CAPITAL ASSESSMENT REPORT: Water Treatment and Distribution System

TOWN OF RIDGWAY

Final Report
May 21, 2019

Approved by Town Council
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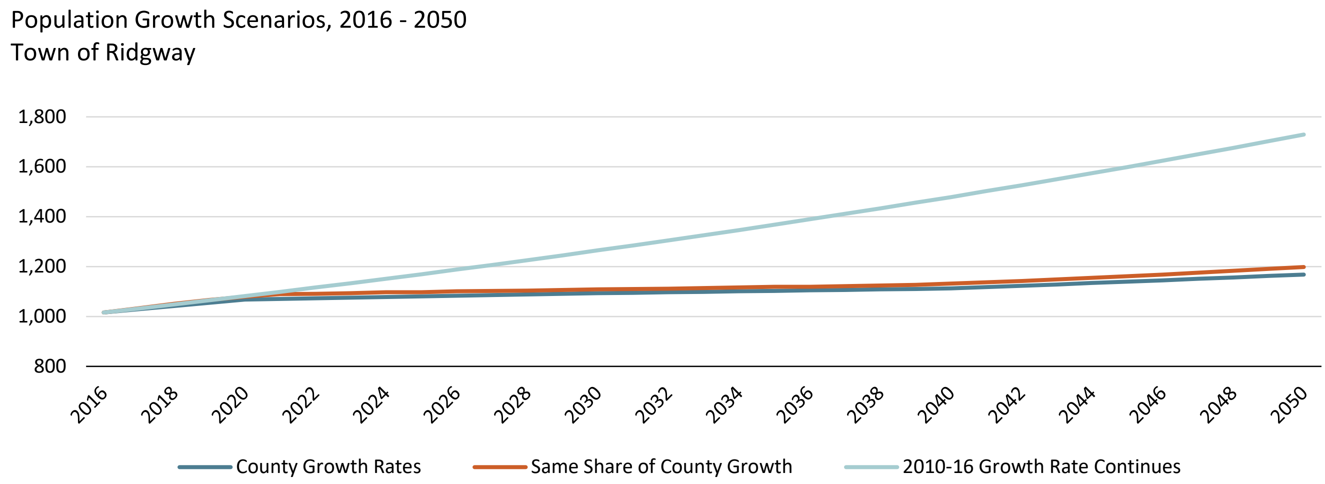
Consolidated Consulting Services

WATER TREATMENT AND DISTRIBUTION SYSTEM

POPULATION ASSESSMENT

Population Projections and Basis for Projecting Future Needs

The following growth scenario graphic and text are adapted from the Town's 2018 Master Plan.



Source: State Demography Office, Colorado Department of Local Affairs; Clarion Associates

Forecasting Ridgway's future growth. Population forecasts are not available from the State of Colorado for municipalities. However, it is possible to estimate what Ridgway's population might be in the future using a variety of growth scenarios.

- County Growth Rates: Under this scenario, the Town of Ridgway will experience the same annual rates of growth as Ouray County. By 2050, the town's population would reach 1,170, an addition of 154 residents from the current 1,016.
- Same Share of County Growth: Under this scenario, the Town of Ridgway will capture the same amount of county growth as it has, on average, since 1980 (roughly 25%). By 2050, the town's population would reach 1,200, an addition of 184 residents.
- 2010-16 Growth Rate Continues: Under this scenario, the Town of Ridgway will experience the same annual rate of growth as it has, on average, between 2010 and 2016 (1.6%). By 2050, the town's population would reach 1,730, an addition of 714 residents.

While it is not certain the growth projected in these scenarios will occur over the next 30 years, they are helpful in showing a range of possible futures that might come to pass under certain conditions. There are many constraints in Ridgway that are likely to limit growth, from the availability of water, to the availability of land to support residential development, to economic shocks that could reduce growth across the region, state, or country.

Using the most aggressive growth rate scenario (1.6%), the Town's population in 2050 is estimated to be 1730. Water and sewer facilities are typically assessed over a 20 year period. In looking at the ability of the Town's facilities to meet the needs of the community for the next 20 years, the population assumed for 2040 will be about 1500. If the growth rate deviates significantly from that assumed, then the timeframe of the evaluations in this assessment that are population specific should be adjusted to the time at which the Town population increases about 50%.

To address needs that are more site specific, it is necessary to consider where within the Town area, growth is likely to occur. The intended growth areas of the Town are identified in the IGA between the Town and Ouray County. They are depicted on the Town's 2011 Master Plan Land Use Map (Figure I-5) as inside the initial growth boundary (IGB) and the Urban Growth Boundary (UGB). Note that the urban growth boundary represented the area for growth for about a 30-year period when it was created in 2011. Because the Town's Master Plan is almost 10 years old, the Town is currently completing a Master Plan update and there may be some changes to the land use map as part of the process. Any changes are expected to be incremental and if they impact the areas within the service area, the likely impact is expected to allow a slight increase in density as that has been the recent trend of the Town officials. Changes to the IGB and UGB will be negotiated with the County, but changes suggested in the 2018-2019 Master plan would likely be a basis for those discussions.

WATER SYSTEM ASSESSMENT

Introduction

The purpose of this section of the Capital Assessment is to summarize and assess the Town's water facilities in terms of their capacity, condition, and ability to meet the Town's needs, and projected needsfor the next 20 plus years. The assessment will evaluate each of the unit processes below. Included will be the ability of the components to handle various changes in demand. Where applicable, the assessment will evaluate nearer term maintenance needs and when it might be time for replacement rather than continuing to maintain various components. It will also consider options that might expand capacity to allow continued use of the component as demands change.

The Town's water system includes: diversions at Beaver Creek and Happy Hollow (Cottonwood Creek), the Ridgway Ditch and transmission lines from each source, raw water storage at Lake Otonowanda, pre-sedimentation ponds above the water treatment plant, a pipeline from Lake Otonowanda to the presedimentation ponds, a microfiltration water treatment plant, treated water storage tanks, and distribution system. There is also a non-potable water system that receives water from the same sources. The non-potable water is settled in the pre-sedimentation ponds and then distributed to the Town parks, the school ballfield on Clinton, and to the Ouray County Fairgrounds.

There are very few pre-existing water users that receive services outside of the municipal boundary; however the Municipal Code currently prohibits extending any services outside of the Town. In order to receive service, one must already be annexed. This policy has worked well for the Town. Over the years, the Town Council has reiterated that service will only be available to properties inside the Town limits. Ridgway is very judicious in its review of requests for annexation, having only approved a few annexations over the last several decades. Projects must be consistent with the Town's Master Plan and with the 2002 Intergovernmental Agreement (IGA) between the Town and County before the Town will consider annexation. Historically, the Town Council has only considered properties providing significant benefits to the Ridgway community. If an annexation petition is approved, upon annexation the newly incorporated lands are usually eligible to apply for municipal services in accordance with the Town's current ordinances and regulations. Where the finds it is impractical to provide service directly and where extending the service has not been a priority for the Town, the Town has allowed properties to be served by Tri-County Water Conservation District. Similarly, where properties are not proximal to the Town's wastewater system, the Town has allowed for individual septic systems although the Town Code requires connection to the Town system when the property line is within 400 feet of any Town main line.

I. Water Rights

The Town has water rights in both the Beaver Creek, which is tributary to Dallas Creek, and the Cottonwood Creek drainage basins. Historically, the diversion from Beaver Creek in to the Ridgway Ditch has provided a significant part of supply in the summer. There are also some small springs that feed into the Ridgway Ditch. Happy Hollow (Cottonwood Creek) is the other major flow right the Town uses for domestic water. The Town also has a storage right in Lake Otonowanda (Otonowanda Reservoir or Lake O). Water in the Lake is available for when the Town's flow rights are either out of priority or there is not water available for use in the ditch or creek. The Town also has additional water rights in town that are below the water treatment plant, and that are primarily used for watering landscape in town.

I.A. Review of Previous Reports

The Town's water rights have been assessed twice since 2005. The first was the 2005 Carter Burgess Study prepared by Wright Water Engineers. The purpose of that report was to examine the feasibility of a joint water treatment plant between the Town of Ridgway and Tri-County Water Conservancy District (TCW). The water rights assessment in that report looked at whether there was sufficient reliable water supply to warrant constructing a water plant for both entities at the Town's current location. The study identified some challenges with the shared operations that would require considerable time to explore whether those challenges could be resolved. The Town was in more immediate need for additional treatment plant capacity and opted to proceed on its own with construction of a new treatment plant, which was completed in 2009.

In follow up to the 2002-2003 drought and direction from the Division of Water Resources to explore water supply options, water rights were again evaluated for the Town in the Applegate Group (AGI) Feasibility Study of the Ridgway Ditch and Otonowanda Reservoir in 2010-11, concluding that a renovation of Lake Otonowanda for water storage should be pursued. In 2014-2015 the Town negotiated and acquired additional property and renovated Lake O to provide for maximum water storage capacity thereby fulfilling the then augmentation need for the Town. Since the completion of the 2011 study, the Town acquired a water right in Cottonwood Creek downstream of Amelia Street. That water is currently used to irrigate the vegetation along Cottonwood Creek parallel to Moffat Street.

I.B. Assessment of Water Demand and Water Rights Needs

The Town has for most of the last 30 years had a relatively low per capita water consumption in the winter months. In summer, Town's water consumption is more typical of the region. For the last decade, the Town's water rates allow for the use of 9,000 gallons with the base water rate. (Water rate structures are discussed in more detail below in the water rates sub section. Rate changes were adopted by the Town Council late in 2018 went into effect December 2018.) For a while as the Town grew, more efficient plumbing fixtures and appliances kept it so that water sold, especially in the winter, did not increase as fast as the population was growing. As the population has recovered from the recession, with new construction and immigration to Ridgway, demand has increased. As of 2017, the amount of water sold annually was still less than the peak demand in 2008 (48.4 MG). However, in 2018, even under mandatory water restrictions with significant outreach encouraging users to decrease water usage during the major drought for the entire summer of 2018, the Town sold 50,561,700 gallons about 5 million gallons more than the previous several years. This is likely a result of the severe drought conditions during the summer of 2018 and people wanting to keep their landscaping alive.

Based on the meter in the water plant, current potable water usage (water produced) was just under 200acre feet (AF) per year 2016 and 2017 and around 230 AF in 2018. Given the extreme drought in 2018, in a more typical year the current demand is about 220 AF. If the Town increases water demand by 50%, in 20 years the potable demand will be in the 330 AF range.

The Town does not track the amount of water consumed through the non-potable system, but it is estimated to be about 0.25 - 0.5 cfs per day for much of the irrigation season which typically runs from mid to late April through early to mid-October. Assuming that at the beginning and end of the season there is less demand and that there are periods of wet weather with less demand, it is assumed there is about 150 days where the demand is 0.4 cubic feet per second (cfs), which would be a total of 120 AF demand. Note that Applegate had assumed around 111 AF of demand in the 2011 assessment. The non-potable demand is a significant amount of the total water demand for the Town during the summer months. During the hotter, drier parts of the irrigation season it is about half of the total demand.

