rethink water JOLIET

Draft Report

Basis of Design
Attachment G
Existing Well Source/Back-up Supply Plan

City of Joliet, IL
November 2020

DRAFT

Stantec CMT STRAND ASSOCIATES CORNWELL ENGINEERING GROUP IMAGES INC

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G.1 Introduction

While both the CDWM and a new Indiana Lake Michigan intake will have a high level of service continuity, there could be times when a back-up source of supply will be needed. The risk of this occurring in any given year is low. In fact, many Lake Michigan supplied systems have gone decades without a service disruption that requires downstream utilities to utilize a back-up source of supply. If there are service disruptions in the intake, treatment system or transmission system, the City would first rely on the extra water in storage to meet the demands within the system. If the service disruption is such that the excess water in storage in the City of Joliet's system can no longer meet the demands on the system, which would likely coincide with a service disruption of greater than 2 days of time, then water from another source of supply will need to be pumped into the water works system. As with many other Lake Michigan supplied systems throughout NE Illinois, the City of Joliet will rely on their existing well network to meet demands under this type of emergency.

Other than the wells tributary to the Fairmount and Garvin Water Treatment Plant (WTP), the existing wells would not be connected to a local water treatment plant. It is assumed it would be cost prohibitive to connect the existing wells to the treatment plant for the new Indiana intake alternative. It also would be difficult and not cost-effective to maintain the existing Hydrous Manganese Oxide (HMO) water treatment plants in working order for the minimal amount of times that they may be needed. While the level of radium in the water distributed from the deep wells would be in excess of the maximum contaminant level (MCL) concentration, it is unlikely that the short duration of well usage would violate the four quarter annual average MCL standard for radium.

If back-up supply is needed, the existing shallow and deep sandstone wells would be placed in operation by City Staff. Deep wells Rock 1, 2 & 3, as well as gravel wells 101 – 105 would be activated and treated within the Fairmount & Garvin WTP. All other wells would pump directly into the water distribution system. Chlorine and a corrosion inhibitor (phosphate blend) would be added to the water prior to injection into the distribution system.

It should be reiterated the wells will only be utilized on an emergency basis. While new Lake Michigan allocation applications may petition the Illinois Department of Natural Resources (IDNR) to grant the use of wells on a semi-regular basis, the applicant must establish they have a legitimate legal or practical basis for its inability to fully convert to Lake Michigan water and further rely on the deep sandstone aquifer as a primary water source. Since the City does not have a legitimate legal or practical basis to continue to withdraw from deep aquifer wells, the IDNR would not grant their continued use other than on an emergency basis.

Additional details of the back-up water supply plan follow.

G.2 Anticipated Drawdown for Existing Wells

The existing City of Joliet wells and water treatment plants are depicted on Exhibit G2-1. The City currently operates 26 water wells, 21 of which withdraw from the Cambrian-Ordovician deep sandstones and five of which withdraw from shallow sand and gravel deposits. The City currently treats water from all 26 wells at one of the eleven (11) water treatment plants. The Fairmount and Garvin Water Treatment Plant provides iron removal and/or radium removal for its eight (8) adjacent wells. The Black Road Water Treatment Plant provides radium removal treatment for the six (6) adjacent wells. The Water Treatment Plants 10D and 11D provide radium removal treatment for two wells each, whereas all other water treatment plants provide radium removal treatment for a single well.

As part of Phase II of the Alternative Water Source Study, the Illinois State Water Survey (ISWS) evaluated numerous back-up supply modeling scenarios. The results of the analysis are included within Appendix L.4 of the Phase II report. Over the last year, the ISWS has refined the model and has evaluated different pumping scenarios. Results of the analysis have been included in Contract Report 2020-04: Analysis of Risk to Sandstone Supply in the Southwest Suburbs, Abrams, and Cullen.

The City of Joliet has been utilizing the modeling results, along with historical and current water level measurements, to trend water levels in each of the deep wells. Figure G2-1 provides historical and projected static and pumping water levels for a well in each of the west, central and east portions of the City.

