Springfield, IL Supplemental Water Supply Project

Project Name:	**Springfield Supplemental Water Supply Project SEIS**
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To:	**Ted Meckes, City of Springfield, CWLP** **Jim Kelley, USACE Rock Island District**
Subject:	**Evaluation of CDM Smith's CWLP Water Demand Analysis**

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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 the Water Demand Analysis Report prepared by CDM Smith (February 2015) for the City. Amec Foster Wheeler Environmental and Infrastructure Inc. contracted with American Environmental Corporation (AEC) for assistance in conducting this review.

This review and evaluation of the Water Demand Analysis 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. The water supply capacity of the Springfield water system was not part of the water demand analysis study. This AEC evaluation reviewed the previous demand analysis and provides general and specific comments regarding the adequacy of the previously conducted report.

The water demand analysis included analyses to determine the effect of seasonal weather patterns and severe drought conditions as well as demographics, economic conditions, and water rates paid by customers. The 1953 – 1954 drought in the Springfield area has been estimated by the Illinois State Water Survey (ISWS) to be approximately a 100-year drought event. A 100-year drought event is defined as a drought that statistically has a 1% chance of occurring in any given year. It is expected to occur with an average frequency of 100 years (i.e., it does not imply that it can be expected to occur every 100-years). The 1953 – 1954 drought was used to predict water demand effects of a future 100-year drought. Water conservation measures and the drought management plan which includes potential use of water use restrictions during drought periods were not specifically addressed in the water demand analysis.

2.0 Methods

CDM Smith Methodology

The Corps requested that the City update the water demand analysis for the City service area to assist in determining the need for supplemental water supplies. CDM Smith conducted the water demand analysis using current and historical water use data, population projections, and future water demand forecasts under baseline and drought conditions.

Information developed from this water demand analysis is to be used as part of the assessment of water supply capacity of the existing water supply and the need for a supplemental water supply (Illinois State Water Survey 2016). The CDM Smith demand analysis considered only the water demand for the public potable water supply system.

However, there are also direct water withdrawals (raw water) from Lake Springfield that do not occur through the public water supply system (CWLP 2016). While there is extensive residential development around the Lake Springfield shoreline and this development may cause numerous small water withdrawals, the primary known direct water withdrawal user is the Dallman Power Plant. Estimates of the Dallman Power Plant water withdrawal is 9.3 mgd and includes make-up water for the cooling tower and water used for sluicing coal combustion ash to impoundments downstream of the lake. This direct withdrawal of water from Lake Springfield is not included in the CDM Smith study. **Therefore, the demand characterized in the report is not the total water supply demand on the Springfield Lake water supply system**. In the discussion below of the water demand projections by CDM Smith, the demand refers to the public potable water supply system unless otherwise indicated to be the total demand.

AEC Methodology

AEC evaluated the collection, generation and analysis of the data in the CDM Smith Water Demand Analysis Report, focusing additional attention on the following factors which could affect the results:

- Identify the future water needs of large water users. The health care segment collectively accounts for the second largest category of large water users after CWLP but ahead of the State of Illinois. AEC contacted the larger water users in the health care segment to discuss growth potential (Curtiss and Schmidt 2016; Mason 2016).
- Review population projections and economic development efforts to determine the relative accuracy. AEC compared the validated US Census Bureau figures to the population projections to see if any readjustments may be necessary.
- Review concern voiced about whether efforts to reduce the amount of "unaccounted-for water" (UAW) might reduce the need to look for water sources to supplement Lake Springfield. AEC evaluated the CWLP figures for this water category to address this concern.

3.0 Results

The following summarizes the results of CDM Smith's Water Demand Analysis Report.

3.1 Current and Historical CWLP Water Use

CWLP Water demand figures for 2004 through 2013 indicate that the average annual water demand on the public water supply system has ranged from 20.9 to 23.6 million gallons per day (mgd). During this time period, Chatham ceased buying water from CWLP. As a result, the 10-year average annual water demand was reduced from 22.3 mgd to 21.5 mgd.

