Project Technical Memorandum

Project Name:	**City of Springfield, Springfield Supplemental Water Supply Project**
Project Number:	**325216041.02.01**
Date:	**December 2016**
To:	**Ted Meckes, City of Springfield, CWLP** **Jim Kelley, USACE Rock Island District**
Subject:	**Review of Potential Yield of Gravel Pits in the Sangamon River Valley, Layne, August 2, 2013**

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1.0 Introduction

The United States Army Corps of Engineers (Corps) intends to prepare a Supplemental Environmental Impact Statement (SEIS) to address the proposed Springfield Supplemental Water Supply Project in Sangamon County, IL. The Corps, working in conjunction with the City of Springfield, Office of Public Utilities, also known as the City Water, Light & Power (City), is preparing a supplement to the previously prepared Environmental Impact Statement (EIS) in accord with the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 et. seq.). This Supplemental EIS (SEIS) is intended to evaluate environmental impacts associated with a range of alternatives considered to provide supplemental water supply to meet a projected deficit in water availability. In conjunction with the SEIS the City has undertaken an update to the water demand analysis, threatened and endangered species bat surveys, wetland delineations, programmatic agreement related to cultural resources, water quality anti-degradation analysis, and mitigation plans. This memorandum summarizes a review of a previously prepared hydrogeological investigation of the water yield capacity of the gravel pits along the Sangamon River previously acquired by the City for the purposes of meeting the water demand of the CWLP service area.

This review is one task in the larger effort to prepare a SEIS for the above-referenced project. Its purpose is to support the NEPA analysis in conjunction with the project.

2.0 Methods

This critical review is based upon the following report submitted to the City:

> Layne. 2013. *Potential Yield of Gravel Pits in the Sangamon River Valley: Refinement of 2012 Estimates*. Layne Hydro, a division of Layne Christensen Company Prepared for the City of Springfield-City Water, Light, and Power.

The estimated water demand of the Springfield Supplemental Water Supply Project is currently under review by Amec Foster Wheeler. However, the assumed additional capacity of the 2013 Layne report was 12 million gallons per day (mgd) of water during an extended drought period. This Technical Memo examines the methods, assumptions, and findings of the report.

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Other supplementary documents used as reference in support of this review included the following:

Anliker, M. A. and Wotler, D.M.. 1998. *Potential Groundwater Resources for Springfield, Illinois*. Technical report. Illinois State Water Survey. Hydrology Division. Prepared for the City of Springfield, Illinois.

Crawford, Murphy, and Tilley (CMT). 1980. *City of Springfield Report on Study of Sangamon River as an Auxiliary Water Source*. Prepared for the City of Springfield, Illinois – City Water, Light, and Power.

CMT. 1998. *Water Supply Alternatives Feasibility Study – Gravel Pit Withdrawal System*. Prepared for the City of Springfield, Illinois – City Water, Light, and Power.

CMT. 1998. *Water Supply Alternatives Feasibility Study – Havana Lowlands Well System*. Prepared for the City of Springfield, Illinois – City Water, Light, and Power.

CMT. 1998. *Water Supply Alternatives Feasibility Study – Illinois River System*. Prepared for the City of Springfield, Illinois – City Water, Light, and Power.

CMT. 2008. *Preliminary Plan to Develop a Sangamon River Backup Water Supply*. Prepared for the City of Springfield, Illinois – City Water, Light, and Power.

Knapp, H. V. 1998. *Operation alternatives for the Springfield Water Supply System and Impact on Drought Yield*. Illinois State Water Survey. Prepared for the City of Springfield, Illinois.

The additional supplementary documents provided a good background into other alternatives being considered. The main focus, upon completing the background review, was to look at the theory, methods, data, and results of the 2013 Layne study. Figure 1 illustrates the locations of the gravel pits in relation to the water supply wells discussed in this review.

