TULUKSAK WATER AND SEWER

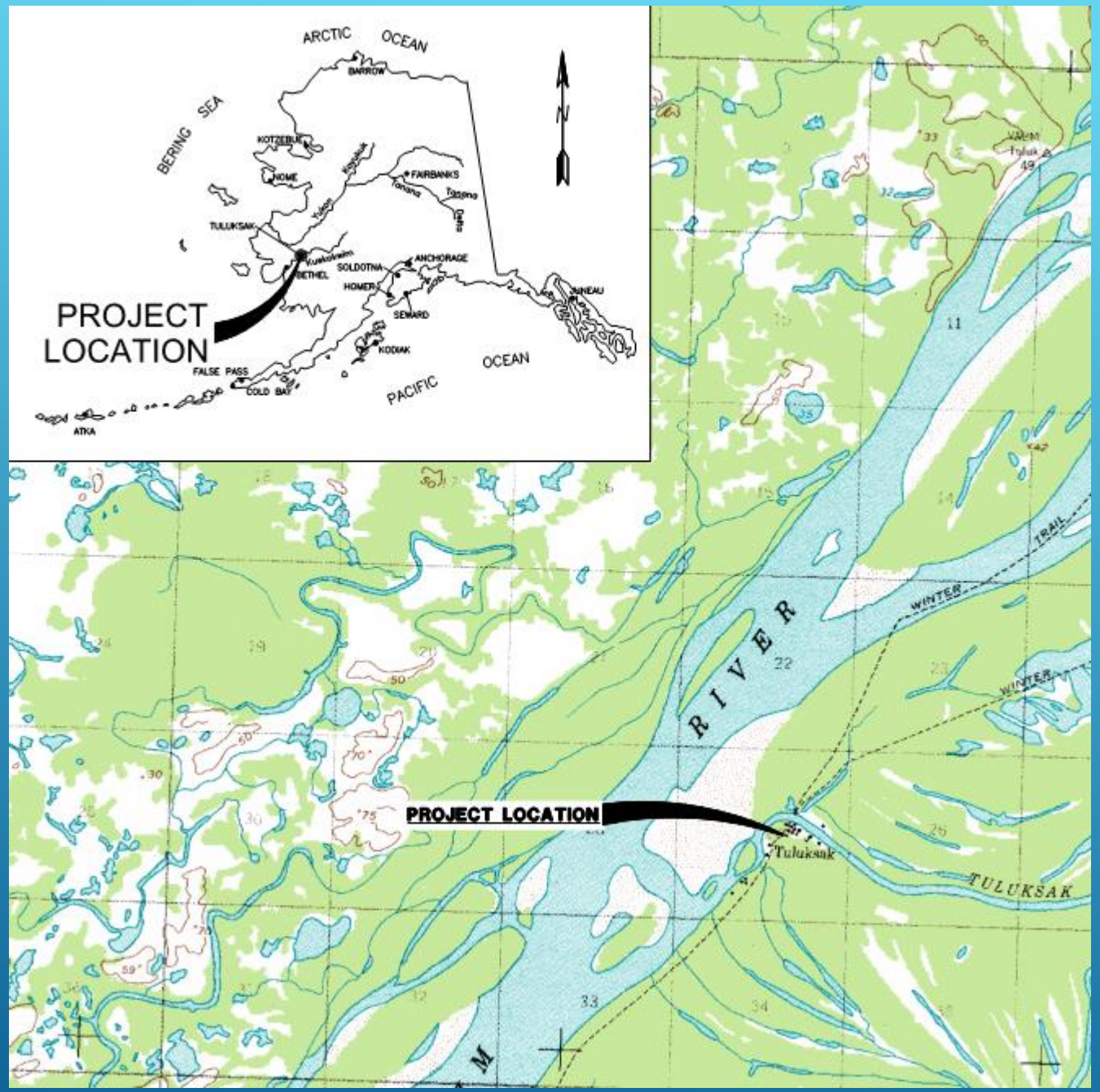
Preliminary Engineering Report

April 2021

PROJECT PLANNING

- The Village Safe Water (VSW) program, in coordination with the Tuluksak Native Community (TNC), retained CRW Engineering Group, LLC (CRW) to provide engineering planning services for a piped water and sewer system to serve the community.

