ANGOON WATER SOURCE, ANGOON, ALASKA
FINAL PRELIMINARY ENGINEERING REPORT
AN 19-U1R
APRIL 2021

PREPARED FOR:

ALASKA NATIVE TRIBAL HEALTH CONSORTIUM
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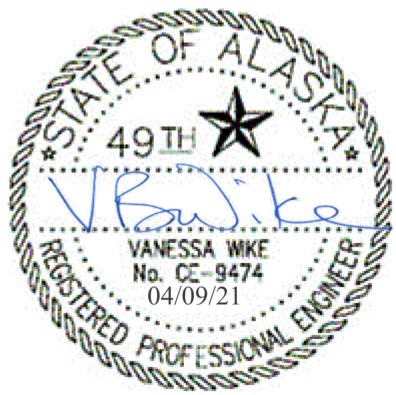
Angoon Water Source

Angoon, AK

Preliminary Engineering Report

The technical material and data contained in this report were prepared under the supervision and direction of the undersigned whose seal as a Professional Engineer is affixed below.

The information provided in this report represents preliminary engineering findings and does not represent a final design or provide final design criteria.



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ABBREVIATIONS

°	degree
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
ADL	Alaska Division of Lands
ADNR	Alaska Department of Natural Resources
ADOL&WD	Alaska Department of Labor and Workforce Development
ALARI	Alaska Local and Regional Information
ANTHC	Alaska Native Tribal Health Consortium
ARUC	Alaska Rural Utility Collaborative
ASCE	American Society of Civil Engineers
AWWA	American Water Works Association
bgs	below ground surface
BOD	biochemical oxygen demand
Bristol	Bristol Engineering Services Company, LLC
cfs	cubic feet per second
City	City of Angoon
CMP	corrugated metal pipe
DBP	disinfection by-products
DCCED	Alaska Department of Commerce, Community and Economic Development
DNR	Alaska Department of Natural Resources
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
ft	feet
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
HDPE	high-density polyethylene
HITS	Housing Inventory Tracking System
IHS	Indian Health Service
LCR	Lead and Copper Rule
LF	linear feet
MCL	maximum contaminant limit
MG	million gallons
mg/L	milligrams per liter (parts per million)
MOR	monthly operator report
MSL	Mean Sea Level
NEPA	National Environmental Policy Act
NPV	net present value
NSF	National Science Foundation
O&M	operation and maintenance
PCE	power cost equalization

PER	Preliminary Engineering Report
PSF	pounds per square foot
psi	pounds per square inch
PVC	polyvinyl chloride
PWSID	Public Water System Identification
RCA	Regulatory Commission of Alaska
ROM	Rough Order of Magnitude
SWIMS	Solid Waste Information Management System
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids
TT	treatment technique, established by EPA in lieu of MCL for some contaminants
µg/L	micrograms per liter (parts per billion)
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
UVA	ultra violet absorbance
WHO	World Health Organization
WRCC	Western Regional Climate Center
WST	Water Storage Tank
WTP	Water Treatment Plant

EXECUTIVE SUMMARY

The objective of this report is to evaluate water source alternatives for the community of Angoon, Alaska to address water quality, water quantity, and power costs issues of the existing local water system.

The current source for Angoon's water system has been referred to as both Auk'tah Lake (also spelled Auk'tau Lake) and Tillinghast Lake throughout past projects, studies, and references. This report will use Auk'tah Lake throughout.

Auk'tah Lake has been used as the raw water source for Angoon since 1992. The lake is composed of two adjacent lakes, separated by a narrow strip of land that is submerged by approximately five feet of water. All historic studies refer to the lake as one lake. A beaver dam has been in place on the outlet of the southernmost section of the lake for decades. The lake is relatively large, with a total surface area of approximately 56 acres, and is 30-40 feet deep.

The current Water Treatment Plant (WTP) relies on an intake located near the bottom of the northern-most section of the lake. The intake feeds a wet well with submersible pumps located at the edge of the lake, which pumps the raw water up to the WTP. The wet well maintains an operating level equal to the lake level.

The raw water has historically had high levels of debris and algae, with water quality that varies significantly with environmental conditions. The resident beavers provide a potential increased risk to protozoal contamination, which is a concern for the community. The raw water quality has impacted water treatment processes, and has challenged the system's ability to meet Surface Water Treatment Rule (SWTR) requirements and the associated requirements of the Disinfectants and Disinfection Byproducts (DBP) Rule. The lake water level has dropped in recent years, reducing the water level in the wet well, requiring a reduction in water production. Limited access to raw water has impacted the community's development plans for housing expansion. In addition to water quality and quantity issues, the current raw water pump system consumes a substantial amount of power, and represents the majority of the water utility costs.

The WTP was originally constructed in 1976. Two substantial renovation projects were completed in 2009 and 2011 by the Alaska Native Tribal Health Consortium (ANTHC). These projects included features to address the raw water quality issues by improving backwash processes, added coagulant control to compensate for the raw water variations, and including improved cleaning processes for the intake line and intake screen. These projects resulted in improvements to water quality. However DBP exceedances continued after these projects were completed.

Four alternatives were considered to address water source issues:

Alternative 1: No Action

Alternative 2: New Water Source Impoundment at Favorite Creek

Alternative 3: Vertical Infiltration Galleries at Auk'tah Lake

Alternative 4: Rebuild Existing Intake System at Auk'tah Lake

These alternatives were evaluated based on their ability to address the water quality, water quantity, and utility cost issues noted in the current system, as well as estimated capital costs.

Alternative 1 is not recommended because it will not address the existing water system issues. Alternative 2, although preferred in the past, is not recommended for several reasons including insufficient raw water volume (Auk'tah Lake would need to be used as a back-up supply), the reduction in water quality following an impoundment construction (due to organic decomposition), and high capital costs. Alternative 3 is not recommended because of insufficient geotechnical data regarding site conditions. Alternative 4, the recommended solution, would rebuild the existing wet well and intake system.

Auk'tah Lake and the surrounding watershed have substantially more available water than any previously studied watershed. In order to ensure an adequate, year-round supply of water, the recommended solution would rebuild the existing intake system so that the WTP could reliably continue to use Auk'tah Lake. The recommended solution would replace the existing 4-foot diameter, corrugated metal pipe (CMP) wet well with a new 8-foot diameter, pre-cast concrete wet well. Two new 20 HP submersible pumps, with variable frequency drive (VFD) controllers, and a new pump control panel would be installed. Each pump would be capable of meeting system design flow requirements at an optimized pump efficiency. The pumps would alternate, in lead / lag configuration. A buoy system would be replaced on the existing intake to keep the intake off the bottom and to help control the organics and sediment entering the WTP. The new intake system would produce at the design flow rate of the filters, 225 gallons per minute, which would optimize filter performance. Power costs would be optimized by operating the pumps within the rated efficiency range.

The estimated capital cost of this alternative is **$1,718,950**. This estimate is based on the following assumptions:

- The estimated costs include an automatic strainer to improve organic removal in the WTP, prior to filtration. The use of the strainer would result in less backwash of the filters. The increased cost due to the use of the strainer would be offset by a lesser use of the backwash pump and blower systems.
- The estimated cost assumes that the existing pump control panel can be reused. A new pump control panel would add approximately $32,000 to the cost (as detailed in Alternate 2 in the Appendix C).

INTRODUCTION

Bristol Engineering Services Company, LLC (Bristol) has prepared this Preliminary Engineering Report (PER) on the Angoon Water Source for the Alaska Native Tribal Health Consortium (ANTHC) in cooperation with the City of Angoon. The objective of this report is to evaluate water source options that address water quality, water quantity, and power cost issues noted with the existing system. These concerns, and the alternatives provided in this report, were discussed with City representatives at multiple stages during this project. The community has expressed concerns that failure to address these issues will not only impact their immediate health and safety, but also the long term sustainability of their community in these already economically challenging times.

There has been a long history of water source studies in the Angoon area, dating back to at least 1980 (Angoon Hydropower Preliminary Reconnaissance Report, Tryck, Nyman & Hayes, November, 1980). These reports were primarily focused on Favorite Creek, because of the preferred water quality of the creek, and the potential for an impoundment in the Favorite Creek watershed. These studies were based on available data and site visits, but there has been no accompanying geotechnical site investigation of the area. An updated geotechnical desktop study, including a review of aerial photography, was completed by Golder as part of this PER, which provided the basis for information on alternatives. The geotechnical assumptions made were conservative, due to lack of actual site data. The area surrounding Angoon is mountainous, heavily forested, with limited trails, and an active bear population. Due to the accessibility challenges of the potential new impoundment site, limited budgets, and travel constraints due to COVID-19 pandemic, no site visit was conducted as part of this report.

Regulatory requirements as well as environmental concerns were also considered in this report. The current regulatory oversight of this water system has changed substantially in the past twenty years. The changes include more stringent requirements for surface water treatment (and disinfection byproducts), dam safety, and the protection of anadromous fish streams. The area for a new impoundment would be located within a designated national monument and federal wilderness area, requiring consideration of Alaska National Interest Lands Conservation Act (ANILCA) Program protections. Recent changes in summer conditions (longer, hotter summers, with less precipitation) have been reported by the community, and appear to be impacting the water balance for the watershed, and associated lake water levels. Climate change studies indicate that this trend will likely continue.

The review of many historical studies, past projects, and technical reports was completed in preparing this PER. References to this information is included, but selective, limited information is attached to maintain brevity. Figures in this PER are provided within the body of the document as referenced, with a compiled version of all figures included in Appendix A.

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1.0 PROJECT PLANNING

a) <u>Location</u>

Angoon is a Second-Class City in the Juneau Recording District. Angoon is the only permanent settlement on Admiralty Island (Exhibit 1-1), located on the southwest coast at Kootznahoo Inlet. Angoon is 55 miles southwest of Juneau and 41 miles northeast of Sitka, at approximately 57.4977 degrees (°) north latitude and -134.5847° west longitude. The community encompasses approximately 22.5 square miles of land and 16.1 square miles of water. The project is located with Sections 25 and 36, Township 50 South, Range 67 East of the Copper River Meridian (Alaska Department of Commerce, Community and Economic Development [DCCED], 2020).

Exhibit 1-1: Angoon Vicinity Map (USGS, 2020)

b) Climate

Angoon has temperatures typical for other areas in south-east Alaska, typically ranging from maximums of -6°F to 77°F. However Angoon has much less rainfall than other areas in south-east, with an annual average precipitation of 42 inches per year and 205 average precipitation days per year (https://www.ncdc.noaa.gov, https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ak0310). Winter storms can be severe and can impact both air and sea access. Residents report more extreme winter storm activity in recent years, with hotter, drier summers that last for a longer period.

The climate weather station for Angoon reported data from 1932-2011. Data were intermittent just prior to 2011 when the station was closed. The Exhibits 1-3 and 1-4 on the following page provide a summary of the last full years of data available. These graphs show the beginning of the climate trends that residents report. More complete climate information is available for the nearby Juneau station. This data was not included because of the observed differences in climate data between Juneau and Angoon for the years of data that were available.

c) Environmental Resources Present

i. Land Use

Angoon is located within the Admiralty Island National Monument, the Tongass National Forest, and the Kootznoowoo Wilderness Area (Exhibit 1-2). Land within the project site is owned by various entities including the City of Angoon, Kootznoowoo Inc., and the State of Alaska. State lands were designated under ANILCA (United States Department of Agriculture [USDA], 2020)

The project site is mostly undeveloped forest with mountainous terrain. There is a gravel road that terminates at the existing water source intake, along the north shore of Auk'tah Lake.

Exhibit 1-2: Kootznoo Wilderness within the Tongass National Forest (USDA, 2020)

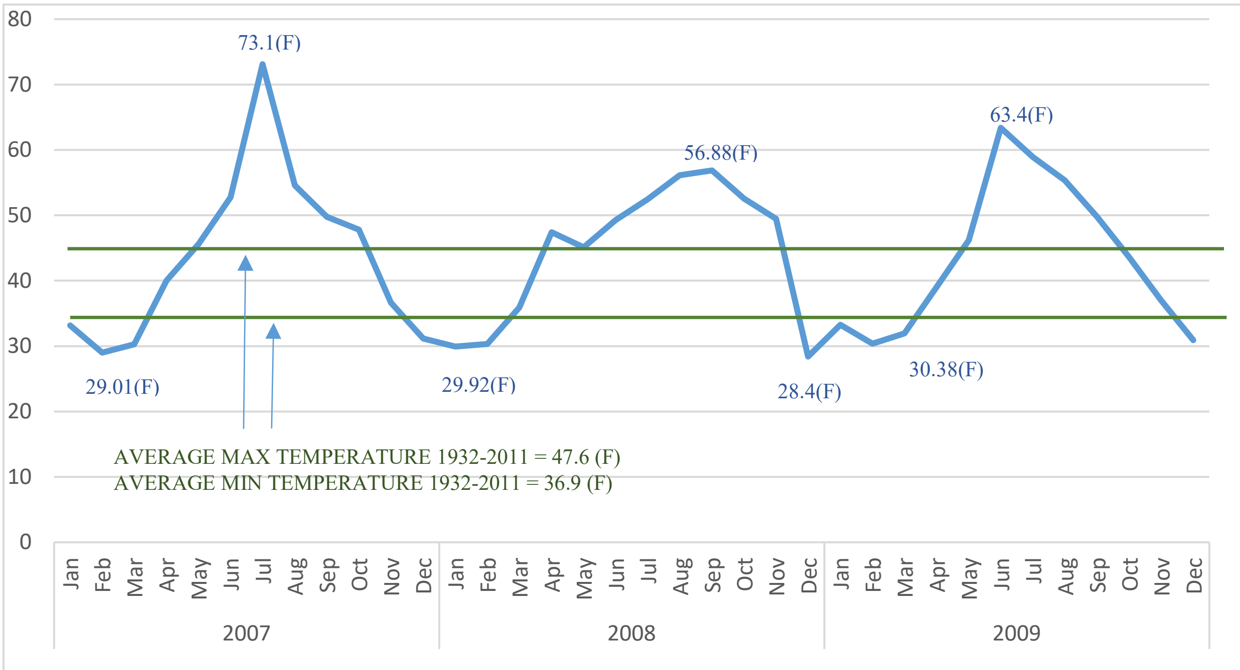
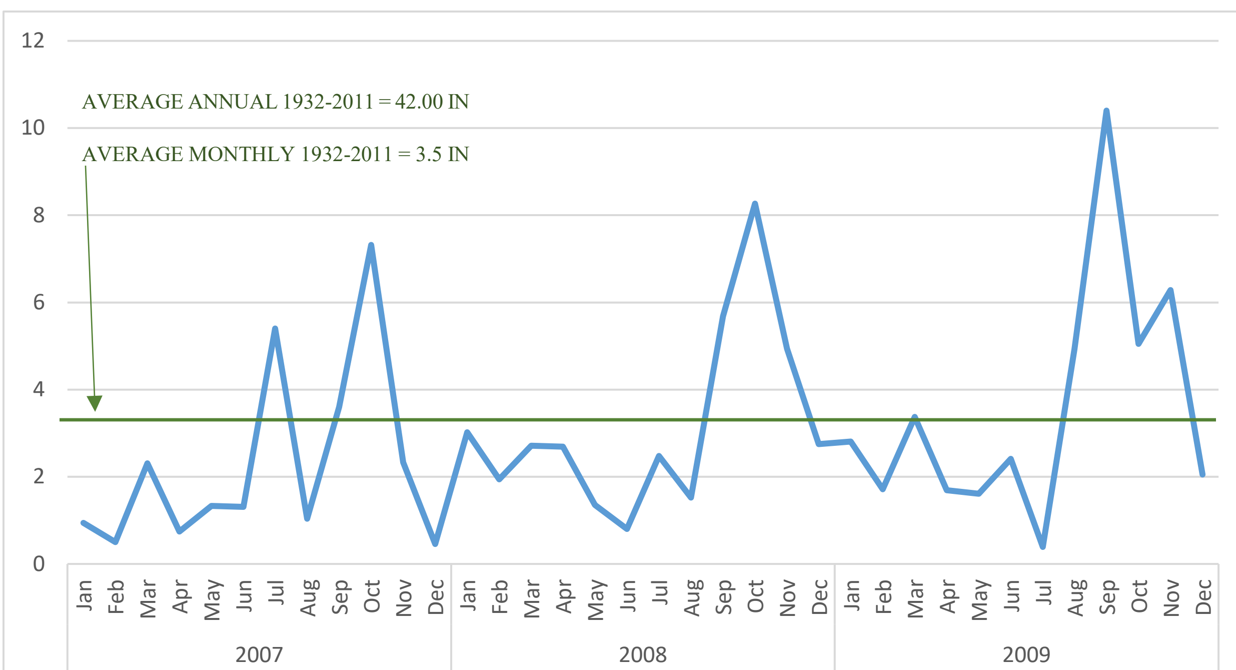


Exhibit 1-3: Angoon Average Temperatures
(NCDC/NOAA, WRCC, accessed Dec 2020)



TOTAL 2007 = 27.28 IN TOTAL 2008 = 38.14 IN TOTAL 2009 = 42.70 IN

Exhibit 1-4: Angoon Precipitation - Inches

(NCDC/NOAA, WRCC, accessed Dec 2020)

ii. Cultural Resources

Admiralty Island has long been the home of the Kootznoowoo Tlingit tribe. From the 1700s to the mid-1800s, fur trading was the major money-making activity in the area. In 1878, the Northwest Trading Company established a trading post and whaling station on nearby Killisnoo Island, and villagers were employed to hunt whales. Whaling did not last long, and the company switched to herring processing. During this time, many Tlingits moved to Killisnoo for employment at the plant. In 1928, Killisnoo was destroyed by fire, and many Tlingits returned to Angoon. A post office was established in 1928. The city was formed in 1963. Many summer homes have developed on Killisnoo Island. Today, Angoon is a Tlingit village with a commercial fishing and subsistence lifestyle (DCCED, 2020).

Since the project area consists of undeveloped wilderness that is difficult to access, it is unlikely that cultural resources are present. However, there may be some archeological sites surrounding the community water source.

iii. Biological Resources

Vegetation & Wildlife

Admiralty Island has a coastal temperate rainforest ecosystem, which consists primarily of tree species such as Western hemlock, Sitka spruce, mountain hemlock, Alaska yellow cedar, western red cedar, and lodgepole pine. Some deciduous hardwood trees such as alder and cottonwood may also be found on avalanche slopes, active riparian zones, or mainland river drainages. The forest supplies a sustainable harvest of timber and forest products (USDA, 2020).

Admiralty Island’s original Tlingit name, Kootznoowoo, means “Fortress of Bears,” which is befitting for a place with one of the highest densities of brown bears in North America. The forests and waterways are also productive habitat for bald eagles, deer, otters, martens, minks, grouse, owls, voles, and more (USDA, 2020).

Threatened and Endangered Species / Critical Habitat

The United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) online system was consulted for the project area to determine presence of threatened and endangered species. The Official Species List (provided in Appendix B) indicates that no threatened, endangered, or candidate species, or critical habitats are present within the project area (USFWS-IPaC, 2020). Documentation of official consultation with USFWS is provided in Appendix B.

Fish Habitat

The State of Alaska Department of Fish and Game (ADF&G) Fish Resource Monitor interactive mapping website was consulted for the Angoon area. According to the Anadromous Waters Catalog (AWC), there are two anadromous streams within the project area including Favorite Creek (AWC Code 112-67-10800) and an unnamed stream (AWC Code 112-67-10802) that drains into Favorite Bay. The unnamed stream contains rearing coho salmon. Table 1-1 shows the anadromous fish and their activity within Favorite Creek (ADF&G, 2020).

Table 1-1: Favorite Creek Anadromous Fish Species Activity

Species	Activity		
	Present	*Rearing*	*Spawning*
Chum salmon	✕		✕
Coho salmon	✕	✕	
Dolly Varden	✕		
Pink salmon	✕		✕

Source: ADF&G, 2020.

It is important to note that there are also several nominations for updates to the AWC for Favorite Creek, which means there are proposed additions or changes to fish presence or activity in the stream. Anyone can make nominations, but ADF&G evaluates and approves the nominations. The nominations for Favorite Creek were made by ADF&G biologists and other observers. Fish on the nomination list include coho salmon, chum salmon, pink salmon, cutthroat trout, Dolly Varden, chinook salmon, Steelhead trout, and sockeye salmon (ADF&G, 2020).

Migratory Birds

Bird species commonly present in the Angoon area include bald eagle, brown creeper, hairy woodpecker, red-breasted sapsucker, and Vancouver Canada goose (USDA, 2020).

The USFWS-IPaC online system was consulted for the project area to determine the presence of migratory birds of particular conservation concern. The IPaC Resources List indicates that no migratory birds of conservation concern are expected to occur in project area (USFWS-IPaC, 2020). Documentation of official consultation with USFWS is provided in Appendix B.

The project will need to comply with the Bald and Golden Eagle Act. In the event that nesting eagles are present, steps will be taken to ensure that temporary disturbances are kept a minimum of 660 feet away from the nest tree, and construction activities are scheduled to avoid times when the birds are nesting (approximately April through September). If a nest is found in or near the project area, construction and clearing activities will cease, and the yet-to-be-determined project contractor will need to immediately consult with USFWS on appropriate action.

iv. Water Resources

Floodplains

Federal Emergency Management Agency (FEMA) flood insurance rate maps (FIRMs) are not available for the Angoon area (FEMA, 2020). According to the "Angoon Airport Master Plan," the last major flood event was in 1984 at an estimated elevation of 22.6 feet (ADOT&PF, 2006). The project will be located inland along mountainous terrain, and will be far enough away from the coast of Favorite Bay to not be impacted by a coastal flooding event.

Water levels of the community water source, Auk'tah Lake, fluctuate due to changes in precipitation, evaporation, community demand, watershed recharge, and lake discharge. "On older maps, Auk'tah Lake is shown as two separate lakes. The two lakes joined into a single lake because of a beaver dam on the outlet of the lower lake. There is a shallow shelf about 5 feet deep which separates the two deep portions of the combined lake. When the lake is full to the top of the beaver dam, the surface elevation is about 70 feet. The maximum depth is 40 feet. The total lake volume is 380 million gallons. The average volume of the upper 5 feet of depth is 18 million gallons per foot of depth" (CRW, 2010). Facilities such as roads and intake structures located along the shore of Auk'tah Lake should be elevated above 70 feet to ensure they are above the floodplain/maximum water level of the lake. The vertical datum for the surface elevation data referenced in the report is unknown.

New roads and pipelines associated with the proposed project may cross existing streams or drainage paths. Design of these facilities should consider stream levels and flow rates to ensure both the infrastructure and surrounding environment are protected from flooding events.

Groundwater

Groundwater surrounds and is hydraulically connected to Auk'tah Lake. However little information is available on aquifer type, depth, extent, and quality in the Angoon area.

Wetlands

The USFWS National Wetlands Inventory (NWI) online mapper was consulted to determine existing wetlands within Angoon and the project area. The NWI maps for Angoon are provided in Appendix B, which indicate various wetland types are located within the project area including: freshwater forested/shrub and freshwater emergent wetlands. Additionally, lakes and estuarine and marine wetlands are located adjacent to the project area (Auk'tah Lake and Favorite Bay). Proposed roads and pipelines to Favorite Creek will likely cross wetlands in some areas, particularly those areas adjacent to Auk'tah Lake (USFWS-NWI, 2020). Proposed facilities that will impact or place fill in wetlands will need to comply with Section 404 of the Clean Water Act, and may require permitting from the US Army Corps of Engineers (USACE).

v. Contaminated Sites

The Alaska Department of Environmental Conservation (ADEC) Contaminated Sites Database was consulted to determine existing contaminated sites near the project area. There are no registered contaminated sites located near Auk'tah Lake or the project area. According to the database, three sites are listed for Angoon, all of which have been assigned a status of "cleanup complete" (ADEC, 2020c). There is one active Class III landfill, one active sewage lagoon, one retired Class III landfill, and two retired woodwaste monofills located in Angoon (ADEC, 2020a). The nearest contaminated site to the community water source is the Angoon landfill, located approximately 2.4 miles northwest from the lake. A map of contaminated sites and drinking water protection areas is provided in Appendix B (ADNR, 2020a).

d) Population Trends

According to the Alaska Department of Labor and Workforce Development (ADOL&WD), Angoon had a population of 404 in 2019 (ADOL&WD, 2020a). Approximately 49.3% of the population is American Indian or Alaska Native, 8.3% Asian, 9.8% black or African American, 22.5% white, and 10% other or two or more races. Additionally, approximately 22.8% of the population is below the age of 20, while approximately 9.2% is 65 or older. The estimated median household income is $27,250, and estimated median family income is $31,042. Approximately 22.9% of the population is below the poverty level (DCCED, 2020).

Table 1-2 shows the population history and 2040-projections for Angoon, including decennial population estimates prior to 2000 (DCCED, 2020), and annual estimates after 2000 (ADOL&WD, 2020a). Exhibit 1-5 shows the estimated population trend for the next 40 years. Using the last 20-years of data (2000-2019), Angoon has had a growth rate of -1.8%. However, the *Alaska Population Projections: 2017 to 2045* report prepared by ADOL&WD predicts the growth rate for the Hoonah-Angoon Census Area between 2020-2025 to be -0.7%, changing every 5 years by approximately -0.2% through 2060. This results in an average annual growth rate of approximately -1.2% between 2020 and 2060 (ADOL&WD, 2020b). Using this growth rate, Angoon will have an estimated population of 314 by year 2040 (a project design period of 20 years).

Table 1-2: Angoon Population Estimates

Historic Population	
Year	**Population**
Before 2000 (10-Year Interval)	
1880	420
1890	0
1900	0
1910	0
1920	114
1930	319
1940	342
1950	429
1960	395
1970	400
1980	465
1990	638

Historic Population	
Year	**Population**
After 2000 (1-Year Interval)	
2000	572
2001	532
2002	520
2003	480
2004	464
2005	478
2006	467
2007	468
2008	431
2009	450
2010	459
2011	477
2012	457
2013	441
2014	420
2015	429
2016	411
2017	406
2018	409
2019	404

Future Projected Population	
Year	**Population**
Growth Rate	**-1.2%**
2020	399
2021	394
2022	390
2023	385
2024	380
2025	376
2026	371
2027	367
2028	362
2029	358
2030	354
2031	350
2032	345
2033	341
2034	337
2035	333
2036	329
2037	325
2038	321
2039	317
2040	**314**

Due to economic uncertainties in the community, it is difficult to predict future population trends. For example, in October 2019, the ferry service to Angoon was suspended due to budget constraints and needed maintenance. Ferry service has since resumed, but the underlying issues with budget and aging ferry systems could put south-east communities at risk of further disruptions, interrupting the community's access to transportation and goods, which could potentially lead to a reduction of Angoon's residential population. However, ADOT&PF is in the process of designing a new land-based airport in Angoon, which could have the opposite effect on the population. ADOT&PF plans to complete the design in 2020. Construction is anticipated to begin in 2021 and could take up to three years (ADOT&PF, 2020). The Angoon Airport Final Environmental Impact Statement estimated a population decline of -2.0% (Federal Aviation Administration [FAA], 2016). This is similar to the calculated growth rate of -1.8% discussed above.

Another consideration is housing. City of Angoon personnel explained that three houses are currently under construction in 2020, and several lots have been purchased, indicating potential development in the next 5-10 years. Overall, there is some potential for growth, but based on recent trends a slow population decline is still anticipated. Therefore, the growth rate estimate of -1.2% from ADOL&WD was assumed because it is more conservative.

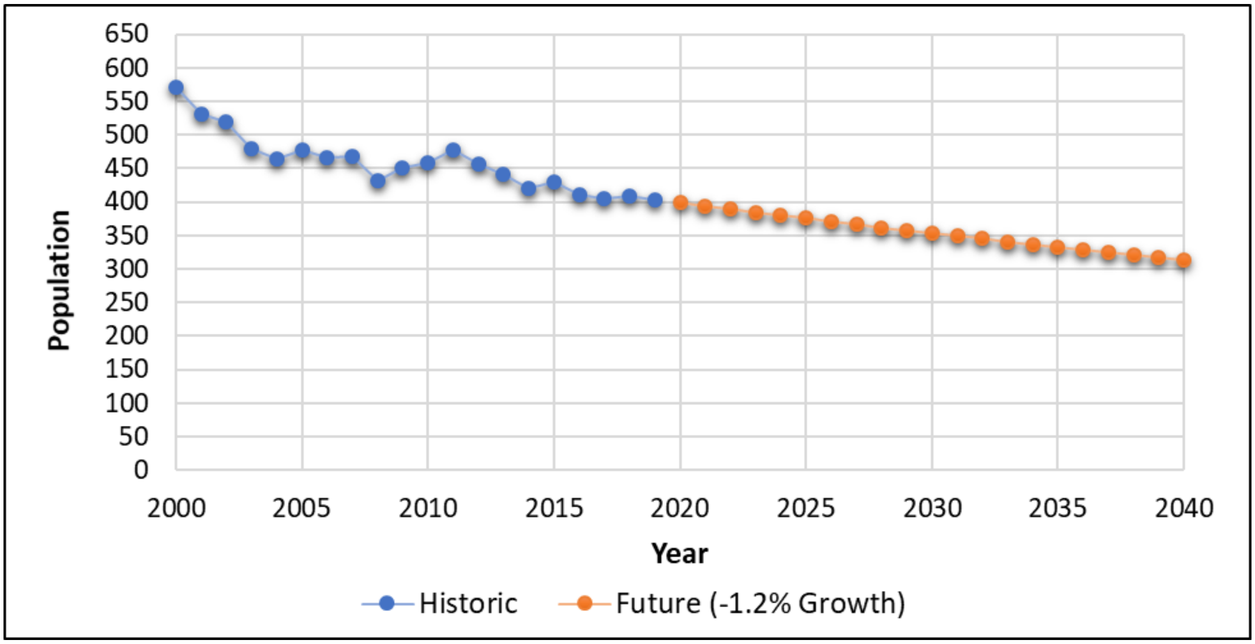


Exhibit 1-5: Angoon Population History & Projection

e) <u>Access</u>

Angoon is currently accessible by float plane and boat for passengers and small freight. Float plane services are available from the state-owned seaplane base at Kootznahoo Inlet. However, poor weather routinely disrupts scheduled flights. A deep draft dock and small boat harbor are also available. In 2019, the Alaska Marine Highway System interrupted mainline ferry service due to maintenance issues. Boat service has resumed. The state currently provides twice weekly scheduled service, two times per month, although COVID concerns have disrupted service during 2020.

f) <u>Community Engagement</u>

At the beginning of this project a kickoff meeting was held which included representatives from ANTHC, Angoon, and Bristol. The basic concerns voiced at the meeting regarding a new intake were ensuring the intake provided a sufficient quantity of water to meet current and future demand; providing raw water of good quality, and minimizing operational costs. Minutes from this meeting are included in Appendix G.

An additional meeting was held with the Mayor (Joshua Bowen) and the Angoon Planning and Zoning Clerk (Christina Joseph), ANTHC (Kevin Ulrich) and Bristol (Vanessa Wike) on December 18, 2020, to discuss the 65% PER in development. Minutes from this meeting are included in Appendix G.

Comments and issues discussed at these meetings include:

- The deficiencies noted in the 2019 Sanitary Survey by Safewater (included in Appendix F), are being addressed (these deficiencies are discussed in detail in Section 2).
- It was recognized that an Environmental Impact Statement (EIS) will be needed for the final design of an impoundment. This would be included at the design stage.
- The existing water supply pond has poor water quality, and substantial power is needed to pump the water through the treatment system.
- Multiple prior studies have identified a potential new water source on Favorite Creek. The water quality of Favorite Creek was preferred over the water quality of the existing source pond (Auk'tah Lake).
- The development of an impoundment in the Favorite Creek area would be challenging due to current regulatory requirements and the seismic activity in the area. However, it could be situated to provide an adequate elevation to eliminate the need for pumping. A partial diversion structure, or smaller intake would avoid safety and regulatory issues associated with a larger structure.
- Organic levels in nearby areas (Saxman) are increasing. This appears to be related to warmer water associated with climate change.
- Additional geotechnical and survey information would be needed for design. Light Detection and Ranging (LIDAR) would be very helpful to understand geologic risks.
- Leakage of the existing water distribution mains is significantly contributing to the demand for the system. A project is underway to address leakage.
- The site for a new impoundment has no current access. A trail to the new site would be helpful in conducting needed site investigations. Helicopter access is possible, but would be expensive. Bear activity in the area would need to be considered.
- There were concerns that the community would not have sufficient quantities of water to meet future demand and planned expansions.
- The community has heard about plans for an impoundment for many years. The community is likely to expect this alternative as the preferred alternative.
- The community asked about options that could include solar panels, to offset power costs.

2.0 EXISTING FACILITIES

The Angoon WTP is the only public water system in the community. It is classified by the ADEC Drinking Water Program as a Community Public Water System and assigned a Public Water System Identification Number (PWSID) of AK2130017. The ADEC Operator Training and Certification Program classifies the Angoon Water Treatment System as a Class 2 Water Treatment System, with a score of 36 points (out of a maximum of 55 points in the Class 2 category), and a Class 1 Water Distribution System (serving 500 or less service connections in 3 pressure zones). The system currently employs operators that meet these requirements. Operator certification information is provided in Appendix F (ADEC, 2020d).

In addition to serving the homes in the community, the water system provides service to public facilities, including the post office, clinic, fire station, community hall, youth center, dock facilities, and local businesses. The Angoon water system also provides service to the PK-12 Angoon School. According to conversation with Angoon School staff members in December 2020, the school has a current enrollment of approximately 67 students, and 16 total staff which includes teachers, administrative, and support staff.

The water system consists of a surface water intake in Auk'tah Lake, direct filtration, hypochlorite disinfection, and treated water storage in three water storage tanks located throughout the community. The distribution system includes 3 pressure zones, and provides service to approximately 159 (158 residential, 1 commercial) service connections (ADEC, 2020b).

a) <u>Location Map</u>

The City of Angoon. the current water source, and the location of a possible alternative water source (impoundment), is shown on Figure 1 (also included in Appendix A).

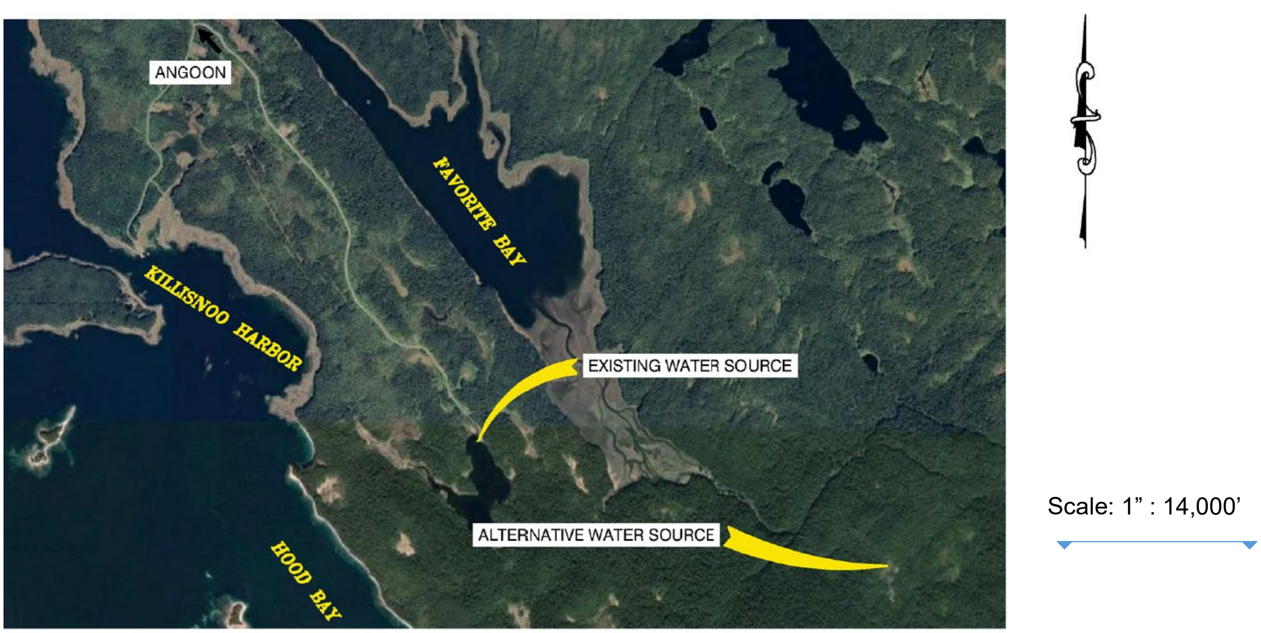


Figure 1: Angoon Project Location Map

b) History

The history of water facilities in Angoon summarized below was obtained from the 2019 *Final Preliminary Engineering Report: Aanya Street Sewer Main* prepared by CRW Engineering Group, as well as from record drawings of ANTHC water system projects:

- 1966 – Log crib dam and polyvinyl chloride (PVC) transmission line installed for Angoon's first lake water storage dam.
- 1967 – First water distribution system was installed, including 20,000-gallon wood stave water storage tank; sewer system was also expanded through town.
- 1973-1976 – Extensions of water and sewer lines to Kookesh Court neighborhood and along Chinook Way, new 100,000-gallon water tank, and new water treatment plant (located adjacent to old 20,000-gallon water tank, which was abandoned after this project).
- 1984 – Water and sewer line extensions along Aan-Deina At Street.
- 1996 – Water and sewer line extensions on south side of town, new sewer lift station near Kootznahoo Inlet outfall, new fire hydrants installed around town with a road-repaving project by ADOT&PF.
- 2005-2009 – Water Treatment Plant Improvements (ANTHC Project AN 05-RA5), which upgraded the existing filters with new underdrains and an air scour system, new online turbidimeters, a streaming current detector for process control, and improved chemical handling and storage facilities.
- 2009-2011 – Raw Water Intake Upgrade (ANTHC Project AN 09-NK3), which replaced the deteriorated timber intake structure, wet well, and raw water transmission main with a new intake platform, intake screen, and new raw water transmission line with pigging system for pipeline maintenance.

c) Condition of Existing Facilities

i. Document Review

No site inspection was conducted for this PER, but a thorough review of past design studies, trip reports, record drawings, and other documents, was conducted to evaluate the condition of existing facilities. Additionally, the consideration of an impoundment structure included a review of a substantial amount of prior studies related to this subject. A geotechnical memorandum, providing an updated desktop study of the geologic conditions, incorporating the consideration of an infiltration gallery was also completed by Golder (full report included in Appendix H).

