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AVENUES NEIGHBORHOOD WATER AND SEWER IMPROVEMENTS

PRELIMINARY ENGINEERING REPORT

Bethel, Alaska

August 2018

AVENUES NEIGHBORHOOD WATER AND SEWER IMPROVEMENTS

Preliminary Engineering Report

Prepared for:

City of Bethel
Post Office Box 1388
Bethel, Alaska 99559

In conjunction with:
United States Department of Agriculture
Rural Utilities Services

Prepared by:

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4041 B Street
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August 2018

W.O. 50118.01

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ACRONYMS

AC ..... Alaska Commercial Supply
ADF&G ..... Alaska Department of Fish and Game
AHRS ..... Alaska Heritage Resources Survey
amsl ..... above mean sea level
APE ..... Area of Potential Effect
BHWTP ..... Bethel Heights Water Treatment Plant
BMPs ..... best management practices
City ..... City of Bethel
CSWTP ..... City Subdivision Water Treatment Plant
DLWD ..... Alaska Department of Labor and Workforce Development
DOT&PF ..... State of Alaska Department of Transportation and Public Facilities
DPW ..... City of Bethel Department of Public Works
FEMA ..... Federal Emergency Management Agency
FIRM ..... Flood Insurance Rate Maps
gpm ..... gallons per minute
HMCP ..... Hazardous Materials Control Plan
IPaC ..... USFWS Information for Planning and Conservation system
NWI ..... USFWS National Wetlands Inventory
O&M ..... operations and maintenance
PER ..... Preliminary Engineering Report
PJCP ..... Dr. Paul John Calricaraq Project
QFC#2 ..... Quick Food Center No. 2 (lift station)
R&R ..... repairs and replacement
SHPO ..... State Historic Preservation Office
SWPPP ..... Storm Water Pollution Prevention Plan
T&E ..... threatened and endangered
USACE ..... United States Army Corps of Engineers
USDA RD ..... United States Department of Agriculture Rural Development
USFWS ..... United States Fish and Wildlife Service
YK ..... Yukon-Kuskokwim
YKHC ..... Yukon Kuskokwim Health Corporation

EXECUTIVE SUMMARY

This Preliminary Engineering Report has been prepared for the City of Bethel in accordance with United States Department of Agriculture Rural Utilities Services Bulletin 1780-4.

This Preliminary Engineering Report was developed to assess alternatives for improving water and sewer service to the area of Bethel known as “The Avenues”. This neighborhood of approximately 130 water and sewer users is part of Bethel’s hauled system, meaning water is delivered via haul truck and wastewater is collected via haul truck. The cost of hauling versus delivering water and sewer via a piped network is nearly three times as high, so the City of Bethel wishes to transition high-density neighborhoods, like “The Avenues”, to a piped network.

This Preliminary Engineering Report recommends a single-phase approach to developing a piped network for The Avenues neighborhood. Over the course of approximately one year, a system of roughly 16,000 linear feet of piped water and sewer would be constructed. This alternative has the lowest life cycle cost for providing water and sewer to this neighborhood and moves the City in the direction of building out its piped water and sewer network.

The capital cost of the recommended alternative is approximately $13.5 million, which includes the construction of three culvert crossings on the Chief Eddie Hoffman Highway, and the procurement of six additional water trucks to meet the needs of other parts of the community. Annual operating expenses are expected to drop to $461,280 from approximately $1.6 million. Total Life Cycle Costs are expected to be $24 million.

The City also needs to contribute a total of $376,120 to a Replacement and Repair Account to cover the costs associated with the replacement of its sewer short lived assets, and $301,507 for its water short lived assets.

1.0 INTRODUCTION

The City of Bethel (City) retained DOWL to provide engineering services related to providing water and sewer services to residents located in The Avenues, located between 3rd Avenue and 7th Avenue between Ridgecrest Drive and Main Street in Bethel, AK.

The “Avenues” neighborhood in Bethel consists of approximately 130 predominantly residential parcels. All residences in the neighborhood currently have water and sewage tanks ranging in size from 500 gallons to 3,000 gallons. This neighborhood contains some commercial users, such as Alaska Commercial Supply (AC). The City delivers potable water and collects sewage from all users in this neighborhood. This type of delivery and collection is more expensive for the homeowner than the alternative; piped water and piped sewer. Piped water and piped sewer is easier to maintain and more efficient to operate for the City.

The purpose and need of this project is to provide the Avenues neighborhood with an improved water and sewer system with the lowest life cycle costs for the City (and the users).

Through the development of this Preliminary Engineering Report (PER), several piped alignments were considered, as well as phasing the project out over several years. The PER also examines the life cycle cost of continuing to provide hauled water and sewer service to the Avenues area with hauled water and sewer.

2.0 PROJECT PLANNING AREA

2.1 Location

The City of Bethel is a Second-Class City located in the Yukon Delta National Wildlife Refuge at the mouth of the Kuskokwim River, 40 miles inland from the Bering Sea (60.7968, -161.7714). It is the largest community in Western Alaska by population and is approximately 44 square miles. Figure 1 shows the proposed project vicinity.

The City is located along the Kuskokwim River, in a treeless subarctic tundra floodplain terrain that is characterized as poorly drained with a shallow permafrost table. The topography is generally flat, with grades ranging from zero to seven percent. Along Bethel's waterfront and townsite, the soils are poorly drained silts, with permafrost depth ranging from 30 to 40 feet. Further inland from the river, the ground is usually saturated or covered with surface water or sandy soils covered with silt loams and 12 inches of peaty mat. Vegetation is typically low-growing shrubs, grasses, and mats of moss and lichens.

Bethel can experience flooding by the Kuskokwim River. Flooding in 1985 was three to four feet deep, which resulted in the flooding of several homes, while the flooding in 1988 was approximately five feet deep and flooded 600 homes. Bethel experiences constant erosion from the Kuskokwim River as it is located on the eroding bend of the river.

Bethel averages 16 inches of rain and 50 inches of snow per year. The temperature ranges from 42°F to 62°F in the summer to -2°F to 19°F in the winter.

Most land around Bethel has permafrost with combinations of wet and dry tundra. The permafrost conditions, poor surface drainage, proximity to the Kuskokwim River flood impact area, wind direction, and the presence of wetlands make much of the land around Bethel difficult to develop. Development in Bethel has resulted in a community with a small downtown and a gridded road system with concentrated mixed-use development. There is a limited supply of private land, and much of the private land is Native allotments. Native allotments pose difficulties for development. It can often take the Bureau of Indian Affairs years to research title and process a land sale. Land ownership is often held by more than 20 people, which can cause coordination and agreement complications, especially if one of the co-owners moves away or passes away. Additionally, Native allotments are often exempt from local land use regulations, which can result in a lack of reserved land for utility easements.

The community of Bethel is a major transportation hub for the Yukon-Kuskokwim (YK) Delta. The YK Delta has a population of about 26,000 people in its 56 remote villages. The hub nature of the community of Bethel makes it the most important in the region.

Bethel's economy is highly dependent on governmental services and the subsequent wages from government employment. Government jobs make up to 50 percent of the jobs in Bethel. Natural resources also play a significant role in the Bethel economy, as many of the residents rely on fishing and hunting for subsistence. Bethel has a small tourism industry that attracts people for birdwatching and sport fishing. The City of Bethel provides many services to its citizens, including water treatment and distribution, sewage collection and treatment, fire and police services, and solid-waste collection and disposal.

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Location Vicinity Map
The Avenues Neighborhood Water & Sewer
Bethel, Alaska

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DATE	Jun 20, 2018

Figure 1

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Bethel is situated along the Kuskokwim River. The Kuskokwim River is the second largest river in Alaska and is the primary river for shipping during the summer. During the winter, it freezes to form a 150-mile ice road that connects surrounding villages. Bethel has a well-used system of trails and boardwalks between buildings within the City, as well as access to surrounding communities. During the winter, the trails are used by snowmachines, dogsleds, cross-country skiers, and pedestrians. During the summer, the trails are used by All-Terrain Vehicles, bicycles, and pedestrians. Since 2008, a public bus system providing approximately 80 to 90 rides per day.

The Port of Bethel operates a small boat harbor, with dry land storage and approximately 5,000 feet of moorage along the seawall. Bethel's port serves more communities and passengers than any other in Western Alaska. The Bethel Airport is served by two major passenger airlines, two cargo carriers, and multiple air taxi services. It is a regional transportation center and is the third busiest airport in terms of landings and take-offs in Alaska.

2.2 Environmental Resources Present

2.2.1 Land Use/Ownership

Ownership and land use for the area were determined from the City of Bethel Comprehensive Plan (2011). Land within Bethel is generally owned by the City, the Bethel Native Corporation, and other private land-owners including native allottees (Bethel 2011). Land use within Bethel is a mix of open space, public lands and institutions, residential, general use, industrial, and some preservation. There are no farmlands of prime, unique, or statewide importance present in the project area. No formally classified land or federal lands exist within the municipal limits.

2.2.2 Wetlands

A review of the United States Fish and Wildlife Service (USFWS) National Wetlands Inventory showed no wetland information for the region. However, the project area is within the Subarctic Coastal Plain ecoregion (Nowicki et al. 1995), which is characterized by low relief, the predominance of wetlands, and braided or meandering streams and rivers. Permafrost is widespread and vegetative cover generally consists of wet graminoid herbaceous communities. Therefore, wetlands are likely present in undeveloped areas.

2.2.3 Floodplains

The Federal Management Agency (FEMA) has mapped flood hazards for Bethel related to the Kuskokwim River floodplain. According to FEMA Map Panel 0201040042C (revised 8/25/2009), the base flood elevation of the floodplain in Bethel is 17 feet above mean sea level (amsl). The elevation of the project area is unknown, therefore consultation with the City will determine if a floodplain permit is required and if the bottom of the structures will be built above 17 feet amsl.

2.2.4 Endangered Species

A search of the USFWS Information for Planning and Conservation (IPaC) online database, which indicated there are no threatened or endangered species within the proposed project limits.

2.2.5 Cultural Resources and Historic Sites

The Area of Potential Effect (APE) encompasses direct impact areas where ground disturbing activities may occur, staging areas temporarily disturbed during construction, and a 500-foot buffer to evaluate potential indirect impacts. A search of the Alaska Heritage Resource Survey (AHRS) was conducted on April 16, 2018 to identify previously recorded sites. The review included all the Project Location, while the APE has been determined to be the area of ground disturbance. One National Historic Register listed property is located on 3rd Avenue, south of the southernmost east-west run. Six additional buildings are recorded in the AHRS, but have not been evaluated for eligibility for the National Register. Review of aerial photographs by United States Department of Agriculture Rural Development (USDA RD), show no structures within the APE, and no predominate land features which would lend themselves to historic, cultural, or subsistence use.

2.2.6 General Fish and Wildlife

There are no Essential Fish Habitat or Habitat Areas of Particular Concern in the waterbody nearest the proposed project area: Browns Slough. Brown's Slough is anadromous (335-10-16600-2621) for sheefish and whitefish. No marine mammals are within the Bethel area. No in-water work will occur as part of the proposed project activities; therefore, impacts to Browns Slough are not anticipated.

2.3 Growth Areas and Population Trends

2.3.1 Areas of Growth

Growth in Bethel has accelerated due to the high costs of living in surrounding villages. Two of the fastest growing populations have been seniors and the youth. Residential growth is expected to continue within the Tundra Ridge Subdivision, Haroldsen Estates, Kasayuli Subdivision, and in the Blueberry Field Subdivision.

The construction of the Dr. Paul John Calricaraq Project (PJCP), the new Yukon Kuskokwim Health Corporation (YKHC) clinic, has resulted recent growth. Once finished (in 2019-2021), the PJCP, is expected to bring approximately 300 new full-time jobs to Bethel over 10 years. According to the YKHC project manager, 100 of there will be right away, and the others will be growth over the next 10 years.

2.3.2 Present and Projected Population

The City of Bethel has a current population of 6,241, with a 1.08:1 male-to-female ratio (Figure 2). During the 1880 census, which was just before the Moravian Church established a mission and gave the City its name, the area that is now Bethel had a population of 41 people. The population of Bethel has steadily increasing every year, as shown by the graph below. Bethel experienced a population growth of 11 percent from 2000 to 2010.

The 2010-2014 American Community Survey (ACS) established the median household income (in 2014 inflation-adjusted dollars) was $78,190 (MOE +/-$8,632). The per capita income for Bethel in 2010 from all sources was $31,160. 71% of Bethel residents are employed according to State of Alaska Department of Commerce, Community, and Economic Development. About 12.3% of all residents had income below the poverty level.

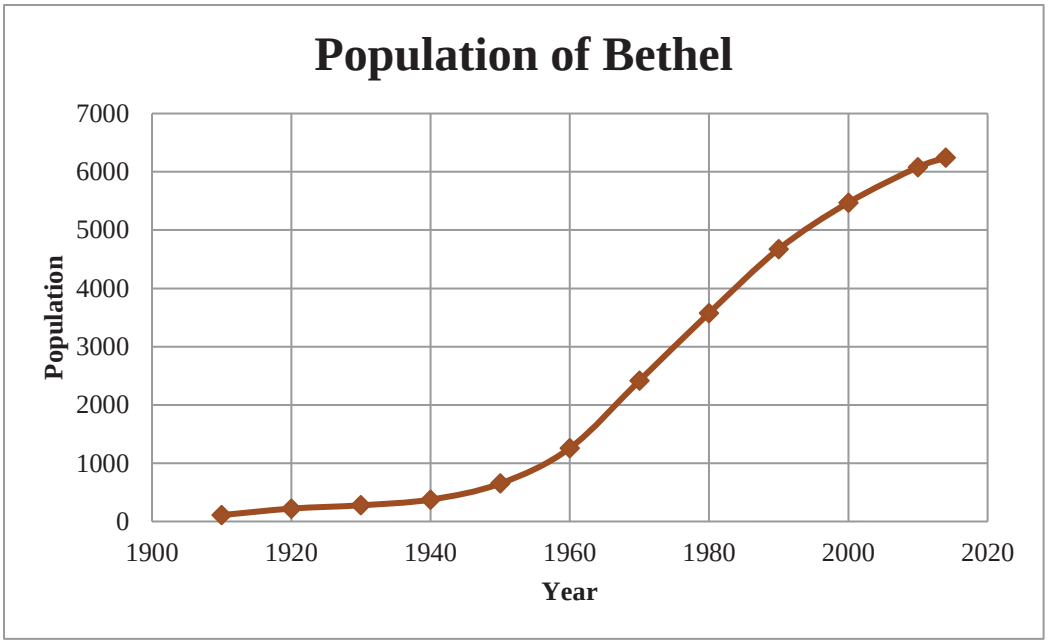


Figure 2: City of Bethel Population: 1910-2015

3.0 EXISTING FACILITIES

The City ruled that for health reasons, residents are no longer allowed to use honeybuckets. There are roughly 1,600 hauled water and sewer customers served by the City's hauled service fleet of water and sewer trucks. In contrast, only about 400 buildings have piped service.

3.1 Location, History, and Condition of Existing Facilities

3.1.1 Hauled Water and Sewer

The cost to deliver the service by pipe is markedly cheaper than the cost to deliver hauled service, and the lower cost is reflected in cheaper rates the residents pay for piped service. Piped residents pay $176.11/mo. for water service and $49.86/mo. for sewer service, or $225.97 total per month. The average hauled customer pays $350/mo. for both services. Figure 3 shows a typical home in "The Avenues" neighborhood with exterior water and sewer tanks.

Figure 3: Water and Sewer Tanks at existing Avenues residence

Residents on the piped system tend to use more water, which has been linked to better skin and respiratory health by the World Health Organization.

The actual City cost to produce and deliver water is more dramatic than the above rates indicate. According to the 2013 City of Bethel Rate Study (CH2M Hill), the cost to produce and deliver water via the haul system is $62.04/1,000 gallons. The cost to collect and dispose of sewage via the haul system is $64.05/1,000 gallons. The cost to produce and deliver piped water is $26.18/1,000 gallons. The cost to collect and dispose of sewage via the piped system is $9.52/1,000 gallons.

The City experiences difficulties with the occasional unwillingness of customers to pay, as well as issues of equity in the cost structure. Customers receiving service from the piped system have lower insurance rates due to proximity of fire hydrants. Additionally, piped service residents are un-metered, so they can use as much water as needed, while the haul-system residents are charged by their volumetric water use (based on tank size and number of deliveries per month).

The water haul trucks collect water at the City Subdivision Water Treatment Plant (CSWTP) (Figure 4). The CSWTP wellhead has a 10-inch diameter steel casing and was drilled to a depth of 500 feet. A Grundfos 385-S400-4 6-inch diameter 40HP submersible pump is installed at 210 feet and delivers approximately 400 GPM. The CSWTP has a storage tank of 428,000 gallons.

The Bethel Heights Water Treatment Plant (BHWTP) wellhead has additional capacity to support the City's truck-hauling. The BHWTP wellhead was drilled in 1969 to a depth of 420 feet and was installed with an 8-inch diameter casing. A Grundfos 385-S400-4 6-inch diameter 40HP submersible pump is installed at 214 feet and delivers approximately 400 GPM. A secondary well located outside of the plant in 1998 with a 10-inch diameter casing and same pump was drilled in 1998 to 211.5 feet. The BHWTP has a storage tank of 505,000 gallons.

According to daily treatment records, and the plant design flow-rates, both treatment plants are operating at approximately 20 percent of their capacity, which is sufficient excess capacity to handle additional piped water and sewer connections. Both these plants were constructed planning for future piped water and sewer projects.

Each well has a filling station for water trucks. The CSWTP station has a 5HP pump, while the BHWTP has a 3HP pump.

Figure 4: Water Truck filling up at City Subdivision Water Treatment Plant

The fleet of City water trucks are typically Ford Sterling LT 8500s with an estimated design life of 15 years. The trucks have a 3,000- to 4,000-gallon capacity tank and consume approximately 80 gallons of diesel fuel a week. The truck tanks are insulated and associated components (fill hoses and pumps) are protected against freezing. The trucks are stored in the 250-foot by 300-foot heated City Public Works storage building located on the outskirts of town. It takes the City approximately six days to serve all the residents. Approximately 15 minutes are spent servicing each residence, and the tanks are pumped to overflow. Residential tanks vary in size and style, which complicates the City's hauling frequency. However, seasonal weather changes do not greatly affect service efficiency. Approximately 26 people are employed by the truck-haul system at various levels.

The City's fleet consists of nine water trucks and nine sewer trucks. Most of the City's fleet is approximately 20 years old and needs replacement. The City was approved to purchase eight new sewage haul trucks through an existing project with USDA Rural development. The City still needs to replace six water trucks. Three of the water trucks have been replaced within the last 5 years.

Recently, the City has also been issued warnings by the State of Alaska Department of Transportation (DOT&PF) following a July 19, 2017 inspection. The City's three axle haul trucks can only weight 42,000 pounds in accordance with DOT&PF weight restrictions (17 AAC 25.100(a)). This means that most of the City's trucks, despite having 3,000+ gallon capacity, can only haul 2,100 gallons at a time. The City trucks with 4,000-gallon capacity can only legally carry 3,000 gallons. In spring months (April, May, June), weight restrictions are tightened even further - to 75 percent of allowable load.

The trucks that haven't been replaced need to be replaced with new trucks because of part scarcity, and because operating the trucks at partial capacity is inefficient. The fleet could be replaced with a fleet of newer models, with longer configurations, which would allow for greater total vehicle loads. Weight restrictions are based on length of vehicle and number of axles, so longer trucks with more axles can carry more weight.

