Water System Master Plan

Johnstown, Colorado

FINAL REPORT – December 1, 2015

Prepared by:

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Town of Johnstown

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Johnstown Water Master Plan

Section 1

1.0 Executive Summary

1.1 Background

1.1-A Reason for Project

The Town of Johnstown was a small farming community in a rural setting in Weld County until the 1990s. Since 1994, the Town has experienced substantial growth with annexations and subdivisions stretching from 3 miles south of downtown to the 2534 annexation area. Considering the Town's proximity to larger populated areas, growth is expected to continue at a substantial pace, averaging 424 additional people annually over the next 10 years. The Town currently serves over 13,000 people through 4,800 taps. The population is estimated to reach 22,210 people, served through 8,000 taps, by 2035.

1.1-B Purpose

The most recent Master Plan for the Town's water distribution and treatment system was completed in 2005. That plan assumed an annual growth in population of nearly 1,100 people per year. Although the actual growth rate was significantly less, the population increased by 75% over the last 10 years, and the pace has accelerated during the last two years. The expansion of the existing water user base and the expected future growth has made necessary the preparation of a new Water Master Plan to address the impacts growth has had on the water system, and its ability to serve future needs. Of special concern is the capacity of the water treatment plant, and the ability to serve projected growth in the 2534 area, the Thompson River Ranch subdivision, and other areas. This report will describe the results of the 2005 study and provide alternatives for the path forward to maintain the high service level currently provided.

1.1-C Project Scope

This executive summary describes current system needs, and identifies strategies to meet those needs. In addition, this summary discusses strategies for future expansion of water treatment processes as the population of the Town grows. As required by the Town's original Request for Proposals (RFP), this report is divided into the following sections:

- System Conditions – an analysis of the water system's service area, projected population, raw water supplies, and resultant demands for water.
- Description of Existing Facilities – a detailed analysis of the water system's raw water delivery capacity, treatment capacity, and distribution capacity. Included is the Town's water system financial status; and a discussion of the Town's technical, managerial and financial capacity (TMF). Also included in this section are the results of multiple scenarios examined through the development and use of a complete hydraulic computer model of the system.
- System Needs – a discussion of the reasons for considering modifications to existing facilities.
- Assessment of Alternatives – a discussion of the alternatives for meeting system needs, applying criteria applicable to modifications, upgrades and expansions of water system components.
- Recommended Alternatives – a discussion of our recommended alternatives for upgrades and expansions of the water treatment and distribution systems.

1.2 Overview

The growth in the Town of Johnstown has made the water system increasingly vulnerable, in part due to its dependency on pumps to deliver a majority of the water to users, and the need for additional functional storage capacity. The Town needs to address a number of issues to reduce vulnerabilities, and to meet future needs. A comprehensive program for maintenance of the water infrastructure is warranted. Computers and equipment in the water treatment plant need to be upgraded or replaced, and the SCADA (supervisory control and data acquisition) system fully implemented, to improve operational efficiency. Infrastructure should be better secured against

vandalism or other physical threats. Operational procedures need to be documented, in compliance with State requirements. Lastly, the Town needs to continue to implement the capital improvements programs developed in prior studies.

The flow meters on the discharge pumps at the water treatment plan are no longer capable of measuring flow rates during peak periods. This, combined with a need to update computers and software, made it difficult during this study to determine the actual current production of the water treatment plant, and its current capacity. Replacement of the software would facilitate a better understanding of the operation of the water treatment plant, as well as the distribution system. Essential to that effort is continuation of the implementation of a SCADA (Supervisory Control and Data Acquisition) system. A fully implemented SCADA system will link the water treatment plant, pump stations, proposed control valves, and storage tanks. This will facilitate a more efficient operation of the plant, and reduce alarms that lead to overtime costs and take personnel away from normal daily functions in both the water and wastewater systems.

The treatment plant's theoretical capacity is 5.9 MGD, which should be sufficient until 2025, as long as necessary equipment is maintained and upgraded as needed. More reliable information needs to be collected to make a final determination of the plant's current capacity. To reach the theoretical capacity, the Town will need to repair, replace or upgrade several pieces of equipment, and implement a SCADA system as discussed above. Several recommendations made in this report were made in a 2002 treatment plant study and in the 2005 master plan to increase the plant's capacity beyond 5.9 MGD, including replacement of some existing equipment and piping, and an upgrade of the filtration technology. These recommendations were based on aggressive estimates of future growth of the water system. The intervening recession caused growth to slow considerably, delaying the need for implementation of some of these recommendations.. We recommend that the Town pursue implementation of the recommendations as the pace of growth increases in the Town. The Town should move forward to accommodate growth and the upcoming expansion in the 2534 area.

Upgrades of controls and flow monitoring will provide a more accurate understanding of the plant's current production and theoretical capacity, and the timeline for expansion of filter

capacity. The pretreatment facility constructed in 2005/2006 incorporated DAF (dissolved air flotation) units into the treatment process. The DAF units can, with the installation of some ancillary equipment, pretreat up to 10 MGD. We estimate that the filter plant's current theoretical capacity of 5.9 MGD will be sufficient until 2025. This is based on our projections for population growth. Should actual growth vary significantly, the timeline for a major plant expansion would have to be readdressed. The Town should plan accordingly, so that upgrades and expansions are operational before demands reach plant capacity.

The Town will need to pursue a multi-year plan to ensure that the system can expand to serve the population growth it anticipates. We make the following recommendations, which include several made in prior studies, to aid the Town in developing a program for this purpose.

1.3 Raw Water System

1.3-A Lonetree Pump Station

The Lonetree pump station has three pumps. Work has begun to replace the impellers in all three pumps to improve efficiency. A second-hand powdered activated carbon (PAC) system was installed in 2013 to improve the quality of the water from Lonetree Reservoir. This system has been subject to breakdowns. Most of the pump station's components, including its electrical panel, are located underground in a hot, damp environment. This has reportedly resulted in corrosion to the equipment, and will likely reduce the lifetime of many components. The Town leases a communications line from Qwest to allow control of the station from the water treatment plant. Operations personnel report that the line sometimes loses signal, resulting in an interruption in service and requiring the link to be manually reset. We recommend that the Town purchase and install the communications equipment necessary to link the station with the water treatment plant, eliminating dependence on the leased phone line. Along with implementation of a system-wide SCADA system, this will automate the pump station, minimizing the risk of an interruption in raw water delivery. Refer to Section 3.2 for a detailed discussion of the proposed system-wide SCADA improvements, and the associated costs for its implementation.

1.3-B Johnstown Reservoir Pump Station

We recommend that the Town purchase and install the communications equipment necessary to enable the SCADA system installed as part of the Johnstown Pump Station project to operate as designed. This will automate the pump station, reducing its cost of operation and eliminate the risk of wastage of water. Refer to Section 3.2 for estimated costs to implement system-wide SCADA improvements.

1.3-C Raw Water Pumping Capacity

The Lonetree Pump Station and raw water transmission line have a capacity of approximately 3,250 gpm, or 4.7 MGD. The Johnstown Reservoir Pump Station has a capacity of 4,700 gpm, or 6.7 MGD. Therefore, the raw water capacity is 6,100 gpm, or 8.78 MGD. This will provide sufficient raw water to meet demands through the planning period of 2035 when max day demands are projected to be 7.18 MGD. The break tank located at the treatment plant should be enlarged as well as the inlet and outlet piping to the tank by 2025.

1.3-D Raw Water Irrigation

The Town irrigates its cemetery and some of its parks with non-potable water from the Home Supply Ditch. Several subdivisions also use non-potable water for irrigation. Use of non-potable water for irrigation needs in future subdivisions should continue to be encouraged.

1.4 Water Treatment Plant

The net theoretical water treatment plant (WTP) capacity is 5.9 MGD. Increased filter loading, with State approval, could increase the net filter plant capacity to 7.08 MGD which would meet demands until 2030. This is consistent with the 2005 Water Master Plan recommendations. If the State approves the higher loading rate, they will require Town to perform additional water quality testing. Should the plant be unable to adequately meet drinking water standards at the higher filter loading rate, the State may require plant expansion prior to 2030. The DAF

pretreatment system capacity can be increased from 5 MGD to 10 MGD with the addition of a second compressor and saturator, or as desired by staff, replacement of the existing compressor saturator system with a pumped saturation system, which would make the addition of a second compressor and saturator unnecessary. It is estimated that the cost to replace the compressor saturator system with a four (4) pump dissolved air system with a capacity of 10 MGD will be $175,000.

Replacing the filtration plant by 2030 with membranes is the recommended treatment alternative. Membrane technology is consistent with the 2002 Water Treatment Plant Study. Retrofitting the filter bays with submerged membranes or implementing a universal rack system for pressurized membrane modules should be determined through a detailed engineering study in 2025. Implementing membrane filtration will require replacement of most system components at the water treatment plant except the pretreatment facilities and finished water system. It is estimated that the cost for a 10.0 MGD membrane retrofit in 2030 will be approximately $12M to $15M.

1.5 Pump Stations

Johnstown is almost completely reliant on its pump stations to deliver treated water to its system, due to the lack of elevated water storage. It is essential that the pump stations be maintained at a high level. Failure of a variable frequency drive (VFD) on any of the distribution pumps represents a significant vulnerability in the system. Because of the age of the VFDs, J-U-B recommends that the Town have the drives for the finished water pumps at the water treatment plant pump station evaluated and replaced if warranted, or at minimum procure a spare VFD for each size pump to keep on site. The replacement cost for this is estimated to be $40,000. We further recommend that the pumps at the water treatment plant, and at Stroh Farm, continue on a maintenance program to minimize the likelihood of major problems.

The east and west finished water pumps are measured through pitot style flow meters that have a measurement capacity of 3,000 gpm each. This is insufficient to accurately measure the discharge from the east and west pumps, respectively, to the distribution system. It is recommended that magnetic (MAG) flow meters be retrofitted to the east and west pump

discharge pipes. It is estimated that the cost to install MAG meters on the finished water pump station discharge pipes, to the east and to the west, will be approximately $40,000.

Related to the vulnerability and reliability of both the water treatment plant and the finished water pump station, we recommend that the backup generator be annually inspected and maintained by a manufacturer's representative. This program should include regular inspections, regular startup of the generator, and routine maintenance. We estimate that the annual cost for a generator service program is $1,500.

1.6 Elevated Water Storage

The Town needs functional water storage that can serve the system in the event of an emergency. Although emergency connections to adjacent water systems exist, they must be manually opened and would therefore not be able to supply fire flows. We propose that the Town build a 1.5 MG tank and connecting pipeline near the Stroh Farm pump station in conjunction with new development. In addition, we recommend that the Town modify the three existing pressure reducing valves (PRVs) along Telep Avenue, and the Clearview PRV, to act as control valves, linked by SCADA to the new tank. This will provide functional storage to most of the Town's water system. The benefits of the proposed tank would include:

- The tank could deliver adequate fire flows to the majority of the Town's system.
- The tank would relieve the east pump station from meeting peak hour demands. This would delay by several years the need to upgrade the pumps.
- The tank would reduce energy costs because the east pumps would only need to meet max day demands, which are slightly more than half the peak hour demands.
- The tank would add operational storage to the system, reducing the amount drained from the existing tanks during backwash cycles.

The estimated cost for land acquisition, the tank and connecting pipeline is $3,000,000. We recommend that the Town begin investigation of preferred tank sites. The cost to install new valves in the existing vaults is $68,000.

Demands in the northern portion of the Town's service area must increase significantly before it will be possible to utilize the 1.0 MG north tank. Although substantial commercial development is proposed along the Highway 34 corridor, this type of development generates much less demand for water per acre than residential development. When total demand reaches the point where the tank can be used, we recommend that the PRV at Highway 402 be modified or replaced with a control valve, and that the valve and the tank be linked to a system-wide SCADA network. This will maximize the benefit of the tank. The estimated current cost of this is $24,000.

1.7 Distribution System

Johnstown's distribution system is able to deliver adequate peak hour pressures under normal conditions. Adequate fire flows are available under peak hour demands, assuming that all pumps serving the area in which the fire is located are operable. The Town has in recent years replaced much of the aging 6-inch waterline that remains in the Old Town area, but approximately 25,000 feet still require replacement. We recommend that the Town plan replacement of the older waterlines as its annual budgets allow. We also recommend that the Town continue the practice of installing 12-inch lines along section lines, 10-inch lines on the half-section, and 8-inch lines at minimum for the rest of the distribution system.

1.8 System-Wide SCADA and Communications

An estimate was prepared for the Town in late 2013 for the purchase and installation of the equipment necessary to bring a system-wide SCADA network into operation (refer to Section 3.2 for a detailed breakdown of the equipment and costs). This estimate included the installation of programmable logic controllers (PLCs) at Lonetree Reservoir and throughout the water treatment plant, and radio equipment to link the pump stations, plant and north tank together. Installation of a SCADA network would automate much of the water system's functions, reducing costs and the risk of an interruption in water service. The cost to upgrade the water system with SCADA is estimated as $150,000 to $200,000.

1.9 Conclusions

The Town's 2016 budget includes funds to address the immediate operational issues identified, which will help minimize the risk of failure and improve overall operation of the system. Work is expected to begin in 2015 on SCADA improvements, and this is expected to continue in 2016. These improvements will help reduce operational costs and increase efficiencies. We recommend that the Town pursue a program to consider and plan improvements to the distribution and storage system, to meet future demands for water.

Johnstown Water Master Plan

Section 2

2.0 System Conditions

The city center of Johnstown lies approximately four miles east of I-25, along State Highway 60. Originally a farming community in rural Weld County, from 1995 to 2014 Johnstown grew at an average annual rate of 10.9%, and during the last three years it has been the third fastest growing municipality in the state. Residential development has occurred in a widely distributed fashion, requiring the Town to take a proactive approach to accommodating the effects that future growth will have on the Town's water system. The Town's 2006 Comprehensive Plan outlined a number of elements to manage growth, such as a capital improvements program and consistent development standards. Although the 2009 Community Vision and Strategic Action Plan represents a partial update of the Comprehensive Plan, no full update has been performed since 2006.

2.1 System Service Area

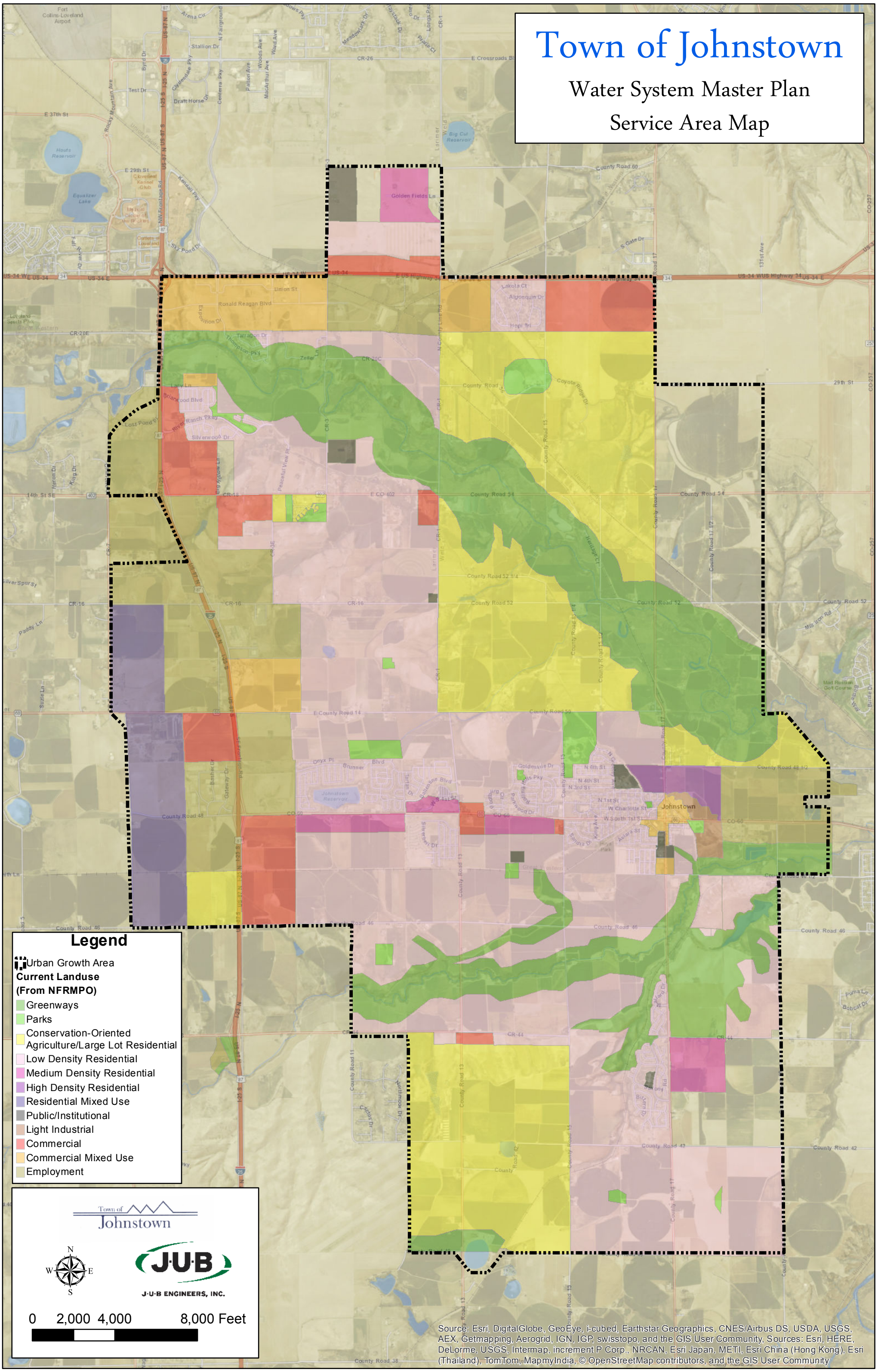
Johnstown's urban growth area includes approximately 48 square miles, and portions of its boundary extend up to one mile west of I-25 to Weld County Road 7; east one half-mile beyond Weld County Road 19; one mile north of Highway 34; and south to Weld County Road 40. Although Johnstown's past is rooted in agriculture, its growth over the last 20 years has been predominantly in the form of residential and commercial development. It is likely that this trend will continue for the foreseeable future.

