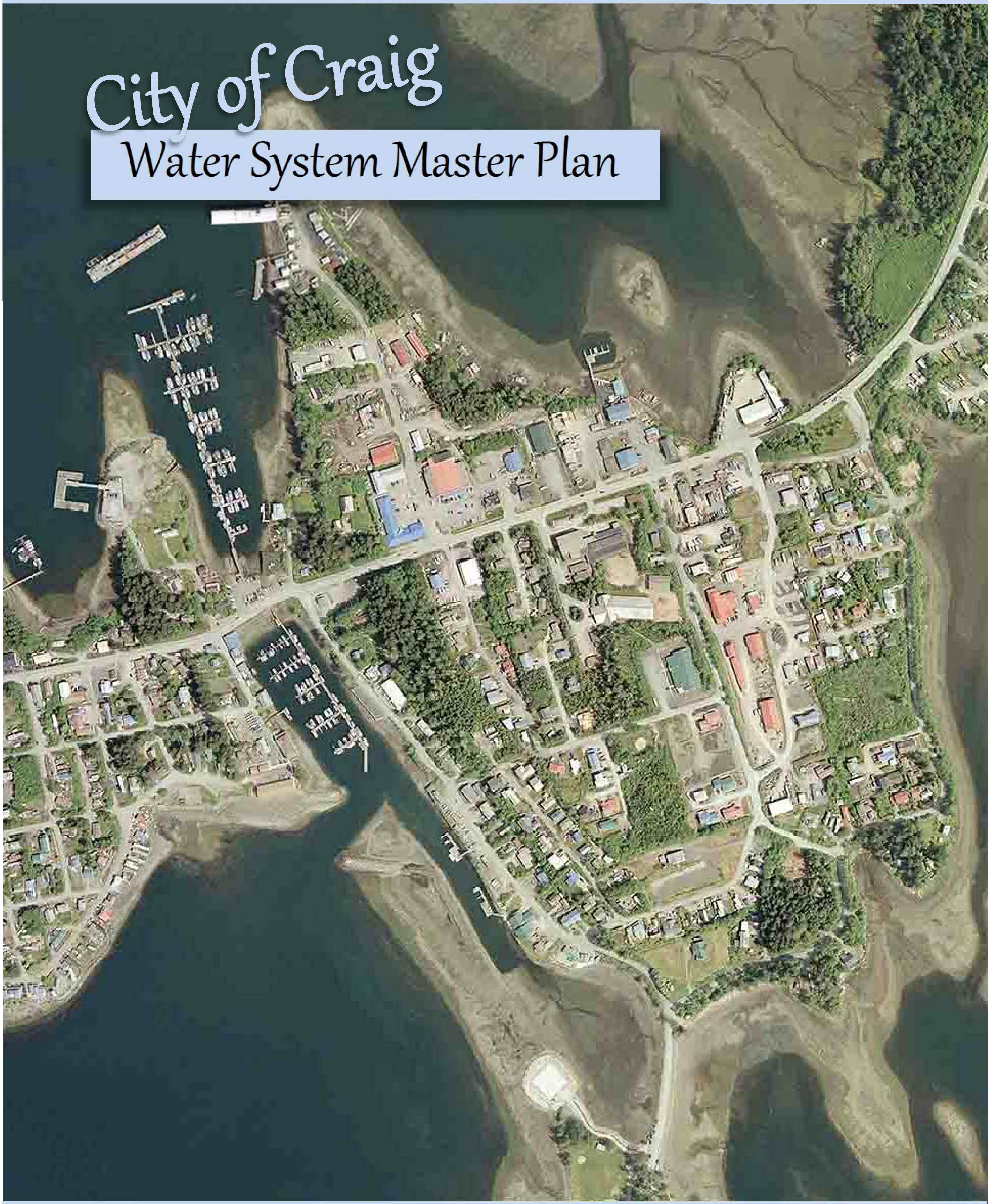
April 2015

City of Craig

Water System Master Plan



DOWL HKM

CITY OF CRAIG
MUNICIPAL WATER SYSTEM
MASTER PLAN

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LIST OF ACRONYMS

°C	degrees Celsius
°F	degrees Fahrenheit
µg/L	micrograms per liter
DEC	Alaska Department of Environmental Conservation
AP&T	Alaska Power & Telephone
CIP	Capital Improvement Project
CT	contact time
D/DBPR	Disinfectants/Disinfection By-Products Rules
DBP	disinfection by-products
DI	ductile iron
DNR	Department of Natural Resources
DO	dissolved oxygen
EPA	United States Environmental Protection Agency
ESWTR	Enhanced Surface Water Treatment Rules
FBRR	Filter Backwash Recycling Rule
GIS	geographic information systems
gpm	gallons per minute
HAA5s	five haloacetic acids
HDPE	high-density polyethylene
IDSE	initial distribution system evaluation
IESWTR	Interim Enhanced Surface Water Treatment Rules
kW	kilowatts
LCR	Lead and Copper Rule
LRAA	locational running annual average
LT1ESWTR	Long Term 1 Enhanced Surface Water Treatment Rule
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
MCL	maximum contaminant levels
mg/l	milligrams per liter
MRDL	maximum residual disinfectant levels
NTU	Nephelometric Turbidity Units
PC	personal computer
PLC	programmable logic controller
ppm min	parts per million per minute
ppm	parts per million
PRV	Pressure Reducing Valves
psi	per square inch
QF	Qualifying Facility
RAA	running annual average
RTU	remote terminal unit
SCADA	Supervisory Control and Data Acquisition
SWTR	Surface Water Treatment Rule
TCR	Total Coliform Rule
TDG	total dissolved gas
TTHM	trihalomethanes
VFD	variable frequency drive
VPN	virtual private network
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

1.0 INTRODUCTION

The City of Craig is located on the west coast of Prince of Wales Island in southeast Alaska (Figure 1.1). It is the largest town on the island, and has a population of 1,201 people according to the 2010 census. This is a slight decrease from the 2000 census when 1,397 people reportedly lived in Craig. Its population is largely dependent on the fishing and logging industries. It began as a fishing town in the early 1900s and was incorporated as a city in 1922. The population fluctuated with the fishing season but was stabilized in 1972 by a sawmill opening which provided year-round employment. Logging has declined in recent years but fishing continues to be an important industry. Tourism is becoming an increasingly important industry for the area.

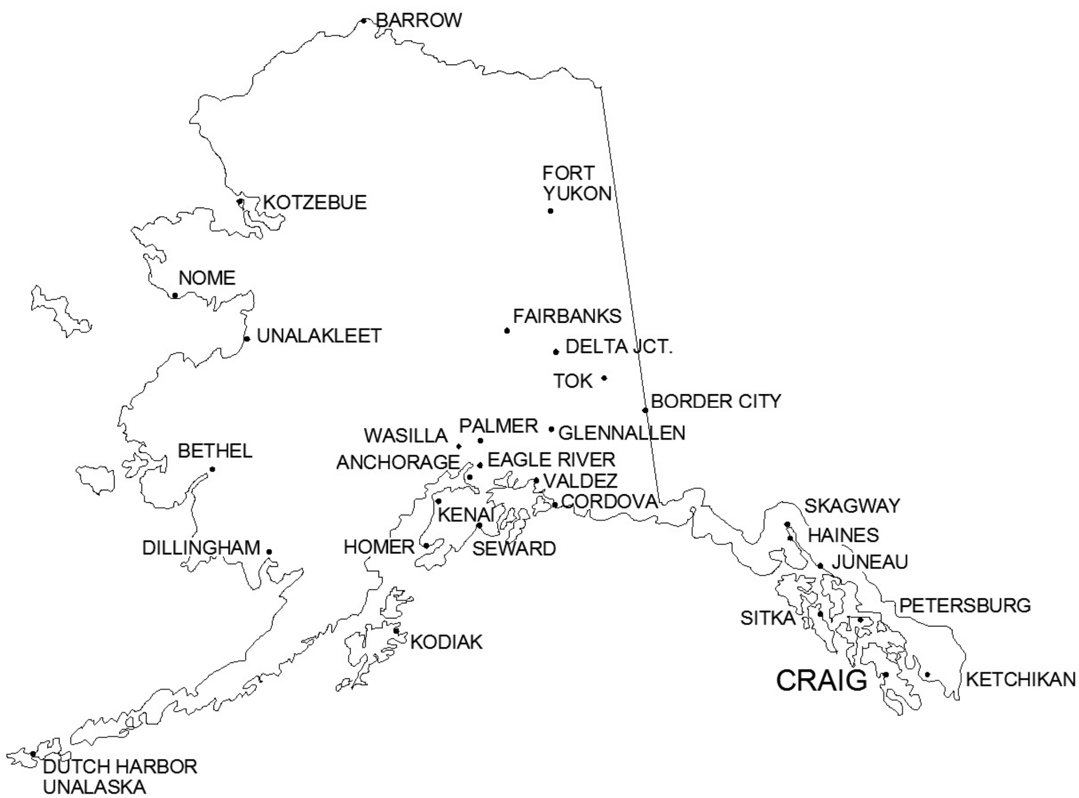

Figure 1.1: Craig, Alaska Vicinity Map

Access to the island is provided by airplane and ferry. Once on the island, the road system provides access to all but a few communities.

Prince of Wales Island has a cool, moist maritime climate. It has rainforest designation, and an average annual precipitation of 120 inches, including more than 40 inches of snow. Summer temperatures range from 49 degrees Fahrenheit (°F) to 82°F while winter temperatures may drop to -2°F. Mean annual temperature is 43°F.

The island is characterized by glacially formed steep, forested mountains and deep U-shaped valleys. There are numerous lakes, straits, and bays. Soils are generally shallow, poorly developed, and low in nutrient content. The cool temperatures and high precipitation suppress decomposition which leads to an accumulation of organic material. This combination causes mass wasting, and gravity-induced erosion.

DOWL HKM prepared this master plan in conjunction with a sewer master plan for Craig, Alaska. The objectives of the master plan are as follows:

- Based on visual inspection and review of applicable record drawings, provide a condition assessment of the existing water system,
- Estimate future water demands and assess the system's ability to meet these demands,
- Analyze present and future regulatory compliance,
- Develop a list of capital improvement projects, and
- Develop cost estimates for the capital improvement projects which could be used to solicit project funding.

2.0 CONDITION ASSESSMENT

2.1 Water Treatment Facility

Craig's raw water comes from North Fork Lake located in Section 11, Township 74 South, Range 82 East. Water is conveyed from the intake to the treatment facility via 6.4 miles of 12-inch ductile iron pipe. The Craig Water Treatment Plant (WTP) is located off Port St. Nicholas Road at Mile 5.25. It was constructed in 1992. There is a pressure reducing valve between the source and the treatment facility, one at the water treatment facility and two inside the facility.

The backbone of the facility consists of four key-tech treatment trains, manufactured by BCA Industrial Controls. The treatment trains treat by serving as sedimentation basins, flocculation chambers, and filters. Alum and polymer are added as coagulants prior to the treatment trains. Following the treatment trains, soda ash is added for pH control and chlorine for disinfection. Sludge from backwashing the filter is discharged to settling ponds on the south side of the plant. Sludge is transported to the local landfill. Figure 2.1 is a schematic representation of the WTP.

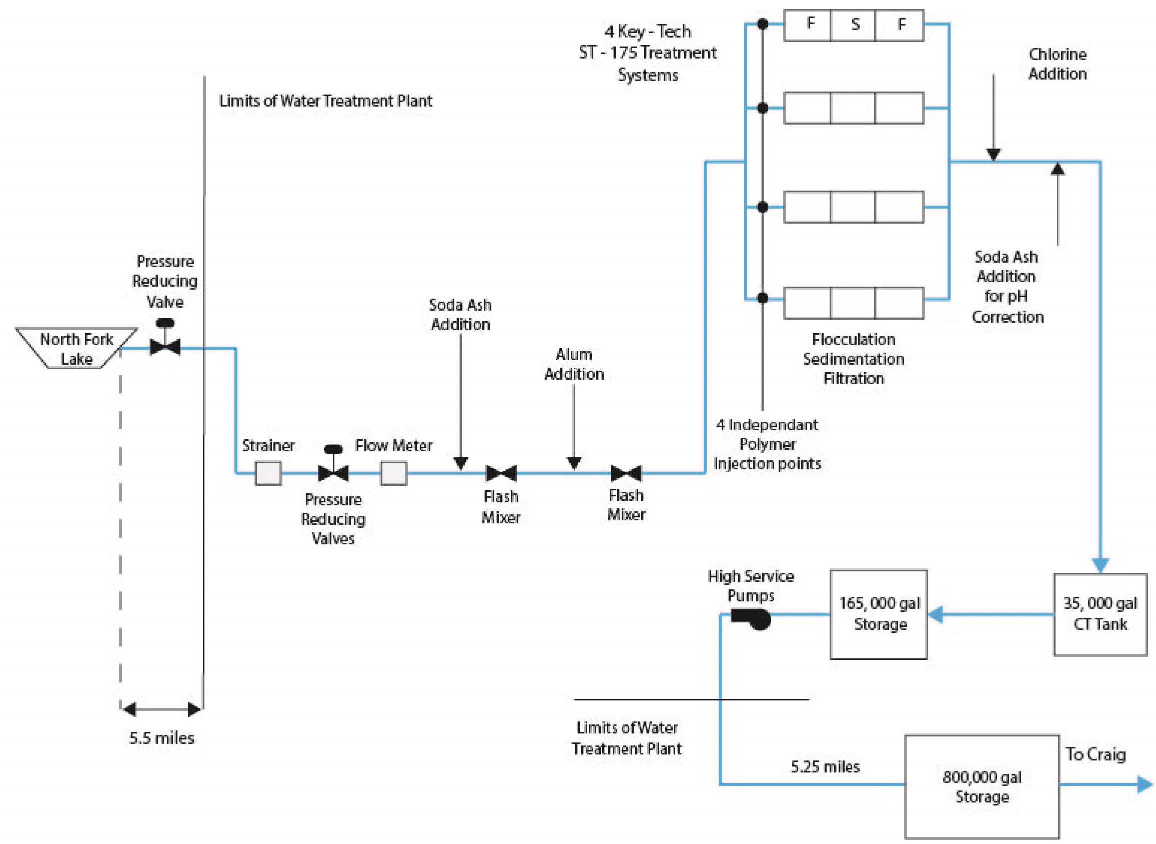

Figure 2.1: Water Treatment Facility Flow Schematic

On-site assessment revealed the following problems:

- Following backwashing of the filters, sludge is pumped to the sludge holding ponds. The sludge holding ponds should be lined with a high density polyethylene liner.
- The alum mixing station is heavily corroded. The automated controls do not function properly on this unit due to corroded control devices. The unit is operated manually.
- The treatment trains are rated for 175 gallons per minute (gpm) each, but only produce approximately 125 gpm each. Only three of the treatment trains can run at one point because running all four of the trains produces too much water to meet contact time requirements. Contact tank volume limits the contact time. This is one of the limiting factors on plant output. In peak demand times, the treatment plant cannot keep up, and the City water treatment plant has to essentially catch up during the hours of the day when the demand is lower. If an increased demand is expected, the system would need expansion.
- Alum precipitate forms in the injection line between the alum station and injection point. This results in a need to frequently clean the injection line (Figure 2.2).
- The controls system at the water plant lacks direct connectivity to the rest of the public works system. The remote terminal unit (RTU) at the 800,000 gallon tank communicates to the plant programmable logic controller (PLC) through a serial radio system and a communication personal computer (PC) at the wastewater treatment plant (WWTP). Overall the Supervisory Control and Data Acquisition (SCADA) communication network could be changed to ethernet to allow direct communication, however this would result in an increase in operations and maintenance costs.
- The soda ash control panel has a failed contactor for the vibrator.
- The polymer mixing system does not always stop automatically after a mixing cycle.

2.1.1 Controls Overview

Control systems for the plant were partially updated in 2004. This included a new plant PLC system, a new high service pump control panel, and the SCADA system. The main PLC is an Allen-Bradley SLC5/03, which controls the plant through both DeviceNet and DH485 communication protocols. Except for the fourth filter, which was installed in 2004, all other control panels in the plant were installed with the original plant in 1992.

Most control panels in the plant are over 20 years old and should be upgraded in the near future.

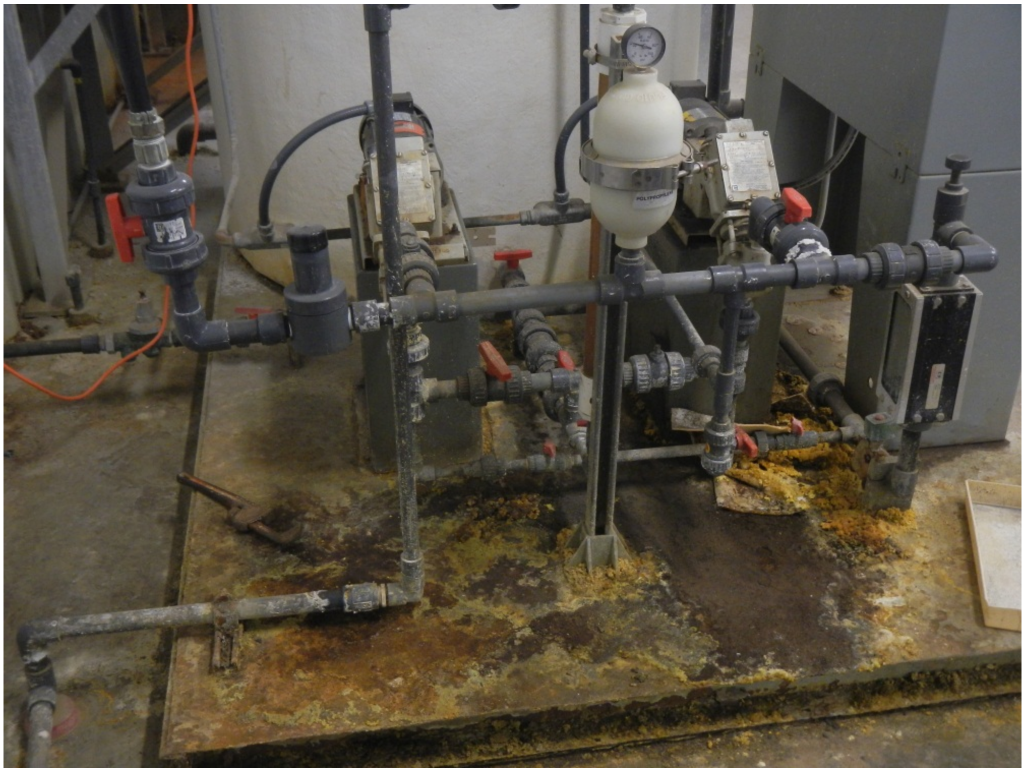

Figure 2.2: Corroded Alum Station

2.2 Water Storage Systems

The City of Craig used to be served by two 400,000 gallon wood stave tanks, one in West Craig and the other in East Craig. In the early-2000s, the East Craig tank was in poor condition and was removed. To replace the East Craig tank, in 2002 the City constructed an 800,000 gallon tank near the intersection of Port St. Nicholas Road and the Craig-Klawock Highway. The tank is in good condition but requires the addition of a new flow meter on the tank input pipe to monitor leakage between the tank and WTP. The tank does not include a mixer. In periods of low water demand the water has a chance to stagnate, which could cause problems with disinfectant by-products. The tank is not plumbed in a way that allows for flow back toward the WTP. If the WTP goes off-line, the customers on Port St. Nicholas road would run out of water when the tank level is below the tank inlet elevation. This has yet to occur, but it is a theoretical problem.

There is a SCADA remote terminal unit at the 800,000 gallon tank that measures tank level and flow. This RTU communicates with the SCADA system through the radio and PC at the WWTP.

On-site assessment revealed the following problems:

- The wood-stave tank in West Craig is half full but is not currently in use. The West Craig tank is kept partially filled to prevent the wood stave from drying out and deteriorating. A small amount of leaking was observed on the south side of the tank.
- The 2000 Water System Comprehensive Plan indicates that the bottom elevation of the West Craig wood-stave tank is 94 feet and the top elevation is 114 feet. At this elevation the tank could provide water to most points in the system, with the exception of Port St. Nicholas Road and the higher elevations of East Craig. The West Craig tank, if operated without the 800,000 gallon tank, would not provide adequate water pressure to residences of West Craig near the tank without the addition of a booster system. The bottom elevation of the 800,000 gallon storage tank is at approximately 175 feet, which is high enough to provide water all the way to the WTP down PSN Road.
- The West Craig tank could provide extra reserve for the system but it would require a variable frequency drive (VFD) operated output pump and controls, which would cycle the tank daily to prevent chlorination byproducts from forming due to a lack of circulation. The conversion would also require automated input pipe control valving to allow the tank to be drawn down daily. If this is not supplied, the tank would simply refill without discharging and using the water in the tank. The tank would also require controls and automation to regulate it from overflow, since it is much lower in elevation than the 800,000 gallon tank. The tank as currently operated serves no effective purpose.

2.3 Drinking Water Distribution System

The distribution system consists of approximately 18 miles of pipe ranging in size from 6- to 12-inches.

The drinking water mains neck down to two water mains between West and East Craig. The preliminary mapping indicates that the system is well looped, but there are a few dead end points. Dead end points allow for stagnation of water and the potential formation of disinfectant by-products. Dead end locations appear to be at:

- The hydrant at the WWTP on cemetery island,
- The hydrant near the Craig Seaplane Base at the northern end of 9th Street,
- The hydrant at the northern end of Front Street,
- The hydrant at the northern end of Cold Storage Road,
- The hydrant at Silver Bay Seafoods, and
- The hydrant to the northeast of the high school.

Dead ends should be minimized, if possible, and if not possible, a regular valve exercising and flushing program should be instituted.

The most recent break was along Port St. Nicholas Road (Figure 2.3). This is a particularly vulnerable point in the system because it is the only main running to Craig from the 800,000 gallon storage tank. When there is a break, the entire system must be shut down for repair.

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2.4 Water Treatment System Production

Figure 2.4 shows the monthly production of treated water and the monthly amount of raw water that goes down the raw water main between the reservoir and the treatment plant.

