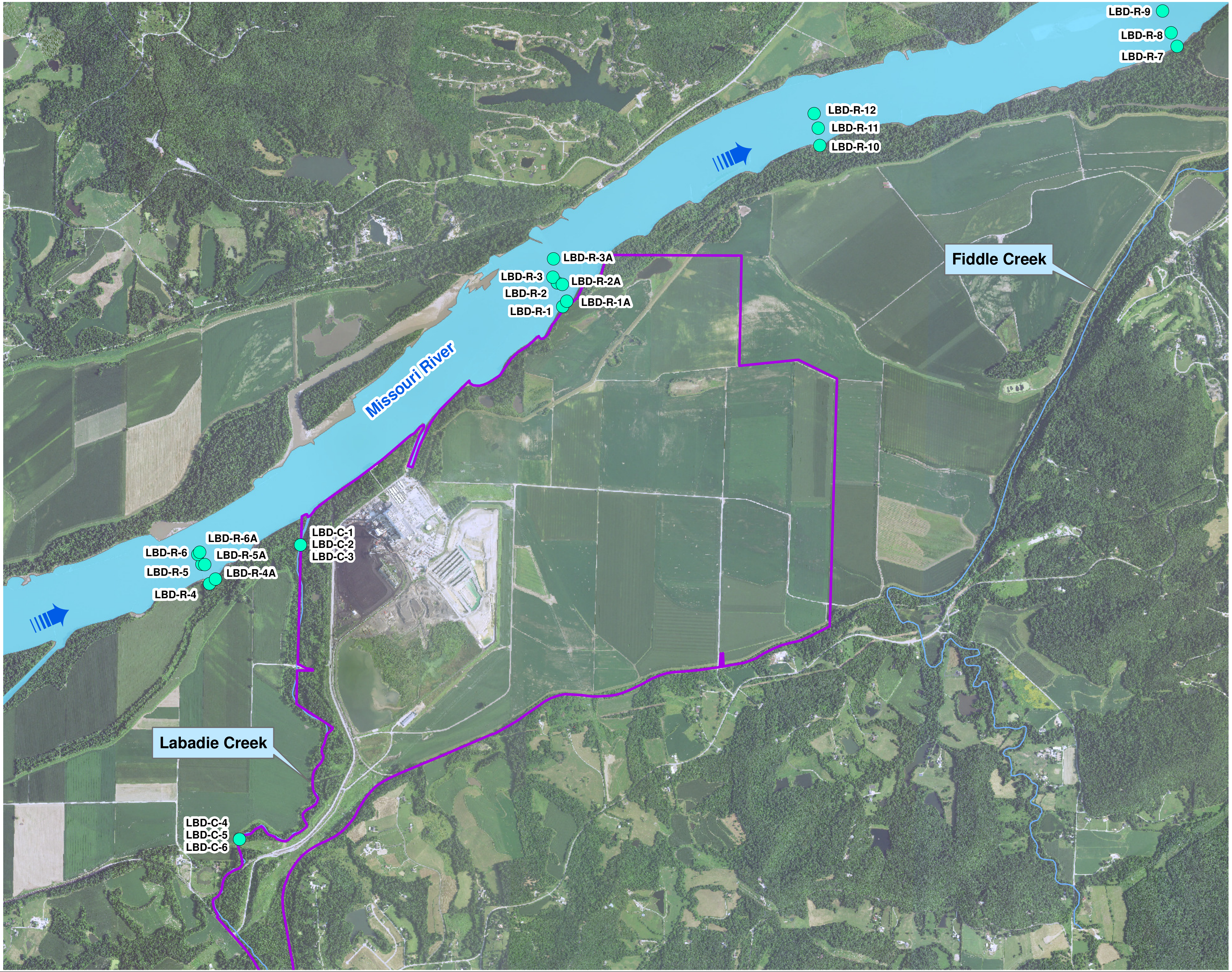
	REVISED:			

Figure 7
Surface Water Monitoring Locations

Ameren Missouri Labadie Energy Center
Franklin County, Missouri



- Labadie Energy Center Property Boundary
- Streams
- Missouri River
- Surface Water Sample

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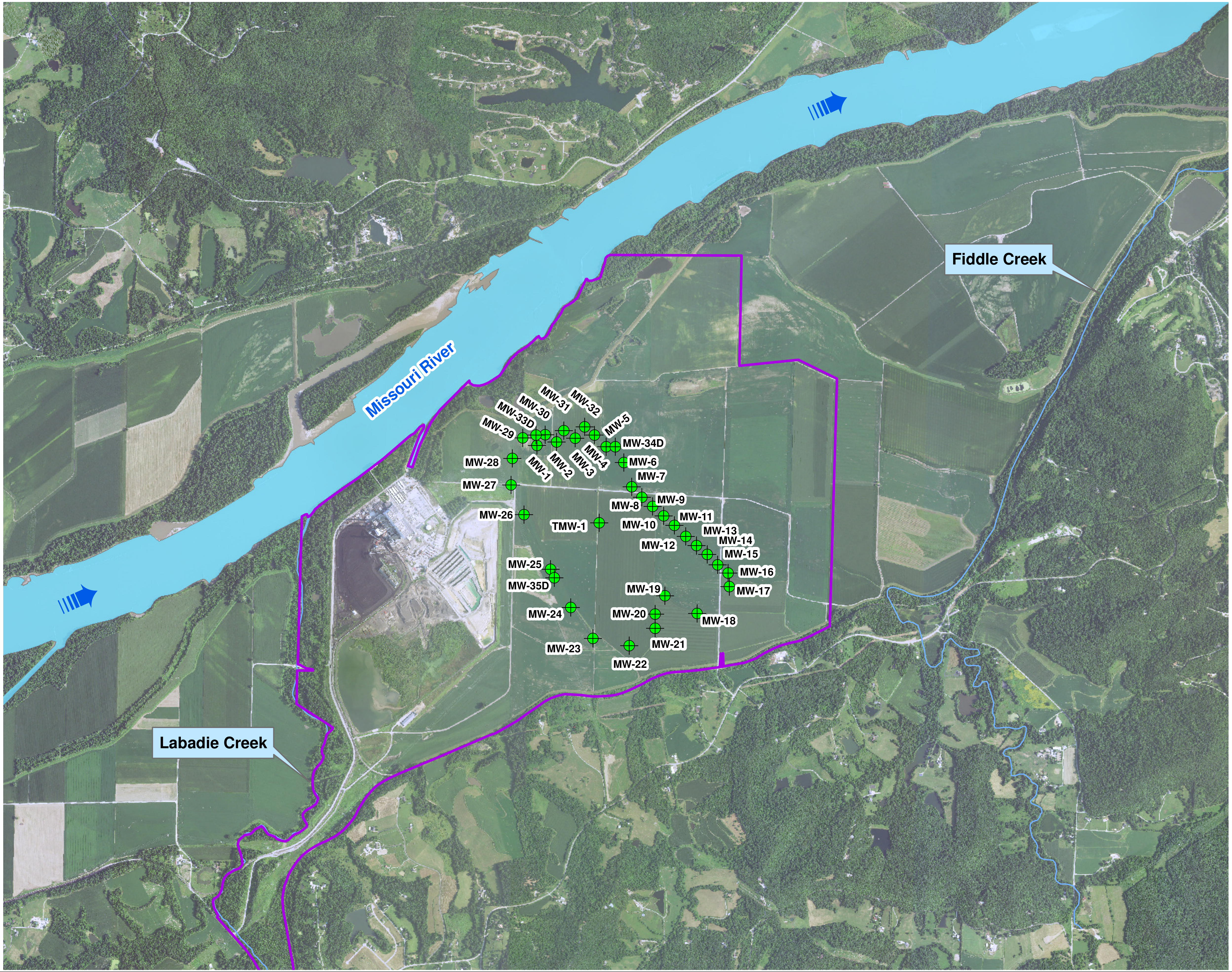

Figure 8
Alluvial Groundwater Monitoring Locations

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

- Streams
- Labadie Energy Center Property Boundary
- Missouri River
- Monitoring Well Locations

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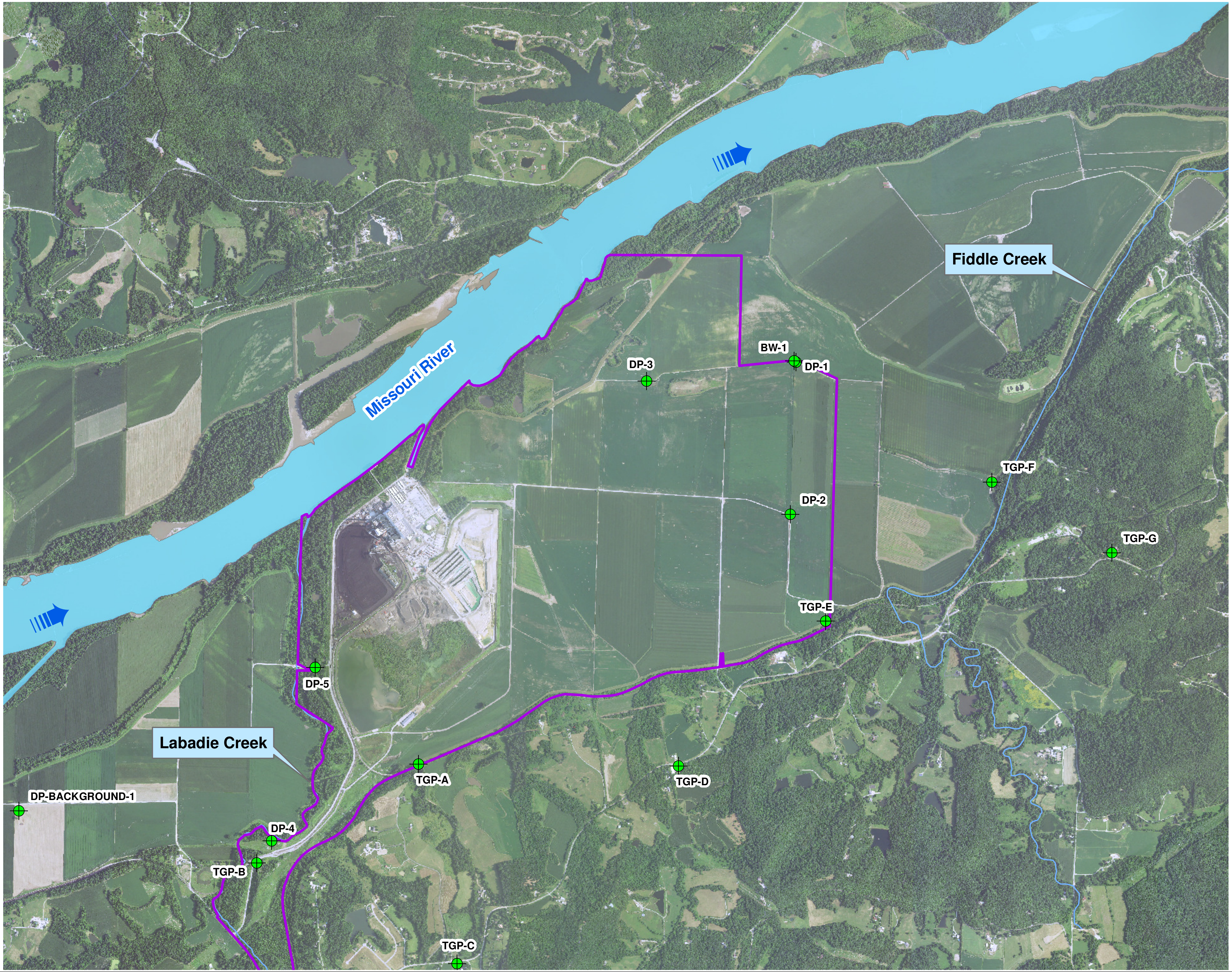

Figure 9
Perimeter and Off-Site Groundwater Monitoring Locations

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

- Streams
- Labadie Energy Center Property Boundary
- Missouri River
- Monitoring Well Locations

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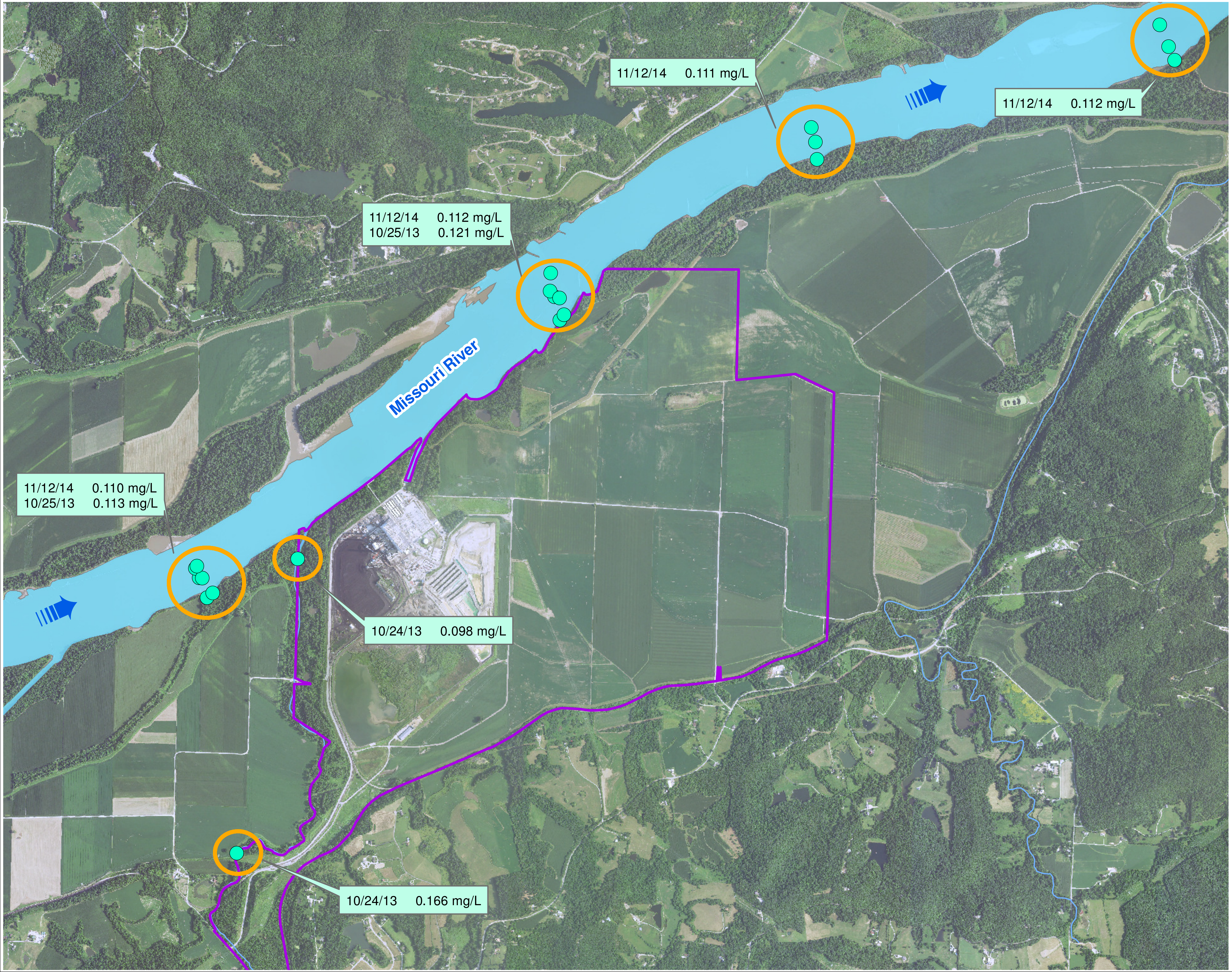

Figure 10
Average Total Boron Concentrations (mg/L) Surface Water

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

- Streams
- Labadie Energy Center Property Boundary
- Missouri River
- Surface Water Sample Locations

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

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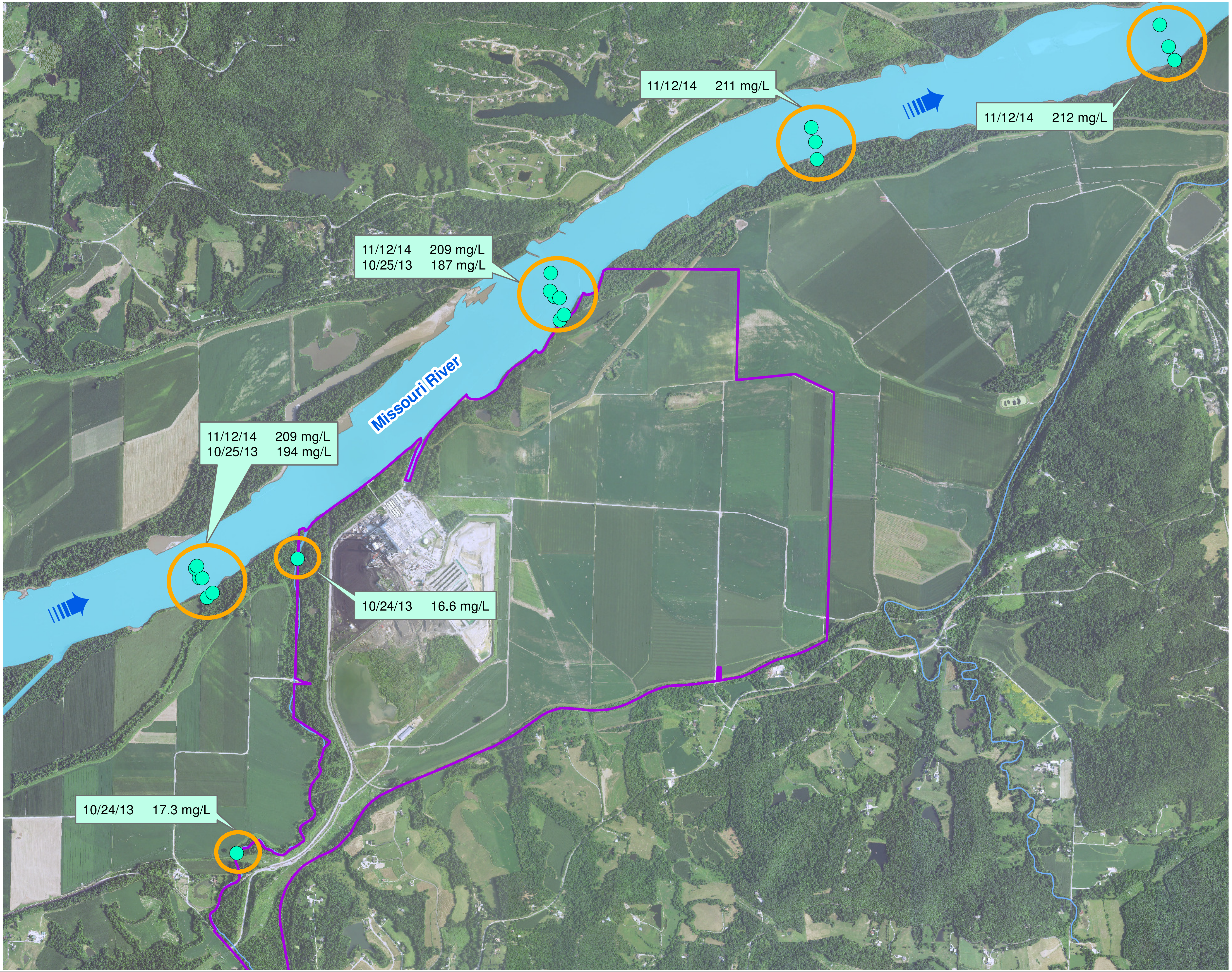

Figure 11
Average Total Sulfate Concentrations (mg/L) Surface Water

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

- Surface Water Sample Locations
- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

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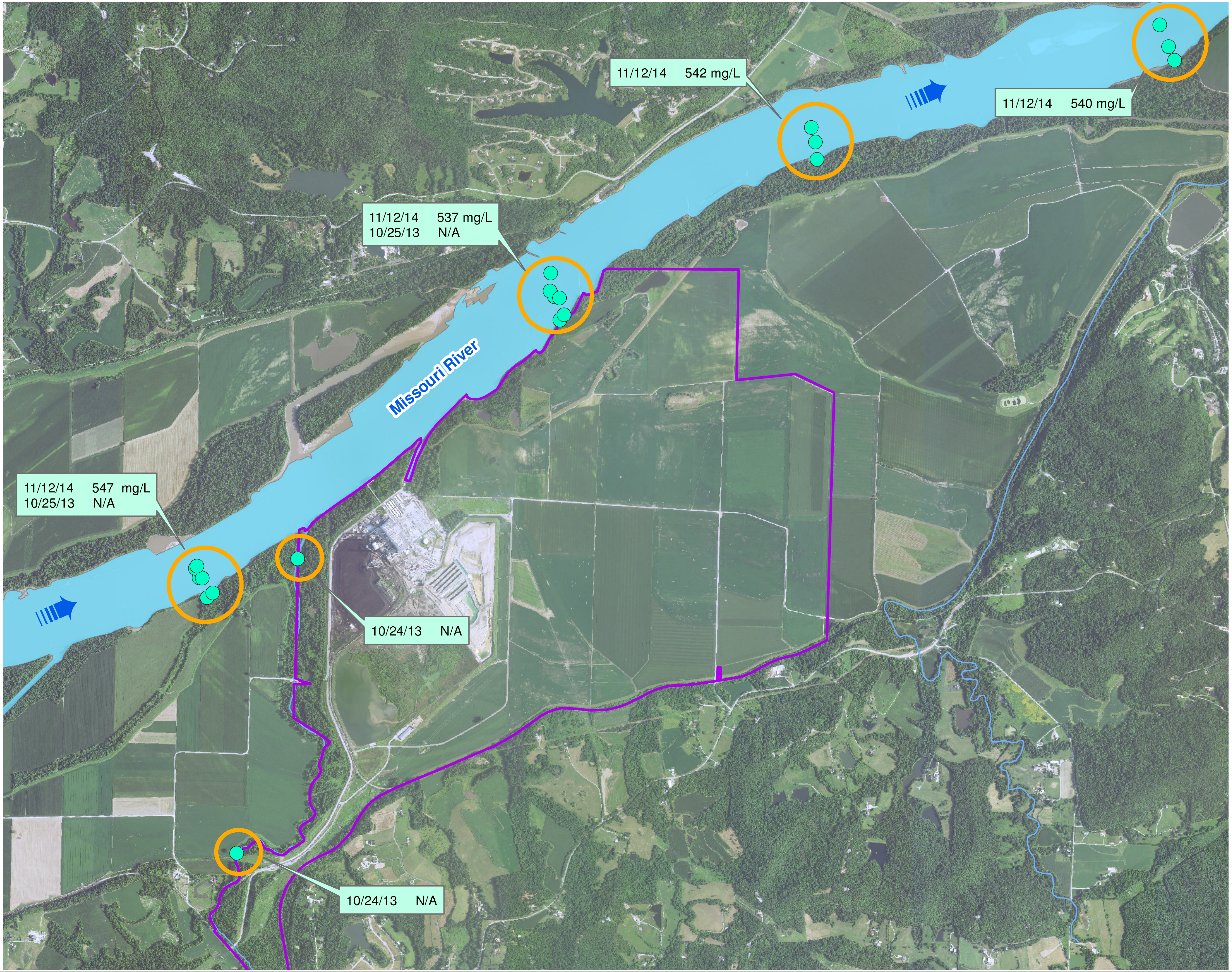

Figure 12
Average TDS Concentrations (mg/L)
Surface Water

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

- Surface Water Sample Locations
- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

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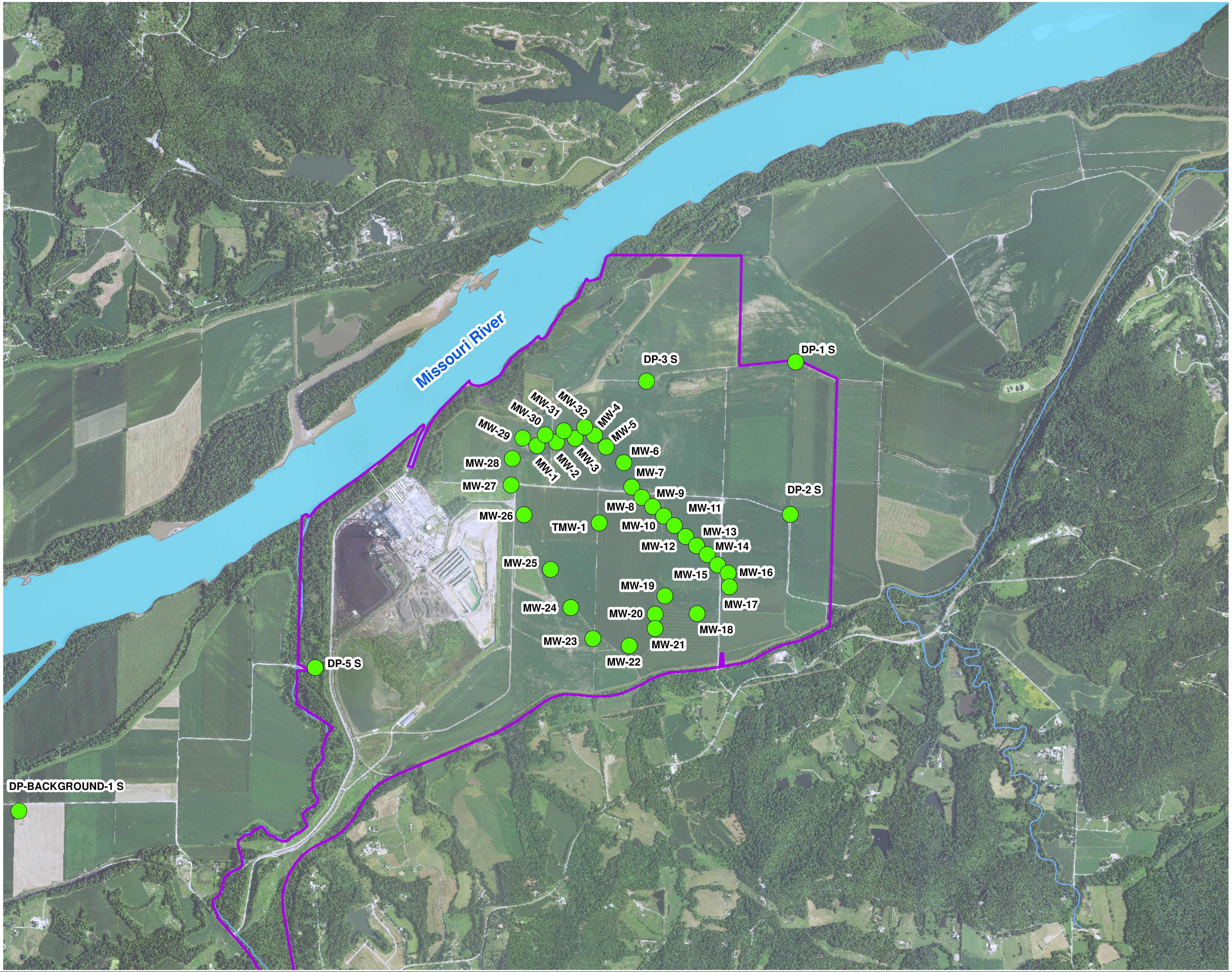

Figure 13
Total Boron Concentrations (mg/L)
Shallow Alluvial Groundwater
Elevation ≥ 430 ft

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

Boron Concentrations

- <2 mg/L
- 2 to 4 mg/L
- > 4 mg/L
- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

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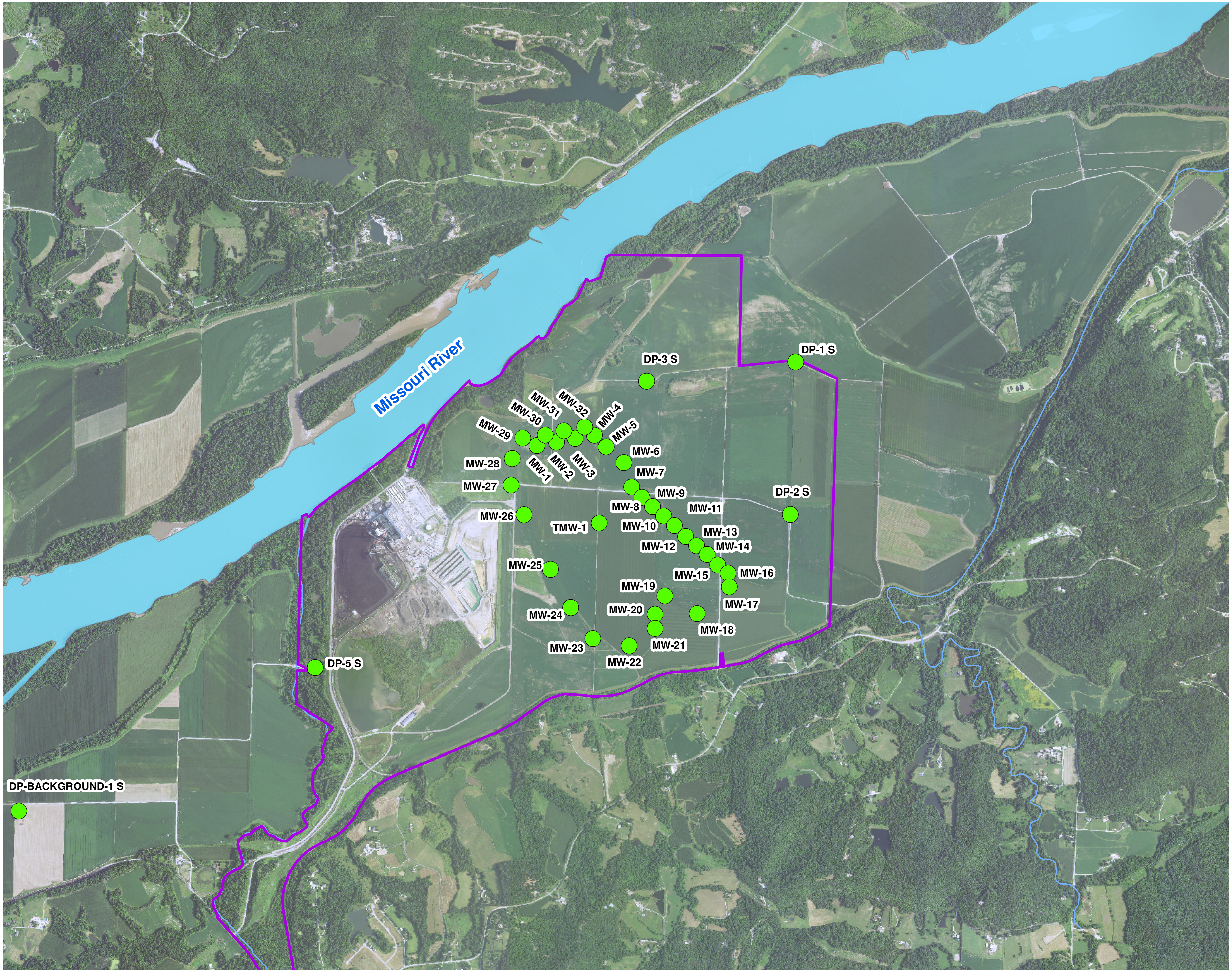

Figure 14
Total Sulfate Concentrations (mg/L)
Shallow Alluvial Groundwater
Elevation ≥ 430 ft

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

Sulfate Concentrations

- < 100 mg/L
- 100 - 250 mg/L
- > 250 mg/L
- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

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0 2,200 4,400
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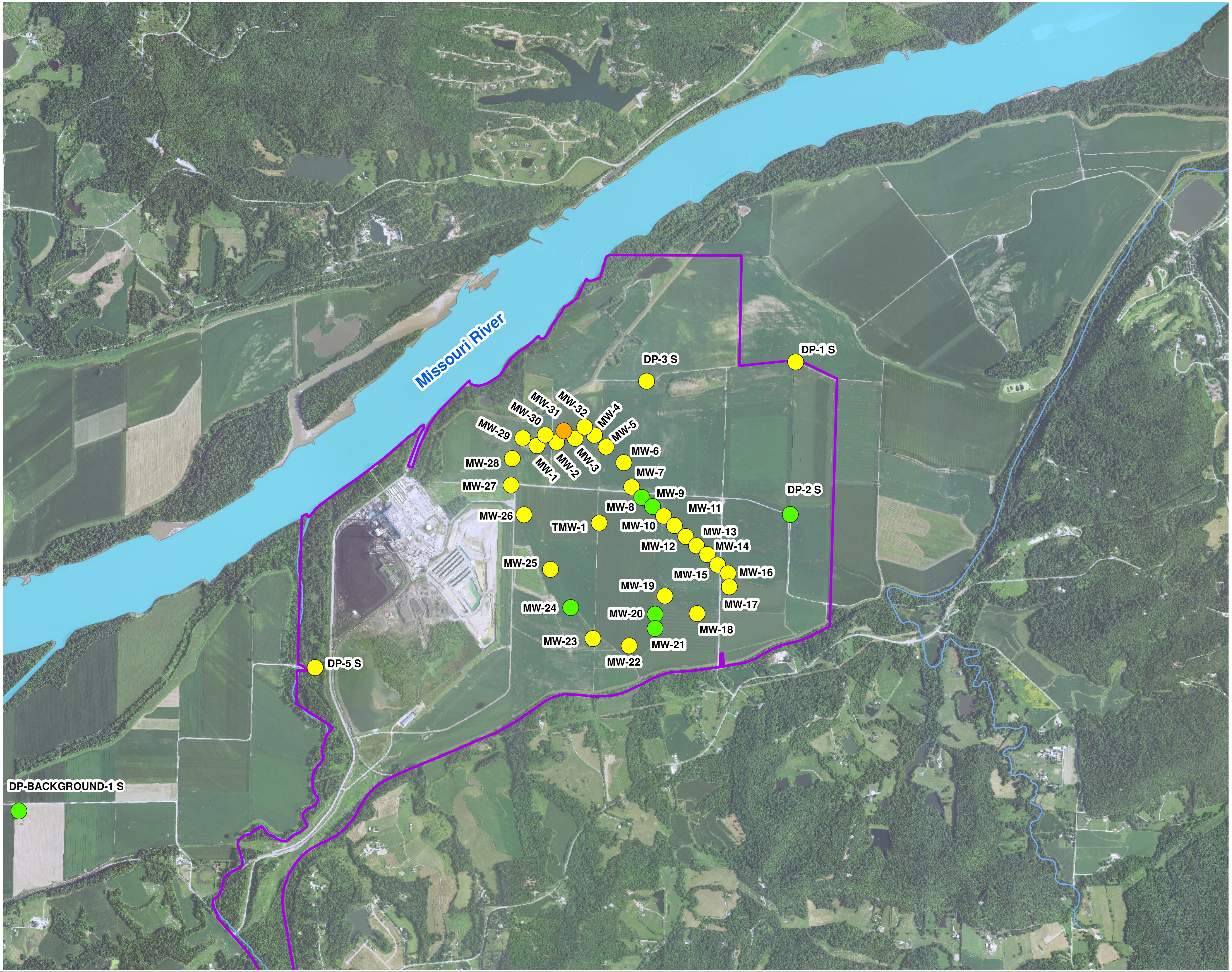