Nearly Complete Lift Station

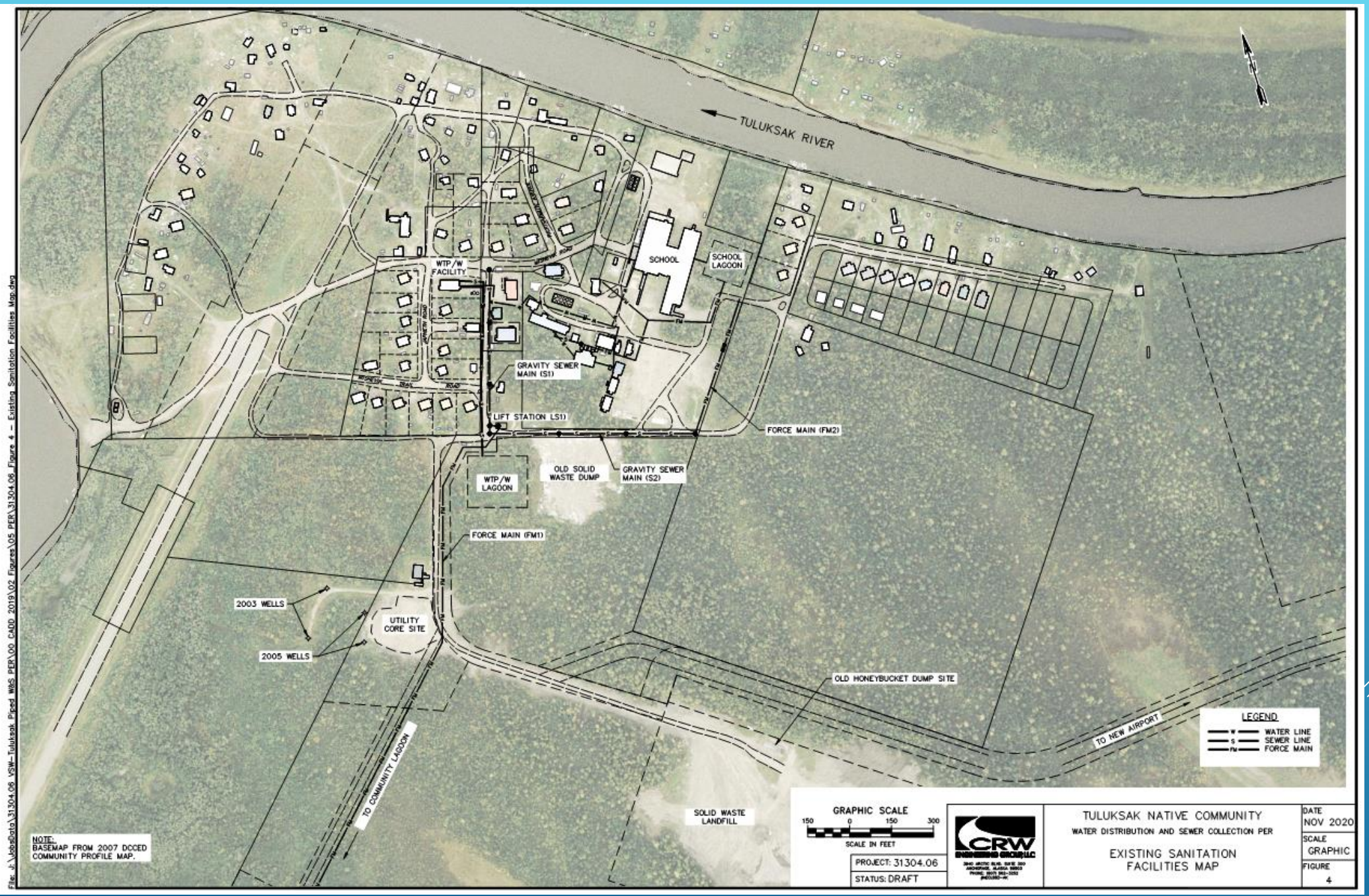

ARCTIC OCEAN
BARROW
BERING SEA
KOTZEBUE
NOME
FAIRBANKS
TANANA
TANANA
DEVIL
TULUKSAK
YUKON
KUSKOKWIM
BETHEL
SOLDOTNA
ANCHORAGE
HOMER
SEWARD
JUNEAU
KODIAK
PROJECT LOCATION
FALSE PASS
COLD BAY
PACIFIC
OCEAN
ATKA
N
RIVER
WINTER TRAIL
WINTER
PROJECT LOCATION
Tuluksak
TULUKSAK

EXISTING FACILITIES

- The community water system currently consists of: a groundwater water sources (WTP well), a 25-foot long raw water transmission line, a water treatment plant/washeteria (WTP/W), two 10,000-gallon water storage tank (WST), and a community watering point in the washeteria.
- The water treatment plant does not produce drinking water that meets regulatory requirements and as a result the community gets the majority of their water from the rivers near the community.
- The WTP burned down in early 2021 and a temporary WTP has been brought in while a permeant water treatment solution is being developed.
- Wastewater systems include a honey bucket haul system, a community lagoon, school lagoon, and WTP lagoon.

Community Lagoon

WTP


TULUKSAK RIVER
WTP/W FACILITY
SCHOOL
SCHOOL LAGOON
GRAVITY SEWER MAIN (S1)
LIFT STATION LS1)
FORCE MAIN (FM2)
OLD SOLID WASTE DUMP
GRAVITY SEWER MAIN (S2)
WTP/W LAGOON
FORCE MAIN (FM1)
2003 WELLS
2005 WELLS
UTILITY CORE SITE
TO COMMUNITY LAGOON
OLD HONEYBUCKET DUMP SITE
TO NEW AIRPORT
SOLID WASTE LANDFILL
LEGEND
WATER LINE
SEWER LINE
FORCE MAIN
GRAPHIC SCALE
150 0 150 300
SCALE IN FEET
PROJECT: 31304.06
STATUS: DRAFT
TULUKSAK NATIVE COMMUNITY
WATER DISTRIBUTION AND SEWER COLLECTION PER
EXISTING SANITATION FACILITIES MAP
DATE
NOV 2020
SCALE
GRAPHIC
FIGURE
4
NOTE:
BASEMAP FROM 2007 DCCED COMMUNITY PROFILE MAP.
File: J:\Jobdata\31304.06_VSW-Tuluksak Piped WKS PER\00_CADD 2019\02 Figures\05 PER\31304.06 Figure 4 - Existing Sanitation Facilities Map.dwg

NEED FOR PROJECT

- The community of Tuluksak is actively seeking to improve the public health of the community and meet the essential sanitary needs for its residents. A significant part of this effort is the goal to replace the community's honeybucket system with a more sanitary collection method and to be able to provide residents with an adequate supply of safe, potable water for drinking and washing purposes. The project under consideration would improve health and safety conditions and provide water and sewer service to the majority of homes in the community.

