



Data Gap Study Report

Former Farmland Industries Nitrogen Plant
1608 North 1400 Road
Lawrence, Kansas 66046

City of Lawrence, Kansas

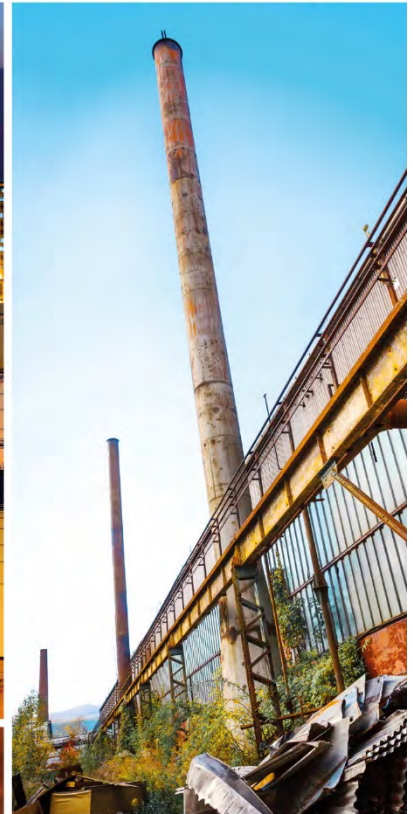




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1. Introduction

GHD Services Inc. (GHD) prepared this Data Gap Study (DGS) Report on behalf of the City of Lawrence (the City). The Data Study Gap (DGS) Report presents the results of the investigation that GHD conducted at the Former Farmland Industries, Inc. (FII) Nitrogen Plant (Site), located at 1608 N 1400 Road, Lawrence, Kansas. The investigation focused on addressing the data gaps identified by GHD in the 2018 Data Gap Study Work Plan, which recommended additional aquifer testing, downgradient groundwater characterization, and additional potential source characterization in the Eastern and Western Ponds Area. This additional study was necessary to update Site conditions and prepare an updated Conceptual Site Model (CSM).

The DGS investigation was conducted in accordance with the procedures and protocols presented in the 2018 Data Gap Study Work Plan, dated November 16, 2018. Under the Data Gap Study Work Plan, GHD:

- i. Performed aquifer tests on the four existing alluvial extraction wells (PW-9, PSW-3B3, PSW-6B4, and PSW-7B2).
- ii. Performed a more comprehensive aquifer test on the PW-9 extraction system separate from the combine extraction system to define the hydraulic characteristics of the alluvial aquifer and calculate an appropriate pumping rate to establish hydraulic containment.
- iii. Collected soil and groundwater samples from the areas surrounding the Bag Warehouse, the West Extension Pond, PSW-5B2, the West Lime Pond, the Rundown Pond, and the East Lime Pond for nitrogen mass characterization and downgradient migration.

Section 2 describes the DGS field activities. Section 3 presents the analytical results. Section 4 provides the data analysis. Section 5 provides conclusions.

1.1 Site Background and History

The FII Nitrogen Plant was a nitrogen fertilizer manufacturing plant located on the east side of Lawrence, Kansas, between E 1500 Road and Highway 10 (Figure 1). The products manufactured at this plant were anhydrous ammonia, nitric acid, urea liquid, ammonium nitrate liquid, and urea/ammonium nitrate (UAN) solution. On April 30, 2004, FII ceased to exist due to bankruptcy. Following approval of FII's Plan of Reorganization by the Bankruptcy Court and concurrence from the United States Environmental Protection Agency (USEPA) and the Kansas Department of Health and Environment (KDHE), the FII Kansas Remediation Trust (Trust) was formed and funded to address the remaining environmental impairments at the Site. In 2006, the Trust was funded to facilitate the sale and manage the administrative activities of the Site.

The Trust, through SELS Administrative Services, LLC as Trustee, managed the environmental and administrative functions of the Site. The Trust retained Shaw Environmental and Infrastructure, Inc. (Shaw) to help manage the mandated compliance and cleanup of the Site in close cooperation and supervision with the KDHE and the USEPA.

On September 29, 2010, ownership of the Former Farmland Nitrogen Plant was transferred to the City. As part of the ownership transfer, the City entered into a consent agreement with KDHE



(Consent Order No. 10-E-94 BER) to accept responsibility for the environmental remediation and management of the Site. The current hydraulic control strategy of nitrogen in the alluvial aquifer follows the requirements of the KDHE-issued Corrective Action Decision (dated March 2010).

1.2 Site Hydrogeology

The Fill Site is comprised of the following hydrostratigraphic (i.e., water bearing) units:

- Newman Terrace Deposits
- Kansas River Alluvial Deposits
- Tonganoxie Sandstone
- Weston Shale

The Newman Terrace Deposits consists of silty clay of low permeability and varies in thickness between 0 and 45 feet. The terrace deposits are partially saturated and exist under unconfined conditions and is considered an aquitard. The groundwater in the terrace can exist under perched conditions that is hydraulically separate from the regional groundwater system. The terrace deposits occur along the northern portion of the Site in the area of the process ponds. The terrace deposits can overlie the sandstone along its southern extent, but it typically overlies the Kansas River Alluvial deposits.

The Kansas River Alluvial Deposits are predominantly sand with interbedded units of sandy clay and gravel. The alluvial deposits vary in thickness from 0 to 30 feet at the Site, but increase in thickness north of the Site towards the Kansas River. The alluvial deposits are classified as an aquifer because of its permeability and exists under unconfined or semi-confined conditions. The alluvial deposits are found along the northern portion of the Site along Sandstone Hill and portions of the process ponds. Groundwater flow in the alluvial deposit is towards the north-northeast to the Kansas River.

Tonganoxie Sandstone is an interbedded sandstone that consists of sandstone, shale and limestone. The sandstone represents a prominent topographic high feature known as Sandstone Hill (see Figure 2) where several nitrogen processes occurred. The sandstone is partially saturated and can exist under unconfined or confined conditions. Given its interbedded nature, the permeability is variable with the interbedded shale units acting as aquitards. Groundwater flow is radially from the Sandstone Hill and controlled by fractures. On the north end of the Site, the sandstone groundwater discharges into the alluvial aquifer, which abuts up against the sandstone.

The Weston Shale represents the basal confining unit for the Site. The shale is an aquitard and prohibits downward migration from the overlying alluvial and sandstone groundwater systems.

2. DGS Field Activities

GHD conducted the following activities to further investigate the identified data gaps:

- Performed aquifer tests on the four existing alluvial extraction wells (PW-9, PSW-3B3, PSW-6B4, and PSW-7B2) to help in calculation of the alluvial aquifer properties and update hydraulic capture estimates.



- Performed additional aquifer testing on PW-9 to better characterize the alluvial aquifer's hydraulic characteristics to determine the hydraulic capture estimate in the PW-9 area.
- Advanced 17 direct push probe borings in the area surrounding the Bag Warehouse for soil sampling and groundwater vertical aquifer profiling (VAP) sampling.
- Advanced 12 direct push probe borings in the area surrounding the West Extension Pond for soil sampling and groundwater VAP sampling.
- Advanced 10 direct push probe borings in the area surrounding the Eastern Ponds (West Lime Pond, Rundown Pond, Overflow Pond, and East Lime Pond) and for soil sampling and groundwater VAP sampling.
- Advanced 10 direct push probe borings in the area surrounding PSW-5B2 for groundwater VAP sampling.

During the DGS work planning and field implementation phase, sampling soil and groundwater within the Overflow Pond was inaccessible. The Site layout and the direct push boring locations are shown on Figure 2.

2.1 Aquifer Testing

2.1.1 Existing Alluvial Wells Aquifer Testing

Aquifer testing was conducted October 5 through October 8, 2018 on each of the four alluvial extraction wells: PW-9, PSW-3B3, PSW-6B4, and PSW-7B2. Extraction well logs are presented in Appendix A, with the exception of PW-9 which is not available. This approach analyzed the PW-9 extraction system separately from the combined extraction system (PSW-3B3, PSW-6B4, and PSW-7B2). These two systems are approximately 2,000 feet apart and act as independent extraction systems. The two tests involved installing water level transducers in select monitoring wells and the extraction wells, turning off the pumps in all of the extraction wells, and then monitoring groundwater recovery for approximately 24 hours. After 24 hours, the pumps were turned back on. For the combined extraction system, the pumping wells were turned on individually to evaluate the additive effects of these pumping wells with PSW-3B3 followed by PSW-6B4 (after 6 hours) and PSW-7B2 (after 32 hours) and then monitoring drawdown for approximately 24 hours. At PW-9, drawdown was monitored approximately 60 hours at the combined extraction system. To reflect the current operating conditions of the systems, all pumps were allowed to operate with throttling valves fully open at their maximum and constant pumping rate during aquifer testing.

Besides the extraction wells, electronic pressure transducers with data loggers were deployed at selected surrounding monitoring wells (PW-8, PSW-19B, PSW-20B, and SW-10) for the PW-9 test, and at PSW5B2 and PSW-6A for the combined extraction well tests to monitor the hydraulic response during recovery and pumping. Transducers recorded pressure head measurements at 30-second intervals. A barometer data logger was deployed at the SW-10 location to measure background barometric atmospheric pressure changes. Water levels and total well depths were manually measured and recorded to within one hundredth of a foot before transducers were deployed in the wells. A summary of the aquifer testing is provided in Table 1. Following the testing, the transducer data were downloaded and compensated for barometric changes that occurred during the tests. Depending on the hydraulic response and data plots, the water level data were



analyzed using the software AQTESOLV™ (Duffield, 2007)¹. Groundwater analytical solutions were selected based on the aquifer characteristics and data plots to estimate the hydraulic properties of the alluvial aquifer, which are discussed further in Section 3.1.

2.1.2 PW-9 Aquifer Testing

The PW-9 aquifer test during October 2018 achieved a maximum constant pumping rate of approximately 13 gallons per minute (gpm). This pumping rate depressed the water table less than one foot and yielded insufficient data for a meaningful aquifer analysis. It was determined that additional aquifer testing was necessary at PW-9 using a much higher pumping rate. After upgrading the piping, pump, and electrical power supply at PW-9, additional aquifer testing was completed during the week of September 2, 2019.

Prior to the aquifer test, the City video-logged PW-9 on May 2, 2019. There is no well construction log for PW-9. Hence, the video-log determined the total well depth, well screen location, and the quality of the well screen.

The second round of aquifer testing at PW-9 occurred after the installation of a new pump with a flow rate capacity and pressure head capability greater than 50 gpm. Before the 24-hour aquifer test was conducted, a step test was done. The step test was a series of 1-hour tests performed at progressively higher pumping rates (e.g., 20 gpm, 30 gpm, and 40 gpm) to measure the drawdown in the pumping well and determine its specific capacity and hydraulic efficiency. Based on the results of the step test, the 24-hour aquifer test was conducted at a constant rate of 63 gpm.

Transducers were placed in select surrounding monitoring wells (PW-8, PSW-19B, PSW-20B, and SW-10) to measure the hydraulic response during pumping and subsequent recovery with the pump turned off. Transducers were programmed to measure hydraulic pressure head at 30-second intervals. A barometer data logger was deployed at PSW-19B. Initial water levels in monitoring and extraction wells were measured and recorded to within one hundredth of a foot before transducers were deployed. During the test, manual water level measurements were collected periodically to compare with the transducer data. A summary of the second round of aquifer testing at PW-9 is provided in Table 1. Transducer data were downloaded and compensated for barometric changes during the test. Aquifer testing data were inputted into the AQTESOLV™ software for analysis using appropriate analytical solutions, which is discussed in Section 3.1.2.

2.2 Direct Push Field Investigation

GHD advanced 49 direct-push borings at the locations shown on Figure 2. Borings were advanced to a maximum depth of 70 feet below ground surface (bgs), or until competent bedrock refusal was met. The depth was also guided by field screening nitrate results. A GHD representative, under the supervision of a Kansas-licensed geologist, examined and classified recovered unsaturated soil samples in the field in accordance with the Unified Soil Classification System (USCS). Stratigraphic boring logs are found in Appendix B. Field documentation is found in Appendix C.

¹ Duffield, G.M., 2007. AQTESOLV for Windows Version 4.5 User's Guide, HydroSOLVE, Inc., Reston, VA.



2.2.1 Soil Sampling

Soil sampling was performed continuously in 5-foot increments for lithologic logging purposes until bedrock or perched groundwater was encountered, whichever occurred first. Unsaturated soil samples were collected at 5-foot intervals starting from the bottom of topsoil or fill material to bedrock refusal or until perched groundwater was encountered, whichever occurred first.

Additional field screening was performed using soil test colorimetric strips for nitrate and nitrite (LaMotte Insta-Test) and ammonia (MicroEssential Labs Hydrion) to adjust sampling location, depth, and frequency. Selected soil samples were submitted to Pace Analytical Laboratories (Pace) in Lenexa, Kansas for laboratory analyses of nitrate content, ammonia content, and percent moisture, under standard chain of custody procedures. A soil sample summary is shown in Table 2. The City laboratory is not enabled to, and therefore did not analyze nitrate and ammonia in soil.

Downhole equipment was field cleaned before the field work and between each new boring. All soil cuttings from direct-push activities were staged on-site with other nitrate/ammonia affected soil and are currently kept covered, until a future date when corrective action alternatives approved for the Site are implemented.

2.2.2 Groundwater Sampling

Groundwater samples were collected from within the direct push drilling equipment. Samples were collected using dedicated polyethylene tubing fitted with a foot valve or with a peristaltic pump. Concurrent with sample collection, the sampled groundwater was measured for pH, temperature, and conductivity. Between one and four groundwater samples were collected from each boring at various depths, depending on geology encountered and the ability of the location to produce groundwater. Groundwater was collected from the perched groundwater (if possible), the upper alluvial aquifer (approximately 30-35 feet bgs), the middle alluvial aquifer (approximately 40-45 feet bgs), and the bottom of each boring (approximately 65-70 feet bgs). Groundwater samples were submitted to the laboratory for analyses of nitrate and ammonia content.

The City, as is customary for this project, performed all water analyses. Duplicate quality control groundwater samples (at the rate of approximately 2 in 10) were analyzed by Pace. A groundwater sampling summary is provided in Table 3. Field documentation is found in Appendix C.

Downhole equipment was cleaned before the field work and between each new boring. As is currently the sampling protocol for the Site, all purged groundwater (not otherwise submitted for analysis) was containerized and disposed of at the City's waste water treatment plant as previously approved by KDHE for investigative derived waste (IDW) water generated during routine groundwater monitoring at the Site.

3. DGS Sampling Results

This section presents the aquifer testing, soil sampling, and groundwater sampling results from the DGS investigation activities. AQTESOLV™ analyses are presented in Appendix D. GHD data validation memorandum and Pace analytical laboratory reports are presented in Appendix E. The



City analytical laboratory reports are presented in Appendix F. GHD did not complete data validation for the City laboratory reports.

3.1 Aquifer Testing Results

3.1.1 October 2018 Aquifer Testing Results

Aquifer testing was conducted to estimate the alluvial aquifer properties in order to identify the groundwater extraction rates necessary to establish and sustain hydraulic capture of nitrate and ammonia in the alluvial aquifer at each alluvial recovery well in accordance with the current CAD for the Site. The results of the first aquifer test at PW-9 showed that a constant pumping rate of 13 gpm created insufficient hydraulic response beyond the pumping well to yield meaningful data analysis. From the combined extraction well test, monitoring wells PSW-5B2 (alluvial aquifer) and PSW-6A (terrace deposits) showed no response during the aquifer test. Hence, the only noted responses were in the three pumping wells.

The aquifer test results were analyzed using one or more of the following methods: Theis (1935²) Recovery, Cooper and Jacobs (1946³), and Papadopoulos and Cooper (1967⁴). GHD used AQTESOLV™ to analyze the results from each pumping well and estimate transmissivities of the aquifer at each location. The average transmissivity for PSW-3B3 is 0.70 square feet per minute (ft²/min); however, this low transmissivity value may be influenced by the well's poor hydraulic efficiency due to clogging issues. For PSW-6B4 and PSW-7B2 the average transmissivities are 3.26 ft²/min and 3.88 ft²/min, respectively. At PW-9, due to its low pumping rate, only the Theis Recovery method could be applied. The average transmissivity for PW-9 was calculated to be 7.91 ft²/min. A summary of aquifer testing results is shown in Table 3.1. AQTESOLV plots are provided in Appendix D.