Reviewed documents are listed below. All documents were not attached to the PER because of size considerations. Pertinent documents that are included in the Appendices are noted as referenced:

1. Comprehensive Energy Audit for Angoon Water Treatment Plant, prepared by ANTHC in August 2016 – Analyzed historical energy use and identifies costs and savings of recommended energy conservation measures (ANTHC, 2016) – Appendix C.
2. Angoon Water Utility Rate Study, prepared by the City of Angoon in February 2013 – Evaluated the amount of water produced per year, cost of water per gallon, current customer charges, number of customers not paying their bill, and more (City of Angoon, 2013) – Appendix C.
3. ADEC Drinking Water Program – Historical monitoring, compliance, and enforcement information was obtained from the online Water Watch database, as well as a summary of past violations. A summary of historical compliance information for the past 10 years is included in Appendix F (ADEC, 2020b).
4. The City of Angoon Public Water Sanitary Survey, prepared by Safewater Alaska in July 2019 – Surveyed existing facilities, generated a deficiency report, and provided recommendations to correct noted deficiencies (Safewater Alaska, 2019) – Appendix F.
5. Remote Maintenance Worker (RMW) Site Visit Reports (Multiple), prepared by the Alaska RMW Program between 2016-2019 – Performed site visits for various reasons including surveying and photographing existing conditions, operator training, routine maintenance, leak detection activities, system upgrades, etc. (RMW Program, 2019) – Appendix G.
6. Record Drawings: Angoon Water Main Upgrade, prepared by Quadra Engineering, Inc. in October 1982 – Provides as-built conditions for a portion of the water system in Angoon (Quadra, 1982).
7. Record Drawings: Angoon Water Treatment Plant Improvements (ANTHC Project AN-05-RA5) and Angoon Raw Water Intake Upgrade (ANTHC Project AN-09-NK3). The record drawings provide information on the substantial water system improvements completed 2009-2011.
8. Angoon, Alaska, Hood Mountain Water Source Feasibility Study (October, 2000), prepared by Andrew Meltzer and Dan Reitz with ANTHC (ANTHC Project AN99-P21). This includes information on the watershed that is important in considering an impoundment alternative. This study includes references to the following:
   - Angoon Hydropower Preliminary Reconnaissance Report, Tryck, Nyman & Hayes, November, 1980.
   - Kootznoohoo Head Water Resources Study, Jay Farmwald, ANTHC, May, 1981.
   - Angoon Water Supply Alternatives, Tryck, Nyman & Hayes (for the Alaska Power Authority), July 1981.
   - City of Angoon – Land Use Plans, CH2M Hill, December, 1982.

- A Comparative Economic Analysis of Electric Energy Alternatives for Angoon, Alaska, Alaska Power Authority, ACRES, February, 1984.
- High Pressure Water Study – City of Angoon, Quadra Engineering, Inc., February, 1985.
- Water Quality Profile – Angoon, Alaska, US Public Health Service, August, 1987.
- Water Source Evaluation, Tillinghast Lake and Favorite Bay Creek, James M. Montgomery Consulting Engineers Inc. (for Angoon Community Association), October, 1987.
- Angoon Water Supply Improvements – Water Line Extension, High Mountain Stream Gravity Supply, Alaska Area Native Health Service, Technical Memorandum, February, 1992.

9. City of Angoon, Favorite Creek Hydrology Study (December 2010), prepared by CRW Engineering Group, LLC and Golder Associates – which discusses the potential for a source water impoundment on Favorite Creek (CRW, 2010).

ii. Water System

A schematic of the existing water system, Figure 2: Existing System Schematic, is provided on the following page (and in Appendix A). An evaluation of the Major Unit Processes (MUPs) for the existing system which collectively evaluates system processes and their ability to meet demand is provided in Exhibit 2-1: Major Unit Process Evaluation, Angoon WTP (included with calculations in Appendix D). This indicates that the renovations completed in 2009 and 2011 were successful in extending the operational life of the original system.

Issues are evident in the disinfection process. The current chlorination system does not provide 1-log of Giardia inactivation and is not in compliance with the treatment requirements of the SWTR. Different operational scenarios are described below that would bring the disinfection system into compliance:

1. Increase the chlorine dosage such that the chlorine residual is at least 0.4 mg/L free chlorine (this was the dosage assumed in the engineered plans for the 2007 WTP renovation). The distribution residual requirement would continue to be 0.2 mg/L;
2. Use the full volume (500,000 gallons) of the water storage tank (WST) adjacent to the WTP for chlorine contact time; or
3. Address the leaks in the system, thereby decreasing the peak hourly flow, allowing for more disinfectant contact time.

The MUP evaluation also shows that the Auk'tah Lake watershed and intake pump systems provide the highest relative capacity in the system. The issues with water availability appear to be due to recent changes in the water surface elevation of the Lake in conjunction with the constructed elevation of the wet well.

Each component of the water system is discussed separately below, including water source, intake, treatment, storage, distribution, and demand.

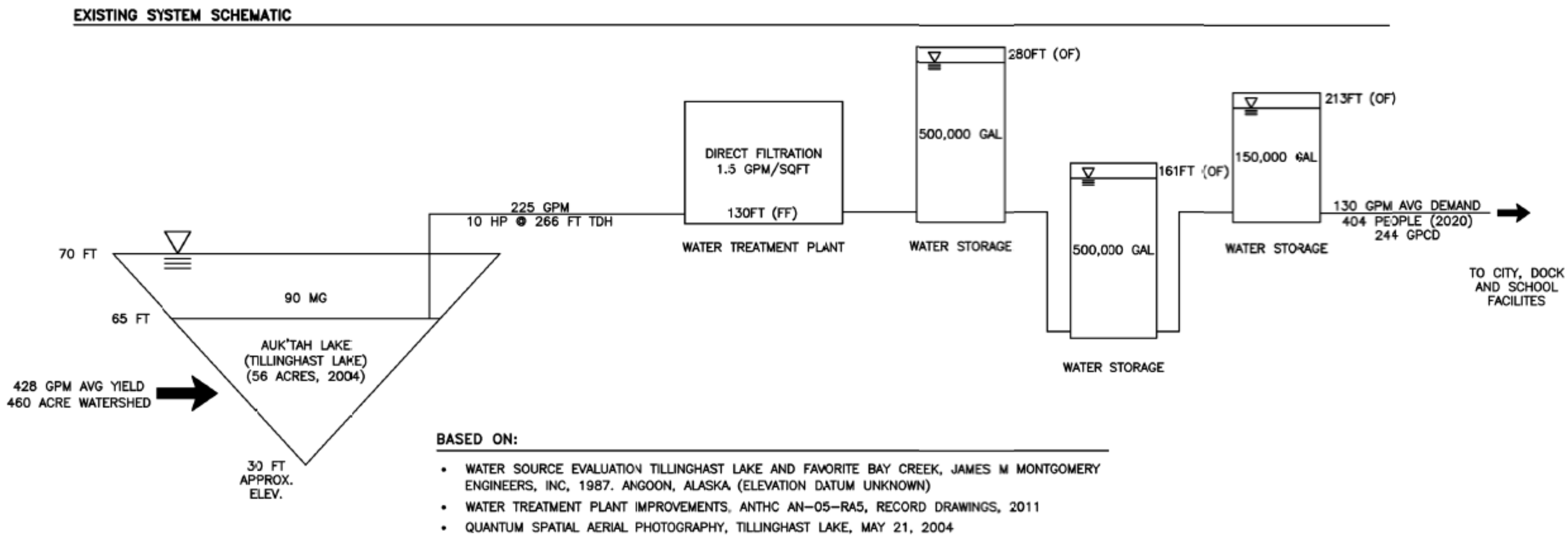
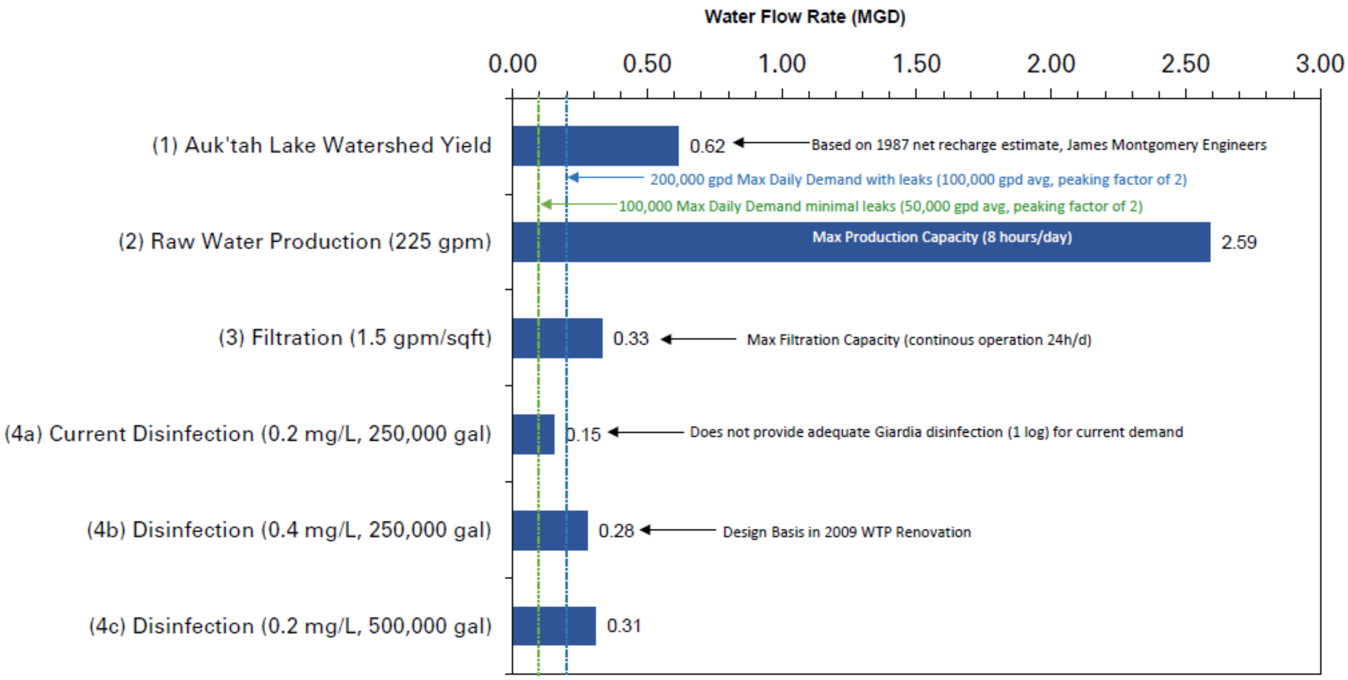


Figure 2: Existing System Schematic

Exhibit 2-1: Major Unit Process Evaluation, Angoon WTP



Water Source

The Angoon water system has relied on Auk'tah Lake for raw water since approximately 1992. Auk'tah Lake is located in an undeveloped area approximately 3.5 miles southeast of town. Auk'tah Lake has a surface area of approximately 56 acres (Aerial photography, 2004, Quantum Spatial). The lake consists of two interconnected lakes, with the northern-most lake (a surface area of approximately 30 acres and 40 feet deep maximum) slightly larger and deeper than the southern-most lake (a surface area of approximately 26 acres and 30 feet deep maximum).

A beaver dam located on the outlet of the southern-most lake has increased the water elevation, flooding the narrow strip of land that divides the two sections of the lake with approximately 5 feet of water. The lake appears as a single lake in documents dating back to the 1980's. However, it has reportedly been shown on early, historic maps as two lakes.

The source intake system was installed in 1993 and rebuilt in 2011. In 1993 the reported elevation of lake surface was 72 feet. In the 2011 ANTHC upgrade project the reported elevation of the lake surface was lower at 65.5 feet. However, the two plan sets may not have been using the same datum. There is no current survey of the intake area, or lake surface elevations.

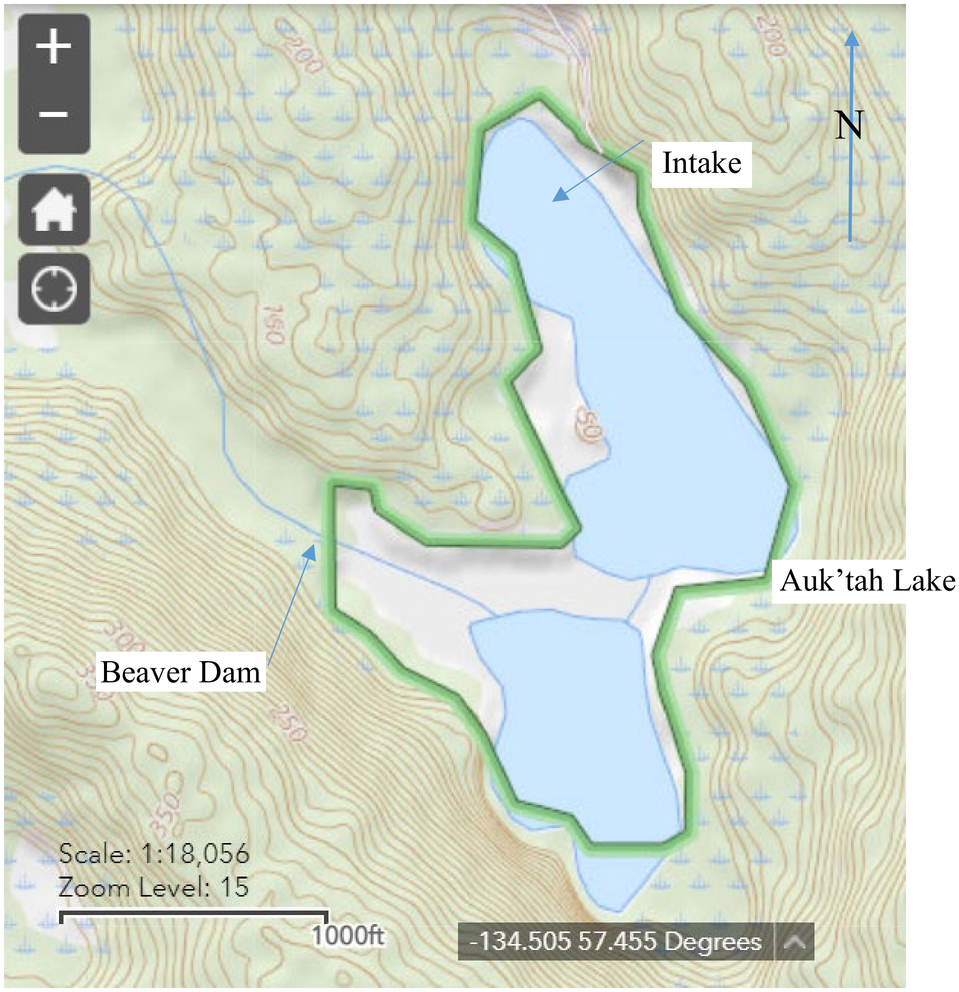


Exhibit 2-2: Auk'tah Lake Topography (usgs.com)

Prior hydrologic studies (CRW/Golder, 2010) assumed that the usable volume of the lake is limited to the top 5 feet of water, with an estimated usable volume of 90 million gallons (MG) of water (18 MG / foot). Below this estimated 5 foot depth, the lake would separate into two adjoining lakes. If the lake water level ever dropped 5 feet or more, the current water intake system (located near the bottom of the northern-most lake) would only have immediate access to the northern-most part of the lake. Based on available topographic information, the total loss of the beaver dam would result in a water elevation level drop of approximately 5 feet, likely resulting in the separation of the two halves of the lake (Exhibit 2-2: Auk'tah Lake Topography (usgs.com)).

For comparison purposes, the top 5 feet of water in the northern-most lake equals approximately 45 MG of water.

In recent years the lake water level has reportedly dropped during the summers, which have become warmer and drier, for a longer period of time.

A conceptual cross section showing approximate lake depths and storage volumes is provided in Exhibit 2-3: Auk'tah Lake Cross Section.

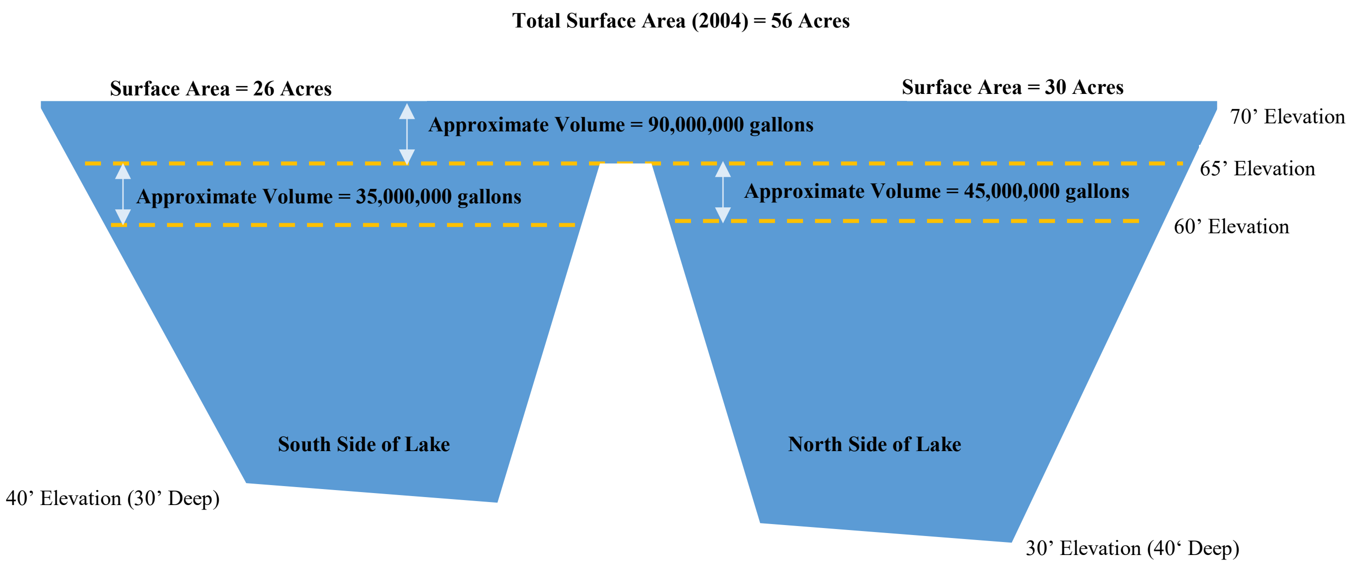


Exhibit 2-3: Auk'tah Lake Cross Section
(Not to Scale)

A review of the current water rights permit (LAS 12057) with the Alaska Department of Natural Resources (ADNR) indicates water rights for Auk’tah Lake (submitted under the name Tillinghast Lake) were first issued in 1988, with an update requested in 1992 (this was not finalized as discussed in Section 2*iii*). The water use rate in the original permit specified a maximum daily use of 432,000 gallons per day (gpd) (ADNR, 2020c).

The Auk’tah Lake water shed is undeveloped and approximately 460 acres in size. Golder’s hydrologic report (included in the 2010 CRW study), estimated a watershed recharge rate of approximately 428 gallons per minute (gpm) (CRW 2010) .

A review of water system operator logs (2019) indicate the system is currently using approximately 100,000 gpd, with over half of the produced water being lost to leakage (as discussed in a section on the distribution system). At the current demand, the 45,000,000 gallons of storage, in the top 5-feet of the north side of the lake, represents 450 days of storage.

The design criteria used in the 2011 renovation assumed water was treated at a maximum rate of 225 gpm (ANTHC 2011). The maximum pump rate is based on a maximum filtration rate (as discussed in the following water treatment discussion). The 225 gpm pump rate represents a maximum possible daily draw of 324,000 gpd (if the pumps ran constantly, 24 hours per day), which is below the current use rate of, the 2011 design rate, and the original ADNR water rights allotment of 432,000 gpd.

A summary of water balance estimates for Auk’tah Lake is provided in Table 2-1: Auk'tah Lake Water Balance Estimates.

Table 2-1: Auk'tah Lake Water Balance Estimates

Watershed Recharge		
Estimated Watershed Recharge Rate (CRW, 2010)	428	gpm
Estimated Annual Evapotranspiration Loss (CRW, 2010)	21.1	inches
Estimated Annual Precipitation (CRW, 2010)[1]	39.1	inches
Net Watershed Precipitation / Runoff (CRW, 2010)	18.0	inches
System Demand		
Estimated average daily water demand (Operator Logs, 2020)	100,000	gpd
Max pumping rate (ANTHC Record Drawings, 2011)	225	gpm
Max pumping rate	0.6020	cfs
Max possible use rate of existing pumps (pumping 24 hours/day)	324,000	gpd
DNR Water Rights (original use allotment, DNR, 1988)	432,000	gpd

Note:

1. The estimated precipitation used in the CRW study is slightly less than the actual precipitation reported by NOAA as shown in Exhibit 1-4.

Within recent years there have been increased concerns due to dropping lake water levels as well as due to an observed decrease in lake water quality (cloudiness, increased biologic growth). There are also concerns that the beaver dam presents an increased risk to the water system because of the potential for protozoal contamination (*Giardia*, *Cryptosporidium*).

Unfortunately, most of the available water test data is based on test results for treated water to evaluate compliance with minimum drinking water standards, so there is very limited data available on the raw water. However, part of the compliance testing did include a requirement for source water screening to determine the risk of *Cryptosporidium* contamination (as required by the Long Term 2 Surface Water Treatment Rule). This screening required sampling (either monthly for two years, or twice monthly for one year) in two sampling events (2009 and 2018). The raw water was sampled for *E. Coli* bacteria which was used as an indicator organism for *Cryptosporidium*. Based on sample results, surface water supplies are ranked from low risk ("Bin 1") to high risk ("Bin 4"). Angoon completed source water sampling and ranked in the lower "Bin 1" in both 2009 and 2018 (test results included in Appendix F). All surface water sources serving public water systems in Alaska have ranked in the lower "Bin 1" category.

Although not a direct measurement of raw water quality, treated water levels for turbidity and disinfection-by-products (DBPs) are an indicator of raw water quality. These are discussed in the following section on treatment.

Intake

The intake was installed in 1993 and upgraded in 2011. The 2011 upgrades included a new floating deck with a hoist to allow maintenance and cleaning of the screened intake. A site plan from the intake project showing the intake, WTP, and WST, is provided in **Figure 3** and **Figure 4**.

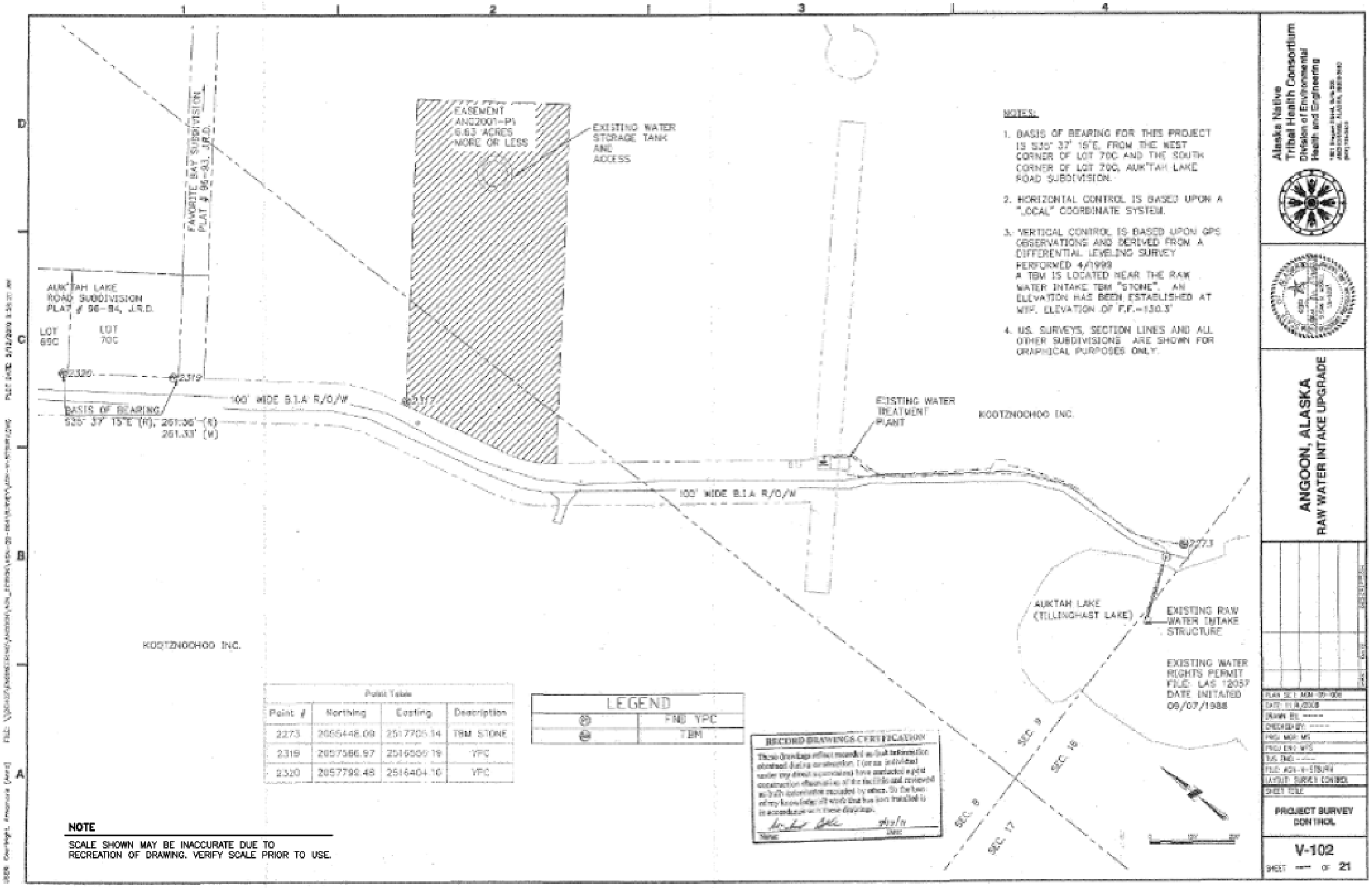


Figure 3: Raw Water Intake Upgrade Project (ANTHC)

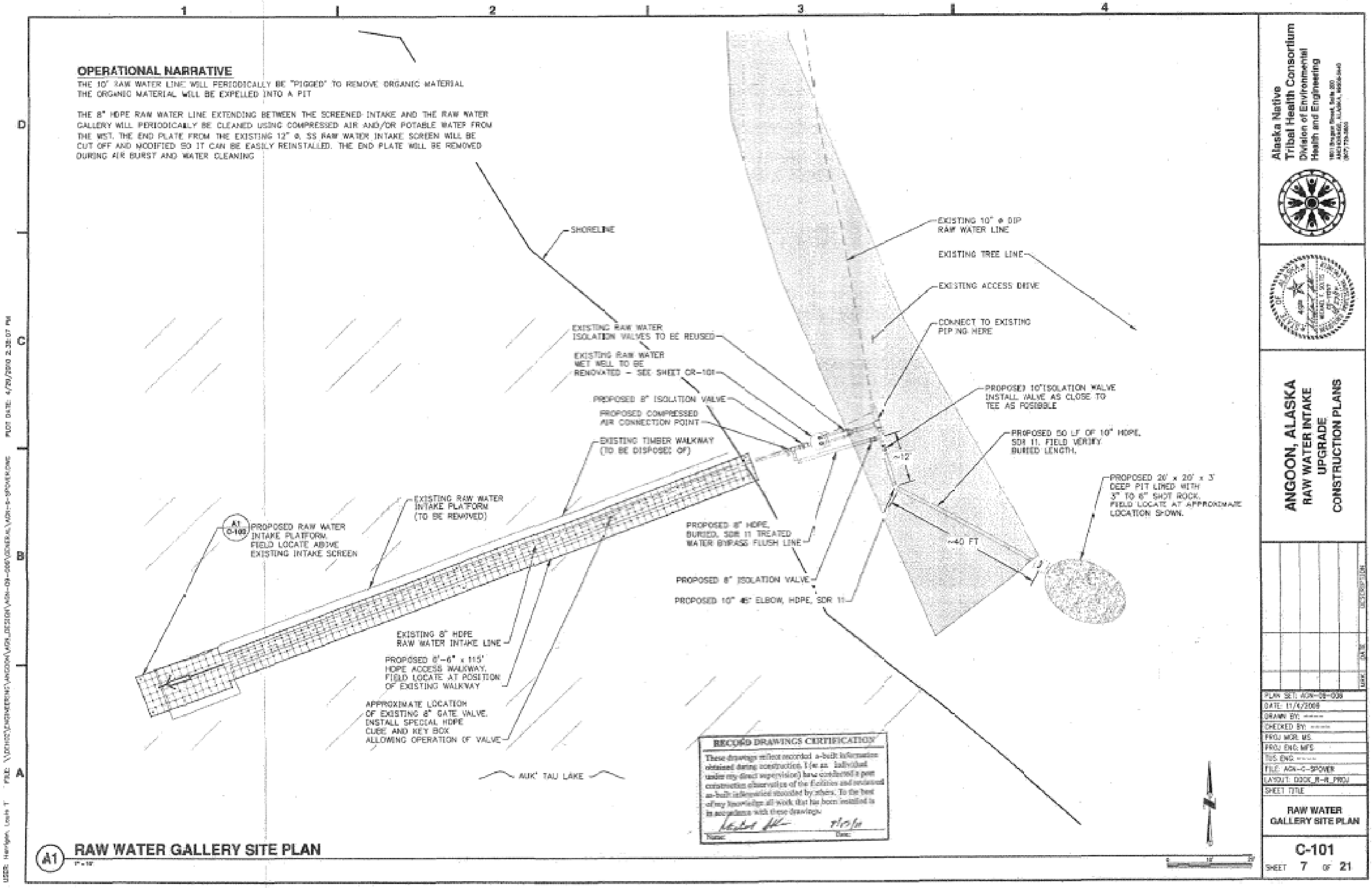


Figure 4: Existing Intake System Site Plan (ANTHC)

Exhibit 2-4: Auk'tah Lake, near Intake (2019)

The source water intake is located near the bottom of the north side of the lake, about 200 linear feet (LF) from shore, beneath an intake access pier that is constructed out into the lake (Exhibit 2-5).

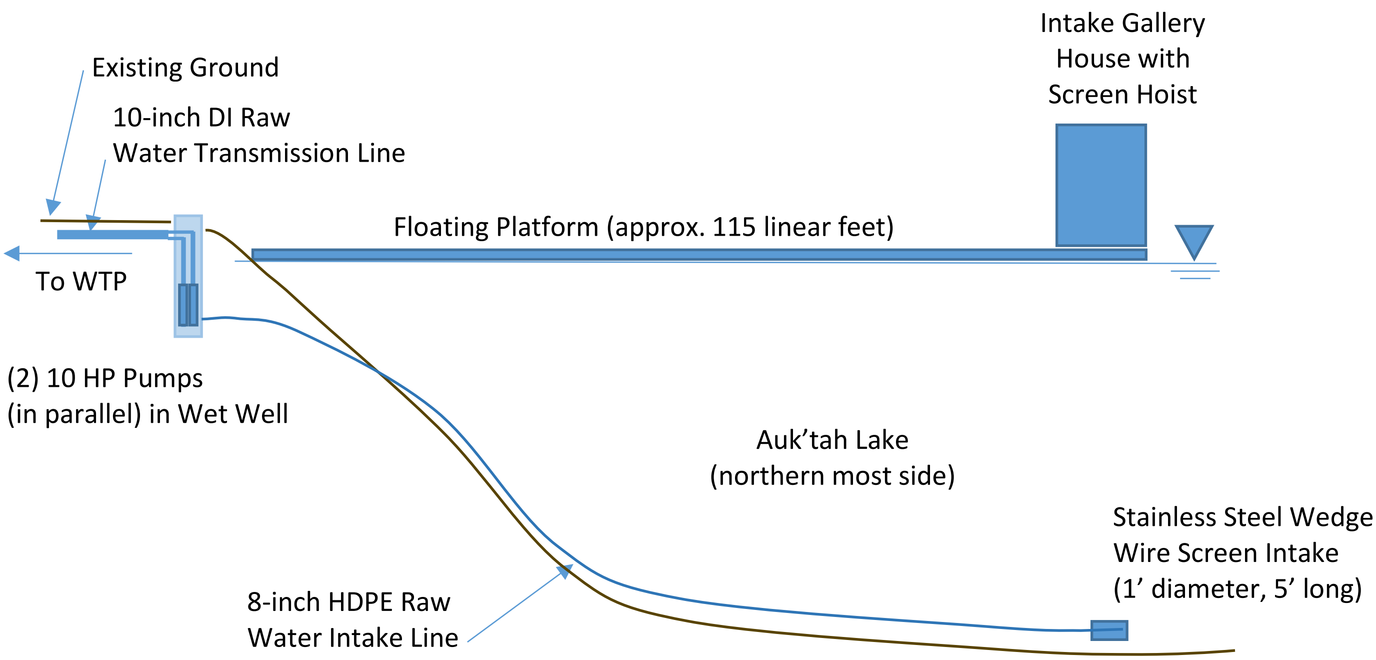


Exhibit 2-5: Auk'tah Lake Intake Schematic
(Adapted from record drawings, ANTHC AN-09-NK3, Not to Scale)

Two new submersible pumps, each 10 horsepower (HP), were installed as part of the 2011 upgrade project. Both pumps were needed to meet the full design flow. These pumps were installed in the existing CMP wet well (**Figure 5**). The wet well is reportedly showing signs of deterioration, which was also evident in the ANTHC Energy Audit (2016). The 2011 design specifies two new pumps, 10 HP Grundfos 85S100-7, that were designed to operate in parallel, providing a total design flow of 225 gpm. The 2011 upgrades also included a new screened intake, new floating platform with a tripod lifting hoist over the intake, and a pig cleaning, air compression system to help clear the intake line of debris (to address an ongoing problem with the system).

After the 2011 intake renovation was completed, inspection reports (including the 2016 ANTHC Energy Audit) refer to VFD controllers that were added and pump rates were lowered to an average of 70-90 gpm. The pumps are run for a longer period (almost continuously) to meet daily demand. This would require the pumps to operate substantially slower than designed and outside their optimum efficiency range (based on the pump curve included with the 2011 design). There are no reported issues with the pump control panel. However, no record documents of the existing systems were available.

Reported issues with the current intake include:

- When the lake level drops there is limited water in the wet well, threatening the ability to have sufficient water to maintain the 80 gpm average pump rate.
- Substantial organics are pumped from the source, requiring frequent cleaning (pigging) of the raw water transmission line.

Intake design will impact raw water quality and the risk of microbial contamination, as well as the level of particulates (turbidity) and organics in the water. Organics in the water will increase DBP formation, as well as make it more difficult to maintain the required chlorine residual. The intake pumping rate needs to consider the filtration loading rate for optimum filter performance (as discussed in the next section on water treatment).

Water Treatment

The WTP is located approximately 750 feet north of the lake. It was originally constructed in 1976 with a direct filtration system, and chlorine disinfection provided in an adjacent 500,000 gallon WST. System design criteria are provided in **Table 2-2**. A flow diagram for the WTP is shown in Exhibit 2-6.

A substantial renovation was completed in 2009 (ANTHC project AN 05-RA5) which included new filter underdrains and added air scour (the original filter vessels were retained), improved treatment processes and equipment (including a streaming current detector for coagulation control), and improved chemical storage.

In 2011 new raw water pumps were added as part of a second project (ANTHC project AN 09-NK3) which renovated the raw water intake.

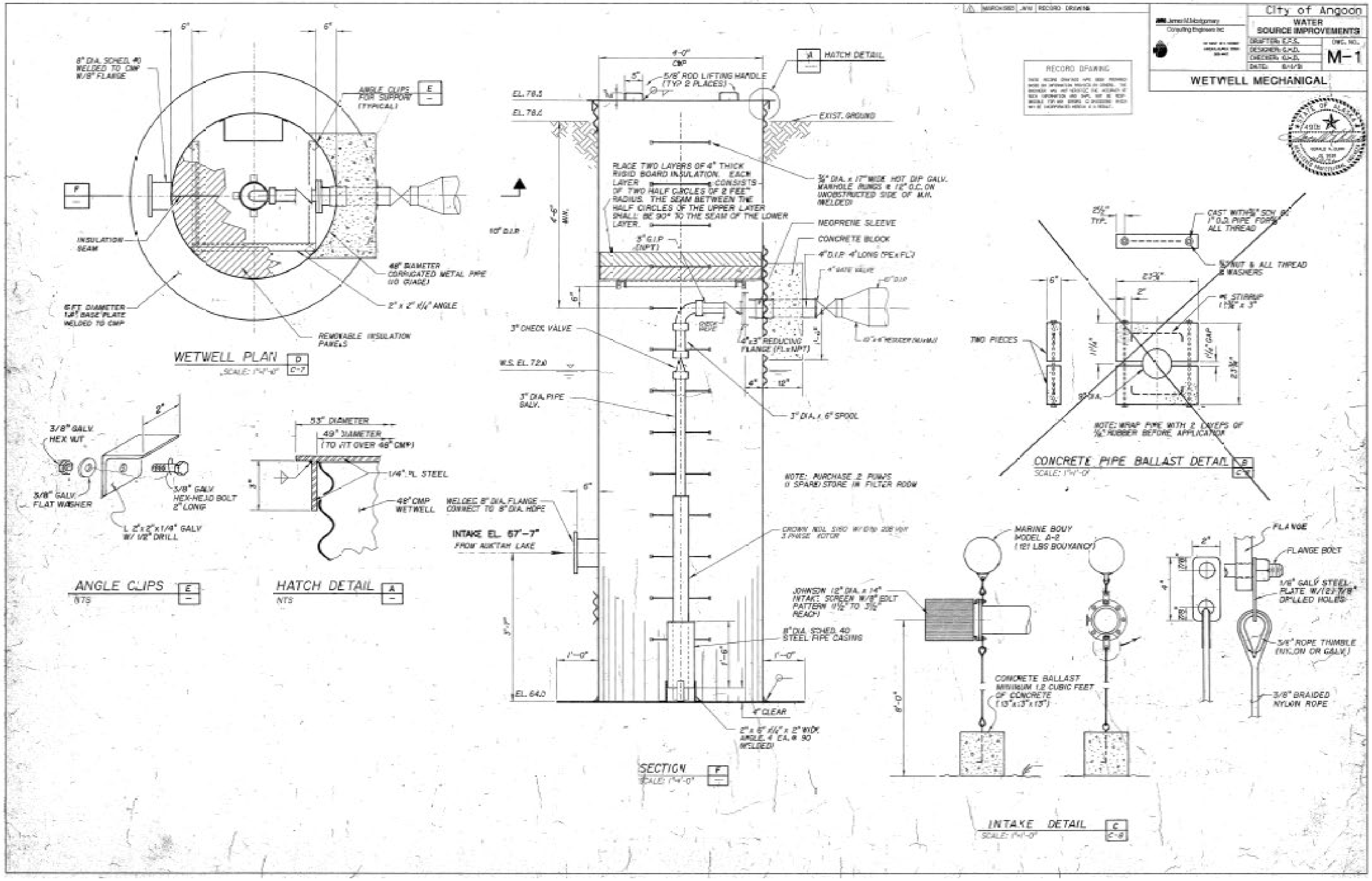


Figure 5: Existing Wet Well (JMM Engineers)

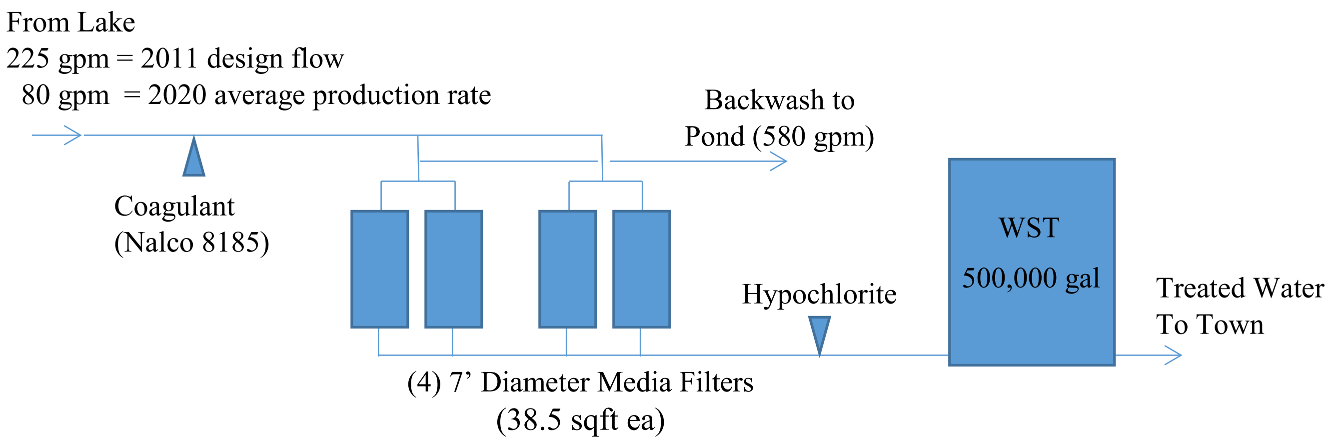


Exhibit 2-6: WTP Flow Diagram
(Based on record record drawings, ANTHC AN 05-RA5)

The design criteria referenced in the WTP and intake renovations is summarized in the following table (and included on Figure 2 in Appendix A).