HEALTH, SANITATION AND SECURITY

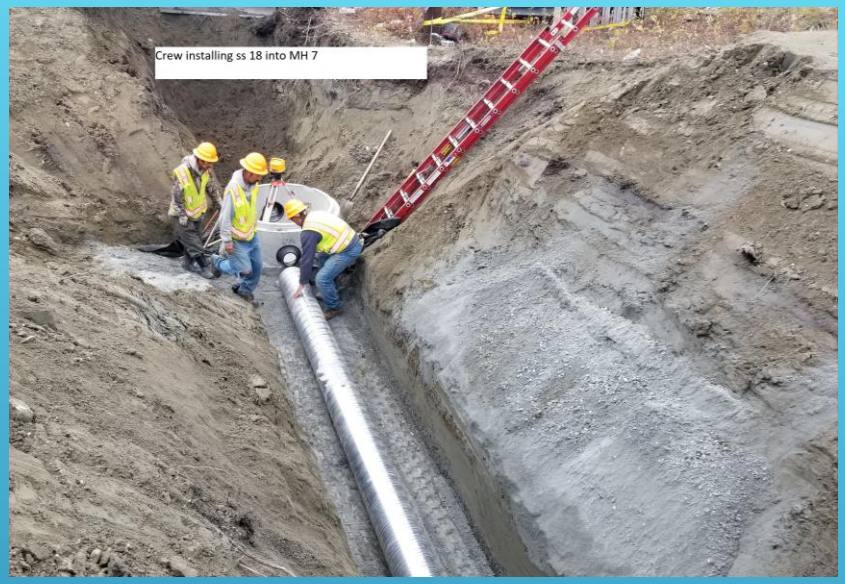
- Based on watering point records, almost all residents in Tuluksak use less than 5 gallons of treated water per capita per day, with most users using 1 to 2 gallons per day if that. The World Health Organization recommends a minimum of 13 gallons per capita per day for basic needs. Increased water use without improved access to water is not likely to occur. In communities that have transitioned from honeybucket and self-haul water systems to piped water and sewer there's a reduction in gastrointestinal disease of up to 40% (Thomas et al., 2003). Experience has also shown that school attendance rates increase with the installation of in-home plumbing, and school districts have noted that it is easier to recruit and retain teachers in communities with piped water and sewer service.

ALTERNATIVES CONSIDERED

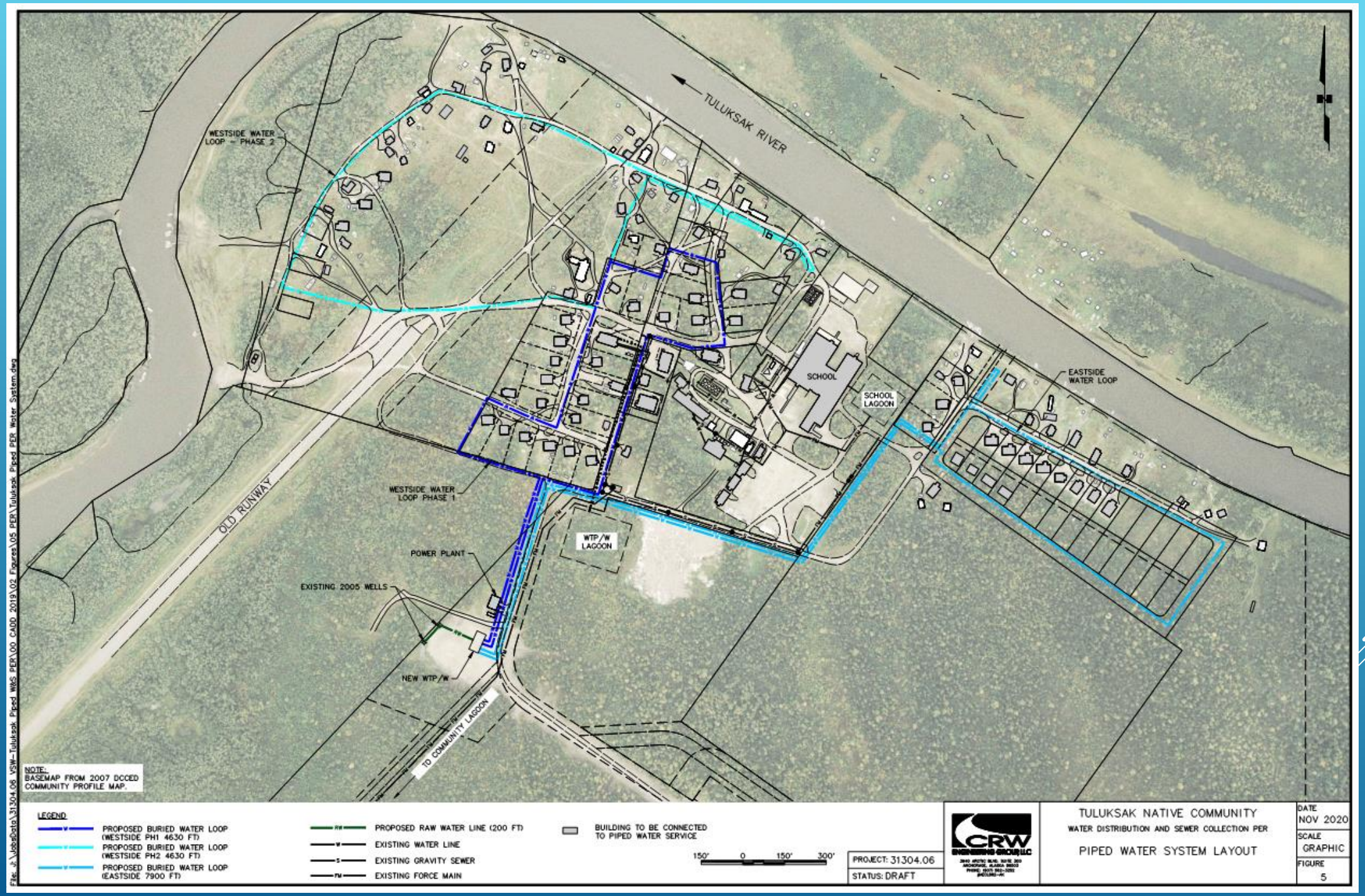
- Below-grade configurations were evaluated for the pipe water distribution system.
- Three different configurations of a sewer collection system including a closed haul (decentralized) system were evaluated, including:
  - Alternative #1 – Gravity Sewer
  - Alternative #2 – Pressure Sewer
  - Alternative #3 – Vacuum Sewer
  - Closed haul (Truck Haul) system was considered
- All alternatives consider a new WTP and use of the community lagoon for wastewater treatment.