Figure 15
TDS Concentrations (mg/L) Shallow Alluvial Groundwater Elevation ≥ 430 ft

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

TDS Concentrations

- < 500 mg/L
- 500 - 700 mg/L
- > 700 mg/L
- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

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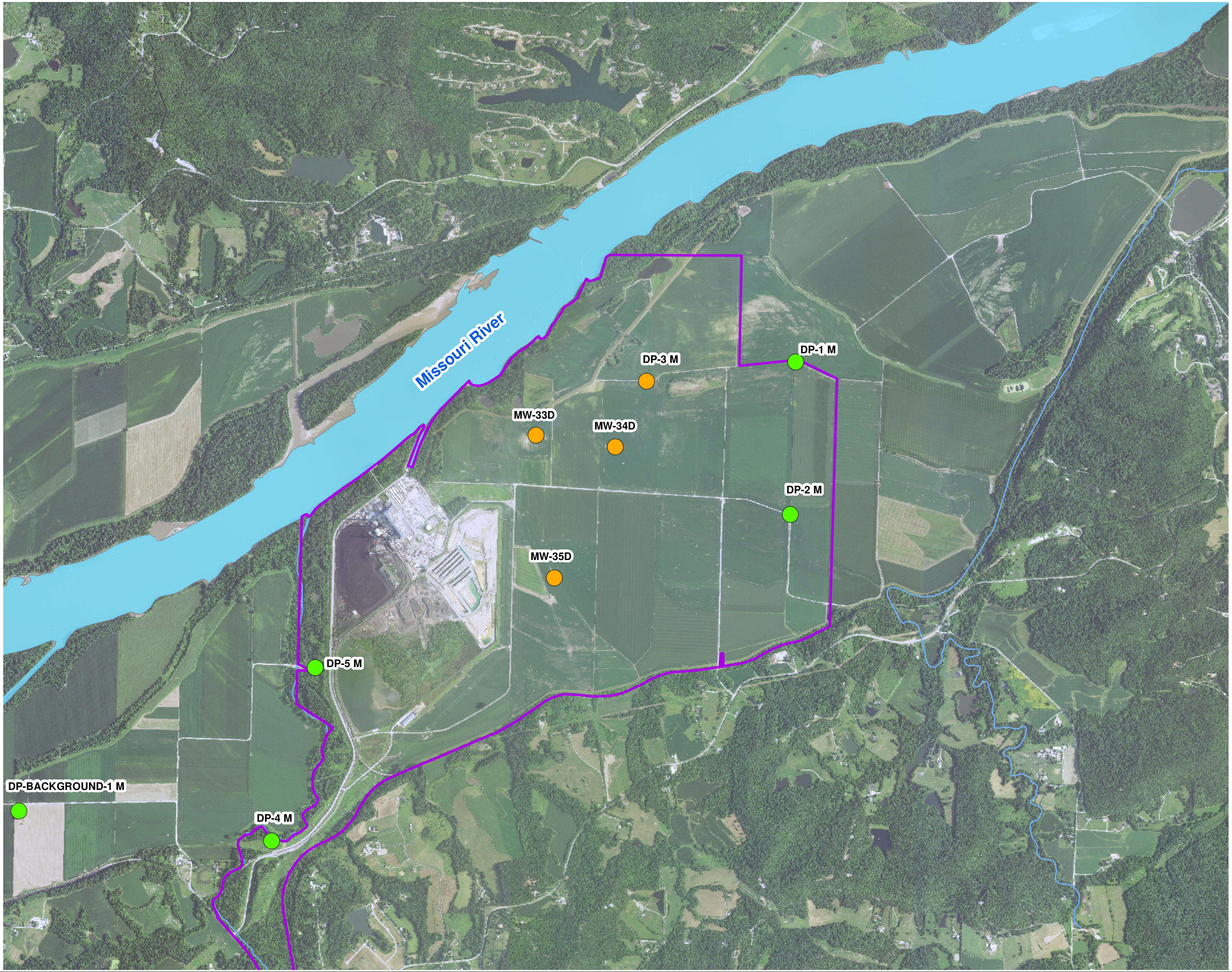

Figure 16
Total Boron Concentrations (mg/L)
Mid-Depth Alluvial Groundwater
Elevation 370 ft to 430 ft

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

Boron Concentrations

- <2 mg/L
- 2 to 4 mg/L
- > 4 mg/L
- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

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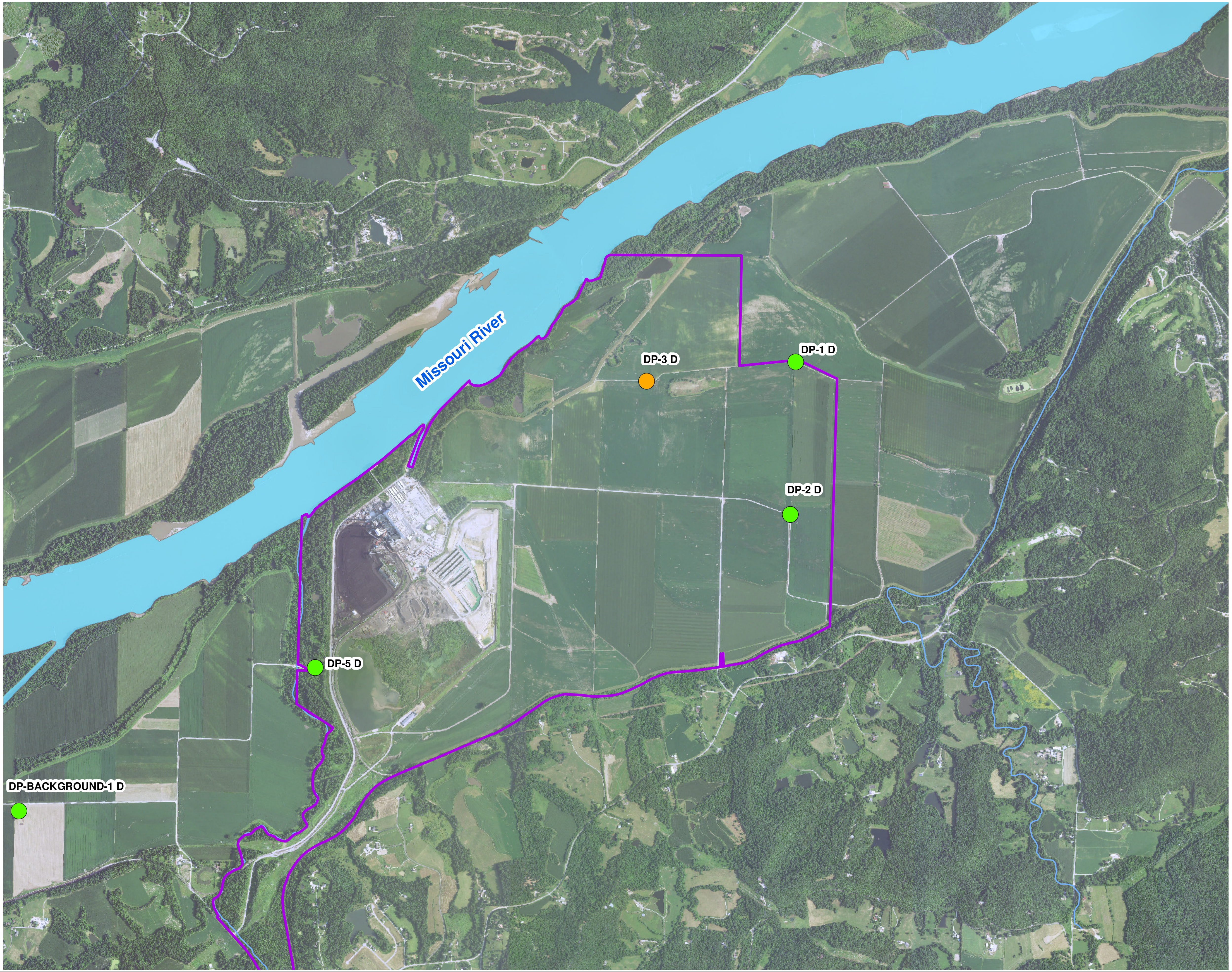
Figure 17
Total Boron Concentrations (mg/L)
Deeper Alluvial Groundwater
Elevation ≤ 370 ft

Ameren Missouri Labadie Energy Center Franklin County, Missouri



Boron Concentrations

- <2 mg/L
- 2 to 4 mg/L
- > 4 mg/L
- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

PROJECT NO.:	6495
DRAWN:	June 2016
DRAWN BY:	ELD
CHECKED BY:	RAF
FILE NAME:	S:\6495 Ameren Labadie\GIS\mxd Boron files\6495_GW.Boron_D_T.mxd

0 2,200 4,400
Feet

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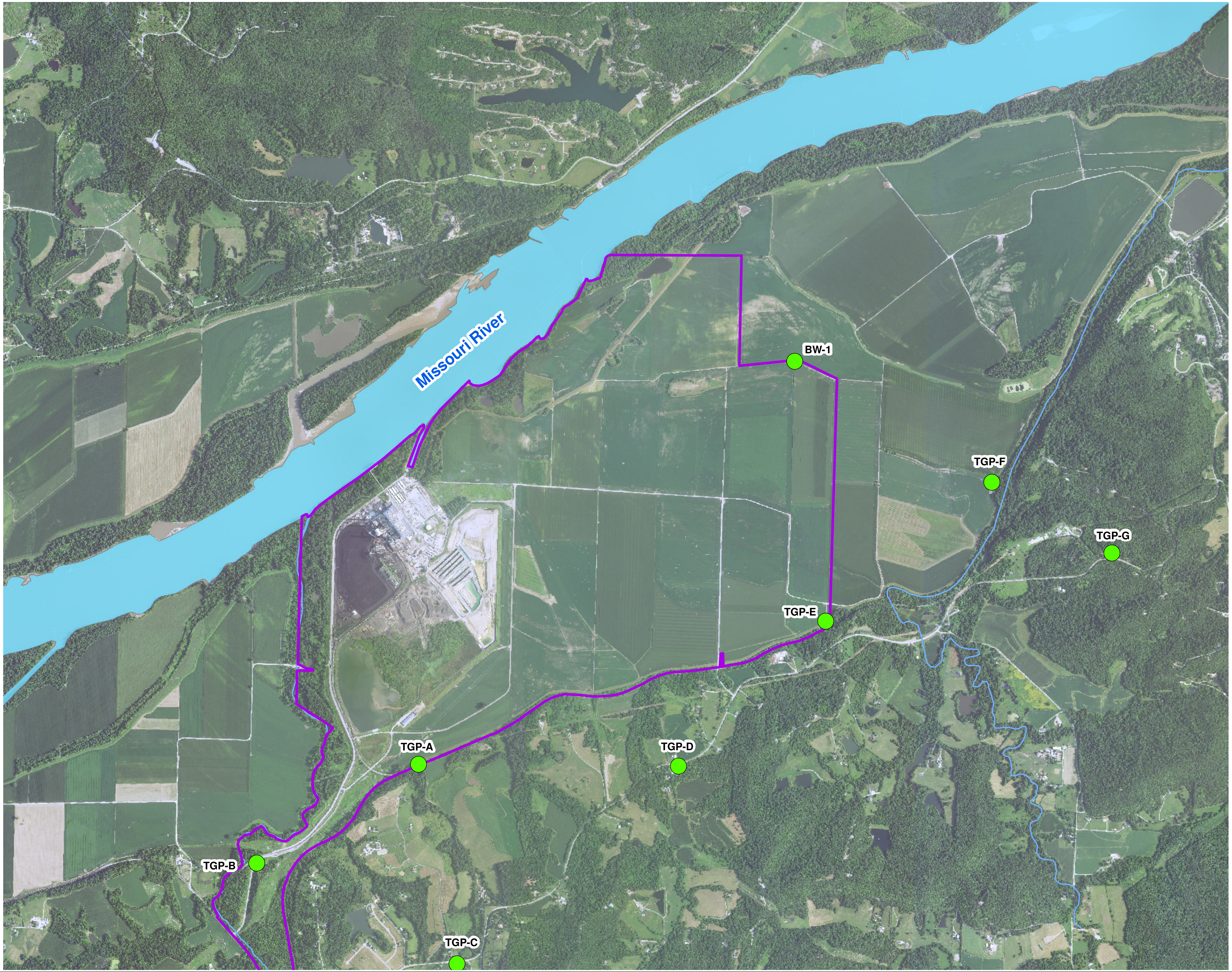

Figure 18
Total Boron Concentrations (mg/L) Bedrock Groundwater

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

Boron Concentrations

- <2 mg/L
- 2 to 4 mg/L
- > 4 mg/L
- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

PROJECT NO.:	6495
DRAWN:	June 2016
DRAWN BY:	ELD
CHECKED BY:	RAF
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0 2,200 4,400
Feet

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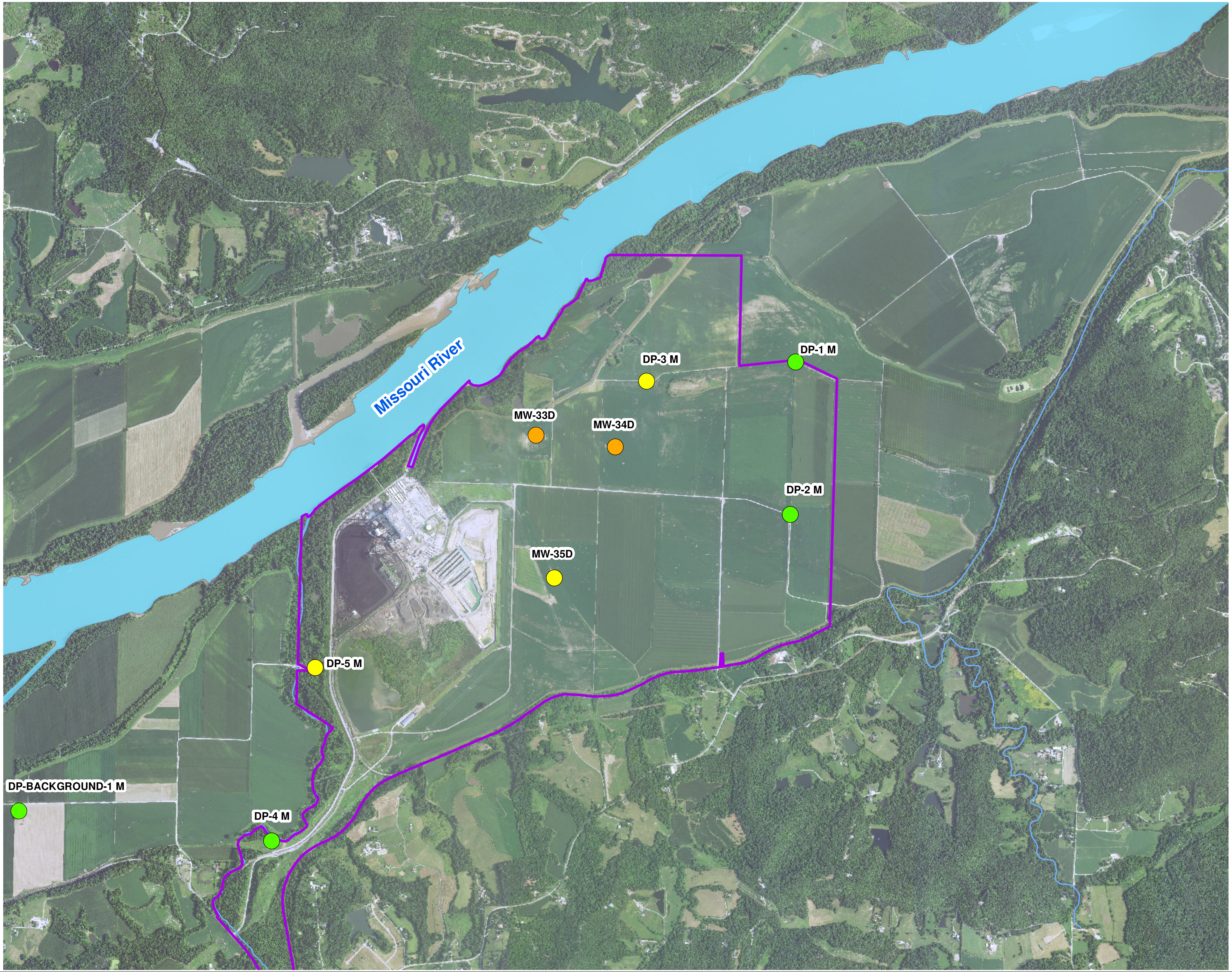

Figure 19
Total Sulfate Concentrations (mg/L)
Mid-Depth Alluvial Groundwater
Elevation 370 ft to 430 ft

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

Sulfate Concentrations

- < 100 mg/L
- 100 - 250 mg/L
- > 250 mg/L
- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

PROJECT NO.:	6495
DRAWN:	June 2016
DRAWN BY:	ELD
CHECKED BY:	RAF
FILE NAME:	S:\6495 Ameren Labadie\GIS\mxd Sulfate files\6495_GW.Sulf_M_T.mxd

0 2,200 4,400
Feet

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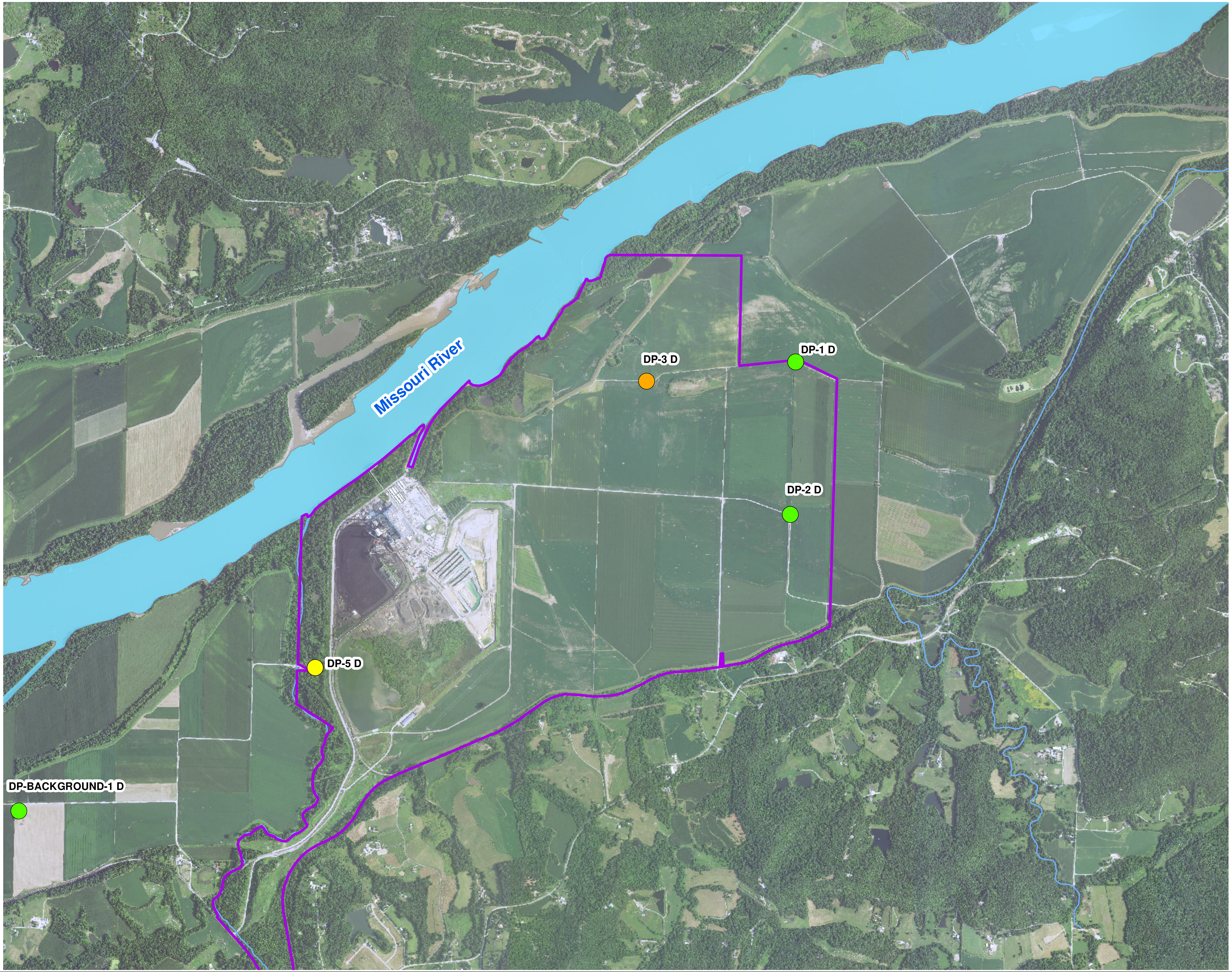

Figure 20
Total Sulfate Concentrations (mg/L)
Deeper Alluvial Groundwater
Elevation ≤ 370 ft

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

Sulfate Concentrations

- < 100 mg/L
- 100 - 250 mg/L
- > 250 mg/L
- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

PROJECT NO.:	6495
DRAWN:	June 2016
DRAWN BY:	ELD
CHECKED BY:	RAF
FILE NAME:	S:\6495 Ameren Labadie\GIS\mxd Sulfate files\6495_GW.Sulf_D_T.mxd

0 2,200 4,400
Feet

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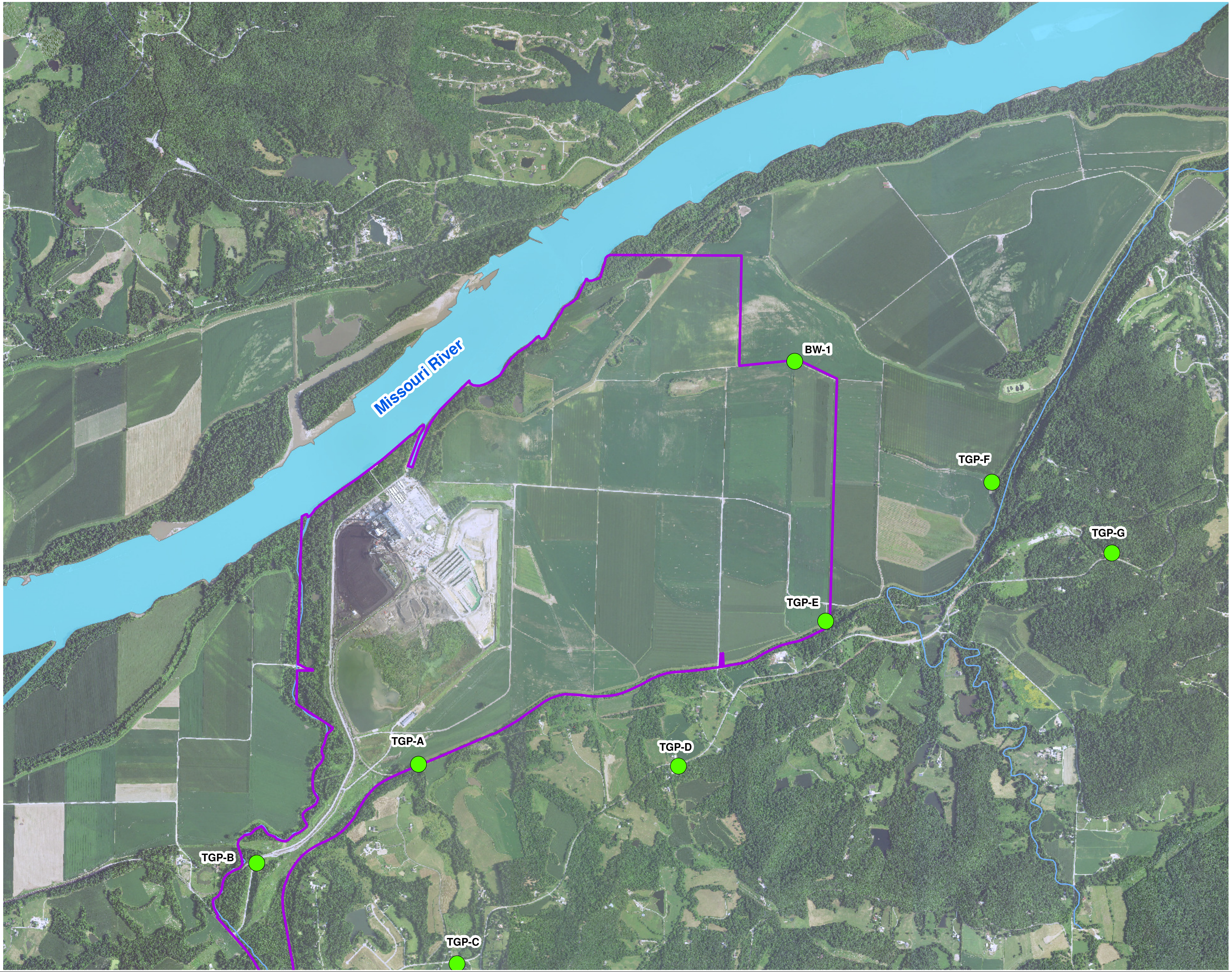

Figure 21
Total Sulfate
Concentrations (mg/L)
Bedrock Groundwater

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

Sulfate Concentrations

- < 100 mg/L
- 100 - 250 mg/L
- > 250 mg/L
- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

PROJECT NO.:	6495
DRAWN:	June 2016
DRAWN BY:	ELD
CHECKED BY:	RAF
FILE NAME:	S:\6495 Ameren Labadie\GIS\mxd Sulfate files\6495_GW.Sulf_TGP.mxd

0 2,200 4,400
Feet

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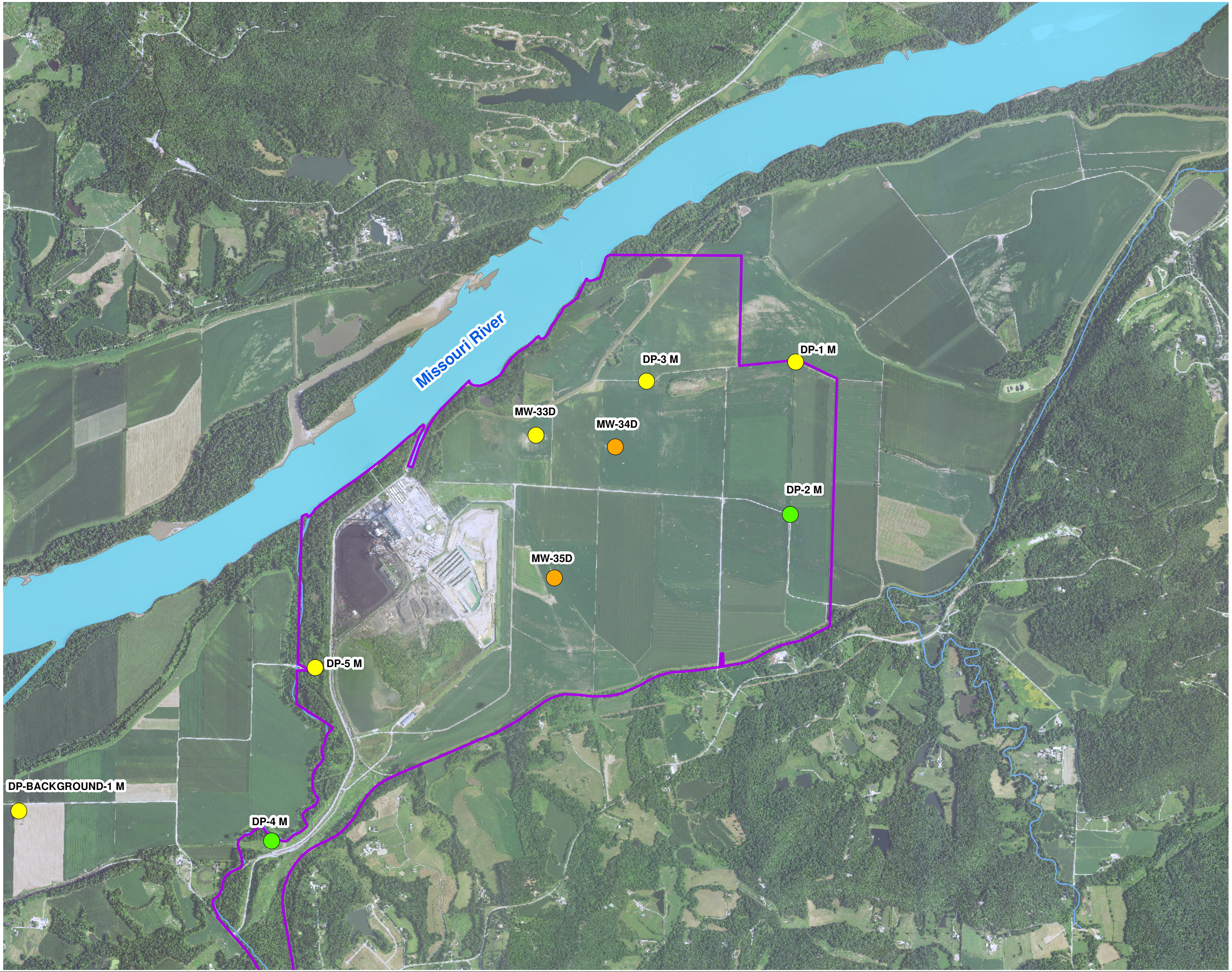

Figure 22
TDS Concentrations (mg/L)
Mid-Depth Alluvial Groundwater
Elevation 370 ft to 430 ft

Ameren Missouri Labadie Energy Center Franklin County, Missouri

TDS Concentrations

- < 500 mg/L
- 500 - 700 mg/L
- > 700 mg/L
- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

PROJECT NO.:	6495
DRAWN:	June 2016
DRAWN BY:	ELD
CHECKED BY:	RAF
FILE NAME:	S:\6495 Ameren Labadie\GIS\mxd TDS files\6495_GW.TDS_M.mxd

0 2,200 4,400
Feet

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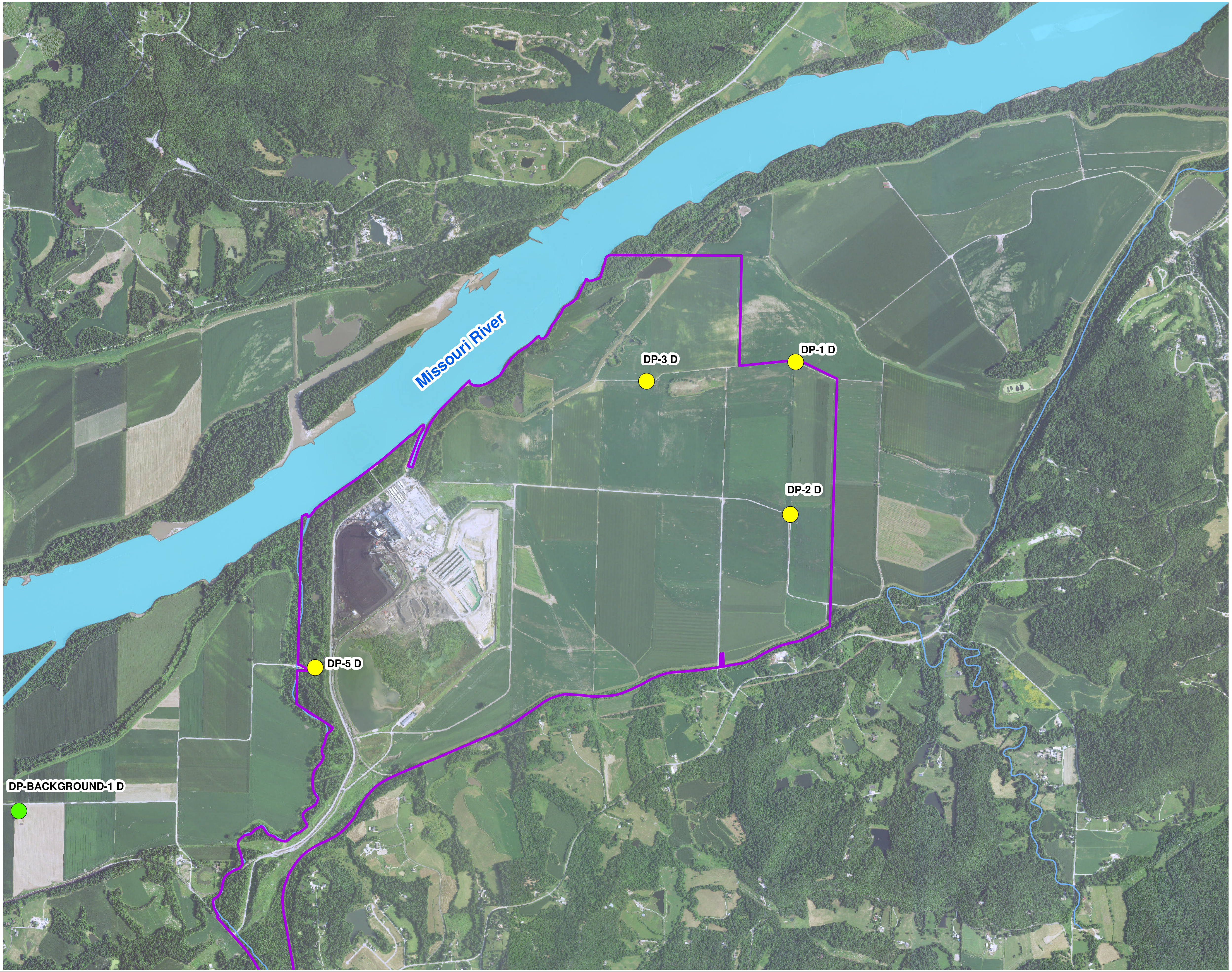