Table 3.1 2018 Aquifer Testing Transmissivity Results

Well	Theis Recovery	Cooper-Jacob	Papadopoulos-Cooper	Transmissivity Average
PW-9	7.91	-	-	7.91
PSW-3B3	0.90	0.50	-	0.70
PSW-6B4	2.36	2.58	4.83	3.26
PSW-7B2	3.05	4.29	4.29	3.88
All results in ft ² /min				

3.1.2 September 2019 PW-9 Aquifer Testing Results

During the second aquifer test at PW-9, the new pump operated at a higher rate (i.e., 63 gpm), which created a measurable hydraulic response at PSW-19B, PW-8, and PSW-20B. Given their hydraulic response, the aquifer test data from PW-9 and PSW-19B were entered into the

² Theis, C.V., 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage, Am. Geophys. Union Trans., vol. 16, pp. 519-524.

³ Cooper, H.H. and C.E. Jacob, 1946. A generalized graphical method for evaluating formation constants and summarizing well field history, Am. Geophys. Union Trans., vol. 27, pp. 526-534.

⁴ Papadopoulos, I.S. and H.H. Cooper, 1967. Drawdown in a well of large diameter, Water Resources Research, vol. 3, no. 1, pp. 241-244.



AQTESOLV program to estimate the transmissivity of the alluvial aquifer at PW-9 using the aquifer analytical methods of Theis (1935⁵), Copper and Jacob (1946⁶), and Hantush and Jacob (1955⁷).

GHD calculated transmissivity results ranging from 4.13 ft²/min to 7.35 ft²/min, with an average value of 5.67 ft²/min. In addition, a distance-drawdown graph was prepared that incorporates the drawdown data from the other monitoring wells at a specific time during the pumping test. The distance drawdown analysis is a variation of the Copper and Jacob (1946) method and produced a transmissivity result of 4.14 ft²/min. The transmissivity results are summarized on Table 3.2. Aquifer analysis plots are provided in Appendix D.

Table 3.2 PW-9 Aquifer Testing Results

Well	Cooper-Jacob	Hantush - Jacob	Theis Recovery	Transmissivity Average
PW-9	6.25	-	5.32	5.79
PSW-19B	5.08	5.08	4.13	4.76
PW-8	7.35	6.56	5.61	6.51
				5.67 (Overall)
All results in ft ² /min				

3.2 Soil Sampling Analytical Results

GHD collected 142 soil samples from above the perched water table at the identified data gap areas. Soil sample results are summarized in Table 4. Soil sample results from each DGS study area are discussed below. Only soil samples collected from the identifiable unsaturated vadose zone were subjected to field and laboratory analysis.

3.2.1 Bag Warehouse Area

Soil sample results from the Bag Warehouse Area are shown on Figure 3. Ammonia soil concentrations in the Bag Warehouse Area ranged from non-detect (ND), which is below the laboratory method detection limit (MDL), to 787J ("J" is the laboratory's qualifier indicating a result has been estimated between the laboratory Reporting Limit and the MDL) milligrams per kilogram (mg/kg). Nitrite/nitrate concentrations in the Bag Warehouse Area range from ND to 55.4J mg/kg, with the majority (65%) of the sample intervals being ND.

Soil samples collected from borehole locations north of PW-9 (SB-12, SB-13, SB-14, SB-48, and SB-49) had no ammonia detections and less than 5 mg/kg to non-detect nitrate concentrations. Only four of the 17 boring locations (SB-16, SB-21, SB-22, and SB-24) contained estimated ammonia concentrations above 100 mg/kg. Whereas, only two out of 17 locations (SB-16 and SB-22) reported soil samples with nitrite/nitrate concentrations above 10 mg/kg. Soil boring SB-16 is located approximately 200 feet south of the Bag Warehouse Area. Soil boring SB-22 is located along the

⁵ Theis, C.V., 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage, Am. Geophys. Union Trans., vol. 16, pp. 519-524.

⁶ Cooper, H.H. and C.E. Jacob, 1946. A generalized graphical method for evaluating formation constants and summarizing well field history, Am. Geophys. Union Trans., vol. 27, pp. 526-534.

⁷ Hantush, M.S. and C.E. Jacob, 1955. Non-steady radial flow in an infinite leaky aquifer, Am. Geophys. Union Trans., vol. 36, pp. 95-100.



north end of the Bag Warehouse building. Overall, the soil concentrations in the Bag Warehouse Area, are relatively low and do not indicate substantial soil impacts at or near the ground surface. The soil results do not indicate the Bag Warehouse are being a potentially significant contributor to groundwater impacts

3.2.2 Western Ponds Area

Soil sample results from the West Extension Pond in the Western Ponds Area are shown on Figure 4. The ammonia concentrations in soil samples collected in the West Extension Pond Area ranged from 3.7J mg/kg to 8,520J mg/kg with 10 out of 12 locations having ammonia above 100 mg/kg. Nitrite/nitrate soil concentrations ranged from 1.1 mg/kg to 5,120 mg/kg with every location having nitrite/nitrate above 10 mg/kg. The majority of high ammonia and nitrite/nitrate concentrations are located within soil borings around the West Extension Pond (i.e., SB-25, SB-27, and SB-36) and to the north of the West Extension Pond (SB-26 and SB-28). A total of 6 out of 12 borehole locations reported soil samples that contained concentrations of both ammonia and nitrite/nitrate that exceeded 1,000 mg/kg; these include SB-25, SB-26, SB-27, SB-28, SB-31, and SB-36. The West Extension Pond Area represents a potentially significant source for ongoing impacts to groundwater and contains a higher amount of nitrogen mass compared to Bag Warehouse and East and West Lime Pond Areas. Certain boring locations, such as SB-25, SB-27, SB-28, and SB-36, show high concentrations throughout most of the vertical soil profile to depths of 20 feet or more bgs.

3.2.3 Eastern Ponds Area

Soil sample results from the East Lime Pond, West Lime Pond, and Rundown Pond in the Eastern Ponds Area are shown on Figure 5. Ammonia concentrations in soil samples collected within the East and West Lime Ponds Area ranged from non-detect (ND) to 5,860 mg/kg with 9 out of 10 borehole locations reporting ammonia above 100 mg/kg. Nitrite/Nitrate concentrations in soil samples ranged from ND to 3,390 mg/kg with every borehole location reporting nitrite/nitrate concentrations above 10 mg/kg. The boreholes from which soil samples contained ammonia and nitrite/nitrate concentrations greater than 1,000 mg/kg include SB-4, SB-42, SB-43, SB-44, and SB-46. In particular the soil samples from the boreholes located within the Rundown Pond showed elevated nitrate and ammonia concentrations starting around 10 feet bgs. The East and West Lime Pond Area shows variable soil impacts with SB-41, SB-42, and SB-43 showing the higher overall nitrogen concentrations compared to other borings in this area with SB-42 and SB-43 exhibiting higher nitrogen concentrations at depths greater than 10 feet bgs.

3.3 Groundwater Sampling Analytical Results

GHD collected 133 groundwater samples within the identified data gap areas to update previous assessment data regarding the horizontal and vertical extent of ammonia and nitrite/nitrate concentrations at the Site. Groundwater sample results are summarized in Table 5. Groundwater sample results for each DGS study area are discussed below.

3.3.1 Bag Warehouse Area

Groundwater sample results from the Bag Warehouse Area are shown on Figure 6. Ammonia concentrations in groundwater samples collected from the Bag Warehouse Area ranged from ND to



121 milligrams per liter (mg/L). Locations from which groundwater samples contained ammonia concentrations greater than 100 mg/L include SB-14 and SB-23. Nitrite/Nitrate groundwater concentrations within the Bag Warehouse Area ranged from 1.5 mg/L to 344 mg/L. All borehole locations contained at least one sample interval from which groundwater samples contained nitrite/nitrate concentrations greater than 10 mg/L, with the exception of SB-20 and SB-47. In addition, several locations showed increasing nitrate concentrations with depth, including SB-11, SB-12, SB-14, SB-23, and SB-24. Elevated nitrate concentrations were typically found to depths of 40 to 50 feet bgs.

3.3.2 Western Ponds Area

Groundwater sample results from the West Extension Pond in the Western Ponds Area are shown on Figure 7. Ammonia concentrations in groundwater samples collected from within the West Extension Pond Area ranged from 14.6 mg/L to 20,400 mg/L. All sample locations reported elevated ammonia. Nitrite/Nitrate concentrations in groundwater samples collected within the West Extension Pond Area ranged from 1.36 mg/L to 23,200 mg/L. All locations had exceedances nitrite/nitrate greater than 10 mg/L, with the exception of SB-31 and SB-34. The SB-36 location had the highest ammonia and nitrite/nitrate concentrations of 20,400 mg/L and 23,200 mg/L, respectively at 31 to 35 feet bgs. The West Extension Pond Area reported the highest dissolved nitrogen concentrations under the DGS with several locations showing elevated nitrate concentrations (> 500 mg/L) at depths greater than 50 feet bgs.

3.3.3 Eastern Ponds Area

Groundwater sample results from the East Lime Pond, West Lime Pond, and Rundown Pond in the Eastern Ponds Area are shown on Figure 8. Ammonia concentrations in groundwater within the East and West Lime Ponds Area range from 2.13 mg/L to 8,960 mg/L, with only one location (SB-41) reporting an elevated (>50 mg/L) ammonia concentration. The nitrite/nitrate concentrations ranged from 0.50 mg/L to 10,900 mg/L, with only two locations (SB-41 and SB-45) reporting nitrate above 10 mg/L. The highest nitrate concentrations were reported within the terrace deposits at depths less than 30 feet bgs.

3.3.4 PSW-5B2 Area

Groundwater sample results from the PSW-5B2 Area are shown on Figure 9. Ammonia concentrations from groundwater samples collected from within the PSW-5A Area ranged from 5.16 mg/L to 288 mg/L, where three locations (SB-4, SB-5, and SB-6) showed ammonia concentrations lower than 100 mg/L. Nitrite/Nitrate concentrations ranged from ND to 5.97 mg/L. No groundwater samples from this area contained a nitrite/nitrate concentration exceeding 10 mg/L.

4. Data Evaluation

This section provides an evaluation of the extraction well efficiency, soil quality, and groundwater quality at the Site. The purpose of this data evaluation is to update the current conditions of soil and groundwater quality across the Site; to update the Site's alluvial aquifer characteristics; and to



update the CSM necessary to form the basis for the Cost-Benefit Analysis of alternative remedial strategies to the current non-viable strategies in use at the Site.

4.1 Aquifer Testing Analysis

The two aquifer testing events provided the data necessary to estimate the hydraulic parameters for the alluvial aquifer system, particularly at PW-9 (north of the Bag Warehouse) area. The alluvial aquifer at PW-9 has a transmissivity (T) of approximately 5.7 ft²/min. This transmissivity value corresponds to a hydraulic conductivity (K) value of 0.19 ft/min, based on an alluvial aquifer thickness of 30 ft. These T and K values indicate that the alluvial aquifer is permeable and is capable of transmitting large quantities (> 70 gpm) of groundwater from a single extraction well.

At PSW-3B3, PSW-6B4, and PSW-7B2, north of the eastern ponds, the alluvial aquifer average transmissivity results were approximately 40% less than the PW-9 area with an average value of 3.5 ft²/min. The aquifer analysis for PSW-3B3 is significantly lower and is considered anomalous due to a history of mineral or biological fouling of the well at this location. Overall, the results from PSW-6B4 and PSW-7B2 show the aquifer is permeable with a corresponding K value of 0.12 ft/min. The aquifer testing results indicate a higher sustainable constant flow rate is attainable than their current design of 25 gpm, with the exception of PSW-3B3. The aquifer testing suggests PSW-3B3 is in need of significant maintenance or replacement if needed for future remediation,

4.1.1 Groundwater Flow Velocity Analysis

The pumping test data determined the hydraulic parameters of the alluvial aquifer. By applying those parameters, the groundwater flow velocity (v) with the alluvial aquifer can be calculated using the following formula:

$$v = \frac{Ki}{ne}$$

where:

K = hydraulic conductivity (ft/min)

i = hydraulic gradient (ft/ft)

ne = effective porosity

The hydraulic gradient across the Site is relatively flat. Using the groundwater elevation data from the 2019 Performance Evaluation Report (PER 85), a hydraulic gradient of 0.0009 ft/ft is estimated. The effective porosity is an assumed value of 0.25. Using the range of K values (0.19 to 0.12 ft/min) from the aquifer tests, the groundwater flow velocity ranges from 6.8×10^{-4} ft/min to 4.3×10^{-4} ft/min or 0.98 ft/day to 0.63 ft/day, respectively.



4.1.2 Groundwater Capture Analysis

Based on the results of the aquifer tests, the zone of capture for each pumping well can be calculated. According to the USEPA⁸, the hydraulic capture zone (d), at the extraction well, is defined by the following equation:

$$d = Q/2Ti$$

where:

Q = extraction rate (ft³/min)

T = transmissivity (ft²/min)

i = hydraulic gradient (ft/ft)

Table 4.1 Capture Width Calculation

Well	Extraction Rate (ft ³ /min)	Transmissivity (ft ² /min)	Hydraulic gradient	Capture Width (ft)
PW-9	1.74 (13 gpm)	5.67	0.0009	171
PSW-3B3	2.00 (15 gpm)	3.5*	0.0009	318
PSW-6B4	3.21 (24 gpm)	3.5	0.0009	510
PSW-7B2	2.27 (17 gpm)	3.5	0.0009	360
* Assumes the transmissivity at PSW-3B3 is comparable to the other nearby extraction wells.				

As noted in Table 4.1, the capture width generated by the four extraction wells ranged from 170 to 510 feet. PSW-3B3 and PSW-6B4 are approximately 300 feet apart. While PSW-7B2 is approximately 850 feet east from PSW-6B4 (see Figure 2), These capture widths indicate that PSW-3B3 and PSW-6B4 would interact with each other as a single well type system to create a large capture zone. However, there is very likely a flow gap between PSW-7B2 and the other two extraction wells because of the distance between them is greater than the combined predicted capture widths. This flow gap may be a moot point, however, because these wells do not capture elevated levels of nitrate or ammonia.

4.2 Analytical Results Analysis

4.2.1 Soil

Soil sampling was conducted in the unsaturated zone within the unconsolidated overburden. The overburden includes organic topsoil, Newman Terrace Deposits, and Kansas Alluvial Deposits.

In the Bag Warehouse Area, the soil samples showed comparatively lower ammonia and nitrite/nitrate concentrations than the other areas within the DGS. At the Bag Warehouse Area, concentrations of ammonia over 100 mg/kg and nitrite/nitrate over 10 mg/kg are found at SB-16 at a depth between 20 and 28 feet bgs and at various intervals at SB-21 and SB-22. None of the soil samples identified a possible source area due to surface releases.

⁸ U. S. Environmental Protection Agency. 2008. A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems. EPA 600/R-08/003



Within the West Extension Pond Area, ammonia and nitrite/nitrate concentrations greater than 1,000 mg/kg are present between 0 to 30 feet bgs. Soil samples collected directly around the West Extension Pond (SB-25, SB-27, and SB-36) had ammonia and nitrite/nitrate concentrations greater than 1,000 mg/kg from the surface to 30 feet bgs, while at boreholes to the north (SB-26 and SB-28) concentrations exceeding 1,000 mg/L were found between the surface and 20 feet bgs (groundwater was encountered during sampling at a depth of approximately 30 feet bgs). Elevated levels of both ammonia and nitrate are found across the unsaturated soil profile down to the water table encountered during sampling at a depth of ranging from approximately 5 bgs to 30 feet bgs. This area has been subject to surface runoff and surface water collection from neighboring ponds and past operations.