Table 2-2: WTP Design Criteria

Treatment Rate (raw water pump rate)	225	gpm
Number of Filters (in parallel)	4	
Filter Diameter (ea)	7	feet
Filter Surface Area (ea)	38.5	sqft
Filter Loading Rate (after intake renovation in 2011)	1.5	gpm/sqft
Backwash Loading Rate (per filter)	15	gpm/sqft
Backwash Discharge (ea, backwashed in series)	580	gpm
Minimum Chlorine Concentration for 1 log *Giardia* Disinfection[1]	0.4	mg/L
Minimum WST volume for *Giardia* disinfection	250,000	gallons

Note: Contact time calculations are provided in Appendix D.

The intake renovation project reduced the pump rate from the original design rate of 308 gpm to 225 gpm, reducing the filter loading rate from 2 gpm/sqft in the original design to 1.5 gpm/sqft. Upgrades to the pumping system after the 2011 renovation added VFD controllers. Afterwards, pump rates were decreased to 80 gpm average. This would result in a loading rate of approximately 0.5 gpm/sqft. Loading rates below 1 gpm/sqft can impede filter performance due to air binding, or bubble formation in the filter bed (EPA, 2012), resulting in shorter filter runs and inefficient use of the filter media.

During a 2019 site inspection, the RMW reported issues with mudballs and fouled media (2019 RMW Trip Report, Appendix G). The RMW inspection report indicates there was limited media expansion during backwash using the standard backwash rate of 700 gpm (18 gpm/sqft). During backwash the filter pressure was reading 100 pounds per square inch (psi) (maximum filter vessel pressure, 20 psi would be typical; 100 psi is too high for standard operations). The backwash rate was increased to 970 gpm (25 gpm/sqft) for an extended period to clean the media. However fouling was still observable through the filter view ports. The system is currently planning to replace their filter media (the media was installed in the 2009 WTP renovation project). Factors contributing to media fouling include organic overflow from the source (a reported ongoing problem), air binding in the filter media (due to low filter loading), coagulant dosing (the SCD was also reporting issues), and/or issues with the air scour system which was retrofitted into the original filter vessels.

The combined filter effluent turbidity values reported in the Drinking Water Monthly Operator Reports (MORs) for 2019 and 2020 were extremely low, between 0.02 and 0.07 NTUs (results summarized in calculations, Appendix D). The MORs are a report of combined filter effluent turbidity values taken at 4 hour intervals throughout the day based on readings on a Hach 1720 E turbidimeter, with a reported accuracy of ± 0.02 NTU. The reported values indicate that the system is producing filtered water below the maximum limit of 0.3 NTUs and below the optimized goal of 0.1 NTUs. Lower turbidity values are typically associated with a lower risk of microbial contamination. However, if short-circuiting is occurring (due to media plugging or air binding) it may not be evident in the four hour turbidity readings.

Turbidity values indicate particulate removal, but do not always correspond to organic removal. Inadequate organic removal will result in the formation of DBPs. The DBPs reported for 2019-2020 are below the MCLs for Total Trihalomethanes (TTHMs) and the five regulated Haloacetic Acids (HAA5s). However, DBP exceedances were common until 2016/2017, as shown in Appendix F (ADEC Regulatory Data, Appendix F). A graph of historical DBP concentrations is provided in Exhibit 2-7: DBP Compliance History.

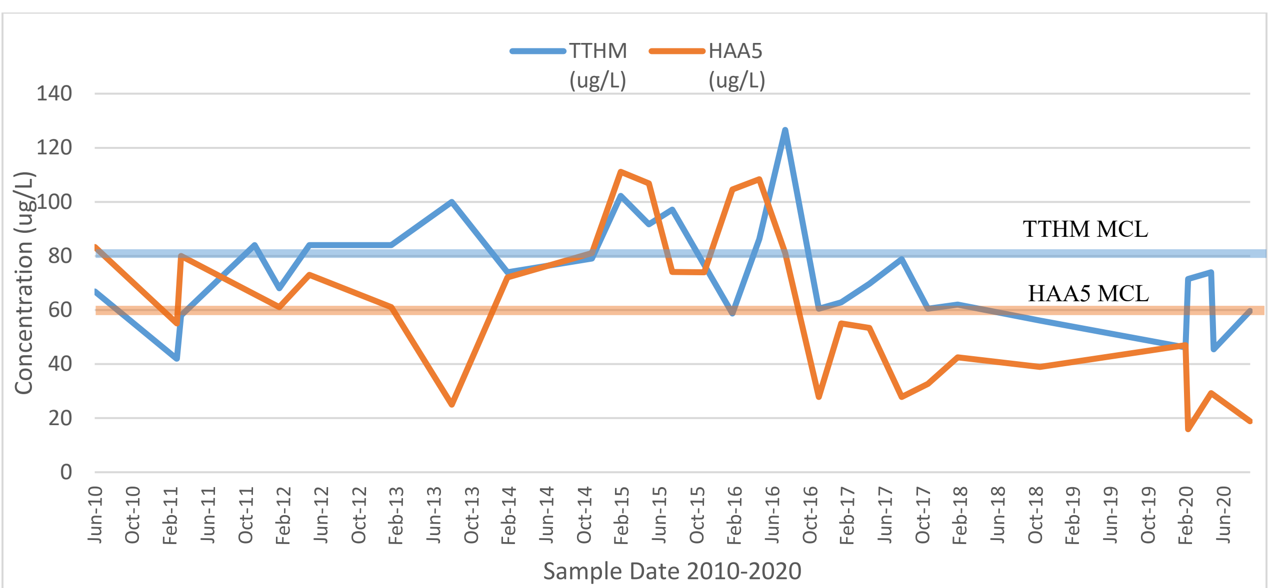


Exhibit 2-7: DBP Compliance History

The DBP values depend on both organics and chlorination. From 2019-2020 the reported chlorine residual after the water storage tank, at the entry point to distribution, was between 0.2 and 0.3 mg/L (ADEC MOR summary, Appendix D). This is less than the 0.4 mg/L chlorine concentration assumed in the design for chlorine disinfection of *Giardia*. Running the system at lower chlorine concentrations may help minimize DBP formation, but would require the entirety of the WST (all 500,000 gallons, at 0.2 mg/L, assuming 100,000 gpd demand) to be reserved for chlorine contact time in order to provide 1-log of *Giardia* inactivation, which combined with 2-logs of filtration credit would meet the 3-logs of *Giardia* treatment required by the SWTR. Calculations are provided in Appendix D.

The most recent site visit and inspection of the WTP was performed by Angoon's RMW at the time, Matt Bradbury, in June 2019. The new RMW for this community, Clay Cook, indicates that additional site visits will occur once the travel restrictions associated with COVID-19 are improved. A summary of the 2019 trip report (Appendix G) includes:

- The Honeywell valve that provides water for polymer dilution is only rated for 30 psi of pressure, but is experiencing around 65 psi of pressure. This valve should be replaced with a new valve of the correct pressure rating.
- An unidentified programming issue was noted regarding the two Flex 70 raw water intake pumps, which were not providing an adequate supply of water to maintain automatic flow for both intake pumps, which sets off a low flow alarm at the control panel.
- The wet well at the intake was only filling to about half capacity due to low levels of the lake. It was noted that the community is seeking out funds to install another deeper wet well until funding can be obtained to construct an alternative water source.
- Filter #3 was not showing up on the Honeywell Multi-Trend.
- All four filters were showing heavy mudball build up, and filter run time was short between backwashes.
- The streaming current detector (SCD) had multiple maintenance issues including worn out bearing and pin, inoperable jet wash, and a blown-out seal.
- Brush needs to be cleared from the water storage tanks.

The Water Plant Operator explained that brush and cleanup around the water storage tanks was performed in 2019.

Treated Water Storage

Three WSTs provide treated water storage for the system. The first WST, adjacent to the WTP, provides chlorine disinfection for *Giardia*, bacteria, and viruses. The system design assumes that half of the WST (250,000 gallons) will be reserved for chlorine contact time. After disinfection the water is gravity-fed down the four-mile long road to the main part of town. No credit for pipeline disinfection contact time was assumed in the design.

In the main part of town, a 500,000 gallon WSTs (tall standpipe) serves the upper townsite. A booster pump is used to fill this water storage tank from the distribution main. Water is then gravity-fed from the water tower to the residents. The third storage tank (150,000 gallons) is specifically for the school. An old wooden tank is also present in the system but it has not been in use for many years (ANTHC, 2016).

The current total water storage capacity of the community is approximately 900,000 gallons (not including 250,000 gallons of storage for disinfection of Giardia). This would provide approximately 9 days of water storage for the community.

The WSTs are reportedly leaking (as discussed in the kickoff meeting for this project). These leaks are reportedly being addressed through planned maintenance. Tank cleaning is also scheduled for 2021 (the tanks have not been cleaned recently).

Water Distribution

The Angoon water system includes approximately 158 residential service connections and one commercial service connection (ADEC, 2020b), in three distribution loops. According to available as-built and site inspection documentation, the water mains in Angoon consist of ductile iron pipe ranging in diameter from 6- to 10-inches. The mains are typically buried 3- to 5-feet below grade and are uninsulated.

There is significant evidence that the water mains are beginning to deteriorate. The newest water mains are 24-years old and are located on South Aan-Deina At Street, where newer housing is located. The oldest water mains are 53 years old and located throughout the main townsite area. City personnel have reported 5 water main breaks and 4 rusted residential saddle connections since 2016, requiring repair. This equates to approximately 2 breaks per year, on average. Additionally, residents have reported frozen service lines to the City, and typically need to keep a faucet running in the winter to avoid frozen lines. City personnel also reported that most, if not all, of the existing fire hydrants in the project area are rusted, clogged, or damaged and non-operational.

Bristol completed a 2020 PER and Environmental Report on the distribution system which proposed upgrades to the water lines throughout the downtown area of Angoon (approximately 9,810 linear feet of water main). Funding is currently being secured for design and construction of this project.

System leakage is contributing significantly to the monthly operational costs for the system. As discussed in the next section (Section iv. Water Demand), the current system use rate is approximately 244 gallons per capita per day (gpcd), or about 100 gpm. This is between 3-5 times the typical use rates, 50-100 gpcd, depending on the community. The system's electric costs could be substantially reduced if the pump time alone could be reduced by two-thirds.

Water Demand

The *Comprehensive Energy Audit for Angoon Water Treatment Plant,* prepared by ANTHC in 2016, describes the flow rates of the Angoon water system, stating, "the community uses approximately 244 gpcd. This is partly because the pumps are controlled improperly and partly because of leaks and excess usage by the community" (ANTHC, 2016). Typical design standards for per capita water use in many urban areas, with lawns and higher levels of outdoor water use, is 75-100 gpcd. ANTHC assumes a 100 gpcd standard in agency design standards. In rural areas with less outdoor water use, 50 gpcd can be more typical. Multiple Angoon residents have gardens and lawns, which would support a higher typical use rate. A demand of 244 gpcd demonstrates that over 60% (conservatively) of the treated water is wasted or lost due to leaks and improper pump controls. Seasonal water loss could also be attributed to some residents keeping a faucet trickling in the winter to prevent pipes from freezing.

During the development of the water distribution PER, Bristol asked the Angoon water plant operator if the 2016 estimate of 80 gpm was still accurate. He explained that production rates have reduced slightly, since they have been repairing leaks in the distribution system, and potentially due to population decrease. He said the WTP typically makes just over 100,000 gpd. For the current population this equates to an average use over 16 hours of approximately 100 gpm and approximately 244 gpcd. Water demands estimates for 2020 are shown in the following table.

Table 2-3: 2019 Water Demand

Criteria	2020 Estimate
Population	404
Total Service Connections (ADEC 2020)	159
Estimated Residential Service Connections[1]	15
Estimated Non-Residential Service Connections	145
Daily Demand (gpd, includes residential & commercial water use and leaks)	100,000
Per Capita Demand (gpcd)	244
Average Water Use[2] (gpm)	100
Peaking Factor[3]	2
Peak Hourly Flow (gpm)	200

Notes:

1. Estimated based on Bristol site visit, 2019.
2. Calculated based on daily metered water use over an assumed 16 hour day.
3. ANTHC WTP Record Drawings AN 05-RA5.

Currently over half of the treated water is wasted or lost due to leaks or other distribution issues. Addressing system leakage would drop the system demand substantially. This would not change the intake pump rate (which is set based on the optimum filtration rate), but would change the amount of time that the pump needs to run. The peak hourly demand would also be lowered, which would affect the disinfection contact time needed for *Giardia* inactivation (either decreasing the required chlorine residual, or decreasing the water volume reserved for inactivation).

iii. Applicable Regulations

The following is a listing of regulatory requirements that are applicable to this project.

ADEC Drinking Water Regulations 18 AAC 80

The Environmental Protection Agency (EPA) grants the State of Alaska the authority to regulate public water systems and enforce federal drinking water requirements. This authority is implemented through the ADEC Drinking Water Program which requires public water systems to obtain engineering approval prior to constructing or operating a public water system, and enforces compliance with federal rules, which are adopted by reference in Alaska Drinking Water Regulations.

The current system does not have ADEC Drinking Water Program Final Operation Approval for the intake upgrade (AN 05-RA5) or the WTP improvements (AN 09-NK5) due to outstanding requests for information that were never resolved (Scott Forgue, ADEC, 2020, correspondence in Appendix F)

The construction of a new intake system (or impoundment), will require engineering plan approval for construction and operation of the new facility. Any outstanding engineering review items would likely require resolution as part of a new approval process.

Sanitary Survey System Deficiencies

A sanitary survey of the Angoon Public Water System was performed on May 29, 2019. In general, the survey indicated the WTP is in good condition and kept clean and organized (Sanitary Survey included in Appendix F). However, the ADEC response letter noted four significant deficiencies and two minor deficiencies that require correction. These deficiencies have not yet been rectified with ADEC, but the Angoon Water Plant Operator explained the status of these items are either complete or in progress, as of March 2020, as noted below:

- Significant deficiencies:
    - The surveyor noted that at the time of the survey, some of the steel water lines serving the harbor were being replaced with 2” HDPE pipe. These changes to the water system require ADEC engineer review.
        - This item is outstanding.
    - Images in the photo log indicate that a check valve has been installed on the main harbor service line. This check valve/shutoff valve does not provide adequate protection against backflow. For high hazard conditions (where a boat’s water system is connected to the harbor section of main water line) a reduced pressure zone valve assembly (RPZ) should be installed on this main service line.
        - This item is outstanding.
    - The surveyor noted that the vents on the top of the treated water storage tanks in town (standpipe and the 500,000-gallon tank) did not have screens.

      - Screens were installed during late 2019. Photos still need to be sent to ADEC.
  - The surveyor noted that the electrical cord for the heat tape at the standpipe pump station is plugged into a non-GFCI (ground fault circuit interrupter) outlet, which could create the risk of electric shock.
      - The heat tape and electrical cord was removed, eliminating this hazard. Photos still need to be sent to ADEC.
- Minor Deficiencies:
  - The surveyor noted that the backflow prevention devices at the water treatment plant have not been tested since their installation in 2010. Backflow prevention devices should be tested each year.
      - Testing was performed in 2019. Documentation of the test still needs to be sent to ADEC.
  - The surveyor noted that the access hatch and ladders for the Auk-Tah Lake storage tank and 500,000-gallon storage tank in town were not locked.
      - This is partially complete and is in progress as of March 2020.

This PER does not address any of these deficiencies. All of the deficiencies are currently being addressed by the City of Angoon, to be funded by the City or others. Additionally, none of these deficiencies are associated with the water source specifically. Addressing these issues would not directly impact the water source or this project.

ADEC Water and Wastewater Operator Certification and Training 18 AAC 74

The ADEC Operations Assistance Program regulates the training and certification requirements for water and wastewater system operators. Operator certification information is provided in Appendix F. The current system is classified as a Class 2 Water Treatment System and a Class 1 Water Distribution System. The construction of a new or modified intake system (or impoundment) is not expected to impact the current system classifications.

EPA Surface Water Treatment Rule (SWTR)

The SWTR has been updated multiple times since its original promulgation in 1989. The main objective of the rule is to protect the public from microbial contaminants that cause acute illnesses. Required treatment is achieved through a combination of filtration (using turbidity as a measure of effectiveness), and inactivation (typically chlorine disinfection). The primary indicators of compliance with the SWTR are chlorine residual (to verify contact time and minimum distribution residual) and filtered water turbidity.

From 2019-2020 the reported chlorine residual was between 0.2 and 0.3 mg/L. This is less than the 0.4 mg/L chlorine concentration assumed in the design. Running the system at lower chlorine concentrations would require the entirety of the WST (all 500,000 gallons at 0.2 mg/L) to be reserved for chlorine contact time in order to provide 1-log of *Giardia* inactivation, which combined with 2-logs of filtration credit would meet the 3-logs of *Giardia* treatment required by the SWTR. Given the disparity between the pump rate (80 gpm) and the average demand (244 gpm) and the estimated peak demand (488 gpm), it would seem unlikely the WST could be kept full. Disinfection calculations are provided in Appendix D.

The combined filter effluent turbidity values reported in the Drinking Water MORs for 2019 and 2020 were extremely low, between 0.02 and 0.07 NTUs. The MORs are a report of combined filter effluent turbidity values taken at 4 hour intervals throughout the day based on readings on a Hach 1720 E turbidimeter, with a reported accuracy of ± 0.02 NTU. The reported values indicate that the system is producing filtered water below the maximum limit of 0.3 NTUs and below the optimized goal of 0.1 NTUs. This indicates an exceptional level of particulate removal, which is associated with a much lower risk of microbial contamination. However, the MORs represent steady state conditions, and may not capture break through or short circuiting events associated with plugged media. These events would result in an increased contamination risk.

EPA Disinfectants and Disinfection-By-Product (DBP) Rule

EPA began regulating DBPs in 1979, and updated the rule in 1998 and 2006. This rule is intended to optimize disinfection practices to reduce public exposure to DBPs. DBPs form when disinfectants react with naturally occurring organics in the water. Current federal regulatory limits for DBPs generated through the use of sodium or calcium hypochlorite disinfection include Total Trihalomethanes (TTHMs), and five Haloacetic Acids (HAA5s).

There are current proposals to increase the regulated DBPs to include:

- Bromochloroacetic Acid, a sixth HAA. This is currently a regulated DBP in Canada.
- Chloral hydrate (CH). Canada has established a health-based value of 0.2 milligrams per Liter (mg/L), the World Health Organization (WHO) has set a provisional guideline value of 0.1 mg/L (WHO, 2020). CH is being evaluated by EPA for regulatory oversight.

In addition to the above chlorination by-products, there is also growing scrutiny on chlorates, which are formed from the slow decomposition of hypochlorite solutions in WSTs with long holding times.

The effectiveness of the filtration process is critical in addressing the organic and DBP issues. Systems can optimize their filtration process to improve organic removal, and mitigate DBP formation.

The current system has had prior DBP exceedances, as shown in Exhibit 2-7: DBP Compliance History (a complete ADEC Compliance Summary is included in Appendix F).

The intake system will affect the level of organics in the raw water. Organics that are not removed in the filtration process will generate DBPs when oxidized in the chlorination process.

EPA Lead / Copper Rule (LCR)

The LCR was first issued in 1991 to address corrosive water, aging piping, and lead solder. Multiple updates to LCR rule have refined the definition of “lead free”, modified sampling methods, and defined steps that must be taken if regulatory action levels are exceeded.

The current system does not have a history of lead/copper exceedances (ADEC, 2020b).

A new intake system should not substantially affect water quality parameters associated with corrosion.

ADNR Dam Safety

"The mission of the Alaska Dam Safety Program is to protect life and property in Alaska through the collection, evaluation, understanding and sharing of the information necessary to identify, estimate and mitigate the risks created by dams" (ADNR, 2020b). This is implemented by first classifying the dam through the submittal of a Hazard Classification and Jurisdictional Review form (included in Appendix F), which will also verify if the system falls under regulatory authority. Regulated dams would then be classified as low risk (Class III), significant risk (Class II), or high risk (Class I). Prior to the construction of a regulated dam, an application to must be submitted to the Dam Safety and Construction Unit requesting approval to construct (included in Appendix F). Following construction, routine inspections are required (visual inspection checklist included in Appendix F) for regulated dams. It should be noted that these forms must be completed by somebody approved by ADNR as adequately experienced in dam design. ADNR Dam Safety Engineer, Charles Cobb, has indicated that several engineers at ANTHC are approved to provide this information. The review of proposed dam plans will include coordination with the ADF&G, because the proposed impoundment is upstream of Favorite Bay Creek which is an anadromous fish stream.

The impoundment discussed in this report is relatively small (0.5 acres in area, 14 feet deep at crest), and would provide the sole source of drinking water for a maximum population that is less than 500 people (the maximum population would be the current population of 404, due to the negative growth rate). This indicates that the impoundment is too small to fall under typical regulatory authority. Verification of this would be critical in early design by submitting the Hazard Classification and Jurisdictional Review form to ADNR for their review and classification.

ADNR Water Rights

A water rights permit is required for any substantial use from a single source. A substantial use includes a consumptive use of over 5,000 gpd. The City of Angoon was originally granted water rights in 1988 for 432,000 gpd. In 1992 an updated water rights application was submitted, and adjudicated by ADNR, but the allotment of water rights was never granted because the final step of submitting a "Statement of Beneficial Use of Water", with a $50 processing fee was never completed. The current water rights for Angoon are listed as "expired" with ADNR, with a water allocation of "0 gpd." Water rights documentation is included in Appendix F (ADNR, 2020c).

The ADEC Drinking Water Program has established a policy which prevents a system from receiving ADEC Drinking Water approvals if water rights have not been granted, or there is not a complete water rights submittal in process. Not completing the water rights application process could result in delays in the ADEC review process.

RCA Provisional Certificate of Public Convenience and Necessity

Alaska Statutes require that any public utility that operates and receives compensation for providing a commodity or service to its customers must obtain a Certificate of Public Convenience and Necessity (certificate) from the Regulatory Commission of Alaska (RCA).

It appears that Angoon began the provisional certification process at RCA, but the process was never completed. The last correspondence on the RCA website states: "Commission records indicate that City of Angoon has 15 or more customers and is a public utility within the definition of AS 42.05.990(5). For this reason, City of Angoon is required to obtain a certificate from the Commission" (RCA, 2020)

The Angoon water system does not currently have the provisional certification required by RCA.

There are provisions in ADEC policy that require simultaneous compliance with RCA requirements. However, this does not seem to be a consideration in ADEC reviews at this time. If this is considered, it could delay the ADEC review process for a new intake system.

d) <u>Financial Status of Existing Facilities</u>

i. Utility Rates

Water utility rates charged by the City are displayed in Table 2-4, based on Ordinance No. 13.20.010 – Charges designated for water. The rate schedule shows the typical fee for a single-family residence is $24 per month for water service, and $4 monthly discount is applied to single-elderly residences. Rates increase for commercial buildings, depending on the type of facility (Municode, 2020).

Table 2-4: City of Angoon Charges for Designated Water

Facility Type	Charge per Month
Single-family residence, apartment	$ 24.00
Single-elderly residence, apartment	$ 20.00
Store	$ 40.00
Restaurant	$ 50.00
Office building	$ 50.00
Lodge	$ 50.00
Lodge with restaurant	$ 70.00
School complex (9 months each)	$ 200.00
School gym (each)	$ 200.00
Fish processing facility	$ 200.00
Laundromat (4 machines and less)	$ 100.00

ii. Financial Statements

The last five years of Certified Financial Statements were obtained to analyze the financial status of the City of Angoon water system. Table 2-5 shows a summary of the budget, expense, and income between fiscal years 2014 and 2019. The full financial statements are included in Appendix C, for reference.

Table 2-5: City of Angoon Water System Financial Summary

Fiscal Year	Budget	Expense	Income
2019	-	76,139	37,804
2018	-	70,315	56,076
2017	-	-	53,274
2016	111,952	160,297	25,939
2015	74,534	100,809	24,478
2014	98,076	68,889	22,257

Notes:

1. Retrieved from City of Angoon Certified Financial Statements.
2. Values are rounded to the nearest dollar.
3. Items left blank were not identified or clearly defined on the statement.

The financial statements indicate water cost exceeded budget values two years in a row, in 2015 and 2016. The financial statement shows electricity and equipment expenses were well over budget in 2015, and that equipment expenses were also over budget in 2016, indicating that unanticipated water equipment purchases were required those years. The statements show that electricity and chemicals are the largest operating expenses for the water system. The reasons for high electricity costs were identified in an energy audit performed in 2016, as discussed in Section 2.0e) below. Historically, the income generated from residential and commercial water utility fees, alone, has not been sufficient to operate and maintain the water system. However, the City's overall revenue has exceeded their overall expenditures every year in the last 5 years. Therefore, City water facilities are in good financial standing. This may change as the water distribution system continues to deteriorate and more maintenance is required.

e) Water/Energy/Waste Audits

A *Comprehensive Energy Audit for Angoon Water Treatment Plant* was prepared by ANTHC in August 2016. The audit is attached to this PER for reference in Appendix C. The study included an analysis of building shell, interior and exterior lighting systems, HVAC systems, plug loads, and more. According to the report, "the total predicted energy cost for the Angoon Water Treatment Plant is $26,292. Electricity represents the largest portion with an annual cost of approximately $24,511. Fuel oil represents the remaining portion with an annual cost of approximately $1,781.

"The Angoon Water Treatment Plant does not receive assistance from the Power Cost Equalization (PCE) program through the State of Alaska, according to the city office. The residents of the community receive assistance from the program but the Angoon Water Treatment Plant pays the full price for electricity. The cost of electricity with PCE is $0.22 per [kilowatt hour] kWh and the cost of electricity without PCE is $0.61 per kWh. The Angoon Water Treatment Plant is eligible for the PCE program and participation in the program would reduce the estimated electricity cost by $15,671 annually" (ANTHC, 2016).

The study also provided a priority list of recommended water and energy conservation measures, as listed in Table 2-6 (ANTHC, 2016).

Additional information, including estimated annual costs savings for each proposed measure, can be found in the full report included in Appendix C (ANTHC, 2016). No other audits are available for the community.

Table 2-6: Water Treatment Plant 2016 Energy Efficient Measures Priority List

Rank	Feature	Improvement Description
1	Lighting: Intake Gallery	Replace with direct-wire LED replacement bulbs.
2	Lighting: Process Room	Replace with direct-wire LED replacement bulbs.
3	Lighting: Office	Replace with direct-wire LED replacement bulbs.
4	Setback Thermostat: Water Treatment Plant and Office	Program the Toyo stove with an unoccupied setback to 50.0 deg F for the water treatment plant and office spaces.
5	Other Electrical: Lift Station Pump	Clean the pumps out of debris for more efficient operation and to keep the pumps from breaking.
6	Other Electrical: Chlorine Room Electric Heater	Lower thermostat setting to 50 deg. F.
7	Lighting: Hallway	Replace with direct-wire LED replacement bulbs.
8	Other Electrical: Generator Room Electric Heater	Shut off electric heater and use only in extreme winter conditions.
9	Other Electrical: Water Intake Pumps	Conduct a leak detection study, repair minor leaks in the distribution system, replace VFD controllers, lower the water usage to appropriate community levels, and install a cooling device inside the VFD electric panel at the intake gallery.
10	Lighting: Chemical Room	Replace with direct-wire LED replacement bulbs.
11	Lighting: Generator Room	Replace with direct-wire LED replacement bulbs.
12	Lighting: Chlorine Room	Replace with direct-wire LED replacement bulbs.
13	Air Tightening	Add weatherization around door edges.
14	Exterior Door: Generator Room	Replace existing door with a new door that includes functioning doorknobs and latches.

Source: ANTHC, 2016.

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3.0 NEED FOR PROJECT

The system has not had reliable access to raw water during hot, dry summers. The intake from the Lake feeds a wet well which houses submersible pumps that pump the water up to the WTP. The pumps cannot be operated if the level in the wet well drops too low. Low water levels have become a recurring issue during summer months. Inadequate access to water has impacted the communities housing and development options.

The existing surface water source has had long term issues with high levels of organics, debris and algae. A decade ago, renovations were completed to the intake system that improved the ability to maintain the intake screens and transmission line, but the repairs and modifications have not been sufficient to address the organics entering the system.

High levels of organics can impact the water systems ability to achieve and maintain chlorine residual for *Giardia* disinfection, as well as increased the potential for DBP formation. This has impacted the system's ability to reliably meet all the safe drinking water standards required in both the SWTR and the DBP Rule.

Improvements to the existing water source are needed for the following reasons.

a) <u>Health, Sanitation, and Security</u>

Inadequate Water Supply
The existing system does not provide an adequate, reliable access to raw water, and subsequently limits the residents access to safe, treated water. This has impacted the community's ability to expand needed housing.

DBP Formation
The treated water is impacted by the poor quality of the raw water, particularly the increased levels of organics, resulting in increased DBP formation (historically exceeding regulatory maximums). High levels of DBPs are linked to bladder cancer, adverse birth outcomes (miscarriages), and birth defects (EPA, 2020).

Diminished Ability to Meet Surface Water Treatment Rule Requirements
The increased organics in the treated water makes it difficult to maintain the chlorine residuals required in the SWTR for inactivation of bacteria, viruses, and *Giardia*. This is particularly important in this system because of the increased filter plugging due to poor raw water quality. Filter plugging increases the risk of short-circuiting and microbial breakthrough. Adequate chlorination is the last barrier in preventing microbial pathogens from contaminating the water source.

b) <u>Aging Infrastructure</u>

The intake system pumps were replaced in 2011 and installed in the original CMP wet well which was constructed in 1992 (**Figure 5**). The elevation of the water in the wet well is controlled by the elevation of water in the lake which has dropped since original system construction. The wet well has deteriorated and the constructed elevation of the wet well is no longer sufficient to provide reliable access to water. Low water levels in the lake have resulted in an inadequate volume of water in the wet well, preventing raw water production.

Access to raw water is further exacerbated by deteriorated piping and system leaks, which artificially increase the water demand. System leaks were addressed in a separate PER (Bristol, 2020).

c) <u>Reasonable Growth</u>

The economic conditions have been challenging for Angoon in recent years, resulting in a decrease in population and a negative growth rate of approximately -1.2% per year. Hopefully, planned improvements in access and community facilities will improve the economic outlook. However, it is likely that a negative growth rate will continue for the near future. Consequently, the current population would represent the highest demand criteria.

This project is needed in order to support community growth and expansion. A reliable, safe water source is crucial in building a resilient community.

d) <u>SDS Deficiencies</u>

Sanitation Deficiency System (SDS): A Guide for Reporting Sanitation Deficiencies for American Indian and Alaska Native Homes and Communities was consulted to identify sanitation deficiencies associated with the proposed project. These are summarized in the following table.

Table 3-1: Sanitation Deficiency Summary

Level	SDS ID	Deficiency Description
Level 3: Inadequate Water Supply.	W3.1	During summer months the lake level drops and there is not sufficient raw water in the wet well to pump water. Water production is delayed until the level in the wet well is sufficient to run the pumps. An unreliable access to safe drinking water has impacted the City's need to expand housing.
Level 3: DBP Exceedance.	W3.1	The treated water system is not consistently in compliance with the Drinking Water Standards for DBPs. The high levels of organics in the raw water has resulted in DBP exceedances.
Level 2: Repairs and replacements necessary to meet community needs.	W2.2	The CMP wet well is now almost 30 years old. The wet well is deteriorated. The wet well needs to be replaced and reconfigured so that an adequate water depth is maintained during low lake levels.

4.0 ALTERNATIVES CONSIDERED

To address the conditions noted above, and provide safe drinking water to the community, three alternatives were considered, including a No-Action alternative, as outlined below. Important criteria in the comparison of alternatives include the impacts to water quantity, water quality, power costs, as well as permitting and regulatory considerations.

Alternative 1: No Action

Alternative 2: New Water Source at Favorite Creek

Alternative 3: New Vertical Infiltration Gallery

Alternative 4: Rebuild Existing Intake System

a) General Design Criteria

Design criteria is included on Figure 2 (Appendix A), and in the calculations (Appendix D). The current system criteria represent the highest demand, due to the negative anticipated population growth rate. The existing system criteria are summarized below in Table 4-1.

Table 4-1: Existing System Criteria

2020 Population Served	404	people
Total Service Connections (ADEC, 2020)	159	each
Estimated Non-Residential Service Connections[1]	15	each
Estimated Residential Service Connections	145	each
Average Daily Demand (including all uses and losses)	100,000	gpd
Average Daily Per Cap Demand	244	gpcd
Treatment Design Flow Rate	225	gpm
Operational Flow Rate	80	gpm
WST 1 – Adjacent to WTP (total volume)	500,000	gallons
WST 1- minimum volume reserved for chlorination	250,000	gallons
WST 2 – Mid Town Tower	500,000	gallons
WST 3 – School Water Storage	150,000	gallons

Notes:

1. The number on non-residential service connections was estimated based on a Bristol site visit in 2019. These service connections include the (2) dock areas, (2) schools, (2) Bed & Breakfasts, City Office, State Office Building, Post Office, Clinic, Store, Tribal Building, and multiple Elder Housing units.

A critical aspect of source evaluation is the quantity of water available in the alternative sources considered. A comparison of source volumes is provided in Table 4-2. Information in this table was obtained from the 2010 Favorite Creek Hydrology Study (CRW, 2010), the 2000 Hood

Mountain Water Source Feasibility Study (ANTHC, AN 99-P21), the prior ANTHC renovation projects (ANTHC Project AN 05-RA5 and N 09-NK3), Quantum Spatial Aerial Photography (2004), and preliminary design volumes (discussed in Alternative 2).

Table 4-2: Source Size Estimates

Favorite Creek Proposed Impoundment		
Impoundment on Favorite Creek Volume (water surface elevation 364 feet)	676,000	gallons
Impoundment on Favorite Creek Surface Area	17,460	sq ft
Impoundment on Favorite Creek Max Depth	14	ft
Current Auk'tah Lake Volume		
Auk'tah Lake Volume (top 5 feet of water, with top elevation at 70 feet)	90,000,000	gallons
Auk'tah Lake Surface Area	2,439,360	sq ft
Auk'tah Lake Max Depth	40	feet
Lake Volumes if Auk'tah Lake Dropped 5 feet and Became 2 Lakes		
Auk'tah Lake North Volume (top 5 feet of water, with top elevation at 65 feet)	45,000,000	gallons
Auk'tah Lake North Surface Area	1,306,800	sq ft
Auk'tah Lake North Max Depth	35	feet
Auk'tah Lake South (top 5 feet of water with top elevation at 65 feet)	35,000,000	gallons
Auk'tah Lake South Surface Area	1,132,560	sq ft
Auk'tah Lake South Max Depth	25	feet

4.1 NO ACTION

a) Description and Design Criteria

The no action alternative would provide no system upgrades and is provided as a baseline for comparison.

The existing intake would continue to be used. It is assumed needed maintenance and repairs would occur to address noted system deficiencies and operational issues.

The existing treatment system design criteria was included in the discussion of the existing treatment system, in Table 2-2: WTP Design Criteria.

The Pros/Cons of the no action alternative are summarized in Table 4-3.