The City keeps track of all insurance claims from water and sewer related truck incidents. One reason the City has identified the need to transition away from water and sewer haul trucks is the number of truck incidents and the impacts it has on the City's insurance.

Table 1: 2012- 2017 Water and Sewer Truck Reportable Incidents

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
Truck struck vehicle when entering/leaving customer premises	0	2	1	0	2	1	4	0	0	1	3	0	
Truck struck building or damaged property	2	0	0	1	1	6	1	3	0	1	0	0	
Overflow tank while delivering water	1	0	2	0	1	3	0	5	0	0	0	0	
Pumped sewage into house	0	1	0	1	0	0	0	0	0	0	0	0	
Truck rollover	0	0	0	0	1	0	0	0	0	0	0	0	
Missed scheduled sewer pick-up	0	0	0	0	0	0	0	1	0	0	0	0	
Stuck in driveway/Property	0	0	0	0	0	0	0	0	0	0	0	0	**Total Incidents**
Monthly Totals	**3**	**3**	**3**	**2**	**5**	**10**	**5**	**9**	**0**	**2**	**3**	**0**	**45**

The cost to operate the hauled water and sewer system does account for insurance payments. Table 2 shows the total value of claims of water and sewer truck incidents made in the last three years. The value of these claims is passed on to the City in their insurance premiums. Reduction in the size of the hauled fleet will reduce claims and premiums.

Table 2: 2014-2017 Cost of Incident Claims

Insurance Year	Insurance Claims Total Payout ($)
2014-2015	$84,343
2015-2016	$33,841
2016-2017	$270,871

3.1.2 The Avenues Project Area

The City of Bethel serves approximately 118 customers in the Avenues by hauled water and sewer trucks. If all vacant lots were occupied this would rise to approximately 130 residences.

There is no piped water in this neighborhood. There is only one existing sewer main in this neighborhood that goes north to south between parcels between 7th Avenue and 6th Avenue (Figure 5). It then goes south along Ridgecrest Drive from 6th Avenue to the easement located between 6th Avenue and 5th Avenue (Figure 6). It then goes east to cross Willow Street and continue to Main Street, at which point it turns southeast to cross 5th Avenue to Kilbuck Lift Station (Figure 7). This existing sewer main provides a convenient tie in point for transitioning the neighborhood over to piped sewer. The existing sewer main is roughly 35 years old and only serves Kilbuck school and approximately 3 residences and 2 businesses. The existing sewer main appears in Figure 8 and 11.

This neighborhood takes two water truck drivers and two sewer truck drivers two and a half days to complete the subdivision routes each week. The cost to operate the truck-haul system is directly proportional to the length of each haul. However, the rate structure is based on the number of haul trips and volume of water and wastewater. The lower cost of the shorter hauls balances the increased costs of the longer hauls. However, as more houses close to the center of the community are serviced by piped water and sewer, there are fewer short hauls. The subdivisions that are farther from the haul-points would not be offset by the subdivisions close to the haul-points, if the all the close subdivisions are piped.

Figure 5: Existing Sewer Main in the Avenues

Figure 6: Existing Sewer Main Going South Along Ridgecrest Drive

Figure 7: Kilbuck Lift Station

The two lift stations that would receive wastewater from this area are the “Main” Lift station and the “Kilbuck” lift station.

All wastewater in Bethel flows through the Main Lift Station, from which wastewater is pumped to the lagoon. The lift station has three variable speed pumps with a capacity of 2,130 GPM with all three operating at high speed. With only one operating at full speed, the pump flow-rate drops to 1,475gpm. The influent truck line is an insulated 8-inch diameter Schedule 40 steel pipe, and the discharge truck line is an insulated 10-inch high-density polyethylene pipe. The Main lift station has adequate capacity to handle increased flow from the Avenues neighborhood. The existing pump run times at the Bethel Main Lift Station appear to be less than three hours/day.

The Kilbuck Lift Station has capacity to handle approximately 103 GPM at 31 feet (TDH), which handles the current influent with minimal pump run time. Not all of the wastewater from the Avenues would be pumped by the Kilbuck lift station, so it appears this has adequate capacity. The City is working on replacement of the controls at Kilbuck lift station to increase the life of the lift station. The improved controls would be compatible with new Variable Frequency Drive pumps which could be upsized, if during design the Kilbuck capacity was found to be low. The two lift stations (and all other City owned) are shown in Figure 8.

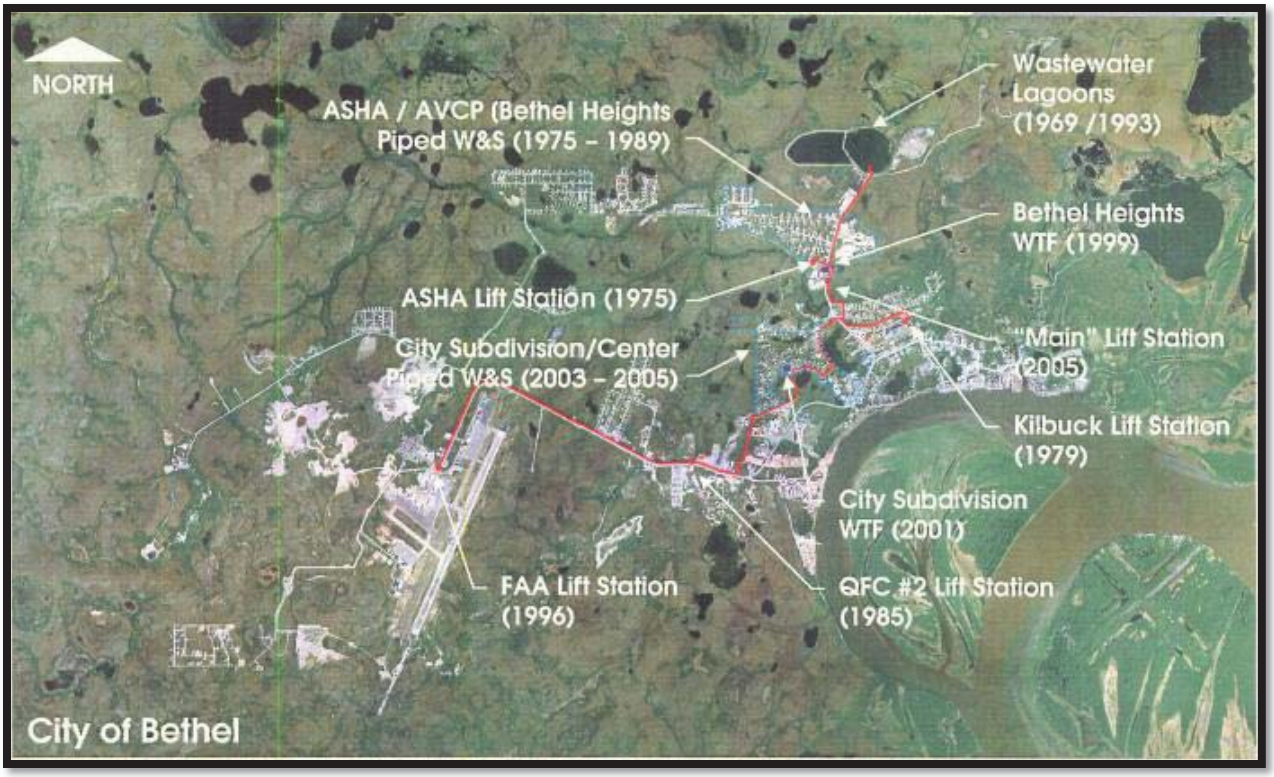


Figure 8: Existing Water and Sewer Service

Throughout much of the community, and adjacent to the project area, water and sewer mains run together. An example of this is shown in Figure 9.

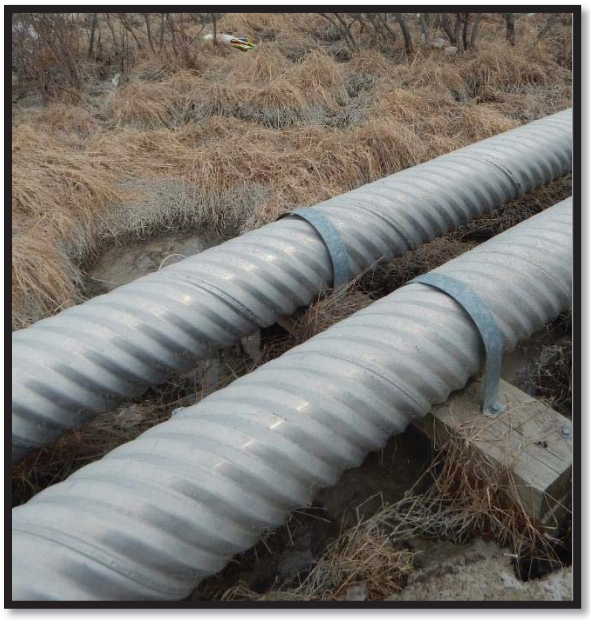


Figure 9: Water and Sewer Mains Located Along the Southern Side of Arthur Dull Lake

The Tundra Women's Coalition on 6th Avenue operates its own well to produce running water for its building. In accordance with Bethel Municipal code, this well would be abandoned and the facility would be hooked up to the adjacent water and sewer mains.

3.2 System Operation and Maintenance

3.2.1 Management Adequacy

Operation and maintenance of public water and sewer systems is the responsibility of the City of Bethel Department of Public Works (DPW). The DPW manages a fleet of equipment, including work trucks, water and wastewater haul trucks, dump trucks, excavators, tractors, loaders, generators, and tools.

The advantage of a piped system over hauled is that Operations & Maintenance (O&M) costs are lower and sanitation conditions are better. The disadvantage of a piped system is the increased potential for pipe freezing, and the higher initial capital costs.

Heavy loads transported by the water and sewer haul trucks damage the roads in Bethel. A piped system would decrease use of haul trucks, which would decrease future road repair needs.

The 2013 utility rate study for the City of Bethel identified a path to make the whole utility financially solvent. The path is in its second year of implementation. The City has implemented a subscription fee for water and sewer funds, but the reserve is not sufficient to cover capital improvements. These must be funded through loan and grant opportunities.

According to the 2013 utility rate study, current sewer system revenues are approximately $2.5 million annually. Hauled sewer service revenue accounts for approximately 61 percent of this total, even though hauled sewer services only account for approximately 30 percent of total wastewater volume.

In years when the water and sewer utility has been over-budget, the City has had to dip into the City general funds. The proposed utility rate structure increase has potential to build up reserves for future emergency repairs if properly accounted for in an R&R account.

The life of water and sewer infrastructure in Bethel, and other arctic and sub-arctic communities, is short. The anticipated life of various water and sewer components is shown in Table 3.

Table 3: Anticipated Life Expectancy of Various Water and Sewer Components

Components	Useful Life (Years)
Storage tanks	40
Water distribution lines	40
Sewage collection lines	30
Lift station (not pumps)	30
Wells	30
Buildings	30
Service connections	15
Trucks	15
Meters	10
Pumps	10
Paint (exterior)	10
Valves	10
Backhoes (occasional use)	10
Tracked vehicles	5
Pumps and Controls	5
Compressors	5

3.3 Growth

3.3.1 Projected Growth

According to the Alaska Department of Labor and Workforce Development (DLWD) 2012 report, "Alaska Population Projections 2012 to 2042," the Bethel Census Area, as of 2012, had a total population of 17,600. This report projects the population of the Bethel Census Area to be 19,246 by 2222 and 22,200 by 2032.

The City is growing disproportionately to the rest of the census area. For the purpose of this PER, the City of Bethel is assumed to be growing at 1.1 percent, which is in accordance with the Water Loops A, B, C, & Lagoon PER prepared by Larsen Consulting Group, LLC in 2013, and is fairly consistent with DLWD projections. This yields the population projection shown in Table 4.

Table 4: Projected Population for Planning Period

Year	Projected Population
2015	(Actual) 6,241
2025	6,962
2035	7,767

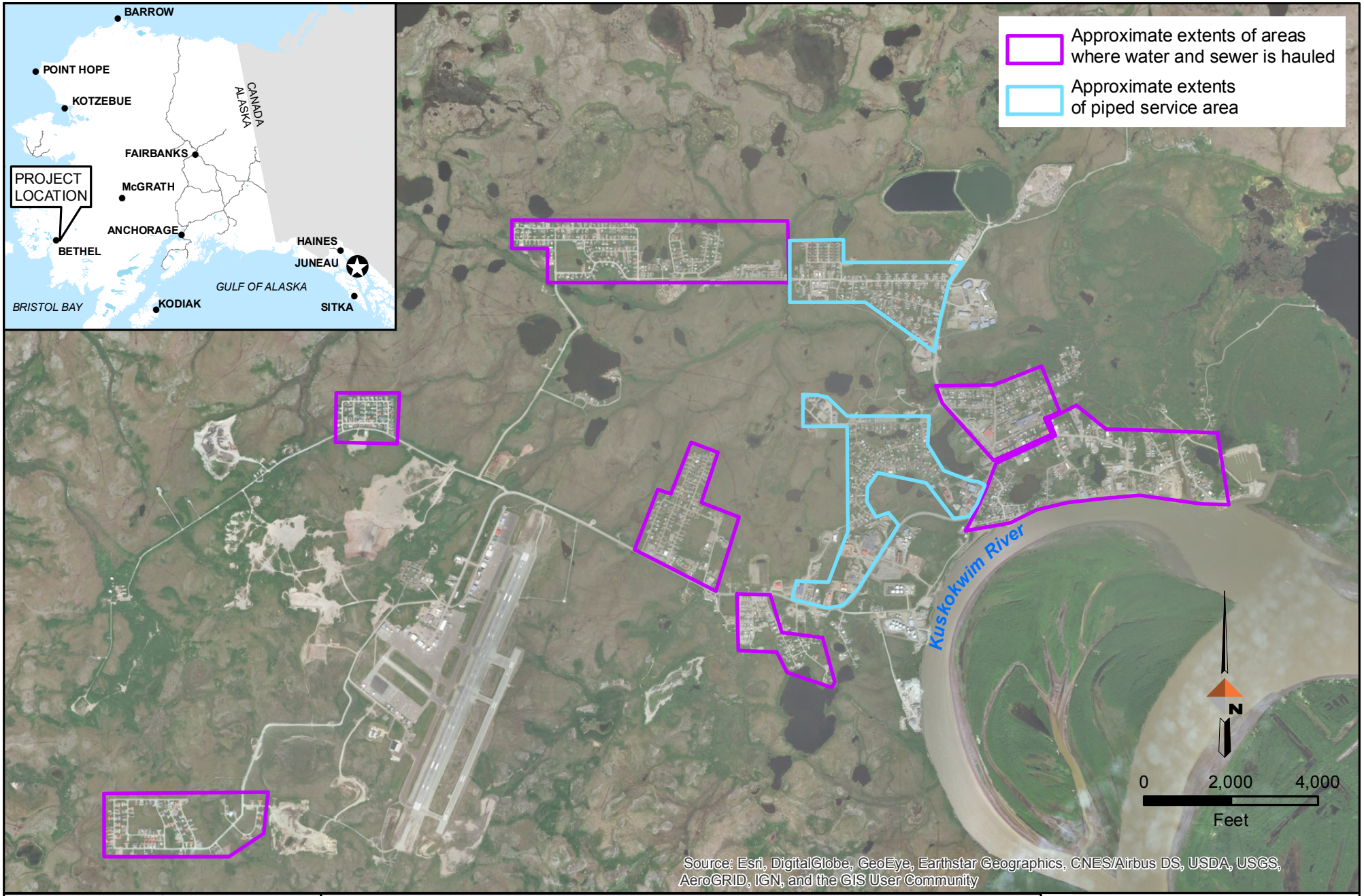
3.3.2 Estimate of New Customers

The 2013 City of Bethel Water and Sewer Cost Allocation and Rate Study (Rate Study) prepared by CH2M Hill, Inc. assumed that new customers, both commercial and residential, would grow at an annual rate of one percent. The City currently has approximately 1,600 water and sewer customers. Approximately 70 percent of these customers are on the hauled systems. This percentage does not correspond proportionally to the volume of hauled wastewater, because most of the major wastewater producers in town are within the 30 percent that receive piped sewer collection. The City is pushing to transition to a piped network throughout the community, but given that most new developments/subdivisions are occurring far from the piped networks, transitioning to a piped network is cost restrictive. In areas of high density, located in close proximity to the existing piped network, transitioning is less cost restrictive. Table 5 projects the growth in hauled customers.

Table 5: Projected Hauled Services for all of Bethel

Year	Total Projected Hauled Services
2015	(Actual) 1,125
2025	1,242
2035	1,372

Approximately half of Bethel's customers have their wastewater collected and brought to the sewage lagoon. The other half has sewage hauled to the lift station near the airport (QFC#2). This project directly impacts what is done with wastewater from approximately 130 services. The delineation between hauled and piped sewer services, in this area and throughout Bethel, is shown in Figure 10.



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Extent of Sewage Haul Service Areas
The Avenues Neighborhood Water & Sewer
Bethel, Alaska

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Figure 10

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4.0 NEED FOR PROJECT

4.1 Health, Sanitation, Security, and Safety

The primary reason to transition from a hauled water and sewer system to a piped water and sewer system is to improve sanitary and safety conditions to reduce the chances for a human disease event. The current system requires storage of sewage at residences for prolonged periods of time, which increases the likelihood of spillage.

Additionally, the truck-haul system introduces inherent dangers due to the increased potential for vehicular accidents and increased traffic. The trucks often exceed weight limitations and can have access issues in arctic road conditions. The City has multiple accidents each year with truck drivers backing into private property. The storage tanks are often hard to find and back-up to, which can be challenging for new haul drivers. The City is continually replacing its drivers as these positions are low paid and have high turn-over rates.

4.2 Regulatory Compliance Concerns

The need for the project is not specifically related to a regulatory compliance issue. The existing infrastructure will soon lose its intended functionality.

As previously discussed, the haul-trucks can only be partially filled because of weight restrictions levied by the State of Alaska Bridge Law. Replacement of the fleet with newer, longer configuration trucks, is required.

4.2.1 Flooding and Wetlands

The entire community of Bethel sits adjacent to the Kuskokwim River and within the broader context of the Yukon-Kuskokwim Delta. FEMA Flood Insurance Rate Maps (FIRM) were reviewed to determine approximate flood risks for the project area.

Much of the project area, as shown in Figure 1, falls within the expected 100-year floodplain (1-percent annual chance of a flood), particularly the areas in proximity to the unnamed tributary that drains the project area to the Kuskokwim River. The remainder of the project area is listed as having “undetermined flood hazards, with flooding possible” (FEMA 2011).

Due to its location and proximity to the Kuskokwim River, construction of any new structures should take into account the possibility of floods and flooding. A proposed lift station should be constructed with enough clearance above ground level to allow for floodwaters.

4.2.2 Alaska State Historic Preservation Office (SHPO)

A review of the AHRS list, on October 7, 2015, indicated that there are known cultural resources in the vicinity of the project and its various alternatives. However, there are no known resources in the immediate vicinity of the existing sewage lagoon and truck dump jetty. The Bethel airport has been evaluated for eligibility as a historic resource and was found to be ineligible. There are, however, a number of sites in the old town center, generally between 3rd Avenue and 6th Avenue. None of the proposed project alternatives are located in this area.