Within the Eastern Pond Area, Rundown Pond and East Lime Pond sample locations SB-41, SB-42, SB-43, and SB-46 had ammonia and nitrite/nitrate concentrations greater than 1,000 mg/kg. Sample locations SB-41 and SB-42 are located within the Rundown Pond and had concentrations greater than 1,000 mg/kg between 10 to 33 feet bgs. The SB-43 and SB-46 sample locations are located within the East Lime Pond and had concentrations greater than 1,000 mg/kg between 0.5 to 9 feet bgs. The elevated samples were found within or near these former pond bottoms. For the East Lime Pond, concentrations decrease with depth. Whereas, at the Rundown Pond the highest concentrations are found near the pond bottom. At the West Lime Pond, the overall ammonia and nitrate concentrations tend to be less compared to the Rundown Pond and East Lime Pond.

4.2.2 Groundwater

The groundwater data were collected across the saturated interval from both the Newman Terrace Deposits and the Kansas Alluvial Deposits down to the top of the bedrock surface.

Groundwater samples indicate that the Bag Warehouse Area has minor ammonia impacts, with only two locations immediately surrounding the Bag Warehouse (SB-15 and SB-23) having ammonia concentrations exceeding 100 mg/L from 43 to 50 feet bgs. Nitrite/Nitrate in groundwater in the Bag Warehouse Area is far more prominent and concentrations exceeding 10 mg/L were found in a majority of the samples at depths between 15 to 59 feet bgs. At several locations, there is an increasing downward concentration (e.g., SB-14, SB-23, and SB-24). This information in conjunction with the soil sampling results (see Figure 3) indicate that the elevated levels may be coming from upgradient of the Bag Warehouse building and migrating underneath the building. The concentrations found near the northern property boundary, along N 1500 road, suggests a plume migrating off-site with an approximate width 1,100 feet from SB-14 to SB-24 (see Figure 6).

The West Extension Pond Area has overall substantially higher ammonia and nitrite/nitrate concentrations compared to the other DGS areas, with concentrations approximately one to two orders of magnitude greater than the Bag Warehouse and Rundown Pond, East Lime Pond, and West Lime Pond Areas. Highest concentrations of both contaminants are found directly next to or north of the West Extension Pond. Borehole SB-34 shows the southern extent of the ammonia and nitrite/nitrate plumes. In this area, the groundwater is found primarily in the low permeability Newman Terrace Deposits, which consists of silty clay, as noted at borings SB-26 and SB-28 (see Appendix B).

The PSW-5B2 Area is north of the West Extension Pond Area. The groundwater samples in this area show significantly lower concentrations than is reported in the West Extension Pond Area.



According to the City's interpretations of historic groundwater elevation data as presented in their Performance Evaluation Reports (PERs), groundwater flows in a generally northerly direction towards the Kansas River. The low ammonia and nitrate concentrations in the PSW-5B2 Area suggest that the affected groundwater from the West Extension Pond, in particular the North Sump Area, may not be moving off-site. However, off-site groundwater further east of PSW-5B2 and downgradient of the Regional Detention Basin is not being monitored.

The Rundown Pond, East Lime Pond and West Extension Pond Areas have a maximum ammonia concentration in groundwater of 8,980 mg/L. However, this result is within the fine-grained silty clay terrace deposits and at a depth comparable to the base of the Rundown Pond. Nitrate is below the drinking water standard in all the samples collected from the alluvial aquifer in this area at SB-38, SB-42, and SB-45. In comparing the soil data to the groundwater data, the data indicate that the low permeable Newman Terrace Deposits successfully mitigate downward migration to the alluvial aquifer.

4.3 Updated Conceptual Site Model

The DGS program provided additional data to update the CSM for the Site. The DGS further characterized certain areas as potential contributing sources of nitrogen for off-site groundwater migration. The DGS evaluated the alluvial aquifer hydraulic characteristics as it relates to hydraulic containment and evaluation of the existing groundwater extraction system.

The various investigations conducted at the Site have identified the primary sources of nitrogen contamination based on past Site operations:

- Sandstone Hill
- Central Ponds Area
- Western Ponds Area
- Eastern Ponds Area

Other areas may be contributing such as the Bag Warehouse and Plant A, but their contributions are relatively minor.

4.3.1 Sandstone Hill Area

The Sandstone Hill Area has identified nitrate and ammonia impacts attributed to the UAN ponds formerly located on top of the Sandstone Hill (see Figure 2 for location of Sandstone Hill). Nitrate and ammonia leached downward into the fractured shale and sandstone. The nitrogen impacts were further mobilized by surface infiltration of precipitation and groundwater flowing underneath the hill from the southwest.

The surface soils on Sandstone Hill are comprised primarily of clay and weathered shale and sandstone. Nitrogen impacted surface runoff from precipitation events flows via sheet flow to the west, south and east. Seeps of groundwater have been observed in rock outcrops and exterior sides on the west, south, east and north sides of the bluff. Groundwater that successfully percolates to the interior base of the hill via fractures within the interbedded layers of sandstone, shale, and siltstone



eventually transport dissolved nitrogen and minerals to the perched groundwater within the terrace deposits and eventually into the underlying regional Kansas River alluvial aquifer.

4.3.2 Central Ponds Area

The Central Ponds Area is located on the southeastern part of Sandstone Hill. In 2006, 1,300 cubic yards of nitrogen impacted soil were removed and relocated to the East Lime Pond. The area was restored using approximately 2,700 cubic yards of imported fill soil. Due to ongoing seepage of nitrogen-impacted groundwater from the south side of Sandstone Hill which re-impacted the Central Ponds Area, additional remedial work was approved by the KDHE. In 2014, a shallow groundwater interception french drain system was installed on the north and south sides of the access road that traces along the north edge of the Central Ponds Area. The trench is connected to a subgrade sump (CP sump). Under previous remedial operations, groundwater gathered by the CP sump was pumped to the ASTs for reuse in irrigation and fertilizer of crops north of the river. The Central Ponds continue to show elevated nitrate and ammonia concentrations as groundwater from the Sandstone Hill continues to seep into this area.

4.3.3 Western Ponds Area

The Western Ponds – including the Krehbiel, Old West and West Extension ponds – were once a key part of the manufacturing process. Historical practices resulted in releases of nitrogen to soil and groundwater in and beneath the ponds. The DGS confirms that substantial nitrogen mass remains in this area both in the unsaturated soil and groundwater. This area may also be affected by groundwater seepage from the Sandstone Hill into the unconsolidated soils that abut against the bedrock. These nitrogen impacts appear to be affecting the perched and alluvial groundwater quality downgradient to the northwest, north and northeast.

4.3.4 Eastern Ponds Area

The Eastern Ponds – including East Lime Pond, Overflow Pond, Rundown Pond and West Lime Pond - were used to store and manage the facility's waste and cooling waters. The DGS indicates that the pond bottoms are constructed of a native very low permeability clay and within the Newman Terrace Deposits. These low permeability materials have effectively inhibited downward migration of nitrogen compounds into the alluvial aquifer, as evidenced by the relatively low to non-detectable nitrogen compound concentrations measured in alluvial aquifer groundwater samples collected with direct-push probes below the ponds and in downgradient extraction well system.

4.3.5 Bag Warehouse Area

The DGS data indicates that minor nitrate and ammonia impacts to surface and subsurface soil in this area is a result of former operations and releases to the environment which occurred during the transfer of final product to truck and rail. However, the area is effectively covered with an impermeable cap (the warehouse and supplemental paving). The groundwater data show that groundwater from Sandstone Hill is carrying dissolved nitrogen north beneath the warehouse.



4.3.6 Plant A

Historical operation and waste management practices impacted the soil and groundwater throughout this area. Due to the network of former utilities, some of which were cleaned and abandoned in place, useful access to the soil and groundwater in this area for the purpose of active remediation is extremely limited. However, the area was networked with a labyrinth of subsurface process and process sewer piping for the duration of the manufacturing use at the Site. The area is currently mostly paved, which limits the potential for leaching nitrogen from impacted soils to the groundwater units below.

4.3.7 Site Groundwater

The Site groundwater has been impacted by past Site operations. In particular, Sandstone Hill represents a significant source to groundwater impacts. Given its topographic location, Sandstone Hill is a groundwater recharge source that discharges radially into the adjoining unconsolidated sediments. If the water discharges into the sandy alluvial sediments it can readily migrate off-site, unless captured by the existing groundwater extraction system. In some instances, the groundwater discharges to the ground surface as seeps and then migrates as surface water down-slope to the west, and the south to the former Central Ponds Area and to the north and east toward the Western Ponds Areas.

The Newman Terrace Deposits are low permeability sediments that appear to effectively inhibit nitrogen migration, particularly in the East Ponds Area where minimal impact to the alluvial aquifer is observed. In the West Ponds Area, the unsaturated terrace deposits are relatively thick (>20 feet, approximately) and is capable of retaining significant nitrogen mass. While downgradient nitrogen impacts are observed off-site in groundwater at monitoring well PSW-5B2, the relative concentrations are orders of magnitude lower compared to what is measured on-site.

The Kansas Alluvial Deposits are permeable sand deposits that are capable of transmitting substantial quantities of water. The hydraulic testing shows the alluvial aquifer to be transmissive with a groundwater flow velocity between 0.5 to 1.0 ft/day (180 to 365 ft/yr). The high alluvial aquifer transmissivity is inversely proportional to hydraulic containment. Hence, PW-9 only effectively captures a portion of the nitrogen plume migrating underneath the Bag Warehouse Area and a potentially significant portion of the plume is allowed to migrate off-site. By rearranging the groundwater capture equation in Section 4.1.2, the minimum pumping rate can be determined, where

$$Q = 2Tid$$

Assuming a 1,000-foot capture width, PW-9 (if continuing to operate alone) would need to pump a minimum of 75 gpm to effect a capture consistent with the requirements of the current CAD. However, the USEPA (2008), recommends a safety factor of 1.5 to 2.0 to account for heterogeneities and unknown boundary conditions.

With respect to the other three groundwater extraction wells (PSW-3B3, PSW-6B4, and PSW-7B2), based on their groundwater effluent data of low to non-detect nitrogen data, these wells appear to provide no useful remedial benefit.



5. Conclusions

The DGS has evaluated the extent and magnitude of other potential source areas and their impact to off-site migration and site remediation.

The Bag Warehouse Area does not appear to represent a significant source area. However, impacted groundwater from the upgradient Sandstone Hill appears to be migrating underneath the Bag Warehouse Area into the alluvial aquifer and off-site. PW-9 captures a portion of the nitrogen affected groundwater. The updated aquifer analysis indicates higher extraction flow rates than the current pumping rate of 13 gpm are achievable and may be needed to improve capture of nitrogen affected groundwater at the location.

The Western Ponds Area contains significant nitrogen mass that occur mostly within the low permeability silt clay near surface terrace deposits. These low permeability deposits appear to inhibit off-site migration as evidenced by the low nitrogen detections found off-site in soil and groundwater near PSW-5B2.

The Eastern Ponds Area also shows high relative nitrogen concentrations within the low permeable deposits. However, the underlying sandy alluvial aquifer deposits do not show elevated nitrogen levels and indicate the terrace deposits are an effective aquitard that limits downward migration of nitrogen compounds, especially in the absence of hydraulic loading when the ponds are empty.

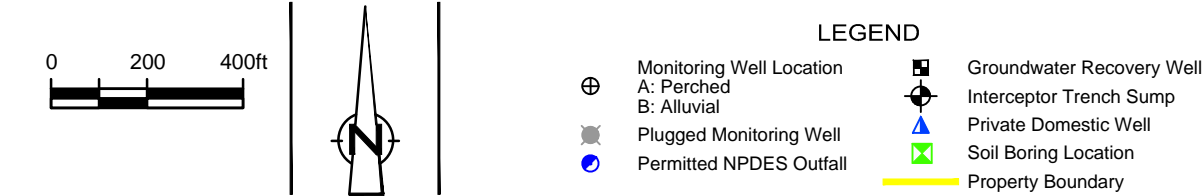
The current groundwater extraction system needs to be modified to more effectively capture migrating impacted groundwater in the areas of PW-9 and PSW-5B2. The groundwater system downgradient of the East Ponds Areas provides no apparent remedial benefit based on the DGS data.

The data, findings, and conclusions will be used to develop the Cost-Benefit Analysis comparing and evaluating potential corrective action alternatives for the Site.