WATER DISTRIBUTION SYSTEM – BELOW GRADE

- Two water distribution loops would serve the community: Westside Loop, and Eastside Loop. The water mains would be constructed of 6x15 Arctic pipe with a 6-inch HDPE water line and an aluminum jacket. All the mains would be buried 3 to 6 feet deep and generally located in existing road rights-of-way (ROW).
- The layout and length of the water loops are shown on Figure 5.



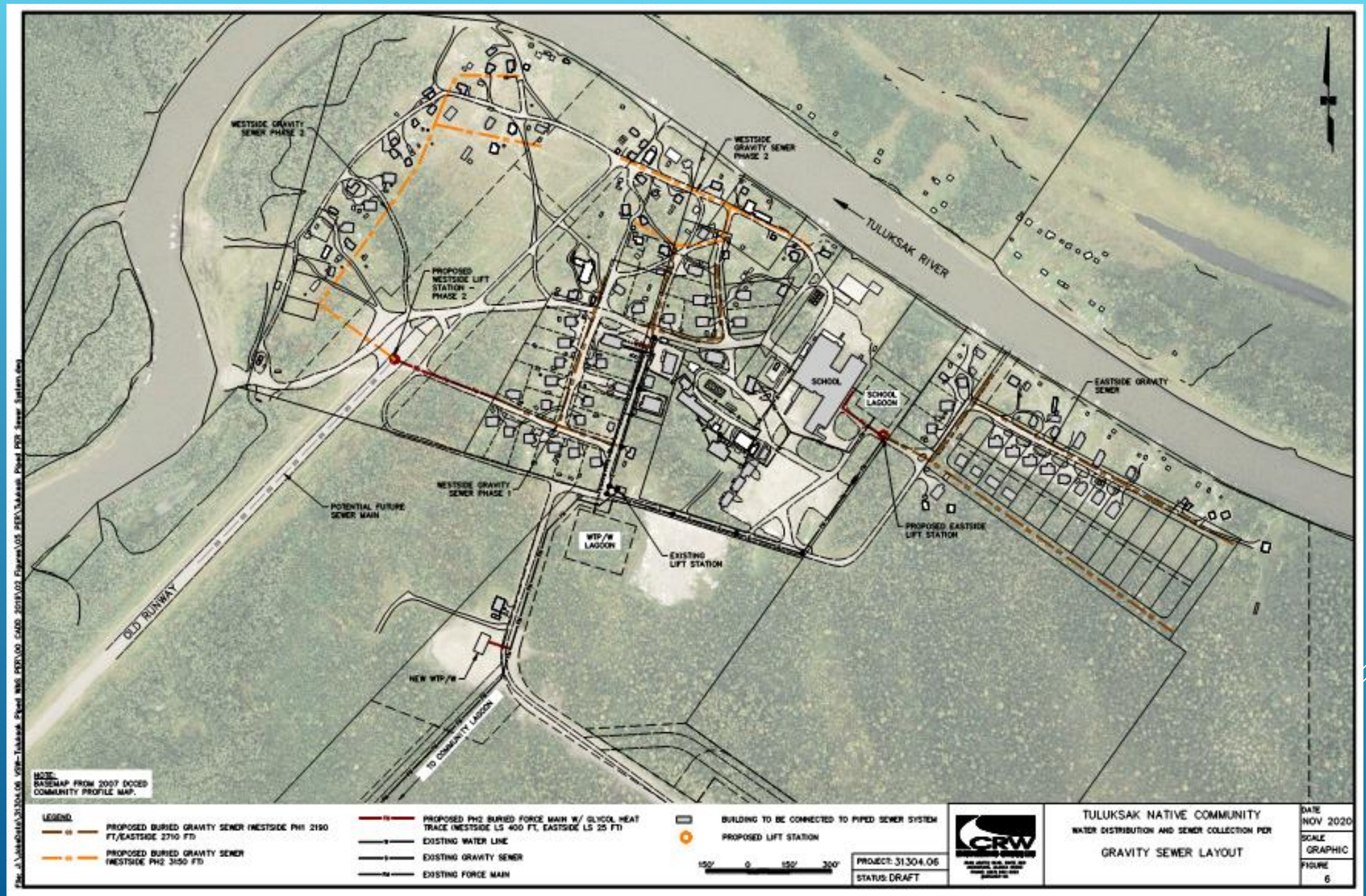
Below grade pipes in Kiana


TULUKSAK RIVER
WESTSIDE WATER LOOP – PHASE 2
WESTSIDE WATER LOOP PHASE 1
EASTSIDE WATER LOOP
SCHOOL
SCHOOL LAGOON
WTP/W LAGOON
POWER PLANT
EXISTING 2005 WELLS
NEW WTP/W
OLD RUNWAY
TO COMMUNITY LAGOON
NOTE:
BASEMAP FROM 2007 DCCED COMMUNITY PROFILE MAP.
LEGEND
PROPOSED BURIED WATER LOOP (WESTSIDE PH1 4630 FT)
PROPOSED BURIED WATER LOOP (WESTSIDE PH2 4630 FT)
PROPOSED BURIED WATER LOOP (EASTSIDE 7900 FT)
PROPOSED RAW WATER LINE (200 FT)
EXISTING WATER LINE
EXISTING GRAVITY SEWER
EXISTING FORCE MAIN
BUILDING TO BE CONNECTED TO PIPED WATER SERVICE
150' 0 150' 300'
PROJECT: 31304.06
STATUS: DRAFT
CRW ENGINEERING GROUP, LLC
TULUKSAK NATIVE COMMUNITY
WATER DISTRIBUTION AND SEWER COLLECTION PER
PIPED WATER SYSTEM LAYOUT
DATE NOV 2020
SCALE GRAPHIC
FIGURE 5
File: J:\Jobs\Tuluksak\31304.06 VSW-Tuluksak Piped W&S PER\00 CADD 2019\02 Figures\05 PER\Tuluksak Piped PER Water System.dwg

WASTEWATER COLLECTION ALTERNATIVE 1 – GRAVITY SEWER

- A gravity sewer system would consist of a service line from each facility, a network of gravity sewer mains, 2 lift stations and a terminal lift station. Wastewater would generally flow from the extremities of the community to a nearby lift station and then to the terminal lift station. The terminal lift station would pump wastewater to the community lagoon. A conceptual layout of the system is shown on Figure 7.

