MEETING DATE: 04/26/21 **ITEM: 8**

AGENDA ITEM SUMMARY

Subject: Water Department – Clearwell construction discussion

Background Summary:

One of the capital projects we have generally discussed during planning and goal setting workshops is the need to increase the below ground clear well capacity at the Water Plant. Currently the city has 500,000 gallons of underground storage which is on the small side of what we should have and prevents the plant from operating at its highest efficiency. We completed an initial study with SEH Engineering to look at what the solutions could be considered. The report (portion attached) concluded a 1Million-gallons of additional underground storage would be the optimal size. The existing 500,000gallon clear well is in very good condition and can continued to be used for years to come.

With the current capacity choke point we have it creates numerous starts and stops of the plant which makes it difficult for operators to run the plant, causes more wear and tear on the plan components. By upgrading to 1.5Million-gallons of capacity those issues would be greatly improved and overall use of lime in the softening process will become more efficient. So, less lime to use and less lime by-product left at the end to load and haul away to area farm fields.

Initial estimate of cost for the project would be about $5.219M. Use of some Water Fund cash reserves and a potential CDBG grant ($600,000) could get the overall loan down to under $4M I would think. We'd then be looking at an SRF Loan through the Iowa Finance Authority which currently is around 2% over 25 years. With an existing loan we have ending in FY22 and with other added revenues we've begun to see, I would expect minimal impact to water rates, if any to fund the project.

Water Plant Superintendent Cory Spieker, SEH Engineer Rustin Lingbeek, and NIACOG Local Assistance Director Chris Diggins will be present to discuss the project and potential next steps.

Our initial discussion internally with staff is that we would like to move this project along by starting with initial application to the IDNR and beginning the process of seeking CDBG grant funding.

SEH

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for All of Us®

April 21, 2021

RE: City of Charles City, Iowa
Water System Storage Tank PER
SEH No. CHARC 156988

Iowa Department of Natural Resources
Water Section
Wallace Building
502 East 9th Street
Des Moines, IA 50319

Attached you will find a copy of the Water System Storage Tank PER for the City of Charles City along with Schedule 1A. The report identifies the current conditions, future needs, and recommended improvements. In general, the City's water treatment plant (WTP) and existing clearwell are not sequencing together very well. The system consists of an upgraded WTP in 2010 and a 500,000-gallon clearwell. The Water Treatment Plant is rated at 5 MGD and operators struggle to achieve long run times. The excessive start and stop of the WTP has led to fatigue of the equipment, extra lime usage, and extra lime removal have resulted in the need for storage improvements.

Based on the need of improvements and limited resources, the recommended improvements have been planned for immediate action. Work associated with the project is proposed to begin as soon as possible depending on financing. The City is anticipating that an application for CDBG funds as well as submitting an IUP application for SRF funds will be completed in the coming months.

I would like to thank you in advance for your assistance with this project. Please feel free to call if you have any questions or need additional information.

Sincerely,

Rustin Lingbeek, PE
Project Manager
(Lic. IA, MN, KY)

enclosure
c: Steven Diers, City of Charles City, 105 Milwaukee Mall, Charles City, IA 50616
Cory Spieker, City of Charles City, 105 Milwaukee Mall, Charles City, IA 50616

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Water System Storage Tank PER

Charles City, Iowa

CHARC 156988 | January 6, 2021

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Water System Storage Tank PER
Charles City, Iowa

SEH No. CHARC 156988

January 6, 2021

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Iowa.

Rustin J. Lingbeek, PE — (Date) 1/6/2021

License Number 20827
My License renewal date is: December 31, 2021.

Responsible for the following sections:

Short Elliott Hendrickson Inc.
215 North Adams Avenue
Mason City, IA 50401-3119
641.424.6344

SEH

Executive Summary

The purpose of this report is to present the results of Short Elliott Hendrickson's (SEH's) evaluation of the Charles City Water Treatment Plant (WTP) existing clearwell and potential additional storage options. This evaluation was requested based on concerns about aggressive start and stops of the plant which could lead to existing equipment fatigue and ultimately failure. The existing clearwell was inspected in August of 2016 and is in good condition. There were no specific concerns expressed by the City, other than the daily number of start and stops of the system along with needed capacity in the system.