Figure 23
TDS Concentrations (mg/L)
Deeper Alluvial Groundwater
Elevation ≤ 370 ft

Ameren Missouri Labadie Energy Center
Franklin County, Missouri

TDS Concentrations

- < 500 mg/L
- 500 - 700 mg/L
- > 700 mg/L
- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

PROJECT NO.:	6495
DRAWN:	June 2016
DRAWN BY:	ELD
CHECKED BY:	RAF
FILE NAME:	S:\6495 Ameren Labadie\GIS\mxd TDS files\6495_GW.TDS_D.mxd

0 2,200 4,400
Feet

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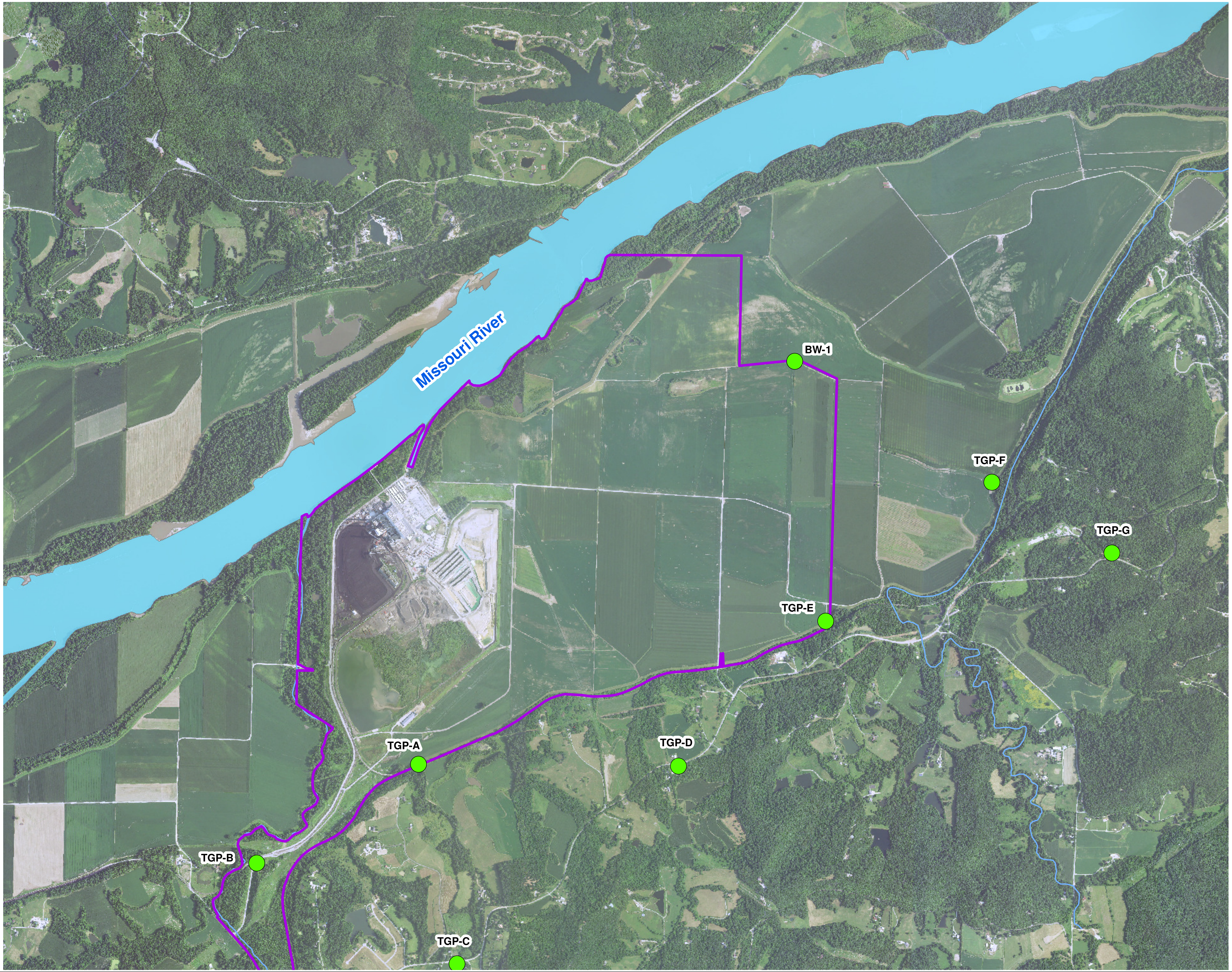
Figure 24
TDS Concentrations (mg/L) Bedrock Groundwater

Ameren Missouri Labadie Energy Center Franklin County, Missouri



TDS Concentrations

- < 500 mg/L
- 500 - 700 mg/L
- > 700 mg/L
- Labadie Energy Center Property Boundary
- Streams
- Missouri River

2014 USDA Orthoimagery
2005 NHD Rivers and Streams

PROJECT NO.:	6495
DRAWN:	June 2016
DRAWN BY:	ELD
CHECKED BY:	RAF
FILE NAME:	S:\6495 Ameren Labadie\GIS\mxd TDS files\6495_GW.TDS_TGP.mxd

0 2,200 4,400
Feet

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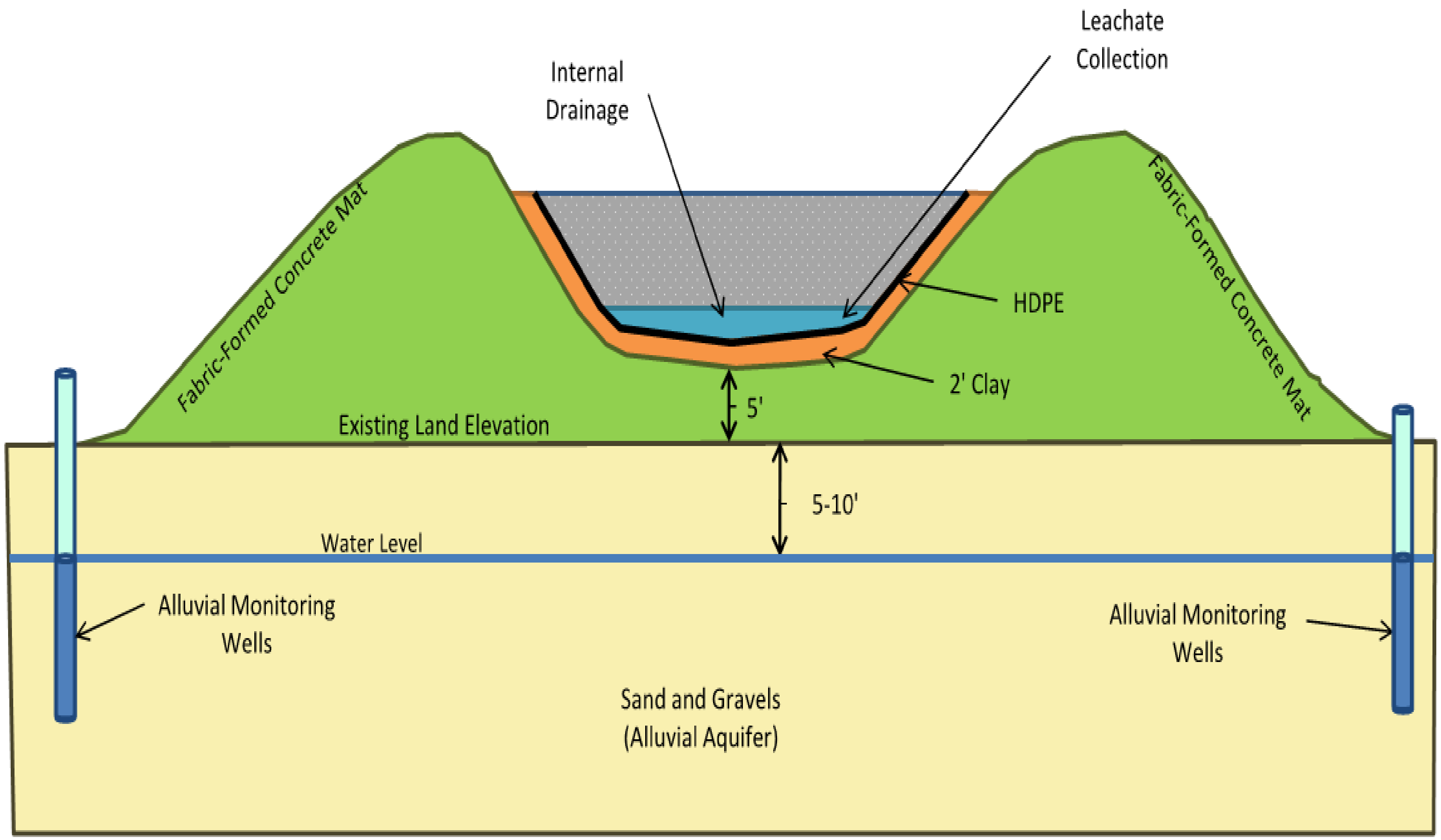

Figure 25: Features of the Labadie Energy Center Utility Waste Landfill

TABLES

Table 1   Parameter Testing Schedule for All Monitoring Locations

	MW and TMW	DP	TGP and BW	LBD Missouri River	LBD Labadie Creek
Aluminum	Yes	Yes	Yes	Yes	Yes
Antimony	Yes	Yes	Yes	Yes	Yes
Arsenic	Yes	Yes	Yes	Yes	Yes
Barium	Yes	Yes	Yes	Yes	Yes
Beryllium	Yes	Yes	Yes	Yes	Yes
Boron	Yes	Yes	Yes	Yes	Yes
Cadmium	Yes	Yes	Yes	Yes	Yes
Calcium	Yes	Yes	Yes	Yes	Yes
Chloride	Yes	Yes	Yes	Yes	
Chromium	Yes	Yes	Yes	Yes	Yes
Cobalt	Yes	Yes	Yes	Yes	Yes
COD	Yes				
Copper	Yes	Yes	Yes	Yes	Yes
DO				Yes	Yes
Fluoride	Yes	Yes	Yes	Yes	Yes
Hardness	Yes	Yes	Yes	Yes	Yes
Iron	Yes	Yes	Yes	Yes	Yes
Lead	Yes	Yes	Yes	Yes	Yes
Magnesium	Yes	Yes	Yes	Yes	Yes
Manganese	Yes	Yes	Yes	Yes	Yes
Mercury	Yes	Yes	Yes	Yes	Yes
Molybdenum	Yes	Yes	Yes	Yes	Yes
Nickel	Yes	Yes	Yes	Yes	Yes
pH	Yes	Yes		Yes	Yes
Redox Potential				Yes	Yes
Selenium	Yes	Yes	Yes	Yes	Yes
Silver	Yes	Yes	Yes	Yes	Yes
Sodium	Yes				
Spec. Cond.	Yes			Yes	Yes
Sulfate	Yes	Yes	Yes	Yes	Yes
TDS	Yes	Yes	Yes	Yes	
Temperature				Yes	Yes
Thallium	Yes	Yes	Yes	Yes	Yes
Tin		Yes	Yes	Yes	Yes
TOC	Yes				
Total Cyanide		Yes	Yes	Yes	Yes
Total Nitrite/Nitrate			Yes	Yes	Yes
TOX	Yes				
Turbidity				Yes	Yes
Zinc	Yes	Yes	Yes	Yes	Yes

Table 2 Characteristics of Groundwater Monitoring Locations

	Depth (feet below ground surface, fbgs) to				Elevation (feet above mean sea level, fmsl)				
Well ID	Bedrock	Top of Screen	Bottom of Screen	Bottom of Well	Ground Surface	Bedrock	Top of Screen	Bottom of Screen	Bottom of Well
AW-1	18.5	8.5	18.5	18.50	463.39	444.89	454.89	444.89	444.89
BW-1	110	130	170	170.00	468.27	358.27	338.27	298.27	298.27
DP-1 D		106	110		468.10		362.10	358.10	
DP-1 M		52	57		468.10		416.10	411.10	
DP-1 S		25	29		468.10		443.10	439.10	
DP-2 D		106	110		465.30		359.30	355.30	
DP-2 M		51	55		465.30		414.30	410.30	
DP-2 S		25	29		465.30		440.30	436.30	
DP-3 D		103	108		467.50		364.50	359.50	
DP-3 M		54	59		467.50		413.50	408.50	
DP-3 S		24	29		467.50		443.50	438.50	
DP-4 M **		42	47		471.30		429.30	424.30	
DP-5 D		131	135		480.10		349.10	345.10	
DP-5 M		56	60		480.10		424.10	420.10	
DP-5 S		28	32		480.10		452.10	448.10	
DP-BACKGROUND-1 D**		105.00	110.00		468.10		363.10	358.10	
DP-BACKGROUND-1 M**		55.00	60.00		468.1		413.10	408.10	
DP-BACKGROUND-1 S**		25.00	30.00		468.1		443.10	438.10	
MW-1		14.96	24.66	25.16	469.45		454.49	444.79	444.29
MW-10		8.53	18.23	18.73	465.84		457.31	447.61	447.11
MW-11		8.31	18.01	18.51	466.11		457.80	448.10	447.60
MW-12		7.91	17.61	18.11	465.74		457.83	448.13	447.63
MW-13		7.71	17.41	17.91	465.61		457.90	448.20	447.70
MW-14		6.91	16.61	17.11	464.15		457.24	447.54	447.04
MW-15		5.44	15.14	15.64	465.03		459.59	449.89	449.39
MW-16		5.70	15.40	15.90	463.97		458.27	448.57	448.07
MW-17		6.92	16.62	17.12	465.29		458.37	448.67	448.17
MW-18		5.53	15.23	15.73	462.76		457.23	447.53	447.03
MW-19		5.34	15.04	15.54	463.51		458.17	448.47	447.97
MW-2		13.59	23.29	23.79	469.30		455.71	446.01	445.51
MW-20		5.06	14.76	15.26	463.61		458.55	448.85	448.35
MW-21		5.01	14.71	15.21	463.40		458.39	448.69	448.19
MW-22		5.12	14.82	15.32	464.20		459.08	449.38	448.88
MW-23		6.81	16.51	17.01	464.90		458.09	448.39	447.89
MW-24		7.28	16.98	17.48	464.59		457.31	447.61	447.11
MW-25		7.98	17.68	18.18	465.95		457.97	448.27	447.77
MW-26		10.26	19.96	20.46	466.66		456.40	446.70	446.20
MW-27		13.07	22.77	23.27	467.41		454.34	444.64	444.14
MW-28		14.28	23.98	24.48	468.60		454.32	444.62	444.12
MW-29		12.55	22.25	22.82	470.42		457.87	448.17	447.60
MW-3		12.43	22.13	22.63	468.49		456.06	446.36	445.86
MW-30		14.09	23.79	24.58	469.31		455.22	445.52	444.73
MW-31		15.01	24.71	25.20	469.85		454.84	445.14	444.65
MW-32		13.22	22.92	23.52	468.19		454.97	445.27	444.67
MW-33D		67.34	77.04	77.54	469.39		402.05	392.35	391.85
MW-34D		65.91	75.61	76.11	467.4		401.49	391.79	391.29
MW-35D		67.39	77.09	77.59	465.88		398.49	388.79	388.29
MW-4		11.72	21.42	21.92	468.34		456.62	446.92	446.42
MW-5		11.84	21.54	22.04	467.42		455.58	445.88	445.38
MW-6		10.31	20.01	20.51	467.09		456.78	447.08	446.58
MW-7		9.24	18.94	19.44	466.65		457.41	447.71	447.21
MW-8		8.94	18.64	19.14	465.57		456.63	446.93	446.43
MW-9		7.31	17.01	17.51	465.14		457.83	448.13	447.63
TGP-A*	36	74	103.85	103.85	479.78	443.78	405.78	375.93	375.93
TGP-B*	1	20	129.7	130.00	491.27	490.27	471.27	361.57	361.27
TGP-C*	14	95	240	240.00	612.23	598.23	517.23	372.23	372.23
TGP-D	62	92	226	226.00	536.26	474.26	444.26	310.26	310.26
TGP-E	20	40	89.7	90.00	462.96	442.96	422.96	373.26	372.96
TGP-F	94	120	160	160.00	466.02	372.02	346.02	306.02	306.02
TGP-G	N/A	80	350	350.00	751.78	N/A	671.78	401.78	401.78
TMW-1		8.95	18.65	19.15	466.91		457.96	448.26	447.76

* Elevations obtained from borehole logs
** Ground Elevation obtained from LiDAR data

Information Sources:

Ameren Missouri Labadie Energy Center Proposed Utility Waste Landfill Franklin County, Missouri, Groundwater Monitoring Well Network Summary Table 1, prepared by Gredell Engineering Resources, Inc., April 2014 (UWL MW INFO.pdf)

AECOM, *Groundwater and Surface Water Data Demonstrate No Adverse Human Health Impact from Coal Ash Management at the Ameren Labadie Energy Center,* January 2014 (AECOM GW and Surface Water Report.pdf)

Borehole Records June 2014 (bedrock Borehole logs (mwd edits).pdf)

Horizontal Datum: Missouri State Plane Coordinates - NAD 83 (Feet), Vertical Datum: NAVD 88 (Feet)

APPENDIX A

Data Summary Tables

Missouri River - Selected Surface Water Parameters

	Date	Location	Boron (mg/L) Total	Boron (mg/L) Filtered	Calcium (mg/L) Total	Calcium (mg/L) Filtered	Chloride (mg/L) Total	Chloride (mg/L) Filtered	Flouride (mg/L) Total	Flouride (mg/L) Filtered	pH (SU) Total	pH (SU) Filtered	Sulfate (mg/L) Total	Sulfate (mg/L) Filtered	TDS (mg/L) Total	TDS (mg/L) Filtered	Al (mg/L) Total	Al (mg/L) Filtered	Iron (mg/L) Total	Iron (mg/L) Filtered	Manganese (mg/L) Total	Manganese (mg/L) Filtered	Arsenic (mg/L) Total	Arsenic (mg/L) Filtered	Molybdenum (mg/L) Total	Molybdenum (mg/L) Filtered	Sodium (mg/L) Total	Sodium (mg/L) Filtered
Missouri River - Upstream	**11/12/2014**	LBD-R-4AS	0.111	0.109	69.9	70.2	19.5		0.52				209		539		1.15	U 0.0082	1.17	U 0.0334	0.0804	0.0116	0.0033	0.0024	J 0.0033	J 0.0036		
		LBD-R-5AS	0.109	0.108	70.7	68.7	20.1		0.52				203		548		1.33	U 0.0082	1.46	U 0.0334	0.0947	J 0.0043	0.0035	0.0023	J 0.0028	J 0.0037		
		LBD-R-5AM	0.112	0.107	71.7	67.8	20.2		0.55				210		553		1.41	0.0117	1.47	J 0.0536	0.0964	0.0084	0.0032	0.0027	J 0.0031	J 0.0038		
		LBD-R-6AS	0.111	0.108	70.0	67.8	20.9		0.55				212		550		1.46	U 0.0082	1.61	U 0.0334	0.105	U 0.0011	0.003	0.0026	J 0.0036	J 0.0041		
		LBD-R-6AM	0.109	0.103	66.2	62.5	18.6		0.52				210		544		1.63	U 0.0082	1.13	U 0.0334	0.0907	J 0.0027	0.0031	0.0026	J 0.0029	J 0.0027		
		Average	**0.110**	**0.107**	**69.7**	**67.4**	**19.9**		**0.53**				**209**		**547**		**1.40**	**0.0056**	**1.37**	**0.0241**	**0.09**	**0.0055**	**0.0032**	**0.0025**	**0.0031**	**0.0036**		
	10/25/2013	LBD-R-4S	0.111	0.120	62.3				J 0.41		8.52		194				2.63	U 0.0143	1.79	U 0.0430	0.1940	0.0111	0.0050	0.0035	J 0.0040	J 0.0035		
		LBD-R-5S	0.114	0.115	63.5				J 0.48		8.59		194				2.67	U 0.0143	2.15	U 0.0430	0.2190	J 0.0029	0.0050	0.0035	J 0.0044	J 0.0035		
		LBD-R-5M	0.114	0.118	63.4				J 0.45		8.57		193				2.83	U 0.0143	2.17	U 0.0430	0.2280	J 0.0040	0.0048	0.0038	J 0.0042	J 0.0041		
		LBD-R-6S	0.115	0.115	65.1				J 0.51		8.56		194				3.04	U 0.0143	2.34	U 0.0430	0.2410	U 0.0008	0.0047	0.0037	J 0.0043	J 0.0038		
		LBD-R-6M	0.113	0.113	64.5				J 0.44		8.58		197				2.85	U 0.0143	2.00	U 0.0430	0.2360	U 0.0008	0.0047	0.0034	J 0.0041	J 0.0036		
		Average	**0.113**	**0.116**	**63.8**				**0.46**		**8.56**		**194**				**2.80**	**U 0.0143**	**2.09**	**U 0.0430**	**0.22**	**0.0038**	**0.0048**	**0.0036**	**0.0042**	**0.0037**		
Missouri River - 1st Downstream	**11/12/2014**	LBD-R-1AS	0.115	0.113	70.7	70.7	20.5		0.54				209		532		1.83	U 0.0082	1.89	U 0.0334	0.113	0.0110	0.0038	0.0028	J 0.0035	J 0.0031		
		LBD-R-2AS	0.111	0.113	69.2	69.8	20.4		0.55				210		541		1.30	U 0.0082	1.24	U 0.0334	0.0873	0.0106	0.0032	0.0024	J 0.0035	J 0.0035		
		LBD-R-2AM	0.113	0.111	70.8	69.4	19.9		0.52				213		531		1.28	U 0.0082	1.54	U 0.0334	0.0978	0.0107	0.0034	0.0022	J 0.0031	J 0.0036		
		LBD-R-3AS	0.110	0.108	70.2	68.6	18.6		J 0.50				208		540		1.62	U 0.0082	1.63	U 0.0334	0.102	J 0.0013	0.0034	0.0026	J 0.0031	J 0.0034		
		LBD-R-3AM	0.110	0.110	71.4	69.4	20.8		0.57				205		541		1.58	U 0.0082	1.67	U 0.0334	0.107	J 0.0013	0.0028	0.0026	J 0.0029	J 0.0037		
		Average	**0.112**	**0.111**	**70.5**	**69.6**	**20.0**		**0.54**				**209**		**537**		**1.52**	**U 0.0082**	**1.59**	**U 0.0334**	**0.101**	**0.007**	**0.0033**	**0.0025**	**0.0032**	**0.0035**		
	10/25/2013	LBD-R-1S	0.120	0.123	63.8				J 0.50		7.32		174				2.30	U 0.0143	1.60	U 0.0430	0.2080	0.0157	0.0044	0.0040	J 0.0044	J 0.0042		
		LBD-R-2S	0.121	0.122	64.7				J 0.47		8.12		187				3.00	U 0.0143	2.11	U 0.0430	0.2300	J 0.0039	0.0045	0.0037	J 0.0044	J 0.0039		
		LBD-R-2M	0.123	0.123	63.6				J 0.48		8.41		193				3.00	U 0.0143	2.08	U 0.0430	0.2300	J 0.0047	0.0047	0.0036	J 0.0044	J 0.0042		
		LBD-R-2M DUP	0.123	0.124	64.6				J 0.50				189				2.82	U 0.0143	2.07	U 0.0430	0.2290	J 0.0049	0.0047	0.0041	J 0.0045	J 0.0040		
		LBD-R-3S	0.118	0.116	64.2				J 0.47		8.47		189				2.84	U 0.0143	2.25	U 0.0430	0.2330	J 0.00085	0.0048	0.0033	J 0.0044	J 0.00360		
		LBD-R-3M	0.119	0.119	65.5				J 0.43		8.53		192				2.85	U 0.0143	2.23	U 0.0430	0.2370	J 0.00089	0.0049	0.0035	J 0.0041	J 0.00370		
		Average	**0.121**	**0.121**	**64.4**				**0.48**		**8.17**		**187**				**2.80**	**U 0.0143**	**2.06**	**U 0.0430**	**0.228**	**0.0052**	**0.005**	**0.0037**	**0.0044**	**0.0039**		
Missouri River - 2nd Downstream	**11/12/2014**	LBD-R-10S	0.111	0.110	70.5	68.6	18.8		U 0.25				215		550		1.94	J 0.0088	1.88	U 0.0334	0.115	U 0.0156	0.0037	0.0026	J 0.0036	J 0.0037		
		LBD-R-10S DUP	0.110	0.109	68.8	68.0	19.5		J 0.51				206				1.70	U 0.0082	2.04	U 0.0334	0.117	U 0.0153	0.0033	0.0027	J 0.0032	J 0.0032		
		LBD-R-11S	0.110	0.109	69.5	68.4	20.4		0.50				210		543		1.58	J 0.0172	1.64	U 0.0334	0.103	U 0.0129	0.0033	0.0027	J 0.0033	J 0.0040		
		LBD-R-11M	0.111	0.110	69.5	68.5	20.5		0.53				210		546		1.57	U 0.0082	1.54	U 0.0334	0.0985	U 0.0120	0.0032	0.0025	J 0.0031	J 0.0048		
		LBD-R-12S	0.110	0.109	69.4	69.4	20.9		0.54				213		516		0.92	U 0.0082	1.51	U 0.0334	0.0949	J 0.0026	0.0035	0.0026	J 0.0034	J 0.0040		
		LBD-R-12M	0.111	0.110	70.2	69.2	18.7		J 0.50				211		555		1.44	U 0.0082	1.44	U 0.0334	0.0968	J 0.0023	0.0035	0.0023	J 0.0032	J 0.0034		
		Average	**0.111**	**0.110**	**69.7**	**68.7**	**19.8**		**0.45**				**211**		**542**		**1.52**	**0.0071**	**1.68**	**U 0.0334**	**0.10**	**0.0055**	**0.0034**	**0.0026**	**0.0033**	**0.0039**		
Missouri River - 3rd Downstream	**11/12/2014**	LBD-R-7S	0.115	0.110	71.6	69.0	16.6		U 0.25				208		524		4.74	0.0112	4.9	U 0.0334	0.257	0.0457	0.0046	0.0027	J 0.0062	J 0.0059		
		LBD-R-7S DUP	0.115	0.111	71.4	69.7	17		U 0.25				211		530		4.74	0.0127	4.86	U 0.0334	0.26	0.0462	0.0049	0.0027	J 0.0039	J 0.0036		
		LBD-R-8S	0.111	0.108	70.1	67.8	18.5		J 0.37				210		538		1.55	J 0.0094	1.54	U 0.0334	0.0953	U 0.0015	0.0034	0.0028	J 0.0038	J 0.0038		
		LBD-R-8M	0.110	0.108	69.6	68.7	18.4		U 0.25				224		551		1.57	J 0.0101	1.51	U 0.0334	0.0953	U 0.00095	0.0034	0.00260	J 0.003	J 0.00400		
		LBD-R-9S	0.111	0.105	70.8	68.7	17.7		U 0.25				206		547		1.71	J 0.0192	1.78	U 0.0334	0.104	U 0.0013	0.0035	0.0025	J 0.003	J 0.0035		
		LBD-R-9M	0.109	0.108	70.2	69.1	19.4		J 0.31				211		551		1.63	0.0131	1.75	U 0.0334	0.117	U 0.0011	0.0037	0.0027	J 0.0032	J 0.0036		
		Average	**0.112**	**0.108**	**70.6**	**68.8**	**17.9**		**0.20**				**212**		**540**		**2.66**	**0.0126**	**2.72**	**U 0.0334**	**0.15**	**0.0157**	**0.0039**	**0.0027**	**0.0039**	**0.0041**		

Blank cells indicate data not found or not sampled   U indicates below the MDL   J indicates a vaue below LOQ   Half of the "U" values were used for averaging purposes when other detects were present

Labadie Creek - Selected Surface Water Parameters

	Date	Location	Boron (mg/L) Total	Boron (mg/L) Filtered	Calcium (mg/L) Total	Calcium (mg/L) Filtered	Chloride (mg/L) Total	Chloride (mg/L) Filtered	Flouride (mg/L) Total	Flouride (mg/L) Filtered	pH (SU) Total	pH (SU) Filtered	Sulfate (mg/L) Total	Sulfate (mg/L) Filtered	TDS (mg/L) Total	TDS (mg/L) Filtered	Al (mg/L) Total	Al (mg/L) Filtered	Iron (mg/L) Total	Iron (mg/L) Filtered	Manganese (mg/L) Total	Manganese (mg/L) Filtered	Arsenic (mg/L) Total	Arsenic (mg/L) Filtered	Molybdenum (mg/L) Total	Molybdenum (mg/L) Filtered	Sodium (mg/L) Total	Sodium (mg/L) Filtered
Labadie Creek - Upstream	**10/24/2013**	LBD-C-4	0.166	0.165	65.6				U 0.4		8.02		J 17.8				0.0968	U 0.0143	J 0.2250	U 0.0430	0.0792	0.0581	0.0056	0.0056	J 0.0029	J 0.0018		
		LBD-C-5	0.164	0.169	64.4				U 0.4		8.19		J 17.6				0.1390	U 0.0143	J 0.2160	U 0.0430	0.0774	0.0598	0.0055	0.0051	J 0.0024	J 0.0022		
		LBD-C-6	0.167	0.17	65.7				U 0.4		8.24		J 16.6				0.2170	U 0.0143	J 0.3090	U 0.0430	0.0862	0.0619	0.0061	0.0051	J 0.0024	J 0.0020		
		Average	**0.166**	**0.168**	**65.2**				**U 0.4**		**8.15**		**17.3**				**0.1509**	**U 0.0143**	J **0.2500**	**U 0.0430**	**0.0809**	**0.0599**	**0.0057**	**0.0053**	**0.0026**	**0.0020**		
Labadie Creek - Downstream	**10/24/2013**	LBD-C-1	0.0978	0.108	56.1				U 0.4		7.08		J 19.4				2.91	J 0.0163	J 2.21	U 0.0430	1.31	1.19	0.0065	0.0039	J 0.0092	J 0.0036		
		LBD-C-1 DUP	0.0986	N/A	56.6				U 0.4				J 15.4				2.98		J 2.39		1.34		0.0067		J 0.0050			
		LBD-C-2	0.0959	0.1	55.4				U 0.4		7.57		J 16.3				3.17	U 0.0143	J 2.47	U 0.0430	1.32	1.19	0.0061	0.0039	J 0.0055	J 0.0031		
		LBD-C-3	0.0999	0.0994	57.7				U 0.4		7.70		J 15.3				3.50	U 0.0143	J 2.71	U 0.0430	1.40	1.24	0.0066	0.0043	J 0.0046	J 0.0030		
		Average	**0.098**	**0.102**	**56.5**				**U 0.4**		**7.45**		**16.6**				**3.14**	**0.0102**	**2.45**	**U 0.0430**	**1.34**	**1.21**	**0.0065**	**0.0040**	**0.0061**	**0.0032**		

Blank cells indicate data not found or not sampled

U indicates below the MDL

J indicates a vaue below LOQ

Half of the U values were used for averaging purposes when other detects were present