The map from the land use plan from the 2006 Comprehensive Plan, updated December 2013, is shown on Figure 2-1. The map does not distinguish between already developed areas and future development, but it does indicate the type of growth anticipated. The growth areas account for about 30 square miles within the urban growth boundary, significantly greater than the original portion of town that accounts for less than one-half square mile. There has been an area north of Highway 34 included in the planning area. It is intended to be a joint commercial and residential development and harbors the northern storage tank.

Town of Johnstown

Water System Master Plan

Service Area Map



2.2 Local and Regional Government Coordination

Since 2002, Johnstown has signed intergovernmental agreements (IGAs) with the Central Weld County Water District (CWCWD), City of Greeley, and Little Thompson Water District (LTWD), for the purpose of obtaining water in the event of an emergency. Typically, the terms of these agreements offer the Town protection from service outages due to equipment failure or damaged transmission mains. Normally these emergency connections are closed, and are thus unavailable to provide "backup" to the system during normal operation. The Greeley connection is bi-directional, allowing either agency to supply water to the other. The terms of the agreements with LTWD and CWCWD limit water supplies to a maximum 90-day period. All current or contemplated water system components lie within the Town's urban growth boundary.

2.3 Growth Areas and Population Trends

Past Population Growth

The State Demographer's Office tracks and forecasts population growth, based mainly on Federal census data, single family building permits, and economic forecasts. An analysis of the data revealed that Johnstown has undergone two phases of growth since 1980. From 1980 to 1994 the Town grew at a rate of less than 1% per year. Since then, the population has exploded, with the population growing from less than 2,000 in 1994 to over 13,000 in 2014. Figure 2-2 below illustrates the two phases of the Town's growth pattern during that time.

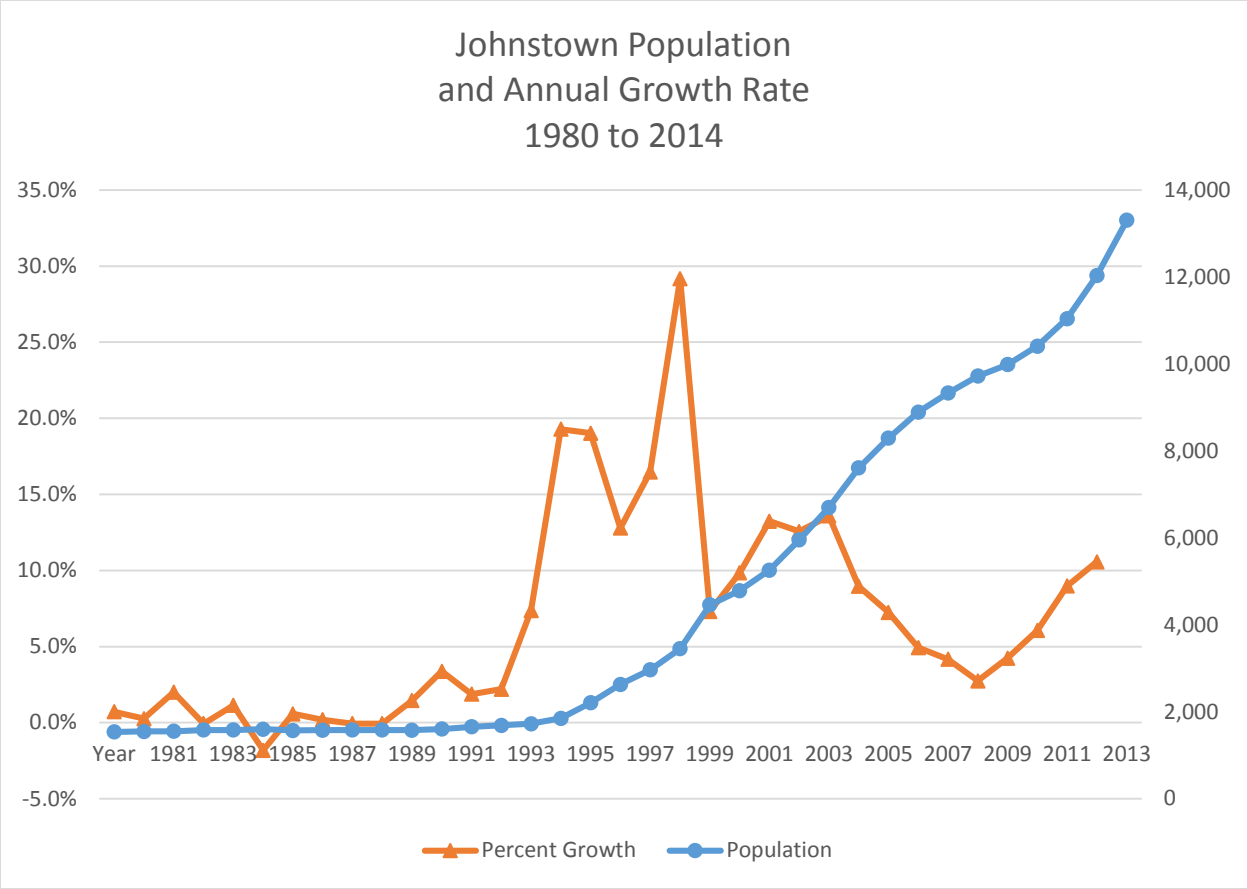


Figure 2-2

Analyzing the data we determined that since 1994 there has been a very strong linear correlation between year and growth. In numbers, the Town has consistently added approximately 424 people each year during that time. Figure 2-3 below illustrates this relationship.

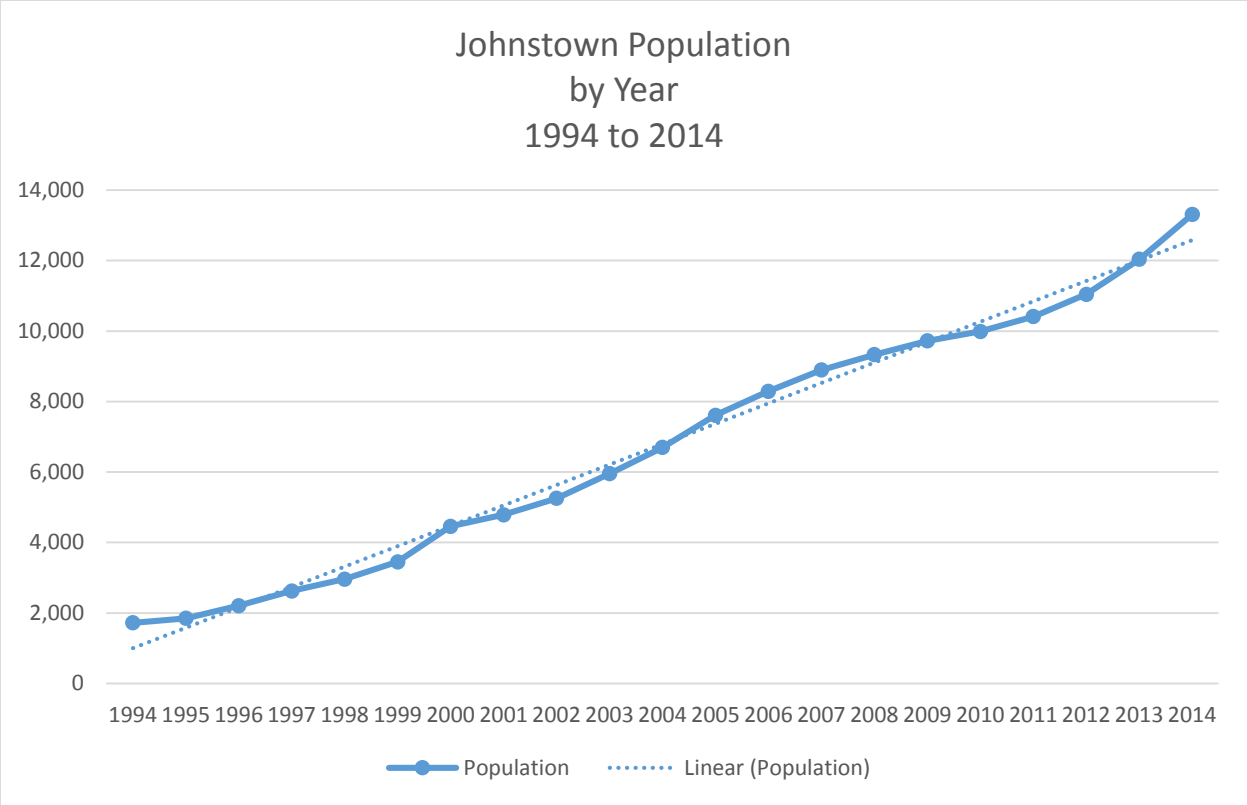


Figure 2-3

Estimate of Future Growth

The 2005 master plan assumed a population growth rate of 1,086 persons per year over a 20-year period, and had this occurred the population of Johnstown would have reached approximately 16,100 in 2014. The Census Bureau estimates a lower figure of 13,306 persons. The Demographer's Office recently published a table of population growth from 2010 to 2013, which represents a post-Recession snapshot. During this period the North Front Range was the fastest growing area in the State, and Johnstown was the third fastest growing municipality in the State, with its population increasing at an average annual rate of 6.4%. However, it is unlikely that the Town could sustain such a growth rate over a 20-year period, especially as it approaches buildout of the primary development areas. We therefore assumed a constant rate of growth of 424 persons per year. In practice, the pace of improvements to and expansion of the water system will have to align with the actual growth that the Town experiences. Table 2-1 shows the projected population of Johnstown at five year intervals over the next twenty years.

Year	Population
2015	13,370
2020	15,850
2025	17,970
2030	20,090
2035	22,210

Table 2-1

Estimated Population – Linear Trend

Alternate Estimate of Growth

We worked closely with Town staff to determine the locations where growth is likely to occur over the next twenty years. In the near term, several developments are likely to move forward. The most significant of these is the new commercial development on the Highway 34 corridor recently announced by Scheels Sporting Goods. The development is projected to have 830,000 square feet of retail space at buildout. To the south of this proposed commercial development, Thompson River Ranch has proposed to develop 7 to 12 additional filings. This, along with the Scheels project, would occur in the northwest quadrant of the urban growth area. All of these properties are currently served by a single 20-inch water transmission main, along with a 1.0 MG water storage tank that is not in current operation.

The Town provided an estimate of how many taps it expects to add within five years, ten years, and beyond. An exhibit is provided in the appendices, giving a detailed breakdown of the numbers by parcel. Table 2-2 below summarizes this information.

Timeline	Number of New Taps	People
1 to 5 Years	1,462	4,079
5 to 10 Years	4,006	11,177
10+ Years	3,569	9,958
Total	**9,037**	**25,214**

Table 2-2

Town's Estimated Growth – Tap Projections

A weighted average of 2.39 persons per lot in Larimer County, and 2.99 persons per lot in Weld County, applied to the prorated numbers of single family residential permits issued by the Town over the last 10 years results in an estimated number of 2.79 persons per lot in Johnstown. In the first five years, the growth in population derived from these numbers 816 persons per year. This is nearly double the growth we have estimated. From 5 to 10 years, the annual population growth would be approximately 2,235 per year, more than 5 times the rate we have forecast. Should all this development occur during the next 10 years, the population of the Town would more than double to approximately 28,600 people by 2025.

The Town provided data on the number of building permits issued in Johnstown by Weld and Larimer Counties from 1994 through July of 2015. We calculated the number of people added to the Johnstown population each year, assuming 2.79 persons per permit issued. We compared these numbers to those obtained from the State Demographer and the U.S. Census. Table 2-3 below shows the results.

Year	Building Permits	People @ 2.77/permit	Per Population Estimates
1995	106	294	127
1996	145	402	357
1997	143	396	420
1998	175	485	336
1999	145	402	488
2000	134	371	1,007
2001	152	421	326
2002	262	726	471
2003	284	787	696
2004	331	917	748
2005	375	1,039	910
2006	180	499	682
2007	160	443	601
2008	97	269	439
2009	89	247	389
2010	124	343	267
2011	180	499	423
2012	314	870	631
2013	378	1,047	992
2014	272	753	1,272
2015	*192	532	424
	Total	**11,739**	**12,006**

* Projected

Table 2-3

Building Permits and Population Growth

As can be seen, the number of building permits correlates extremely well with population growth.

Numerous factors can, and likely will, limit the rate of growth of the Town. The development of a particular parcel of land might be hindered by a lack of raw water supply to dedicate to the Town, lack of financing, environmental issues, construction costs, economic downturns, etc. We have therefore applied historical growth patterns in forecasting future demands for water, and the water infrastructure needed to meet these demands.

2.4 Drinking Water Supply

The draft Water Rights Integration Plan Report (2005), prepared by Helton & Williamson, details the Town's water rights portfolio. According to the report, Johnstown's yield from its interests in the Consolidated Home Supply Ditch and Reservoir Company totals 4,757 acre-feet. The Town obtains and additional 360 acre-feet through the Consolidated Hillsborough Ditch Company, for a total of 5,117 acre-feet from these two sources. In addition, the Town owns shares in the Farmers, Hill and Brush, Greeley, Loveland, and Highland Ditch companies that it can use for non-potable irrigation. The report advised the Town to reserve the Home Supply and Hillsborough rights for potable water production. In particular, the Hillsborough source is desirable due to its senior direct flow rights, and the Home Supply source is desirable due to its senior storage rights. Combined, these sources provide for a stable raw water supply for the Town. The Town currently stores water in Lonetree Reservoir as its primary source for raw water supply to its water treatment plant, with Johnstown Reservoir as a secondary source. Water must be pumped from either source to reach the water treatment plant.

The Town manages its additional raw water needs by requiring sufficient raw water dedication at the time of annexation or prior to development filing. This arrangement works well since the water that is used to irrigate land that is developed can be transferred to the Town and used through the Town's facilities. However, Home Supply, Hillsboro, and other supplies must be converted (through Water Court) from seasonal irrigation to year round municipal use. This can be a time intensive process. The City of Loveland has a similar case that it has taken to the Water Court this year, a case that began in preparation eight years ago.

The Town also owns some Colorado Big Thompson (CBT) shares that can be delivered to the Town through the Home Supply system. However, delivery of that water results in a 50% "shrink" in actual water delivered through the system. One advantage to CBT water is that it can be made available for treatment and delivery upon dedication. However, its high cost makes it unattractive to developers located within the Johnstown area.

Significant portions of water rights acquired by the Town were used on farms, the return flows from which accrued to the Big Thompson and Little Thompson Rivers. Based on statutory and case law, the Town's existing and future water rights decrees will require that the Town manage its return flows to simulate historical return flow patterns in amount, location, and timing. These terms and conditions are imposed by the Water Court to protect senior water rights from injury which might otherwise result from changing water rights from seasonal irrigation use to year-round municipal use and from use on a direct flow basis to use on both a direct flow and storage basis. The senior rights of concern include the Hill and Brush Ditch and the Thompson and Platte Ditch. The Hill and Brush Ditch owns Priority No. 11 for 61.8 cubic feet per second as of June 30, 1866. The Thompson and Platte Ditch owns Priority No. 8 for 35.0 cubic feet per second as of November 18, 1865.

The Town's existing Central Wastewater Treatment Plant is located east of Town and discharges to the Little Thompson River just above its confluence with the Big Thompson River. While this facility provides substantial year-round flows to the river, and in amounts generally exceeding the historical agricultural return flows, the location of these returns is of no benefit to the important senior water rights described above. Therefore, the Town's Low Point WWTP is important to the Town due to its location upstream of these senior water rights. Effluent from the plant is discharged to the Big Thompson River at County Road 3E. This location is approximately ½-mile upstream of the diversion for the Hill and Brush Ditch and 4 miles upstream of the Thompson and Platte diversion point.

In 2014 the Town allocated 37.5 Home Supply shares for raw water irrigation of parks and open spaces. Although the total acreage irrigated with non-potable is unknown, some the areas irrigated with raw water include:

- Lake Park
- Clearview Park
- Portions of Rocksbury Ridge
- Johnstown Cemetary
- Rolling Hills

For the purposes of this report the Town provided data on water usage from meter read routes for July of 2013, January and July of 2014, and January 2015. This information is comprised of billing for individual subdivisions, as well as sub-districts of the older portions of the Town, totalized for the months provided. Daily water treatment plant production data was provided by the Town for the years 2011 through 2014. Annual and monthly usage patterns were determined from the WTP production data, and then correlated with the meter read information, to generate meaningful numbers for peak day and peak hour usage, as well as losses to the system.

