October 10, 2023

Ms. Tonya Howell
Remedial Project Manager
Site Remediation West Section
Superfund and Emergency Management Division
11201 Renner Boulevard
Lenexa, Kansas 66219

<submitted electronically Howell.Tonya@epa.gov and Sperry.Clint@epa.gov>

Re: **Huster Substation, Findett Superfund Site, OU4 (MOD006333975), St. Charles, Missouri – FINAL Ammonia Memorandum (August and September 2023 Data)**

Dear Ms. Howell,

Attached is the final memorandum regarding to the ammonia levels in Elm Point wellfield relative to Huster substation remediation activities. This memo includes the August and September 2023 data collected by EPA.

There is no technical basis for the City of St. Charles' claim that remedial activities at or around the substation have caused any significant impact on water quality at city production well #10.

For questions, please contact me at 314-488-0151.

Sincerely,

Lisa A. Meyer
Manager, Environmental
Ameren Missouri
Lmeyer2@ameren.com

Cc: C. Giesmann, Ameren
S. Knowles, Ameren
J. Martin, Ameren

File: SharePoint

Loureiro
Engineering • Construction • EH&S • Energy
Waste • Facility Services • Laboratory

Memorandum

Date: **October 10, 2023**

To: **Lisa Meyer, Ameren**
From: **Derek Ingram**
Subject: **Evaluation of Impacts of Remedial Activities at Huster Substation on Ammonia Levels at City Well 10 – August and September 2023 Data**

Ameren Missouri, Huster Substation, St. Charles, Missouri
Operable Unit 4 (OU4), CERCLA No. 07-2012-0026

CONCLUSION

The City of St. Charles (City) contends that the remedial activities on the Huster Substation (Substation) may have caused a decrease in ammonia levels in the groundwater pumped from City Well number 10 (CW-10), resulting in the installation of an ammonia feed system at the water treatment plant for disinfection of the water prior to entering the City distribution system. Ammonia in groundwater is primarily from decay of organics and fertilizers with higher levels typically observed in more shallow reaches of the aquifer. In response to the City's concerns, in August and September 2023, the United States Environmental Protection Agency (EPA) performed an evaluation of ammonia levels in groundwater within the capture zone of CW-10, which includes the Substation. The two sets of data collected by EPA and from Ameren's monitoring well network do not support the City's contention that remedial activities at the Substation have impacted ammonia concentrations measured at CW-10. In addition, a hydraulic analysis of the groundwater capture zone for CW-10 demonstrates that impacted groundwater underlying the Substation in the area of remediation activities, has the potential to contribute **one percent** of the groundwater pumped from CW-10, making it impossible for remedial activities at the site to have caused any significant impact on water quality at CW-10, much less the drop in ammonia observed by the City. To the extent the City has installed an ammonia feed system at its water treatment plant, there is no reasonable technical basis to assume it was necessary due to remediation activities at the Substation.

DETAILS

To determine the potential impact of remediation of impacted shallow groundwater at the Substation on ammonia levels at CW-10, Loureiro Engineering Associates, Inc. (LEA) developed two analyses:

- An evaluation of two ammonia data sets collected by EPA in August and September 2023 within the capture zone of CW-10, and

- An evaluation of the volume of the shallow impacted groundwater underlying the Substation as a percentage of the pumped volume of groundwater from CW-10. This evaluation was performed by Groundwater Services Inc. (GSI; d/b/a GSI Environmental Inc.).

ANALYSIS OF AMMONIA DATA COLLECTED BY EPA

In August of 2023, the EPA sampled 30 wells to determine the concentration and distribution of ammonia within the CW-10 capture zone. The 30 wells consisted of 14 wells installed and monitored by Ameren, associated with remedial activities at the Substation, to provide a thorough understanding of affects within and radially surrounding the Substation. Of the 14 Ameren wells, 6 are located on or close to the remediation areas on the Substation property. The additional 16 wells sampled as part of the EPA evaluation were distributed across the CW-10 capture zone and were not associated with the Substation remediation activities.

In September of 2023, the EPA sampled 31 wells to further validate the concentration and distribution of ammonia within the CW-10 capture zone. The 31 wells consisted of 14 wells installed and monitored by Ameren, associated with remedial activities at the Substation. Of the 14 Ameren wells sampled, 5 are located on or close to the remediation areas on the Substation property. The additional 17 wells sampled as part of the EPA evaluation were distributed across the CW-10 capture zone and were not associated with the Substation remediation activities. **Figure 1** and **Figure 2** present the locations and labels for the wells sampled within the EPA evaluation program. **Table 1** presents the results of the EPA sampling of all the wells for ammonia in August and September 2023.