Groundwater Samples Selected Parameters

Sample	Date	Boron (mg/L)		Calcium (mg/L)		Chloride (mg/L)		Flouride (mg/L)		pH (SU)		Sulfate (mg/L)		TDS (mg/L)		Aluminum (mg/L)		Iron (mg/L)		Manganese (mg/L)		Arsenic (mg/L)		Molybdenum (mg/L)		Sodium (mg/L)	
		Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered
MW-1	4/16/2013	0.0794		158		10		0.11		6.83		26.0		536		< 0.050		17.000		1.470		0.0221		< 0.010		5.05	
	8/19/2013	0.0826		195		7		0.16		6.76		27.0		600		< 0.050		0.178		0.539		< 0.0030		< 0.010		6.09	
	11/19/2013	0.1030		209		6		0.20		6.63		24.0		602		< 0.050		0.192		0.425		< 0.0030		< 0.010		4.97	
	3/18/2014	0.0950		S 203		5		< 0.10		6.61		31.0		676		< 0.050		0.128		0.512		< 0.0030		J 0.005		4.92	
	6/17/2014	0.0910		191		6		0.12		6.66		38.0		614		< 0.050		0.075		0.654		< 0.0030		J 0.003		5.24	
	8/26/2014	0.0924		195		6		0.14		6.55		S 31.0		642		< 0.050		0.043		0.264		J 0.0004		J 0.006		7.57	
	12/9/2014	0.0912		S 195		5		0.15		6.51		27.0		670		< 0.050		0.062		0.173		J 0.0005		< 0.010		6.43	
	3/4/2015	0.0945		S 197		J 4		0.14		6.54		S 19.0		682		< 0.050		0.060		0.109		J 0.0005		J 0.004		4.60	
	6/2/2015	0.0944		195		6		0.13		6.49		S 18.0		640		< 0.050		0.029		0.232		J 0.0005		J 0.004		6.06	
	9/9/2015	0.0997		200		J 4		0.15		6.38		26.0		672		< 0.050		J 0.013		0.029		BJ 0.0005		< 0.010		12.00	
	12/8/2015	0.0910		S 207		J 4		0.14		6.47		24.0		622		< 0.050		< 0.020		0.034		J 0.0006		< 0.010		S 7.46	
	Average	**0.0922**		**195**		**6**		**0.14**		**6.58**		**26.5**		**632.4**		**< 0.050**		**1.617**		**0.404**		**0.0028**		**0.005**		**6.40**	
MW-2	4/16/2013	0.1210		S 185		17		0.21		6.85		31.0		696		< 0.050		S 28.400		2.960		0.0295		< 0.010		8.98	
	8/19/2013	0.1090		221		6		0.18		6.74		38.0		738		< 0.050		0.707		1.300		J 0.0010		< 0.010		8.60	
	11/19/2013	0.1160		198		J 5		0.17		6.66		S 44.0		616		< 0.050		1.090		0.032		JS 0.0018		< 0.010		7.01	
	3/18/2014	0.1410		189		J 4		J 0.10		6.75		29.0		732		< 0.050		0.876		1.320		JS 0.0022		J 0.007		8.47	
	6/17/2014	0.1500		206		J 4		0.21		6.71		43.0		698		< 0.050		0.855		1.830		< 0.0030		< 0.010		9.62	
	8/26/2014	0.1260		195		J 5		0.16		6.57		38.0		704		< 0.050		0.252		0.956		J 0.0009		< 0.010		7.96	
	12/9/2014	0.1330		200		J 5		0.18		6.65		48.0		726		< 0.050		1.120		1.710		J 0.0017		< 0.010		8.57	
	3/4/2015	0.1040		182		J 5		0.13		6.55		33.0		674		< 0.050		0.123		0.008		J 0.0006		J 0.004		6.44	
	6/2/2015	0.1240		S 196		J 4		0.15		6.65		30.0		696		< 0.050		0.266		0.486		J 0.0004		< 0.010		8.31	
	9/9/2015	0.1230		198		J 4		0.16		6.64		45.0		690		< 0.050		0.118		0.703		BJ 0.0007		< 0.010		9.54	
	12/8/2015	0.1200		201		J 4		0.16		6.55		42.0		646		< 0.050		0.085		0.385		J 0.0006		J 0.004		8.73	
	Average	**0.1243**		**197**		**6**		**0.16**		**6.67**		**38.3**		**692.4**		**< 0.050**		**3.081**		**1.063**		**0.0037**		**0.005**		**8.38**	
MW-3	4/16/2013	0.0636		141		9		0.12		6.99		54.0		516		< 0.050		16.200		2.760		J 0.0012		< 0.010		8.58	
	8/19/2013	0.0672		174		5		0.18		6.88		S 66.0		606		< 0.050		3.110		1.580		J 0.0024		< 0.010		10.40	
	11/19/2013	0.0813		S 163		5		0.14		6.77		75.0		558		< 0.050		1.020		1.840		J 0.0010		< 0.010		8.17	
	3/18/2014	0.0743		166		8		< 0.10		6.85		55.0		614		< 0.050		3.100		1.740		J 0.0011		< 0.010		8.84	
	6/17/2014	0.0749		162		7		0.14		6.94		35.0		572		< 0.050		9.720		2.280		J 0.0019		< 0.010		9.27	
	8/26/2014	0.0724		161		7		0.13		6.75		37.0		600		< 0.050		3.630		2.190		J 0.0025		< 0.010		8.45	
	12/9/2014	0.0724		156		8		0.13		6.80		29.0		582		< 0.050		4.680		2.220		J 0.0021		< 0.010		8.32	
	3/4/2015	0.0792		169		7		0.11		6.67		50.0		584		< 0.050		1.230		1.420		J 0.0010		< 0.010		8.16	
	6/2/2015	0.0749		161		6		0.12		6.84		25.0		604		< 0.050		11.700		2.580		J 0.0014		J 0.004		8.90	
	9/9/2015	0.0790		S 163		6		0.16		6.66		45.0		594		< 0.050		0.201		0.438		BJ 0.0003		< 0.010		14.20	
	12/8/2015	0.0909		179		6		0.14		6.66		37.0		596		J 0.031		14.700		1.640		0.0054		J 0.004		10.50	
	Average	**0.0755**		**163**		**7**		**0.13**		**6.80**		**46.2**		**584.2**		**0.026**		**6.299**		**1.881**		**0.0018**		**0.005**		**9.44**	
MW-4	4/16/2013	0.0728		162		6		0.18		6.94		25.0		532		< 0.050		0.115		1.240		< 0.0030		< 0.010		6.02	
	8/19/2013	0.0718		180		5		0.17		6.93		33.0		600		< 0.050		J 0.009		0.155		< 0.0030		< 0.010		5.90	
	11/19/2013	0.0835		161		6		0.15		6.87		25.0		506		< 0.050		0.021		0.033		J 0.0009		< 0.010		5.43	
	3/18/2014	0.0802		157		7		< 0.10		6.90		19.0		568		< 0.050		J 0.018		0.085		< 0.0030		< 0.010		5.75	
	6/17/2014	0.0879		180		5		0.16		6.83		36.0		614		< 0.050		0.021		0.590		< 0.0030		< 0.010		6.36	
	8/26/2014	0.0846		176		J 5		0.15		6.69		30.0		624		< 0.050		J 0.015		0.203		J 0.0004		< 0.010		5.78	
	12/9/2014	0.0810		177		5		0.15		6.84		37.0		594		< 0.050		J 0.013		0.096		J 0.0005		< 0.010		5.89	
	3/4/2015	0.0745		160		7		0.12		6.82		25.0		580		< 0.050		J 0.010		0.019		J 0.0005		< 0.010		5.32	
	6/2/2015	0.0863		170		JS 5		0.14		6.77		30.0		600		< 0.050		J 0.014		0.604		J 0.0005		< 0.010		5.81	
	9/9/2015	0.0897		174		J 5		0.14		6.70		39.0		588		< 0.050		< 0.020		0.162		BJ 0.0006		< 0.010		9.82	
	12/8/2015	0.0964		182		5		0.14		6.69		32.0		586		< 0.050		< 0.020		0.065		J 0.0005		< 0.010		6.74	
	Average	**0.0826**		**171**		**6**		**0.14**		**6.82**		**30.1**		**581.1**		**< 0.050**		**0.023**		**0.296**		**0.0009**		**< 0.010**		**6.26**	
MW-5	4/16/2013	0.0529		157		J 2		0.16		6.86		S 16.0		482		< 0.050		0.210		0.458		< 0.0030		< 0.010		5.33	
	8/19/2013	0.0550		170		J 2		0.18		6.83		21.0		562		< 0.050		< 0.020		J 0.004		< 0.0030		< 0.010		6.79	
	11/19/2013	0.0654		157		J 3		0.18		6.82		18.0		476		< 0.050		J 0.009		0.007		J 0.0008		< 0.010		5.53	
	3/18/2014	0.0653		159		J 3		< 0.10		6.86		10.0		548		< 0.050		J 0.013		0.081		< 0.0030		< 0.010		5.57	
	6/17/2014	0.0670		S 174		J 3		0.15		6.77		27.0		546		< 0.050		J 0.010		0.106		< 0.0030		< 0.010		5.91	
	8/26/2014	0.0577		152		J 2		0.17		6.72		10.0		548		< 0.050		J 0.020		0.022		J 0.0003		< 0.010		7.59	
	12/9/2014	0.0623		160		J 2		0.17		6.80		S 20.0		566		< 0.050		< 0.020		J 0.002		J 0.0004		< 0.010		10.20	
	3/4/2015	0.0554		160		J 3		0.15		6.79		S 13.0		582		< 0.050		< 0.020		0.009		J 0.0004		< 0.010		8.17	
	6/2/2015	0.0653		162		J 3		0.14		6.68		17.0		558		< 0.050		< 0.020		0.029		J 0.0003		< 0.010		5.97	
	9/9/2015	0.0661		162		J 2		0.16		6.62		22.0		564		< 0.050		< 0.020		0.006		BJ 0.0004		< 0.010		10.40	
	12/8/2015	0.0726		171		J 2		0.14		6.64		21.0		548		< 0.050		< 0.020		0.010		J 0.0005		< 0.010		6.76	
	Average	**0.0623**		**162**		**2**		**0.15**		**6.76**		**17.7**		**543.6**		**< 0.050**		**0.029**		**0.067**		**0.0008**		**< 0.010**		**7.11**	

Groundwater Samples Selected Parameters

Sample	Date	Boron (mg/L)		Calcium (mg/L)		Chloride (mg/L)		Flouride (mg/L)		pH (SU)		Sulfate (mg/L)		TDS (mg/L)		Aluminum (mg/L)		Iron (mg/L)		Manganese (mg/L)		Arsenic (mg/L)		Molybdenum (mg/L)		Sodium (mg/L)	
		Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered
MW-6	4/16/2013	0.0622		163		J 3		0.14		6.82		S 19.0		566		J 0.037		0.053		0.106		< 0.0030		< 0.010		6.78	
	8/19/2013	0.0585		S 182		J 3		0.17		6.79		23.0		608		< 0.050		< 0.02		< 0.005		< 0.0030		< 0.010		S 7.56	
	11/19/2013	0.0691		168		J 3		0.16		6.78		20.0		536		< 0.050		J 0.0071		J 0.002		J 0.0008		< 0.010		6.76	
	3/18/2014	0.0694		172		J 3		< 0.10		6.83		J 8.0		600		< 0.050		< 0.02		< 0.005		< 0.0030		< 0.010		6.69	
	6/17/2014	0.0787		186		J 3		0.15		6.80		29.0		604		< 0.050		J 0.0087		0.038		< 0.0030		J 0.004		7.22	
	8/26/2014	0.0625		S 152		J 2		0.15		6.69		14.0		570		< 0.050		< 0.02		< 0.005		J 0.0004		< 0.010		6.40	
	12/9/2014	0.0646		158		J 3		0.15		6.80		18.0		556		< 0.050		< 0.02		< 0.005		J 0.0004		< 0.010		6.72	
	3/4/2015	0.0589		148		J 3		0.13		6.79		15.0		552		< 0.050		< 0.02		< 0.005		J 0.0004		< 0.010		6.32	
	6/2/2015	0.0723		174		J 3		0.14		6.62		20.0		636		< 0.050		< 0.02		0.008		J 0.0005		< 0.010		6.90	
	9/9/2015	0.0662		156		J 3		0.14		6.52		19.0		528		< 0.050		< 0.02		< 0.005		BJ 0.0005		< 0.010		7.45	
	12/8/2015	0.0811		182		J 3		0.13		6.61		16.0		610		< 0.050		< 0.02		< 0.005		J 0.0005		< 0.010		8.96	
	Average	**0.0676**		**167**		**3**		**0.14**		**6.73**		**18.3**		**578.7**		**0.026**		**0.014**		**0.016**		**0.0009**		**0.005**		**7.07**	
MW-7	4/16/2013	0.0726		150		15		0.20		7.07		26.0		568		0.246		30.300		1.670		0.0666		< 0.010		9.99	
	8/19/2013	0.0677		167		5		0.23		6.96		39.0		598		< 0.050		5.900		1.800		0.0189		< 0.010		9.66	
	11/19/2013	0.0606		174		J 3		0.17		6.83		40.0		568		< 0.050		0.855		1.060		J 0.0022		< 0.010		7.63	
	3/18/2014	0.0615		166		J 3		< 0.10		6.88		28.0		624		< 0.050		0.271		1.090		J 0.0014		< 0.010		9.83	
	6/17/2014	0.0762		173		J 4		0.16		6.89		34.0		594		< 0.050		1.140		1.860		J 0.0016		< 0.010		9.66	
	8/26/2014	0.0657		159		J 3		0.15		6.75		21.0		618		< 0.050		0.209		0.848		J 0.0015		J 0.006		7.86	
	12/9/2014	0.0766		163		J 4		0.16		6.85		20.0		580		< 0.050		0.147		1.480		J 0.0012		< 0.010		9.32	
	3/4/2015	0.0569		166		J 3		0.13		6.82		27.0		602		< 0.050		0.078		0.243		J 0.0009		< 0.010		7.72	
	6/2/2015	0.0768		173		J 5		0.14		6.72		J 9.0		606		< 0.050		0.039		1.140		J 0.0008		< 0.010		9.96	
	9/9/2015	0.0649		165		J 3		0.15		6.63		34.0		584		< 0.050		J 0.009		0.636		BJ 0.0008		< 0.010		10.70	
	12/8/2015	0.0731		175		J 3		0.14		6.71		36.0		572		< 0.050		0.025		0.355		J 0.0009		< 0.010		8.96	
	Average	**0.0684**		**166**		**5**		**0.15**		**6.83**		**28.5**		**592.2**		**0.045**		**3.543**		**1.107**		**0.0088**		**0.005**		**9.21**	
MW-8	4/16/2013	0.0453		136		8		0.16		6.83		J 10.0		460		< 0.050		23.600		0.896		0.0136		< 0.010		4.95	
	8/19/2013	0.0485		155		J 3		0.21		6.85		23.0		514		< 0.050		3.440		0.997		J 0.0021		< 0.010		4.64	
	11/19/2013	0.0537		152		J 3		0.24		6.76		22.0		434		< 0.050		0.389		0.556		J 0.0011		< 0.010		4.20	
	3/18/2014	0.0539		147		J 3		< 0.10		6.87		10.0		482		< 0.050		3.430		1.100		J 0.0014		< 0.010		4.40	
	6/17/2014	0.0608		151		J 3		0.19		6.87		13.0		476		< 0.050		4.370		1.140		J 0.0014		< 0.010		5.20	
	8/26/2014	0.0578		139		J 2		0.17		6.60		12.0		500		< 0.050		0.723		1.080		J 0.0009		< 0.010		4.59	
	12/9/2014	0.0591		159		J 3		0.18		6.75		32.0		560		< 0.050		0.113		0.480		J 0.0004		< 0.010		7.63	
	3/4/2015	0.0508		146		J 3		0.15		6.73		16.0		504		< 0.050		0.119		0.311		J 0.0003		< 0.010		4.06	
	6/2/2015	0.0548		152		J 3		0.16		6.63		34.0		532		< 0.050		0.025		0.107		J 0.0003		< 0.010		4.91	
	9/9/2015	0.0554		148		J 2		0.17		6.49		30.0		504		< 0.050		0.200		0.318		BJ 0.0003		< 0.010		4.69	
	12/8/2015	0.0635		148		J 2		0.16		6.67		29.0		464		< 0.050		0.387		0.054		J 0.0007		< 0.010		7.00	
	Average	**0.0549**		**148**		**3**		**0.17**		**6.73**		**21.0**		**493.6**		**< 0.050**		**3.345**		**0.640**		**0.0020**		**< 0.010**		**5.12**	
MW-9	4/16/2013	0.0536		121		J 5		0.18		7.16		20.0		414		< 0.050		16.7		1.450		0.0264		< 0.010		5.44	
	8/19/2013	0.0430		110		J 4		0.26		7.05		18.0		370		< 0.050		0.255		0.534		J 0.0012		< 0.010		3.90	
	11/19/2013	0.0499		116		J 3		0.22		7.00		21.0		382		< 0.050		0.447		0.712		J 0.0015		< 0.010		3.99	
	3/18/2014	0.0518		128		J 3		< 0.10		7.12		S 17.0		462		< 0.050		0.400		1.070		0.0039		< 0.010		4.51	
	6/17/2014	0.0588		121		J 3		0.16		7.07		25.0		426		< 0.050		0.554		1.120		J 0.0011		< 0.010		4.91	
	8/26/2014	0.0609		118		JS 2		0.16		6.78		S 10.0		460		< 0.050		0.291		1.300		J 0.0015		< 0.010		5.00	
	12/9/2014	0.0449		117		J 2		0.21		7.00		17.0		418		< 0.050		0.0675		0.206		J 0.0008		< 0.010		3.34	
	3/4/2015	0.0422		111		J 2		0.16		6.98		12.0		390		< 0.050		0.0715		0.146		J 0.0007		< 0.010		3.27	
	6/2/2015	0.0477		121		JS 3		0.16		6.82		21.0		450		< 0.050		0.0429		0.0615		J 0.0009		< 0.010		4.07	
	9/9/2015	0.0469		123		J 2		0.2		6.59		15.0		398		< 0.050		0.0646		0.0447		BJ 0.0010		< 0.010		4.02	
	12/8/2015	0.0477		114		J 2		0.16		6.84		13.0		370		< 0.050		0.0701		0.0909		J 0.0008		< 0.010		4.04	
	Average	**0.0498**		**118**		**3**		**0.17**		**6.95**		**17.2**		**412.7**		**< 0.050**		**1.724**		**0.612**		**0.0036**		**< 0.010**		**4.23**	
MW-10	4/16/2013	0.0567		144		6		0.17		6.99		54.0		430		J 0.027		16.9		1.350		0.0088		< 0.010		7.79	
	8/19/2013	0.0556		162		J 3		0.21		6.86		S 30.0		516		< 0.050		0.768		0.052		< 0.0030		< 0.010		6.37	
	11/19/2013	0.0636		153		J 3		0.16		6.82		33.0		502		< 0.050		0.640		< 0.005		J 0.0009		< 0.010		6.31	
	3/18/2014	0.0642		151		J 2		< 0.10		6.87		38.0		534		< 0.050		0.122		0.041		< 0.0030		J 0.005		6.31	
	6/17/2014	0.0668		154		J 3		0.16		6.90		34.0		510		< 0.050		0.102		0.532		< 0.0030		< 0.010		6.96	
	8/26/2014	0.0606		139		J 3		0.14		6.75		21.0		538		< 0.050		0.127		< 0.005		J 0.0004		< 0.010		5.79	
	12/9/2014	0.0605		144		J 2		0.14		6.81		25.0		518		< 0.050		0.0907		< 0.005		J 0.0004		< 0.010		5.90	
	3/4/2015	0.0589		139		J 3		0.12		6.57		20.0		502		< 0.050		0.148		< 0.005		J 0.0005		< 0.010		5.58	
	6/2/2015	0.0596		144		J 3		0.13		6.64		17.0		514		< 0.050		0.0484		J 0.0041		J 0.0003		< 0.010		6.03	
	9/9/2015	0.0632		144		J 2		0.15		6.50		21.0		484		< 0.050		0.0683		< 0.005		BJ 0.0005		< 0.010		6.67	
	12/8/2015	0.0721		151		J 2		0.13		6.63		16.0		510		< 0.050		0.0346		< 0.005		J 0.0004		< 0.010		9.41	
	Average	**0.0620**		**148**		**3**		**0.14**		**6.76**		**28.1**		**505.3**		**0.025**		**1.732**		**0.181**		**0.0015**		**0.005**		**6.65**	

Groundwater Samples Selected Parameters

Sample	Date	Boron (mg/L)		Calcium (mg/L)		Chloride (mg/L)		Flouride (mg/L)		pH (SU)		Sulfate (mg/L)		TDS (mg/L)		Aluminum (mg/L)		Iron (mg/L)		Manganese (mg/L)		Arsenic (mg/L)		Molybdenum (mg/L)		Sodium (mg/L)	
		Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered
MW-11	4/16/2013	0.0548		145		J 2		0.12		6.89		S 64.0		460		< 0.050		0.436		0.523		J 0.0008		< 0.010		8.32	
	8/19/2013	0.0609		166		J 3		0.16		6.79		48.0		596		< 0.050		0.0221		J 0.004		< 0.0030		< 0.010		16.70	
	11/19/2013	0.0690		168		J 3		0.14		6.76		51.0		542		< 0.050		J 0.018		0.036		< 0.0030		< 0.010		8.58	
	3/18/2014	0.0624		S 155		J 3		< 0.10		6.80		33.0		598		< 0.050		< 0.020		0.040		< 0.0030		< 0.010		8.00	
	6/17/2014	0.0629		147		J 3		0.12		6.82		51.0		494		< 0.050		J 0.011		0.203		< 0.0030		< 0.010		8.22	
	8/26/2014	0.0619		142		J 2		0.14		6.59		40.0		570		< 0.050		< 0.020		0.006		J 0.0004		< 0.010		7.33	
	12/9/2014	0.0631		160		J 2		0.13		6.82		41.0		590		< 0.050		< 0.020		J 0.0034		J 0.0004		< 0.010		8.04	
	3/4/2015	0.0600		S 151		J 3		0.12		6.63		37.0		546		< 0.050		< 0.020		0.0057		J 0.0004		< 0.010		7.65	
	6/2/2015	0.0588		147		J 3		0.11		6.58		28.0		564		< 0.050		J 0.012		0.0101		J 0.0003		< 0.010		7.49	
	9/9/2015	0.0645		154		J 2		0.13		6.50		40.0		534		< 0.050		J 0.0071		0.0071		BJ 0.0005		< 0.010		8.17	
	12/8/2015	0.0671		S 166		J 2		0.12		6.62		36.0		594		< 0.050		< 0.02		J 0.0044		J 0.0005		< 0.010		8.34	
	Average	**0.0623**		**155**		**3**		**0.12**		**6.71**		**42.6**		**553.5**		**< 0.050**		**0.051**		**0.077**		**0.0008**		**< 0.010**		**8.80**	
MW-12	4/16/2013	0.0529		128		J 2		J 0.10		6.93		42.0		448		J 0.018		0.419		0.483		J 0.0014		< 0.010		6.96	
	8/19/2013	0.0535		164		J 3		0.16		6.80		37.0		540		< 0.050		J 0.019		J 0.002		< 0.0030		< 0.010		7.59	
	11/19/2013	0.0634		154		J 3		0.14		6.79		43.0		516		< 0.050		0.0204		0.008		J 0.0013		< 0.010		7.17	
	3/18/2014	0.0630		141		J 3		< 0.10		6.82		32.0		530		< 0.050		< 0.020		0.179		S< 0.0030		J 0.006		6.85	
	6/17/2014	0.0641		143		J 3		0.12		6.88		40.0		490		< 0.050		0.0977		0.252		< 0.0030		< 0.010		7.12	
	8/26/2014	0.0629		138		J 2		0.11		6.61		31.0		518		< 0.050		J 0.011		0.154		J 0.0003		< 0.010		6.48	
	12/9/2014	0.0651		166		J 2		0.13		6.80		37.0		606		< 0.050		J 0.014		J 0.0021		J 0.0004		< 0.010		8.77	
	3/4/2015	0.0605		153		J 3		0.12		6.64		S 33.0		552		< 0.050		J 0.0085		< 0.005		J 0.0003		J 0.004		6.79	
	6/2/2015	0.0588		S 145		J 3		0.11		6.59		22.0		532		< 0.050		< 0.020		0.0425		J 0.0003		< 0.010		6.88	
	9/9/2015	0.0628		149		J 2		0.12		6.56		35.0		510		< 0.050		< 0.020		< 0.005		BJ 0.0004		< 0.010		7.61	
	12/8/2015	0.0748		168		J 2		0.11		6.66		31.0		582		< 0.050		< 0.020		< 0.005		J 0.0004		J 0.003		9.30	
	Average	**0.0620**		**150**		**3**		**0.12**		**6.73**		**34.8**		**529.5**		**0.024**		**0.057**		**0.103**		**0.0008**		**0.005**		**7.41**	
MW-13	4/16/2013	0.0535		143		J 2		0.12		6.87		S 64.0		498		J 0.033		0.0592		0.117		< 0.0030		< 0.010		6.42	
	8/19/2013	0.0629		167		J 3		0.17		6.77		49.0		590		< 0.050		J 0.012		< 0.005		< 0.0030		< 0.010		7.82	
	11/19/2013	0.0768		157		J 3		0.15		6.79		61.0		538		< 0.050		J 0.009		J 0.002		J 0.0012		< 0.010		7.90	
	3/18/2014	0.0720		163		J 3		< 0.10		6.78		47.0		626		< 0.050		< 0.020		0.057		< 0.0030		< 0.010		7.14	
	6/17/2014	0.0684		168		J 3		0.14		6.78		55.0		590		< 0.050		0.0922		0.225		< 0.0030		< 0.010		6.61	
	8/26/2014	0.0756		160		J 2		0.12		6.54		44.0		618		< 0.050		< 0.020		0.016		J 0.0003		J 0.005		7.32	
	12/9/2014	0.0771		S 165		J 2		0.13		6.77		53.0		614		< 0.050		J 0.013		< 0.005		J 0.0003		< 0.010		7.81	
	3/4/2015	0.0750		158		J 3		0.11		6.61		50.0		596		< 0.050		< 0.020		< 0.005		J 0.0003		< 0.010		7.65	
	6/2/2015	0.0700		173		J 3		0.11		6.53		30.0		630		< 0.050		< 0.020		0.097		J 0.0003		J 0.004		6.79	
	9/9/2015	0.0795		S 152		J 2		0.16		6.60		S 30.0		542		< 0.050		< 0.020		0.009		BJ 0.0005		< 0.010		8.45	
	12/8/2015	0.0785		154		J 2		0.12		6.49		40.0		558		< 0.050		< 0.020		0.026		J 0.0003		< 0.010		6.75	
	Average	**0.0718**		**160**		**3**		**0.13**		**6.68**		**47.5**		**581.8**		**0.026**		**0.022**		**0.051**		**0.0008**		**0.005**		**7.33**	
MW-14	4/16/2013	0.0482		140		J 3		0.14		6.95		42.0		490		J 0.030		3.59		0.979		0.0071		< 0.010		5.82	
	8/19/2013	0.0614		144		J 2		0.20		6.77		36.0		528		< 0.050		0.347		0.252		J 0.0019		< 0.010		8.97	
	11/19/2013	0.0642		158		J 3		0.17		6.74		41.0		496		< 0.050		0.46		0.156		0.0031		< 0.010		7.01	
	3/18/2014	0.0493		153		J 3		< 0.10		6.76		23.0		548		< 0.050		0.323		0.218		J 0.0021		< 0.010		5.99	
	6/17/2014	0.0553		152		JS 3		0.17		6.77		S 40.0		530		< 0.050		0.443		0.365		J 0.0020		< 0.010		6.40	
	8/26/2014	0.0600		S 155		J 2		0.14		6.55		34.0		558		< 0.050		0.13		0.247		J 0.0017		< 0.010		6.28	
	12/9/2014	0.0626		165		J 2		0.17		6.74		39.0		576		< 0.050		0.0796		0.0549		J 0.0013		< 0.010		7.69	
	3/4/2015	0.0525		152		J 3		0.14		6.62		29.0		524		< 0.050		0.105		0.0516		J 0.0012		< 0.010		6.55	
	6/2/2015	0.0538		153		JS 3		0.14		6.66		S 24.0		542		< 0.050		J 0.016		0.0484		J 0.0007		< 0.010		6.94	
	9/9/2015	0.0641		150		J 2		0.16		6.60		37.0		514		< 0.050		< 0.020		0.186		BJ 0.0006		< 0.010		14.20	
	12/8/2015	0.0672		153		J 2		0.14		6.70		33.0		542		< 0.050		< 0.020		0.0147		J 0.0006		< 0.010		7.90	
	Average	**0.0581**		**152**		**3**		**0.15**		**6.71**		**34.4**		**531.6**		**0.025**		**0.501**		**0.234**		**0.0020**		**< 0.010**		**7.61**	
MW-15	4/16/2013	0.0581		136		J 2		0.16		6.84		27.0		404		< 0.050		J 0.016		0.018		< 0.0030		< 0.010		5.64	
	8/19/2013	0.0668		S 152		J 3		0.22		6.75		29.0		538		< 0.050		0.111		0.041		< 0.0030		< 0.010		5.74	
	11/19/2013	0.0592		150		J 3		0.17		6.74		23.0		464		< 0.050		< 0.020		0.027		J 0.0010		< 0.010		5.43	
	3/18/2014	0.0660		161		J 3		< 0.10		6.74		28.0		558		< 0.050		< 0.020		< 0.005		< 0.0030		< 0.010		5.58	
	6/17/2014	0.0733		S 156		J 3		0.16		6.74		33.0		626		< 0.050		J 0.01		0.006		< 0.0030		< 0.010		5.80	
	8/26/2014	0.0693		154		J 2		0.15		6.44		22.0		544		< 0.050		J 0.011		< 0.005		J 0.0003		J 0.007		5.29	
	12/9/2014	0.0742		170		J 3		0.16		6.73		46.0		600		< 0.050		< 0.020		J 0.0042		J 0.0003		< 0.010		6.04	
	3/4/2015	0.0492		150		J 3		0.12		6.57		20.0		514		< 0.050		< 0.020		J 0.0021		< 0.0030		< 0.010		4.93	
	6/2/2015	0.0599		162		J 3		0.15		6.53		10.0		552		< 0.050		< 0.020		< 0.005		J 0.0003		< 0.010		5.58	
	9/9/2015	0.0781		164		J 3		0.15		6.55		39.0		554		< 0.050		< 0.020		0.0356		BJ 0.0003		< 0.010		6.73	
	12/8/2015	0.0835		168		J 2		0.13		6.64		22.0		562		< 0.050		< 0.020		0.0265		J 0.0004		< 0.010		6.20	
	Average	**0.0671**		**157**		**3**		**0.15**		**6.66**		**27.2**		**537.8**		**< 0.050**		**0.020**		**0.015**		**0.0009**		**0.005**		**5.72**	

