EXECUTIVE SUMMARY

RIVERBANK FILTRATION ALONG THE WABASH RIVER IN TIPPECANOE COUNTY

STREAM-AQUIFER CHARACTERIZATION
AND YIELD ESTIMATES

Prepared for:
State of Indiana

Prepared by:
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1.0 INTRODUCTION

The State of Indiana has identified the need to assess the feasibility of developing a large-scale water supply in Central Indiana. The area identified for investigation is along the Wabash River where it crosses an unconsolidated aquifer in the shallow subsurface.

The assessment focuses on evaluating the potential for water production from a series of radial collector wells (collector wells) located along the Wabash River downstream of West Lafayette. This document presents a summary of the results of exploration and testing at the first three potential collector well sites, conducted at two parcels located on the south bank of the river (Figure 1).

1.1 Collector Wells

A collector well consists of a circular central caisson sunk into the ground with horizontal screens (laterals) at the bottom of the caisson that are hydraulically jacked into the aquifer sediments (Figure 2). The planned collector wells along the river will utilize riverbank filtration (RBF) to sustain high yields and provide quality source water. By design, an RBF well induces recharge of river water through the riverbed sediments.

1.2 Approach

The process for estimating yields at the three sites included a field investigation and an extensive modeling analysis. The field program was conducted to characterize the hydrogeologic setting, determine critical aquifer properties used for predictive modeling, and assess the quality of the groundwater. The field program included a regional aerial electromagnetic (AEM) survey (Abraham and others, 2023) and site-specific testing, including drilling sonic test borings, logging geologic sediments, installing monitoring wells and test production wells, conducting aquifer tests, and collecting water-quality samples.

Sites 1 and 2 were on a 75-acre parcel of land located east of the Granville Bridge, downstream of West Lafayette. In the summer of 2023, two test production wells were constructed on the parcel and seventeen borings were drilled and converted to monitoring wells for subsequent aquifer testing (Figure 3). Site 3 was on a 45-acres parcel located downstream of Sites 1 and 2. In the Fall of 2023, a test well was constructed, and nine borings were drilled and converted to monitoring wells prior to an aquifer test (Figure 4).

Results from the field investigation were analyzed and incorporated into a previously developed regional groundwater flow model (INTERA, 2023a) to estimate potential yields by simulating collector wells located at the three test sites. Results from the field program at Test Sites 1 and 2 are reported in INTERA (2023b) and the results from Test Site 3 are reported in INTERA (2024).