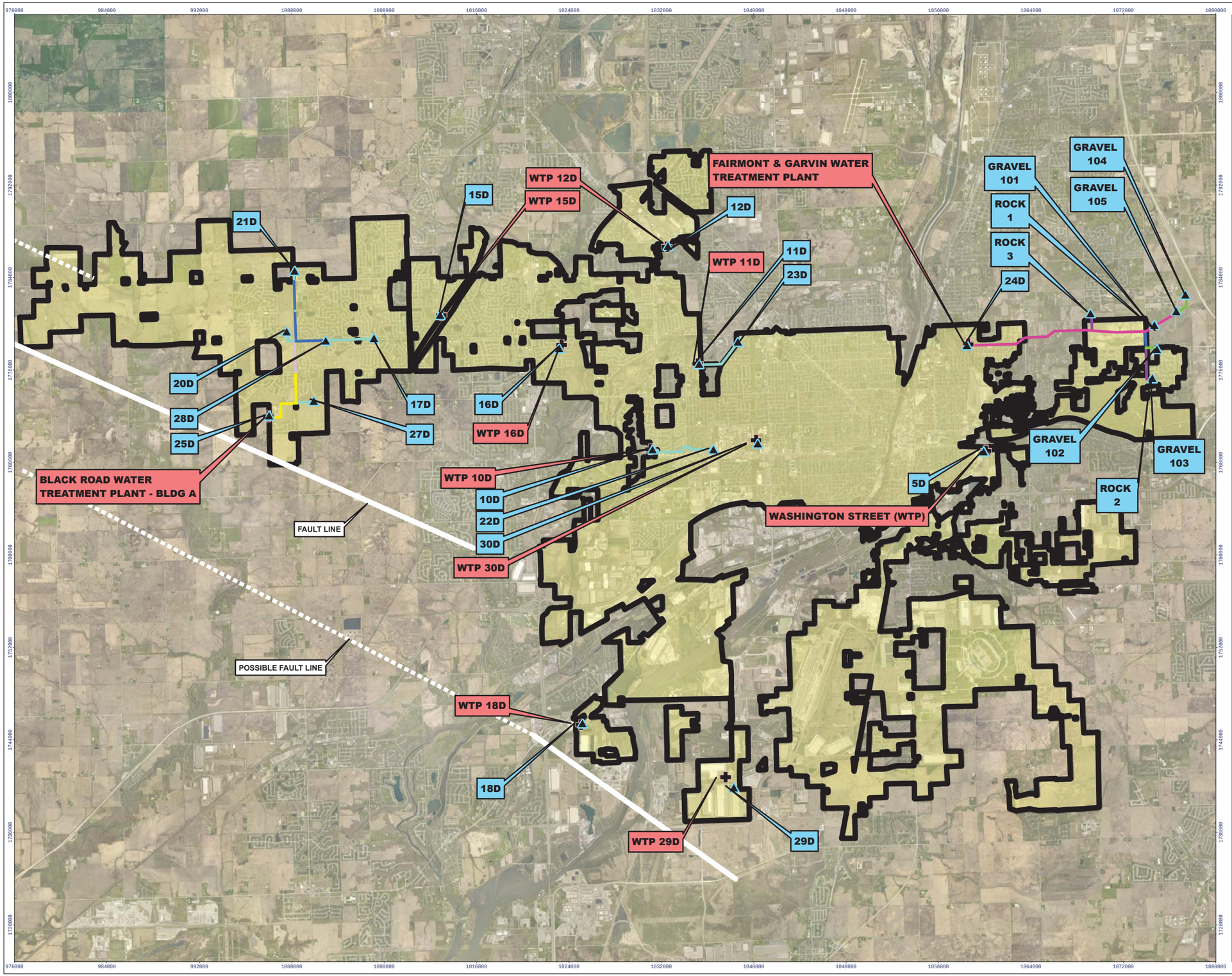


Figure No.