Figure 2-4 illustrates the daily plant production over the 4 year period. During the non-irrigation months of November through February, average monthly plant production consistently stayed below 0.75 MGD. On a daily basis, on only a handful of days did winter production exceed 1.0 MG, and in some of these cases the plant readings are almost certainly in error.

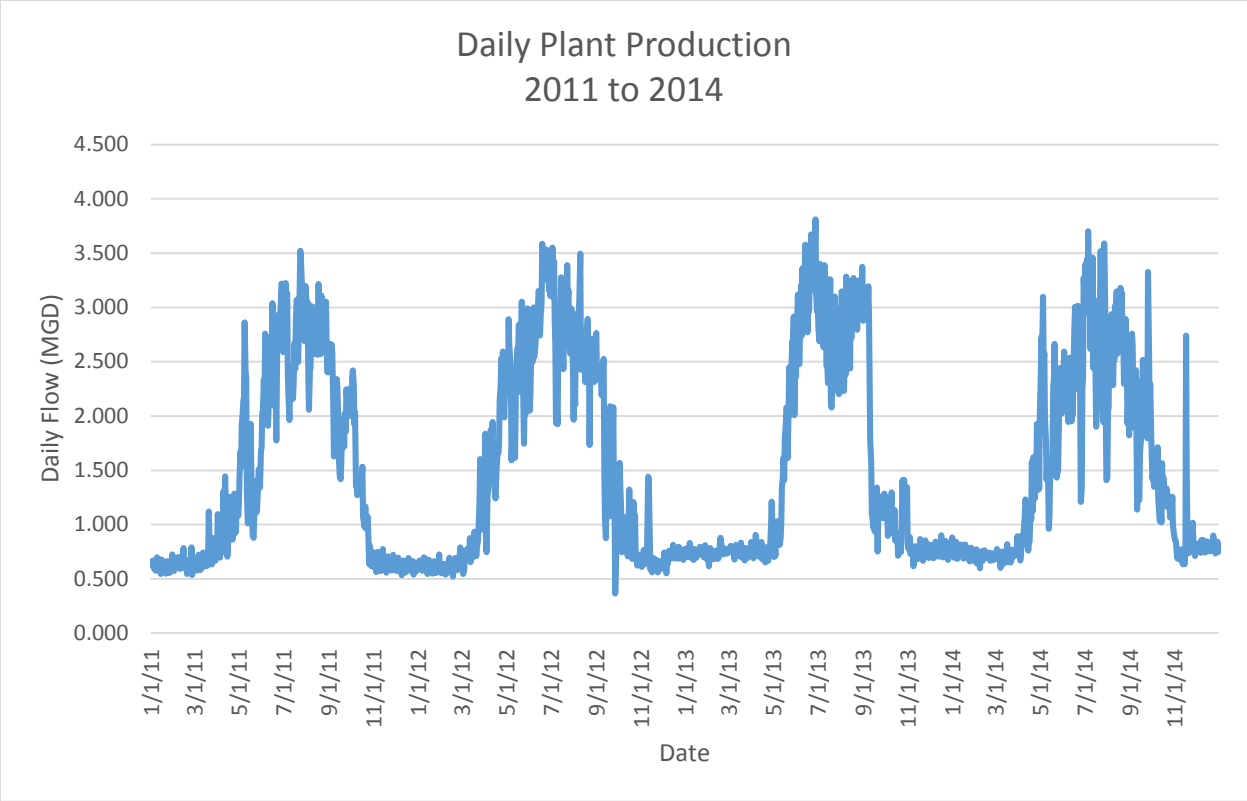
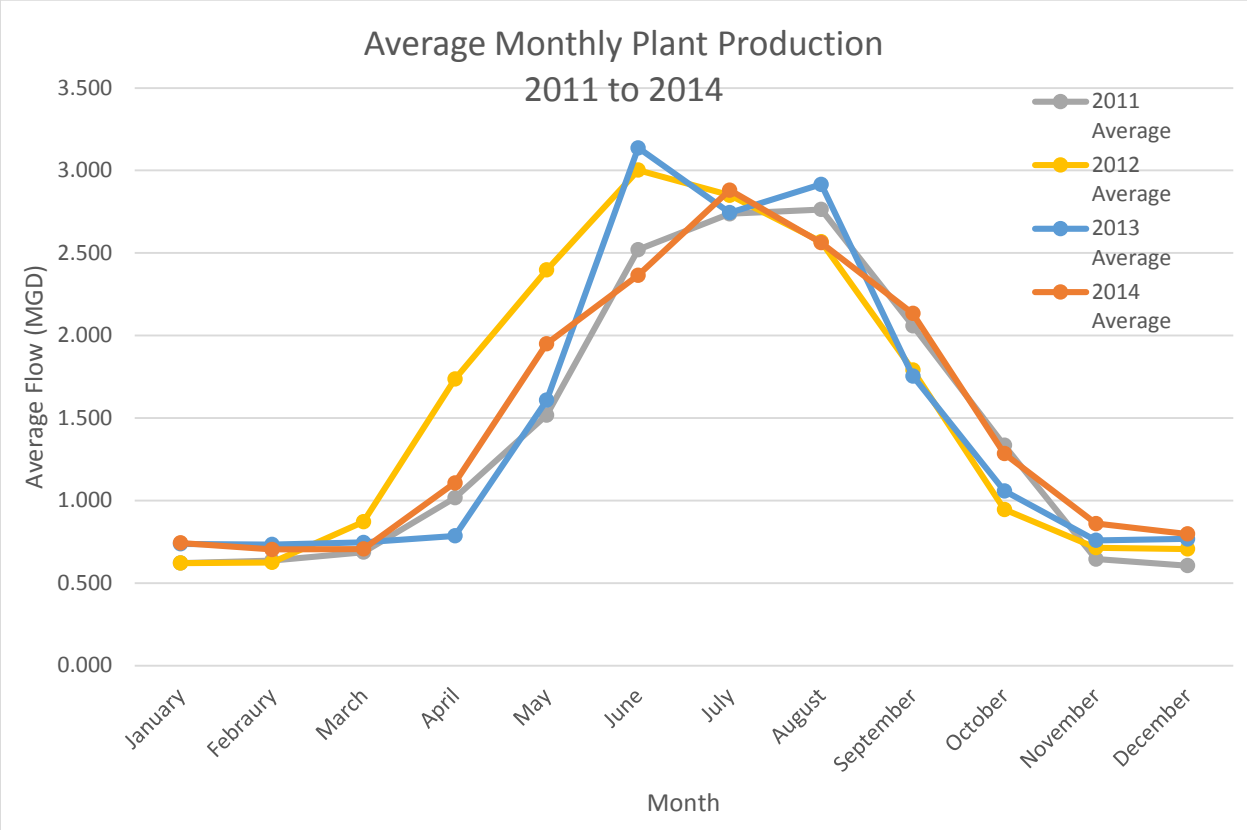


Figure 2-4

Figure 2-5 illustrates the annual variation in plant production. It is important to note that the production data understates the actual production to some degree. The equipment used to meter

the flow from the East pumps is limited to approximately 4.32 MGD. Beyond that the meter "flatlines" and does not show flows beyond that level. We attempted to corroborate the production data using readings from the plant inflow meter. However, this information was limited by that lack of a means to generate digital or tabulated data.

Outside irrigation accounts for a substantial percentage of total water use in the summer. A study performed by Heany[1], et. al, calculated that outdoor water use accounted for 57.2% of the total domestic usage in Boulder, and for 59.7% in Denver. The true value for Johnstown is dependent upon such variables as average lot sizes in various subdivisions, the level of water conservation practices, the level of use of raw water for irrigation, etc. Low density development, such as what has been the trend in Johnstown, tends to increase the water user per capita because there is a greater amount of irrigable area per person. For the purposes of this report we assumed that outdoor use is 60% of the total water usage during the summer.



[1] "Nature of Residential Water Use and Effectiveness of Conservation Programs," Heany, James P., et. al.

Figure 2-5

Water usage during the summer is highly dependent on weather. For example, as can be seen on the graph above, early season water use in 2012 was significantly higher than the other years shown, but late season demand was less. The Heany study found that more than 80% of the peak hour usage in the summer is outside irrigation. Dividing the year up into irrigation and non-irrigation seasons, April through October and November through March, we compiled the production data for the WTP, shown in Table 2-4. Due to the variability of the summer season data, it is difficult to draw conclusions concerning the growth in usage based on the annual usage. However, the winter usage can be considered a baseline because it minimizes the effects of outside usage. From 2011 to 2014 the cold weather water used increased by an annual average of 6.0% each year. During that same period, the population increased by an annual average of approximately 8.5%. This is a reasonably good correlation, given the limited amount of data available.

Year	**Water Use (MG) Jan-Apr, Nov-Dec**	**Water Use (MG) May-Oct**	**Total Annual Water Use (MG)**
2011	96.6	426.9	523.5
2012	107.1	467.5	574.6
2013	113.2	428.5	541.7
2014	115.2	437.3	552.5

Table 2-4

Total Plant Production by Season

2011 to 2014

Given that there was more data available for population than for water usage, we chose to use our estimates of population growth to generate projections for future water usage. For the years 2011 through 2014, the average per capita production was approximately 130 gallons/capita/day. It is important to note that this is not usage at the tap, but rather production at the plant. Table 2-5 gives the past and projected water production through 2035.

Year	Population	Annual Production (MG)	Average Daily Production (MGD)
2011	10,411	524	1.43
2012	11,042	575	1.57
2013	12,034	542	1.48
2014	13,306	553	1.51
2015	13,730	648	1.78
2020	15,850	748	2.05
2025	17,970	848	2.32
2030	20,090	949	2.60
2035	22,210	1,049	2.87

Table 2-5

Annual and Average Daily Water Production

2011 - 2035

The numbers in the previous table are useful for managing raw water supply. However, the Town must maintain its raw water pumping and water treatment capacity to meet maximum day demands, and its treated water pumping capacity to meet peak hour demands. This is due to a lack of treated water storage in its system, and is discussed later in this report. Based on the plant production data provided from 2011-2014, shown in Table 2-6, we calculated a peak day to average day factor of 2.44. Given the limited data, we have applied a more conservative factor of 2.5 to our projections.

Year	Max Day Demands (MG)	Average Day Demands (MG)	Peak Day Factor
2011	3.521	1.434	2.46
2012	3.589	1.572	2.28
2013	3.810	1.484	2.57
2014	3.703	1.514	2.45
average	**3.656**	**1.501**	**2.44**

Table 2-6

Peak Day Factor

To generate useful numbers to size water treatment plant capacity, and to ensure that the distribution system is sufficient to meet all demand conditions, both a max day and peak hour demand must be calculated. Based on a review of data gathered at the Town's water treatment plant, we calculated a peak hour to peak day multiplier of 1.85. Table 2-7 shows the resulting required production.

Year	Max Day Demand (MGD)	Peak Hour Demand (gpm)
2011	*3.52	4,524
2012	*3.59	4,611
2013	*3.81	4,895
2014	*3.70	4,757
2015	4.44	5,704
2020	5.13	6,585
2025	5.81	7,466
2030	6.50	8,347
2035	7.18	9,227

*Numbers obtained from treatment plant records – these records are believed to be under-reported as the finished water flow meters do not accurately measure flow above 4.32 MGD.

Table 2-7

Past and Future Max Day and Peak Hour Demands

Water system planning must be done with a worst case scenario mentality. While a water system cannot be built to withstand every conceivable disaster, a prudent utility must maintain the ability to experience equipment breakdowns and water main breaks with minimal interruption to service. The following sections of this report discuss the adequacy of the Town's water system under current conditions, and what it will need to do to meet future demands.

Johnstown Water Master Plan

Section 3

3.0 Description of Existing Facilities

3.1 Service Area Features

The most significant characteristic of the Johnstown water system is that all raw water and all treated water is pumped. Johnstown's primary point of raw water supply is Lonetree Reservoir, located approximately nine miles west of the water treatment plant. Raw water is pumped from Lonetree Reservoir to the water treatment plant through a 10.6 mile long 16-inch water main, with additional raw water pumped from Johnstown Reservoir during peak usage periods. Treated water is pumped from the clearwell into two 750,000-gallon ground-based tanks adjacent to the water treatment plant, and a pump station then pumps treated water from the tanks into the distribution system. Pressure regulating valves (PRVs) separate the Town into pressure zones. Water delivered to Stroh Farms passes through one raw water and two treated pump stations, and one set of PRVs, due to the topography of the service area and the configuration of the water system.

The Johnstown water treatment plant (WTP) is a conventional media filtration plant with two filter trains, originally constructed in 1966. Clarifier improvements were made in 1987, and the dissolved air flotation (DAF) pretreatment system and building was constructed in 2005. Improvements to the filter influent and effluent piping were made in 2006. It is believed that this allowed the plant to achieve the maximum loading rate of the filters allowed by the State Health Department of 5.0 gpm/sf of filter area. This in turn increased the gross approved filter capacity to 6.2 MGD. Assuming 5% filtered water used for backwash, the net capacity of the plant should be 5.9 MGD. The actual capacity of the plant may be less. According to the 2005 master plan, besides the DAF and pretreatment building, modifications to the plant were kept to a minimum, anticipating a future upgrade to membrane filters. There may be constrictions in the treatment process that limit the plant to less than 5.9 MGD. The filter rate of flow controllers are

currently set at a maximum of 3.5 MGD per filter. If filter flow were allowed at 3.5 MGD, this rate of flow would exceed the filters' currently State approved design capacity of 5.0 gpm/sf under State Health Department regulations.

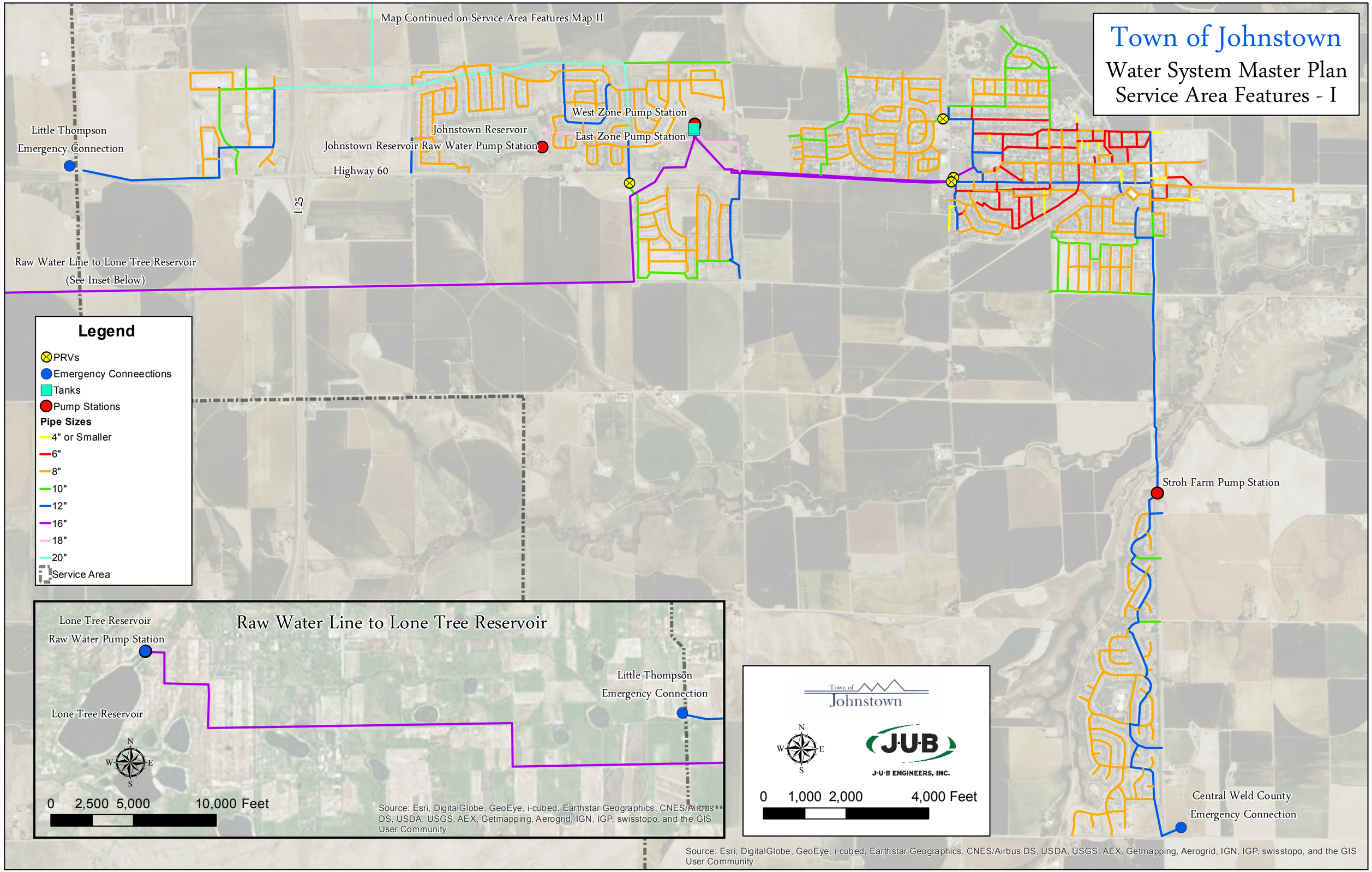
The State has allowed other plants with adequate pretreatment facilities to operate their filters at rates as high as 6.0 gpm/sf. This would increase the gross filter capacity to 7.45 MGD. Assuming 5% filtered water used for backwash, the net capacity would be 7.08 MGD. The State requires additional MPA (microscopic particulate analysis) when it allows filters to be loaded beyond the 5.0 gpm/sf threshold.