The primary longer term operating remedial technology applied on the Substation was bioaugmentation. Bioaugmentation introduces the necessary amendments into the shallow impacted groundwater to stimulate the native and introduced natural bacteria to destroy the contaminants of concern (COCs) underlying the Substation. At the Substation, the primary COCs are cis-1,2-dichloroethene and vinyl chloride. Both COCs are biodegradable using the bioaugmentation approach. *Miracle-Gro Water-Soluble All-Purpose Plant Food*, a common additive found in home improvement stores and plant nurseries, was added in the bioremediation areas to supply additional nutrients into the groundwater during the bioaugmentation applications. This amendment has an NPK ratio of 24-8-16, which means that it contains 24 percent nitrogen, 8 percent phosphorus and 16 percent potassium.

LEA performed some simple averaging separately on the ammonia data collected in August and September 2023, under the EPA sampling program, to determine if the ammonia levels associated with the on-site remediation may be negatively impacting ammonia levels at CW-10. The averaging analyses performed on the data are presented in **Table 2**.

Comparison of the ammonia levels in the Ameren monitoring wells (14 wells), in the City monitoring wells (9 wells), in the OU3 monitoring wells (4 wells), and in City municipal wells (3 wells in August and 4 wells in September) provide the following conclusions:

- The average of all 30 wells monitored by EPA in August was 0.51 milligrams per liter (mg/L) ammonia. This value represents the average value across the western half of the

CW-10 capture zone including the location of the Substation. (Data is not available for the eastern half of the CW-10 capture zone). In September the average of the 31 wells sampled was 0.55 mg/L.

- The average of the 14 onsite and offsite Ameren monitoring wells in August was 0.50 mg/L (excluded MW-25). For the September sampling the average was 0.44 mg/L (excluded MW-23).
- For the 6 wells within or near the Substation remediation areas (MW-8, 11, 18, 19, 23 and 24) the average for the August sampling was 0.56 mg/L. Only 5 of the 6 wells were sampled in September (all except MW-23), the average was 0.49 mg/L.
- In August, the average of the 9 City monitoring well locations was 0.48 mg/L. In September the average was 0.59 mg/L.
- In August, the average of the 4 OU3 monitoring wells was 0.31 mg/L. In September the average was 0.29 mg/L.
- In August, the average of 3 municipal wells (CW-4, 8 and 10) was 0.96 mg/L (CW-10 was the lowest of the 3 wells at 0.31 mg/L). In September[1], CW-7 was included in the sampling event and the average of the 4 wells was 1.00 mg/L (CW-10 was 0.30 mg/L).
- Overall, the variation between August and September data was well within 25 percent.

The combined average concentration of ammonia in groundwater on the Substation property for August and September 2023 (0.53 mg/L) is commensurate with the combined average of all the wells within the western half of the capture zone of CW-10 (0.53 mg/L). **Therefore, data collected by EPA confirms that remedial activities on the Substation *had no impact* on the available ammonia at CW-10, relative to other areas within the CW-10 capture zone**.

FLOW CONTRIBUTION ANALYSIS FROM SHALLOW IMPACTED GROUNDWATER UNDERLYING THE SUBSTATION TO OVERALL FLOW FROM CW-10.

Based on the modeling performed by GSI, groundwater underlying the impacted portion of the Substation comprises approximately 3 percent of CW-10's capture zone / extracted groundwater volume. That 3 percent is further broken down into 1 percent contributed from the upper/impacted portion of the aquifer underlying the Substation and 2 percent contributed from the lower/unimpacted portion of the aquifer underlying the Substation. Addendum A provides the details of the GSI modeling evaluation. **The minimal 1 percent contribution attributed to the impact zone associated with the Substation remediation activities makes it impossible to have caused any significant change in ammonia at CW-10**.

[1] In EPA letter to the City dated October 6, 2023, EPA stated CW-9 was not sampled in either round 1 or 2 of its investigation and therefore could not concur with the City's characterization regarding naturally occurring ammonia at that location. Table 1 includes the correct data for MW-C9.

Attachments

- Figure 1 – EPA Ammonia Sample Locations within OU4
- Figure 2 – EPA Ammonia Sample Locations within OU3
- Table 1 – EPA Ammonia Results for August and September 2023
- Table 2 – Averages of EPA Ammonia Results for August and September 2023
- GSI Memorandum: *Addendum A: Modeling the Contribution of Water from the Huster Substation Source Area to the Capture Zone of City of St. Charles' Well, CW-10*

FIGURE 1

Loureiro

LEGEND

- PROPOSED 2023 EHC INJECTION LOCATION (ASSUMED 5 FT ROI)
- PZ-11 — MONITORING WELL
- CW-6 — CITY WELL
- PROPOSED MONITORING WELL LOCATION (PERMANENT)
- PROPOSED MONITORING WELL LOCATION (TEMPORARY)
- SUBSTATION FENCE

NOTES:

1. WELLS WITH "MW" NOMENCLATURE INDICATE WELLS LOCATED ON AMEREN PROPERTY.
2. WELLS WITH "PZ" NOMENCLATURE INDICATE WELLS LOCATED ON THE CITY OF ST. CHARLES, MO PROPERTY.