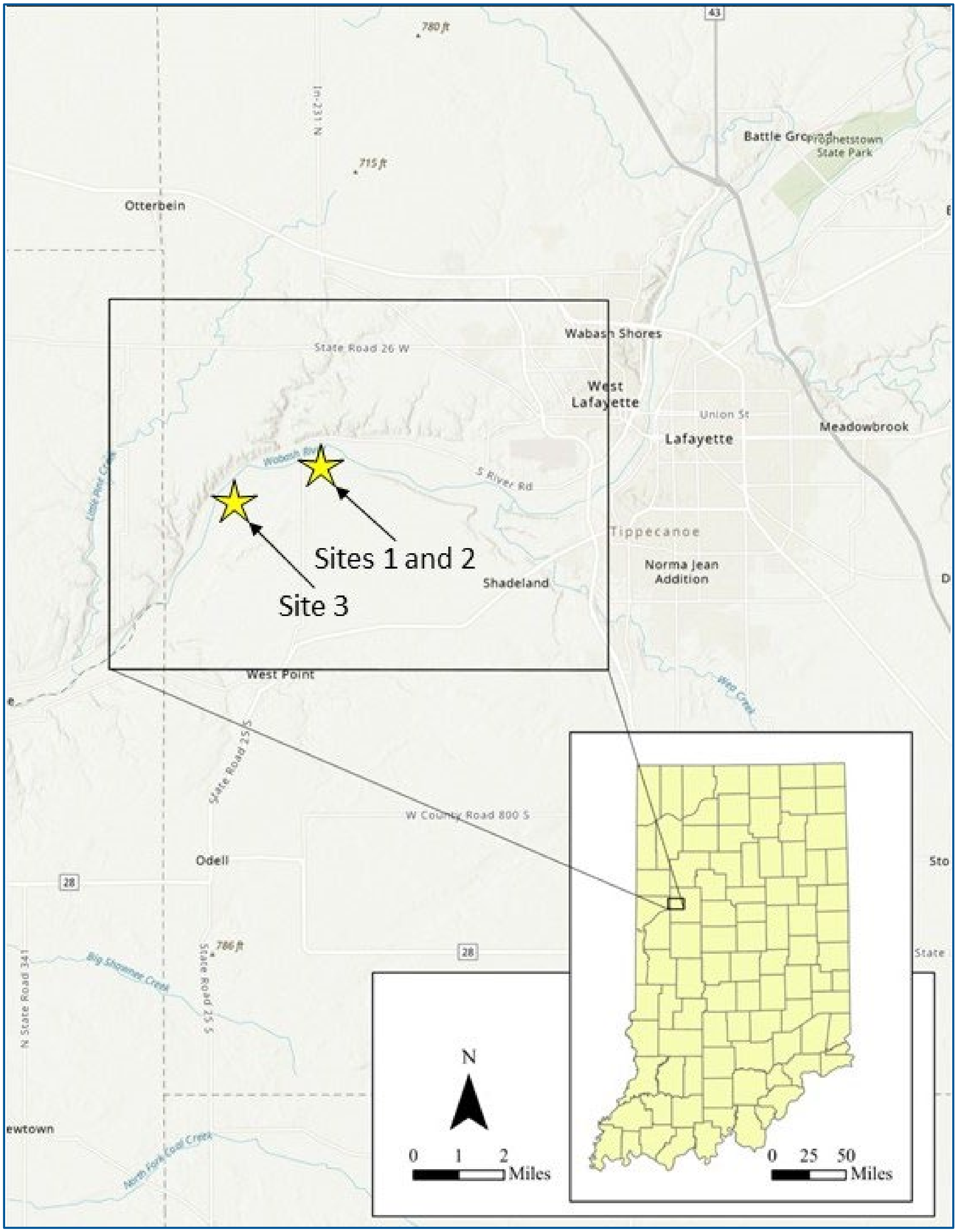

Figure 1. Location of target area and Test Sites 1, 2, and 3 along the Wabash River in Tippecanoe County.

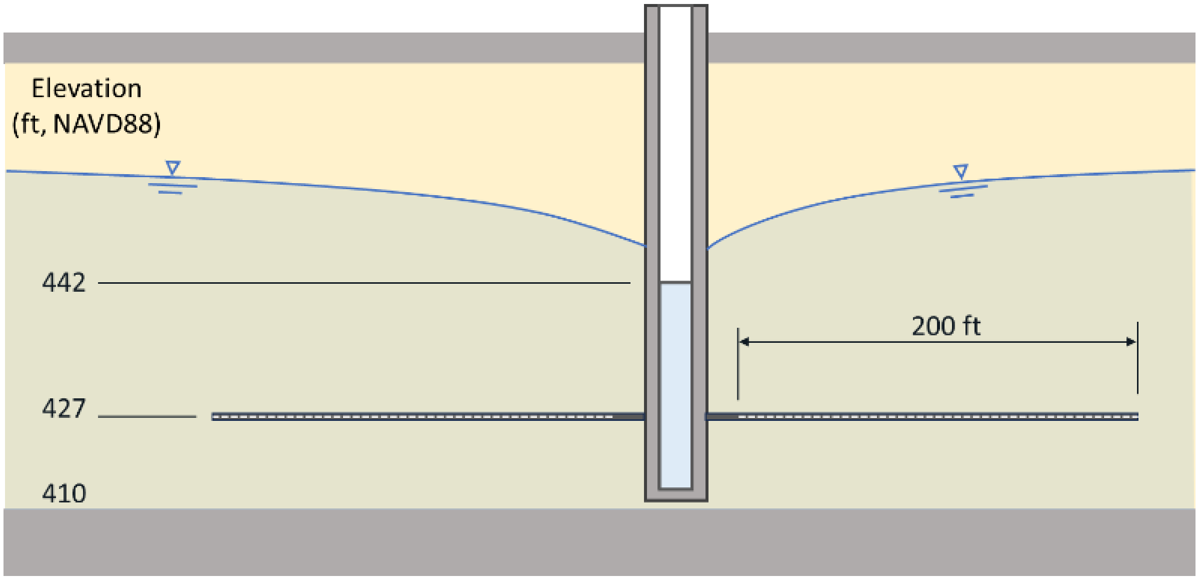

Figure 2. Conceptual illustration of a collector well in cross section, showing the central caisson and horizontal lateral screens.