Figure IB-1

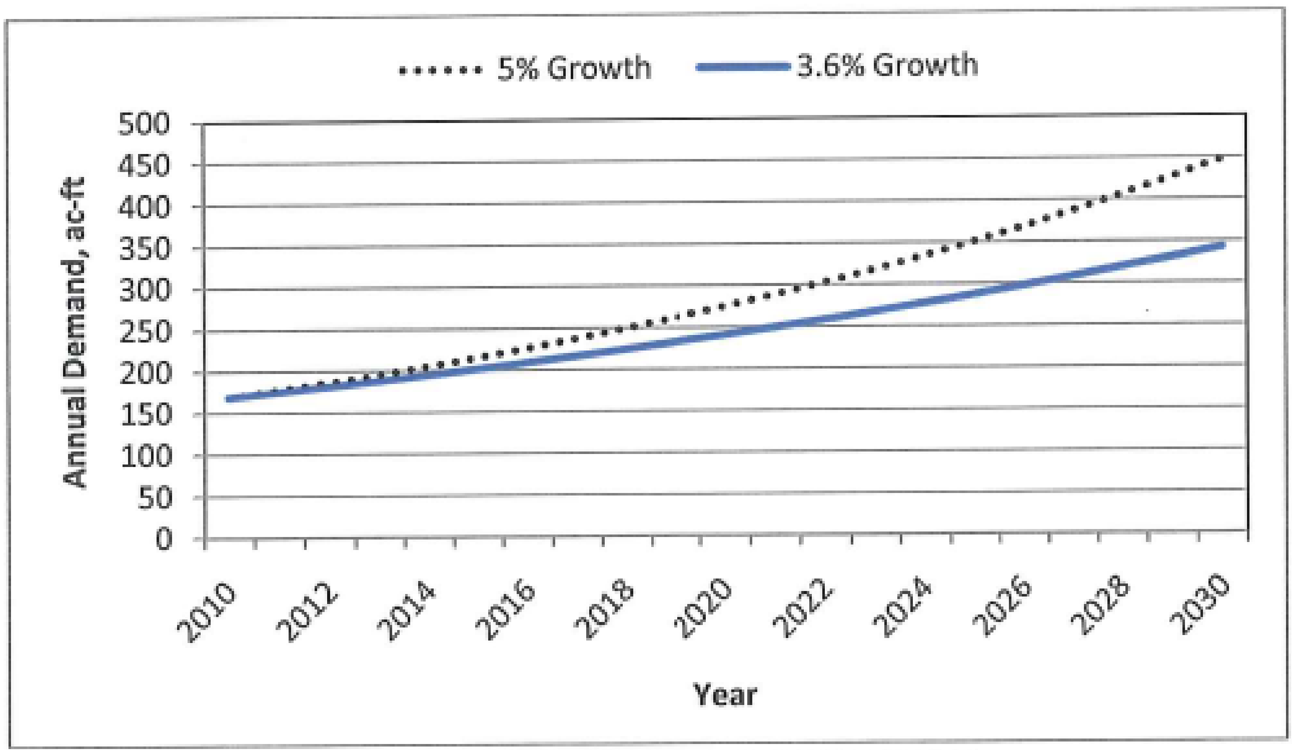


Table 1B-2

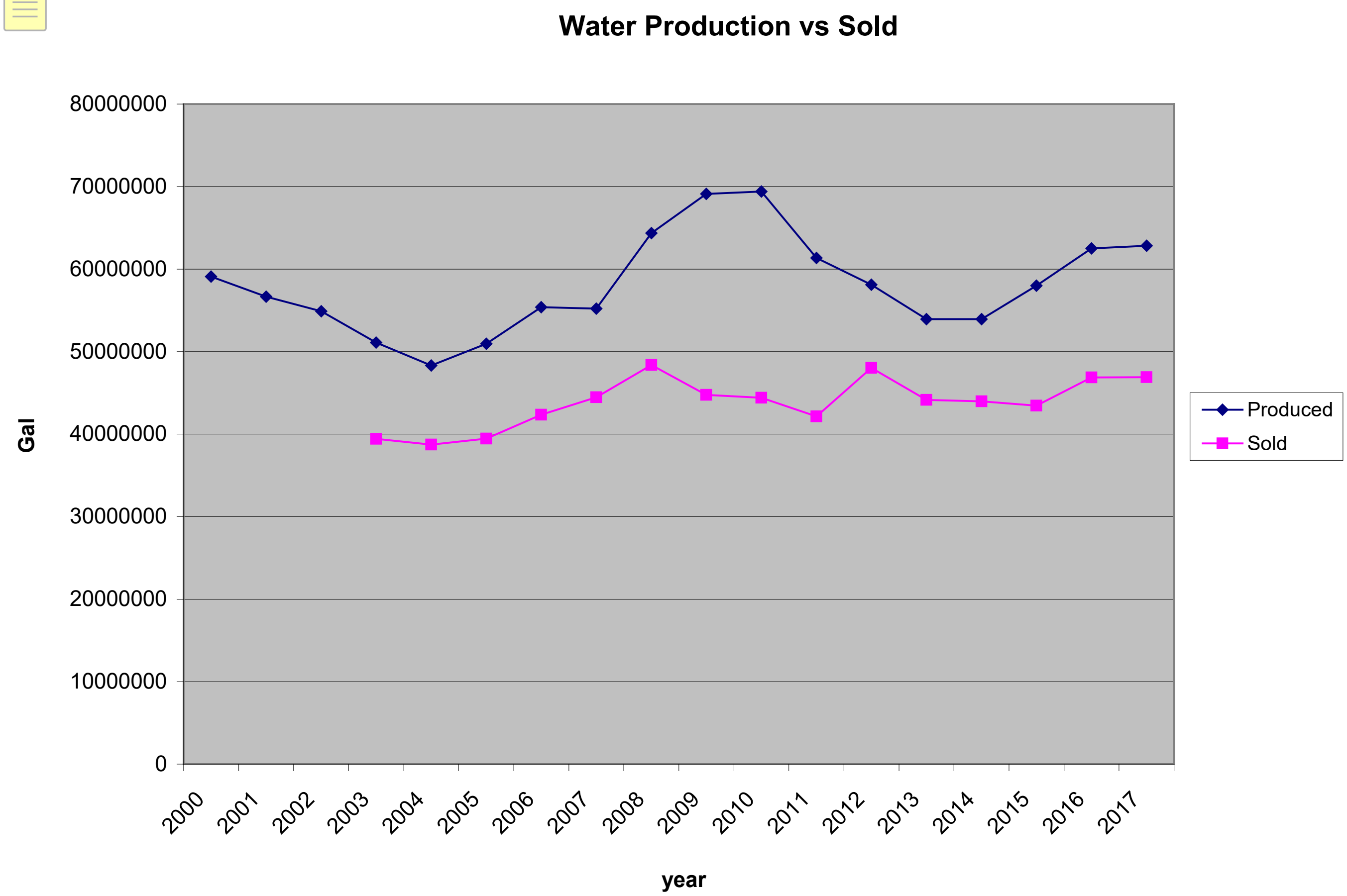


Table I.B-1 (above) summarizes the water treatment plant production and water sold for the last 18 years. Water production in 2016 was approximately 62.5 million gallons (MG) or 192 AF. Both June and July had a demand of around 9 MG or 0.29 MG per day (MGD). Looking at the data, as the Town has recovered from the recession, water sold has increased about 7% between 2014 and 2016 which seems reasonable given that population per the State Demographer increased about 3.5% per year. In 2017, the Town sold about 46.9 million gallons, a very small increase from the 46.87 mil sold in 2016 even though the population continued to increase, perhaps because it was a relatively wet year.

As the State, and the west as a whole, grapples with how to meet the State's projected water shortage with parallel population increases and an apparent long-term drought cycle, we hope that plumbing fixtures and water consuming appliances will continue to become more efficient. It will be necessary to make landscaping increasingly water efficient, and/or explore land use regulations that discourage high water use. These types of efforts may lead to a slight drop in per user consumption; however, as the population grows water demand is likely to grow with it, absent any significant changes in the cost of water or policy changes to limit water use. Making matters more challenging, climate change, which is discussed below, is likely to reduce the yield (wet water) from the Town's source of water supply.

A detailed study that would explore augmentation of water rights and establish priorities and estimated costs is recommended.

I.C. Review RMC Adequate Water Supply Rules

I.C.1. Why Adequate Water Supply Rules Are the Needed

The Town has a responsibility to ensure that there is adequate water to serve all its customers. As part of insuring that development pays its own way, the Town needs to be sure the development provides the water to meet the water demand the development will impose on the Town's water supply. The Town made this a priority in 2008 and adopted Chapter 7-6 Adequate Public Water Supply into the Town Code. In addition, the Town amended its Annexation Policy in 2014 to "require dedication of water rights or fees in lieu of dedication commensurate with future water demands on the property".

I.C.2. Should Water Supply Rules be Modified?

The Town code regarding adequate water supply is currently based on the requirements in Colorado Revised Statutes (CRS) 29-20-103 which says that developments with less than 50 single family equivalent (SFE) are exempt but allows for individual communities to set a lower limit and to provide more stringent requirements. In addition, the CRS seems to just ask for documentation that water is available rather require that development actually supply water to supply their increased demand.

Given that the Town's typical major subdivisions are 10-20 SFE, it is recommended that the Town look at whether the Town code is accomplishing its goal. If the Town is going to keep its water right portfolio in line with increasing water demands, the Town may want to significantly reduce the threshold for when a developer is required to address the adequate water supply requirements and also to more clearly compel furnishing water rights or paying into a fund so that the Town can purchase water rights when needed.

The Annexation Policy may also warrant another look. It would be beneficial if the Town's Master Plan consultant reviews both of these and makes recommendations for any policy changes needed.

II. Beaver Creek Diversion

The Town has two principal diversion locations for raw water. One is the "Beaver Creek Diversion" and the other is the "Happy Hollow Diversion" aka Cottonwood Creek Diversion.

At the Beaver Creek diversion, the Town diverts the water from Beaver Creek into a side channel that runs the water over a "grizzly", which screens out the larger rocks and some debris and into a trough. The first section of the trough includes a swing gate that can either direct the water directly into the Ridgway Ditch and/or divert some or all of the flow into a side channel that serves as both an overflow and rock chute. Spring water is also diverted into the Ridgway Ditch in various locations.

II. A. Upgrades

The old trough was likely constructed in the mid to late 1970's is largely made of what was rough sawn lumber. The photos on page 11 show some of the reasons the trough was rated yond its useful life. The wood on the floor of the trough had been worn down by the rocks and gravel running over the wood. Large storm events and time have allowed water to get behind the trough and time also caused the wood to warp. The old trough was replaced in the fall of 2018. The new trough is about 40% larger capacity to about 10 cfs, using a conservative n-value of about 0.03, which is far more than the capacity of the Ridgway Ditch (about 4 cfs in the most restricted areas of the ditch?). The rock chute was designed to work as both a rock chute and overflow channel. The existing chute which already has a capacity of about 20 cfs, is now increased to about 25 cfs. The design for the new trough is included in the appendices. This new design should have a 50-year life.

III. Ridgway Ditch

Downstream of the trough there is a ramp flume that measures the flow coming from the diversion. The Ridgway Ditch carries water approximately 5 miles winding across varying terrain from the diversion in upper Beaver Creek to Lake Otonowanda. The Ditch travels through some relatively flat areas where there is sediment deposition and some steeper areas where the water accumulates sediment and some erosion potential. The Ditch is almost exclusively located on private property over which the Town has an easement.

The capacity of the ditch changes through the varying terrains. The capacity restricting areas, which typically have topographic or geological limits, are capable of carrying at least 4 cfs. There are sections that can carry much more than 4 cfs, but increasing the restricted areas would be challenging without piping significant lengths of the Ditch.

The amount of water that is available for the ditch varies seasonally. Available flows typically peak in early June with peak snow melt. In an average or better water year, during runoff there is typically more water than the ditch can carry, and more important to the operation, is that the rock load is substantial, limiting how much water the Town can physically divert without damaging the diversion structure.

The Town monitors flows near the diversion, below the Elk Meadows Road (CR 5A) and just above the Lake. Although there have been concerns that transit losses in a 5-mile open ditch could be significant, the ramp flumes show little difference along the route. Flows as measured at the three points are relatively close, within the margin of error of the measurements.

In the last decade or so, there has been some development of the land through which the Ridgway Ditch travels. There are now some houses in close proximity to the Ditch and some of the roads that the Town has historically used to access the Ditch have locked gates. The Town should reach out to the land owners to plan as needed for continued access to the Ditch. The Town adopted a Source Water Protection Plan in 2012 that identifies development along the Ridgway Ditch as an area of concern and encourages the Town to work with Ouray County Land Use on setback regulations as well as educating developers in the vicinity of the Ditch to protect that Town's water from contamination. There are also state regulations that require setbacks from ditches and ditches that are for a potable water supply. Town Staff has prepared a memo on this matter and delivered it to the Ouray County Planning Commission in the Spring of 2019 for consideration.

III.A. Piping Options - pros and cons

The Town has considered piping all and/or parts of the ditch a number of times over the last several decades. Advantages of piping include being able to size the pipe for the capacity desired, protecting the water quality of the water, and reduced contamination opportunities and maintenance. Challenges with piping the ditch include how to size the pipe (how much of the peak flow to accommodate), and the cost of the pipe and the installation.

The access to the ditch easement is limited and the soils in which the pipe would need to be buried would likely require importing bedding materials or screening native materials.

The open ditch could be subject to losses from seepage, evaporation, Phreatophytes (water absorbing vegetation), cattle and wildlife, and potentially unauthorized human uses.

Another reason one might consider piping the ditch is to keep the water from causing erosion and/or transporting sediment. As discussed in the Lake Otonowanda subsection of this report below, over the last 25-30 years, the original part of the lake likely lost a vertical foot or more of capacity over the footprint of the original lake due to sedimentation. The water in the upper sections of the Ridgway Ditch are mostly clear; however, there are several reaches farther downstream, where the water gains a sediment load. Based on staff observations, the areas where the water gains sediment are shown in figure XX III.A.-X and are from stations XXX and Station XX – XX. The neighbors to the Lake O property previously suggested piping a section of the ditch to mitigate the sediment deposit and subsequent discoloration of the east portion of the lake, although the correlation of that section of ditch to the increased sediment in the lake has not been affirmed.

III.B. Prioritize Locations for Piping

Because of the cost of piping the entire ditch is likely cost prohibitive, another option may be to pipe only specified sections of the ditch. Using the Applegate Study permeability information as a guide, it looks like the best area for pipe to address water lost to seepage would be to start just below the diversion and continue to about 7000 ft downstream. This stretch, from 0+00 to 70+00 goes through areas with high to moderately high permeability and moderately slow permeability. Based on flow measurements at Beaver Creek and at the flume below County Road 5A, staff does not think there is much water is lost to seepage so piping that section may not be as high a priority as originally anticipated. However, there is also some erosion along this section that eats into the access road, that would also be addressed by piping it.

If addressing sediment accumulation is a priority, piping upstream of Lake O from XXX to XXX is recommended.

The size of the pipe depends on how much flow the pipe needs to carry. Assuming the pipe will flow open channel and is designed to carry up to 7 cfs at 2/3's full on a 1.1% slope a 15" (ID) PVC or HDPE pipe should work.

Given the construction challenges including remote location, poor soils, limited access, for budget purposes, furnishing and installing the pipe is currently estimated to cost around $65 per foot. To pipe the full length of the moderately and moderately high seepage areas (about 7000 ft) is estimated to cost around $455,000 plus mobilization and engineering fees. If one limited the pipe to just the moderate to high permeability areas, that would reduce the amount of pipe in half and reduce the cost by about the same amount. If the Town continues to not see a variation in flow along the ditch, the primary reason to pipe would be for capacity, water quality, and potentially reduced maintenance. In 2011 Applegate estimated the construction cost of piping the entire ditch at $1.1M. This construction cost is now dated and estimated to be closer to $2.2M today.

III. C. Micro-hydro options

There is about 100 feet of fall in the 7000 ft of the Ridgway ditch, a net slope of about 1.4%. Flows in a pipe could range from about 0.3 cfs or less in the winter to probably 2-4 cfs for a few months around runoff. If the pipe ran pressurized rather than open channel, there probably is sufficient head and flow for a micro hydro system on this line, but finding a place to tie to the grid could prove challenging. The Town explored this option a bit in the 2009-2010 time frame but other priorities took precedence. This is still an option for the Town with support for the research, paperwork, funding and priority of the project. Advantages of adding a micro hydro system to the line is that it would generator some "green" power and the potential for some revenue. Disadvantages include the highly variable flows which make it hard to size the hydro system optimally, potential for the pressurized pipe to freeze, capital costs, finding a location for the generator and how to connect to the grid.

<u>IV. Lake Otonowanda</u>

Lake Otonowanda is a raw water reservoir located on Miller Mesa off County Road 5 in a natural depression. The Town acquired the reservoir site consisting of about 39.4 acres in 1936. As originally configured the Town owned only a portion of the natural depression, so to confine town water on town property, a dam was built on the east and southern sides of the Town property. Water from Beaver Creek is routed to Lake Otonowanda through an open ditch called the "Ridgway Ditch". The original outlet from the Town's reservoir is thought to have been a tunnel that went through the saddle off the northwest side of the reservoir. The photo insert is the

original lake. In 2015 the Town acquired an additional 28.531 acres to the east of the dam in the photo, expanding the storage capacity of the lake to approximately 640 acre feet.