Figures



Source: GOOGLE AERIAL IMAGE DATED SEPTEMBER 21, 2018

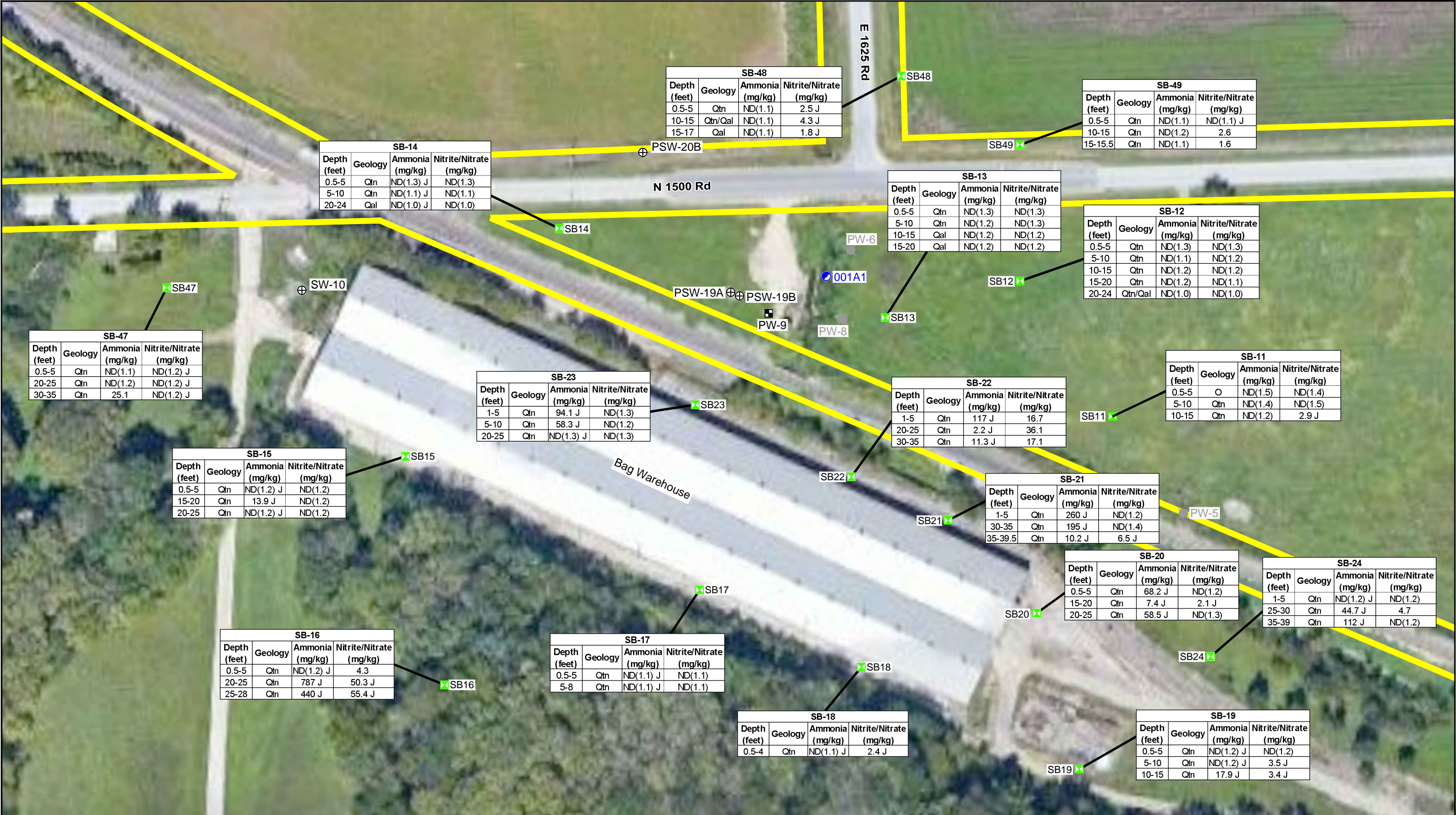


FORMER FARMLAND INDUSTRIES NITROGEN PLANT
2018 DATA GAP STUDY REPORT
1608 N 1400 ROAD, LAWRENCE, KANSAS

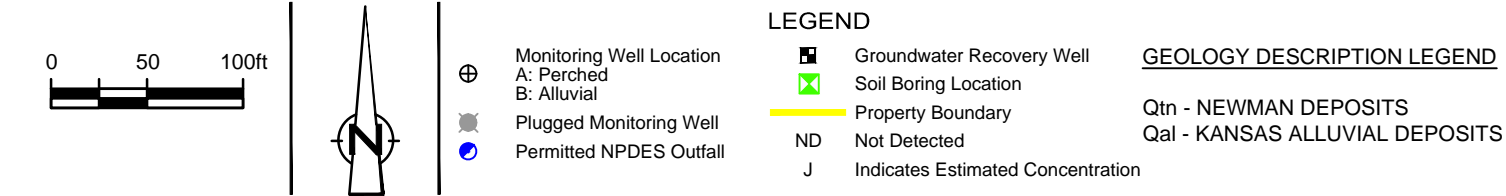
SITE LAYOUT - DGS SOIL BORING LOCATIONS

11152783-02
Feb 11, 2020

FIGURE 2



Source: GOOGLE AERIAL IMAGE DATED SEPTEMBER 21, 2018

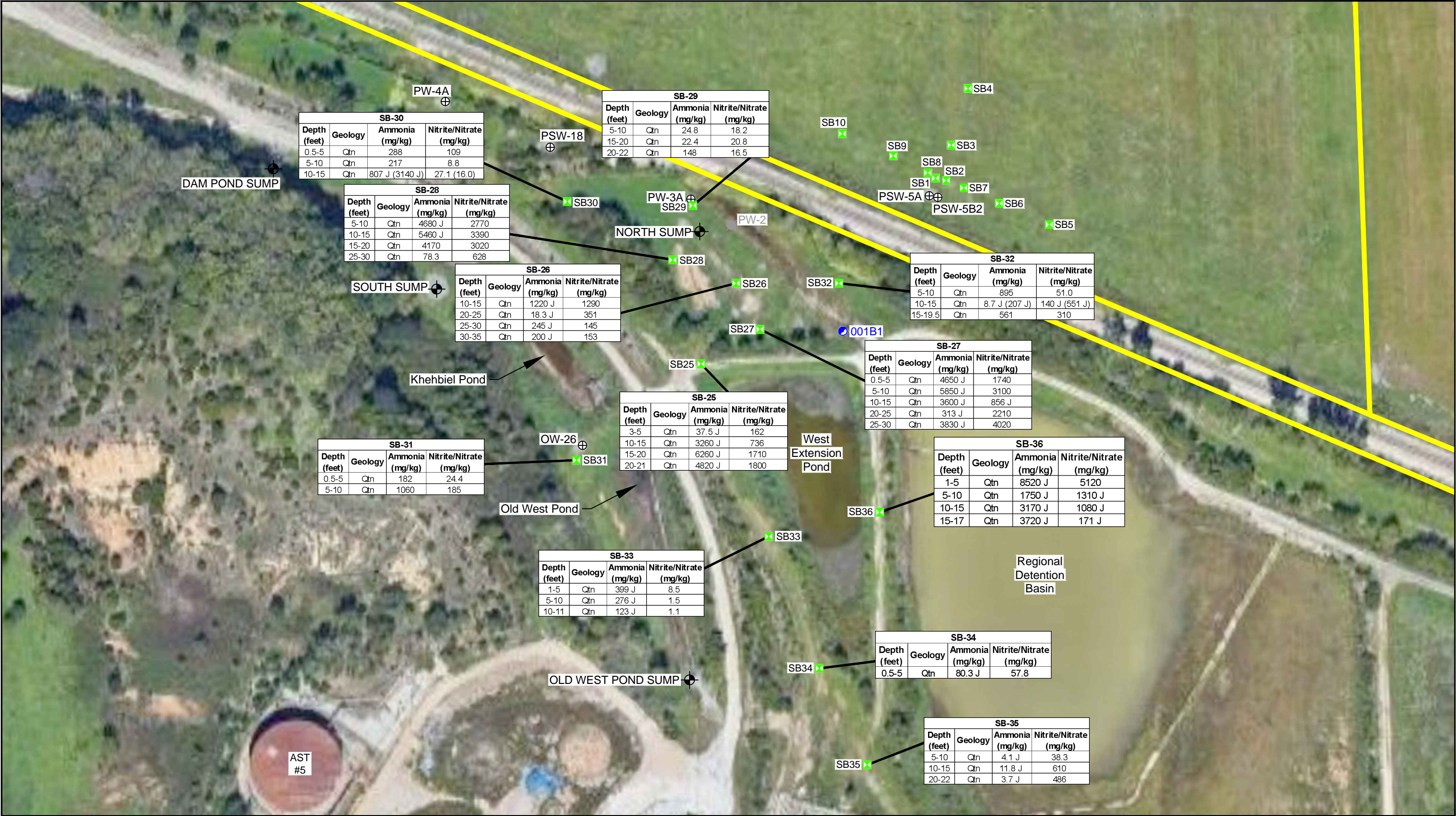


FORMER FARMLAND INDUSTRIES NITROGEN PLANT
2018 DATA GAP STUDY REPORT
1608 N 1400 ROAD, LAWRENCE, KANSAS

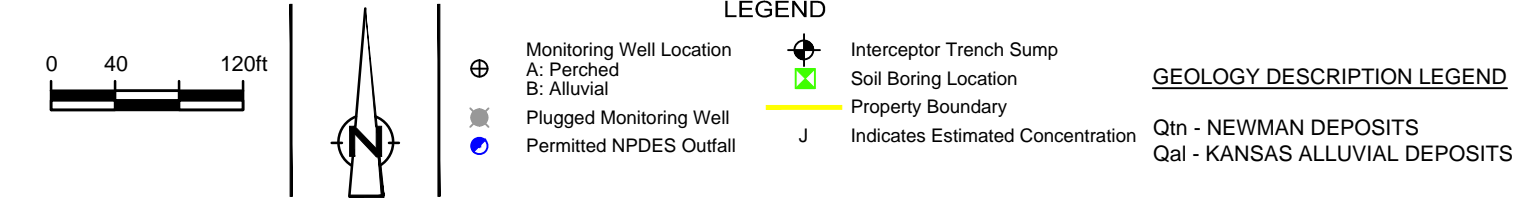
SOIL SAMPLING RESULTS - BAG WAREHOUSE

11152783-02
Sep 3, 2019

FIGURE 3



Source: GOOGLE AERIAL IMAGE DATED SEPTEMBER 21, 2018



FORMER FARMLAND INDUSTRIES NITROGEN PLANT
2018 DATA GAP STUDY REPORT
1608 N 1400 ROAD, LAWRENCE, KANSAS

SOIL SAMPLING RESULTS - WEST EXTENSION POND

11152783-02
Sep 3, 2019

FIGURE 4



Source: GOOGLE AERIAL IMAGE DATED SEPTEMBER 21, 2018

0200400ft

Monitoring Well Location

A: Perched

B: Alluvial

Plugged Monitoring Well

Groundwater Recovery Well

Interceptor Trench Sump

Soil Boring Location

Property Boundary

ND

J

GEOLOGY DESCRIPTION LEGEND

Qtn - NEWMAN DEPOSITS

Qal - KANSAS ALLUVIAL DEPOSITS

FORMER FARMLAND INDUSTRIES NITROGEN PLANT

2018 DATA GAP STUDY REPORT

1608 N 1400 ROAD, LAWRENCE, KANSAS

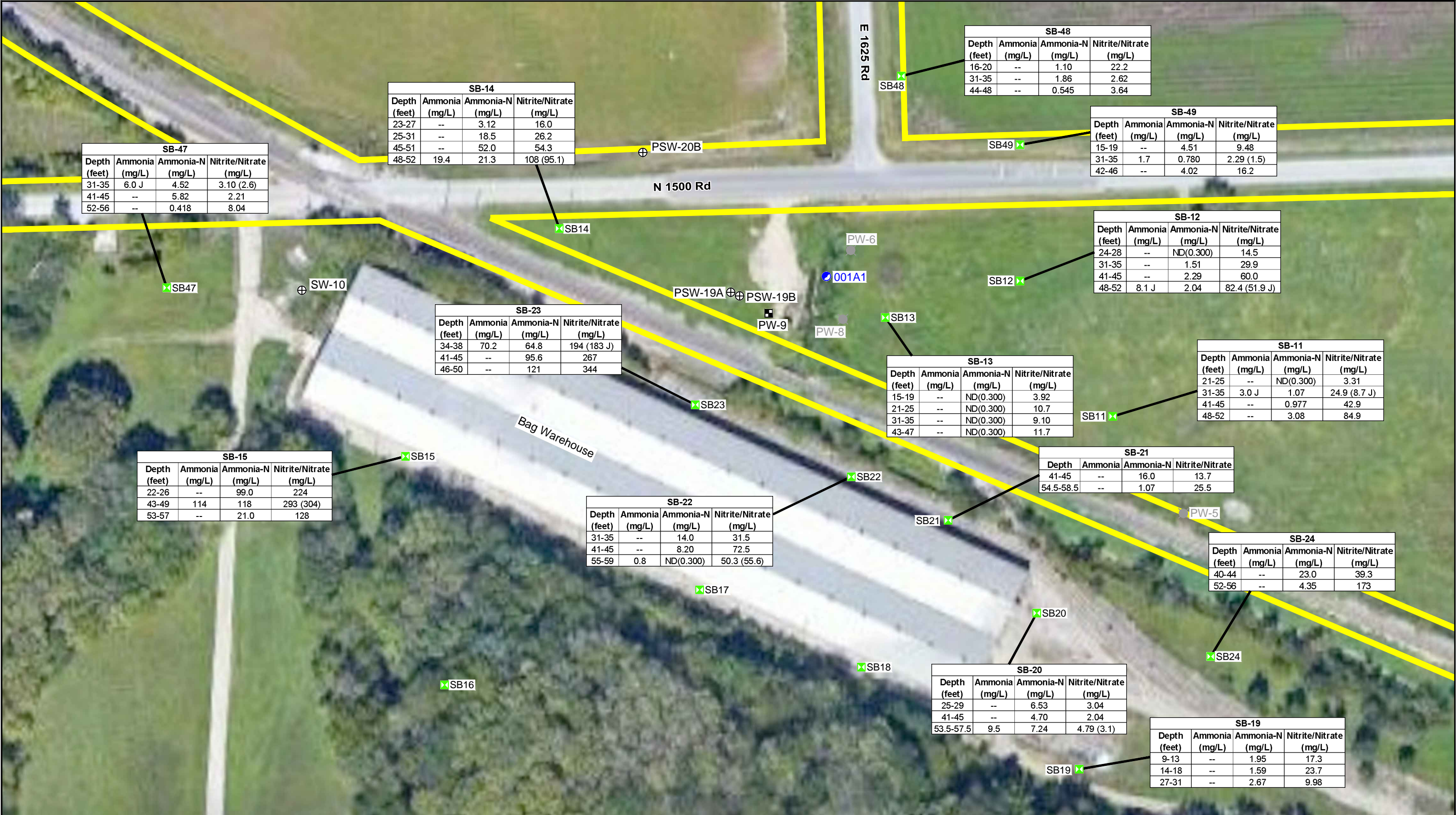
SOIL SAMPLING RESULTS - EAST AND WEST LIME PONDS

11152783-02

Sep 3, 2019

FIGURE 5

CAD File: I:\CAD\Files\Eight Digit Job Numbers\1115----\11152783-Lawrence_Farmland\Reports\11152783-02(002)Farmland Data Gap\11152783-02(002)GN-DL001.dwg



Source: GOOGLE AERIAL IMAGE DATED SEPTEMBER 21, 2018

050100ft

⊕

Monitoring Well Location

A: Perched

B: Alluvial

Plugged Monitoring Well

Permitted NPDES Outfall

■

Groundwater Recovery Well

Soil Boring Location

—

Property Boundary

ND

Not Detected

J

Indicates Estimated Concentration

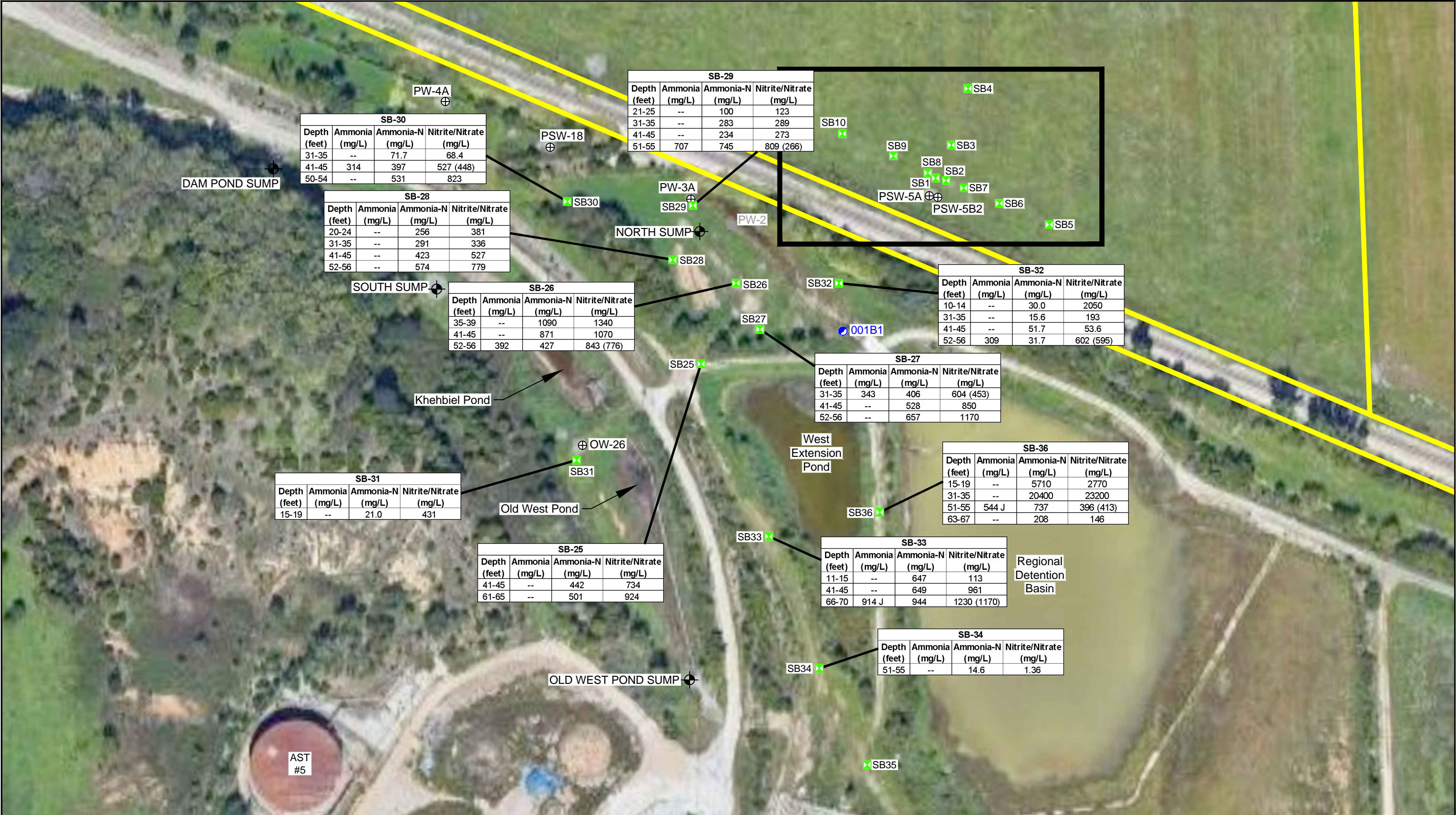
FORMER FARMLAND INDUSTRIES NITROGEN PLANT
2018 DATA GAP STUDY REPORT
1608 N 1400 ROAD, LAWRENCE, KANSAS