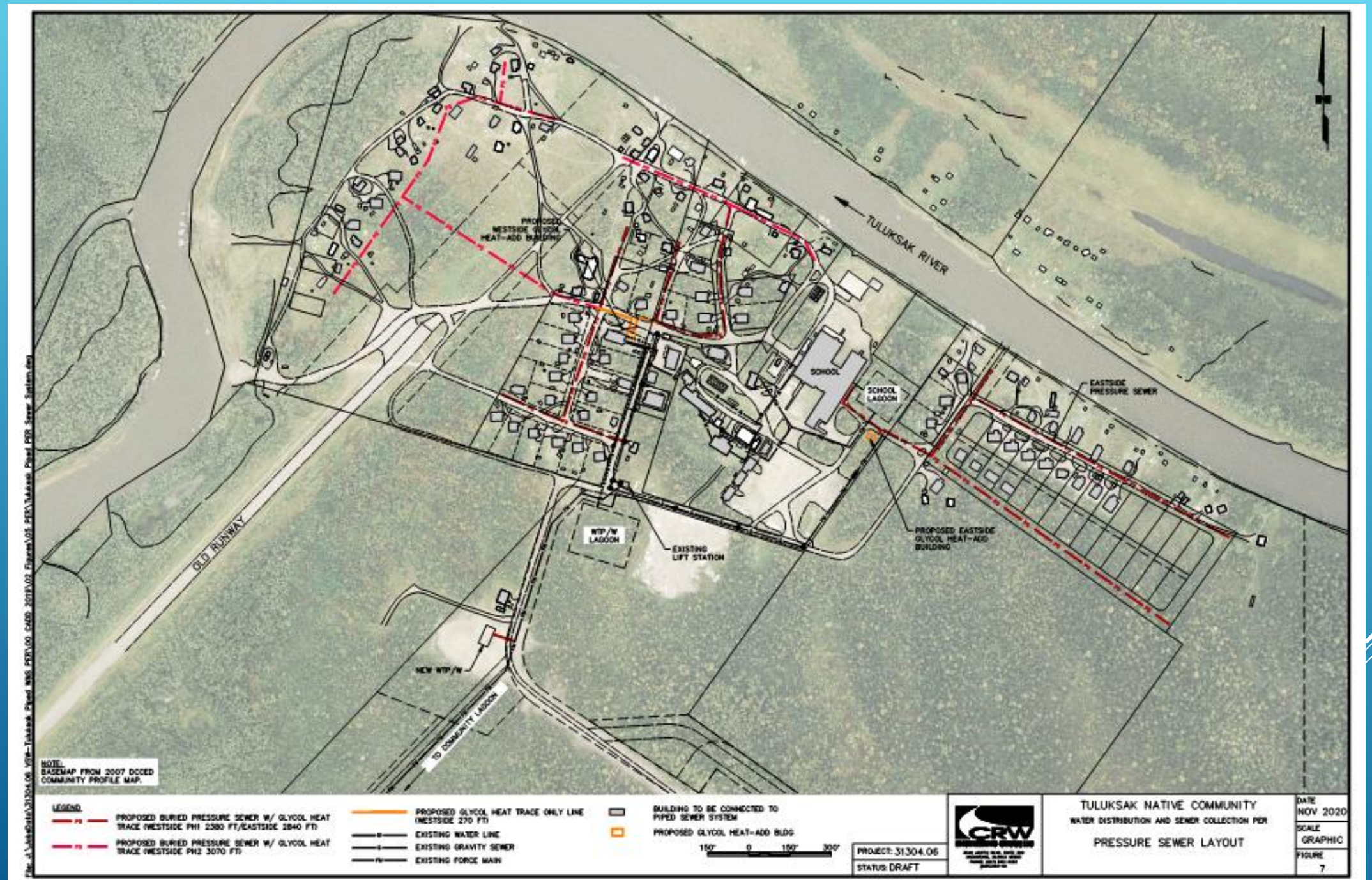
Advantages	Disadvantages
• Lowest capital costs for the piped systems • Low O&M cost. • The simplest system for the homeowner to operate and maintain. • No specialty or custom components to repair or replace • Lowest freeze potential as the sewer mains and services lines are typically near empty.	• Requires more water than a vacuum sewer system • The sewer mains and service lines are grade sensitive, so there is less tolerance for ground movement than with a pressure sewer system. • The flat topography requires multiple lift stations for a relatively small service area.