The northern and southern portions of the distribution system are not looped, each being served by a single distribution main. The single source of supply for these areas represents a vulnerability in the system, as there is no operational storage to supply them in the event of a break in the supplying pipelines. This situation is mitigated somewhat for areas north of Highway 60 by emergency connections to the Little Thompson Water District (LTWD), and to the City of Greeley. In the event of a main break the Town could receive water from these agencies on a temporary basis. However, this source is not available for normal operation or to fight a fire. Another such connection is planned for 2016 at Stroh Farm with the Central Weld County Water District (CWCWD), but until it is completed that portion of the system is isolated.

The Town's 1.0 MG tank, located near the northern boundary of their service area, is not currently useful, due to its distance from the primary consumption area. Thus, the Town's two storage tanks at the water treatment plant, totaling 1.5 MG, provide the only operational storage to its distribution system. Their volume is equal to the average daily demand in 2014. Figures 3-1 and 3-2 display the major components of the water system on the Town's planning map.

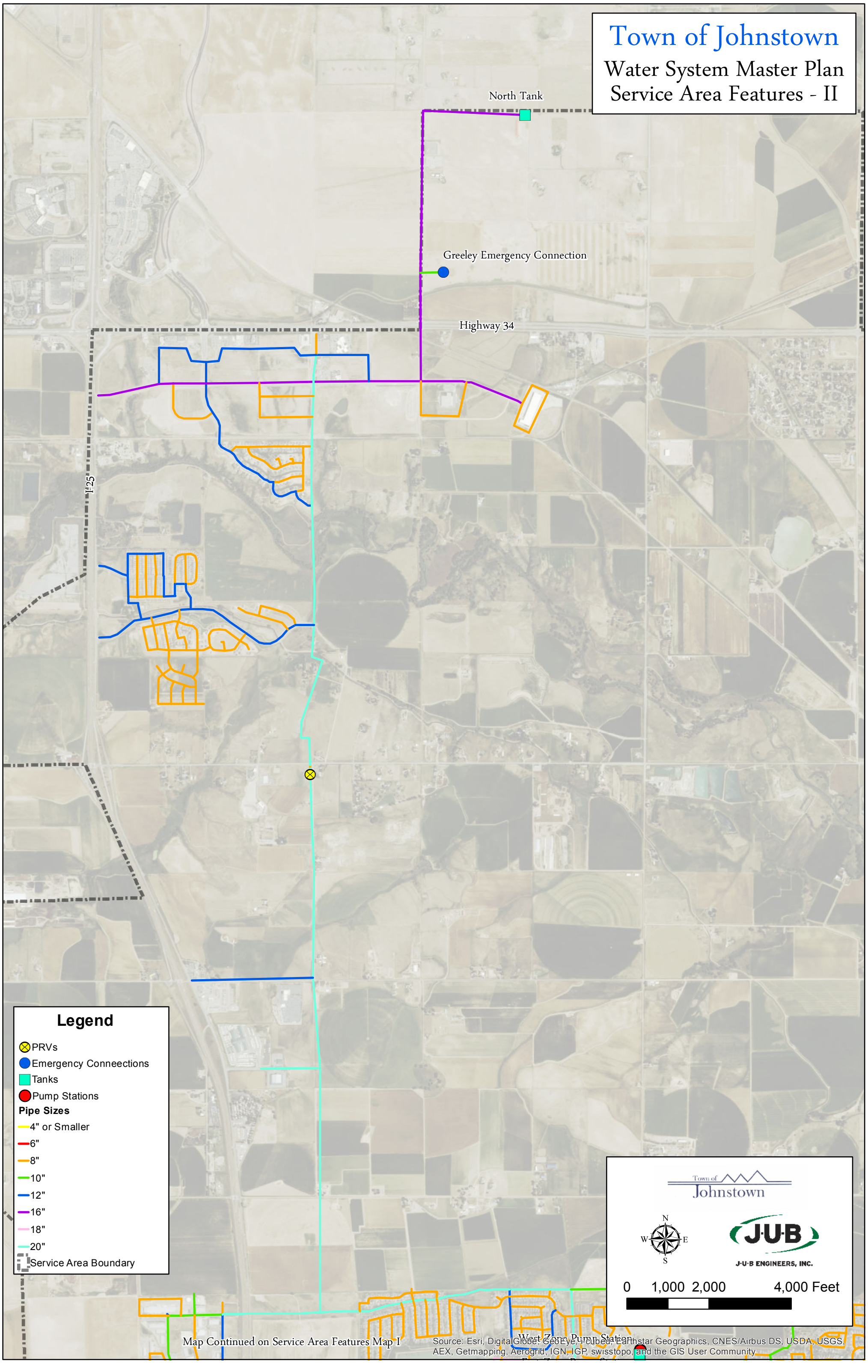
Town of Johnstown

Water System Master Plan
Service Area Features - I



Town of Johnstown

Water System Master Plan
Service Area Features - II



3.2 Facilities Layout and Description

Lonetree Pump Station and Raw Water Transmission Main

Raw water is currently delivered from Lonetree Reservoir to the WTP through a 10.6-mile, 16-inch diameter ductile iron pipeline. The elevation at Lonetree is approximately 160-feet higher than the treatment plant. However, there is a hill located east of the reservoir at an elevation of 5200 feet that requires water to be pumped under all operating conditions. A hydraulic profile of the transmission line is show in Figure 3-3. The profile shows the hydraulic grade line with one, two, and all three pumps running at the Lonetree Pump Station. As shown, with one pump running and the WTP operating at 1.8 MGD, there is excess pressure at the end of the line that is dissipated by the influent control valve at the WTP.

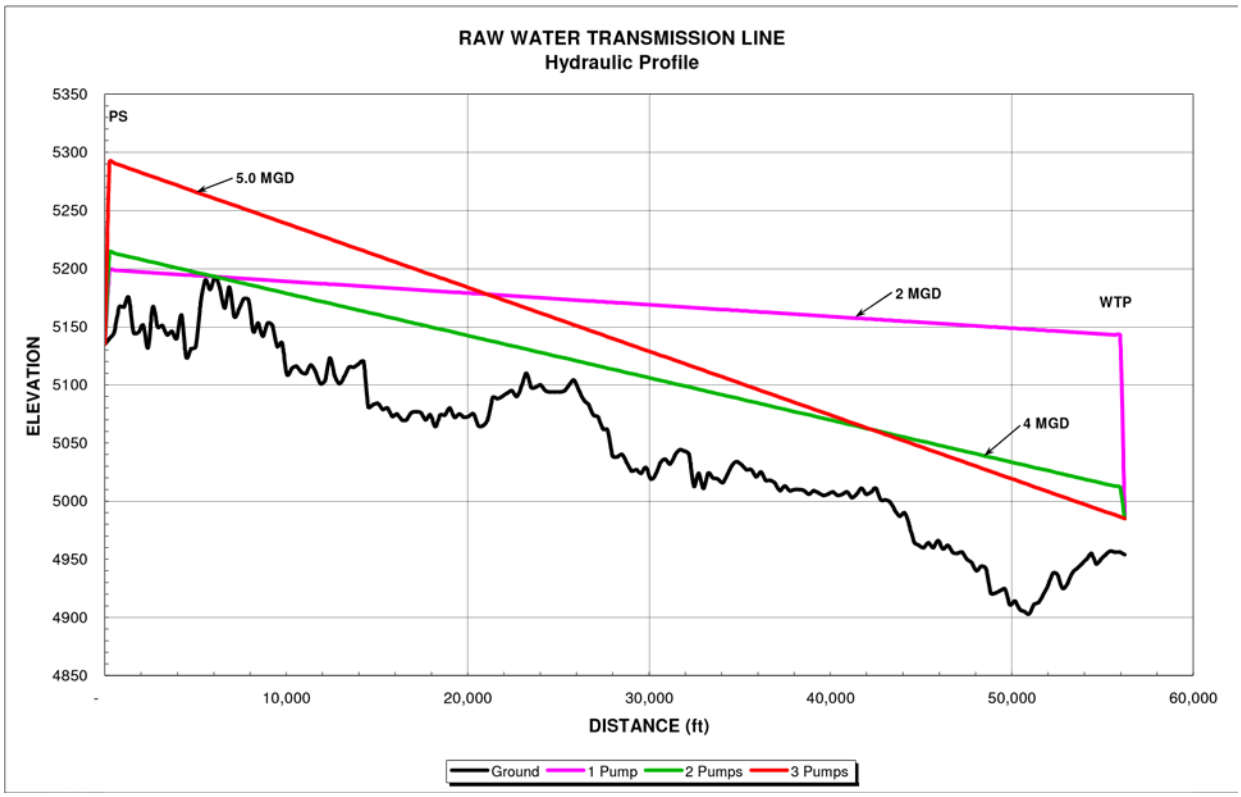


Figure 3-3

Hydraulic Gradelines for Lonetree Pump Station

Three 75 horsepower (HP), vertical turbine pumps are installed at the Lonetree Pump Station located at the reservoir that deliver flow to the transmission pipeline to the WTP. Each of the three pumps is designed to deliver 1,250 gpm at 190-feet of head. The system curves for the pump station are shown in Figure 3-4. Analysis of the curves indicates that with one pump on, the system should be able to deliver up to 1,800 gpm (2.6 MGD), although its preferred operating range is between 950 and 1,650 gpm. The pump station capacity is increased to 3,000 gpm (4.3 MGD) with two pumps running, and with all three pumps operating, the maximum capacity is estimated to be 3,250 gpm (4.7 MGD).

In 2015 the Town replaced the impellers on the three pumps to improve efficiency. This also addressed an instability issue with one of the pumps that led to cracking of the pump housing.

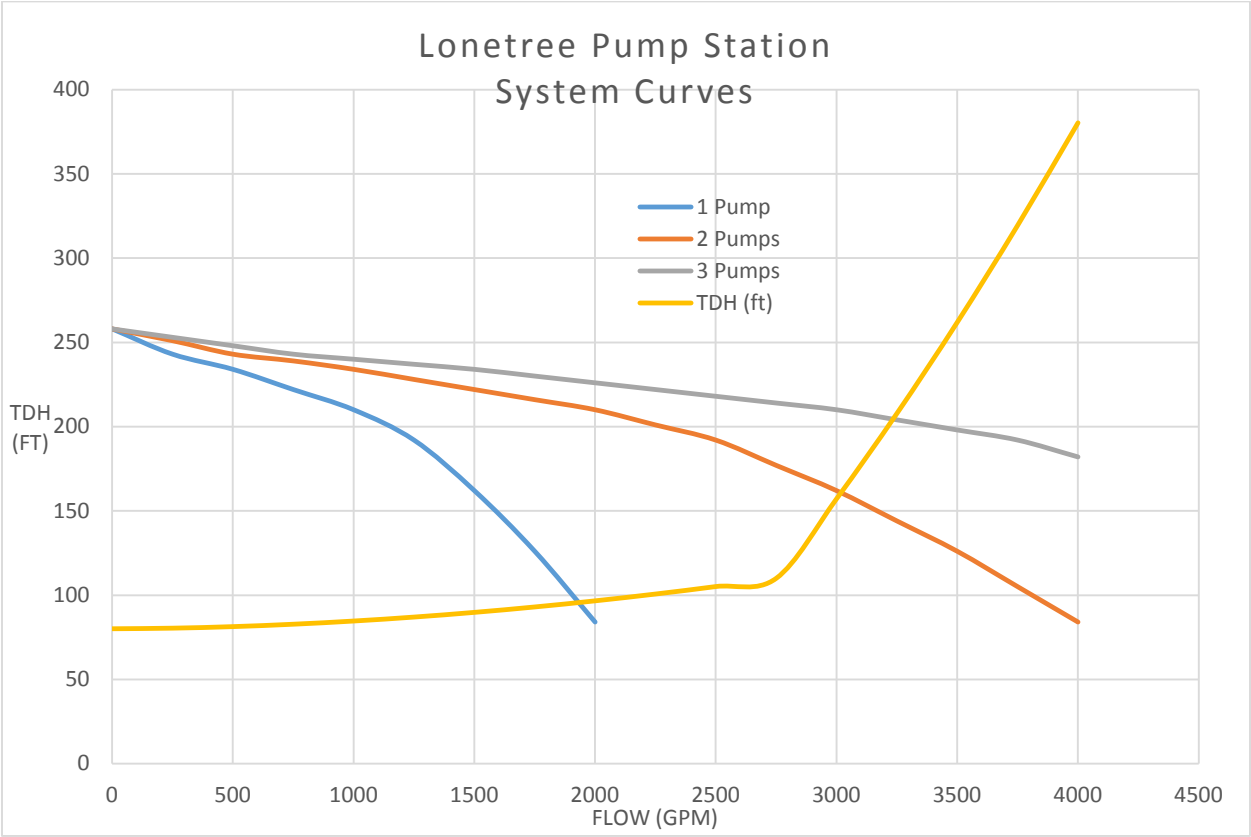


Figure 3-4

Lonetree Pump Station System Curves

Johnstown Reservoir Pump Station and Raw Water Transmission Main

In 2008 the Town completed construction of a new pump station at Johnstown Reservoir, along with approximately 410 feet of 18-inch waterline. The station has four pumps; two 50-hp raw water pumps with variable frequency drives (VFDs); one 25-hp irrigation pump; and one 3-hp irrigation pump. The facility replaced an existing pump station at the site. The raw water pumps are low head/high flow types, such is as found in irrigation systems, and were likely chosen because Johnstown Reservoir and the water treatment plant are at roughly the same elevation. Each of the pumps is designed to deliver 3,500 gpm at 41.8-feet of head. The system curves for raw water pumps in this station are shown in Figure 3-5. Analysis of the curves indicates that with one pump on the system should be able to deliver approximately 4,100 gpm (5.9 MGD) at full speed. This capacity is increased to 4,700 gpm (6.7 MGD) with two pumps running at full speed. The VFDs were installed to operate the pumps within their design range, and to modulate their discharge to match the demand at the plant.

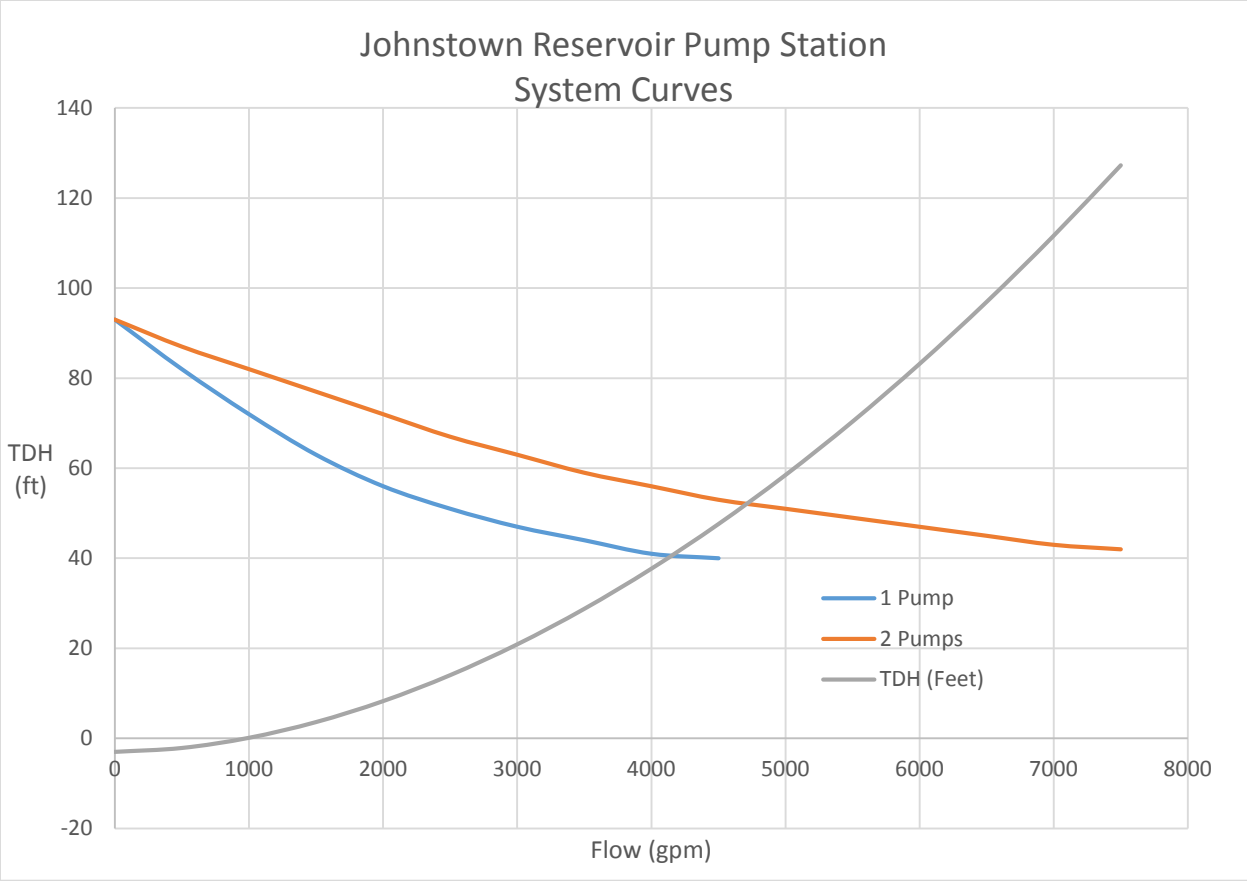


Figure 3-5

Johnstown Reservoir System Curves

A complete SCADA (supervisory control and data acquisition) system was installed as part of the pump station project, including controls, telemetry and communications. The intent was to link the Lonetree and Johnstown pump stations with the water treatment plant. The control system would monitor the water levels in the two tanks at the water treatment plant, switching on the pumps at the Lonetree station in sequence to meet demands. Should the Lonetree station be unable to meet demands, the control apparatus would then activate the Johnstown Reservoir station. The system would also control the VFDs on the pumps at Johnstown Reservoir, adjusted their speed to pump the amount of water specifically required at the plant. Currently, as a result, operators must travel to the plant to turn it on, and then partially open a waste valve to modulate the discharge of the pumps.