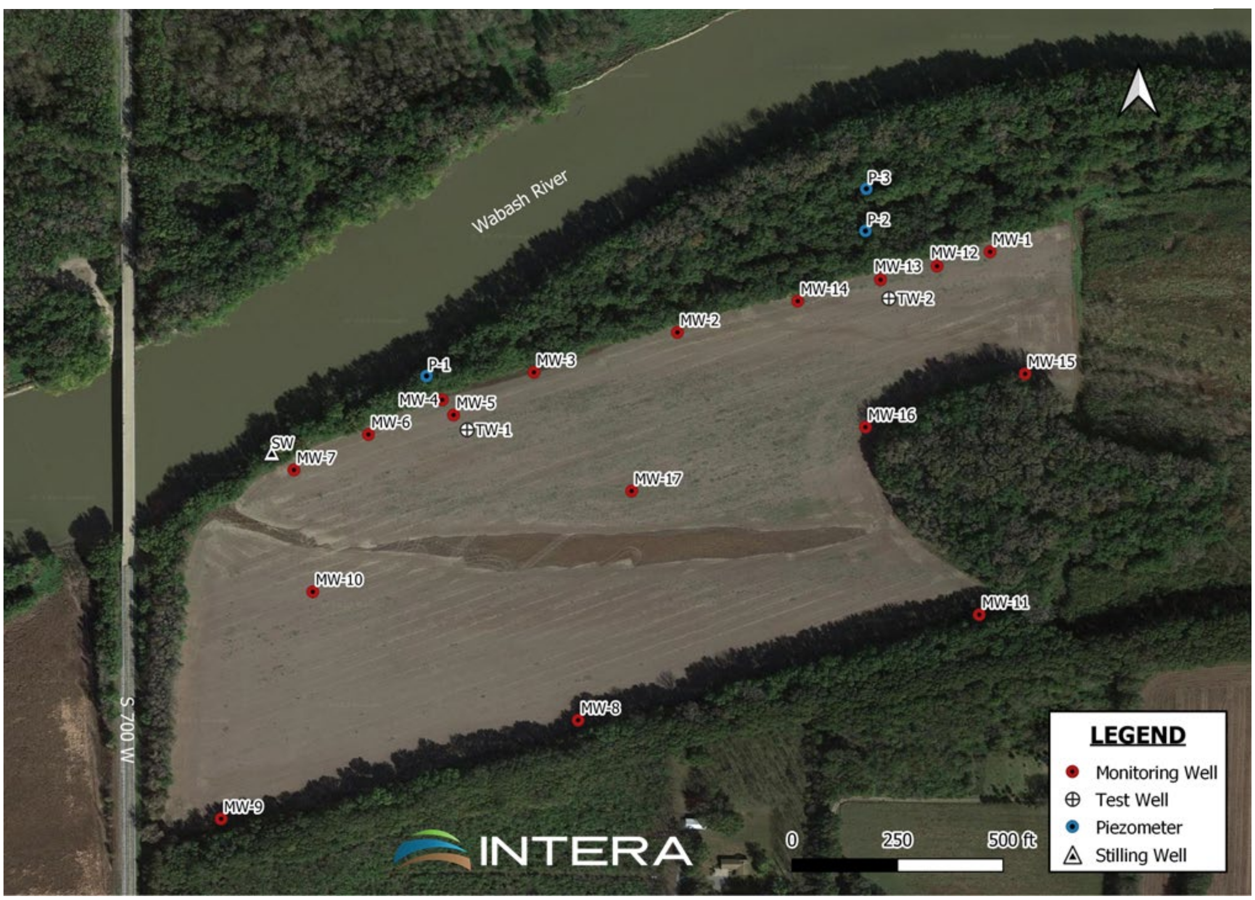

Figure 3. Layout of test wells and measuring points at Test Sites 1 and 2.