0 125 250

APPROXIMATE SCALE (FEET)

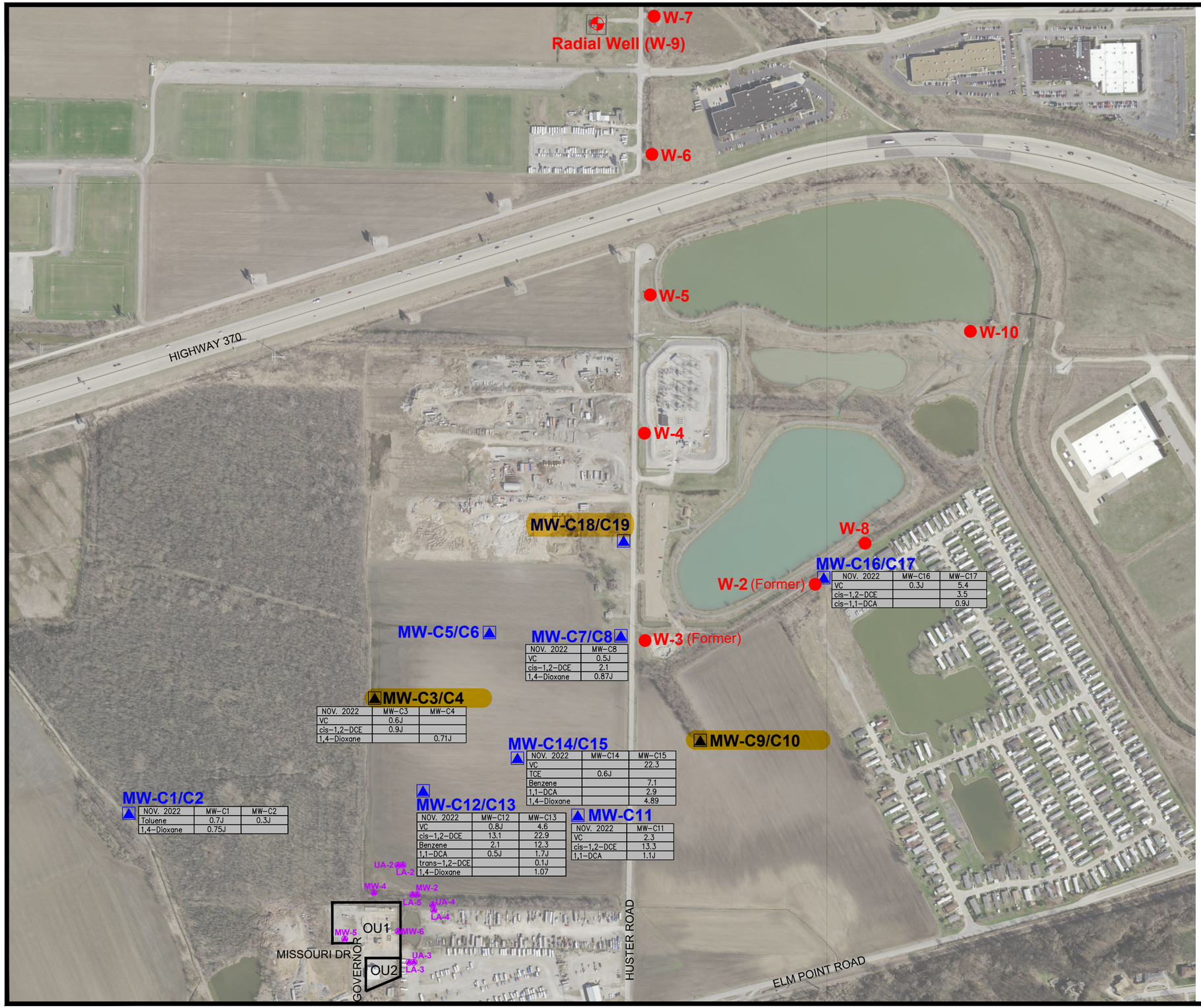
TITLE:

MONITORING WELL & INJECTION LOCATIONS
HUSTER RD. SUBSTATION
ST. CHARLES, MISSOURI

SCALE: AS SHOWN	
DATE: MAY 2023	DRAWN BY: PC
PROJECT NO.: 088UE2.14	CHECKED BY: DI
CLIENT: AMEREN	PROJ. MGMT. APPROVAL: DI

DRAWING NO.

FIGURE 2



NOV. 2022	MW-C3	MW-C4
VC	0.6J	
cis-1,2-DCE	0.9J	
1,4-Dioxane		0.71J

NOV. 2022	MW-C1	MW-C2
Toluene	0.7J	0.3J
1,4-Dioxane	0.75J	

NOV. 2022	MW-C12	MW-C13
VC	0.8J	4.6
cis-1,2-DCE	13.1	22.9
Benzene	2.1	12.3
1,1-DCA	0.5J	1.7J
trans-1,2-DCE		0.1J
1,4-Dioxane		1.07

NOV. 2022	MW-C14	MW-C15
VC		22.3
TCE	0.6J	
Benzene		7.1
1,1-DCA		2.9
1,4-Dioxane		4.89

NOV. 2022	MW-C11
VC	2.3
cis-1,2-DCE	13.3
1,1-DCA	1.1J

NOV. 2022	MW-C16	MW-C17
VC	0.3J	5.4
cis-1,2-DCE		3.5
cis-1,1-DCA		0.9J

NOV. 2022	MW-C8
VC	0.5J
cis-1,2-DCE	2.1
1,4-Dioxane	0.87J

NOTES

1. Plan adapted from "2015 Aerial Imagery for the St. Louis Region" supplied by East-West Gateway Council of Governments.