For water supply systems in general, it is important and standard procedure to determine the variation in demand over the course of the year resulting from seasonal weather conditions. The CDM Smith report included analyses to quantify the seasonal variation in demand on the public water supply. However, it must be recognized that, while this seasonal variation, and daily variations, also, are important for the treatment and distribution system, the supply capacity of the Lake Springfield system is relatively insensitive to that variation. It appears to be caused by the large water storage volume in Lake Springfield and the critical drought duration for the lake being 18 months relative to shorter seasonal variations. The ISWS has identified that the critical drought duration of Lake Springfield is approximately 18 months. There is significant emphasis on the seasonal and monthly variation and peak ratio in the CDM Smith report, and that information is useful, but will have little influence on the estimated capacity of the reservoir based water supply. Certainly if the peak water demand months occur coincidentally with the peak of the drought lake drawdown, the peak will produce a few inches of increased lake drawdown. With severe droughts having extended duration and complex temporal characteristics, the result will not significantly alter the estimated lake supply capacity for a given risk of occurrence (e.g., a 100-year drought). This is reflected in the reservoir system water supply simulation analyses performed by Knapp (ILSWS 1998).

The CDM Smith water demand analysis used 10 years of weather data to characterize the seasonal variation in water demand and correlation of water demand with precipitation and with air temperature (Changnon et. al. 2004). There is some concern regarding the adequacy of 10 years of data to determine these relationships, particularly when additional data is readily available. For the water demand evaluation however, the 10 years of data are considered ample to define a pattern which, as described above, does not have a large influence on the water demand estimate.

A distinct seasonal pattern shows winter water use at, or below, 20 mgd that increases to almost 28 mgd in July and August. This rise in seasonal demand was observed among all categories of water users. In late winter and spring, snow melt and spring rains typically fill the lake. As seasonally higher temperatures, reduced streamflow, and peak lake evaporation occur and coincide with seasonally high water demand, lowering of the lake level occurs. *Peak monthly usage for the time period between 2004 through 2013 occurred in July 2012 when demand reached 36.28 mgd.*

CDM Smith's analysis revealed that in 2011 and 2012 water usage and Lake Springfield water levels fell below desired minimum levels from August to December and from July to December, respectively. During these time periods, water was diverted from the South Fork of the Sangamon River to augment storage levels in Lake Springfield. The City regularly augments Lake Springfield with water from the South Fork. The July 2012 peak usage occurred during a severe, but brief, drought period and the City determined that implementation of water use restrictions was appropriate.

In terms of water use, residential use accounts for approximately 42.5% of the metered water demand, while commercial, institutional, and industrial use accounts for approximately 57.5% of the metered water demand. While residential water use has shown a gradual decline during the studied time period, water use among commercial, institutional, and industrial customers has increased (CDM Smith).

3.2 Unaccounted-For Water

Water losses occur in virtually every drinking water supply distribution system. Unaccounted-for Water (UAW) is a combination of "apparent" water loss resulting from inaccurate water meters or billing discrepancies and real losses resulting from leakage at water mains, service connections, and joint and fittings within buildings. CWLP has implemented a leak detection program and is

actively working to mitigate leakage where practicable. Some leakage, however, is not economically feasible to remove. UAW in the CWLP water system averages about 14.3 percent of the total treated water. In 2013, this amount is estimated to have been 2.99 mgd. According to the U.S. Environmental Protection Agency (USEPA), average water loss in water supply distribution systems is 16 percent (USEPA 2013).

3.3 Analysis of Trends

July 2012 was the hottest month on record in Springfield and 2012 was the hottest year on record in Springfield. A drought was observed in Sangamon County during 2012; however, higher precipitation amounts during the winter and spring resulted in annual precipitation levels that were well above those associated with a critical duration 100-year drought. The ISWS has identified the critical duration drought period for Lake Springfield to be 18 months. The 2012 drought was intense, but the duration was relatively short compared to other historic droughts in the region. Severe droughts in the region occurred in 1894-95, 1930-31, and 1933-34 as well as the1953-54 drought.

The recession" that began in 2008 and its lingering effects on employment, new housing starts, and business activity negatively impacted water demand.

3.4 Population Projections

Population projections for the CWLP service area were provided by the Springfield-Sangamon County Regional Planning Commission (SSCRPC). The SSCRPC provided population projections for the year 2040 using an average of three different projection techniques. This projection method was identified as the Planning Scenario. The population by community for the interim years between 2010 and 2040 are interpolated from the 2010 US Census and the SSCRPC projected populations. The water demand forecast extends to the year 2065, therefore the 2040 population projects are extended to the year 2065 assuming a linear extrapolation of the 2010 to 2040 trend for each community. After the population projections of each community are added together the result is an overall annual growth rate of 0.11 percent per year from 2010 to 2065.