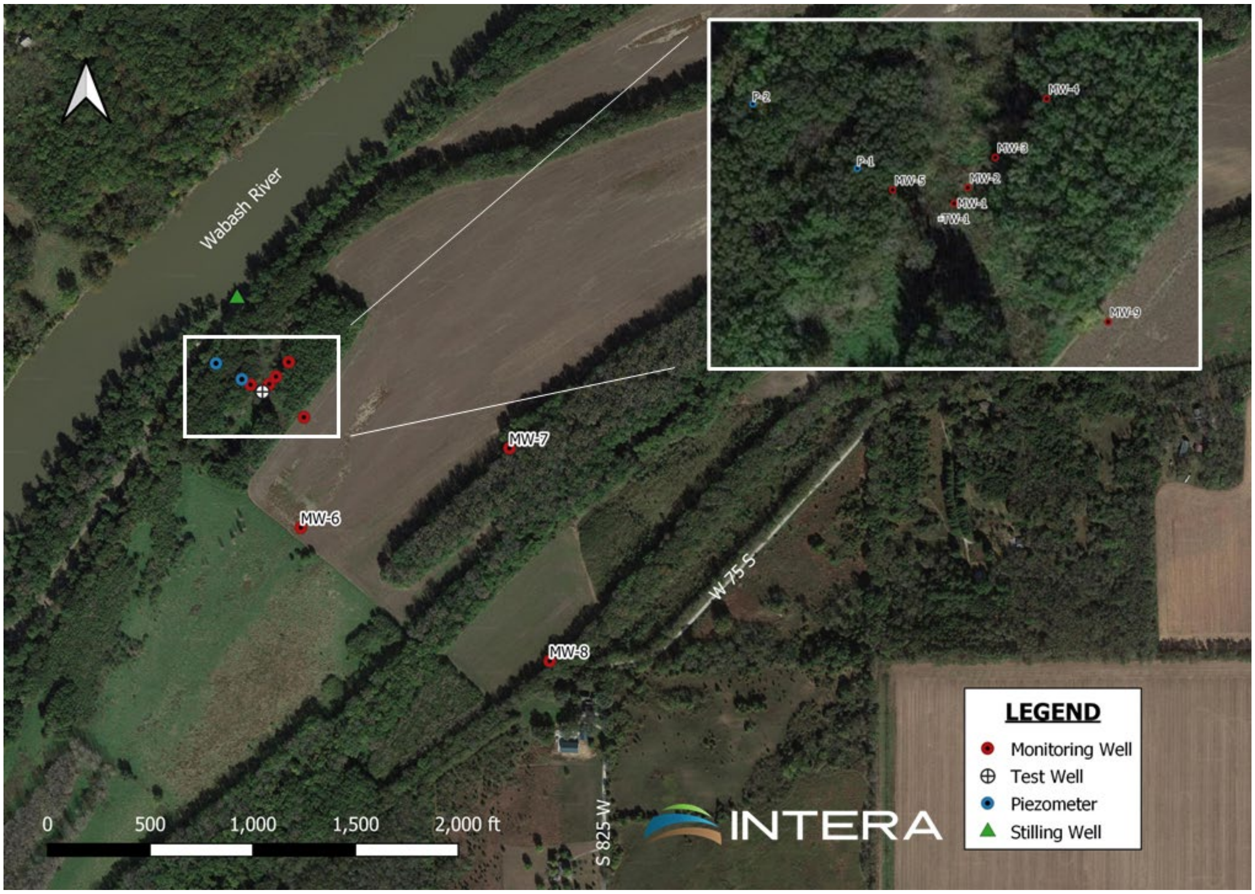

Figure 4. Layout of test well and measuring points at Test Site 3.

2.0 FINDINGS

Test drilling revealed consistent underlying stratigraphy across all three sites. The aquifer consists of permeable unconsolidated sand and gravel formations deposited as glacial outwash or alluvial valley fill. Notably, hydraulic connectivity between the aquifer and riverbed was established, facilitating the potential for recharge of river water into the aquifer—a significant feature for RBF.

Predictive groundwater flow modeling, which incorporated test results provides conservative estimates for collector well yields, with simulations suggesting a conservative lower bound of 30 MGD combined yield for three collector wells pumping in total at Test Sites 1-3. Higher yields are possible in the summer when the river water is warm. The upper bound on the combined operational capacity of the three sites in the summer months is projected to reach up to 57 MGD. However, such intensive pumping could lead to regional drawdown effects, as illustrated by simulated groundwater level reductions of up to 20 feet at adjacent parcels.