Groundwater Samples Selected Parameters

Sample	Date	Boron (mg/L)		Calcium (mg/L)		Chloride (mg/L)		Flouride (mg/L)		pH (SU)		Sulfate (mg/L)		TDS (mg/L)		Aluminum (mg/L)		Iron (mg/L)		Manganese (mg/L)		Arsenic (mg/L)		Molybdenum (mg/L)		Sodium (mg/L)	
		Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered
MW-16	4/16/2013	0.1020		157		6		0.22		6.85		30.0		554		J 0.031		8.580		3.740		0.0125		< 0.010		9.50	
	8/19/2013	0.1060		S 161		J 3		0.26		6.83		34.0		636		< 0.050		1.060		3.810		J 0.0016		< 0.010		9.61	
	11/19/2013	0.0880		176		J 3		0.16		6.69		49.0		580		< 0.050		0.103		0.772		J 0.0010		< 0.010		8.13	
	3/18/2014	0.0901		182		J 3		< 0.10		6.80		24.0		630		< 0.050		J 0.01		0.034		< 0.0030		< 0.010		8.25	
	6/17/2014	0.0657		173		J 3		0.16		6.78		44.0		694		< 0.050		0.0399		J 0.002		< 0.0030		< 0.010		7.87	
	8/26/2014	0.0842		172		J 3		0.14		6.55		34.0		620		< 0.050		0.999		0.648		J 0.0012		< 0.010		7.88	
	12/9/2014	0.0728		181		J 3		0.14		6.73		59.0		642		< 0.050		J 0.017		0.0118		J 0.0004		< 0.010		7.44	
	3/4/2015	0.0640		171		J 3		0.11		6.58		49.0		616		< 0.050		J 0.017		0.0136		J 0.0004		< 0.010		7.13	
	6/2/2015	0.0628		172		J 3		0.12		6.57		32.0		620		< 0.050		< 0.020		J 0.0023		J 0.0004		< 0.010		7.78	
	9/9/2015	0.0845		178		J 3		0.14		6.73		54.0		604		< 0.050		J 0.018		0.469		BJ 0.0004		< 0.010		8.59	
	12/8/2015	0.0841		173		J 2		0.12		6.71		S 44.0		584		< 0.050		J 0.013		0.0122		J 0.0004		< 0.010		7.96	
	Average	**0.0822**		**172**		**3**		**0.15**		**6.71**		**41.2**		**616.4**		**0.026**		**0.988**		**0.865**		**0.0019**		**< 0.010**		**8.19**	
MW-17	4/16/2013	0.0649		S 165		J 2		0.13		6.79		59.0		580		0.119		1.62		1.270		0.0053		< 0.010		8.58	
	8/19/2013	0.0644		144		J 4		0.25		6.85		21.0		532		J 0.021		J 0.017		0.017		< 0.0030		< 0.010		5.36	
	11/19/2013	0.0682		155		J 3		0.19		6.77		33.0		502		< 0.050		J 0.017		J 0.005		J 0.0008		< 0.010		6.04	
	3/18/2014	0.0611		151		J 3		J 0.07		6.94		18.0		492		< 0.050		J 0.013		0.048		< 0.0030		< 0.010		5.66	
	6/17/2014	0.0639		150		J 3		0.20		6.83		26.0		602		< 0.050		1.560		0.244		J 0.0023		< 0.010		5.92	
	8/26/2014	0.0674		155		JS 2		0.16		6.58		S 30.0		586		< 0.050		0.0223		J 0.002		J 0.0004		< 0.010		5.78	
	12/9/2014	0.0613		163		J 2		0.18		6.78		22.0		576		< 0.050		< 0.020		0.0124		J 0.0004		< 0.010		5.28	
	3/4/2015	0.0532		156		J 3		0.12		6.64		22.0		560		< 0.050		J 0.010		J 0.0043		J 0.0003		< 0.010		5.54	
	6/2/2015	0.0530		152		J 3		0.17		6.63		J 6.0		548		< 0.050		< 0.020		0.0173		J 0.0005		< 0.010		5.27	
	9/9/2015	0.0526		149		J 2		0.17		6.81		24.0		512		< 0.050		< 0.020		0.0931		BJ 0.0004		< 0.010		5.10	
	12/8/2015	0.0648		150		J 2		0.15		6.77		16.0		520		< 0.050		< 0.020		0.0644		J 0.0004		< 0.010		5.28	
	Average	**0.0613**		**154**		**3**		**0.16**		**6.76**		**25.2**		**546.4**		**0.033**		**0.300**		**0.162**		**0.0013**		**< 0.010**		**5.80**	
MW-18	4/16/2013	0.0458		135		J 1		0.18		7.00		34.0		476		< 0.050		0.0223		0.090		< 0.0030		< 0.010		6.93	
	8/19/2013	0.0860		140		J 2		0.24		6.96		37.0		536		< 0.050		< 0.020		0.219		< 0.0030		< 0.010		8.17	
	11/19/2013	0.1420		137		J 3		0.25		6.87		32.0		470		< 0.050		0.0998		1.110		J 0.0013		< 0.010		10.50	
	3/18/2014	0.1450		143		J 4		0.12		6.94		J 10.0		516		< 0.050		6.18		1.320		0.0045		J 0.006		11.80	
	6/17/2014	0.0695		130		J 3		0.24		7.01		42.0		574		< 0.050		J 0.0094		< 0.005		< 0.0030		< 0.010		8.59	
	8/26/2014	0.0864		130		J 3		0.21		6.83		35.0		514		< 0.050		J 0.013		0.084		J 0.0007		< 0.010		7.08	
	12/9/2014	0.0672		148		J 3		0.19		6.98		43.0		564		< 0.050		< 0.020		0.0759		J 0.0007		< 0.010		6.75	
	3/4/2015	0.0536		140		J 3		0.15		6.90		38.0		534		< 0.050		< 0.020		0.0455		J 0.0007		J 0.004		6.67	
	6/2/2015	0.0681		150		J 3		0.17		6.75		24.0		544		< 0.050		< 0.020		0.0326		J 0.0008		J 0.003		7.12	
	9/9/2015	0.0903		141		J 3		0.18		6.86		35.0		488		< 0.050		0.0952		0.806		BJ 0.0007		< 0.010		9.05	
	12/8/2015	0.0880		155		J 2		0.16		6.86		30.0		510		< 0.050		< 0.020		0.124		J 0.0008		< 0.010		7.68	
	Average	**0.0856**		**141**		**3**		**0.19**		**6.91**		**32.7**		**520.5**		**< 0.050**		**0.588**		**0.355**		**0.0013**		**0.005**		**8.21**	
MW-19	4/16/2013	0.0721		143		J 2		0.15		6.83		72.0		500		< 0.050		0.136		0.099		< 0.0030		< 0.010		9.86	
	8/19/2013	0.0691		124		J 2		0.27		6.73		39.0		506		< 0.050		0.0838		0.249		< 0.0030		< 0.010		8.24	
	11/19/2013	0.0766		143		J 3		0.20		6.82		55.0		470		< 0.050		0.407		0.806		J 0.0013		< 0.010		8.84	
	3/18/2014	0.0557		137		J 3		J 0.06		6.90		53.0		456		< 0.050		J 0.017		0.180		< 0.0030		< 0.010		7.86	
	6/17/2014	0.0844		148		J 3		0.17		6.85		55.0		652		< 0.050		J 0.018		0.044		< 0.0030		< 0.010		9.73	
	8/26/2014	0.0766		146		J 3		0.16		6.66		63.0		546		< 0.050		0.0687		0.237		J 0.0005		< 0.010		8.67	
	12/9/2014	0.0611		140		J 3		0.18		6.93		35.0		546		< 0.050		0.0389		0.0231		J 0.0007		< 0.010		7.25	
	3/4/2015	0.0716		134		J 3		0.14		6.83		49.0		522		< 0.050		J 0.017		0.15		J 0.0004		< 0.010		8.31	
	6/2/2015	0.0609		133		J 3		0.18		6.68		15.0		524		< 0.050		0.110		J 0.0019		J 0.0009		< 0.010		7.18	
	9/9/2015	0.0736		136		J 3		0.2		6.86		41.0		468		< 0.050		J 0.0072		0.0721		BJ 0.0008		< 0.010		7.64	
	12/8/2015	0.0682		135		J 3		0.16		6.83		33.0		470		1.300		1.010		0.0253		J 0.0012		< 0.010		7.57	
	Average	**0.0700**		**138**		**3**		**0.17**		**6.81**		**46.4**		**514.5**		**0.141**		**0.174**		**0.172**		**0.0011**		**< 0.010**		**8.29**	
MW-20	4/16/2013	0.0487		106		J 2		0.19		6.99		21.0		356		< 0.050		0.0309		0.154		< 0.0030		< 0.010		5.21	
	8/19/2013	0.0602		121		J 3		0.27		6.92		36.0		466		< 0.050		J 0.0092		0.008		< 0.0030		< 0.010		12.80	
	11/19/2013	0.0612		S 130		J 3		0.25		6.87		36.0		404		< 0.050		J 0.0071		J 0.003		J 0.0011		< 0.010		5.96	
	3/18/2014	0.0590		128		J 3		J 0.08		6.99		S 17.0		406		< 0.050		< 0.020		J 0.002		< 0.0030		< 0.010		5.42	
	6/17/2014	0.0601		119		J 3		0.20		6.95		26.0		510		< 0.050		J 0.011		0.035		< 0.0030		< 0.010		5.36	
	8/26/2014	0.0573		111		J 3		0.18		6.72		20.0		416		< 0.050		< 0.020		0.064		J 0.0003		< 0.010		4.80	
	12/9/2014	0.0650		143		J 3		0.21		6.94		32.0		540		< 0.050		0.0246		< 0.005		J 0.0004		< 0.010		6.23	
	3/4/2015	0.0549		134		J 3		0.18		6.96		27.0		502		< 0.050		< 0.020		< 0.005		J 0.0003		< 0.010		5.61	
	6/2/2015	0.0543		127		JS 3		0.19		6.68		S 15.0		518		< 0.050		< 0.020		< 0.005		J 0.0003		< 0.010		5.52	
	9/9/2015	0.0571		128		J 3		0.2		6.88		32.0		452		< 0.050		< 0.020		< 0.005		BJ 0.0005		< 0.010		5.69	
	12/8/2015	0.0661		122		J 2		0.17		6.83		22.0		392		< 0.050		< 0.020		< 0.005		J 0.0004		< 0.010		5.67	
	Average	**0.0585**		**124**		**3**		**0.19**		**6.88**		**25.8**		**451.1**		**< 0.050**		**0.013**		**0.025**		**0.0008**		**< 0.010**		**6.21**	

Groundwater Samples Selected Parameters																											
Sample	Date	Boron (mg/L)		Calcium (mg/L)		Chloride (mg/L)		Flouride (mg/L)		pH (SU)		Sulfate (mg/L)		TDS (mg/L)		Aluminum (mg/L)		Iron (mg/L)		Manganese (mg/L)		Arsenic (mg/L)		Molybdenum (mg/L)		Sodium (mg/L)	
		Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered
MW-21	4/16/2013	0.0577		107		J 3		0.16		6.92		30.0		262		< 0.050		1.08		0.412		J 0.0010		< 0.010		9.05	
	8/19/2013	0.0817		102		J 3		0.30		7.03		22.0		396		< 0.050		J 0.012		0.060		J 0.0025		< 0.010		5.01	
	11/19/2013	0.0860		101		J 4		0.29		6.96		25.0		330		< 0.050		1.93		0.536		0.0044		J 0.003		4.48	
	3/18/2014	0.0810		102		J 3		0.15		7.01		14.0		364		< 0.050		0.649		0.228		0.0037		J 0.007		4.36	
	6/17/2014	0.0561		S 51		J 5		0.24		7.15		12.0		300		4.200		2.32		0.019		J 0.0027		J 0.005		2.48	
	8/26/2014	0.0714		104		J 3		0.22		6.87		31.0		392		0.052		1.81		1.090		0.0180		J 0.008		3.45	
	12/9/2014	0.0419		84.8		J 3		0.19		7.07		16.0		342		0.080		0.091		J 0.0022		J 0.0012		< 0.010		3.20	
	3/4/2015	0.0436		101		J 3		0.15		6.83		S 17.0		370		0.085		0.168		0.0292		0.0042		J 0.004		3.50	
	6/2/2015	0.0561		92.7		J 3		0.19		6.77		J 7.0		372		0.102		0.0784		0.0154		J 0.0013		J 0.005		3.54	
	9/9/2015	0.0741		110		J 2		0.22		6.81		22.0		320		< 0.050		0.316		0.069		J 0.0018		< 0.010		4.28	
	12/8/2015	0.0382		74.2		J 3		0.17		6.98		17.0		238		8.320		9.3		0.125		0.0044		J 0.005		4.37	
	Average	**0.0625**		**94**		**3**		**0.21**		**6.95**		**19.4**		**335.1**		**1.178**		**1.614**		**0.235**		**0.0041**		**0.005**		**4.34**	
MW-22	4/16/2013	0.1560		145		6		0.25		6.88		30.0		560		< 0.050		19.9		1.900		0.0457		< 0.010		14.10	
	8/19/2013	0.1400		138		J 3		0.25		6.86		30.0		572		J 0.020		8.41		1.510		0.0161		< 0.010		11.80	
	11/19/2013	0.1690		144		J 4		0.25		6.89		37.0		528		< 0.050		23.5		1.720		S 0.0499		< 0.010		12.90	
	3/18/2014	0.1680		147		J 3		0.14		6.90		21.0		538		< 0.050		15.5		1.450		0.0208		< 0.010		14.50	
	6/17/2014	0.1360		136		J 3		0.21		6.78		49.0		640		< 0.050		13.2		1.440		0.0255		< 0.010		10.90	
	8/26/2014	0.1450		134		J 3		0.20		6.74		30.0		554		< 0.050		6.02		1.320		0.0166		< 0.010		11.10	
	12/9/2014	0.0681		128		J 2		0.2		6.81		24.0		476		< 0.050		0.388		0.0396		J 0.0020		< 0.010		5.93	
	3/4/2015	0.1270		134		J 3		0.17		6.75		36.0		546		< 0.050		7.29		1.830		0.0101		< 0.010		10.50	
	6/2/2015	0.0656		S 123		J 3		0.17		6.64		J 9.0		472		0.069		1.03		0.0098		J 0.0025		< 0.010		6.13	
	9/9/2015	0.1080		136		J 2		0.2		6.57		24.0		482		< 0.050		0.435		0.279		J 0.0016		< 0.010		8.42	
	12/8/2015	0.0906		131		J 2		0.16		6.86		20.0		448		J 0.050		0.853		0.0169		J 0.0028		< 0.010		7.40	
	Average	**0.1248**		**136**		**3**		**0.20**		**6.79**		**28.2**		**528.7**		**0.031**		**8.775**		**1.047**		**0.0176**		**< 0.010**		**10.33**	
MW-23	4/16/2013	0.0940		144		J 4		0.18		6.84		21.0		508		0.153		3.6		0.180		0.0034		< 0.010		17.00	
	8/19/2013	0.1460		143		5		0.24		6.90		24.0		624		0.284		5.6		0.519		0.0088		< 0.010		21.20	
	11/19/2013	0.2090		147		6		0.23		6.82		J 9.0		620		0.062		18.3		0.467		0.0262		< 0.010		38.60	
	3/18/2014	0.1620		150		J 5		J 0.05		6.78		15.0		616		0.051		22.7		0.472		0.0440		< 0.010		34.10	
	6/17/2014	0.1080		139		J 4		0.20		6.72		26.0		624		0.189		1.74		0.120		J 0.0012		< 0.010		13.70	
	8/26/2014	0.1710		149		J 5		0.18		6.79		24.0		648		0.065		12.4		0.618		0.0175		< 0.010		25.00	
	12/9/2014	0.1190		151		J 4		0.17		6.77		28.0		606		< 0.050		3.17		0.262		J 0.0055		< 0.010		15.60	
	3/4/2015	0.0948		143		J 4		0.14		6.68		23.0		594		J 0.030		2.03		0.207		J 0.0029		< 0.010		14.40	
	6/2/2015	0.1040		141		J 4		0.15		6.59		J 8.0		564		0.078		2.76		0.280		0.0034		J 0.005		14.30	
	9/9/2015	0.1190		149		J 4		0.19		6.63		22.0		560		< 0.050		2.82		0.642		0.0047		< 0.010		16.60	
	12/8/2015	0.1370		S 150		J 4		0.15		6.72		20.0		556		J 0.030		6.13		0.481		0.0090		< 0.010		17.70	
	Average	**0.1331**		**146**		**4**		**0.17**		**6.75**		**20.0**		**592.7**		**0.090**		**7.386**		**0.386**		**0.0115**		**0.005**		**20.75**	
MW-24	4/16/2013	0.0471		128		J 3		0.18		6.94		36.0		426		0.154		0.277		J 0.004		< 0.0030		< 0.010		7.71	
	8/19/2013	0.0601		126		J 4		0.22		6.88		35.0		486		< 0.050		J 0.015		0.007		< 0.0030		< 0.010		7.30	
	11/19/2013	0.0587		131		J 4		0.20		6.87		36.0		438		< 0.050		0.0211		J 0.005		< 0.0030		< 0.010		6.97	
	3/18/2014	0.0525		130		J 4		J 0.06		6.87		20.0		440		< 0.050		0.0219		0.011		< 0.0030		< 0.010		6.87	
	6/17/2014	0.0639		110		J 5		0.20		6.82		S 31.0		510		< 0.050		0.0201		J 0.003		< 0.0030		< 0.010		5.81	
	8/26/2014	0.0690		122		6		0.18		6.63		25.0		458		< 0.050		J 0.0092		< 0.005		J 0.0006		< 0.010		6.48	
	12/9/2014	0.0566		S 122		7		0.16		6.86		26.0		472		J 0.041		0.0426		0.0059		J 0.0009		< 0.010		5.83	
	3/4/2015	0.0617		130		7		0.14		6.84		28.0		494		< 0.050		J 0.0075		J 0.0046		J 0.0005		< 0.010		6.36	
	6/2/2015	0.0625		131		6		0.15		6.59		13.0		486		0.116		0.0963		J 0.0032		J 0.0007		< 0.010		6.64	
	9/9/2015	0.0848		136		7		0.18		6.34		29.0		446		< 0.050		J 0.0078		0.0177		J 0.0008		< 0.010		7.01	
	12/8/2015	0.0712		134		7		0.15		6.73		29.0		472		0.814		0.537		0.012		J 0.0011		< 0.010		6.90	
	Average	**0.0626**		**127**		**5**		**0.17**		**6.76**		**28.0**		**466.2**		**0.118**		**0.096**		**0.007**		**0.0011**		**< 0.010**		**6.72**	
MW-25	4/16/2013	0.1240		132		J 4		0.14		7.18		17.0		406		J 0.038		4.85		2.730		0.0065		< 0.010		7.04	
	8/19/2013	0.1440		130		J 3		0.18		7.04		39.0		506		< 0.050		0.294		1.150		J 0.0014		< 0.010		7.44	
	11/19/2013	0.1480		146		J 4		0.14		6.97		S 32.0		464		< 0.050		0.174		0.762		< 0.0030		< 0.010		6.81	
	3/18/2014	0.1140		143		J 4		< 0.10		7.04		23.0		468		< 0.050		0.0464		0.115		< 0.0030		J 0.005		6.57	
	6/17/2014	0.1030		140		J 4		0.16		6.98		74.0		646		< 0.050		0.0267		1.270		< 0.0030		< 0.010		6.47	
	8/26/2014	0.1080		140		J 4		0.12		6.74		53.0		516		< 0.050		J 0.014		0.020		J 0.0004		< 0.010		6.06	
	12/9/2014	0.1110		151		J 4		0.11		6.91		34.0		538		< 0.050		0.0209		< 0.005		J 0.0005		< 0.010		6.59	
	3/4/2015	0.1120		S 138		J 4		J 0.10		6.89		42.0		530		< 0.050		0.0295		0.008		J 0.0004		< 0.010		6.14	
	6/2/2015	0.1090		143		J 4		0.11		6.77		33.0		518		< 0.050		0.0214		0.016		J 0.0004		< 0.010		6.54	
	9/9/2015	0.1250		133		5		0.15		6.70		33.0		446		< 0.050		J 0.02		2.430		J 0.0006		< 0.010		6.37	
	12/8/2015	0.1090		135		J 4		0.11		6.85		34.0		468		< 0.050		J 0.017		0.154		J 0.0005		< 0.010		7.76	
	Average	**0.1188**		**139**		**4**		**0.12**		**6.92**		**37.6**		**500.5**		**0.026**		**0.501**		**0.787**		**0.0014**		**0.005**		**6.71**	

Groundwater Samples Selected Parameters

Sample	Date	Boron (mg/L)		Calcium (mg/L)		Chloride (mg/L)		Flouride (mg/L)		pH (SU)		Sulfate (mg/L)		TDS (mg/L)		Aluminum (mg/L)		Iron (mg/L)		Manganese (mg/L)		Arsenic (mg/L)		Molybdenum (mg/L)		Sodium (mg/L)	
		Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered
MW-26	4/16/2013	0.0827		146		J 4		0.16		7.02		45.0		504		0.056		0.63		3.000		< 0.0030		< 0.010		7.84	
	8/19/2013	0.0698		139		J 5		0.21		7.01		38.0		556		< 0.050		0.0375		0.141		< 0.0030		< 0.010		8.19	
	11/19/2013	0.0597		140		J 4		0.18		6.93		30.0		446		< 0.050		J 0.015		0.131		< 0.0030		< 0.010		5.90	
	3/18/2014	0.0666		139		J 4		< 0.10		7.01		15.0		474		< 0.050		J 0.011		0.366		< 0.0030		< 0.010		6.75	
	6/17/2014	0.0728		142		J 5		0.16		6.88		34.0		612		< 0.050		J 0.017		1.570		< 0.0030		< 0.010		7.05	
	8/26/2014	0.0564		142		J 4		0.16		6.80		19.0		508		< 0.050		J 0.0089		0.031		J 0.0004		< 0.010		5.47	
	12/9/2014	0.0585		145		J 4		0.16		7.07		30.0		514		< 0.050		J 0.017		0.0131		J 0.0005		< 0.010		5.82	
	3/4/2015	0.0540		140		J 4		0.14		6.98		22.0		510		< 0.050		< 0.020		0.0356		J 0.0004		J 0.004		5.04	
	6/2/2015	0.0719		146		J 4		0.13		6.73		12.0		524		< 0.050		< 0.020		1.140		J 0.0004		< 0.010		6.99	
	9/9/2015	0.0778		140		5		0.16		6.64		28.0		476		< 0.050		< 0.020		1.240		J 0.0004		< 0.010		7.33	
	12/8/2015	0.1200		162		18		0.13		6.86		18.0		508		< 0.050		< 0.020		0.647		J 0.0005		< 0.010		7.77	
	Average	**0.0718**		**144**		**6**		**0.15**		**6.90**		**26.5**		**512.0**		**0.028**		**0.071**		**0.756**		**0.0009**		**0.005**		**6.74**	
MW-27	4/16/2013	0.0986		169		11		0.18		6.83		29.0		576		J 0.031		3.22		1.280		0.0033		< 0.010		6.74	
	8/19/2013	0.0861		191		20		0.20		6.73		37.0		690		< 0.050		1.19		0.667		J 0.0020		< 0.010		6.73	
	11/19/2013	0.1040		203		16		0.18		6.65		43.0		606		< 0.050		0.129		0.149		< 0.0030		< 0.010		6.54	
	3/18/2014	0.1360		207		20		< 0.10		6.67		20.0		672		< 0.050		0.307		0.418		< 0.0030		< 0.010		6.72	
	6/17/2014	0.1930		175		9		0.18		6.75		29.0		672		< 0.050		0.503		0.690		< 0.0030		< 0.010		6.09	
	8/26/2014	0.1190		J,S 196		13		0.15		6.47		35.0		672		< 0.050		0.117		0.278		J 0.0005		< 0.010		6.10	
	12/9/2014	0.0970		210		14		0.15		6.60		54.0		722		< 0.050		0.0546		0.0416		J 0.0005		< 0.010		7.88	
	3/4/2015	0.1010		197		36		0.13		6.53		49.0		710		< 0.050		0.0404		0.126		J 0.0003		< 0.010		6.26	
	6/2/2015	0.1320		190		24		0.14		6.42		29.0		660		< 0.050		0.0508		0.204		J 0.0003		< 0.010		6.60	
	9/9/2015	0.1000		199		35		0.14		6.36		50.0		642		< 0.050		0.0243		0.172		J 0.0003		< 0.010		6.70	
	12/8/2015	0.0881		212		28		0.12		6.53		63.0		694		< 0.050		J 0.016		0.0792		J 0.0004		< 0.010		9.28	
	Average	**0.1141**		**195**		**21**		**0.15**		**6.59**		**39.8**		**665.1**		**0.026**		**0.514**		**0.373**		**0.0011**		**< 0.010**		**6.88**	
MW-28	4/16/2013	0.0867		162		6		0.16		6.78		31.0		556		J 0.016		2.02		0.402		J 0.0015		< 0.010		5.84	
	8/19/2013	0.0912		165		8		0.19		6.78		32.0		600		0.203		0.8		0.147		J 0.0015		< 0.010		5.68	
	11/19/2013	0.0921		173		9		0.18		6.64		24.0		542		< 0.050		0.0299		0.013		< 0.0030		< 0.010		5.11	
	3/18/2014	0.0935		175		9		< 0.10		6.71		11.0		582		< 0.050		0.13		0.196		< 0.0030		< 0.010		5.56	
	6/17/2014	0.0949		173		7		0.17		6.68		48.0		690		< 0.050		0.176		0.448		< 0.0030		< 0.010		5.95	
	8/26/2014	0.0873		168		10		0.15		6.48		11.0		598		< 0.050		J 0.018		J 0.004		< 0.0030		J 0.006		5.92	
	12/9/2014	0.0903		180		13		0.16		6.72		22.0		634		< 0.050		J 0.017		< 0.005		J 0.0003		< 0.010		5.86	
	3/4/2015	0.0887		175		17		0.14		6.63		S 15.0		634		< 0.050		0.0393		< 0.005		J 0.0003		< 0.010		6.54	
	6/2/2015	0.0920		178		12		0.14		6.47		S 13.0		622		< 0.050		J 0.018		0.015		J 0.0003		< 0.010		6.55	
	9/9/2015	0.0945		179		15		0.15		6.43		23.0		602		< 0.050		J 0.0094		0.037		J 0.0003		< 0.010		6.33	
	12/8/2015	0.1030		185		15		0.13		6.60		16.0		608		< 0.050		< 0.020		0.045		J 0.0004		< 0.010		6.99	
	Average	**0.0922**		**174**		**11**		**0.15**		**6.63**		**22.4**		**606.2**		**0.040**		**0.297**		**0.119**		**0.0010**		**0.005**		**6.03**	
MW-29	3/18/2014	0.6430		169		6		0.11		6.89		27.0		590		< 0.050		J 0.015		0.733		< 0.0030		0.018		11.30	
	6/17/2014	0.2890		153		6		0.19		6.79		27.0		610		< 0.050		J 0.019		0.816		< 0.0030		J 0.010		7.56	
	8/26/2014	0.2680		167		J 4		0.18		6.64		S 14.0		556		< 0.050		< 0.020		0.298		J 0.0004		0.018		8.39	
	12/9/2014	0.1000		172		J 3		0.2		6.75		23.0		624		< 0.050		J 0.007		0.210		J 0.0004		J 0.006		4.15	
	3/4/2015	0.0894		S 160		J 3		0.15		6.68		22.0		576		< 0.050		< 0.020		0.213		J 0.0003		J 0.010		3.86	
	6/2/2015	0.0847		170		J 3		0.17		6.53		11.0		586		< 0.050		< 0.020		0.200		J 0.0003		J 0.008		4.27	
	9/9/2015	0.0718		140		J 3		0.18		6.49		16.0		432		< 0.050		< 0.020		0.0119		J 0.0004		< 0.010		3.16	
	12/8/2015	0.0804		142		J 3		0.15		6.69		14.0		456		< 0.050		< 0.020		0.041		J 0.0004		J 0.006		3.36	
	Average	**0.2033**		**159**		**4**		**0.17**		**6.68**		**19.3**		**553.8**		**< 0.050**		**0.011**		**0.315**		**0.0007**		**0.010**		**5.76**	
MW-30	3/18/2014	0.112		178		6		J 0.06		6.87		J 8.0		628		< 0.050		6.13		0.693		0.0103		J 0.005		5.60	
	6/17/2014	0.125		174		6		0.17		6.82		26.0		714		0.062		15.1		0.768		0.0150		J 0.006		6.03	
	8/26/2014	0.228		181		6		0.15		6.72		14.0		616		< 0.050		0.397		0.499		J 0.0015		J 0.009		7.58	
	12/9/2014	0.1760		183		5		0.15		6.69		30.0		664		< 0.050		0.805		1.170		J 0.0019		< 0.010		7.03	
	3/4/2015	0.1140		183		6		0.15		6.69		28.0		666		< 0.050		0.268		1.310		J 0.0007		J 0.007		6.21	
	6/2/2015	0.1050		183		6		0.16		6.63		< 10.0		654		< 0.050		9.27		0.913		0.0088		< 0.010		9.75	
	9/9/2015	0.1170		182		6		0.16		6.68		23.0		622		< 0.050		0.767		1.560		J 0.0013		< 0.010		7.45	
	12/8/2015	0.1150		185		7		0.13		6.65		16.0		636		< 0.050		0.34		1.040		J 0.0006		< 0.010		13.00	
	Average	**0.1365**		**181**		**6**		**0.14**		**6.72**		**18.8**		**650.0**		**0.030**		**4.135**		**0.994**		**0.0050**		**0.006**		**7.83**	
MW-31	3/18/2014	1.160		200		13		J 0.06		6.93		120.0		790		0.145		2.12		3.270		0.0048		0.021		17.70	
	5/2014	0.545	0.485			7.5		ND				119.0		756		0.105		11.7	12.60	3.190	3.260	0.0129	0.0143	0.009	0.008		
	6/17/2014	0.121		196		5		0.15		6.94		95.0		760		0.123		16.7		3.110		0.0174		J 0.003		7.15	
	8/26/2014	0.275		199		5		0.13		6.78		88.0		776		J 0.015		1.22		2.680		0.0036		J 0.007		9.44	
	12/9/2014	0.1870		S 208		J 5		0.13		6.79		91.0		776		< 0.050		2.24		2.700		0.0034		J 0.005		9.04	
	3/4/2015	0.2950		201		8		0.12		6.77		101.0		792		< 0.050		1.06		1.580		J 0.0020		J 0.006		9.99	
	6/2/2015	0.0896		210		J 4		0.13		6.83		50.0		854		< 0.050		12.5		3.270		0.0093		< 0.010		8.08	
	9/9/2015	0.1200		216		6		0.14		6.68		98.0		778		0.229		0.492		2.100		J 0.0013		J 0.003		9.75	
	12/8/2015	0.1020		211		J 5		0.1		6.68		116.0		714		< 0.050		4.55		3.080		J 0.0024		J 0.003		8.91	
	Average	**0.3216**		**205**		**7**		**0.12**		**6.80**		**97.6**		**777.3**		**0.080**		**5.842**		**2.776**		**0.0063**		**0.007**		**10.01**	

Groundwater Samples Selected Parameters

Sample	Date	Boron (mg/L)		Calcium (mg/L)		Chloride (mg/L)		Flouride (mg/L)		pH (SU)		Sulfate (mg/L)		TDS (mg/L)		Aluminum (mg/L)		Iron (mg/L)		Manganese (mg/L)		Arsenic (mg/L)		Molybdenum (mg/L)		Sodium (mg/L)	
		Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered
MW-32	3/18/2014	0.131		182		7		< 0.10		7.04		27.0		642		< 0.050		16.60		1.830		0.0359		< 0.010		7.32	
	6/17/2014	0.082		189		5		0.14		6.96		55.0		674		< 0.050		23.90		2.030		0.0695		< 0.010		6.81	
	8/26/2014	0.287		175		6		0.12		6.88		36.0		674		< 0.050		6.30		1.320		0.0229		< 0.010		7.57	
	12/9/2014	0.0906		192		5		0.13		6.85		43.0		674		< 0.050		4.41		1.450		0.0127		J 0.004		6.79	
	3/4/2015	0.0721		169		J 4		0.11		6.86		27.0		642		< 0.050		1.13		0.431		0.0066		< 0.010		6.41	
	6/2/2015	0.0768		192		J 5		0.13		6.87		16.0		712		< 0.050		15.00		2.150		0.0371		< 0.010		6.62	
	9/9/2015	0.0936		179		J 5		0.13		6.73		34.0		588		< 0.050		0.44		1.070		0.0038		< 0.010		8.40	
	12/8/2015	0.0830		193		J 4		0.12		6.74		28.0		644		< 0.050		11.90		1.980		0.0339		< 0.010		7.32	
	Average	**0.1145**		**184**		**5**		**0.12**		**6.87**		**33.3**		**656.3**		**< 0.050**		**9.959**		**1.533**		**0.0278**		**0.005**		**7.16**	
MW-33(D)	3/18/2014	12.900		102		30		0.21		7.08		299.0		628		< 0.050		6.27		0.461		J 0.0023		1.220		60.30	
	5/2014	11.600	12.100			23.5		ND				239.0		621		ND	ND	4.06	3.93	0.300	0.295	0.0009	0.00097	1.090	1.08		
	5/2014 DUP	11.800	11.800			23.1		ND				263.0		629		ND	ND	4.11	3.90	0.301	0.294	0.0009	0.0011	1.110	1.08		
	6/17/2014	S 11.400		S 99		23		0.29		7.18		232.0		708		< 0.050		5.48		0.287		< 0.0030		1.050		S 49.20	
	8/26/2014	11.900		91.2		25		0.27		7.18		329.0		638		< 0.050		4.65		0.248		J 0.0021		1.270		67.80	
	12/9/2014	11.500		90.1		27		0.3		7.33		316.0		684		< 0.050		4.58		0.214		J 0.0029		1.350		75.90	
	3/4/2015	10.800		86.7		25		0.27		7.26		317.0		708		< 0.050		4.45		0.212		J 0.0029		1.240		77.00	
	6/2/2015	11.200		83.5		22		0.3		7.10		287.0		622		< 0.050		4.78		0.232		J 0.0010		1.260		69.20	
	9/9/2015	11.700		92		32		0.29		7.32		331.0		660		< 0.050		5.08		0.239		J 0.0026		1.410		81.80	
	12/8/2015	10.600		83.8		22		0.24		7.21		294.0		628		< 0.050		4.91		0.229		J 0.0021		1.320		85.90	
	Average	**11.540**		**91**		**25**		**0.27**		**7.21**		**290.7**		**652.6**		**< 0.050**		**4.837**		**0.272**		**0.0019**		**1.232**		**70.89**	
MW-34(D)	3/18/2014	13.600		119		27		0.18		7.12		301.0		708		0.123		7.62		0.450		J 0.0026		0.827		59.10	
	5/2014	13.500	13.200			22		ND				315.0		738		0.019	ND	5.61	5.48	0.329	0.321	0.0018	0.0023	0.988	0.987		
	6/17/2014	13.300		117		20		0.28		7.21		314.0		940		< 0.050		6.61		0.308		J 0.0018		0.996		77.70	
	8/26/2014	13.200		106		24		0.25		7.12		356.0		796		< 0.050		6.00		0.276		0.0031		1.030		72.10	
	12/9/2014	12.000		110		27		0.26		7.24		348.0		782		< 0.050		6.14		0.27		0.0033		1.070		77.00	
	3/4/2015	12.100		105		24		0.23		7.26		326.0		784		< 0.050		6.01		0.267		0.0033		0.982		76.60	
	6/2/2015	11.800		116		20		0.24		7.10		364.0		806		< 0.050		6.52		0.295		0.0031		0.994		81.10	
	9/9/2015	12.600		122		30		0.24		7.01		387.0		796		< 0.050		6.95		0.312		0.0032		1.020		84.40	
	12/8/2015	11.800		108		20		0.19		7.10		332.0		724		< 0.050		6.84		0.302		0.0033		1.030		85.90	
	Average	**12.656**		**113**		**24**		**0.23**		**7.15**		**338.1**		**786.0**		**0.035**		**6.478**		**0.312**		**0.0028**		**0.993**		**76.74**	
MW-35(D)	3/18/2014	12.600		S 226		35		0.10		6.35		157.0		1200		J 0.048		S 17.7		1.570		0.0052		0.249		S 67.30	
	5/2014	12.100	11.900			16.7		ND				181.0		676		ND	ND	4.03	3.94	0.368	0.369	ND		0.468	0.459		
	6/17/2014	12.500		121		23		0.26		7.10		201.0		788		J 0.021		5.52		0.350		< 0.0030		0.566		54.90	
	8/26/2014	11.700		115		18		0.24		7.09		275.0		712		< 0.050		5.09		0.326		< 0.0030		0.745		66.80	
	12/9/2014	11.400		118		18		0.25		7.23		237.0		810		< 0.050		5.25		0.316		< 0.0030		0.752		69.90	
	3/4/2015	11.300		121		17		0.22		7.11		157.0		696		< 0.050		5.55		0.336		< 0.0030		0.479		56.20	
	6/2/2015	10.800		137		17		0.22		6.92		260.0		754		< 0.050		6.30		0.384		< 0.0030		0.534		57.90	
	9/9/2015	10.200		120		21		0.26		6.87		S 312.0		734		< 0.050		5.22		0.332		< 0.0030		0.789		71.80	
	12/8/2015	9.720		122		17		0.23		7.11		285.0		696		< 0.050		5.76		0.358		< 0.0030		0.716		74.40	
	Average	**11.369**		**135**		**20**		**0.22**		**6.97**		**229.4**		**785.1**		**0.024**		**6.713**		**0.482**		**0.0020**		**0.589**		**64.90**	
TMW-1	4/16/2013	0.1000		S 163		6		0.26		7.01		128.0		674		< 0.050		S 12.100		4.690		0.0295		< 0.010		11.00	
	8/19/2013	0.0917		155		J 5		0.28		6.93		83.0		658		< 0.050		1.010		4.600		0.0085		< 0.010		10.50	
	11/19/2013	0.0995		158		J 5		0.25		6.89		85.0		576		< 0.050		0.784		3.620		0.0061		< 0.010		9.60	
	3/18/2014	0.0987		161		5		0.12		6.92		75.0		612		< 0.050		0.570		2.170		0.0046		< 0.010		9.79	
	6/17/2014	0.1020		165		J 5		0.25		6.91		90.0		732		< 0.050		0.535		3.930		J 0.0020		< 0.010		9.83	
	8/26/2014	0.0991		163		J 4		0.21		6.83		81.0		664		< 0.050		0.956		4.040		0.0032		< 0.010		10.20	
	12/9/2014	0.0908		166		J 5		0.21		6.85		86.0		672		< 0.050		1.060		4.440		0.0043		< 0.010		10.40	
	3/4/2015	0.0809		156		J 5		0.18		6.66		81.0		654		< 0.050		0.540		3.410		0.0033		< 0.010		9.55	
	6/2/2015	0.0898		168		J 4		0.18		6.77		80.0		704		< 0.050		0.187		3.580		J 0.0022		< 0.010		10.20	
	9/9/2015	0.0957		164		J 4		0.22		6.82		74.0		628		< 0.050		0.046		2.500		J 0.0015		< 0.010		13.10	
	12/8/2015	0.1040		169		J 4		0.17		6.81		89.0		626		< 0.050		0.528		3.790		0.0035		< 0.010		11.80	
	Average	**0.0957**		**163**		**5**		**0.21**		**6.85**		**86.5**		**654.5**		**< 0.050**		**1.665**		**3.706**		**0.0062**		**< 0.010**		**10.54**	