4.2.3 Biological Resources (United States Fish and Wildlife Service)

An investigation into threatened and endangered (T&E) species and critical habitat, via the USFWS Information for Planning and Conservation (IPaC) system, on July 31, 2015, indicated no T&E species or critical habitat areas in or near the project area. Migratory birds are known to nest and breed in this part of Alaska; however, it is unlikely that they would nest and breed within the more densely populated part of Bethel. Regardless, vegetative clearing in support of additional development should occur outside of the USFWS migratory bird nesting window (May 5 to July 25), as defined for this area of Alaska.

Bethel sits on the true right bank of the Kuskokwim River, which is listed as an anadromous waterway. According to the Alaska Department of Fish and Game (ADF&G) anadromous waters catalog, the Kuskokwim River hosts all five species of Pacific salmon: Chinook salmon (Oncorhynchus tshawytscha), Coho salmon (Oncorhynchus kisutch), Chum salmon (Oncorhynchus keta), Pink salmon (Oncorhynchus gorbuscha), Sockeye salmon (Oncorhynchus nerka), as well as arctic lamprey, Pacific lamprey, Humpback whitefish (Coregonus oidschian), Least cisco (Coregonus said), Sheefish (Stendous leucichthys), and Whitefish (ADF&G 2011).

Vegetation communities in the Yukon-Kuskokwim Delta are wet sedge and moss communities (Raynolds et al. 2005). Wetlands are dominated by sedges, grasses, crowberry, and sphagnum mosses.

4.2.4 Water Resources

The USFWS National Wetlands Inventory (NWI) was reviewed to determine wetland presence and extent in the project area. Unfortunately, the NWI does not contain mapping data for Bethel and its surroundings.

However, given its location in the YK Delta and based on aerial photointerpretation, it is highly likely that much or most of the project area and vicinity is comprised of wetlands. The undeveloped terrain appears to consist of small ponds, sedge meadows, and palustrine and riparian shrub margins.

The Kuskokwim River lies just southeast of the project area, and an unnamed tributary thereof appears to drain most of the project area.

Best management practices (BMPs) to avoid and minimize erosion and to control sedimentation during construction will be implemented to minimize impacts to water resources. The project will have an Erosion and Sediment Control Plan from which the Contractor will also prepare a Storm Water Pollution Prevention Plan (SWPPP) and a Hazardous Materials Control Plan (HMCP). These plans would detail erosion and siltation control measures and other pollution prevention meas ures that would be used during project construction to minimize impacts to surface water.

5.0 ALTERNATIVES CONSIDERED

5.1 Alternative One - No-Build

5.1.1 Description

The “No-Build” alternative is to continue using the existing haul system for the Avenues. Residents in the Avenues area will see no difference in cost, quality, or quantity of water to their homes. The City would continue to replace water and sewer trucks every fifteen years and continue to deliver water and sewer as they currently do. This alternative would result in minimal change to operations and practice.

5.1.2 Environmental Impacts

There are no additional environmental impacts resulting from the No-Build Alternative. The City’s haul trucks would continue to have wear impacts on DOT&PF and City roads, resulting in more frequent roadway upgrades.

5.1.3 Land Requirements

The No-Build alternative does not have specific land requirements, as nothing would be constructed with this option. The City’s haul trucks would continue to be stored at the Department of Public Works shop.

5.1.4 Advantages and Disadvantages

The advantage to No-Build is low capital cost. The only capital costs are the recurring cost to replace trucks. The replacement frequency for the City’s haul trucks is every fifteen years. Additionally, there will be no disturbance to daily life and commerce that would ordinarily occur during construction. Construction of other alternatives could potentially take multiple years.

The disadvantage is that No-Build results in high O&M costs for the City to produce and deliver water and collect and dispose of sewage.

Retention of truck drivers is a constant challenge for the City and new drivers have often resulted in traffic incidents, another expense to the City.

5.1.5 Construction Challenges

There are no construction challenges associated with this alternative.

5.1.6 Cost Estimate

5.1.6.1 Capital Cost

There is no construction cost associated with this alternative. The only costs associated with this alternative is the cost to replace trucks, and the cost to provide water and sewer with the haul-systems. Assuming a 25-year design life, new water trucks would be immediately procured, and then again at year 15. The sewer trucks would require replacement at year 15. The trucks at the end of the design life would have some salvage value.

5.1.6.2 Operation and Maintenance Cost

The O&M costs are the cost to continually deliver and collect water and sewage via the hauled network. These costs are shown in Table 6. An interest rate of 0.4% was used based on an average of the 20 (0.2%) and 30 (0.6%) year discount rates published by the White House Office of Management and Budget Circular A-94.

Table 6: O&M Costs of Alternative 1

Operation and Maintenance Cost	Quantity	Present Value of Expense
Water Delivery Cost	12,921,000 gallons/year	$19,035,000
Sewage Collection Cost	12,921,000 gallons/year	$19,652,000
	Present Value of O&M Costs	**$38,686,000**

5.2 Alternative Two: Phased Piped Water and Sewer System

5.2.1 Description

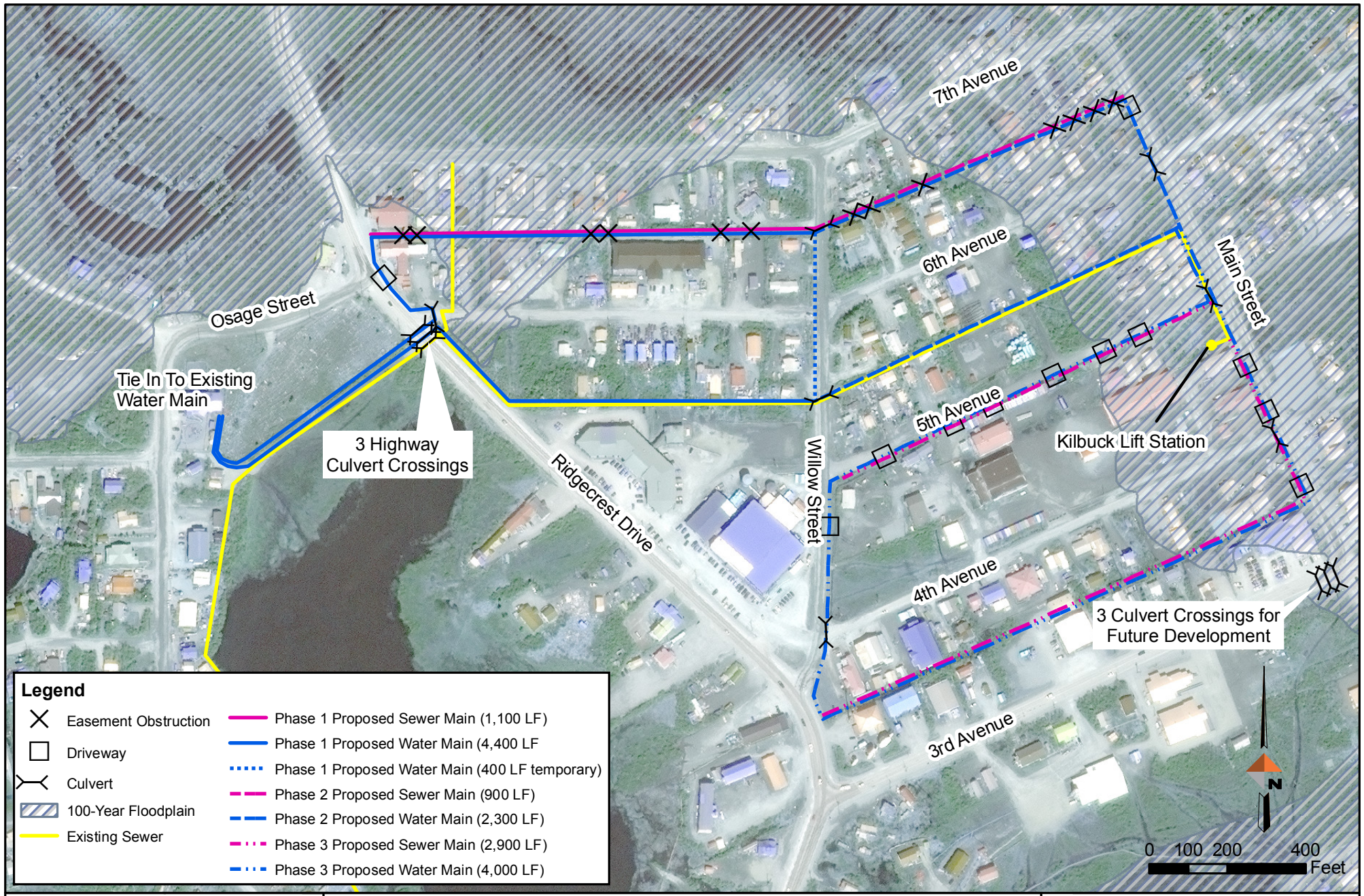
This alternative provided piped water and sewer to the Avenues area over the course of multiple years. This alternative was considered because the capital cost of a full-build out in one phase may not be financially possible for the City. This alternative is made of three phases, and each phase would end in a substantial completion that would allow that part of the project to be up and running. Additional water trucks would be procured for the Avenues area as part of this alternative.

The water and sewer pipe alignments are discussed in detail in this section. The water mains would be designed to provide constant circulation, and the sewer mains would be designed to work with combined (multiple buildings combining flow into one central lift station) or independent residential lift stations. A piped network would provide fire protection to the neighborhood, as new hydrants would be constructed throughout the project area.

Some of the proposed improvements for this alternative occur in areas below the 100- year flood elevation. This is unavoidable because the homes/businesses this project targets are in this area. Design and Construction measures will be taken to “flood-proof” the proposed improvements, as required by Bethel Municipal Code. The water and sewer pipes will be kept as close to the ground as possible to allow flood waters to pour over the pipes if a flooding event occurs. The pipes will also be fastened to the ground by the pipe supports, to restrict the pipes from “floating off”. In certain areas where there is an existing roadway embankment made of imported fill, the pipes may be buried.

The existing Kilbuck lift station will be improved as part of this alternative. The existing wet well will be re-used, but the pumps, rails, and other appurtenances will be replaced to extend the life of the lift station. No ground disturbance will be included with the Kilbuck lift station improvements.

Figure 11 shows the pipe alignments and proposed phases for this alternative.



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Alternative 2 - Phased Approach
The Avenues Neighborhood Water & Sewer
Bethel, Alaska

PROJECT	1529.50118.01
DATE	Jun 20, 2018

Figure 11

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Phase 1:

The proposed water main will tie in to the existing water main near the Youth Center on Osage Street. It will then follow the existing sewer main northeast and cross Ridgecrest Drive. The water main will then continue north along Ridgecrest Drive to the easement located between 6th and 7th Avenue and follow the easement to Willow Street. The water main will then head south to cross 6th Ave to follow Willow Street until it reaches the easement between 5th Avenue and 6th Avenue. The water main would then follow the easement west to Ridgecrest Drive, at which point it would follow Ridgecrest Drive northwest to cross Ridgecrest Drive, and then follow the existing main path to tie in to the existing water main near the Youth Center on Osage Street.

The proposed sewer main will branch off from the existing sewer main that runs perpendicular to the easement located between 6th and 7th Avenue to extend east to Ridgecrest Drive and west to Willow Street.

Phase 2:

The water and sewer mains in the easement between 6th and 7th Avenue will cross Willow Street and continue along the easement to Main Street.

The water main will then continue southeast to cross 6th Avenue, and then run southwest along the easement between 5th and 6th Avenue to cross Willow Street and connect with the water main constructed in *Phase 1*.

The section of water main installed in *Phase 1* that runs north and south between the easement between 6th and 7th Avenue and the easement between 5th and 6th Avenue will be abandoned as Phase 2 is brought on-line at the end of Phase 2 construction. This section would be removed because no water services would originate from it, and to ensure circulation in the larger loop- this section would need removal.

Phase 3:

The proposed water main will tie in to the main constructed in Phase 2 at the intersection of the easement between 5th and 6th Avenue, and Main Street. The main will travel south to cross 5th Avenue, 4th Avenue, and then travel southwest along the full extent of the easement between 3th and 4th Avenue until Willow Street. It will then travel north to cross 4th Avenue and travel north along Willow Street. The main will then travel northeast along the southern side of 5th Avenue until Main Street, at which point it will travel north to cross 5th Avenue and to tie in to the main constructed in Phase 2.

The proposed sewer main will tie in to the existing Kilbuck Lift Station and travel south to cross 4th Avenue to turn southwest to travel the full extent of the easement between 3th and 4th Avenue. Another proposed sewer main will tie in to the existing sewer main near Kilbuck Lift Station, and travel southwest along 5th Avenue until Willow Street.

5.2.2 Environmental Impacts

Floodplains: Prior to project construction or ground disturbing activities within naturally vegetated areas, authorization for fill in wetlands would be obtained. The City of Bethel currently administers a General Permit, issued by the Corps per Section 404 of the Clean Water Act, that authorizes work in wetlands. This project is anticipated to qualify for this general permit.

Wetlands: The proposed action consists of modifying existing structures or installing new facilities within the 100-year floodplain. The elevation of the project area is unknown, therefore consultation with the City of Bethel will determine if a floodplain permit is required and if the bottom of the structures will be built above 17 feet amsl.

Biological Resources: Although this project would not bisect or fragment wildlife habitat, the proposed action would disturb 32,000 square feet of previously disturbed lands. Disturbed areas would be stabilized to prevent the introduction and spread of invasive species. Removal of shrubs and trees would occur outside of the USFWS migratory bird window (April 15 to July 15).

Historic and Cultural Properties: DOWL's finding and recommendation is that there will be no effects to buried historic properties within the APE due to minimal subsurface impacts, and the lack of previously recorded sites within the APE. Although one site is located within the APE, the project will not have any direct effects on the building. Construction will occur adjacent to the structure at the existing pipe with the addition of the intercept. Construction would create increased dust and noise at the site. The effects of this action would be short-term and not alter the location, setting, design, materials, workmanship, feeling, or association or otherwise create adverse effects to the historic property. No adverse effects to historic properties are anticipated from the project.

5.2.3 Land Requirements

The above-grade arctic pipes are placed on driven pile foundations or on timber supports. A driven pile or timber support will be required every 10 feet to support the arctic water and sewer pipes. The actual ground penetrations for each pile are less than 1 square foot. The total ground disturbance to place the pipe on the ground is minimal. To construct the pipe networks, an area approximately 10 to 15 feet wide is required (which is why easements tend to be 10 to 15 feet wide). The proposed alternative as described above would result in a total of 16,000 linear feet of water and sewer pipe. The footprint of the pipe would be roughly 32,000 square feet.

The elimination of residential water and sewer tanks will free up significant amounts of land on each privately-owned parcel. Residents could elect to keep their water and sewer tanks for back-up.

5.2.4 Advantages and Disadvantages

Alternative 2 provides the City with an alternative that phases the project. It would be a step-by step approach to bringing The Avenues piped water and sewer.

The fully built out alternative improves sanitation conditions on each private property by eliminating the sewage tank and it will reduce the City's O&M costs.

Providing piped water to this neighborhood also has the major advantage of providing fire hydrant coverage, making it a safer neighborhood. Individual residents could also see a decrease in insurance rates because of the improved fire hydrant coverage.

The haul trucks procured for this alternative would be re-used in other parts of the community as they would no longer be needed in The Avenues.

The disadvantage of Alternative 2 is it has a high initial capital cost. It will also require a multi-phase approach that will span construction over the course of several summer seasons.

5.2.5 Construction Challenges

Pipes will be placed in easements and along the City roads. Many of the easements have significant encroachments (e.g. homes, sheds, old vehicle). While it is technically the responsibility of the homeowner to keep easements open, this has not been standard practice in Bethel. Many residents may not have money available to relocate items in easements.

Another construction challenge will be to transition each residence over to the new City water and sewer mains. Each residence has a unique plumbing system, and it is not possible to engineer each connection. Many of the connections will have to be field engineered with a certified plumber and a project representative from the design team. The City's goal is to connect homes as quickly as possible. The capital cost estimates for this Alternatives includes $25K for each service, which will cover a portion of the cost of the water and sewer service. Additionally, the City has more than 10,000LF of water and sewer service pipe that will be provided in kind to this project to reduce the cost of each service.

Homeowners may not want to remove their water and sewer tanks, even though it would free up valuable space on their property. If this is the case, the water and sewer tanks could be left in place, with back-flow prevention between the tanks and the City mains.

5.2.6 Sustainability Considerations (Energy Use)

Hauled water and sewer costs more because it takes more resources than piped water and sewer. Piping water is a more energy efficient way of providing the same service.

5.2.7 Cost Estimate

Assuming a three-phase approach, over three to five years, is taken to construct this alternative, the present value of the capital costs are shown in Table 7. The capital cost for Phase 1 includes procurement of two new water trucks to serve the needs of the Avenues neighborhood, and four additional trucks to cover the on-going needs of the rest of the community (Additional discussion on this is included in section 5.4.3) . The Avenues neighborhood trucks would be used to deliver water for The Avenues area until the project is built out in three to five years. Those water trucks would then be used to service other areas of Bethel. Detailed capital and O&M cost breakdowns are available in Appendix A.

Table 7: Capital Costs of Alternative 2

Phase	Capital Cost	Present Value of Capital Cost
Water Haul Trucks	$1,500,000	$1,500,000
Phase 1 (Including three DOT&PF Highway Culverts)	$4,650,000	$4,650,000
Phase 2	$3,020,000	$3,010,000
Phase 3 (Including three DOT&PF Highway Culverts)	$4,590,000	$4,560,000
	Present Value of Capital Costs	**$13,720,000**

The City would continue to haul water and sewer to the neighborhood as the project is built out. Hauled water and sewer costs for the first three years were calculated into the overall O&M costs for this alternative (Table 8).