During the drought of 2002, the Town's water rights were out of priority from July through September 2, 2002. The State Engineer's office allowed the Town to continue to divert water, but put the Town on notice they needed an augmentation plan to supply water or another method of supplying water to the Town when the Town's water rights were out of priority. In 2009, the Town contracted with The Applegate Group (AGI) to complete a feasibility study to determine how best to serve the Town when the Town's water rights were out of priority. The study evaluated a number of potential solutions including acquiring senior water rights, purchasing augmentation water, and ways to store water for use when the Town's water rights are priority. The Applegate study **recommended expanding Lake Otonowanda.** Water could be stored in the Lake when there was no call on the Town's water rights and could be withdrawn from the lake and piping to the Town's treatment plant when the Town's water rights were out of priority. The study provided two options to expand the Lake. One raised the height of the existing dam and could be constructed on the property the Town already owned. The other option was to make use of the natural depression, expanding the lake by removing or overtopping the dam and letting the lake expand into the basin. The Town's property is surrounded by privately owned lands, most of which is held in a conservation land trust with the Rocky Mountain Elk Foundation so that to expand the Lake required purchasing additional land and condemnation proceedings for the conservation easement. The study recommended raising the height of the dam mostly because it did not require land acquisition. **The Applegate report suggested an active volume about 350 acre feet or about one year of potable demand in 2035. The Town had concerns about** limiting the area over which it could expand and was interested in a larger lake capacity. The Town decided to see if they might be able to purchase land east and south of the existing dam, which would create a more natural environment in an existing basin. Shortly after opening discussions with the Walther Ranch land owners in 2012, the Ranch sold to new landowners. Over the next year or so the Town worked with the new land owners and Rocky Mountain Elk Foundation to modify the lake design, providing for some desires of the new landowners and structuring a purchase agreement to acquire about 28.5 acres to the east and southeast.

In 2014, construction began to expand the Lake. The footprint (at high water line) of the lake was increased from roughly 32 acres to about 58 acres. The rating table of the expanded lake is listed in the table below and at the right. The rating table was developed using the merged topographic lines thus it should take into account that the older part of the lake has a fairly irregular bottom. The lower inlet elevation to the new 12" pipe through the saddle is at 8536.25'.

Elev	Vol per contour	Cumulative Volume
8551		
8550		
8549	57.253	659.903
8548	56.130	602.650
8547	55.216	546.520
8546	54.634	491.304
8545	54.037	436.671
8544	53.364	382.634
8543	52.599	329.270
8542	51.713	276.670
8541	50.492	224.957
8540	48.983	174.465
8539	47.209	125.482
8538	44.848	78.273
8537	33.425	

There is also a second inlet at elevation 8544' which can be used to withdraw water from higher up in the water pool if the water quality higher up in the lake is thought to be advantageous. Construction was completed in late summer 2015 and the Town commenced active efforts to fill the renovated reservoir with water.

IV. A. Sediment

The 1985 facility assessment surveyed the lake from a rubber raft and tried to measure depth on a grid. The measurements at the time suggested the middle parts of the lake varied from 5-7 feet deep on top of the sediment. The bathymetric survey in 2009 was likely far more accurate. It found the depths of the lake to be 4-5+' deep. It is likely that between1-2' of sediment has accumulated in the lake in 28 years between the assessments.

It is not likely cost effective to remove sediment in the near term. Dredging the older portion of the lake could remove the sediment, but it could also damage what seal is present on the lake bottom. As will be discussed below, keeping the lake from losing water via seepage may be a challenge especially if the existing seal is lost and not replaced, so keeping what seal is in place is important. In addition, with dredging, one needs to have a place to store or make use of the removed materials, or be prepared to pay extensive costs for removal and relocation of the significant amount of material that could be removed. Piping the ditch where it gains sediment is likely a better answer to controlling sediment going forward, as it should help reduce the rate of sediment accumulation in the lake as well as potentially improving the water quality in the Lake.

IV. B. Fill Rate

During the winter, little to no flow from the Ridgway Ditch gets into the Lake. In mild winters, we estimate approximately 0.2 cfs, gets into the Ridgway Ditch and at best a small portion of that gets to the Lake. In colder winters, the Ditch can freeze to the point that little to no water gets through during the coldest part of winter in January/February. Flows pick up in the spring. Runoff from snow melt typically peaks in mid-June depending on the snowpack and temperatures in the spring. Flows then start to drop through the summer and drop even more in the fall.

When there is water available in the ditch that the Town does not need to store in the lake or for immediate use in Town the Town diverts that water to the other water rights holders pursuant to the Ouray County District Court 1969 Stipulation No. C-2649. In a normal to dry year there may be about 100 AF available to fill the lake, over the 12-month period.

IV.C. Seepage and Evaporation

Over the years the staff have speculated that the original portion of the lake was losing water to seepage before the Lake was renovated in 2014-2015. The Lake would typically fill but did not over fill. When there is sufficient water at the Happy Hollow diversion to meet the Town needs, water in the Ridgway Ditch is routed to Lake O.

The Applegate study noted that the rate of water loss seemed to have decreased over time which they attributed to the formation of biological seal on the undisturbed bottom of the Lake. They estimated that the 20" of precipitation was about equal to the rate of seepage. They also determined that the evaporation from the Lake estimated at 2.8' per year, exceeded the precipitation into the Lake by about 14" a year As part of the Lake O renovation project, the area around the tunnel inlet was backfilled and compacted with clayey materials and the lower sections lined with a PVC liner.

The Town has more accurately monitored the Lake levels since the 2014-15 renovation project. The Staff are monitoring inflows more closely to confirm how much water is coming in and out of the lake. The Town might also install and use equipment to monitor evaporation and rainfall. In the interim the Town has been approximating the evaporation using the RAWS (Remote Automated Weather Station) Data for Sanborn Park (https://raws.dri.edu/cgi-bin/rawMAIN.pl?coCSAN) which is about 25 miles from Ridgway and about 650 feet lower (7893 ft compared to the Lake at about 8545 ft), and should continue to do this. The Town should continue to monitor flows into and out of the Lake and compare it to precipitation and evaporation to determine whether seepage from the Lake is excessive over time.

V. Transmission Line

The transmission line from Lake O to the pre-sedimentation ponds above the water plant was constructed in about 1980. The first 20 feet of pipe is 12", then 20' of 10" and then most of the pipe is 8" with some 10" in the flatter sections of the line. Except for approximately the bottom 1850 ft of pipe, which is ductile iron, almost all the rest of pipe is SDR 26 Class 160 PVC pipe limiting the pressures the pipes can handle.

Water can be directed to the transmission pipe directly from the Ridgway Ditch below the Lake O saddle (as it was in the recent past) or can come from the pipe from the Lake through the saddle on the northwest side of the Lake. The new structure that accommodates flows from both directions (the Ridgway Ditch and Lake O) is shown at left. The blue pipe is coming from the Lake and the water seen flowing into the box is from the Ridgway Ditch. There is bar screen to screen the water from the Ditch at this structure and a bar screen on the inlet to the pipe from the Lake. The structure also includes an overflow weir in case the transmission line becomes blocked. The Town replaced the upstream 20 feet or so of pipe with 12" diameter C900 pipe in 2015.

Transmission Line Capacity

For open channel flow, which is the current flow regime of the transmission line, the entrance losses into the pipe for the most part control the capacity of the pipe. Most of the length of pipe it slopes downhill; there are however a few areas where the pipe slope flattens and likely backs up the water a small distance. To be conservative about the capacity of the pipe, assuming the pipe is flowing as an open channel with an 8" pipe three quarters full on a 1% minimum slope, it can carry about 1.5 cfs. In July of 2018, the Town sold 7.4 MG or about 240,000 gpd. That is about 3 AF a day and should meet the potable and non-potable demand for the next 20 years, assuming 375 gpm potable and 250 gpm non potable for peak day (about 1.4 cfs) in about 20 years. If park space continues to grow at the rate the Town was seeing before the recession, non-potable demand could be higher. Taking a more detailed look at the as-builts for the transmission line, it looks like the flattest section is around Station 91+00 at elevation of about 8393' to around 94+00 at 8397' with a slope of about 1.3% and at the Lake outfall where there is about 30' of 12" and 20' of 10" pipe before reducing to 8". The grades on that section are not in the as built profile, but that section looks fairly flat. From station 111+00 to about 13+50 (the approximate start of the 8" pipe section), there is 3' of fall or about a 1.2% slope. If the 8" pipe is close to full or even a little surcharged, the pipe can carry about 1.7 cfs.

Given that the Town is currently using about 1.25 cfs (0.75 potable and 0.5 non-potable water combined) in the summer months (May – August) and the population and demand both for domestic use and parks is expected to perhaps increase about 50% in the next 20 years or so, in that timeframe the line should have adequate capacity, but not long after that timeframe, the Town may need to look to increase the capacity of the upper section of the transmission line by the outfall from the Lake. Upsizing the pipe to 12" to about station 110+00 would increase the capacity of that section of line to about 3.5 cfs. Downstream sections that are flat likely can flow under a little pressure for short distances to increase capacity. If that proved detrimental to the hydraulic profile, the pipe in the other flatter sections could also be upsized to improve capacity in the sections of the line that are limiting the flow.

Transmission Line Condition

The pipe was installed in the early 1980's. The first 20 feet of pipe (starting at the Lake outfall) on the 1980 line is 12" Cl160. Below the 12" pipe is about 20' of 10" Class 160 PVC and downstream of that is 8" Class 160 for about 8400 lineal ft. Below that there is about 1000 LF for 10" Cl 160 and Cl 200 dropping from an elevation of about 8538 to about 8015 where the pipe changes to 8" ductile iron. There is about 2200 lf of the 8" ductile which terminates at the PRV vault above the pre-sedimentation ponds.

As part of the Lake O project, the existing 12" pipe at the Lake outfall was replaced with C900 and about 20' of additional 12" pipe was extended to the new outfall box at the Lake. The Town has not had issues with the line so it is assumed to be in good condition. Should the Town decide to build pressure up in the line for micro-hydro or other reasons, the condition of the pipe should be investigated in more detail in terms of its condition its pressure rating and its frost protection.

Transmission Line Assessment

There is a section of the transmission line where a road (off High Noon Rd) has been constructed over the pipe line which is an area of concern. The existing line mostly has only 3' cover which makes it more vulnerable to both traffic loads and potential freezing than it would if there was more cover.

There have also been a few issues with the air vacs in that area and a thorough inspection of the air vac valves on the full transmission line is recommended. They could be approaching the end of their useful life and some may need to be replaced in the coming years. The existing PVC pipe especially since it is not under pressure is expected to have a life span of about 80 years or even longer. A Unibell Pipe Association report entitled "Life Cycle Assessment of PVC Water and Sewer Pipe and Comparative Sustainability Analysis of Pipe Materials" references a lift expectancy of in excess of 100 years.

The shallow depth and the low-pressure rating of the pipe limit how far it would be practical to back up water in the line to either gain pressure to push water through the membranes in water plant or to build head for hydro power generation. If the Town wanted to convert the existing transmission line from gravity (open channel) flow to flow under pressure, it is recommended the Town look not only at the strength of the pipe but also if the water does not flow continuously whether the water would be likely to freeze.

VI. Happy Hollow

The Happy Hollow diversion is located on Cottonwood Creek about a mile south of town just off the east side of County Road 5. The Town and another water rights holder divert the water from the creek into Tidwell Ditch and then to their respective ditches. From the split point, the Town's water is diverted into the Town's pipeline that flows to the pre-sedimentation ponds above the water treatment plant. The original design of the pipe discharged into the upper pre-sedimentation pond very close to the outlet from that pond. A number of years ago, the Town staff modified the piping to allow the water from Happy Hollow flow to the "upstream" end of the upper pond to allow for more sediment removal. The Happy Hollow water tends to have less sediment and less chlorinated byproducts potential (Trihalomethanes (THM's) and Halo acetic acids (HHA5)) than the water from Beaver Creek or Lake O. Until recently the flows in Happy Hollow most of year were in the 0.3 - 0.5 cfs range. During the irrigation season, the Town shares the water with the irrigation user at the diversion. In the last few years, flows in Happy Hollow have increased where in the spring of 2017 and 2018, flows have been as high as 1 cfs, allowing the Town to operate the water plant with mostly Happy Hollow water. In 2017 the flows remained higher than normal most of the year, however, during the prolonged drought of the summer of 2018, flows dropped significantly and the Town needed to use water from Lake O in 2018 to meet the demand of the Town, even with mandatory water restrictions in place from June 12 – October 11, 2018.

VI.A. Happy Hollow Capacity

There is a 9" Parshall Flume at the diversion at Happy Hollow. A 9" flume can accurately measure flows from about 40 gpm to up to about 2000 gpm (over 4 cfs), far more water than is in the drainage or than the ditch could carry, so the flume is sufficient.

At the Tidwell Ditch diversion in Happy Hollow, the pipe is 10". The pipe elevation drops from about 7674' to about 7558' at the pre-sedimentation ponds. The pipe appears to mostly flow as open channel flow with variable slopes. To determine an approximate pipe capacity we looked at the slope for the 1st 1500 feet of pipe where the slope appears to be more variable. In that area elevation drops from 7674 to 7638, which is a slope of about 2.4%. To determine capacity we have assumed a 10" pipe, three quarters full with the minimum slope of 0.75% to be conservative. That results in the capacity about 2.25 cfs, which should be adequate for the next 20+ years which is projected to be about 1.5 cfs.

VI.B. Happy Hollow Condition

The Town recently replaced the diversion structure with flow measuring equipment at Happy Hollow. The water commissioner would like for the Town to add which replaced the Town's distribution system with new PVC lines, constructed the transmission line from Lake O, constructed a water plant, and the first 300,000 gallon water storage tank. Note that the 1980 project predates nearly all of the current employees. Most of the pipeline is buried, but what is visible (mostly the ends) is PVC and the line is assumed to be PVC throughout. There have not been any issues with the pipe to date. Given that the pipe has been in the ground for about 40 years without identified problems, suggests that the pipe was properly installed and that it should serve the Town well for many decades to come.

To confirm the condition of the interior of the existing line it is possible to video inspect the line. This would require exposing and opening the pipeline every 400-500 ft to allow the camera to get into and be removed from the pipe. This would be expensive, and tricky and is only recommended if the Town feels like there are issues with the line or if the Town is thinking about pressurizing the line for a micro hydro system or other reasons. As will be discussed in greater detail in the sewer collection system evaluation, just because there are no signs of defects visible from the surface, does not mean that the line was installed properly or is in good condition but so far the Town has not seen any evidence that there may be issues.

VI.C. Happy Hollow Assessment

In summary, the main infrastructure at Happy Hollow is expected to be adequate for the next 20 years, although transmission line capacity could become limiting during the summer months in about 20 years should there be sufficient flow available to meet the peak summer demand in Happy Hollow. The Town plans to add the flow measuring equipment to measure the flow going to each diversion from Happy Hollow in the next year to two. The existing pipe has the capacity for the amount water that is available at the diversion, +/- 1 cfs and for about twice that much if the water is available. If the Town is able to get considerably more than 2 cfs to the Happy Hollow diversion, the pipe capacity could become an issue and a more detailed investigation of the profile and pipe condition is recommended. Before pressurizing the pipe, the Town should complete a video inspection of the line and assess the impacts of pressurizing the pipe.