Groundwater Samples Selected Parameters

Sample	Date	Boron (mg/L)		Calcium (mg/L)		Chloride (mg/L)		Flouride (mg/L)		pH (SU)		Sulfate (mg/L)		TDS (mg/L)		Aluminum (mg/L)		Iron (mg/L)		Manganese (mg/L)		Arsenic (mg/L)		Molybdenum (mg/L)		Sodium (mg/L)	
		Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered
DP-1S	9/17/2014	0.0895	0.0872	168	165	5.0		U 0.25		7.04	7.04	24.8		590		J 0.0645	U 0.0082	42.1	40.9	2.380	2.340	0.0730	0.072	J 0.003	J 0.005		
DP-1M	9/17/2014	0.0916	0.0933	130	131	6.4		U 0.25		6.90	6.90	12.8		518		0.393	U 0.0082	15.2	14	1.420	1.420	J 0.0011	U 0.00082	J 0.004	J 0.005		
DP-1D	9/17/2014	1.0700	1.0400	136	133	9.4		U 0.25		7.04	7.04	51.5		521		0.362	U 0.0082	10.2	9.28	0.245	0.229	0.0044	0.0043	J 0.0051	J 0.0049		
DP-2 S	9/12/2014	0.0494	0.0482	69.8	67.7	2.9		U 0.25		7.24	7.24	5.0		258		0.172	U 0.0082	10.9	9.83	1.930	1.850	0.0512	0.0540	J 0.004	J 0.004		
DP-2M	9/12/2014	J 0.0443	J 0.0438	112	110	2.3		U 0.25		7.28	7.28	36.9		418		0.518	U 0.0082	10.9	9.21	1.750	1.710	J 0.0015	U 0.00082	J 0.007	J 0.006		
DP-2M DUP	9/12/2014	J 0.0402	J 0.0409	112	111	2.3		U 0.25				36.7		421		0.623	U 0.0082	10.9	9.28	1.750	1.710	J 0.0010	U 0.00082	J 4.700	J 4.100		
DP-2D	9/12/2014	0.0571	0.0568	142	141	4.0		U 0.25		7.15	7.15	7.6		528		1.11	U 0.0082	12.4	10.2	0.393	0.344	0.0021	J 0.00099	0.0161	0.014		
DP-3S	9/24/2014	0.1280	0.1050	151	150			U 0.25		6.84	6.84	15.0		565		0.678	U 0.0082	15.5	14.7	1.770	1.740	0.0235	0.0241	J 0.006	J 0.014		
DP-3M	9/24/2014	7.6400	7.5100	136	133	16.6		U 0.25		7.23	7.23	169.0		554		0.31	U 0.0082	12.1	11	1.520	1.480	U 0.0008	U 0.00082	0.095	0.098		
DP-3D	9/24/2014	13.400	14.6000	111	110	22.1		U 0.25		7.94	7.94	263.0		611		0.541	J 0.0127	10.4	9.17	0.321	0.299	0.0103	0.0084	0.0492	0.0565		
DP-4M	9/26/2014	J 0.0478	J 0.0457	83.5	84.6	7.7		U 0.25		6.66	6.66	U 1.5		357		1.11	J 0.0188	23	22.3	0.591	0.570	0.0224	0.0212	0.01	J 0.009		
DP-5S	9/5/2014	0.6460	0.6480	179	180	21.0		U 0.25		6.76	6.76	92.7		682		0.139	U 0.0082	1.86	1.73	0.0272	0.0254	U 0.0008	U 0.00082	0.0109	0.0108		
DP-5M	9/5/2014	0.9950	0.9830	93.3	89.8	21.8		J 0.33		7.50	7.50	202.0		592		1.09	J 0.0085	5.71	3.12	0.384	0.358	0.0061	0.0056	0.074	0.076		
DP-5D	9/5/2014	1.3000	1.2900	93.3	92	21.8		J 0.42		7.53	7.53	102.0		542		0.407	U 0.0082	6.15	4.56	0.363	0.342	0.0022	J 0.0012	0.076	0.079		
DP-BACKGROUND-1 S	11/13/2014	0.0510	0.0517	147	147	3.4		U 0.25		7.02	7.02	30.8		477		1.22	U 0.0082	3.04	1.93	0.240	0.232	J 0.0013	U 0.00082	J 0.004	J 0.0071		
DP-BACKGROUND-1 M	11/13/2014	0.0618	0.0620	153	154	16.4		U 0.25		7.14	7.14	67.8		567		0.306	U 0.0082	13.8	13.2	0.351	0.351	0.0376	0.0359	J 0.0024	J 0.0026		
DP-BACKGROUND-1 D	11/13/2014	0.0839	0.0795	121	117	8.3		U 0.25		7.08	7.08	23.3		467		0.307	U 0.0082	10	9.17	0.679	0.637	J 0.0015	J 0.00096	J 0.0043	J 0.0044		
TGP-A	9/9/2014	J 0.0090		69.4		6.1		U 0.25				15.1		336		0.129		J 0.0839		J 0.0017		J 0.0011					
	3/13/2014	J 0.0094	U 0.0084	70.9				U 0.40				15.3				0.107	U 0.0143	J 0.1220	U 0.0430	J 0.0025	U 0.00083	J 0.0009	U 0.00078	J 0.0020			
	4/12/2012	U 0.0240				5.8		0.20				13.0										U 0.0024					
	Average	**0.0101**		**70.2**		**6.0**		**0.18**				**14.5**		**336**		**0.1180**		**0.1030**		**0.0021**		**0.0011**					
TGP-B	9/8/2014	J 0.0168		73.8		29.9		J 0.34				23.2		376		U 0.0082		U 0.0334		U 0.00083		J 0.0009		J 0.00210			
	9/8/2014 DUP	J 0.0159		72.4		30.1		U 0.25				23.7		371		J 0.0115		U 0.0334		U 0.00083		J 0.0010					
	3/12/2014	J 0.0164	J 0.0155	77.6				U 0.40				22.5				U 0.0143	U 0.0143	U 0.0430	U 0.0430	U 0.00083	U 0.00083	0.0021	0.0033	J 0.00240	J 0.00420		
	4/13/2012	U 0.0240				29.0		0.25				25.0										U 0.0024					
	Average	**0.0153**		**74.6**		**29.7**		**0.23**				**23.6**		**373.5**		**0.0076**		**ND**		**U 0.00083**		**0.0013**					
TGP-C	10/3/2014	0.0531		73.9		39.1		U 0.25				28.8		408		J 0.0117		U 0.0334		U 0.00083		J 0.0009					
	3/13/2014	J 0.0088	J 0.0087	79.1				U 0.40				27.8				U 0.0143	U 0.0143	J 0.1530	U 0.0430	J 0.0012	U 0.00083	J 0.0008	J 0.00082				
	4/12/2012	U 0.0240				43.0		J 0.16				34.0										U 0.0024					
	Average	**0.0246**		**76.5**		**41.1**		**0.16**				**30.2**				**0.0094**		**0.0849**		**0.0008**		**0.0010**					
TGP-D	10/6/2014	J 0.0114		66.4		5.7		U 0.25				15.9		308		J 0.0141		U 0.0334		U 0.00083		U 0.0008					
	3/25/2014	J 0.0144		72.0				U 0.40				14.1				U 0.0143		J 0.0848		J 0.0011		U 0.0008		J 0.0020			
	Average	**0.0129**		**69.2**				**ND**				**15.0**				**0.0106**		**0.0508**		**0.0008**		**0.0004**					
TGP-E	9/8/2014	J 0.0399		77.0		2.1		J 0.34				23.1		335		J 0.0159		U 0.0334		J 0.0034		U 0.0008					
	3/24/2014	J 0.0465		79.5				U 0.40				21.8				U 0.0143		U 0.0430		J 0.0030		J 0.0016		J 0.0022			
	Average	**0.0432**		**78.3**				**0.27**				**22.5**				**0.0115**		**ND**		**0.0032**		**0.0010**					
TGP-F	9/30/2014	0.1130		76.2		2.6		J 0.30				25.2		331		J 0.0284		J 0.0693		J 0.0046		0.0061		J 0.0020			
TGP-G	9/3/2014	0.0063		93.6		4.2		J 0.32				27.7		351		J 0.0188		U 0.0334		J 0.0014		J 0.0009		J 0.0032			
BW-1	9/9/2014	0.1980		63.8		J 1.8		0.95				20.3		280		J 0.0190		J 0.0400		J 0.0039		J 0.0013					

Blank cells indicate parameter not sampled
ND indicates nondetect with no MDL known

< indicates below the LOQ
U indicates below the MDL
J Indicates analyte detected blow quantitation limits
S indicates spike recovery outside recovery limits
B indicates analyte detected in associated Method Blank

Half of the "<" or "U" values were used for averaging purposes when other detects were present

APPENDIX B

Technical Review of "Potential for Contamination of Domestic Wells, Labadie Bottoms, Franklin County, Missouri" by Dr. Robert E. Criss

Technical Review of "Potential for Contamination of Domestic Wells, Labadie Bottoms, Franklin County, Missouri" by Dr. Robert E. Criss

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INTRODUCTION

At a public hearing on June 11, 2015 before the Franklin County Commission, Dr. Robert E. Criss presented his views on Article 2 and 10 of the Unified Land-Use Regulations of Franklin County, specifically regarding utility waste landfills, including the proposed amendments thereto. Some of Dr. Criss' opinions are also memorialized in his paper entitled "Potential for Contamination of Domestic Wells, Labadie Bottoms, Franklin County, Missouri" dated December 9, 2010 (Criss Paper, also called Paper). Set forth herein is a response to Dr. Criss' Paper and opinions including backup documentation and analysis. Such backup documentation includes data from monitoring wells installed in nearby areas, a review of the sources used in the Criss Paper, and groundwater modeling conducted for the Labadie Bottoms area.

SUMMARY OF CRISS PAPER CONCLUSION

The Criss Paper specifically identifies 13 private wells located to the southeast of the proposed Utility Waste Landfill (UWL) facility that are all cased in bedrock and draw water from the bedrock aquifer. These wells are highlighted in the Criss Paper due to their reported low static water levels and casing depths as depicted in the state of Missouri database well logs and well certification forms.[1] Dr. Criss contends that the alluvial aquifer can discharge water to the bedrock aquifer during times of high river levels, thereby potentially impacting private wells in the event groundwater becomes contaminated with materials from the proposed UWL landfill. Underlying Dr. Criss's assumption is a belief that the UWL's design is insufficient to protect groundwater.

1.0 BACKGROUND INFORMATION - BEDROCK WELL SAMPLING AND MONITORING

From 2012 to 2015, Golder Associates, Inc. (Golder) has installed and obtained groundwater elevations in 8 monitoring wells within the bedrock aquifer. The following sections present the results and compare them to the claims made in the Criss Paper. A map displaying the locations of all of the bedrock monitoring wells and the locations of the 13 wells from the 2010 Criss Paper is displayed in Figure 1.

1.1 Bedrock Aquifer Water Level Monitoring and Groundwater Flow Direction

Groundwater surface elevation monitoring has been completed at the 8 bedrock monitoring wells located near the Labadie Energy Center and the results are tabulated in Table 1. Using these groundwater elevations, potentiometric surface maps have been generated and are presented in Figures 2 through 7. These potentiometric surface maps demonstrate that groundwater in the bedrock aquifer consistently flows downward from the bluffs in the south and toward the Missouri River to the north. Groundwater flow

[1] The private wells relied upon by Criss are detailed in Attachment A along with their state database plotted locations. Most wells appear to be incorrectly plotted in the state database.

in the bedrock aquifer in the bluff area near the residential wells steadily flows toward the Missouri River even during times of large fluctuations in the river levels (ranging from 448.77 to 465.06 ft amsl).

2.0 RESPONSE TO CRISS PAPER

A review of the Criss Paper by titled section is provided below and includes technical comments to statements made within the Paper.

2.1 Hydrogeologic setting

The first section of the Paper discusses the hydrogeological setting of the Labadie Bottoms area and the difference between the bedrock and alluvial aquifers.

2.1.1 Use of the Alluvial Aquifer

The Paper discusses the use of the alluvial aquifer as follows:

"The aquifer supplies hundreds of irrigation wells and large well fields supply municipalities including Independence and Columbia, Missouri."

The alluvial aquifer does have many irrigation and drinking water wells in the Missouri River Valley located within Missouri. However, the Labadie Bottoms area only has had two known alluvial aquifer irrigation wells and no alluvial well fields used for public water supply, based on field observation, state records, and well certification forms. One of the irrigation wells was abandoned in August 2014 (MDNR ref no. 486650) and the other well appears to be in-operable based on visual observations. Therefore, while the generalized statement from the Criss paper quoted above is true on a state-wide scale, it has essentially no relevance to the Labadie Bottoms area. Furthermore, the alluvial aquifer in the Labadie Bottoms is not used for public water supply and Independence and Columbia, Missouri are located many miles upstream of Labadie in western and central Missouri, respectively.

2.1.2 Permeability and Flow Rate of the Alluvial Aquifer

The Criss Paper also discusses the permeability and the flow rate of the alluvial aquifer, including the quote listed below:

"Available data show that the water table in this highly permeable aquifer adjusts to be well within about ±10 feet of the fluctuating river level, requiring rapid flow of groundwater over large distances, with the flow being either towards or away from the river."

Such characterization relies on undefined terms and therefore is of limited value. For example, the "*Available data…*" fails to identify the specific source of the data relied upon. In addition, the words "*… highly permeable…*" lack measured or reported values of hydraulic conductivity. Similarly, the words *"…*

rapid flow…" do not state the actual linear velocities of the groundwater.. Groundwater is said to be required to be rapid over "*…large distances…*", without defining such "large distances". Furthermore, groundwater flow in the alluvial aquifer is not always away from or toward the River; it is also parallel to the River.

Groundwater conductivity and velocity rate values for the alluvial aquifer were estimated in a 2011 detailed site investigation (Gredell Engineering Resources, Inc., and Reitz & Jens, 2011, referred to as DSI) for the proposed UWL Site. The calculations revealed hydraulic conductivity ranges from 9.47 x 10^{-2} to 2.15 x 10^{-2} ft/min (feet per minute) with an arithmetic mean of 4.91 x 10^{-2} ft/min. Using representative hydraulic conductivities and groundwater elevation differences, groundwater velocity is calculated as typically being between 0.1 to 10 ft/yr (DSI). The higher velocities were reported in areas that were more affected by the Missouri River (northwest portion of UWL, nearest the river); gradients and velocities were much lower in areas away from the Missouri River (central and southeast portion of UWL). It is also important to note that this 0.1 to 10 ft/yr range is not in a constant direction, since groundwater in the alluvial aquifer changes its flow direction throughout the year as a result of precipitation and river levels.

The data that is referred to in the above statement of "available data" is presumably provided in Figure 2 of the Criss Paper. Figure 2 of the Criss Paper displays the hydrograph for one week of data in May 2010 for a well located in the alluvial aquifer at the Eagle Bluffs Conservation Area located in central Missouri near Columbia, Missouri. The Criss Paper observes an approximately 5-foot change in river elevation over a two week period. However, this location is approximately 90 miles to the west of the Labadie Bottoms area site and the selection only addressed data from one month of the year. May is also typically a month of substantial river stage fluctuations due to spring flooding. Data from Eagle Bluffs is of marginal utility in assessing river stage fluctuations at the Labadie Bottoms area because of its great distance from the Labadie Bottoms site.

The Criss Paper states further that *"However, local flow systems may be superimposed on this regional flow system, and infiltration can occur where the aquifer crops out along the Missouri River (Imes, 1985, P.35)."*

Page 35 of the Imes paper referenced above relates to groundwater modeling. The model discussed by Imes is a regional model which includes a large number of Missouri counties, with St. Charles County near the southeastern corner of the model. A local flow system discussed on Page 35 is a large groundwater drawdown cone near the City of O'Fallon, Missouri due to pumping of groundwater for municipal purposes. Importantly, no such large-scale withdrawal of water exists in the Labadie Bottoms area. While local flow systems are hypothetically possible, the conclusion drawn by Criss requires direct supporting evidence of local large-scale groundwater withdrawal. Since no large-scale withdrawals occur in the Labadie Bottoms, no local flow system is superimposed on the regional groundwater flow system. Accordingly, Criss' hypothetical conclusion should be disregarded.

2.2 Seep Water

The second section of the Paper discusses "seep water" in the Labadie Bottoms area and refers to an upward flow of water from the ground to the surface due to high groundwater levels.

No documentation is provided by Dr. Criss for review to substantiate a personal communication he claims occurred with one of the local farmers to document the presence of seep water. The Paper also does not provide any information as to how much seep water is claimed to have been observed to flow, how frequently seep water is noted, where the seep water is noted, and the duration of such observed seep water. Since these data are not provided, potential effects of seep water are speculative. Seep water, if any, is likely to be noted at areas of the Labadie Bottoms which are topographically lowest, east of the UWL area and what has been claimed to be seep water may actually be ponded surface water.

2.2.1 High Groundwater Table and Effects

The paper further discusses that high groundwater levels could cause several undesirable outcomes. The Paper describes the first of these as, *"…contamination of the groundwater by direct contact with the waste is possible, with every defect in the landfill underliner providing an avenue for transport."*

The liner system designed for the construction of the UWL is a composite system designed to provide containment using both geomembrane and compacted clay liners. The UWL will also have a leachate collection and monitoring system that will be installed with the UWL construction. The landfill base will be located five feet above ground surface. These design components will prevent direct contact of groundwater with the coal combustion residuals.

Secondly, the Paper discusses that *"…the upflow of groundwater will be impeded directly beneath the large landfills, so upwelling water will be displaced laterally, particularly to the remaining agricultural lands to the northeast."*

No factual support for substantial upflow is provided in the Criss Paper. The footprint of the landfill is relatively small compared to the area of the alluvial aquifer in the Labadie Bottoms area. The suggestion that the upflow would cause *"…waterlogging of soils, and impede the use of farm machinery…"* is speculative in the absence of supporting data and the relative size of the landfill footprint to surrounding floodplain is small, resulting in negligible change in "upflow" elevations. Furthermore, the landfill and its liner are being placed at least 5 feet above the existing grade. It is not displacing groundwater below the existing grade.

2.3 Infiltration of Shallow Groundwater Into the Ozark Aquifer

This section of the Criss Paper discusses the impact of high river levels and possible interaction between the alluvial and bedrock aquifers.

2.3.1 Hydraulic Gradients

The first part of this section of the Criss Paper discusses how during periods of high river stage, it is possible for the normal hydraulic gradients to become reversed between the two aquifers. This section does not provide any data or references to confirm this. Potentiometric maps developed from data presented in the DSI do indicate gradient reversal in the alluvial aquifer, but no such evidence exists that gradient reversal occurs in the bedrock aquifer. In fact, Figures 2 through 7 prove just the opposite. Groundwater elevations have been collected by Golder from 2012 to 2015 within the bedrock aquifer, and potentiometric surface maps have been generated from these groundwater elevations (see Figures 2 – 7). All of these maps display that groundwater within the bedrock aquifer flows toward the Missouri River from the bluff area where residential bedrock wells are located. Even at high river levels (465.06 ft amsl, October 16th, 2014), the overall flow direction of the bedrock aquifer in the bluff area **did not change** and still flowed in a northerly direction, toward the Missouri River. Even during extreme flood events like the 1993 flood of record, groundwater levels in the upper bluffs will still be above the river flood stage continuing to push water down the bluffs toward the Valley. All of the private drinking water wells located near the Labadie Energy Center are installed in the bedrock aquifer in the bluff area. Therefore, because the site data demonstrate that the groundwater in the bedrock aquifer in the bluff area is consistently flowing towards the Missouri River and not changing direction, the bluff area wells are not susceptible to water flow direction reversal during periods of high water levels in the alluvial aquifer during high river level conditions.

Groundwater modeling has been conducted by Golder for the Labadie Bottoms area and the bluff area to the south of the Labadie Energy Center in an effort to assess the gradient changes from flooding asserted by Criss. This groundwater modeling has demonstrated that the effects of worst case flooding (based on the 1993 flood event) in the Labadie Bottoms area would be negligible in the bedrock wells. Figure 8 illustrates that even after 55 days of continuous flooding, groundwater contours at the north edge of the bluffs area still demonstrate northward flow of groundwater.

2.3.2 Bedrock Aquifer Groundwater Pumping

The Criss Paper asserts that large cones of depression produced by significant pumping of private wells could cause a reverse in hydraulic gradient between the alluvial and bedrock aquifer. Review of the well certification forms for the wells discussed in the Criss Paper demonstrates that such wells do not have the capability of pumping at significant rates. These private well records report water withdrawal rates of between 15 and 40 gallons per minute (gpm) of water. These wells are intended for private use only and are not used for large scale irrigation or industrial use, and therefore, are not, and cannot, cause large-scale drawdown. Additionally, groundwater elevation measurements from the nearby monitoring wells do not display any localized effects from groundwater pumping/removal from residential wells.

2.3.3 Static Water Levels

The Paper asserts the possibility of a reversal of hydraulic gradient based on low static water levels in the bedrock aquifer. The Paper cites to information from MDNR (Missouri Department of Natural Resources) well logs and well certification reports. The Criss Paper states:

"Table 1 provides several examples of shallow domestic wells that are proximal to and southeast of the proposed CCP landfill, that have low static water levels and short casings. In particular, the water table in the alluvial aquifer is typically above 450 feet and can attain levels of 465 feet msl or more, and therefore has the hydraulic potential to enter these domestic wells whenever their water levels are lower, especially when those levels are reduced by heavy pumping and below the casing."

The static water levels listed in Table 1 of the Criss Paper were derived from the driller's logs created at the time of the installation of each well and subsequently entered into state database records. Such elevations are typically collected shortly after drilling and well development procedures are completed. Therefore, such levels may not represent true static water levels that would be indicative of normalized conditions. In fact, based upon analysis derived from the well network installed by Golder, the "static water levels" portrayed in the Criss Paper are not accurate.

Table 2 displays estimated static water elevations in the vicinity of the wells discussed in the Criss Paper (Column entitled Static Water Level (ft AMSL))[2]. A number of monitoring wells were installed by Golder to assess bluff area bedrock groundwater conditions. These wells were developed after installation and static water levels have been gauged on many separate dates. Results from these measurements are tabulated in Table 1 and potentiometric surface maps generated from this data are displayed in Figures 2 through 7.

The potentiometric groundwater surfaces consistently show movement of groundwater in the bedrock aquifer flowing northward toward the Missouri River and the alluvial aquifer. In addition, the water level data collected over different seasons provide more accurate data on static water levels in the area. The potentiometric surface contours and groundwater flow directions derived from these were used to more accurately estimate the water levels at the locations of the wells reported in the Criss Paper. These water levels, portrayed in the column entitled "Groundwater Elevation Range Based on

[2] The water level in an individual well while pumping might be somewhat lower than these values, but clearly that influence does not extend very far from the well as proven by the water level data we collected.

Potentiometric Surface Maps" of Table 2, demonstrate that the "static water levels" portrayed in the Criss Paper are inaccurate. In all cases where the well certification forms had a static water level of less than 465 ft AMSL, the actual water levels are above the levels presented in the Criss Paper. Therefore**, no infiltration of groundwater from the alluvial aquifer into the bedrock aquifer is supported**. As stated above, all of these potentiometric surface maps demonstrate that groundwater in the bedrock aquifer flows to the north toward the Missouri River.

This section of the Criss Paper also states that groundwater elevations in the alluvial aquifer *"…can attain levels of 465 ft msl or more and therefore has the hydraulic potential to enter these domestic wells whenever their water levels are lower, especially when those levels are reduced by heavy pumping…"*

Water level data from the bedrock aquifer in the bluffs area where the residential wells are located demonstrate that the water levels are higher in the bedrock aquifer in the bluffs and there is no hydraulic potential for the physical condition identified by Criss to occur. The DSI reports that Missouri River levels were on average higher in 2010 than previous years and the alluvial piezometer closest to the domestic wells in the Criss Paper (P-197 of the DSI Paper) ranged in groundwater elevation from 459.81 – 462.98 ft amsl. In recent years (Rietz and Jens, 2013a, 2013b, 2013c, and 2014), water levels in this area of the alluvial aquifer (MW-18) have ranged only from approximately 451 to 458 ft amsl. Groundwater within the alluvial aquifer in the southeastern portion of the Facility typically ranges from 451-458 ft amsl and during brief occurrences can obtain levels as high as approximately 463 amsl.

The Criss Paper states that:

"*This alluvial aquifer is typically 80 to 120 feet thick, mostly represented by an upward-fining sequence of unconsolidated sediments underlain by Paleozoic bedrock whose permeability is lower by several orders of magnitude."*

One conclusion of the DSI was that when groundwater moving within the alluvial aquifer comes into contact with the less permeable bedrock, the bedrock will impede the flow of the water (due to its lower permeability) and the groundwater will flow parallel to the barrier through more permeable sands and gravels and will remain in the alluvial aquifer. Therefore, movement of water from the alluvial aquifer into the bedrock aquifer, if any, would be very limited, and cannot flow upward to the bluffs where water levels are naturally higher.

3.0 RESPONSES TO CRISS JUNE 11, 2015 TESTIMONY

During the June 11, 2015 Commission hearing, Dr. Criss made inaccurate statements that are addressed and corrected in this section.

Criss Hearing Statement #1 "*The Groundwater along the alluvial aquifer is an incredibly important renewal resource. It's just five miles downstream is a big well field that supplies much of the citizens of St. Charles County." "Further upstream that alluvial aquifer provides drinking water for almost all the people in Columbia, Missouri, and further upstream of that there's even huger well fields that supply big populations in Independence and Kansas City, Missouri*".

> **<u>Response -</u>** The Weldon Spring alluvial aquifer well field is located approximately 8 river miles downstream, not 5 as asserted by Dr. Criss. Furthermore, the Weldon Spring well field is located on the north side of the Missouri River, which effectively serves as a hydraulic barrier to alluvial groundwater flow from the Labadie Bottoms.
>
> Well fields located many miles upstream such as at Columbia and Independence are upgradient and therefore, do not receive water from the Labadie Bottoms portion of the alluvial aquifer. Well fields upgradient of the UWL site are irrelevant.

Criss Hearing Statement #2: "*So it's [the alluvial aquifer] something to protect. It's something that's valuable and recognized…"*

> **<u>Response -</u>** Ameren agrees that the alluvial aquifer should be protected and the design of the UWL will do that. This is the reason that Ameren has gone to great effort to include multiple redundant safeguards into the design and construction of the UWL.

Criss Hearing Statement #3: "*Now, however, because this aquifer is so dynamic and it responds very quickly to changes in river level, contaminants can move." "That means that water is easily subject to contamination, and if it's contaminated, it will also contaminate the aquifer. Plus that contamination can move. It doesn't have to stay in one place. So any contamination of the aquifer can affect innocent property owners elsewhere off site."*

> **<u>Response -</u>** Based on the information already provided in this paper, it has been demonstrated that water or any "contamination" contained therein does not quickly move in the alluvial aquifer. Dr. Criss has failed to demonstrate any factual basis for how "innocent landowners elsewhere" can be impacted or even how a single innocent landowner can be impacted**.** The facts presented in this paper prove the opposite.

4.0 REFERENCES

Criss, Robert E., 2010. Potential for Contamination of Domestic Wells, Labadie Bottoms, Franklin County, Missouri.

Gredell Engineering Resources, Inc., and Reitz & Jens. 2011. Detailed Site Investigation Report for: Ameren Missouri Labadie Power Plant Proposed Utility Waste Disposal Area Franklin County, Missouri. Prepared by GREDELL Engineering Resources, Inc. Jefferson City, MO, and Reitz & Jens, Inc. St. Louis, MO. Revised March 2011.

Imes, JL (1985). The Ground-water Flow System in Northern Missouri With Emphasis on the Cambrian-Ordovician Aquifer. US Geological Survey, v. 43, p. 258-399.

MDNR. 2015a. Missouri Well Information Management System (WIMS), Wellhead Protection Program. Missouri Department of Natural Resources.

MDNR. 2015b. Geologic Well Logs of Missouri, Water Resource Center. Missouri Department of Natural Resources.

Reitz & Jens. 2013a. Groundwater Monitoring Report – 1st Background Sampling Event – April 16-17, 2013. Ameren Missouri, Labadie Energy Center. Prepared by Reitz & Jens, Inc., St. Louis, MO, and Gredell Engineering Resources, Inc., Jefferson City, MO. May 2013.

Reitz & Jens. 2013b. Groundwater Monitoring Report – 2nd Background Sampling Event – August 19-21, 2013. Ameren Missouri, Labadie Energy Center. Prepared by Reitz & Jens, Inc., St. Louis, MO, and Gredell Engineering Resources, Inc., Jefferson City, MO. September 2013.

Reitz & Jens. 2013c. Groundwater Monitoring Report – 3rd Background Sampling Event – November 19-20, 2013. Ameren Missouri, Labadie Energy Center. Prepared by Reitz & Jens, Inc., St. Louis, MO, and Gredell Engineering Resources, Inc., Jefferson City, MO. December 2013.

Reitz & Jens. 2014. Groundwater Monitoring Report – 4th Background Sampling Event – March 18-20, 2014. Ameren Missouri, Labadie Energy Center. Prepared by Reitz & Jens, Inc., St. Louis, MO, and Gredell Engineering Resources, Inc., Jefferson City, MO. April 2014.

TABLES

Table 1
Record of Groundwater Levels
Labadie Energy Center, Franklin County, MO
Ameren Missouri

	TGP-A		TGP-B		TGP-C		TGP-D		TGP-E		TGP-F		TGP-G		BW-1		Missouri River	
Ground Surface Elevation (ft. MSL)* NAVD 88	479.78		491.27		612.23		536.26		462.96		463.98		751.78		468.27		NA	
Top of Casing Elevation (ft. MSL)* NAVD 88	482.32		494.62		611.50		536.03		466.18		466.02		751.52		471.16		NA	
Date	Water Level (ft BTOC)	Water Elevation (ft MSL)	Water Level (ft BTOC)	Water Elevation (ft MSL)	Water Level (ft BTOC)	Water Elevation (ft MSL)	Water Level (ft BTOC)	Water Elevation (ft MSL)	Water Level (ft BTOC)	Water Elevation (ft MSL)	Water Level (ft BTOC)	Water Elevation (ft MSL)	Water Level (ft BTOC)	Water Elevation (ft MSL)	Water Level (ft BTOC)	Water Elevation (ft MSL)	Water Level (ft BTOC)	Water Elevation (ft MSL)
3/12/2014	27.31	455.01	34.43	460.19	123.67	487.83	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	448.77
3/28/2014	27.47	454.85	34.46	460.16	123.31	488.19	66.43	469.60	13.65	452.53	NA	NA	NA	NA	NA	NA	NA	450.27
4/2/2014	27.24	455.08	34.33	460.29	123.22	488.28	67.93	468.10	13.52	452.66	NA	NA	NA	NA	NA	NA	NA	451.59
5/14/2014	24.36	457.96	31.12	463.50	119.78	491.72	64.86	471.17	10.44	455.74	NA	NA	NA	NA	NA	NA	NA	452.90
10/16/2014	17.91	464.41	26.17	468.45	120.56	490.94	64.54	471.49	6.11	460.07	9.16	456.86	252.91	498.61	15.34	455.82	NA	465.06
10/29/2014	19.17	463.15	27.07	467.55	121.58	489.92	63.38	472.65	5.95	460.23	8.65	457.37	252.72	498.80	14.68	456.48	NA	456.29
11/11/2014	20.39	461.93	28.15	466.47	119.79	491.71	63.12	472.91	6.61	459.57	8.61	457.41	252.32	499.20	15.01	456.15	NA	454.56
1/9/2015	21.89	460.43	28.96	465.66	117.50	494.00	61.24	474.79	5.69	460.49	9.01	457.01	252.68	498.84	16.33	454.83	NA	451.22
2/20/2015	23.04	459.28	30.35	464.27	117.67	493.83	60.75	475.28	7.07	459.11	9.76	456.26	252.22	499.30	17.81	453.35	NA	452.49
4/1/2015	22.17	460.15	28.86	465.76	116.79	494.71	60.35	475.68	7.65	458.53	9.47	456.55	251.77	499.75	17.98	453.18	NA	454.00

Notes:
1.) * Survey performed by Zahner & Associates (TGP-A, TGP-B and TGP-C on 3/5/12 and 3/6/12, TGP-D and TGP-E on 3/25/14, and TGP-F, TGP-G, and BW-1 on 10/01/2014).
2.) BTOC - below the top of casing.
3.) MSL - mean sea level.
4.) ft - feet.
5.) NA - not available.
6.) Missouri River levels obtained by Ameren Missouri, Labadie Energy Center.