Table 8: O&M Costs of Alternative 2

O&M Cost	Total Annual Cost	Present Value of O&M Cost
Hauled Water Cost (For Three Years)	$802,000	$2,386,000
Hauled Sewer Cost (For Three Years)	$828,000	$2,463,000
Piped Water Cost (For years Four to Twenty-Five)	$338,000	$7,026,000
Piped Sewer Cost (For years Four to Twenty-Five)	$123,000	$2,555,000
	Present Value of O&M Costs	**$14,429,000**

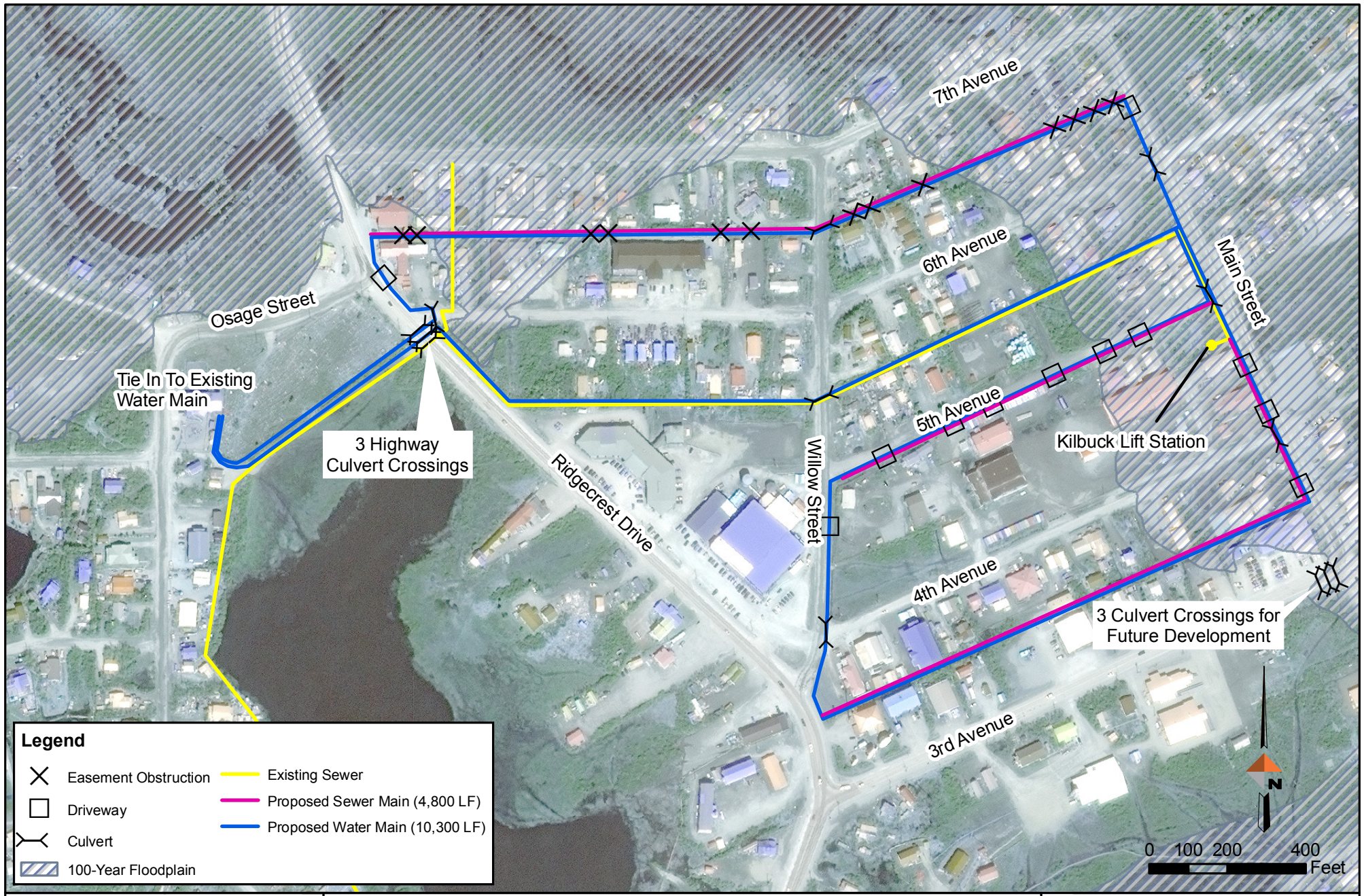
5.3 Alternative 3: Single Phase Piped Water and Sewer Alternative

5.3.1 Description

The City also has the alternative of building out the entire piped network in one single phase. This has many advantages over a phased approach including the following:

- It would eliminate multiple mobilizations over several construction seasons;
- Larger projects will increase bid competition resulting in better unit costs;
- It would eliminate stretches of water and sewer main that would be constructed as “temporary” to go from phase 1 to phase 2 and phase 2 to phase 3.

The alignment of the pipes would be similar to what is proposed in Alternative 2, but the build-out would be in one single phase. The capital cost of this alternative is significantly higher than the Alternative 1, but has decreased O&M cost. The capital cost of this alternative is also less than that of Alternative 2. The life cycle cost of this alternative is the lowest of all the alternatives. The land requirements and construction challenges are no different than Alternative 2 (Figure 12).



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Alternative 3 - Single Phased Approach
The Avenues Neighborhood Water & Sewer
Bethel, Alaska

PROJECT	1529.50118.01
DATE	Jun 20, 2018

Figure 12

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The same flood proofing measures will be taken for Alternative 3 as Alternative 2, and the same improvements to Kilbuck lift station are proposed.

5.3.2 Capital Cost

The capital cost for this alternative is the lower than the phased approach because it builds out the entire project area in a single phase. The City would not be paying for multiple mobilizations, and it eliminates the need to construct temporary water mains to go from one phase to the next. The anticipated construction would take approximately one year.

The capital cost estimate includes three culverts to be placed along the Chief Eddie Hoffman Highway, and the cost of three additional ones along 3rd Avenue, near the Nicholson's gas station. The culverts would serve as a conduit for the piped water and sewer pipes to pass through for development of water and sewer on the south side of 3rd Avenue (Table 9).

Table 9: Capital Costs of Alternative 3

Phase	Present Value of Capital Cost
Single Phase Build Out	$13,490,000
	$13,490,000

5.3.3 Operations and Maintenance Costs

The O&M costs for this alternative consist of providing piped water and sewer to residents and commercial users in the project area for the 25-year life of the project (Table 10).

Table 10: O&M Costs of Alternative 3

O&M Cost	Total Annual Cost	Present Value of O&M Cost
Piped Water Cost (For Twenty-five Years)	$338,000	$8,032,000
Piped Sewer Cost (For Twenty-five)	$123,000	$2,921,000
	Present Value of O&M Costs	**$10,953,000**

5.4 Other Alternatives Considered

5.4.1 Other Piped Water and Sewer Alternatives

At least four other alternative pipe alignments were considered for either a phased build-out alternative or a single-phase approach. These alternatives were eliminated based on the following considerations:

- Higher per capita/parcel cost
- City's preference to locate water and sewer mains in easements and not along roadways

For a detailed assessment of the other alternatives, please refer to Appendix B. Ultimately, the preferred alternative was selected because it has the least capital cost per parcel, and it also provided the best future development potential. Constructing piped water and sewer to the areas known as “Alligator Acres”, and the area south of 3rd Street, which includes the Longhouse Motel, is possible with the construction of the preferred alternative. Providing water and sewer to these areas is also a City priority.

5.4.2 Sewer Collection Systems

5.4.2.1 Sewer Main Alternative 1: Individual Residential Lift Stations

This alterative would place a small individual lift station in service for each residence or commercial user. Individual lift stations would pump sewage from each residence to the nearest sewer main.

The advantage of this Alternative is that it is not dependent on topography. A lift station would be constructed at each residence or business, regardless of whether a gravity sewer system could be constructed. The City already maintains 174 individual residence lift stations, and the City has settled in on a standard design, which allows for easy stockpiling of spare parts. It is a simple design that would allow for standard community-wide lift station construction.

A disadvantage of this Alternative is that each residence would have to make space for each lift station. The lift station is owned by the property owner, but is maintained by the City of Bethel. Each lift station is located on private property, and the electric controls are routed to the home. The operation costs for the heat trace and sewage pumping are paid by the homeowner.

5.4.2.2 Sewer Main Alternative 2: Multi-Residential Lift Stations

This alterative would place larger lift stations at low points where they would collect sewage from multiple homes via gravity sewer pipes. From the combined lift stations, a force main would be constructed to the nearest sewer main. There are locations in The Avenues where four or five houses could be served by the same lift station.

The advantage of this Alternative is that it would require fewer lift stations with fewer moving parts for the City to maintain.

The disadvantage of this Alternative is the City has historically struggled with gravity sewer systems. Because of freeze-thaw ground movements, gravity pipes are hard to maintain. Furthermore, combining multiple homes into one lift station does not reduce total pipe requirements.

5.4.2.3 Sewer Collection System Preferred Alternative

Combining multiple residences into one lift station is appealing for a few locations throughout The Avenues, but cannot be implemented throughout the whole project area. For this reason, the preferred alternative is to construct individual lift stations at each residence. A standardized design the City already uses could be used for this project. Each individual lift station can be constructed for approximately $20,000, and this cost is included in the capital cost estimates shown in section 5.2.7.

5.4.3 Additional Water and Sewer Trucks

The City of Bethel rotates their fleet through all of their haul routes, since some are short-haul and others are long-haul. The same trucks are not delivering to The Avenues every week. Given the age of the City's fleet and their violation of weight restrictions levied by the State of Alaska, it is recommended the City's fleet be replaced. This recommendation is made separately from The Avenues project area recommendations. Through another USDA RD grant funded opportunity, the City is in the process of replacing five sewer trucks. This only leaves the water trucks to be replaced. Table 11 shows the estimated cost of replacing the water trucks. The capital cost for additional water trucks was included in each of the three alternatives, since the truck replacement is for the entire community, not just the Avenues neighborhood.

Table 11: Additional Water and Sewer Truck Costs

Capital Cost	Unit Cost	Units	Total Cost
Water Trucks	$250,000	6	$1,500,000
			$1,500,000

5.5 Cost Summary of Alternatives

Table 12 table provides a summary of the capital, O&M, and lifecycle costs of the alternatives under consideration.

Table 12: Summary of Alternative Life Cycle Costs

	Avenues Water and Sewer Alternatives		
	Alt. 1 No Build	**Alt. 2 Phased Piped Water and Sewer**	**Alt. 3 Single Phase Piped Water and Sewer**
[1]Present Value of Capital Costs - Total	$1,500,000	$13,720,000	$13,490,000
[2]Annual O&M Cost	$1,630,000	$1,630,000 / $460,000	$460,000
[3]25-Year Salvage/Book Value - Total	$500,000	$500,000	$500,000
Present Worth of Salvage Value	$460,000	$460,000	$460,000
[4]Annual O&M Present Worth	$38,700,000	$14,430,000	$10,950,000
Total Present Worth Cost	$39,700,000	$27,700,000	$24,000,000

[1]The Present Value Capital costs includes the procurement of 6 trucks.

[2]For Alt 2, the first value is the O&M costs for the first three years (costs for haul system). The second number this is the O&M cost for operating the piped system once constructed.

[3]Based upon straight-line depreciation and ultimate salvage value of $0.00 at end of respective useful life. For Alt 1, there is salvage value- because trucks will only be 10 years old at end of 25 years.

See Appendices for detail of salvage/book value calculations.

[4]Present Value of Annual O&M = Fixed Cost Ordinary Annuity;

Present Value Factor of Annuity= $[1-(1+r)^{-n}]/r$;

r = Real Interest Rate (0.4%, per OMB Circular No. A-94, Appendix C, November 2017;

n = Number of Period (years).

5.6 Alternative Selection

5.6.1 Design Criteria

The selected alternative must be designed for the following criteria (Table 13). Both alternatives can meet these criteria.

Table 13: Design Criteria

General	
Design Period (years)	25
Customers- Existing/Potential	118/130
Population Per Parcel	3
Design Population	354
Environmental Conditions	
Mean Temperature	29.1°F
Design High Temperature	90°F
Design Low Temperature	-48°F
Mean Annual Precipitation	16 inches
Mean Annual Snowfall	55 inches
Ground Snow Load	40 PSF
Design Wind Speed	120 miles per hour
Water Demand & Wastewater Production	
Water Usage Per Capita (gallons/day)	100
Design Daily Water Demand (gallons)- Avenues Area	35,400
Peak Factor	1.6
Peak Hourly Demand (gallons/hour)	2,360
Design Daily Wastewater Generation (gallons)	35,400
Peak Hourly Wastewater Generation (gallons)	2,360

5.6.2 Non-Monetary Considerations

The City of Bethel's Water and Sewer Master Plan (CRW 2005) prioritized the provision of piped water and sewer to all areas of the community. Piped water and sewer has the following non-monetary advantages:

- Users on the piped system use more water, which has been linked to better health;
- Fire hydrant coverage has the potential to reduce insurance premiums for homeowners and the City;
- Elimination of water and sewer truck incidents;
- Elimination of the hard-to-fill water and sewer truck driver positions; and
- Minimization of road wear.

6.0 PROPOSED PROJECT (RECOMMENDED ALTERNATIVE)

6.1 Recommended Alternative Description

The recommended alternative is Alternative 3, which is the single phase piped water and sewer alternative. This Alternative has the lowest life cycle costs and will provide the most cost-benefit to the City. While a phased approach is attractive from the standpoint of managing smaller projects, it has increased capital costs.

It is recommended the City immediately procure water haul trucks to meet the immediate need of the other hauled neighborhoods. The City continues to plan for piped water and sewer for all of Bethel's neighborhoods, but given the time required to obtain funding and public support hauled water and sewer trucks are needed in the interim.

6.1.1 Project Schedule

The State of Alaska DOT&PF will be constructing improvements to Ridgecrest Drive and 3rd Street in summer-fall 2018, which has provided the City a unique opportunity to install culverts in the roadway embankment (through which piped water and sewer would be threaded). The City is moving forward with paying DOT&PF to construct these culvert crossings as the roadways are under construction. The culvert installations will begin in summer 2018.

Topographic survey, public involvement, geotechnical investigations, design, permitting, and easement acquisition will take approximately 18 months. The driven piles (driven to a depth of approximately 20 feet) on which the arctic water and sewer mains are installed could be installed during the winter months, and water and sewer main installation could occur in summer months. At the time of this PER development, the projected construction schedule is forecast to begin in the first months of 2020 and would progress through the summer. It is anticipated substantial completion could be reached by the end of 2020.

This PER should be used to solicit funds from the USDA RD Fiscal Year 2019 (FY19) allocations.

6.1.2 Permit Requirements

Final permit requirements will be included in the Environmental Report for this project. It is currently anticipated that permits will be minimal for the proposed action, because the proposed action does not disturb much ground, not have a large footprint, and takes place mainly in previously disturbed areas.

Once engineering documents are developed, the State of Alaska Department of Environmental Conservation (ADEC) will require an Engineering Plan Set review prior to granting an approval to construct and operate the piped water and sewer systems. This is a standard permit for the City's engineering firm to obtain. The project area would have many water and sewer separation violations, but ADEC will grant waivers because all the water and sewer mains are above ground, and leaks are easy to identify.

6.2 Project Cost Estimate for the Recommended Alternative

6.2.1 Cost Estimate

The projected capital cost for water and sewer to the Avenues Neighborhood Single-Phase Piped Water and Sewer alternative is shown in Table 14.

This estimate includes projected costs for the installation of six highway culverts (on Ridgecrest Drive and on Third Avenue) to facilitate crossings at these locations.

The unit cost of pipe installation includes considerations for the American Iron and Steel provisions. Additional costs were also included for the removal and clearance of easement obstructions.

USDA Rural Development may require a Value Engineering assessment prior to construction.

Table 14: Recommended Alternative Single-Phase Piped Water and Sewer Cost Estimate

Item Description	Estimated Quantity	Unit	Unit Price	Total Price
Phase 1				
Installation of Arctic Main	15,600	LF	$250	$3,900,000
Highway Direct Bury Crossing	6	EA	$70,000	$420,000
Driveway Casing Crossing	3	EA	$3,000	$9,000
Hydrants	20	EA	$10,000	$200,000
Services (water and sewer)	118	EA	$25,000	$2,950,000
Easement Obstruction Clearance	20	EA	$10,000	$200,000
			Construction Sub-Total	$7,679,000
Mobilization/Demobilization (5% of Subtotal)	1	Each	$383,950	$383,950
Taxes, Bonds, Insurance (3% of Subtotal)	1	Each	$230,370	$230,370
Traffic Control and Public Relations (2% of Subtotal)	1	Each	$153,580	$153,580
Construction Surveying (1% of Subtotal)	1	Each	$76,790	$76,790
Preparation of SWPPP (0.5% of Subtotal)	1	Each	$38,395	$38,395
			Subtotal	$8,562,000
			10% Design	$856,000
			10% Construction Administration	$856,000
			20% Contingency	$1,713,000
			Water Truck Replacement	$1,500,000
			Total Estimated Project Capital Cost	$13,487,000

6.4 Annual Operating Budget

6.4.1 Income

Residents of the Avenues will see a decrease in their water and sewer bills as they transition from hauled to piped. The average size of the residential water and sewer tanks in the haul system is approximately 1,000 gallons, which are filled and emptied an average of once per week. According to the 2018 haul utility rate schedule, a haul service consumer located in either Zone 1 or Zone 2 with those tank sizes and refill/empty frequency will pay $208.67 per month for water haul service and $156.38 for sewer haul service, which results in a total expenditure of $365.05 per month.

Transitioning to a piped system, will result in less water and sewer revenue for the City - but it is more than offset by the reduction in Operations and Maintenance Costs (Table 15).

In 2017 the City passed an ordinance that modified the utility rate code 13.16.070 that allowed the City Council to raise all utility rates 3% per year, until the water and sewer funds are profitably operating. For the purposes of this PER, we assume the City will continue to raise rates by 3% for the planning period.

Table 15: Anticipated Water and Sewer Revenue from The Avenues

Recommended Alternative				
Service	Monthly Cost to Residents, First Year	Projected Yearly Revenue, First Year	Monthly Cost to Residents, Year 25	Projected Yearly Revenue, Year 25
Piped Water	$176.11	$250,000	$358.00	$560,000
Piped Sewer	$49.86	$70,000	$101.36	$160,000
Total Yearly Revenue, First Year		**$320,000**	**Total Yearly Revenue, Year 25**	**$720,000**

6.4.2 Debt Repayments

The City has existing debt to USDA Rural Development for a recent sewage lagoon project. The City needs to be able to service its existing debt while/if taking on additional debt. The City currently has an outstanding loan of $913,000.

6.4.3 Short Lived Assets

The City must continue to plan for repairs and replacement (R&R) of all water and sewer short lived assets. The City needs to continually contribute to an R&R account to plan for these eventualities. Table 16 lists all short-lived assets that need to be planned.