LEGEND:

- Well of Elm Point Well Field
- Radial Well - Elm Point Well Field
- OU3 Monitoring Well Location (Existing)
- OU1 Monitoring Well Location (Existing)

VC	Vinyl Chloride
cis-1,2-DCE	cis-1,2-dichloroethene
TCE	Trichloroethene
Benzene	Benzene
1,1-DCA	1,1-Dichloroethane
Toluene	Toluene
trans-1,2-DCE	trans-1,2-dichloroethene
1,4-Dioxane	1,4-Dioxane
J	Detected Below Reporting Limit

All Results Reported in Parts Per Billion (µg/l)

0 500 1000

APPROXIMATE SCALE IN FEET

N

Drawn By: WAH	Ck'd By: JYG	App'vd By: KJH
Date: 12-15-22	Date: 12-18-22	Date: 12-18-22

GEOTECHNOLOGY
A Universal Engineering Sciences Company

Operable Unit 3
Hayford Bridge Road Groundwater Site
St. Charles, Missouri

GROUNDWATER CONCENTRATIONS NOVEMBER 2022

Project Number J006295.11

PLATE 5

Table 1 - EPA Ammonia Results for August and September 2023

Well Location		AUGUST 2023 Ammonia Conc. (mg/L)	SEPTEMBER 2023 Ammonia Conc. (mg/L)
Ameren Monitoring Wells	MW-8	1.50	1.17
	MW-11	0.48	0.51
	MW-17S	0.52	0.41
	MW-17D	0.39	0.52
	MW-18	0.19	0.15
	MW-19	0.22	0.19
	MW-20D	0.83	0.79
	MW-23	0.17	Not Sampled
	MW-24	0.77	0.42
	MW-25	Not Sampled	0.13
	PZ-5	0.40	0.40
	PZ-8	0.38	0.37
	PZ-9	0.49	0.48
	PZ-11	0.24	0.22
	PZ-14D	0.41	0.38
City Monitor Wells	CPZ-2	0.42	0.4
	MW-52A	1.96	1.70
	MW-52B	0.11	1.39
	MW-53A	0.43	0.36
	MW-53B	0.18	0.15
	MW-54A	0.30	0.31
	MW-54B	0.26	0.27
	MW-61A	0.29	0.34
	MW-61B	0.37	0.39
City Municipal Wells	CW-4	1.51	1.46
	CW-7	Not Sampled	0.87
	CW-8	1.07	1.35
	CW-9	Not Sampled	Not Sampled
	CW-10	0.31	0.30
OU3 Group Wells	MW-C9	0.01	ND*
	MW-C10	0.43	0.47
	MW-C18	0.4	0.23
	MW-C19	0.39	0.47

*Per EPA letter to the City of St. Charles dated October 6, 2023, EPA identified a reporting error; data initially reported in September for CW-9 was actually MW-C9.

Table 2 - Averages of EPA Ammonia Resuls for August and September 2023

Well Location	AUGUST 2023 Average Ammonia Concentration (mg/L)	SEPTEMBER 2023 Average Ammonia Concentration (mg/L)
Ameren Monitoring Wells	0.50	0.44
Ameren Onsite Monitoring Wells (MW-8,11,18,19,23,24)	0.56	0.49
City Monitoring Wells	0.48	0.59
City Municipal Wells	0.96	1.00
OU3 Group Monitoring Wells	0.31	0.29
Total Average	**0.51**	**0.55**

GSI Job No. 6449
Issued: 22 September 2023

GSI ENVIRONMENTAL

MEMORANDUM

TO: Lisa Meyer, Ameren

FROM: Sorab Panday, Jim McDade, and Schuyler Robinson, GSI Environmental Inc.