WESTSIDE GRAVITY SEWER PHASE 2
WESTSIDE GRAVITY SEWER PHASE 2
TULUKSAK RIVER
PROPOSED WESTSIDE LIFT STATION - PHASE 2
SCHOOL
SCHOOL LAGOON
EASTSIDE GRAVITY SEWER
WESTSIDE GRAVITY SEWER PHASE 1
POTENTIAL FUTURE SEWER MAIN
WTP/W LAGOON
EXISTING LIFT STATION
PROPOSED EASTSIDE LIFT STATION
OLD RUNWAY
NEW WTP/W
TO COMMUNITY LAGOON
NOTE:
BASEMAP FROM 2007 DOCED COMMUNITY PROFILE MAP.
LEGEND
PROPOSED BURIED GRAVITY SEWER (WESTSIDE PH1 2190 FT/EASTSIDE 2710 FT)
PROPOSED BURIED GRAVITY SEWER (WESTSIDE PH2 3150 FT)
PROPOSED PH2 BURIED FORCE MAIN W/ GLYCOL HEAT TRACE (WESTSIDE LS 400 FT, EASTSIDE LS 25 FT)
EXISTING WATER LINE
EXISTING GRAVITY SEWER
EXISTING FORCE MAIN
BUILDING TO BE CONNECTED TO PIPED SEWER SYSTEM
PROPOSED LIFT STATION
150' 0 150' 300'
PROJECT: 31304.06
STATUS: DRAFT
CRW
TULUKSAK NATIVE COMMUNITY
WATER DISTRIBUTION AND SEWER COLLECTION PER
GRAVITY SEWER LAYOUT
DATE NOV 2020
SCALE GRAPHIC
FIGURE 6

WASTEWATER COLLECTION ALTERNATIVE 2 – PRESSURE SEWER

- A pressure sewer system would include: a grinder pump station and glycol circulation pump at each house/business, a service line from each facility, and a network of low-pressure sewer mains. Wastewater would generally flow from the outer part of the community towards a central collection point then to the community shown on Figure 7.

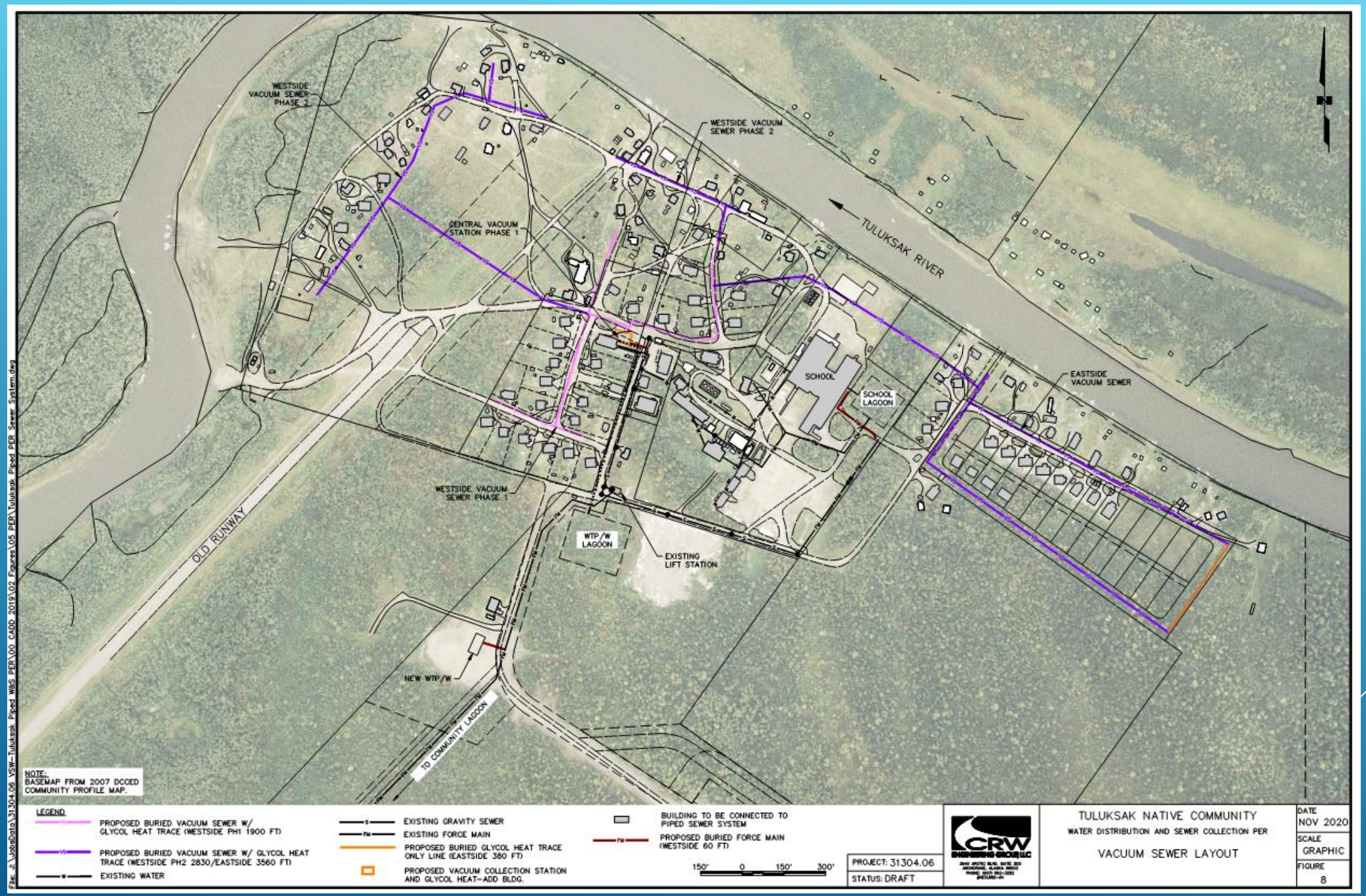
Advantages	Disadvantages
• Pressure sewer mains are not grade sensitive, so there is greater tolerance for ground movement. • More flexibility in the routing of mains as the grinder pumps have more head capacity than vacuum pumps. • Sewer mains can be shallowly buried to avoid challenging soil. • Homeowners pay for the electricity to operate the grinder pump, so there is an incentive to conserve water.	• More expensive to operate and maintain than a gravity or vacuum sewer system with vacuum toilets. • The system's operation will require approximately 90 grinder pumps compared to three pumps for the vacuum sewer system and four pumps for gravity sewer. • Requires more water to operate than a vacuum sewer system. • Increased freeze potential as the mains and services lines are always full of liquid.