Table 16: Water Short Lived Assets

ASSET	Type/Size	Replacement Cost	Total Number	Total Value	Annual Reserve
5 Year Replacements					
Water Department Computers	Generic	$2,500	2	$5,000	$1,000
Copiers, Printers	Generic	$3,000	2	$6,000	$1,200
City Sub Computer and Monitoring		$3,600	1	$3,600	$720
Bethel Heights Computer and Monitoring		$2,500	1	$2,500	$500
Lab Equipment	Hach	$6,300	2	$12,600	$2,520
		5 Year Replace Budget		**$29,700**	**$5,940**
10 Year Replacements					
City Sub Circulation Pumps	5hp	$4,000	4	$16,000	$1,600
City Sub Pressure Pumps	7.5hp	$4,000	4	$16,000	$1,600
Bethel Heights Circulation Pumps	5hp	$4,000	4	$16,000	$1,600
Bethel Heights Pressure Pumps	7.5hp	$4,000	4	$16,000	$1,600
High Demand Fire Pumps	125hp	$70,000	2	$140,000	$14,000
Water Department Truck	Ford	$25,000	1	$25,000	$2,500
Water System Meter		$3,000	60	$180,000	$18,000
Air Release Valves		$2,500	120	$300,000	$30,000
		10 Year Replace Budget		**$709,000**	**$70,900**
15 Year Replacements					
Water Haul Trucks	Kenworth	$200,000	9	$1,800,000	$120,000
Glycol Heat Exchangers		$25,000	2	$50,000	$3,333
Bethel Heights Boilers	250,000BTU	$140,000	2	$280,000	$18,667
City Sub Boilers	250,000BTU	$140,000	2	$280,000	$18,667
Water System Controls	Municipal	$100,000	2	$200,000	$13,333
Well Submersible Pumps	40hp	$40,000	3	$120,000	$8,000
Hydrants	Mueller	$8,000	80	$640,000	$42,667
		15 Year Replace Budget		**$3,370,000**	**$224,667**
		Annual Contribution to R&R Account			**$301,507**

Table 17: Sewer Short Lived Assets

ASSET	Type/Size	Replacement Cost	Total Number	Total Value	Annual Reserve
5 Year Replacements					
Lift Station Submersible Pumps	2hp	$2,500	78	$195,000	$39,000
Lift Station Submersible Pumps	3hp	$3,000	6	$18,000	$3,600
Lift Station Submersible Pumps	4hp	$3,600	4	$14,400	$2,880
Lift Station Submersible Pumps	8.5hp	$60,000	3	$180,000	$36,000
Lift Station Submersible Pumps	5hp	$9,000	3	$27,000	$5,400
Lift Station Submersible Pumps	14hp	$75,000	3	$225,000	$45,000
Lagoon Pump	5 MGD	$75,000	1	$75,000	$15,000
Public Works Computers		$2,000	2	$4,000	$800
Public Works Copiers, Printers		$1,000	1	$1,000	$200
		Total 5 Year Replacement Budget		**$739,400**	**$147,880**
10 Year Replacements					
Lift Station Submersible Controls	Residential	$800	78	$62,400	$6,240
Lift Station Submersible Pumps	2hp	$2,500	78	$195,000	$19,500
Sewer Line Truck	Ford	$25,000	1	$25,000	$2,500
Glycol loop heat pumps	Various	$10,000	6	$60,000	$6,000
		Total 10 Year Replacement Budget		**$342,400**	**$34,240**
15 Year Replacements					
Sewage Haul Trucks	Kenworth	$200,000	9	$1,800,000	$120,000
Lift Station Rails, Valves	Municipal	$15,000	8	$120,000	$8,000
Lagoon Divider	Curtain	$250,000	2	$500,000	$33,333
Lagoon Motor Boat	Generic	$10,000	1	$10,000	$667
Lift station Controls	Municipal	$60,000	8	$480,000	$32,000
		Total 15 Year Replacement Budget		**$2,910,000**	**$194,000**
		Total Contribution to R&R Account			**$376,120**

7.0 CONCLUSION

The preferred alternative is to provide piped water and sewer to The Avenues in a single phased approach. This alternative versus a multi-phased alternative eliminates multiple mobilizations and reduces capital costs. If the City cannot afford the expected costs with a single-phase build-out, it is recommended the City take on Alternative 2 the phased approach.

The recommended alternative is in line with the City's long-term priorities and will reduce O&M costs for this project area.

The preferred alternative will require three culvert crossings on the Chief Eddie Hoffman Highway for threading the water and sewer mains. The City has a unique opportunity to move forward with these culverts in summer 2018 because DOT&PF will have the Highway torn-up for re-construction.

The preferred alternative also calls for the placement of three culverts across 3rd Avenue near Nicholson's gas station to facilitate future piped water and sewer to that part of the community.

DOWL also recommends the City solicit funding for the procurement of six new water trucks to continue providing hauled water and sewer service to the other parts of the community. The haul trucks will not be needed for the Avenues neighborhood but will be needed to continue providing hauled service, as the community and City works towards the goal of providing piped water and sewer to all the community.

8.0 REFERENCES

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APPENDIX A

Detailed Cost Tables

Project: City of Bethel Avenues Neighborhood Water and Sewer Improvements
Alternatives Analysis

Life Cycle (yrs)	25
Interest Rate	0.40%
Parcels	118

Capital Costs for Tuck Purchase, Alternatives 1, 2, & 3

Alternative 1, 2, & 3

Item	Quantity	Type	Unit Price	Total Cost	Present Value
No Build	6	All Procured in Year 1	$250,000.00	$ 1,500,000	$ 1,500,000
			Total Capital Costs	**$ 1,500,000**	
				Total Present Value Capital Costs	**$ 1,500,000**

Salvage Value @25 yrs	$ 253,333
Salvage Value Present Value	$ 229,271

Total Truck Life Cycle Costs	**$ 1,270,729**

O&M Costs, Alternative 1

Alternative 1: No Build

Item	Quantity	Type	Unit Price	Total Cost	Present Value
Water Haul Costs (gallons/year)	12921000	1000 Gallons	$62.04	$ 801,619	$ 19,034,856
Sewer Haul Costs (gallons/year)	12921000	1000 Gallons	$64.05	$ 827,590	$ 19,651,556
*Assuming 100 gallons per person per day, 3 people per parcel			Total Yearly O&M Costs	**$ 1,629,209**	
*Trucks will be replaced at year 15.				Total Present Value O&M Costs	**$ 38,686,411**

Capital Costs, Alternative 2

Alternative 2: Piped Sewer and Water, Phase 1

Item	Quantity	Type	Unit Price	Total Cost
Installation of Arctic Main	5900	LF	$250	$1,475,000
Removal of Water Main	430	LF	$50	$21,500
Highway Direct Bury Crossing	3	EA	$70,000	$210,000
Driveway Casing Crossing	3	EA	$3,000	$9,000
Hydrants	8	EA	$10,000	$80,000
Services (water and sewer)	45	EA	$25,000	$1,125,000
Easement Obstruction Clearance	6	EA	$10,000	$60,000
			Sub-total of Construction Costs (Excluding Truck Replacement Cost)	$2,980,500
Mobilization/Demobilization (5% of Subtotal)	1	Each	$149,025.02	$149,025.02
Taxes, Bonds, Insurance (3% of Subtotal)	1	Each	$89,415.01	$89,415.01
Traffic Control and Public Relations (2% of Subtotal)	1	Each	$59,610.01	$59,610.01
Construction Surveying (1% of Subtotal)	1	Each	$29,805.00	$29,805.00
Preparation of SWPPP (0.5% of Subtotal)	1	Each	$14,902.50	$14,902.50
			Subtotal	$3,323,258
			Design (10%)	$332,326
			Construction Administration (10%)	$332,326
			Contingency (20%)	$664,652
			Total*	**$4,652,561**

Present Value of Phase 1	**$ 4,652,561**

Alternative 2: Piped Sewer and Water, Phase 2

Item	Quantity	Type	Unit Price	Total Cost
Installation of Arctic Main	3200	LF	$250	$800,000
Removal of Water Main	0	LF	$50	$0
Highway Direct Bury Crossing	0	EA	$70,000	$0
Driveway Casing Crossing	1	EA	$3,000	$3,000
Hydrants	6	EA	$10,000	$60,000
Services (water and sewer)	40	EA	$25,000	$1,000,000
Easement Obstructions	7	EA	$10,000	$70,000
			Sub-total of Construction Costs	$1,933,000
Mobilization/Demobilization (5% of Subtotal)	1	Each	$96,650.00	$96,650.00
Taxes, Bonds, Insurance (3% of Subtotal)	1	Each	$57,990.00	$57,990.00
Traffic Control and Public Relations (2% of Subtotal)	1	Each	$38,660.00	$38,660.00
Construction Surveying (1% of Subtotal)	1	Each	$19,330.00	$19,330.00
Preparation of SWPPP (0.5% of Subtotal)	1	Each	$9,665.00	$9,665.00
			Subtotal	$2,155,295
			Design (10%)	$215,530
			Construction Administration (10%)	$215,530
			Contingency (20%)	$431,059
			Total	**$3,017,413**

Present Value of Phase 2	**$ 3,005,391**

Alternative 2: Piped Sewer and Water, Phase 3

Item	Quantity	Type	Unit Price	Total Cost
Installation of Arctic Main	6900	LF	$250	$1,725,000
Removal of Water Main	0	LF	$50	$0
Highway Direct Bury Crossing	3	EA	$70,000	$210,000
Hydrants	6	EA	$10,000	$60,000
Services (water and sewer)	35	EA	$25,000	$875,000
Driveway Casing Crossing	1	EA	$3,000	$3,000
Easement Obstructions	7	EA	$10,000	$70,000
			Sub-total of Construction Costs	$2,943,000
Mobilization/Demobilization (5% of Subtotal)	1	Each	$147,150.00	$147,150.00
Taxes, Bonds, Insurance (3% of Subtotal)	1	Each	$88,290.00	$88,290.00
Traffic Control and Public Relations (2% of Subtotal)	1	Each	$58,860.00	$58,860.00
Construction Surveying (1% of Subtotal)	1	Each	$29,430.00	$29,430.00
Preparation of SWPPP (0.5% of Subtotal)	1	Each	$14,715.00	$14,715.00
			Subtotal	$3,281,445
			Design (10%)	$328,145
			Construction Administration (10%)	$328,145
			Contingency (20%)	$656,289
			Total	**$4,594,023**

Present Value of Phase 3	**$ 4,557,490**

Total Capital Costs	**$ 12,263,997**
Total Present Value Capital Costs	**$ 12,215,443**

Total Present Value (include trucks)	**$ 13,715,443**

O&M Costs, Alternative 2

Alternative 2

Item	Annual Quantity (gallons)	Type	Unit Price	Total Annual Cost	Present Value
Water Haul Costs	12921000	Gallons	$62.04	$ 801,619	$ 2,385,745
Sewer Haul Costs	12921000	Gallons	$64.05	$ 827,590	$ 2,463,040
Water Piped Costs	12921000	Gallons	$26.18	$ 338,272	$ 7,025,688
Sewer Piped Costs	12921000	Gallons	$9.52	$ 123,008	$ 2,554,796
*Assuming 100 gallons per person per day, 3 people per parcel					
		Total Yearly O&M Costs	Annual O&M Years 1-3	**$ 1,629,209**	
			Annual O&M Years 4-25	**$ 461,280**	
				Total Present Value O&M Costs	**$ 14,429,269**

Total Present Value of O&M costs for Alt 2	**$ 14,429,269**

Capital Costs, Alternative 3

Alternative 3: Piped Sewer and Water- All Build

Item	Quantity	Type	Unit Price	Total Cost
Installation of Arctic Main	15600	LF	$250	$3,900,000
Highway Direct Bury Crossing	6	EA	$70,000	$420,000
Driveway Casing Crossing	3	EA	$3,000	$9,000
Hydrants	20	EA	$10,000	$200,000
Services (water and sewer)	118	EA	$25,000	$2,950,000
Easement Obstruction Clearance	20	EA	$10,000	$200,000
			Sub-total of Construction Costs	$7,679,000
Mobilization/Demobilization (5% of Subtotal)	1	Each	$383,950.00	$383,950.00
Taxes, Bonds, Insurance (3% of Subtotal)	1	Each	$230,370.00	$230,370.00
Traffic Control and Public Relations (2% of Subtotal)	1	Each	$153,580.00	$153,580.00
Construction Surveying (1% of Subtotal)	1	Each	$76,790.00	$76,790.00
Preparation of SWPPP (0.5% of Subtotal)	1	Each	$38,395.00	$38,395.00
			Subtotal	$8,562,085
			Design (10%)	$856,209
			Construction Administration (10%)	$856,209
			Contingency (20%)	$1,712,417
			Total	$11,986,919

Present Value	**$ 11,986,919**

Total Present Value (including trucks)	**$ 13,486,919**

O&M Costs, Alternative 3

Alternative 3

Item	Annual Quantity (gallons)	Type	Unit Price (Per 1,000 gallons)	Total Annual Cost	Present Value
Water Piped Costs	12921000	Gallons	$26.18	$ 338,272	$ 8,032,439
Sewer Piped Costs	12921000	Gallons	$9.52	$ 123,008	$ 2,920,887
*Assuming 100 gallons per person per day, 3 people per parcel			Total Yearly Capital Costs	**$ 461,280**	
				Total Present Value O&M Costs	**$ 10,953,326**

Total Present Value of O&M costs For Alt 3	**$ 10,953,326**

Project: City of Bethel Avenues Neighborhood Water and Sewer Improvements
Life Cycle Cost Analysis

Present Worth Analysis	Alt 1: No Build	Alt 2: Phased Piped Water and Sewer	Alt 3: Full Build-out Piped Water and Sewer
Capital Costs - Total =	$1,500,000	$13,715,443	$ 13,486,919
Annual O&M Cost=	$1,629,209	$461,280	$ 461,280
[1]25-Year Salvage/Book Value - Total =	$500,000	$500,000	$500,000
Present Worth of Salvage Value (.4%) =	$461,631.83	$461,631.83	$ 461,632
[2]Annual O&M Present Worth (.4%) =	$38,686,411	$14,429,269	$ 10,953,326
Total Present Worth Cost =	$39,724,779	$27,683,080	$ 23,978,613

Salvage value of trucks. In year 25, current trucks will be 10 years old, and have 5 years of life remaining.

Project: City of Bethel Avenues Neighborhood Water and Sewer Improvements
Design Criteria

General	
Design Period	25 years
Parcels	118
Population Per Parcel	3
Design Population	354
*Real Interest Rate	0.4%
Environmental Conditions	
Mean Temperature	29.1°F
Design High Temperature	90°F
Design Low Temperature	-48°F
Mean Annual Precipitation	16 inches
Mean Annual Snowfall	55 inches
Ground Snow Load	40 PSF
Basic Wind Speed	120 miles per hour
Water & Wastewater	
Water Usage Per Capita (gallons)	100
Design Daily Water Demand (gallons)	35400
Peak Factor	1.6
Peak Hourly Demand (gallons)	2360
Design Daily Wastewater Generation (gallons)	35400
Peak Hourly Wastewater Generation (gallons)	2360

*United States Office of Management and Budeget, A-94, Average of 20-year & 30-year Rates

Project: City of Bethel Avenues Neighborhood Water and Sewer Improvements
Revenue Projections

Revenue Projections	
Residents	118

Alternative 1

Service	Monthly Cost to Residents, First Year	Projected Yearly Revenue, First Year	Monthly Cost to Residents, Year 25	Projected Yearly Revenue, Year 25
*Hauled Water	$ 208.67	$ 295,477	$424.18	$600,639
*Hauled Sewer	$ 156.38	$ 221,434	$317.89	$450,132
Total Yearly Revenue, First Year		**$516,911**	**Total Yearly Revenue, Year 25**	**$1,050,771**

*1,000 gallon water and sewer tanks, filled/emptied once per week, Zone 1. 2018 rates

Alternative 2

Service	Monthly Cost to Residents, First Year	Projected Yearly Revenue, First Year	Monthly Cost to Residents, Year 3	Projected Yearly Revenue, Year 3	Monthly Cost to Residents, Year 4	Projected Yearly Revenue, Year 4	Monthly Cost to Residents, Year 25	Projected Yearly Revenue, Year 25
Piped Water	$208.67	$295,477	$221.38	$313,474	$192.44	$272,495	$358.00	$558,480
Piped Sewer	$156.38	$221,434	$165.90	$234,914	$54.48	$77,144	$101.36	$158,122
Total Yearly Revenue, First Year		**$516,911**	**Total Yearly Revenue, Year 3**	**$548,388**	**Total Yearly Revenue, Year 4**	**$349,639**	**Total Yearly Revenue, Year 25**	**$716,602**

*First three years customers are on the haul system. After construction, customers are on the piped system.

Alternative 3

Service	Monthly Cost to Residents, First Year	Projected Yearly Revenue, First Year	Monthly Cost to Residents, Year 25	Projected Yearly Revenue, Year 25
Piped Water	$176.11	$249,372	$358.00	$558,473
Piped Sewer	$49.86	$70,602	$101.36	$158,114
Total Yearly Revenue, First Year		**$319,974**	**Total Yearly Revenue, Year 25**	**$716,587**

Project: City of Bethel Avenues Neighborhood Water and Sewer Improvements
Equipment List for Public Works- Not Water and Sewer

Type	Make	Model	Vehicle Serial #
Flat Bed	Ford	F-350	2FDKF37H6CA54082
Pick-Up	Ford	F-250	1FTHF26H4PLA95309
Pick-Up	Ford	F-350	2FTHF36H7RCA27041
Flat bed Sander	Ford	F-350	2FDKF38GOKCA18676
Flat Bed Sander	Ford	F-350	2FDKF38G9KCA18675
Water Truck	Ford	F-600	F61DCU23214
Water Truck	Ford	LT 9000	1FTYU9OLINVA17132
Dump Truck	Ford	LN 8000	U81DVEH2292
Dump Truck	Ford	LN 8000	U80UVHG7957
Dump Truck	Ford	LN 8000	U80UVGD6299
Dump Truck	Ford	LN 9000	1FDYY90RICVA05693
Tilt Bed Trailer	Trail King	TKT20-2000	1TKCO2027LM067159
Tar Kettle	Cimline		1320320
Loader	Terex	L72-31	55398
Loader	Cat	950E	22Z05144
Loader	Cat	950 G	3JW02270
Loader	Cat	966 F	3XJ02208
Grader	Cat	160 M	CAT0160MJB9T00155
Grader	Cat	140 G	72V06760
Grader	Cat	163 H	OARL00311
Track-Loader-Backhoe	John Deere	450 B	122939T
Wheel-Loader-Backhoe	John Deere	310 D	T0310DG805852
Wheel-Loader-Backhoe	Cat	420 D	Cat 0420DCFDP12654
Excavator	Hitachi	200-H-3C	14F82741
Track Loader	Cat	953 B	5MK2728
Tractor	John Deere	350 C Wide Track	U4DJD350C
Tractor	Cat	D3C	4HJ00177
Tractor	Cat	D8N	9TC06237
Compactor	Ingersal Rand	SD100D	69405
Dump Truck	GMC	Top Kick	1GDT7HJ7TJ505134
Dump Truck	International	7400	1HTWGAAR16J342846
Dump Truck	International	7500	1HTWNAZR76J342845
Welder-Trailer	Miller	Miller 225 D	0337-209238
Compressor	Smith	Smith 200	200B256
Sander	Hi-Way Sander	F-2020-13-XT	10322
Pump-Trailer	CH&E	2806T	T00060018
Steamer	Sioux	200-GTT	O78154
Steamer	Sioux	400-2	O285131
Spreader	Epoke	TMK 10	140000379
Hydro-Mulcher	Bowie	1100 Skid	110293882
F-250 Pick up	Ford	F-250	1FTEF26 E7C RA19857
Spreader-Sander	Monroe	0042735-A	98-10-8285
Compactor-Pull	Hyster	PTA-5882	39220
Generator	Yamaha	EF3800	
Generator	Yamaha	EF6000	
Generator	Yamaha	EF6600DEY	7WW0220264
Generator	Dayton		
Generator	Robin	RGD3300	
Compactor-Hand	Bomag	P22R	2C0230

City of Bethel Sewer Department
Date: May 2018

Sewer Short Lived Assets

ASSET	Type/Size	Replacement Cost	Total Number	Total Value	Annual Reserve
		5 Year Replacements			
Lift Station Submersible Pumps	2hp	$2,500	78	$195,000	$39,000
Lift Station Submersible Pumps	3hp	$3,000	6	$18,000	$3,600
Lift Station Submersible Pumps	4hp	$3,600	4	$14,400	$2,880
Lift Station Submersible Pumps	8.5hp	$60,000	3	$180,000	$36,000
Lift Station Submersible Pumps	5hp	$9,000	3	$27,000	$5,400
Lift Station Submersible Pumps	14hp	$75,000	3	$225,000	$45,000
Lagoon Pump	5 MGD	$75,000	1	$75,000	$15,000
Public Works Computers		$2,000	2	$4,000	$800
Public Works Copiers, Printers		$1,000	1	$1,000	$200
		Total 5- Year Replacement Budget		**$739,400**	**$147,880**
		10 Year Replacements			
Lift Station Submersible Controls	Residential	$800	78	$62,400	$6,240
Lift Station Submersible Pumps	2hp	$2,500	78	$195,000	$19,500
Sewer Line Truck	Ford	$25,000	1	$25,000	$2,500
Glycol loop heat pumps	Various	$10,000	6	$60,000	$6,000
		Total 10- Year Replacement Budget		**$342,400**	**$34,240**
		15 Year Replacements			
Sewage Haul Trucks	Kenworth	$200,000	9	$1,800,000	$120,000
Lift Station Rails, Valves	Municipal	$15,000	8	$120,000	$8,000
Lagoon Divider	Curtain	$250,000	2	$500,000	$33,333
Lagoon Motor Boat	Generic	$10,000	1	$10,000	$667
Lift station Controls	Municipal	$60,000	8	$480,000	$32,000
		Total 15- Year Replacement Budget		**$2,910,000**	**$194,000**
		Total Annual Contribution to R&R Account			**$376,120**