Micro Hydro

The Happy Hollow piping is a lot shorter than the transmission line from Lake O. It also has less fall, only about 100 ft. As with the Lake O line, the hydro power could be generated near the pre-sedimentation ponds where it is a relatively short distance for the line to connect with the grid. The short pipe length and the proximity of the more significant drop area being just before reaching the plant site, suggests a limited amount of pipe replacement would be needed with any hydro power. If adding hydro power is desired, it is recommended a feasibility study be completed to compare the costs with the benefits.

VII. Pre-sedimentation Ponds

The earthen reservoirs above the treatment plant were constructed decades ago. It is thought that the upper pond was constructed in the early 1900's and the two lower ponds perhaps in the 1960's. In the early 1900's, it is likely that the upper pond provided for sediment removal and some years later the Town began adding chlorine to the water before delivering it to the Town's distribution system. In 1980, as part of the water system replacement, the Town also constructed a new water treatment plant. The pre-sedimentation ponds continued to serve the function of turbidity reduction in advance of the treatment plant. The operational flexibility of the ponds has been limited with the flow of water in and out of the ponds being somewhat fixed. About 20 years ago, the town staff modified the piping so that Happy Hollow water could enter the upper pond at the far end of the pond outlet, and in the last several years town staff has been adding piping and valving that allows the water to bypass the ponds. Figure VII-1 XXX shows the current piping around the ponds.

VII. A. Pre-sedimentation Ponds: Volume

The 1980 drawings for the water system have an aerial photo of the pre-sedimentation ponds, but no volumes or depths. To determine the volume for this assessment, a scaled google earth image of the ponds was inserted into cad and the rough area of the high-water line was determined. The slopes were assumed to be 3:1 slope and the upper pond was assumed to be 8' deep which results in a volume of about 1.25 MG, the big pond was assumed to be 12' deep which results in a volume of about 3.4 MG and the small pond about 8' deep with a volume of about 0.5 MG and an overall volume of all ponds combined about 5.15 MG. If the assumptions about the slopes or depths are modified, the assumed volumes would change as they would if the surface area assumptions change. With a current peak demand of about 0.375 MGD treated and non-potable demand of about 0.5 cfs (0.323 MGD), detention time through the pre-sedimentation ponds in the summer is about 7.3 days.

As the Town's water demand increases, the detention time of the water in the ponds will decrease. It will also decrease if sediment increases. If total (potable and non-potable) water demand increases 50% in the next two decades, detention time in the pre-sedimentation ponds would drop to about 4.9 days in the summer if the current capacity is not reduced due to sediment build up. Given that most of the sediment seems to accumulate in the first part of the upper pond and the Town at times able to remove some of the accumulation, the reduction in detention time due to sediment may not be problematic in the next 10-15 years or so. Longer term, the Town might want to consider renovating the ponds. The pond area is mostly land locked with the ponds occupying most of the Town-owned land and they are also a bit topographically constrained in that there is a steep slope on the upstream side of the upper pond and a steep drop off the lower side of the big ponds. The most practical solution for expansion may be to increase the height of the dam southwest of the water plant and maybe to combine the larger and small pond. Options for renovation and capacity should be evaluated in greater detail when additional capacity is needed.

VII. B. Pre-sedimentation Ponds: Efficiency

If one judges the efficiency of the pre-sedimentation ponds by the amount of sediment that has accumulated in the ponds over the decades, the ponds appear to be quite efficient. The Town does not monitor the turbidity coming into the ponds, but the turbidity of the water coming into the treatment plant is estimated to be quite low, under 3 Nephelometric Turbidity Units (NTU) in the spring and and less most of time the rest of the year, suggesting that the ponds are working well. The other suggestion that the ponds are working well is the amount of sediment that accumulates at the Lake O transmission line inlet to the upper pond. In the last decade, the Town has been working on putting this sediment to beneficial use such as finding sites that can use the material for fill.

The ponds support a significant amount of aquatic vegetation which can reduce the water quality coming into the water plant. It is likely part of that aquatic vegetation contributes to the formation of the trihalomethane (THM) and haloacetic acid (HAA). Some of the aquatic vegetation also contributes taste, odor, and color to the water. Over the years the Town has tried to control the growth by applying copper to the ponds and also using sterile grass carp. Because of the drinking water rules that limit the amount of lead and copper in the finished water, the Town rarely uses copper any more. Staff is hopeful that draining and drying the ponds will reduce the amount of potentially problematic aquatic vegetation and mitigate future challenges. At least the initial attempts at drying the big pond looks to have caused some of the vegetation to come back more aggressively. If the aquatic vegetation becomes more of a nuisance, the Town may want to explore ways to control the vegetation perhaps by carefully balancing the amount of copper that is applied to the pre-sedimentation ponds with the copper concentrations in the finished potable water. The Town may want to also continue exploring other potential solutions to managing this vegetation.

The pre-sedimentation pond piping could be modified so that Lake O water could be settled in the upper pond and then piped directly to the non-potable system and Happy Hollow water routed to the two lower ponds and then to the treatment plant. The costs to add the needed piping and valve cluster are estimated at about $10,000 and the addition would improve operational flexibility of the ponds. If different pre-sedimentation ponds are used to supply the potable and non-potable supplies separately, Staff might be able to apply copper to the non-potable supply to control aquatic vegetation and then switch the ponds that are used for potable and non-potable and treat the aquatic vegetation in the other ponds, rotating which ponds are used for what purpose.

VIII. Water Treatment

After water is settled in the pre-sedimentation ponds water for domestic use, it flows by gravity into the water treatment plant building where it is pressurized and pretreated with chlorine dioxide as the water flows to the microfiltration system. The existing water plant was installed in the 2008 timeframe. The membrane plant was purchased from US Filter but while the plant was being constructed the company became Siemens. In the last few years, Evoqua became the contact. It is a 500 gpm US Filter (Siemens) (Evoqua) vacuum microfiltration plant. In 2017 the Town replaced the modules with a slightly modified fiber design that is supposed to provide better performance, which we are experiencing now. This Assessment addresses only plant components of the water plant, The Assessment from SGM completed in 2018 addresses the water plant building, HVAC systems, etc. as a companion to this report.

VIII. A. Water Treatment: Chlorine Dioxide

Chlorine dioxide provides taste and odor control and removes color and THM and HAA precursors from the water. The Town leases the chlorine dioxide generator, currently at a cost of about $1650 per month, which includes a maintenance contract. The lease runs for several years and is then renewable. The capacity of the current generator is sufficient to provide chlorine dioxide for the current peak flows. As demand grows, the Town could have the lessor provide a larger generator or look to change the type of generator and the vendor. There are a number of different options on the market. The Town selected the Pureline model because it was easier to operate, included a service contract, and did not require the use of chlorine gas while allowing some flexibility as a lease rather than a purchase. If the Town decides that the use of chlorine gas for other uses is a practical option, looking to change the process by which chlorine dioxide is generated would make sense and could reduce the operating costs of chlorine dioxide generation. If chlorine dioxide generation is the only use for chlorine gas, it is likely better to continue to generate chlorine dioxide without gas chlorine, especially given the higher level of operator certification, with corresponding higher labor costs for the Town, that is now required when a system uses chlorine gas.

VIII. B. Water Treatment: Microfiltration

Following the addition of the chlorine dioxide to the raw water, the water flows into the microfiltration modules where particles in excess of about one micron are removed through a physical "straining" process. Following microfiltration, the water is disinfected with chlorine solution and flows to the water tank(s) for storage and chlorine contact time.

To keep performing efficiently, the microfiltration modules need to be backwashed regularly (typically about 30 minutes) and every few weeks they need to be deep cleaned in place (CIP) with concentrated chlorine solution or citric acid. Although Ridgway has not done so, other plants also use sodium hydroxide and hydrogen peroxide to restore modules that are clogged. The Town should check with the module supplier before trying any chemicals not specifically recommended for the Evoqua modules. Approximately 5 - 10% of the water produced is used to backwash and cleaning processes. Although the design capacity of the plant was specified to be a net of 500 gpm, i.e. 500 gpm going to the distribution system, the plant is closer to a gross of 500 gpm and net of about 450 gpm.

The water used to backwash and clean is discharged to the backwash pond to the east of the plant. There the water is settled and the supernatant is pumped back to the pre-sedimentation ponds. This keeps the backwash pond from overflowing and needing a discharge permit. It also allows for "reuse" of the settled backwash water.

VIII. B.1. Water Treatment: Plant Capacity

The microfiltration plant is rated at 500 gpm, 250 gpm in each of the filter trains. From the initial start-up, the plant was not able to produce water at the specified rates. There was space for extra modules in each of the trains and Siemens furnished the additional modules to fill out the filter trains in an attempt to meet the project requirements of 250 gpm net produced per train. In the summer months, the plant came close to meeting the rated capacity, but the functional capacity of membrane plants is somewhat water-temperature dependent and in the winter months, the plant's capacity dropped to 150 gpm or less even though the plant was supposed to meet a net production of 200 gpm per train in the winter Staff did not have trouble meeting the demands of the Town with the reduced capacity during the recession, but current demands are noticeably higher and demand is likely to continue to grow. Membrane filtration modules need to be replaced about once a decade, timing depends on raw water quality and volume of water they have treated. Based on observed performance efficiency changes, in 2017, staff determined that it was time for module replacement and purchased all new modules from Evoqua. The new modules are a slightly different design than the original and so far it seems like they better handle differences in water temperature and also have a better through-put throughout the year. The Town replaced the filters in 2017 at a discounted cost of approximately $60,000. These regular filter replacements will need to be a planned and budgeted expense. The next replacement cost could be upwards of $80,000 for both filters. During the summer of 2018, the Town was producing about 310,000 gallons per day or 215 gpm if operating 24 hours a day or about 260 gpm in a 20 hour day (allowing time for backwash, cleaning, and off time), which is about 60% of the plant capacity if it is able to produce the rated 500 gpm. The Town should start to plan to expand the plant when demand is about 75% of the functional capacity of the existing plant. If the plant is able to produce 500 gpm for 20 hours a day or 0.6 MGD, when demand is 0.45 MGD, the Town should start to plan for expansion. Assuming a 50% increase in population with a similar increase in water demand, the Town is expected to have a demand of around 0.53 MGD in 20 years. Thus if the plant is able to produce 500 gpm, the need to start planning for treatment plant expansion is likely more than 20 years out. Of note, 2018 was another very significant drought year and the Town had mandatory water restrictions in place from June 12th through October 10th for the first time in the recent history of the town. With the water restrictions in place, there was no noticeable difference in demand from prior years, so the figures used here should be accurate for projections. Effective December 1, 2018, pursuant to Ordinance 18-06, the Town implemented a significant water rate increase and with some rate structure changes, which are anticipated to significantly curb water use as rates were adjusted to work toward covering the cost of water treatment and delivery town-wide. The town will want to closely monitor water use and costs over time and on a regular basis to insure rates keep pace with expenses.

The original design of the membrane plant contemplated the need to expand in the future and there is room in the older building at the water plant site to add at least two more filter trains with their own blowers, compressors and controls. Expanding would require replicating most of the infrastructure so the costs to expand will be similar to the costs for the current Siemens plant adjusted for inflation. As part of the planning for the expansion, it is recommended that the Town explore multiple treatment options and determine what will best meet the Town's needs going forward. There are communities that have switched from membrane to conventional treatment mostly because the raw water quality was problematic for the membranes. Another membrane system decided to add coagulation and sedimentation ahead of the membranes as a way to better control THM precursors and total organic carbons (TOC) in general. The current Ridgway membrane system including downstream disinfection provides pathogen removal and destruction respectively, but does not address removal of TOC and other THM precursors instead relying on chlorine dioxide to provide THM and HAA control as well as taste and odor control. This system has worked well for Ridgway but as demand expands, taking another look at options is advisable.

VIII. B. <u>Water Treatment:</u> Condition

The main pumps at the head of the plant are in good working order, but are mechanical and will need replaced at some point. The chlorine dioxide machine was replaced when the Town signed a new lease about 5 years ago (est. 2013). As noted above the Town may want to explore other options when it i time to renew the lease and/or increase chlorine dioxide capacity.

The microfiltration plant is about 10 years old. The new modules installed in 2017 have improved the plant performance and the modules should provide about 10 years of useful life. Replacing the modules is expensive (~$60,000 in 2017 and that price was a negotiated discount) and it is recommended that the town set aside funds to have available to purchase new modules when needed. There are now third-party vendors that make modules for the Siemens systems that maybe worth exploring before the next replacement. The plant has also had issues with automatic valves, blowers, compressors and SCADA system. These should be operated and maintained as needed to keep them functioning reliably. In the next 5-10 years some of this mechanical equipment will likely approach the end of its useful life and the Town should budget to replace this equipment as it becomes less cost effective to maintain rather than replace it.

VIII. C. Water Treatment: Operational Improvements

When the town purchased the membrane system, the microfiltration market was relatively new. The change from pressurized sedimentation and filtration to microfiltration made good sense. The new plant is much less finicky in that it does not require constant changes to coagulant and polymer dosing to control turbidity. The new plant requires little adjustment to produce very low turbidity water that easily meets the increasing stringent turbidity limits.

The existing plant is run by software and firmware provided by Siemens. As the microfiltration technologically has continued to evolve and with turnover in personnel, Siemens and now Evoqua have made changes to their controls and to some extent have lost the institutional knowledge to easily maintain and modify the controls for the Ridgway plant. It is also very costly to have Siemens work on the controls. At some point the Town may want to explore either having Evoqua thoroughly update the controls, if they can do so, or having a controls-based company redo the controls converting to non-proprietary software. At least one other community on the West Slope that has a membrane system has done the latter with success.

There have been several occasions when lightning strikes impact the level monitoring and control of the tanks and the SCADA system. Replacing the pressure transducer in the tank costs several hundred dollars, but replacing the PLC in the SCADA system is about $1500. It is recommended that the Town explore additional lightning and surge protection for the plant.

As noted above the Town may also want explore whether the Pureline chlorine dioxide generator is the best way to generate chlorine dioxide and whether chlorine dioxide is the best way to control taste, odor, and color when it is time to upgrade the Pureline system and/or expand the water plant.

When it is next time to replace the modules, it is recommended that the Town compare the modules offered by Evoqua with some of the third-party replacement modules. The third-party market looks to be growing and perhaps to becoming more innovative.