Title

EXHIBIT G.2-1
EXISTING WATER SUPPLY AND TREATMENT FACILITIES

Client/Project

City of Joliet Department of Public Utilities
Alternative Water Source Study - Phase II

Project Location
Will, Cook, DuPage, Kendall, Grundy, and LaSalle County, IL. Lake County, IN

Prepared by MJT on 2020-21-10
TR by NJS on 2020-21-10
IR Review by MJT on

N

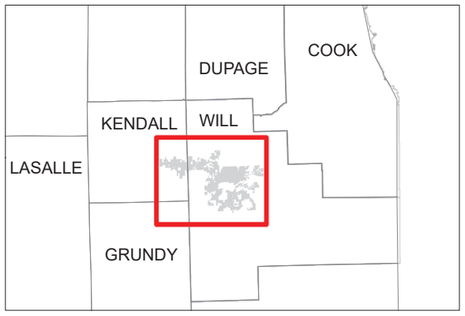
0 4,000 8,000 Feet
(At original document size of 22x34)
1:48,000

Legend

- Existing Treatment Plant
- Existing Water Wells

Existing Raw Water Main

- 8" Water Main
- 10" Water Main
- 12" Water Main
- 14" Water Main
- 16" Water Main
- 20" Water Main
- 24" Water Main
- 30" Water Main



Location Map: Not to Scale

Notes
1. Coordinate System: NAD 1983 StatePlane Illinois East FIPS 1201 Feet
2. Data Sources: WILL CO., COOK CO., DUPAGE CO., IDOT, INDOT, INDNR and USFWS DATA DOWNLOADED FROM WEB 3/11/2019 to 8/26/2019
3. Background: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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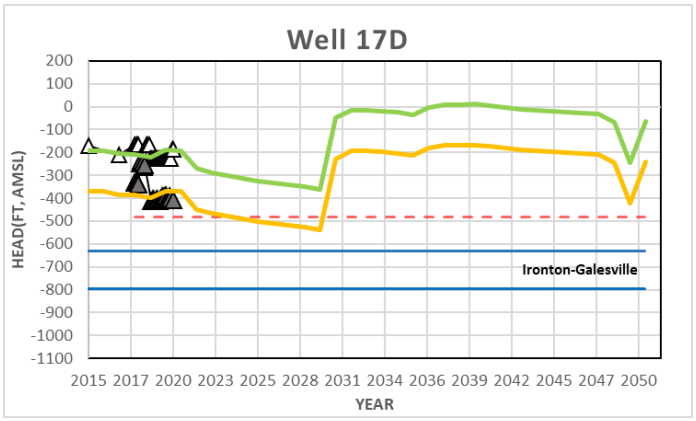
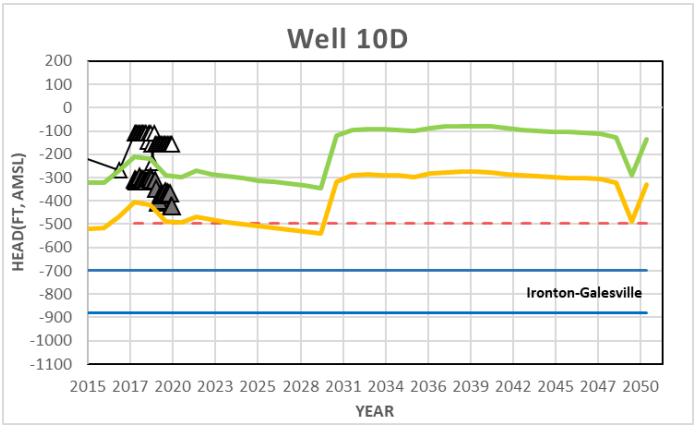
Disclaimer: The location of facilities associated with this alternative is approximate for the purpose of conceptually estimating alternative costs. Siting of proposed facilities will be evaluated during preliminary design following water source alternative selection.

