

City of Brookfield
Source of Water Supply Discussion
January 2005

In 2001, the City completed a study that evaluated the City's water system needs for the next 25 years or ultimate build out. This study evaluated water supply options including groundwater and surface water (i.e. Lake Michigan water). The study evaluated current water use, projected water use for the ultimate build out of Brookfield (projected to occur by 2025), and analyzed how to meet this growing demand.

Water Supply Concerns

There has been much discussion and much misinformation about the status of the City's current source of water supply and groundwater in the region. The following discussion will attempt to clarify this and set the record straight.

Deep Sandstone Aquifer

The City currently has 22 groundwater wells serving about 70 percent of the City (all properties are not yet connected to municipal water). Of these 22 wells, nine are located in the deep sandstone aquifer accounting for approximately 51 percent of the City's water capacity. This is the aquifer that has been dropping about six feet per year on average over the last century as wells have been constructed and pumping of this aquifer increased over time. This aquifer is separated from surface waters that are replenished by rain soaking into the ground by a nearly impermeable layer of shale. To replenish this aquifer, water must travel underground from about Oconomowoc where the shale layer ends to Brookfield through the permeable layer of sandstone. Accordingly, the aquifer is dropping because the pumpage rate is higher than the replenishment rate. There is still water in the deep aquifer, even as water levels decline. It just costs more to pump and treat it from greater depths.

In addition, the deep sandstone aquifer has water quality concerns including high total dissolved solids – or very hard water in the deepest wells and radium levels that exceed the maximum concentration levels allowed by law for drinking water. Two of the City's nine deep sandstone wells are not in compliance with the radium standard. Both of these wells are on the west side of the City. The City is currently investigating methods of treatment for the radium at these two wells.

Shallow Dolomite (limestone) Aquifer

The other 13 wells in the City are shallow wells in the dolomite (limestone) aquifer accounting for just over 49 percent of the City's water capacity. This aquifer is replenished with rainwater as it soaks into the ground. All of the City's shallow wells are stable (no permanent drawdown), and are projected to be sustainable well into the foreseeable future. Accordingly, shallow groundwater wells appear to be a reliable source of water supply.

Water quality from these wells is very good. Occasionally these wells have high iron content that is easily removed through treatment. These wells are also more susceptible to contamination from spills of petroleum or other chemicals as they are hydraulically connected to the surface water above through permeable layers of soil and rock. The timeframe for these spills to be conveyed to the wells varies dramatically depending on the location of the spill, the soil type and the pumpage rate at the well. However, most of the known contaminated sites have been cleaned up or are in the process of being remediated. In addition, over time, many of these spills bioremediate, meaning nature takes over and reduces the contamination to non-harmful components. Finally, the utility has wellhead protection plans in place to protect the wells from contamination and staff regularly checks the water quality from all our wells to ensure it is safe to drink. So while water quality can be affected, it is a concern that is manageable and fairly minor.

In summary, talk of declining water aquifers is true for only the deep sandstone wells. The other wells are fine, and the water supply from these wells is sustainable to meet the City's projected demand for water.

One other matter that should be included is the provision for a supply of water in case of emergencies. The City has backup power to many of its wells and portable generators for wells not so supplied. In addition, water stored in water towers is available for use during fires and other periods where additional flow is required. Finally, the City has agreements with our neighbors to the west for interconnected water systems during an emergency. These interconnections can serve as another source of supply when needed. It would be appropriate to have similar interconnect agreements with our neighbors to the north, east and south as well.

Evaluation of Options

The water system study projected water needs for the City and evaluated options for meeting those needs. In evaluating the City's options for water supply, there are four major factors to evaluate. They include technical feasibility, cost, environmental impacts and politics. The following discussion will take these factors into consideration.

Technical Feasibility and Costs

The City of Brookfield is in a unique position related to obtaining surface water from Lake Michigan. The City straddles the sub-continental divide, which is the topographical feature that separates drainage areas in this part of the Country. The east side of the divide flows to the Great Lakes and out to the Atlantic Ocean. The west side of the divide flows to the Mississippi River down to the Gulf of Mexico.

