A Special Report on District Engineering and Construction Activities Since 2008

The District contracted with Matrix Design Group in Colorado Springs during 2008 for a Preliminary Engineering Study and Report for essential improvements to the District's potable water storage facility and its distribution system. The lead P.E. was Melanie Jollett assisted by 5 other engineers and two contractors. One of the engineers was an owner of the company and he personally supervised the Tanks reconstruction. He had previously supervised the construction of a nuclear power plant! Melanie worked with the District to develop detailed plans over a period of about a year. Matrix had been working for the District for about 4 years. The 118 page PER was submitted to CDPHE on November 18, 2009. It was also submitted to Woodland Park and Teller County building departments for approval. Then, the PER served as the basis for a Drinking Water Revolving Fund (DWRF) loan of $1,718,000. The 2% interest loan was approved during 2011.

A. Tank Repairs – Mid 2011~ January 2012.

1. Our consulting engineers prepared bid documents, published and solicited bids from qualified contractors for the Water Tank repairs. The bids were reviewed and we awarded the contract to RN Civil of Centennial, who had extensive experience in water tank construction and repair.

2. T he District's tank is located at the top of Ute Tr. the highest elevation in our system. It was built during 1957. The tank was taken out of service during April 2008 after it was penetrated by several rodents as the result of negligence on the part of a water operator. CDPHE would not allow the tank to be put back in service until approved repairs and improvements were made. The Board had been working on improvement or replacement plans for some time. The most significant issues with the tank were a failing roof and leaks. After exposing 15' of the 120' circumference of the tank's concrete wall 5 leaks were found suggesting that many more leaks existed although the inside of the tank had been coated with a waterproof product which appeared in good condition. No leaks are permitted in buried tanks as water can flow in and compromise the potable water supply. In addition, we had five 12,000 gallon buried steel tanks in Forest Service land between the concrete tank and Ute Tr. To clean and recoat these tanks was considered to be too costly so it was decided to dispose of them. They were excavated and donated to the Fire Station on Evergreen Heights Dr. for non-potable emergency water storage, the City's northeast sewerage treatment facility, and to others. RN Civil took the initiative to find good local parties in need of these non-potable water storage tanks.

3. After considerable study of the options, It was decided to "bag" the inside of the tank with a high quality water proof fabric that would be cut and fussed in place. A product from a local area company with an excellent history of this kind of work was chosen. Unfortunately, after the tank roof was removed the

walls were found in a highly irregular condition as the height of the tank had been increased several times. This presented serious problems for the integrity of the liner. Engineering solutions were developed and a contract change order was issued to allow for the increasing costs for the additional work. With those improvements completed including extending the tank wall higher by 5' as had been planned for the new roof, the bag was built in place and hung from the new wall. Then a superior roof was built and a small 2 story vault or utility & plumbing room was constructed on Forest Service land with approval of the Service. Completion documents including as-built designs were submitted to the authorities for approval. The tank returned to service mid January 2012. Overall, this work went reasonably well.

Our Renovated 75,724 Gallon Tank & Plumbing Vault

B. Distribution System Improvement. 2012 ~ Present

Completed Projects

Our consulting engineers prepared bid documents, published and solicited bids from qualified horizontal directional drilling companies for the installation of new and replacement water mains. The bids were reviewed and we awarded the contract to Global Underground, based in Colorado Springs. The company had an excellent reputation and extensive experience in water main drilling projects.

We had had one prior directional drilling project under the direct supervision of a District consulting engineer during 2004~5. That was a nearly 1000' drill of a 3" fused together HDPE pipe. While HDPE has certain advantages, such as the ability to make tight turns, there were significant disadvantages as well. Meanwhile the District's Board member and project supervisor met the seller of fusible PVC pipe at a Colorado Rural Water Association meeting and became impressed with its advantages, primarily that it has a much thinner pipe wall that meant a larger inside pipe diameter and a smaller drill hole. The District's consulting engineers were introduced to the product and they also became convinced that fusible PVC pipe was the better option for our projects.