Figure G2-1: Historic and Projected Water Levels

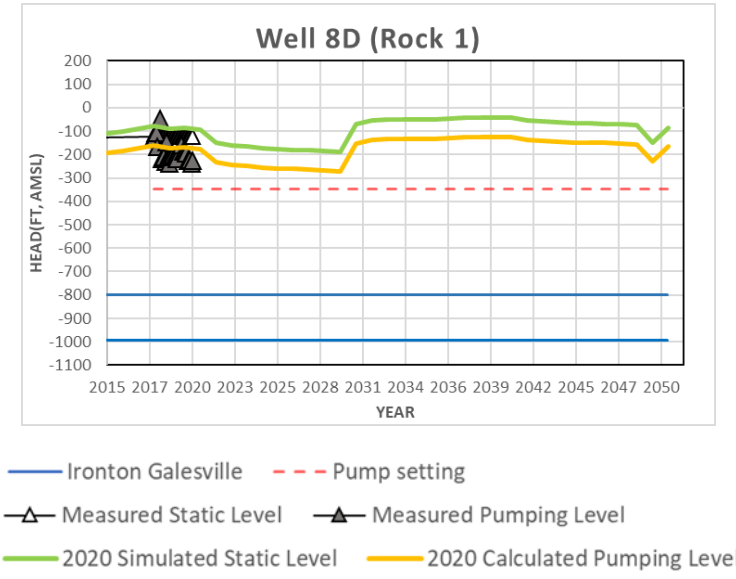
A) Historical and projected water levels in typical well in the western portion of the City.



B) Historical and projected water levels in typical well in the central portion of the City.



C) Historical and projected water levels in typical well in the eastern portion of the City.



The hydrographs presented in Figure G2-1 include the historical static and pumping water levels for three of the wells across the Water Works System. The hydrographs also include the ISWS regional deep sandstone model projected static water levels for the regional Current Trends water use projection. The current specific capacity for each well was utilized to calculate the projected pumping water level under the Current Trends demand scenario.

The model assumes the City of Joliet switches to a Lake Michigan supply in 2030. The model predicts water levels to recover to the same level, or higher levels, than current water levels. Depending on the number of communities in the region who switch from the deep sandstone aquifer, the water levels could increase even higher. The model also includes a Lake Michigan water service disruption in 2049. The modeled disruption assumes the City would need to switch to the deep sandstone aquifer to meet 100% of the City's demand for a 14 consecutive day stretch. While the model predicts there will be measurable decline in the water levels in wells across the City, the lowest pumping water levels are comparable to, or above, the 2030 projected water levels.

It should be noted some of the City's wells, especially the wells that are close to the Sandwich Fault (Wells No. 18D, 25D, 27D and 29D) and wells with very low specific capacities (Wells No. 18D, 22D and 27D) could draw down to levels close to the top of the Ironton-Galesville during extended service disruptions. Even after the City switches to Lake Michigan water, it will be important that water levels in each of the City's back-up wells be monitored to confirm there will be sufficient head to meet potential service disruption withdrawal needs.

G.3 Well Source/Back-up Supply Requirements

The back-up supply capacity should be sufficient to meet the targeted demand with an appropriate amount of redundancy. Given the limited risk of a service disruption on either of the Lake Michigan supplied systems, the back-up supply capacity shall be sufficient to meet the average day demand. It is assumed it would not be cost-effective to maintain sufficient capacity to meet the maximum day demand. Demands can be managed to be consistent with, or lower than, the average day demands through community-wide education, and if need be, by implementing water restrictions.

Table G3-1 summarizes the June 2020 production capacity of the City's wells. In addition to the total production capacity, it also summarizes the well capacity with the largest and two largest wells out of service. The City's current average day demand and maximum day demand are 15.5 MGD and 19.2 MGD, respectively. The 2050 projected average day demand and maximum day demand are 23.6 MGD and 29.3 MGD, respectively. If the combined well production is equivalent to, or better than, the current production, the back-up well network would be able to meet the 2050 projected average day demand even with two wells out of service during a short term Lake Michigan supply disruption.