Water-quality results show that the source water meets drinking-water standards, with no contamination detected above regulatory limits. These findings underscore the significance of informed planning to mitigate potential impacts on groundwater resources and ensure the sustainability and safety of a future water supply.

2.1 Exploration and Testing

The exploration and testing phase of the field program has yielded critical insights into the aquifer. The field program has provided essential data to evaluate potential source-water quality, estimate yields, and inform the conceptual well field design. Key findings include:

- The underlying stratigraphy at all three sites is consistent between the sites and with the regional setting.
- The aquifer system consists of large bodies of highly permeable unconsolidated sand and gravel which were deposited as glacial outwash or alluvial valley fill (Figure 5). These permeable sediments fill both the recent alluvial valleys as well as the ancient valleys eroded into the bedrock by pre-glacial drainage.
- The aquifer and the riverbed are hydraulically connected, an important feature for inducing recharge of river water through the riverbed sediments.

2.2 Collector Well Yield

Results from the testing were incorporated into a predictive groundwater flow modeling analysis. The objective of the analysis was to provide a conservative, lower bound on collector well yield. Table 1 summarizes the design yields of individual collector wells constructed at each of the three sites, the total yield for Sites 1 and 2 operating, and the total yield with wells at all three sites operating. Estimated yields are lower in the winter due to lower river temperature and the associated increase in viscosity of river water being induced through the riverbed and into the aquifer. Based on the modeling scenarios,

- The simulated collector wells at Sites 1 and 2 are close enough together that there is some interference with both wells running, reducing the individual yields by about 10%. Site 3 is far enough away from the other Sites 1 and 2 that well interference is insignificant.
- A conservative lower bound on the combined yield of three collector wells pumping in together in winter at Test Sites 1-3 is 30 MGD.
- Higher yields are possible in the summer months when the river water is warm. The summer low-stage scenario predicts a total yield of 43-57 MGD from three collector wells.

Table 1. Summary of Design Yields for the three test sites for Summer and Winter Low Stage Scenarios.

	Units	Summer Low Stage	Winter* Low Stage
Lateral Resistance/Width	days/ft	0.02—0.01	0.02—0.01
Test Site 1, Individual Yield	MGD	15—21	11—15
Test Site 2, Individual Yield	MGD	16—22	11—15
Test Site 3, Individual Yield	MGD	14—18	10—13
Sites 1 and 2, Total Yield	MGD	29—39	20—27
Sites 1, 2 and 3, Total Yield	MGD	43—57	30—40
***Note: Winter yields reduced by 30% to account for the increased viscosity of water at 32 degrees °F.**			

2.3 Regional Effects of Pumping on Groundwater Levels

Withdrawing large volumes of water from the aquifer will lower water levels in the aquifer and potentially impact existing wells. Understanding the potential effects on nearby wells is important for planning efforts to mitigate impacts. Figure 6 shows the simulated drawdown in groundwater levels due to combined pumping from the three sites. The drawdown contours are developed from the yield model of summer low-river stage conditions with low lateral resistances, and therefore represents a worst-case scenario. This worst-case scenario produces maximum drawdown corresponding to the largest possible pumping rates of the wells for the scenarios shown in Table 1, where the simulated combined pumping rate of the three collector wells is 57 MGD. The simulated drawdown for this worst-case scenario is:

- Up to 20 feet at adjacent parcels.

- 5-15 feet at neighboring domestic wells.
- 5-10 feet south of the river where multiple irrigation wells are located.
- Up to 5 feet on the opposite side of the river.

2.4 Water Quality

Raw-water samples were collected from the test wells during each aquifer test. Samples were collected according to a sampling and analysis plan (SAP) developed by Black and Veatch (Black and Veatch, 2023). The objectives of the sampling effort were to:

- characterize the groundwater component of the source water and inform assumptions related to treatment process strategies, and
- identify any contamination that might be present near the proposed collector well locations.