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A previous 2012 Study conducted (Layne 2012)(not reviewed by Amec Foster Wheeler), only had bathymetric data on gravel pits at Clear Lake Sand and Gravel (Area A). The depths used in Areas B and C were based on information obtained from the operations at each sand and gravel pit. The 2012 Study concluded a rate of 12 mgd could be maintained from just the gravel pits during an 18-month drought, but any additional drawdown of the adjacent municipal wells would result in increased pumping costs for the municipality and could disable some wells. This recommendation was based partially on assumptions of the depths and size of the gravel pits. The 2012 Study however, never investigated the actual depths of the other gravel pits, the effect any pumping may have on any of the nearby municipal wells, or the effect water drawdown would have on the day to day operations of the existing gravel pits.

The Lane 2013 Study was a refinement of the 2012 Study. Several data gaps were filled in the 2013 Study including additional gravel pit bathymetric data, actual water level, pump level, and pumping data from the existing municipal wells near the gravel pits. This additional data allowed for better study criteria and assumptions, an estimation of volume of water that could be added to the Springfield water system, and a determination of the maximum volume of water that could be pumped to the system without affecting nearby municipal wells.

Using the new bathymetric data and well construction data the objectives of the 2013 Study were to estimate the following:

1) *Maximum drought yield* – Maximum amount of water that could be pumped from all the gravel pits. For this purpose, no consideration of effects to nearby municipal water wells was considered. Models were set to pump at a steady rate from each group of gravel pit so at the end of the 18 month drought, no water would be left in the gravel pits.
1) *Allowable Drought Yield* – Yield of individual gravel pit groups that is estimated based on impacts to the nearest adjacent municipal well fields. These yields are restricted by a drawn down level to four feet above the municipal well screen to avoid potential impacts to the nearby municipal well fields.
2) *Total Allowable Drought Yield* – The sum of each gravel pit group allowable drought yield.

For the updated study, additional data was considered including bathymetric data on the Area B and C Gravel Pits. Current pumping rates, water levels, and well construction data of the nearby municipal wells, as well as previous data used for the 2012 Study, were included in the new model. MODFLOW 2000, the general standard groundwater flow modelling software, was used to develop the models. Drought conditions were input into the models to adjust for evaporation and lack of (minimal) recharge for an 18-month drought. Aquifer thickness and boundary conditions remained the same from the previous study.

3.0 Summary of Results of Layne 2013 Report

3.1 Maximum Drought Yield

The findings show the Maximum Allowable Yield from all of the gravel pits independent of municipal well operations as described above to be 9.1 mgd. The estimated yield was based on the actual bathymetric data of the gravel pits at Areas B and C which were significantly smaller than previously calculated.

Even if the pumping of the gravel pit water did not affect the pumping elevations in other municipal wells, this water source would require additional yield from other sources to meet the supplemental water supply need.

3.2 Allowable Drought Yield

An allowable impact on the municipal wells was set to keep the pumping level in each well at least four feet above the elevation of the top of the well screen. This is a reasonable assumption as to not have any detrimental effect on the municipal wells. The allowable impact did allow for the lowering of some pumps to a lower elevation, as long as the pump intake was four feet above the top of the well screen. Models were run using various pumping rates from each gravel pit and the effect on individual municipal wells near each of the gravel pits. The following subsections summarize Layne's findings from pumping from individual Gravel Pit Areas.

3.2.1 Area A (Clear Lake Sand and Gravel)

Based on the 2013 Study, pumping from Area A Gravel Pits would affect the Riverton Municipal Wells and the Dawson Well Field. Because of the distance and sheltering effect of Area B Gravel Pits, minimal impact is anticipated to the South Sangamon Water Commission (SSWC) well field. The limiting factor of pumping from Area A Gravel Pits is the Riverton Well #4 based on the close proximity to the gravel pits and the well screen elevation. To maintain the specifications of minimizing impacts on municipal wells, the Allowable Drought Yield is estimated to be 0.2 mgd from Area A.