VIII. D. Water Treatment: Disinfection

Since the Culligan plant was installed in 1980, the Town has used solution chlorine to disinfect. In the early years the Town mixed calcium hypochlorite and more recently the Town has been using sodium hypochlorite (strong bleach) for disinfection. Currently a chemical metering pump feeds chlorine solution to water as it flows from the microfiltration modules to the treated water storage tank. Solution chlorine is less hazardous to use than gas chlorine, but is still quite hazardous. Chlorine gas is required to be in a separate room that is specifically designed for the hazards associated with the gas. Solution chlorine can be located in a general work space and has been in the general work space at the Ridgway water plant. There have been occasions when there have been problems with the chlorine solution system that have resulted in a chlorine vapor in the work space. The Town recently (2016) installed a ventilation system that is designed to change the air in the building several times per hour. The Town also installed garage doors that can be opened for faster air exchange when needed. In order to improve employee safety and minimize corrosion inside the building, the Town might want to consider having the chlorine solution in a separate room from the main building. There are also occasionally issues with the chlorine dioxide generator. If the water plant is expanded into the old building, the Town may want to consider housing the chlorine dioxide generator in a separate, well ventilated space as well.

As the mechanical equipment ages, the Town should budget for not only increased operational costs but also for the need for equipment replacement.

VIII. E. Water Treatment: Backwash pond

The 1980 water system improvements included a backwash pond for the old Culligan plant. As the Culligan plant was expanded, the Town added second backwash pond. When the plant capacity was again increased with the construction of the Siemens membrane plant in the 2008 timeframe, the two backwash ponds were merged into a single larger pond. However, there were times when the backwash pond would overflow and discharge. The Town needed to either secure a discharge permit and monitor the quality of the discharge or make it so the pond would not discharge. The Town opted to do the latter by installing a system where the settled water discharged to a sump with a pump, which recycles the backwash water to the pre-sedimentation ponds. The backwash pond at its current size and usage allows for settlement of most of solids before the water is cycled back to the treatment plant. There will come a time when the sediment will need to be removed for the backwash ponds to recover the planned capacity in the ponds. The Town should monitor sediment depth in the backwash pond and make arrangements to clean it when it is about a third full, perhaps in the next several years. When the treatment plant capacity is increased, that expansion should include additional backwash pond capacity.

The backwash pond is not lined. Over the years the pond has silted in and likely is somewhat water tight. When removing sediment, the Town should be careful to not clean to the very bottom of the sediment and damage the seal. In the last few years, CDPHE has asked some communities to demonstrate that their backwash ponds are water tight or to install groundwater monitoring wells to confirm the backwash pond is not leaking. If this question comes up, the Town may want to install flow measuring equipment and do a mass balance on the water coming in versus the water going out.

IX. Treated Water Storage

A 300,000 gallon 24' high water storage tank was constructed at the water plant site when the Culligan water plant was constructed as part of the 1980 water system replacement project. The Town added a second 300,000 treated water tank at the water plant site in 1992 along with piping that allowed the two tanks to run in series or parallel. The Town uses these storage tanks to provide chlorine contact time so bypassing one is allowable but bypassing both is not an option.

There is also a small, functionally approximately 18,000 gallon tank above the Vista Terrace Subdivision, east of Highway 550. This tank is set up to mostly serve the parts of Vista Terrace that are in the upper two pressure zones, which are the zones above the Vista Terrace pump station. The adequacy of storage east of the river is discussed below.

IX.A. Treated Water Storage: Review Inspection Data

There are two common ways to inspect tank interiors. One is with divers when the tank is full of water and the other is to drain the tank and install scaffolding and examine the inside without water. The divers do a thorough inspection and can see more of the walls without having to install scaffolding.

Draining the tank allows for more thorough surface preparation and larger repairs. There are times where corrosion is easier to see as the tank dries out. Repairs that require welding are impractical with water in the tank. We recommend that every 10 - 15 years, the tank be drained to check for issues that are not visible when the tank is wet and/or under water. If there are repairs that are better completed without water in the tank, the tank should be drained to make those repairs at a frequency that protects the structural and sanitary integrity of the tank. Working without water in the tank also allows an opportunity to better clean and repaint areas that are more difficult to reach when submerged such as the welds around the manways. The disadvantages of draining the tank include having one tank off line for weeks, the need for scaffolding to work on the upper parts of the tank, and the need to clean and disinfect the tank before it can be put back in service. Note that although the divers can view the rafters in the tank, in most cases their ability to make repairs is quite limited compared to what can be done with scaffolding with the tank drained.

For the last several decades, the Town has inspected the tank interiors about every 5 years mostly using professional divers to clean and check the tanks and make in situ repairs. They furnish written reports with videos of the interior inspection. The most recent inspection of each tank occurred in 2017. The following summarizes the observations from reviewing the videos.

<u>North Tank</u>

The inspection of the north tank, the one that was constructed in about 1980 found about 1/2 - 1" of sediment on the bottom which the dive team was easily able remove with their vacuum. The sediment was bit thicker toward the tank center and near the outlet. They presumed that the sediment was mostly iron and manganese. The floor below was in good shape with some light staining and a few rust nodules. The walls also have light staining and a few rust nodules mostly at the welded seams.

The manway at 3:00 (assuming north is at noon) had some delamination of paint and a moderate amount of rust in several locations. The one at 9:00 had rust noduling at the top with some delamination and some rust and delamination at the gasket lip. There were also rust nodules on the bottom of the manway. Initially the tank had a combined inlet and outlet. A separate outlet, which was added when the tank was last repainted in about 1993, exits the tank through the sidewall. There was some staining and some rust nodules around the pipe and on the plate that holds the pipe support.

The cables for the float for the target are broken but the cables are still connected at the roof of the tank. The inspectors recommended that the cables be reconnected. The inspectors did not include a video of the inside ladder. The overflow pipe is just a pipe sticking through the tank sidewall. It has some staining and rusting on the pipe. There are some corrosion nodules on the bottom of the weld between the pipe and the wall, and the ceiling above the overflow pipe has a rusted area.

Most of the center column was in good condition, but there was significant damage to the coating where the water level fluctuates toward the top of the column. These were repaired in 2018. There was rusting at the rafters and at the connections between the rafters and the walls. The rafters on this tank are welded rather than bolted which is typically a better design. The video did not include a good look at these features. We recommend the next inspection do a thorough job of checking the roof system.

Overall the tank is in good condition with minor repairs needed as noted here. The Town should be setting aside reserves for a complete repaint of the tanks in approximately 10 years (2029).

<u>South Tank</u>

The newer tank, the one to the south, had about 1" of sediment toward the outside of the tank that got deeper toward the center which the divers were easily able to remove with their vacuum. They classified the sediment as mostly iron and manganese. The floor was found to be in excellent condition with almost no rust and a little staining.

The floor to wall seam was also found to be in excellent condition with just some light staining. The walls are stained through-out with some fairly heavy staining in places. The wall seams had sporadic rust nodules. The inlet and outlet pipes had some light staining and some blistering inside the pipe and some pitting on the pipe edge. The bases for the pipes were in excellent condition. There was a little delamination on the top of inlet riser and some staining on the outside of the pipes. The insides of the pipes had rusting and some delamination.

The floor seam at the drain was in good condition. There was some staining on the pipe with a few rust nodules. This pipe stub is removable, but they did not lift it so see if there was any damage below. There was some rust on the edge of the pipe and there were some underwater paint repairs on the pipe. The overflow pipe had staining on the outside.

The inside ladder was in good to excellent condition, with some staining, and some rust nodules on ladder standouts. The top step was rusted with some tubercles. The float and target were not functional.

On the manway at 1:00, the outside welds have a little rust and there was rust on the edge of the 4" standout with a few rust nodules and blistering on the inside of the 4" insert. The other manway was in great condition. It was staining throughout, but no rust on the outside. The inside of manhole had some rust nodules as well.

The center column support had no rust on the base. It did have some staining and the wings (used to lift and set the column) had a little rust and delamination on the edges. The coating on the column was in very good condition from the tank floor to where the water level fluctuates. As is typical of tanks in our region, where the water level fluctuates, and ice surrounds the column as the water and ice go up and down, there was considerable damage to the coating system with surface corrosion and delamination.

The inspectors said that the roof was in good condition with some rust and staining that follows the rafters and runs down the walls to water level. The seam between wall and roof was pretty consistently rusted. They could see no daylight which is the goal. They showed some bolts on I-beams at the roof wall intersection had rust nodules, but did not look at other sections of the roof. All the bolts on the I-beams should be thoroughly checked at the next inspection.

Overall the tank is in good condition with minor repairs needed as noted here.

IX.B. Treated Water Storage: Assess capacity, condition, water quality impacts

Historically the recommendation for storage volume was two times peak day plus fire flow. The Town's peak demand is around 350,000 gpd and fire demand is typically set at 500 gpm to two hours or 60,000 gallons. However, with more concern about water age, the time from when the water was treated with chlorine until it is delivered to the consumer, being an issue, the current recommendation is for about a day of storage plus fire flow. The concern with water age is that the longer the water is in contact with the chlorine residual the more likely that the chlorine will react to form other chlorinated byproducts, specifically trihalomethanes (THMs) and haloacetic acids (HAAs). There have been times when the Town has struggled with meeting the THM and HAA5 limits, and although there have been no violations, using the newer volume criteria seems appropriate. Using that criteria, the Town has adequate storage for about a 50% growth in peak day demand. This should be adequate for the next 20 years, but might need to be expanded in the next 25-30 years if water storage is not added east of the Uncompahgre River.

The condition of each of the 300,000 gallon tanks is generally good. Shortly after the second 300,000 tank was constructed, the original tank was sand blasted to bare metal and repainted. The paint systems from the early 1990's have held up well and many of the areas of corrosion that were visible to the divers have been corrected. Protecting the integrity of coating system of the tank is critical to insuring that the tanks will remain in good condition going forward. It is likely in the next 5 - 10 years the Town will need to drain the tank to make the comprehensive repairs needed to the center columns of the tanks and other areas with corrosion that are easier to repair with a dry tank. In the next 10-15 years the tanks may need to be completely repainted. This is a very expensive, likely $125,000 - $150,000 for each tank. The Town should set aside resources in the coming years in order to be able to funding blasting and recoating the tanks when needed. Since many of the coating issues are related to the columns and the roof system, the Town might want to explore changing the roof to an aluminum dome when it is time to repaint. An aluminum dome eliminates the need for columns and for painting the roof, which is the most expensive part of the tank to paint.

IX. C. Treated Water Storage: Storage and/or secondary supply East of the River

There is very little storage on the east side of the river, just the small underground tank in Vista Terrace with a functional capacity thought to be about 18,000 gallons. The tank is set up to mostly provide water just for Vista Terrace. The system is currently set up with a check valve to keep water that is pumped to Vista Terrace from flowing back to other developments east of the river. Current average daily demand in the peak month on the east side of the river is about 30,000 gpd. That demand is expected to grow as there are currently plans for construction of about 30 more residential units east of Highway 550 that are currently being reviewed. The storage at Vista Terrace is somewhat adequate to meet the current users above the check valve, but that leaves other users east of the river relying on a single river crossing and only the storage west of the river at the treatment plant. This is less than optimal. Sooner than later, and as growth continues east of the river, it is recommended that the Town add both a second river crossing and another storage tank on the east side of the river. Preferably the new storage tank would be at an elevation that could serve both pressure zones in Vista Terrace was well as the lower areas east of the river. In the meantime, the Town is working on an interconnection with another water supply district in 2019 to have water available east of the river in an emergency.

X. Distribution System

The distribution system consists of the treated water storage tanks by the water plant and the piping network that carries water throughout the town. Much of the Town's existing water distribution system was installed in 1980. Distribution lines below the pressure regulating station at Moffat and Amelia Streets are PVC and mostly 6" with an 8" main along Sherman and South Amelia Streets. Most lines are looped. However, there is a single river crossing that is the only supply for all the users east of the river. There is some looping on the east side of the river, but with a single supply under the river, it functionally makes for a long dead end for everything east of the river.

With the annexation of the Vista Terrance area at the northeast end of the Town in the early 1980's water distribution lines were extended east of Highway 550 and north to service the Vista Terrance Subdivision. Those distribution lines are 6" PVC. The piping through the development is adequate for currently platted development and has not caused any significant problems over the years, except limited storage to serve Vista Terrance and for the lack of a redundant line across the river which, at times, has created water outages for properties east of the river, including Vista Terrace. There is also very little capacity for fire flows in Vista Terrace. Due to elevation, water for most of Vista Terrace has to be pumped. An underground concrete tank was installed above the Vista Terrance development as part of the project. It has a functional capacity of about 18,000 gallons. A new pump station that pumps directly to the concrete tank was installed in 2010-11. It includes two pumps, controls, and an alarm system. With the very limited storage, even with the alarm system, a pump problem or power failure results in the upper most Vista Terrace residences calling to say they are out of water.

In the early 1990's developers extended water lines to the east of Highway 550 to serve Ridgway Land Co and Ridgway USA. Shortly after that development, lines were extended from the historic section of Town to the south to serve Solar Ranches. Due to increasing elevations as the Solar Ranches development extended south and west, the second phase of the development of Solar Ranches created the need for a second, higher, pressure zone in the southwest part of the development and in the southwest end of the historic part of town. The Town installed the new pressure regulating station at the south end of South Amelia Street and a new pressure relief station was installed at Cottonwood Creek. The Town placed a surcharge on new taps that would be served by the new station to defer the costs as shown in RMC 9-1-24(B).

While the southern phases of Solar Ranches were developing, Cottonwood Creek and Marie Scott subdivisions on the southwest side of town developed with water lines being extended by the respective developers prior to final plat approval of the subdivisions. In 2000, developers extended water lines to the north of the Town Core into the River Park subdivisions and in 2005 the School District and a developer extended water lines farther to the west and north in the Green Street area. In conjunction with the Green Street extension, the Parkside Subdivision was constructed between River Park and Green St. All these main lines are PVC 6" and 8" lines.

Most of Town has a good fire rating of 6 (lower is better) from the Insurance Service Office (ISO) which is in part result of the looping, line sizes, and hydrant placement. However, Vista Terrace with its limited storage, the need for the water to be pumped, and only 6" lines, has poor rating of 9. To improve the rating in Vista Terrace would at a minimum require more storage.

X.1. Distribution System: Pressure Regulating Stations (PRV's)

There is a pressure reducing station at the bottom of the water plant road before the first customer and a pressure relief valve for that pressure zone at Cottonwood Creek at Amelia Street that was installed in the early 1990's. That pressure zone serves the upper part of Amelia Street, the upper parts of Solar Ranches, almost all of Marie Scott and Western Hills and the far west end of Moffat Street and is referred to as the upper zone. There is another pressure reducing station at the intersection of Amelia and Moffat Streets that creates the pressure zone that serves most of the Town that was installed with the 1980 water system replacement. The relief valve for this zone referred as the main pressure zone is located on the east side of the river just north of the SH 62 Bridge.