Unfortunately, the radio antennas used for communication between the facilities encountered too much interference from similar equipment in the area, rendering the system too unreliable to use. Currently, the operators must manually turn on the pumps at the Johnstown Reservoir station. If the pumps are allowed to run too long, the forebay at the plant can overflow into the backwash pond, which will in turn overflow when the filters are backwashed. The overflow ultimately reaches the Hillsborough Ditch and the operators must contact the Ditch company to identify and document the ditch flow. The proposed completion of the SCADA system in 2016 will address this issue.

In 2013, the Town obtained an estimate of approximately $123,000 to upgrade its communications and control equipment. This work, planned to be completed in 2016, is expected to include:

- Phase 1 – Radio licensing, design work, and installation of programmable logic controllers (PLCs) at Lonetree pump station and the finished water pump station. Ethernet cables and switches would be installed at the water treatment plant, including the dissolved air flotation (DAF) building and DAF electrical room.
- Phase 2 – Materials procurement and preparatory work for the water treatment main building, the finished water pump station, the DAF building, and the DAF electrical room. Flow meters in the treatment plant and the finished water pump station would be replaced, along with the PLCs in the DAF building and DAF electrical room.
- Phase 3 – Materials procurement and preparatory work for installation of radio equipment at the two raw water pump stations, the north tank, and the water treatment plant.
- Phase 4 – Radio equipment would be installed at all sites. PLCs would be installed and programmed in the main treatment plant, the DAF controller, and the DAF electrical room.
- Phase 5 – The SCADA computers in the main treatment plant and in the DAF building would be installed and programmed.

Installation of this equipment would significantly reduce risk of system failure, and lead to greater efficiency in the operation of the pumping stations and water treatment plant, reduce staff overtime, and prevent loss of water due to overflow of the backwash pond. It is recommended

that the Town integrate this system with other SCADA systems they may install at their wastewater treatment plants and other facilities.

Water Treatment Plant

The current gross capacity of the WTP is estimated to be 6.2 MGD. Assuming 5% backwash this yields a net capacity of 5.9 MGD. This is projected to be adequate until 2025. As indicated, Johnstown can request a variance from the State Health Department to exceed the maximum filter loading rate of 5.0 gpm/sf. The State has allowed filter loading rates up to 6.0 gpm/sf which would increase the gross plant capacity to 7.45 MGD. Again, assuming 5% filtered water used to backwash, this would provide a net capacity of 7.08 MGD. Additional MPA will likely be required by the State in association with increased filter loading beyond 5.0 gpm/sf. Increasing the loading rate to the filter with State approval to a net capacity of 7.08 MGD would therefore be adequate until approximately 2030 when the projected Max Day Demand is estimated to be 6.5 MGD.

Projecting the mathematical capacity of the plant treatment capacity is necessary for planning purposes. However, the reality at the Johnstown Water Treatment Plant is that many of the systems at the plant are original, aged, or maintenance has been deferred in anticipation of upgrading the plant to 10 MGD with submerged membranes as recommended in the 2002 and 2005 master plans. The 2005 report anticipated that even with approval by the State to increase filter loading rates the conversion to membranes would be necessary by 2011 to 2013. Plant records and /or as-built drawings have been very difficult to obtain for the water system making detailed analyses impractical. J-U-B and staff identified the following challenges that currently require attention at the water treatment plant.

Plant Components

The following plant components were found to be aging, and in need of continued maintenance or replacement. Repairs or replacements of these components will reduce the risk of failure.

- Age of equipment makes repair / in-kind replacement difficult

- The pneumatic valve actuation system – past failures have occurred
- Plant HMI (Human Machine Interface) / Communications
    - Aging
    - No way to extract data for analysis
- SCADA (Supervisory Control and Data Acquisition)
- Aged Pump Motor VFD's (Variable Frequency Drives)
- Finished Water Meters
- Emergency Generator
- DAF PLC Control Panel (Dissolved Air Flotation – Programmable Logic Controller) and HMI
- DAF Saturator / Compressor
- Finished Water PRV between East and West Zone rebuilding

Plant Operations

Plant staffing has been minimal in the past, but the Town has budgeted the addition of a new position. Minimal staffing coupled with insufficient SCADA of raw water, plant, and distribution system components establishes a pattern whereby staff function between daily operations of the facilities and addressing problems. The increase in staff should improve record keeping, and provide more time to develop standard operating procedures (SOP). Johnstown operations staff do an amazing job maintaining superior water quality production and distribution under these circumstances.

Distribution System

Pump Stations

The WTP Pump Station was constructed in 1998 to supply increased demands due to the addition of Rolling Hills and the Landings developments to the east, and future projected development to the west, including Gateway Center. The station includes two separate 125 HP pumps that deliver water to the east, and two 250 HP pumps that deliver water to the west

pressure zone through a 20-inch waterline running to the Gateway Center and north to the Thompson River Ranch and 2534 developments.

East Pumps

The two 125 HP pumps boost the pressure for Rolling Hills and Landings developments and ultimately to Stroh Farm and the older part of town through pressure reducing valves (PRVs). The pumps each have a design capacity of 3,000 gpm (4.3 MGD) at a head of 125-feet. The pumps are equipped with variable frequency (speed) drives (VFDs) currently set to maintain a pressure of 40 psi. Figure 3-6 is a graph of the pump and system curves for these pumps. The curves indicate that the capacity with one pump running is between 3,600 and 4,200 gpm (5.18 MGD and 6.05 MGD) depending on whether the storage tanks at the plant are full or empty. When both pumps are running their combined capacity is between 4,250 and 5,150 gpm (6.12 MGD and 7.42 MGD). These latter numbers are conservative, due to the methodology used to determine system curves. The true pump capacities are likely higher.

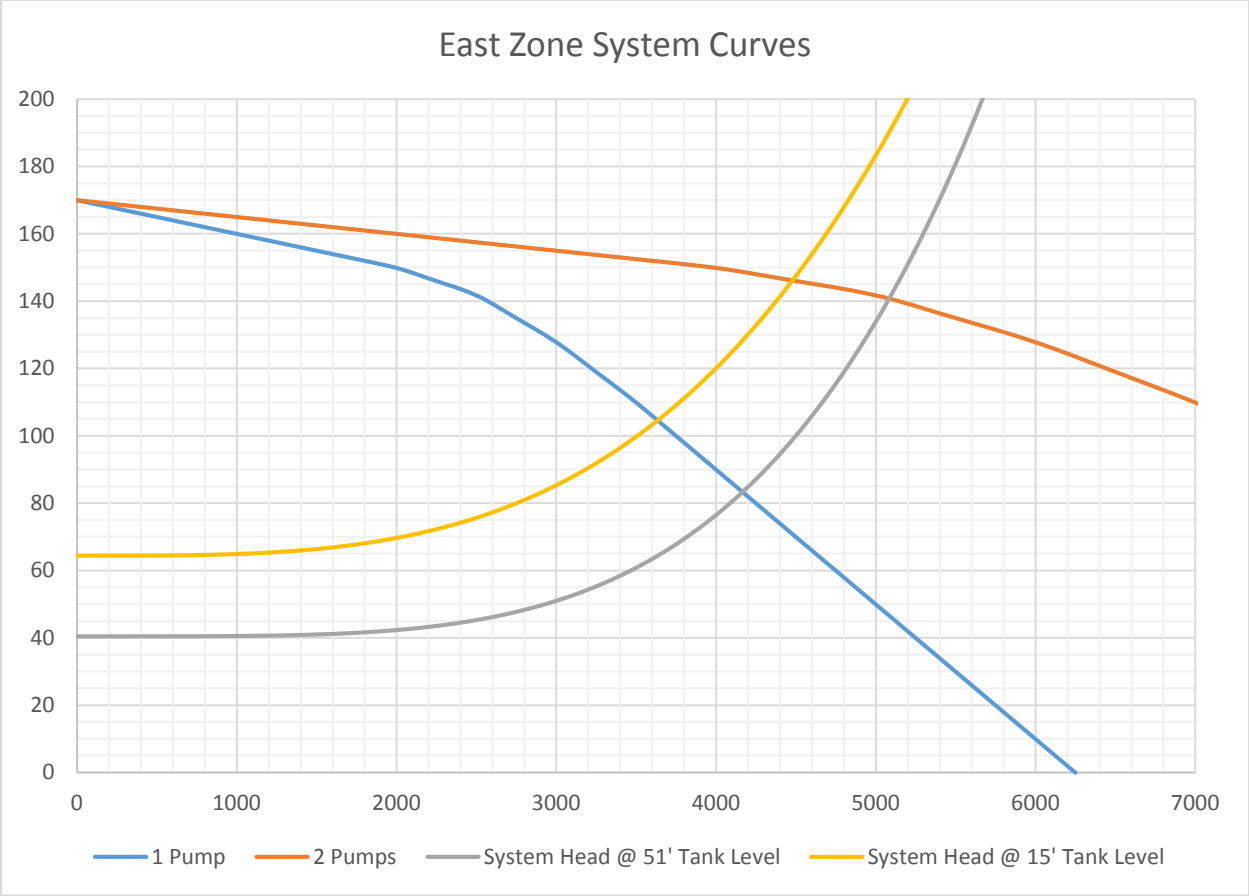


Figure 3-6

East Zone Pump Station System Curves

There are no storage tanks located downstream of this pump station. Therefore the pumps must be capable of supplying the peak hour demand, as well as the maximum day demand plus fire flows. Referring to Section 2.4, the estimated max day demand in 2015 is 4.44 MGD, or 3,083 gpm, and the estimated peak hour demand is 5,704 gpm, although due to difficulties measuring peak production at the plant the true numbers may be higher. The original design of the pump station included pitot-style meters, a common practice at the time. However, they appear to be limited in their ability to measure peak flows. A review of production records indicates that the East pumps typically pump about 70% to 75% of the plant's total production. Assuming to be conservative that the East pumps pump 75% of the plant production, the current max day demand delivered through the East pumps is 2,313 gpm. Adding this to 2,500 gpm as maximum fire flow

results in a max day plus fire flow demand of 4,813 gpm. This is greater than the peak hour demand the East pumps must deliver, which is 75% of 5,704 gpm, or 4,278 gpm. Therefore, the max day plus fire flow demand is the peak demand the pumps must currently be able to deliver. On a daily operational basis, the pumps need to be able to deliver the peak hour demand of 4,278 gpm. The system curves indicate that this demand exceeds the capacity of a single pump, requiring both pumps to remain in service. Our conclusion is that the true system curves are not as severe as shown above, but nonetheless, a single pump will be operating near its capacity. Should there be a major fire in the zones it serves, both pumps would be required fire flow.

By 2020 the demands on this station are expected to reach 3.85 MGD (2,670 gpm) on the max day, and 4,940 gpm during the peak hour. The max day plus fire flow demand will be 5,170 gpm. These demands will just barely be within the pumps' capacity. Backup capacity to the east can be provided from the West pumps through the east-west zone PRV connection located in the pump station.

West Pumps

The two 250 HP pumps serve areas to the west and north of the WTP. The pumps have a design capacity of 3,000 gpm at a head of 250-feet. These pumps are also equipped with variable frequency (speed) drives (VFDs) and are set to maintain a downstream pressure of 90 psi. Figure 3-7 is a graph of the pump and system curves for these pumps. The curves indicate that the capacity with one pump running is between 3,300 and 3,500 gpm depending on whether the storage tanks at the plant are full or empty. The capacity is estimated to be between 3,700 and 3,900 gpm when both pumps are running. Just as with the East pumps, these curves are likely conservative in terms of the pumps' true capacities.

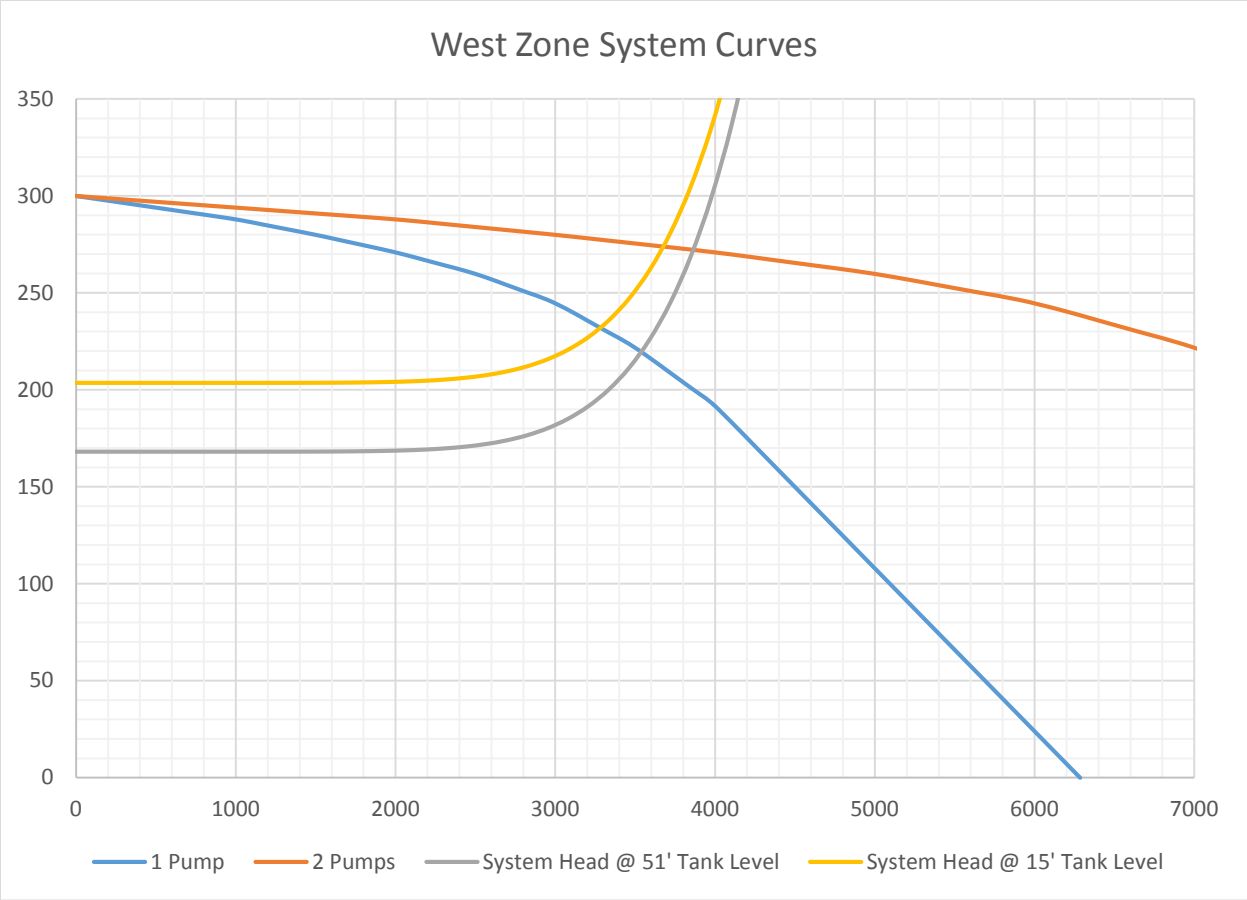


Figure 3-7

West Zone Pump Station System Curves

As with the East Pumps, there are currently no operational storage tanks located downstream of this pump station, so these pumps must also supply the peak hour as well as the maximum day demand plus fire flows. The current demands for this part of the system are estimated at 25% of the total system (based on plant production records). Therefore, the current demand is estimated to be 1.11 MGD (770 gpm) on the max day and 1425 gpm during peak hour. Adding a maximum fire flow of 2,500 gpm to the max day demand results in a maximum draw on the pump station of 3,270 gpm.