11152783-02
Sep 3, 2019

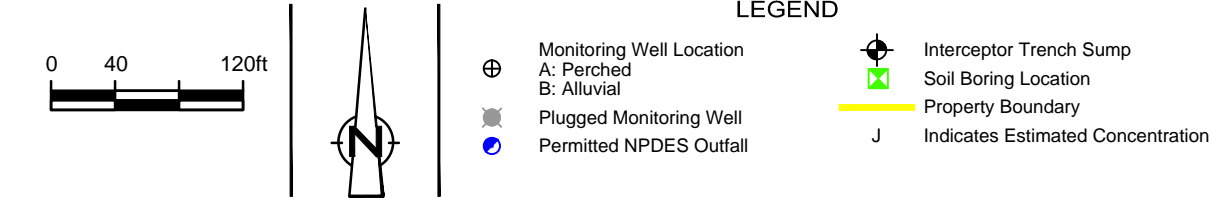
GROUNDWATER SAMPLING RESULTS - BAG WAREHOUSE

FIGURE 6

CAD File: I:\CAD\Files\Eight Digit Job Numbers\1115----\11152783-Lawrence_Farmland\Reports\11152783-02\002\Farmland Data Gap\11152783-02\002\GN-DL001.dwg



Source: GOOGLE AERIAL IMAGE DATED SEPTEMBER 21, 2018



FORMER FARMLAND INDUSTRIES NITROGEN PLANT
2018 DATA GAP STUDY REPORT
1608 N 1400 ROAD, LAWRENCE, KANSAS

11152783-02

Sep 3, 2019

GROUNDWATER SAMPLING RESULTS - WEST EXTENSION POND **FIGURE 7**



Source: GOOGLE AERIAL IMAGE DATED SEPTEMBER 21, 2018

0200400ft

⊕

Monitoring Well Location
A: Perched
B: Alluvial

⊗

Plugged Monitoring Well

⬜

Groundwater Recovery Well

⊕

Interceptor Trench Sump

⊗

Soil Boring Location

—

Property Boundary

FORMER FARMLAND INDUSTRIES NITROGEN PLANT
2018 DATA GAP STUDY REPORT
1608 N 1400 ROAD, LAWRENCE, KANSAS

GROUNDWATER SAMPLING RESULTS - EAST AND WEST LIME PONDS

11152783-02
Sep 3, 2019

FIGURE 8

CAD File: I:\CAD\Files\Eight Digit Job Numbers\1115----\11152783-Lawrence_Farmland\Reports\11152783-02(002)Farmland Data Gap\11152783-02(002)GN-DL001.dwg

Tables

Table 1

**Aquifer Testing Summary
Former Farmland Industries Nitrogen Plant
Lawrence, Kansas**

Pumping Well ID	Well Screen Interval (ft bgs)	Observation Well ID	Pumping Rate (gpm)	Date Pump Turned off	Date Pump Turned Back On	Recovery (feet)	Drawdown (feet)
October 2018							
PW-9	40-50	PW-19A, PW-19B, PW-20B, SW-10	13	10/8/2018	10/9/2018	+0.56	-0.35
PSW-3B3	47-57	PSW-5B2, PSW-6B4, PSW-7B2, PSW-6A	15	10/10/2018	10/11/2019	+9.65	-7.49
PSW-6B4	50-60	PSW-5B2, PSW-3B3, PSW-7B2, PSW-6A	24	10/10/2018	10/11/2019	+9.55	-8.38
PSW-7B2	42-57	PSW-5B2, PSW-3B3, PSW-6B4, PSW-6A	17	10/10/2018	10/12/2018	+10.58	-9.64

September 2019

	Well Screen Interval (ft bgs)	Initial Water Level	Pumping Rate (gpm)	Start Pumping	End Pumping	Total Drawdown
PW-9	40-50	19.64	63	9/4/2019, 11:00 am	9/5/2019, 11:25 am	-2.04
PW-8	40-50 (est.)	17.43	--	--	--	-0.69
PSW-19A	5-15	17.50	--	--	--	-0.14 (dry)
PSW-19B	22-52	18.87	--	--	--	-0.92
PSW-20B	22-52	16.88	--	--	--	-0.38
SW-10	50-60	26.85	--	--	--	-0.23

Notes:

ft bgs - feet below ground surface

Soil Sample Summary
Former Farmland Industries Nitrogen Plant
Lawrence, Kansas

Location	Interval (feet)	Date	Time	Sample Number
Bag Warehouse Area				
SB-11	0.5-5	5/2/2019	14:50	SO-050219-NL-001
SB-11	5-10	5/2/2019	14:55	SO-050219-NL-002
SB-11	10-15	5/2/2019	15:05	SO-050219-NL-003
SB-12	0.5-5	5/3/2019	11:00	SO-050319-NL-008
SB-12	5-10	5/3/2019	11:05	SO-050319-NL-009
SB-12	10-15	5/3/2019	11:10	SO-050319-NL-010
SB-12	15-20	5/3/2019	11:20	SO-050319-NL-011
SB-12	20-24	5/3/2019	11:40	SO-050319-NL-012
SB-13	0.5-5	5/3/2019	9:05	SO-050319-NL-004
SB-13	5-10	5/3/2019	9:15	SO-050319-NL-005
SB-13	10-15	5/3/2019	9:25	SO-050319-NL-006
SB-13	15-20	5/3/2019	9:30	SO-050319-NL-007
SB-14	0.5-5	5/3/2019	13:55	SO-050319-NL-013
SB-14	15-20	5/3/2019	14:15	SO-050319-NL-016
SB-14	20-24	5/3/2019	14:25	SO-050319-NL-017
SB-15	0.5-5	5/6/2019	9:00	SO-050619-NL-019
SB-15	15-20	5/6/2019	9:25	SO-050619-NL-022
SB-15	20-25	5/6/2019	9:50	SO-050619-NL-023
SB-16	0.5-5	5/6/2019	12:20	SO-050619-NL-029
SB-16	20-25	5/6/2019	13:00	SO-050619-NL-033
SB-16	25-28	5/6/2019	13:10	SO-050619-NL-034
SB-17	0.5-5	5/6/2019	14:10	SO-050619-NL-035
SB-17	5-8	5/6/2019	14:20	SO-050619-NL-036
SB-18	0.5-4	5/6/2019	14:50	SO-050619-NL-037
SB-19	0.5-5	5/6/2019	15:10	SO-050619-NL-038
SB-19	5-10	5/6/2019	15:20	SO-050619-NL-039
SB-19	10-15	5/6/2019	15:30	SO-050619-NL-040
SB-20	5-10	5/6/2019	17:00	SO-050619-NL-044
SB-20	15-20	5/6/2019	17:20	SO-050619-NL-046
SB-20	20-25	5/6/2019	17:30	SO-050619-NL-047
SB-21	1-5	5/7/2019	10:10	SO-050719-NL-048
SB-21	30-35	5/7/2019	10:55	SO-050719-NL-054
SB-21	35-39.5	5/7/2019	11:00	SO-050719-NL-055
SB-22	1-5	5/7/2019	12:20	SO-050719-NL-056
SB-22	20-25	5/7/2019	12:45	SO-050719-NL-060
SB-22	30-35	5/7/2019	13:00	SO-050719-NL-062

Soil Sample Summary
Former Farmland Industries Nitrogen Plant
Lawrence, Kansas

Location	Interval (feet)	Date	Time	Sample Number
SB-23	1-5	5/7/2019	15:00	SO-050719-NL-063
SB-23	5-10	5/7/2019	15:05	SO-050719-NL-064
SB-23	20-25	5/7/2019	15:30	SO-050719-NL-067
SB-24	1-5	5/8/2019	11:20	SO-050819-NL-068
SB-24	25-30	5/8/2019	12:10	SO-050819-NL-073
SB-24	35-39	5/8/2019	12:35	SO-050819-NL-075
SB-47	0.5-5	5/17/2019	15:50	SO-051719-NL-191
SB-47	20-25	5/17/2019	16:20	SO-051719-NL-195
SB-47	30-35	5/17/2019	16:35	SO-051719-NL-197
SB-48	0.5-5	5/20/2019	11:50	SO-052019-NL-198
SB-48	10-15	5/20/2019	12:00	SO-052019-NL-200
SB-48	15-17	5/20/2019	12:05	SO-052019-NL-201
SB-49	0.5-5	5/20/2019	12:45	SO-052019-NL-202
SB-49	10-15	5/20/2019	13:05	SO-052019-NL-204
SB-49	15-15.5	5/20/2019	13:10	SO-052019-NL-205
West Extension Pond Area				
SB-25	3-5	5/8/2019	15:00	SO-050819-NL-076
SB-25	10-15	5/8/2019	15:10	SO-050819-NL-078
SB-25	15-20	5/8/2019	15:25	SO-050819-NL-079
SB-25	20-21	5/8/2019	15:30	SO-050819-NL-080
SB-26	10-15	5/8/2019	17:35	SO-050819-NL-083
SB-26	20-25	5/8/2019	17:50	SO-050819-NL-085
SB-26	25-30	5/8/2019	17:55	SO-050819-NL-086
SB-26	30-35	5/8/2019	18:05	SO-050819-NL-087
SB-27	0.5-5	5/9/2019	10:30	SO-050919-NL-088
SB-27	5-10	5/9/2019	10:35	SO-050919-NL-089
SB-27	10-15	5/9/2019	10:45	SO-050919-NL-090
SB-27	20-25	5/9/2019	11:05	SO-050919-NL-092
SB-27	25-30	5/9/2019	11:15	SO-050919-NL-093
SB-28	5-10	5/9/2019	14:15	SO-050919-NL-095
SB-28	10-15	5/9/2019	14:15	SO-050919-NL-097
SB-28	15-20	5/9/2019	14:25	SO-050919-NL-098
SB-28	25-30	5/9/2019	14:45	SO-050919-NL-100
SB-29	5-10	5/9/2019	16:05	SO-050919-NL-102
SB-29	15-20	5/9/2019	16:25	SO-050919-NL-104
SB-29	20-22	5/9/2019	16:35	SO-050919-NL-105

Soil Sample Summary
Former Farmland Industries Nitrogen Plant
Lawrence, Kansas

Location	Interval (feet)	Date	Time	Sample Number
SB-30	0.5-5	5/10/2019	9:05	SO-051019-NL-106
SB-30	5-10	5/10/2019	9:10	SO-051019-NL-107
SB-30	10-15	5/10/2019	9:20	SO-051019-NL-108
SB-30	10-15	5/10/2019	9:20	SO-051019-NL-109
SB-31	0.5-5	5/10/2019	11:30	SO-051019-NL-110
SB-31	5-10	5/10/2019	11:35	SO-051019-NL-111
SB-32	5-10	5/10/2019	14:00	SO-051019-NL-113
SB-32	10-15	5/10/2019	14:10	SO-051019-NL-114
SB-32	10-15	5/10/2019	14:10	SO-051019-NL-115
SB-32	15-19.5	5/10/2019	14:20	SO-051019-NL-116
SB-33	1-5	5/13/2019	9:50	SO-051319-NL-117
SB-33	5-10	5/13/2019	10:00	SO-051319-NL-118
SB-33	10-11	5/13/2019	10:10	SO-051319-NL-120
SB-34	0.5-5	5/13/2019	12:20	SO-051319-NL-121
SB-35	5-10	5/13/2019	14:35	SO-051319-NL-123
SB-35	10-15	5/13/2019	14:45	SO-051319-NL-124
SB-35	20-22	5/13/2019	15:05	SO-051319-NL-126
SB-36	1-5	5/13/2019	16:45	SO-051319-NL-127
SB-36	5-10	5/13/2019	16:50	SO-051319-NL-128
SB-36	10-15	5/13/2019	16:55	SO-051319-NL-129
SB-36	15-17	5/13/2019	17:00	SO-051319-NL-130
<i>East and West Lime Ponds Area</i>				
SB-37	2-5	5/14/2019	9:40	SO-051419-NL-131
SB-37	5-8	5/14/2019	9:45	SO-051419-NL-132
SB-37	10-13	5/14/2019	9:50	SO-051419-NL-133
SB-37	13-15	5/14/2019	9:55	SO-051419-NL-134
SB-38	5-9	5/14/2019	11:40	SO-051419-NL-136
SB-38	10-14	5/14/2019	11:45	SO-051419-NL-137
SB-38	16-20	5/14/2019	11:50	SO-051419-NL-138
SB-38	23.5-25	5/14/2019	12:20	SO-051419-NL-139
SB-38	33-35	5/14/2019	12:40	SO-051419-NL-140
SB-38	40-41	5/14/2019	13:00	SO-051419-NL-142
SB-39	0.5-5	5/15/2019	9:10	SO-051519-NL-143
SB-39	5-7	5/15/2019	9:15	SO-051519-NL-144
SB-39	15-20	5/15/2019	9:20	SO-051519-NL-145
SB-39	20-24	5/15/2019	9:40	SO-051519-NL-146
SB-39	24-25	5/15/2019	9:45	SO-051519-NL-147

Soil Sample Summary
Former Farmland Industries Nitrogen Plant
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Location	Interval (feet)	Date	Time	Sample Number
SB-40	5-8	5/15/2019	10:25	SO-051519-NL-149
SB-40	14-15	5/15/2019	10:30	SO-051519-NL-150
SB-40	17-20	5/15/2019	10:40	SO-051519-NL-151
SB-40	20-25	5/15/2019	10:45	SO-051519-NL-152
SB-40	25-26	5/15/2019	10:50	SO-051519-NL-153
SB-40	26-28	5/15/2019	10:55	SO-051519-NL-154
SB-41	0-5	5/15/2019	12:40	SO-051519-NL-156
SB-41	5-10	5/15/2019	12:50	SO-051519-NL-157
SB-41	10-15	5/15/2019	12:55	SO-051519-NL-158
SB-41	17-20	5/15/2019	13:15	SO-051519-NL-160
SB-42	0-5	5/15/2019	14:05	SO-051519-NL-161
SB-42	5-10	5/15/2019	14:10	SO-051519-NL-162
SB-42	10-15	5/15/2019	14:20	SO-051519-NL-163
SB-42	20-25	5/15/2019	14:25	SO-051519-NL-164
SB-42	25-30	5/15/2019	14:35	SO-051519-NL-165
SB-42	31-33	5/15/2019	14:50	SO-051519-NL-167
SB-43	0.5-5	5/15/2019	16:25	SO-051519-NL-169
SB-43	5-9	5/15/2019	16:30	SO-051519-NL-170
SB-43	16.5-20	5/15/2019	16:40	SO-051519-NL-171
SB-43	35-40	5/15/2019	17:20	SO-051519-NL-173
SB-44	0.5-5	5/17/2019	9:00	SO-051719-NL-174
SB-44	5-10	5/17/2019	9:05	SO-051719-NL-175
SB-44	20-25	5/17/2019	0:00	SO-051719-NL-176
SB-44	26-27	5/17/2019	9:25	SO-051719-NL-178
SB-45	0.5-5	5/17/2019	10:40	SO-051719-NL-180
SB-45	5-10	5/17/2019	10:45	SO-051719-NL-181
SB-45	17.5-20	5/17/2019	10:55	SO-051719-NL-182
SB-45	20-25	5/17/2019	11:00	SO-051719-NL-183
SB-45	28-29	5/17/2019	11:05	SO-051719-NL-184
SB-46	0.5-5	5/17/2019	13:35	SO-051719-NL-186
SB-46	5-6	5/17/2019	13:40	SO-051719-NL-187
SB-46	15-19	5/17/2019	14:00	SO-051719-NL-LIME
SB-46	19-20	5/17/2019	13:55	SO-051719-NL-188
SB-46	20-25	5/17/2019	14:00	SO-051719-NL-189
SB-46	38-40	5/17/2019	14:20	SO-051719-NL-190

