TECHNICAL MEMORANDUM
WATER DEMAND PROJECTIONS –RESPONSE TO DNR

To:	**Waukesha Water Utility**
Prepared by:	**Richard Hope, P.E., AECOM**
Date:	**February 19, 2014**
Subject:	**Water Demand Projections – Response to DNR Waukesha, Wisconsin**

EXECUTIVE SUMMARY

The purpose of this Technical Memorandum (TM) is to respond to the WDNR TM dated December 3, 2013, particularly regarding industrial demand projections.

Water demand projections for the Waukesha Water Supply Service Area (WWSSA) were presented in the Water Demand Projections TM dated July 12, 2013. An envelope of projected water demands was developed to cover the range of probable water demands over a long range planning period. Figure 1 presents the envelope of projected average day water demands presented in the July 12, 2013 TM. After the additional analysis presented in this TM, the average day demand of 10.1 million gallons per day (MGD) at buildout (estimated 2050) – as presented in Water Demand Projections TM dated July 12, 2013 – is considered appropriate for planning purposes by current water industry standards and based on communication with industrial water customers. The 2050 projected water demand includes the impact of reducing water usage by 1.0 MGD through a proactive water conservation program.

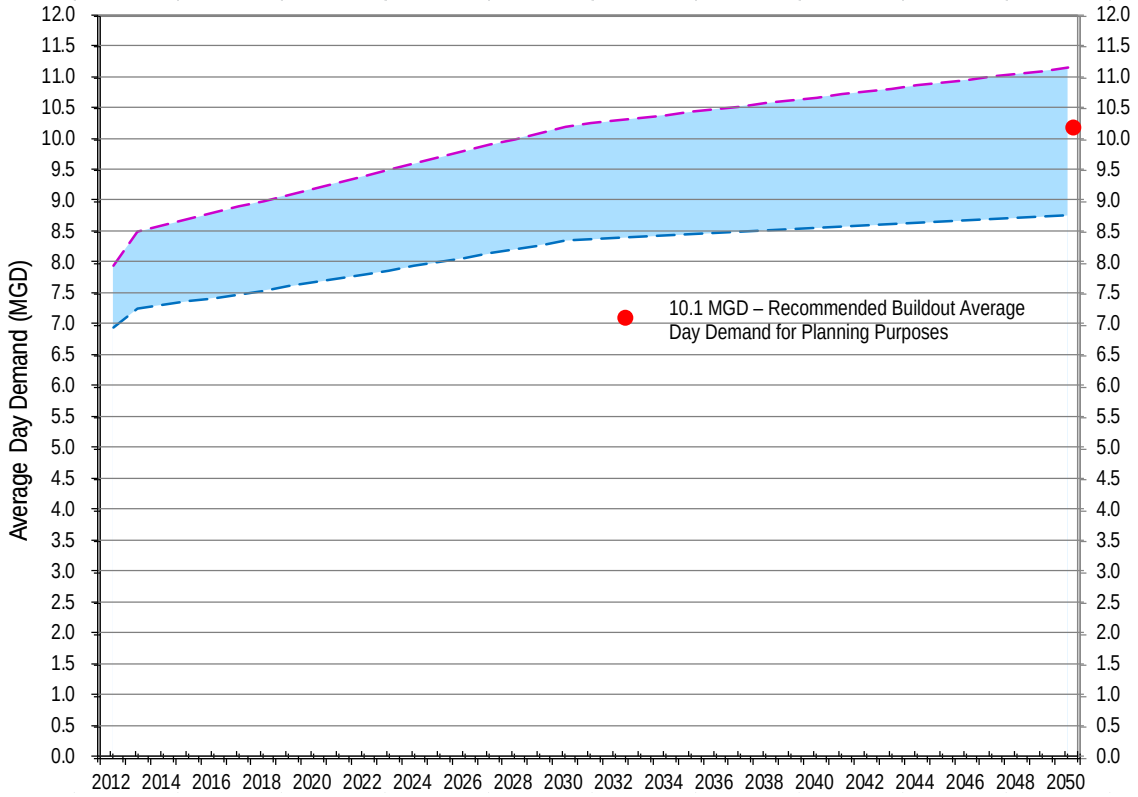

FIGURE 1: PROJECTED AVERAGE DAY WATER DEMANDS WITH ENVELOPE

The low estimate in the envelope in Figure 1 assumes that current water usage continues at recent historical levels but is adjusted for the planned impact of water conservation. This is reasonable for residential, commercial and public water use. However, industrial water use is difficult to forecast due to potential expansion or redevelopment of existing industrial customers and the variability of potential water use by new industrial customers. The small number of industries served by the City of Waukesha had an average day water demand of 0.9 MGD in 2012, which represents approximately 13 percent of the total demand. Therefore, a change in water use of existing industrial customers or a new moderately water intensive industrial customer will have a material impact on the future water needs of the Utility.