As stated in Section G.2, once the City, and presumably many of the neighboring communities, go off of the deep sandstone aquifer, water levels will rebound. With the increase in water levels, the short-term production of all the deep wells in the region will increase. It would be difficult to estimate by how much each well would increase, because it would require a detailed analysis of the projected water levels along with all 26 well pump curves. However, it is reasonable to assume the total production level would increase to the point that the existing well network would be able to meet the City's maximum day demand for short durations during a Lake Michigan supply disruption for many years as the maximum day water demand increases from the current level of 19.2 MGD to the 2050 projected level of 29.3 MGD. It is even possible that the existing well network could meet the 2050 projected maximum day demand for a short duration. As the hydrographs in Figure G2-1 show, the projected water level declines for even a 14-day disruption are significant. Therefore, the deep wells will only be sustainable for periodic, short duration use as a back-up supply source.

Table G3-1: City of Joliet June 2020 Deep Well Production Capacity

WELL DESIGNATION	AQUIFER[1] SG	SL	GP	SP	IG	MS	CURRENT FLOW RATE (GPM)	YEAR DRILLED	MOTOR HP	CASING DIAMETER (INCHES)
WELL-G101	●						613	2005		
WELL-G102	●						592	2005		
WELL-G103	●						591	2005		
WELL-G104	●						568	2005		
WELL-G105	●						541	2005		
WELL-ROCK 1			●	●	●		700	1949	500	28/19/15
WELL-ROCK 2			●	●	●		850	1950	500	28/20/16
WELL-ROCK 3			●	●	●		650	1950	450	26/20/16
WELL 5D			●	●	●		850	1937	500	18 (12.25: 917 - 980)
WELL 10D			●	●	●		1,050	1970	400	30/26/20/16
WELL 11D					●		700	1975	500	20/16
WELL 12D					●		849	1975	300	20/16
WELL 15D					●		900	1997	400	18
WELL 16D					●		950	1999	400	18
WELL 17D					●		850	2000	400	18
WELL 18D					●		450	2000	400	18
WELL 20D					●		575	2003	400	18
WELL 21D					●		700	2003	400	18
WELL 22D					●		500	2005	400	18
WELL-23D					●		700	2005	400	18
WELL-24D					●		1,100	2006	400	18
WELL-25D					●		700	2005	450	18
WELL-27D					●		850	2006	400	18
WELL-28D					●		1,000	2006	400	18
WELL-29D					●		675	2010	400	18 (16: 1064 - 1148)
WELL-30D					●		800	2011	400	18

TOTAL CURRENT FLOW CAPACITY ALL SOURCES:	**19,304 GPM** / **27.80 MGD**
TOTAL FIRM CAPACITY (Largest Well Out of Service):	**18,204 GPM** / **26.21 MGD**
TOTAL MODIFIED FIRM CAPACITY (Two Largest Wells Out of Service):	**17,154 GPM** / **24.70 MGD**

Notes:

1. Aquifer Designations: SG = Sand & Gravel; SL = Silurian Dolomite; GP = Galena-Platteville Dolomite; SP = St. Peter (Ancell) Sandstone; IG = Ironton-Galesville Sandstone; MS = Mt. Simon Sandstone

G.4 Siting for Additional Well(s)

As stated in Section G.3, the City's existing deep sandstone well capacity should be sufficient to meet the average day demands in 2050, even with up to two wells out of service. Therefore, it is not anticipated that any new wells will be needed before 2050.

Given the fact that the City is likely to continue to grow beyond the population and water demands assumed for 2050, it seems possible that future demands could exceed the City's back-up well capacity. If that becomes the case, and sufficient redundancies have not been built into the Lake Michigan supply system by that time or it is determined demand management cannot meet the required demand reductions, then the City would need to consider drilling a new well, or wells, to meet the demands.

Given the fact that a new well would not be needed for more than 30 years, it is difficult to predict where the optimal location for a new well would be. The demand distribution, capabilities of the water distribution system to transfer supply inputs to high demand areas and the location of the existing back-up wells would need to be considered. The state of the groundwater levels and production capacity of the deep aquifer would also need to be considered. Based on the current conditions in the aquifer, the target location for a new well would be on the far west side of the current corporate boundaries west of the Sandwich Fault. Since the area on the west side of the community likely will see the most amount of growth over the next 30 years, it is also likely that this will be an area where a new back-up supply well could meet local demands.