A delivery of 45foot long 4" 6" & 8" Fusible PVC Pipes

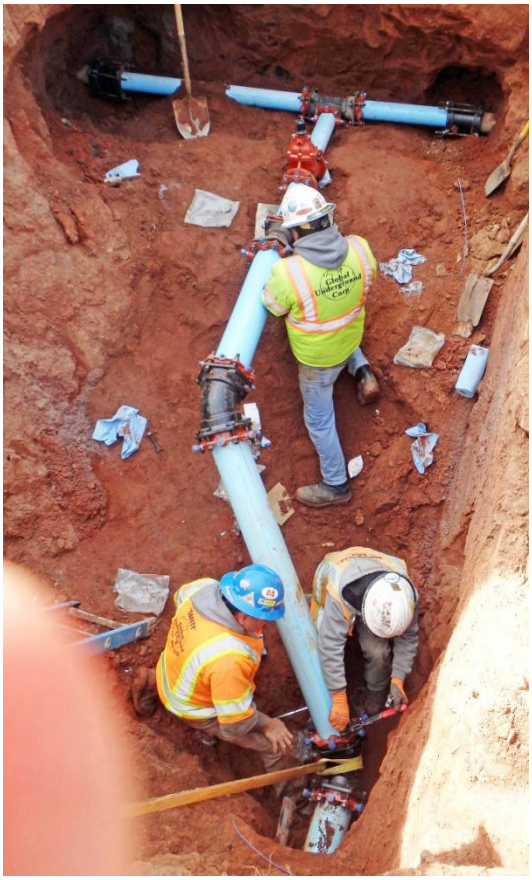
The object and the imperative of the first five projects was to replace the remaining known old steel pipelines in our system because they were clearly leaking and on the verge of catastrophic failure.

1. ***Blackfoot Trail Extension*** – During the '50's or early '60's a 2" steel/GI main had been extended from the north side of Kelly's Road to the homes on the south side between Chippewa and a private driveway referred to as "Blackfoot Tr." We had already experienced several expensive breaks in this line in the paved intersection of Kelly's Road and Blackfoot. In 2012 a 6" main was drilled under Kelly's Rd from the north to the south side and from there west to the intersection of "Blackfoot Tr." and Kelly's Rd. for a

hydrant in consultation with the Fire Chief. Then a 3" PVC water main was drilled south from the "T" to the hydrant behind the homes in parallel with the old GI pipe. That's when everything went wrong. It turned out that 4 homes were on a semi-independent improvised system probably predating the District's first water main. The situation was unacceptable so the Board and the homeowners agreed to a cost sharing arrangement whereby these homes would be individually connected to the new water main. This delayed the work very significantly and increased costs substantially. During this period an emergency water main break took Global off our work for nearly a month.

2. ***West Kelly Road*** – The first 3 homes on Kelly's Road on the north side of the street heading east from 67 are in our system with a water line running west behind the homes from the Blackfoot water main on the east side of that street. These homes backed up to the old golf course between Blackfoot and 67. The old steel/GI pipe was in a bad condition and leaking. We drilled a new 2" HDPE line for these homes and that project went well. We chose HDPE in this instance because it is available in rolls long enough for the entire length of the drill.

3. ***Wildflower Water Main Upgrade*** – Wildflower had a 3" steel/GI pipe linking Chippewa and Sunshine Circle. We replaced this pipe with a 6" PVC pipe and installed a hydrant mid-block. The work was undertaken during the winter months so excavations to connect service lines would be significantly minimized so we could keep the street open for emergency vehicles and homeowners. A number of homeowners took the opportunity to have the contractors replace their steel/GI service lines which we had anticipated. While excavations during the winter are more difficult and go more slowly we significantly minimized the foot print of the excavations from 10' to 15' in width to just 2' to 3'. However, refilling these excavations during the winter often results in the excavation sinking in the summer months requiring additional fill. The most significant problem we encountered here and on the remaining projects was locating all of the utilities in the road before drilling could begin. While the other utilities presented few problems the District's water and service lines were untraceable so our contractor was obliged to do a great deal of "potholing" - drilling holes with high pressure water while vacuuming up the slurry - to locate everything in the road so a drilling plan could be developed. We had not anticipated just how difficult it would be to find the District's mains and homeowner's service lines! These lines were installed before the use of trace wires became standard practice. After weeks of potholing the 6" PVC pipeline was drilled in two days. Service line connections followed over a period of about a month because of weather events.