The potential for an increase in industrial water demands is reinforced by recent communications the City of Waukesha had with existing and potential new industrial customers, which is summarized below:

1. Several industrial customers are considering increasing production to pre-recession levels. If this transpires, industrial water demand could increase by approximately 0.6 MGD.

2. An industry is investigating developing within the City of Waukesha, which may increase the average industrial water usage by approximately 1.0 MGD.

As one would expect representatives for industries considering increasing production and potential new development have requested that their plans remain confidential for business reasons.

To maximize water conservation, Waukesha Water Utility will continue to work with existing and future users to help evaluate and implement ways to reduce their water use.

The average day water demand of 10.1 MGD for buildout is reasonable for planning of future infrastructure improvements, based on current water industry planning standards and communications with industrial water customers.

1.0 INTRODUCTION

The Wisconsin Department of Natural Resources' (WDNR) Technical Memorandum "Waukesha Diversion Application Demand Rate Projections" dated December 3, 2013 provided comments on the methodology for the projection of industrial water demands presented in the final draft of the Technical Memorandum on Water Demand Projections dated July 12, 2013 (AECOM).

The WDNR correctly recognized that industrial water demand has the potential for the greatest impact on the future water demands and requested a response to the following:

1. A description of the types of industries the city intends to attract and their anticipated water demands.
2. A detailed account of existing industries that may be currently running at reduced capacity and how economic changes would lead to expanded water use for those facilities.
3. An explanation of how a projected significant increase in industrial demand will conform with the City's water conservation plan and its effort to promote conservation to industrial customers.

4. Evidence-based explanation for the departure from recent trends in the industrial demand rate.

Representatives from Waukesha and WDNR met on December 18, 2013 to review the water demand projections and the key items discussed were:

1. An underestimate of future water demands would have significant cost implication in the construction of water supply facilities. The life expectancies of water infrastructure facilities range from 20 to 40 years for pumping equipment and 100 years for pipelines; therefore, it is good engineering practice not to undersize major water infrastructure.

2. It is difficult to accurately project water demands 40 years in the future. Therefore, it is best practice to develop a range of water demands based on varied planning assumptions. The range of possible future demands is framed by high and low projections. For planning purposes, the City selected an average day water demand at buildout of 10.1 MGD that is approximately in the middle of the projected range. This demand includes the impact of a 1.0 MGD reduction in water use from conservation.

3. The water demand for an existing industrial user could change due to expansion and/or a change in industry type.

4. The Waukesha Water Utility currently has a small number of industries and their associated low current water demand (0.9 MGD in 2012) represents approximately 13 percent of the total water requirements. Consequently, a change in water usage of a small number of existing or future industrial customers can have a major impact on the projected water use for industrial class customers.

5. The demand forecast information for residential, commercial and public customer sectors – based on a combined per capita (before conservation) of 81 gallons per capita per day (gpcd) as presented in the Water Demand Projections TM dated July 12, 2013 – is accepted for planning purposes.

2.0 PURPOSE

The purpose of this TM is to respond to the WDNR TM dated December 3, 2013. This TM focuses on the industrial portion of the demand forecast for buildout (2050) for the WWSSA.

3.0 LOW ESTIMATE OF WATER DEMAND

In the final draft of the Technical Memorandum on Water Demand Projections dated July 12, 2013 (AECOM), an envelope of projected water demands was developed, which is an established approach for predicting the likely range of future water demands. This section presents how the estimates that frame the low end of the envelope were determined and why this low estimate should not be used for planning purposes.

Industrial water demand in the City of Waukesha has experienced a declining trend over the last 20 plus years, but appears to have stabilized in the last 4 to 5 years as illustrated in Figure 2. Fluctuations in water demands are expected due to weather, impact of water conservation, and the status of the economy.