Table 4-3: Alternative 1 No Action Pros/Cons

Pros	Cons
• No capital costs.	• Inability to reliably meet system demand during summer months.
	• Ongoing maintenance issues due to organics and debris in the current intake system.
	• Continuing operation of pumps outside stated efficiency range could limit pump life, and limit filter performance. This would result in increased facility maintenance costs.
	• The filtration and chlorination processes will continue to be impacted by the debris and organics in the raw water, increasing DBP formation and impeding the establishment of needed disinfectant residual.
	• Current lack of reliable access to raw water is limiting community growth and housing expansion.

b) <u>Evaluation Criteria</u>

Water Availability

The existing system relies on Auk'tah Lake for raw water. The lake level has been dropping in recent years. If the lake level drops by approximately 5 feet, the lake will become divided into two adjacent lakes, and the intake will only have immediate access to the northern-most lake. This northern portion of the lake includes a substantial amount of water that would be more than sufficient to meet the City's needs. However, the configuration of the existing wet well is such that insufficient water is available to meet production demands (even at very low pump rates) during low lake levels. So, although the volume of the lake is sufficient, an auxiliary pump is needed to be able to provide access to the raw water. This pump is not part of the water system, and is implemented by the operator on an emergency basis as needed.

Water Quality

The current intake has an established history of issues with debris and organics in the raw water.

Power Consumption

The current pumps are being operated out of their stated efficiency range. Over time, this can increase power consumption, and decrease the design life of the pumps.

Impacts to Existing Water System

Poor water quality increases the need for maintenance on the intake lines (pigging and flushing) and the screen. The added debris in the raw water can foul the filter media and require more frequent media change-outs. Organics in the raw water impact chlorination processes, making it difficult to maintain needed chlorine residual (increasing the amount of chlorine required) and creating disinfection by-products.

c) Map

The existing source (Auk'tah Lake) is shown on Figure 6: Water Source Locations, on the next page, and in Appendix A.

d) Environmental Impacts

There are no environmental impacts associated with continued use of the existing system.

e) Land Requirements

No additional land is required for this alternative.

f) Potential Construction Problems

No construction is required for this alternative.

g) Sustainability Considerations

i. Water and Energy Efficiency

A 2016 energy audit (ANTHC, 2016) identified measures that could be taken to improve the energy efficiency of the WTP. Some of these measures appear to have been completed (the heating fuel costs are lower in recent budget reports). The community has expressed an interest in installing solar panels for the WTP, to help offset energy costs.

Ongoing leaks represent over half of the daily water use. This represents a substantial amount of lost revenue, for pumping and treating wasted water. A PER was completed in 2020 which addresses repair and replacement of leaking pipes in the downtown area.

ii. Green Infrastructure

No green infrastructure is associated with Alternative 1.

iii. Other

System resilience and reliable access to raw water is currently impeding development opportunities within the community.

h) Cost Estimates

There are no capital costs associated with the No Action alternative. The operations and maintenance cost estimate is provided in **Table 4-4**. See Appendix C for financial information, references, and NPV cost summary.

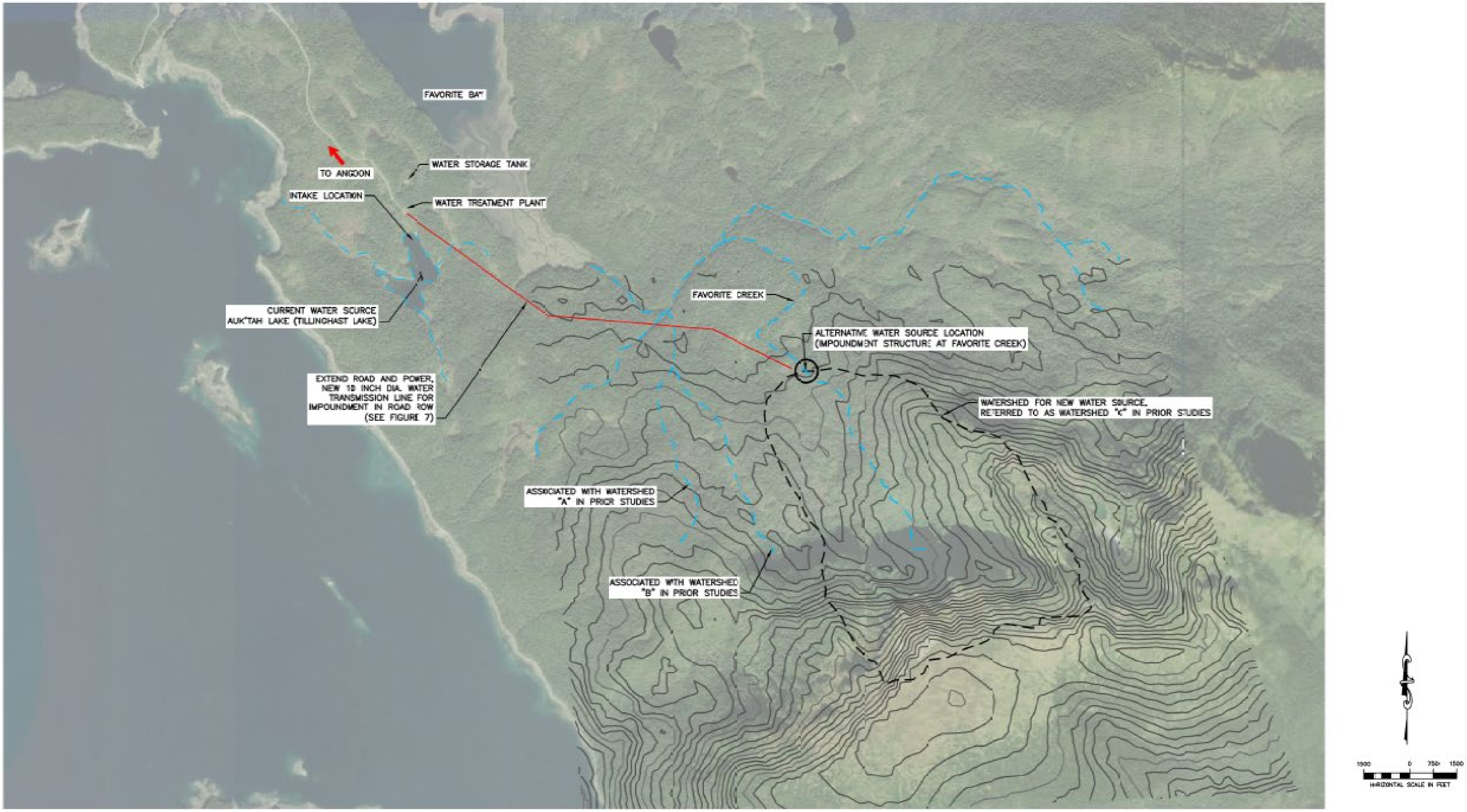

Figure 6: Water Source Locations

Table 4-4: Alternative 1 Operations and Maintenance Cost Estimate

Description	Annual Cost
Personal Services	$ 38,880
Travel & Per Diem	$ 2,000
Electricity	$ 30,000
Fuel Oil	$ 750
Vehicle Fuel	$ 2,000
Materials and Supplies	$ 2,000
Freight	$ 7,500
Water Testing	$ 3,000
Chemicals	$ 30,000
Miscellaneous	$ -
Short Lived Assets	$ 1,267
Annual Total	**$ 117,397**

4.2 ALTERNATIVE 2: NEW WATER SOURCE AT FAVORITE CREEK

a) Description and Design Criteria

Alternative 2 would construct a new 150 feet wide concrete impoundment structure on Favorite Creek, approximately 3 miles south east from the WTP, as well as a new access road and transmission main. The existing intake structure would be retained as a backup water supply. The proposed impoundment is relatively small (0.5 acres in area, 14 feet deep at the crest). It is located at an elevation of 350 feet, sufficient to gravity feed the source water into town, through the treatment system, and fill the WST adjacent to the WTP (with a minimum net head of approximately 30 psi).

The entire watershed for the impoundment is located within the Admiralty Island National Monument, the Tongass National Forest, and the Kootznoowoo Wilderness Area as shown in Exhibit 1-2: Kootznoo Wilderness within the Tongass National Forest (USDA, 2020). The impoundment location is upstream of Favorite Bay Creek, which is an anadromous fishway.

The potential for an impoundment on Favorite Creek has been considered for many years due to the high quality of the raw water. However, limited test data was available. Raw water was tested for primary regulated contaminants in 2000 as part of the Hood Mountain Water Source Feasibility Study (ANTHC, 2000). No contaminants were found. A summary of water quality criteria of interest is provided in **Table 4-5**. Organics, turbidity, or conductivity were not sampled.

Table 4-5: Favorite Creek Water Quality (2000)

Iron	0.113	mg/L
Manganese	<MRL	
Color	<MRL	
Odor	None	
Alkalinity	68.1	mg/L
Total Dissolved Solids	75	mg/L
Nitrite	<MRL	
Nitrate	0.35	mg/L

Notes:
mg/L = milligrams per liter
MRL = method reporting limit
Source: ANTHC, 2000

The quality of Favorite Creek is considered superior to that of Auk'tah Lake. However, the quality of the impounded water will not be the same as the Favorite Creek water. Following the filling of the impoundment, it will take decades for the water quality to equilibrate. If the brush and trees are left in place when flooded, depending on the type of vegetation, they will slowly decay over time releasing organics into the water. If they are removed, depending on the soils, raw water turbidity can be elevated. Overall, the water quality parameters listed in Table 4-5 cannot be assumed for the new impoundment source.

The 2010 Favorite Creek Hydrology Study (CRW, 2010) estimated the size of the impoundment based on a minimum impoundment inflow of 1.2 cubic feet per second (cfs) (50-year recurrence 30-day low flow), an assumed stream outflow reservation for DNR (1 cfs), design demand (0.44 cfs or 200 gpm), and evapotranspiration losses (.03 cfs). This resulted in a reservoir volume of 676,000 gallons of water, or just under one week for stored water (under current water use rates). It was assumed that the current source and well pumps would need to be retained to act as a backup.

The need for a backup source would be most pronounced in the summer, during prolonged hot, dry periods. The length of time that the backup source (Auk'tah Lake) would be needed would depend on weather patterns and climate trends (as discussed in Section 1b). Switching between the new impoundment and Auk'tah Lake automatically would be difficult, due to the distance between the sources. The differences in water quality between the sources would make changing sources challenging for the water treatment system.

To fit within the topography at 350 feet in elevation, a reinforced concrete dam would be used with an armored overflow weir, inlet and outlet armoring with energy dissipation, and seasonal sluice gates. Pressure relief would be provided by a diversion structure and wells along the base of the impoundment (6 wells total, 8-10 feet on center, 6 inch diameter, set 20 feet into rock surface, with 10 foot slotted screen at bottom, and top of casing screened to allow overflow).

Site preparation would include:

- Remove soil and deleterious matter.
- Scale loose and frost fractured rock.
- Expose hard competent rock along sides and base; limited blasting may be needed.
- Rock excavate keyway into competent rock along base of dam, assume 3-foot-wide, 2-3-foot-high, for the length of dam structure (50 ft estimated), assume drill and shoot required.
- Grouted rock anchors into rock along base of dam.
- Sidewall grouted anchors between rock and dam, may require keyway also depending on rock mass quality.
- It was assumed that no rock grouting would be needed to control seepage through the rock, under the dam, or at the dam/rock contact.

Final design for a reinforced concrete dam was recently completed for Saxman (2019, ANTHC, Joseph Hess, PE), that would be similar to an impoundment for Angoon.

Impoundment design criteria are provided in Table 4-6, with plan and profile views of the dam included on Figure 7 and Figure 8 on the following pages.

Table 4-6: Impoundment Design Criteria

Impoundment Volume	676,000	gallons
Height at Center (including freeboard)	16	feet
Freeboard (minimum)	2	feet
Top Span Length	150	feet
Base Span Length	50	feet
Top Width	2	feet
Base Width	10	feet

In order to provide 5 MG of stored raw water (an estimated 1-month supply), and eliminate the need for the lake as a backup source, the dam would need to be built at an elevation of 320 feet (30 feet lower than the proposed impoundment), and would be 30 feet high and 200 feet wide (14 feet higher and 50 feet wider than the proposed impoundment). The elevation would not be sufficient for gravity flow to fill the WST, so a pump system would be necessary. This option for a larger dam, at a lower elevation was not considered in the 2010 Favorite Creek Hydrology Study (CRW, 2010), or in this PER.

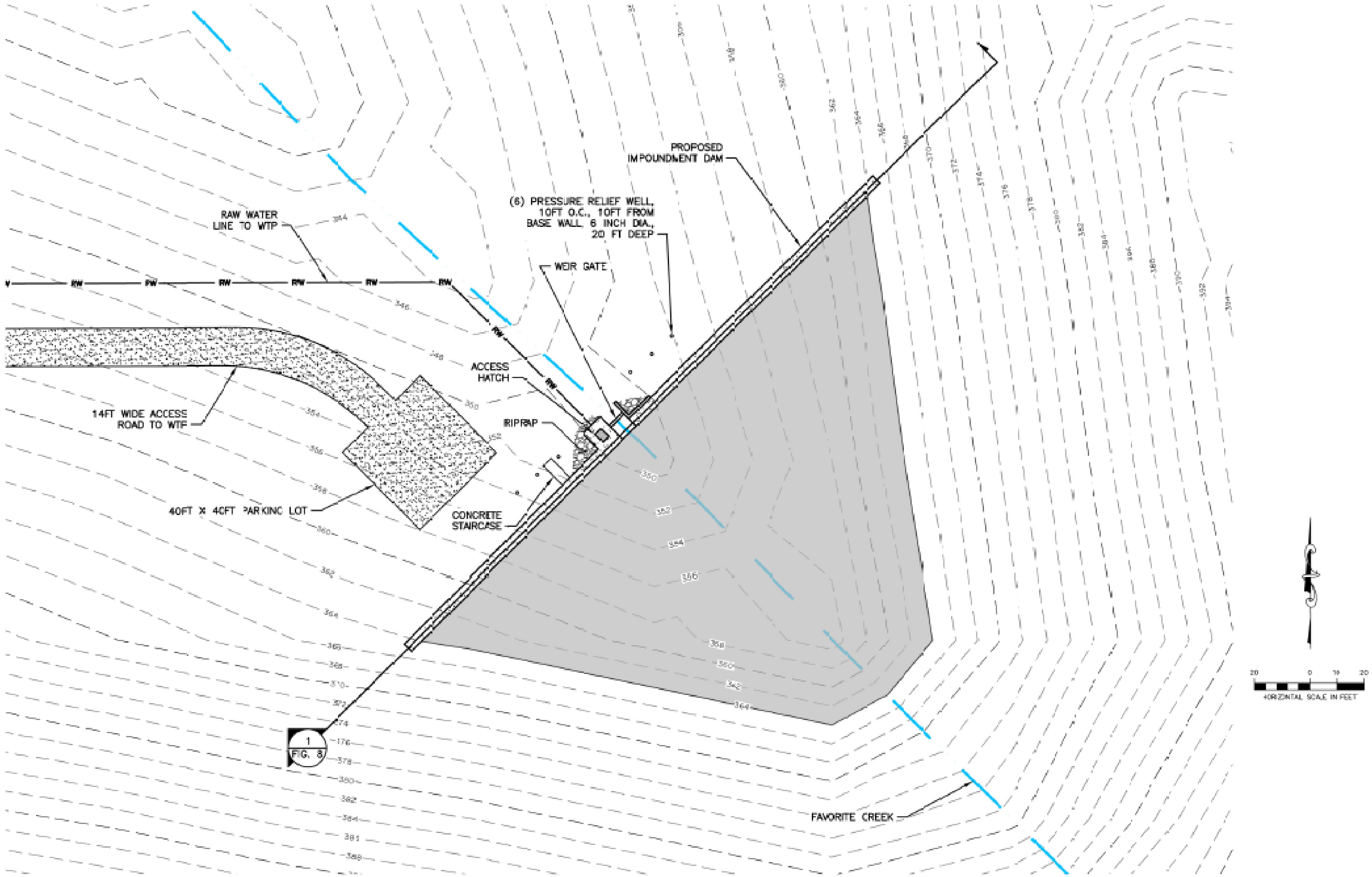

Figure 7: Impoundment Structure Plan View

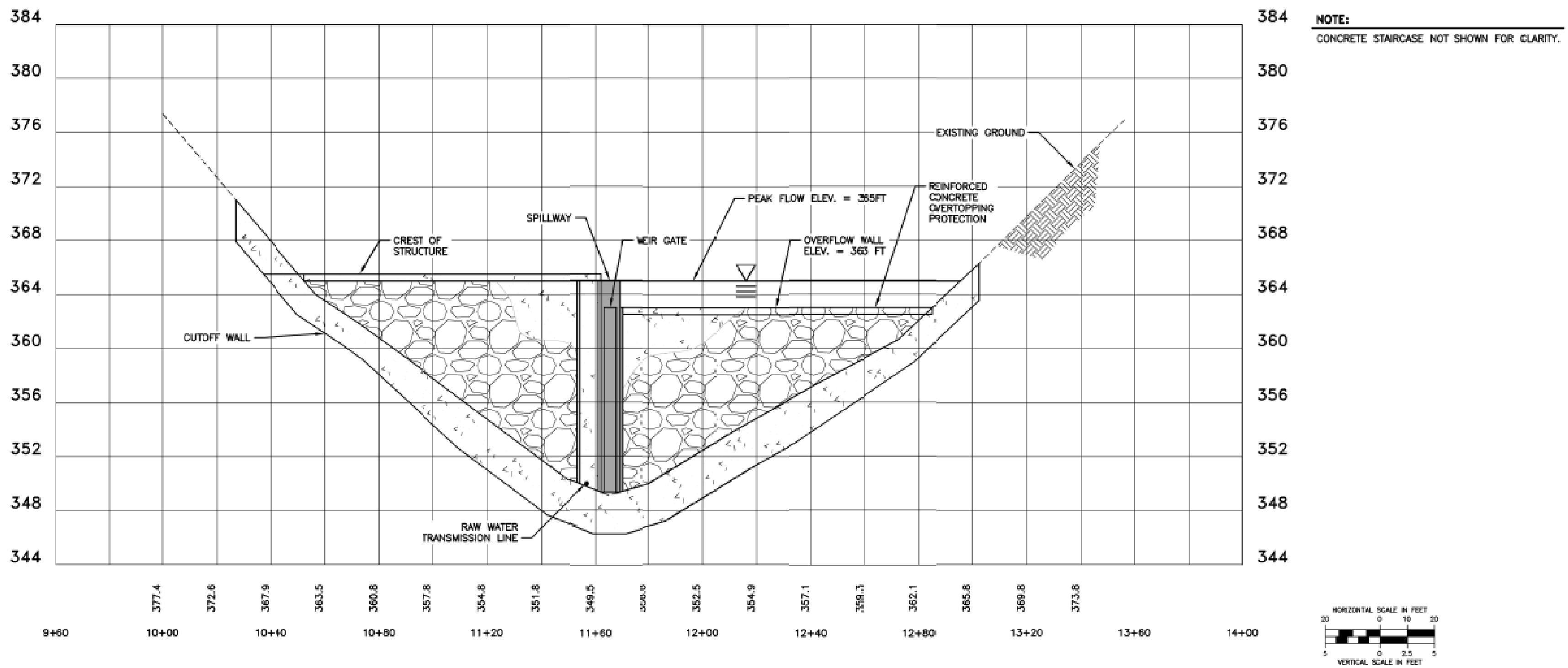

Figure 8: Impoundment Structure Profile View

In addition to the impoundment structure, a new gravel road and raw water transmission line would be needed. The new access road would connect to the end of the existing road at Auk'tah Lake. Previous studies referenced a shorter road to the impoundment area because a planned road to a new airport would have shortened the amount of new road required. However, the airport road has not been constructed (although it is still planned). Approximately 15,000 LF (2.8 miles) of road and transmission pipeline would be needed to reach the new impoundment. Improvements to the existing gravel roadway between the WTP and the end of road at Auk'tah Lake may also be warranted (and may be needed for construction vehicle access to the impoundment site). A parking lot and turn-around area (approximately 40 ft by 40 ft) would be provided at the base of the impoundment. Design Criteria for the access road is provided in **Table 4-7**. Typical roadway details and sections are provided on **Figure 9: Roadway Details and Typical Sections**.

The transmission line (HDPE SDR 11) would follow the road, and be constructed within the road prism, buried a minimum of 4 feet below grade. A recent study on the water mains in town completed by Bristol for a PER addressing pipeline replacement, found that some of the water mains in downtown Angoon were experiencing frost issues, with a reported depth of burial of 3-5 feet below grade. This should be verified and further evaluated in final design. An increased depth of burial may be considered, substituting insulation as needed to avoid bedrock excavation. The final design of the alignment and profile would limit excavation as much as possible. Multiple stream crossings (culverts) would be required. Air release valves would be provided at high points. Design Criteria for the transmission line is provided in

Table 4-8.

Favorite Creek is relatively small from a hydropower perspective. The 14 feet of head provided by the water, and the low flow volume of the stream, may produce enough electricity for the electrical fixtures in the impoundment area, but would not provide a substantial amount of electricity to the community. Also, a power line extension to the impoundment was not included in estimated project costs.

Table 4-7: Gravel Access Road Design Criteria

Length	15,000	LF
Width	14	feet
Max Grade	10	%
Crown (Typical)	2	%
Pull-out Interval	0.5	mile

Table 4-8: Transmission Pipeline Design Criteria

Length	15,000	LF
Diameter	10	inch
Design Flow	225	gpm
Velocity	1-2	fps
Max Headloss	2	ft/1000 ft
Isolation Valve Interval	2,500	ft
Cleanout / Drain Interval	5,000	ft
Minimum Depth of Bury	4	ft

The Pros/Cons of Alternative 2 are provided in Table 4-9.

Table 4-9: Alternative 2 Impoundment Pros/Cons

Pros	Cons
• The community has heard about this alternative for decades, has been aware of the studies, and is expecting to see this alternative.	• The impoundment would only store approximately one week of raw water. This would require the retention of the existing source as a backup supply.
• No routine water pumping would be required. Gravity flow would provide sufficient pressure to fill the WST adjacent to the WTP.	• The quality of the raw water will include increased levels of organics and particulates until the water stabilizes. Stabilization could take decades.
	• Permitting, design, and construction effort would be considerable because of the impoundment location in a protected federal reserve, upstream from an anadromous fish stream.
	• Dam safety permitting may be required.
	• The road to the impoundment (approximately 3 miles) would need to be maintained to ensure year-round access and impoundment inspection.
	• Almost 6x higher capital costs and slightly higher O&M costs than Alternative 3.

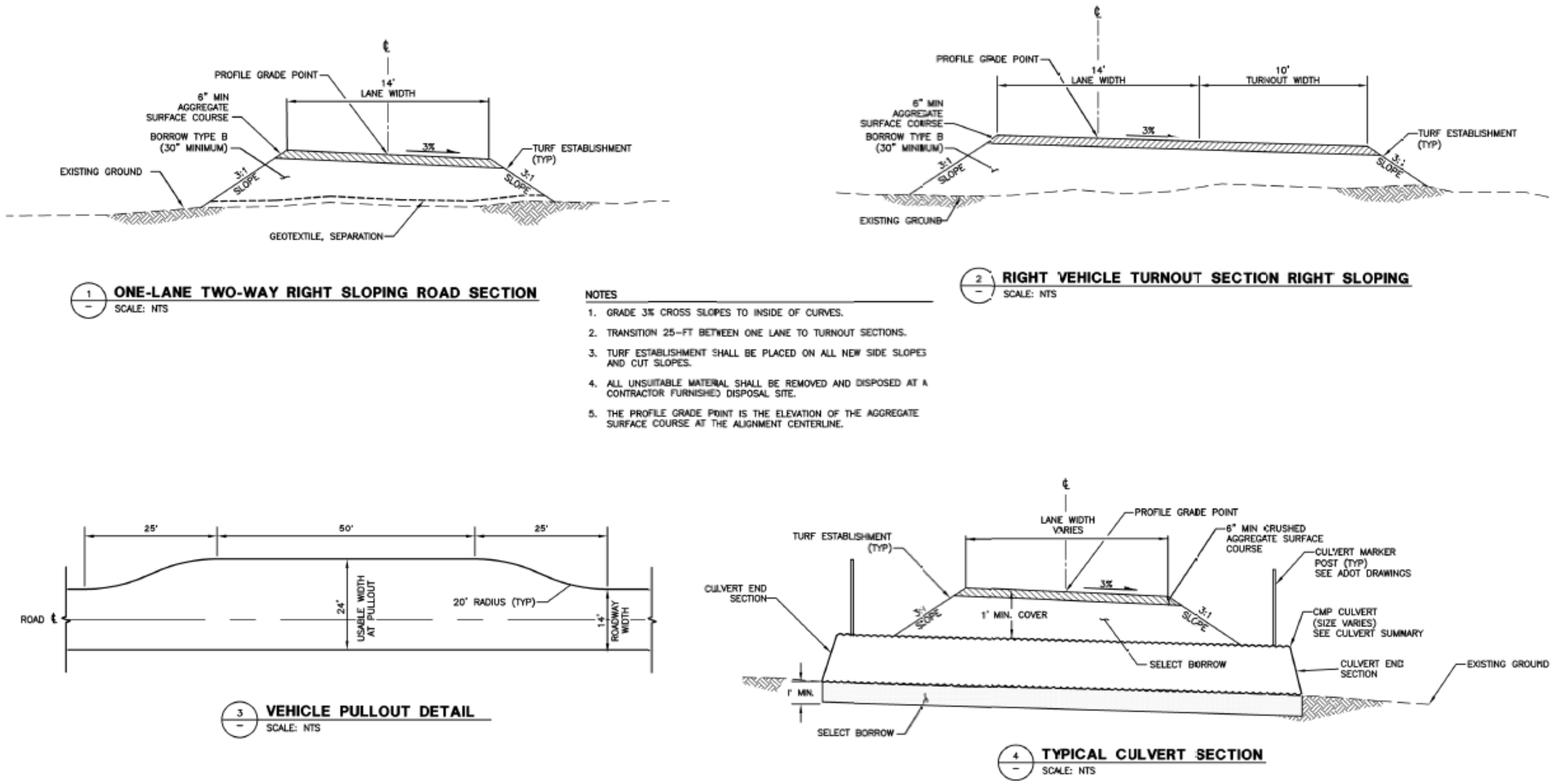

Figure 9: Roadway Details and Typical Sections

b) Evaluation Criteria

Water Availability

An impoundment on Favorite Creek would provide access to much less raw water than the current intake system on Auk'tah Lake (Table 4-2). This would require the current intake system to be retained and maintained, and be available as a backup water supply. It is likely that the impoundment water shortage would occur during hot, dry periods in summer. This is the time that the current system already experiences raw water access issues (because of the elevation of the original wet well construction). Therefore, some modification of the existing intake system (specifically the wet well and pump systems) would be needed for it to function as a backup supply.

Careful monitoring of the impoundment would be needed to ensure the community had adequate time to switch sources, with no interruption in treatment. Remote monitoring systems may be possible, but visual verification and daily inspection would be needed as the water level dropped to levels that would require switching sources.

Water Quality

The water quality in Favorite Creek is preferred over Auk'tah Lake. However, the water quality of the impoundment water will have elevated levels of organics and particulates until equilibrium is established. This could take a prolonged period, up to several decades.

Power Consumption

The elevation of the impoundment would provide sufficient pressure for raw water to flow by gravity to the WTP, through the treatment system, and fill the WST adjacent to the WTP. This would save a substantial amount of power cost. Some power would be needed at the impoundment (lights, a priming pump, etc). It is assumed that a sufficient amount of hydraulic power could be obtained from the impoundment for incidental power needs. The overflow from the impoundment does not appear to be sufficient to generate excess power for the City.

Impacts to Existing Water System

If both raw water sources were used, treating water from the different water sources could be complicated, requiring different chemical dosages for optimum coagulation. If the water sources are substantially different, a different coagulant may be needed for each source.

c) Map

A map of the impoundment area was provided in Figure 6: Water Source Locations in the prior section, and is provided with Figures in Appendix A.

d) Environmental Impacts

The following permits and approvals would be needed:

- National Environmental Policy Act, Environmental Impact Statement (EIS).
- Alaska National Interest Land Conservation Act (ANILCA) Title VIII and Title XI review.

- Section 106 Review, National Historic Preservation Act (State Historic Preservation Office review).
- Section 7 Endangered Species Permit would be required. However, the IPAC did not note any issues.
- Section 404 Permit (United States Army Corps of Engineers [USACE]) for fill in wetlands, or waters of the US.
- Section 401 Permit (USACE), to address stormwater runoff
- ADNR Dam Safety Hazard Classification and Jurisdictional Review determination.
- ADNR Water Rights.
- ADF&G Fish Habitat Permit.
- ADEC Stormwater Permit (ADEC Construction General Permit AKR100000).
- ADEC Drinking Water Engineering Plan Review and Construction Approval.

The potential for environmental impacts will be a substantial planning component of this project. The impoundment would be located within Kootznoowoo Wilderness, a conservation area protected under the ANILCA. However, ANILCA includes exemptions for specific exceptions, including the placement of transportation and utility systems, including roads and water pipelines. Requirements for these provisions are outlined in Title XI of ANILCA. Title VIII of ANILCA would require an evaluation of the impact to subsistence.

In addition, an EIS will be required by the National Environmental Policy Act. A rough order of magnitude cost of $500,000 was included in the cost estimate for this alternative. An EIS was completed for the Angoon runway project, which may address part of the new road construction area. However, the area covered in the runway EIS does not appear to extend far enough to the east to cover the impoundment area and associated watershed. Additional details on land status was provided in the Favorite Creek Hydrology Study (CRW/Golder 2010).

A Section 106 Review is required by the National Historic Preservation Act for federal-aid projects needing a permit that may affect cultural or historical resources (State Historic Preservation Office review).

An ADF&G Fish Habitat Permit would be needed for the impoundment, as well as for the stream crossings and culvert installations on the impoundment access road.

ADEC Drinking Water Program review and approval of engineered plans of the new impoundment would be required prior to construction. Final operation approval would be required following construction. This would include sampling for primary regulated contaminants. In addition, the source water sampling conducted for the SWTR (discussed in Section_2cii), would need to be completed for the new impoundment source.

e) Land Requirements

The land is currently owned by Kootznoowoo, Incorporated (DCCED, 2020). The impoundment area will be approximately 0.5 acres in size. Right of way access will be also needed for the proposed roadway and transmission line.

f) Potential Construction Problems

An existing stream diversion structure will be needed to facilitate the dam construction. An extensive geotechnical investigation and survey would be needed for final design to verify the assumptions made in the design criteria.

g) Sustainability Considerations

i. Water and Energy Efficiency

This project would reduce power costs for pumping under routine operations. However, the intake and pump systems would still be needed for a backup water supply.

ii. Green Infrastructure

The area disturbed for the total project may exceed one acre and require an Alaska Pollution Discharge Elimination System (APDES) permit, or Notice of Intent, through ADEC.

iii. Other

The oversight of dam safety has increased substantially since an impoundment for Angoon was first considered over 30 years ago. Regulatory requirements were updated after the Kake dam failure in 2000. The submittal of a Hazard Classification and Jurisdictional Review form is required to determine if the impoundment will be subject to regulatory oversight.

h) Cost Estimates

The estimated capital cost of this alternative is $6,713,376. The operations and maintenance (O&M) cost estimate is provided in Table 4-10 below and includes a comparison to the O&M costs for the existing system. See Appendix C for financial information, references, and NPV cost estimate.

Noted changes to O&M costs include an increase in personal services for routine WTP operator inspections, a decrease in electric costs associated with gravity feed raw water (possible use of the backup water supply and associated costs were not considered), and an increase in road maintenance cost (based on current road maintenance costs) for the access road to the impoundment. Assumptions and calculation of the O&M costs are included with the NPV calculations in Appendix C.

Table 4-10: Alternative 2 Operations and Maintenance Cost Estimate

Description	Annual Cost	Change
Personal Services	$ 41,472	$ 2,592
Travel & Per Diem	$ 2,000	$ -
Electricity	$ 10,000	$ (20,000)
Fuel Oil	$ 750	$ -
Vehicle Fuel	$ 2,400	$ 400
Materials and Supplies	$ 2,000	$ -
Freight	$ 7,500	$ -
Water Testing	$ 3,000	$ -
Chemicals	$ 30,000	$ -
Miscellaneous (New Road Maintenance)	$ 11,625	$ 11,625
Short Lived Assets	$ 18,834	$ 17,568
Annual Total	**$ 129,581**	**$ 12,185**

Although reductions in the electric costs reduce the O&M for the system, this is offset by the other increases in maintenance costs, and the increase in short lived assets.

4.3 ALTERNATIVE 3: NEW VERTICAL INFILTRATION GALLERY

a) Description and Design Criteria

Alternative 3 would renovate the existing source by installing two vertical infiltration galleries (shallow wells) on the edge of Auk'tah Lake. This would replace the existing intake, wet well, and submersible pump systems. Each infiltration gallery would be approximately the same depth as the lake (30 feet). An attempt would be made to find an area near the lake edge, with non-cohesive soils for placement. If needed, blasting could be done to provide improved subsurface conditions for the installation. The infiltration galleries would have a lower debris loading than the current intake screen which pulls from the bottom of the lake. Each infiltration gallery would include a 20 HP pump, which would be sufficient to meet the design treatment flow and fill the WST adjacent to the WTP, while operating within the optimum efficiency range of the pump. The two pumps would alternate pump operations, which would be controlled by a new pump control panel. The vertical infiltration gallery location is shown on **Figure 10**, with details shown on **Figure 11**.

The two infiltration galleries would be located approximately 40 feet apart. Each would connect to a new A 10 inch HDPE transmission line, which would connect to the existing 10 inch DI transmission line, from the existing intake to the WTP. This connection would require crossing the gravel road. The pipeline installation and road crossings would be similar to those used in the intake renovation project (as shown in **Figure 12**).

Auk'tau Lake has the largest available reservoir of raw water of any of alternate water sheds considered, including the impoundment of Favorite Creek (Table 4-2). Even if the water table were to drop substantially (more than five feet), separating Auk'tah into two lakes, each lake would contain a substantial amount of raw water. Vertical infiltration system design criteria are summarized in the following table.

Table 4-11: Vertical Infiltration Gallery Design Criteria

Number of Vertical Infiltration Galleries (20 HP each)	2	each
Diameter	12	inches
Depth (approx., extend to bottom elevation of lake)	30	feet
Total Dynamic Head	266	feet
Production Rate (equal to filtration rate)	225	gpm
Top of Casing (above grade)	1	foot
Drainage Away from Casing (radius)	10	feet
Horizontal Separation Distance to Potential Contamination	200	feet
Minimum Pitless Depth	4	feet

The Pros/Cons of Alternative 3 are shown in Table 4-12.

Table 4-12: Alternative 3 Infiltration Gallery Pros/Cons

Pros	Cons
• Improved raw water quality, less debris in intake. Less maintenance for intake line.	• A geotechnical investigation would be needed to locate the optimum location for the intake galleries. Without the geotechnical investigation there is not sufficient information on the ability of the vertical infiltration galleries to meet demand.
• Access to large quantities of raw water.	• Conducting a geotechnical investigation would delay the project.
• New pumps would operate at design filter loading rate, within optimum pump efficiency range.	• Would not eliminate power costs for pumping raw water. Would have to pump water through the treatment system, and into the WST adjacent to the WTP.
• Less complex permitting and construction. The project area would stay within areas of prior construction near the WTP.	• Vertical infiltration gallery would require maintenance to address any fouling.