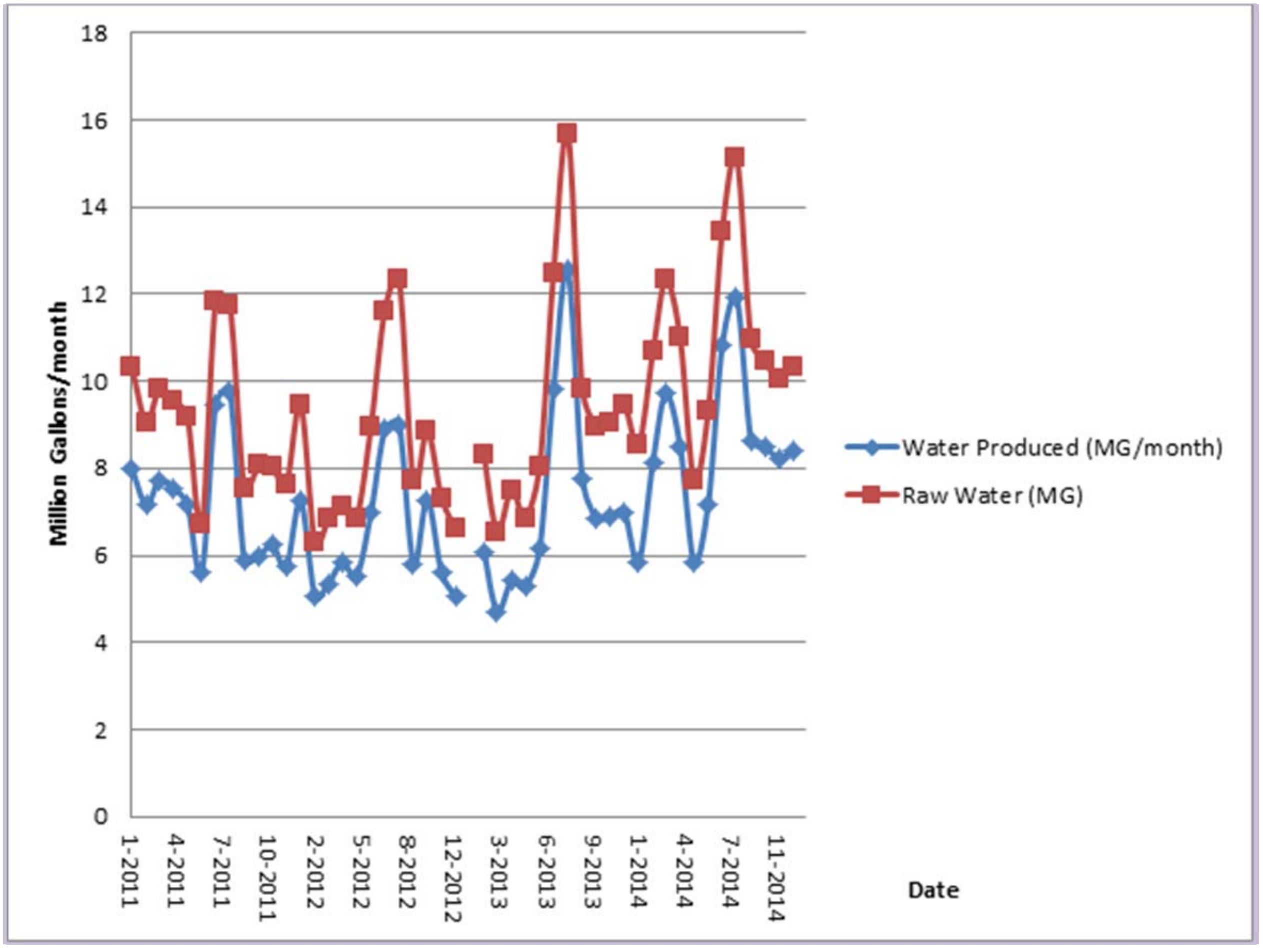


Figure 2.4: Raw Water and Water Produced

3.0 PROJECTED GROWTH SUMMARY

The population in the Craig area has increased and decreased over time. This fluctuation has been caused by factors including the fishing, timber and tourism industries, and the national economy. DOWL HKM used the most current information available in order to plan for future water and sewer service demand. These projections were developed from information provided by:

- The United States Census Bureau,
- The State of Alaska,
- The City of Craig,
- The Southern Southeast Regional Aquaculture Association,
- The Southeast Conference,
- The Shaan Seet Native Village Corporation, and
- The Klawock Heenya Native Village Corporation.

The population projections were used with planning assumptions and computerized models to estimate total water and sewer service demand for the City of Craig service area through the 20-year planning period.

Data sets provided by federal, state, and local government agencies were used to estimate the City of Craig's projected service area population through 2035. The starting point for this analysis is census data. The U.S. Census Bureau provided a count of the local population for a 2010 baseline. The State of Alaska has also developed population projections for Prince of Wales Island based on economic trends and governmental policies. Population projections by the State of Alaska for Prince of Wales Island can be seen in Table 3.1. Please note that the State of Alaska did not produce population projections for the City of Craig. The State of Alaska has projected that the population on Prince of Wales Island-Hyder census area will decrease annually over the next 20 years. Based on the projections provided by the State of Alaska, it was assumed that the population of the City of Craig may drop at the same rate as the rest of the census area to approximately 1,124 in the year 2040. It is important to note that the actual population in the City of Craig has grown in recent years, which defies State of Alaska projections and highlights the difficulty in long-range population projection. For the purposes of this report, we will assume the projections made by the State of Alaska are valid and that the long-range trend will be for a slight reduction in population over the next 20 years.

Table 3.1: Craig Population Projection Provided by the State of Alaska

	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040
Average Annual Percent Change	--0.22%	-0.26%	--0.26%	-0.22%	-0.22%
City of Craig Population at Start of Period	1,194	1,180	1,164	1,149	1,136
City of Craig Population at End of Period	1,180	1,164	1,149	1,136	1,124

*Average annual percent change is for Prince of Wales- Hyder Census Area. It was assumed Craig will increase/decrease in population at same rate as the census area. In 2010, Craig had a population of 1,201, since then the reported population in the census area was projected to decrease annually by 0.12 percent, which would result in a 2015 population of 1,194. Source: *Alaska Department of Labor and Workforce Development, Research and Analysis Section*

3.1 Local Stakeholder Interviews Regarding Projected Growth

DOWL HKM interviewed several of the organizations that own land in the area to determine future growth. Representatives from the Native Village Corporations of Klawock Heenya and Shaan Seet were contacted. Klawock Heenya owns land surface rights north of the City of Craig. They are one of the larger land owners in the area. They have no plans for future residential or commercial development of their lands within the Craig water service area. At the time of our call, they had no plans for any other significant economic development such as large timber sales, etc. Shaan Seet owns large portions of land where residential housing is within the City of Craig water distribution area. Shaan Seet does not own the housing. Their representative indicated they had only two minor activities planned in the foreseeable future. One of their projects includes the construction of a single family dwelling within the water service area. The other project is a storage facility which will not require water or sewer service. Craig Tribal Association has plans to construct a nine building, 16-unit subdivision on the uphill side of East Hamilton Drive at the 2000 Block, immediately north of Windy Way. Construction could begin in the year 2015.

3.2 Water Demand History

The total annual metered water demand has not changed much since 2006. There has been fluctuation in the total annual demand, but no significant growth in the total annual demand. A breakdown of the total annual metered usage is below (Figure 3.1). This data was supplied by the City of Craig. In this figure we see that some user groups have experienced fluctuations in usage.

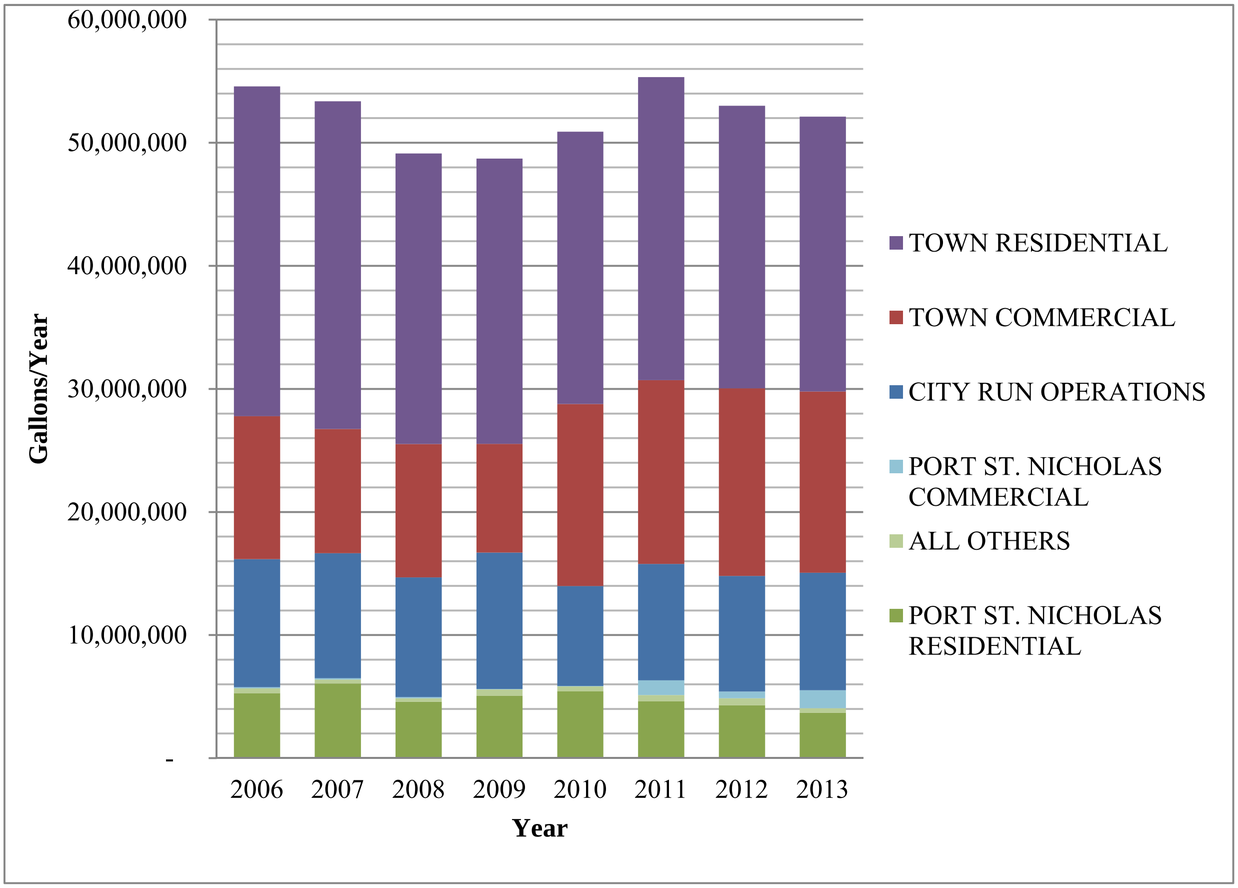


Figure 3.1: Current Water Use Breakdown

3.3 Projected Water Demand

The projected water demand is a study of the local water users and the growth trends they are experiencing. The various water user groups play an important role in forecasting future water use rates. Each grouping is represented in the paragraphs below.

3.3.1 Projected Commercial Growth

Craig currently has several industries built around the local aquaculture and seafood processing. These industries include commercial fishing and local fishing guides and companies such as Silver Bay Seafoods. Each of these users utilize water for processing and preserving their products. These users can consume large quantities of treated water and are seasonal in their usage. The growth of these industries in the area has strained the City of Craig's water treatment capacity during peak demand season. These users provide employment and are a valuable part of the local economy. Silver Bay Seafoods began operations in 2009. They are the major commercial water user in the area during the months of June through September. They experience peak demand in July and August. Providing adequate water for these industries is critical to the economic health of the City of Craig. The City of Craig has provided usage data from commercial meter readings to aid in forecasting the future water needs of these users. The proportion of commercial water use versus total water use for 2006 and 2013 can be seen in Figure 3.2 and Figure 3.3, respectively.

In these figures, commercial water use represents all water used by businesses and the City. The commercial use is modest, 11 percent to 34 percent, compared to other uses for the majority of the year, except in the summer when it dominates the water use at 45 percent to 68 percent for the City of Craig.

The City of Craig, in peak demand months, struggles to keep up with the residential and commercial demands. If large commercial users increased water demand, the City would not have the capacity to meet the need, while ensuring adequate stored water for fire flow. The City should continue to coordinate with large commercial customers to foresee potential increases in demand.

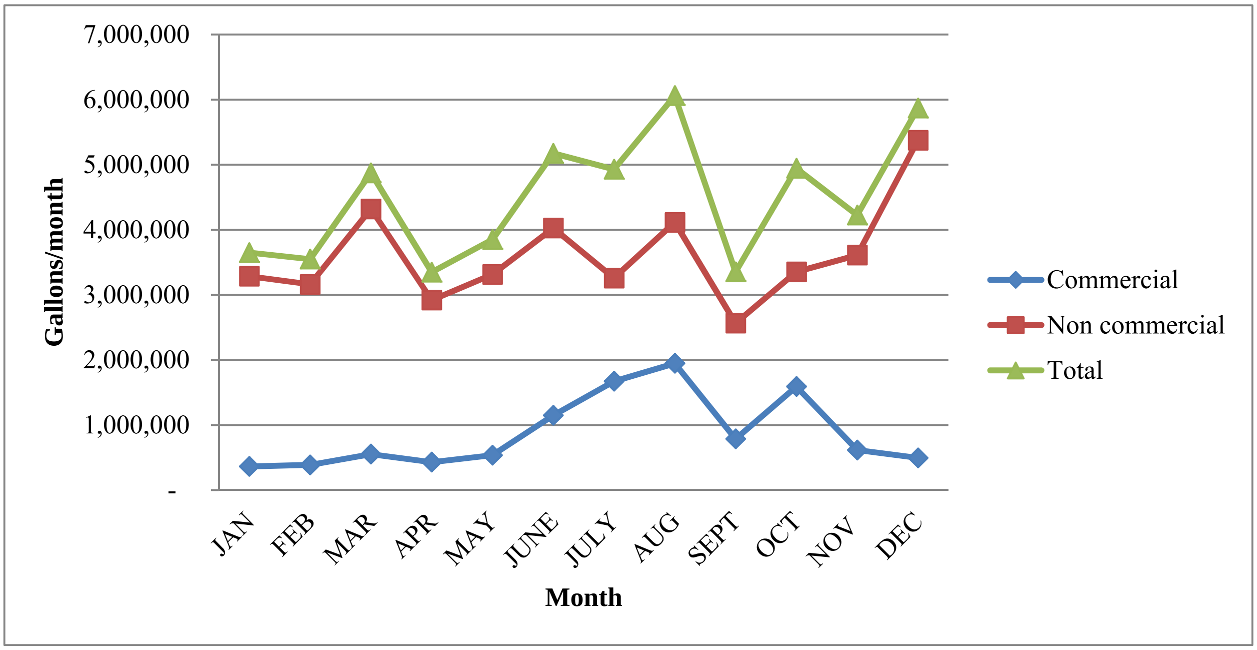


Figure 3.2: 2006 Commercial and Other User Demand

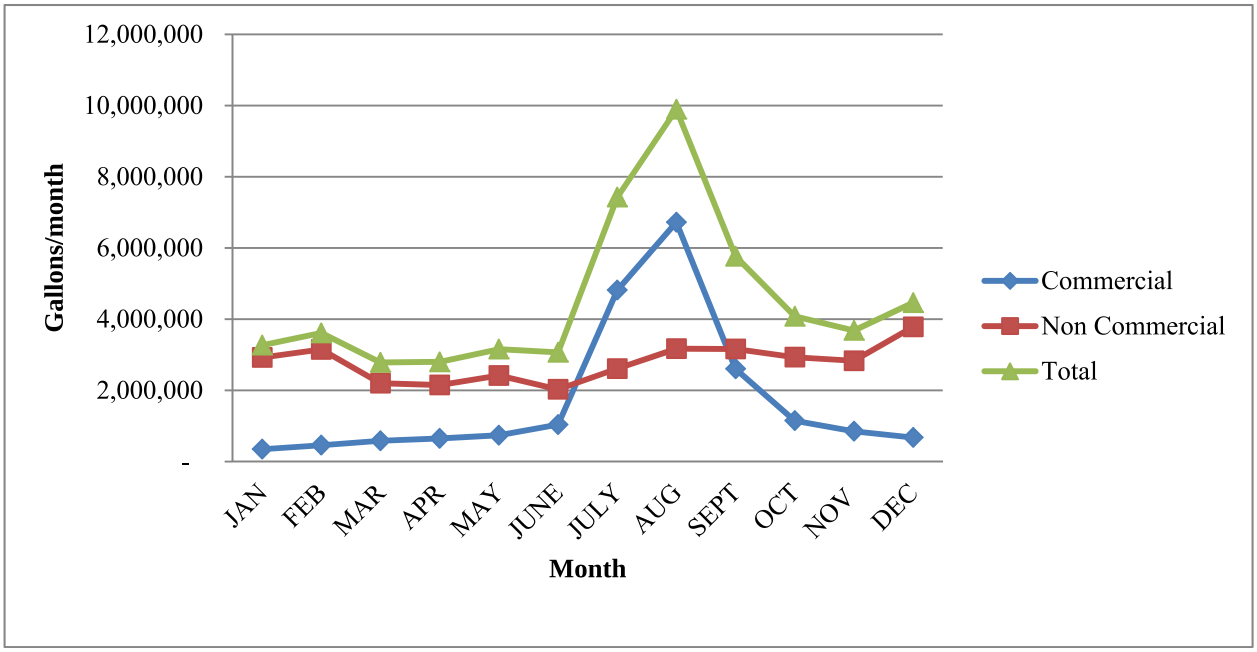


Figure 3.3: 2013 Commercial and Other User Demand

3.3.2 Projected Aquaculture Growth

Craig currently has a fish hatchery operating on a lot adjacent to the Craig WTP. This fish hatchery raises Chinook salmon. The hatchery uses untreated water, which comes from the same 12-inch raw water main that supplies the WTP. The hatchery is in the planning stages to add Chum salmon, and to increase production of Chinook salmon. The addition to this fish hatchery operation will increase the raw water demand from the North Fork Lake. This expansion could happen as early as 2015. This growth is important because it utilizes the same reservoir, raw water supply pipes, and land used by the current City of Craig WTP. The Southern Southeast Regional Aquaculture Association, along with the City of Craig Fish Hatchery, have provided use data and projected use data for the hatchery operation. This data accounts for the fish currently raised and for the fish that the groups intend to raise with the proposed expansion. These water use projections can be seen below (Figure 3.4). The peak in February is due to the expected surge in demand required for flushing of the hatchery in preparation for the release of the Chums.

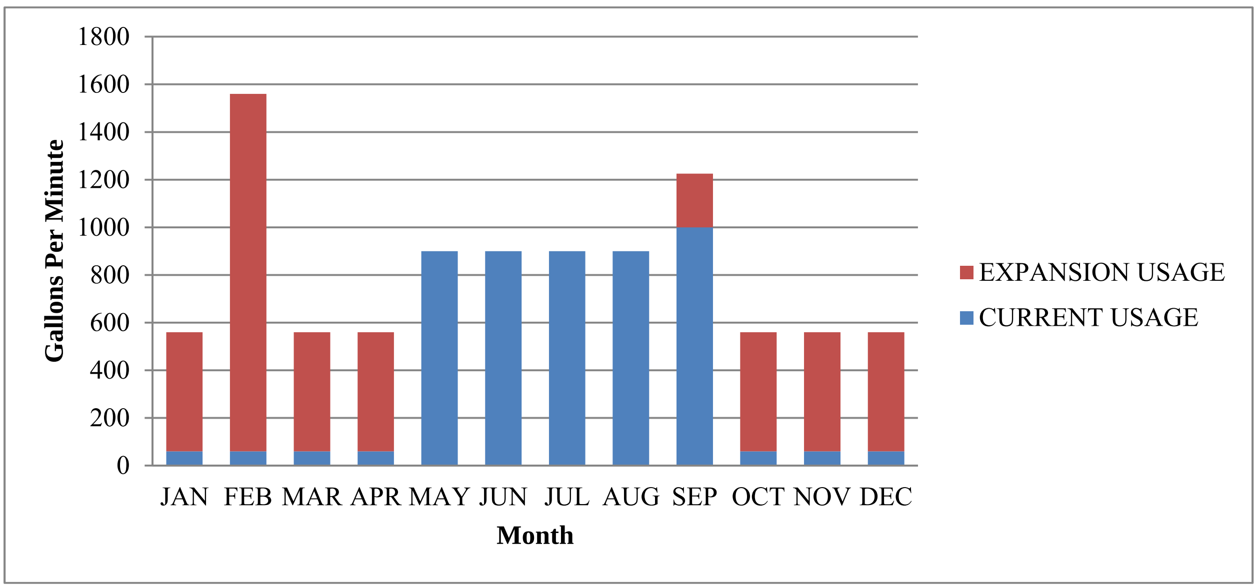


Figure 3.4: Current and Future Fish Hatchery Demand

3.3.3 Projected Total Raw Water Demand

The previous sections described the basic elements used to project water demand. These elements included:

- The anticipated total per capita water usage rate,
- The total anticipated commercial water usage rate,
- The total fish hatchery usage rate, and
- Trends seen in the water usage data.

The City of Craig's annual total raw water demand is projected to grow due to an increase in hatchery demand and potable water demand.

The City of Craig currently operates under a raw water rights permit issued by the Alaska Department of Natural Resources (DNR). The existing permit is #11738. According to Clint E. Gundelfinger of DNR, in a memorandum dated March 28, 2014, the City of Craig is limited to one million gallons per day. Another water right application must be submitted for the additional water used and the application must also specify the hatchery as a water user for the new permit. The City of Craig is filing for a new raw water rights permit, which would allow 2.5 million gallons per day of water from North Fork Lake. This increase in permitted take will cover the expected increase in future raw water demand. The current and future raw water demands are shown below (Figure 3.5 and Figure 3.6, respectively).

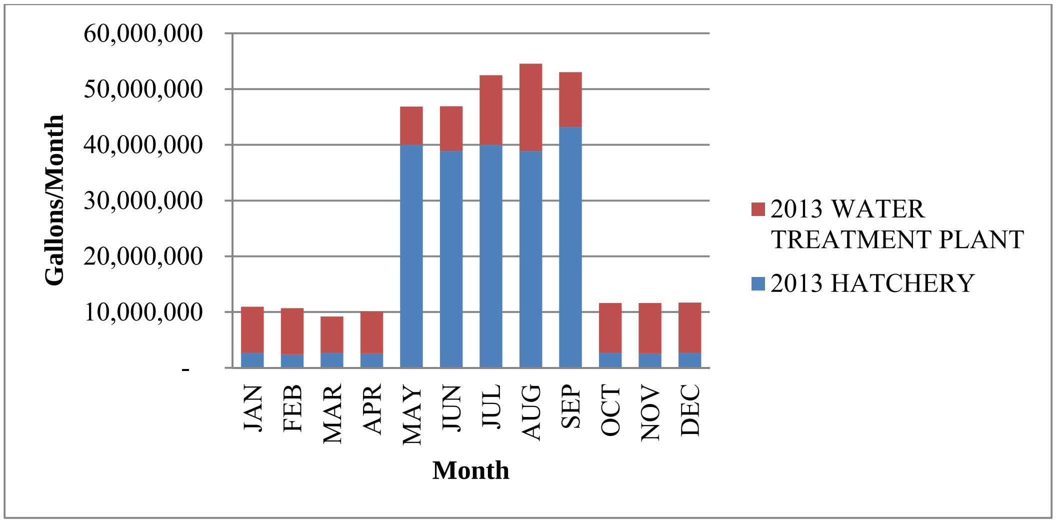


Figure 3.5: Current Raw Water Demand

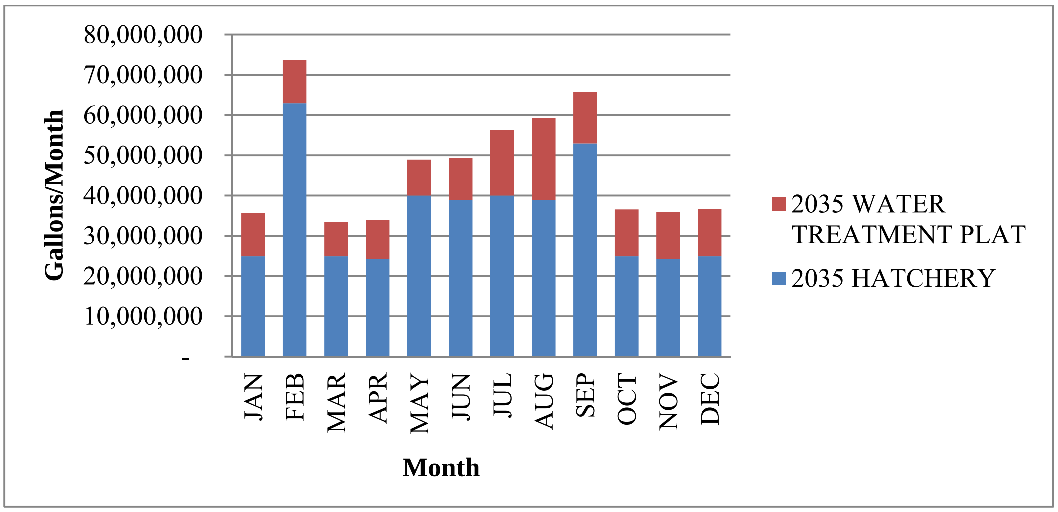


Figure 3.6: Future Raw Water Demand

3.3.4 Current Unserved Demand

The City of Craig has not been able to meet the treated water demand of Silver Bay Seafoods. It has been limited on water delivery due to the WTP. The City has stated that the fish processor would like additional flow, possibly by as much as 700 gpm more than it currently receives. A modest rate of increase would be more like 100 gpm more. Given the uncertainty of how much more is desired, this master plan assesses increases in demand at the fish processing plant by 100 gpm to 700 gpm. This plant typically processes fish between the months of June and September. The plant operates 24 hours a day, seven days a week during the processing season. The Public Works Department has stated that they struggle to fill the 800,000 gallon water tank during the night, only to have it nearly drained by the end of the following day during the fish processing season. This scenario can lead to fire protection issues. When the tank is drained, the WTP cannot produce enough water for fire flow demand. The required fire flow, which has been used for modeling, is 1,500 gpm for four hours. This equals 360,000 gallons of water (see Section 4.0 Fire Flow Analysis). With the current water system, the tank must be kept at or above 360,000 gallons at all times to ensure adequate fire flow capacity. The City must be able to provide adequate fire flow at all times.