SUBJECT: **Addendum A: Modeling the Contribution of Water from the Huster Substation Source Area to the Capture Zone of City of St. Charles' Well, CW-10**
Ameren Missouri, Huster Substation, St. Charles, Missouri
Operable Unit 4 (OU4), CERCLA No. 07-2012-0026

OVERVIEW OF MODEL DEVELOPMENT

A numerical groundwater flow model was developed by Groundwater Services Inc. (GSI; d/b/a GSI Environmental Inc.) and Ameren in 2013 (GSI, 2013) to evaluate subsurface flow conditions and assist with the design of a groundwater extraction treatment system (GETS) at the Huster electrical substation (i.e., the site; GSI, 2013). The flow model domain encompassed most of the groundwater basin between the Missouri and Mississippi Rivers. The model is regional in nature to prevent boundary condition impacts near the site but uses a fine grid around the site to accommodate the fine resolution required to test potential remedial alternatives. Figure 1 shows the model domain and boundaries. The model incorporates regional trends to provide ambient flow conditions using the average river stages in the Mississippi and Missouri Rivers as boundary heads. Additionally, the model incorporates local site-specific data including groundwater potentiometric surface measurements, transmissivity, and storativity calculated from results of an aquifer pumping test and slug tests (see discussion below).

Site Lithology and Hydrogeology

In general, the lithology beneath the Huster Substation and surrounding vicinity consists of the following layers, listed from top to bottom:

- 20-ft to 25-ft thick surface clay layer,
- 1-ft to 5-ft thick transition zone, and
- Alluvial sand and gravel aquifer that extends to bedrock at a depth of approximately 110 ft bgs.

Groundwater is confined with a potentiometric surface rising to several feet above the top of the alluvial sand stratum. Slug and aquifer pumping tests conducted in December 2012 indicated a range of values for hydraulic conductivity on the order of 10^{-2} cm/sec (30 ft/day) to 10^{-1} cm/sec (300 to 400 ft/day). Grain size within the alluvial aquifer generally appears to coarsen with depth; consequently, hydraulic conductivity may be inferred to be greater in the lower portions of the aquifer than in the shallow zone. A constant rate pumping test conducted at well MW-07 in 2013 (GSI, 2013) indicated that the upper portions of the aquifer extending from 27 ft to 49 feet below ground surface (ft bgs), exhibited a hydraulic conductivity of approximately 1.1×10^{-1} cm/s (312 ft/d). Lower portions of the aquifer deeper than 49 ft bgs exhibited a slightly higher hydraulic

conductivity of approximately 1.4 x 10^{-1} cm/s (397 ft/d). The surface clay layer has an estimated hydraulic conductivity of approximately 1 x 10^{-5} cm/s (3 x 10^{-2} ft/d).

During initial model development and sensitivity testing, static water levels measured in December 2012 in monitoring wells located at the Huster Substation indicated that groundwater flows in a north-northwesterly (NNW) direction under a hydraulic gradient of approximately 0.001 ft/ft. Other local measurements showed similar flow vectors and velocities (NNW direction with a gradient of 0.0007 ft/ft measured in July 2012). Note that according to available records, City Wells CW-6, CW-8, and CW-9 were operable in July 2012, and CW-9 was the only well operable in December 2012. Additionally, it should be noted that during model development, chemicals of concern (COCs – mainly cis-1,2-dichloroethene and vinyl chloride) observed in groundwater only exceeded their respective Maximum Contaminant Levels (MCLs) in the upper portion of the aquifer (i.e., shallower than 50 ft bgs), with concentrations generally decreasing to non-detectable levels deeper than 60 ft bgs.

GSI Model Development

A numerical model consistent with the conceptual model illustrated in Figure 2 was constructed using Groundwater Vistas (Version 6.14, Build 16; ESI Inc.). Originally, the aquifer in the model consisted of 3 layers with a confining layer atop the aquifer units. The top layer corresponds to the upper portion of the aquifer (i.e., 27 to 49 ft bgs) that exhibits a lower hydraulic conductivity. The second layer (i.e., 49 to 62 ft bgs) represents the upper portion of the relatively higher hydraulic conductivity in the lower portion of the aquifer. The third (bottom) layer (i.e., deeper than 62 ft bgs) consists of the unimpacted portion of the lower aquifer. The horizontal model gride size is 20 ft x 20 ft. The model was later expanded into 13 numerical layers to account for the solutes penetrating part of the lower aquifer unit and the varying screen depths of both City and proposed groundwater extraction wells. The updated 13-layer model, used in this evaluation, consists of: i) Layer 1, which represents the confining layer, ii) Layers 2 through 5, which represent the upper transmissive zone, and iii) Layers 6-13, which represent the lower transmissive zone.

As shown by the discussion above, hydraulic conductivities of the hydrostratigraphic units were taken from the pumping test values above, with a hydraulic conductivity of 3 x 10^{-2} ft/d for the surface clay layer, 312 ft/d for the upper transmissive zone, and 397 ft/d for the lower transmissive zone. Boundary conditions to the model were prescribed heads in the Missouri River of 430 feet and in the Mississippi River of 418 feet (the average conditions along the segments of the rivers within the model domain). Other boundary conditions include the City wells pumping and the remediation wells pumping. The depth of the City wells were generally between 70 and 100 ft bgs and the remediation wells were generally 35 to 45 ft bgs, consistent with the well construction diagrams.