**Groundwater Sample Summary
Former Farmland Industries Nitrogen Plant
Lawrence, Kansas**

Location	Interval (feet bgs)	Date	Time	pH	Temperature (°C)	Conductivity (mS/cm)	Sample Number
PSW-5A Area							
SB-2	40-44	4/29/2019	17:05	6.44	13.83	0.788	WG-042919-NL-003
SB-2	48-44	4/29/2019	16:55	6.33	14.16	1.458	WG-042919-NL-002
SB-2	52-56	4/29/2019	16:45	5.98	15.46	3.409	WG-042919-NL-001
SB-3	40-44	5/1/2019	10:35	6.61	14.22	1.987	WG-050119-NL-006
SB-3	44-48	5/1/2019	10:25	6.64	13.71	0.763	WG-050119-NL-005
SB-3	44-48	5/1/2019	10:25	6.64	13.71	0.763	WG-050119-NL-005A
SB-3	54-58	5/1/2019	10:05	6.32	13.34	3.286	WG-050119-NL-004
SB-4	40-44	5/1/2019	11:55	7.06	13.59	0.621	WG-050119-NL-009
SB-4	44-48	5/1/2019	11:40	6.82	15.39	1.262	WG-050119-NL-008
SB-4	56-60	5/1/2019	11:25	6.89	14.47	0.864	WG-050119-NL-007
SB-5	40-44	5/1/2019	13:15	6.93	14.8	1.576	WG-050119-NL-012
SB-5	48-47	5/1/2019	13:05	7.04	13.77	0.998	WG-050119-NL-011
SB-5	52-56	5/1/2019	12:50	6.96	13.86	2.771	WG-050119-NL-010
SB-5	52-56	5/1/2019	12:50	6.96	13.86	2.771	WG-050119-NL-010A
SB-6	40-44	5/1/2019	14:35	6.73	13.73	0.638	WG-050119-NL-015
SB-6	40-44	5/1/2019	14:35	6.73	13.73	0.638	WG-050119-NL-015A
SB-6	44-48	5/1/2019	14:20	6.8	14.13	0.929	WG-050119-NL-014
SB-6	52-56	5/1/2019	14:10	6.93	15.34	2.394	WG-050119-NL-013
SB-7	40-44	5/1/2019	15:35	7.07	14.44	1.258	WG-050119-NL-018
SB-7	44-48	5/1/2019	15:25	6.85	14.7	1.684	WG-050119-NL-017
SB-7	52-56	5/1/2019	15:15	6.83	15.03	3.044	WG-050119-NL-016
SB-8	40-44	5/1/2019	16:40	6.73	15.48	1.849	WG-050119-NL-021
SB-8	44-48	5/1/2019	16:30	6.77	15.63	1.868	WG-050119-NL-020
SB-8	44-48	5/1/2019	16:30	6.77	15.63	1.868	WG-050119-NL-020A
SB-8	52-56	5/1/2019	16:15	7.05	15.14	3.288	WG-050119-NL-019
SB-9	40-44	5/2/2019	10:45	6.73	14.11	1.33	WG-050219-NL-024
SB-9	44-48	5/2/2019	10:35	6.59	13.87	1.221	WG-050219-NL-023
SB-9	52-57	5/2/2019	10:25	6.58	14.16	3.228	WG-050219-NL-022
SB-10	40-44	5/2/2019	12:00	6.87	13.68	0.516	WG-050219-NL-027
SB-10	44-48	5/2/2019	11:50	6.51	13.39	1.012	WG-050219-NL-026
SB-10	52-56	5/2/2019	11:40	6.61	13.96	2.913	WG-050219-NL-025
SB-10	52-56	5/2/2019	11:40	6.61	13.96	2.913	WG-050219-NL-025A
Bag Warehouse Area							
SB-11	21-25	5/2/2019	15:55	6.98	12.6	0.486	WG-050219-NL-031
SB-11	31-35	5/2/2019	15:40	7.14	14.01	0.653	WG-050219-NL-030
SB-11	31-35	5/2/2019	15:40	7.14	14.01	0.653	WG-050219-NL-030A

**Groundwater Sample Summary
Former Farmland Industries Nitrogen Plant
Lawrence, Kansas**

Location	Interval (feet bgs)	Date	Time	pH	Temperature (°C)	Conductivity (mS/cm)	Sample Number
SB-11	41-45	5/2/2019	15:35	6.65	13.19	1.148	WG-050219-NL-029
SB-11	48-52	5/2/2019	15:30	6.64	14.1	1.221	WG-050219-NL-028
SB-12	24-25	5/3/2019	12:10	6.45	12.74	0.609	WG-050319-NL-039
SB-12	31-35	5/3/2019	12:00	6.53	13.09	0.762	WG-050319-NL-038
SB-12	41-45	5/3/2019	11:55	6.45	14.08	1.294	WG-050319-NL-037
SB-12	48-52	5/3/2019	11:50	6.57	14.05	1.373	WG-050319-NL-036
SB-12	48-52	5/3/2019	11:50	6.57	14.05	1.373	WG-050319-NL-036A
SB-13	15-19	5/3/2019	10:30	6.76	12.14	0.291	WG-050319-NL-035
SB-13	21-25	5/3/2019	10:30	6.64	12.67	0.503	WG-050319-NL-034
SB-13	31-35	5/3/2019	10:10	6.68	13.13	0.561	WG-050319-NL-033
SB-13	43-47	5/3/2019	10:05	6.55	13.37	1.469	WG-050319-NL-032
SB-14	23-27	5/3/2019	15:05	6.91	13.51	0.941	WG-050319-NL-043
SB-14	25-31	5/3/2019	14:55	6.95	13.25	0.525	WG-050319-NL-042
SB-14	45-51	5/3/2019	14:45	7.00	13.24	0.763	WG-050319-NL-041
SB-14	48-52	5/3/2019	14:35	6.87	13.39	1.401	WG-050319-NL-040
SB-14	48-52	5/3/2019	14:35	6.87	13.39	1.401	WG-050319-NL-040A
SB-15	22-26	5/6/2019	11:30	6.95	15.95	1.754	WG-050619-NL-046
SB-15	43-49	5/6/2019	11:15	7.35	14.93	2.155	WG-050619-NL-045
SB-15	43-49	5/6/2019	11:15	7.35	14.93	2.155	WG-050619-NL-045A
SB-15	53-57	5/6/2019	11:10	7.28	14.15	1.418	WG-050619-NL-044
SB-19	9-13	5/6/2019	16:15	7.96	16.85	0.49	WG-050619-NL-049
SB-19	14-18	5/6/2019	16:10	7.92	14.96	0.338	WG-050619-NL-048
SB-19	27-31	5/6/2019	16:00	7.41	19.14	0.4	WG-050619-NL-047
SB-20	25-29	5/6/2019	17:45	6.74	16.6	0.22	WG-050619-NL-052
SB-20	41-45	5/6/2019	17:40	6.64	16.77	0.771	WG-050619-NL-051
SB-20	53.5-57.5	5/6/2019	17:35	7.53	18.01	0.7	WG-050619-NL-050
SB-20	53.5-57.5	5/6/2019	17:35	7.53	18.01	0.7	WG-050619-NL-050A
SB-21	41-45	5/7/2019	11:35	6.76	13.17	0.788	WG-050719-NL-054
SB-21	54.5-58.5	5/7/2019	11:25	5.86	13.49	0.803	WG-050719-NL-053
SB-22	31-35	5/7/2019	14:25	6.9	1.333	15.52	WG-050719-NL-057
SB-22	41-45	5/7/2019	14:15	6.76	1.149	14.38	WG-050719-NL-056
SB-22	55-59	5/7/2019	14:05	7.22	0.862	14.76	WG-050719-NL-055
SB-22	55-59	5/7/2019	14:05	7.22	0.862	14.76	WG-050719-NL-055A
SB-23	34-38	5/8/2019	10:10	6.53	14.14	1.568	WG-050819-NL-060
SB-23	34-38	5/8/2019	10:10	6.53	14.14	1.568	WG-050819-NL-060A
SB-23	41-45	5/8/2019	9:55	6.5	14.13	1.676	WG-050819-NL-059
SB-23	46-50	5/8/2019	9:35	6.83	14.32	2.332	WG-050819-NL-058

**Groundwater Sample Summary
Former Farmland Industries Nitrogen Plant
Lawrence, Kansas**

Location	Interval (feet bgs)	Date	Time	pH	Temperature (°C)	Conductivity (mS/cm)	Sample Number
SB-24	40-44	5/8/2019	13:35	6.89	15.79	1.579	WG-050819-NL-062
SB-24	52-56	5/8/2019	13:25	6.93	17.51	1.738	WG-050819-NL-061
SB-47	31-35	5/20/2019	10:20	7.55	15.04	1.136	WG-052019-NL-105
SB-47	31-35	5/20/2019	10:20	7.55	15.04	1.136	WG-052019-NL-105A
SB-47	41-45	5/20/2019	10:10	7.69	14.53	0.987	WG-052019-NL-104
SB-47	52-56	5/20/2019	9:55	7.43	13.9	1.142	WG-052019-NL-103
SB-48	16-20	5/20/2019	12:20	7.12	0.368	12.31	WG-052019-NL-108
SB-48	31-35	5/20/2019	12:15	6.47	0.653	12.77	WG-052019-NL-107
SB-48	44-48	5/20/2019	12:10	6.87	0.888	12.68	WG-052019-NL-106
SB-49	15-19	5/20/2019	13:35	7.13	0.66	12.3	WG-052019-NL-111
SB-49	31-35	5/20/2019	13:25	7.03	0.779	12.77	WG-052019-NL-110
SB-49	31-35	5/20/2019	13:25	7.03	0.779	12.77	WG-052019-NL-110A
SB-49	42-46	5/20/2019	13:15	6.98	1.113	12.49	WG-052019-NL-109
West Extension Pond Area							
SB-25	41-45	5/8/2019	13:35	6.51	18.32	6.004	WG-050819-NL-064
SB-25	61-65	5/8/2019	13:25	7.13	16.82	6.181	WG-050819-NL-063
SB-26	35-39	5/9/2019	10:05	7.62	12.11	7.053	WG-050919-NL-067
SB-26	41-45	5/9/2019	9:55	7.39	12.31	5.648	WG-050919-NL-066
SB-26	52-56	5/9/2019	9:45	7.19	12.6	5.297	WG-050919-NL-065
SB-26	52-56	5/9/2019	9:45	7.19	12.6	5.297	WG-050919-NL-065A
SB-27	31-35	5/9/2019	12:10	6.99	12.31	3.929	WG-050919-NL-070
SB-27	31-35	5/9/2019	12:10	6.99	12.31	3.929	WG-050919-NL-070A
SB-27	41-45	5/9/2019	12:05	6.9	12.43	5.992	WG-050919-NL-069
SB-27	52-56	5/9/2019	12:00	6.84	12.87	6.395	WG-050919-NL-068
SB-28	20-24	5/9/2019	15:30	6.9	2.738	13.29	WG-050919-NL-074
SB-28	31-35	5/9/2019	15:25	6.92	3.157	13.02	WG-050919-NL-073
SB-28	41-45	5/9/2019	15:15	7.04	4.5	13.55	WG-050919-NL-072
SB-28	52-56	5/9/2019	15:10	6.8	5.449	13.63	WG-050919-NL-071
SB-29	21-25	5/9/2019	17:15	7.19	3.128	10.88	WG-050919-NL-078
SB-29	31-35	5/9/2019	17:00	7.19	3.128	10.88	WG-050919-NL-077
SB-29	41-45	5/9/2019	16:50	6.89	4.053	12.91	WG-050919-NL-076
SB-29	51-55	5/9/2019	16:45	6.45	5.577	11.94	WG-050919-NL-075
SB-29	51-55	5/9/2019	16:45	6.45	5.577	11.94	WG-050919-NL-075A
SB-30	31-35	5/10/2019	10:30	6.82	1.33	13.78	WG-051019-NL-081
SB-30	41-45	5/10/2019	10:10	6.92	4.716	15.23	WG-051019-NL-080
SB-30	41-45	5/10/2019	10:10	6.92	4.716	15.23	WG-051019-NL-080A

**Groundwater Sample Summary
Former Farmland Industries Nitrogen Plant
Lawrence, Kansas**

Location	Interval (feet bgs)	Date	Time	pH	Temperature (°C)	Conductivity (mS/cm)	Sample Number
SB-30	50-54	5/10/2019	10:05	6.59	4.93	15.01	WG-051019-NL-079
SB-31	15-19	5/10/2019	12:50	6.94	2.102	12.89	WG-051019-NL-079B
SB-32	10-14	5/10/2019	15:15	7.05	2.91	16.35	WG-051019-NL-085
SB-32	31-35	5/10/2019	15:05	7.05	2.91	16.35	WG-051019-NL-084
SB-32	41-45	5/10/2019	14:55	6.95	1.829	14.91	WG-051019-NL-083
SB-32	52-56	5/10/2019	14:50	6.74	4.103	16.29	WG-051019-NL-082
SB-32	52-56	5/10/2019	14:50	6.74	4.103	16.29	WG-051019-NL-082A
SB-33	11-15	5/13/2019	11:20	8.07	13.19	3.759	WG-051319-NL-088
SB-33	41-45	5/13/2019	11:10	6.84	18.5	6.71	WG-051319-NL-087
SB-33	66-70	5/13/2019	11:00	6.64	16.13	8.41	WG-051319-NL-086
SB-33	66-70	5/13/2019	11:00	6.64	16.13	8.41	WG-051319-NL-086A
SB-34	51-55	5/13/2019	13:00	6.46	0.585	18.64	WG-051319-NL-089
SB-36	15-19	5/13/2019	18:20	9.48	22.12	12.18	WG-051319-NL-094
SB-36	31-35	5/13/2019	18:10	6.94	115.3	14.37	WG-051319-NL-093
SB-36	51-55	5/13/2019	17:50	7.39	4.262	17.63	WG-051319-NL-091
SB-36	51-55	5/13/2019	17:50	7.39	4.262	17.63	WG-051319-NL-091A
SB-36	63-67	5/13/2019	17:40	7.97	4.446	19.97	WG-051319-NL-090
East and West Lime Ponds Area							
SB-37	11-15	5/14/2019	10:50	8.03	3858	14.29	WG-051419-NL-095
SB-38	41-45	5/14/2019	14:00	7.89	0.612	19.93	WG-051419-NL-097
SB-38	64-68	5/14/2019	13:50	7.58	0.528	19.36	WG-051419-NL-096
SB-40	24-28	5/15/2019	11:15	7.35	5.597	17.92	WG-051519-NL-098
SB-41	15-19	5/15/2019	13:30	8.59	45.23	15.83	WG-051519-NL-099
SB-42	62-66	5/15/2019	15:25	8.69	0.671	19.31	WG-051519-NL-100
SB-42	62-66	5/15/2019	15:25	8.69	0.671	19.31	WG-051519-NL-100A
SB-45	29-33	5/17/2019	11:10	6.9	1.833	18.4	WG-051719-NL-102
SB-45	62-66	5/17/2019	11:40	7.82	0.652	18.6	WG-051719-NL-101

Notes:

bgs - below ground surface

°C - degrees celsius

mS/cm - milli-siemens per centimeter

**Soil Analytical Results Summary
Former Farmland Industries Nitrogen Plant
Lawrence, Kansas**

Lawrence, Kansas						
Location	Sample Number	Date	Units Lab	Ammonia	Nitrite/Nitrate	Percent Moisture
				mg/kg PACE	mg/kg PACE	% PACE
Bag Warehouse Area						
SB-11	SO-050219-NL-001	5/2/2019	(0.5-5) ft	ND(1.5)	ND(1.4)	30.8
SB-11	SO-050219-NL-002	5/2/2019	(5-10) ft	ND(1.4)	ND(1.5)	31.9
SB-11	SO-050219-NL-003	5/2/2019	(10-15) ft	ND(1.2)	2.9 J	19.7
SB-12	SO-050319-NL-008	5/3/2019	(0.5-5) ft	ND(1.3)	ND(1.3)	25.9
SB-12	SO-050319-NL-009	5/3/2019	(5-10) ft	ND(1.1)	ND(1.2)	14.6
SB-12	SO-050319-NL-010	5/3/2019	(10-15) ft	ND(1.2)	ND(1.2)	17.5
SB-12	SO-050319-NL-011	5/3/2019	(15-20) ft	ND(1.2)	ND(1.1)	15.5
SB-12	SO-050319-NL-012	5/3/2019	(20-24) ft	ND(1.0)	ND(1.0)	3.8
SB-13	SO-050319-NL-004	5/3/2019	(0.5-5) ft	ND(1.3)	ND(1.3)	23.9
SB-13	SO-050319-NL-005	5/3/2019	(5-10) ft	ND(1.2)	ND(1.3)	21.3
SB-13	SO-050319-NL-006	5/3/2019	(10-15) ft	ND(1.2)	ND(1.2)	18.2
SB-13	SO-050319-NL-007	5/3/2019	(15-20) ft	ND(1.2)	ND(1.2)	17.6
SB-14	SO-050319-NL-013	5/3/2019	(0.5-5) ft	ND(1.3) J	ND(1.3)	27.8
SB-14	SO-050319-NL-015	5/3/2019	(5-10) ft	ND(1.1) J	ND(1.1)	17.2
SB-14	SO-050319-NL-017	5/3/2019	(20-24) ft	ND(1.0) J	ND(1.0)	8.1
SB-15	SO-050619-NL-019	5/6/2019	(0.5-5) ft	ND(1.2) J	ND(1.2)	19.0
SB-15	SO-050619-NL-022	5/6/2019	(15-20) ft	13.9 J	ND(1.2)	17.0
SB-15	SO-050619-NL-023	5/6/2019	(20-25) ft	ND(1.2) J	ND(1.2)	20.3
SB-16	SO-050619-NL-029	5/6/2019	(0.5-5) ft	ND(1.2) J	4.3	16.0
SB-16	SO-050619-NL-033	5/6/2019	(20-25) ft	787 J	50.3 J	17.9
SB-16	SO-050619-NL-034	5/6/2019	(25-28) ft	440 J	55.4 J	17.5
SB-17	SO-050619-NL-035	5/6/2019	(0.5-5) ft	ND(1.1) J	ND(1.1)	16.8
SB-17	SO-050619-NL-036	5/6/2019	(5-8) ft	ND(1.1) J	ND(1.1)	12.0
SB-18	SO-050619-NL-037	5/6/2019	(0.5-4) ft	ND(1.1) J	2.4 J	14.8
SB-19	SO-050619-NL-038	5/6/2019	(0.5-5) ft	ND(1.2) J	ND(1.2)	20.3
SB-19	SO-050619-NL-039	5/6/2019	(5-10) ft	ND(1.2) J	3.5 J	18.9
SB-19	SO-050619-NL-040	5/6/2019	(10-15) ft	17.9 J	3.4 J	21.6
SB-20	SO-050619-NL-043	5/6/2019	(0.5-5) ft	68.2 J	ND(1.2)	20.1
SB-20	SO-050619-NL-046	5/6/2019	(15-20) ft	7.4 J	2.1 J	23.0
SB-20	SO-050619-NL-047	5/6/2019	(20-25) ft	58.5 J	ND(1.3)	26.1