3.4 Potential External Impacts on Future Water Supply and Demand

There are a number of factors that can cause water demand to change over time. Many of these variables are external factors, which are beyond the control of the City of Craig. Some of these factors are discussed below.

3.4.1 Types of Water Use

Changes in the amount of residential, commercial, and industrial water use within the Planning Area will create a change in the community's total per capita water usage rate. The community could experience an increase in fish processing. This usage coincides with high demand periods for the other users in this area. These uses include commercial fishing, canneries, ice production, and other dock facilities. Fish hatcheries also have spikes in water usage that affect the raw water supply for both the hatchery and the WTP. The size and type of industrial growth in the area is, to some extent, under the control of the City of Craig.

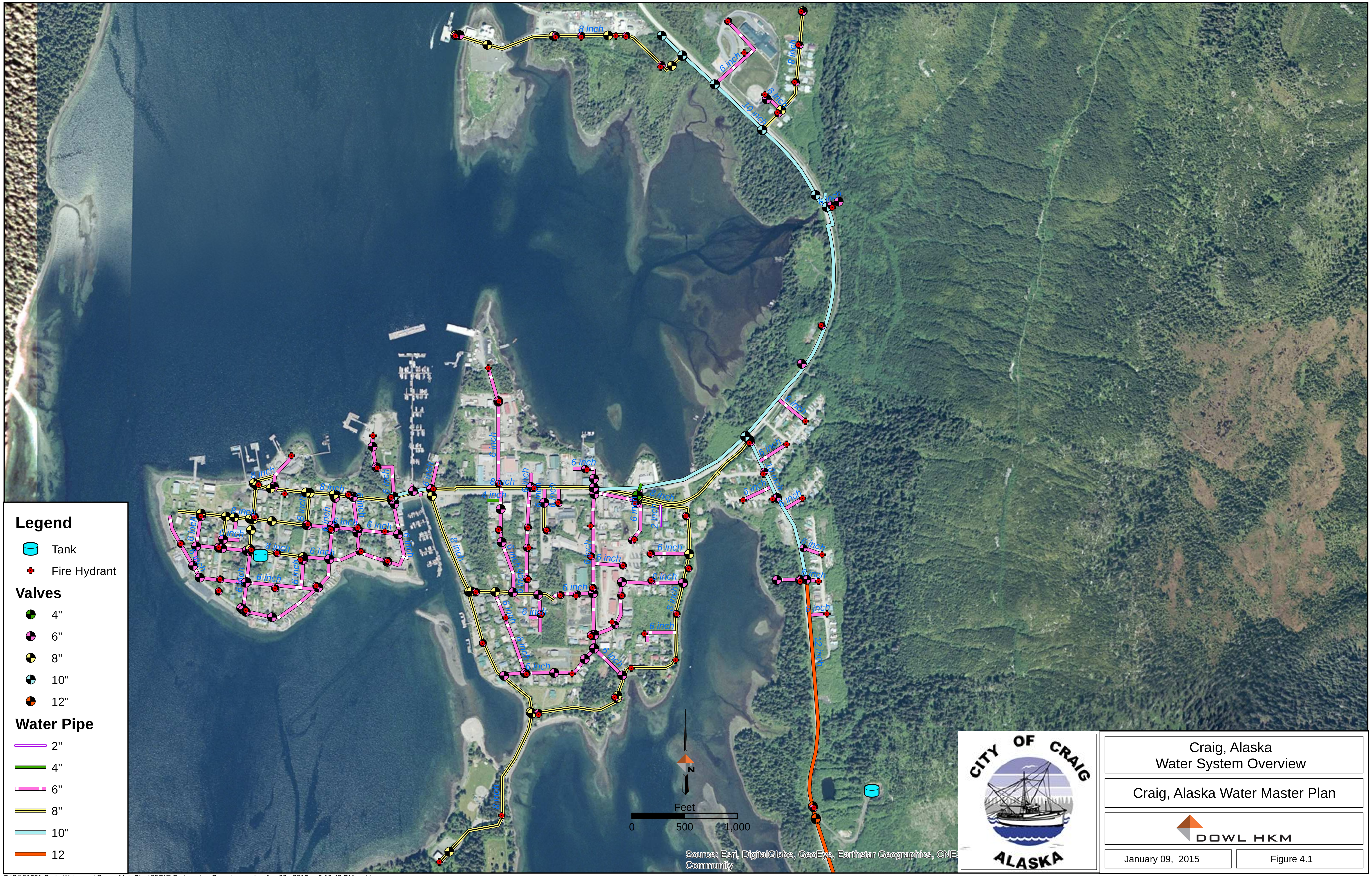
3.4.2 Resource Development Policy

The total water demand projection is driven largely by the rate of population growth in the area. Population in the area is driven by several factors. Two of these factors are federal policy regarding natural resources, and the national economy. These factors are beyond the control of the City of Craig and will affect the population growth rate. An example of this was seen in the late 1990's when the pulp mill closed due to a change in Federal policy regarding timber harvests in the area. This change in policy can be partially attributed to a 28 percent reduction in population in the City of Craig between 1997 and 2007. During this period the State of Alaska changed their methods for tabulating population (SOA went from using mailing addresses to physical addresses). This change in tabulation techniques contributed to Craig's population decrease from 1997 to 2007. Since 2007, the population has increased slightly. Federal policy regarding mining can have an effect on the population in the future, also. Two large mines are planned for future development on Prince of Wales Island. These mines will most likely bring additional population to the area, if developed. The national economy has an effect on the local population through tourism related business. A strong national economy produces larger numbers of tourists. More tourism means more jobs, and an increase in population to fill those jobs. The fishing industry is one of the major employers in the area as well. Long term policy changes regarding fish harvest numbers in Southeast Alaska could affect the population of the City of Craig.

4.0 FIRE FLOW ANALYSIS

4.1 Geographic Information System

Fire flow analysis began with the creation of a map of the water system of the City of Craig. Survey points of valves and hydrants were combined with AutoCAD drawings of water lines. The AutoCAD files were provided by the City of Craig. The valve survey points were imported into AutoCAD and the water lines were adjusted to match these points. Water lines and valves were then placed on separate AutoCAD layers based on diameter, and the layers were exported as geographic information systems (GIS) shapefiles. Shapefiles were then imported into ArcMap. Water lines and valves were color coded according to their diameter. Fire hydrants were identified following the same process (Figure 4.1).



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4.2 Hydraulic Modeling

Bentley® WaterGEMS® V8i (SELECTseries 3) was used to model the Craig water system. Pipes from the GIS shapefiles were converted to a WaterGEMS database using the ModelBuilder tool.

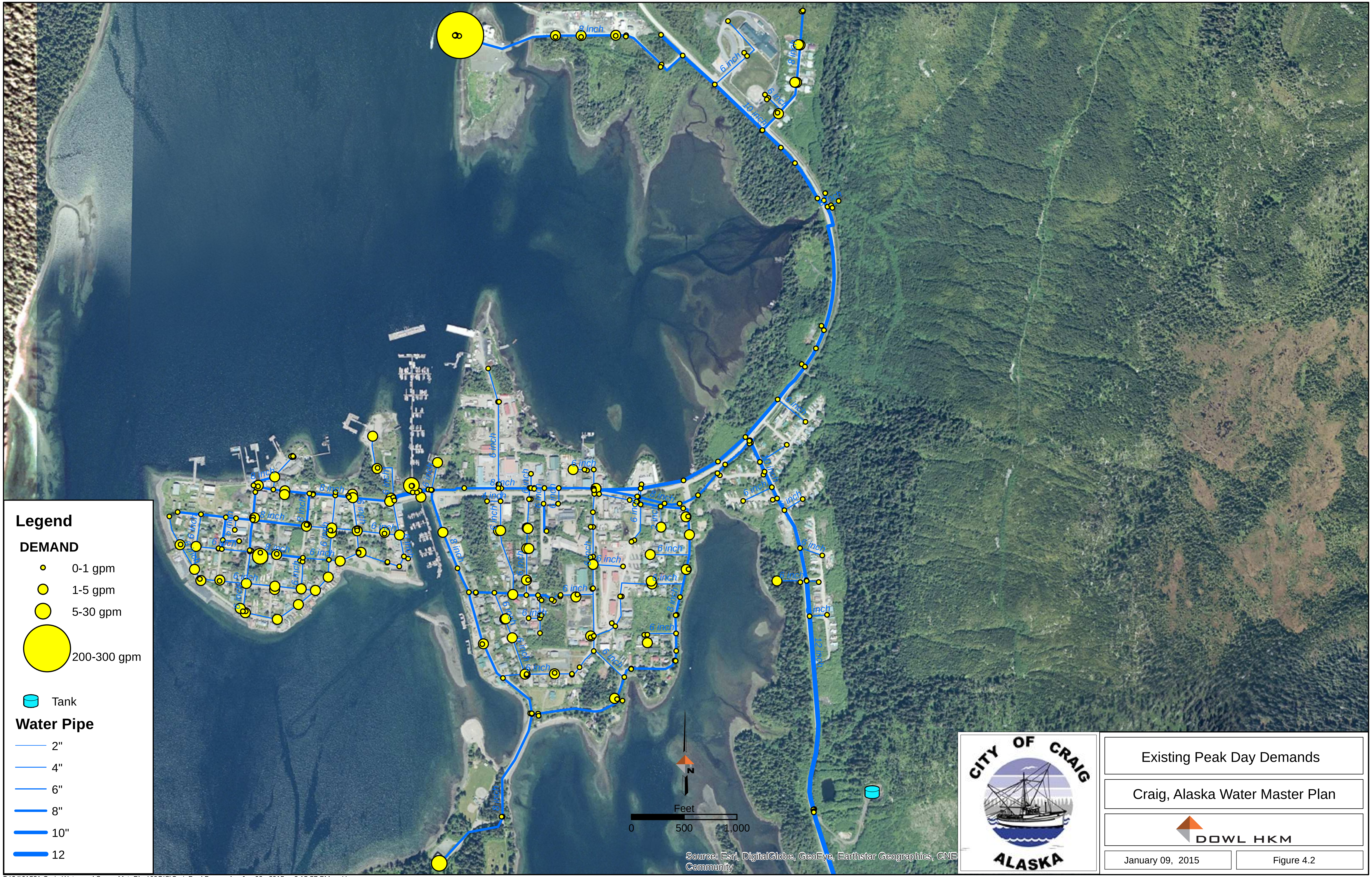
Record drawings and online maps were used to assign elevations to system elements, such as nodes, tanks and reservoirs. Elevations throughout the system range from near sea-level, at Silver Bay Seafoods, to 670 feet at the source reservoir.

Base demands were allocated to selected junctions by single family, multifamily, commercial, public, and city-owned units. Specific water demands were identified for a few individual accounts, but were mainly by land use. These demands were based on the average of all 12 months for the year 2013. A point was created to identify parcels within the water system, to allocate water demands across the model. Parcels were grouped using the City's land use maps. Once land use was identified, the known usages were allocated evenly throughout the categories listed above and adjusted to match the WTP records. Industry standard peaking factors of 2.65 (average) was used to create peak day demand, and 4.2 (average peak hour demand) were used to create peak demands (Figures 4.2 and 4.3). Silver Bay Seafoods operates 24 hour a day, so actual peak day demands were used for the peak hour demand scenario rather than those created from the peaking factor. No increase in demands for future use other than the projected demand at Silver Bay Seafoods was applied to the modelWater demand information can be found in Appendix A. A summary of the demands used in the model is shown in Table 4.1.

The water tank was set up according to known elevations and operating ranges. For modeling purposes, the variable speed drive pump station that supplies water to the tank from the WTP was set at a flow of 175 gpm (which is near the average annual flow-rate). The pump station was set up with an estimated pump curve to give an outlet pressure of 62 pounds per square inch (psi). The pump curve was created as a standard (3-point) pump definition. With this definition, known pump operating points were used to estimate a pump curve. The pump station was also set up with controls using known settings so that the pumps turn on when the tank reaches a level of 28.5 feet and shut off when the tank is full, at 35 feet.

The following modeling scenarios were run:

- Capacity of transmission mains,
- Base average day demands,
- Existing peak day demands (Figure 4.2),
- Existing peak hour demands (Figure 4.3),
- Existing fire flow analysis (Figure 4.5),
- Fire flow analysis with Spruce St wood stave tank (Figure 4.6),
- Fire flow analysis with new 300,000 gallon tank near high school (Figure 4.7), and
- Fire flow analysis with new 300,000 gallon tank and restoration of Spruce Street tank (Figure 4.8).



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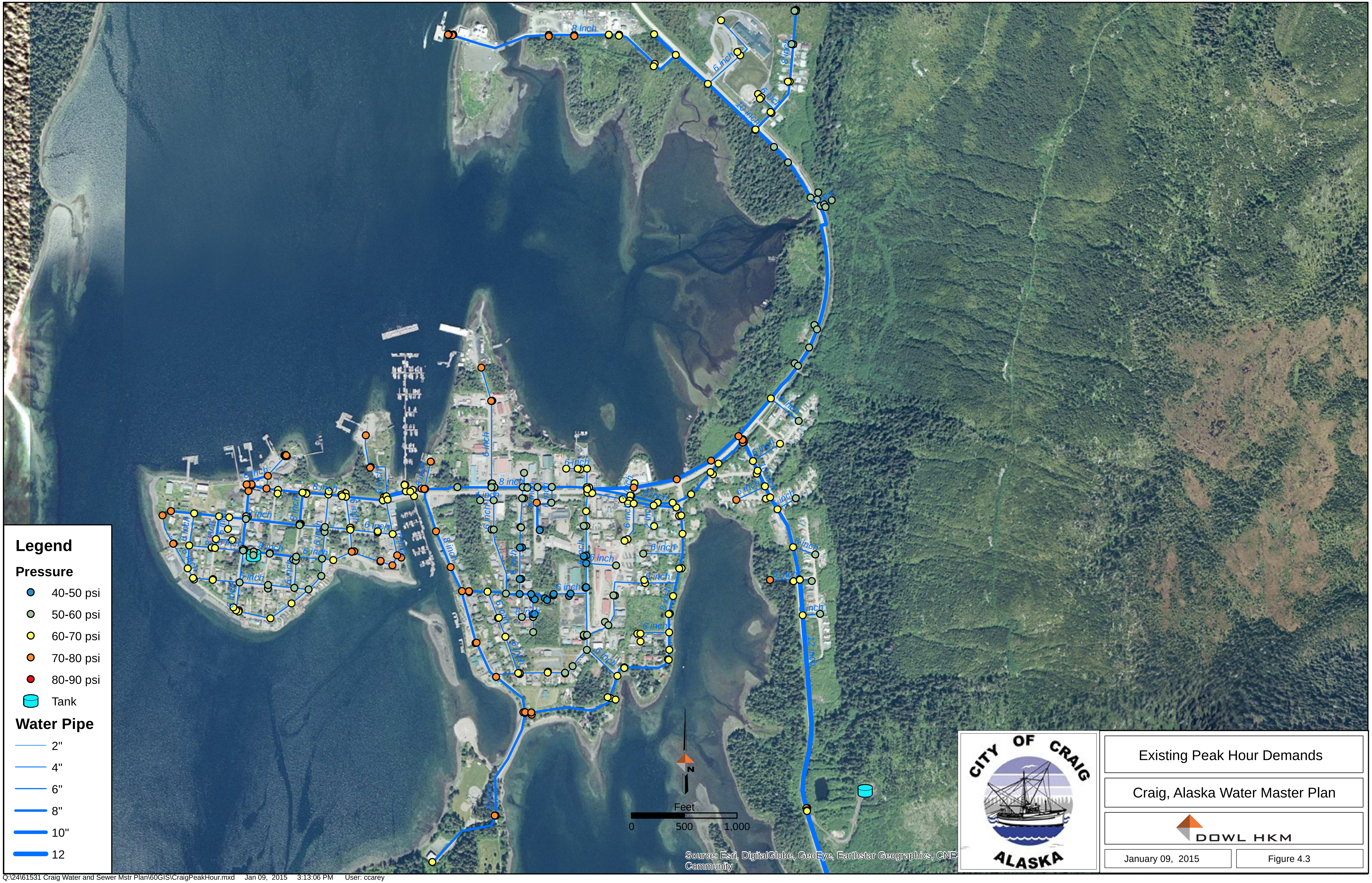

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Table 4.1: City of Craig Water System Demands

	Current Peak Day Demand (gpm)	Current Peak Hour Demand (gpm)	Future Peak Hour Demand (includes existing) (gpm)
West Craig	161	264	264
East Craig	153	218	218
North Craig	35	46	46
Port St. Nicholas	49	75	75
Silver Bay Seafoods	262	262	962*
Totals	**660**	**865**	**1565**

*Assuming an increase of 700 gpm for the Silver Bay Seafoods plant. This is assuming major improvements at the plant, and the increase represents the greatest possible increase based on discussions with project stakeholders.

4.2.1 Modeling Results

The system appears to have adequate pressures during peak day and peak hour demand scenarios. The system appears to have the following attributes:

1. The capacities of three transmission lines were evaluated:
   - The capacity of the existing 12-inch ductile iron raw water line from the reservoir to the WTP is 3,159 gpm at 0 psi residual pressure at the plant (if no in-line PRVs were present) and 2,000 gpm at a residual pressure of 160 psi at the plant.
   - The capacity of the water line from the WTP to the water tank is based on the capacity of the pumps at the WTP. Pump selection for pumping from the WTP to the tank can be guided by the following system curve (Figure 4.4). The system curve shows the energy required to pump from the WTP to the tank for each corresponding flow rate.
   - The capacity of the water line from the water tank to Silver Bay Seafoods is 1,126 gpm. This is the amount of water that can be supplied to Silver Bay Seafoods during a peak day demand scenario and still maintain system pressures of at least 35 psi. It is important to note the limiting pipe is between Silver Bay Seafoods and the intersection with PSN Road, not the stretch of main between the PSN intersection and the 800,000 gallon storage tank.

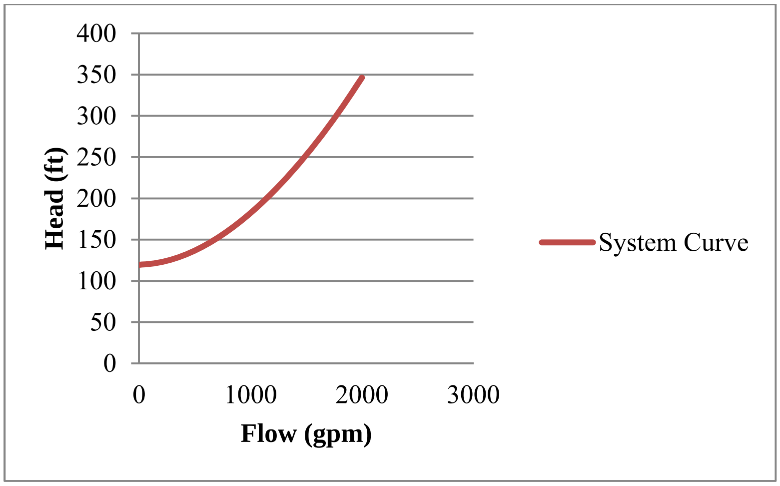


Figure 4.4: System Head Curve from WTP to Tank

2. With the existing pumps at the WTP, the current peak day demand (when Silver Bay Seafoods is in operation) is higher than the output of the plant. This is problematic in that the tank is eventually drained. The capacity of the pumps and the WTP needs to be increased to meet the existing demands.

3. Using current peak day demand, the fire flow analysis evaluated the flow available at hydrants while maintaining system pressures of at least 20 psi. The hydrants in West Craig, East Craig, and North Craig provide less than the minimum fire flow of 1,500 gpm. Only hydrants along Port St. Nicholas Road have fire flows greater than 1,500 gpm (Figure 4.5).

4. In order to achieve fire flows greater than 1,500 gpm throughout the system, a scenario was created to place a pump at the existing wood stave tank on Spruce Street. This pump would turn on and supply additional water in the case of a fire. With this pump and tank in operation, almost all of the hydrants in West and East Craig would have available fire flows greater than 1,500 gpm. Under this scenario, the hydrants in North Craig have flows between 1,000 gpm and 1,500 gpm with the exception of the hydrant at the high school and at the end of the line near Silver Bay Seafoods (Figure 4.6). With storage capacity of only 300,000 gallons, a 1,500 gpm fire flow would last approximately two hours. For this improvement, pump station control, and a means to provide turnover in the tank need to be considered. Also, the tank would need an altitude valve to prevent

overfilling of the tank. Valving and piping would also need to be incorporated to prevent short-circuiting of water when the fire pumps are turned on.

5. In future peak hour situations with Silver Bay Seafoods future demand (of an additional 700 gpm), total demand will be near 1,000 gpm. The current capacity of the 8-inch waterline is 1,126 gpm, which is sufficient to handle the increase in water demand. As a comparison, if the waterline was increased to a 10-inch diameter, the capacity would increase to 1,379 gpm. Currently, the tank drains and fills every day when Silver Bay Seafoods is operating which is related to the ability of the WTP to supply water. When the 800,000 gallon tank is at a low level, there is a risk that adequate fire flow reserve will be unavailable. Disregarding the capacity of the WTP and the treatment plant pumps, the distribution system appears able to supply the additional 700 gpm.

Modeling efforts have shown the following items should be considered for improvements. These items are included in the capital improvement project sections.