3.2.2 Area B (Hidden Valley Lake, Sangamon S&G, and Vulcan Materials)

Pumping from Area B Gravel Pits potentially can impact both the Dawson Wells Field and SSWC Well Field. The limiting well in this model was the SSWC Well #3. The model for drought conditions without any pumping from the Area B Gravel Pits shows the pumping elevation in SSWC Well #3 to drop below the allowable effect. No data were presented to show the impact from pumping from individual gravel pits in Area B. If this option is pursued, additional modeling data from Area B may be necessary. Layne may have assumed all three pits are conductively interconnected. Layne's models showed that in drought conditions, the pumping level in SSWC Well #3 would drop below the allowable effect specification. Therefore, it was assumed that no pumping should occur out of Area B Gravel Pits. Allowable Drought Yield is 0.0 mgd from Area B.

3.2.3 Area C (Buckhart S&G and Sang Chris Sand & Gravel)

Buckhart S&G operates two larger gravel pits to the east of the SSWC Well Field. The limiting well in this model was SSWC Well #3. A small amount of pumping from the Buckhart Gravel Pits lowers the pumping elevation in SSWC Well #3; therefore, as in Area B, no pumping would be recommended from the Buckhart S&G Gravel Pits. Allowable Drought Yield is 0.0.

Sang Chris Sand & Gravel is located approximately ¾ mile to the east of the Buckhart S&G pits. The limiting well in this model is the SSWC Well #9. The model was run at 1.4 mgd and the pumping elevation in SSWC Well #9 remained above the allowable effect of four feet above the well screen. Therefore, the allowable drought yield from the Sang Chris Sand & Gravel is estimated to be 1.4 mgd.

3.3 Total Allowable Drought Yield

Based on the assumption that pumping from the pits should not affect any of the existing municipal/industrial wells, the models showed no pumping could be done from any of the Area B

sand/gravel pits or from the Buckhart S&G pits in Area C. Pumping can be done in Area A and Area C (Sang Chris Sand & Gravel) for yields of 0.2 mgd and 1.4 mgd, respectively. The Total Allowable Drought Yield from all the gravel pits is estimated to be 1.6 mgd.

4.0 Summary

This Technical Memorandum is based solely on the information reviewed. The modelling input data, actual result data, and well construction data were not independently verified. The 2013 Study is a natural progression from the 2012 Study to fill the data gaps, and use the new data to provide a more quantitative model and estimates of water volume.

Scope of the 2013 Study consisted of the following:

1. Review and analysis of new bathymetric and municipal well data which was not used in the 2012 Study.
2. Revision of groundwater flow models developed as part of the 2012 Study into a single model of the entire region.
3. Establishment of maximum allowable drawdown criteria for each neighboring well field.
4. Use of groundwater flow models to estimate maximum, allowable, and total allowable drought yields from the gravel pits during the 100-year drought.

Based on the information reviewed, the pumping of the gravel pits along the Sangamon River would not meet the needs for a supplemental water supply during drought conditions by itself, but could safely contribute up to 1.6 mgd.

Amec Foster Wheeler's evaluation of the Layne 2013 Report indicates that the Layne analysis was a good approach to addressing the objectives of the study. Their assumptions were clearly established and appropriate for the study criteria requested. Based on Amec Foster Wheeler's evaluation, Layne's findings are reasonable and appropriate given the information reviewed and evaluated. They used normal standards in their evaluation and good, sound assumptions and limiting criteria to reach their findings. The estimate of 1.6 mgd from the gravel pits is a reasonable volume given the constraints and assumptions used in the model.

5.0 References:

Anliker, M. A. and Wotler, D.M. 1998. *Potential Groundwater Resources for Springfield, Illinois*. Technical report. Illinois State Water Survey. Hydrology Division. Prepared for the City of Springfield, Illinois.

Crawford, Murphy, and Tilley. 1980. *City of Springfield Report on Study of Sangamon River as an Auxiliary Water Source*. Prepared for the City of Springfield, Illinois – City Water, Light, and Power.

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