Testing and Confirmation of GSI's Model – H&A's Model

Confirmation of the hydraulic conductivities and modeling outputs of GSI's 2013 model was tested by Haley & Aldrich (H&A) in their 2021 Site Conceptual Model study evaluating the hydrogeologic conditions under the site. The 2021 H&A study indicated that the site is situated on the Mississippi River Alluvial Aquifer comprising of a 100 to 150 ft thick sequence of sands and gravels which were sequentially covered by fine-grained floodplain deposits creating a semi-confining layer of silts and clays. This is similar to the conceptualization of the GSI numerical model. The aquifer

south of the site is recharged by an elevated bedrock subcrop from infiltration of precipitation and stream water infiltration. The ambient flow under the site is likely affected by floods in the Mississippi River floodplain, though truly natural conditions have not been observed onsite, since groundwater elevations have been strongly influenced by groundwater extraction for at least the past 50 years. The calibrated GSI model also indicates that gradients across the site are small and are highly influenced by the pumping that occurs in and around the site.

The aquifer properties conceptualized by the H&A study are also similar to those used by the GSI model. Transmissivities examined by the study indicate a hydraulic conductivity value of 362 to 452 ft/day with an average aquifer thickness of 80 to 100 feet. The H&A numerical model included a shallow confining layer with an isotropic hydraulic conductivity of 0.01 ft/day, an upper aquifer layer with an isotropic hydraulic conductivity of 300 ft/day, and a lower aquifer layer with isotropic hydraulic conductivity of 400 ft/day. These values are very similar to those in the GSI model.

MODELING CONTRIBUTION OF SOURCE AREA TO CW-10 CAPTURE ZONE

Modeling Results

The GSI model was used to evaluate the capture zone of City Well 10 (CW-10), and the contribution of that capture zone coming from the source area located on the Huster Substation. For this evaluation the source area was assumed to approximately encompass the northern half of the substation, which is likely conservative based on actual concentration data. In addition, the model assumed the following pumping regime from City and GETS wells:

- CW-10 pumping at 1,000 gallons per minute (gpm),
- MW-05 pumping at 42 gpm,
- MW-07 pumping at 14 gpm, and
- No other City wells pumping.

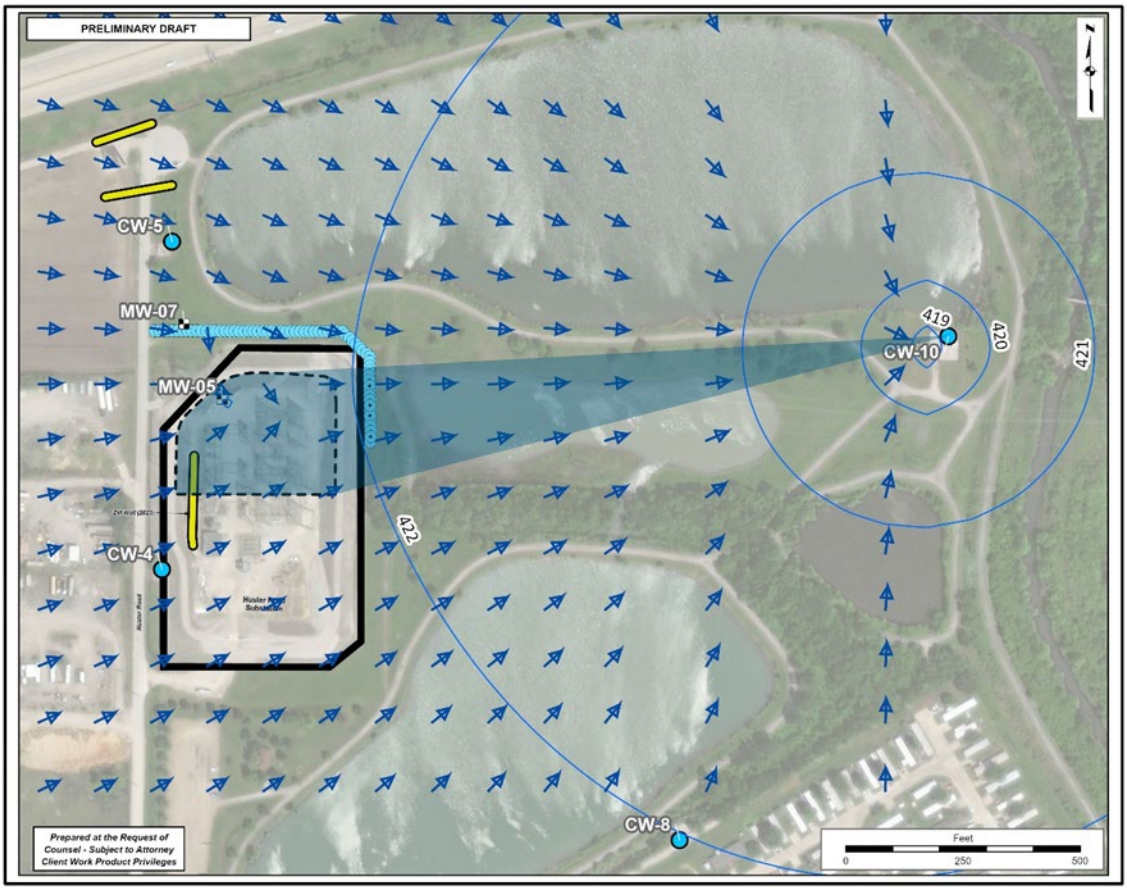
The pumping rate at CW-10 is approximately based on the average of historical pumping totals. Exhibit 1 below shows the flow direction and capture zone of CW-10 under the pumping scenario listed above. In general, groundwater in the vicinity of the Huster Substation is captured by CW-10, with flow slightly towards the northeast before directly heading east towards CW-10. Comparatively minor volumes of water are captured by MW-05 and MW-07 as shown by flow arrows in the northeastern portion of the site. Using particle tracking, travel times from the Huster Substation to CW-10 were estimated by the model to be between 788 and 1,632 days.