The max day plus fire flow demand can be supplied with one pump operating, although just barely. In 2035, maximum day demands on the West station are estimated to be

approximately 1.80 MGD. Adding the maximum fire flow results in a maximum draw on the pump station of 3,750 gpm, which is within the west pump's capacity.

The discharge from the east and west pumps is measured through a pitot tube-style flow meter on each side of the pump station. It appears that the pitot tube flow meter has a peak capacity of 3,000 gpm or 4.32 MGD. This type of meter was frequently used at the time the pump station was built. In the intervening years development has pushed demands beyond the ability of the meters to measure the peaks. Current state of the art would be to use magnetic flow meters in this application. Although these were available at the time the pump station was built, they were not yet widely accepted in the industry. Figure 3-8 depicts a screen capture of the HMI indicating a time period when the finished water flow meter for the East pumps has flat-lined and is underreporting – see the highlight red circle.

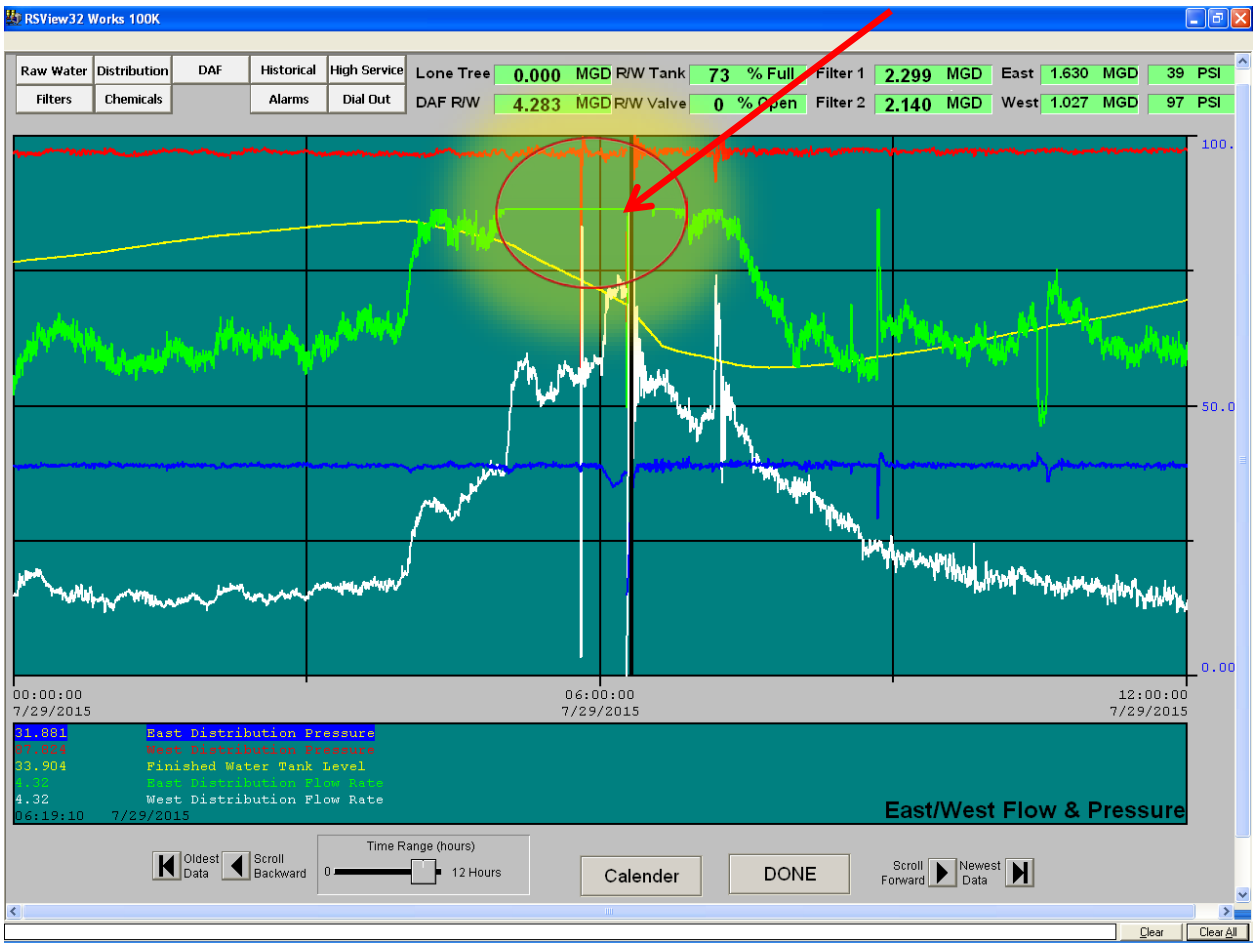


Figure 3-8

Finished Water Flow Meters, July 29, 2015

We recommend that the east-west zone PRV located between the pump discharges that can pass water between the pressure zones if needed be maintained / overhauled. The failure of the VFD earlier this year brought to light the need to maintain the valve so that it can pass water from the west side of the pump station to the east side in the event that there is a failure of the east pumps.

Stroh Farm Pump Station

The Stroh Farm pump station is located at the north end of the Stroh Farm development. The station is an underground, factory built station with four pumps designed to supply the demands of the Stroh Farm development in a closed loop system (no tank). Pump No. 1 is designed to supply low demands up to 50 gpm. Pump No. 2 and No. 3 are sized for 600 gpm at 95 ft. TDH and are to supply normal and peak flows. The fourth pump is a fire pump designed for a flow of 1,725 gpm and total dynamic head of 95 feet. The system curves for the Stroh Farm development and the pump curves for the Stroh Farm Pump Station are shown below in Figure 3-9.

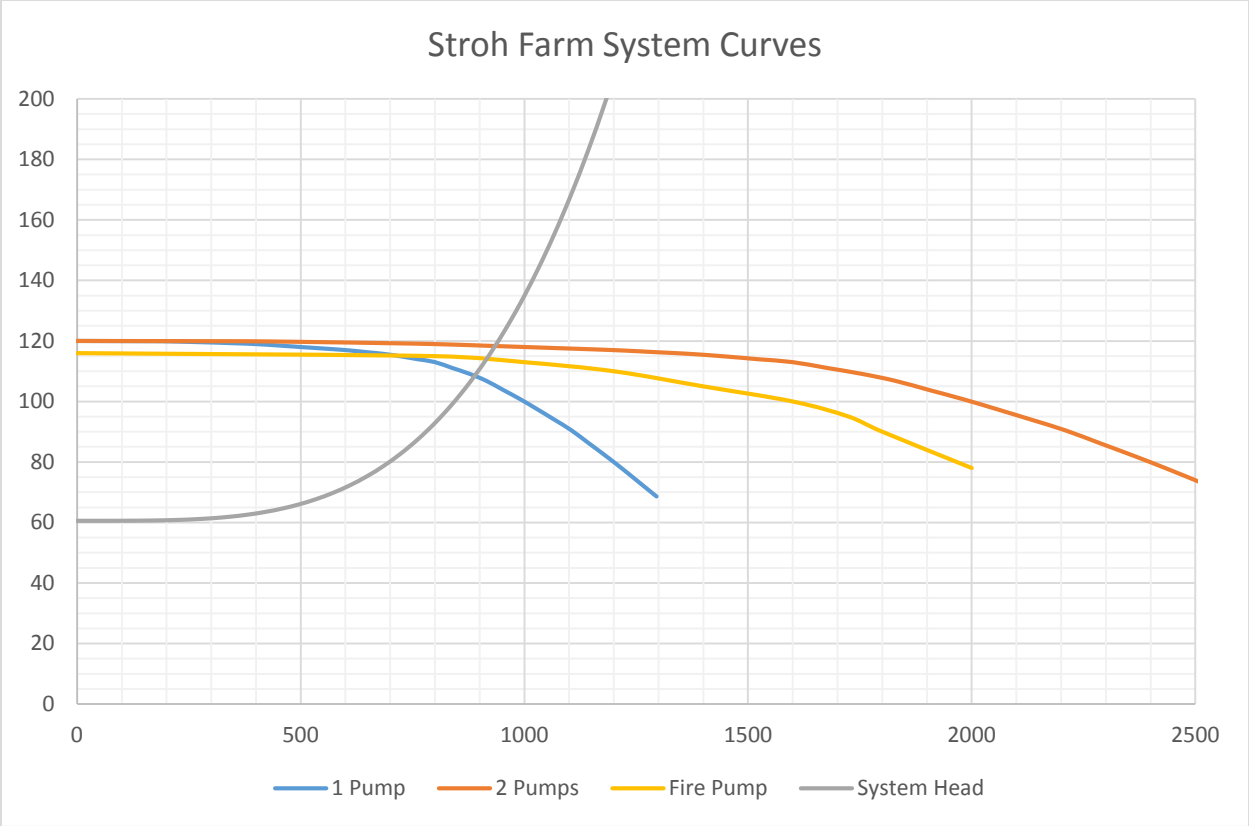


Figure 3.9

Stroh Farm Pump Station System Curves

In 2012 the Town upgraded both service pumps to address concerns that adequate fire flows could not be delivered to the school. The above curves indicate that Pumps 2 or 3 can now supply up to 900 gpm when operating separately and could supply up to 950 gpm when operating together. The fire pump by itself can supply 900 gpm. As with the other pump analyses in this report, these figures are conservative. The previous master plan stated that the station as then configured could deliver fire flows of 2,500 gpm to the school, but at a pressure of just 5 psi. The school is equipped with fire sprinklers, reducing the necessary fire flow to what is required for the surrounding structures, or 1,500 gpm at a minimum pressure of 20 psi.

If Pumps 2 and 3 are operated at the same time as the fire pump, the system can supply a fire flow to the most remote point in the Pioneer Ridge development of 2,066 gpm at 20 psi on the max day. Based on this analysis, the pump station will be able to supply domestic demands within the Stroh Farm development, as well as adequate fire protection.

The previous report proposed a storage tank located approximately three miles west of the Stroh Farm area, in part to improve fire flows. The upgrade of the service pumps improved fire flows, but the amount that a pump station of any size could deliver is limited by the 12-inch waterline that serves the area. This line is not looped, and as a result, there is significant pressure loss between the water treatment plant and the pump station under conditions of high flow. The tank proposed in the prior report would have improved fire flows, but as with the north tank, it would have been too remotely located to operate. J-U-B has proposed a tank for a site to the northeast of Stroh Farm, discussed in following sections, which would significantly improve fire flows to the pump station, owing to its much closer location.

Distribution Piping

The Town's distribution system is built around a "backbone" of mostly 16- and 20-inch pipelines, with some 10-inch and 12-inch pipelines serving key areas. Currently a 20-inch line runs from the water treatment plant west and north up to US 34, serving areas north of Highway 402. While this pipeline is the sole source of water for Thompson River Ranch and the Highway 34 corridor during normal operations, in an emergency the area can be served from the Greeley emergency connection via the 16-inch water main that links the 1.0 MG tank to the system.

Pioneer Ridge is served by a 12-inch waterline that links the Stroh Farm pump station serving the area to the rest of the distribution system. In the event that the station fails, the future interconnection with the Central Weld County Water District can be opened to serve the area.

From the water treatment plant, a 16-inch waterline runs southeast to Highway 60, and an 18-inch line extends to Colorado Boulevard and then south to Highway 60. From there, two 16-inch lines run east to County Road 15 (Telep Ave.) to a pair of PRVs. A 12-inch line runs east from there to County Road 17 (Parish Ave.), and then south to the Stroh Farm Pump Station.

The newer portions of the distribution system are predominantly made up of 8-inch lines, with some 10-inch and 12-inch lines located to support future development. Old Town still has approximately 25,000 feet of 6-inch waterline.

Storage

Typically a water distribution system will maintain gravity storage to perform three functions. The first is to provide emergency storage in the event of a plant shutdown, transmission main break, or other event. The second is to provide fire flow under the scenario that there is some system failure, such as a waterline break, between the water treatment plant and the site of the fire. The third is operational storage. This component allows the water treatment plant and main pump stations to be sized to meet the max day demand, by supplying water to offset the short term peaks that occur during the day. Our analysis indicates that the peak hour demand in Johnstown is nearly double the maximum day's demand.

An additional function of operational storage is to provide water during backwash cycles. During these periods water from the tanks is drained back into the plant to wash the filter media in the plant. At the same time, water is being pumped from the tanks into the distribution system. During a typical backwash cycle on a high demand day, the amount of water in the tanks will decrease by approximately 385,000 gallons during the cycle. In 2035, if the existing conventional media plant is not replaced, this amount will increase to approximately 560,000 gallons, more than one-third of the storage capacity.

The Town's two existing emergency connections with Greeley and the LTWD, and its planned connection with the CWCWD, partially offset the need for emergency storage. These connections must be opened manually by operations personnel, and by necessity there would be

some delay before they were opened. The contracts with these agencies stipulate that emergency service is the primary purpose of the connections. These contracts expressly state that they are not intended to meet operational needs. Nor would they be of any significant use in the event of a fire, due to the delay that would occur before they were manually opened.

Currently, the only functional storage in the Town's system is in the two 750,000-gallon tanks at the water treatment plant. The combined capacity of 1.5 MG is approximately the same as the average daily demand in 2014. In the event of a failure of the WTP pump station, much of the system could be fed by gravity from the tanks for a period of time at reduced pressures. One such possible scenario is a power failure at the plant. The backup generator at the site is intended to supply power for both the treatment plant and east and west pump stations, and requires maintenance to ensure it will operate when needed. Figure 3-10 shows the initial pressures in the event that the east and west pumps stopped working, with the tanks 60% full, a typical level at the end of a backwash cycle on the peak day. Most of Corbett Glen, Clearview and areas to the east would initially have pressures greater than 20 psi with the tanks at the water treatment plant 60% full. However, pressures in Carlson Farms, and Rocksbury Ridge would be less than 20 psi, and Gateway Center would receive no water. Thompson River Ranch, Thompson Crossing and the Highway 34 corridor would receive no water because the high point in the pipeline serving those areas is above the elevation of the tanks. This situation would be alleviated if it was possible to have the north tank operational. In areas that they could serve, the tanks would provide water until the emergency connections with other water districts/systems could be opened.

In addition to the two 750,000-gallon tanks at the water treatment plan, the Town constructed a new 1.0 MG tank north of Highway 34 in 2006. This tank was intended to serve the pressure zone that includes the Highway 34 corridor and Thompson River Ranch. Most of the current demand for water in the North Tank Zone is located within Thompson River Ranch. The Town found that water in the tank was not "cycling" and therefore not usable. This is likely because this development is much closer to the Highway 402 pressure regulating valve (PRV), creating an unfavorable hydraulic gradient for the development to be fed by the tank. This could be remedied by replacing the PRV with a control valve that would open and close, depending on the

Town of Johnstown

Water System Master Plan
East and West Pump Station Failure

To Lone Tree Reservoir

Legend

- Valves
- Pumps
- Tanks

Pipe Sizes

- 4" or Smaller
- 6"
- 8"
- 10"
- 12"
- 16"
- 18"
- 20"
- Pressure Contours

Pressure Zones

- North Tank Zone
- West Zone
- East Zone
- Old Town Zone
- Stroh Farm Zone
- Service Area Boundary

Peak Hour Pressures

- Less Than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- Greater Than 100 psi

Town of Johnstown

J-U-B ENGINEERS, INC.