Under current law, water from the Great Lakes (i.e. Lake Michigan) is only available to the east side of Brookfield. Accordingly, the aforementioned study considered how the east side of Brookfield could be served by Lake Michigan water.

Source of Water Supply Discussion
January 2005

The water study indicated that the City could meet the projected needs for water by using groundwater or a combination of groundwater for the west side of Brookfield and surface water for the east side of Brookfield. The study did not evaluate if the entire City could be served with Lake Michigan water and if so, how. However, it is technically feasible to provide surface water to the whole of the City. So the three options to evaluate include:

1. Groundwater only
2. Combination groundwater (west side) and surface water (east side)
3. Surface water only

Under option 1 – Groundwater, the City would not pursue Lake Michigan water, so it would need to find two new wells on the east side of the City to meet the growing demand, plus three additional wells on the west side of the City. Infrastructure costs for these improvements are estimated at approximately \$14.5 million in 2000 dollars.

By providing new wells in coming years (one well every three years beginning in 2010), the City can meet the growing demand for water in Brookfield. This is shown on the attached graph labeled Water Supply Pumpage Forecast for the City of Brookfield Water Utility. Tabular data is shown on the attached table with the same name as the graph.

Under option 2 – Combination Groundwater and Surface Water, the City would not need any new wells on the east side of the City, since it would use surface water from Lake Michigan. Providing surface water to the east side of the City will require infrastructure improvements including new reservoirs, pump stations and upgraded mains. In addition, the City would need one new well on the west side and need to construct transmission mains from two existing wells on the east side of the City to convey this water to the west side of the City. Infrastructure costs for these improvements are estimated at approximately \$15.5 million in 2000 dollars.

A summary of infrastructure costs for the above options is presented on the attached table called Capital Costs for Water Supply Improvements. This table was assembled from the 2001 water system evaluation study. The table also includes an estimated timetable from the study of when these improvements would be needed. The study has actually estimated a higher water use demand than the Utility has experienced over the past three years. So the City could delay some of the improvements a few years if desired.

As can be seen from the figures above, infrastructure costs (mains, reservoirs, pump stations, etc.) in Brookfield for Lake Michigan water was estimated to be about equal to that of infrastructure needed for enhancing the groundwater supply (wells, mains, water towers). These figures include the value of land for the facilities (e.g. reservoirs, pump stations, wells) but these land acquisition costs assume raw land and no need for relocating houses or businesses, which could add significantly to the costs.

The infrastructure costs from the report also do not include costs for any infrastructure improvements in the City of Milwaukee to transport the water to the City of Brookfield. It does include approximately \$1 million for improvements to Wauwatosa's water system which is likely to be required.

Taking into consideration the costs for infrastructure improvements in “supply” communities could add millions of dollars to the Combination Groundwater and Surface Water option (option 2). A detailed study has not been performed to estimate these costs. The City of Milwaukee would be willing to conduct such a study provided Brookfield is serious in its pursuit of Lake Michigan water. The City of Brookfield would be expected to finance such a study and would be required to finance the infrastructure improvements.

In addition to the infrastructure costs, the operation and maintenance costs for each of the above options was also evaluated. The typical operation and maintenance costs (flushing hydrants, reading meters, checking pumps, disinfecting water, fixing water main breaks, etc.) for both options are about the same. The cost for the water (amount Brookfield would need to pay Milwaukee) was estimated at \$25 million over the 25 year period evaluated. Including the cost for purchasing water from Milwaukee (current rate about \$1.10 per thousand gallons) to Brookfield’s current rate of \$2.19 per thousand would add about 50% to current water rates for Lake Michigan water vs. groundwater. That is a significant increase in rates and not popular at any time, especially in today’s economy.

Under option 3 – Surface Water, the City would not need any new wells, but would need to enhance its infrastructure to transport water from Milwaukee or Wauwatosa to areas within the City. Infrastructure costs are not available for this option as this was not evaluated in 2001. This option could be evaluated if there are other communities who would pursue this option for transporting water over the subcontinental divide. There may be an economy of scale on infrastructure costs if enough communities join in a creation and construction of a regional water supply system.