The percentage of CW-10's capture zone coming from the Huster Substation source area was calculated using geometric techniques. The capture zone of CW-10 was assumed to be a circle, and the arc from the Huster Substation source area was calculated as a percentage of the total circle. Additionally, contribution from the arc was divided into the contribution from the layers of the aquifer (i.e., upper and lower portions of the aquifer). As noted previously, COCs observed in the aquifer are mainly encountered in the upper portion of the aquifer (i.e., 35 to 50 ft bgs), and the lower portions of the aquifer generally remain unimpacted.

Based on the modeling estimate and calculations, water captured at CW-10 from the source area of the Huster Substation comprises approximately 3% of CW-10's capture zone. That 3% is

further broken down into 1% contributed from the upper/impacted portion of the aquifer and 2% contributed from the lower/unimpacted portion of the aquifer. Therefore, if concentrations of COCs from the substation were to reach CW-10, then the concentrations detected at CW-10 would likely be diluted 100x (i.e., 1%).

Exhibit 1. Groundwater Flow Arrows and Capture Zone of CW-10. Blue shaded area represents the capture zone from the source area on the Huster Substation.



Sensitivity Analysis

Loureiro Engineering Associates, Inc. (LEA) has conducted extensive investigation and remediation activities at the Huster Substation and vicinity from 2015 to present. Through these activities, LEA has obtained additional lithology information, specifically the thickness and depth of the confining layer (i.e., upper clay and silt unit) and the upper transmissive zone (see Figure 2). Based on LEA's field observations, the upper confining unit (i.e., clay) extends to approximately 25 ft bgs and a low permeability silty clay extends from approximately 25 to 31 ft bgs, which is approximately 6 ft deeper than described in GSI's model. The 25 to 31 ft bgs interval corresponds to Layer 2 in GSI's model, which for the modeling run described above, was assumed to be a part of the upper transmissive zone with a hydraulic conductivity of 312 ft/day. For this sensitivity analysis, the hydraulic conductivity for Layer 2 was changed to 0.03 ft/day, which is more representative of the confining unit (Layer 1), in order to evaluate the impacts to the flow

gradients, flow direction, and contribution of water from the Huster Substation source area to CW-10's capture zone.

By changing the hydraulic conductivity of Layer 2 in the model from 312 ft/day to 0.03 ft/day under the pumping scenario described above, water levels in all 13 layers changed. For Layers 3 through 13, the water levels differed by less than 0.7 ft, and the maximum water level changes observed in Layers 1 and 2 were 0.88 ft and 0.76 ft, respectively. The water table decreased in Layers 1 and 2 with the exception of a few cells in layer 2 near CW-10 that increased and specified head boundaries, which inherently do not change. In Layers 3 through 13, most water levels decreased with a minor amount that either didn't change or increased at specified head boundaries or near CW-10, respectively. Additionally, no changes were observed in the travel times from the Site to CW-10. While the overall water levels were lower, changing the hydraulic conductivity in Layer 2 had little to no impacts on the overall flow direction (i.e., water flowing northeast and then east towards CW-10) and flow gradients, and no change to the contribution from the Site's source area to the capture zone of CW-10 (i.e., 1%).