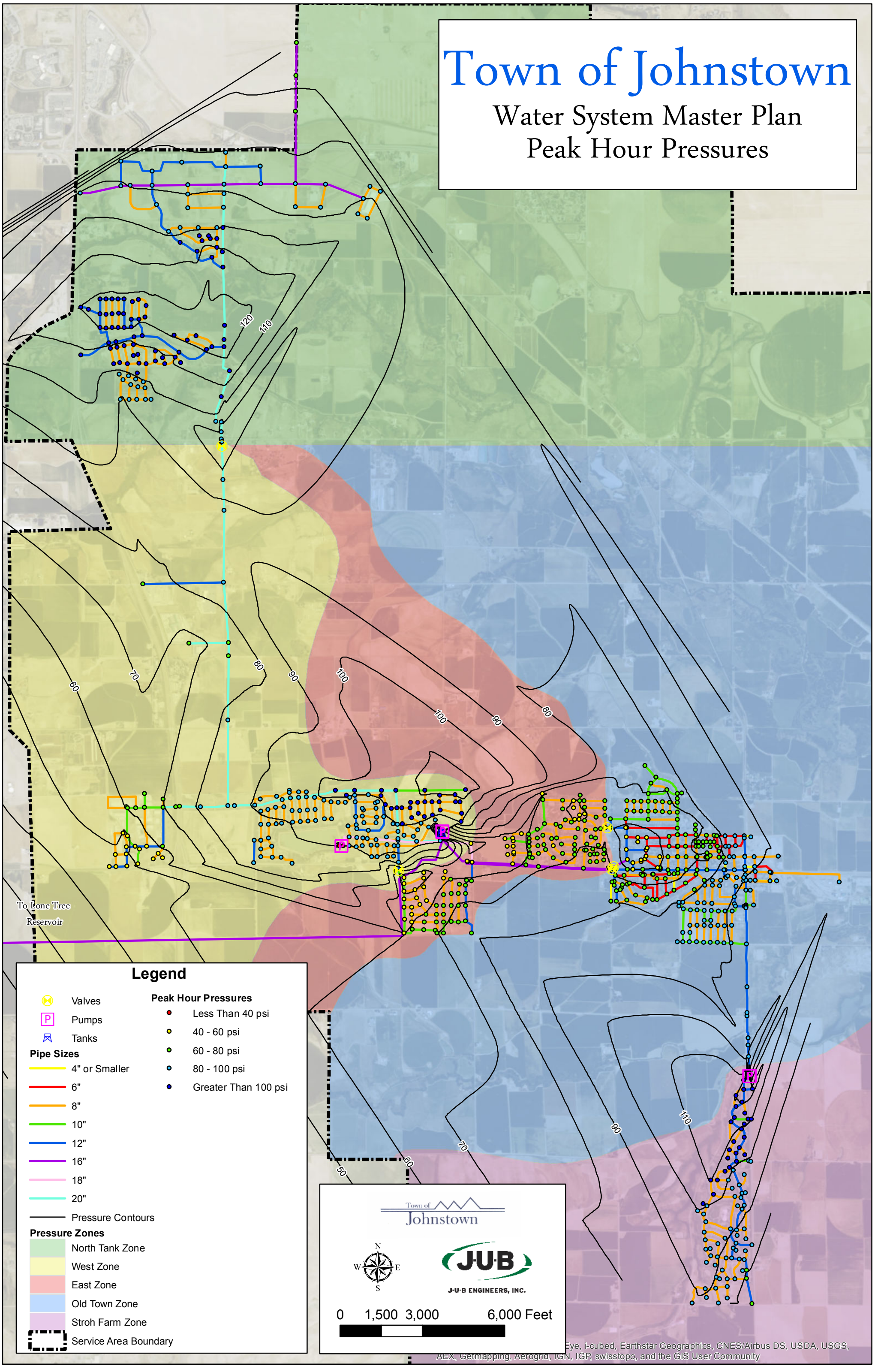
N W E S

0 1,500 3,000 6,000 Feet

Eye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Town of Johnstown

Water System Master Plan
Peak Hour Pressures



tank level. This might allow the tank to cycle enough that water quality problems related to overly long storage times would not develop.

A new storage tank could be sited northeast of Stroh Farm, within the Old Town pressure zone. The water level in this tank would be controlled by the PRVs that separate the East and Old Town zones. The four existing PRVs could be replaced with control valves linked to a proposed SCADA system upgrade. These valves would either operate as PRVs when the tank level is low, or close when it is high. This would allow the tank to backfeed Old Town, as well as supply the Stroh Farm pump station. In this manner the tank would cycle, minimizing water quality issues. The tank would provide both fire flow and operational storage. Fire flow storage would be available to the Old Town zone, Stroh Farm though its pump station, and to some extent the East pressure zone. The tank would also provide some operational storage, pushing back the date when the East Zone pumps would need to be replaced.

Pressure Regulating Valves (PRV's) & Pressure Zones

The Town's service area ranges from a high elevation of 5080 to a low elevation of 4790. This 290-foot difference in elevation translates into a pressure difference of 126 psi. In order to maintain adequate pressures at the highest elevations, while keeping the pressures at the lowest elevations within acceptable limits, the service area is separated into 5 pressure zones. The pressure zones are summarized in the following table and the peak hour pressures and theoretical pressure zones are illustrated on Figure 3-11.

Location	Upper Limit	Lower Limit	Upper Controls	Lower Controls
Stroh Farm Zone	5040	4850	Stroh Farm PS	N/A
Middle Zone (West Zone)	5080	4950	West Zone PS	402 PRV, Clearview PRV
North Tank Zone	5130	5000	North Tank	N/A
Lower Zone (East Zone)	4950	4900	East Zone PS, Clearview PRV	Old Town PRVs
Old Town Zone	4900	4780	Old Town PRVs	N/A

Table 3-1
Johnstown Pressure Zones

The Old Town Zone serves older Johnstown through two pressure reducing valves Near CO 60 and WCR 15, and another just to the north at North 3rd Street. Pressures range from 68 psi at the PRVs to the maximum of 100 psi near the southeastern portion of Johnson Farm. The Lower Zone or East Pressure Zone serves the area between the Water Treatment Plant on the west and the Old Town PRVs, and the Clearview and Stroh Farm developments on the east and south. Pressures in this zone range from 40 psi to 90 psi.

The Stroh Farm Zone includes all of the development served by the Stroh Farm Pump Station. Upgrading of the pumps has improved pressures in this zone, which range from 80 to 125 psi. This has alleviated issues regarding the ability to deliver adequate fire flow to the school.

The North Tank Zone includes the area north of the 402 PRV. The pressures in this area vary from 70 to 145 psi. Pressures in the Big Thompson River valley will be higher than traditional pressures; however, the pressures are set in order to accommodate filling the northern tank without any additional pumping. Currently, however, the pressures in this zone are controlled by the PRV.

The Middle Zone or West Pressure Zone serves all of the new and existing development between the water treatment plant and the service area boundary west of I-25, and north to Hwy. 402.

This zone also services the Gateway Center development via a 20-inch main under I-25, with pressures ranging from 57 psi to 80 psi.

Due to the topography of the area and friction loss through the pipe network, the actual operation of the system does not adhere completely to the "ideal" zones indicated on the figure. Consequently, the "theoretical" zones indicated above, and shown on the exhibit, are included only as guidelines to indicate locations that may have low pressure or high pressure, based on their altitude and the zone in which they are situated.

Emergency Treated Water Supply Sources

In addition to its raw water supplies, Johnstown maintains two interconnections with neighboring water systems for the purpose of supplying the Town in the event of an emergency, with a third planned for construction in 2016. Under the definitions of these agreements, drought is explicitly excluded as an emergency. In addition, as the isolation valves for these connections are operated manually, it would be impractical for them to augment fire flows in a timely manner. Their practical purpose is to supply the Town in the event of an interruption in service. Should this occur, service outages would be experienced in some areas until the interconnection was opened, as there is no gravity storage currently available in the system.

An emergency potable water connection with the Little Thompson Water District (LTWD) is located near the intersection of State Highway (SH) 60 and Weld County Road (WCR) 7. This connection was completed in 2004 and is made through a 12-inch line to the Town's 20-inch line at the Gateway Development. The connection can supply up to 3.5 to 4.0 MGD to the Town system. The current Intergovernmental Agreement (IGA) dated 2002 is included in the Appendix. The terms of the IGA limit the period that the LTWD would supply water to 90 days.

An emergency, bi-lateral, potable water connection with the City of Greeley is located near the intersection of State Highway (SH) 34 and Larimer County Road (LCR) 3. This connection was completed in 2006 and is made through a 12-inch connection. The connection can supply up to 1.0 MGD to the Greeley System and 2.0 MGD to the Town system. The current Intergovernmental Agreement (IGA) dated 2005 is included in the Appendix.

An emergency potable water connection with the Central Weld County Water District (CWCWD) is currently under design, to be located near the intersection of Weld County Roads 17 and 42. The Johnstown system will be connected to CWCWD's 20-inch line via a master meter and 700 feet of 12-inch waterline, which will feed into the Town's distribution system in Stroh Farm. This connection is scheduled for completion in 2016. The connection will be able to supply up to 1.0 to 2.0 MGD to the Town system. A copy of the signed Intergovernmental Agreement (IGA) is included in the Appendix. The terms of the IGA limit the period that the CWCWD would supply water to 90 days.

Non-Potable Irrigation

The Town is implementing and encouraging non-potable water irrigation in new developments as a means to reduce demands on the treated water system. Dual systems have been installed in some cases.

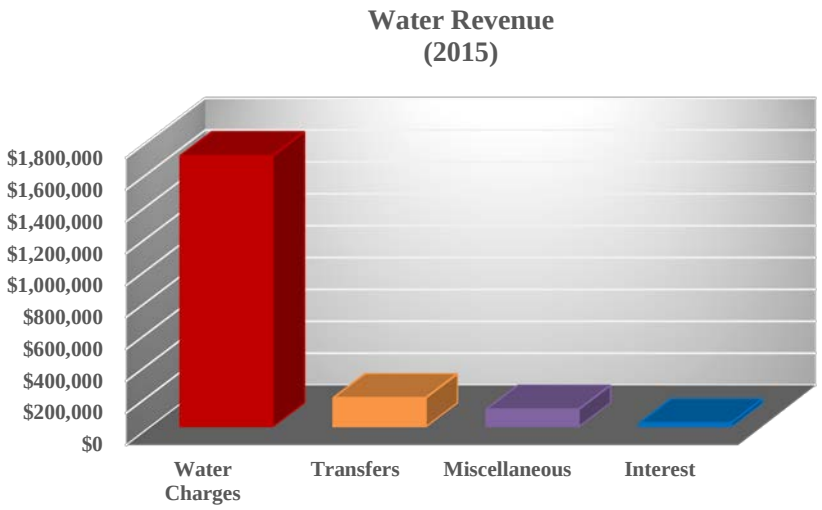
3.3 Financial Status and Users

Town Water Fund

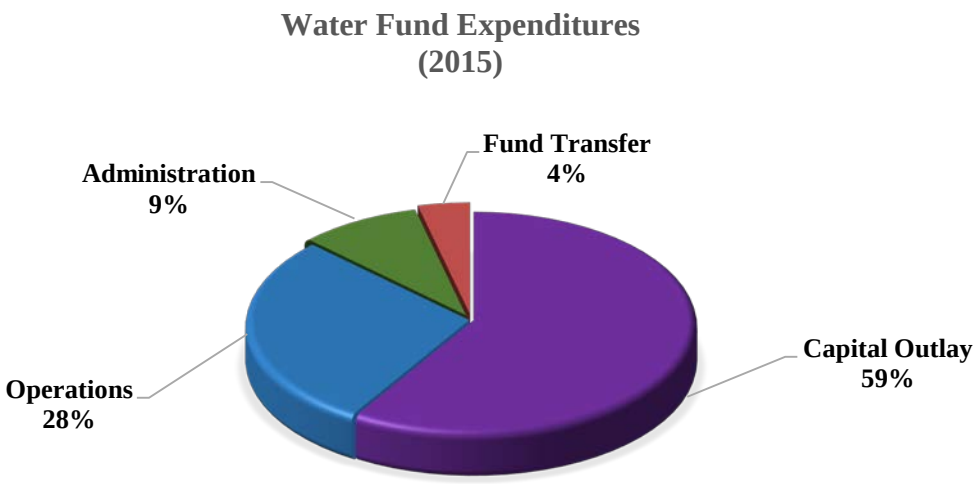
The Johnstown Water Fund revenue for 2015 has been budgeted at $2,017,200. Included in this total is the following:

- $1,700,000 of water sales
- $25,000 of interest income
- $110,000 of "miscellaneous" income
- $182,200 transferred from the General Fund for payment of water charges incurred by the various town departments.

Revenue derived from tap fees and raw water development fees is not included in the proposed budget in accordance with the recommendation of the state auditor. However, 2014 tap fee revenue was $809,467 and raw water development fee revenue was $1,489,771.



2015 Water Fund Expenditures budget is:	$2,719,400
Operations:	$2,478,900
• Operations & Maintenance	$1,006,400
• State Highway 60 water line replacement	$850,000
• Emergency water interconnect and line extension	$165,000
• Meters/meter transmission units	$95,000
• Instrumentation upgrades/SCADA System	$85,000
• Lone Tree pumps/motors	$55,000
• System improvements	$50,000
• Update of town water master plan and water rate study	$66,000
• New vehicle (one)	$37,500
• Fire hydrant repairs	$30,000
• Water line replacement	$30,000
• Tools	$5,000
• Testing equipment	$4,000
Administration	$216,500
Fund Transfer	$90,000



The fund balance at the beginning of 2015 was $12,003,161.

Johnstown retired its Water Fund Debt in 2014.

3.4 Technical, Managerial and Financial (TMF) Capacity

Review of the State Technical, Managerial and Financial (TMF) guidance document used for the State Revolving Fund (SRF) Load Program identified the following areas for consideration by the Town of Johnstown:

Staffing

A review of the duties and hours required for routine water department activities is strongly recommended.

Maintenance Scheduling and Record Keeping

A computerized maintenance management system (CMMS) software program is recommended for the water department.

Vulnerability Assessment and Protection from Crime –Terrorism

We recommend that the Town update its vulnerability assessment to address security issues in its water system.

3.5 Hydraulic Computer Model

J-U-B modeled the Town's water system using InfoWater, a GIS-based program that is compatible with EPANET2. InfoWater offers accurate dynamic modeling with many advanced features for evaluating alternate scenarios and system configurations. It also allows the results to be displayed in a variety of graphic formats. The GIS capabilities of InfoWater were used to generate many of the exhibits for this report.

The Town provided a copy of the model from the 2005 master plan for use in developing a model for current conditions, and for year 2035 conditions. J-U-B converted the existing static model to a dynamic model, and updated it to include upgrades to pump stations, additional waterlines, and the north water tank. This allowed us to make sure that the proposed water storage tank would cycle over time, and also allowed us to better model the behavior of the Towns pump stations.

Figure 3-12 shows the future peak hour pressures in the distribution system. This map was generated based on projected demands, and on the Town's estimated locations for future development. We added pipes to the model to serve new development, using the proposed standard sizes for water main design. The figure shows that distribution system will be able to deliver adequate peak hour pressures.

We were also able to model both the existing water storage tanks, and the proposed tank, over time. Operators report that the finished water tanks occasionally draw down to a level of 28 feet. Our model reproduced a minimum level of 32 feet on max day. However, the model does not take into account the backwash cycle, during which water is drained back into the plant from the tanks. Assuming a backwash volume of 110,000 gallons, and an average max day demand of

Town of Johnstown

Water System Master Plan
Future Peak Hour Pressures

To Lone Tree Reservoir

Legend

- Valves
- Pumps
- Tanks

Pipe Sizes

- 4" or Smaller
- 6"
- 8"
- 10"
- 12"
- 16"
- 18"
- 20"
- Assumed Future Pipes
- Pressure Contours

Pressure Zones

- North Tank Zone
- West Zone
- East Zone
- Old Town Zone
- Stroh Farm Zone
- Service Area Boundary

Future Peak Hour Pressures

- Less Than 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- Greater 100 psi

Town of Johnstown

J-U-B ENGINEERS, INC.

N W E S

0 1,500 3,000 6,000 Feet

Eye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

3,080 gpm, the expected tank level at the end of a backwash cycle would be, if modeled, 29.4 feet. This correlates well with observations.

We modeled the tank proposed for a location near Stroh Farm to determine if it would cycle sufficiently to prevent water quality concerns, and if it would improve fire flows. Our results indicate that a 1.5 MG would cycle adequately under average day demands. As part of a tank siting study, further modeling of the tank based on the chosen site and alignment of the connecting pipeline would ensure that the tank would operate as intended.

Our analysis of peak hour plus fire flow conditions indicates that the system can deliver fire flows of 1,500 gpm at pressures at or above 20 psi to nearly all locations. The exceptions are at points at the end of dead end lines in Old Town. Looping existing lines and prudent placement of hydrants would likely mitigate these deficiencies. Figure 3-13 shows the results of our analysis.

Town of Johnstown

Water System Master Plan
Peak Hour Plus Fireflow
Residual Pressures at 1,500 gpm

To Lone Tree Reservoir

Legend

- Valves
- Pumps
- Tanks

Pipe Sizes

- 4" or Smaller
- 6"
- 8"
- 10"
- 12"
- 16"
- 18"
- 20"

Pressure Zones

- North Tank Zone
- West Zone
- East Zone
- Old Town Zone
- Stroh Farm Zone
- Service Area Boundary

Residual Pressure at 1,500 gpm

- Less Than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- Greater Than 100 Ppsi

Town of Johnstown

N W E S

J-U-B ENGINEERS, INC.

0 1,500 3,000 6,000 Feet

Eye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Johnstown Water Master Plan

Section 4

4.0 System Needs

4.1 Health and Compliance

During the 2014 calendar year, the Town tested for water quality and the presence of contaminants in its water system. Ten samples were taken to measure chlorine residual, four samples were taken to test for total trihalomethanes (TTHM), and one sample for total haloacetic acids (HAA5). In addition, tests were performed for total coliform, copper, lead, organic carbon, turbidity, radium, barium and total dissolved solids. No violations were reported for these tests. A copy of the 2015 Drinking Water Report is included in the appendices.

The Town's 2015 reporting period does not end until December 31st. However, as of the writing of this report there have been no violations of applicable water quality contaminant limits.

4.2 Security

Subsequent to the 9/11 attacks, Johnstown performed a vulnerability assessment of their water system infrastructure. Although some actions were taken to reduce the vulnerability of the system, the opportunity exists for further work. We recommend the following measures:

- Install a 6-foot secure fence with a locking gate around the perimeter of the water treatment plant.
- Install secure locks on the doors of all plant facilities and pump stations.
- Install locking ladder gates on the two water tanks at the water treatment plant.