Connecting the 4"Chippawa main (top) to new the 6"Wildflower Main

The upgraded Wildflower water main provides enhanced control of flows in that area of our system so that we can minimize the number of customers who are impacted by water main maintenance and repair activities.

4. Kiowa Water Main Extension and Upgrade – We replaced an assortment of small diameter steel/GI pipes in Kiowa with a 6” PVC pipe from a new hydrant about mid-block east of Main Street all the way through to the existing Sunshine Circle 6” PVC water main. This was the second strategic project enhancing our ability to flow water in two directions to minimize the number of customers impacted by maintenance and repair activities while providing significant improvement in flows to hydrants in that sector. That is, with flows to hydrants from two directions. The photo shows the 6" pipe being pulled into the drill hole on the South side of Kiowa toward Sunshine Cr. This work went reasonably well.

5. Blue Sky Water Main Extension – We were delighted to discover that most of the Blue Sky water main east of Main St. had been replaced with 2” schedule 80 PVC pipe. We extended the line about 100’ to the two homes at the east end of the street. While potholing on Blue Sky we drilled right through the steering wheel of a boat that had been used along with other junk to fill a drainage ditch many years ago.

6. Apache–Blackfoot Central Transmission System Line and Chippewa–Blackfoot Lateral – This was our most significant project in that it provided a strategic second connection between the northern system with the water tank and southern systems.

When the District was formed during1964~5 it consisted of homes on the north and south sides of a golf course in Loy Gulch. The two, nearly equal systems were separated by more than 1000' and the southern system was served by just one 6" water main that entered the southern system about midway up Navajo Tr. The water flowed down Navajo to Chippewa Tr. where, unfortunately, the water main became a 4" line that in turn supplied 80% of the southern system although the other pipeline beyond Chippewa had been upgraded to 6" during the '70's & '80's.

Fusing 8" pipe on Blackfoot Tr.

In the original PER plan, this connection was to have been made up Apache Tr. just west of its intersection with Sioux Tr. The bridging line was to have connected the Apache water main to the east end of the Navajo Tr. water main and on to a planned Kiowa 6” main that would bridge Main St. and Sunshine Cr. The merits of these connections were so compelling that it was difficult to see viable alternatives but drilling issues that these connections presented and costs forced us to rethink this option. Ultimately, we became convinced the second connection between the system should be made behind the Treatment Facilities on Piute Tr. using an 8” water main that could be connected to the City’s 6” high pressure, high volume water main in Piute Tr. Moreover, this water main could be run through an existing easement under the Church parking lot to the 6” Blackfoot Tr. water main and by a 4” lateral to the 4” Chippewa Tr. water main. These connections provided equal or better improvements in our ability to move water in multiple directions around areas in our southern system to minimize the number of customers who would be impacted by maintenance and repair activities while improving flows to hydrants from multiple directions. In addition, the flows from the water plant would go directly into this

Pulling the fused 8" Pipe Under Valley View from Blackfoot Tr.

8” lateral and a line from it east into the south side of the vacant lot on the east side of Piute where Well#5 had been located would allow us to abandon the original water main that ran through the front yard of 222 Piute and the vacant lot to the line which ran past old Well#3 to Navajo Tr. As we focused on this bridge between the systems we began to see its advantages and lower cost were better options than the first choice.

This project went very well indeed although we drilled through the old to-be-abandoned water main in the vacant lot which had been relocated at some point in time as properties along Valley View were platted for development. There doesn’t seem to be a record of that change and the incident very nearly shutdown the entire southern system. While there were drawings of the buried plumbing in the vicinity of the Treatment buildings, these turned out to be "plan" and not "as-built" drawings and of no value at all!