SEH presents a model consisting of the existing system and several scenarios that would increase storage capacity to gain a better understanding of how additional storage would affect the water treatment plant operation. The following scenarios are evaluated:

- Existing Clearwell (0.5 MG)
- Existing Clearwell and 1.0 MG Additional Storage
- Existing Clearwell and 1.5 MG Additional Storage

To further investigate optimizing the operation of the water treatment plant, two additional scenarios are modeled by adjusting the lower level control on the clearwell to allow for a longer period of run time as follows:

- Existing Clearwell and 1.0 MG Additional Storage with Adjusted Clearwell Control
- Existing Clearwell and 1.5 MG Additional Storage with Adjusted Clearwell Control

The modeling results indicate that adding either storage addition would result in the WTP operating between 3 and 4 times a day. The results would be a significant improvement to the existing system operation. The WTP would further improve operations by lowering the level control on the clearwell to allow the water levels to have greater bounce. The higher bounce will cause the WTP to run for a longer time period. Further along in the design process the water model can be utilized to fine tune the clearwell lower level controls and optimize the WTP operation.

The report provides cost estimates for the 1.0 and 1.5 MG clearwell construction and future funding options for the upcoming project.

Based off the model and cost estimated provided, SEH recommends the Charles City Water Plant expands their system by adding an additional 1.0 MG clearwell. The clearwell will be constructed without taking the existing unit out of service, provide service for the next 50+ years, and reduce the plants start and stops to 2 to 4 times a day. The decrease in cycles will reduce equipment fatigue, consume less lime and prolong the life of the WTP. Also, it is recommended that the pump VFDs be reprogramed to slow down starts and stops of the system. This would also help with equipment preservation. Furthermore, there will be less wear on the lime feeding equipment, pumps, and lime removal components. Two additional pumps will be added to the system to supply water to the City and Valero. It is recommended that an interior coating system should be included to prevent corrosion.

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Prepared for City of Charles City, Iowa

1 Background Information

1.1 Water Treatment Facility

The Charles City Water Treatment Plant (WTP) receives water from three wells located throughout the City. The plant treats its water by aeration, lime softening, filtration, chlorination, small pH adjustments and corrosion control. Currently, the Water Treatment Facility pumps an average of 2.5 million gallons per day. With new improvements implemented in 2010, the plant now has the maximum operating capacity of 5 million gallons per day. The water system also includes two elevated storage facilities, a booster station, and a single clearwell. The clearwell is a ground storage reservoir which provides water to the system and Valero Renewable Energy west of Charles City. Valero Renewable Energy receives about half of the water supply Charles City produces.

Although the Facility's system clearwell structure is in good condition, there are a few operational concerns that need to be addressed to ensure the longevity of the plant. The existing water treatment plant is having to start up and stop too frequently due to the current storage volume. In the future, the irregularity will cause fatigue to the existing equipment which could ultimately lead to failure. WTP staff indicate that the constant starting and stopping is challenging to control the lime feeding. This excessive start/stop cycle leads to a greater use of lime in the treatment process. The plant needs to add additional ground storage to reduce the number of starts and stops.

According to the 2019 Water Model Report, available storage should be large enough to provide equalization storage (15% of MD), fire storage to fight a 3-hour fire at 3,500, and average day demand for reserve storage. This sizing practice is a commonly used industry requirement for storage that also accounts for hourly system operation to satisfy peak water demands.

When recommending storage volume for the City, recent water use trends, the average demand of 2.4 MGD, the maximum demand of 3.2 MGD, and the water storage level of service goal previously stated were utilized. The resulting calculation revealed a recommended total system storage volume of 3.5 MG. If the City were to add additional water storage in the future, it is recommended that at a minimum volume 1.0 MG be added to supply additional clearwell storage. To evaluate the City's potential storage options, a model of the existing system and several scenarios that would increase storage capacity was created for the purposes of this report.