4.3 Operation and Maintenance

Numerous operations and maintenance issues have been identified in the water system. Many of these are related to aging equipment in the water treatment plant, and the finished water and Lonetree pump stations. Of immediate concern are the following items:

- The powdered activated carbon (PAC) system has broken down multiple times.
- One of the three recycle pumps in the water treatment plant is out of service.
- The leased communication line between the Lonetree pump station and the treatment plant is subject to intermittent interruptions, requiring plant controls to be manually reset. (SCADA upgrades are proposed for the 2016 budget).
- The backup generator at the water treatment plant was out of service for eight weeks during 2015 due to failure of a transfer switch, and the long lead time to obtain a replacement for the older part.
- The PRV located in the finished water pump station between the east and west finished water pump discharge requires servicing.
- The backup generator at the water treatment plant should be regularly inspected and tested. (A generator maintenance agreement is budgeted for 2016).
- The PRVs along Telep Avenue should be serviced on a regular basis.
- The computers and other electronic equipment at the water treatment plant need to be replaced.

The Town needs to upgrade the equipment required for reliable operation of its water treatment plant. The central requirement to improve this situation is a SCADA system that links the pump stations and tanks with the water treatment plant, and automates their operation. The proposed installation of a SCADA system will reduce in inefficiencies and costs of operation.

A municipal water system will experience losses in its distribution system of anywhere from 10% to 50% of the finished water it produces, depending on the age of the pipes, soils, and other factors. We were unable to calculate the losses in Johnstown's system due to lack of detailed meter records, and inaccurate measurements of pump discharge at the plant. The pitot type flow meters on the finished water pumps at the treatment plant are not measuring accurately. Neither

registers any flow above 4.32 MGD (3,000 gpm). Thus, we were unable to accurately determine how much finished water the plant delivers into the system. The Town provided usage data from meter read routes, which combine the readings of individual meters into groups by housing subdivision. Even with accurate measurements of pump discharges at the plant, the meter read data would have limited the ability to accurately calculate where losses are occurring. Without knowing the true production of the plant it is not possible to accurately determine the magnitude of the losses. Replacement of the pitot-type meters with magnetic flow meters would address this shortcoming.

4.4 Growth

Referring to Section 2.4, the Town has a diverse portfolio of water rights. The Town provided a draft of the Water Rights Integration Plan Report (2005), prepared by Helton & Williamson. The draft report characterized the Town's portfolio as able to provide the Town a stable water supply.

The Town draws raw water from both Lonetree Reservoir and Johnstown Reservoir. Lonetree is preferred for water quality reasons, as there are sometimes taste and odor issues related to the Johnstown Reservoir water.

Referring to Section 3.2, continually maintaining plant components will facilitate the water treatment plant's ability to produce its current net design capacity of 5.9 MGD. With this ongoing effort, the plant is projected to be adequate until 2025. Prior to that time, the Town can request a variance from the State to increase the filter loading rate to 6.0 gpm/sf, which would yield a net plant capacity of 7.08 MDG, which would be adequate until 2030. We recommend that the Town perform a specific study on the merits of replacing the media filters as Max Day Demand approaches 5.8 MGD with ultrafiltration (UF) membranes as the next evolution of the Town's water treatment plant. This will require the upgrade or replacement of other plant components associated with membrane treatment. It may be possible that membranes could be installed in the existing medial filter bays. This water treatment plant planning study should be conducted will determine the regulatory and industry options for membrane filtration at that

time. We recommend that the capacity of a new membrane plant be approximately 10.0 MGD with provision for modular capacity increases.

Referring to Section 3.2, the Town has an immediate need for storage to provide fire flows in the event of a pump station failure. As the plant capacity is increased, the Town will need more operational storage than is provided by the existing tanks at the water treatment plant to avoid drawing the tanks down below a serviceable level. Construction of a 1.5 MG tank in the Old Town Zone will meet both current and future needs.

The Town should continue to replace old 6-inch waterlines in the Old Town area in conjunction with other infrastructure projects, and require 12-inch waterlines on section lines and 10-inch waterlines on half-section lines to serve new development. Additions to the distribution system should be looped to the extent possible.

Referring to Section 2.3, he North Front Range is expected to grow at a rate well in excess of the State average. Our projections for growth are based primarily on the State Demographer's estimates, and the North Front Range Regional Transportation Plan Update, with additional input by the Town. The Town's projections anticipate the continued addition of residential developments to the system, with commercial development along the Highway 34 corridor.

The Town's water rates are among the lowest of water utilities in the area. We recommend that the Town perform a rate study to align its rates with the expenditures required to address vulnerabilities of its water system, and to fund its capital improvements program.

Johnstown Water Master Plan

Section 5

5.0 Assessment of Alternatives

5.1 Description

Water Treatment

Johnstown is able to meet current requirements for removal of contaminants and disinfection with its existing water treatment plant. Johnstown will be able to satisfy Maximum Day Demand production until 2025 when demand is projected to be 5.81 MGD, at the current approved filter loading rate of 5 gpm/sf. If the Town were to obtain State approval to increase the filter loading rate to 6 gpm/sf the net filter capacity would be 7.08 MGD. Since the installation of the DAF in 2005, the Town has been able to produce water of high quality, according to its annual Water Quality Reports. The Town's two most feasible options for increasing its water treatment capacity are retrofitting the water treatment plant with ultrafiltration (UF), or the addition of a third filter train.

The 2002 water treatment plant study identified several options that would fit within the existing site. Addition of a third filter train would require expansion of the existing building to accommodate the filters, piping improvements, clearwell pumps, a clearwell expansion, increased chemical systems, controls, and other associated equipment. The recommended alternatives in 2002 included a dissolved air flotation (DAF) pre-treatment system, ballasted flocculation, membranes, and high rate clarification. The Town subsequently constructed the recommended alternative, a DAF system. Associated work included conversion to liquid sodium hypochlorite, replacement of the effluent piping, filter media replacement, and improvements to the filter building. This increased the plant's capacity to 5.0 MGD. Improvements associated with the filters were limited, anticipating a conversion to membrane filtration.

The most cost effective and treatment effective option for the Town is to first address deficiencies in equipment, operations and maintenance identified in this report. Referring to Section 3.2, plant capacity can be increased without major capital construction to meet needs for several years. The current DAF saturator creates significant turbulence in the DAF and the compressor is prone to operations and maintenance demands. It is recommended to replace the DAF compressor and saturator tank with an upgrade that does not require an air compressor. The Nikuni dissolved air pump system upgrade for 10 MGD would cost approximately $175,000.

The Town should continue to study membrane installation as max day demands increase in preparation of when max day demands exceed 6.5 MGD. As of 2015, our investigation into current industry trends suggests pricing for close (pressure) membranes has reduced significantly. Additionally, we identified a universal UF rack that will allow competitive bidding of UF modules as compared to submerged membrane systems that required proprietary membranes when replacement is needed. As stated above, the existing WTP will produce Max Day Demand until 2025. Ten years from now, technologies will likely have evolved again as they have since 2005 and a detailed engineering analysis will be needed to identify the most cost effective solution for Johnstown.

Water Distribution and Storage

Referring to Section 3.2, Johnstown's water system lacks the storage necessary to supply fire flows in the rare event of a failure of the finished water pumps. Deficiencies in operational storage will grow as treatment capacity increases. Although the emergency connections with Greeley, CWCWD and Little Thompson Water District can provide an emergency supply, they cannot meet operational and firefighting needs.

Options for adding storage include construction of a tank to the southwest of the Stroh Farm development, construction of additional storage at the water treatment plant site, construction of a tank on the western boundary of the service area, and construction of a tank in the southeast part of the service area. The previous master plan recommended a 2.0 MG ground-based tank to

the southwest of Stroh Farm to augment fire flows and to serve proposed development in that area. This option was not pursued by the Town. This tank would have required 2 miles of pipeline to connect it to the Pioneer Ridge development. The development anticipated in previous studies for this area has not occurred, and the demands of the existing development in the Stroh Farm pressure zone are not sufficient to allow a remote tank to cycle. It is likely that this tank would not be operational until future demands were significantly higher, as is the case with the north tank.

A storage tank located on the western boundary of the service area could be connected to the existing 20-inch pipeline serving the North Tank Zone. This tank would serve the West Zone directly, and could serve to the east if additional piping and PRVs were installed. However, the West pumps currently deliver only 25% of the water produced by the plant. This tank would be geographically removed from the bulk of the demand in the system, and would not provide operational storage to the East pumps.

Additional storage at the water treatment plant site would provide operational storage, and augment fire flows in the East and Old Town pressure zones. However, it could not effectively augment fire flows for the Stroh Farm area due to distance and long pipe runs.

A 1.5 MG elevated water storage in the Old Town Zone would supply that zone, the Stroh Farm pump station, and provide higher pressures in the East Zone than would be provided by the tanks at the water treatment plant in the event of pump failure. It is also the only option that would allow the East pumps to pump to storage. This would eliminate the need for them to deliver peak hour demands, and thereby extend the number of years until they would need to be upgraded. We recommend that the Town investigate potential sites to the northeast of the Stroh pump station. A tank between 170 feet and 190 feet tall, depending on location, would provide the necessary storage, and would operate efficiently in the current system.

5.2 Design Criteria

Water Treatment

Any substantial modification to a treatment plant requires a design review by the Colorado Department of Public Health and Environment. A substantial modification is typically defined as one that either increases the treatment capacity, or changes an element of the treatment process.

Installation of the DAF reduced the amount of residual solids going to the backwash pond by reducing the amount of alum necessary for treatment. The 2002 report estimated that residuals production would be cut in half.

The State of Colorado Design Criteria for Potable Water Systems states that a filtration plant with two trains, such as Johnstown's, must be able to meet the plant design capacity with one train removed from service. We discussed this with the State's lead drinking water engineer, and were told that the intent is to provide redundancy to the system. In Johnstown's case, this redundancy is provided by its interconnections with other water districts, and that it would be highly unlikely that a third filter train would be required for this purpose.

Water Distribution and Storage

The maximum allowable resident time for potable water in storage varies by jurisdiction, and the State of Colorado is not specific. We recommend that a new tank be sited and designed such that its operation would limit resident time to between two and three days. We recommend that as part of a formal siting study for a new tank the system be modeled to determine that adequate mixing and turnover would occur. The hydraulic model developed as part of this study could be modified for this purpose.

Water storage tanks can be made of concrete, welded or bolted steel, or a composite of the two. The Town's north tank is a welded steel pedestal design. This type of tank would be well suited

to the proposed location, due to its clean appearance. Steel tanks are typically coated on the interior and exterior, and these coatings must be maintained. The maintenance cycle for such work is typically 8 to 10 years.

The distribution system is not looped to the north, west and the southeast. Interconnects to other water systems exist, but are not available to supply normal demands. As new development occurs in the service area, the Town should promote or require as necessary the construction of water mains to loop these areas.

5.3 Environmental Impacts

Water Treatment

Work confined to the existing water treatment plant site would likely not initiate concerns related to floodplains, wetlands, wildlife habitat, or historical and archaeological issues.

Water Distribution and Storage

We do not anticipate any environmental impacts arising from replacement of PRVs and installation of the associated communications equipment linking them to the SCADA system, or with construction at potential tank sites. For the purposes of estimating costs, we have assumed that a pipeline serving the new tanks would not cross the Little Thompson River, and would instead cross agricultural land. However, a river crossing would shorten the pipeline and possibly decrease its cost. This option would require work in the floodplain. Project requirements would include delineation of wetlands, assessment of wildlife habitat, floodplain permitting, and more in depth reviews by agencies having jurisdiction over the work.

5.4 Land Requirements

Water Treatment

The water treatment plant is located on a 13.65 acre parcel. However, approximately two-thirds of this property is given over the Town's cemetery, leaving about 4.5 acres to house the plant, DAF building, clarifiers, finished water tanks, backwash pond, and associated facilities. There is room to expand the existing filter plant building to accommodate a third filter train. However, space for a new membrane building could be made by demolition and removal of the clarifiers if retrofitting the filter bays was not the chosen membrane option. The existing finished water tanks should meet disinfection requirements through 10 MGD production. Backwash pond capacity could prove limited if conventional media filtration remains the treatment technology after 2025, but would be more than sufficient with membrane treatment.

Water Distribution and Storage

We recommend that the Town investigate the acquisition of property for the tank, as well as easement or right-of-way for the connecting pipeline. A one-acre parcel would be sufficient for the tank itself. The required easement or right of way for the connecting pipeline would depend on its alignment.

5.5 Construction Problems

Water Treatment

The subsurface geology of the existing plant site is unknown, but the experience of prior construction at the site would provide a guide. The site is located on a relative summit, with the Hillsboro Ditch nearby. The presence of the ditch would increase the likelihood of groundwater during any construction below grade. Access to the plant is through the cemetery. Construction problems are not anticipated associated with future projects at the water treatment plant.

Water Distribution and Storage

The existing PRV installations are in vaults adjacent to or within public right of way. The proposed tank would be located on property purchased by the Town. Access to the site would be via a permanent easement to allow maintenance of the tank. The connecting pipeline could either be laid within the Town's tank access easement, or within an easement separate for the purpose for crossing the Little Thompson River.

5.6 Operational Aspects

Water Treatment

Plant staffing has been minimal in the past, but the Town has budgeted the addition of a new position. Minimal staffing coupled with insufficient SCADA of raw water, plant, and distribution system components establishes a pattern whereby staff function between daily operations of the facilities and addressing problems. The increase in staff should improve record keeping, and provide more time to develop standard operating procedures (SOP). Johnstown operations staff do an amazing job maintaining superior water quality production and distribution under these circumstances.

We recommend the Town increase staffing and implement SCADA. Staff members should be put through regular training. When the plant is upgraded to membrane filtration, staff should continue training in the new technology. SOPs should be developed for the current plant facility and distribution system, and they should be updated on regular intervals.

Water Distribution and Storage

Other than routine monitoring, we recommend that trained service personnel perform maintenance of the proposed tank, and of the proposed control valves.

5.7 Cost Estimates

Historically the Town has tended to defer capital improvements pending the pace of development. Should the Town move forward with construction of the proposed storage tank, the operations costs will be negligible by comparison as there is very little involved in operating a tank. The significant maintenance costs of a tank accrue when it requires recoating. This is required for the first time anywhere from 7 to 15 years after the tank is built. Annual costs cannot be calculated until the tank itself is constructed.

We estimate that in 2030 the cost to retrofit the water treatment plant will be between $12M and $15M. This is a rough order of magnitude (ROM) cost. Technologies, and their associated costs, have changed significantly from those recommended in the 2005 plan. It is likely they will change even more in the next 15 years. It is therefore not possible to provide a meaningful economic analysis of a project that will occur that far in the future.

5.8 Advantages/Disadvantages

Water Treatment

It is likely that the recommended treatment technology in 2030 will be some form of membrane. Current generation membrane-based plants can be operated more reliably and with greater automation than comparable media filter-based plants. Since the 2005 plan, costs for different types membrane have come down considerably, making them more attractive to small municipal systems. When the Town elects to move forward with plant expansion, a cost-benefit analysis of the options available at that time should be required as part of a preliminary design and feasibility study.

Water Distribution and Storage

Addition of water storage to the Town's water distribution system would meet the needs for increased reliability, operational stability, and adequate fire flows. Section 5.1 discusses the relative merits of four different locations for a tank. Actual costs of each alternative would depend on a variety of factors, each of which is sensitive to when the project moves forward. The Town would be prudent in acquiring property for a tank site now while there is still undeveloped land available for this purpose.

Johnstown Water Master Plan

Section 6

6.0 Recommended Alternative

6.1 Justification of the Recommended Alternative

Water Treatment Plant

As discussed in Section 5, the water treatment plant can meet demands until 2025 at the current approved filter loading rate, and until 2030 if the State were to approve an increase in the filter loading rate to 6 gpm/sf. Prior to demands reaching 6.5 MGD the Town should perform a full treatment study to determine the best alternatives for a complete retrofit. In the interim, the Town should continue investment in training; replacement of equipment; maintenance of infrastructure; and the addition of components, such as a full SCADA system, to provide operational and economic efficiency of the water treatment plant.

Distribution System

As discussed in Section 5, an elevated water storage tank placed in the southeastern portion of the service area would meet both immediate and long term needs for the Town. Although the Town's emergency connections to adjacent water systems mitigate the need for additional storage, they do not eliminate it.

6.2 Costs

Project	Total	2016	2017	2018	2019	2020 & Beyond
Water Treatment						
Retrofit Plant with Membrane Techonology	$15,000,000					$15,000,000
Compressor Saturator System	$175,000		$175,000			
New Flow Meters, East & West Pumps	$40,000	$40,000				
SCADA System Installation & Upgrades	$150,000	$150,000				
Water Distribution						
Replace (3) Telep PRVs & Clearview PRV w/ Control Valves	$68,000	$17,000	$17,000	$17,000	$17,000	
Replace Highway 402 PRV w/ Control Valve	$24,000					$24,000
Water Storage						
Land Acquisition	$75,000		$75,000			
1.5 MG Old Town Zone Tank	$2,625,000			$2,625,000		
Connecting Pipeline	$300,000			$300,000		
Totals	**$18,457,000**	**$207,000**	**$267,000**	**$2,942,000**	**$17,000**	**$15,024,000**