The Central Transmission Line went live at 3:10 PM May 8, 2014.

4. ***Navajo – Sunshine Lateral*** – With this lateral water flows from the tank and the water plant directly through to Sunshine Cr. and on to Kiowa and Main St. while water can flow from the 8” connection from Apache Tr. to Blackfoot Tr. and Chippewa to Wildflower and Kelly’s Rd. then east on Kelly’s to Main St. These options significantly enhance the District’s ability to flow water to hydrants in the southern system and around maintenance and repair work. This project went very well.

5. ***Well#11a – Central Treatment Facility Raw Water and Communication Lines*** – Well#11a was taken out of service when its temporary GAC filtration system failed during 2005. In consultation with the US Forest Service it was decided to pipe the raw water from this well to the Central Treatment Facility on Piute Tr. rather than to build a new GAC filtration system on-site. The Forest Service agreed to reimburse these costs. This project was integrated into other distribution system upgrades but ultimately it became an independent project as integration efforts were unsuccessful. A 2” raw water line and a 1.25” communication conduit from the Well Head on Lovell Gulch past the tank to the Central Treatment Facility was completed during the fall of 2015. This drilling was very nearly a mile in length.

   We are currently waiting for CDPHE to approve a request to return the Well#11a to service.

Pending Projects

1. ***Apache – Sunnywood Lateral*** – When sufficient funds are available we will drill a 675 foot 6” Lateral between West Apache Tr. and West Sunnywood Ln. on the east side of the Church of Latter Day Saints on 67. Pipe for this project is in stock. This lateral will direct flows to hydrants on Sunnywood Ln, Sunnywood Loop and Lovell Gulch Rd from the West. There is an existing 6" water main across the east end of Sunnywood from Hopi Tr. to Lovell Gulch so flow through 4" lines from these 6" mains will significantly enhance fire flows in this area. Several additional hydrants are also required in Sunnywood.

2. ***Water Tank Plumbing Modifications*** – The plumbing in the tank vault/utility room was designed to create an essential circulation in the tank. Unfortunately we were forced to abandon certain other distribution system improvements on which this plumbing layout depended. We have reengineered the plumbing to achieve the original object without the benefit of those projects. This work will be undertaken when the funds become available.

3. ***City of Woodland Park 6" Emergency Supply Connection*** – The City of Woodland Park graciously approved continuing to supply the District with emergency water which saved the district about $500,000 for additional storage. We plan to connect the 8" Central Transmission Line to the City's 6" water main in Piute Tr. which has water at over 40% higher pressure and is capable of flowing several thousand gallons of water per minute. With this capability we will improve fire flows from all hydrants in the system and it will give us the capacity to fight fires in both of our systems simultaneously.

   If the District and the City were to merge in the future this connection will make that possible without any additional cost. The 6" connection will incorporate an 8" pressure reducing valve that will become redundant in the tank vault by the plumbing changes we plan to make there. This is a very expensive special purpose valve that is ideal for the new City connection. Incidentally, the District already has a connection to the City in its Treatment Facility that provides water during small scale emergencies and pump maintenance or replacement events.

Conclusion:

Almost all of the $1,718,000 State Drinking Water Revolving Fund loan was spent; however, about $150,000 of this amount was used for the Well#11a Raw Water and Communication Pipeline project which the US Forest Service reimbursed. These funds are held in reserve pending allocation for projects.

Thanks to all the homeowners who though inconvenienced were wonderfully helpful in every way possible. Without their cooperation and support the task would have been more costly and difficult.

Kent Brady
Project Manager
3/25/17

An Addendum to the Progress Report – Automation and Alarm Notification, 2004 to the Present

During 2004~06 Martin Rasmussen P.E. a highly qualified civil engineer worked for the District on a 'moonlighting' basis at about 1/3 the going rate. He oversaw the re-drilling of Wells #8, #9 and #11a, a major undertaking involving a lot of regulatory as well as engineering and construction supervision. Martin was also successful in establishing a "diversion plan" for the District whereby the District is allowed to operate its wells without regard to the specific rates of production and total annual production allowed by the individual well permits. As we were operating 6 wells at that time this flexibility greatly simplified operations. Re-drilling Well #8, our largest well, was a major activity and it required the services of an electrical engineer to design and construct the power supply equipment on-site as the Well is almost 1000' away from the Water Treatment Plant. Martin hired Dan Henderson, Engineered Systems Inc. of Pueblo. Dan subsequently sold his company and retired but he has continued to help us nevertheless.