G.5 Conceptual Design Parameters

Based on current water level predictions, the City's existing well network will provide the needed back-up supply capacity to meet the City's projected 2050 average day demand. It is assumed the current HMO treatment systems for most of the wells will be taken out of service. All wells currently have piping in place where the wells can pump directly into the distribution system. Therefore, minimal piping modifications will be needed. Chlorine feed and blended phosphate feed systems will need to be installed within each of the well houses. A further description of the design components is as follows.

G.5.1 Design Hydraulic Capacity of Back-up System

The current operating head of the pump and motors within the wells provide sufficient pressure to pump through the HMO treatment systems under pressure and out into the distribution system. With the removal of the HMO treatment systems, the head on the well pump will be reduced by an estimated 20 – 50 feet. Given the fact that the current operating point for each of the well pumps is over 1,000 feet of head, the reduction in discharge head due to the HMO water treatment plant removal will likely be indiscernible on the pump curve. Therefore, it is anticipated no hydraulic modifications will be required for the existing deep sandstone wells.

G.5.2 Well Pumping System *Capacity*

As stated in Section G.3, the City's existing deep well capacity is sufficient to meet 2050 average day demands will all wells in service. Since water levels are predicted to increase once the City of Joliet and several of its neighbors switch to an alternative water supply, it is assumed the production capacity of the wells will increase. Therefore, the current deep sandstone wells are projected to have sufficient capacity to meet the 2050 average day demand even with up to two wells out of service.

G.5.3 Pumping Station Building *(size and characteristics)*

A description of the building improvements, or modifications is as follows:

- The City's wells have separate, stand-alone well houses except Well No. 29D. The existing well houses will be maintained for each well.
- The water treatment portion of the Well No. 29D building will be demolished. A smaller building will be constructed around Well No. 29D and its electrical equipment.
- Due to the fact that the five sand and gravel wells and three deep wells tributary to the Fairmount and Garvin Water Treatment Plant have iron concentrations to the level that treatment would be needed to utilize them, both the north and south water treatment plant buildings at the Fairmount and Garvin site would remain in service.
- The Washington Street Water Treatment Plant (East side of City), Well No. 11D Water Treatment Plant (central portion of the City) and Black Road Water Treatment Plant (west end of the City at the Aux Sable Wastewater Treatment Facility) will be repurposed into satellite Public Utilities/Public Works Buildings. The treatment equipment and piping will be removed. The surge tank will be cleaned out and filled. An overhead door will be installed on the exterior of each of the buildings.

- Water Treatment Plants No. 10D, 12D, 15D, 16D, 18D, 29D and 30D will all be demolished.

G.5.4 Chemical Feed System

The chlorine feed system will be sized to achieve the pertinent combined or free residual. The chlorine demands of the existing raw water quality will be taken into effect, along with the target residual.

The blended phosphate feed system will be sized to achieve a target concentration range of 1 – 3 mg/l.

G.5.5 Power Supply: Primary and Back-up

The existing primary and back-up electrical supplies for the wells will be maintained in service. It is not anticipated that any additional power supply improvements will be needed.

G.5.6 SCADA Configuration

All of the existing wellhouses contain programmable logic controllers (PLCs) that connect to the systemwide SCADA system. The wellhouse PLCs will remain in service and will continue to stay connected to the SCADA system.

G.5.7 Major Site Improvements

Other than the restoration needs created by the demolitions and modifications described in Section G.5.3, no additional site improvements are contemplated at the back-up well and water treatment plant sites.

G.5.8 Operational Considerations

Each of the back-up supply wells will need to be sampled monthly. A typical operational process for each of the wells would be to read the static water level prior to turning the well on. After the well has been in operation for a couple hours, the well should be sampled, and the pumping water level should be recorded. The water level measurements should then be recorded in the well water level management spreadsheets. The samples would be submitted for the typical monthly coliform testing. The wells also likely will need to be tested for organics and inorganics on a regular basis; however, they likely will be on a reduced testing schedule given the fact that they are back-up wells.