1.2 Existing Clearwell

The Charles City water treatment facility has a single clearwell that follows the water treatment system. Its purpose is to provide efficient WTP run time and additional storage for the treated water prior to being pumped by high service pumps to the distribution system. The existing clearwell is 500,000 gallons and currently is limiting the run time of the WTP.

The existing clearwell has several high service pumps located on the peripheral edges on the top that pump the finished water to the distribution system or to Valero Renewables ethanol production plant.

The characteristics of the existing clearwell are approximately as follows:

- 500,000 Gallon Concrete Clearwell
  - 75' Diameter
  - Underground with 1 ft above ground

The existing operation conditions for the plant consist of the water treatment facility turning on and off between 4 to 8 times a day. The City has reported that a maximum day would be considered when the WTP was cycled 12 times.

1.2.1 Review of Preliminary Maintenance Inspection of Clearwell

A complete Preliminary Maintenance Inspection was completed in August of 2016. This included an external review along with a remote operated vehicle (ROV) internal inspection. The purpose of the inspection was to evaluate the interior and exterior coatings performance and life expectancy, assess conditions of the concrete surfaces and make budgetary recommendations for any future improvements.

During the inspection, the interior and exterior components were evaluated. The concrete on the exterior roof is in good condition with only small cracks and slight spalling. The concrete on the interior roof had only minor cracking and no spalling on the roof. The interior sidewall concrete had no cracks or spalling. Overall, other than a few minor cracks throughout the existing structure the clearwell is in good condition.

Based off the information gathered, recommendations were made for possible improvements to the clearwell that included scheduled regular cleanings and inspections, and repairs of the small cracks.

The written report provided is included in Appendix A at the end of this report.

2 Clearwell Storage Analysis Water Modeling

2.1 Model Overview

To gain a better understanding of how additional storage would affect the water treatment plant operation, several storage capacity scenarios were analyzed. The model consisted of evaluating the existing system and several scenarios that would increase the storage capacity. The scenarios are outlined below:

- Existing Clearwell (0.5 MG)

2.3.6 Summary of Results

The following table summarizes the model's results. The increase in storage and adjusted clearwell level will result in less start and stops for the plant.

Table 1 – Clearwell Model Results

Model Scenario	Hydraulic Bounce (Feet)	On/off cycle (Number of cycles)	Operation/Run Time (Hours)	Cycle Time - On (Hours)	Pumps off (Hours)	Cycle Time – Off (Hours)
Current System	1005.9'-1009.3'	4-8	2.3	0.5-5	1.5	1-4
Additional 1 MG Storage	1005.9'-1009.3'	3-4	4.3	1-6	2.6	1-5
Additional 1.5 MG Storage	1005.9'-1009.3'	2-3	6.1	3-8	3.9	1-6
Additional 1 MG Storage (Adjusted Clearwell Controls)	1,000.0' – 1,009.7'	1-2	11	9-14	7	6-8
Additional 1.5 MG storage (Adjusted Clearwell Controls)	1,000.0' – 1,009.7'	1	14.6	11-15	9.3	10

2.4 Model Summary and Conclusions

The modeling results indicate that adding either storage addition would result in the WTP operating between 3 and 4 times a day. The larger amount of storage yields less operational starts and stops. To further optimize the WTP operation the lower level control on the clearwell can be adjusted to allow the clearwell levels to bounce more and the WTP to run for a longer time. More information regarding the pumps will need to be gathered as to how far the clearwell can actually be lowered. Further along in the design process the water model can be utilized to fine tune the clearwell lower level controls and optimize the WTP operation.

With less start/stop cycles at the WTP there will be less wear on the lime feeding equipment, pumps and lime removal components. This is a cost savings for the City for less lime disposal, less power usage, reduced staff maintenance, longer life of equipment, etc.

3 New Clearwell Additional Storage Alternatives

Since the existing clear well is in good condition, an additional new tank would be sized to provide a volume of either 1,000.000 gallons or 1,500,000 gallons (two separate alternatives). This new clearwell would be tied to the existing clearwell via pumps or piping to allow smooth, concise operation of the WTP.