The City of Waukesha is considering the option of applying for Lake Michigan water and is looking for partners to join them in this pursuit. This option is certainly worthy of additional evaluation.

Environmental Impacts and Policy Considerations

Under current law, the City cannot use Lake Michigan water on the west side of the City without pumping the water back to Lake Michigan and getting all eight Governors of the Great Lakes to agree to allow this diversion of water.

Under the proposed Annex 2001, a policy statement by the Great Lakes Governors who oversee water diversions from the Great Lakes, the City could request water to serve the west side without pumping any water back to Lake Michigan. The City of Brookfield and City of Waukesha both maintain that since each community is pumping the deep sandstone groundwater aquifer that is hydraulically linked to Lake Michigan, each City is already pumping Lake Michigan water now. Accordingly (it’s argued), abandoning the deep groundwater wells (which would flow to the Lake) in favor of a surface supply from the Lake, would not constitute a new diversion of water, but rather a grandfathered one, since the cities are already using Lake Michigan water (that which is connected by the groundwater to the lake). Accordingly, the Cities would not need to pump the water back

Source of Water Supply Discussion
January 2005

to the Lake. Science supports this approach with a recent study from the United States Geological Survey. Whether it is supported politically has yet to be determined.

The City has made comments to this affect on the Annex 2001 documents during the formal comment period this Fall. These comments are currently being reviewed, and the Great Lakes Governors, Great Lakes State Legislatures, and ultimately the United States Congress will debate the issue before the Annex 2001 agreement is formalized and approved. This will likely take several years.

Environmentalists agree that the environmental impact of removing 10 million gallons per day for Brookfield from Lake Michigan can not be measured on the Great Lakes Basin. In other words, the amount of water proposed for removal for serving Brookfield is so small compared to the amount of water in Lake Michigan and its recharge, that there would be no measurable environmental impact to the Great Lakes or Lake Michigan.

To put the 10 million gallons per day figure needed for Brookfield's water supply needs in perspective, the total volume of the Great Lakes is nearly 6 quadrillion gallons (that's a six followed by 15 zeros). Chicago withdraws 2.1 billion gallons per day which is not returned to Lake Michigan. But, Ontario adds 3.6 billion gallons per day to the Great Lakes basin by reversing the flow of the Long Lac and Ogoki Rivers into Lake Superior. Furthermore, stormwater runoff has certainly increased as development has occurred in the Great Lakes basin, adding billions of gallons more to the lakes than in pre-settlement days. Accordingly, scientists believe lake levels are affected by climatological changes much more significantly than withdrawals from the lakes for municipal or domestic uses.

Pumping wastewater from the west side of the City back to Lake Michigan would have devastating environmental impacts on the Fox River, where half of the City's treated wastewater effluent is currently discharged. If the City pumped its wastewater back to the Lake, and if other communities did likewise (Waukesha, Sussex, etc.) then the Fox River base flow would be severely depleted, resulting in severe environmental impacts to the area and its surrounding wetlands.

Ultimately, the issue comes down to economics, politics and the environment. The water supply study concluded that it is currently too costly to use Lake Michigan water. But, as costs for pumping and treating groundwater increase, Lake Michigan water may look become cost-effective. This will need to be evaluated in the future. If others pursue Lake Michigan water, it may be best to partner with them to achieve economy of scale savings.

Furthermore, there needs to be a spirit of cooperation within the region to provide Lake Michigan water to the region. Previously there has not been the cooperation necessary between the City of Milwaukee and its surrounding suburbs. Hopefully that is changing and will continue to improve in the future.

Finally, it is probably better environmentally to use Lake Michigan water without pumping it back to the lake, than pumping it back, since the effects environmentally on

Lake Michigan are immeasurable, but the effects on the Fox River and the associated wetlands surrounding the Fox River would be severe.

Implementation

Currently, the City is keeping its options open, while continuing to look for groundwater wells in the shallow aquifer in accordance with the recommendations of the water system study. If other communities, such as Waukesha pursue Lake Michigan water, Brookfield should also consider joining Waukesha in at least applying for the water withdrawal. Implementation of such an application if approved would be dependent on an economic and technical analysis that would be conducted at that time.