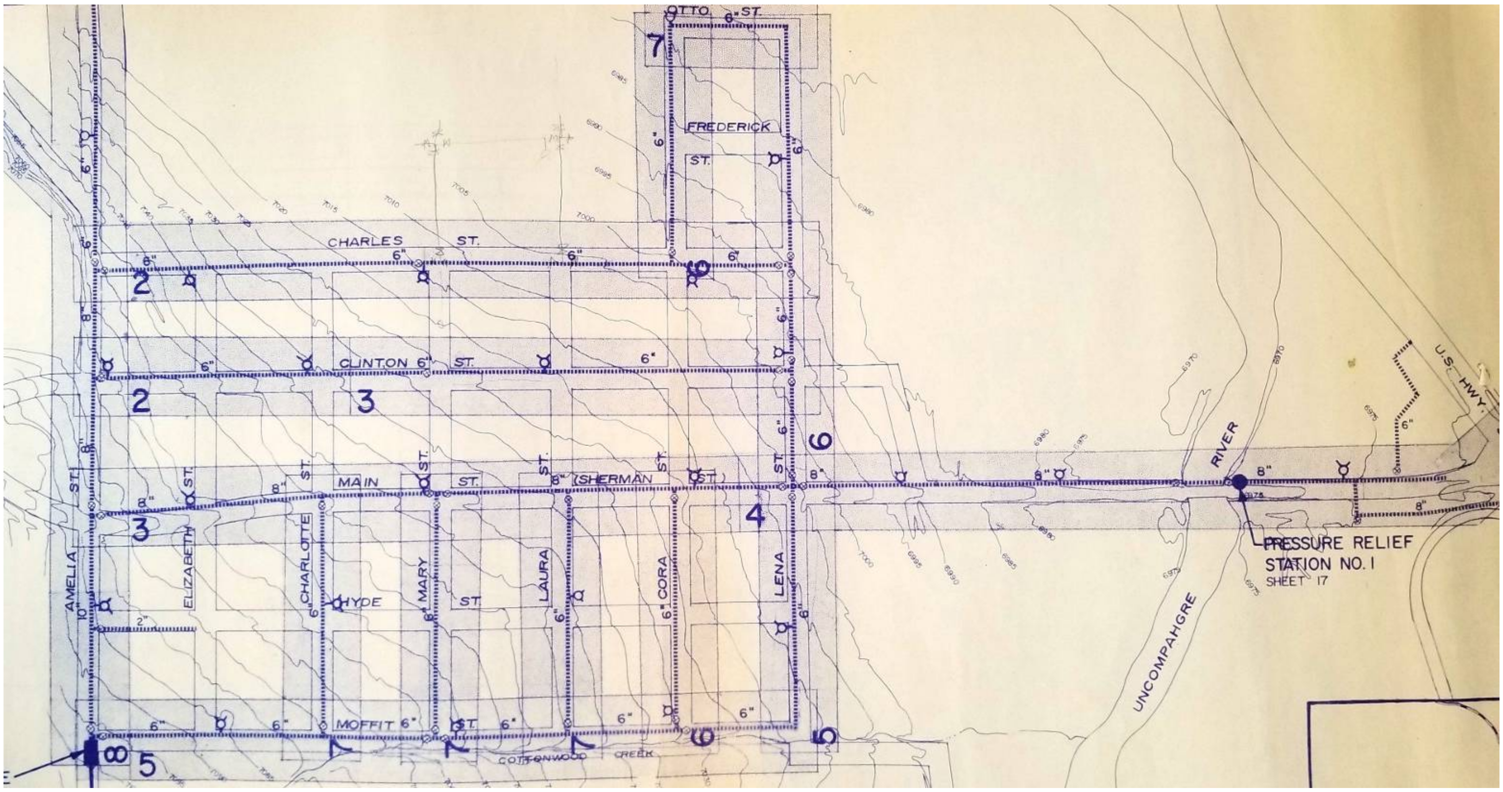
The Moffat/Amelia Street station is the oldest and its internals have been replaced as have some of the internals on the station at the South end of Amelia. The Moffat station serves most of the historic part of Town. The regulating stations in Vista Terrace were upgraded with the new pump station for Vista Terrace in 2010. All the stations appear to be operating well. The only known deficiency is that there are customers at the upper end of the main pressure zone (served from the Moffat and Amelia Street station) that do not have as much pressure as they would like. It is recommended that the Town look at options to relocate at least the customers with the least pressure to the upper zone.

It is recommended that the salient detail in this section be included in the Town's GIS mapping database for ease of access and use of the information, including the location and scope of the various pressure zones.

X.2. <u>Distribution System:</u> Distribution Lines

The original water system replacement in 1980 was funded by the Farmer's Home Administration (FmHA). At that time FmHA required that water systems be designed to just meet the immediate needs of the community. Because Ridgway was a town,FmHA did allow for some provisions for fire protection, but the 1980 system was in some ways set up as a minimalist town water system as can be seen below which is an overview of the plans for the 1980 project. There are a number of streets without water lines likely because there were not enough taps on those streets to meet FmHA criteria and hydrants are typically every other block rather than every block. The lines below the pressure regulating station at Moffat and Amelia Streets are all PVC and many of them are just class 160 PVC a relatively low pressure, thin walled pipe. Most of the water lines from that project are 6". As there has been infill in the historic part of town, there have been opportunities to add water mains to the blocks that were skipped allowing for better looping, but as can be seen in Figure X-2 -2 XX, there are still a number of streets with no water main. In many cases development on the north south streets without water mains are served by individual service lines tapped into the mains on the east/west streets and run north or south in the cross street to service the user.

As subdivisions have expanded the Town's water distribution system, they have been required to provide lines and looping to meet a 1000 gpm fire flow in residential developments and 1500 gpm in commercial areas. These lines are mostly C900 PVC, a pipe with a heavier wall and much more durable than the class 160 pipe that was largely used in the 1980 system. Since the early 1990's the Town's infrastructure standards have required C900 pipe unless the pressures are so high that ductile iron pipe is needed. Most



lines are 8" diameter.

PVC pipe, even the class 160 pipe, if properly installed is expected to have a useful life of over 80 years. The Town has had to replace the line under the river due to river erosion and the line just below the water tanks at the water plant due to the hillside sloughing. To date there have been no issues with the distribution main lines due to installation or materials problems. That does not mean that there are not installation issues but if there are problems, they have yet to surface. The Town should keep track if they find main line damage to see if there are patterns. Patterns could indicate a need to replace sections of the system.

The Town recently became aware of a potential corrosion issue with the flange and mechanical joint bolts used to secure the gate valves to the fittings (tee or cross) on valve clusters north of North Railroad Street. Town staff is planning to look into the severity of this problem in 2019. If there are a significant number of corroded bolts, it is recommended that Town staff begin a program to systematically replace the bolts before there are catastrophic failures.

Most of the distribution system meets the fire flow requirements and where it does, there is typically adequate capacity for any domestic infill growth on those lines. Hydraulic modeling of the distribution system is beyond the scope of this report, but as the Town gets more of the distribution system into GIS, developing a model that would help identify areas that might be problematic in terms of flow and/or pressure should be easier to do. The Town is aware of some pressure problems experienced by customers that are in the main pressure zone that are topographically close to the elevation of the pressure regulator at Amelia and Moffat Streets. The Town considered increasing downstream pressure at the regulator for the main zone, but that would result in pressures of about 100 psi in the lower part of the main zone. A more practical solution is likely trying to serve those users with relatively low pressure from the upper pressure zone. Note that the Town has checked pressures in the upper part of the main pressure zone is not aware of any users that have less than 40 psi static pressure or 20 psi dynamic pressure which are the CDPHE minimums.

It is recommended that the salient detail in this section be included in the Town's GIS mapping database for ease of access and use of the information.

X.3. Distribution System: Valves and hydrants

With the original FmHA funded project, hydrants were typically placed at about 750-foot intervals and often gate valves were just installed on the branch of the valve cluster. Many of the valves and fittings installed with the 1980 project are push-on rather than mechanical joint or flanged, the latter being a more secure joint.

A number of the hydrants installed with the 1980 replacement project have had some issues and when problems are identified they are remedied. There have not been many issues with the 1980 gate valves although the valves are in gravel streets and buried, which makes it a bit more challenging to exercise the valves. The Public Works Crew uncovered and exercised all the valves in April 2019, and they are in very good condition. All valves were located with GPS and will be input into the GIS map. Keeping the valves exercised will help extend their useful life as well as keeping staff aware of the condition of the valves to plan for replacement as needed. Valve testing and replacement can be logged and tracked in the GIS database.

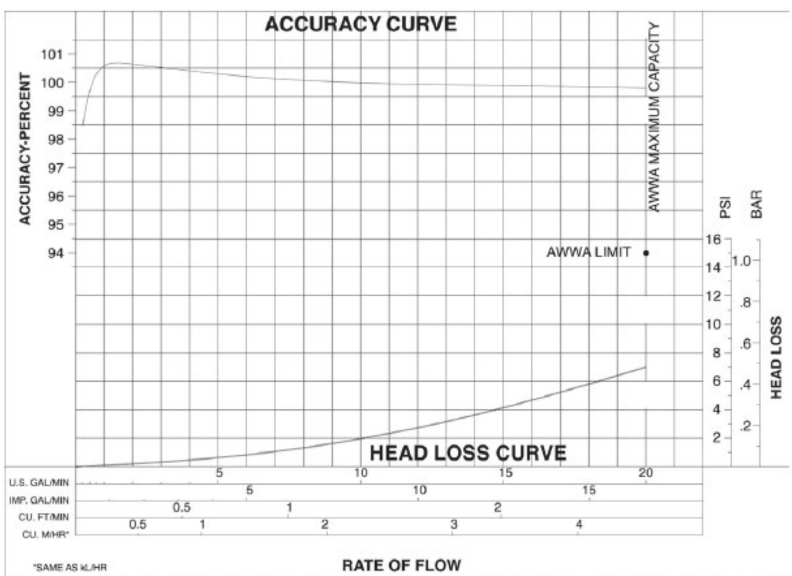
Since the 1980 water line replacement project, most line extensions have included valves on each leg of a valve cluster with the valves typically flanged to the fitting. Hydrants are placed at each intersection and where there are few intersections, hydrants are typically at a 500 ft or less spacing. The town is not aware of any issues with the distribution system improvements installed since the early 1990's.

It is likely that as the Town exercises more of the valves and hydrants installed in 1980 and perhaps more recently, they will find more that need to be serviced and/or replaced. When there are opportunities to add looping with valves and hydrants to the historic part of the distribution system, this should be done.

X.4. Distribution System: Meters - inventory, accuracy

All of the town's customers are metered and almost all of the town government services are metered as well. The Town has standardized with Sensus meters and the Town typically furnishes and installs the meters for new customers, requiring the customer to reimburse the cost for the materials and service. Most of the meters are 5/8" x 3/4". There are also a number of larger meters, up to 2", some of which are compound meters that serve high use commercial customers and larger residential and mixed-use buildings. The age of the meters varies widely. The Town replaced most of the 1980 meters in the mid 1990's when they changed from meters that required removing the meter can lid and frost lid to see the meter to read it, to a meter that had a gear that logged to a display outside the meter, which was typically on a fence post by the meter. With this system, staff did not need to open the meter cans, but still needed to record each reading manually. The Town added MXU's (automated meter reading) to all the meters (meters were not replaced) over a few years in the mid 2000's. With the MXU's the Town can mostly drive by the meters and the receiver will log the meter reading. This is much faster than walking the entire town and eliminates potential logging errors. Some recent subdivisions have proposed internal walkways and meters, which will require the town staff to walk through the subdivision and read meters. The staff have tried to balance good land use with increasing demands on operations and maintenance.

Many of the meters date back to the meter change out in the early to mid-1990's but most are newer, having been installed as buildings were constructed over the last 25 or so years. As meters age they can lose accuracy, most commonly reading less water than the customer actually uses when the flows are above 1 gpm. Meters are also most accurate at the flow range they are designed to serve. The graphic at the left shows the accuracy of the 5/8" x 3/4" meter. Note that at flows of about 0.5 gpm it is 98.5% accurate. On the other hand, a 2" meter needs to be flowing at about 1.5 gpm to be that accurate unless it is a compound meter with elements for low and higher flows. When unaccounted for water is high, the Town should randomly remove a number of meters and test them for accuracy. Montrose, Olathe, and Delta all have equipment to test meters and have been happy to help other communities test meters. Since the larger meters should in theory be using more water, starting with those would likely offer the better reward. We recommend testing all of the larger meters every several years or when readings seem out of line with past readings. Because larger single meters are less accurate at low flows, if a larger meter is serving a facility that often has flows under 1 gpm, the Town should work with the facility to have them install either a compound meter or a meter that is more in line with the demands of the facility.

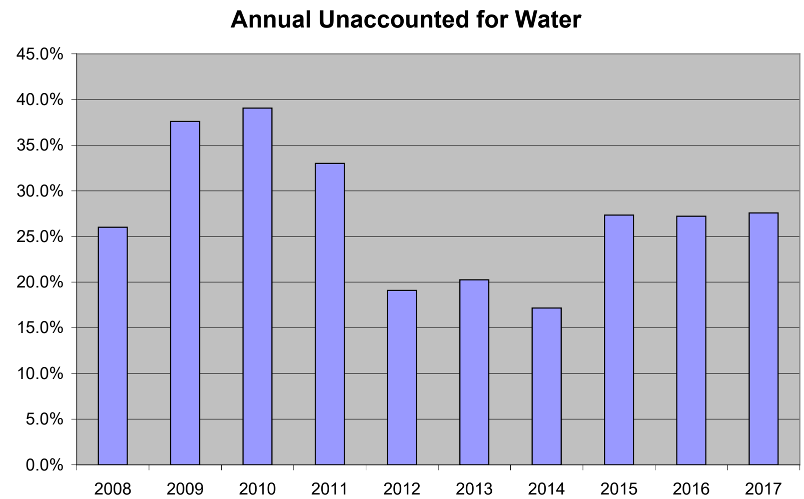


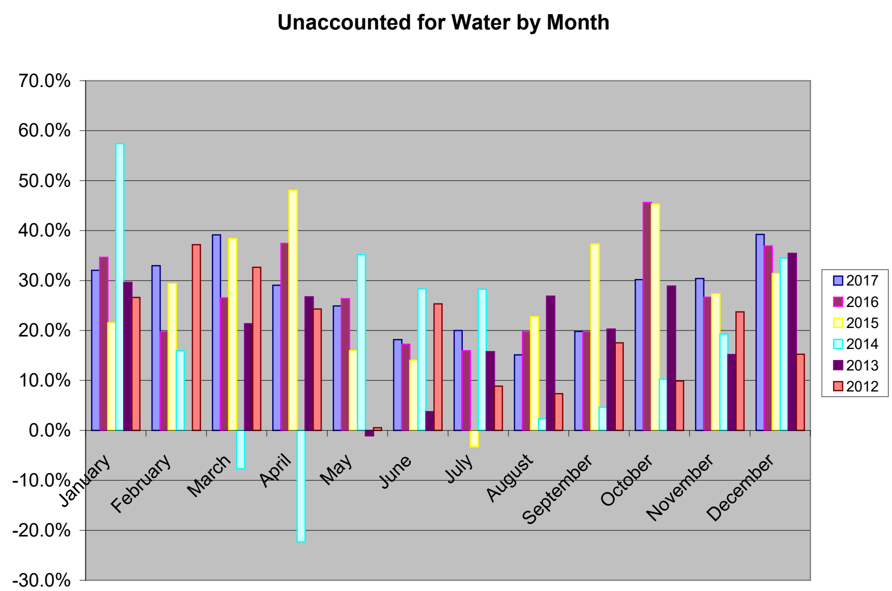
The 1980 water replacement project utilized polybutylene (PB) service lines from the mains to the meter and mostly from the meter to the house. The advantage of the PB pipes was that they were less likely to break if the water froze; however in the early 1990's there started to be issues with the PB lines nationwide. The Town did not experience serious problems until the mid-2000's when the number of breaks on the Town side of the service line increased exponentially. The Town replaced all of the Town's portion of the PB lines with copper lines in the late 2000's. Coincident with this effort, the Town offered for private properties to also replace their PB lines, at the property owner's expense; however few land owners accepted. The project was funded in large part by a zero interest loan. The Town borrowed money for the Town-owned lines and is still paying off this loan today.