An alternative to the Planning Scenario was developed by CDM Smith as there may be some uncertainty in the SSCRPC population projections. The High Growth Scenario took the SSCRPC population projections for 2040 and increased them by 5 percent to simulate a scenario of greater growth. The +/- 5 percent error is a common and reasonable assumption of forecast error. It is not an assumption of annual growth. As before, the 2010 US Census and the new 2040 population high growth estimates were used to interpolate the high growth scenario population for the interim planning years and also extrapolated to the year 2065 for each community. The result for the high growth scenario is an overall annual population growth rate of 0.26 percent per year from 2010 to 2065.

3.5 Water Demand Forecasts

Eight assumptions were used to develop the following four future average annual water demand estimates for the year 2065:

- *Baseline Forecast* assumes weather conditions similar to the time period from 2004 through 2013 and the Planning Scenario population projections will result in 22.9 mgd demand.

- *100-Year Drought Forecast* assumes weather conditions of the time period from April 1953 through March 1954 and the Planning Scenario population projections will result in a 23.4 mgd demand.

- *High Growth Forecast* assumes weather conditions similar to the time period from 2004 through 2013 and the High Growth Scenario population projections will result in a 25.1 mgd demand.

- *High Growth with 100-Year Drought Forecast* assumes the weather conditions of the time period from April 1953 through March and the High Growth Scenario population projections will result in a 25.6 mgd demand.

4.0 Summary

The following provides a summary of findings from the evaluation of CDM Smith's Water Demand Analysis Report.

General Comments

- The water demand analysis performed by CDM Smith follows practices recommended in The American Water Works Association Manual M50 – Water Resources Planning which is widely recognized as an industry standard in future water supply planning.
- Facts about historical water use, population, and weather conditions were verifiable. The US Census Bureau data were in line with the population projections used.
- The forecasted average annual water demand through the public potable water system in the year 2065 provides for seasonal weather patterns, drought conditions, and changes in population growth.
- The analysis indicates that water demand factors associated with population growth and other non-weather related influences has a significantly larger effect on future demands than does the 100-year drought condition.
- The CDM Smith water demand analysis considers only the public potable water supply system and does not include other water supply withdrawals from Lake Springfield.
- Potential climate change effects on water demand were not addressed. While climate change has a larger potential to affect water yield (e.g., additional rain events), it also may cause changes in water demand due to potential increased length of summers and related increased seasonal water demand.

Specific Comments

CDM Smith identified eight basic assumptions associated with the development of the water demand projections:

- Water use patterns in future years are represented by water use patterns observed from 2004 to 2013.
- Average weather patterns observed from 2004 to 2013 are representative of normal weather patterns in future years.
- Weather patterns observed from April 1953 to March 1954 are representative of 100-year drought conditions that could re-occur in any given year in the future.
- Water and sewer rates will remain the same as 2013 in real terms (i.e., nominal rates will only increase over time to adjust for inflation).
- Unemployment rates will return to 2004 to 2007 average of 4.7 percent in future years.
- Large and wholesale customers will remain without major additions or loss of customers in future years.
- Authorized unmetered water use will remain at about 2.2 percent of metered use and unaccounted for water will remain at about 14.3 percent of total production. These numbers appear to be slightly lower than the national average.

- Population growth will occur in future years as projected for both the baseline and high growth scenarios. An additional 5 percent population growth was added to SSCRPC population projection for 2040 as an assumption for the high growth planning scenario. This additional 5 percent growth rate was not an annual growth rate but added in 2040 and then extrapolated over the proposed timeframe (see Section 3.4). The result for the high growth scenario is an overall annual population growth rate of 0.26 percent per year from 2010 to 2065.

The concerns associated with specific assumptions are discussed below.

1.) **"Large and wholesale customers will remain without major additions or loss of customers in future years."** This assumption should be reevaluated. The healthcare sector in the Springfield area is cumulatively the second largest user of water behind CWLP and ahead of the State of Illinois. Discussions involving HSHS St. John's Hospital, Memorial Medical Center, and SIU School of Medicine reveal specific expansion plans during the next five to ten years (Curtiss and Schmidt 2016; Mason 2016). For example, St. John's Hospital plans for the construction of a new four-story medical building approximately 100,000 square feet and the Memorial Medical Center has two projects that would expand square footage by approximately 385,000 square feet. These expansion projects will increase the amount of water purchased by these institutions by an estimated 100,000 gallons per day. Providing a sufficient supply of water to the healthcare sector is necessary for continued growth.