- Based on elevations in the record drawings, it appears possible for the tank to supply the system between the WTP and the tank when the WTP pumps are not in operation. From discussions with the operators, the system currently operates this way, but only when the level of the tank is above the inlet piping. When the tank level drops below the inlet piping and the WTP pumps are off, the line between the WTP and the tank will become drained. This potential issue could be eliminated by placing a check valve between the inlet and outlet pipe at the tank to provide water to the users between the tank and the WTP. This may also be accomplished by modifying the inlet piping in the tank to allow water to leave the inlet line when the tank is at a low level.
- Upgrades to the WTP pumps to be able to supply more water during Silver Bay Seafoods operating season and supply future demands. These upgrades should include:
  - Increased capacity, and
  - Operational controls to operate based on tank levels, treatment plant production rates, and system pressures.
- Improvements to the system to increase fire flows within the City of Craig.

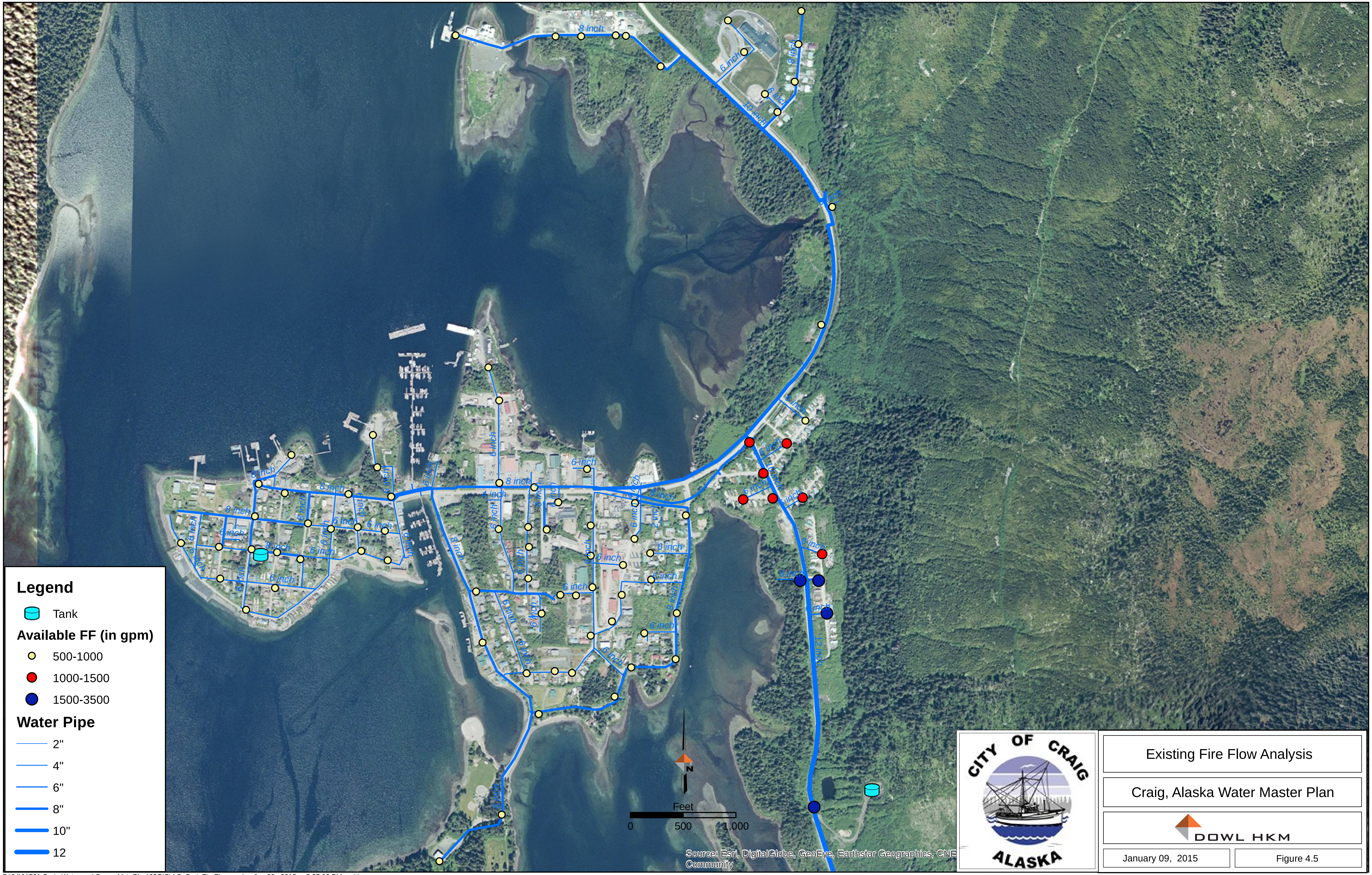
Additional fire flow analysis was performed to better understand the requirements for providing sufficient fire flow to all parts of Craig. Two additional scenarios were modeled.

6. A new 300,000 gallon storage tank located near the high school, at the same elevation as the 800,000 gallon tank. (Figure 4.7), and

7. A new 300,000 gallon storage tank located near the high school, and restoring the wood stave Spruce Street water tank. (Figure 4.8).

In summary, providing an additional 300,000 gallon storage tank at the high school does not provide adequate fire flow to West Craig unless it is in conjunction with restoration of the Spruce Street tank. Another option for increasing fire flow to West Craig would be scaling up the transmission mains between the 800,000 gallon storage tank and West Craig.

In a fire event where 1,500 gpm of fire flow is provided, the 800,000 gallon tank would be drained in 7 hours under existing peak demand (assuming the WTP is operating at max existing capacity, and Silver Bay Seafoods is in operation). In a fire event where 1,500 gpm of fire flow is provided under future peak demands, the tank would drain in 5 hours.


Legend
Tank
Available FF (in gpm)
500-1000
1000-1500
1500-3500
Water Pipe
2"
4"
6"
8"
10"
12
N
Feet
0
500
1,000
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics,
Community
CITY OF CRAIG
ALASKA
Existing Fire Flow Analysis
Craig, Alaska Water Master Plan
DOWL HKM
January 09, 2015
Figure 4.5

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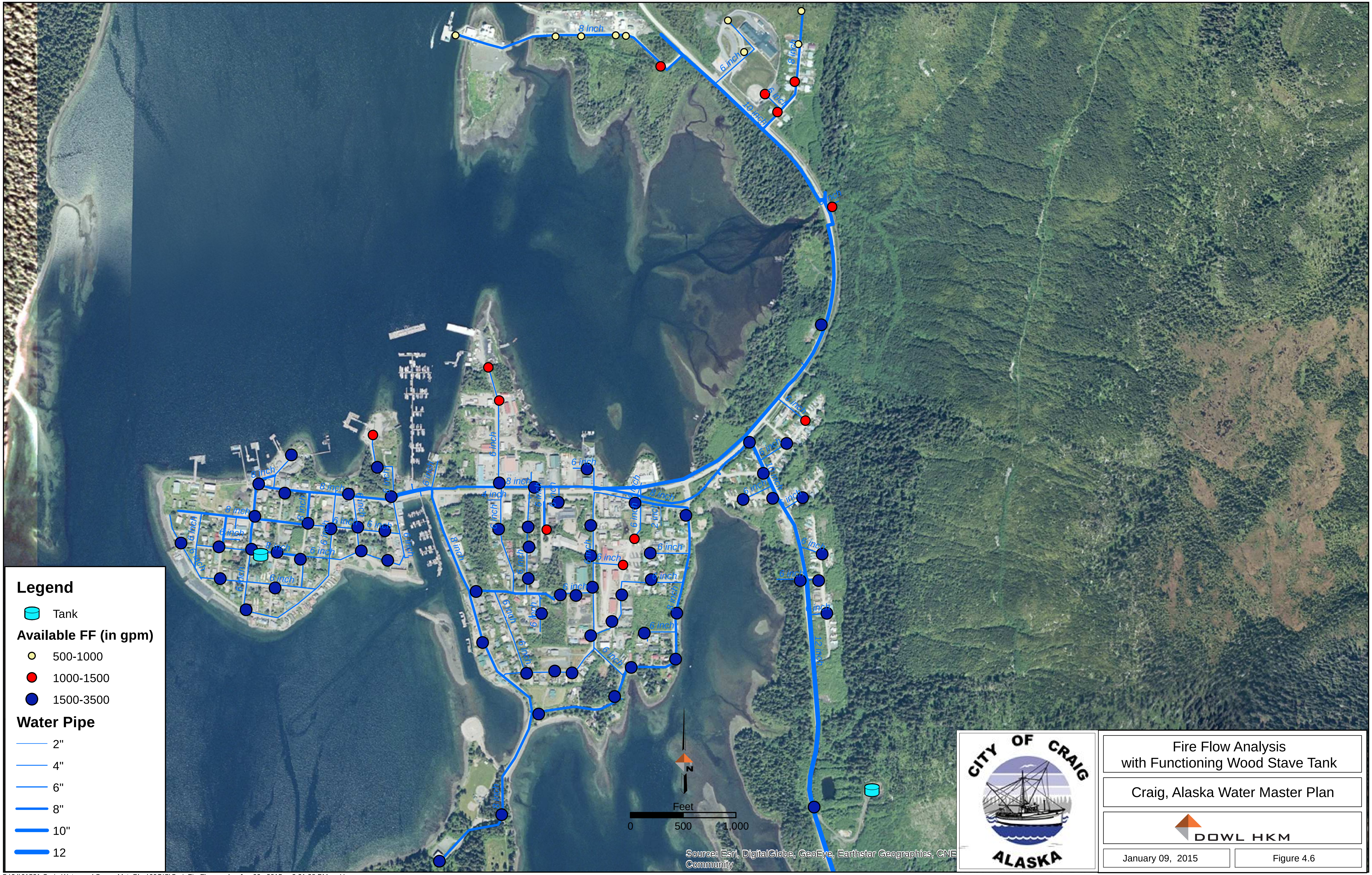

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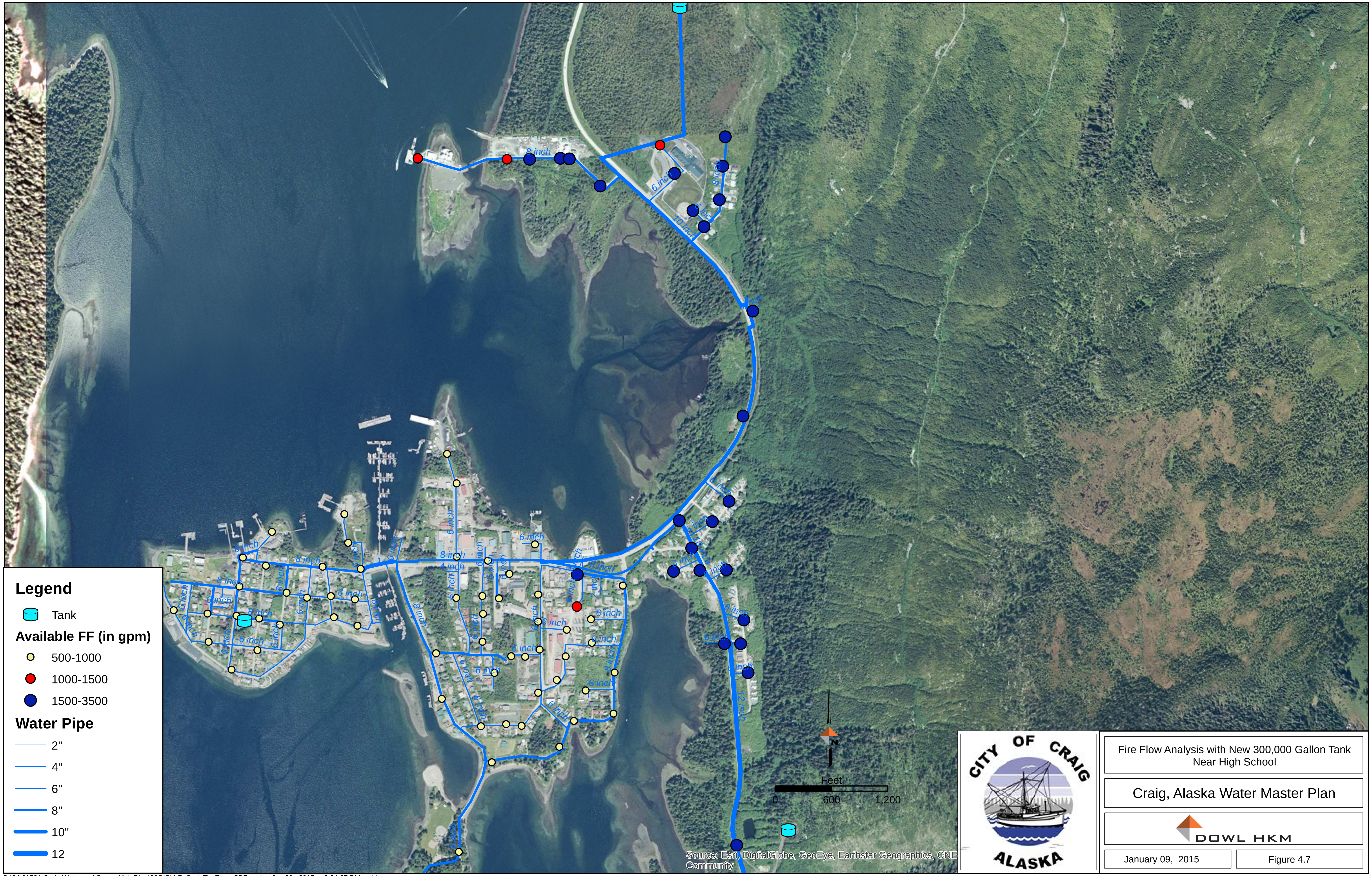
Legend
Tank
Available FF (in gpm)
500-1000
1000-1500
1500-3500
Water Pipe
2"
4"
6"
8"
10"
12
Feet
0
600
1,200
N
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES
Community
CITY OF CRAIG
ALASKA
Fire Flow Analysis with New 300,000 Gallon Tank Near High School
Craig, Alaska Water Master Plan
DOWL HKM
January 09, 2015
Figure 4.7

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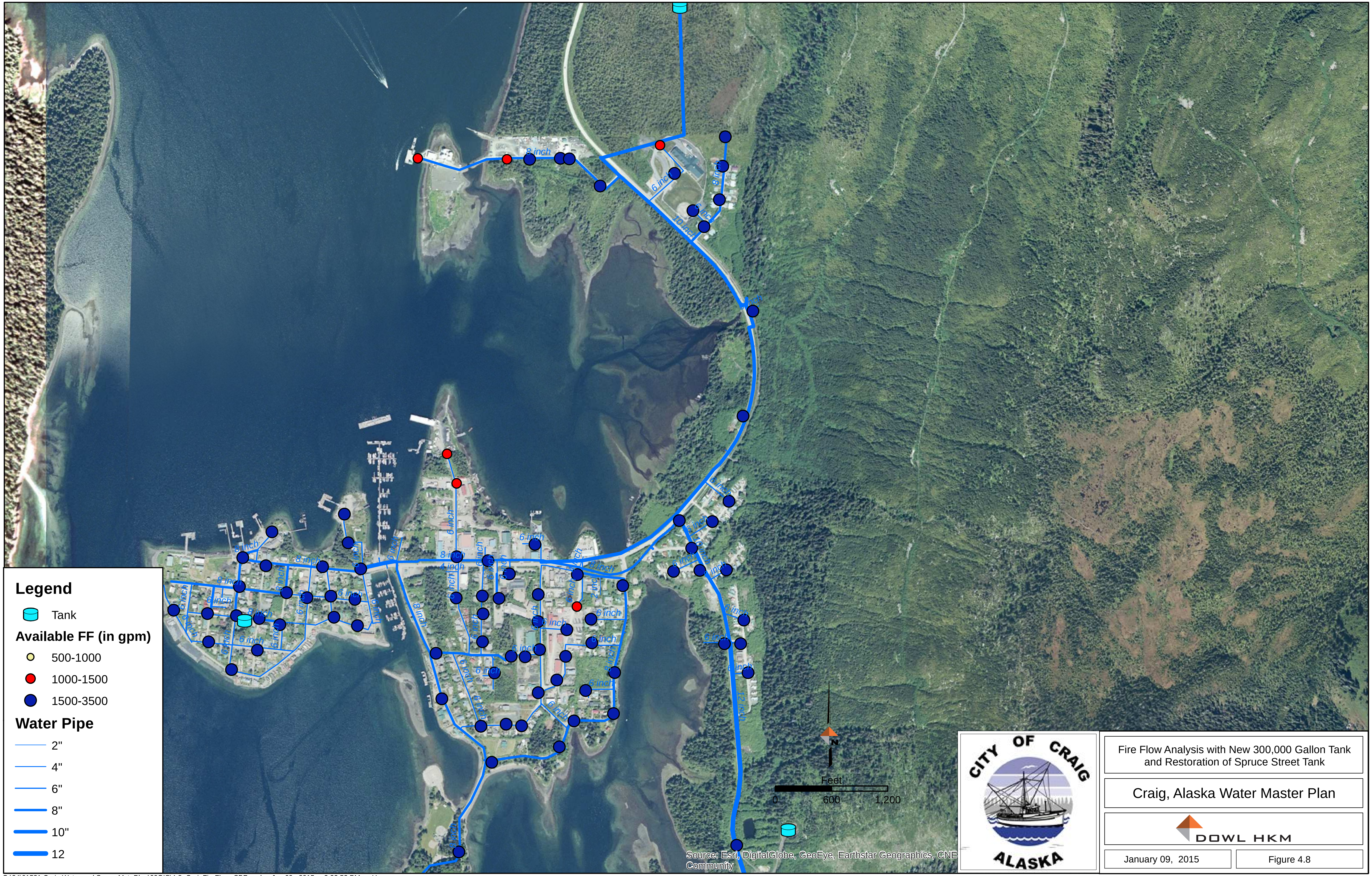
Legend
Tank
Available FF (in gpm)
500-1000
1000-1500
1500-3500
Water Pipe
2"
4"
6"
8"
10"
12
N
Feet
0
600
1,200
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
CITY OF CRAIG
ALASKA
Fire Flow Analysis with New 300,000 Gallon Tank and Restoration of Spruce Street Tank
Craig, Alaska Water Master Plan
DOWL HKM
January 09, 2015
Figure 4.8

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5.0 REGULATORY COMPLIANCE ANALYSIS

5.1 Compliance Standards

This is a summary of regulations that apply to Craig's water system. The summary is based on regulatory information provided by the United States Environmental Protection Agency (EPA) and the State of Alaska Department of Environmental Conservation (DEC). DEC has acquired primacy over federal water system regulations, and compliance information is outlined in 18 AAC 80, Drinking Water, as amended August 20, 2012.

The Federal regulations that are summarized in this document include the current rules listed below. These federal regulations manifest themselves within 18 AAC 80:

- *Surface Water Treatment Rule* (SWTR, published June 29, 1989)
- Enhanced Surface Water Treatment Rules (ESWTRs)
    - Interim Enhanced Surface Water Treatment Rules (IESWTR, January 16, 2001)
    - Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR, January 14, 2002)
    - Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR, January 6, 2006)
- *Filter Backwash Recycling Rule (FBRR, published June 8, 2001)*
- Disinfectants/Disinfection By-Products Rules (D/DBPRs)
    - Stage 1 Disinfectants/Disinfection By-Products Rule (Stage 1 D/DBPR, January 16, 2001)
    - Stage 2 Disinfectants/Disinfection By-Products Rule (Stage 2 D/DBPR, January 2, 2006)
- *Lead and Copper Rule* (LCR, January 12, 2000, revised October 10, 2007)
- *Total Coliform Rule* (TCR, June 29, 1989)

5.2 Summary of Regulatory Impacts to Craig

The City of Craig is currently serving approximately 1,100 residents with a conventional filtration treatment water system. Drinking water comes from North Fork Lake. Craig's water system meets all current regulations, with treatment options being driven primarily by the SWTR, and some additional treatment added to meet the Lead and Copper Rule.

The Long Term 2 Enhanced Surface Water Treatment Rule requires inactivation of *Cryptosporidium*. Additional control of disinfection by-products is also required through the Stage 2 Disinfectants/Disinfection By-Products Rule. Therefore, any treatment modifications incorporated to address microbial inactivation must also consider the impacts of disinfection by-products. The following sections summarize the impact of each rule on the current system (taking into consideration that there are different requirements for systems serving less than 10,000 people):

5.2.1 Surface Water Treatment Rule

The main legislation for regulation of surface water systems is the Surface Water Treatment Rule (SWTR). Most other legislation builds off the SWTR. The SWTR requires that all water sources be treated to achieve a minimum 3-log removal of *Giardia* and 4-log removal of enteric viruses.

Craig currently operates a conventional filtration system and currently achieves all microbial inactivation required for SWTR compliance using chlorine disinfectant along with residence time in a clearwell as follows:

- Three filter trains at 175 gpm (design, current operation is 125 gpm) = 525 gpm
- Clearwell volume = 35,000 gal
- Chlorine dose rate (average) = 1.5 parts per million (ppm)
- Assume poor baffling ∴ $T_{10}/T = 0.3$

CT_{avail} = 1.5 ppm x 0.3 x 35,000 gal/525 gpm = 30.0 parts per million per minute (ppm·min)

$CT_{required}$ = 10.7 (based on for 4-Log inactivation of virus, minimum water temperature of 2°C, an average pH of 7.8, Appendix C, page C-8, EPA Guidance Manual for Disinfection Profiling and Benchmarking)

$CT_{required}$ for *Giardia* will depend on the credits given for the filtration system. Typical $CT_{required}$ values for *Giardia* at 3-Log removal with these water temperatures and pH values are near 325 ppm·minimum excluding log removal credits for filtration.

5.2.2 Enhanced Surface Water Treatment Rules

The Enhanced Surface Water Treatment Rules (ESWTRs) were issued as a supplement to the SWTR to provide additional microbial and disinfection controls for surface water systems. The ESWTRs were implemented in separate stages as the Interim Enhanced Surface Water Treatment Rules (IESWTR), and Long Term 1 and Long Term 2 Enhanced Surface Water Treatment Rules (LT1ESWTR and LT2ESWTR). These rules build upon the provisions set forth in the SWTR by providing improved public health protection against *Cryptosporidium*, while addressing risk trade-offs with disinfection by-products (DBPs).

The ESWTRs added *Cryptosporidium* monitoring and inactivation to the watershed control requirements. In addition, a 2-log Cryptosporidium removal requirement was established for filtered surface water systems. Other specific provisions that have an impact on Craig include disinfection profiling and benchmarking provisions, a requirement that filtered surface water systems achieve more stringent turbidity removal requirements, and conducting continuous turbidity monitoring for each individual filter.

Since all of the above ESWTRs are now in full effect, the major provisions for filtered systems in all of the ESWTRs are:

1. Provide 4-log virus inactivation.
2. Provide 3-log *Giardia lamblia* inactivation.
3. Provide 2- or 3-log *Cryptosporidium* inactivation depending on its presence in the source water. If the source water monitoring demonstrates a mean level of *Cryptosporidium*

above 100 cysts/100 liters, the system must provide at least 3-log *Cryptosporidium* inactivation.

4. Maintain a minimum of 0.2 milligrams per liter (mg/l) residual disinfectant at the entrance to the distribution system.