Because most of the Town's streets are gravel, rather than use a curb stop as a shut off on the service lines upstream of the meter can, the Town opted to use a ball valve in the meter can on the street side of the service in the meter can. Especially where there is saline groundwater in the bottom of the meter can, a number of ball valves have corroded sufficiently to leak and need repair. This may continue to be an issue going forward. It is recommended that the Town check the condition of the ball valves approximately annually coincident with checking the condition of all the equipment in the meter can and the Town should likely budget to need to continue to make these repairs as needed.

X.5. <u>Distribution System:</u> Unaccounted for water

Unaccounted for water is the difference between the water produced and the water sold. Until the drought in 2002, the generally accepted range in Colorado for unaccounted for water was in the 20% range which dated back to a time when water lines were less tight. Since the drought in the early 2000's, and as it has become more obvious that there is a limit to the water resources in the State, the State has been encouraging communities to reduce the unaccounted for water rate to 10% or less.





Some unaccounted for water is really lost and some is the result of water used that is not metered. Often a municipality will not meter public water uses since they are not billed; however Ridgway does meter public water use and reads those meters. Water breaks upstream of the water meters and water from fire hydrants are not metered, but in Ridgway that does not account for a lot of water. Another source of difference between produced and sold in Ridgway is that the Town currently measures the water produced using a meter that measures what exits the membrane plant going to the tanks, but does not take into account the water from the tanks that is used for backwash and to clean the membranes.

The upper bar chart above shows the unaccounted for water by year. The annual assessment is likely more representation of the differences between produced and sold because it smooths out the differences between what day in the month meters are read versus the water produced. The annual chart shows that there were several years where the unaccounted for water was in excess of 30%, then several years where it was 15-20% and the last few years have all been above 25%. The lower bar chart shows the unaccounted for water by month over several years. Although there is large variability, in general, it looks like in the summer months, the unaccounted for water is less than in the winter. This might be the result of both producing and selling more water in the summer making the percent look lower.

To better understand how much water is lost to backwash and cleaning, it is recommended that staff install a meter downstream of the water tanks to compare water going to town to the water for which the Town is billing. Staff might also want to start tracking how much water from the tanks comes back to the plant for backwash. Staff is also encouraged to begin bench testing water meters, starting with a random selection of larger meters and older meters. The Town might also try to ensure that the water produced is compared to the water sold on the same day the meters are read.

In April 2019 Town Staff completed overnight leak detection throughout the system and identified 2 leaks on the town system, which have been repaired. In addition, a number of leaks on private lines were detected and the owners notified of the needed repair work. If neither those repairs do not result in significant reductions in unaccounted for water, it is recommended that the Town investigate adding some distribution system meters. One good location would be at the river crossing. Because there is a single supply crossing the river, it is an easy area to isolate. Within the parts of the distribution system that are looped, additional listening late at night is advised.

X.8. <u>Distribution System:</u> Emergency Connection

In early 2002, the water line under the river north of the SH 62 bridge became exposed. The Town was appropriately concerned that spring runoff could potentially wash out the line and the Town began planning to not only replace the crossing but to provide for an emergency connection with Tri-County Water Conservancy District (TCW) in case the water line washed out before the Town could install a temporary emergency line on the SH 62 bridge. There is an existing TCW line in County Road (CR) 12 about 50 ft south of the end of the Town's water line in Palomino. The Town worked with TCW and reached an agreement that if the water line washed out, the Town could, on an emergency basis, connect to the TCW line in CR12. The Town connected a line to the flushing hydrant at the south end of Palomino and ran it to CR 12 to be ready to make an emergency connection. However, the Town was able to get the materials for the temporary line on the bridge and get it installed before there was only damage to the exposed line so the emergency connection was not put into use.

The Town and TCW continued to talk about an interconnection between the two entities for a while after the concerns with the river crossing washing out were abated. In about 2005, the Town and TCW participated in a joint study, prepared by Carter Burgess, to determine whether working cooperatively on a water treatment plant was in both their best interests. As part of that study the two entities discussed a possible service area agreement and continued discussion of an interconnection. It turned out that the joint water plant was not feasible and the negotiations with TCW about an interconnection also languished.

In 2018 TCW applied for grant funds to create an emergency connection on Log Hill between TCW and Dallas Water Company. That connection would allow either of those entities to buy water from the other should one of the entities have a shortage of supply or have distribution issues on or serving the Log Hill area. Specific advantages on the interconnection for TCW include the possibility of better fire protection, supply if a pump station goes down, or if there is a long-term power failure. The benefits to Dallas Creek include providing water when there is a shortage of water in Dallas Creek or there are problems with the Dallas Creek pump station. Given the similarity of benefits and needs between Ridgway and TCW and Dallas Creek and TCW, the Town approached TCW in 2018 to see if the timing is now better for completing an agreement for an interconnection and the two parties are again working on agreement and interconnection in 2019.

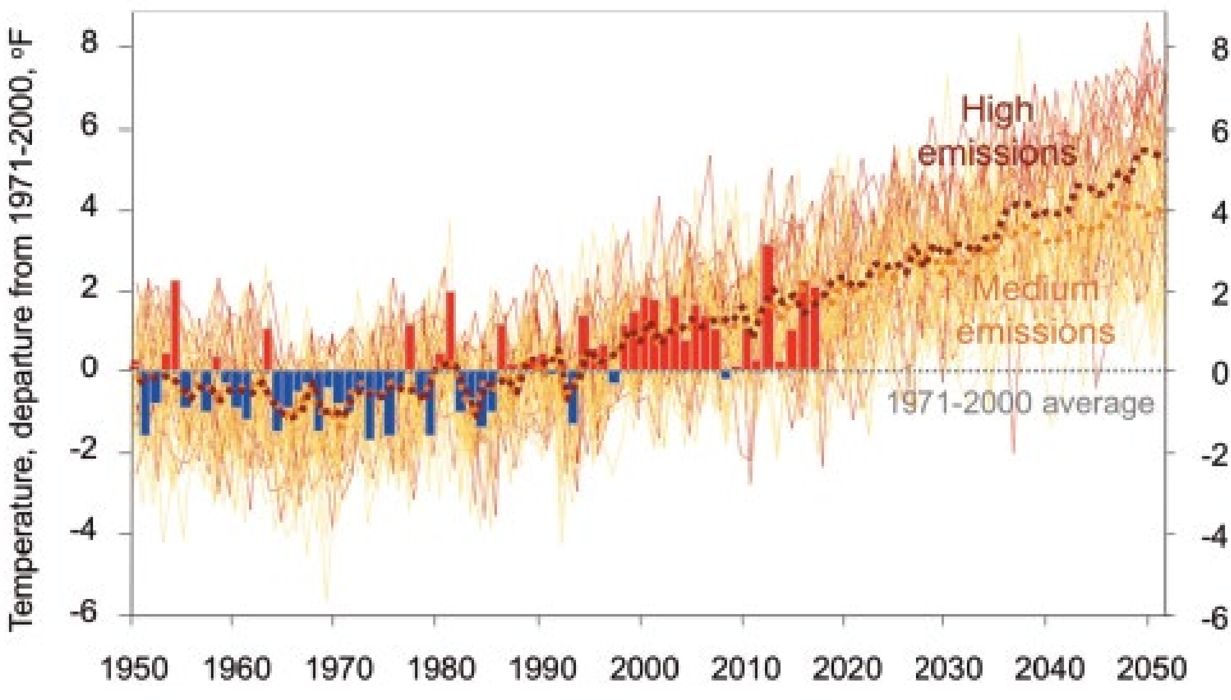
If the two entities can reach an agreement for an interconnection, it is likely that the Town would need to construct a pressure regulating station and install a meter vault. The Town applied for and was awarded a DoLA grant in 2018, which will offset a portion of the cost. This interconnection offsets the urgency for a new storage tank and secondary water line across the river; however, the tank and secondary line need to remain a short-term high priority for the town to have adequate water supply east of the Uncompahgre River.

XI. Water Conservation

As the Town and the State both continue to grow in population and therefore water demand, there is a need to make more efficient use of the limited water supply. Entities that consume more than 2000 AF in a year are required to have a Water Conservation Plan to encourage the efficient use of water. Water suppliers with less demand are not required to have a plan but are encouraged to complete one. With 350 AF of use annually, Ridgway is not required to have the State mandated Water Conservation Plan, although the Town adopted an abbreviated plan for water conservation and management in 2018, which is a great first step and necessary one given the Town's water supply constraints. The State mandated plan should include a description of the water supply system, projections of future water demands, ways that water demand could be reduce with costs and expected water savings. Potential methods to fund implementation could also be included. The Colorado Water Conservation Board has a template for such plans that makes it relatively easy to develop.

XII. Climate Change

The Town Source Water Protection Plan includes Climate Change as a potential to impact on the Town's source of water supply as well as on water demands. Climate change and overall increase in the global temperature is likely to change precipitation patterns, storm patterns and intensity, snow pack, and stream flows over the coming years. The Colorado Water Conservation Board's 2018 Updated Colorado Climate Plan includes the chart below which compares projected future temperatures to the average temperature from 1971 - 2000. Note that from 2000 to 2010 the temperatures have been above the 1971 - 2000 average. The report notes that as the temperature has warmed substantially in the last 30 years, snowmelt has happened earlier, with peak runoff sometimes coming as much as a month earlier and increasing drought severity (Lukas et al). The report projects that by 2050 Colorado is likely to warm by an additional 2.5 - 5.0˚ F. As the temperature is projected to continue to increase, water demand is also projected to increase.



Source: Adapted from Lukas et.al, Climate Change in Colorado, 2014

Temperature Increase - In Colorado, between 1977 and 2006, the temperature increased about 2˚ F. There are a large number of models and their projections vary, but it is likely that over the next few decades, the average temperature will continue to increase, as indicated above. Warmer temperatures will increase evaporation and likely increase water consumption of both municipal and agricultural users.

Precipitation and Snowpack - Whether it's a coincidence or an impact of climate change, there have been an increasing number of large storms in the last decade nationwide. In Colorado, earlier in the decade, we saw very dry conditions on the Front Range, followed by very significant flooding that was unprecedented. Snowpack is typically the source of about 70% of the state's surface water (CWCB Climate Plan 2018). Some climate models predict significant reductions in snow pack which would likely reduce the overall water supply. A very low snowpack going into the 2018 summer resulted in significant use of existing and stored water supplies, which resulted in many communities, including Ridgway, being concerned about water availability in subsequent years. Another low snowpack year in 2018-2019 could result in significant water supply challenges statewide. The 2019 water year is looking a bit better than the 2018, but the west has had more drier than wetter than average years in the recent decades, and the Town needs to plan for the drier years going forward

Runoff - A number of factors impact how much of the snow pack runs off and when, what is absorbed into the ground locally and what evaporates. In a winter like 2017 - 2018 where there was little precipitation in the Fall, the ground was dry so when the snow melts some of the runoff will be absorbed in the ground. The previous year, the ground was saturated when it froze and most of the water in the snow ran off. The rate of melt and runoff is also impacted by when and how fast the temperatures rise in the spring and the amount of dust on the snow. In the Uncompahgre basin, dust events, with dust mostly coming from the Colorado Plateau, are having a significant impact on the how fast the snow melts. In years with a lot of dust in the snow, the runoff has been more rapid than in years where the snow is not as dirty. The dust on snow makes the snow warmer and that can also increase how much of the moisture evaporates.

Evaporation Rates - If the water is warmer the evaporation rates will increase especially from reservoirs, but also in streams. This could decrease the overall amount of water that would be available for beneficial use. In addition, plant transpiration is likely to increase and longer growing seasons means the agricultural will likely need to use more water.

A drier, warmer climate could also have secondary impacts. For example, the fire risk increases with decrease in humidity and soil moisture. Warmer temperatures and less soil moisture will stress vegetation that is poorly adapted to the changing conditions. This could impact the susceptibility of the trees in the Town's watershed to disease again increasing the fire risk. Any significant fire in the Town's watershed would have adverse impacts to water quality and the ability of the Town to treat water running through a burn zone. h

A CWCB summary report from around 2007 on Climate Change includes the table below on the likely impacts on water supply:

Issues	Observed and/or Projected Change
Water demands for agriculture and outdoor watering	Increasing temperatures raise evapotranspiration by plants, lower soil moisture, alter growing seasons, and thus increase water demand.
Water supply infrastructure	Changes in snowpack, streamflow timing, and hydrograph evolution may affect reservoir operations including flood control and storage. Changes in the timing and magnitude of runoff may affect functioning of diversion, storage, and conveyance structures.
Legal water systems	Earlier runoff may complicate prior appropriation systems and interstate water compacts, affecting which rights holders receive water and operations plans for reservoirs.
Water quality	Although other factors have a large impact, "water quality is sensitive both to increased water temperatures and changes in patterns of precipitation" (CCSP SAP 4.3, p. 149). For example, changes in the timing and hydrograph may affect sediment load and pollution, impacting human health.
Energy demand and operating costs	Warmer air temperatures may place higher demands on hydropower reservoirs for peaking power. Warmer lake and stream temperatures may affect water use by cooling power plants and in other industries.
Mountain habitats	Increasing temperature and soil moisture changes may shift mountain habitats toward higher elevation.
Interplay among forests, hydrology, wildfires, and pests	Changes in air, water, and soil temperatures may affect the relationships between forests, surface and ground water, wildfire, and insect pests. Water-stressed trees, for example, may be more vulnerable to pests.
Riparian habitats and fisheries	Stream temperatures are expected to increase as the climate warms, which could have direct and indirect effects on aquatic ecosystems (CCSP SAP 4.3), including the spread of in-stream non-native species and diseases to higher elevations, and the potential for non-native plant species to invade riparian areas. Changes in streamflow intensity and timing may also affect riparian ecosystems.
Water- and snow-based recreation	Changes in reservoir storage affect lake and river recreation activities; changes in streamflow intensity and timing will continue to affect rafting directly and trout fishing indirectly. Changes in the character and timing of snowpack and the ratio of snowfall to rainfall will continue to influence winter recreational activities and tourism.
Groundwater resources	Changes in long-term precipitation and soil moisture can affect groundwater recharge rates; coupled with demand issues, this may mean greater pressures on groundwater resources.