Prepared by: JSI
Checked by: LAB/EPW
Reviewed by: MNH

Table 2
Private Wells and Nearby Bedrock Well and Sample Locations
Labadie Energy Center, Franklin County, MO
Ameren Missouri

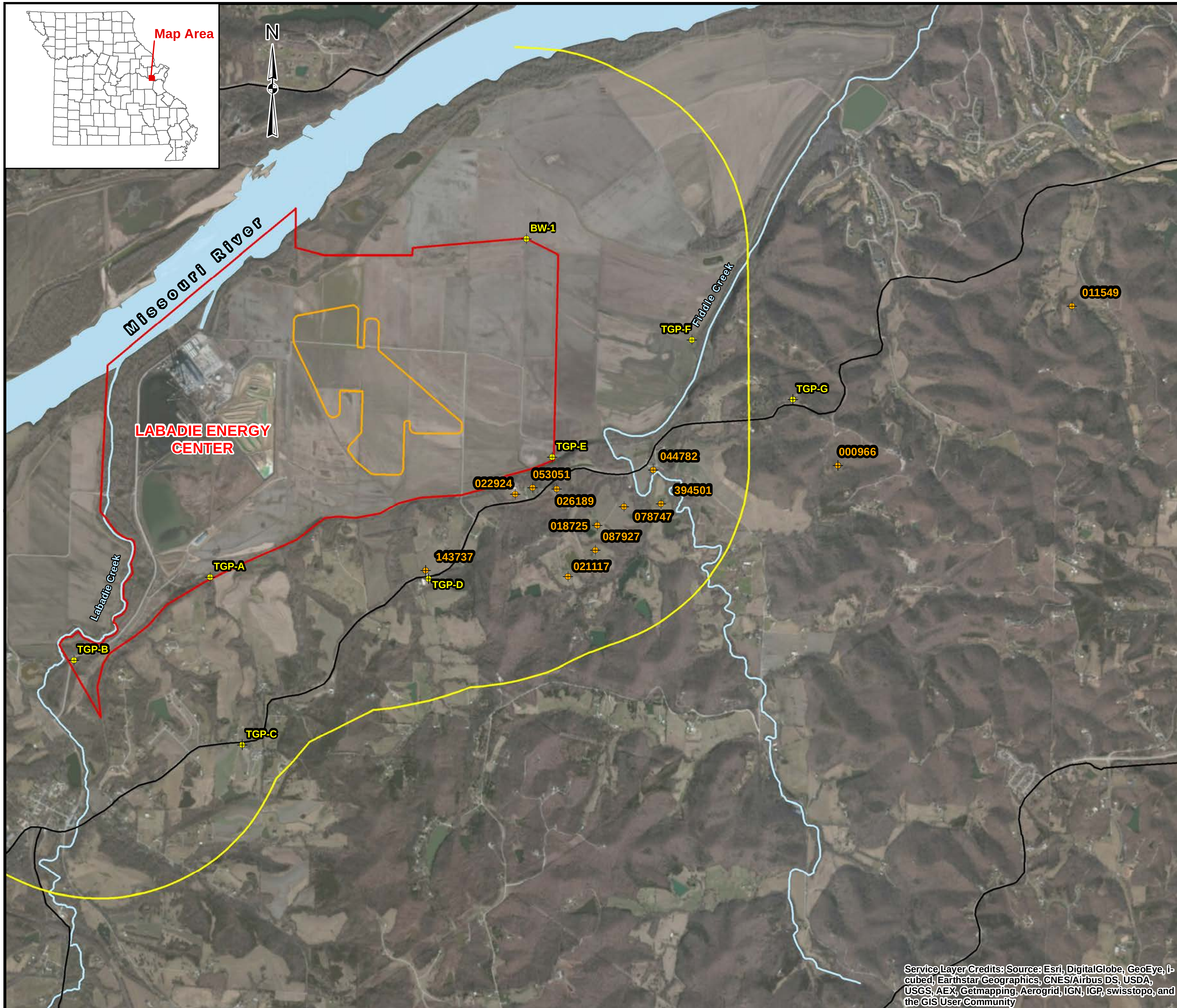
Well ID No.	Ground Surface Elevation (ft AMSL)	Total Depth (ft BGS)	Casing Length (ft BGS)	Static Water Level (ft AMSL) [1]	Bottom Of Casing (ft AMSL)	Bottom of Well (ft AMSL)	Well Completion Date	Groundwater Elevation Range Based on Potentiometric Surface Maps	Approximate Distance from Proposed Landfill (miles)
Private Wells									
022924	575	310	86	470	489	265	2/19/1964	463-465	0.45
026189	644	380	81	NA	563	264	7/19/1967	463-465	0.58
021117	560	382	103	440	457	178	4/17/1962	478-480	0.94
154295[3]	540	406	84	440	456	134	NA	NA	NA
143737	540	315	105	452	435	225	7/25/1995	472-475	0.52
053051	580	363	121	480	459	217	11/8/1990	463-465	0.48
018725	540	406	84	440	456	134	7/13/1996	470-473	0.87
044782	480	410	87	455	393	70	8/29/1989	466-467	1.03
078747	510	256	115	415	395	254	5/21/1993	465-467	0.37
394501	489 [2]	266	105	429	384	223	10/10/2006	470-472	1.11
000966	600	363	60	360	540	237	2/20/1987	>495	2.00
087927	540	400	126	430	414	140	10/6/1992	474-477	0.94
011549	600	250	82	460	518	350	12/27/1988	NA	3.25
Nearby Bedrock Well and Sample Locations									
TGP-C	612.23	240	94	NA	518.23	372.23	2/24/2012	489-494	1.56
TGP-D	536.26	226	92	NA	444.26	310.26	3/21/2014	471-476	0.57
TGP-E	462.96	90	40	NA	422.96	372.96	3/20/2014	458-461	0.49
TGP-F	463.98	160	120.3	NA	343.68	303.98	9/17/2014	456-458	1.28
TGP-G	751.78	350	80	NA	671.78	401.78	7/9/2014	498-500	1.73

Notes:
[1] Static water level based on well certification report .
[2] No elevation provided in the well certification report. Elevation based on Digital Elevation Map of the Well Location.
[3] Well information not presented on well certification reports. Information based on Criss (2010) Report.
See figures 2-6 for more information on the groundwater elevation range.
NA - not available.
ft - feet.
BGS - below ground surface.
AMSL - above mean sea level.

Prepared by: JSI
Checked by: EPW
Reviewed by: MNH

FIGURES

Map Document: G:\Projects\130 Projects\1301560 - Ameren Ash Ponds - MO\800 - FIGURES-DRAWINGS\PRODUCTION\Phase 0001 - Labadie\Arcgis\Criss Paper Figures\Figure 1 - Bedrock vs Criss Locations.mxd / Modified 4/17/2015 8:14:24 AM by JIngram / Exported 6/9/2015 1:36:55 PM by JIngram



TITLE

PRIVATE WELLS COMPARED TO SAMPLE LOCATIONS

LEGEND

- Proposed Landfill
- Labadie Energy Center Property Boundary
- Approximate 1-Mile Radius
- Bedrock Aquifer Well and Sample Location
- Private Well Locations From Criss (2010) Report

NOTES

1.) All boundaries and locations are approximate.
2.) Bedrock aquifer wells were surveyed by Zahner & Associates.
3.) More information regarding the private wells from the Criss (2010) Report is provided in Appendix A.

REFERENCES

1.) Ameren, 2011. Ameren Missouri Labadie Energy Center, Labadie Property Control Map, November 2011.
2.) Golder. 2012. Laboratory Analytical Results for Groundwater Monitoring Samples Collected on April 12-13, 2012 from Temporary Groundwater Piezometers Installed Near Labadie Plant. Prepared by Golder Associates Inc., St. Charles, MO. April 2012.
3.) Criss, Robert E. 2010. Potential for Contamination of Domestic Wells, Labadie Bottoms, Franklin County, Missouri. December 2010.
4.) COORDINATE SY STEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 3,500 7,000 Feet

PROJECT

Ameren

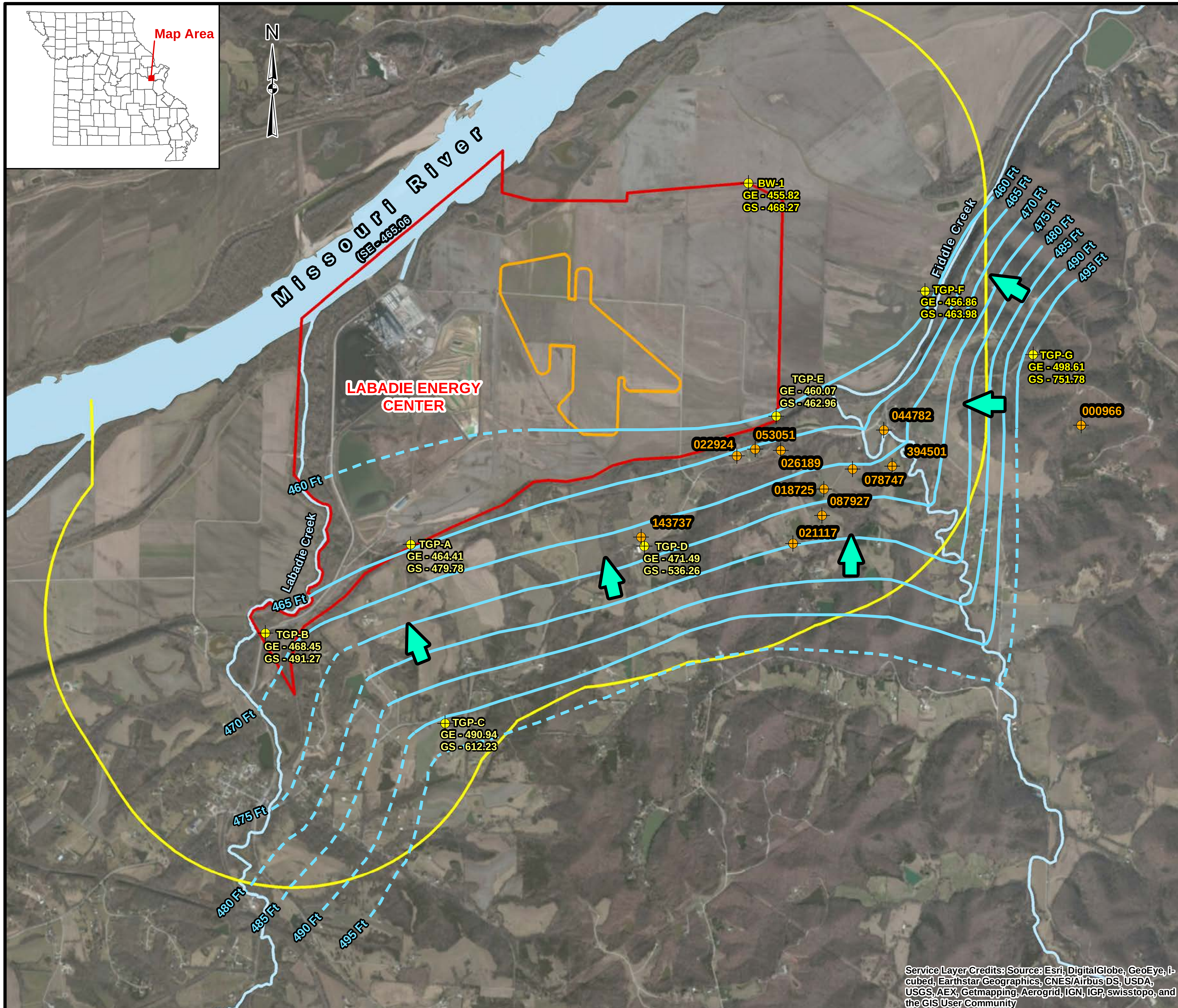
AMEREN MISSOURI LABADIE ENERGY CENTER
FRANKLIN COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Figure 1 - Bedrock vs Criss Locations.mxd
DESIGN	-	-	SCALE: AS SHOWN REV. 0
GIS	JSI	4/9/2015	Figure 1
CHECK	EPW	4/10/2015	
REVIEW	MNH	4/16/2015	

TITLE

POTENTIOMETRIC SURFACE MAP
OCTOBER 16, 2014



LEGEND

- Labadie Energy Center Property Boundary
- Proposed Landfill
- Approximate 1-Mile Radius
- Private Well Locations From Criss (2010) Report
- TGP-A GE 464.41 GS 479.78 — Piezometer Location with Groundwater Elevation (GE) and Ground Surface (GS) Elevation (ft Above MSL)
- Groundwater Potentiometric Surface Contour (ft Above MSL) (Dashed Where Inferred)
- Groundwater Flow Direction

NOTES

1.) All boundaries and locations are approximate.
2.) Piezometer locations were surveyed by Zahner & Associates.
3.) Groundwater elevations measured on October 16, 2014 by Golder.
4.) MSL - mean sea level.
5.) GE - groundwater elevation (ft above MSL).
6.) GS - ground surface elevation (ft above MSL).
7.) ft - feet.
8.) SE - surface water elevation (ft above MSL).
9.) Surface water elevation obtained by Ameren on October 16, 2014.
10.) Proposed landfill boundary outlines the proposed fence perimeter around the landfill.
11.) More information regarding the private wells from the Criss (2010) Report is provided in Appendix A.

REFERENCES

1.) Ameren, 2011. Ameren Missouri Labadie Energy Center, Labadie Property Control Map, November 2011.
2.) Golder. 2012. Laboratory Analytical Results for Groundwater Monitoring Samples Collected on April 12-13, 2012 from Temporary Groundwater Piezometers Installed Near Labadie Plant. Prepared by Golder Associates Inc., St. Charles, MO. April 2012.
3.) Golder. 2014. Piezometer Installation and Groundwater Sampling, Labadie Energy Center, Missouri. Prepared by Golder Associates Inc., St. Charles MO. April 2014.
4.) Reitz & Jens. 2014. Groundwater Detection Monitoring Well Installation Report. March 18-20, 2014. Ameren Missouri, Labadie Energy Center.
5.) Criss. 2010. Potential for Contamination of Domestic Wells, Labadie Bottoms, Franklin County, Missouri.

6.) COORDINATE SY STEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 1,250 2,500 5,000 Feet

PROJECT

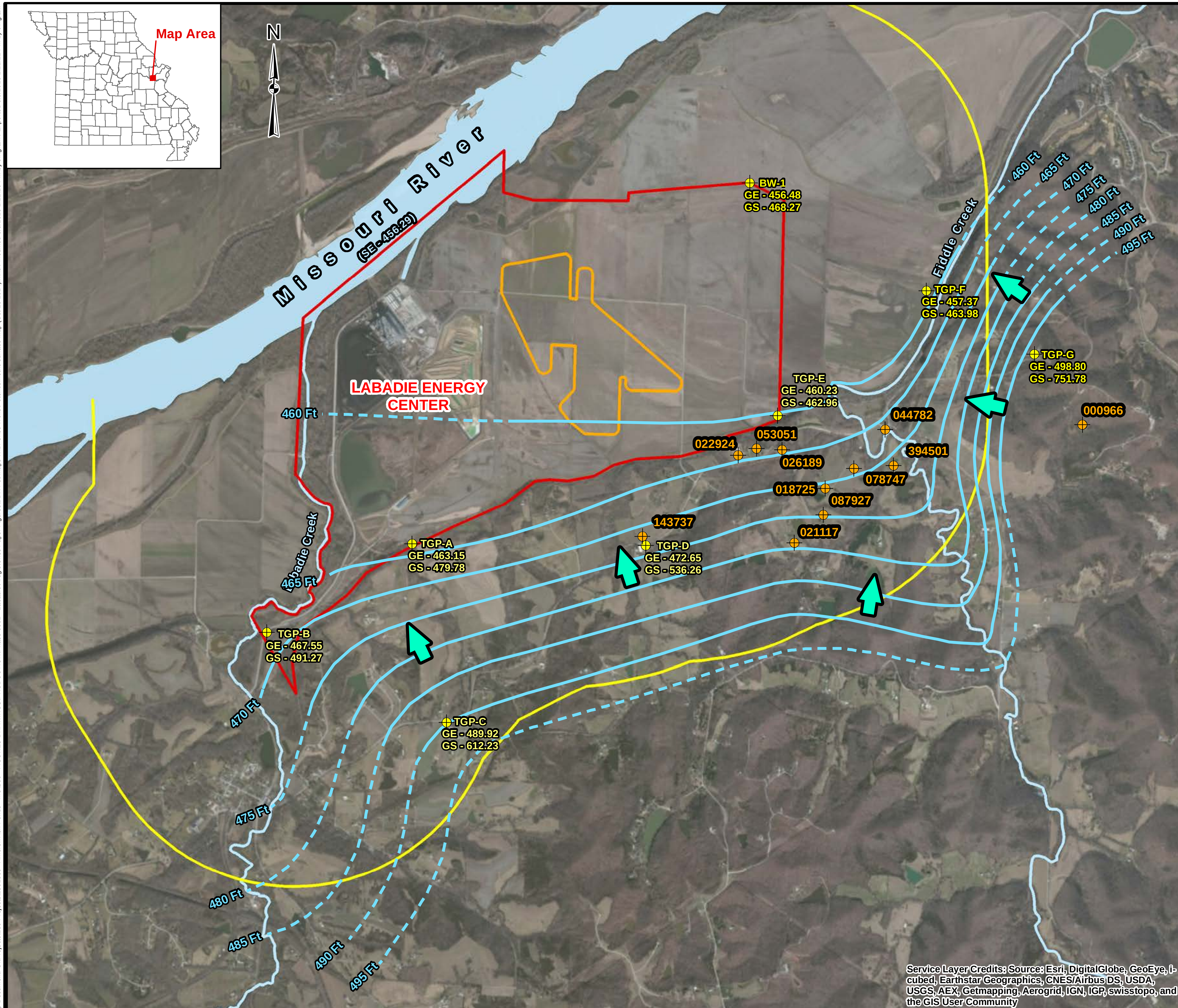
Ameren

AMEREN MISSOURI LABADIE ENERGY CENTER
FRANKLIN COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Potentiometric surface map (Oct 16 2014).mxd	
DESIGN	-	-	SCALE: AS SHOWN	REV. 0
GIS	JSI	4/10/2015	Figure 2	
CHECK	EPW	4/10/2015		
REVIEW	MNH	4/16/2015		

Map Document: G:\Projects\130 Projects\1301560 - Ameren Ash Ponds - MO\800 - FIGURES-DRAWINGS\PRODUCTION\Phase 0001 - Labadie\Arcgis\Criss Paper Figures\BDX Pot Maps With Criss Wells\Potentiometric surface map (Oct 16 2014).mxd / Modified 6/19/2015 3:08:19 PM by Jlngram / Exported 6/19/2015 3:10:17 PM by Jlngram



TITLE

POTENTIOMETRIC SURFACE MAP OCTOBER 29, 2014

LEGEND

- Labadie Energy Center Property Boundary
- Proposed Landfill
- Approximate 1-Mile Radius
- Private Well Locations From Criss (2010) Report
- TGP-A GE 463.15 GS 479.78 — Piezometer Location with Groundwater Elevation (GE) and Ground Surface (GS) Elevation (ft Above MSL)
- Groundwater Potentiometric Surface Contour (ft Above MSL) (Dashed Where Inferred)
- Groundwater Flow Direction

NOTES

1.) All boundaries and locations are approximate.
2.) Piezometer locations were surveyed by Zahner & Associates.
3.) Groundwater elevations measured on October 29, 2014 by Golder.
4.) MSL - mean sea level.
5.) GE - groundwater elevation (ft above MSL).
6.) GS - ground surface elevation (ft above MSL).
7.) ft - feet.
8.) SE - surface water elevation (ft above MSL).
9.) Surface water elevation obtained by Ameren on October 29, 2014.
10.) Proposed landfill boundary outlines the proposed fence perimeter around the landfill.
11.) More information regarding the private wells from the Criss (2010) Report is provided in Appendix A.

REFERENCES

1.) Ameren, 2011. Ameren Missouri Labadie Energy Center, Labadie Property Control Map, November 2011.
2.) Golder. 2012. Laboratory Analytical Results for Groundwater Monitoring Samples Collected on April 12-13, 2012 from Temporary Groundwater Piezometers Installed Near Labadie Plant. Prepared by Golder Associates Inc., St. Charles, MO. April 2012.
3.) Golder. 2014. Piezometer Installation and Groundwater Sampling, Labadie Energy Center, Missouri. Prepared by Golder Associates Inc., St. Charles MO. April 2014.
4.) Reitz & Jens. 2014. Groundwater Detection Monitoring Well Installation Report. March 18-20, 2014. Ameren Missouri, Labadie Energy Center.
5.) Criss. 2010. Potential for Contamination of Domestic Wells, Labadie Bottoms, Franklin County, Missouri.

6.) COORDINATE SY STEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 1,250 2,500 5,000 Feet

PROJECT

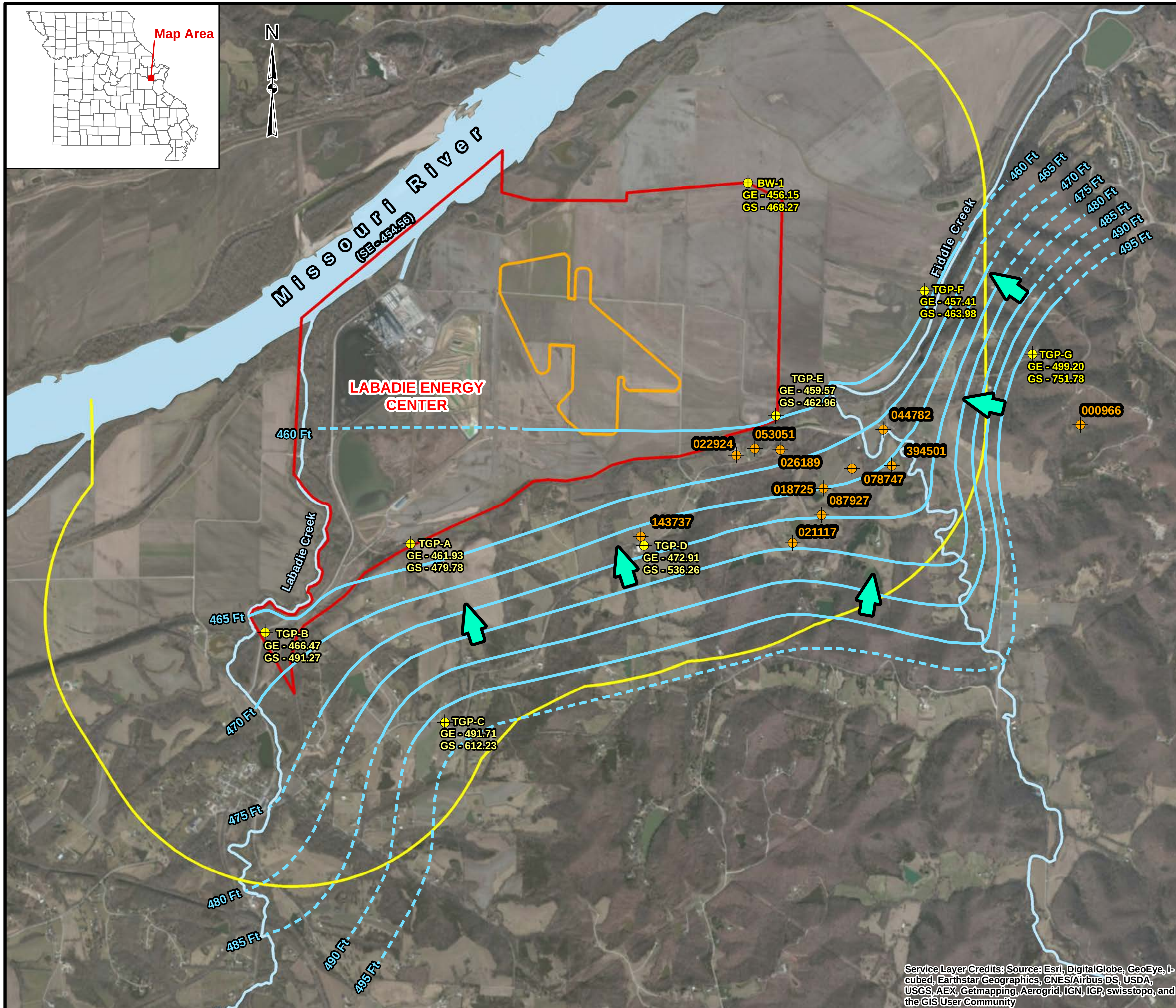
Ameren

AMEREN MISSOURI LABADIE ENERGY CENTER
FRANKLIN COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Potentiometric surface map (Oct 29 2014).mxd	
DESIGN	-	-	SCALE: AS SHOWN	REV. 0
GIS	JSI	4/10/2015		
CHECK	EPW	4/10/2015		
REVIEW	MNH	4/16/2015		

Figure 3



TITLE

POTENTIOMETRIC SURFACE MAP NOVEMBER 11, 2014

LEGEND

- Labadie Energy Center Property Boundary
- Proposed Landfill
- Approximate 1-Mile Radius
- Private Well Locations From Criss (2010) Report
- TGP-A / GE 461.93 / GS 479.78 — Piezometer Location with Groundwater Elevation (GE) and Ground Surface (GS) Elevation (ft Above MSL)
- Groundwater Potentiometric Surface Contour (ft Above MSL) (Dashed Where Inferred)
- Groundwater Flow Direction

NOTES

1.) All boundaries and locations are approximate.
2.) Piezometer locations were surveyed by Zahner & Associates.
3.) Groundwater elevations measured on November 11, 2014 by Golder.
4.) MSL - mean sea level.
5.) GE - groundwater elevation (ft above MSL).
6.) GS - ground surface elevation (ft above MSL).
7.) ft - feet.
8.) SE - surface water elevation (ft above MSL).
9.) Surface water elevation obtained by Ameren on November 11, 2014.
10.) Proposed landfill boundary outlines the proposed fence perimeter around the landfill.
11.) More information regarding the private wells from the Criss (2010) Report is provided in Appendix A.

REFERENCES

1.) Ameren, 2011. Ameren Missouri Labadie Energy Center, Labadie Property Control Map, November 2011.
2.) Golder. 2012. Laboratory Analytical Results for Groundwater Monitoring Samples Collected on April 12-13, 2012 from Temporary Groundwater Piezometers Installed Near Labadie Plant. Prepared by Golder Associates Inc., St. Charles, MO. April 2012.
3.) Golder. 2014. Piezometer Installation and Groundwater Sampling, Labadie Energy Center, Missouri. Prepared by Golder Associates Inc., St. Charles MO. April 2014.
4.) Reitz & Jens. 2014. Groundwater Detection Monitoring Well Installation Report. March 18-20, 2014. Ameren Missouri, Labadie Energy Center.
5.) Criss. 2010. Potential for Contamination of Domestic Wells, Labadie Bottoms, Franklin County, Missouri.
6.) COORDINATE SY STEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 1,250 2,500 5,000
Feet

PROJECT

Ameren

AMEREN MISSOURI LABADIE ENERGY CENTER
FRANKLIN COUNTY, MISSOURI

PROJECT No. 130-1560			Potentiometric surface map (Nov 11 2014).mxd
DESIGN	-	-	SCALE: AS SHOWN REV. 0
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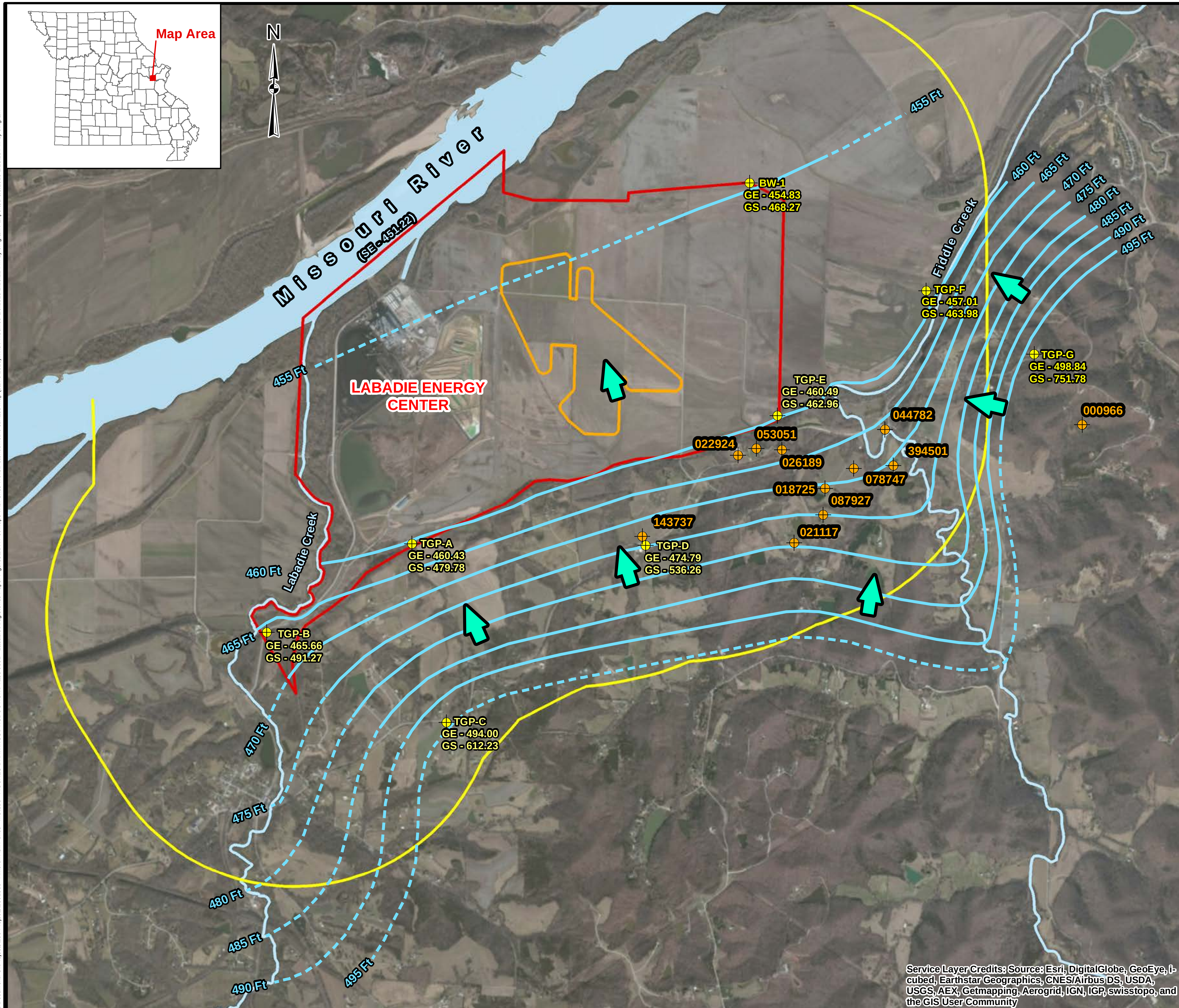
CHECK	EPW	4/10/2015	
REVIEW	MNH	4/16/2015	

Golder Associates



TITLE

POTENTIOMETRIC SURFACE MAP JANUARY 9TH, 2015

LEGEND

- Labadie Energy Center Property Boundary
- Proposed Landfill
- Approximate 1-Mile Radius
- Private Well Locations From Criss (2010) Report
- TGP-A GE 460.43 GS 479.78 — Piezometer Location with Groundwater Elevation (GE) and Ground Surface (GS) Elevation (ft Above MSL)
- Groundwater Potentiometric Surface Contour (ft Above MSL) (Dashed Where Inferred)
- Groundwater Flow Direction

NOTES

1.) All boundaries and locations are approximate.
2.) Piezometer locations were surveyed by Zahner & Associates.
3.) Groundwater elevations measured on January 9th, 2015 by Golder.
4.) MSL - mean sea level.
5.) GE - groundwater elevation (ft above MSL).
6.) GS - ground surface elevation (ft above MSL).
7.) ft - feet.
8.) SE - surface water elevation (ft above MSL).
9.) Surface water elevation obtained by Ameren on January 9th, 2015.
10.) Proposed landfill boundary outlines the proposed fence perimeter around the landfill.
11.) More information regarding the private wells from the Criss (2010) Report is provided in Appendix A.