5. Monitor combined filter effluent for turbidity at least every four hours and maintain ≤ 0.3 NTU in the combined effluent.

6. Monitor each filter effluent continuously (one sample at least every 15 minutes) and follow-up on any reported values exceeding 1.0 NTU taken 15 minutes apart.

Disinfection profiling was required to begin by July 1, 2003 and included weekly calculation of the inactivation of *Giardia lamblia* (and viruses) on the same calendar day each week for 12 consecutive months. The City of Craig completed disinfection profiling as required.

5.2.3 Filter Backwash Recycling Rule

The Filter Backwash Recycling Rule (FBRR) applies to all public water systems that use surface water and practice conventional filtration. It does not appear that the Craig system has the capability to recycle decant from the backwash ponds; however, if this is the case, the recycle flow must enter the system with the raw water and be subject to all processes any raw water is subjected to during normal filtration. The current drawings indicate that the overflow from the backwash decant ponds is routed to a stream discharge.

5.2.4 Disinfectants/Disinfection By-Products Rules

The Disinfectants/Disinfection By-Products Rules (D/DPBRs) apply to all water systems that add a chemical disinfectant during any part of the treatment process. The rules are being implemented in two separate stages – Stage 1 and Stage 2. The D/DBPRs address levels of disinfection by-products that are allowed in finished water supplies. Historically, the DBPs regulated under the SWTR were total trihalomethanes (TTHMs). The D/DBPRs expand the DBP regulations to include five haloacetic acids (HAA5s).

5.2.5 Stage 1 Disinfectants/Disinfection By-Products Rules

The Stage 1 rule establishes maximum contaminant levels (MCLs) of 80 micrograms per liter (µg/L) for TTHMs and 60 µg/L for HAA5. As of January 1, 2004, Craig's water system, as one of the small systems serving less than 10,000 people, was required by the Stage 1 D/DBPRs to collect DBP samples from the distribution system on a quarterly basis and comply with the rule. Compliance is based on a running annual average (RAA) of all sampling sites.

The Stage 1 D/DBPR also contains maximum residual disinfectant levels (MRDLs) for chlorine. Craig is required to limit the chlorine residual of water entering the distribution system to less than 4 mg/L as Cl_2, based on a RAA.

5.2.6 Stage 2 Disinfectants/Disinfection By-Products Rules

The Stage 2 D/DBPR was promulgated simultaneously with the LT2ESWTR to address concerns about risk trade-offs between pathogens and DBPs. The Stage 2 D/DBPR addresses reduction in DBP occurrence peaks in the distribution system based on changes to compliance-monitoring provisions. Compliance monitoring will be preceded by an initial distribution system evaluation (IDSE), with the purpose of selecting site-specific optimal sampling points for capturing peaks of TTHMs and HAA5s. The monitoring frequencies and locations of IDSE depend on the system type and size.

Compliance with the MCLs for two groups of disinfection by-products (TTHMs and HAA5s) will be calculated for each monitoring location in the distribution system. This approach, referred to as the locational running annual average (LRAA), differs from RAA calculation defined by Stage 1 requirements. The LRAA avoids the high DBP occurrences at certain locations by ensuring every monitoring site is in compliance with the MCLs on an annual average. The DBP MCLs remain the same as Stage 1 MCLs – 80 µg/L for TTHMs and 60 µg/L for HAA5s.

Each system must determine if they have exceeded an operational evaluation level based on their compliance-monitoring results. A system that exceeds an operational evaluation level is required to conduct an operational evaluation and submit to their state a report that identifies actions that must be taken to mitigate future high DBP levels, particularly those that may jeopardize their compliance with the DBP MCLs.

The Craig WTP was in violation of the TTHM limit from January 1, 2010 through March 31, 2010. Following the second quarterly report of 2010, the City returned to compliance. Since this event, the WTP has not been in violation for exceeding a DBP MCL. 5.2.7 Lead and Copper Rule.

Published in 1991, the Lead and Copper Rule (LCR) established monitoring requirements for lead and copper, whereby Craig is required to monitor consumers' taps for lead and copper every six months. Water samples at the customers' taps must not exceed the following action levels:

- ***Lead***: 0.015 mg/L detected at the 90th percentile of all samples
- ***Copper***: 1.3 mg/L detected at the 90th percentile of all samples

If the action levels are exceeded for either lead or copper, Craig is required to collect source-water samples and submit the data with a treatment recommendation to the State. Additionally, if the lead action level is exceeded, Craig is required to present a public education program to its customers within 60 days of learning the results. The public education program must be continued as long as Craig water exceeds the lead action levels.

5.2.7 Total Coliform Rule

The Total Coliform Rule (TCR) establishes a MCL based on the presence or absence of total coliforms, modifies monitoring requirements including testing for fecal coliforms or E. coli, requires use of a sample siting plan, and also requires sanitary surveys for systems collecting fewer than five samples per month. The City of Craig is currently serving approximately 1,100 persons; therefore, a minimum of 2 samples are required per month.

General requirements for this rule are:

- Total coliform samples must be collected at sites which are representative of water quality throughout the distribution system according to a written sample siting plan subject to state review and revision.
- Samples must be collected at regular time intervals throughout the month, except groundwater systems serving 4,900 persons or fewer may collect them on the same day (not applicable to the City of Craig).

- Monthly sampling requirements are based on population served.
- A reduced monitoring frequency may be available for systems serving 1,000 persons or fewer and using only groundwater if a sanitary survey within the past five years shows the system is free of sanitary defects (the frequency may be no less than one sample/quarter for community and one sample/year for non-community systems) (not applicable to the City of Craig). The City of Craig's most recent sanitary survey was completed in 2014.
- Each total coliform-positive routine sample must be tested for the presence of fecal coliforms or E. coli.
- If any routine sample is total coliform-positive, repeat samples are required.

5.3 Water Sampling Schedule

Samples are collected by Craig staff and analyzed on-site and in laboratories in Ketchikan. The sampling protocol is derived from the regulations previously explained. The following samples are collected (Table 5.1). The sampling schedule as shown is in accordance with DEC regulations.

Table 5.1: Sampling Schedule

Sample Parameter	Sample Frequency	Sample Location
Chlorine	Daily or as available*	Treatment Plant
Turbidity	Daily or as available*	Treatment Plant
Total organic carbon (TOC) and Alkalinity	Quarterly	North Fork Intake
HAA5	Quarterly	Distribution Point
Lead and Copper	Every 3 years	Distribution Point
TTHM	Quarterly	Distribution Point
DBP1 (TTHM and HAA5)	Quarterly	Distribution Point
Arsenic, Asbestos, Inorganics, Radium 226 and 228, and Total Gross Alpha	Every 9 years	Treatment Plant
Nitrate	Yearly	Treatment Plant
SOC	Quarterly	Treatment Plant
VOC	Yearly	Treatment Plant
Total Carbon	Quarterly	Treatment Plant
Total Coliform	Twice Monthly	Distribution Points According to Sampling Plan

*Daily or constant monitoring.

5.4 Summary of Violations

The City has received eight monitoring and reporting violations since 2010. The last violation was for failure to submit a Stage 2 D/DBPR result on time. Compliance with regulatory regulations was achieved on March 29, 2012. The City of Craig does not have any MCL violations on file with the State of Alaska with the exception of the DBP violation as stated in Section 5.2.6. The table below summarized the City's recent violation history.

Table 5.2: Recent Violation History

Violation Year	Violation Number	Violation Type	Return To Compliance?
2015	2015-11608	HAA5 Monitoring	Yes
2015	2015-11617	TTHM Monitoring	Yes
2012	2012-1129152	DBP Stage 2 Failure to submit plan	Yes
2012	2012-1129146	Consumer Confidence Rule Content Inadequacy	Yes
2012	2012-1129147	Chlorine Monitoring	Yes
2012	2012-1129151	Chlorine Monitoring	Yes
2012	2012-1129145	Coliform Monitoring	Yes
2011	2011-1129144	Alkalinity Monitoring	Yes

6.0 HYDROPOWER FEASIBILITY EVALUATION

6.1 Location

The WTP Pressure Reducing Valves (PRVs) are located on the 12-inch-diameter raw water main in the existing WTP building. These PRVs reduce pressure before flows enter the WTP process equipment. Installing a hydropower turbine and generator at this site would allow the power generated to be used directly by the WTP and fish hatchery. The proposed hydropower turbine and equipment would be located in a new building between the WTP and hatchery to capture energy from flow in the raw water pipeline before splitting flows to the two facilities.

There is also a PRV located near North Fork Lake that reduces pipeline pressure by approximately 50 psi. Although the existing pipeline would likely fail due to high internal pressures without the upper PRV, to provide best case power generation estimates for this study it is assumed that the existing system could operate with the upper PRV removed. For the future pipeline system it is assumed that the replacement pipeline would be designed to function properly without the upper PRV.

In order to check the feasibility, order-of-magnitude cost estimates and power generating evaluations were performed.

6.2 Demand Trend

The current trend in flow available for power generation exhibits two different levels of operation:

- May through September: flows from 1,000 gpm to 1,300 gpm, and
- October through April: flows from 200 gpm to 300 gpm.

Based on current demands and potential growth, the future operational flows are:

- February and May through September: flows from 1,100 gpm to 1,850 gpm, and
- October through April, not including February: flows from 750 gpm to 850 gpm.

6.3 Power Potential

In order to assess order-of-magnitude maximum power generation potential at the WTP PRV site based on current and future raw water demands, power output at a water-to-wire efficiency of about 70 percent was assumed for this site. Such efficiency would be characteristic of fixed-geometry turbine and induction generator equipment suitable for small installations such as this. Assumed operation of a hydropower plant at the Craig WTP is based on constant flow settings through the turbine. Variable WTP rates would need to be balanced by varying flow to the hatchery to maintain optimal hydropower production.

$$P(kw) = Q(gpm) \times H(ft) \times 62.4\frac{Lb}{ft^3} \times .746\frac{Kw}{hp} \div 448.8\frac{gpm}{cfs} \times 550\frac{ft-lb}{sec/hp} \times \%efficiency$$

At the WTP PRV, the majority of the elevation drop in this pipeline has occurred, so the maximum head that can be used to generate hydropower is available at that point. Our understanding is that the existing PRVs reduce the raw water main hydraulic grade line to an elevation of approximately 150 feet (Elevation 60 feet plus 40 psi). For this evaluation it was assumed the target turbine discharge hydraulic grade line elevation is 150 feet. The elevation at the North Fork Lake water source is approximately 650 feet. This means approximately 500 feet of head is available for hydropower generation through the approximately 6.4-mile-long pipeline.

The following assumptions and conditions were used to calculate potential energy production:

1. Operation under normal pipeline and water supply system conditions, in order that the recommended facilities not infringe upon non-power-related beneficial purposes of the system.

2. Current and future water demands are based on the data presented in the DOWL HKM City of Craig Growth Summary Memorandum dated March 31, 2014.

3. Available head figures represent the pressure differential between the inlet and outlet of the existing PRVs at the WTP. These figures have been estimated conservatively and are assumed to represent available head across the turbine. Small losses in turbine interconnecting piping and isolation valves are, thereby, assumed to be allowed for in these figures.

4. To calculate water main friction losses for the current demands, the existing 12-inch raw water main was used for calculations. To calculate friction losses for future demands, an enlarged 18-inch raw water main was assumed. The future power potential assumes there is adequate water supply from North Fork Lake to provide the projected demands. However, the City's water rights and water availability from North Fork Lake should be evaluated as part of future hydropower studies.

5. Assuming an average flow rate for each operation period (Spring/Summer and Fall/Winter), 100 percent equipment availability (24-hour-per-day operation, zero downtime), maximum annual energy production is then calculated (average kilowatts (kW) from each operation period times 24 hours times operation period in days). The results of the maximum energy production evaluation are summarized in Table 6.1.

The maximum annual potential energy production from this site is included at the end of this memorandum (Appendix B).

Based on information provided by the City of Craig for 2008 to 2013, annual energy use at the WTP and hatchery has varied between approximately 261,000 kWh and 325,000 kWh. Future energy demands have not been estimated as part of the energy analysis. Peak energy usage is typically from October to May, which corresponds to the lower flow periods in the water main. To estimate actual power that can be used at the WTP and hatchery, hydropower equipment sizing was estimated.

Table 6.1: Maximum Hydropower Production Summary

Operation Scenario/Period	Maximum Power (kW)	Maximum Available Power1 (kW)	Energy Production (kWh)	Total Annual Energy Production (kWh)
Current – May to Sept	75	52	188,400	
Current – Oct to April	27	19	99,000	
Current Total	--	--	--	**287,400**
Future – May to Sept and Feb	123	86	372,500	
Future – Oct to April	73	51	228,100	
Future Total	--	--	--	**600,600**

1 – Maximum available power assumes a water to wire efficiency of 70 percent.

6.4 Equipment Sizing

General equipment selection is driven by conditions of operation. The closed-conduit operation dictates that reaction turbine technology should be employed (versus impulse or “Pelton Wheel” technology). Maintaining closed-conduit operation also prevents exposing the raw water supply to atmospheric pressure, which could over-oxygenate the water supply and have negative impacts at the hatchery. The relative size of the proposed project and the need to minimize cost dictate that a fixed geometry type turbine (pump equipment) be chosen. An adjustable geometry turbine, with wicket gates and/or runner vanes that can be adjusted to improve performance over a range of hydraulic conditions is prohibitively costly in this size of project (three to five times higher in cost). However, fixed-geometry machines have more limited operating ranges.

Since this installation would exist at a WTP and fish hatchery with significant electrical load, two operating scenarios are possible:

1. The plant can operate as a Qualifying Facility (QF), under which the local utility interconnects with the project and purchases the excess generated power at rates based upon its avoided cost of energy.

2. The power generated can be used onsite, reducing the facility's energy costs (load-shaving operation).

The resulting electrical installation can avoid some of the control and protection costs associated with a typical QF installation.

Alaska Power & Telephone (AP&T) provides electrical service on Prince of Wales Island. AP&T only buys back power from QFs when running their diesel generators, and then they will only purchase up to 25 kW. Typically, diesel generation occurs in March and April, and occasionally in the summer if flows are too low to meet demand through their hydropower facility. Water demands in the City of Craig's raw water main are typically lowest in March and April. The load-shaving hydropower installation was selected for further evaluation in this memorandum and the QF buy-back configuration was excluded from feasibility for several reasons: WTP and hatchery electric demands can be at least partially met by an onsite load-shaving hydropower facility; constructing a QF facility would cost significantly more than a load-shaving facility; and AP&T buy-back periods are typically short and infrequent, which limits revenue potential.

Two sizing alternatives were developed – one for the current demands and one for future demands:

- Alternative 1 – Current Demands: Select a small unit, sized to operate best on the year-round lower range of flows. This minimizes cost, but sacrifices the power generating potential of the high flow summer months when power would be available for sale to AP&T.
- Alternative 2 – Future Demands: Select a slightly larger unit sized to operate during the year-round lower-range of project future flows.

On the basis of the site condition data, equipment manufacturer recommendations[1] for unit sizing were as follows:

- Alternative 1 – Current Demands: Cornell turbine, 25-kW-rated turbine output, 22-kW-rated generator output.

[1] Phone and email correspondence with Steve Perry, P.E., April 3, 2014, Cornell Pump Co. Clackamas, OR.

- Alternative 2 – Future Demands: Cornell turbine, 45-kW-rated turbine output, 40-kW-rated generator output.

The above configurations are based upon preliminary equipment selections and manufacturer budgetary quotations. At flows beyond a given turbine's maximum discharge capacity, the unit is assumed to remain online, while excess flow is bypassed by the existing or new PRVs.

6.5 Estimated Annual Energy Production

The annual energy production for the two equipment alternatives was estimated assuming 100 percent equipment availability (24-hour-per-day operation, zero downtime) and multiplying the equipment kW output by 24 hours and by 365 days.

The hydropower generation evaluation for the City of Craig WTP PRV site is summarized in Table 6.2.

Table 6.2: Hydropower Evaluation Summary

Alternative	Generating Equipment	Annual Energy Production (kWh)	Annual Energy Value1	Estimated Project Cost (2014)
1 - Current	25 kW	153,000	$32,000	$255,000
2 - Future	45 kW	276,000	$58,000	$286,000

1 – Energy value based on recent retail rates quoted by AP&T.

6.6 Cost Estimates

Detailed cost estimates for the current and future alternatives are included in Appendix B. Cost estimates should be considered order-of-magnitude with 2014 as the cost basis year.

Annual Energy Production: The figures are based upon current and projected future pipeline operation. In addition, they are based upon ideal staging of unit(s) as pipeline flow varies. They should, therefore, be considered maximum values. Energy costs are derived from recent electric rates quoted by AP&T for Prince of Wales Island.

Permitting and Mitigation: No mitigation costs are anticipated. All land-disturbing activities are confined to areas within the existing WTP and PRV.

Access/right-of-way: All nonutility construction occurs at the existing WTP, so no easement or right-of-way costs were included in the estimates.

Preliminary Engineering/Final Design: This line item includes costs for additional studies, final design, construction documents, construction administration, and inspection. This is estimated as a percentage of construction cost.

6.7 Recommendations

As mentioned previously, a reaction turbine is preferred over an impulse or "Pelton Wheel" turbine. Reaction turbines are more efficient for pressurized pipelines and this turbine would also prevent aerating the raw water supply prior to the WTP or hatchery. For salmonid hatcheries, low dissolved oxygen (DO) levels in the water supply are typically more of a concern than high DO. However, it is possible for fish to suffer from gas bubble disease at very high total dissolved gas (TDG) concentrations (>103 percent TDG).[2] Gas bubble disease can cause salmonid fry to develop certain conditions that can eventually lead to death. Increasing the dissolved oxygen content of the water supply before the WTP can also create treatment issues, such as reducing settling efficiency, "air binding" in filter media, and inaccurate turbidity measurements.[3] However, because a reaction type turbine should have minimal effect on increasing DO concentrations in the raw water supply, this type of turbine is recommended for a hydropower system at the Craig WTP.

Based on initial economic analysis of alternatives, it appears that a hydropower turbine at the Craig WTP has potential to reduce power costs at the WTP and hatchery. However, a detailed economic evaluation should be performed along with a preliminary engineering report to determine the payback period before the City of Craig has enough information to determine if constructing a hydropower facility at this location is economically feasible.

7.0 CAPITAL PROJECT DEVELOPMENT

Capital improvement projects were developed based on the findings from all previous sections. This section prioritizes these projects on a scale from 1 to 4. Projects with a rating of 1 or 2 are considered to be short term capital improvement projects (CIPs), and projects rated 3 and 4 are considered to be long-term CIPs. This rating system, along with the priority explanation, can be

[2] Alaska Department of Fish and Game. (April 2014). *Non-Infectious Diseases - Gas Bubble Disease.* http://www.adfg.alaska.gov/static/species/disease/pdfs/fishdiseases/gas_bubble_disease.pdf.

[3] Scardina, Paolo. (2004). *Effects of Dissolved Gas Supersaturation and Bubble Formation on Water Treatment Plant Performance.*. Blacksburg, Virgina.

seen in Table 7.1. These projects are listed in table format, in Table 7.2, and the locations are shown in Figure 7.1. Descriptions of each of the proposed CIPs follow Figure 7.1.

Table 7.1: Capital Improvement Priority Rating System

Rating No.	Priorities	Explanation
1	Immediate	Potential threat to human health.
2	High	Serious concern for major disruption of City operations.
3	Medium	Concern for disruption to City operations, or project would improve system efficiency.
4	Low	Long term need to facilitate development in Craig.

Table 7.2: Water System Capital Improvement Projects

No.	CIP NAME	System*	BASIC SCOPE	Priority
1	Increase North Fork dam height	WCS	Increase height of dam at North Fork Lake	1 (project underway)
2	Spruce Street Tank Upgrades	WTPE	Repair leaks, install variable frequency drive operated output pump and associated controls to operate pump manually and automatically and keep the tank from overflowing. Install automated input pipe control valve. Pressure switch to turn on for fire flow or low pressure assist.	1**
3.1	System Expansion	WTPE	Add baffling to existing tanks, and place 4 additional conventional treatment trains.	1
3.2	System Upgrades	WTPE	Remove existing conventional treatment trains and replace with membrane filtration units.	1
4	Replace alum mixing station at WTP	WTP	Replace corroded alum mixing station, and co-locate it with the polymer injection system.	2
5	Repairs to Soda Ash and Polymer addition stations at WTP	WTP	Soda ash control panel has a failed contactor, and polymer mixing system does not stop automatically after each mixing cycle.	2
6	800,000 gallon tank upgrades	WTPE	Install tee and low pressure opening check valve at bottom of inlet pipe to allow reverse flow when WTP pumps shut down to backflow Port St. Nicholas road for water supply while maintaining design mixing strategy.	2
7	Upgrade SCADA system for direct communications	WTP	Install master PLC at Wastewater Treatment Plant (WWTP) and improved communication links between the WWTP, the storage tanks, and the WTP.	3
8	Hydroelectric Facility	WCS	Construct hydroelectric facility for powering water treatment plant.	3
9	New Raw Water Main	RW	Replace 5.5 miles of raw water main with 18" HDPE Main.	3
10	Port St. Nicholas Water Main Upgrade	DS	Replace 500LF section of water main where main breaks have occurred.	3
11	Dam Improvements - New dam at new reservoir and new pipeline	WCS	Construct new pipeline to additional water source. Construct inlet structure. Permit new dam.	4

* WTP = Water Treatment Plant; WTPE = WTP Expansion & Storage Systems; WCS = Water Control Systems; RW = Raw Water; DS = Distribution Systems

**This project has been given a #1 priority, because there is major concern over adequate fire flow in summer months during high demand. The best solution would be thorough distribution improvements (larger mains), but a more immediate solution would be improvements to the Spruce St Tank .

Water CIPs	
1	Increase North Fork dam height
2	Spruce Street tank upgrades
3.1	WTP system expansion
3.2	WTP system upgrades
4	Replace alum mixing station at WTP
5	Repairs to soda ash and polymer addition stations at WTP
6	800,000 gallon tank upgrades
7	Upgrade SCADA system for direct communications
8	Hydroelectric facility
9	New raw water main
10	Port St. Nicholas water main upgrade
11	New dam at reservoir and new pipeline

Water
Capital Improvement Projects

Craig, Alaska
Water Master Plan

January 08, 2015

Figure 7.1

Q:\22\61531 Craig Master Plan\GIS\W-CIP.mxd Jan 08, 2015 4:01:35 PM User: jnicolazzo

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7.1 WATER PROJECT DESCRIPTIONS

Each project is described in this section. A cost estimate summary follows the descriptions in Section 8.0 (Table 8.1).

7.1.1 Project # 1: Increase North Fork Dam Height (Priority 1)

As projected in the Task 3 – Projected Growth Summary Memorandum, water demand will continue to grow. As a result, the City of Craig needs to continue to work on improvements to the system to meet the demand starting at the raw water source. Increasing raw water can be accomplished in two projects, 7.1 and 7.2.

The City of Craig currently is designing improvements to the existing dam. This project would raise the reservoir height by 4 feet. This project is underway.

