CUWCD Manganese Well Mitigation

Students: Ethan Vernon, Ian Horrocks, & Gavin West

UVU Capstone Advisor: Khaled Shaaban, Ph.D. P.E., PTOE, Utah Valley University

CUWCD Project Representative: KC Shaw

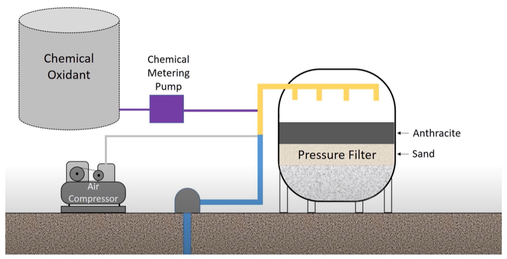
CIVE 4820 . Civil Engineering Capstone II . Spring 2022

INTRODUCTION

- CUWCD water transmission system that supplies water to Orem, Vineyard and Saratoga Springs
- Receives water from 2 sources:
  - Don A. Christiansen Regional Treatment Plant in Orem
  - Deep groundwater wells in Vineyard
- Wells 8, 9, and 10 have high manganese and iron concentrations
  - Turbidity and faucet staining
  - Produces metallic-tasting water
  - Promote bacterial growth
  - Manganese can cause incrustation in the water main

PRESSURE FILTER MITIGATION

- Oxidizes and filtrates in a single process
- Requires maintenance and recoating of filter
- Requires backwashing and maintenance
- Pressure filters are primarily used for iron & manganese removal
- Gets manganese levels below .01 mg/L
- Pressure filters administer and oxidant then suspends manganese particles in media.

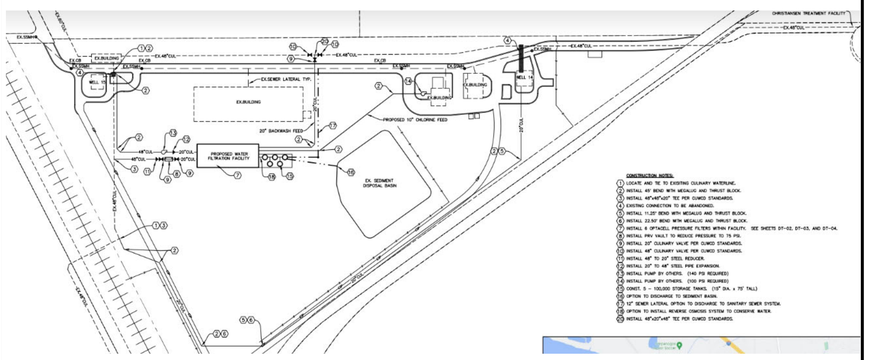


ANALYSIS & DESIGN

- CUWCD provided average flow data for wells 8, 9, 10, 14, and 15.
- CUWCD provided high manganese concentrations found in the wells
- From our team's calculations we plan to design a 20 MGD (million gallons per day) filtration facility to meet average flow demand.