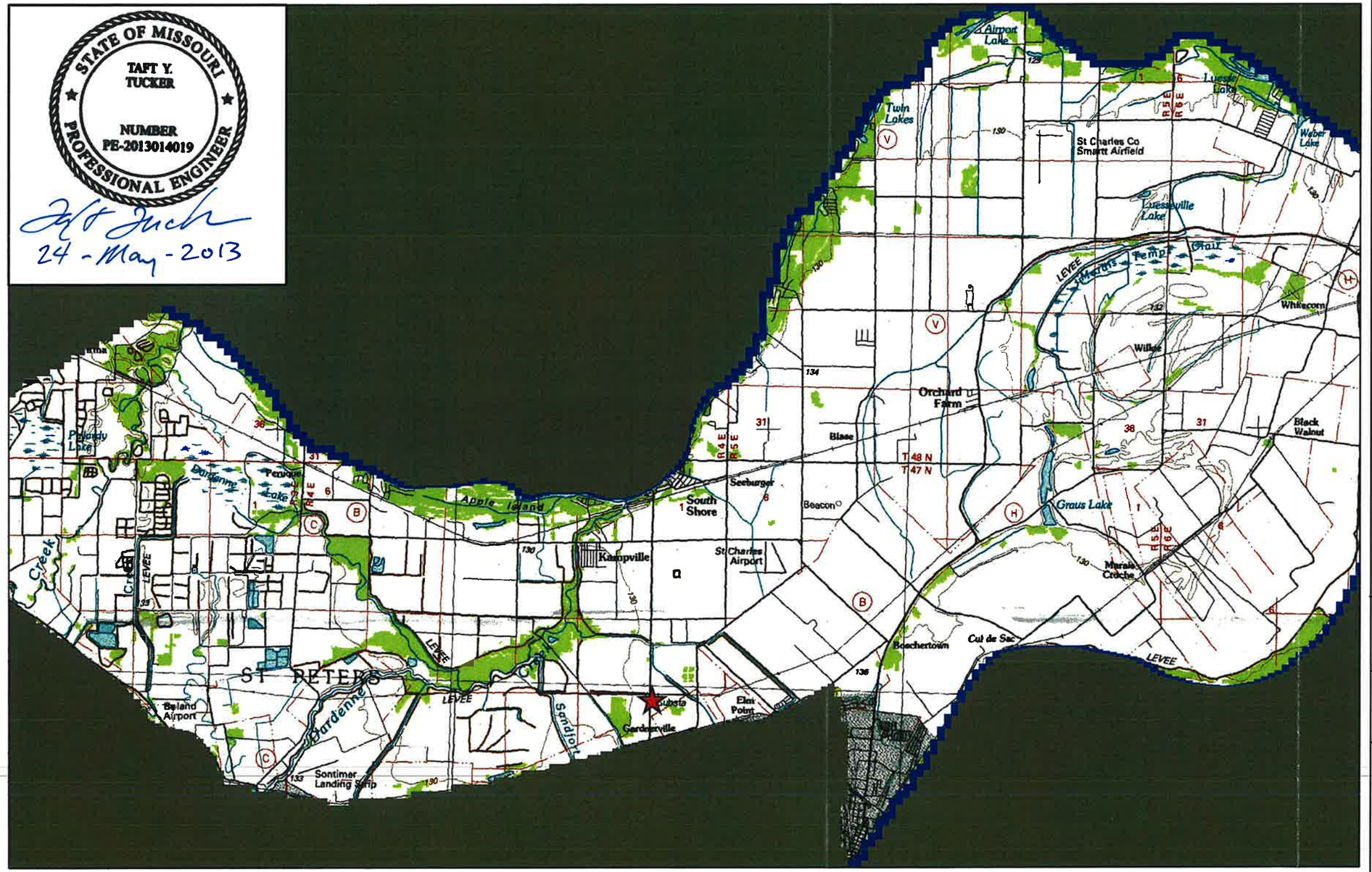
Overall, changes to the hydraulic conductivity in Layer 2 had universal changes in the water levels of all model layers, but had no impact on the flow direction, gradient, or contribution to CW-10's capture zone. As shown in Exhibit 1, operation of the City Wells has the biggest impact to the flow direction and gradient observed in the aquifer, and universal changes to the modeling layers or subtle to changes to hydraulic conductivities will not have any significant impacts to the overall flow direction and gradient.

REFERENCES

GSI, 2013. Groundwater containment system design package, Huster Road Substation, Ameren Missouri, St. Charles, Missouri.

Haley & Aldrich, 2021. Conceptual Site Model, Huster Road Substation, 3800 Huster Road, St. Charles, Missouri, for Ameren, St. Louis, Missouri, September 2021.

STATE OF MISSOURI
TAFT Y. TUCKER
NUMBER PE-2013014019
PROFESSIONAL ENGINEER
24 - May - 2013



N

LEGEND

- Huster Road Substation
- Constant Head Boundary Condition
- No Flow Boundary Condition

Notes

1. Background Imagery: Prepared by Intrasearch Inc. - www.mapmart.com
   Collection Dates: 2-Feb-2012 through 9-March-2012
2. The proposed piping pathway is subject to change based on the location of electrical substation structures and equipment.

Feet
0 4,000 8,000

Projected Coordinate System
Datum: NAD 1983
Projection: Missouri East - 2401 (STP - US ft)

GSI ENVIRONMENTAL

REGIONAL GROUNDWATER FLOW MODEL DOMAIN

CERCLA-07-2012-0026
Ameren Missouri, Huster Road Substation
St. Charles, Missouri

GSI Job No.	3807	Drawn By:	TYT
Issued:	29-May-2013	Chk'd By:	TYT
Map ID:	020_02	Appv'd By:	RSL

FIGURE 1

Figure 2
Conceptual Model Used as Basis for MODFLOW Capture Zone Model