**Soil Analytical Results Summary
Former Farmland Industries Nitrogen Plant
Lawrence, Kansas**

Lawrence, Kansas						
				Ammonia	Nitrite/Nitrate	Percent Moisture
			Units Lab	mg/kg PACE	mg/kg PACE	% PACE
Location	Sample Number	Date	Depth			
SB-21	SO-050719-NL-048	5/7/2019	(1-5) ft	260 J	ND(1.2)	21.3
SB-21	SO-050719-NL-054	5/7/2019	(30-35) ft	195 J	ND(1.4)	33.0
SB-21	SO-050719-NL-055	5/7/2019	(35-39.5) ft	10.2 J	6.5 J	23.6
SB-22	SO-050719-NL-056	5/7/2019	(1-5) ft	117 J	16.7	19.5
SB-22	SO-050719-NL-060	5/7/2019	(20-25) ft	2.2 J	36.1	22.7
SB-22	SO-050719-NL-062	5/7/2019	(30-35) ft	11.3 J	17.1	24.4
SB-23	SO-050719-NL-063	5/7/2019	(1-5) ft	94.1 J	ND(1.3)	26.2
SB-23	SO-050719-NL-064	5/7/2019	(5-10) ft	58.3 J	ND(1.2)	19.9
SB-23	SO-050719-NL-067	5/7/2019	(20-25) ft	ND(1.3) J	ND(1.3)	21.3
SB-24	SO-050819-NL-068	5/8/2019	(1-5) ft	ND(1.2) J	ND(1.2)	20.6
SB-24	SO-050819-NL-073	5/8/2019	(25-30) ft	44.7 J	4.7	24.4
SB-24	SO-050819-NL-075	5/8/2019	(35-39) ft	112 J	ND(1.2)	24.8
SB-47	SO-051719-NL-191	5/17/2019	(0.5-5) ft	ND(1.1)	ND(1.2) J	16.7
SB-47	SO-051719-NL-195	5/17/2019	(20-25) ft	ND(1.2)	ND(1.2) J	18.4
SB-47	SO-051719-NL-197	5/17/2019	(30-35) ft	25.1	ND(1.2) J	17.7
SB-48	SO-052019-NL-198	5/20/2019	(0.5-5) ft	ND(1.1)	2.5 J	12.1
SB-48	SO-052019-NL-200	5/20/2019	(10-15) ft	ND(1.1)	4.3 J	10.2
SB-48	SO-052019-NL-201	5/20/2019	(15-17) ft	ND(1.1)	1.8 J	10.1
SB-49	SO-052019-NL-202	5/20/2019	(0.5-5) ft	ND(1.1)	ND(1.1) J	12.6
SB-49	SO-052019-NL-204	5/20/2019	(10-15) ft	ND(1.2)	2.6	18.1
SB-49	SO-052019-NL-205	5/20/2019	(15-15.5) ft	ND(1.1)	1.6	13.2
West Extension Pond Area						
SB-25	SO-050819-NL-076	5/8/2019	(3-5) ft	37.5 J	162	17.4
SB-25	SO-050819-NL-078	5/8/2019	(10-15) ft	3260 J	736	18.9
SB-25	SO-050819-NL-079	5/8/2019	(15-20) ft	6260 J	1710	22.9
SB-25	SO-050819-NL-080	5/8/2019	(20-21) ft	4820 J	1800	23.1
SB-26	SO-050819-NL-083	5/8/2019	(10-15) ft	1220 J	1290	20.8
SB-26	SO-050819-NL-085	5/8/2019	(20-25) ft	18.3 J	351	24.0
SB-26	SO-050819-NL-086	5/8/2019	(25-30) ft	245 J	145	33.0
SB-26	SO-050819-NL-087	5/8/2019	(30-35) ft	200 J	153	28.1
SB-27	SO-050919-NL-088	5/9/2019	(0.5-5) ft	4650 J	1740	18.6
SB-27	SO-050919-NL-089	5/9/2019	(5-10) ft	5850 J	3100	22.3
SB-27	SO-050919-NL-090	5/9/2019	(10-15) ft	8520 J	5120	22.7

**Soil Analytical Results Summary
Former Farmland Industries Nitrogen Plant
Lawrence, Kansas**

Location	Sample Number	Date	Units Lab	Ammonia	Nitrite/Nitrate	Percent Moisture
				mg/kg PACE	mg/kg PACE	% PACE
Location	Sample Number	Date	Depth			
SB-27	SO-050919-NL-092	5/9/2019	(20-25) ft	313 J	2210	21.4
SB-27	SO-050919-NL-093	5/9/2019	(25-30) ft	3830 J	4020	36.7
SB-28	SO-050919-NL-095	5/9/2019	(5-10) ft	4680 J	2770	21.3
SB-28	SO-050919-NL-097	5/9/2019	(10-15) ft	5460 J	3390	25.3
SB-28	SO-050919-NL-098	5/9/2019	(15-20) ft	4170	3020	20.0
SB-28	SO-050919-NL-100	5/9/2019	(25-30) ft	78.3	628	27.2
SB-29	SO-050919-NL-102	5/9/2019	(5-10) ft	24.8	18.2	22.0
SB-29	SO-050919-NL-104	5/9/2019	(15-20) ft	22.4	20.8	21.2
SB-29	SO-050919-NL-105	5/9/2019	(20-22) ft	148	16.5	28.5
SB-30	SO-051019-NL-106	5/10/2019	(0.5-5) ft	288	109	20.7
SB-30	SO-051019-NL-107	5/10/2019	(5-10) ft	217	8.8	26.6
SB-30	SO-051019-NL-108	5/10/2019	(10-15) ft	807 J	27.1	26.5
SB-30	SO-051019-NL-109	5/10/2019	(10-15) ft	3140 J	16.0	26.0
SB-31	SO-051019-NL-110	5/10/2019	(0.5-5) ft	182	24.4	18.0
SB-31	SO-051019-NL-111	5/10/2019	(5-10) ft	1060	185	21.1
SB-32	SO-051019-NL-113	5/10/2019	(5-10) ft	895	51.0	22.1
SB-32	SO-051019-NL-114	5/10/2019	(10-15) ft	8.7 J	140 J	22.8
SB-32	SO-051019-NL-115	5/10/2019	(10-15) ft	207 J	551 J	27.5
SB-32	SO-051019-NL-116	5/10/2019	(15-19.5) ft	561	310	27.0
SB-33	SO-051319-NL-117	5/13/2019	(1-5) ft	399 J	8.5	18.2
SB-33	SO-051319-NL-118	5/13/2019	(5-10) ft	276 J	1.5	17.9
SB-33	SO-051319-NL-120	5/13/2019	(10-11) ft	123 J	1.1	15.8
SB-34	SO-051319-NL-121	5/13/2019	(0.5-5) ft	80.3 J	57.8	19.1
SB-35	SO-051319-NL-123	5/13/2019	(5-10) ft	4.1 J	38.3	22.9
SB-35	SO-051319-NL-124	5/13/2019	(10-15) ft	11.8 J	610	18.8
SB-35	SO-051319-NL-126	5/13/2019	(20-22) ft	3.7 J	486	24.8
SB-36	SO-051319-NL-127	5/13/2019	(1-5) ft	1750 J	1310 J	18.8
SB-36	SO-051319-NL-128	5/13/2019	(5-10) ft	3170 J	1080 J	24.9
SB-36	SO-051319-NL-129	5/13/2019	(10-15) ft	3720 J	171 J	22.0
SB-36	SO-051319-NL-130	5/13/2019	(15-17) ft	3600 J	856 J	25.3

Table 4

**Soil Analytical Results Summary
Former Farmland Industries Nitrogen Plant
Lawrence, Kansas**

				Ammonia	Nitrite/Nitrate	Percent Moisture
			Units Lab	mg/kg PACE	mg/kg PACE	% PACE
Location	Sample Number	Date	Depth			
East and West Lime Ponds Area						
SB-37	SO-051419-NL-131	5/14/2019	(2-5) ft	ND(1.2)	3.0 J	18.0
SB-37	SO-051419-NL-132	5/14/2019	(5-8) ft	4.1 J	2.0 J	19.8
SB-37	SO-051419-NL-133	5/14/2019	(10-13) ft	20.1 J	ND(1.3) J	22.8
SB-37	SO-051419-NL-134	5/14/2019	(13-15) ft	147 J	11.8 J	18.8
SB-38	SO-051419-NL-136	5/14/2019	(5-9) ft	ND(1.5) J	20.2 J	31.8
SB-38	SO-051419-NL-137	5/14/2019	(10-14) ft	766 J	768 J	40.2
SB-38	SO-051419-NL-138	5/14/2019	(16-20) ft	141 J	351 J	19.5
SB-38	SO-051419-NL-139	5/14/2019	(23.5-25) ft	ND(1.3) J	505 J	21.4
SB-38	SO-051419-NL-140	5/14/2019	(33-35) ft	58.3 J	1.5 J	22.2
SB-38	SO-051419-NL-142	5/14/2019	(40-41) ft	151 J	16.7 J	26.5
SB-39	SO-051519-NL-143	5/15/2019	(0.5-5) ft	ND(1.2) J	1.8 J	17.5
SB-39	SO-051519-NL-144	5/15/2019	(5-7) ft	2.9 J	ND(1.5) J	32.6
SB-39	SO-051519-NL-145	5/15/2019	(15-20) ft	411 J	376 J	35.6
SB-39	SO-051519-NL-146	5/15/2019	(20-24) ft	896 J	280 J	20.4
SB-39	SO-051519-NL-147	5/15/2019	(24-25) ft	680 J	240 J	22.5
SB-40	SO-051519-NL-149	5/15/2019	(5-8) ft	7.0 J	2.0 J	26.7
SB-40	SO-051519-NL-150	5/15/2019	(14-15) ft	158	170	40.1
SB-40	SO-051519-NL-151	5/15/2019	(17-20) ft	563 J	3.8	18.3
SB-40	SO-051519-NL-152	5/15/2019	(20-25) ft	232 J	36.2	18.2
SB-40	SO-051519-NL-153	5/15/2019	(25-26) ft	218 J	34.3	21.4
SB-40	SO-051519-NL-154	5/15/2019	(26-28) ft	193 J	124	31.0
SB-41	SO-051519-NL-156	5/15/2019	(0-5) ft	ND(1.3) J	4.5	27.9
SB-41	SO-051519-NL-157	5/15/2019	(5-10) ft	77.8 J	805	22.3
SB-41	SO-051519-NL-158	5/15/2019	(10-15) ft	1650 J	931	25.6
SB-41	SO-051519-NL-160	5/15/2019	(17-20) ft	3130 J	1030	19.1
SB-42	SO-051519-NL-161	5/15/2019	(0-5) ft	ND(1.3)	10.9	27.8
SB-42	SO-051519-NL-162	5/15/2019	(5-10) ft	24.9 J	282	21.2
SB-42	SO-051519-NL-163	5/15/2019	(10-15) ft	475 J	885	26.6
SB-42	SO-051519-NL-164	5/15/2019	(20-25) ft	3650 J	1450	23.5
SB-42	SO-051519-NL-165	5/15/2019	(25-30) ft	5860 J	2600	21.7
SB-42	SO-051519-NL-167	5/15/2019	(31-33) ft	3390 J	1890	29.2
SB-43	SO-051519-NL-169	5/15/2019	(0.5-5) ft	2030 J	1390	23.7
SB-43	SO-051519-NL-170	5/15/2019	(5-9) ft	1570 J	822	22.6
SB-43	SO-051519-NL-171	5/15/2019	(16.5-20) ft	56.3 J	38.7	20.6
SB-43	SO-051519-NL-173	5/15/2019	(35-40) ft	19.9 J	54.1	22.3

**Soil Analytical Results Summary
Former Farmland Industries Nitrogen Plant
Lawrence, Kansas**

Location	Sample Number	Date	Units Lab Depth	Ammonia	Nitrite/Nitrate	Percent Moisture
				mg/kg PACE	mg/kg PACE	% PACE
SB-44	SO-051719-NL-174	5/17/2019	(0.5-5) ft	38.3 J	107	21.7
SB-44	SO-051719-NL-175	5/17/2019	(5-10) ft	475 J	2640	20.6
SB-44	SO-051719-NL-176	5/17/2019	(20-25) ft	193 J	102 J	15.7
SB-44	SO-051719-NL-178	5/17/2019	(26-27) ft	37.1 J	85.9 J	26.7
SB-45	SO-051719-NL-180	5/17/2019	(0.5-5) ft	5.4 J	3.0 J	15.8
SB-45	SO-051719-NL-181	5/17/2019	(5-10) ft	2.9 J	59.2 J	19.0
SB-45	SO-051719-NL-182	5/17/2019	(17.5-20) ft	33.7 J	ND(1.2) J	18.9
SB-45	SO-051719-NL-183	5/17/2019	(20-25) ft	43.3	21.3 J	18.3
SB-45	SO-051719-NL-184	5/17/2019	(28-29) ft	6.7	37.5 J	16.1
SB-46	SO-051719-NL-186	5/17/2019	(0.5-5) ft	1150	519 J	21.1
SB-46	SO-051719-NL-187	5/17/2019	(5-6) ft	346	335 J	19.1
SB-46	SO-051719-NL-188	5/17/2019	(19-20) ft	36.2	4.8 J	16.2
SB-46	SO-051719-NL-189	5/17/2019	(20-25) ft	ND(1.1)	72.8 J	15.9
SB-46	SO-051719-NL-190	5/17/2019	(38-40) ft	10.5	34.6 J	17.1
SB-46	SO-051719-NL-SB-46 (LIME)	5/17/2019	(15-19) ft	9.9	35.6 J	45.9

Notes:

mg/kg - milligram per kilogram
 PACE Pace Analytical Laboratories, Lenexa, Kansas
 ft - feet
 ND - not detected at the associated reporting limit
 J - estimated concentration