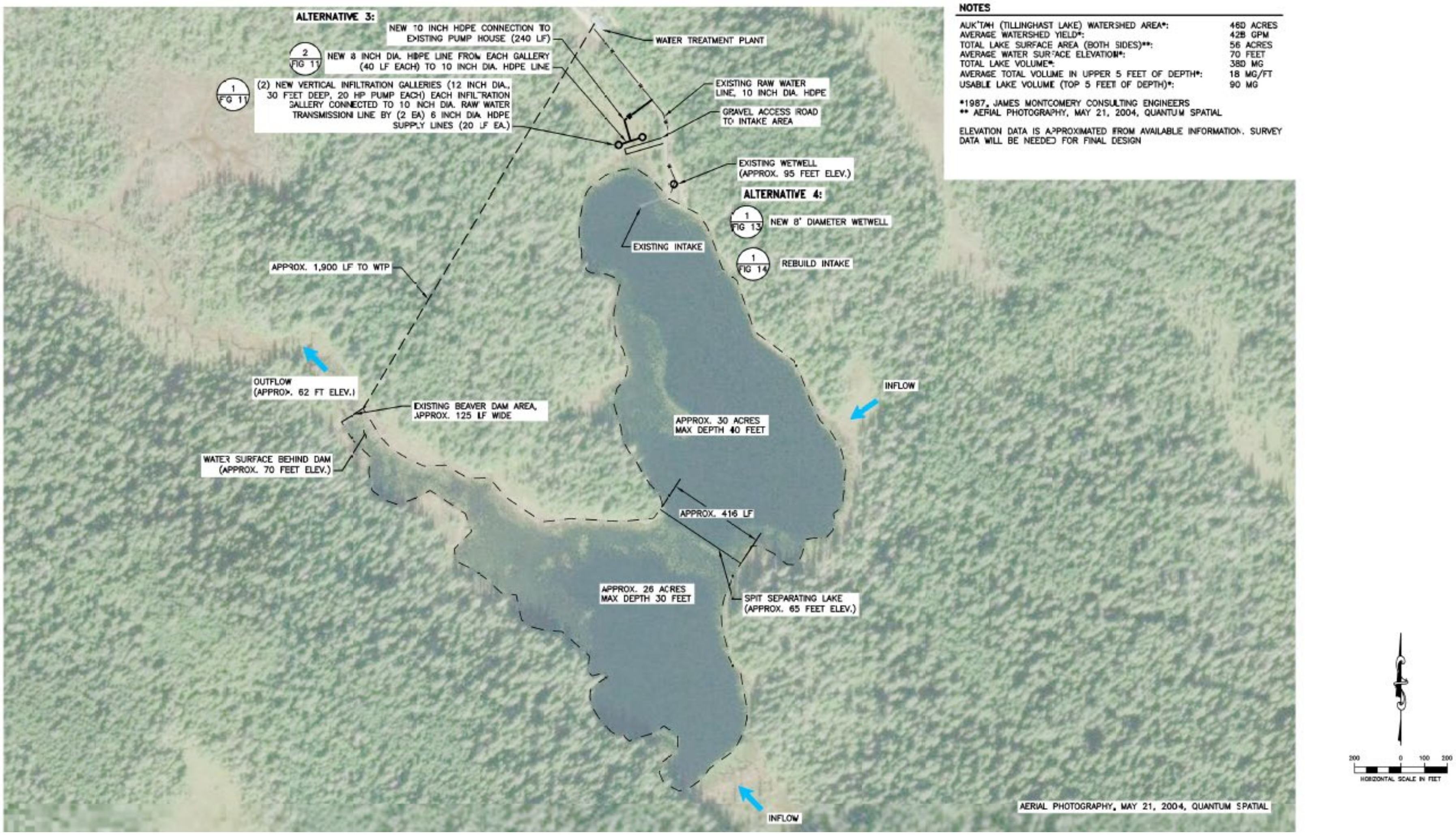

Figure 10: Current Water Source and Vertical Infiltration Gallery Location

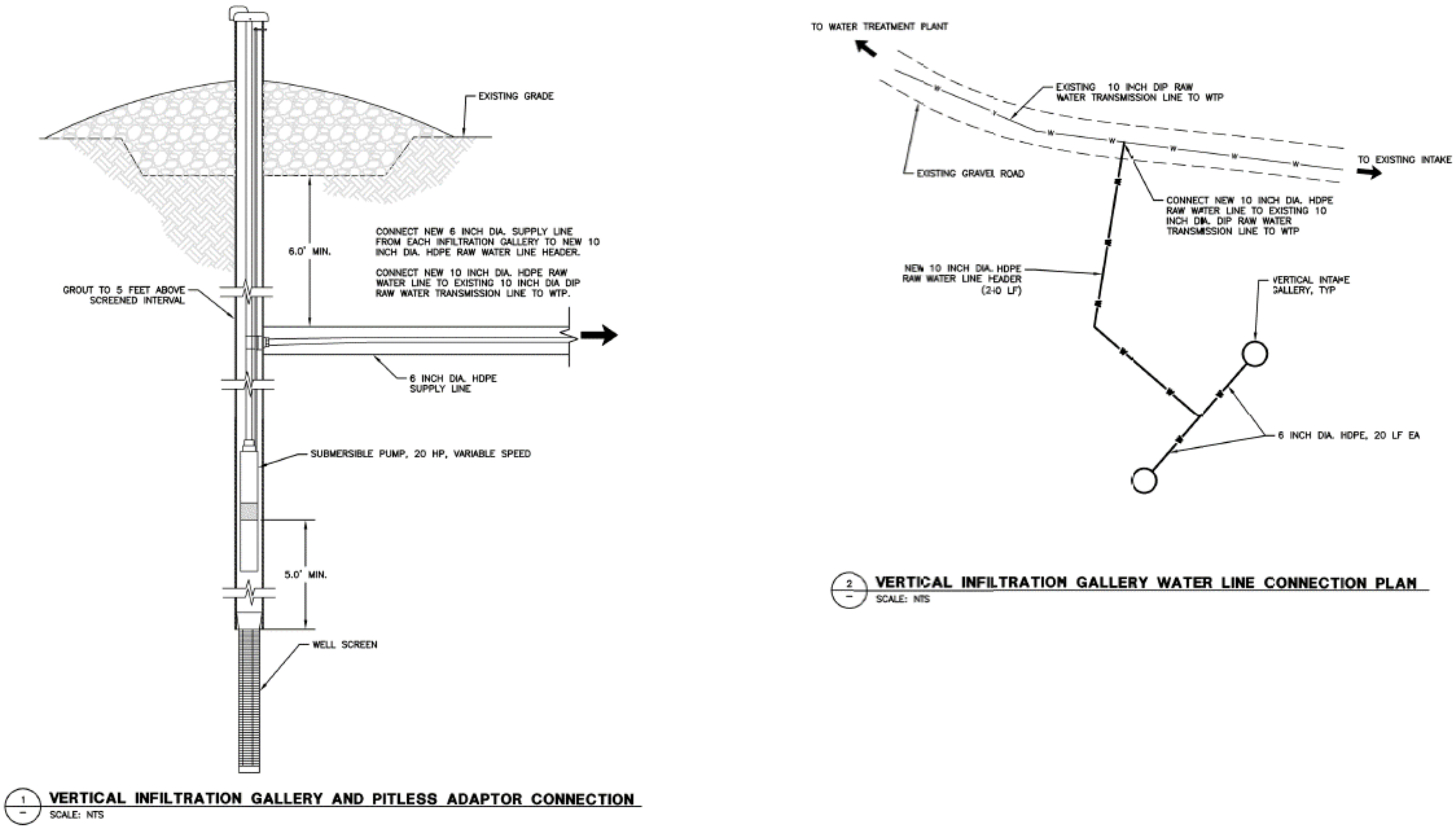

Figure 11: Vertical Infiltration Gallery Details

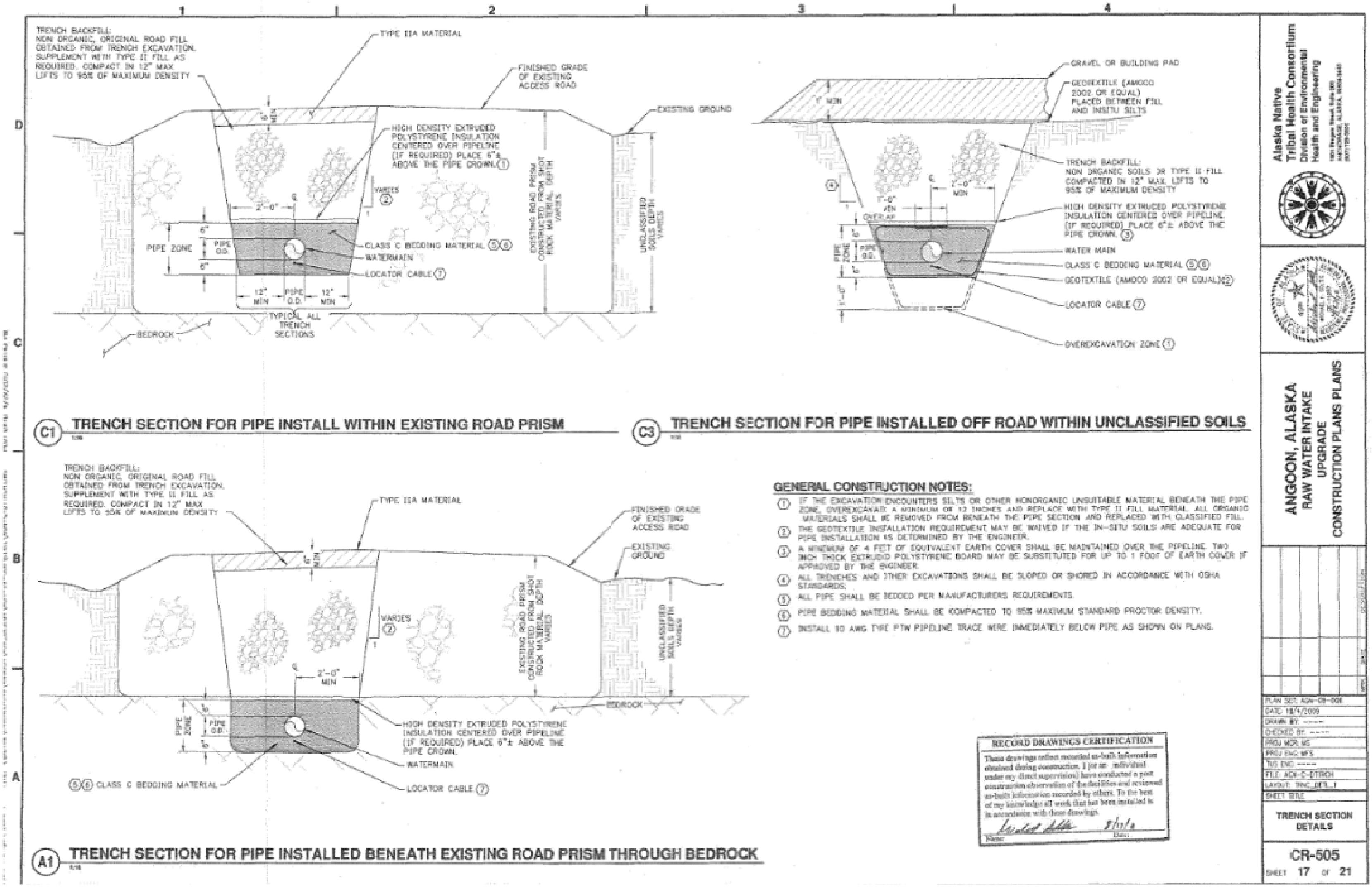

Figure 12: Trench Section Details (from ANTHC)

b) Evaluation Criteria

Water Availability

This alternative would provide the largest supply of raw water. The improved intake design would address current operational issues with the wet well. However, there has been no geotechnical investigation of the area surrounding the Lake. A geotechnical investigation would be needed to confirm that the infiltration galleries would be able to reliably meet design flows (225 gpm).

Water Quality

The vertical infiltration galleries would not be pulling water directly from the bottom of the lake. This would reduce debris issues and help reduce organics and provide some natural filtration. The variability of the water quality would be less severe, optimizing treatment processes. However, ANTHC reports that the vertical infiltration galleries may be prone to fouling and more difficult to maintain (as compared to the current intake).

Power Consumption

The power costs for the current pump system is one of the biggest power utility expenses in the WTP. This option would not remove the pump system, but it would include the installation of new pumps designed to provide the design flow of the system at optimum pump efficiency, optimizing power consumption and maximizing pump life.

Impacts to Existing Water System

The design flow for the filters (225 gpm, 1.5 gpm/sqft) would again be implemented. This would allow the pump to operate within the manufacturer's recommended efficiency curve, and assure more effective filter operations.

c) Map

A map of the proposed system was provided in Figure 10.

d) Environmental Impacts

Since this option will be renovating an existing source, permit requirements would be significantly less. The permits required for this process are listed below:

- ADNR Water Rights.
- ADEC Drinking Water Engineering Plan Review and Construction Approval.
- United States Army Corps of Engineers (USACE) 404 Permit for fill in wetlands, waters of the US.

The current water rights application process with ADNR should be completed.

Any outstanding items required for the system renovation projects will need to resolved in order to obtain needed ADEC Drinking Water Program construction approval.

The location of the intakes would be determined in the geotechnical investigation. The construction would occur on the land, near the lake edge. There would be no construction in open water. However, the final location may fall within a wetlands area, which is classified as waters of the US. If so a Section 401 and 404 Permitting would be needed.

Any runoff during intake construction would be captured and contained onsite. The project would result in limited site disturbance. But disturbance could exceed 1-acre. A stormwater permit may be needed.

e) Land Requirements

The new vertical infiltration galleries would be adjacent to WTP existing facilities, within areas with prior construction projects. The land is currently owned by Kootznoowoo, Incorporated (DCCED, 2020). The City would need obtain access for the construction of the intakes.

f) Potential Construction Problems

A geotechnical investigation would be needed to identify optimum locations for the infiltration galleries (and the potential need for subsurface blasting).

g) Sustainability

i. Water and Energy Efficiency

The proposed system would improve treatment efficiency (less plugging of the filter media). Energy efficient pumps and control systems would be used to minimize power costs. The community has expressed interest in solar panels, to help offset power costs.

ii. Green Infrastructure

No green infrastructure is associated with this alternative.

iii. Other

No other impacts are anticipated for this alternative.

h) Cost Estimates

The estimated capital cost of this alternative is $1,141,521. The operations and maintenance cost estimate is provided in Table 4-13: Alternative 3 Operations and Maintenance Cost Estimate1, and includes a change in O&M costs as compared to the existing system. See Appendix C for financial information, references, and NPV cost estimate

The costs for O&M are not expected to increase, as compared to the current costs. The need for ongoing raw water transmission line and screen maintenance should decrease operator hours needed for system maintenance (this was not included to be conservative). The change in short lived assets is due to the installation of new pumps.

Table 4-13: Alternative 3 Operations and Maintenance Cost Estimate

Description	Annual Cost	Change
Personal Services	$ 38,880	$ -
Travel & Per Diem	$ 2,000	$ -
Electricity	$ 30,000	$ -
Fuel Oil	$ 750	$ -
Vehicle Fuel	$ 2,000	$ -
Materials and Supplies	$ 2,000	$ -
Freight	$ 7,500	$ -
Water Testing	$ 3,000	$ -
Chemicals	$ 30,000	$ -
Miscellaneous	$ -	
Short Lived Assets	$ 1,967	$ 700
Annual Total	**$ 118,097**	**$ 700**

4.4 ALTERNATIVE 4: REBUILD EXISTING INTAKE SYSTEM

a) Description and Design Criteria

Alternative 4 would replace the existing 4-foot diameter, CMP, wet well with a new 8-foot diameter precast concrete wet well in approximately the same location (**Figure 13**). The new wet well would be set so that the low lake level would equate to a minimum of 4 feet of active depth in the wet well (**Figure 14**).

The 1992 plans for the wet well indicate that the lake level was at 72 feet elevation, with the intake from the lake set at feet 67.6 feet, and the base of the wet well at 64 feet. In 2011 the plans for the intake upgrade indicate that the lake level was at 65.5 feet. It does not appear that the two projects used a common datum. There is no current survey of the intake area.

The buried portion of the existing intake is 15 feet bgs, which can be constructed using common construction techniques. For excavations deeper than 15 feet special construction considerations may be warranted. In order to deep the wet well sufficiently it may be necessary to drop the level of the area around the wet well, before installing the new wet well. A current survey, confirming lake and surface elevations is needed prior to final design.

The existing pumps would be replaced with two 20 HP pumps with variable frequency drives. Each pump would be sufficient to meet the design treatment flow (225 gpm) and fill the WST adjacent to the WTP, while operating within the optimum efficiency range of the pump. The two pumps would alternate pump operations. There were no available record drawings of the existing pump control panel. The adequacy of the panel should be verified in final design. Intake system design criteria are summarized in the following table.

Table 4-14: Intake System Design Criteria

INTAKE (HDPE)		
Diameter	8	inches
Minimum Height Above Bottom of Lake	6	feet
Screen Length (1 foot diameter)	5	feet
WET WELL (Pre-cast Concrete)		
Maximum depth of burial (wet well base).	14	feet
Diameter	8	feet
Unit Volume of Wet Well	376	gallons/foot
Minimum Depth of Wet Well	4	feet
Maximum Depth of Wet Well (corresponds to lake elevation)	8	feet
Active Volume of Wet Well	2,632	gallons
Design Maximum Pump Rate	225	gpm
Pump Cycle (at Design Pump Rate, assuming no inflow)	11.7	minutes

The Pros/Cons of Alternative 4 are shown in **Table 4-15**.

Table 4-15: Alternative 4 Rebuild Existing Intake System Pros / Cons

Pros	Cons
• Access to large quantities of raw water.	• Would not eliminate power costs for pumping raw water. Would continue to have to pump water through the treatment system, and into the WST adjacent to the WTP.
• New pumps would operate at design filter loading rate, within optimum pump efficiency range, prolonging the design life of the pumps.	• Surface elevations would be critical in setting the elevation of the wet well and the pumps. A site survey would be needed for final design.
• Less complex permitting and construction. The project area would stay within areas of prior construction near the WTP.	
• Elevated intake screen will help manage sediment and organic inflow.	

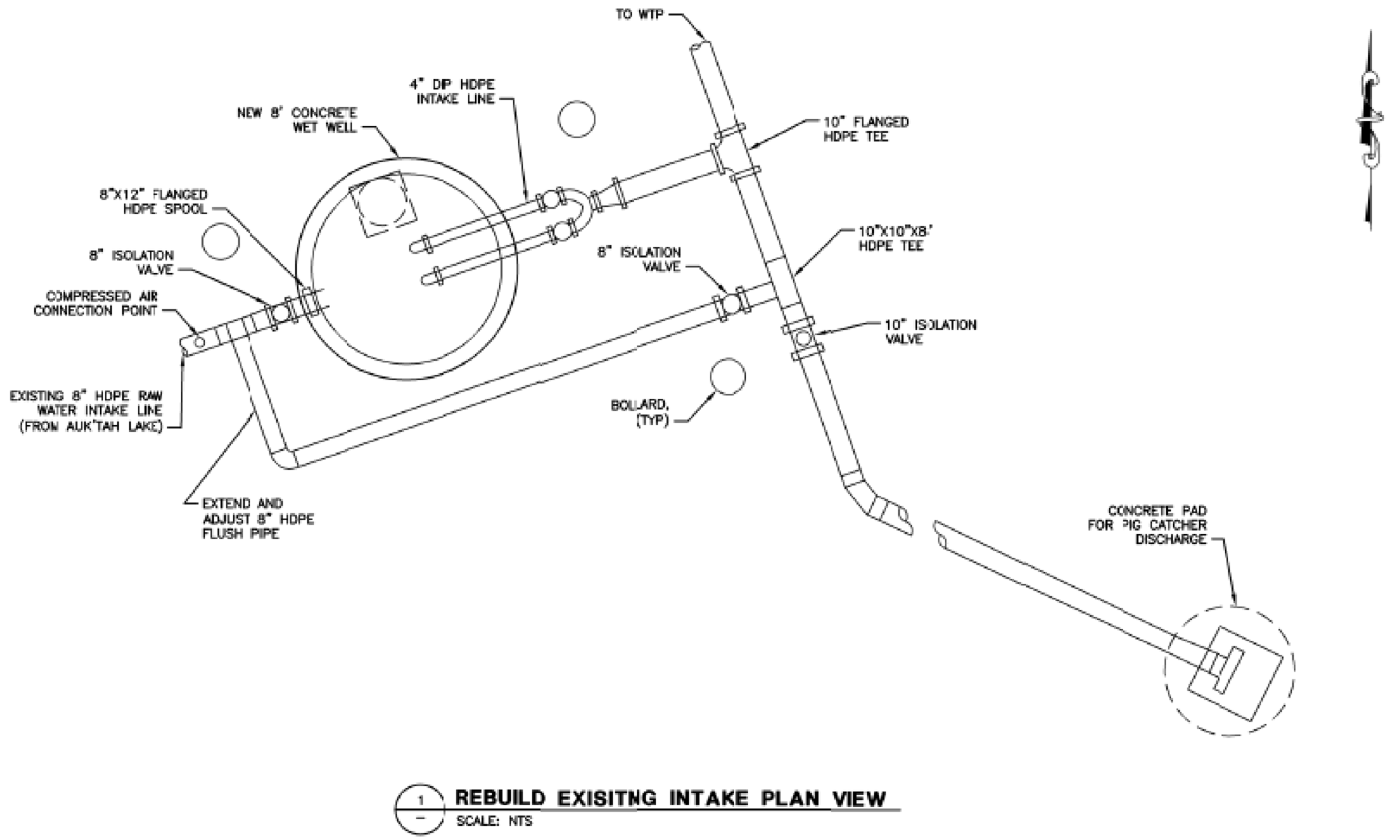

Figure 13: Rebuild Existing Intake System, Plan View

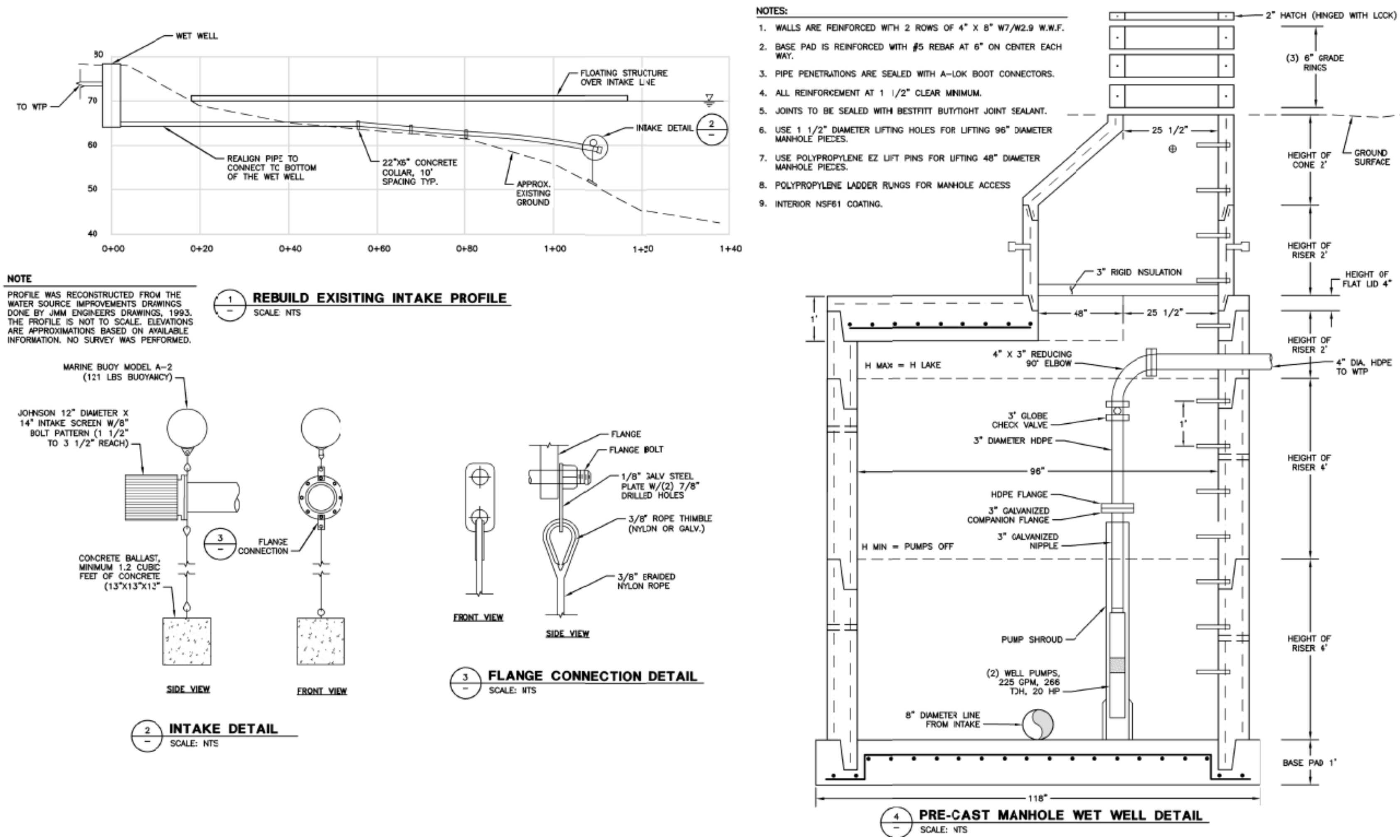

Figure 14: Rebuild Existing Profile and Details

b) Evaluation Criteria

Water Availability

Like the vertical infiltration gallery alternative, this alternative would provide the largest supply of raw water. The improved intake design would address current operational issues with the wet well.

Water Quality

Elevating the intake screen at least 8 feet above the pond bottom will help minimize sediment and organic inflow. However, organic contamination could continue to be an issue, and increase the potential for DBP formation. An additional roughing filter may be needed in the WTP.

Power Consumption

The power costs for the current pump system is one of the biggest power utility expenses in the WTP. This option would include the installation of new pumps in the new wet well, designed to provide the design flow of the system at optimum pump efficiency, minimizing power consumption as much as possible, and maximizing pump life.

Impacts to Existing Water System

The design flow for the filters (225 gpm, 1.5 gpm/sqft) would again be implemented. This would optimize filter performance and help prevent shorter filter run times.

c) Map

A map of the proposed system was provided in Figure 10.

d) Environmental Impacts

Since this option will be renovating an existing source, permit requirements would be significantly less. The permits required for this process are listed below:

- ADNR Water Rights.
- ADEC Drinking Water Engineering Plan Review and Construction Approval.
- A Section 401 Permit for stormwater runoff.
- A Section 404 Permit for fill in wetlands, or waters of the US.
- A State of Alaska General Permit for Construction Dewatering may be needed, if groundwater is encountered during the construction of the wet well.

The current water rights application process with ADNR should be completed.

Any outstanding items required for the system renovation projects will need to resolved in order to obtain needed ADEC Drinking Water Program construction approval.

The elevation of the wet well and the surrounding pad would be set following the site survey. The wet well construction would occur on the land, near the lake edge. The new intake would be placed in the lake. Therefore, a Section 404 Permit (USACE) would be needed.

Any runoff during upgrade construction would be captured and contained onsite. The area disturbed would be limited, but could exceed 1-acre. A stormwater permit may be required.

e) <u>Land Requirements</u>

The new wet well and intake upgrade would replace the existing systems in their current location (approximately). There would be no change to existing site control/site access.

f) <u>Potential Construction Problems</u>

The distance between the wet well intake and the lake surface has increased since construction in 1992. There is no longer sufficient water in the wet well to run the pumps. The existing wet well had an installation depth of 14 feet. Standard construction methods would typically limit maximum depth to approximately 15 feet. In order to deepen the wet well it will be necessary to flatten an area around the wet well, so that the top elevation in the wet well matches the lake elevation (**Figure 14**). The limited information available indicates that this will require a cut approximately 4 feet deep. A survey will be needed for final design, to verify elevations.

There is no geotechnical information available for the site. If cohesive bedrock is encountered, blasting may be needed. If the groundwater is encountered, dewatering would be needed (along with a construction dewatering permit).

Demolition materials (CMP, HDPE piping) would need to be appropriately disposed of at the landfill.

g) <u>Sustainability</u>

i. Water and Energy Efficiency

The proposed system would improve treatment efficiency (less plugging of the filter media). Energy efficient pumps and control systems would be used to minimize power costs. The community has expressed interest in solar panels, to help offset power costs.

ii. Green Infrastructure

No green infrastructure is associated with this alternative.

iii. Other

No other impacts are anticipated for this alternative.

h) <u>Cost Estimates</u>

The estimated capital cost of this alternative is $1,718,950. This estimate is based on the following assumptions:

- The estimated costs include an automatic strainer in the WTP to improve organic removal prior to filtration (equipment information provided in Appendix I). The use of the strainer would result in less backwash of the filters. The increased cost due to the use of the strainer would be offset by a lesser use of the backwash pump and blower systems.

- The estimated cost assumes that the existing pump control panel can be reused. A new pump control panel would add approximately $32,000 to the cost (as detailed in Alternate 2 in the Appendix C).

The operations and maintenance cost estimate is provided in **Table 4-16**. Since there are no substantial changes that would affect utility costs as compared to the existing system, it is assumed that utility costs will be relatively the same. See Appendix C for financial information, references, and NPV cost estimate

The costs for O&M are not expected to increase, as compared to the current costs. The change in short lived assets is due to the installation of new pumps.

Table 4-16: Alternative 4 Operations and Maintenance Cost Estimate

Description	Annual Cost	Change
Personal Services	$ 38,880	$ -
Travel & Per Diem	$ 2,000	$ -
Electricity	$ 30,000	$ -
Fuel Oil	$ 750	$ -
Vehicle Fuel	$ 2,000	$ -
Materials and Supplies	$ 2,000	$ -
Freight	$ 7,500	$ -
Water Testing	$ 3,000	$ -
Chemicals	$ 30,000	$ -
Miscellaneous	$ -	
Short Lived Assets	$ 1,967	$ 700
Annual Total	**$ 118,097**	**$ 700**

5.0 SELECTION OF AN ALTERNATIVE

The alternatives were evaluated on the basis of cost as well as non-monetary concerns. That analysis is provided in the following sections.

a) Life Cycle Analysis

A life cycle present worth cost comparison is provided below. Complete calculations, with assumptions, are provided in Appendix C.

Table 5-1: Net Present Value Comparison

	Capital Cost	Annual O&M	Salvage Value	Lifetime O&M	NPV Total
Alternative 1: No Action	$0	$117,397	$0	$3,388,992	$3,388,992
Alternative 2: New Source Impoundment at Favorite Creek	$6,713,376	$129,581	$0	$3,740,741	$10,454,117
Alternative 3: New Infiltration Galleries at Auk'tah Lake	$1,141,521	$118,097	$0	$3,409,199	$4,550,720
Alternative 4: Rebuild Intake System at Auk'tah Lake	**$1,718,950**	**$118,097**	**$0**	**$3,409,199**	**$5,128,149**
Notes: See Appendix C for a complete cost estimate and life-cycle cost assumptions and calculations. Annual O&M includes short lived assets. *Assumptions:* *Federal Discount Rate (10/2020): 0.25%* *Life cycle:* 30 *years*					

b) Non-monetary Factors

Non-monetary factors, including social and environmental aspects were also considered in determining which alternative is recommended. These include:

- Raw water access and quantity
- Raw water quality and treatability
- Cost of power
- Community preference
- Construction challenges

- Land requirements, permitting issues, and environmental impacts
- O&M requirements

Alternative 4, rebuilding the intake system, including new wet well and intake, best meets the objectives of this PER and addresses the primary concerns of adequate raw water quantity and improved raw water quality for the least capital cost.

- This alternative would provide the best raw water access. Even if the lake level dropped and the Auk'tah lake was separated into two lakes, the northern most lake would contain a substantial amount of water (far more water than in the proposed impoundment). Providing two vertical infiltration galleries would provide redundancy and ensure adequate water in the event of a pump failure.
- The quality of the raw water would be optimized by removing the intake from the bottom of the lake to minimize sediment and organic inflow.
- The pumping costs would be minimized by maximizing pump efficiency, which would also maximize pump life.
- It is recognized that Auk'tah Lake was not the stated community preference. However, an improved intake design can address their concerns regarding water quality, quantity, and power costs as discussed.
- The construction would be relatively easy (as compared to an impoundment).
- This option would rebuild systems at, or immediately adjacent, to their current location. Since construction would occur near the existing facilities, permitting would be much simpler and take significantly less time. The environmental impacts would be substantially less than the impoundment option.
- The O&M requirements would not increase. There would be no new road to maintain.

6.0 PROPOSED PROJECT

a) Preliminary Project Design

i. Drinking Water

The proposed upgrade to the existing intake system is described in Section 4.4 (page 68). In addition, a mechanical strainer was recommended to increase organic removal immediately prior to the filtration process in the WTP. A self-cleaning mechanical strainer, the Eliminator 793 Series (sureflowequipment.inc), would maximize filter run times and maximize filter efficiency. This unit produces a backwash discharge, which would need to go to the backwash pond across the street from the WTP (assuming there is sufficient capacity in the pond). Improving filter performance would help maintain compliance with the SWTR.

Select equipment information included in the proposed alternative is included in Appendix I.

ADEC Drinking Water Program approval to construct and to operate would be needed for all system modifications.

ii. Wastewater

No impacts to the community wastewater system are expected.

iii. Solid Waste

The existing wet well (CMP, 4-foot diameter, 14 feet long), would need to be disposed of at the landfill.

iv. Stormwater

A stormwater discharge permit would be needed (as discussed in Section 4.4)

b) Project Schedule

The proposed project schedule is provided below.

Table 6-1: Proposed Project Schedule

Task	Anticipated Completion Date
Preliminary Engineering	April 2021
Funding Acquired and Site Survey	April 2022
Design / Permitting / Easements	April 2023
Construction	October 2024

c) Permit Requirements

Anticipated permit requirements are discussed in Section 4.4d (page 72).

d) Sustainability Considerations

Sustainability considerations of Alternative 4 are discussed in Section 4.4g (page 73).

i. Water and Energy Efficiency

Water and energy efficiency is discussed in Section 4.4g.

ii. Green Infrastructure

No green infrastructure is associated with this alternative.

iii. Other

It should be noted that if the construction phase of this project receives federal funding via the United States Department of Agriculture Rural Development Rural Alaska Village Grant program then the project must abide by American iron and steel requirements per Section 746 Division A Title VII of the Consolidated Appropriations Act of 2017.

e) Total Project Cost Estimate

The capital cost of this project is estimated at **$1,718,950**. A detailed cost estimate is provided in Appendix E. This assumes the existing pump control panel can be reused. This panel is reportedly in acceptable condition. If a new panel is needed this would add approximately $32,000 to the estimate (as detailed in Alternative 2 of the cost estimate).

f) Annual Operating Budget

Annual operating budgets for 2019 and 2020 are included in Appendix C. The financial statements show electricity and chemicals are the largest operating expenses for the water system. The reasons for high electricity costs were identified in an energy audit performed in 2016, as discussed in Section 2.0e). The ongoing leaks in the system add significantly to system costs. However, a PER was completed in 2020 to secure funding for needed infrastructure repairs to address this issue.

g) Income

Water utility rates charged by the City were shown in Table 2-4, based on Ordinance No. 13.20.010 – Charges designated for water. The rate schedule shows the typical fee for a single-family residence is $24 per month for water service, and $4 monthly discount is applied to single-elderly residences. Rates increase for commercial buildings, depending on the type of facility (Municode, 2020).

i. Annual O&M Costs

Annual O&M costs are not expected to vary significantly from current O&M costs. New pumps should make pumping more efficient. More efficient filtration would reduce the frequency of backwash processes, which also consume power. A more efficient intake, with less debris accumulation, would require less oversight and maintenance. The changes proposed to the system should help reduce O&M costs. The O&M costs are provided in **Table 4-16** with NPV calculations and assumptions included in Appendix C.

ii. Debt Repayments

No debt repayment was noted in the WTP budget documents.

iii. Reserves

No reserves were noted in the WTP budget documents.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Alternative 4, a replacement and reconstruction of the intake system, in its current location at the edge of Auk'tah Lake, will provide a reliable quantity of raw water. New pumps will provide for improvements in system efficiency. The intake would be reconstructed, to ensure a minimum separation of 8 feet off the lake bottom, to help prevent organics and sediment from entering the the water system. The construction of the upgrades does not require development or disturbance of protected lands, or a long permitting process. The new system will address operational issues with low wet well levels during hot dry periods. Other operations of the system will not be impacted.

The recommended solution is based on available water and surface elevation. The distance between the wet well intake and the lake surface has increased since that time. There is no longer sufficient water in the wet well to run the pumps. The existing wet well had an installation depth of 14 feet. Standard construction methods would typically limit burial to a 15 foot maximum depth. In order to deepen the wet well it will be necessary to flatten an area around the wet, so that the maximum depth

The increasing distance between the ground surface at the existing wet well and the surface of the lake could be due to a lower lake level associated with longer, dryer summers. For the purposes of this report, it was assumed that the longer, dryer summers that have become more common in the past decade will continue. If these trends accelerate and become more extreme, the problem with inadequate water in the wet well could reoccur in the future.

Many studies have been completed which focused on using Favorite Creek as a water supply for the community, using either an impoundment (as discussed in Alternative 2), or an intake located in the stream bed (as discussed below). A careful review of prior studies revealed multiple concerns in relying on Favorite Creek as a water source for the community.

- The biggest challenge in using Favorite Creek is the volume of the creek water available for use. ADNR typically allows the use of up to approximately 20% of creek flow. Prior studies indicated that this does not leave sufficient volume to meet the community's needs during hot dry periods, and Auk'tah Lake would be needed in the summer as a back-up water supply. The main problem with the existing water system is inadequate water supply during the summer. Using Favorite Creek as a source would not address this issue.
- Maintenance for a backup water supply (including water supply pumps), will increase system O&M costs.
- The costs of maintaining the road to the Favorite Creek intake, as well as the intake, will increase the system O&M costs.
- The water in Favorite Creek would be more easily impacted by storms and runoff. The increased turbidity of the water in Favorite Creek would result in shortened filter run times, and increased backwash requirements, which will increase system O&M costs.
- It would be difficult for the WTP to effectively treat water with different raw water characteristics when using two different sources. This would require more system

oversight by the operators. Changing raw water sources seasonally would increase the risk of compliance problems, until the treatment process were adjusted to the new source water.

- Maintaining two separate intakes, in two separate water bodies (Favorite Creek and Auk'tah Lake), would require additional raw water compliance testing.
- Utilizing Favorite Creek, and the Favorite Creek watershed would require multiple, lengthy environmental studies and approvals. This would be expensive and delay the design and construction of an intake in Favorite Creek.

<u>Alternatives Not Considered</u>

i. In-Stream Intake (and diversion structure) in Favorite Creek

In the early stages of developing the projects, an alternative which included an infiltration gallery constructed in the stream bed was considered. This is discussed in the Geotechnical Report by Golder in Appendix H. This option was rejected for the following reasons:

- Insufficient reliable access to year-round raw water. Auk'tah lake would need to be retained as a back-up supply during low stream flow periods. This would likely occur at the same time that the lake is experiencing low lake levels. This would leave the community without a reliable water source. This is significant problem with the current system.
- The water quality of the Lake and stream are different. Switching between sources would have to include changes in treatment processes, to meet SWTR requirements.
- Potential for debris issues in a longer transmission line.
- Potential for poor raw water quality after season storm events and snowmelt. The water quality in the small stream would be more influenced by precipitation and runoff events.
- Increased maintenance issues associated with stream-bed intake.

Since an in-stream intake would not address any of the issues listed in the PER scope (it would not provide an adequate quantity or quality of raw water, or decrease operational and power costs), it was not considered a viable alternative.

ii. Raw Water Storage Tank

The current system uses approximately 100,000 gpd, or 244 gpcd (**Table 2-2**). A PER addressing system leakage was provided in 2020. Assuming the majority of the leakage issues are addressed, the system demand would be approximately 50,000 gpd. One month of raw water storage equates to 1.5 MG of water. The most recent temperature data available is from 2007-2009 (**Exhibit 1-3**). This data indicates that warmer summer weather lasts from June-August. Residents report that summers are longer and hotter in recent years. This could be a continuing trend. If so, the raw water storage tank would need to be sized accordingly. Without additional weather data, a conservative assumption of 3 months of storage would be used, resulting in a 4.5 MG raw water storage tank, making this option impractical. .

iii. Groundwater Source

There was no documentation of any groundwater well near Angoon. The geologic conditions, and prevalent bedrock, make a groundwater source less likely. There was insufficient information available to include a groundwater option.