City of Bethel Water Department
Date: May 2018

Water Short Lived Assets

ASSET	Type/Size	Replacement Cost	Total Number	Total Value	Annual Reserve
		5 Year Replacements			
Water Department Computers	Generic	$2,500	2	$5,000	$1,000
Copiers, Printers	Generic	$3,000	2	$6,000	$1,200
City Sub Computer and Monitoring		$3,600	1	$3,600	$720
Bethel Heights Computer and Monitoring		$2,500	1	$2,500	$500
Lab Equipment	Hach	$6,300	2	$12,600	$2,520
		Total 5- Year Replacement Budget		**$29,700**	**$5,940**
		10 Year Replacements			
City Sub Circulation Pumps	5hp	$4,000	4	$16,000	$1,600
City Sub Pressure Pumps	7.5hp	$4,000	4	$16,000	$1,600
Bethel Heights Circulation Pumps	5hp	$4,000	4	$16,000	$1,600
Bethel Heights Pressure Pumps	7.5hp	$4,000	4	$16,000	$1,600
High Demand Fire Pumps	125hp	$70,000	2	$140,000	$14,000
Water Department Truck	Ford	$25,000	1	$25,000	$2,500
Water System Meter		$3,000	60	$180,000	$18,000
Air Release Valves		$2,500	120	$300,000	$30,000
		Total 10- Year Replacement Budget		**$709,000**	**$70,900**
		15 Year Replacements			
Water Haul Trucks	Kenworth	$200,000	9	$1,800,000	$120,000
Glycol Heat Exhangers		$25,000	2	$50,000	$3,333
Bethel Heights Boilers	250,000BTU	$140,000	2	$280,000	$18,667
City Sub Boilers	250,000BTU	$140,000	2	$280,000	$18,667
Water System Controls	Municipal	$100,000	2	$200,000	$13,333
Well Submersible Pumps	40hp	$40,000	3	$120,000	$8,000
Hydrants	Mueller	$8,000	80	$640,000	$42,667
		Total 15- Year Replacement Budget		**$3,370,000**	**$224,667**
		Total Annual Contribution to R&R Account			**$301,507**

APPENDIX B

Piped Water and Sewer Alignment Alternatives

MEMORANDUM

TO:	Peter Williams, City of Bethel Robert Chambers, United States Department of Agriculture
FROM:	Chase Nelson, P.E., DOWL
DATE:	April 10th, 2018
SUBJECT:	The Avenues PER/EA Water and Sewer Main Alternatives, Second Proposal

The purpose of this project is to provide piped water and sewer mains for Bethel residents located in the area between 7th Avenue and 5th Avenue, commonly referred to as "The Avenues". Alternatives have been prepared for different water and sewer main alignments to serve the project area. All water main alternatives have been set up to provide constant circulation, and sewer main alternatives have been set up to work with combined or independent lift stations.

Preliminary analysis on five alternatives has been performed. The narrative descriptions are followed by figures and conceptual level costs estimates.

Alternative 1

Phase 1:
The proposed water main will tie in to the existing water main near the Youth Center on Osage Street. It will then follow the existing sewer main northeast and cross Ridgecrest Drive. The water main will then continue north along Ridgecrest Drive to the easement located between 6th and 7th Avenue, and follow the easement to Willow Street. The water main will then head south to cross 6th Ave to follow Willow Street until it reaches the easement between 5th Avenue and 6th Avenue. The water main then follows the easement west to Ridgecrest Drive, at which point it follows Ridgecrest Drive northwest to cross Ridgecrest Drive, and then follow the existing main path to tie in to the existing water main near the Youth Center on Osage Street.

The proposed sewer main will branch off from the existing sewer main that runs perpendicular to the easement located between 6th and 7th Avenue to extend east to Ridgecrest Drive and west to Willow Street.

Phase 2:
The water and sewer mains in the easement between 6th and 7th Avenue will cross Willow Street and continue along the easement until Main Street.

The water main will then continue southeast to cross 6th Avenue, and then run southwest along the easement between 5th and 6th Avenue to cross Willow Street and connect with the water main constructed in *Phase 1*.

The section of water main installed in *Phase 1* that runs north and south between the easement between 6th and 7th Avenue and the easement between 5th and 6th Avenue will be abandoned.

Phase 3:
The proposed water main will tie in to the main constructed in *Phase 2* at the intersection of the easement between 5th and 6th Avenue, and Main Street. The main will travel south to cross 5th Avenue, 4th Avenue, and then travel southwest along the full extent of the easement between 3th and 4th Avenue until Willow Street. It will then travel north to cross 4th Avenue until the intersection of 5th Avenue and Willow Street. The main will then travel northeast along the

southern side of 5th Avenue until Main Street, at which point it will cross 5th Avenue to tie in to the main constructed in *Phase 2.*

The proposed sewer main will tie in to the existing Kilbuck Lift Station and travel south to cross 4th Avenue to turn southwest to travel the full extent of the easement between 3th and 4th Avenue. Another proposed sewer main will tie in to the existing sewer main near Kilbuck Lift Station, and travel southwest along 5th Avenue until Willow Street.

Advantages of Alternative 1

- Second cheapest Alternative.
- Cheapest cost per parcel Alternative.
- Fewer roadside mains allow for less potential vehicular damage.
- Relatively cheap *Phase I* cost.

Disadvantages of Alternative 1

- Serves the second fewest parcels
- Poor future development potential along the west side of Ridgecrest Drive.
- Requires long services for parcels located along the north side of 4th Avenue.

Alternative 2

Phase 1:
The proposed water main will tie in to the existing water main near the Youth Center on Osage Street. It will then follow the existing sewer main northeast and cross Ridgecrest Drive. The water main will then continue north along Ridgecrest Drive to the easement located between 6th and 7th Avenue, and follow the easement to Willow Street. The water main will then head south to cross 6th Ave to follow Willow Street until it reaches the easement between 5th Avenue and 6th Avenue. The water main then follows the easement west to Ridgecrest Drive, at which point it follows Ridgecrest Drive northwest to cross Ridgecrest Drive, and then follow the existing main path to tie in to the existing water main near the Youth Center on Osage Street.

The proposed sewer main will branch off from the existing sewer main that runs perpendicular to the easement located between 6th and 7th Avenue to extend east to Ridgecrest Drive and west to Willow Street.

Phase 2:
The water and sewer mains in the easement between 6th and 7th Avenue will cross Willow Street and continue along the easement until Main Street.

The water main will then continue southeast to cross 6th Avenue, and then run southwest along the easement between 5th and 6th Avenue to cross Willow Street and connect with the water main constructed in *Phase 1*.

The section of water main installed in *Phase 1* that runs north and south between the easement between 6th and 7th Avenue and the easement between 5th and 6th Avenue will be abandoned.

Phase 3:
The proposed water main will tie in to the main constructed in *Phase 1* at the point at which the easement between 5th and 6th Avenue intersects with Ridgecrest Drive. The main will then extend southeast to Willow Street, at which point it will travel north and cross Willow Street to travel along the northern side of 4th Avenue until Main Street. It will then cross 4th Avenue and to

travel southwest through the easement between 3rd Avenue and 4th Avenue to cross Ridgcrest Drive. The main will then travel north along Ridgecrest Drive to tie in to the water main constructed in *Phase 1.*

The water main constructed in Phase 1 of intersection of Ridgecrest Drive and the easement between 5th Avenue and 6th Avenue to the point where the proposed water main tied into the main constructed in *Phase 1* at the point at which the easement between 5th and 6th Avenue intersects with Ridgecrest Drive will be abandoned.

The proposed sewer main will extend from Kilbuck Lift Station south until 4th Avenue. From that point it will split. One branch will extend along the north side of 4rth Avenue until Willow Street. The other branch will extend southeast to cross 4th Avenue and then turn southwest to travel the full extend of the easement between 3rd Avenue and 4th Avenue to cross Ridgecrest Drive. From that point, the main will travel northwest along Ridgecrest Drive to reach the last parcel on the western side of the road.

Advantages of Alternative 2

- Relatively cheap *Phase I* cost.

Disadvantages of Alternative 2

- Would require long services for parcels along the south side of 5th Avenue.
- More roadside mains allow for greater potential vehicular damage.

Alternative 3

Phase 1:
The proposed water main will tie in to the existing water main near the Youth Center on Osage Street. It will then follow the existing sewer main northeast and cross Ridgecrest Drive. The water main will then continue north along Ridgecrest Drive to the easement located between 6th and 7th Avenue, and follow the easement to Willow Street. The water main will then head south to cross 6th Ave to follow Willow Street until it reaches the easement between 5th Avenue and 6th Avenue. The water main then follows the easement west to Ridgecrest Drive. The proposed sewer main will tie in to the existing sewer main at that location, and the water and sewer mains will cross Ridgecrest Drive. The mains will travel southeast along Ridgecrest Drive to intersection with Willow Street. The mains will then travel southwest for approximately 300 feet, at which point the sewer main ends and the water main travels along Arthur Dull Lake to tie in to the existing water main that provides service to that area.

The proposed sewer main will branch off from the existing sewer main that runs perpendicular to the easement located between 6th and 7th Avenue to extend east to Ridgecrest Drive and west to Willow Street.

Phase 2:
The water and sewer mains in the easement between 6th and 7th Avenue will cross Willow Street and continue along the easement until Main Street.

The water main will then continue southeast to cross 6th Avenue, and then run southwest along the easement between 5th and 6th Avenue to cross Willow Street and connect with the water main constructed in *Phase 1*.

The section of water main installed in *Phase 1* that runs north and south between the easement between 6th and 7th Avenue and the easement between 5th and 6th Avenue will be abandoned.

Phase 3:
The proposed water main will tie in to the main constructed in *Phase 1* at the point near the intersection of Ridgecrest Drive and Willow Street at which the main diverts from the road to connect to the existing main. They will then travel south, cross Ridgcrest Drive, extend northeast the full extent of the easement between 4th Avenue and 5th Avenue until Main Street. The mains will then travel northwest to cross 4th Avenue, and then extend southwest along the northern side of 4th Avenue until Willow Street. The water main will cross Willow street, and then travel south to cross Ridgecrest Drive to tie in to the main constructed in *Phase 1*.

Advantages of Alternative 3

- Relatively cheap cost per parcel.

Disadvantages of Alternative 3

- Would require long services for parcels along the south side of 5th Avenue.
- More roadside mains allow for greater potential vehicular damage.

Alternative 4

Phase 1:
The proposed water main will tie in to the existing water main near the Youth Center on Osage Street. It will then follow the existing sewer main northeast and cross Ridgecrest Drive. The water main will then continue north along Ridgecrest Drive to the easement located between 6th and 7th Avenue, and follow the easement to Willow Street. The water main will then head south to cross 6th Ave to follow Willow Street until it reaches the easement between 5th Avenue and 6th Avenue. The water main then follows the easement west to Ridgecrest Drive. The proposed sewer main will tie in to the existing sewer main at that location, and the water and sewer mains will cross Ridgecrest Drive. The mains will travel southeast along Ridgecrest Drive to intersection with Willow Street. The mains will then travel southwest for approximately 300 feet, at which point the sewer main ends and the water main travels along Arthur Dull Lake to tie in to the existing water main that provides service to that area.

The proposed sewer main will branch off from the existing sewer main that runs perpendicular to the easement located between 6th and 7th Avenue to extend east to Ridgecrest Drive and west to Willow Street.

Phase 2:
The water and sewer mains in the easement between 6th and 7th Avenue will cross Willow Street and continue along the easement until Main Street.

The water main will then continue southeast to cross 6th Avenue, and then run southwest along the easement between 5th and 6th Avenue to cross Willow Street and connect with the water main constructed in *Phase 1*.

The section of water main installed in *Phase 1* that runs north and south between the easement between 6th and 7th Avenue and the easement between 5th and 6th Avenue will be abandoned.

Phase 3:

The proposed water main will tie in to the main constructed in *Phase 1* at the point near the intersection of Ridgecrest Drive and Willow Street at which the main diverts from the road to connect to the existing main. It will then travel northeast to cross Ridgecrest Drive and follow Willow Street north until it crosses Willow Street to extend northeast along the southern side of 5th Avenue until it reaches Main Street. The main then travels southeast to extend along the northern side of 4th Avenue until Willow Street. It then travels south until it reaches the easement between 3rd Avenue and 4th Avenue. It travels northeast along the extend of the easement until it reaches Main Street, at which point it travels southeast to cross 3rd Avenue, and then southwest along the southern side of 3rd Avenue until it crosses Willow Street and ties in to the water main that was constructed in *Phase 1*.

The main constructed in *Phase 1* from the point of tie-in until north to Ridgecrest Drive will be abandoned.

The proposed sewer shall tie in to the Kilbuck Lift Station and follow the proposed water main as it travels along the northern side of 4th Avenue, the easement between 3rd Avenue and 4th Avenue, and ends at the last parcel on the southern side of 3rd Avenue. Another proposed sewer main will tie in to the existing sewer main near Kilbuck Lift Station and will extend southwest along the southern side of 5th Avenue.

Advantages of Alternative 4

- Requires shorter service lines to parcels between 4th Avenue and 5th Avenue.
- Serves the largest number of parcels.

Disadvantages of Alternative 4

- Most expensive Alternative.
- Most expensive cost per parcel Alternative.
- More roadside mains allow for potential vehicular damage.

Alternative 5

Phase 1:
The proposed water main will tie in to the existing water main near the Youth Center on Osage Street. It will then follow the existing sewer main northeast and cross Ridgecrest Drive. The water main will then continue north along Ridgecrest Drive to the easement located between 6th and 7th Avenue, and follow the easement to Willow Street. The water main will then head south to cross 6th Avenue to follow Willow Street to cross Ridgcrest Drive, and then travel southwest along Arthur Dull Lake to tie in to the existing water main that provides service to that area.

The proposed sewer main will branch off from the existing sewer main that runs perpendicular to the easement located between 6th and 7th Avenue to extend east to Ridgecrest Drive and west to Willow Street.

Phase 2:
The water and sewer mains in the easement between 6th and 7th Avenue will cross Willow Street and continue along the easement until Main Street.

The water main will then continue southeast to cross 6th Avenue, and then run southwest along the easement between 5th and 6th Avenue to cross Willow Street and connect with the water main constructed in *Phase 1*.

The section of water main installed in *Phase 1* that runs north and south between the easement between 6th and 7th Avenue and the easement between 5th and 6th Avenue will be abandoned.

Phase 3:
The proposed water main will tie in to the main constructed in *Phase 1* at the point near the intersection of Ridgecrest Drive and Willow Street at which the main diverts from the road to connect to the existing main. It will then travel south and cross Ridgecrest Drive to extend northeast through the easement between 3rd Avenue and 4th Avenue until it reaches Main Street. It will then travel northwest to cross 4th Avenue and travel the northern side of 4th Avenue until it crosses Willow Street to ties in to the water main that was constructed in *Phase 1*.

The main constructed in *Phase 1* from the point of tie-in until south to cross Ridgecrest Drive will be abandoned.

The proposed sewer main will tie in to Kilbuck Lift Station and travel south to cross 4th Avenue until it reaches the easement located between 3rd Avenue and 4th Avenue. Two branches will extend from that alignment. One branch will travel along the northern side of 4th Avenue to cross Willow Street, head southwest to cross Ridgecrest Drive, and then follow the water main that was constructed in *Phase 1* for approximately 300 feet. The other sewer main branch will extend along the easement between 3rd Avenue and 4th Avenue.

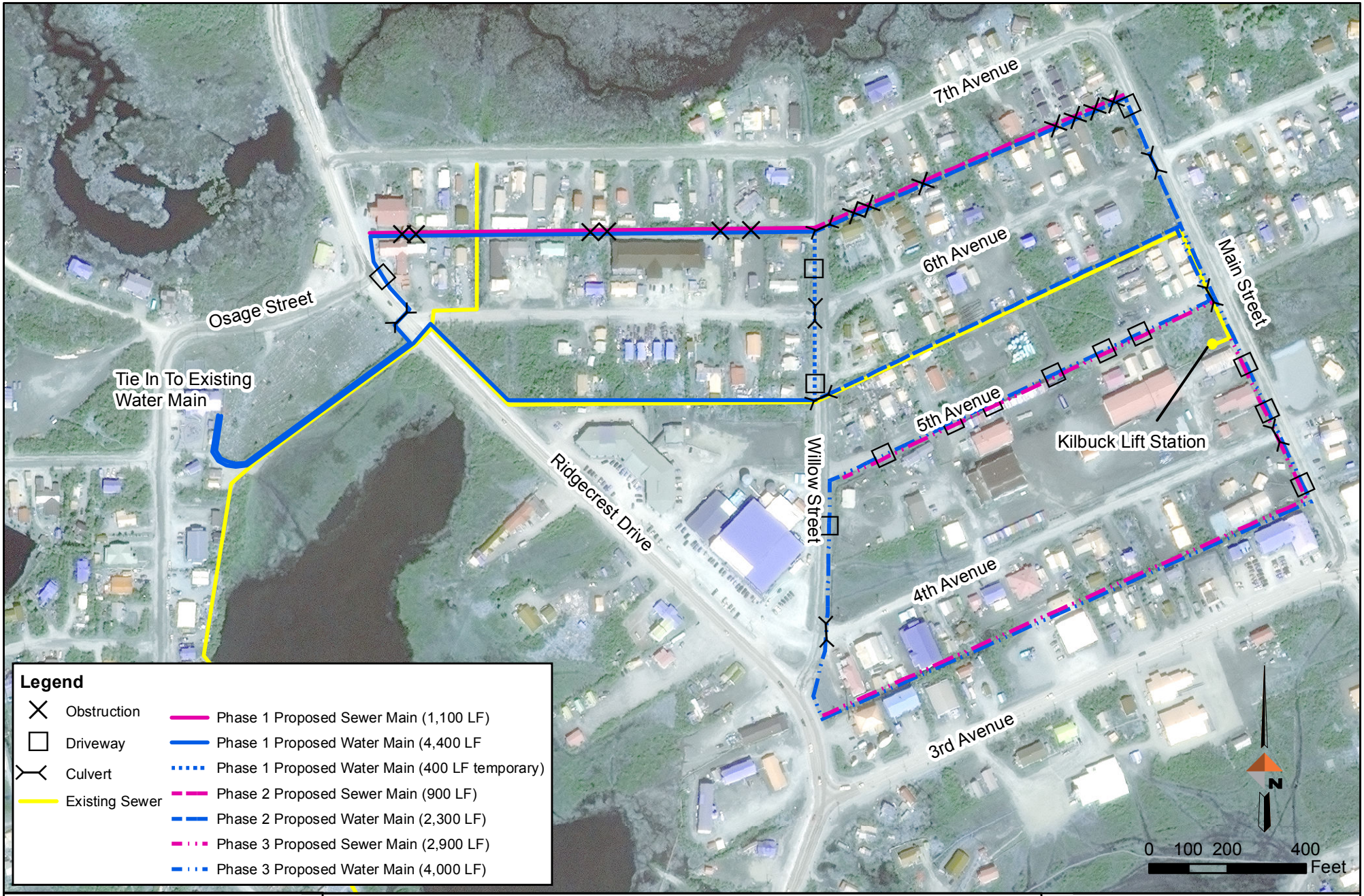
Advantages of Alternative 5

- Cheapest cost Alternative.
- Relatively cheap cost per parcel.
- Fewer roadside mains allow for less potential vehicular damage.