7.1.2 Project # 2: Spruce Street Tank Upgrades (Priority 1)

The water tank located at Spruce Street does not supply water to the City in its current state. The tank is kept partially full to maintain the wood staves in the tank. The tank is due for several upgrades so it can function properly with the current water distribution system. The tank elevation is below the 800,000-gallon tank elevation and cannot be used without manual or automatic filling control. The tank lacks enough head elevation to produce required flow and pressure for some portions of the City. The tank also shares a common inlet and outlet pipe which does not facilitate proper mixing and circulation inside the tank. The upgrades required to make this tank an effective part of the water distribution system will include implementation of PLC controlled inlet and outlet valves as well as two VFD controlled pumps. These valves and pumps will need to be controlled by the PLC, which can activate the pump on a daily basis, as well as in times of low system pressures. This controller will provide a means of daily filling and draining the tank without short circuiting water flow and simply mixing the tank contents. Water elevation detection equipment will need to be installed in the tank as part of this control scenario. This will prevent overfilling the tank due to the elevation differences between the tanks. It will also prevent the pump from draining the tank and running the pump dry. Pressure control switches can also be implemented to close the tank inlet and turn a pump on in the event of a fire or problem with the 800,000-gallon tank. This PLC will communicate with the SCADA system through the radio network at the WWTP. In order to provide a suitable system for fire flows a standby generator will need to be installed at the tank.

7.1.3 Project # 3.1: System Expansion (Priority 1)

As discussed in the projected growth summary and condition assessment, the existing WTP cannot keep up with peak demand at existing conditions. The WTP must produce water all night to fill the water storage tank, which are depleted during the day. To meet future demand and provide adequate supply for fire flow the WTP should be upgraded to produce 1,000 gpm. There are two options for meeting this ultimate goal, a system expansion (project 3.1) or a system upgrade to more sophisticated technology (project 3.2). This project description is for Project 3.1: system expansion.

An expansion of this magnitude would require the addition of four new conventional filtration treatment trains similar to the City's current units. It would also require additional disinfection contact time (CT) (concentration of the disinfectant x contact time, i.e. the power of disinfection). Preliminary CT calculations indicate a $CT_{Required} = 161$; therefore, at a peak flow of 1,000 gpm, 230,000 gallons of contact volume would be required. The City's existing 35,000 and 165,000 gallon tanks could be treated as one CT tank. This would require an additional 30,000 gallons of storage to meet the required CT. To obtain the required CT value, the two existing tanks would require the addition of internal baffling to prevent "short circuiting" of the flow, with the goal of approaching "plug flow" conditions as much as is practical. The new 30,000 gallon tank would also require baffling. The finished water would not be considered potable until after the new 30,000 gallon tank; therefore, piping modifications will be required as well.

As part of the Capital Improvement Project (CIP) estimate for this project, costs for the completion of a design study report have been included. This would be the necessary first step in this project.

The benefits of this option include:

- Current operations and maintenance staff will already be well versed in the existing treatment technology.

- This is likely the lowest total lifecycle cost option. Capital costs for the installation of the additional treatment trains, additional storage, new tank baffling, and piping modifications would likely be the highest initial capital cost option; however, operating and maintenance costs over time will be lower than the membrane filtration option.

The disadvantages of this option include:

- This design is the most susceptible to degradation in raw water quality as well as future increases in regulatory requirements.
- This will also be the most challenging construction option as the tank baffling installation will require the tanks to be out of service during construction activities.

The current WTP building (including space currently used for other purposes) is sufficient in size for the addition of four new treatment trains. The City currently uses a portion of the treatment plant for storage, and it would be likely this storage would have to be located elsewhere. From a planning perspective, the high demand service pumps and main between the treatment plant and the 800,000 gallon storage tanks are capable of handling 1,000 gpm.

The system expansion could be phased. 1,000 gpm is the ultimate build-out capacity based on an increased demand at Silver Bay Seafoods of 700 gpm. The expansion could be phased by adding one treatment train at a time and improving baffling in the CT tanks. Baffling could be added to the 35,000 gallon tank, then the 165,000 gallon tank. The description, the schematic (Figure 7.2), and the cost estimate are focused around full build-out. The first step of the system expansion should consist of a design study report to assess phasing the project and refining the cost estimate. The design study report makes up $60,000 of the overall CIP estimate. The WTP expansion DSR should be undertaken separately before final engineering of either a system expansion or upgrade.

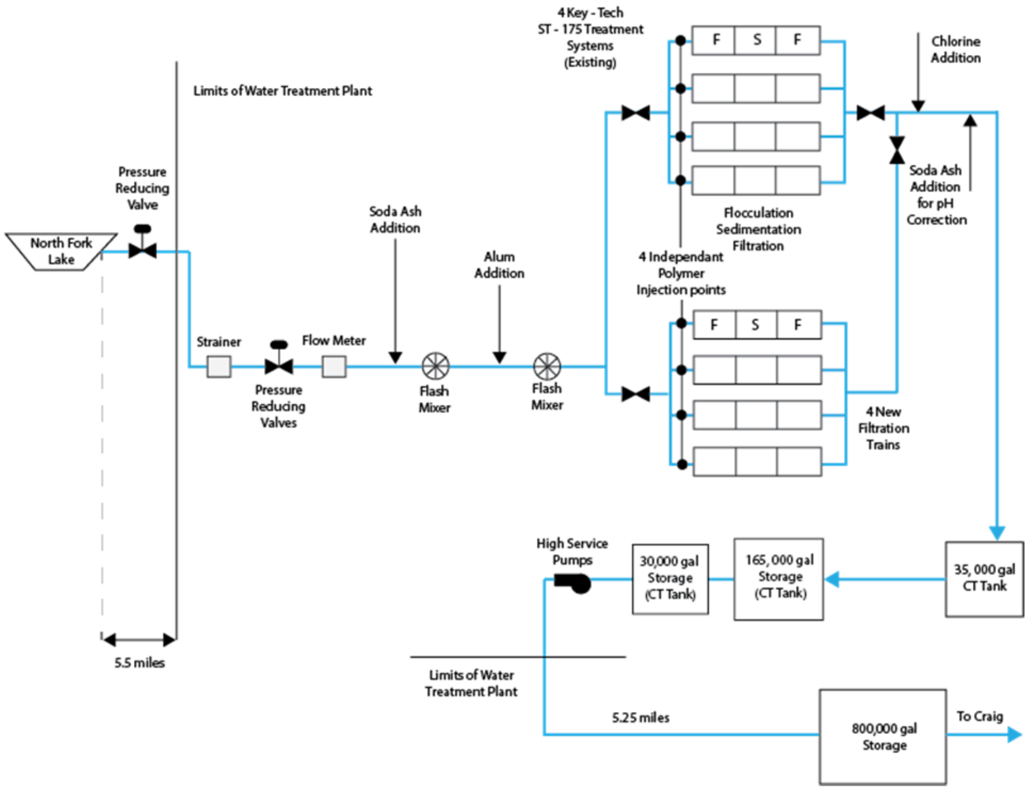

Figure 7.2: Schematic of WTP expansion

7.1.4 Project # 3.2: System Upgrades (Priority 1)

As part of the CIP estimate for this project, costs for the completion of a design study report have been included. This would be the necessary first step in this project.

This option would consist of several modifications to the chemical injection scheme as well as a complete replacement of the filtration system as follows:

- Replace the current raw water soda ash and alum addition stations with a new pH control system and polymer based coagulant injection system.
- Install a new membrane filtration skid with a minimum of 2-Log removal credits for *Giardia*.
- Modify or update the post-filtration chemical injection system to optimize pH control and chlorine injection.
- Demolish and remove the existing four conventional treatment trains.

This option would not result in a footprint expansion of the overall WTP. The conventional filter trains would be replaced with three new membrane filtration skid-mounted units, each rated for approximately 500 gpm. Since the filtration skids have a 2-log removal credit for *Giardia*, this reduces the required CT for chlorination. Preliminary calculations indicate a $CT_{Required}$ of 52 for this option, which would require a CT volume of approximately 75,000 gallons which could be accomplished in the existing tanks without additional baffling.

To summarize, benefits of this option include:

- No need for additional storage for increased CT.
- No need for the addition of tank baffling.
- Chemical injection of polymer based coagulant and pH controls can be optimized for a significant reduction in disinfection byproducts.
- It is very likely that the overall chemical usage would be reduced; however, this would require verification using a pilot study.
- Most robust design and most likely to provide protection against degradation in raw water quality or increases in regulatory pressure.

The disadvantages of this option include:

- Operations and maintenance personnel would be required to learn a new treatment technology.
- This will likely be the higher total lifecycle cost option. The installation of the membrane filtration system would likely be the lowest capital cost option; however, lifecycle costs could favor the conventional treatment system. This is highly dependent on the power cost associated with the membrane system selected and whether or not the inlet head could be used to move the water all the way through the membrane system without the use of feed pressure pumps (which are typically the highest O&M cost item for a membrane plant). As previously mentioned, further study and possibly pilot testing would be required to determine which option has the lowest lifecycle cost.

The following schematic represents the required modifications as discussed above (Figure 7.3).

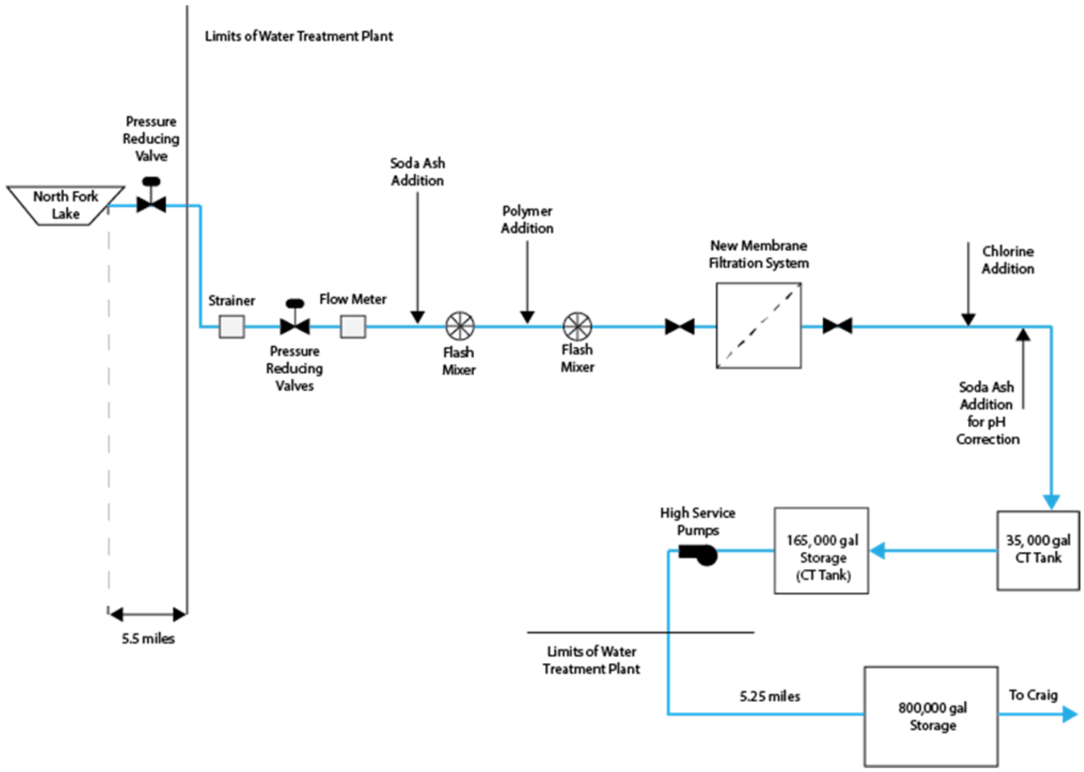

Figure 7.3: Schematic of WTP expansion

7.1.5 Project # 4: Replace Alum Mixing Station at WTP (Priority 2)

The existing alum mixing station is heavily corroded and in need of replacement. It could be built on a skid similar to the existing system, allowing for a quick switch out. The new mixing station will require controls as well as mechanical equipment. It is likely this repair could be executed under routine maintenance procedures so it wouldn't require an engineered plan set or DEC plan review.

7.1.6 Project # 5: Repairs to Soda Ash and Polymer Addition Station at WTP (Priority 2)

The soda ash control panel has a failed contactor that needs replacement. The Polymer Mixing System does not stop automatically after each mixing cycle. This issue needs to be further investigated, by a technician, to identify the specific problem and a solution. It is likely this repair could be executed under routine maintenance procedures so it wouldn't require an engineered plan set or DEC plan review.

7.1.7 Project # 6: 800,000-Gallon Water Tank Upgrades (Priority 2)

Two upgrades should be made to improve operation of the 800,000-gallon water tank. The tank needs an inlet water meter and a revised inlet pipe configuration. The inlet water meter will allow the City to monitor water used and/or lost in the transmission pipe between the WTP and the tank. The inlet pipe needs to be modified to allow water to backflow through the inlet pipe, in the event of a pump shutdown at the WTP. The current inlet pipe terminates high in the tank, making it impossible for water to backflow once the water level has dropped below the inlet. As the tank is configured residents along Port St. Nicholas road would run out of water shortly after a situation where the WTP pumps shutdown. One solution is to insert a tee and check valve where the inlet pipe penetrates the floor of the tank. This check valve would not allow water from the pressurized inlet pipe to short circuit to the exit pipe under normal operation, but would allow water to backflow in the event of a WTP shutdown. This option would also maintain the water mixing flows that the tank was originally designed to incorporate.

7.1.8 Project # 7: Upgrade SCADA System for Direct Communications (Priority 3)

This project includes the installation of a master PLC at the WWTP. The current communication link between the WWTP and the WTP requires a PC at the WWTP which runs gateway communication software and relies on a virtual private network (VPN) between the plants. The system was recently improved with the installation of hardware VPN routers at each end, but the PC is still a weak link. The master PLC is much more robust and will also manage the radio communications to each of the remote terminal units (RTUs) in the town area. These RTUs include East and West Hamilton lift stations and the 800,000-gallon tank. The existing Spruce Street Tank monitoring and control system will need to be connected into this system to provide efficient control, monitoring, and operation. Any future lift station RTUs will also connect to this radio network.

Since the WTP expansion is a longer-range priority, it may not be a reality for 10 or more years. If this is the case, the existing WTP controls should be improved.

Control systems for the plant were partially updated in 2004. This included a new plant PLC system, a new high service pump control panel, and the SCADA system. The main PLC is an Allen-Bradley SLC5/03, which controls the plant through both DeviceNet and DH485 communication protocols. All other control panels in the plant are older and were installed with the original plant in 1992 except the fourth filter which was installed in 2004. The older control panels are near the end of their expected life and should be replaced.

7.1.9 Project # 8: Hydroelectric Facility (Priority 3)

Based on an initial economic analysis for a hydro-electric facility, a hydropower turbine at the Craig WTP has potential to reduce power costs at the WTP and Hatchery. This project would start with a detailed economic evaluation, along with a preliminary engineering report, to determine the payback period. The evaluation would build off the information provided in this master plan. The cost estimate assumes an evaluation would find the project economically feasible.

7.1.10 Project # 9: New Raw Water Main (Priority 3)

Replace the 5.5 miles of existing 12-inch ductile iron (DI) raw water main between the North Fork reservoir and the WTP with a new 18-inch high-density polyethylene (HDPE) Main. A new HDPE main would reduce the potential for corrosion that is present with the DI main, and upsizing it would provide additional flow which could be used for hydro-electric generation.

7.1.11 Project # 10: Port St. Nicholas Water Main Upgrade (Priority 3)

The water main on Port St. Nicholas road needs to be upgraded. This main is a major arterial pipe for the city and a failing main jeopardizes the water supply for most of East and West Craig. These failures also pose a threat to the operation of Silver Bay Seafoods as well as other local employers. There have been at least three failures over the last three years on this water main. A stretch of the Port St. Nicholas main was replaced in summer 2014, but an additional 500 linear feet should be replaced.

7.1.12 Project # 11: New Dam at New Reservoir and New Pipeline (Priority 4)

Beginning with a reconnaissance study, a new water source would be identified. A dam would be built at the new water source and a new raw water line would be constructed. This is a long-term solution, but is a CIP the City of Craig should investigate further. A cost estimate for this CIP has not been included, only an estimate for the reconnaissance study has been included.

8.0 CAPITAL COST ESTIMATES

Table 8.1: Water Capital Cost Estimates

No.	CIP NAME	Description	Total Cost
1	Increase dam height	Increase height of dam at North Fork Lake	Underway
2	Spruce Street Tank Upgrades	Repair leaks, install variable frequency drive operated output pump and associated controls to operate pump manually and automatically and keep the tank from overflowing. Install automated input pipe control valve. Pressure switch to turn on for fire flow or low pressure assist.	$300,000
3.1	System Expansion	Add baffling to existing tanks and place 4 additional conventional treatment trains	$3,000,000
3.2*	System Upgrades	Remove existing conventional treatment trains and replace with membrane filtration units	$4,000,000
4	Replace alum mixing station at WTP	Replace corroded alum mixing station, and co-locate it with the polymer injection system.	$23,000
5	Repairs to Soda Ash and Polymer addition stations at WTP	Repair failed contactor on soda ash control panel and automatic stop function for polymer mixing system.	$30,000
6	800,000 gallon tank upgrades	Install tee and low pressure opening check valve at bottom of inlet pipe to allow reverse flow when WTP pumps shut down to backflow Port St. Nicholas road for water supply while maintaining design mixing strategy.	$80,000
7	Upgrade SCADA system for direct communications	Install master PLC at Wastewater Treatment Plant (WWTP)_ and improved communication links between the WWTP, the storage tanks, and the WTP.	$65,000
8	Hydroelectric Facility	Construct hydroelectric facility for powering water treatment plant.	$400,000
9	New Raw Water Main	Replace 5.5 miles of raw water main with 18-inch HDPE Main.	$2,900,000
10	Port St. Nicholas Water Main Upgrade	Replace 500LF section of water main where main breaks have occurred.	$210,000
11	New dam and pipeline at new reservoir	Complete Reconnaissance study for construction of new pipeline to additional water source. Study would include investigation of water sources, inlet structures, allowable take, and other pertinent information.	$100,000
		Total	**$8,108,000**

*Only estimate for system upgrades is included in total.

9.0 CONCLUSION

The City of Craig should begin using this master plan to solicit project funding as soon as possible. The City of Craig's water system infrastructure was found to be in generally good condition, and compliant with existing and future regulations. Based on population projections using State of Alaska information, Craig is not expected to grow over the planning period, but given the complicated boom-bust nature of resource development, and the actual increase in population seen in Craig lately, it is important for the City of Craig to continue developing its water system and build out to meet potential future demand. DOWL HKM recommends the following be executed as soon as possible. These are all from the CIP lists, or are the first step in a higher priority CIP.

- Spruce Street Tank Upgrades
  - Starting with a design study report, and an engineered system
- Water Treatment Plant Expansion Design Study Report
- Replace the Alum mixing station as routine maintenance
- Repair the soda ash and polymer addition stations as routine maintenance

APPENDIX A

Water Demand Records

MONTHLY WATER METER SUMMARY

MONTH/YEAR		Jan-13		
METERED UNITS		**# METERS**	**GALLONS**	**$$$$$$$$**
COM / SINGLE	**A**	8	47,500	$ 208.50
COM / MULTI	**B**	6	34,600	$ 324.30
COMMERCIAL	**C**	53	346,600	$ 1,910.00
MULTI FAMILY	**M**	49	1,853,600	$ 6,573.00
PUBLIC (billable)	**N**	8	36,400	$ 193.50
PUBLIC/CITY OWNED		0		
SINGLE FAMILY	**S**	169	648,153	$ 3,709.80
METERED TOTALS		**293**	**2,966,853**	**12,919.10**
UNMETERED		40		$ 1,720.98
UNMETERED TOTALS		**40**		**$ 1,720.98**
PSN-COM / SINGLE	**A**			
PSN-COMMERCIAL	**C**	1	1,000	$ 53.75
PSN-MULTI FAMILY	**M**	7	34,000	$ 752.50
PSN-SINGLE	**S**	64	269,000	$ 3,651.25
ST NICK TOTALS		**72**	**304,000**	**$ 4,457.50**
CITY ACCOUNTS (5555)				
NORTH COVE (1NC Harbor)			158,000	
ICEHOUSE (100 JT Brown St)			16,269	
CANNERY (100 Main St)			-	
RESTROOM/WASHDOWN (114 JT Brown St)			1,000	
BOAT HAULOUT (120 JT Brown St)			12,000	
WOOD BOILER BLD (1300 Water tower rd)			-	
GARDEN CLUB(1301 water tower rd)			-	
PEACE MEDICAL (1800 C-K Hwy)			5,000	
POOL (1400 Water Tower Rd)			59,415	
HIGH SCHOOL (1950 C-K Hwy)			22,000	
WASTEWATER PLANT (2 Cemetery Isl) 301			145,150	
FLOATPLANE DOCK (201 8th St)			1,000	
SALMON HATCHERY (2A PSN)			-	
WATER TANK (403 Spruce St)			248,000	
HARBORMASTER BLD (410 Hamilton Dr)			4,000	
SOUTH COVE (2SC Harbor)			57,000	
		CITY ACCOUNTS TOTAL	**728,834**	

MONTHLY WATER METER SUMMARY					
MONTH/YEAR		**Feb-13**			
METERED UNITS		**# METERS**	**GALLONS**	**$$$$$$$$**	
COM / SINGLE	**A**	8	46,200	$	197.10
COM / MULTI	**B**	6	31,800	$	322.50
COMMERCIAL	**C**	55	457,500	$	2,310.50
MULTI FAMILY	**M**	49	2,246,700	$	8,073.50
PUBLIC (billable)	**N**	8	32,000	$	193.50
PUBLIC/CITY OWNED					
SINGLE FAMILY	**S**	167	522,126	$	3,685.50
METERED TOTALS		**293**	**3,336,326**		**14,782.60**
UNMETERED		40		$	1,720.98
UNMETERED TOTALS		**40**		**$**	**1,720.98**
PSN-COM / SINGLE	**A**				
PSN-COMMERCIAL	**C**	1	4,000	$	53.75
PSN-MULTI FAMILY	**M**	7	30,000	$	752.50
PSN-SINGLE	**S**	65	243,000	$	3,570.00
ST NICK TOTALS		**73**	**277,000**	**$**	**4,376.25**
CITY ACCOUNTS (5555)					
NORTH COVE (1NC Harbor)			87,000		
ICEHOUSE (100 JT Brown St)			6,412		
CANNERY (100 Main St)			-		
RESTROOM/WASHDOWN (114 JT Brown St)			-		
BOAT HAULOUT (120 JT Brown St)			7,000		
WOOD BOILER BLD (1300 Water tower rd)			-		
GARDEN CLUB(1301 water tower rd)			-		
PEACE MEDICAL (1800 C-K Hwy)			4,000		
POOL (1400 Water Tower Rd)			41,900		
HIGH SCHOOL (1950 C-K Hwy)			18,000		
WASTEWATER PLANT (2 Cemetery Isl) 301			240,232		
FLOATPLANE DOCK (201 8th St)			1,000		
SALMON HATCHERY (2A PSN)			-		
WATER TANK (403 Spruce St)			220,000		
HARBORMASTER BLD (410 Hamilton Dr)			5,000		
SOUTH COVE (2SC Harbor)			25,000		
		CITY ACCOUNTS TOTAL	**655,544**		