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APPENDIX A: FIGURES

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ANGOON WATER SOURCE
PRELIMINARY ENGINEERING REPORT
ANTHC PROJECT: AN-19-U1R
ANGOON, ALASKA
100% SUBMITTAL
APRIL 2021

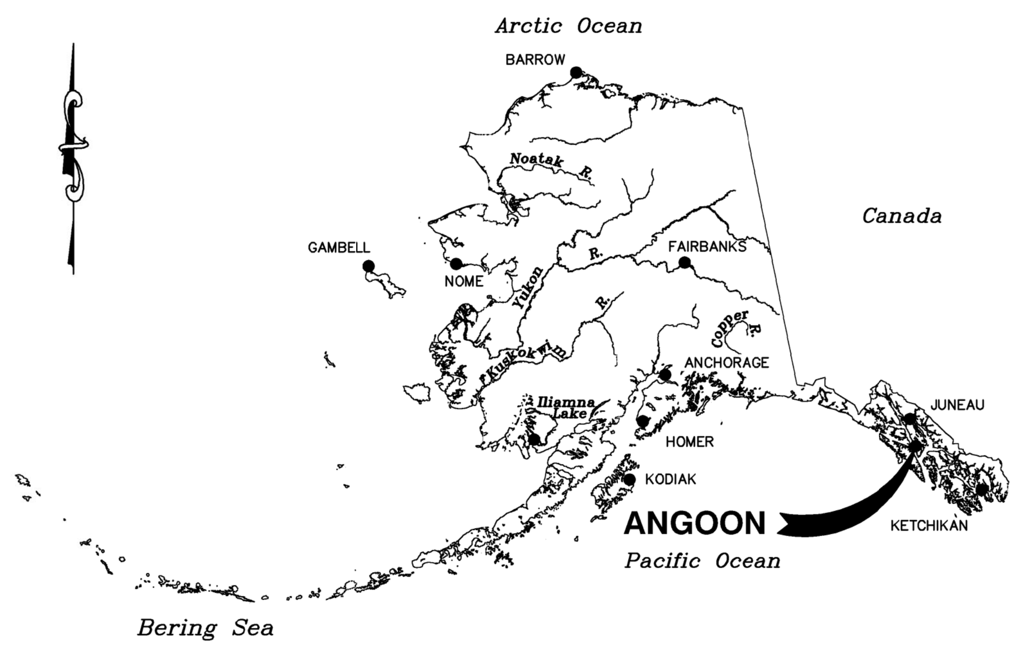
SCOPE:

THE COMMUNITY OF ANGOON UTILIZES A SURFACE WATER SOURCE THAT IS DEPENDENT ON A BEAVER DAM TO MAINTAIN WATER SURFACE ELEVATION. THE COMMUNITY HAS EXPERIENCED WATER SHORTAGES ASSOCIATED WITH WARM SUMMER CONDITIONS. THE INABILITY TO MEET COMMUNITY DEMAND HAS INTERFERED WITH THE COMMUNITIES EFFORTS TO EXPAND HOUSING. ADDITIONALLY, THE COMMUNITY IS CONCERNED THAT THE EXISTING SOURCE MAY BE AT AN INCREASED RISK OF PROTOZOAL CONTAMINATION BECAUSE OF THE BEAVER POPULATION.

THIS PRELIMINARY ENGINEERING REPORT (PER) EVALUATES THE FOLLOWING ALTERNATIVES TO IMPROVE THE WATER SOURCE:

1. NO ACTION
2. CONSTRUCT A NEW IMPOUNDMENT ON FAVORITE CREEK
3. CONSTRUCT NEW VERTICAL INFILTRATION GALLERIES NEAR EXISTING INTAKE ON AUK'TAH LAKE
4. REBUILD EXISTING INTAKE SYSTEM

VICINITY MAP
NOT TO SCALE



ALASKA MAP
NOT TO SCALE

FINAL PER

REVISIONS			
NO.	DATE	BY	DESCRIPTION

REVISIONS			
NO.	DATE	BY	DESCRIPTION

Project No. 32210029

Bristol
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Division of Environmental Health and Engineering
4500 Diplomacy Drive
Anchorage, Aaska 99508
(907) 729-3600

NOT FOR CONSTRUCTION! CONCEPTUAL ONLY!

ANGOON WATER SOURCE PER
ANGOON, ALASKA

TITLE SHEET, VICINITY MAPS, SHEET INDEX AND SCOPE OF WORK

SHEET NO. FIG. 1

SCALE:N/A	DESIGNED: VBW	CHECKED: VBW	DRAWN: JJK	DATE: APRIL 2021	SHEET 1 OF 14

User: JKINDER Mar 30, 2021 – 1:27pm
Drawing: K:\JOBS\32210029 ANGOON PER\ACAD-DESIGN\32210029_01_ANGOON PER_FIG1&2.DWG – Layout: FIG 1
Xrefs: BR22X34REV.DWG – Images: ANGOON LOCATION GOOGLE EARTH 2.JPG

EXISTING SYSTEM DESCRIPTION:

THE COMMUNITY WATER SYSTEM SERVING THE CITY OF ANGOON CONSISTS OF A SURFACE WATER INTAKE IN AUK' TAH LAKE (TILLINGHAST LAKE), FOLLOWED BY A DIRECT FILTRATION SYSTEM, CHLORINATION, AND A 500,000 GALLON WATER STORAGE TANK (250,000 GALLONS IS RESERVED FOR DISINFECTION CONTACT TIME). TWO WATER TOWERS ARE CONNECTED TO THE DISTRIBUTION SYSTEM WHICH PROVIDE AN ADDITIONAL 650,000 GALLONS (TOTAL) OF STORAGE.

THE WATER TREATMENT PLANT WAS ORIGINALLY CONSTRUCTED IN 1976. THE CURRENT TREATMENT SYSTEM IS THE RESULT OF UPGRADES COMPLETED IN 2007 BY THE ALASKA NATIVE TRIBAL HEALTH CONSORTIUM (ANTHC PROJECT AN-05-RA5). INTAKE SYSTEM UPGRADES WERE COMPLETED IN 2011 (ANTHC PROJECT AN-09-NK3).

AUK'TAH LAKE (TILLINGHAST LAKE) CONSISTS OF TWO LAKES THAT ARE INTERCONNECTED BECAUSE OF A WELL ESTABLISHED BEAVER DAM CONSTRUCTED ON THE OUTLET. RECENTLY THE WATER LEVEL IN THE LAKE HAS DROPPED TO LOW LEVELS DURING THE WARMER SUMMER MONTHS, LIMITING ACCESS TO RAW WATER. AN INADEQUATE RAW WATER SUPPLY IS IMPACTING COMMUNITY DEVELOPMENT.

THE CURRENT SURFACE WATER SOURCE HAS BEEN DESIGNATED AS "BIN 1" UNDER THE LONG TERM 2 ENHANCED SURFACE WATER TREATMENT RULE, INDICATING THAT THE SOURCE IS CLASSIFIED IN THE LOWEST RISK CATEGORY FOR CRYPTOSPORIDIUM CONTAMINATION.

ECONOMIC UNCERTAINTIES IN THE COMMUNITY HAS RESULTED IN AN OVERALL DECLINE IN THE POPULATION FROM A HIGH POINT OF 638 IN 1990, TO THE CURRENT POPULATION OF 399.

A PIPED WATER DISTRIBUTION SYSTEM IS PROVIDED THROUGHOUT THE CITY. HOWEVER PARTS OF THE DISTRIBUTION SYSTEM ARE OVER 50 YEARS OLD. DETERIORATION HAS RESULTED IN ONGOING WATER MAIN AND SERVICE LINE FAILURES, RESULTING IN CHRONIC LEAKAGE AND AN INFLATED AVERAGE WATER USE RATE OF 244 GALLONS PER CAPITA PER DAY. A PRELIMINARY ENGINEERING REPORT EVALUATING NEEDED UTILITY / PIPELINE REPAIRS WAS SUBMITTED TO THE UNITED STATES DEPARTMENT OF AGRICULTURE, RURAL DEVELOPMENT (USDA RD), APRIL 2020.

SIGNIFICANT PRIOR PROJECTS:

1976 ORIGINAL SYSTEM CONSTRUCTION

DIRECT FILTRATION SYSTEM WITH (4) 84" DIAMETER PRESSURE FILTERS, WITH A DESIGN FLOW OF 308 GPM, FOR A LOADING RATE OF 2 GPM/SQFT.

2005-2009 ANTHC PROJECT AN 05-RA5

A WTP RENOVATION PROJECT THAT RETROFITTED THE (4) ORIGINAL FILTER VESSELS WITH NEW UNDERDRAINS AND AN AIR SCOUR SYSTEM, PROVIDED NEW INSTRUMENTATION (TURBIDIMETERS), COAGULANT CONTROL (STREAMING CURRENT DETECTOR), AND IMPROVED CHEMICAL STORAGE AND HANDLING FACILITIES. THE DESIGN FLOW WAS REDUCED TO 225 GPM FOR A LOADING RATE OF 1.5 GPM/SQFT (HOWEVER NEW PUMPS WERE NOT INSTALLED UNTIL THE SUBSEQUENT INTAKE RENOVATION).

2009-2011: ANTHC PROJECT AN-09-NK3

A SOURCE WATER INTAKE RENOVATION PROJECT THAT REPLACED THE DETERIORATED BOARDWALK AND INTAKE BOX, AND PROVIDED (2) NEW WELL PUMPS AT 10 HP EA, AND COMPRESSED AIR / PIGGING SYSTEMS, TO MANAGE DEBRIS/ALGAE ACCUMULATION IN THE INTAKE LINE. NEW INTAKE PUMPS PROVIDED AN INTAKE FLOW OF 225 GPM (AT A TOTAL DYNAMIC HEAD OF 266 FT).

ABBREVIATIONS

~ , APPROX.	APPROXIMATE
ADEC	ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
AKDOL&WD	ALASKA DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT
ANTHC	ALASKA NATIVE TRIBAL HEALTH CONSORTIUM
AVG	AVERAGE
CT	CONTACT TIME
DIA	DIAMETER
DWG	DRAWING
ELEV	ELEVATION
FF	FINISHED FLOOR ELEVATION
FT	FEET
FM	FORCE MAIN
GAC	GRANULAR ACTIVATED CARBON
GAL	GALLONS
GPD	GALLONS PER DAY
GPCD	GALLONS PER CAPITA PER DAY
GPM	GALLONS PER MINUTE
HDPE	HIGH-DENSITY POLYETHYLENE
HP	HORSEPOWER
LF	LINEAR FEET
MAX	MAXIMUM
MG	MILLION GALLONS
MIN	MINIMUM
NTS	NOT TO SCALE
OF	OVERFLOW ELEVATION
OC	ON CENTER
PWSID	PUBLIC WATER SYSTEM IDENTIFICATION NUMBER
SQFT	SQUARE FEET
TDH	TOTAL DYNAMIC HEAD
TYP	TYPICAL
WST	WATER STORAGE TANK
WTP	WATER TREATMENT PLANT

PRELIMINARY DESIGN CRITERIA

RENOVATED SYSTEM DESIGN CRITERIA (BASED ON ANTHC AN-05-RA5)		
DESIGN POPULATION	675	PEOPLE
DAILY AVERAGE DEMAND	81,000	GPD
DOCK FACILITY DEMAND	7,000	GPD
DISTRIBUTION LOSSES	100,000	GPD
TOTAL DESIGN DEMAND	188,000	GPD
AVERAGE DESIGN FLOW RATE	130	GPM
PEAKING FACTOR	2	
MAX DAILY DEMAND	276,000	GPD
DESIGN FLOW RATE	225	GPM
2020 CURRENT SYSTEM SUMMARY		
PUBLIC WATER SYSTEM ID (PWSID)	2130017	
PUBLIC WATER SYSTEM DESIGNATION	COMMUNITY	
SOURCE DESIGNATION	SURFACE WATER, BIN 1	
PRIMARY SOURCE	AUK'TAH LAKE	
WATER RIGHTS (DATE/NUMBER)	11/22/1988 LAS 12057	
1988 WATER RIGHTS	432,000	GPD
2020 WATER RIGHTS	0 (EXPIRED 1993)	GPD
POPULATION SERVED	404	PEOPLE
AVG ANNUAL POPULATION GROWTH RATE (2020)	-1.2% (AKDOL&WD)	
SERVICE CONNECTIONS (ADEC)	159	CONNECTIONS
TOTAL DAILY DEMAND (ALL USES AND LOSSES)	100,000	GPD
TOTAL AVERAGE DAILY USER DEMAND	244	GPCD
WTP OPERATION FLOW RATE	80	GPM
WST-1: TOTAL WATER STORAGE AND CT	500,000	GALLONS
WST-1: MIN WATER STORAGE RESERVED FOR CT	250,000	GALLONS
WST-2: MIDTOWN WATER TOWER STORAGE	500,000	GALLONS
WST-3: SCHOOL WATER STORAGE	150,000	GALLONS
2040 DESIGN CRITERIA (BASED ON 2020 GROWTH RATE OF -1.2% PER YEAR)		
POPULATION	314	PEOPLE
AVERAGE DAILY DEMAND	244	GPCD
TOTAL PROJECTED DEMAND	76,616	GPD
DESIGN PRODUCTION RATE	225	GPM
TOTAL DYNAMIC HEAD	266	FT

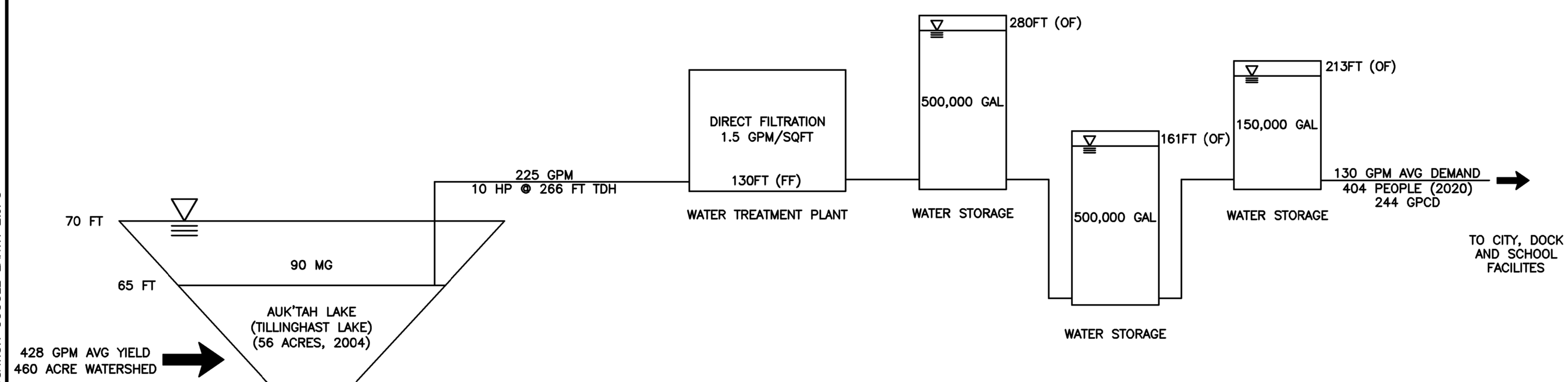
THE ACCURACY OF FUTURE POPULATION PROJECTIONS IS IMPACTED BY THE CURRENT ECONOMIC SITUATION IN THE COMMUNITY, AS WELL AS DEVELOPMENT LIMITATIONS IMPOSED BY LIMITED ABILITY TO EXPAND WATER SERVICES. PLANS FOR IMPROVED SITE ACCESS (INCLUDING AIRPORT DEVELOPMENT), AND AN IMPROVED SOURCE WATER INTAKE SYSTEM, WOULD HAVE A BENEFICIAL IMPACT ON FUTURE POPULATION GROWTH.

THE 2040 DESIGN CRITERIA ASSUMED NO CHANGE IN WATER DEMAND OR LEAKAGE RATE. ADDRESSING THE DISTRIBUTION SYSTEM DETERIORATION AND SYSTEM LEAKS, WOULD DECREASE DAILY DEMAND, AND HAVE A SIGNIFICANT IMPACT ON FUTURE DEMAND PROJECTIONS. FOR THE PURPOSES OF THIS REPORT, THE CURRENT TOTAL WATER USE RATE PER CAPITA (244 GPD), WHICH INCLUDES LOSSES, WAS USED WITH A FUTURE PROJECTED POPULATION BASED ON THE CURRENT GROWTH RATE OF -1.2% PER YEAR.

DESIGN OF SYSTEM PROCESSES IN THE 2007 WTP RENOVATION WAS BASED ON A TREATMENT DESIGN FLOW RATE OF 225 GPM. THIS RATE EQUATES TO A FILTER LOADING RATE OF 1.5 GPM/SQFT. THIS DESIGN FLOW RATE IS BASED ON TREATMENT EFFICACY AND IS ASSUMED FOR THE SOURCE WATER PRODUCTION RATE FOR 2040. THE CURRENT PUMPING RATE OF 80 GPM WAS NOT USED.

AFTER THE WTP AND INTAKE SYSTEM RENOVATIONS WERE COMPLETED, VARIABLE SPEED CONTROLLERS WERE ADDED TO THE INTAKE PUMP SYSTEM. THE SYSTEM THEN REDUCED THE INTAKE PUMP RATE TO APPROXIMATELY 80 GPM OPERATING CONTINUOUSLY. THIS EQUATES TO A FILTER LOADING RATE OF 0.5 GPM/SQFT. THIS LOADING RATE IS MUCH LESS THAN THE FILTER DESIGN AND COULD RESULT IN ISSUES WITH FILTER PERFORMANCE. THIS INTAKE PUMP RATE WAS NOT ASSUMED IN THE PRELIMININARY ESTIMATES FOR A NEW INTAKE.

EXISTING SYSTEM SCHEMATIC



BASED ON:

- WATER SOURCE EVALUATION TILLINGHAST LAKE AND FAVORITE BAY CREEK, JAMES M MONTGOMERY ENGINEERS, INC, 1987. ANGOON, ALASKA (ELEVATION DATUM UNKNOWN)
- WATER TREATMENT PLANT IMPROVEMENTS, ANTHC AN-05-RA5, RECORD DRAWINGS, 2011
- QUANTUM SPATIAL AERIAL PHOTOGRAPHY, TILLINGHAST LAKE, MAY 21, 2004

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NO.	DATE	BY	DESCRIPTION	NO.	DATE	BY	DESCRIPTION

Project No. 32210029

Bristol
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License Number: AECC697

Alaska Native Tribal Health Consortium
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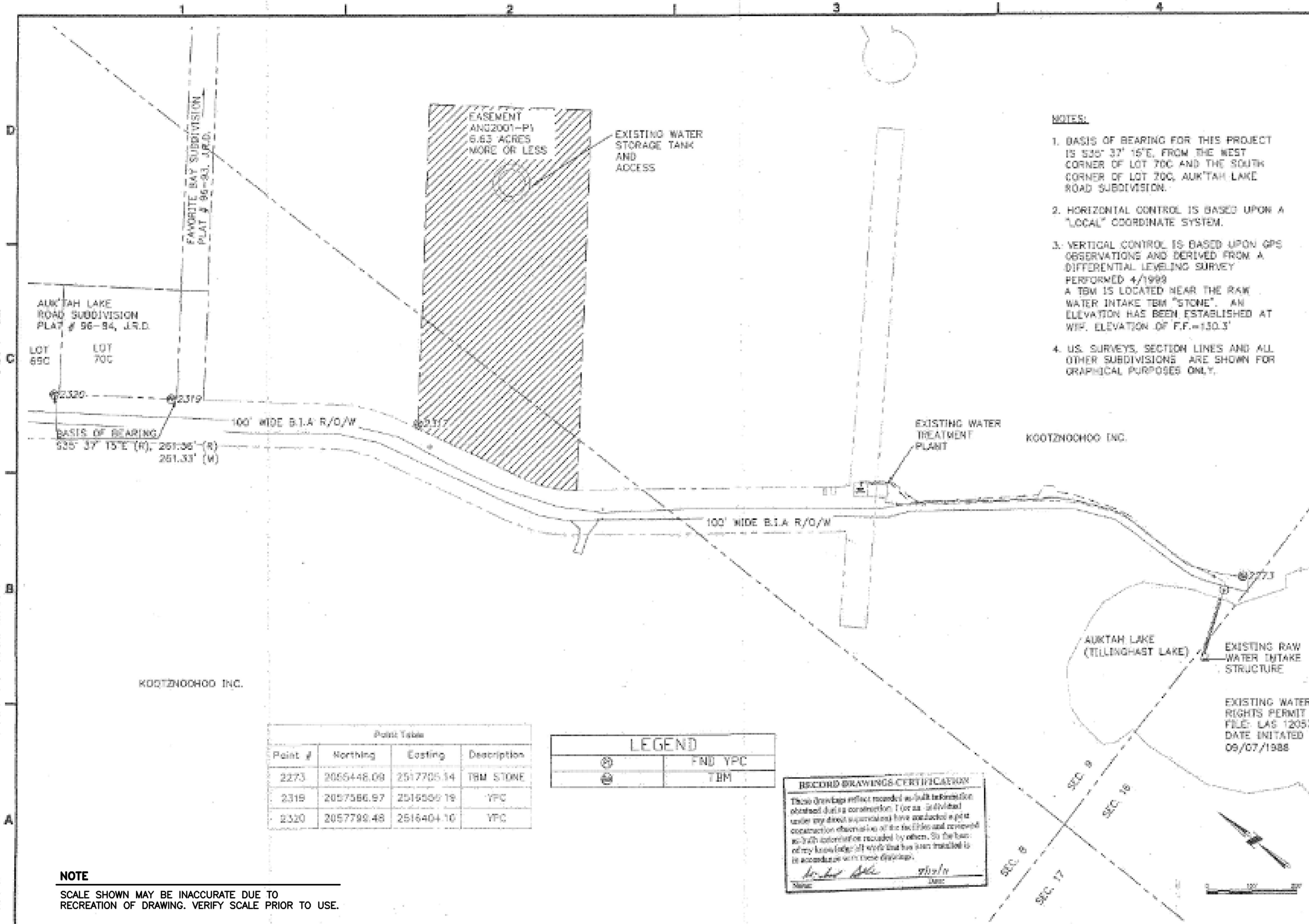
ANGOON WATER SOURCE PER
ANGOON, ALASKA

COMMUNITY DATA, PRELIMINARY DESIGN CRITERIA AND EXISTING SYSTEM SCHEMATIC

SHEET NO. FIG. 2

SCALE:N/A	DESIGNED: VBW	CHECKED: VBW	DRAWN: JJK	DATE: APRIL 2021	SHEET 2 OF 14



NOTES:

1. BASIS OF BEARING FOR THIS PROJECT IS S35° 37' 15"E, FROM THE WEST CORNER OF LOT 70C AND THE SOUTH CORNER OF LOT 70C, AUK'TAH LAKE ROAD SUBDIVISION.
2. HORIZONTAL CONTROL IS BASED UPON A "LOCAL" COORDINATE SYSTEM.
3. VERTICAL CONTROL IS BASED UPON GPS OBSERVATIONS AND DERIVED FROM A DIFFERENTIAL LEVELING SURVEY PERFORMED 4/1999. A TBM IS LOCATED NEAR THE RAW WATER INTAKE TBM "STONE". AN ELEVATION HAS BEEN ESTABLISHED AT WTP. ELEVATION OF F.F.=130.3'
4. U.S. SURVEYS, SECTION LINES AND ALL OTHER SUBDIVISIONS ARE SHOWN FOR GRAPHICAL PURPOSES ONLY.

Point Table

Point #	Northing	Easting	Description
2273	2055448.09	2517705.14	TBM STONE
2319	2057586.97	2516506.19	YPC
2320	2057799.48	2516404.10	YPC

LEGEND

⊗	FND YPC
⊖	TBM

RECORD DRAWINGS CERTIFICATION

These drawings reflect recorded as-built information obtained during construction. I (or an individual under my direct supervision) have conducted a post construction observation of the facilities and reviewed as-built information recorded by others. To the best of my knowledge all work that has been installed is in accordance with these drawings.

Name: Date:

NOTE

SCALE SHOWN MAY BE INACCURATE DUE TO RECREATION OF DRAWING. VERIFY SCALE PRIOR TO USE.

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Division of Environmental Health and Engineering

ANGOON, ALASKA
RAW WATER INTAKE UPGRADE

PROJECT SURVEY CONTROL

V-102
SHEET OF 21

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REVISIONS			
NO.	DATE	BY	DESCRIPTION

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ANGOON WATER SOURCE PER
ANGOON, ALASKA

RAW WATER INTAKE UPGRADE PROJECT
SURVEY CONTROL (FROM ANTHC)

SHEET NO. FIG. 3

SCALE: NTS | DESIGNED: VBW | CHECKED: VBW | DRAWN: JJK | DATE: APRIL 2021 | SHEET 3 OF 14

User: JKINDER Mar 30, 2021 – 1:28pm
Drawing: K:\JOBS\32210029 ANGOON PER\ACAD-DESIGN\32210029_07_ANGOON PER_REFERENCES.DWG – Layout: FIG 3
Xrefs: BR22X34REV.DWG – Images: None

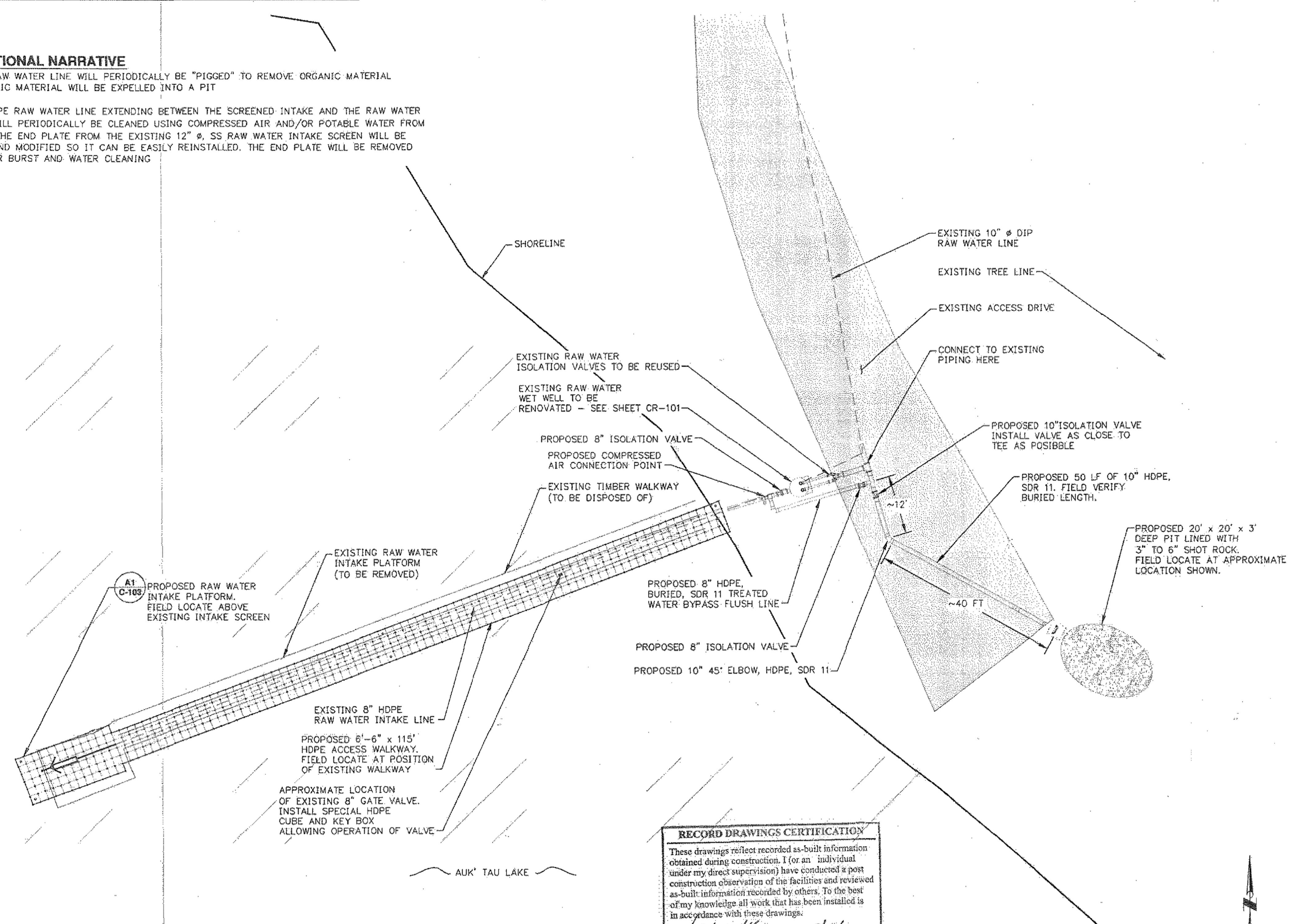
User: JKINDER Mar 30, 2021 – 1:28pm
Drawing: K:\JOBS\32210029 ANGOON PER\ACAD-DESIGN\32210029_02_ANGOON PER_EXISTING SITE PLAN.DWG – Layout: FIG 4
Xrefs: BR22X34REV.DWG – Images: None

USER: Harrigan, Louis T FILE: \\DEH02\ENGINEERING\ANGOON\AGN_DESIGN\AGN-09-006\GENERAL\AGN-C-SPOVER.DWG PLOT DATE: 4/29/2010 2:38:07 PM

OPERATIONAL NARRATIVE

THE 10" RAW WATER LINE WILL PERIODICALLY BE "PIGGED" TO REMOVE ORGANIC MATERIAL
THE ORGANIC MATERIAL WILL BE EXPELLED INTO A PIT

THE 8" HDPE RAW WATER LINE EXTENDING BETWEEN THE SCREENED INTAKE AND THE RAW WATER GALLERY WILL PERIODICALLY BE CLEANED USING COMPRESSED AIR AND/OR POTABLE WATER FROM THE WST. THE END PLATE FROM THE EXISTING 12" ø, SS RAW WATER INTAKE SCREEN WILL BE CUT OFF AND MODIFIED SO IT CAN BE EASILY REINSTALLED. THE END PLATE WILL BE REMOVED DURING AIR BURST AND WATER CLEANING



RECORD DRAWINGS CERTIFICATION

These drawings reflect recorded as-built information obtained during construction. I (or an individual under my direct supervision) have conducted a post construction observation of the facilities and reviewed as-built information recorded by others. To the best of my knowledge all work that has been installed is in accordance with these drawings.

Name: Michael ... Date: 7/13/11

A1 **RAW WATER GALLERY SITE PLAN**
1" = 10'

Alaska Native Tribal Health Consortium
Division of Environmental Health and Engineering
1901 Bragaw Street, Suite 200
ANCHORAGE, ALASKA, 99508-3440
(907) 729-3600

STATE OF ALASKA 49th MICHAEL F. SOLTIS CE-11767 REGISTERED PROFESSIONAL ENGINEER

ANGOON, ALASKA
RAW WATER INTAKE UPGRADE
CONSTRUCTION PLANS

MRK	DATE	DESCRIPTION

PLAN SET: AGN-09-006
DATE: 11/4/2009
DRAWN BY: ----
CHECKED BY: ----
PROJ MGR: MS
PROJ ENG: MFS
TUS ENG: ----
FILE: AGN-C-SPOVER
LAYOUT: DOCK_R-R_PROJ
SHEET TITLE
RAW WATER GALLERY SITE PLAN

C-101
SHEET 7 OF 21

NOTE

SCALE SHOWN MAY BE INACCURATE DUE TO RECREATION OF DRAWING. VERIFY SCALE PRIOR TO USE.

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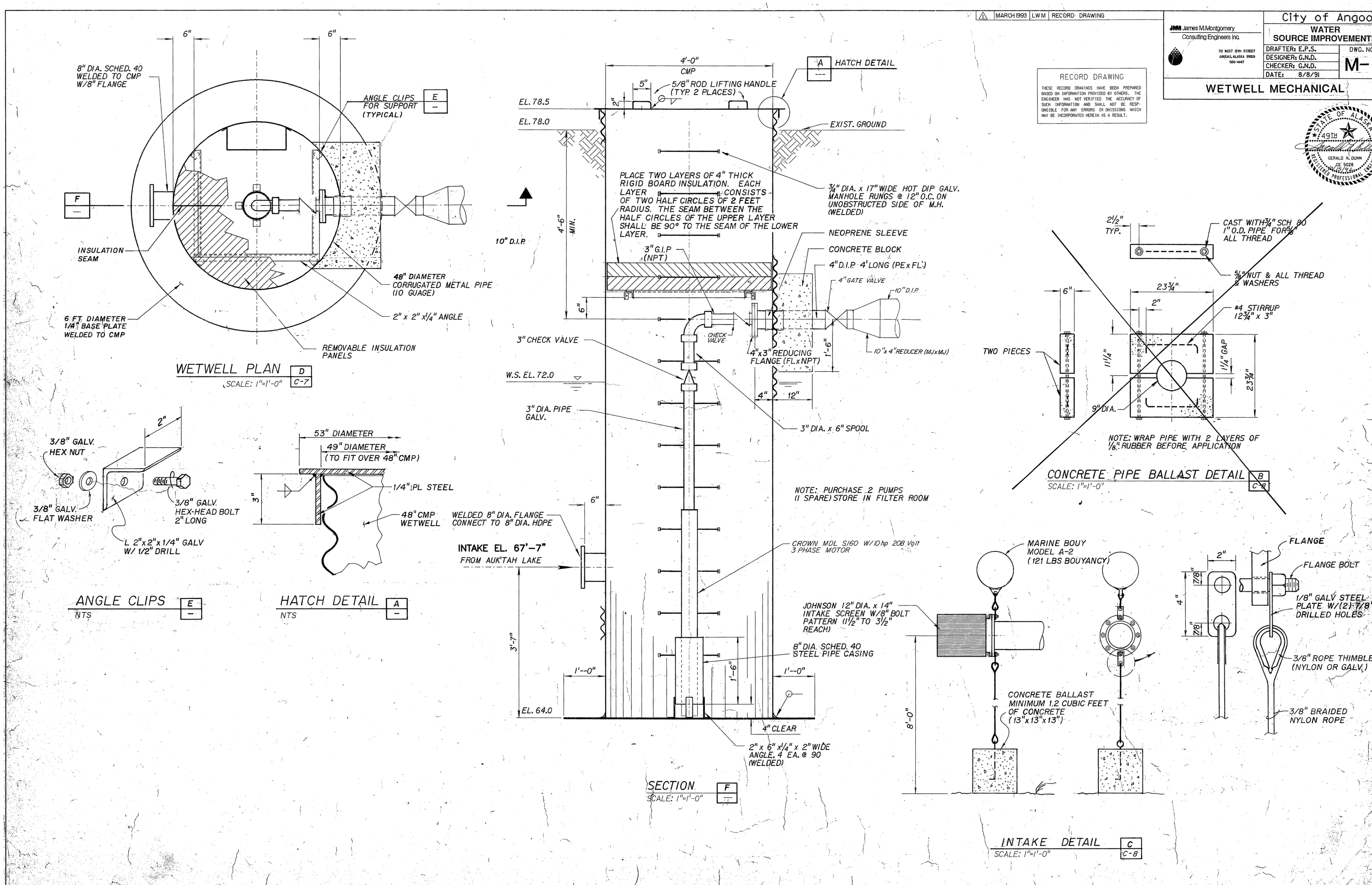
ANGOON WATER SOURCE PER
ANGOON, ALASKA

EXISTING INTAKE SYSTEM SITE PLAN
(FROM ANTHC, 2011)

SHEET NO.
FIG. 4

SCALE: NTS	DESIGNED: VBW	CHECKED: VBW	DRAWN: JJK	DATE: APRIL 2021	SHEET 4 OF 14



NOTE

SCALE SHOWN MAY BE INACCURATE DUE TO RECREATION OF DRAWING. VERIFY SCALE PRIOR TO USE.