If the wells need to be engaged for back-up supply, then the first step will be to secure the appropriate amount of chemical for each facility. Since it will be important to get as many wells operational as quickly as possible, it is recommended the City focus on obtaining chlorine and phosphate blend for the deep wells throughout the City, first. Next, the City should focus on securing chemicals for the HMO treatment systems, so Wells Rock 1 – 3 and Gravel 101 – 105 can be brought online. If the Fairmount and Garvin WTP is operational before the wells are needed, then the wells tributary to that facility would be placed in service first. The other wells would be turned on throughout the system where the demands are the highest. If the water levels in the storage facilities continue to drop, then more wells would be placed online until water levels in the storage facilities are stable at a preferred operating level – at least 50% of the storage tank capacity.

G.6 Schedule and Implementation

The existing wells and treatment systems will need to remain operational at least up to the point that the City has switched to the alternative water source in 2030. It is recommended that the current systems remain in operable condition for at least one year after the switchover has occurred just in case they are needed to work through any transitional challenges.

G.6.1 Final Design

It is recommended the back-up well improvements design phase be initiated in the first part of 2030 to coincide with the Lake Michigan switchover timeline.

G.6.2 Permitting

Since no modifications to the well pump, motor and piping is anticipated, there would be no need for permitting for the wells. Permits will need to be obtained for the chemical feed systems to be installed at each of the well sites. If it is determined any of the wells should be abandoned, then a well abandonment permit will be required from the Will County Public Health Department. The back-up supply improvements permit submittal(s) should be toward the end of 2030.

G.6.3 Bid, Construction, and Start-up

The back-up supply improvements bidding should take place in the first part of 2031, with construction initiation taking place in the middle of 2031. The improvements should be completed by the end of 2031 or first part of 2032.

G.7 Opinion of Probable Construction Cost/O&M Costs

Table G7-1 summarizes the opinion of probable construction cost and total anticipated costs for the improvements.

Table G7-1: Back-up Supply Improvements Cost Estimate

Improvement	Cost
Chlorine & Phosphate Feed Systems @ Each Well Site	$420,000
Washington Street WTP - Convert to Utilities/PW Department Satellite Facility	$123,000
Fairmount & Garvin WTP - Maintain Iron Removal Water Treatment Capability For Wells Rock 1, 2 & 3 & G-101 - G-105; No Modifications Anticipated	--
WTP 29D - Demolish Water Treatment Portion of Building	$187,000
WTP 30D - Demolish Water Treatment Plant Building	$187,000
WTP 18D - Demolish Water Treatment Plant Building	$187,000
WTP 11D - Convert to Utilities/PW Department Satellite Facility	$238,000
WTP 12D - Demolish Water Treatment Plant Building	$187,000
WTP 10D - Demolish Water Treatment Plant Building	$308,000
WTP 16D - Demolish Water Treatment Plant Building	$187,000
WTP 15D - Demolish Water Treatment Plant Building	$187,000
Black Road WTP - Convert to Utilities/PW Department Satellite Facility	$493,000
Subtotal	**$2,704,000**
Contractor OH & Profit (10%)	$270,400
Mobilization (1.5%)	$40,560
Bond & Insurance (2.5%)	$67,600
Subtotal with Markup	**$3,082,560**
Contingency (25%)	$770,640
Opinion of Probable Construction Cost	**$3,853,200**
Engineering, Legal, Administrative Costs (20%)	$770,640
Allowance for Land Acquisition	--
Total	**$4,623,840**

COST ASSUMPTIONS

1. Remove concrete down to 3-ft below grade, remaining tanks/foundations to be buried
2. Two WTP's at Black Road site. WTP 10D and 11 D serve two wells, each. All other WTP's are single well, single WTP.
3. Special waste removal of backwash contents via licensed hauler, full tank depth removal as residual.