MONTHLY WATER METER SUMMARY

MONTH/YEAR		Mar-13		
METERED UNITS		**# METERS**	**GALLONS**	**$$$$$$$$**
COM / SINGLE	**A**	7	44,400	$ 200.20
COM / MULTI	**B**	5	24,000	$ 279.50
COMMERCIAL	**C**	57	580,400	$ 2,666.10
MULTI FAMILY	**M**	50	1,281,600	$ 5,149.50
PUBLIC (billable)	**N**	7	33,200	$ 172.00
PUBLIC/CITY OWNED				
SINGLE FAMILY	**S**	170	548,725	$ 3,710.00
METERED TOTALS		**296**	**2,512,325**	**12,177.30**
UNMETERED		40		$ 1,720.98
UNMETERED TOTALS		**40**		**$ 1,720.98**
PSN-COM / SINGLE	**A**			
PSN-COMMERCIAL	**C**	2	4,000	$ 107.50
PSN-MULTI FAMILY	**M**	7	35,000	$ 752.50
PSN-SINGLE	**S**	66	233,000	$ 3,838.75
ST NICK TOTALS		**75**	**272,000**	**$ 4,698.75**
CITY ACCOUNTS (5555)				
NORTH COVE (1NC Harbor)			105,000	
ICEHOUSE (100 JT Brown St)			17,922	
CANNERY (100 Main St)			-	
RESTROOM/WASHDOWN (114 JT Brown St)			4,000	
BOAT HAULOUT (120 JT Brown St)			10,000	
WOOD BOILER BLD (1300 Water tower rd)			-	
GARDEN CLUB(1301 water tower rd)			-	
PEACE MEDICAL (1800 C-K Hwy)			5,000	
POOL (1400 Water Tower Rd)				
HIGH SCHOOL (1950 C-K Hwy)			11,000	
WASTEWATER PLANT (2 Cemetery Isl) 301			81,860	
FLOATPLANE DOCK (201 8th St)			1,000	
SALMON HATCHERY (2A PSN)			-	
WATER TANK (403 Spruce St)			208,000	
HARBORMASTER BLD (410 Hamilton Dr)			4,000	
SOUTH COVE (2SC Harbor)			54,000	
CITY ACCOUNTS TOTAL			**501,782**	

MONTHLY WATER METER SUMMARY

MONTH/YEAR		Apr-13			
METERED UNITS		**# METERS**	**GALLONS**	**$$$$$$$$**	
COM / SINGLE	**A**	8	54,000	$	205.50
COM / MULTI	**B**	5	36,000	$	279.50
COMMERCIAL	**C**	57	647,187	$	2,856.86
MULTI FAMILY	**M**	51	889,800	$	4,609.10
PUBLIC (billable)	**N**	8	31,300	$	193.50
PUBLIC/CITY OWNED					
SINGLE FAMILY	**S**	175	637,142	$	3,869.50
METERED TOTALS		**304**	**2,295,429**		**12,013.96**
UNMETERED		40		$	1,638.28
UNMETERED TOTALS		**40**		**$**	**1,638.28**
PSN-COM / SINGLE	**A**				
PSN-COMMERCIAL	**C**	2	3,000	$	107.50
PSN-MULTI FAMILY	**M**	7	41,000	$	752.50
PSN-SINGLE	**S**	67	461,000	$	5,003.75
ST NICK TOTALS		**76**	**505,000**	**$**	**5,863.75**
CITY ACCOUNTS (5555)					
NORTH COVE (1NC Harbor)			105,000		
ICEHOUSE (100 JT Brown St)			17,922		
CANNERY (100 Main St)					
RESTROOM/WASHDOWN (114 JT Brown St)			4,000		
BOAT HAULOUT (120 JT Brown St)			10,000		
WOOD BOILER BLD (1300 Water tower rd)					
GARDEN CLUB(1301 water tower rd)					
PEACE MEDICAL (1800 C-K Hwy)			5,000		
POOL (1400 Water Tower Rd)			50,600		
HIGH SCHOOL (1950 C-K Hwy)			11,000		
WASTEWATER PLANT (2 Cemetery Isl) 301			81,860		
FLOATPLANE DOCK (201 8th St)			1,000		
SALMON HATCHERY (2A PSN)					
WATER TANK (403 Spruce St)			208,000		
HARBORMASTER BLD (410 Hamilton Dr)			4,000		
SOUTH COVE (2SC Harbor)			54,000		
		CITY ACCOUNTS TOTAL	**552,382**		

MONTHLY WATER METER SUMMARY

MONTH/YEAR		May-13		
METERED UNITS		**# METERS**	**GALLONS**	**$$$$$$$$**
COM / SINGLE	**A**	9	58,000	$ 245.00
COM / MULTI	**B**	5	44,000	$ 291.50
COMMERCIAL	**C**	55	734,515	$ 2,989.15
MULTI FAMILY	**M**	53	1,046,100	$ 4,644.00
PUBLIC (billable)	**N**	9	41,800	$ 221.00
PUBLIC/CITY OWNED				
SINGLE FAMILY	**S**	175	777,190	$ 3,957.00
METERED TOTALS		**306**	**2,701,605**	**12,347.65**
UNMETERED		39		$ 1,679.63
UNMETERED TOTALS		**39**		**$ 1,679.63**
PSN-COM / SINGLE	**A**			
PSN-COMMERCIAL	**C**	2	6,000	$ 107.50
PSN-MULTI FAMILY	**M**	8	81,000	$ 925.00
PSN-SINGLE	**S**	73	370,000	$ 3,486.75
ST NICK TOTALS		**83**	**457,000**	**$ 4,519.25**
CITY ACCOUNTS (5555)				
NORTH COVE (1NC Harbor)			616,000	
ICEHOUSE (100 JT Brown St)			13,293	
CANNERY (100 Main St)			-	
RESTROOM/WASHDOWN (114 JT Brown St)			7,000	
BOAT HAULOUT (120 JT Brown St)			6,000	
WOOD BOILER BLD (1300 Water tower rd)			-	
GARDEN CLUB(1301 water tower rd)			1,000	
PEACE MEDICAL (1800 C-K Hwy)			6,000	
POOL (1400 Water Tower Rd)			50,900	
HIGH SCHOOL (1950 C-K Hwy)			21,000	
WASTEWATER PLANT (2 Cemetery Isl) 301			109,397	
FLOATPLANE DOCK (201 8th St)			1,000	
SALMON HATCHERY (2A PSN)			2,000	
WATER TANK (403 Spruce St)			283,000	
HARBORMASTER BLD (410 Hamilton Dr)			10,000	
SOUTH COVE (2SC Harbor)			17,000	
CITY ACCOUNTS TOTAL			**1,143,590**	

MONTHLY WATER METER SUMMARY

MONTH/YEAR		Jun-13		
METERED UNITS		**# METERS**	**GALLONS**	**$$$$$$$$**
COM / SINGLE	**A**	9	49,000	$ 233.00
COM / MULTI	**B**	5	35,000	$ 279.50
COMMERCIAL	**C**	56	1,030,493	$ 3,957.68
MULTI FAMILY	**M**	52	831,000	$ 4,634.50
PUBLIC (billable)	**N**	9	27,000	$ 215.00
PUBLIC/CITY OWNED				
SINGLE FAMILY	**S**	181	657,375	$ 4,043.00
METERED TOTALS		**312**	**2,629,868**	**13,362.68**
UNMETERED		46		$ 1,803.68
UNMETERED TOTALS		**46**		**$ 1,803.68**
PSN-COM / SINGLE	**A**			
PSN-COMMERCIAL	**C**	2	7,000	$ 107.50
PSN-MULTI FAMILY	**M**	8	56,000	$ 812.50
PSN-SINGLE	**S**	75	374,000	$ 4,625.00
ST NICK TOTALS		**85**	**437,000**	**$ 5,545.00**
CITY ACCOUNTS (5555)				
NORTH COVE (1NC Harbor)			584,000	
ICEHOUSE (100 JT Brown St)			14,058	
CANNERY (100 Main St)			-	
RESTROOM/WASHDOWN (114 JT Brown St)			11,000	
BOAT HAULOUT (120 JT Brown St)			7,000	
WOOD BOILER BLD (1300 Water tower rd)			-	
GARDEN CLUB(1301 water tower rd)			3,000	
PEACE MEDICAL (1800 C-K Hwy)			5,000	
POOL (1400 Water Tower Rd)			146,600	
HIGH SCHOOL (1950 C-K Hwy)			5,000	
WASTEWATER PLANT (2 Cemetery Isl) 301			123,102	
FLOATPLANE DOCK (201 8th St)			2,000	
SALMON HATCHERY (2A PSN)			1,000	
WATER TANK (403 Spruce St)			207,000	
HARBORMASTER BLD (410 Hamilton Dr)			9,000	
SOUTH COVE (2SC Harbor)			34,000	
CITY ACCOUNTS TOTAL			**1,151,760**	

MONTHLY WATER METER SUMMARY					
MONTH/YEAR		**Jul-13**			
METERED UNITS		**# METERS**	**GALLONS**	**$$$$$$$$**	
COM / SINGLE	**A**	9	59,000	$	314.80
COM / MULTI	**B**	5	53,000	$	239.60
COMMERCIAL	**C**	57	4,789,535	$	15,159.05
MULTI FAMILY	**M**	53	1,103,000	$	5,715.60
PUBLIC (billable)	**N**	9	38,100	$	247.92
PUBLIC/CITY OWNED					
SINGLE FAMILY	**S**	184	809,420	$	5,129.13
METERED TOTALS		**317**	**6,852,055**		**26,806.10**
UNMETERED		42		$	1,893.54
UNMETERED TOTALS		**42**		**$**	**1,893.54**
PSN-COM / SINGLE	**A**	1		$	35.00
PSN-COMMERCIAL	**C**	2	27,000	$	286.00
PSN-MULTI FAMILY	**M**	8	48,000	$	664.00
PSN-SINGLE	**S**	77	500,000	$	6,695.00
ST NICK TOTALS		**88**	**575,000**	**$**	**7,680.00**
CITY ACCOUNTS (5555)					
NORTH COVE (1NC Harbor)			623,000		
ICEHOUSE (100 JT Brown St)			44,930		
CANNERY (100 Main St)					
RESTROOM/WASHDOWN (114 JT Brown St)			19,000		
BOAT HAULOUT (120 JT Brown St)			4,000		
WOOD BOILER BLD (1300 Water tower rd)			-		
GARDEN CLUB(1301 water tower rd)			2,000		
PEACE MEDICAL (1800 C-K Hwy)			7,000		
POOL (1400 Water Tower Rd)			45,400		
HIGH SCHOOL (1950 C-K Hwy)			2,000		
WASTEWATER PLANT (2 Cemetery Isl) 301			405,946		
FLOATPLANE DOCK (201 8th St)			2,000		
SALMON HATCHERY (2A PSN)			2,000		
WATER TANK (403 Spruce St)			276,000		
HARBORMASTER BLD (410 Hamilton Dr)			13,000		
SOUTH COVE (2SC Harbor)			102,000		
CITY ACCOUNTS TOTAL			**1,548,276**		

MONTHLY WATER METER SUMMARY				
MONTH/YEAR		**Aug-13**		
METERED UNITS		**# METERS**	**GALLONS**	**$$$$$$$$**
COM / SINGLE	**A**	9	56,200	$ 305.84
COM / MULTI	**B**	5	51,000	$ 233.20
COMMERCIAL	**C**	57	6,699,370	$ 20,192.28
MULTI FAMILY	**M**	53	913,000	$ 5,107.60
PUBLIC (billable)	**N**	9	48,600	$ 281.52
PUBLIC/CITY OWNED				
SINGLE FAMILY	**S**	182	543,929	$ 4,288.57
METERED TOTALS		**315**	**8,312,099**	**30,409.01**
UNMETERED		43		$ 1,936.95
UNMETERED TOTALS		**43**		**$ 1,936.95**
PSN-COM / SINGLE	**A**	1	-	$ 35.00
PSN-COMMERCIAL	**C**	2	25,000	$ 270.00
PSN-MULTI FAMILY	**M**	8	64,000	$ 792.00
PSN-SINGLE	**S**	79	564,000	$ 7,277.00
ST NICK TOTALS		**90**	**653,000**	**$ 8,374.00**
CITY ACCOUNTS (5555)				
NORTH COVE (1NC Harbor)			604,000	
ICEHOUSE (100 JT Brown St)			46,838	
CANNERY (100 Main St)			-	
Library (504 3rd)			-	
RESTROOM/WASHDOWN (114 JT Brown St)			16,000	
BOAT HAULOUT (120 JT Brown St)			3,000	
WOOD BOILER BLD (1300 Water tower rd)			1,000	
GARDEN CLUB(1301 water tower rd)			4,000	
PEACE MEDICAL (1800 C-K Hwy)			4,000	
POOL (1400 Water Tower Rd)			44,000	
HIGH SCHOOL (1950 C-K Hwy)			5,000	
WASTEWATER PLANT (2 Cemetery Isl) 301			79,915	
FLOATPLANE DOCK (201 8th St)			3,000	
SALMON HATCHERY (2A PSN)			2,000	
WATER TANK (403 Spruce St)			1,000	
HARBORMASTER BLD (410 Hamilton Dr)			19,000	
SOUTH COVE (2SC Harbor)			97,000	
CITY ACCOUNTS TOTAL			**929,753**	

MONTHLY WATER METER SUMMARY

MONTH/YEAR		Sep-13		
METERED UNITS		**# METERS**	**GALLONS**	**$$$$$$$$**
COM / SINGLE	**A**	8	56,300	$ 292.16
COM / MULTI	**B**	5	63,000	$ 271.60
COMMERCIAL	**C**	58	2,560,296	$ 8,874.62
MULTI FAMILY	**M**	52	1,035,200	$ 5,484.64
PUBLIC (billable)	**N**	9	42,800	$ 262.96
PUBLIC/CITY OWNED				
SINGLE FAMILY	**S**	177	577,771	$ 4,326.87
METERED TOTALS		**309**	**4,335,367**	**19,512.85**
UNMETERED			40	$ 1,806.72
UNMETERED TOTALS		**0**		**$ 1,806.72**
PSN-COM / SINGLE	**A**	1	-	$ 35.00
PSN-COMMERCIAL	**C**	2	45,000	$ 430.00
PSN-MULTI FAMILY	**M**	8	93,400	$ 1,027.20
PSN-SINGLE	**S**	78	306,000	$ 5,178.00
ST NICK TOTALS		**89**	**444,400**	**$ 6,670.20**
CITY ACCOUNTS (5555)				
NORTH COVE (1NC Harbor)			548,000	
ICEHOUSE (100 JT Brown St)			19,937	
CANNERY (100 Main St)			-	
LIBRARY (504 3rd)			2,000	
RESTROOM/WASHDOWN (114 JT Brown St)			7,000	
BOAT HAULOUT (120 JT Brown St)			9,000	
WOOD BOILER BLD (1300 Water tower rd)			-	
GARDEN CLUB(1301 water tower rd)			-	
PEACE MEDICAL (1800 C-K Hwy)			5,000	
POOL (1400 Water Tower Rd)			64,485	
HIGH SCHOOL (1950 C-K Hwy)			15,000	
WASTEWATER PLANT (2 Cemetery Isl) 301			287,454	
FLOATPLANE DOCK (201 8th St)			2,000	
SALMON HATCHERY (2A PSN)			2,000	
WATER TANK (403 Spruce St)			-	
HARBORMASTER BLD (410 Hamilton Dr)			8,000	
SOUTH COVE (2SC Harbor)			18,000	
CITY ACCOUNTS TOTAL			**987,876**	

MONTHLY WATER METER SUMMARY				
MONTH/YEAR		**Oct-13**		
METERED UNITS		**# METERS**	**GALLONS**	**$$$$$$$$**
COM / SINGLE	**A**	9	46,500	$ 274.80
COM / MULTI	**B**	5	34,000	$ 178.80
COMMERCIAL	**C**	56	1,139,310	$ 4,429.79
MULTI FAMILY	**M**	49	1,065,900	$ 5,540.88
PUBLIC (billable)	**N**	9	46,600	$ 275.12
PUBLIC/CITY OWNED				
SINGLE FAMILY	**S**	176	661,920	$ 4,582.14
METERED TOTALS		**304**	**2,994,230**	**15,281.53**
UNMETERED		39		$ 1,763.31
UNMETERED TOTALS		**39**		**$ 1,763.31**
PSN-COM / SINGLE	**A**	1		$ 35.00
PSN-COMMERCIAL	**C**	2	9,000	$ 142.00
PSN-MULTI FAMILY	**M**	7	35,000	$ 525.00
PSN-SINGLE	**S**	71	287,000	$ 4,781.00
ST NICK TOTALS		**81**	**331,000**	**$ 5,483.00**
CITY ACCOUNTS (5555)				
NORTH COVE (1NC Harbor)			584,000	
ICEHOUSE (100 JT Brown St)			7,690	
CANNERY (100 Main St)			-	
LIBRARY (504 3rd)			1,000	
RESTROOM/WASHDOWN (114 JT Brown St)			16,000	
BOAT HAULOUT (120 JT Brown St)			1,000	
WOOD BOILER BLD (1300 Water tower rd)			1,000	
GARDEN CLUB(1301 water tower rd)			1,000	
PEACE MEDICAL (1800 C-K Hwy)			4,000	
POOL (1400 Water Tower Rd)			44,385	
HIGH SCHOOL (1950 C-K Hwy)			19,000	
WASTEWATER PLANT (2 Cemetery Isl) 301			45,710	
FLOATPLANE DOCK (201 8th St)			1,000	
SALMON HATCHERY (2A PSN)			3,000	
WATER TANK (403 Spruce St)			-	
HARBORMASTER BLD (410 Hamilton Dr)			5,000	
SOUTH COVE (2SC Harbor)			22,000	
CITY ACCOUNTS TOTAL			**755,785**	

MONTHLY WATER METER SUMMARY

MONTH/YEAR		Nov-13		
METERED UNITS		**# METERS**	**GALLONS**	**$$$$$$$$**
COM / SINGLE	**A**	8	44,100	$ 253.12
COM / MULTI	**B**	5	25,000	$ 150.00
COMMERCIAL	**C**	56	825,168	$ 3,424.54
MULTI FAMILY	**M**	51	1,141,300	$ 5,810.16
PUBLIC (billable)	**N**	9	29,300	$ 219.76
PUBLIC/CITY OWNED				
SINGLE FAMILY	**S**	178	566,389	$ 4,304.44
METERED TOTALS		**307**	**2,631,257**	**14,162.02**
UNMETERED		36		$ 1,573.06
UNMETERED TOTALS		**36**		**$ 1,573.06**
PSN-COM / SINGLE	**A**	1		$ 35.00
PSN-COMMERCIAL	**C**	2	27,000	$ 286.00
PSN-MULTI FAMILY	**M**	7	39,000	$ 557.00
PSN-SINGLE	**S**	68	244,000	$ 4,332.00
ST NICK TOTALS		**78**	**310,000**	**$ 5,210.00**
CITY ACCOUNTS (5555)				
NORTH COVE (1NC Harbor)			553,000	
ICEHOUSE (100 JT Brown St)			4,663	
CANNERY (100 Main St)			-	
LIBRARY (504 3rd)			1,000	
RESTROOM/WASHDOWN (114 JT Brown St)			2,000	
BOAT HAULOUT (120 JT Brown St)			9,000	
WOOD BOILER BLD (1300 Water tower rd)			-	
GARDEN CLUB(1301 water tower rd)			39,000	
PEACE MEDICAL (1800 C-K Hwy)			4,000	
POOL (1400 Water Tower Rd)			39,430	
HIGH SCHOOL (1950 C-K Hwy)			23,000	
WASTEWATER PLANT (2 Cemetery Isl) 301			45,600	
FLOATPLANE DOCK (201 8th St)			1,000	
SALMON HATCHERY (2A PSN)			5,000	
WATER TANK (403 Spruce St)			-	
HARBORMASTER BLD (410 Hamilton Dr)			5,000	
SOUTH COVE (2SC Harbor)			11,000	
		CITY ACCOUNTS TOTAL	**742,693**	

MONTHLY WATER METER SUMMARY

MONTH/YEAR		Dec-13		
METERED UNITS		**# METERS**	**GALLONS**	**$$$$$$$$**
Meters not yet installed		**1**	2,000	**20.40**
COM / SINGLE	**A**	8	35,000	224.00
COM / MULTI	**B**	5	19,000	130.80
COMMERCIAL	**C**	56	637,161	2,822.91
MULTI FAMILY	**M**	51	1,954,880	8,413.62
PUBLIC (billable)	**N**	7	40,700	228.24
PUBLIC/CITY OWNED				
SINGLE FAMILY	**S**	177	667,911	4,615.31
METERED TOTALS		**305**	**3,356,652**	**16,455.28**
UNMETERED		34		$ 1,546.26
UNMETERED TOTALS		**34**		**$ 1,546.26**
PSN-COM / SINGLE	**A**	1		$ 35.00
PSN-COMMERCIAL	**C**	2	40,000	$ 390.00
PSN-MULTI FAMILY	**M**	7	32,000	$ 501.00
PSN-SINGLE	**S**	69	294,000	$ 4,767.00
ST NICK TOTALS		**79**	**366,000**	**$ 5,693.00**
CITY ACCOUNTS (5555)				
NORTH COVE (1NC Harbor)			540,000	
ICEHOUSE (100 JT Brown St)			6,136	
CANNERY (100 Main St)				
LIBRARY (504 3rd)			3,000	
RESTROOM/WASHDOWN (114 JT Brown St)				
BOAT HAULOUT (120 JT Brown St)			14,000	
WOOD BOILER BLD (1300 Water tower rd)				
GARDEN CLUB(1301 water tower rd)				
PEACE MEDICAL (1800 C-K Hwy)			5,000	
POOL (1400 Water Tower Rd)			35,900	
HIGH SCHOOL (1950 C-K Hwy)			14,000	
WASTEWATER PLANT (2 Cemetery Isl) 301			26,650	
FLOATPLANE DOCK (201 8th St)				
SALMON HATCHERY (2A PSN)			5,000	
WATER TANK (403 Spruce St)				
HARBORMASTER BLD (410 Hamilton Dr)			4,000	
SOUTH COVE (2SC Harbor)			86,000	
CITY ACCOUNTS TOTAL			**739,686**	