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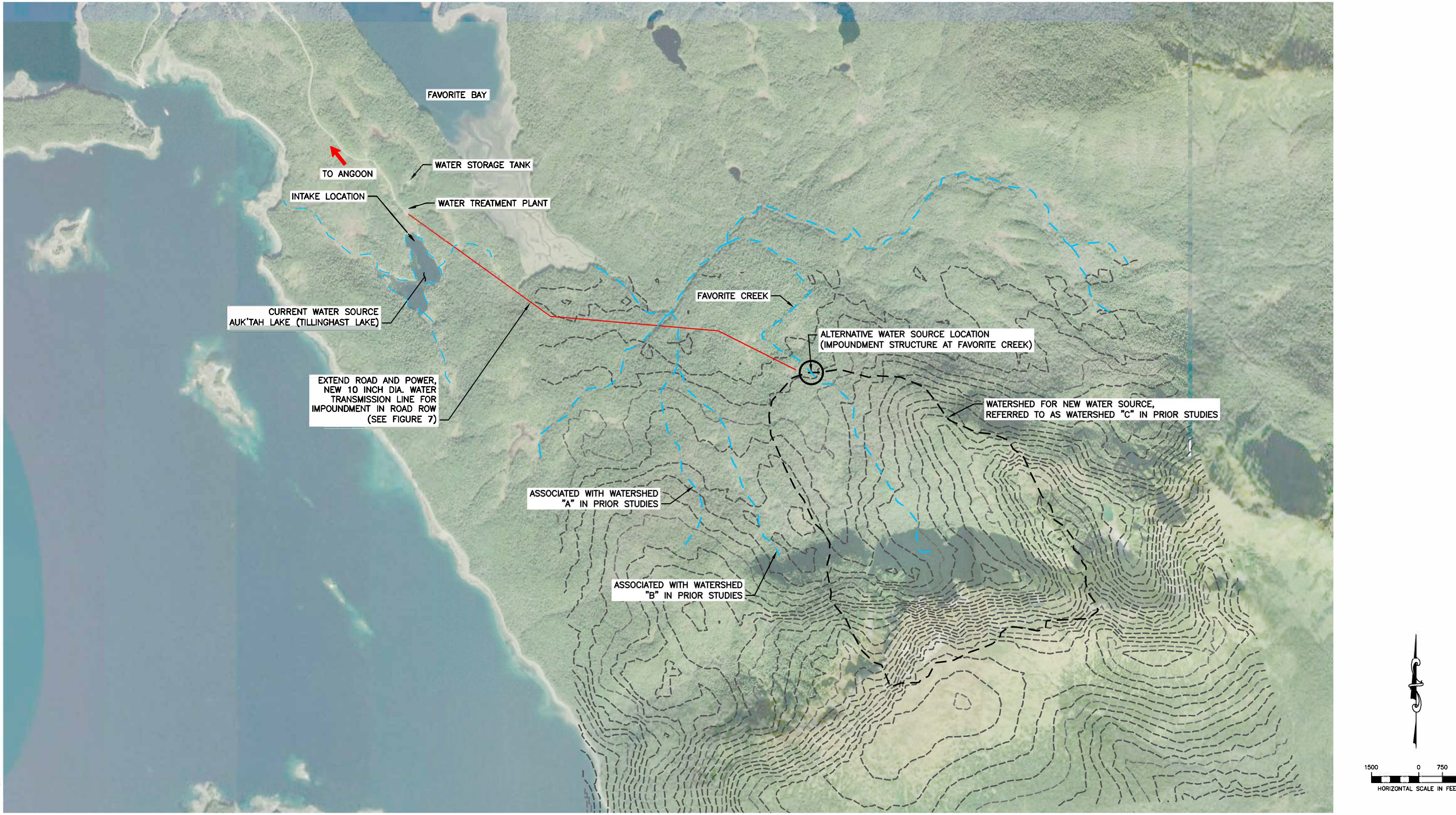
ANGOON WATER SOURCE PER
ANGOON, ALASKA

EXISTING WET WELL DETAILS (FROM JMM ENGINEERS, 1992)

SHEET NO.
FIG. 5

SCALE: NTS	DESIGNED: VBW	CHECKED: VBW	DRAWN: JJK	DATE: APRIL 2021	SHEET 5 OF 14

User: JKINDER Mar 30, 2021 – 1:28pm
Drawing: K:\JOBS\32210029 ANGOON PER\ACAD-DESIGN\32210029_02_ANGOON PER_EXISTING SITE PLAN.DWG – Layout: FIG 5
Xrefs: BR22X34REV.DWG – Images: None



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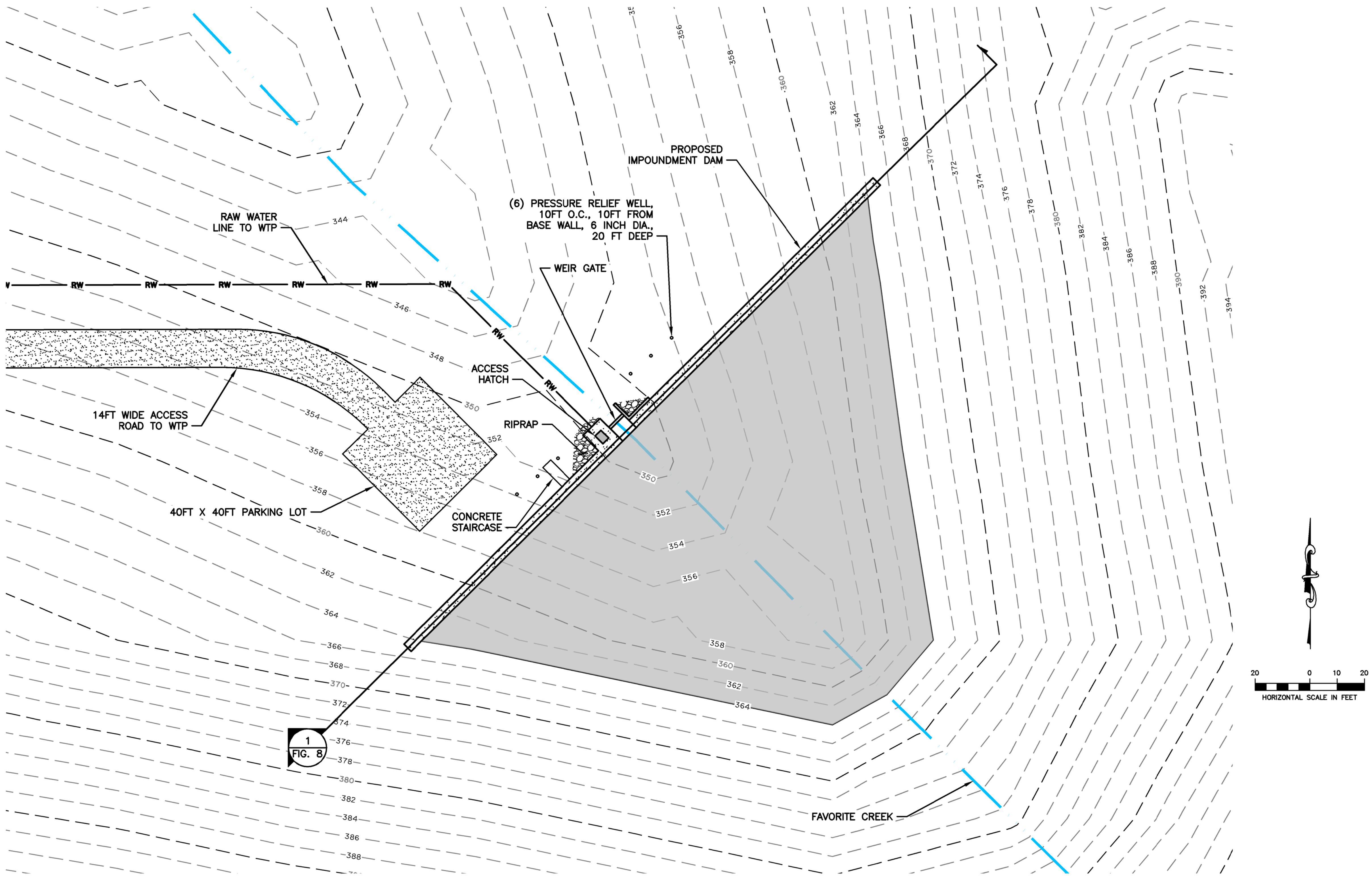
ANGOON WATER SOURCE PER
ANGOON, ALASKA

WATER SOURCE LOCATIONS

SHEET NO.

FIG. 6

SCALE: SHOWN | DESIGNED: VBW | CHECKED: VBW | DRAWN: JJK | DATE: APRIL 2021 | SHEET 6 OF 14



1 / – **IMPOUNDMENT STRUCTURE PLAN VIEW**
SCALE: SHOWN

User: JKINDER Mar 30, 2021 – 1:29pm
Drawing: K:\JOBS\32210029 ANGOON PER\ACAD-DESIGN\32210029_04_ANGOON PER_NEW DAM.DWG – Layout: FIG 7
Xrefs: BR22X34REV.DWG XR_32210029_ANGOON BASEMAP.DWG – Images: (DIESEL evaluation failed)

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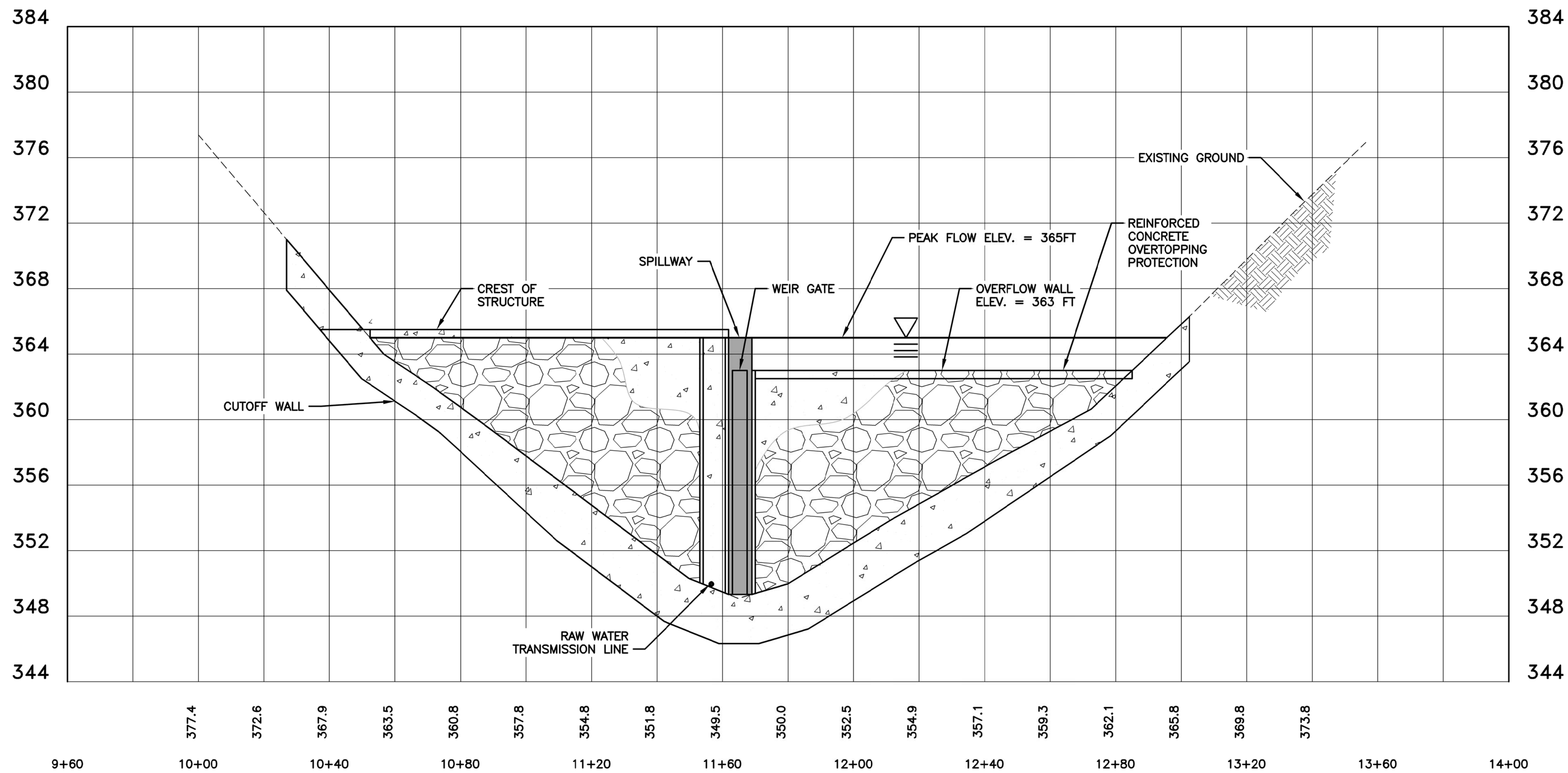
ANGOON WATER SOURCE PER
ANGOON, ALASKA

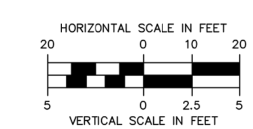
IMPOUNDMENT STRUCTURE PLAN VIEW

SHEET NO.
FIG. 7

SCALE: SHOWN | DESIGNED: VBW | CHECKED: VBW | DRAWN: JJK | DATE: APRIL 2021 | SHEET 7 OF 14

NOTE:
CONCRETE STAIRCASE NOT SHOWN FOR CLARITY.





1 IMPOUNDMENT STRUCTURE PROFILE VIEW
SCALE: SHOWN

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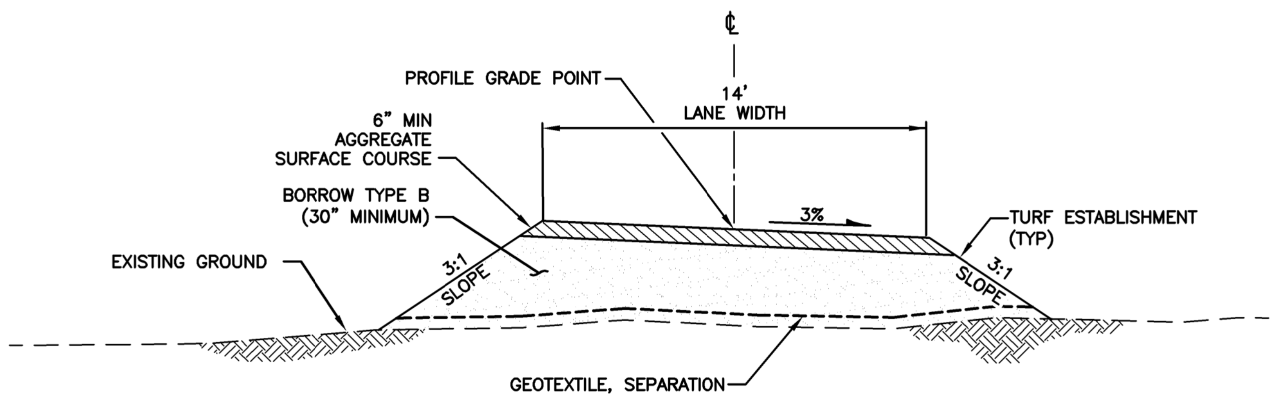
ANGOON WATER SOURCE PER
ANGOON, ALASKA

IMPOUNDMENT STRUCTURE PROFILE VIEW

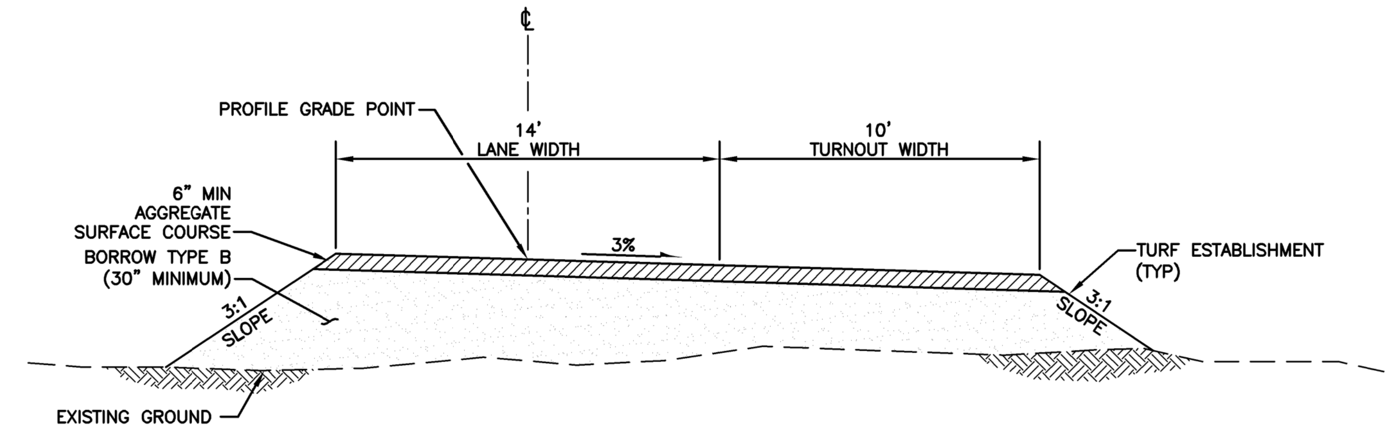
SHEET NO.
FIG. 8

SCALE: SHOWN | DESIGNED: VBW | CHECKED: VBW | DRAWN: JJK | DATE: APRIL 2021 | SHEET 8 OF 14

User: JKINDER Mar 30, 2021 – 1:33pm
Drawing: K:\JOBS\32210029 ANGOON PER\ACAD-DESIGN\32210029_04_ANGOON PER_NEW DAM.DWG – Layout: FIG 8
Xrefs: BR22X34REV.DWG XR_32210029_ANGOON BASEMAP.DWG – Images: (DIESEL evaluation failed)



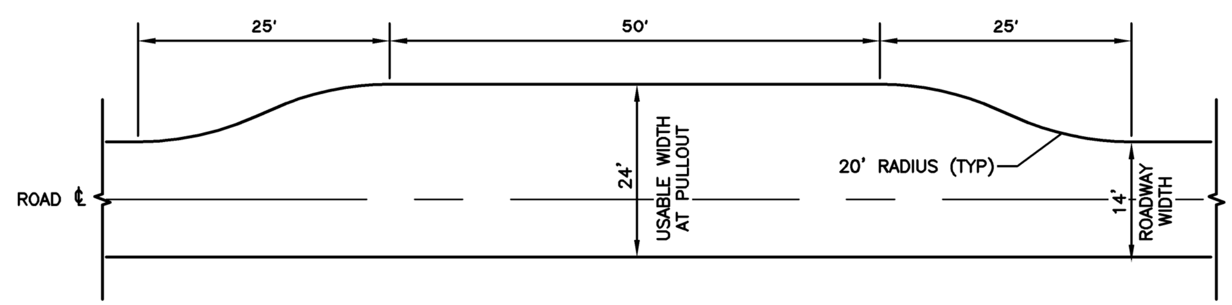
1 ONE-LANE TWO-WAY RIGHT SLOPING ROAD SECTION
SCALE: NTS



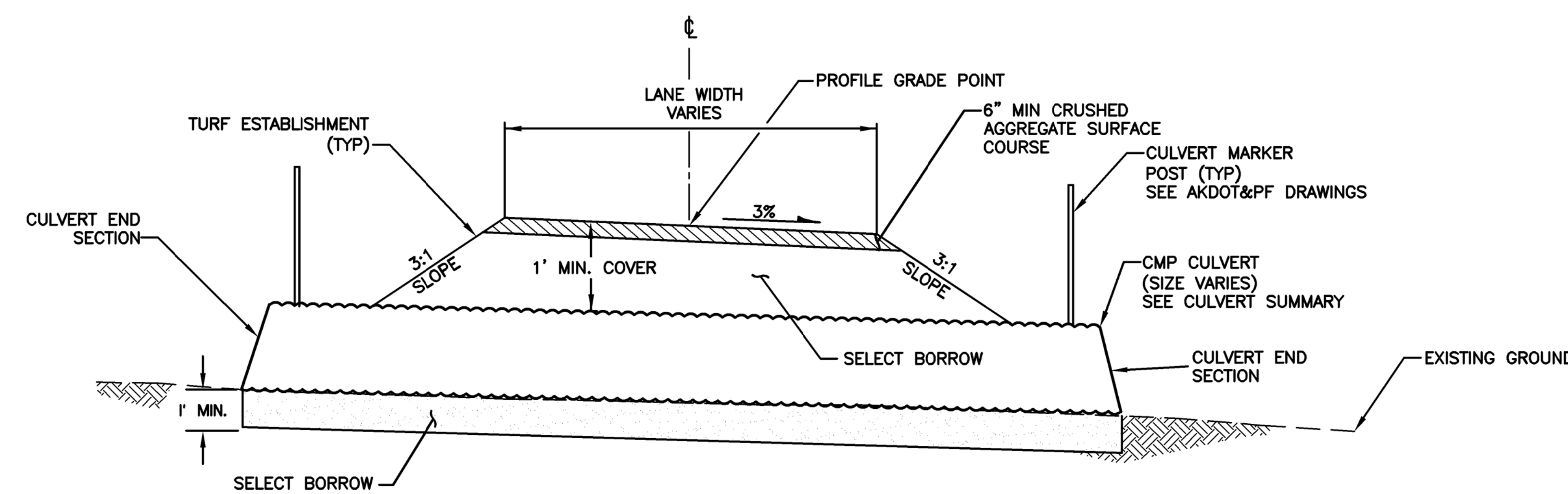
2 RIGHT VEHICLE TURNOUT SECTION RIGHT SLOPING
SCALE: NTS

NOTES

1. GRADE 3% CROSS SLOPES TO INSIDE OF CURVES.
2. TRANSITION 25-FT BETWEEN ONE LANE TO TURNOUT SECTIONS.
3. TURF ESTABLISHMENT SHALL BE PLACED ON ALL NEW SIDE SLOPES AND CUT SLOPES.
4. ALL UNSUITABLE MATERIAL SHALL BE REMOVED AND DISPOSED AT A CONTRACTOR FURNISHED DISPOSAL SITE.
5. THE PROFILE GRADE POINT IS THE ELEVATION OF THE AGGREGATE SURFACE COURSE AT THE ALIGNMENT CENTERLINE.



3 VEHICLE PULLOUT DETAIL
SCALE: NTS



4 TYPICAL CULVERT SECTION
SCALE: NTS

User: JKINDER Mar 30, 2021 – 1:29pm
Drawing: K:\JOBS\32210029 ANGOON PER\ACAD-DESIGN\32210029_05_ANGOON PER_DETAILS.DWG – Layout: FIG 9
Xrefs: BR22X34REV.DWG – Images: None

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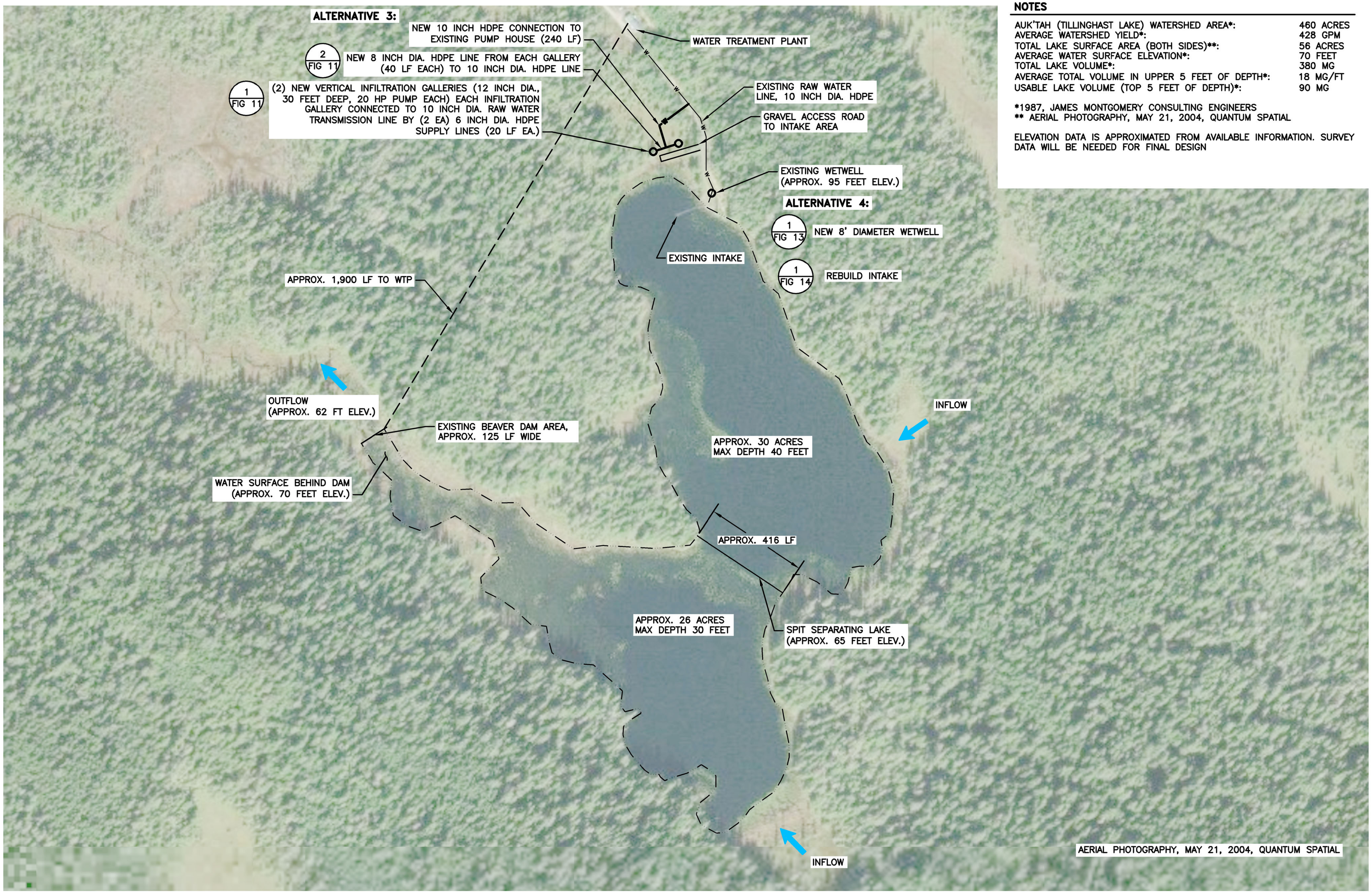
ANGOON WATER SOURCE PER
ANGOON, ALASKA

ROADWAY DETAILS AND TYPICAL SECTIONS

SHEET NO.
FIG. 9

SCALE: NTS | DESIGNED: VBW | CHECKED: VBW | DRAWN: JJK | DATE: APRIL 2021 | SHEET 9 OF 14



NOTES

AUK'TAH (TILLINGHAST LAKE) WATERSHED AREA*:	460 ACRES
AVERAGE WATERSHED YIELD*:	428 GPM
TOTAL LAKE SURFACE AREA (BOTH SIDES)**:	56 ACRES
AVERAGE WATER SURFACE ELEVATION*:	70 FEET
TOTAL LAKE VOLUME*:	380 MG
AVERAGE TOTAL VOLUME IN UPPER 5 FEET OF DEPTH*:	18 MG/FT
USABLE LAKE VOLUME (TOP 5 FEET OF DEPTH)*:	90 MG

*1987, JAMES MONTGOMERY CONSULTING ENGINEERS
** AERIAL PHOTOGRAPHY, MAY 21, 2004, QUANTUM SPATIAL

ELEVATION DATA IS APPROXIMATED FROM AVAILABLE INFORMATION. SURVEY DATA WILL BE NEEDED FOR FINAL DESIGN

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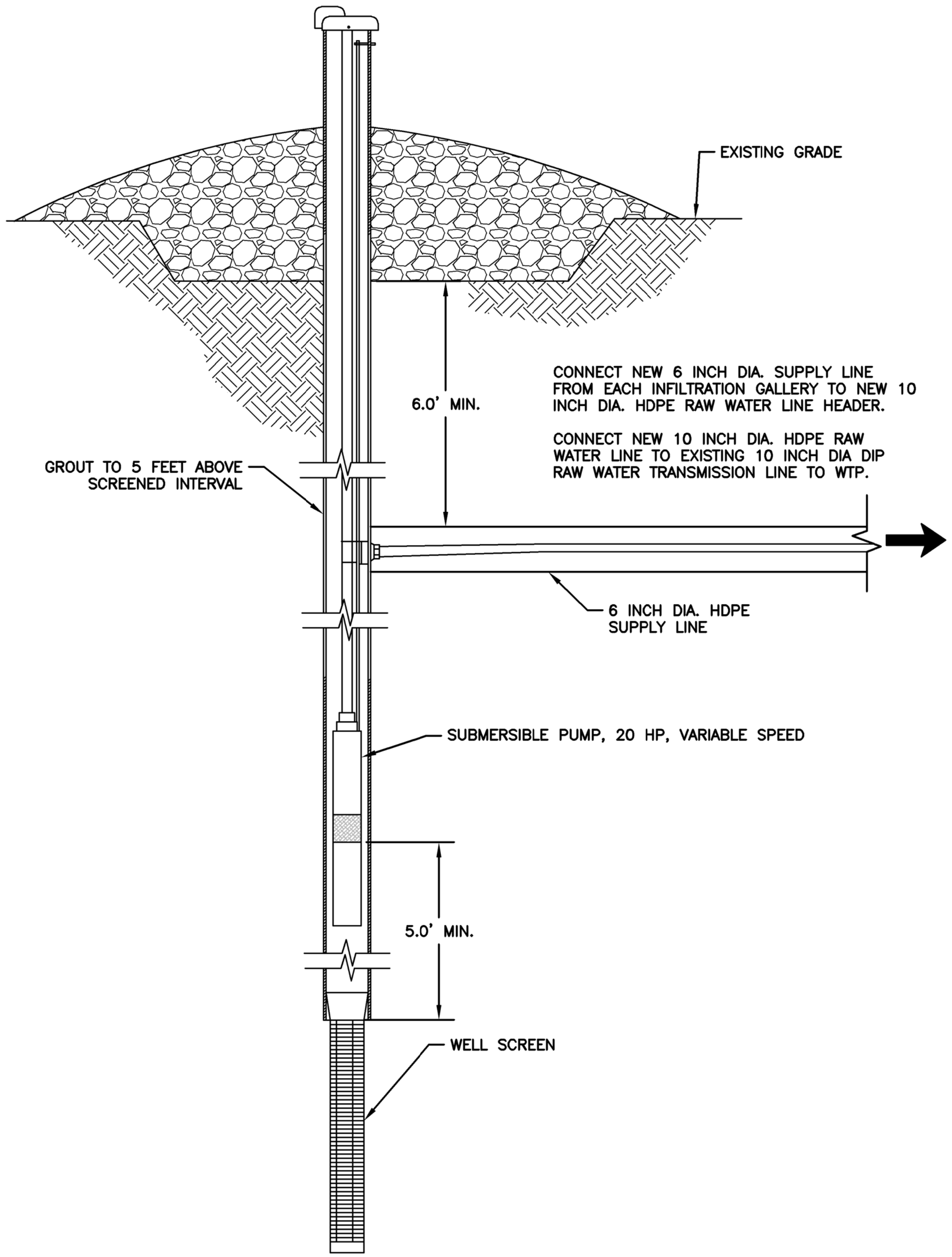
ANGOON WATER SOURCE PER
ANGOON, ALASKA

AUK'TAH LAKE
SOURCE DEVELOPMENT ALTERNATIVES

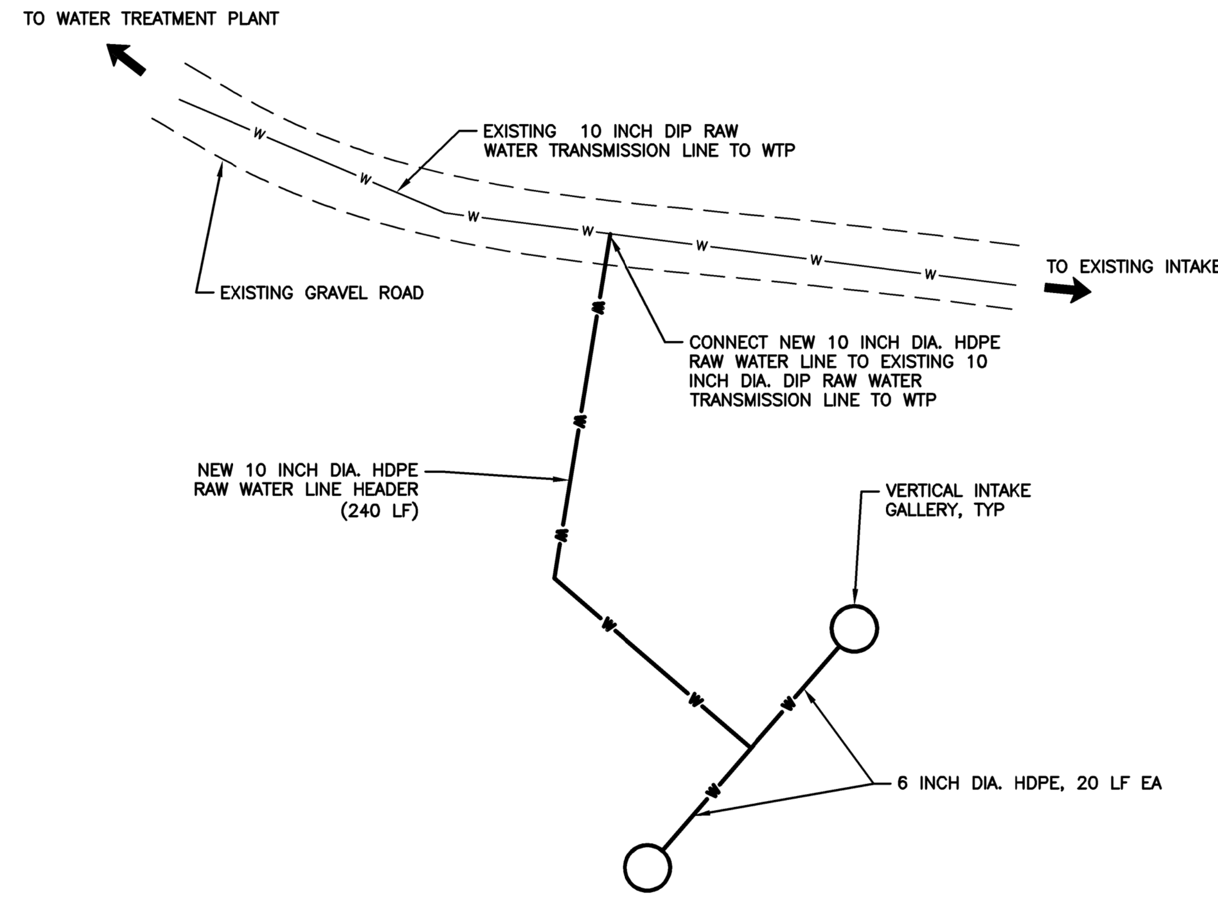
SHEET NO.
FIG. 10

SCALE: SHOWN | DESIGNED: VBW | CHECKED: VBW | DRAWN: JJK | DATE: APRIL 2021 | SHEET 10 OF 14

User: JKINDER Mar 30, 2021 – 1:29pm
Drawing: K:\JOBS\32210029 ANGOON PER\ACAD–DESIGN\32210029_06_ANGOON PER_CURRENT WATER SOURCE.DWG – Layout: FIG 10
Xrefs: BR22X34REV.DWG XR_32210029_ANGOON BASEMAP.DWG – Images: (DIESEL evaluation failed)



1 / –
VERTICAL INFILTRATION GALLERY AND PITLESS ADAPTOR CONNECTION
SCALE: NTS



2 / –
VERTICAL INFILTRATION GALLERY WATER LINE CONNECTION PLAN
SCALE: NTS

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NO.	DATE	BY	DESCRIPTION	NO.	DATE	BY	DESCRIPTION

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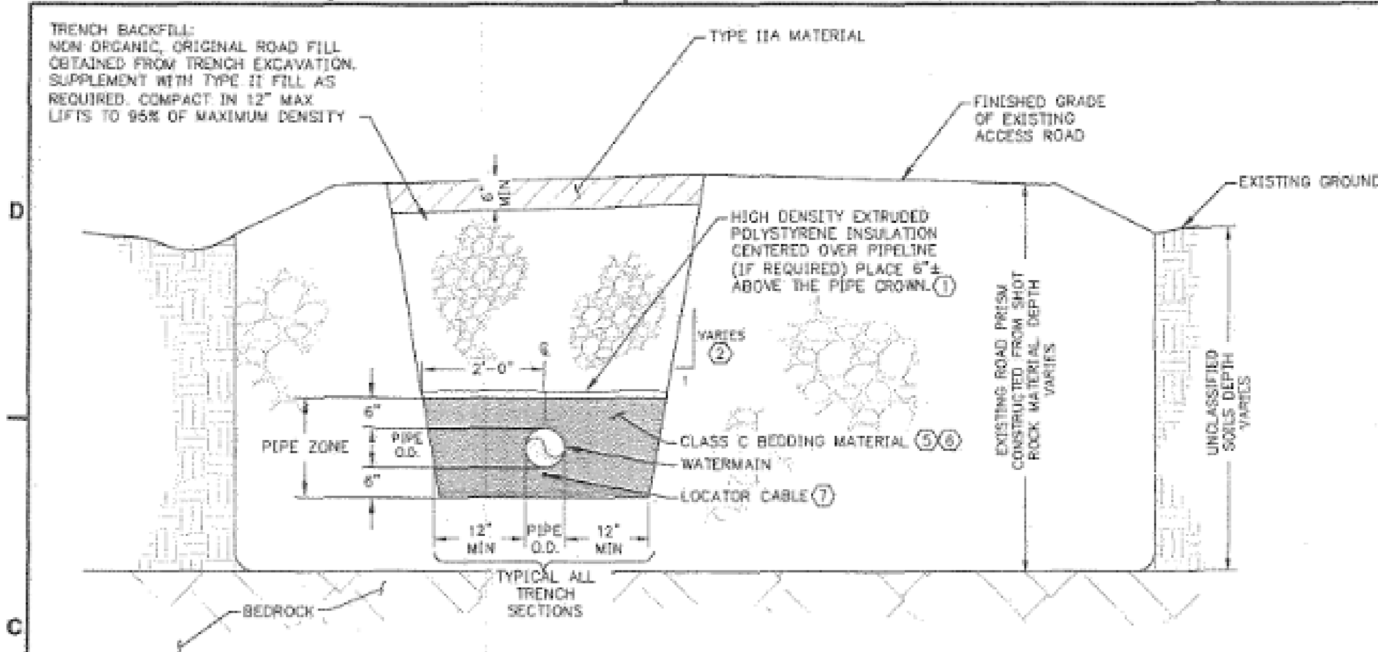
ANGOON WATER SOURCE PER
ANGOON, ALASKA

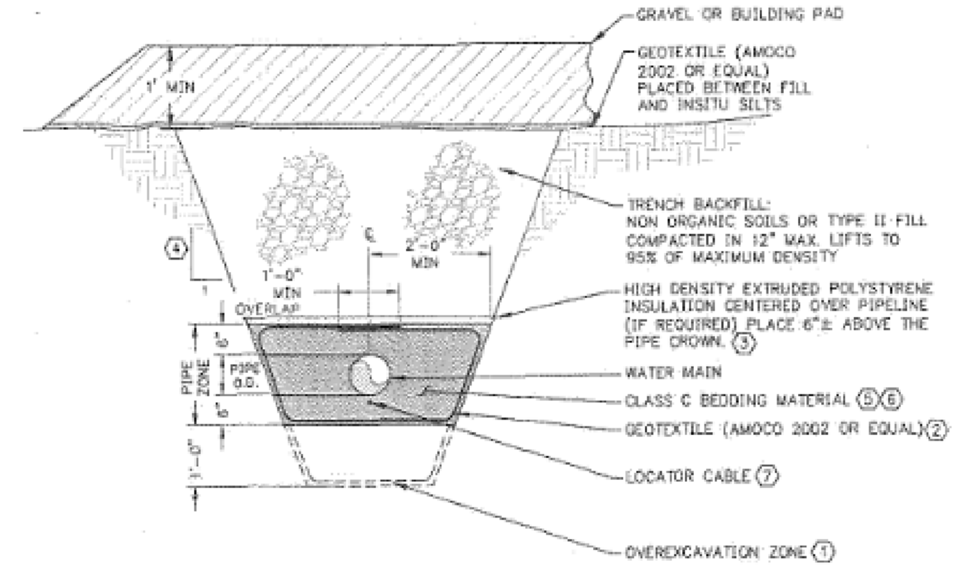
VERTICAL INFILTRATION GALLERY DETAILS

SHEET NO.
FIG. 11

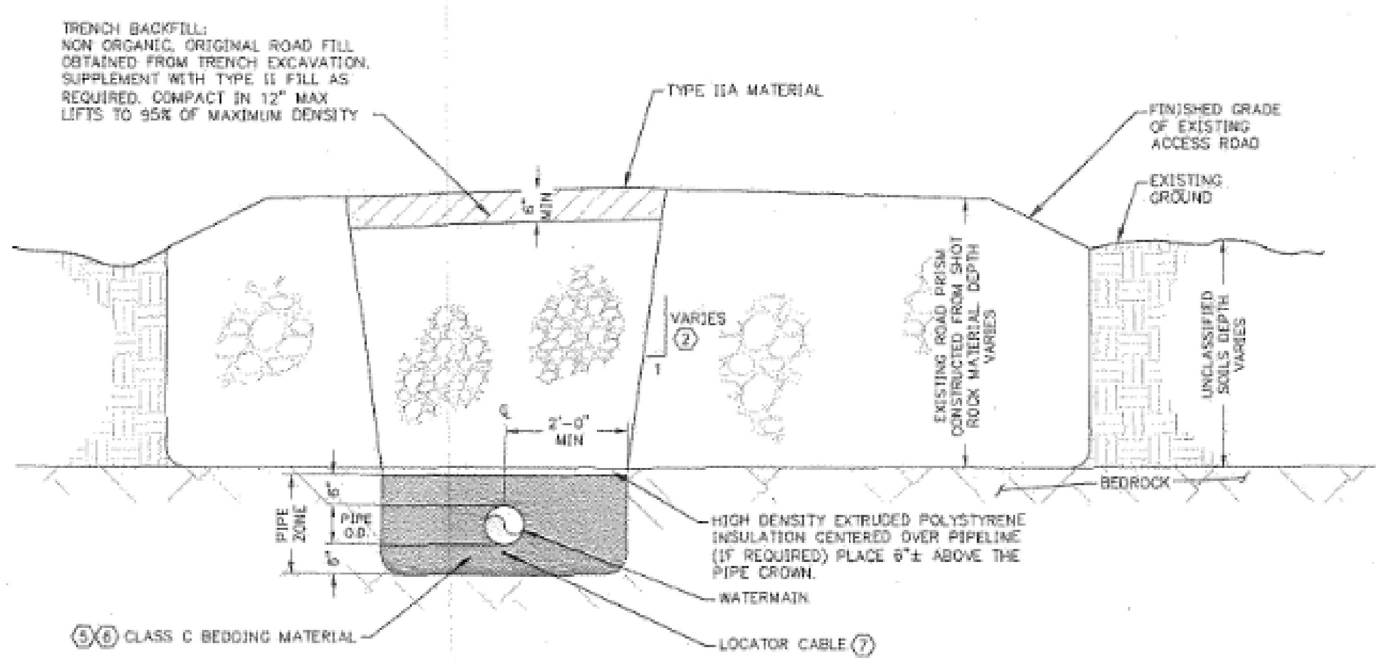
SCALE: NTS | DESIGNED: VBW | CHECKED: VBW | DRAWN: JJK | DATE: APRIL 2021 | SHEET 11 OF 14



(C1) TRENCH SECTION FOR PIPE INSTALL WITHIN EXISTING ROAD PRISM



(C3) TRENCH SECTION FOR PIPE INSTALLED OFF ROAD WITHIN UNCLASSIFIED SOILS



(A1) TRENCH SECTION FOR PIPE INSTALLED BENEATH EXISTING ROAD PRISM THROUGH BEDROCK

GENERAL CONSTRUCTION NOTES:

1. IF THE EXCAVATION ENCOUNTERS SILTS OR OTHER NONORGANIC UNSUITABLE MATERIAL BENEATH THE PIPE ZONE, OVEREXCAVATE A MINIMUM OF 12 INCHES AND REPLACE WITH TYPE II FILL MATERIAL. ALL ORGANIC MATERIALS SHALL BE REMOVED FROM BENEATH THE PIPE SECTION AND REPLACED WITH CLASSIFIED FILL.
2. THE GEOTEXTILE INSTALLATION REQUIREMENT MAY BE WAIVED IF THE IN-SITU SOILS ARE ADEQUATE FOR PIPE INSTALLATION AS DETERMINED BY THE ENGINEER.
3. A MINIMUM OF 4 FEET OF EQUIVALENT EARTH COVER SHALL BE MAINTAINED OVER THE PIPELINE. TWO INCH THICK EXTRUDED POLYSTYRENE BOARD MAY BE SUBSTITUTED FOR UP TO 1 FOOT OF EARTH COVER IF APPROVED BY THE ENGINEER.
4. ALL TRENCHES AND OTHER EXCAVATIONS SHALL BE SLOPED OR SHORED IN ACCORDANCE WITH OSHA STANDARDS.
5. ALL PIPE SHALL BE BEDDED PER MANUFACTURERS REQUIREMENTS.
6. PIPE BEDDING MATERIAL SHALL BE COMPACTED TO 95% MAXIMUM STANDARD PROCTOR DENSITY.
7. INSTALL 10 AWG TYPE PTW PIPELINE TRACE WIRE IMMEDIATELY BELOW PIPE AS SHOWN ON PLANS.