As stated above, the City is currently evaluating numerous locations in the City where it can potentially develop additional high capacity wells (600 gpm or greater) in the shallow aquifer. Previous efforts have focused on those potential well sites that are the easiest to develop and that are located in the midst of the pressure zone where the need is the greatest (south side of the City along the Bluemound Road corridor). In addition, there are other sites to investigate, but they tend to be in areas of the City that won't need additional water supplies for well over a decade.

In looking for groundwater sources first, the City is not precluding its ability to obtain Lake Michigan water. The need for additional capacity on the east side of the City will not arise for over a decade. Water needs on the west side of the City (primarily along Bluemound Road) are more of a short term concern (need additional supply well by 2010), which is why well investigation efforts have focused there. These investigations are being conducted now since it takes time to find, develop and construct a well.

At the City's current pace of constructing water main, water will be available to all properties in the City by 2022 or 2025, depending on funding. This is consistent with the pace that was estimated as part of the water study (by 2025). In addition, not all properties connect the year the water main is constructed. Many properties wait several years and some up to the full ten years to connect, meaning some will not likely connect until 2035. Accordingly, the estimate for water needs in Brookfield is conservative, meaning the study estimates that Brookfield would need water sooner than is likely to occur. That being said, the City is on track for implementing the recommendations of the study in the timeframe recommended by the report.

Over the last three years, Brookfield's Water Superintendent, Mark Simon, has been a member of the SEWRPC regional water study developing the computer model for groundwater in the region. Brookfield's Director of Public Works, Tom Grisa, is also now a member of the technical committee assisting SEWRPC with its regional study once it gets underway. This study should provide additional information and direction to the City on regional water supply issues. And since staff members serve on the committee, they will be able to review in detail the assumptions made and shape the recommendations coming out of the study.

In addition, Tom Grisa has set up a "grass roots" organization consisting of local water municipal officials in this area who are concerned with water supply and radium. The Waukesha Water Utility, City of New Berlin, City of Pewaukee, Village of Pewaukee, Village of Menomonee Falls, City of Muskego and others are members of this group. The City maintains regular communication with these agencies about the potential for applying for Lake Michigan water since Waukesha and New Berlin are pursuing this actively. This group supports the issue of cooperation in the region for water supply.

Recommendations

Based on the above, the City should continue to look for groundwater wells in the shallow aquifer, and pursue an application for Lake Michigan water at the appropriate time. This will act as a belt and suspender approach to the issue of providing drinking water to Brookfield properties. The groundwater wells will act as the belt, which is the cost-effective alternative at this time, and the application for Lake Michigan water will serve as the suspenders, in case the belt (wells) ever fails or become too costly to operate.

In addition, the City should cooperate with regional partners to pursue an application for obtaining Lake Michigan water from the Great Lakes. This application, if approved, would provide the City with the ability to connect to Lake Michigan water in the future when and if needed. It does not obligate the City at this time to commit to using Lake Michigan water. In other words, the City would not necessarily need to construct the infrastructure to get Lake Michigan water once the application is approved. The City could delay until it best suited Brookfield or when the City participates with others in constructing a regional pipeline.

The City should pursue interconnection agreements with our neighbors to the north, east and south to provide a water supply during emergencies. This would add reliability to Brookfield's and our neighboring communities' water systems.

While not specifically mentioned above, staff also recommends implementing conservation measures for water consumption including continuance of summer sprinkling restrictions (even numbered houses are allowed to sprinkle on even number days, odd numbered houses are allowed to sprinkle on odd number days).

Furthermore, it would be wise at the next rate increase to consider charging the same unit price for water regardless of use. Currently, rates drop by approximately 5 percent when more than 100,000 gallons are used in a quarter and by over 40 percent when more than 500,000 gallons are used in a quarter. This does not provide incentives for large water users to reduce their water consumption. Providing a single rate for all water use, regardless of amount will provide a financial incentive for these large water users to reduce the amount of water they use. Other communities and utilities have successfully implemented such water conservation methods.

In summary, these recommendations provide a blueprint to follow to ensure that the City of Brookfield has a safe, plentiful and affordable water supply.