TULUKSAK RIVER
PROPOSED WESTSIDE GLYCOL HEAT-ADD BUILDING
SCHOOL
SCHOOL LAGOON
EASTSIDE PRESSURE SEWER
PROPOSED EASTSIDE GLYCOL HEAT-ADD BUILDING
WTP/W LAGOON
EXISTING LIFT STATION
OLD RUNWAY
NEW WTP/W
TO COMMUNITY LAGOON
NOTE:
BASEMAP FROM 2007 DCCED COMMUNITY PROFILE MAP.
LEGEND
PROPOSED BURIED PRESSURE SEWER W/ GLYCOL HEAT TRACE (WESTSIDE PH1 2380 FT/EASTSIDE 2840 FT)
PROPOSED BURIED PRESSURE SEWER W/ GLYCOL HEAT TRACE (WESTSIDE PH2 3070 FT)
PROPOSED GLYCOL HEAT TRACE ONLY LINE (WESTSIDE 270 FT)
EXISTING WATER LINE
EXISTING GRAVITY SEWER
EXISTING FORCE MAIN
BUILDING TO BE CONNECTED TO PIPED SEWER SYSTEM
PROPOSED GLYCOL HEAT-ADD BLDG
150' 0 150' 300'
PROJECT: 31304.06
STATUS: DRAFT
TULUKSAK NATIVE COMMUNITY
WATER DISTRIBUTION AND SEWER COLLECTION PER
PRESSURE SEWER LAYOUT
DATE NOV 2020
SCALE GRAPHIC
FIGURE 7

WASTEWATER COLLECTION ALTERNATIVE 3 – VACUUM SEWER

- A vacuum sewer system would consist of: a vacuum toilet and 10-gallon greywater sump in each house/business, a sewer service line from each facility, a network of vacuum sewer mains, and a central vacuum collection station.

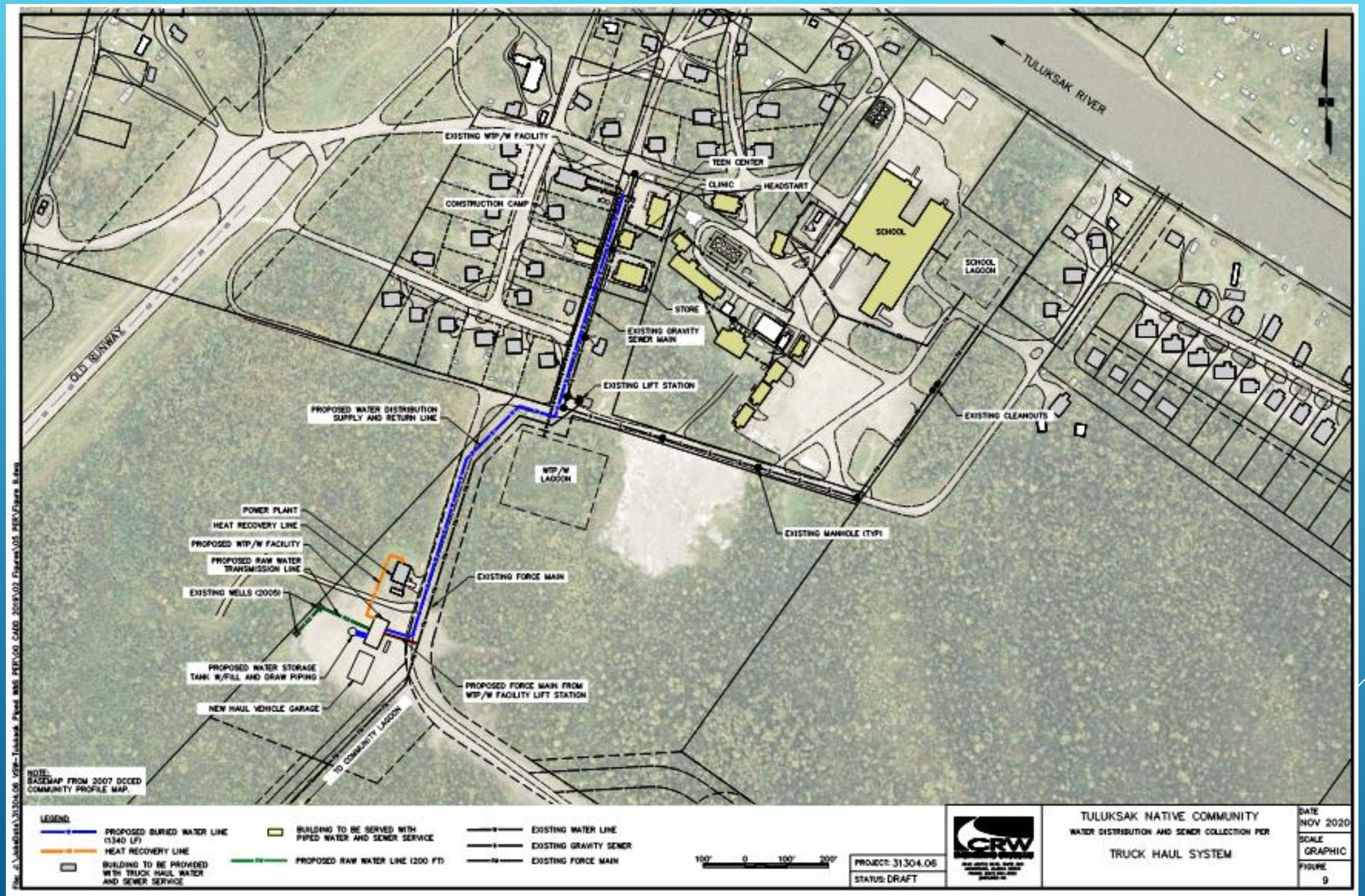
Advantages	Disadvantages
• Requires the least amount of water when vacuum toilets are utilized. The vacuum station equipment is above grade, making it cleaner and easier to work on than submersible sewage pumps in a wet well. • There are fewer pumps to operate and maintain. • Sewer mains can be shallowly buried to avoid challenging soil conditions. • Reduced freeze potential as the sewer mains and services lines are typically less than half full.	• The sewer mains and service lines are grade sensitive, so there is less tolerance for ground movement. • The vacuum pumps are expensive to replace ($15K versus $5k for a typical submersible sewage pump). • Unreported vacuum leaks or faulty valves can significantly increase the electrical cost for the utility. • The vacuum toilets and greywater sumps are noisy when discharged.