Our small (16' x 22') Water Treatment Plant was built for the District during 1993~94 by the City of Woodland Park in exchange for water. The plant included a crude low level pump automation system employing lawn-sprinkler timers. There was no communication with the District's tank so operators, using a large pressure gauge in the plant would guess how long pumps should run before the tank would overflow. Hence the tank overflowed all the time! So when Dan completed his work on Well #8 we asked how we might control the pumps to maintain a suitable tank level without overflows. Naturally, we wanted to keep this simple but foolproof. So, Dan installed a Programmable Logic Controller – a PLC – and a few components in the cabinet that had contained the sprinkler timers (they had all stopped working), and we dropped a water pressure transducer in the tank and rented a dedicated telephone line. Problem solved and we were now automated. But Dan hardly got out the door before it occurred to us that it needed an enhancement, then another and then we were off into areas of automation that hadn't occurred to any of us on the Board.

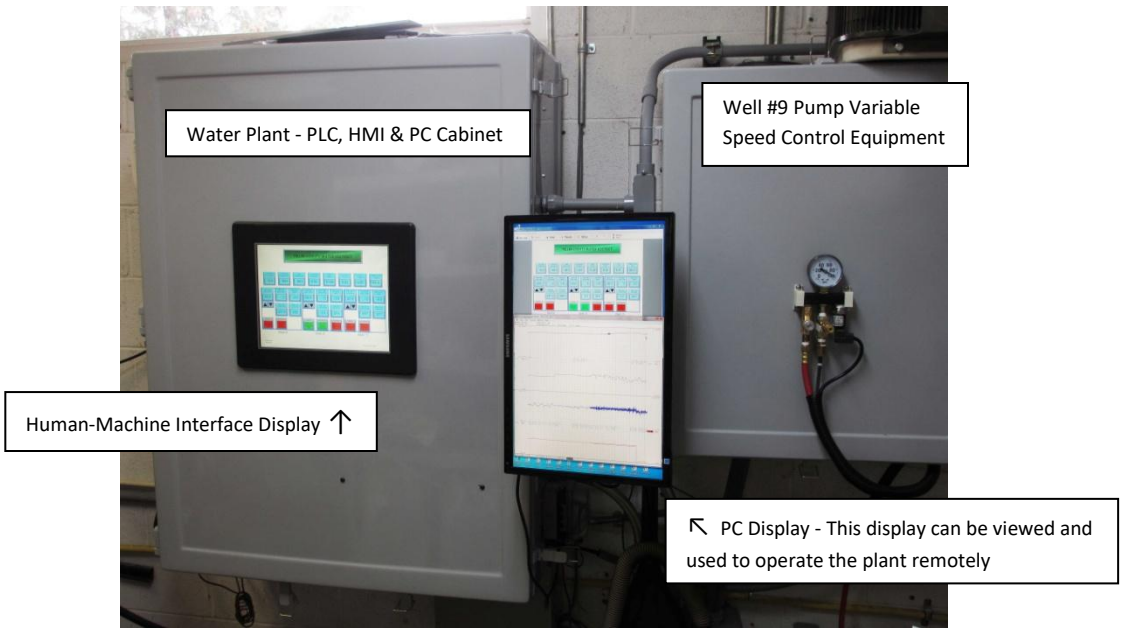
Up to this time we had always used local water operators. The State requires that we hire licensed water operators. Our system requires a Class C Water Treatment Operator and Class 1 Distribution System Operator - usually one person. But then, for a number of reasons, including the tank rodent incident, we decided to hire a company that manages several dozen water systems in Colorado and they were not local. At this point we had a simple alarm notification system in place which would page the operator if for example a pump failed to start or the tank was low. The paging alarm system was designed by Sayeh Blamoh a retired electrical and software engineer in Dayton, Ohio. But, now we had operators who could be several hours away and we realized we would have to provide them more alarm information so they could determine if they needed to head this direction immediately or could delay doing so for hours or even wait for the twice weekly scheduled inspection. That was a serious challenge. For example, if the pumps were taken out by a lightning strike, an operator would want know the tank's level at useful intervals or by calling the Water Plant for updates. Therefore a low tank alarm should have imbedded the tank's actual level. In addition, pagers had become obsolete so the system had to call mobile phones and provide a verbal message. Sayeh donated over 2/3 of his time on this activity which grew into a rather major software engineering project. A friend donated critical Microsoft Visual Basic programming software, a nice $5,000 gift.