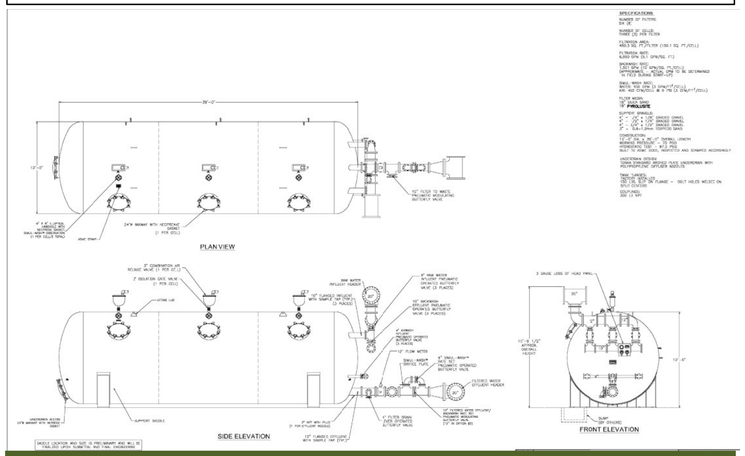
AVERAGE FLOW CONDITIONS				
Vineyard Pipeline				
Condition	Source	GPM	MGD	Manganese (mg/L)
Future?	Well 1	0	0	
Future?	Well 2	0	0	
Future?	Well 6	0	0	
Future?	Well 7	0	0	
Existing	Well 8	2050	2.952	0.097
Existing	Well 9	3920	5.6448	0.042
Existing	Well 10	3800	5.472	0.037
Existing	Well 14	3110	4.4784	0.069
Existing	Well 15	2	0.00288	0.062
Future?	Well 16	0	0	
Future?	Well 17	0	0	
		GPM	MGD	Manganese (mg/L)
TOTAL		12882	18.550	.05580

- 6 Optacell Pressure Filters can meet the current flow demands from wells 8, 9, 10, 14, and 15.
- Optacell filters require 75 psi to function adequately.
- System pressure functions at 140 psi.
- Pressure Reducing Valve (PRV) will reduce pressure to 75 psi so that pressure filters can function.
- Pump will be installed on the outflow end of the system to increase pressure back to 140 psi.
- Chlorine feed from existing chemical building will provide oxidants to facility.
- CUWCD will have the option to dispose of sediments in existing sediment basin, discharge to sewer system, or install reverse osmosis system to conserve the water.



CONCLUSIONS

- From the concept assessment our team found that filtration would be the only successful option.
- Taking the average flow rates from each well our team determined that the filtration system would need to handle more than 18 million gallons per day.
- To meet this requirement, CUWCD would need 6 filters to provide 19.8 million gallons per day.
- The filters will consist of the media pyrolusite. Once the filters had been selected site logistics were next.
- The location our team suggested was approved by CUWCD.
- Our team planned the piping reroute, filter building layout, pipelines that needed to be added, backwash needed, backwash storage, and if CUWCD would need to pump the water before or after the filtration.
- CUWCD's main issue was that their well water had high levels of manganese and iron that created a yellow hue. The concentration levels for manganese were upwards of .03 mg/L.
- The concentration levels needed to be less than .01 mg/L. Filtration ensures that this level is reached. Therefore our team concludes that filtration will be best for CUWCD well water system.



REFERENCES

Crittenden, J. C., Tchobanoglous, G., Howe, K. J., Hand, D. W., & Trussell, R. R. (2012). Water Treatment Principles and Design. John Wiley.

Land, B. (1998). Iron and manganese in drinking water. Retrieved December 2, 2021, from https://www.fs.fed.us/eng/pubs/html/99711308/99711308.html.

Volpe, D. (2012). Assessment of Iron and Manganese Sequestration. Retrieved December 2, 2021, from https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1053&context=cee_ewre.

Ferguson Pipe. Ferguson. (n.d.). Retrieved April 13, 2022, from https://www.ferguson.com/The Magic of Manganese Dioxide. WCP Online. (2020, May 20). Retrieved April 13, 2022, from https://wcponline.com

National Storage Tanks. National Storage Tank. (2020, August 27). Retrieved April 13, 2022, from https://www.nationalstoragetank.com

Pressure Reducing Valve. Flomatic Valves. (2021, July 21). Retrieved April 13, 2022, from https://www.flomatic.com

Pyrolusite Filter Media: Water Engineers Singapore Pte Ltd. Water Engineers Sing. (n.d.). Retrieved April 13, 2022, from https://www.waterengineers.sg/filter-media

Waste Rates. E.T. Technologies, Inc. (n.d.). Retrieved April 13, 2022, from http://etsrs.com/rates/

Water Rates. City of Orem. (n.d.). Retrieved April 13, 2022, from https://orem.org/waterrates/