WESTSIDE VACUUM SEWER PHASE 2
WESTSIDE VACUUM SEWER PHASE 2
CENTRAL VACUUM STATION PHASE 1
TULUKSAK RIVER
SCHOOL
SCHOOL LAGOON
EASTSIDE VACUUM SEWER
WESTSIDE VACUUM SEWER PHASE 1
WTP/W LAGOON
EXISTING LIFT STATION
OLD RUNWAY
NEW WTP/W
TO COMMUNITY LAGOON
NOTE:
BASEMAP FROM 2007 DCCED COMMUNITY PROFILE MAP.
LEGEND
PROPOSED BURIED VACUUM SEWER W/ GLYCOL HEAT TRACE (WESTSIDE PH1 1900 FT)
PROPOSED BURIED VACUUM SEWER W/ GLYCOL HEAT TRACE (WESTSIDE PH2 2830/EASTSIDE 3560 FT)
EXISTING WATER
EXISTING GRAVITY SEWER
EXISTING FORCE MAIN
PROPOSED BURIED GLYCOL HEAT TRACE ONLY LINE (EASTSIDE 380 FT)
PROPOSED VACUUM COLLECTION STATION AND GLYCOL HEAT-ADD BLDG.
BUILDING TO BE CONNECTED TO PIPED SEWER SYSTEM
PROPOSED BURIED FORCE MAIN (WESTSIDE 60 FT)
150' 0 150' 300'
PROJECT: 31304.06
STATUS: DRAFT
CRW ENGINEERING GROUP, LLC
TULUKSAK NATIVE COMMUNITY
WATER DISTRIBUTION AND SEWER COLLECTION PER
VACUUM SEWER LAYOUT
DATE NOV 2020
SCALE GRAPHIC
FIGURE 8
File: J:\Jobs\Jobs\31304.06 VSW-Tuluksak Piped W&S PER\00 CADD 2019\02 Figures\05 PER\Tuluksak Piped PER Sewer System.dwg

TRUCK HAUL SYSTEM ALTERNATIVE 4

- This alternative would consist of individual water and sewer systems for each residence with a tuck haul system. Figure 9 shows the project layout.

Advantages	Disadvantages
• Fixed Costs for the utility are lower. • Lowest capital cost alternative. • The condition of the local roads will be improved. • Road maintenance equipment will be provided.	• The lowest level of service. • Labor intensive and service is dependent on weather conditions and a high maintenance haul vehicle. • Highest O&M cost. • Once a home is served with a haul system, it is typically not eligible for future service from a piped system.


TULUKSAK RIVER
EXISTING WTP/W FACILITY
TEEN CENTER
CLINIC
HEADSTART
CONSTRUCTION CAMP
SCHOOL
SCHOOL LAGOON
STORE
EXISTING GRAVITY SEWER MAIN
OLD RUNWAY
EXISTING LIFT STATION
PROPOSED WATER DISTRIBUTION SUPPLY AND RETURN LINE
EXISTING CLEANOUTS
WTP/W LAGOON
EXISTING MANHOLE (TYP)
POWER PLANT
HEAT RECOVERY LINE
PROPOSED WTP/W FACILITY
PROPOSED RAW WATER TRANSMISSION LINE
EXISTING WELLS (2005)
EXISTING FORCE MAIN
PROPOSED WATER STORAGE TANK W/FILL AND DRAW PIPING
PROPOSED FORCE MAIN FROM WTP/W FACILITY LIFT STATION
NEW HAUL VEHICLE GARAGE
TO COMMUNITY LAGOON
NOTE:
BASEMAP FROM 2007 DCCED COMMUNITY PROFILE MAP.
LEGEND
PROPOSED BURIED WATER LINE (1340 LF)
HEAT RECOVERY LINE
BUILDING TO BE PROVIDED WITH TRUCK HAUL WATER AND SEWER SERVICE
BUILDING TO BE SERVED WITH PIPED WATER AND SEWER SERVICE
PROPOSED RAW WATER LINE (200 FT)
EXISTING WATER LINE
EXISTING GRAVITY SEWER
EXISTING FORCE MAIN
100' 0 100' 200'
PROJECT: 31304.06
STATUS: DRAFT
CRW
TULUKSAK NATIVE COMMUNITY
WATER DISTRIBUTION AND SEWER COLLECTION PER
TRUCK HAUL SYSTEM
DATE NOV 2020
SCALE GRAPHIC
FIGURE 9

LIFE CYCLE COST

Alternative	Capital Cost[1]	O&M Cost[1]	20-Year Salvage Value[1]	NPV[1]
Alternative 1 – Piped Water & Gravity Sewer	$40,830,000	$261,900	$18,920,000	$28,087,000
Alternative 2 – Piped Water & Pressure Sewer	$50,180,000	$300,000	$17,480,000	$39,530,000
Alternative 3 – Piped Water & Vacuum Sewer	$46,640,000	$277,300	$22,209,000	$31,100,000
Alternative 4 – Truck Haul Water & Sewer System	$36,090,000	$464,800	$11,715,000	$34,070,000

Notes: *[1] Rounded to the nearest $1,000.*

RECOMMENDATIONS

- Water Distribution System
  - Below-grade water system
- Sewer Collection System
  - Below-grade gravity sewer
- Wastewater Treatment System
  - Community Lagoon