The water samples were submitted to Eurofins Environmental Testing Laboratory for analysis of a broad suite of analytes, including the United States Environmental Protection Agency's (USEPA's) primary and secondary drinking-water contaminants and additional water-quality parameters. Also sampled and analyzed were analytes included in the USEPA Unregulated Contaminant Monitoring Rule (UCMR).

The testing results indicate that the potential source water from the three test wells can be classified as calcium-bicarbonate type water and is elevated above the Secondary Maximum Contaminant Level (SMCL) for iron and manganese, typical for Indiana groundwater. The testing results also indicate that the water meets necessary criteria and is safe for use as a drinking water source:

- No primary USEPA standard was exceeded.
- No Volatile Organic Compound, Semi-volatile Organic Compound, or pesticide was detected above a respective reporting limit.
- No UCMR analyte was detected.

3.0 NEXT STEPS

The field program has provided valuable insights into the hydrogeological characteristics of Sites 1-3 and the hydrologic information needed to make conservative estimates of collector well. For project demands that are above the lower bound on well field capacity of 30 MGD, additional sites in the target area need to be secured, explored, and tested. For the existing three sites, additional steps are needed to develop a design-level analysis for the three proposed collector wells:

1. Perform detailed modeling analysis that evaluates well location, number of laterals, lateral alignment, and lateral elevation.
2. Perform preliminary assessment of mechanical capacity of the well screens.
3. Re-asses the simulated pumping level in the caissons based on the results of 1 and 2 above.

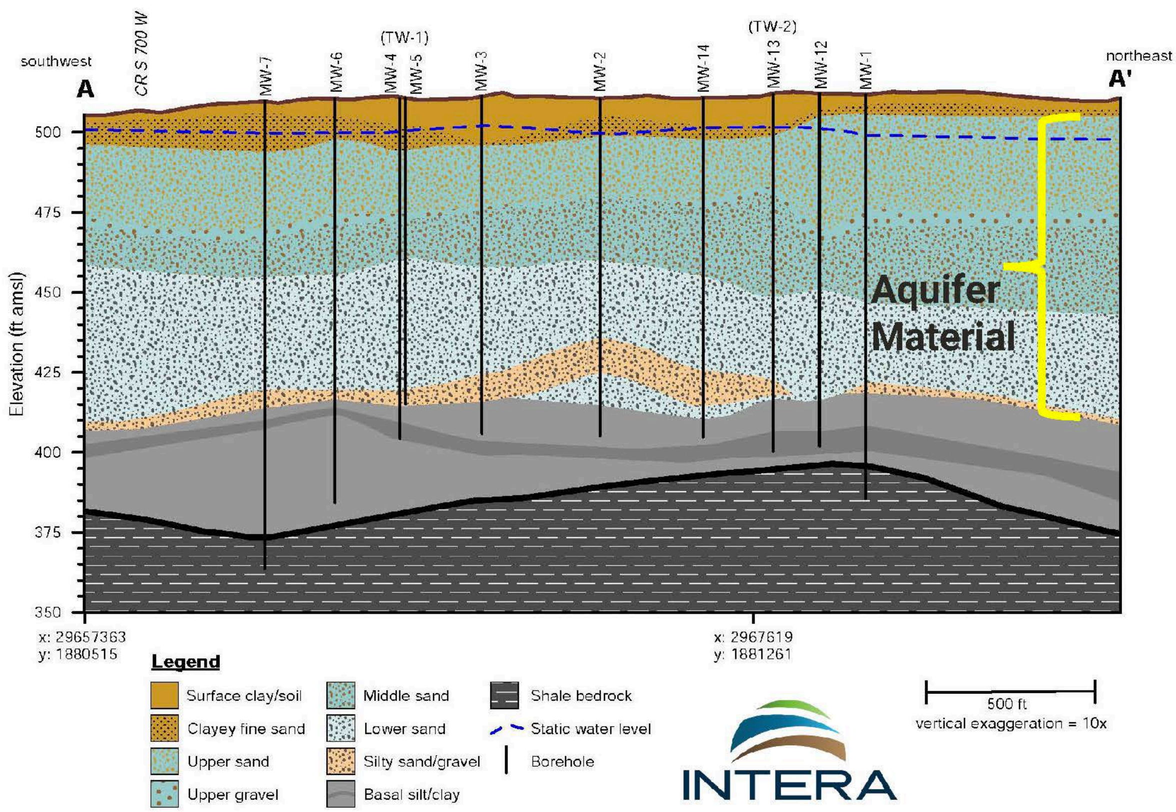

Figure 5. Geologic cross section at Sites 1 and 2.