3.1 Conceptual Design of Additional Storage

The new tank in this alternative would be a cast-in-place concrete wall tank with a concrete cover and vent system. We would suggest that the new tank be square or rectangular with the same depth and high water level as the existing tanks in order to maintain the same hydraulic conditions so that modifications to the high service pumping facilities would not be necessary at this time. The two tanks would be acting as a single unit. To provide the capability of shutting down one tank for maintenance and cleaning, we suggest the appropriate piping and valving be constructed between the two. The new clearwell tank would also be designed to provide for adequate contact time for chlorine disinfection requirements with the IDNR. There would be two pumps added to the system. These pumps will distribute water to the City and Valero.

A water level measurement system would be installed to communicate with the existing level control system used for the existing tank. This would be to allow the operators operational control. System programming will be needed to allow the existing and new clearwell to control the WTP.

Concrete water storage tanks are not coated in the interior. In some cases, an interior coating system is included to prevent-biofilm from adhering to the walls and provide additional protection against corrosion. It is recommended that an interior coating system should be considered if this alternative is chosen.

It is anticipated that construction of a new tank will take approximately 6 - 9 months to construct and be ready for service.

Appendix B at the end of this report presents a schematic layout of a new tank on the existing site. The 1 MG option will fit on the existing site relatively easily, a 1.5 MG tank would require more investigation for placement on existing land owned. A temporary construction easement may be needed to allow for the construction and equipment lay down during construction of either option.

3.2 Engineer's Opinion of Probable Project Cost

Preliminary Opinions of Cost have been prepared for the purpose of making a monetary comparison between the proposed alternatives. Material and equipment costs were determined by review of local construction projects of similar nature and consultation with various material and equipment manufacturers and suppliers. Material and labor costs have increased over the recent years resulting in increasing construction, operation, and maintenance costs. Market conditions indicate that this trend will likely continue in the future at varying rates. The cost opinions have been prepared based on present value construction costs for comparison purposes. Included in the Opinions of Project Costs are construction and professional services (engineering design, bidding, and construction services) costs.

3.2.1 Alternative 1A – New Additional 1.0 Million Gallon Tank

The table below presents a summary of the Engineer's Opinion of Probable Total Project Cost for construction of a new 1.0 MG gallon tank to connect to existing 0.5 MG tank (Alternative 2A). This alternative includes the following summarized work:

- New 1,000,000 gallon covered concrete tank
- New isolation valves and yard piping
- New matching level measurement/control system
- New mixing system
- New Pumps and building

Table 2 -New 1,000,000 Gallon Clearwell Tank

Total Construction Cost	$4,515,600
Total Professional Services Cost	$704,000
Opinion of Total Project Cost	$5,219,600

3.2.2 Alternative 1B – New Additional 1.5 Million Gallon Tank

The table below presents a summary of the Engineer's Opinion of Probable Total Project Cost for construction of a new 1.5 MG tank to connect to existing 0.5 MG tank (Alternative 2B). This alternative includes the following summarized work:

- New 1,500,000 gallon covered concrete tank
- New isolation valves and yard piping
- New matching level measurement/control system
- New mixing system
- New pumps and building

Table 3 -Alternative 1,500,000 Gallon Clearwell Tank

Total Construction Cost	$5,325,300
Total Professional Services Cost	$825,000
Opinion of Total Project Cost	$6,150,300

Detailed Opinions of Probable Project Cost for each of the two alternatives are provided for information in Appendix C at the end of this report.

4 Tank Alternatives Evaluation

4.1 New Additional 1,000,000 Tank Alternative

Below are advantages and disadvantages of implementing this alternative:

4.1.1 Advantages:

- Can be constructed without taking existing tanks out of service
- Start and stops are reduced to 4 times a day
- Provides redundancy (dual compartments) for shutting down portion of tank for maintenance
- New tank will provide service for next 50+ years
- Lower maintenance cost into the future
- Less lime needed in treating process
- New tank can be designed to provide better chlorine contact provisions

4.1.2 Disadvantages:

- Higher capital cost
- Start and stops only cut in half

4.2 New Additional 1,500,000 Tank Alternative

Below are advantages and disadvantages of implementing this alternative:

4.2.1 Advantages:

- Can be constructed without taking existing tanks out of service
- Start and stops will be 2 to 4 times a day
- Provides redundancy (dual compartments) for shutting down portion of tank for maintenance
- New tank will provide service for next 50+ years
- Lower maintenance cost into the future
- Less lime needed in treatment process
- New tank can be designed to provide better chlorine contact provisions

4.2.2 Disadvantages:

- Higher capital cost
- Requires additional land to implement

4.3 Adjusted Clearwell Level Control

Below are advantages and disadvantages of implementing this alternative:

4.3.1 Advantages:

- Longer run time
- Start and stops on system will be reduced to 2 or less a day.
- Less fatigue on the system
- Operator flexibility in control of system and plant

4.3.2 Disadvantages:

- Potentially less storage volume in clearwell
- Water age
- Possibly more chlorine demand

5 Summary of Opinions of Probable Costs of All Alternatives

The table below presents a summary of all alternatives evaluated in this study.

Table 4 - Opinions of Cost

Alternative	Opinion of Total Project Cost
1A - New 1,000,000 Gal Tank	$5,219,600
1B - New 1,500,000 Gal Tank	$6,150,300

6 SEH Recommendations

Based off the model and cost estimated shown above, SEH recommends the Charles City Water Plant expands their system by adding an additional 1.0 MGD clearwell. The clearwell will be constructed without taking the existing unit out of service, provide service for the next 50+ years, and reduce the plants start and stops to 2 to 4 times a day. The decrease in cycles will reduce equipment fatigue and prolong the life of the WTP. Furthermore, there will be less wear on the lime feeding equipment, pumps, and lime removal components. This is a cost savings for the City for less lime disposal, reduced staff maintenance, longer life of equipment, etc. Adjusting the clearwell level control would even further reduce the number of starts and stops to 2 or less times a day.

Since Valero Renewable Energy receives half of the Charles City Water Supply, it would be beneficial to reprogram the pumps' Variable Frequency Drives (VFDs) when moving forward with the project. The improvements would be able to slow down the starts and stops of the pumps which would reduce fatigue to the pumps overtime and allow better operation of the WTP.

Also, concrete water storage tanks are not coated in the interior. In some cases, an interior coating system is included to prevent-biofilm from adhering to the walls and provide additional protection against corrosion. It is recommended that an interior coating system should be considered if this alternative is chosen.

7 Potential Financing Opportunities for Improvements

There are several potential opportunities available for funding water system projects, including:

- Cash-in-Hand
- Revenue Bonds
- The Iowa Economic Development Authority CDBG Grant Program
- Drinking Water State Revolving Loan Fund (DWSRF)
- The USDA Rural Development Loan and Grant Program

A combination of some or all of these funding sources is also possible. Considering the significant capital construction costs of the improvements, it may prove beneficial to pursue funding assistance from one or more of the public programs listed above. A general description of each of these funding methods, as well as projected annual debt service and additional monthly user costs for each alternative, based upon a total of approximately 3,400 (meters), is provided below.

7.1 Revenue Bonds

Revenue bonds may be issued by utilities or jurisdictions that provide services for which revenues are collected. Debt service on the revenue bond issue is paid from the net revenues of the utility. One requirement of revenue bonds is that the total revenues of the utility must exceed the amount of the bond issue by an excess amount referred to as "coverage". This coverage is typically as much as 30% of the annual debt service payments to make the bonds attractive to buyers. In projects such as this with large expenditures and debt service requirements, the revenue bond requirement for 30% to 50% coverage often is a hardship to the owner, which makes other forms of financing more attractive. Revenue bonds are currently sold at interest rates of 2.5-4% for 15-20 year terms, depending on market conditions and credit worthiness of the issuer.

7.2 IEDA CDBG Grant Program

The Iowa Economic Development Authority's (IEDA) Community Development Block Grant (CDBG) program provides grant money for eligible municipal water system projects.

The amount of funding is based on community population as follows:

- Less than 300 and unincorporated areas receive up to $1,000 per capita
- Less than 1,000 receive up to $300,000
- Between 1,000 and 2,500 receive up to $500,000
- Between 2,500 and 15,000 receive up to $600,000
- Greater than 15,000 receive up to $800,000

Based upon Charles City's 2010 census population of 7,652, the amount of CDBG grant funding that the City may apply for is up to $600,000.