Disadvantages of Alternative 5

- Poor future development potential along the west side of Ridgecrest Drive.

Proposed Alternatives Figures



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Proposed Water & Sewer Mains, Alternative 1
The Avenues Neighborhood Water & Sewer
Bethel, Alaska

PROJECT	1529.50118.01
DATE	Apr 10, 2018

Alternative for CIP #1

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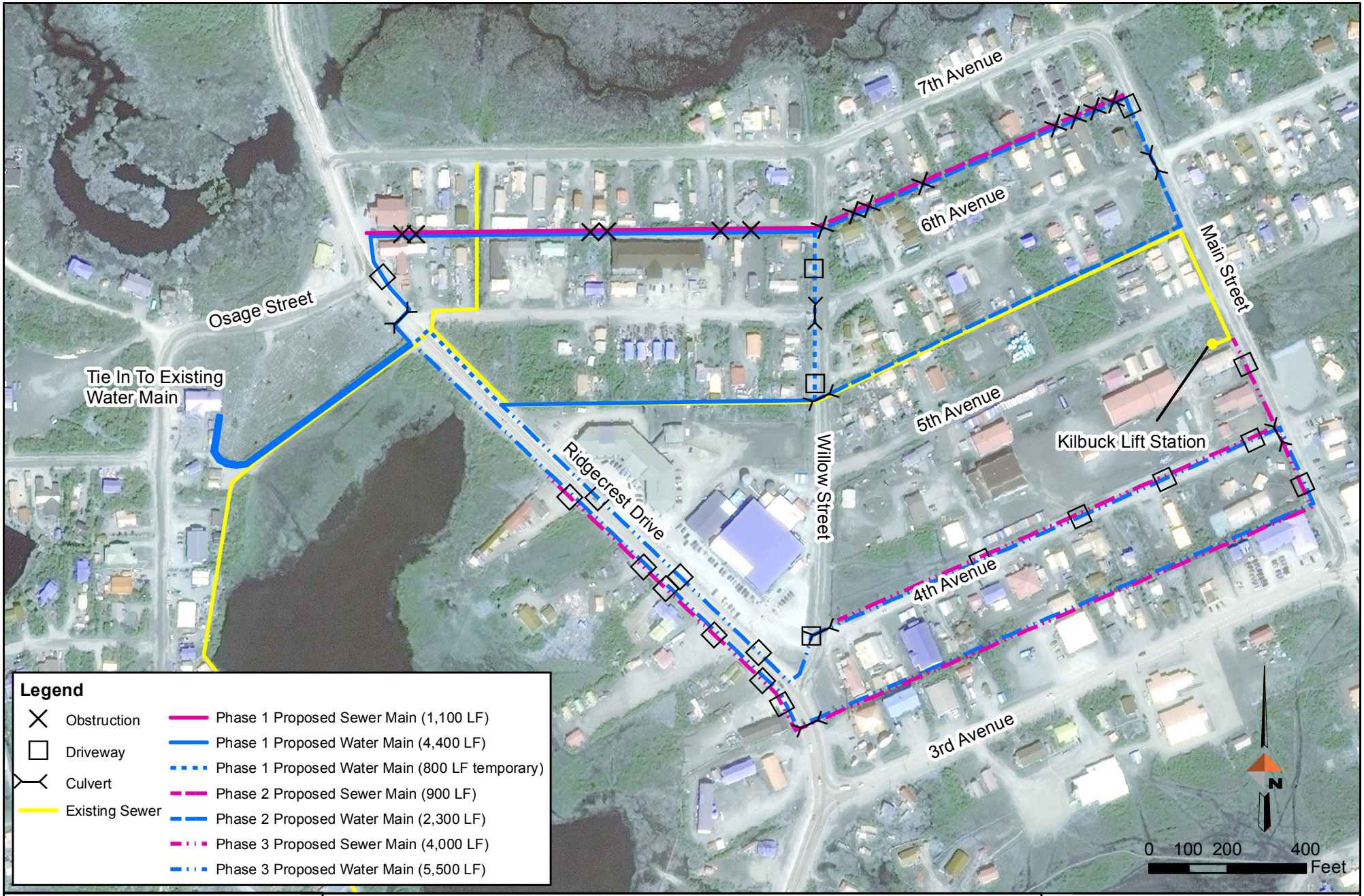

DOWL
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Proposed Water & Sewer Mains, Alternative 2
The Avenues Neighborhood Water & Sewer
Bethel, Alaska

PROJECT	1529.50118.01
DATE	Apr 10, 2018

Alternative for CIP #2

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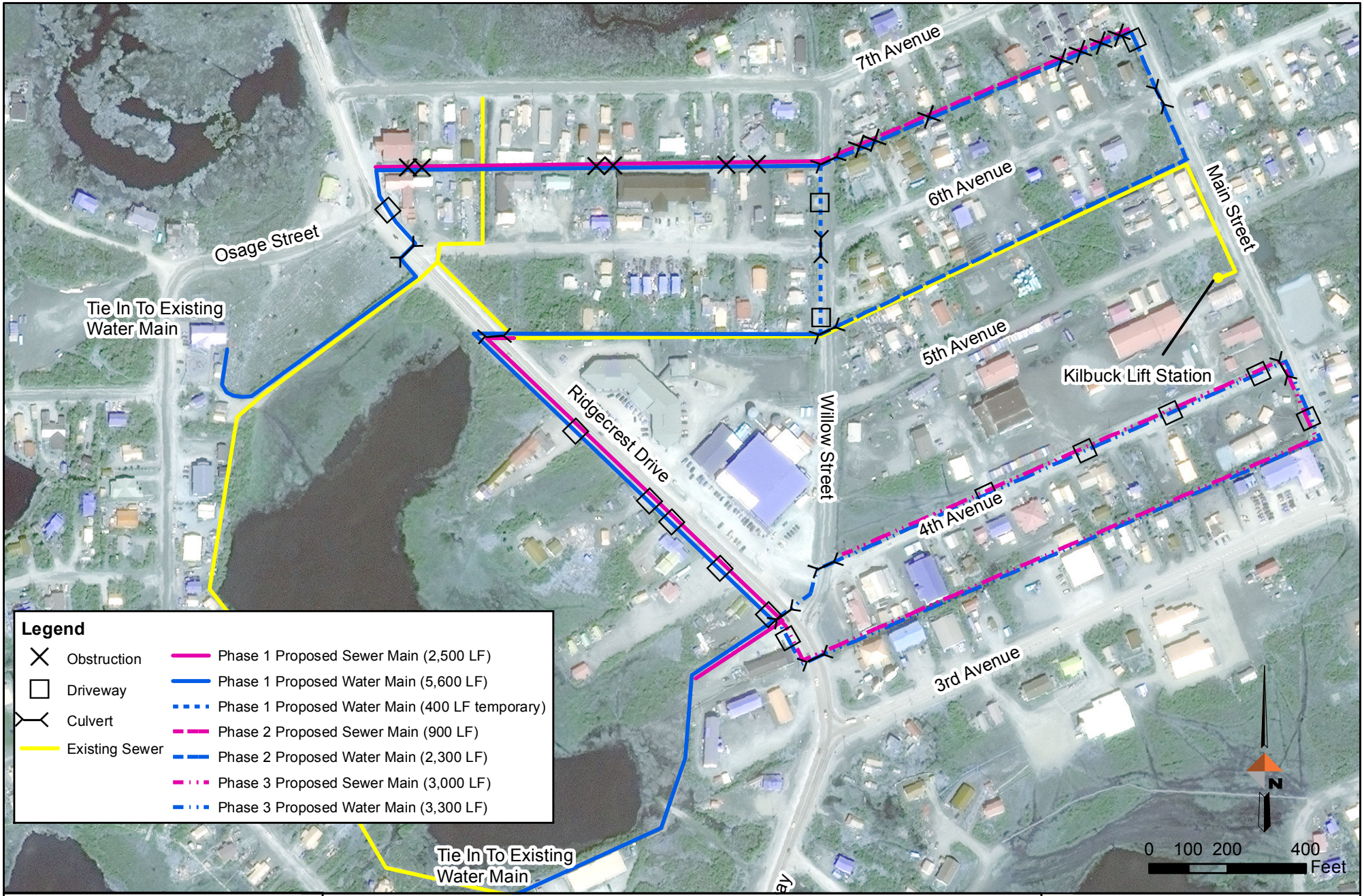

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Proposed Water & Sewer Mains, Alternative 3
The Avenues Neighborhood Water & Sewer
Bethel, Alaska

PROJECT	1529.50118.01
DATE	Apr 10, 2018

Alternative for CIP #3

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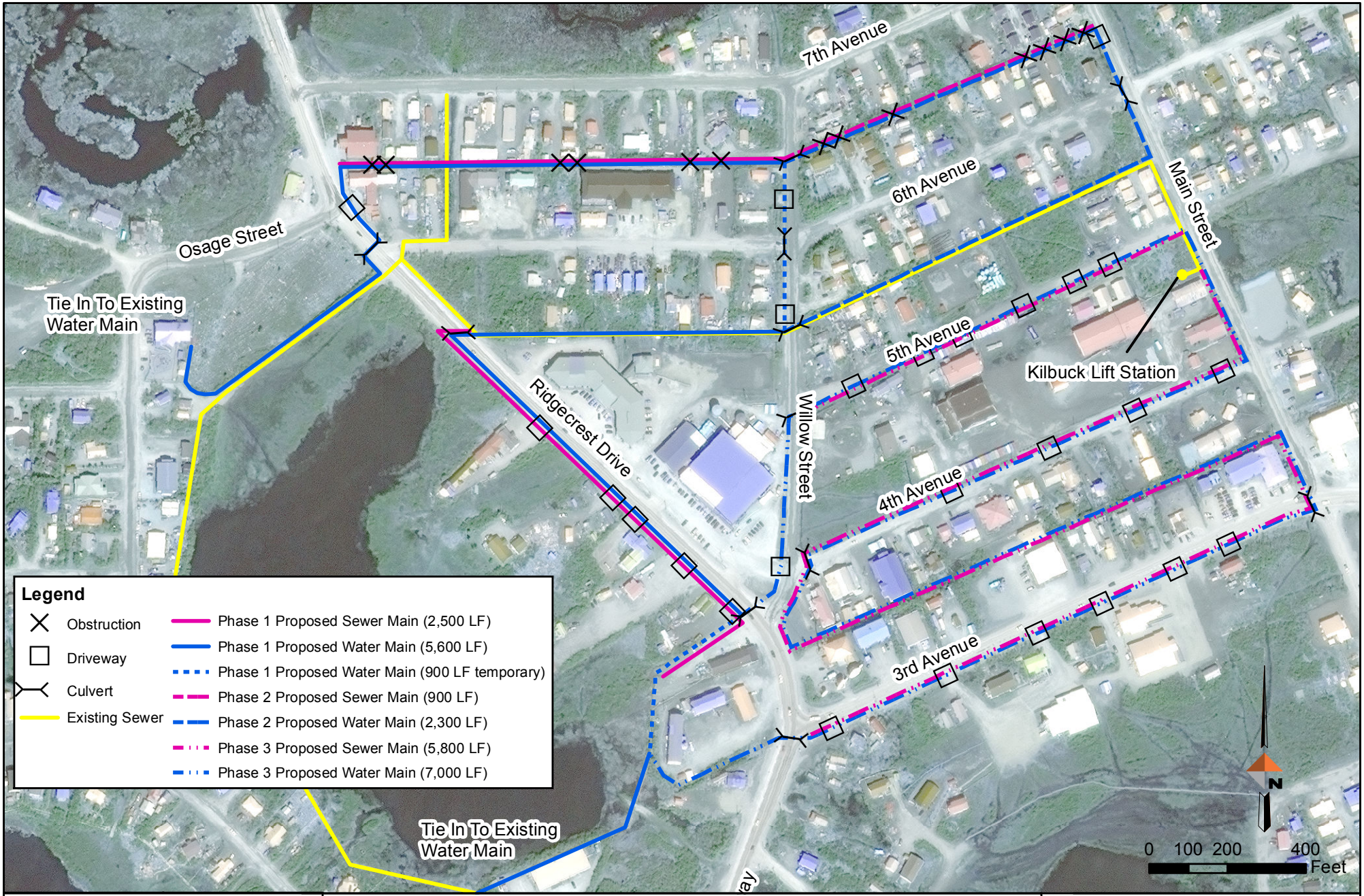

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Proposed Water & Sewer Mains, Alternative 4
The Avenues Neighborhood Water & Sewer
Bethel, Alaska

PROJECT	1529.50118.01
DATE	Apr 10, 2018

Alternative for CIP #4

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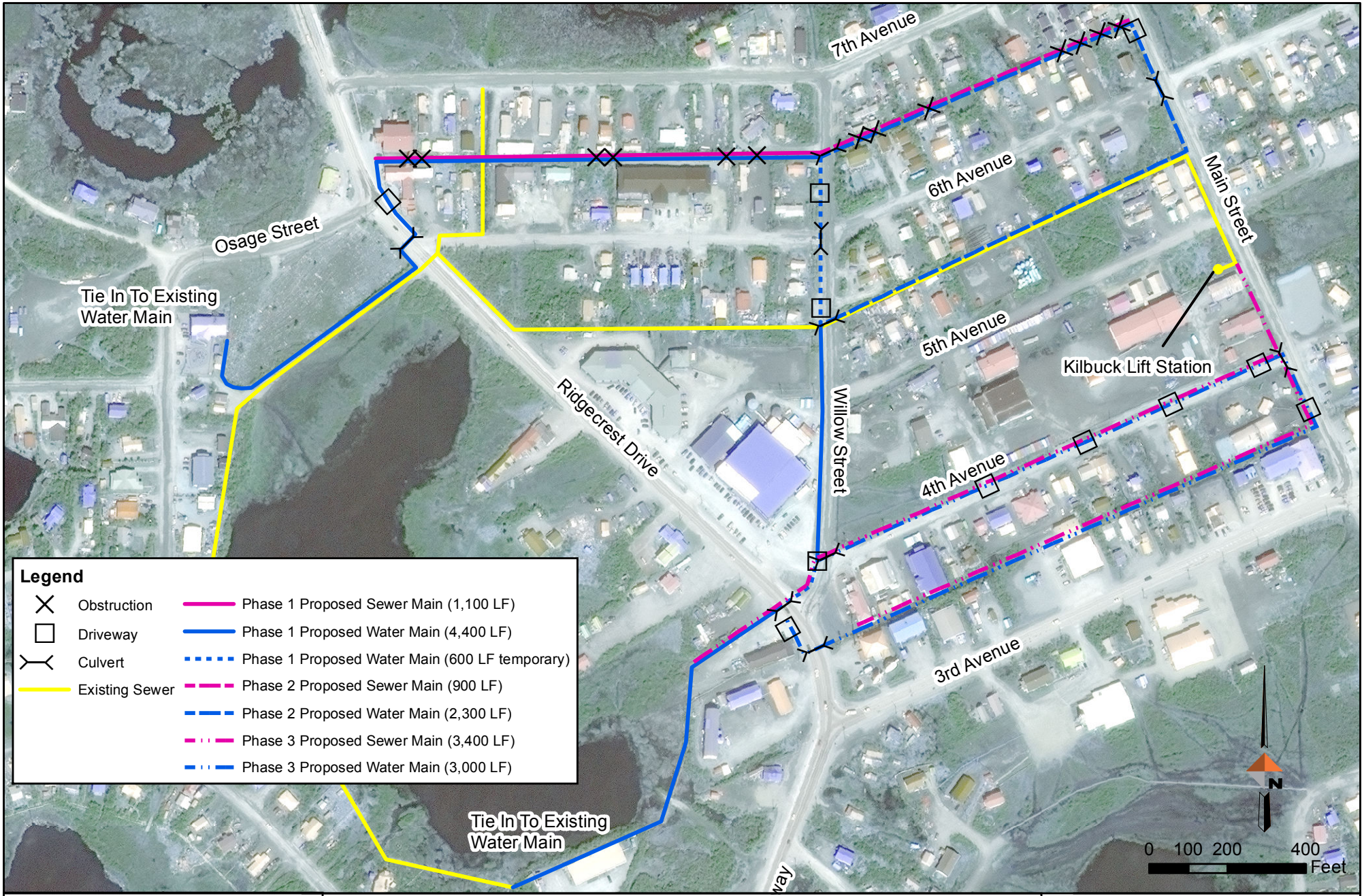

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Proposed Water & Sewer Mains, Alternative 5
The Avenues Neighborhood Water & Sewer
Bethel, Alaska

PROJECT	1529.50118.01
DATE	Apr 10, 2018

Alternative for CIP #5

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Cost Estimate Summary

Cost Estimate Summary						
Alternative/Phase	Cost	Costs (Total)	Parcels Serviced	Parcels (Total)	Cost Per Parcel	Cost Per Parcel (Total)
Alternative 1						
Phase 1	$ 3,340,000		38		$ 88,000	
Phase 2	$ 2,050,000	$ 9,440,000	34	118	$ 60,000	$ 80,000
Phase 3	$ 4,050,000		46		$ 88,000	
Alternative 2						
Phase 1	$ 3,360,000		38		$ 88,000	
Phase 2	$ 2,050,000	$ 10,950,000	34	131	$ 60,000	$ 84,000
Phase 3	$ 5,540,000		59		$ 94,000	
Alternative 3						
Phase 1	$ 4,820,000		51		$ 95,000	
Phase 2	$ 2,050,000	$ 10,620,000	34	131	$ 60,000	$ 81,000
Phase 3	$ 3,750,000		46		$ 82,000	
Alternative 4						
Phase 1	$ 4,840,000		51		$ 95,000	
Phase 2	$ 2,050,000	$ 14,370,000	34	134	$ 60,000	$ 107,000
Phase 3	$ 7,480,000		49		$ 153,000	
Alternative 5						
Phase 1	$ 3,450,000		31		$ 111,000	
Phase 2	$ 2,050,000	$ 9,290,000	34	114	$ 60,000	$ 81,000
Phase 3	$ 3,790,000		49		$ 77,000	

Cost Estimate Calculations

Alternative 1, Phase 1					
Bid Item	**Description**	**Quantity**	**Type**	**Unit Price**	**Total Cost**
1	Mobilization	1	LS	$173,275	$173,275
2	Construction surveying	1	LS	$69,310	$69,310
3	Installation of Arctic Main	5,583	LF	$350	$1,953,959
4	Removal of Water Main	430	LF	$50	$21,500
5	Highway Direct Bury Crossing	2	EA	$50,000	$100,000
6	Driveway Casing Crossing	3	EA	$3,000	$9,000
7	Easement Obstructions	6	EA	$10,000	$60,000
				Subtotal	$2,387,044
				Design (10% Subtotal)	$238,704.43
				Construction Administration (10%)	$238,704.43
				Contingency (20%)	$477,408.87
				Total	**$3,341,862**