SILVER BAY SEAFOODS

WATER USAGE

Date	Time	Process Meter	Process usage GP24HR	Plant Meter	Plant usage GP24HR
7/23/2013	23:55	24,380,150		4,872,000	
7/24/2013	23:51	24,444,320	64,170	4,887,000	15,000
7/25/2013	23:55	24,516,550	72,230	4,900,000	13,000
7/26/2013	23:57	24,684,050	167,500	4,911,000	11,000
7/27/2013	23:55	24,863,280	179,230	4,921,000	10,000
7/28/2013	23:55	25,031,950	168,670	4,933,000	12,000
7/29/2013	23:51	25,218,770	186,820	4,944,999	11,999
7/30/2013	23:50	25,388,800	170,030	4,954,000	9,001
7/31/3012	0:26	25,550,120	161,320	4,966,000	12,000
8/1/2013	23:53	25,714,350	164,230	4,979,000	13,000
8/2/2013	23:56	25,867,140	152,790	4,990,000	11,000
8/3/2013	23:59	25,977,420	110,280	5,004,000	14,000
8/4/2013	23:57	26,158,120	180,700	5,015,000	11,000
8/5/2013	23:52	26,329,200	171,080	5,026,000	11,000
8/6/2013	23:55	26,515,820	186,620	5,037,000	11,000
8/7/2013	23:56	26,701,950	186,130	5,050,000	13,000
8/8/2013	23:55	26,905,800	203,850	5,063,000	13,000
8/9/2013	23:56	27,101,100	195,300	5,074,000	11,000
8/10/2013	23:55	27,301,120	200,020	5,085,000	11,000
8/12/2013	1:30	27,518,180	217,060	5,097,000	12,000
8/12/2013	23:57	27,670,700	152,520	5,111,000	14,000
8/13/2013	23:55	27,860,400	189,700	5,123,000	12,000
8/14/2013	23:57	28,041,000	180,600	5,133,000	10,000
8/15/2013	23:55	28,216,700	175,700	5,145,000	12,000
8/16/2013	23:57	28,398,950	182,250	5,156,000	11,000
8/17/2013	23:56	28,570,190	171,240	5,167,000	11,000
8/18/2013	23:55	28,759,770	189,580	5,176,000	9,000
8/20/2013	0:35	28,946,250	186,480	5,188,000	12,000
8/21/2013	23:50	29,303,370	357,120	5,208,000	20,000
8/22/2013	23:50	29,471,420	168,050	5,218,000	10,000
8/23/2013	23:55	29,628,500	157,080	5,228,000	10,000
8/24/2013	23:53	29,780,640	152,140	5,238,000	10,000
8/25/2013	23:55	29,945,500	164,860	5,249,000	11,000
8/26/2013	23:54	30,111,860	166,360	5,260,000	11,000
8/27/2013	23:55	30,252,850	140,990	5,270,000	10,000
8/28/2013	23:57	30,440,320	187,470	5,282,000	12,000
8/29/2013	23:59	30,571,180	130,860	5,303,000	21,000
8/30/2013	23:55	30,690,790	119,610	5,316,000	13,000
8/31/2013	23:55	30,871,140	180,350	5,330,000	14,000
9/1/2013	23:55	31,007,880	136,740	5,345,000	15,000
9/3/2013	8:00	31,032,080	24,200	5,359,000	14,000
9/4/2013	8:00	31,074,250	42,170	5,374,000	15,000
9/5/2013	8:00	31,202,300	128,050	5,391,000	17,000
9/6/2013	8:00	31,247,200	44,900	5,404,000	13,000
9/7/2013	8:00	31,329,350	82,150	5,418,000	14,000
9/8/2013	8:00	31,362,500	33,150	5,431,000	13,000
9/9/2013	8:00	31,422,700	60,200	5,444,000	13,000
9/10/2013	9:25	31,465,300	42,600	5,456,000	12,000
9/11/2013	9:00	31,471,800	6,500	5,472,000	16,000
9/12/2013	11:30	31,498,150	26,350	5,489,000	17,000
9/13/2013	8:00	31,515,680	17,530	5,502,000	13,000
9/14/2013	8:00	31,526,500	10,820	5,514,000	12,000
9/15/2013	8:00	31,540,920	14,420	5,529,000	15,000
9/16/2013	8:00	31,553,700	12,780	5,543,000	14,000

APPENDIX B

Cost Estimates

Spruce Street Tank Upgrades

Bid Item	Description	Quantity	Type	Unit Price	Total Cost
1	Mobilization	1	LS	$25,000	$25,000
2	Construction Surveying	1	LS	$5,650	$5,650
3	Installation of Variable Frequency Drive (VFD) Controlled Pumps	2	EACH	$25,000	$50,000
4	Installation of PLC Controlled Inlet and Outlet Valves	1	EACH	$10,000	$10,000
6	Installation of Pressure Control Switches	1	EACH	$5,000	$5,000
7	Utility Hut for Pumps and Controls	1	EACH	$15,000	$15,000
8	Small Leak Repairs on Spruce St. Tank	1	EACH	$15,000	$15,000
9	SCADA Connections between tank and WWTP- radio transmission	1	EACH	$35,000	$35,000
10	New Water Main, Bends, Elbows	140	LF	$200	$28,000
11	Connect to Existing Water Main for separated outlet	1	EACH	$5,183	$5,183
				25% Engineering	$48,458
				20% CA & Contingency	$38,767
				Total	$300,000

SOURCES

1. Average price for mobilization (see below) for similar project.
2. Average price for surveying (see below) for similar project, but surveying would be minimal, so 50% of average construction surveying was applied.

Services	Contractor				Average
	B-3 Contractors, Inc.	Southeast Road Builders, Inc.	P&T Construction	Pool Engineering Inc.	
Mob/Demob	$11,000	$41,000	$3,500	$44,175	$24,919
Survey	$4,000	$20,000		$10,000	$11,333
Excavation		$8 per cy			$8 per cy
8" C900 sewer pipe	$50 per LF	$50 per LF		$100 per LF	$67 per LF
Temporary traffic control		$22,350			$22,350
Connect to existing	$1,150	$10,900		$3,500	$5,183
Temporary water					
12" HDPE Water main		$65.50 per LF	$58.50 per LF		$62 per LF

Bid Item	Description	Quantity	Type	Unit Price	Total Cost
1	Mobilization	1	LS	$25,000	$25,000
2	Equipment Installation	1	LS	$781,830	$781,830
3	4 new Corix Filtration Skids	1	LS	$945,050	$945,050
4	Misc. interconnecting piping	1	LS	$45,000	$45,000
5	Electrical / SCADA upgrades	1	LS	$65,000	$65,000
6	Add baffling in 2 exist. tanks	1	LS	$122,000	$122,000
7	New 30,000 gallon storage tank	1	LS	$126,000	$126,000
				40% CA & Contingency	$843,952
				Total	$3,000,000

SOURCES

1. Average price for mobilization (see below)
2. Vendor budget quote for baffles
3. DOWL HKM Database of similar projects
4. Vendor budget quote for filtration equipment
5. Assumes existing building
6. Mike Burg (Engineering America) (651) 252-8819

Services	Contractor				Average
	B-3 Contractors, Inc.	Southeast Road Builders, Inc.	P&T Construction	Pool Engineering Inc.	
Mob/Demob	$11,000	$41,000	$3,500	$44,175	$24,919
Survey	$4,000	$20,000		$10,000	$11,333
Excavation		$8 per cy			$8 per cy
8" C900 sewer pipe	$50 per LF	$50 per LF		$100 per LF	$67 per LF
Temporary traffic control		$22,350			$22,350
Connect to existing water main	$1,150	$10,900		$3,500	$5,183
Temporary					
12" HDPE Water main		$65.50 per LF	$58.50 per LF		$62 per LF

Bid Item	Description	Quantity	Type	Unit Price	Total Cost
1	Mobilization	1	LS	$25,000	$25,000
2	Equipment Installation	1	LS	$1,013,700	$1,013,700
3	3x500 gpm Membrane Skids	1	LS	$1,620,000	$1,620,000
4	Misc. interconnecting piping	1	LS	$32,000	$32,000
5	Electrical / SCADA upgrades	1	LS	$37,500	$37,500
6	Chem feed & Misc. items - included with membrane skid equipment price				$0
				40% CA & Contingency	$1,091,280
				Total	$4,000,000

SOURCES

1. Average price for mobilization (see below)
2. DOWL HKM Database of similar projects
3. Recent vendor quotes for similar membrane equipment (DOWL HKM database)
4. Assumes existing building

Services	Contractor				Average
	B-3 Contractors, Inc.	Southeast Road Builders, Inc.	P&T Construction	Pool Engineering Inc.	
Mob/Demob	$11,000	$41,000	$3,500	$44,175	$24,919
Survey	$4,000	$20,000		$10,000	$11,333
Excavation		$8 per cy			$8 per cy
8" C900 sewer pipe	$50 per LF	$50 per LF		$100 per LF	$67 per LF
Temporary traffic control		$22,350			$22,350
Connect to existing water main	$1,150	$10,900		$3,500	$5,183
Temporary water bypass					
12" HDPE Water main		$65.50 per LF	$58.50 per LF		$62 per LF

#	Name	Description	Quantity	Unit	Unit Price	Cost
1	Labor	2 Craig laborers	40	Hours	$30	$2,400
2	Technician	Flown to Craig - 2 Days	36	Hours	$150	$5,400
2	Dosing pump	1 GPH, 100 PSI, 115 volt	1	EA	$2,000	$2,000
3	Tank	50 gallon, stainless steel	1	EA	$1,560	$1,560
4	Inline mixer	4" static mixer	1	EA	$875	$875
5	Shipping	Material shipping	1	EA	$2,000	$2,000
6	Materials	Pipes, fittings and appurtenances	1	EA	$3,000	$3,000
					40% CA & Contingency	$4,894
					Total	$23,000

SOURCES

1. Two people working for 16 hours at $30 per hour each (city personnel).
2. Pulsatron diaphram metering pump, 1 GPH, 100 PSI (http://www.grainger.com/product/PULSATRON-Diaphragm-Metering-Pump-4UP27?functionCode=P2IDP2PCP).
3. Corrosion resistant tank (Greer Tank, (907) 452-1711).
4. Flanged static mixer with injection port, 3-element (http://www.usabluebook.com/p-268879-4-flanged-static-mixer-with-injection-port-3-element.aspx).

*Assumes mixer is installed by City of Craig staff with assistance from a technician.

#	Name	Description	Quantity	Unit	Unit Price	Cost
1	Labor	2 Craig laborers	40	Hours	$30	$2,400
2	Technician	Flown to Craig - 2 Days	36	Hours	$150	$5,400
3	Materials	Soda Ash Contactor Replacement	1	EA	$5,000	$5,000
4	Materials	Polymer Mixing System Replacement	1	EA	$5,000	$5,000
5	Shipping	Material shipping	1	EA	$2,000	$2,000
6	Materials	Pipes, fittings, Tees, and appurtenances	1	EA	$5,000	$5,000
					40% CA & Contingency	$3,120
					Total	$30,000

1. Two men working for 40 hours at $30 per hour each (city personnel), and one technician flown to Craig for two days.

#	Name	Description	Quantity	Unit	Unit Price	Cost
1		Mobilization	1	LS	$25,000	$25,000
2	INSTALL	12" DI TEE	1	EA	$5,493	$5,493
3	INSTALL	12" DI CHECK VALVES	1	EA	$9,285	$9,285
4		Temporary Water System Bypass	1	EA	$20,000	$20,000
					10% Addition for Confined Space Work	$3,978
					40% CA & Contingency	$15,911
					Total	$80,000

SOURCES

1. Two men working 4 hours at $30 per hour (city personnel).
2. 12" DI tee. HD Supply Waterworks, LTD., Kenneth Jensen (907) 563-3315.
3. 12" low pressure opening check valve. HD Supply Waterworks, LTD., Kenneth Jensen (907) 563-3315.

*Assuming Contractor build.

Upgrade SCADA System for Direct Communications

Bid Item	Description	Quantity	Type	Unit Price	Total Cost
1	Mobilization	1	LS	$10,000	$10,000
2	Construction Surveying	1	LS	$11,300	$11,300
3	BCI or Equivalent Communication Upgrades	1	EA	$25,000.00	$25,000
				40% CA & Contingency	$18,520
				Total	$65,000

SOURCES
Boreal Controls Estimate for Communications Improvement

Bid Item	Description	Quantity	Type	Unit Price	Total Cost
1	Facility	1	LS	$255,000	$255,000
				40% CA & Contingency	$102,000
				Total	$400,000

SOURCES

1. Hydropower Assesment (DOWL HKM)- See other appendix.

Bid Item	Description	Quantity	Type	Unit Price	Total Cost
1	Mobilization	1	LS	$25,000	$25,000
2	Construction Surveying	1	LS	$11,300	$11,300
3	Common Excavation	24200	CY	$8	$193,600
4	18" DI pipe	29040	LF	$60	$1,742,400
5	Temporary water bypass	1	LS	$50,000	$50,000
6	Connect to existing water main	2	EA	$5,183	$10,366
				40% CA & Contingency	$813,066
				Total	$2,900,000

SOURCES
1. Average price for mobilization (see below).
2. Average price for surveying (see below).
3. Average price for common excavation (see below).
4. Class 50, 18" DI water main. Ferguson (Fairbanks), Jason Prine (907) 458-2408.
5. Average price to connect the pipe to an existing water main (see below).

Services	Contractor				
	B-3 Contractors, Inc.	Southeast Road Builders, Inc.	P&T Construction	Pool Engineering Inc.	**Average**
Mob/Demob	$11,000	$41,000	$3,500	$44,175	$24,919
Survey	$4,000	$20,000		$10,000	$11,333
Excavation		$8 per cy			$8 per cy
8" C900 sewer pipe	$50 per LF	$50 per LF		$100 per LF	$67 per LF
Temporary traffic		$22,350			$22,350
Connect to existing water main	$1,150	$10,900		$3,500	$5,183
Temporary water					
12" HDPE Water main		$65.50 per LF	$58.50 per LF		$62 per LF

Bid Item	Description	Quantity	Type	Unit Price	Total Cost
1	Mobilization	1	LS	$25,000	$25,000
2	Construction surveying	1	LS	$11,300	$11,300
3	12" HDPE water main	500	LF	$62	$31,000
4	Connect to existing water main	2	EA	$10,400	$20,800
5	Excavation	1336	CY	$8	$10,688
6	Backfill	534	CY	$25	$13,360
7	Temporary traffic control	1	EA	$22,350	$22,350
8	Temporary water bypass	1	EA	$10,000	$10,000
				40% CA & Contingency	$57,799
				Total	$210,000

SOURCES

1. Average price for mobilization (see below).
2. Average price for surveying (see below).
3. Average price for 12" HDPE water main (see below).
4. Average price for a connection to an existing water main (see below).
5. Average price for excavation (see below).
6. Average price for temporary traffic control (see below).
7. Temporary water system bypass (assumption).

Services	Contractor				Average
	B-3 Contractors, Inc.	Southeast Road Builders, Inc.	P&T Construction	Pool Engineering Inc.	
Mob/Demob	$11,000	$41,000	$3,500	$44,175	$24,919
Survey	$4,000	$20,000		$10,000	$11,333
Excavation		$8 per cy			$8 per cy
8" C900 sewer pipe	$50 per LF	$50 per LF		$100 per LF	$67 per LF
Temporary traffic control		$22,350			$22,350
Connect to existing water main	$1,150	$10,900		$3,500	$5,183
Temporary water bypass					
12" HDPE Water main		$65.50 per LF	$58.50 per LF		$62 per LF

Reconnaissance study for identification of new water source

a)					
1	Complete Reconnaissance study for construction of new pipeline to additional water source. Study would include investigation of water sources, inlet structures, permittable take, and other pertinent information.	1	LS	$100,000	$100,000
				Total	$100,000

Assuming Consultant would spend approximately 400 hours at an average of $150/hour, and incur $40,000 in reimbursible expenses from mapping and travel related expenses.

APPENDIX C

Small Hydropower Feasibility Hydroelectric Maximum Power Estimate

City of Craig - Small Hydropower Feasibility
Hydroelectric Maximum Power Estimate
Existing Demands

Power (kilowatts) = H (ft) x Q (gpm) x 62.4 lb/ft^3 x 0.746 kW/hp / (448.8 gpm/cfs x 550 ft-lb/sec
Enter data in green cells; yellow cells contain formulas

Summer Operation

Flow	1200	gpm
Pipe Diameter	12	in
Reservoir El.	650	ft
Turbine El.	60	ft
Velocity	3.41	fps
Pipe Headloss	167.0	ft
Pressure In (psi)	183.2	(1 psi=2.31 ft)
Pressure Out (psi)	40	(1 psi=2.31 ft)
System Efficiency	70%	
Operation Period	150	days
Max Theoretical Power	74.8	kW
Available Power	52.3	kW
Energy	188,386	kWh

Spring/Winter Operation

Flow	300	gpm
Pipe Diameter	12	in
Velocity	0.85	fps
Pipe Headloss	12.8	ft
Pressure in (psi)	250.1	(1 psi=2.31 ft)
Pressure out (psi)	40	(1 psi=2.31 ft)
System Efficiency	70%	
Operation Period	215	days
Max Theoretical Power	27.4	kW
Available Power	19.2	kW
Energy	99,044	kWh

Maximum Annual Revenue/Avoided Costs

APC Rate B - Diesel Fuel Avoided Cost	$ 0.2709	$/kWh - Effective Jan. 30 , 2014
APC Rate C - Net Metering Avoided Cost	$ 0.0906	$/kWh - Effective Jan. 30 , 2014
Average Rate paid at WTP/Hatchery	$ 0.2100	Based on recent data from APC
Total Generated Energy	**287,430**	**kWh**
Annual Diesel Buyback Value	**$ 77,865**	Assumes all energy at Diesel value
Annual Net Buyback Value	**$ 26,041**	Assumes all energy at Net Metering value
Annual Avoided Cost	**$ 60,360**	Assumes all energy at Retail value

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MaxPower-Existing

4/7/2014

City of Craig - Small Hydropower Feasibility
Hydroelectric Maximum Power Estimate
Future Demands with Enlarged Pipeline

Power (kilowatts) = H (ft) x Q (gpm) x 62.4 lb/ft^3 x 0.746 kW/hp / (448.8 gpm/cfs x 550 ft-lb/sec
Enter data in green cells; yellow cells contain formulas

Summer Operation

Flow	1400	gpm
Pipe Diameter	18	in
Reservoir El.	650	ft
Turbine El.	60	ft
Velocity	1.77	fps
Pipe Headloss	30.9	ft
Pressure In (psi)	242.3	(1 psi=2.31 ft)
Pressure Out (psi)	40	(1 psi=2.31 ft)
System Efficiency	70%	
Operation Period	180	days
Max Theoretical Power	123.2	kW
Available Power	86.2	kW
Energy	372,496	kWh

Spring/Winter Operation

Flow	800	gpm
Pipe Diameter	18	in
Velocity	1.01	fps
Pipe Headloss	11.0	ft
Pressure in (psi)	250.9	(1 psi=2.31 ft)
Pressure out (psi)	40	(1 psi=2.31 ft)
System Efficiency	70%	
Operation Period	185	days
Max Theoretical Power	73.4	kW
Available Power	51.4	kW
Energy	228,131	kWh

Maximum Annual Revenue/Avoided Costs

APC Rate B - Diesel Fuel Avoided Cost	$ 0.2709	$/kWh - Effective Jan. 30 , 2014
APC Rate C - Net Metering Avoided Cost	$ 0.0906	$/kWh - Effective Jan. 30 , 2014
Average Rate paid at WTP/Hatchery	$ 0.2100	Based on recent data from APC
Total Generated Energy	**600,627**	**kWh**
Annual Diesel Buyback Value	**$ 162,710**	Assumes all energy at Diesel value
Annual Net Buyback Value	**$ 54,417**	Assumes all energy at Net Metering value
Annual Avoided Cost at WTP/Hatchery	**$ 126,132**	Assumes all energy at Retail value

City of Craig - Small Hydropower Feasibility
Hydroelectric Power Estimate
Existing Demand

Power (kilowatts) = H (ft) x Q (gpm) x 62.4 lb/ft^3 x 0.746 kW/hp / (448.8 gpm/cfs x 550 ft-lb
Enter data in green cells; yellow cells contain formulas

Annual Operation

Flow	300	gpm
Pipe Diameter	12	in
Reservoir El.	650	ft
Turbine El.	60	ft
Velocity	0.85	fps
Pipe Headloss	12.8	ft
Pressure In (psi)	250.1	(1 psi=2.31 ft)
Pressure Out (psi)	40	(1 psi=2.31 ft)
Max Theoretical Power	27.4	kW
Turbine/Generator Rating	25.0	kW
System Efficiency	70%	
Available Power	17.5	kW - Turbine/generator output
Operation Period	365	days
Total Generated Energy	**153,300**	**kWh**

Annual Avoided Energy Cost

Average Rate paid at WTP/Hatchery	$ 0.210	Based on recent data from APC
Annual Avoided Cost at WTP/Hatchery	**$ 32,200**	

City of Craig - Small Hydropower Feasibility
Hydroelectric Power Estimate
Future Demand

Power (kilowatts) = H (ft) x Q (gpm) x 62.4 lb/ft^3 x 0.746 kW/hp / (448.8 gpm/cfs x 550 ft-lb
Enter data in green cells; yellow cells contain formulas

Annual Operation

Flow	800	gpm
Pipe Diameter	18	in
Reservoir El.	650	ft
Turbine El.	60	ft
Velocity	1.01	fps
Pipe Headloss	11.0	ft
Pressure In (psi)	250.9	(1 psi=2.31 ft)
Pressure Out (psi)	40	(1 psi=2.31 ft)
Max Theoretical Power	73.4	kW
Turbine/Generator Rating	45.0	kW
System Efficiency	70%	
Available Power	31.5	kW - Turbine/generator output
Operation Period	365	days
Total Generated Energy	**275,940**	**kWh**

Annual Avoided Energy Cost

Average Rate paid at WTP/Hatchery	$ 0.210	Based on recent data from APC
Annual Avoided Cost at WTP/Hatchery	**$ 57,900**	

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Power-Future
4/7/2014

City of Craig, AK
DOWL HKM #: 1124.61531.01
Water Master Plan
Small Hydropower Feasibility

Existing Pipeline and Demands - 25 kW turbine and generator installed at location of existing PRV near WTP.

Item	Quantity	Unit Cost	Total Cost		Subtotals
Project Components					**$128,000**
Mobization, Taxes, Bonds, Insurance[1]	1 LS	$21,000	$21,000		
25 kW Turbine & Generator Equipment	1 LS	$25,000	$25,000		
New 12" PRV for Bypass flow	1 LS	$15,000	$15,000		
Other Mechanical	1 LS	$12,000	$12,000		
Switchgear and Controls	1 LS	$8,000	$8,000		
Interconnection Equipment	1 LS	$12,000	$12,000		
Structures and Sitework	1 LS	$30,000	$30,000		
Miscellaneous	1 LS	$5,000	$5,000		
Major Field Items					**$128,000**
Unlisted Items & Contingencies		25%		$32,000	
Total Field Cost					**$160,000**
Legal Fees			1%	$2,000	
Permitting/Fees			3%	$5,000	
Preliminary Engineering/Final Design/Const. Admin			55%	$88,000	
Non-Contract Costs					**$95,000**
TOTAL ESTIMATED COST					**$255,000**

Notes: 1 - Mobilization, taxes, bonds and insurance estimated at 20% of sum of other construction items

Future Pipeline and Demands - 45 kW turbine and generator installed at location of existing PRV near WTP.

Item	Quantity	Unit Cost	Total Cost		Subtotals
Project Components					**$144,000**
Mobization, Taxes, Bonds, Insurance[1]	1 LS	$24,000	$24,000		
25 kW Turbine & Generator Equipment	1 LS	$28,000	$28,000		
New 18" PRV for Bypass flow	1 LS	$25,000	$25,000		
Other Mechanical	1 LS	$12,000	$12,000		
Switchgear and Controls	1 LS	$8,000	$8,000		
Interconnection Equipment	1 LS	$12,000	$12,000		
Structures and Sitework	1 LS	$30,000	$30,000		
Miscellaneous	1 LS	$5,000	$5,000		
Major Field Items					**$144,000**
Unlisted Items & Contingencies	25%			$36,000	
Total Field Cost					**$180,000**
Legal Fees	1%			$2,000	
Permitting/Fees	3%			$5,000	
Preliminary Engineering/Final Design/Const. Admin	55%			$99,000	
Non-Contract Costs					**$106,000**
TOTAL ESTIMATED COST					**$286,000**

Notes: 1 - Mobilization, taxes, bonds and insurance estimated at 20% of sum of other construction items