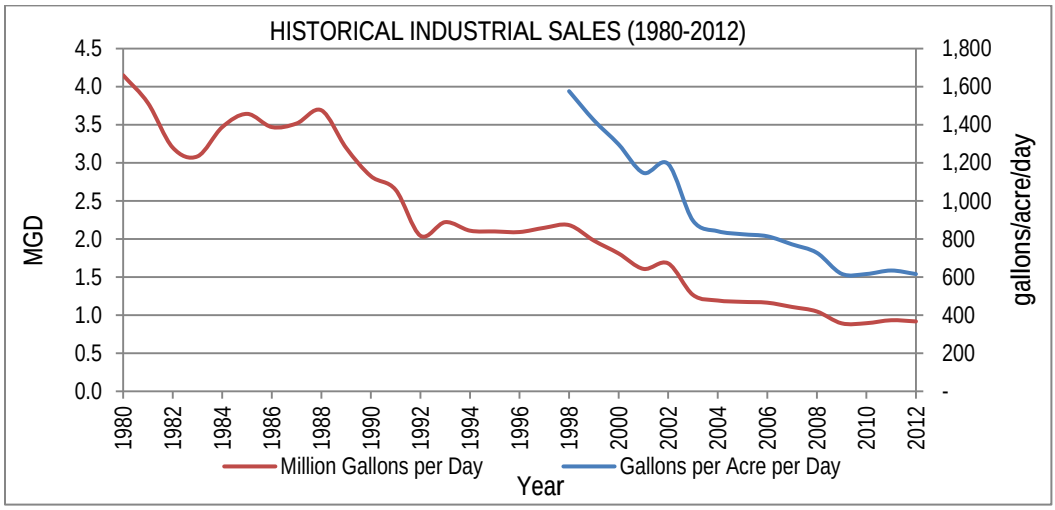

FIGURE 2: HISTORICAL INDUSTRIAL WATER USE

The average daily water demand for industrial users from 2008 through 2012 was approximately 0.9 MGD. Based on the 1,452 acres of developed industrial land, the average industrial water demand is 642 gallons per acre per day. It should be noted that existing industries may expand their facilities within their current boundaries and this would increase water use per acre.

Using an industrial water demand intensity of 642 gallons per acre per day and a total per capita water demand of 81 gallons per person per day for residential, commercial and public water use (without conservation) results in projected water demands of approximately 8.91 MGD and 9.85 MGD for 2030 and buildout (2050), respectively.

With the water conservation goals (0.5 MGD by 2030 and 1.0 MGD by buildout), the projected water demands are reduced to 8.41 MGD and 8.85 MGD by 2030 and buildout.

These projections represent the low estimate for water demands. Because future conditions are uncertain and the financial and environmental consequences of undersizing water infrastructure are large, major new water supply systems are not designed or planned to meet only the lowest predicted demands. Responsible planning and proven professional engineering best management requires the City of Waukesha to account for the impact of potential growth in industrial water use in the overall projection of water demands. The following sections discuss the impact of industrial demand and highlight the impact that the future industrial water usage has on the total water demand projections.

4.0 INDUSTRIAL WATER USAGE

The City of Waukesha, similar to most cities, welcomes industrial development and the associated economic benefit it brings. It is very difficult to project the types of industry that will develop in the City of Waukesha and their associated water needs over the next 40 years.

As noted earlier, the number of industrial customers within the City of Waukesha is relatively small (less than 1 percent of the current total utility customers). As a result, a change in the water use of a small number of existing industrial customers or a new industry with higher than the current average water demand can have a large impact on the industrial water usage. This is illustrated by the following facts:

1. Two industrial customers' water use, post-September 11, 2001, account for an industrial sector usage decline of approximately 380 gallons per acre per day. Therefore, if the two customers were still operating at pre-September 11, 2001 levels, the City of Waukesha's current industrial usage would be approximately 1,000 gallons per acre per day (an increase of approximately 0.6 MGD).

2. A good example of the expected increased industrial water demand is the recent notice from an industry that has informed the City that they plan to increase production to pre 2001 levels within the next 5 years.

3. An existing industrial customer is planning to increase production at their existing facilities and this will result in water usage above current levels.

4. The City was recently approached by a representative for an industrial customer wanting to locate within the City of Waukesha. The estimated water use of this potential new customer would increase the average industrial water usage by approximately 700 gallons per acre per day (an increase of approximately 1.0 MGD).

5. The impact of four new industrial customers with water demands between 0.25 and 0.5 MGD would result in an overall industrial demand increase of 1 to 2 MGD above the low water demand.

Growth in industrial water demand will be due to a combination of new industries and the expansion of existing industries within their current boundaries (Item 1, 2, and 3 above). Increased production or expansion of existing industries will increase the water intensity factor (gallons per acre per day) of the current developed industrial land.