Alternative 1, Phase 2					
Bid Item	**Description**	**Quantity**	**Type**	**Unit Price**	**Total Cost**
1	Mobilization	1	LS	$109,215	$109,215
2	Construction surveying	1	LS	$43,686	$43,686
3	Installation of Arctic Main	3,110	LF	$350	$1,088,464
4	Removal of Water Main	0	LF	$50	$0
5	Highway Direct Bury Crossing	3	EA	$50,000	$150,000
6	Driveway Casing Crossing	1	EA	$3,000	$3,000
7	Easement Obstructions	7	EA	$10,000	$70,000
				Subtotal	$1,464,365
				Design (10% Subtotal)	$146,436.47
				Construction Administration (10%)	$146,436.47
				Contingency (20%)	$292,872.94
				Total	**$2,050,111**

Alternative 1, Phase 3					
Bid Item	**Description**	**Quantity**	**Type**	**Unit Price**	**Total Cost**
1	Mobilization	1	LS	$217,282	$217,282
2	Construction surveying	1	LS	$86,913	$86,913
3	Installation of Arctic Main	6,883	LF	$350	$2,409,086
4	Removal of Water Main	0	LF	$50	$0
5	Highway Direct Bury Crossing	3	EA	$50,000	$150,000
6	Driveway Casing Crossing	10	EA	$3,000	$30,000
7	Easement Obstructions	0	EA	$10,000	$0
				Subtotal	$2,893,281
				Design (10% Subtotal)	$289,328.15
				Construction Administration (10%)	$289,328.15
				Contingency (20%)	$578,656.29
				Total	**$4,050,594**

Alternative 2, Phase 1					
Bid Item	**Description**	**Quantity**	**Type**	**Unit Price**	**Total Cost**
1	Mobilization	1	LS	$173,275	$173,275
2	Construction surveying	1	LS	$69,310	$69,310
3	Installation of Arctic Main	5,581	LF	$350	$1,953,330
4	Removal of Water Main	752	LF	$50	$37,603
5	Highway Direct Bury Crossing	2	EA	$50,000	$100,000
6	Driveway Casing Crossing	3	EA	$3,000	$9,000
7	Easement Obstructions	6	EA	$10,000	$60,000
				Subtotal	$2,402,518
				Design (10% Subtotal)	$240,251.80
				Construction Administration (10%)	$240,251.80
				Contingency (20%)	$480,503.61
				Total	**$3,363,525**

Alternative 2, Phase 2					
Bid Item	**Description**	**Quantity**	**Type**	**Unit Price**	**Total Cost**
1	Mobilization	1	LS	$109,215	$109,215
2	Construction surveying	1	LS	$43,686	$43,686
3	Installation of Arctic Main	3,110	LF	$350	$1,088,464
4	Removal of Water Main	0	LF	$50	$0
5	Highway Direct Bury Crossing	3	EA	$50,000	$150,000
6	Driveway Casing Crossing	1	EA	$3,000	$3,000
7	Easement Obstructions	7	EA	$10,000	$70,000
				Subtotal	$1,464,365
				Design (10% Subtotal)	$146,436.47
				Construction Administration (10%)	$146,436.47
				Contingency (20%)	$292,872.94
				Total	**$2,050,111**

Alternative 2, Phase 3					
Bid Item	**Description**	**Quantity**	**Type**	**Unit Price**	**Total Cost**
1	Mobilization	1	LS	$303,297	$303,297
2	Construction surveying	1	LS	$121,319	$121,319
3	Installation of Arctic Main	9,523	LF	$350	$3,333,033
4	Removal of Water Main	0	LF	$50	$0
5	Highway Direct Bury Crossing	3	EA	$50,000	$150,000
6	Driveway Casing Crossing	16	EA	$3,000	$48,000
7	Easement Obstructions	0	EA	$10,000	$0
				Subtotal	$3,955,649
				Design (10% Subtotal)	$395,564.88
				Construction Administration (10%)	$395,564.88
				Contingency (20%)	$791,129.76
				Total	**$5,537,908**

Alternative 3, Phase 1					
Bid Item	**Description**	**Quantity**	**Type**	**Unit Price**	**Total Cost**
1	Mobilization	1	LS	$246,913	$246,913
2	Construction surveying	1	LS	$98,765	$98,765
3	Installation of Arctic Main	8,126	LF	$350	$2,843,970
4	Removal of Water Main	430	LF	$50	$21,500
5	Highway Direct Bury Crossing	3	EA	$50,000	$150,000
6	Driveway Casing Crossing	8	EA	$3,000	$24,000
7	Easement Obstructions	6	EA	$10,000	$60,000
				Subtotal	$3,445,149
				Design (10% Subtotal)	$344,514.87
				Construction Administration (10%)	$344,514.87
				Contingency (20%)	$689,029.73
				Total	**$4,823,208**

Alternative 3, Phase 2					
Bid Item	**Description**	**Quantity**	**Type**	**Unit Price**	**Total Cost**
1	Mobilization	1	LS	$109,215	$109,215
2	Construction surveying	1	LS	$43,686	$43,686
3	Installation of Arctic Main	3,110	LF	$350	$1,088,464
4	Removal of Water Main	0	LF	$50	$0
5	Highway Direct Bury Crossing	3	EA	$50,000	$150,000
6	Driveway Casing Crossing	1	EA	$3,000	$3,000
7	Easement Obstructions	7	EA	$10,000	$70,000
				Subtotal	$1,464,365
				Design (10% Subtotal)	$146,436.47
				Construction Administration (10%)	$146,436.47
				Contingency (20%)	$292,872.94
				Total	**$2,050,111**

Alternative 3, Phase 3					
Bid Item	**Description**	**Quantity**	**Type**	**Unit Price**	**Total Cost**
1	Mobilization	1	LS	$191,606	$191,606
2	Construction surveying	1	LS	$76,642	$76,642
3	Installation of Arctic Main	6,255	LF	$350	$2,189,412
4	Removal of Water Main	0	LF	$50	$0
5	Highway Direct Bury Crossing	4	EA	$50,000	$200,000
6	Driveway Casing Crossing	6	EA	$3,000	$18,000
7	Easement Obstructions	0	EA	$10,000	$0
				Subtotal	$2,675,660
				Design (10% Subtotal)	$267,566.01
				Construction Administration (10%)	$267,566.01
				Contingency (20%)	$535,132.03
				Total	**$3,745,924**

Alternative 4, Phase 1					
Bid Item	**Description**	**Quantity**	**Type**	**Unit Price**	**Total Cost**
1	Mobilization	1	LS	$246,913	$246,913
2	Construction surveying	1	LS	$98,765	$98,765
3	Installation of Arctic Main	8,102	LF	$350	$2,835,833
4	Removal of Water Main	900	LF	$50	$45,014
5	Highway Direct Bury Crossing	3	EA	$50,000	$150,000
6	Driveway Casing Crossing	8	EA	$3,000	$24,000
7	Easement Obstructions	6	EA	$10,000	$60,000
				Subtotal	$3,460,525
				Design (10% Subtotal)	$346,052.49
				Construction Administration (10%)	$346,052.49
				Contingency (20%)	$692,104.97
				Total	**$4,844,735**

Alternative 4, Phase 2					
Bid Item	**Description**	**Quantity**	**Type**	**Unit Price**	**Total Cost**
1	Mobilization	1	LS	$109,215	$109,215
2	Construction surveying	1	LS	$43,686	$43,686
3	Installation of Arctic Main	3,110	LF	$350	$1,088,464
4	Removal of Water Main	0	LF	$50	$0
5	Highway Direct Bury Crossing	3	EA	$50,000	$150,000
6	Driveway Casing Crossing	1	EA	$3,000	$3,000
7	Easement Obstructions	7	EA	$10,000	$70,000
				Subtotal	$1,464,365
				Design (10% Subtotal)	$146,436.47
				Construction Administration (10%)	$146,436.47
				Contingency (20%)	$292,872.94
				Total	**$2,050,111**

Alternative 4, Phase 3					
Bid Item	**Description**	**Quantity**	**Type**	**Unit Price**	**Total Cost**
1	Mobilization	1	LS	$412,714	$412,714
2	Construction surveying	1	LS	$165,085	$165,085
3	Installation of Arctic Main	12,751	LF	$350	$4,462,683
4	Removal of Water Main	0	LF	$50	$0
5	Highway Direct Bury Crossing	5	EA	$50,000	$250,000
6	Driveway Casing Crossing	17	EA	$3,000	$51,000
7	Easement Obstructions	0	EA	$10,000	$0
				Subtotal	$5,341,482
				Design (10% Subtotal)	$534,148.17
				Construction Administration (10%)	$534,148.17
				Contingency (20%)	$1,068,296.33
				Total	**$7,478,074**

Alternative 5, Phase 1					
Bid Item	**Description**	**Quantity**	**Type**	**Unit Price**	**Total Cost**
1	Mobilization	1	LS	$182,996	$182,996
2	Construction surveying	1	LS	$73,198	$73,198
3	Installation of Arctic Main	5,582	LF	$350	$1,953,808
4	Removal of Water Main	588	LF	$50	$29,384
5	Highway Direct Bury Crossing	3	EA	$50,000	$150,000
6	Driveway Casing Crossing	4	EA	$3,000	$12,000
7	Easement Obstructions	6	EA	$10,000	$60,000
				Subtotal	$2,461,386
				Design (10% Subtotal)	$246,138.60
				Construction Administration (10%)	$246,138.60
				Contingency (20%)	$492,277.19
				Total	**$3,445,940**

Alternative 5, Phase 2					
Bid Item	**Description**	**Quantity**	**Type**	**Unit Price**	**Total Cost**
1	Mobilization	1	LS	$109,215	$109,215
2	Construction surveying	1	LS	$43,686	$43,686
3	Installation of Arctic Main	3,110	LF	$350	$1,088,464
4	Removal of Water Main	0	LF	$50	$0
5	Highway Direct Bury Crossing	3	EA	$50,000	$150,000
6	Driveway Casing Crossing	1	EA	$3,000	$3,000
7	Easement Obstructions	7	EA	$10,000	$70,000
				Subtotal	$1,464,365
				Design (10% Subtotal)	$146,436.47
				Construction Administration (10%)	$146,436.47
				Contingency (20%)	$292,872.94
				Total	**$2,050,111**

Alternative 5, Phase 3					
Bid Item	**Description**	**Quantity**	**Type**	**Unit Price**	**Total Cost**
1	Mobilization	1	LS	$191,074	$191,074
2	Construction surveying	1	LS	$76,430	$76,430
3	Installation of Arctic Main	6,483	LF	$350	$2,269,030
4	Removal of Water Main	0	LF	$50	$0
5	Highway Direct Bury Crossing	3	EA	$50,000	$150,000
6	Driveway Casing Crossing	6	EA	$3,000	$18,000
7	Easement Obstructions	0	EA	$10,000	$0
				Subtotal	$2,704,534
				Design (10% Subtotal)	$270,453.41
				Construction Administration (10%)	$270,453.41
				Contingency (20%)	$540,906.82
				Total	**$3,786,348**

Alternative 1												
Water		Sewer		Obstructions	Driveways	Culverts						
Phase 1												
Length (ft)	Abandoned	Length (ft)	Notes				Total Phase 1, Alternative 1	Totals For All Phases				
4,448	430	1,135		6	3	2	5,583	Length	Obstructions	Driveways	Culverts	Abandoned
Phase 2								15,576	13	14	8	430.00898
Length (ft)	Abandoned	Length (ft)	Notes				Total Phase 2, Alternative 1					
2,251		859		7	1	3	3,110					
Phase 3												
Length (ft)	Abandoned	Length (ft)	Notes				Total Phase 3, Alternative 1					
4,032		2,851		0	10	3	6,883					
Alternative 2												
Water		Sewer		Obstructions	Driveways	Culverts						
Phase 1												
Length (ft)	Abandoned	Length (ft)	Notes				Total Phase 1, Alternative 2	Totals For All Phases				
4,439	752	1,142		6	3	2	5,581	Length	Obstructions	Driveways	Culverts	Abandoned
Phase 2								18,214	13	20	8	752.065122
Length (ft)	Abandoned	Length (ft)	Notes				Total Phase 2, Alternative 2					
2,251		859		7	1	3	3,110					
Phase 3												
Length (ft)	Abandoned	Length (ft)	Notes				Total Phase 3, Alternative 1					
5,484		4,039		0	16	3	9,523					
Alternative 3												
Water		Sewer		Obstructions	Driveways	Culverts						
Phase 1												
Length (ft)	Abandoned	Length (ft)	Notes				Total Phase 1, Alternative 3	Totals For All Phases				
5,610	430	2,516		6	8	3	8,126	Length	Obstructions	Driveways	Culverts	Abandoned
Phase 2								17,491	13	15	10	430.00898
Length (ft)	Abandoned	Length (ft)	Notes				Total Phase 2, Alternative 3					
2,251		859		7	1	3	3,110					
Phase 3												
Length (ft)	Abandoned	Length (ft)	Notes				Total Phase 3, Alternative 3					
3,262		2,994		0	6	4	6,255					
Alternative 4												
Water		Sewer		Obstructions	Driveways	Culverts						
Phase 1												
Length (ft)	Abandoned	Length (ft)	Notes				Total Phase 1, Alternative 4	Totals For All Phases				
5,563	900	2,540		6	8	3	8,102	Length	Obstructions	Driveways	Culverts	Abandoned
Phase 2								23,963	13	26	11	900.286719
Length (ft)	Abandoned	Length (ft)	Notes				Total Phase 2, Alternative 4					
2,251		859		7	1	3	3,110					
Phase 3												
Length (ft)	Abandoned	Length (ft)	Notes				Total Phase 3, Alternative 4					
6,989		5,761		0	17	5	12,751					
Alternative 5												
Water		Sewer		Obstructions	Driveways	Culverts						
Phase 1												
Length (ft)	Abandoned	Length (ft)	Notes				Total Phase 1, Alternative 5	Totals For All Phases				
4,448	588	1,135		6	4	3	5,582	Length	Obstructions	Driveways	Culverts	Abandoned
Phase 2								15,175	13	11	9	587.688607
Length (ft)	Abandoned	Length (ft)	Notes				Total Phase 2, Alternative 5					
2,251		859		7	1	3	3,110					
Phase 3												
Length (ft)	Abandoned	Length (ft)	Notes				Total Phase 3, Alternative 5					
3,038		3,445		0	6	3	6,483					

***Note for Lucas, all "Abandoned" piping was water main built in Phase 1

APPENDIX C

Insurance Incident Analysis

Matrix of Incidents relating to Utility Services Operations

Type of Incident	Policy Year	Number of Incidents per month of year											
		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Truck struck vehicle when entering/leaving customer premises	2012-2013		**1**	**1**			**1**						
Truck struck building or damaged property	Total = 5												
Overflow tank while delivering water													
Pumped sewage into house			**1**										
Truck rollover						**1**							
Truck struck vehicle when entering/leaving customer premises	2013-2014												
Truck struck building or damaged property	Total = 1								**1**				
Overflow tank while delivering water													
Pumped sewage into house													
Truck rollover													
Truck struck vehicle when entering/leaving customer premises	2014-2015												
Truck struck building or damaged property	Total = 6									**1**			
Overflow tank while delivering water				**2**			**1**	1	**1**				
Pumped sewage into house													
Truck rollover													
Truck struck vehicle when entering/leaving customer premises	2015-2016		**1**					**2**				**2**	**1**
Truck struck building or damaged property	Total = 11					**1**		**1**		**1**			
Overflow tank while delivering water						**1**	**1**						
Pumped sewage into house													
Truck rollover													

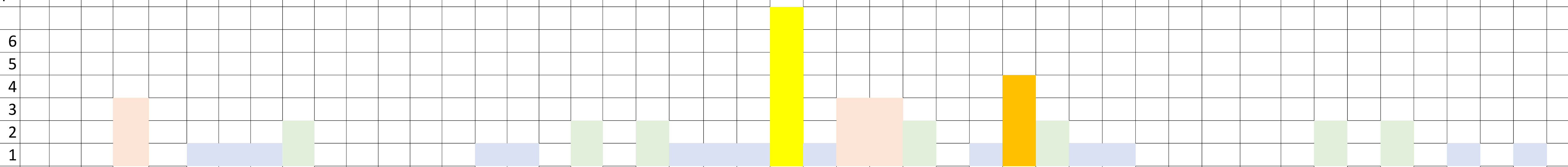
Type of Incident		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Truck struck vehicle when entering/leaving customer premises	2016-2017												
Truck struck building or damaged property	Total = 11		**1**						**1**				
Overflow tank while delivering water							**1**	**3**	**3**				
Pumped sewage into house					**1**								
Truck rollover													
missed scheduled sewer pick-up									**1**				
Truck struck vehicle when entering/leaving customer premises	2017-2018					**2**		**2**			1	1	
Truck struck building or damaged property	Total = 21	2	**1**		**1**		**6**		**1**		1		
Overflow tank while delivering water		1							**1**				
Pumped sewage into house													
Truck rollover													
missed scheduled sewer pick-up													
stuck in driveway/Property						**1**							
Monthly Totals 2012 to 2018		3	5	3	2	6	10	9	9	2	2	3	1
Total all													

NOTE: Based on the raw data there was an increase in the incidents in the last three policy years but this could be related to several factors:

1. Better/Increased reporting - In 2015 GCI gave out free cell phones to everyone in town
2. Short staffed resulting in long work days and a fatigue factor
3. High turnover in staff resulting in inexperienced drivers

Incident Analysis

Incidents per Month



	JULY 14	15	16	17	AUGUST 14	15	16	17	SEPTEMBER 14	15	16	17	OCTOBER 14	15	16	17
Truck v. Vehicle						1										
Building/Property				2			1	1								1
Water Overflow				1					2							
Pumped sewage into house															1	

	NOVEMBER 14	15	16	17	DECEMBER 14	15	16	17	JANUARY 14	15	16	17	FEBRUARY 14	15	16	17
Truck v. Vehicle				2						2		2				
Building/Property		1						6		1					1	1
Water Overflow		1			1	1	1		1		3			1	3	1
Pumped sewage into house																

	MARCH 14	15	16	17	APRIL 14	15	16	17	MAY 14	15	16	17	JUNE 14	15	16	17
Truck v. Vehicle								1		2		1		1		
Building/Property		1						1								
Water Overflow																
Pumped sewage into house																

Cost per category per year

All Listed Claims

TOTAL Cost for 3 Years = $389,055

AVE Cost per Year = $129,685

	Cost	Incidents
Truck v. Vehicle		
2014 - 2015		
2015 - 2016	23, 419	6 incidents
2016 - 2017		
Building/Property		
2014 - 2015	35, 535	1 incident
2015 - 2016	5, 889	3 incidents
2016 - 2017	1, 450	2 incidents
Water Overflow		
2014 - 2015	48, 808	5 incidents
2015 - 2016	4, 533	2 incidents
2016 - 2017	149, 344	7 incidents
Pump sewage into home		
2016 - 2017	119, 117	1 incident

Paid out/Year

2014 - 2015	$84, 343
2015 - 2016	$33, 841
2016 - 2017	$ 270, 871

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 210 220 230 240 250 260 270

Total All Claims for four categories above — Dollars in thousands