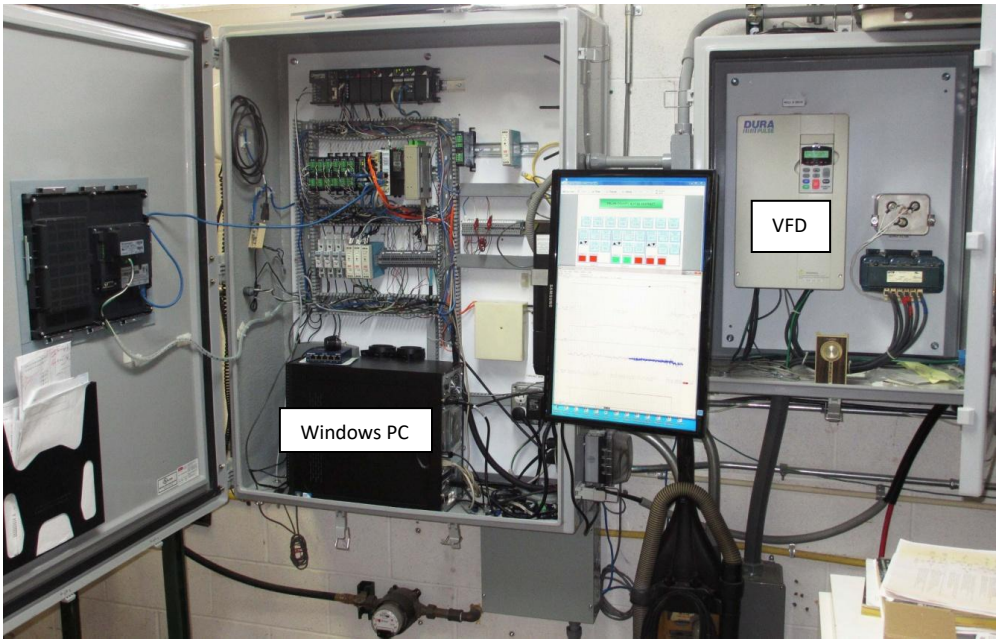
So automation and alarm notification moved forward to the present in many small steps.

Perhaps the most significant leap forward in these efforts came with the drilling of Well#11a's raw water line at the end of 2015. This well is located at 225 E Lovell Gulch Rd. The raw water line goes south up the

hill past the tank and then southwest down Ute Tr. and Apache Tr. to the Water Treatment Plant on Piute Tr., nearly a mile. Working with Peak Internet, who contributed over 4000' of 1.25" communication conduit, they pulled/installed the fiber optic lines, and they provided the pedestals that allow for quick repair of damaged lines so we now have Well#11a, the Tank and even Well#8 on fiber optic lines. While the phone line worked, lightning often disrupted communication and electronic components were damaged all too often. And there were CenturyLink outages as well. Fiber optic communications has drastically reduced our lightning issues. And, the collaboration with Peak Internet will also diminished our downtime and costs when the fiber lines are damaged.