The industries which have been in contact with the City regarding increased production, expansion of their facilities, or new development have requested that their business plans remain confidential.

Although it is difficult to project industrial usage in the future, it is reasonable to forecast that 8 to 10 moderately sized new industrial customers could redevelop existing industrial acreage or develop the available industrial land within the WWSSA. It is also a reasonable assumption that the City's existing industrial customers water usage could rebound to pre-recession levels over the planning period. Either or both of these could increase the industrial water usage.

The July 2013 TM projected industrial water demand is based on 1,297 gallons per acre per day (discussed further below). The industrial demand at buildout (without conservation) is projected at 2.38 MGD. This represents a potential 1.2 MGD increase over the low water demand industrial projection.

To provide additional explanation of the projected industrial water demands, the following were reviewed:

1. Guidelines for projecting industrial water demand based on acreage of industrial land
2. Impacts of new industrial water user(s) and/or the expansion of existing industrial user(s)

Projected industrial low water demands for both current and future consumption were developed by applying the recent industrial water use of 642 gallons per acre per day.

Limited guidelines are available on typical industrial water use intensity factors, however, the following were considered:

1. The Southeastern Wisconsin Regional Planning Commission (SEWRPC) assumes 1,500 gallons per acre per day for undeveloped industrial land.
2. The Water Distribution System Handbook edited by Larry Mays from Arizona State University and published by McGraw Hill provided the following general information for industrial water demand:

Industry	Water Intensity Factors (gallons/acres/day)		
	Low	High	Average
Light Industrial	200	4,700	1,620
Heavy Industrial	400	3,100	2,270

3. The July 2013 AECOM TM on water demand addressed the uncertainty in future industry development by assuming an industrial water demand of 1,297 gallons per acre per day. This was the Waukesha industrial water intensity factor from 2000 (prior to downturn in the economy).
4. Current industrial water demand of 642 gallons per acre per day.
5. Information from Waukesha from existing and potential industrial customers indicated that the water usage could increase by approximately 1,000 gallons per acre per day to 1,642 gallons per acre per day.

The wide range of potential industrial water intensity factors, illustrates how water use is heavily influenced by the type of industry and/or changes by a small number of users. Therefore, projections are difficult for industrial users.

As discussed previously, new industries or the expansion of an existing industry is hard to predict. However, it is prudent to plan for industrial water use to change over the next 40 years.

Table 1 summarizes the change in industrial demand projection based on varying industrial demand intensities.

TABLE 1: SUMMARY OF CHANGE IN INDUSTRIAL DEMAND AT BUILDINGOUT

Industrial Water Demand Intensity	Source	Increase in Industrial Demand at Buildout from Low Water Demand Projection[1]
1,500 gallons per acre per day[2]	SEWRPC	0.3 MGD
1,620 gallons per acre per day[2]	Water Distribution System Handbook	0.4 MGD
1,297 gallons per acre per day[3]	Water Demand Projections TM dated July 12, 2013	1.2 MGD[4]
1,642 gallons per acre per day[3]	Based on discussion with existing and potential customers by the Utility	1.8 MGD
Higher water user(s) and/or change in water use of existing user(s)		1 to 2 MGD

[1] Industrial water demand in the low water demand projection is based on 642 gallons per acre per day.
[2] Water demand intensity for future land development (380 acres).
[3] Water demand intensity for entire buildout acreage (1,832 acres).
[4] Industrial water demand increase included in the projected planning average day demand for buildout.

4.1 Conclusion

This section illustrates the potential range in future industrial water demands. The water demand envelope presented in the July 2013 TM addresses this uncertainty. The projected increase of 1.2 MGD in industrial water demand is used to project the average day water demand of 10.1 MGD at buildout which includes consideration for water conservation.

5.0 SUMMARY

Responsible planning and professional management practice requires that the design of a new water supply must accommodate water demands that can meet more than just the lowest estimated water demands. This is because conditions in the future are uncertain and the financial and environmental consequence of underestimating water demands, and therefore undersizing system improvements, are large. The following water demand projections for buildout from the final draft of the Technical Memorandum on Water Demand Projections dated July 12, 2013 are reasonable for planning purposes:

Buildout Average Day Demand – 10.1 MGD
Buildout Maximum Day Demand – 16.7 MGD

It is also recommended that the Waukesha Water Utility continue its established practice of reviewing water demand projections every five years.