In addition, to receive funding the community must meet low-and moderate-income (LMI) thresholds. The most recent (LMI) figures issued by the American Community Survey (5-Year Estimates 2006-2010) for the City of Charles City, IA is 55.2%. In order to qualify for funding under the CDBG – Water and Wastewater (CDBG – W) Category, the community must have an LMI percentage of 51% or higher. Therefore, it initially appears that the community is eligible for CDBG funding.

Applications for CDBG funding are now received on a quarterly basis in lieu of the previous schedule of annual application submittals.

CDBG funding is subject to Federal Davis Bacon prevailing wages for construction.

7.3 Drinking Water State Revolving Fund (DWSRF)

Another viable financing option is the State Revolving Fund (SRF) administered by the Iowa Finance Authority (IFA). These loans are available for 1.75% interest, plus a 0.25% loan servicing fee for both standard and disadvantaged communities. The normal term of the loan is 20 years for the construction of a water system project. In some cases, the term of the loan can be extended to up to 30 years if the project being funded has a lifespan greater than the 30-year term.

SRF funding is also subject to Federal Davis Bacon prevailing wages for construction. The need to purchase American Iron and Steel (AIS) is also a requirement of this program.

7.4 USDA Rural Development Loan and Grant Program

USDA Rural Development offers loans and potential grants for utility improvements. The grant formula takes into account the number of households, median household income, current utility rates, existing debt, current operations and maintenance costs, and short-lived assets. To determine grant funding, the loan amount is applied first until the predetermined affordability utility rate is reached.

USDA Rural Development uses the community's median household income (MHI) when considering funding eligibility for its loan/grant program. The state of Iowa's MHI is $54,188. A community at or above this figure is considered market rate and does not qualify for USDA funds. A community that falls between $43,350 and $54,188 is considered intermediate. A community below $43,350 is eligible for USDA poverty rate assistance. Based upon the most recent Census, the MHI for the City of Charles City is $34,102, which means the City is at the poverty rate level. However, to receive grant funding, additional specific criteria must be met, which may increase the project cost. Those criteria include:

- A more extensive facility report will need to be produced to meet USDA RD guidelines.
- Considerable coordination is required between IDNR and USDA RD, adding planning phase costs.
- It is likely an interim construction loan will be needed; USDA does not disperse funding until the project is completely constructed.
- Any amount financed would be on a 40-year term.
- Funding a project with USDA RD requires the City to perform a yearly audit; the annual audit is estimated to cost $5,000.

7.5 Funding Scenario Calculations

The tables at the end of Appendix C (after the Opinions of Probable Costs) provide anticipated annual debt service amounts and corresponding additional monthly cost per customer (meter) for each of the alternatives evaluated should cash-in-hand not be used to finance the project. The calculations are based upon spreading the financing costs equally over all 3,400 water customers that the system serves.

The financing options considered for the purposed of this report include: 1) a 20-year Revenue Bond at 3.5% interest rate, 2) a State Revolving Fund (SRF) loan at terms of 20 years and 30 years, which is at a 2% interest rate, 3) financing with a combination of a CDBG grant and SRF Loan, and 4) USDA loan financing over a 40-year term.

8 Limitations

The assessment and recommendations in this report are based on limited site observations and review of inspection documents and videos.

Further observations may lead to different conclusions, and conditions may be discovered during repairs and rehabilitation that contradict the limited observations and assumptions described in this report. If conditions that appear to be unsafe are discovered, SEH recommends suspending work and limiting access at the discretion of the owner and/or the repair contractor until the situation can be further evaluated.

Verbal descriptions of potential modifications are provided in this report. These descriptions are not intended to be complete or final design recommendations. We will be pleased to work with you in developing construction plans, details and specifications whether the preferred approach is decided to be repair or reconstruction.

Our services for this project have been conducted to those standards considered normal for services of this type at this time and location. No warranty, express or implied, is intended.