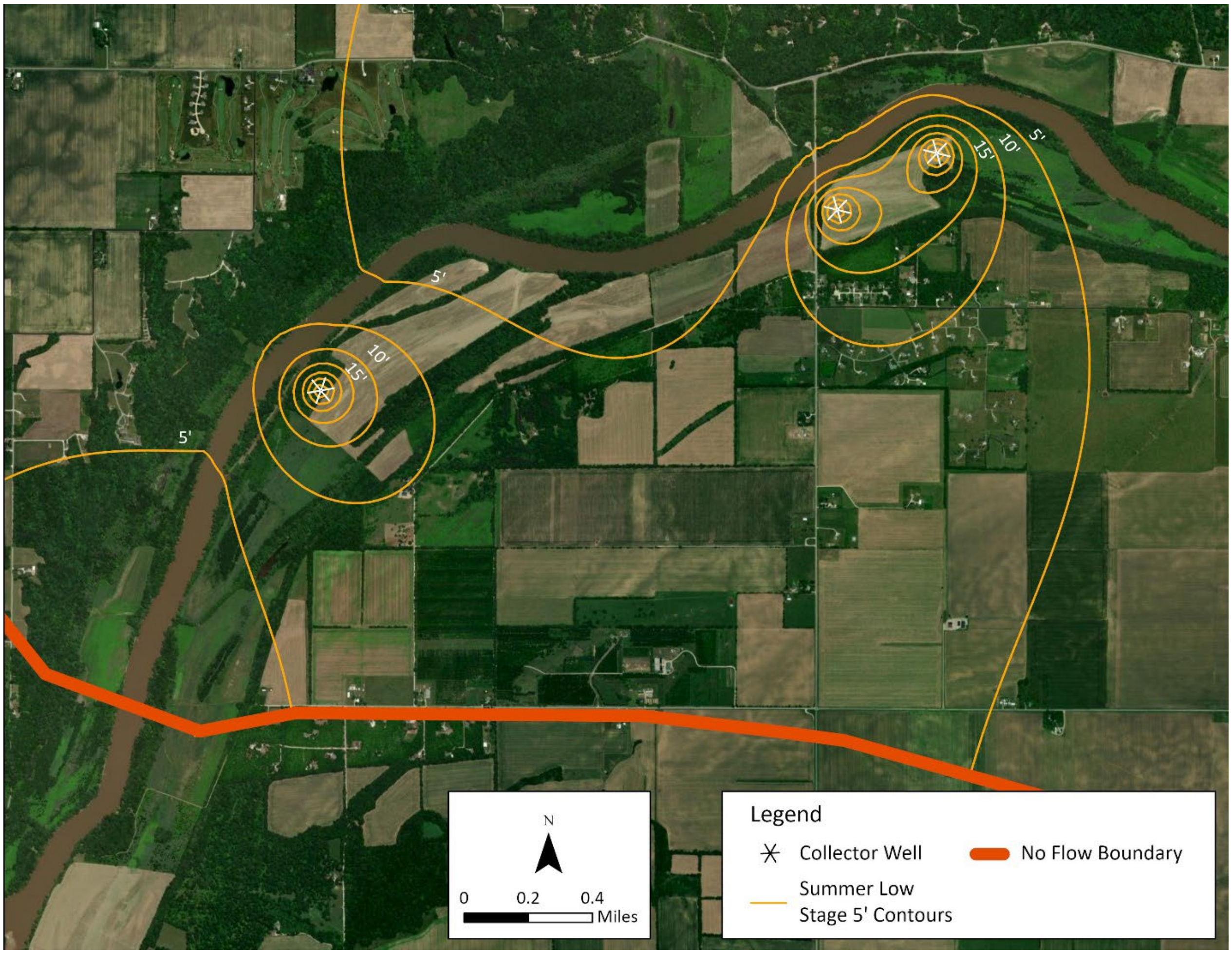

Figure 6. Simulated drawdown of three collector wells pumping at a maximum combined rate of 57 MGD at Sites 1, 2, and 3.

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