A few photos of the District's automation, control and communication equipment, work-in-progress:



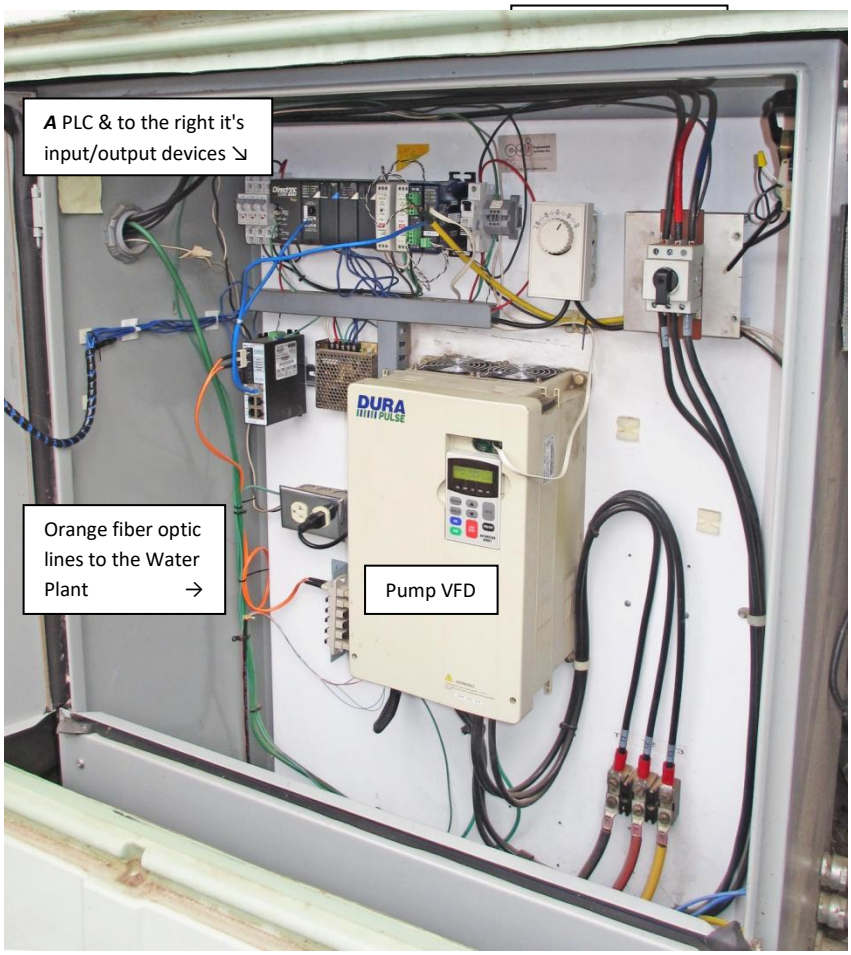


Pumps are now set to turn on when the level falls to set-points. For example, Well #9 is set to turn on when the tank falls to 10.5 feet and to turn off at 11.2 feet. Well #11a is set to turn on at 10 feet and to turn off 10.5 feet. Well #9 has our most efficient pump at the present time. If demand is light, it can handle the load