   Changes in whole sale customers may occur. Chatham stopped purchasing water from the City in 2012 but could start purchasing water from the City again. The potential exists for other communities to start purchasing water from the City.

   Similarly, CWLP's Dallman Power Plant uses water both potable water use and direct withdrawal from the Lake Springfield and is the largest single consumer. Much of this water use is for Dallman Unit 4 and also for dust control. Additional consideration should be given to the impact on demand associated with implementation of requirements associated with the Coal Combustion Residuals Rule (CCR Rule) or the Steam Electric Power Generating Effluent Guidelines (ELG Rule), or the retirement of one or more generation units.

   The water demand study in Table 6 identifies the water park as a new customer. The Knight's Action Park has been operating several years now and annual average water use should be reviewed to determine if any changes to the table are appropriate. The City should review all its large water uses to determine anticipated changes in their future water demands.

2.) **100-year Droughts.** A 100-year drought has a 1 percent probability of occurring in any given year. While the weather from April 1953 to March 1954 is representative of 100-year drought conditions, droughts occur with varying intensities over relatively long and varying durations, making it difficult to generalize. This is an important consideration for characterization of both the water demand and the water supply. Seasonal variability and peaking of water demand is an important factor for water supply treatment and distribution; it is not highly significant for estimating the water supply capacity for a water supply reservoir with a critical drought duration of 18 months.

3.) **Climate Change**. The CDM Smith water demand projection did not consider potential climate change affects. Climate change predictions include a continuation of recent trends of warmer temperatures and a general increase in precipitation, but occurring as heavier precipitation events during winter and spring months and less precipitation occurring during drier summer

months (USEPA 2016). Therefore, weather patterns from 2004 to 2013 may not be the normal weather patterns in the future.

4.) **Unaccounted-for Water Loss.** According to CDM Smith, unaccounted-for water will remain at about 14.3 percent of total production (approximately 3 mgd). According to the US EPA, the national average water loss for distribution systems is 16 percent (USEPA 2013). The City initiated a leak detection program in 2007. Further review and/or updated information on unaccounted-for water estimates may change this percentage of water loss and reduce water demand. It is unlikely that all leakages in the water distribution system can be eliminated and therefore, it is not feasible for all of 3.3 mgd attributed to unaccounted-for water to be prevented.

5.) **Water Conservation.** The CDM Smith study did not address potential effects of water conservation or water use restrictions to reduce water demand. In the 2000 FEIS, water conservation measures were estimated to reduce water demand by less than 0.65 mgd. Since that time, CWLP has continued to expand its water conservation program. During drought conditions, CWLP implemented water use restrictions. Water use restrictions have been implemented within the CWLP service area in the past and are a common water demand management tool. The benefits of water conservation and water use restrictions in reducing water demand should be quantified and included in a base condition in the water demand analysis.

6.) **Population Growth Rate in High Growth Rate Scenario**. CDM Smith included a 5 percent growth rate which is a cumulative growth rate and not an annual growth rate. This 5 percent additional growth assumption and its impacts are not clearly explained in the CDM Smith study and will be a potential source of concern by the public. A clarification or more detailed explanation of how this growth rate number was selected and how it relates to an annual growth rate would be beneficial is discussed in Section 3.4.

Based on additional information from CDM Smith, for the baseline population scenario, the SSCRPC projected population growth rates and identified that the annual growth rate is 0.11 percent per year from 2010 to 2065. The high growth scenario incorporated an additional 5 percent growth to the 2040 population projection for each community as reasonable range of error on the high side of the SSCRPC projections (see Section 3.4). The result for the high growth scenario is an overall annual growth rate of 0.26 percent per year from 2010 to 2065.

7.) **Direct Water Withdrawal or Raw Water Use.** The CDM Smith study only accounted for potable water supply but did not include direct water withdrawal volumes by the Dallman Power Plant. The power plant uses an estimated at 9.3 mgd of water directly from Lake Springfield. This water volume needs to be captured in the demand analysis.

In summary, it is concluded that the water demand analysis provided by CDM Smith does not provide a full and complete analysis of projected water demand either in the base condition or for the design year of the project (assumed to be 2065). As such Amec Foster Wheeler recommends that the identified deficiencies with the analysis be addressed prior to its use as a basis for the overall project Purpose and Need.

5.0 References

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