It is likely that the yield from the Town's water supply will decrease over the next several decades unless something is done to reduce or better manage the impacts of a changing climate. The Town will likely need additional water sources and more aggressive conservation to meet increasing water demands.

XIII. Non–potable Water

The Town provides non-potable water for watering the Town parks, the grade school ballfields, the County Fairgrounds and, a couple of commercial St Park, when developed, may use water from the waste ditch that flows through the park; however the town does not currently have a pumping system in place to do this and the School properties that are close to the main line. The non-potable water supply is settled in the pre-sedimentation ponds at the water plant and then piped to the various points to use. Using non-potable water on the public green spaces reduces the demands on the water treatment plant and therefore reduces treatment costs. The supply for the non-potable system is the same as for the potable, from Beaver Creek and Happy Hollow. Green District has expressed numerous issues with the pumping that is created by the sediment that comes with the waste ditch water. In addition, the reliability of the waste ditch water is poor and not likely to be an adequate single water source for the Green Street Park. The existing distribution lines for the non-potable system mostly have about 3' of cover and need to be drained for the winter.

XIII A. Non–potable Water: Capacity

The existing pipe line from the pre-sedimentation ponds is an 8" line. An 8" line with 80 psi pressure can carry about 600 gpm at a velocity of under 4 fps. The headloss in 9000 ft (the distance from the ponds to the fairgrounds is 38 psi which would give a residual pressure of 42 psi). The functional capacity of the existing lines is likely closer to 500 gpm. The Town tries to limit the size of the sprinkler zones and also to limit how many zones run at one time to maximize the water that can be delivered from the non-potable pipe system. The Town also tries to stagger what sprinkler zones run and when they run so that the demand is spread out over the course of the hours it is appropriate to water (not in the heat of day). If the Town wished to expand the areas that are served by the non-potable system much more, there will be a need to increase some of the distribution lines. Depending on the particular situations, as the Town adds more public irrigated spaces, providing non-potable water from other sources may be more cost-effective than up-sizing the current system.

The other capacity question that relates to the non-potable system is the available water supply from Beaver Creek and Happy Hollow. As the Town needs to use more of those sources for potable water supply, finding other sources for the non-potable supply would be advantageous. Since the non-potable water does not need to go the treatment plant, there are more potential opportunities to find supplies of non-potable water.

XIII.B. Non–potable Water: Efficiency

The existing non potable system is very efficient. The town is able to sufficiently water most of the Town-owned lands, including the new downtown streetscape landscape, with water that does not need to be treated. The non-potable supply lines all flow by gravity and all the sprinkler zones are run on the pressure in the supply lines, similar to most of the potable distribution system. If the Green Street Park is watered from the waste ditch that runs through that park, that water would need to be pumped. There may be water quality issues that would either need to be addresses with the waste ditch or would make using that water less practical, as mentioned previously.

XIII.C. Non–potable Water: Additional Service Areas

Initially the Town thought supplying the public areas with non-potable water would be the first step in a plan to provide most of the domestic users in town with a non-potable supply; however there are a number of challenges with extending non-potable lines to even the historic part of town. These include both the capital and operational costs of having two water systems, finding space in the roads and alleys for the secondary distribution system, metering the usage, and keeping the usage reasonable. When the costs of implementing and maintaining a secondary system were calculated, unless the Town took a loss on the non-potable water, there would be no savings to the customer, and if there was a savings to the customer, they would be likely to use more water rather than conserving water. At this time extending the non-potable water system to the public does not appear to be cost effective or look to promote conservation, which has been an expressed desire and need of the town. Given that the existing system is also getting close to capacity, serving non-public users is not recommended at this time.

XIV. Water Rates

Rate History

In constructing the new water system in 1980, the Town incurred considerable debt. The water rates needed to generate enough revenue to operate the new facilities and to service the debt. The Town started out with a typical rate structure, a base fee with a few thousand gallons and then a cost per thousand for additional usage. The initial rate structure did not generate enough revenue to meet the expenses, so the town raised rates. As the Town raised rates, people reduced how much water they used and the expenses continued outpace the revenues. As the landscaping around Town became increasingly brown, the Town Council decided to try something different. They determined how much water the new plant could produce and how much revenue they needed. With the number of users at the time, it worked out that they needed a base fee of $22 per month (in the early 1980's) and they could allow each connection to use 26,000 gallons (or was it $26 for 22k). Since they were giving each user what in total was about what the plant could produce, they set the rate for overage (exceeding the base allocation of water) at $6 per thousand gallons, which at the time was perceived to be an "astronomical" amount. The rate structure encouraged people to keep their landscaping irrigated and allowed the Town to pay the bills and the debt. To help people not be wasteful of the water, the Town in most years implemented voluntary watering restrictions, which asked that people not water in the hot part of the day and/or when the wind was blowing. Over the ensuing decades the base rate has increased and the amount of water one gets for the base rate has decreased. The base rate increasing has been to keep up with the increased cost to run the water system. The allocation going down has in some instances been a result of funding agencies telling the town that the town is giving users too much water. Both the drop from 22,000 gallons to 18,000 gallons and the drop from 18,000 to 9,000 were a result of such requests. There has also been a feeling that the Town is in a high desert and landscaping needs to be water conscientious. The most recent rate change was adopted in 2018, again reducing base allocations and increasing the cost of water, and went into effect December 1, 2018.

Current Rates and Expenses

This 2018 study compared operating costs and operating revenues. Looking at the 2018 budget it appeared that the water budget was depending on tap fees to cover operating expenses. To determine costs, we looked at the last several budgets and developed a typical year total expense. Table XIV - 1XXX shows the data we used and the typical year expenses. To get a simplistic look at the cost per thousand gallons, the total expense, with debt services and capital outlay, were divided by the water sold. With capital outlay and debt service, the cost per thousand gallons came out to about $10.50 per thousand gallons delivered. The Town had been charging residential uses $42 for 9,000 gallons as the base fee and $1 per thousand to 18,000, $2 per thousand to 26,000 and then $6 per thousand over 26,000 gallons. For non-residential uses, the charge was $36.75 for 4,000 gallons, with similar $1, $3, $6 per thousand or increased usage. None of these rates meet the current cost of production. In the summer of 2018, the Town Council began discussion to modify the rate structure to bring revenue in line with expenses. Table XIV-2 is a summary of the 2018 adopted rate changes.

XV. Conclusions

The water system is generally in good condition. Most components of the water system have adequate capacity for a 50% growth in demand, to meet the proposed increase that is projected for the next twenty or so years. Looking beyond that horizon, several major water system components including the water treatment plant could need expansion and much of the water system will need some sort of improvement or upgrade in this time frame. In the near term, the Town is likely to need additional water to meet demands of a growing town and will need to encourage more conservation to make the existing water accommodate more users, including charging users at a minimum for the cost of water and charging more for significant water use. Climate change could exacerbate that need and also the demand for water. Assuming there is sufficient "wet" water in Beaver Creek and Happy Hollow, the Town may need a source of augmentation water to back up Lake Otonowanda in a prolonged dry period when the Town's water rights might be out of priority. Looking at 2018, even though the Town's most senior rights were not out of priority, there was insufficient water in Beaver Creek and Happy Hollow for the Town to divert the 2 cfs to which the Town was entitled. This resulted in the Town imposing mandatory water restrictions and using water out of Lake Otonowanda from June through September. Of note is that water demand in 2018 was the highest ever, which seems to indicate some significant community education may be in order for the Town. The Town should examine its Adequate Water Supply regulations and see if changes are needed that would help the Town meet demands going forward.

As development occurs the Town should continue to require development to expand the distribution system, keep it looped with capacity to provide fire flows, and when a certain threshold is met, supply new and sufficient sources of water. The Town should also take advantage of any opportunities to improve looping and fire protection in the historic parts of Town, and actively explore options for water supply augmentation.

Deficiencies in the distribution system include a single river crossing serving everything east of the river, and the very limited storage east of the river. Adding storage east of the river, would not only help the areas east of the river but also increase the overall storage available. West of the river, the limited pressure in the upper parts of the main pressure zone could be a concern. Determining whether the unaccounted for water is a measuring problem or water that is lost will allow the Town determine what needs to be done to reduce unaccounted for water and whether the Town can recover some real water. Meters may need to be replaced in the coming decades and issues with ball valves deteriorating on the service lines will likely continue to be an issue in areas of town with shallow saline groundwater.

Table XV-1 is a summary of the potential water system needs in the coming years. The list of issues includes where they are discussed in this report, their priority, potential costs and potential funding sources. Funding sources are likely to change over time and the costs provided are highly conceptual, based on limited information and should be used as order of magnitude estimates.

	Table XV-1 Water System - Summary of Needs				
Ref #	Description	Priority	Urgency	Est Cost	Funding Options
I.B.	Explore options to increase reliable water supply	1	1-3 years	Depends on options likely $500,000+++	CWCB, DOLA
I.C.	Review Adequate Water Supply Rules	2	1-3 years	depends on changes	Water Fund
II.A.	Upgrade Beaver Creek Diversion to steel trough	1	6-18 months	$50,000	Water Fund & water rights holders
III.A.	Pipe parts of Ridgway Ditch	3	5-10 yrs	depend on how much is piped	CWCB, CDPHE, DOLA
III	Address increasingly limited access to Ridgway Ditch & development along the Ditch	2	1-3 yrs	Mostly staff time	Staff w/ consultant assistance
IV.C.	Lake O - Investigate potential seepage	2	6-24 months	$30,000 + staff time	Water Fund
V.	Transmission Line from Lake O. Increase capacity by the Lake outfall - 400' of 12" line. (Longer term may need to increase pipe size in flatter sections of the ditch).	3	+/- 20 years	$45,000	CWCB, CDPHE, DOLA, RD
V.	Keep an eye on development that could impact transmission line	3	maintenance		Staff time
V.	Video Inspection Tranmission Lines	3	If have concerns	$2/ft + opening & closing access pts	Water Fund
V.	Check condition of Air vac valves on transmission lines	3	maintain, potential replace in 5-10 yrs	Replace - ~ $1000 ea valve	Staff time, water fund
VI.B.	Flow Measurement improvements at Happy Hollow	2	1-2 years	$ 5,000	Water Fund
VI.D.	Happy Hollow - How water is administered	1	6-18 months	Mostly staff time	
VII.B.	Piping changes at presed ponds to allow Happy Hollow water to go to WTP and Lake O water to go to non potable.	3	1-2 years	$ 10,000	Water Fund
VII.A.	Pre sed pond sediment removal and disposal	3	on going	$5000/yr	Water Fund

VII	Controlling aquatic nuisance vegetation in pre sed ponds	2	on going	$5000/yr	Water Fund
VIII.A.	How to generate ClO_2 - Is the lease the best option	3	2-4 yrs	Mostly staff time	Staff w/ engg assistance
VIII.A.	Is ClO_2 the best option for taste, odor, color control	3	2-4 yrs	Mostly staff time	Staff w/ engg assistance
VIII.B.	Plan for and Expand Water Treatment Plant	2	+/- 20 years	$ 1,500,000	CDPHE, DOLA, RD
VIII.C.	Surge and Lightning protection	1	next 12 months		Water Fund
VIII.C.	Back up Power	3	1-2 years	$ 75,000	Emergency funding options
VIII.C.	Blower and Compressor upgrades	3	5-10 years	varies - budget $20K for each	Water Fund
VIII.C.	Water Plant controls upgrade	3		$ 25,000	Water Fund
VIII.D.	Chlorination - separate room.			$ 30,000	Water Fund
VII.E.	Monitor sediment accumulation in backwash pond	3	Annually	$ 5,000	Water Fund
IX.A.	Address tank corrosion	1	Each Tank Insp & as needed	$ 10,000	Water Fund
IX.A.	Thorough inspection of roof and i beams	1	1-3 years	$ 10,000	Water Fund
IX.A.	Repaint Tank - Start buildng reserve to fund this now, price is per tank	2	+/- 10 years	$ 150,000	Water Fund
	Micro Hydro options	4		TBD	CWCB, maybe SRF
IX.C.	New storage east of the river.	2	5-10 years	$ 750,000	CDPHE, DOLA, RD
X.1.	Relocate customers in the main pressure zone with very low pressure in the upper pressure zone.	3	3-5 years	Depends on the solution	CDPHE, DOLA, RD
X.3	Hydrant and Valve replacement	3	As needed	Mostly staff time	Water Fund
X.3	Valve exercise and directional flushing	3	Annually	Mostly staff time	Town Staff
X.2.	Add water mains to streets in HR that lack lines. (Cost is per block)	4	As needed	$ 41,500	CDPHE, DOLA
X.2.	Develop hydraulic model of distribution system			Part of GIS?	Staff w/ engg assistance
	Test Water meter accuracy, start with larger meters	3	Annually	Mostly staff time	Use testing equipment in neighboring jurisdictions

X.6.	Add water meter downstream of water tanks	2		$ 10,000	Staff, water fund
X.5	Address unaccounted for water	2	6-18 months	$ 10,000	Water fund, Staff w/ engg assistance
X.4	Meter Replacement		As needed	~$1500 each	Water fund
X.4	Ball Valve Issues		As needed	Staff time +~$200	Water fund
X.9	Tri County Water interconnection	3	Explore in the next year or so	$ 50,000	CDPHE, DOLA, as part of a larger project east of the river
X.10	Water Conservation Plan	3	1-2 years	Mostly staff time	CWCB

Note: estimates of costs to address the needs in the report are highly conceptual, based on very limited information and should be used as order of magnitude estimates.