Table 5

**Groundwater Analytical Results Summary
Former Farmland Industries Nitrogen Plant
Lawrence, Kansas**

				Ammonia	Ammonia - N	Nitrite / Nitrate	Nitrite / Nitrate
				mg/L	mg/L	mg/L	mg/L
				PACE	CLMSLA	PACE	CLMSLA
				NS ²	NS	1 / 10	1 / 10
Location	Sample Number	Date	Depth	Units			
				Lab			
				MCL ¹			
PSW-5B2 Area							
SB-2	WG-042919-NL-003	4/29/2019	(40-44) ft	--	26.9	--	0.316
SB-2	WG-042919-NL-002	4/29/2019	(48-44) ft	--	47.5	--	0.32
SB-2	WG-042919-NL-001	4/29/2019	(52-56) ft	--	288	--	0.256
SB-3	WG-050119-NL-006	5/1/2019	(40-44) ft	--	105	--	0.358
SB-3	WG-050119-NL-005	5/1/2019	(44-48) ft	--	9.04	--	0.465
SB-3	WG-050119-NL-005A	5/1/2019	(44-48) ft	9.9	--	0.10U J	--
SB-3	WG-050119-NL-004	5/1/2019	(54-58) ft	--	235	--	0.284
SB-4	WG-050119-NL-008	5/1/2019	(44-48) ft	--	15	--	0.583
SB-4	WG-050119-NL-009	5/1/2019	(44-40) ft	--	5.16	--	0.421
SB-4	WG-050119-NL-007	5/1/2019	(56-60) ft	--	6.42	--	0.321
SB-5	WG-050119-NL-012	5/1/2019	(40-44) ft	--	16.6	--	0.355
SB-5	WG-050119-NL-011	5/1/2019	(48-47) ft	--	7.22	--	0.417
SB-5	WG-050119-NL-010	5/1/2019	(52-56) ft	--	56.1	--	0.428
SB-5	WG-050119-NL-010A	5/1/2019	(52-56) ft	57.4	--	0.10U J	--
SB-6	WG-050119-NL-015	5/1/2019	(40-44) ft	--	6.26	--	0.362
SB-6	WG-050119-NL-015A	5/1/2019	(40-44) ft	7.7 J	--	0.10U J	--
SB-6	WG-050119-NL-014	5/1/2019	(44-48) ft	--	12.8	--	0.379
SB-6	WG-050119-NL-013	5/1/2019	(52-56) ft	--	42.3	--	0.366
SB-7	WG-050119-NL-018	5/1/2019	(40-44) ft	--	49.8	--	0.302
SB-7	WG-050119-NL-017	5/1/2019	(44-48) ft	--	42.9	--	0.409
SB-7	WG-050119-NL-016	5/1/2019	(52-56) ft	--	184	--	0.416
SB-8	WG-050119-NL-021	5/1/2019	(40-44) ft	--	83.6	--	ND(0.250)
SB-8	WG-050119-NL-020	5/1/2019	(44-48) ft	--	43.3	--	0.412
SB-8	WG-050119-NL-020A	5/1/2019	(44-48) ft	73.3 J	--	0.10U J	--
SB-8	WG-050119-NL-019	5/1/2019	(52-56) ft	--	252	--	0.437
SB-9	WG-050219-NL-024	5/2/2019	(40-44) ft	--	90.1	--	2.31
SB-9	WG-050219-NL-023	5/2/2019	(44-48) ft	--	96.6	--	1.76
SB-9	WG-050219-NL-022	5/2/2019	(53-57) ft	--	259	--	5.97
SB-10	WG-050219-NL-027	5/2/2019	(40-44) ft	--	7.84	--	0.667
SB-10	WG-050219-NL-026	5/2/2019	(44-48) ft	--	45.8	--	1.73
SB-10	WG-050219-NL-025	5/2/2019	(52-56) ft	--	218	--	3.89
SB-10	WG-050219-NL-025A	5/2/2019	(52-56) ft	284 J	--	3.0 J	--
Bag Warehouse Area							
SB-11	WG-050219-NL-031	5/2/2019	(21-25) ft	--	ND(0.300)	--	3.31
SB-11	WG-050219-NL-030	5/2/2019	(31-35) ft	--	1.07	--	24.9
SB-11	WG-050219-NL-030A	5/2/2019	(31-35) ft	3.0 J	--	8.7 J	--
SB-11	WG-050219-NL-029	5/2/2019	(41-45) ft	--	0.977	--	42.9
SB-11	WG-050219-NL-028	5/2/2019	(48-52) ft	--	3.08	--	84.9

**Groundwater Analytical Results Summary
Former Farmland Industries Nitrogen Plant
Lawrence, Kansas**

Location	Sample Number	Date	Depth	Units	Ammonia	Ammonia - N	Nitrite / Nitrate	Nitrite / Nitrate
				Lab MCL ¹	mg/L PACE NS ²	mg/L CLMSLA NS	mg/L PACE 1 / 10	mg/L CLMSLA 1 / 10
SB-12	WG-050219-NL-039	5/3/2019	(24-28) ft		--	ND(0.300)	--	14.5
SB-12	WG-050219-NL-038	5/3/2019	(31-35) ft		--	1.51	--	29.9
SB-12	WG-050219-NL-037	5/3/2019	(41-45) ft		--	2.29	--	60.0
SB-12	WG-050219-NL-036	5/3/2019	(48-52) ft		--	2.04	--	82.4
SB-12	WG-050319-NL-036A	5/3/2019	(48-52) ft		8.1 J	--	51.9 J	--
SB-13	WG-050219-NL-035	5/3/2019	(15-19) ft		--	ND(0.300)	--	3.92
SB-13	WG-050219-NL-034	5/3/2019	(21-25) ft		--	ND(0.300)	--	10.7
SB-13	WG-050219-NL-033	5/3/2019	(31-35) ft		--	ND(0.300)	--	9.10
SB-13	WG-050219-NL-032	5/3/2019	(43-47) ft		--	ND(0.300)	--	11.7
SB-14	WG-050219-NL-043	5/3/2019	(23-27) ft		--	3.12	--	16.0
SB-14	WG-050219-NL-042	5/3/2019	(25-31) ft		--	18.5	--	26.2
SB-14	WG-050219-NL-041	5/3/2019	(45-51) ft		--	52.0	--	54.3
SB-14	WG-050219-NL-040	5/3/2019	(48-52) ft		--	21.3	--	108
SB-14	WG-050319-NL-040A	5/3/2019	(48-52) ft		19.4	--	95.1	--
SB-15	WG-050619-NL-046	5/6/2019	(22-26) ft		--	99.0	--	224
SB-15	WG-050619-NL-045	5/6/2019	(43-49) ft		--	118	--	293
SB-15	WG-050619-NL-045A	5/6/2019	(43-49) ft		114	--	304	--
SB-15	WG-050619-NL-044	5/6/2019	(53-57) ft		--	21.0	--	128
SB-19	WG-050619-NL-049	5/6/2019	(9-13) ft		--	1.95	--	17.3
SB-19	WG-050619-NL-048	5/6/2019	(14-18) ft		--	1.59	--	23.7
SB-19	WG-050619-NL-047	5/6/2019	(27-31) ft		--	2.67	--	9.98
SB-20	WG-050619-NL-052	5/6/2019	(25-29) ft		--	6.53	--	3.04
SB-20	WG-050619-NL-051	5/6/2019	(41-45) ft		--	4.70	--	2.04
SB-20	WG-050619-NL-050	5/6/2019	(53.5-57.5) ft		--	7.24	--	4.79
SB-20	WG-050619-NL-050A	5/6/2019	(53.5-57.5) ft		9.5	--	3.1	--
SB-21	WG-050719-NL-054	5/7/2019	(41-45) ft		--	16.0	--	13.7
SB-21	WG-050719-NL-053	5/7/2019	(54.5-58.5) ft		--	1.07	--	25.5
SB-22	WG-050719-NL-057	5/7/2019	(31-35) ft		--	14.0	--	31.5
SB-22	WG-050719-NL-056	5/7/2019	(41-45) ft		--	8.20	--	72.5
SB-22	WG-050719-NL-055	5/7/2019	(55-59) ft		--	ND(0.300)	--	50.3
SB-22	WG-050619-NL-055A	5/7/2019	(55-59) ft		0.75	--	55.6	--
SB-23	WG-050819-NL-060	5/8/2019	(34-38) ft		--	64.8	--	194
SB-23	WG-050819-NL-060A	5/8/2019	(34-38) ft		70.2	--	183 J	--
SB-23	WG-050819-NL-059	5/8/2019	(41-45) ft		--	95.6	--	267
SB-23	WG-050819-NL-058	5/8/2019	(46-50) ft		--	121	--	344
SB-24	WG-050819-NL-062	5/8/2019	(40-44) ft		--	23.0	--	39.3
SB-24	WG-050819-NL-061	5/8/2019	(52-56) ft		--	4.35	--	173
SB-47	WG-051319-NL-105	5/20/2019	(31-35) ft		--	4.52	--	3.10
SB-47	WG-052019-NL-105A	5/20/2019	(31-35) ft		6.0 J	--	2.6	--
SB-47	WG-051319-NL-104	5/20/2019	(41-45) ft		--	5.82	--	2.21
SB-47	WG-051319-NL-103	5/20/2019	(52-56) ft		--	0.418	--	8.04

**Groundwater Analytical Results Summary
Former Farmland Industries Nitrogen Plant
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				Lab MCL ¹	mg/L PACE NS ²	mg/L CLMSLA NS	mg/L PACE 1 / 10	mg/L CLMSLA 1 / 10
SB-48	WG-051319-NL-108	5/20/2019	(16-20) ft	--	--	1.10	--	22.2
SB-48	WG-051319-NL-107	5/20/2019	(31-35) ft	--	--	1.86	--	2.62
SB-48	WG-051319-NL-106	5/20/2019	(44-48) ft	--	--	0.545	--	3.64
SB-49	WG-051319-NL-111	5/20/2019	(15-19) ft	--	--	4.51	--	9.48
SB-49	WG-051319-NL-110	5/20/2019	(31-35) ft	--	--	0.780	--	2.29
SB-49	WG-052019-NL-110A	5/20/2019	(31-35) ft	1.7	--	--	1.5	--
SB-49	WG-051319-NL-109	5/20/2019	(42-46) ft	--	--	4.02	--	16.2
West Extension Pond Area								
SB-25	WG-050819-NL-064	5/8/2019	(41-45) ft	--	--	442	--	734
SB-25	WG-050819-NL-063	5/8/2019	(61-65) ft	--	--	501	--	924
SB-26	WG-050919-NL-067	5/9/2019	(35-39) ft	--	--	1090	--	1340
SB-26	WG-050919-NL-066	5/9/2019	(41-45) ft	--	--	871	--	1070
SB-26	WG-050919-NL-065	5/9/2019	(52-56) ft	--	--	427	--	843
SB-26	WG-050919-NL-065A	5/9/2019	(52-56) ft	392	--	--	776	--
SB-27	WG-050919-NL-070	5/9/2019	(31-35) ft	--	--	406	--	604
SB-27	WG-050919-NL-070A	5/9/2019	(31-35) ft	343	--	--	453	--
SB-27	WG-050919-NL-069	5/9/2019	(41-45) ft	--	--	528	--	850
SB-27	WG-050919-NL-068	5/9/2019	(52-56) ft	--	--	657	--	1170
SB-28	WG-050919-NL-074	5/9/2019	(20-24) ft	--	--	256	--	381
SB-28	WG-050919-NL-073	5/9/2019	(31-35) ft	--	--	291	--	336
SB-28	WG-050919-NL-072	5/9/2019	(41-45) ft	--	--	423	--	527
SB-28	WG-050919-NL-071	5/9/2019	(52-56) ft	--	--	574	--	779
SB-29	WG-050919-NL-078	5/9/2019	(21-25) ft	--	--	100	--	123
SB-29	WG-050919-NL-077	5/9/2019	(31-35) ft	--	--	283	--	289
SB-29	WG-050919-NL-076	5/9/2019	(41-45) ft	--	--	234	--	273
SB-29	WG-050919-NL-075	5/9/2019	(51-55) ft	--	--	745	--	809
SB-29	WG-050919-NL-075A	5/9/2019	(51-55) ft	707	--	--	266	--
SB-30	WG-051019-NL-081	5/10/2019	(31-35) ft	--	--	71.7	--	68.4
SB-30	WG-051019-NL-080	5/10/2019	(41-45) ft	--	--	397	--	527
SB-30	WG-051019-NL-080A	5/10/2019	(41-45) ft	314	--	--	448	--
SB-30	WG-051019-NL-079	5/10/2019	(50-54) ft	--	--	531	--	823
SB-31	WG-051019-NL-079B	5/10/2019	(15-19) ft	--	--	21	--	431
SB-32	WG-051019-NL-085	5/10/2019	(10-14) ft	--	--	30	--	2050
SB-32	WG-051019-NL-084	5/10/2019	(31-35) ft	--	--	15.6	--	193
SB-32	WG-051019-NL-083	5/10/2019	(41-45) ft	--	--	51.7	--	53.6
SB-32	WG-051019-NL-082	5/10/2019	(52-56) ft	--	--	31.7	--	602
SB-32	WG-051019-NL-082A	5/10/2019	(52-56) ft	309	--	--	595	--
SB-33	WG-051319-NL-088	5/13/2019	(11-15) ft	--	--	647	--	113
SB-33	WG-051319-NL-087	5/13/2019	(41-45) ft	--	--	649	--	961
SB-33	WG-051319-NL-086	5/13/2019	(66-70) ft	--	--	944	--	1230

**Groundwater Analytical Results Summary
Former Farmland Industries Nitrogen Plant
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Location	Sample Number	Date	Depth	Units	Ammonia	Ammonia - N	Nitrite / Nitrate	Nitrite / Nitrate
				Lab MCL ¹	mg/L PACE NS ²	mg/L CLMSLA NS	mg/L PACE 1 / 10	mg/L CLMSLA 1 / 10
SB-33	WG-051319-NL-086A	5/13/2019	(66-70) ft		914 J	--	1170	--
SB-34	WG-051319-NL-089	5/13/2019	(51-55) ft		--	14.6	--	1.36
SB-36	WG-051319-NL-094	5/13/2019	(15-19) ft		--	5710	--	2770
SB-36	WG-051319-NL-093	5/13/2019	(31-35) ft		--	20400	--	23200
SB-36	WG-051319-NL-091	5/13/2019	(51-55) ft		--	737	--	396
SB-36	WG-051319-NL-091A	5/13/2019	(51-55) ft		544 J	--	413	--
SB-36	WG-051319-NL-090	5/13/2019	(63-67) ft		--	208	--	146
East and West Lime Ponds Area								
SB-37	WG-051319-NL-095	5/14/2019	(11-15) ft		--	3.2	--	2.19
SB-38	WG-051319-NL-097	5/14/2019	(41-45) ft		--	13.2	--	1.58
SB-38	WG-051319-NL-096	5/14/2019	(64-68) ft		--	3.48	--	0.755
SB-40	WG-051319-NL-098	5/15/2019	(24-28) ft		--	25.7	--	1460
SB-41	WG-051319-NL-099	5/15/2019	(15-19) ft		--	8980	--	10900
SB-42	WG-051319-NL-100	5/15/2019	(62-66) ft		--	17.4	--	7.62
SB-42	WG-051519-NL-100A	5/15/2019	(62-66) ft		6.2	--	0.5	--
SB-45	WG-051319-NL-102	5/17/2019	(29-33) ft		--	2.13	--	324
SB-45	WG-051319-NL-101	5/17/2019	(62-66) ft		--	2.28	--	0.634

Notes:

- ¹ US EPA Maximum Contaminant Level for drinking water
- ² no US EPA standard is available
- mg/L - milligrams per liter
- PACE Pace Analytical Laboratories, Lenexa, Kansas
- CLMSLA - City of Lawrence, Kansas, Municipal Services Laboratory Analysis
- ft - feet
- ND - not detected at the associated reporting limit
- J - estimated concentration

Appendices

Appendix A

Stratigraphic Logs for Extraction Wells PSW-3B3, PSW-6B4, and PSW-7B2

Appendix B

Stratigraphic Logs for Data Gap Study Soil Borings

Appendix C

Field Documentation

Appendix D

AQTESOLV™ Analyses

Appendix E

Data Validation Memo and Pace Analytical Laboratory Reports

Appendix F

City of Lawrence Laboratory Reports



about GHD

GHD is one of the world's leading professional services companies operating in the global markets of water, energy and resources, environment, property and buildings, and transportation. We provide engineering, environmental, and construction services to private and public sector clients.

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