REFERENCES

1.) Ameren, 2011. Ameren Missouri Labadie Energy Center, Labadie Property Control Map, November 2011.
2.) Golder. 2012. Laboratory Analytical Results for Groundwater Monitoring Samples Collected on April 12-13, 2012 from Temporary Groundwater Piezometers Installed Near Labadie Plant. Prepared by Golder Associates Inc., St. Charles, MO. April 2012.
3.) Golder. 2014. Piezometer Installation and Groundwater Sampling, Labadie Energy Center, Missouri. Prepared by Golder Associates Inc., St. Charles MO. April 2014.
4.) Reitz & Jens. 2014. Groundwater Detection Monitoring Well Installation Report. March 18-20, 2014. Ameren Missouri, Labadie Energy Center.
5.) Criss. 2010. Potential for Contamination of Domestic Wells, Labadie Bottoms, Franklin County, Missouri.
6.) COORDINATE SY STEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 1,250 2,500 5,000
Feet

PROJECT

Ameren

AMEREN MISSOURI LABADIE ENERGY CENTER
FRANKLIN COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Potentiometric surface map (Jan 9 2015).mxd	
DESIGN	-	-	SCALE: AS SHOWN	REV. 0
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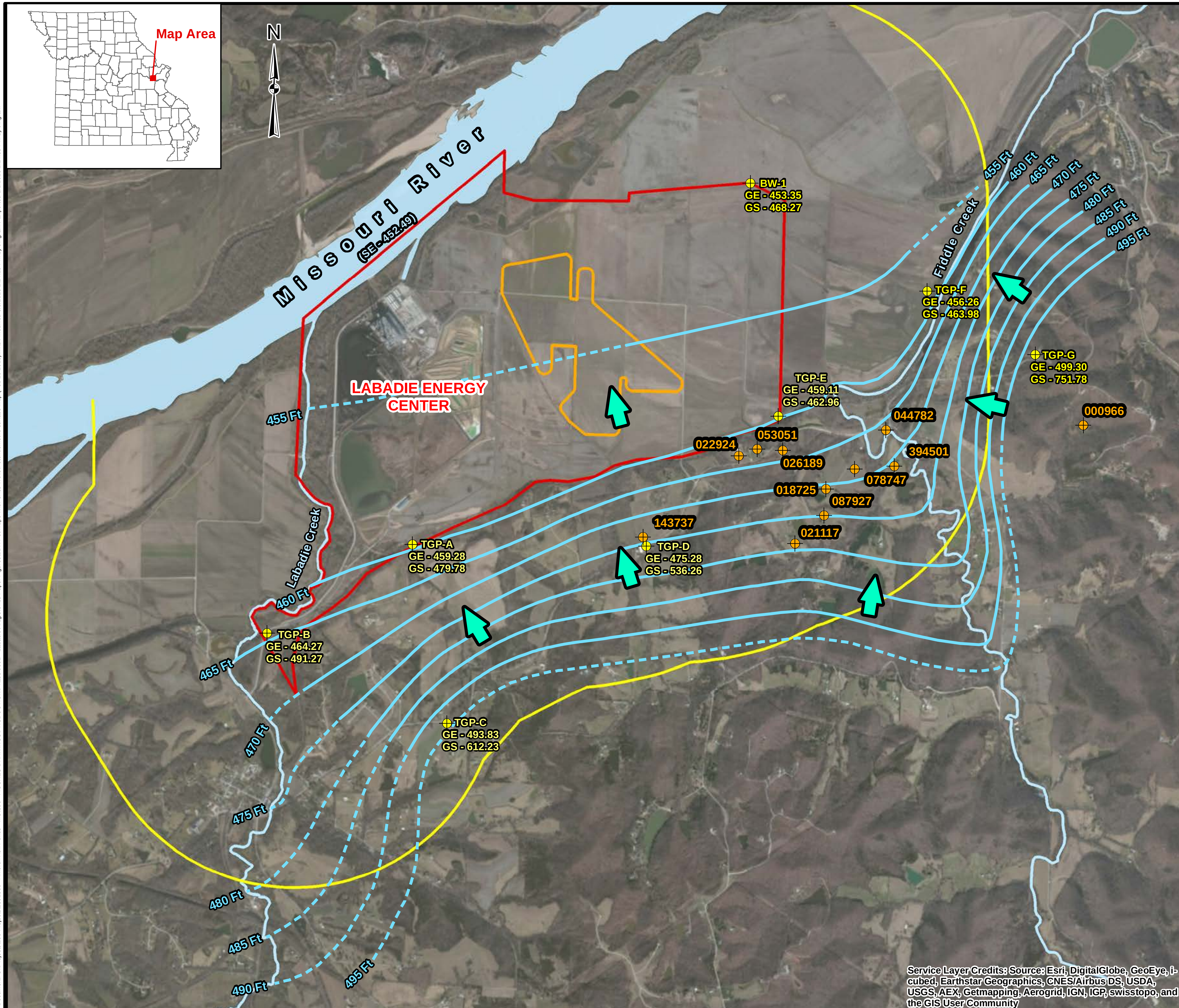

TITLE

POTENTIOMETRIC SURFACE MAP FEBRUARY 20TH, 2015

LEGEND

- Labadie Energy Center Property Boundary
- Proposed Landfill
- Approximate 1-Mile Radius
- Private Well Locations From Criss (2010) Report
- TGP-A GE 459.28 GS 479.78 — Piezometer Location with Groundwater Elevation (GE) and Ground Surface (GS) Elevation (ft Above MSL)
- Groundwater Potentiometric Surface Contour (ft Above MSL) (Dashed Where Inferred)
- Groundwater Flow Direction

NOTES

1.) All boundaries and locations are approximate.
2.) Piezometer locations were surveyed by Zahner & Associates.
3.) Groundwater elevations measured on February 20th, 2015 by Golder.
4.) MSL - mean sea level.
5.) GE - groundwater elevation (ft above MSL).
6.) GS - ground surface elevation (ft above MSL).
7.) ft - feet.
8.) SE - surface water elevation (ft above MSL).
9.) Surface water elevation obtained by Ameren on February 20th, 2015.
10.) Proposed landfill boundary outlines the proposed fence perimeter around the landfill.
11.) More information regarding the private wells from the Criss (2010) Report is provided in Appendix A.

REFERENCES

1.) Ameren, 2011. Ameren Missouri Labadie Energy Center, Labadie Property Control Map, November 2011.
2.) Golder. 2012. Laboratory Analytical Results for Groundwater Monitoring Samples Collected on April 12-13, 2012 from Temporary Groundwater Piezometers Installed Near Labadie Plant. Prepared by Golder Associates Inc., St. Charles, MO. April 2012.
3.) Golder. 2014. Piezometer Installation and Groundwater Sampling, Labadie Energy Center, Missouri. Prepared by Golder Associates Inc., St. Charles MO. April 2014.
4.) Reitz & Jens. 2014. Groundwater Detection Monitoring Well Installation Report. March 18-20, 2014. Ameren Missouri, Labadie Energy Center.
5.) Criss. 2010. Potential for Contamination of Domestic Wells, Labadie Bottoms, Franklin County, Missouri.
6.) COORDINATE SY STEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 1,250 2,500 5,000 Feet

PROJECT

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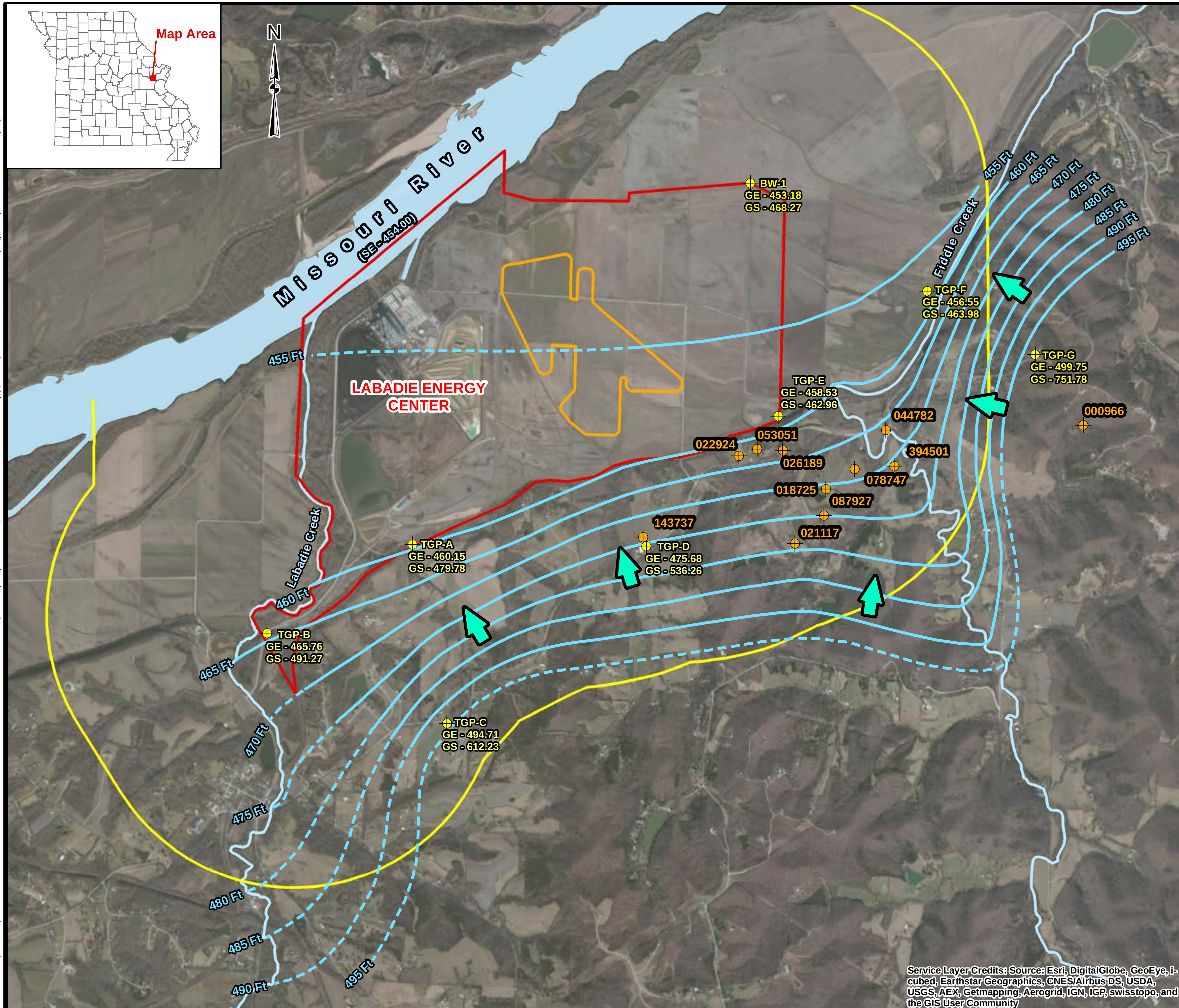
FRANKLIN COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Potentiometric surface map (Feb 20 2015).mxd	
DESIGN	-	-	SCALE: AS SHOWN	REV. 0
GIS	JSI	4/10/2015		
CHECK	EPW	4/10/2015		
REVIEW	MNH	4/16/2015		

Figure 6

Map Document: G:\Projects\130 Projects\1301560 - Ameren Ash Ponds - MO\800 - FIGURES-DRAWINGS\PRODUCTION\Phase 0001 - Labadie\Arcgis\Criss Paper Figures\BDX Pot Maps With Criss Wells\Potentiometric surface map (Feb 20 2015).mxd / Modified 6/9/2015 2:24:28 PM by Jlngram / Exported 6/9/2015 2:24:35 PM by Jlngram



TITLE

POTENTIOMETRIC SURFACE MAP APRIL 1ST, 2015

LEGEND

- Labadie Energy Center Property Boundary
- Proposed Landfill
- Approximate 1-Mile Radius
- Private Well Locations From Criss (2010) Report
- TGP-A / GE 460.15 / GS 479.78 — Piezometer Location with Groundwater Elevation (GE) and Ground Surface (GS) Elevation (ft Above MSL)
- Groundwater Potentiometric Surface Contour (ft Above MSL) (Dashed Where Inferred)
- Groundwater Flow Direction

NOTES

1.) All boundaries and locations are approximate.
2.) Piezometer locations were surveyed by Zahner & Associates.
3.) Groundwater elevations measured on April 1st, 2015 by Golder.
4.) MSL - mean sea level.
5.) GE - groundwater elevation (ft above MSL).
6.) GS - ground surface elevation (ft above MSL).
7.) ft - feet.
8.) SE - surface water elevation (ft above MSL).
9.) Surface water elevation obtained by Ameren on April 1st, 2015.
10.) Proposed landfill boundary outlines the proposed fence perimeter around the landfill.
11.) More information regarding the private wells from the Criss (2010) Report is provided in Appendix A.

REFERENCES

1.) Ameren, 2011. Ameren Missouri Labadie Energy Center, Labadie Property Control Map, November 2011.
2.) Golder. 2012. Laboratory Analytical Results for Groundwater Monitoring Samples Collected on April 12-13, 2012 from Temporary Groundwater Piezometers Installed Near Labadie Plant. Prepared by Golder Associates Inc., St. Charles, MO. April 2012.
3.) Golder. 2014. Piezometer Installation and Groundwater Sampling, Labadie Energy Center, Missouri. Prepared by Golder Associates Inc., St. Charles MO. April 2014.
4.) Reitz & Jens. 2014. Groundwater Detection Monitoring Well Installation Report. March 18-20, 2014. Ameren Missouri, Labadie Energy Center.
5.) Criss. 2010. Potential for Contamination of Domestic Wells, Labadie Bottoms, Franklin County, Missouri.

6.) COORDINATE SY STEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 1,250 2,500 5,000 Feet

PROJECT

Ameren

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FRANKLIN COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Potentiometric surface map (April 1 2015).mxd	
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CHECK	EPW	4/10/2015	**Figure 7**	
REVIEW	MNH	4/16/2015		

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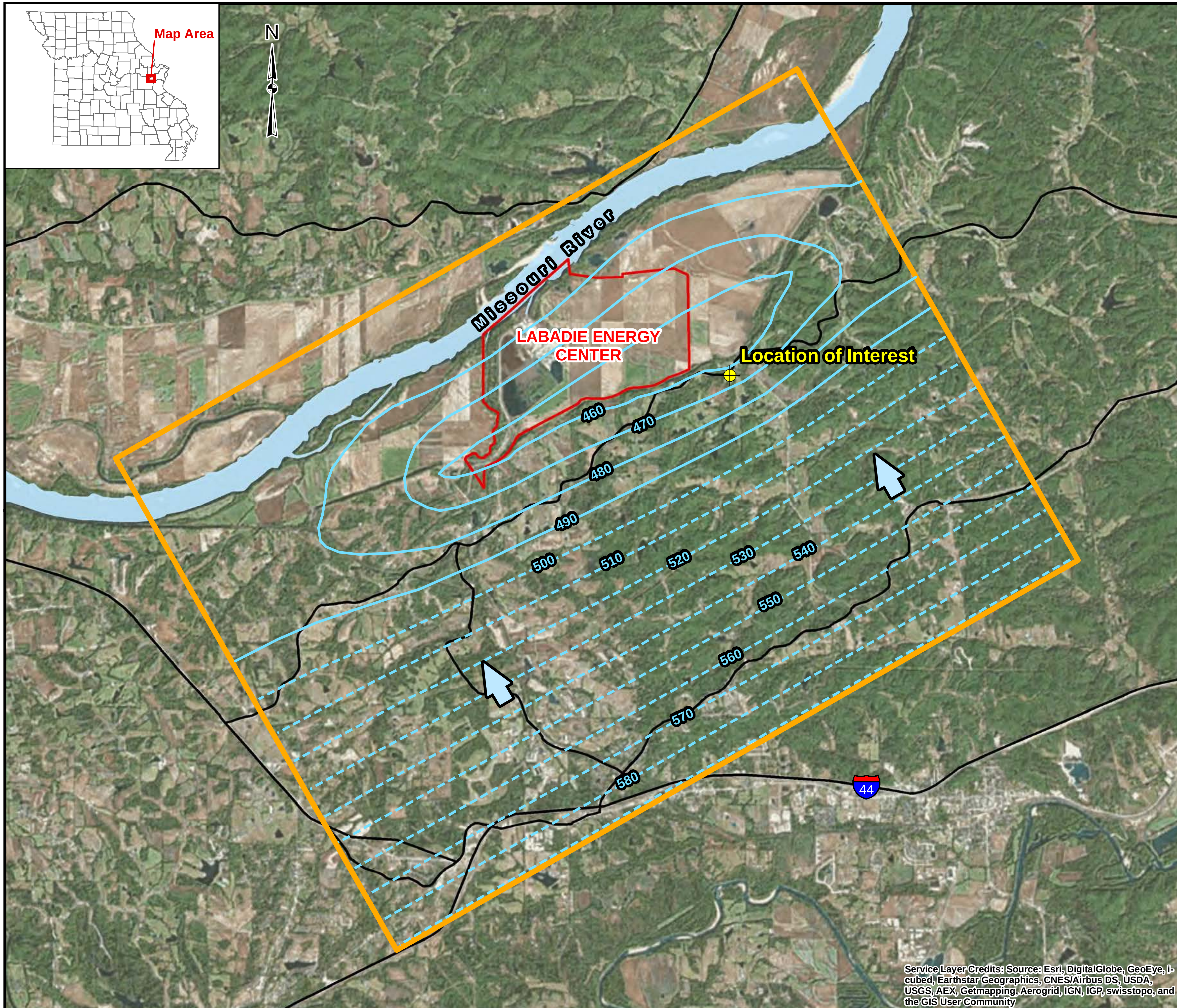

TITLE

GROUNDWATER MODEL DOMAIN BOUNDARY AND RESULTING GROUNDWATER ELEVATIONS

LEGEND

- Labadie Energy Center Property Boundary
- Groundwater Model Domain
- Location of Interest
- Model Groundwater Elevation Contours
- Model Estimated Groundwater Elevation Contours
- Groundwater Flow Direction

NOTES

1.) All boundaries and locations are approximate.
2.) Model contour interval is 10 feet.
3.) Upgradient contours are used for generalized gradient and are not considered locally accurate.
4.) Model results reflect 55 continuous days of river level at 486.6 feet above mean sea level (peak level of the 1993 flood).

REFERENCES

1.) Ameren, 2011. Ameren Missouri Labadie Energy Center, Labadie Property Control Map, November 2011.
2.) MSDIS (Missouri Spatial Data Information Service) Database, 2014.
3.) MODFLOW groundwater modeling program.
4.) COORDINATE SY STEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 5,000 10,000
Feet

PROJECT

Ameren

AMEREN MISSOURI LABADIE ENERGY CENTER
FRANKLIN COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			1993_GWFlood_model.mxd	
DESIGN	-	-	SCALE: AS SHOWN	REV. 0
GIS	JSI	6/9/2015	Figure 8	
CHECK	JRS	6/16/2015		
REVIEW	MNH	6/17/2015		

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ATTACHMENT A
WELL LOCATION INFORMATION

1.0 WELL LOCATIONS

Dr. Criss's Report discusses 13 wells that lie to the southeast of the Facility and the proposed UWL landfill. Dr. Criss's selection of wells is based on both their geographic location and the physical properties (casing length, reported static water levels, etc). Information for this analysis was collected from two different Missouri Department of Natural Resources (MDNR) well databases. The first of these two databases is the Well Information Management System (WIMS) (MDNR, 2015b) and it provides data on wells that were installed after November 1987. The second database, generated by the Water Resource Center (MDNR 2015c) at MDNR provides data on wells installed prior to November 1987. As with any large database records, some errors exist in the database. While many wells appear to be located at a relatively close proximity (within ½ mile) to where they are believed to be located, some of the wells in this area do not appear to be located close to their state database coordinate location. Accurate locations of wells are needed for comparison of static water levels to determine groundwater flow.

The summaries below paired with Figure A-1 display Golder's estimated locations of these 13 private wells based on state database coordinates, field observation, review of the well certification forms and well logs from MDNR databases, United States Geological Survey (USGS) Digital Elevation Maps (DEM) (USGS 2013), as well as a review of the property plat maps provided to Golder by Ameren.

1.1 Well #022924

Well #022924 was installed on February 19, 1964 and owned by Marvin Newman (Newman). The well is listed with a surface elevation of 575 feet Above Mean Sea Level (ft AMSL) based on the MDNR well log. DEM elevations of the state plotted database location displayed an elevation of 547 ft AMSL. After review of the plat map and DEM, the well is plotted on property owned by Newman in an area where less than 100 ft to the north the elevation changes to approximately 570 to 585 ft AMSL. Therefore, the plotted location for this well is likely correct to within approximately 100 ft of the probable location based on the original database location and the plat map.

1.2 Well #026189

Well #026189 was installed on July 19, 1967 and owned by Carl Stettes. The well is listed with a surface elevation of 644 ft AMSL based on the MDNR well log. DEM elevations of the state plotted database location displayed an elevation of 651 ft AMSL. After review of the well log, the remarks describe the location as 1 mile west of the former village of Oetters on Highway N. Oetters is located on Highway T (not Highway N) and the plotted well location is approximately 0.6 miles to the west of Oetters near a residential property on Osage Lane off of Highway T. Due to the similarities in elevation and the distance from Oetters, this well is most likely plotted in the correct location.

1.3 Well #021117

Well #021117 was installed on April 17, 1962 and owned by H.E. Bohren. The well is listed with a surface elevation of 560 ft AMSL according to the MDNR well log. DEM elevations of the state plotted database location displayed an elevation of 611 ft AMSL. After review, three homes are located near the state database plotted location for this well with elevations at approximately 560 ft AMSL. Two of the houses correspond with wells #018725 and #087927 which are discussed below. This well is likely located at the home that does not already have a corresponding well. Therefore, based on the state coordinates, surface elevation, and nearby wells, this well is likely located 0.2 miles to the south of its current state database location near a home at an elevation of approximately 560 ft AMSL.

1.4 Well #154295

Well #154295 is not listed in Franklin County in either MNDR database. The well logs from the Water Resource Center (MNDR 2015c) do not display any well with this reference number and the WIMS database displays well #154295 as being located in Taney County. Due to the conflicting data and lack of state database records, this well is not plotted on the map.

1.5 Well #143737

Well #143737 was installed on July 25, 1995 and owned by Marvin Newman. The MDNR well certification form lists a surface elevation of 540 ft AMSL. DEM elevations of the state plotted database location displayed an elevation of 464 ft AMSL. This well is plotted in the Labadie Bottoms north of the bluffs; however, the geological log displays bedrock to be at 55 ft below ground surface (BGS). Based on plat maps of the area, this well is likely located on the land owned by Newman along Highway T near 3 silos and at an elevation of approximately 540 ft AMSL. Based on the property plat maps and the surface elevation in the well certification log, this well is most likely located near the silos on Newman's property about 0.5 miles to the south of its current state database location.

1.6 Well #053051

Well #053051 was installed on January 28, 1991 and owned by Jackie Barringhaus. The well is listed as having a surface elevation of 580 ft AMSL according to the MDNR well certification form. DEM elevations of the state plotted database location displayed an elevation of 517 ft AMSL. After review of the plat maps, Barringhaus owns property about 0.17 miles to the east of the aforementioned state plotted database location. A small building at an elevation of approximately 570 to 580 ft AMSL is located on the western edge of the property. Therefore, based on the plat map and the elevation information, the well is likely located on Barringhaus's property about 0.2 miles to the east of its state plotted database location.

1.7 Well #018725

Well #018725 was installed on March 26, 1997 and owned by Steven Gambaro. According to the MDNR well certification form, the well is listed as having a surface elevation of 540 ft AMSL. DEM elevations of the state plotted database location display an elevation of approximately 663 ft AMSL. Review of the plat maps demonstrate that Gambaro owns property about 0.15 miles to the southeast of the state plotted location, at an elevation of approximately 550 to 580 ft AMSL. Additionally, the well certification form lists an owner address of 33 Owl Creek which corresponds to the location of the Gambaro property on the plat map. Based on the plat map and the correlation in elevations in the nearby area, the well is likely located about 0.15 miles to the southeast of its current database plotted location.

1.8 Well #044782

Well #044782 was installed on April 21, 1991 and owned by Marion and Rosena Thiebes. The well is listed as having a surface elevation of 480 ft AMSL according to the well certification form. DEM elevations of the state plotted database location display an elevation of approximately 528 ft AMSL. The well certification form lists an owner address of 1015 Fiddle Creek Road. 1015 Fiddle Creek Road lies about 0.2 miles to the northeast of the state plotted location in an area that has a surface elevation of approximately 484 ft AMSL. Therefore based on the address in the well certification form along with the correlation in surface elevations, this well is likely located at 1015 Fiddle Creek Rd about 0.2 miles to the northeast of its plotted database location.

1.9 Well #078747

Well #078747 was installed on August 19, 1993 and owned by Merle Newman. The well is listed with a surface elevation of 510 ft AMSL on the MDNR well certification form. DEM elevations of the state plotted database location displayed an elevation of 528 ft AMSL. The well is plotted in the middle of a farm field and the well has a total depth of 256 ft BGS based on the well certification form. Review of the plat maps indicate that Merle Newman owns property to the west of the state plotted database location. On the listed Merle Newman property, the only areas with elevations near 510 ft AMSL are in the lowlands down near the creeks, and not near any of the buildings (elevations of approximately 560 to 570 ft AMSL). Additionally, well certification form #188174, contains record of the reconstruction (deepening) of a Merle Newman well from 251 to 394 ft BGS in 1998. The form does not reference what well is being reconstructed. State database coordinates for the reconstruction are plotted about 3.5 miles to the west of well #078747. No elevation of the reconstructed well is provided in the certification form. Based on the current information provided in the well certification forms and plat maps, the likely location of this well is still unknown and will be plotted in its current state database location.

1.10 Well #394501

Well #394501 was installed on March 1, 2007 and owned by J. George. The well does not have a surface elevation listed on the MDNR well certification form. DEM elevations of the state plotted database location displayed an elevation of 490 ft AMSL. Review of the well certification form list the, "address of well (if different than above)" as Fiddle Creek Road. The plat map indicates that George owns a property in the same location as the state database, which lies about 0.15 miles off of Fiddle Creek Road in an area with a surface elevation of approximately 489 ft AMSL. Based on the plat map, the address in the well certification form, and the state database coordinates, this well is most likely located correctly in the database on George's property.

1.11 Well #000966

Well #000966 was installed on February 20, 1987 and owned by Greg Smith. The well lists a surface elevation of 600 ft AMSL according to the MDNR well certification form. DEM elevations of the state plotted database location displayed an elevation of approximately 525 ft amsl. Review of the well certification form displays an address of Lot #2 Fairfield in Labadie. Plat maps list a property owned by Smith located about 0.7 mile to the east of the listed state database location off of Fairfield Ridge Road. While most of the property appears to be at elevations of greater than 700 ft AMSL, the far western edge of the property contains a small building with an elevation of approximately 600 ft AMSL. Based on the address, the plat map, and the elevation of the small building, this well is likely located about 0.7 miles to the east of its current state database location.

1.12 Well #087927

Well #087927 was installed on October 14, 1992 and owned by David Wehner. The well lists a surface elevation of 540 ft AMSL according to the MDNR well certification form. DEM elevations of the state plotted database locations also display an elevation of 540 ft AMSL. After review, this well is plotted in a location on the edge of a farm field and not within close proximity of any buildings. Plat maps display that Wehner owns property about 0.9 miles to the southwest of the state database plotted location. Wehner's property includes a home within an area of elevations ranging approximately 550 to 560 ft AMSL. Based on the plat map and the similar elevation, this well is most likely located about 0.9 miles to the southwest of the current state database coordinates.

1.13 Well #011549

Well #011549 was installed on December 27, 1988 and owned by Danny Barnoski. This well is listed with a surface elevation of 600 ft AMSL on the MDNR well certification form. DEM elevations of the state plotted database location list an elevation of 697 ft AMSL. The well certification form lists the owners address as 3333 Bassett Road in Pacific, MO. No address is provide in the, "address of well (if different than above)" section of the form. The plat map lists that the owner address is owned by Barnoski. At this property there are a couple of buildings with elevations ranging from approximately 600 to 640 ft AMSL. Based on the information in the well certification form, the plat maps, and the similar surface elevations, this well is most likely located about 1.6 miles to the northeast of the current state plotted database location.

2.0 REFERENCES

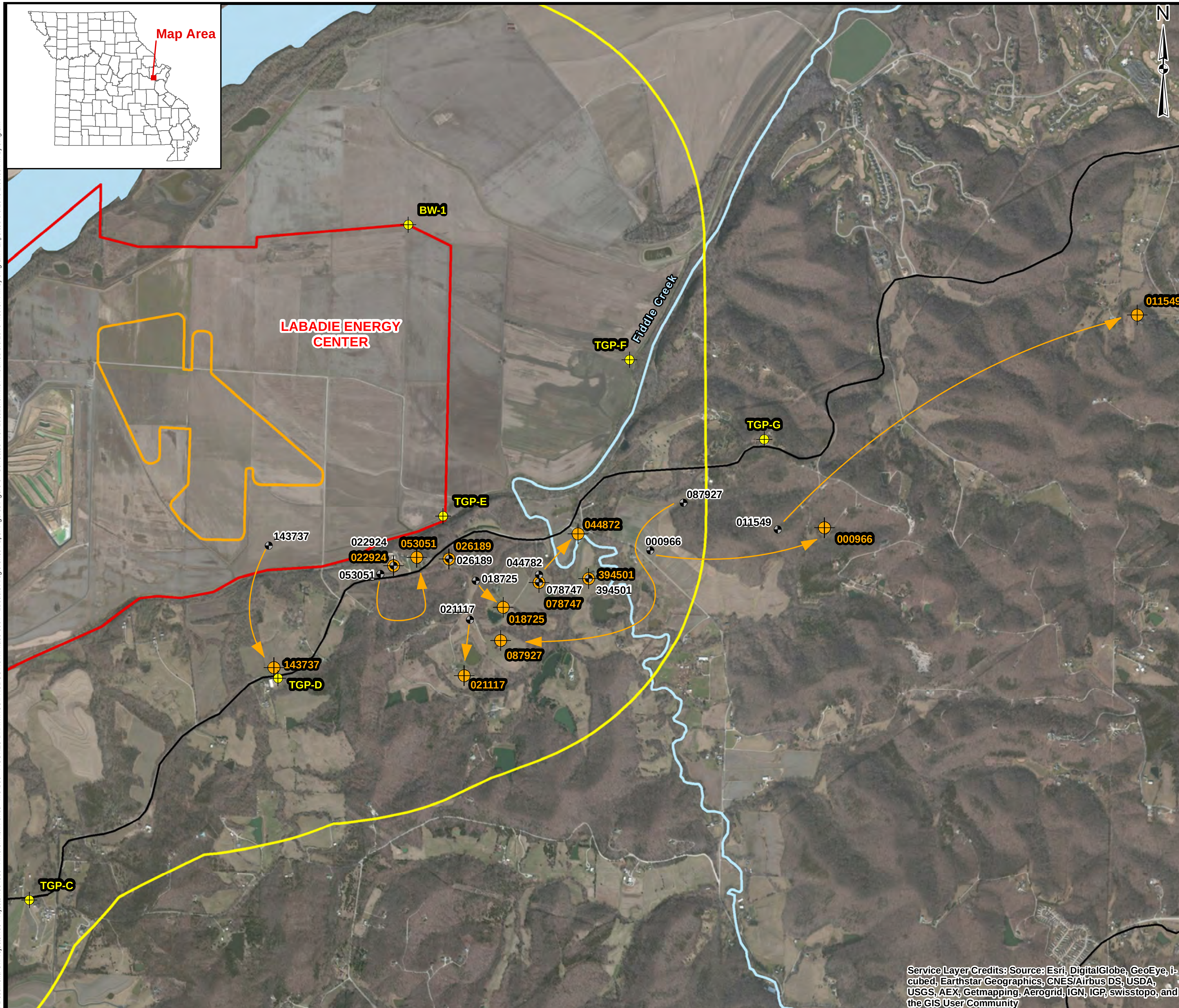
Franklin County. 2015. Franklin County Assessor Records. Available at: http://www.franklinmo.net/assr/Assessor.aspx

MDNR. 2015a. Missouri Department of Natural Resources (MDNR) Geosciences Technical Resource Assessment Tool (GeoSTRAT). Available at: http://dnr.mo.gov/geology/geostrat.htm

MDNR. 2015b. Missouri Well Information Management System (WIMS), Wellhead Protection Program. Missouri Department of Natural Resources. Available at: https://dnr.mo.gov/mowells/publicLanding.do

MDNR. 2015c. Geologic Well Logs of Missouri, Water Resource Center. Missouri Department of Natural Resources. Available at: http://dnr.mo.gov/env/wrc/logmain/

USGS. 2013. United States Geological Survey (USGS) National Elevation Dataset (NED) map n39w091 1/3 arc-second 2013 1 x 1 degree ArcGrid. Available at: http://viewer.nationalmap.gov/viewer/



Map Document: G:\Projects\130 Projects\1301560 - Ameren Ash Ponds - MO\800 - FIGURES-DRAWINGS\PRODUCTION\Phase 0001 - Labadie\Arcgis\Criss Paper Figures\Figure 8 - Corrected Well Locations.mxd / Modified 6/9/2015 1:59:57 PM by JIngram / Exported 6/9/2015 2:00:09 PM by JIngram

TITLE

WELL LOCATIONS BASED ON AVAILABLE INFORMATION

LEGEND

- Proposed Landfill
- Labadie Energy Center Property Boundary
- Approximate 1-Mile Radius
- Original State Database Well Location
- Corrected Private Well Location
- Bedrock Aquifer Well and Sample Location

NOTES

1.) All boundaries and locations are approximate.
2.) Figure displays the state database coordinates for the wells that are in Dr. Criss's 2010 Paper and the believed location of each of these wells based on available information on the well certification forms, available plat maps, and other available data.
3.) More information on the relocation of these wells is provided in Appendix A.

REFERENCES

1.) Ameren, 2011. Ameren Missouri Labadie Energy Center, Labadie Property Control Map, November 2011.
2.) Reitz & Jens. 2014. Groundwater Detection Monitoring Well Installation Report. March 18-20, 2014. Ameren Missouri, Labadie Energy Center.
3.) MDNR. 2015a. Missouri Department of Natural Resources (MDNR) Geosciences Technical Resource Assessment Tool (GeoSTRAT).
4.) MDNR. 2015b. Missouri Well Information Management System (WIMS), Wellhead Protection Program. Missouri Department of Natural Resources.
5.) MDNR. 2015c. Geologic Well Logs of Missouri, Water Resource Center. Missouri Department of Natural Resources.
6.) Franklin County Plat Maps.
7.) COORDINATE SY STEM: NAD 1983 StatePlane Missouri East FIPS 2401 Feet.

0 2,500 5,000
Feet

PROJECT

Ameren

AMEREN MISSOURI LABADIE ENERGY CENTER
FRANKLIN COUNTY, MISSOURI

Golder Associates

PROJECT No. 130-1560			Figure 8 - Corrected Well Locations.mxd
DESIGN	-	-	SCALE: AS SHOWN REV. 0
GIS	JSI	4/9/2015	
CHECK	EPW	4/14/2015	Figure A-1
REVIEW	MNH	4/16/2015	