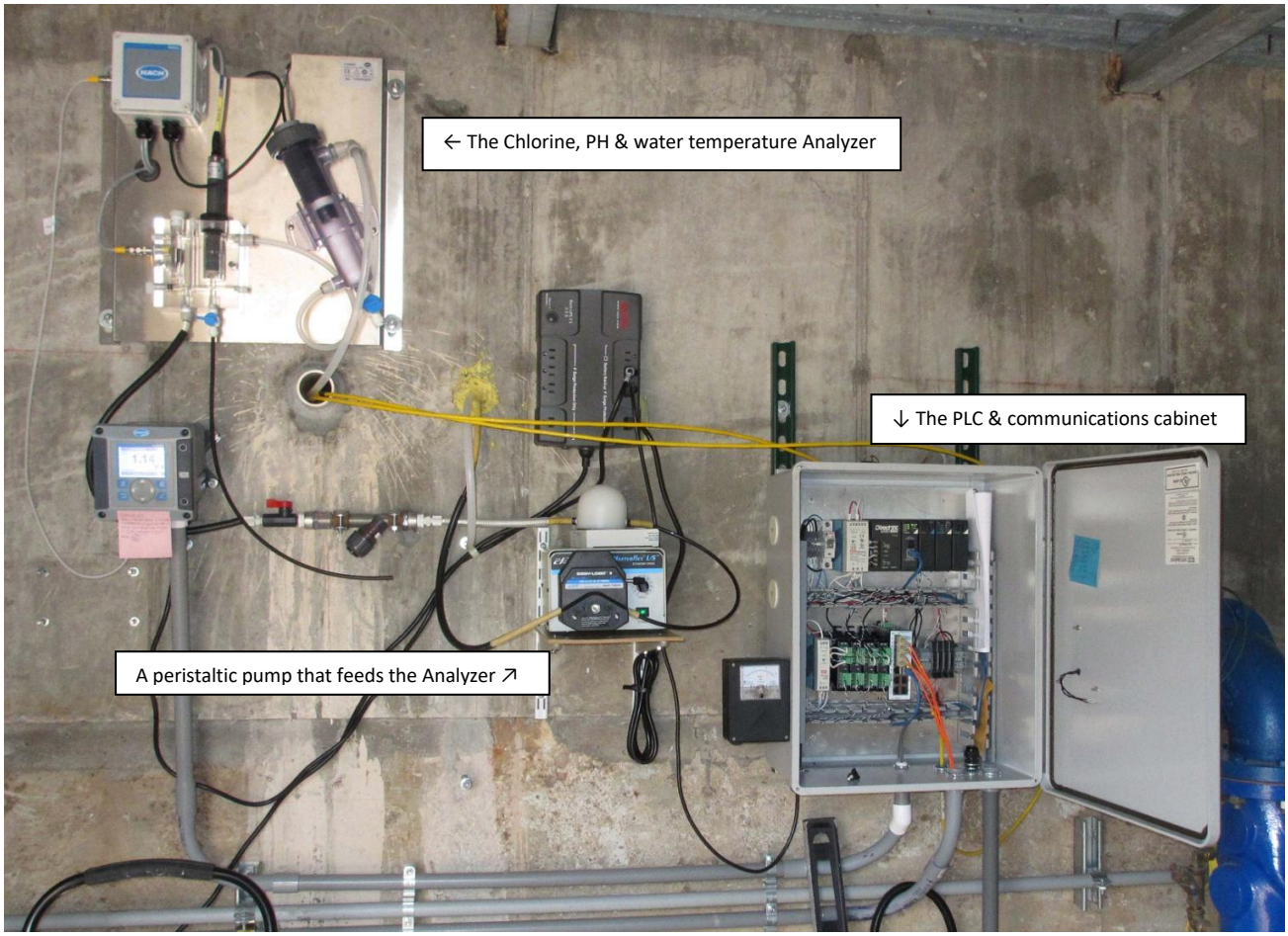
without assistance. However, if demand is high, Well #11a will join #9 to maintain the level at or above 10 feet. At this level we have about 60,000 gallons for emergencies.

Well #8, photos above, to the right and below, is located in Paton Park on Valley View. After 9/11 we hardened our wells to prevent mischief. We had in fact experienced several expensive incidents of vandalism.

In the Water Tank, we monitor the water level, we also observe the residual Chlorine level, the water PH and temperature. This data is relayed to the Water Plant so it can be viewed remotely. We are required to maintain a minimum "residual" Chlorine level at the most remote ends of our system for our safety. If our Chlorine injection pump should fail - and it does from time-to-time - our operators can observe the Chlorine level of the tank water for an indication of the residual level and thereby gauge how quickly they need to get here to repair the "dosing" pump. Usually, these repairs can be made during regular twice week inspections.



We also monitor the room temperature of the vault. Of course we monitor the temperature at the small Well #11a building, at the GAC Filtration Facility; and, at the Water Plant (the Treatment Facility). It is essential that pipes not be allowed to freeze. We are currently considering the addition of entry alarms and security cameras. See a photo of the Tank's electronics on the next page.



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