RECORD DRAWINGS CERTIFICATION

These drawings reflect recorded as-built information obtained during construction. I (or an individual under my direct supervision) have conducted a post construction observation of the facilities and reviewed as-built information recorded by others. To the best of my knowledge all work that has been installed is in accordance with these drawings.

Name: [signature] Date: 8/13/1?

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ANCHORAGE, ALASKA, 99508-3440
(907) 729-3600

ANGOON, ALASKA
RAW WATER INTAKE UPGRADE
CONSTRUCTION PLANS PLANS

PLAN SET: AGN-09-006
DATE: 11/4/2009
DRAWN BY: ----
CHECKED BY: ----
PROJ MGR: MG
PROJ ENG: MFS
TUS ENG: ----
FILE: AGN-C-DTRCH
LAYOUT: TRNC_DET_1
SHEET TITLE

TRENCH SECTION DETAILS

CR-505
SHEET 17 OF 21

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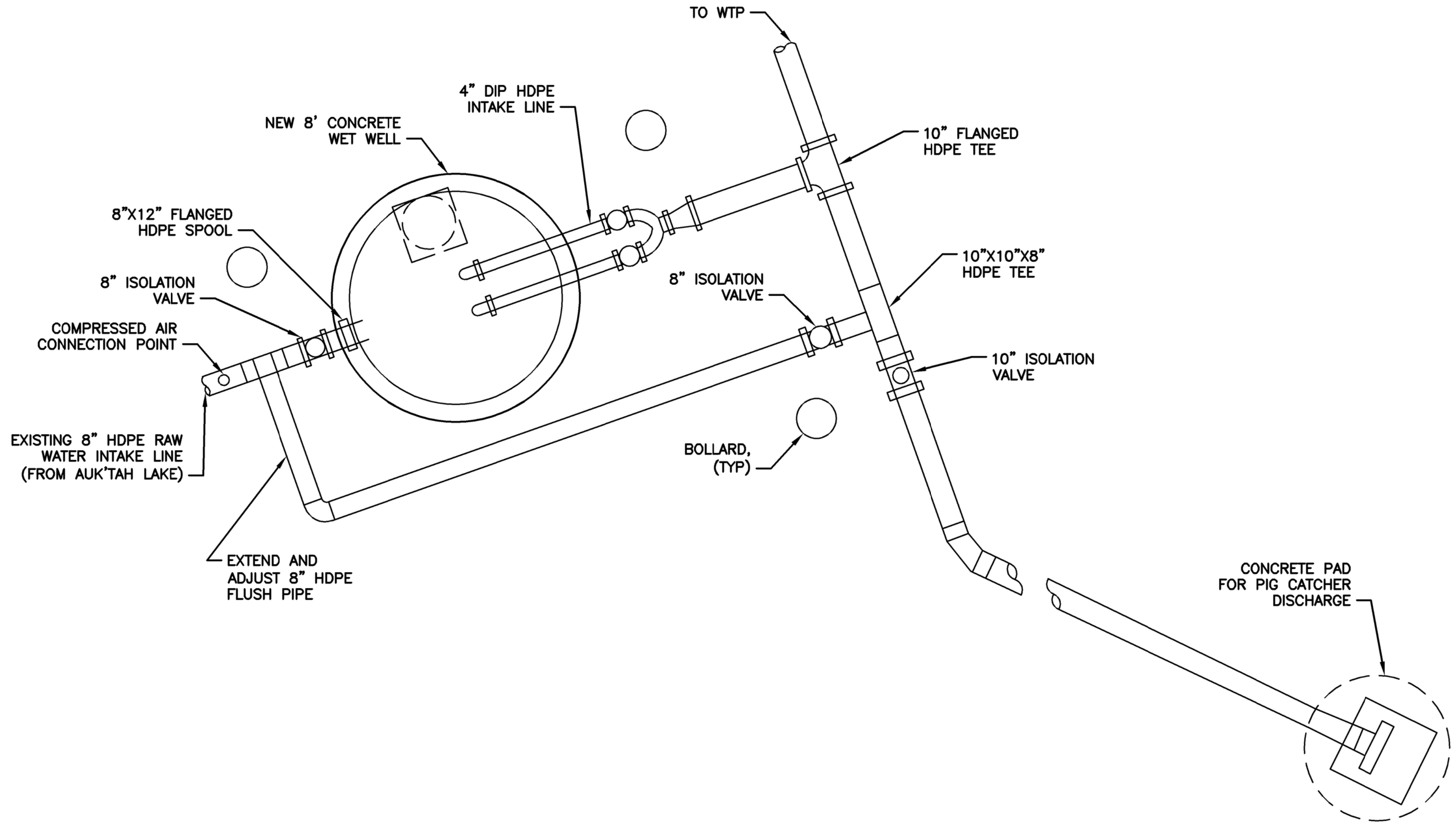
ANGOON WATER SOURCE PER
ANGOON, ALASKA

TRENCH SECTION DETAILS (FROM ANTHC)

SHEET NO. FIG. 12

SCALE: N/A | DESIGNED: VBW | CHECKED: VBW | DRAWN: JJK | DATE: APRIL 2021 | SHEET 12 OF 14

User: JKINDER Mar 30, 2021 – 1:29pm
Drawing: K:\JOBS\32210029 ANGOON PER\ACAD-DESIGN\32210029_07_ANGOON PER_REFERENCES.DWG – Layout: FIG 12
Xrefs: BR22X34REV.DWG – Images: None



1
–

REBUILD EXISITNG INTAKE PLAN VIEW

SCALE: NTS

User: JKINDER Mar 30, 2021 – 1:30pm
Drawing: K:\JOBS\32210029 ANGOON PER\ACAD-DESIGN\32210029_08_ANGOON PER_REBUILD EXISTING INTAKE.DWG – Layout: FIG 13
Xrefs: BR22X34REV.DWG – Images: None

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Bristol
ENGINEERING SERVICES COMPANY, LLC
111 W. 16th Avenue, Third Floor
Anchorage, AK 99501
Phone (907) 563-0013 Fax (907) 563-6713
License Number: AECC697

Alaska Native Tribal Health Consortium
Division of Environmental Health and Engineering
4500 Diplomacy Drive
Anchorage, Aaska 99508
(907) 729-3600

NOT FOR CONSTRUCTION! CONCEPTUAL ONLY!

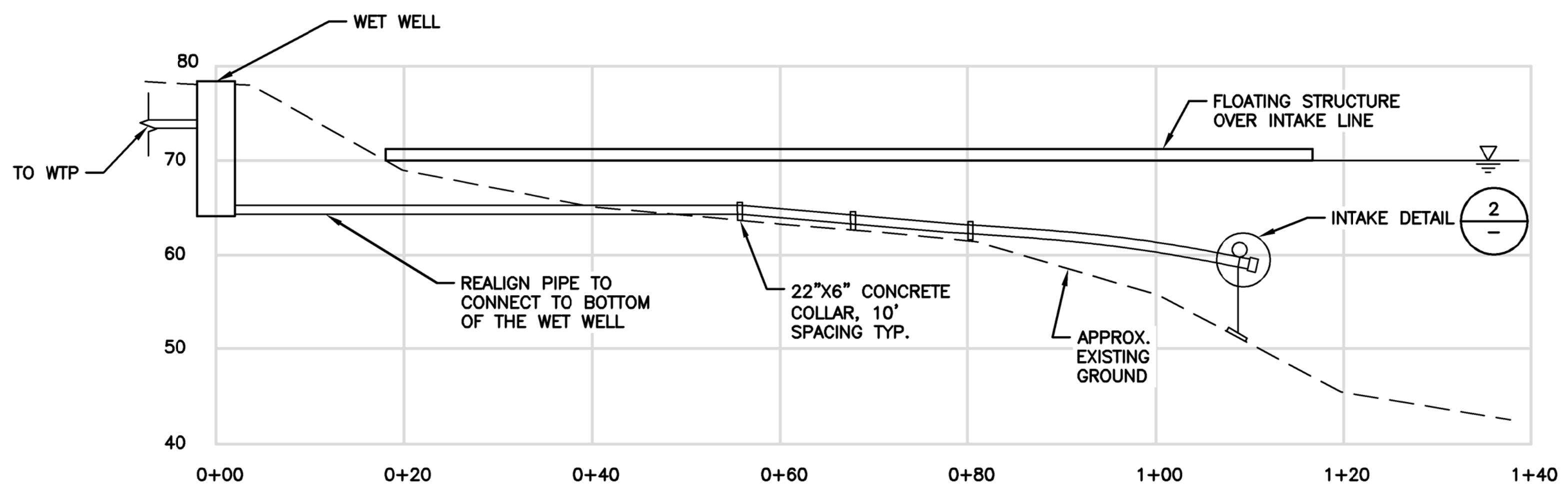
ANGOON WATER SOURCE PER
ANGOON, ALASKA

REBUILD EXISTING INTAKE SYSTEM SITE PLAN

SHEET NO.

FIG. 13

SCALE: NTS	DESIGNED: VBW	CHECKED: VBW	DRAWN: JJK	DATE: APRIL 2021	SHEET 13 OF 14

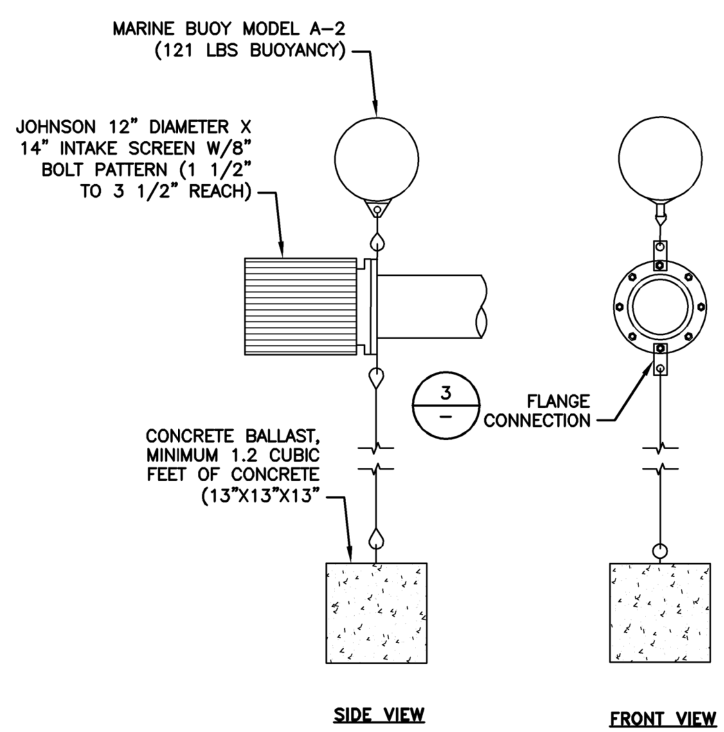


NOTE

PROFILE WAS RECONSTRUCTED FROM THE WATER SOURCE IMPROVEMENTS DRAWINGS DONE BY JMM ENGINEERS DRAWINGS, 1993. THE PROFILE IS NOT TO SCALE. ELEVATIONS ARE APPROXIMATIONS BASED ON AVAILABLE INFORMATION. NO SURVEY WAS PERFORMED.

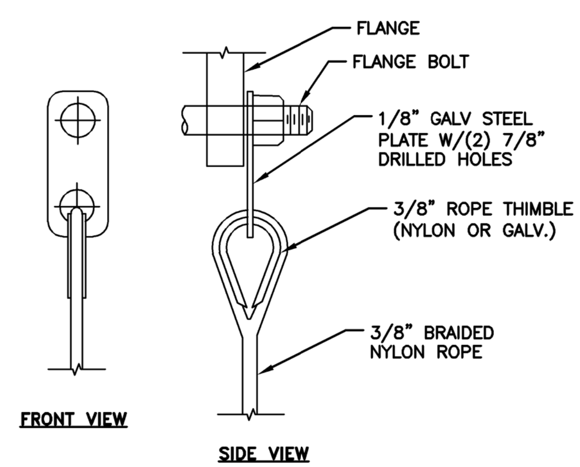
1 REBUILD EXISITING INTAKE PROFILE

SCALE: NTS



2 INTAKE DETAIL

SCALE: NTS

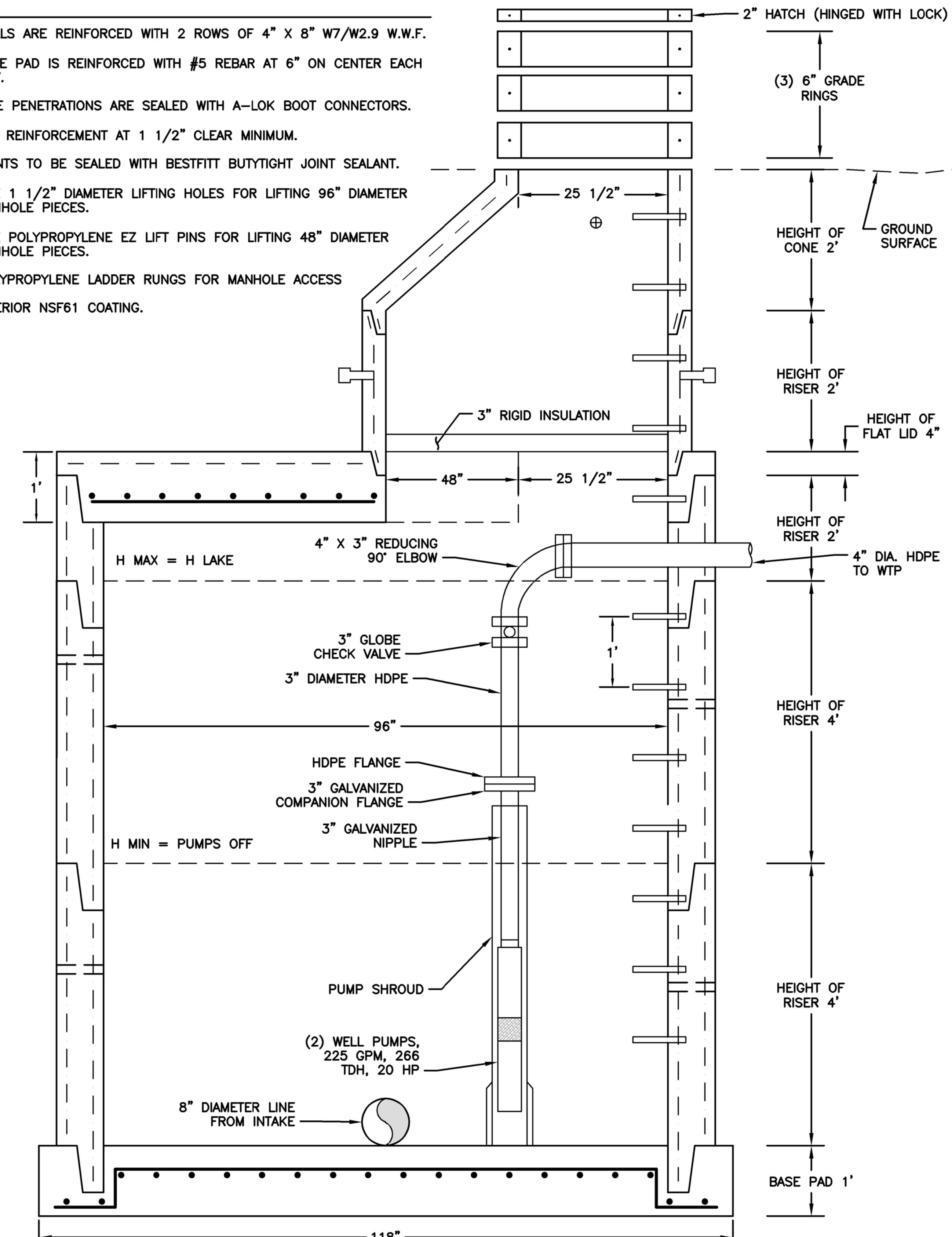


3 FLANGE CONNECTION DETAIL

SCALE: NTS

NOTES:

1. WALLS ARE REINFORCED WITH 2 ROWS OF 4" X 8" W7/W2.9 W.W.F.
2. BASE PAD IS REINFORCED WITH #5 REBAR AT 6" ON CENTER EACH WAY.
3. PIPE PENETRATIONS ARE SEALED WITH A-LOK BOOT CONNECTORS.
4. ALL REINFORCEMENT AT 1 1/2" CLEAR MINIMUM.
5. JOINTS TO BE SEALED WITH BESTFITT BUTYTIGHT JOINT SEALANT.
6. USE 1 1/2" DIAMETER LIFTING HOLES FOR LIFTING 96" DIAMETER MANHOLE PIECES.
7. USE POLYPROPYLENE EZ LIFT PINS FOR LIFTING 48" DIAMETER MANHOLE PIECES.
8. POLYPROPYLENE LADDER RUNGS FOR MANHOLE ACCESS
9. INTERIOR NSF61 COATING.



4 PRE-CAST MANHOLE WET WELL DETAIL

SCALE: NTS

FINAL PER

REVISIONS				REVISIONS			
NO.	DATE	BY	DESCRIPTION	NO.	DATE	BY	DESCRIPTION

Project No. 32210029

Bristol

ENGINEERING SERVICES COMPANY, LLC

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NOT FOR CONSTRUCTION! CONCEPTUAL ONLY!

ANGOON WATER SOURCE PER
ANGOON, ALASKA

REBUILD EXISTING INTAKE SYSTEM
PROFILE VIEW & DETAILS

SHEET NO.

FIG. 14

SCALE: NTS | DESIGNED: VBW | CHECKED: VBW | DRAWN: JJK | DATE: APRIL 2021 | SHEET 14 OF 14

User: JKINDER Mar 30, 2021 - 1:30pm
Drawing: K:\JOBS\32210029 ANGOON PER\ACAD-DESIGN\32210029_08_ANGOON PER_REBUILD EXISTING INTAKE.DWG - Layout: FIG 14
Xrefs: BR22X34REV.DWG - Images: None

APPENDIX B: ENVIRONMENTAL DOCUMENTATION

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COMMUNITY POPULATION DATA

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Alaska Local And Regional Information

Angoon city

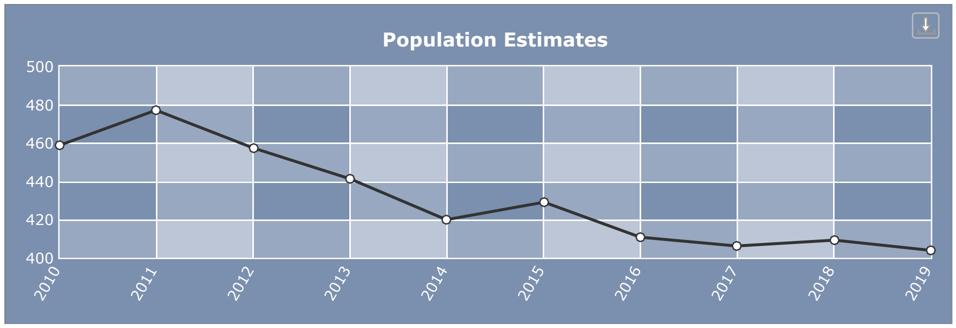
Map

Angoon is an incorporated second class city located on the southwest coat of Kootznahoo Inlet.

Population estimates 2010 Census

Population Estimates (Population Estimates page)

Year	Population
2010	459
2011	477
2012	457
2013	441
2014	420
2015	429
2016	411
2017	406
2018	409
2019	404



Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section.

Return to top

Population estimates   2010 Census

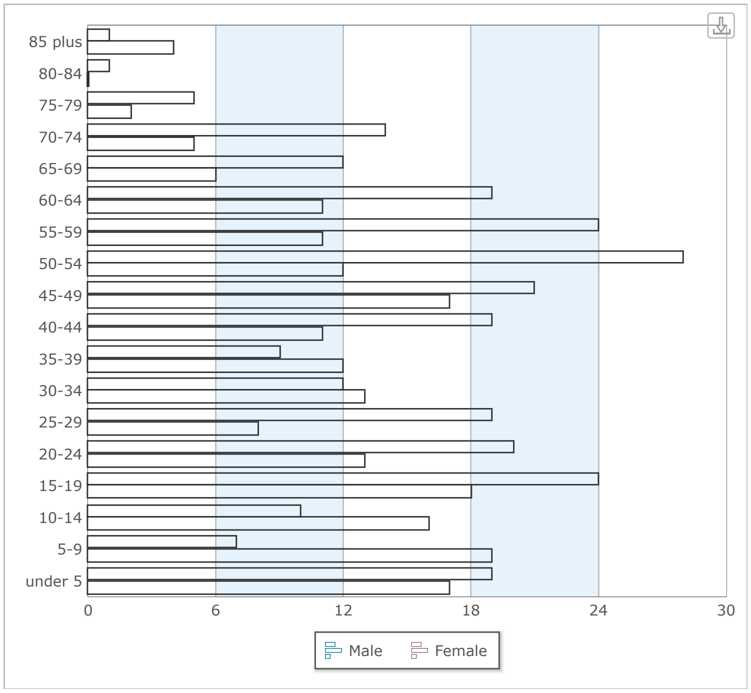
2010 Census (Demographic profile Excel – PDF – Text)

Age and Sex

	Total	Male	Female
Total	459	264	
Under 5 years	36	19	
5 to 9 years	26	7	
10 to 14 years	26	10	
15 to 19 years	42	24	
20 to 24 years	33	20	
25 to 29 years	27	19	
30 to 34 years	25	12	
35 to 39 years	21	9	
40 to 44 years	30	19	
45 to 49 years	38	21	
50 to 54 years	40	28	
55 to 59 years	35	24	
60 to 64 years	30	19	
65 to 69 years	18	12	
70 to 74 years	19	14	
75 to 79 years	7	5	
80 to 84 years	1	1	

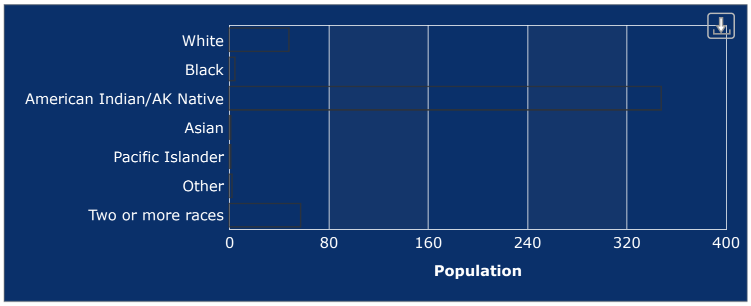
85 years and over	5	1	

Median Age		
Both	**Male**	**Female**
39.1	43.7	



Race

	Number	Percent
White	48	
Black	4	
American Indian/AK Native	348	
Asian	0	
Pacific Islander	0	
Other	2	
Two or more races	57	



Household and Family Size

Average Household Size	
Average Family Size	

Vacancy Rates

Total Housing Units	256
Homeowner Vacancy Rate	0.0%
Rental Vacancy Rate	14.6%

To see more census data, visit our 2010 Census website.

Source: United States Census Bureau.

Return to top

Department of Labor & Workforce Development
P.O. Box 111149
Juneau, AK 99811
Phone: (907) 465-2700
Fax: (907) 465-2784

Alaska Local And Regional Information

Angoon city

Map

Angoon is an incorporated second class city located on the southwest coat of Kootznahoo Inlet.

Population estimates 2010 Census

Population Estimates (Population Estimates page)

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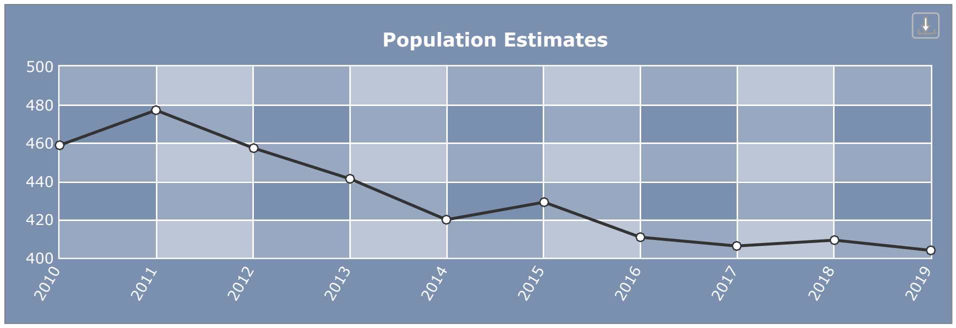

Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section.

Return to top

Population estimates 2010 Census

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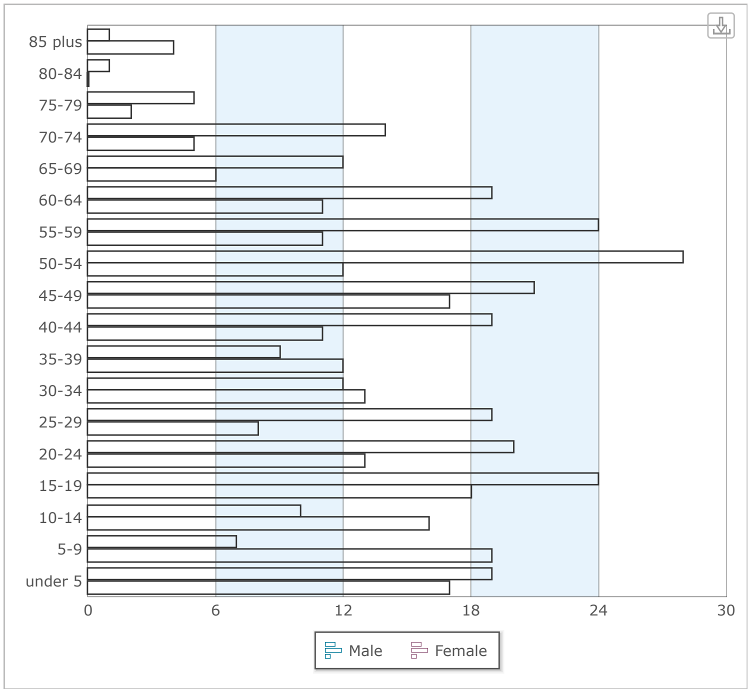

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Black	4	
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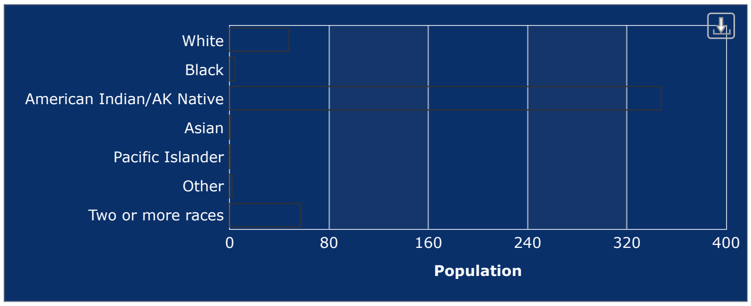
Pacific Islander	0	
Other	2	
Two or more races	57	



Household and Family Size

Average Household Size	
Average Family Size	

Vacancy Rates

Total Housing Units	256
Homeowner Vacancy Rate	0.0%
Rental Vacancy Rate	14.6%

To see more census data, visit our 2010 Census website.

Source: United States Census Bureau.

Return to top

Department of Labor & Workforce Development
P.O. Box 111149
Juneau, AK 99811
Phone: (907) 465-2700
Fax: (907) 465-2784

This site is not optimized for mobile use

Unfortunately, this site is not optimized for use on small screens at this time. We encourage users to access this site from laptop or desktop computer.

Close

Enrollment by School

Source: Alaska Department of Education (2015)

School, ID	Enrolled Students
Angoon School, 90010	70

Close

Source: Alaska Department of Labor and Workforce Development

Full datasets:

- Population Estimates by Community and Year
- Employment Summary Data by Community and Year

Close

Population by Age and Sex,

Source: U.S. Census Bureau

Close

Sources:

- "AHFC/DCRA": Alaska Housing Finance Corporation or Division of Community and Regional Affairs
- "CES FCS": Cooperative Extension Service Food Cost Survey
- "PCE": Power Cost Equalization program data

Full datasets:

- Fuel Price Survey Data
- Energy Prices from UAF Cooperative Extension Service Food Cost Survey
- Power Cost Equalization (PCE) Data

Close

Close

Source: Cooperative Extension Service Food Cost Survey

Full dataset: Energy Prices from UAF Cooperative Extension Service Food Cost Survey

Close

Sources:

- "AHFC/DCRA": Alaska Housing Finance Corporation or Division of Community and Regional Affairs
- "CES FCS": Cooperative Extension Service Food Cost Survey

Full datasets:

- Fuel Price Survey Data
- Energy Prices from UAF Cooperative Extension Service Food Cost Survey

Close

Source: Alaska Energy Statistics 2013, Table 2.4a

Full dataset: Alaska Energy Statistics Table 2.4a

Close

Sources:

- Power Cost Equalization program data
- Alaska Energy Statistics 2013, Table 2.5a

Full datasets:

- Power Cost Equalization (PCE) Data

- Power Cost Equalization (PCE) Data
- Alaska Energy Statistics Table 2.5a

Close

Source: Alaska Energy Statistics 2013, Tables 2.3a and 2.3b

Full datasets:

- Alaska Energy Statistics Table 2.3a
- Alaska Energy Statistics Table 2.3b

Close

Source: Alaska Energy Statistics 2013, Table 2.5a

Full dataset: Alaska Energy Statistics Table 2.5a

Close

Community Data Summary

Angoon

Select another community

Angoon

Overview

Geography

Borough/Census area	Hoonah-Angoon Census Area	map
Energy region (AEA)	Southeast	map
Alaska Native Regional Corporation	Sealaska Corporation	map
Latitude, Longitude	57.5033333, -134.5838889	
Connected to Road System or Marine Highway?	Yes	

Population and Employment

Details

Population (2017)	404
Residents age 16 and over (2016)	299
Residents employed (2016)	176
Unemployment insurance claimants (2016)	41
Population by Age and Sex	2000 2010

Education

Enrollment by School

Number of Schools 1 **Total Enrollment** 70

Election Districts

House Districts	35
Senate Districts	R

Fuel Prices

Diesel

Details

Retail	$4.10 per gallon – No. 1, AHFC/DCRA Aug 2018 $4.08 per gallon – No. 2, AHFC/DCRA Aug 2018	History History
Power Sector	$3.72 per gallon – PCE Dec 2014	History

Electricity

Utility

Utility	Inside Passage Electric
PCE status	PCE Eligible Active

Rates

Details

Residential Rate	$0.60 per kWh, Dec 2014
PCE Rate	$0.37 per kWh, Dec 2014
Effective Rate	$0.23 per kWh, Dec 2014

Fuel 2013

Details

Fuel Type	Fuel Used	Emissions
Distillate Fuel Oil	139,340 gallons	1,414 metric tons CO_2

Production 2013

Details

Gross Generation		1,830 MWh
Net Generation:	Total	1,760 MWh
	Oil	1,760 MWh

Sales, Revenue and Customers 2013

Details

Customer Type	Sales	Revenue	Customers
Residential	883 MWh	$573,000	196
Commercial	464 MWh	$301,000	25
Other	248 MWh	$161,000	15

Alaska Affordable Energy Model

Climate

Heat Degree Days 7523.085

Goals

Community Goals

- Thayer Creek Hydro or other renewable project
- Biomass and heat pumps for space heat

- Public building energy audits and retrofits

Regional Goals

- DSM/EE Programs
- Biomass Conversion Programs
- Next Increment of Hydro and Other Renewable Projects

This community has Affordable Energy Model Outputs

To view additional energy information about this community, and to view modeled economic viability of energy projects in this community please visit the AAEM model results page.

We ask that you include the following citation in publications that make use of this data:
Alaska Energy Data Gateway, developed by the Institute of Social and Economic Research, University of Alaska Anchorage, is supported by the U.S. Department of Energy (DOE), Office of Science, Basic Energy Sciences (BES), under EPSCoR Award # DE-SC0004903 (database and web application development), and by Alaska Energy Authority (Renewable Energy Fund data management and reporting). Database and web hosting is provided by the Institute of Social and Economic Research, University of Alaska Anchorage.

Alaska Energy Data Gateway

The Alaska Energy Data Gateway is a public resource funded by grants from the Alaska Energy Authority as well as the U.S. Department of Energy's EPSCoR program and Grid Modernization Initiative.

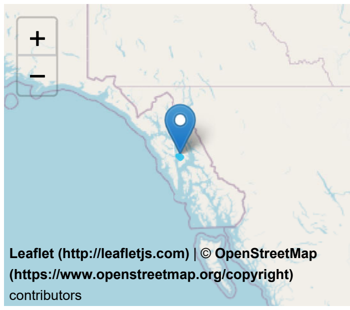
- About Us
- Contact Us

Angoon School

Attendance Rate	Grades Served	Number of Students
89.07%	**PK - 12**	**75**
Math Proficiency	**English Language Arts Proficiency**	**Number of Teachers**
14.29%	**17.50%**	**8**

ABOUT YOUR SCHOOL

Contact My Local Leadership



500 Big Dog Salmon Way Angoon, AK 99820

Box 109 Angoon, AK 99820

(907) 788-3302

View School Website (https://ak01001788.schoolwires.net/)

View School Calendar (/DOE_Rolodex/SchoolCalendar/Home/SchoolCalendar/5453)

Share Your Feedback (https://education.alaska.gov/survey/the-compass-feedback-questionnaire)

Overview

Support Designation	School Index Value
Universal Support	**32.74**

View designation report (/compass/Reports/SchoolProfile?schoolId=90010&schoolYear=2019)

School Spending Per Pupil: **$22,130.00**
More Info (/compass/Report/2018-2019/9/90010#financial-data)

District	Principal
Chatham School District (http://www.chathamsd.org)	Ron Gleason

School Type	School Board President
Traditional public school	Elizabeth Hooge

View My District's Smart Start 2020 Plan (https://docs.google.com/spreadsheets/d/1PMpqGUXxV9cG7aQhZq91j2L35vU9AzJtH

What is this school's poverty level?	How has enrollment changed since last year?
Mid-Poverty	-5.06%

Safety & Well-Being

How many students received an out-of-school suspension in 2015-2016?

0

How many counselors does this school have access to?

2

What percentage of students were chronically absent from school?

50%

How many nurses does this school have access to?

0

Teacher Quality

What percent of teachers have been at this school for 5 or more years?

37.50 %

What percent of teachers are teaching in their field of study?

67.61 %

What percent of teachers are inexperienced?

0

Student Demographics

How many students are considered economically disadvantaged (low-income)?

88.00 %

How many students are from families on active duty?

N/A

How many students with disabilities does this school serve?

28.00 %

CRITICAL HABITAT
SPECIES

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Anchorage Fish And Wildlife Conservation Office
4700 Blm Road
Anchorage, AK 99507
Phone: (907) 271-2888 Fax: (907) 271-2786

In Reply Refer To: June 19, 2019
Consultation Code: 07CAAN00-2019-SLI-0229
Event Code: 07CAAN00-2019-E-00629
Project Name: Angoon Streets Repaving Project

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, and proposed species, designated critical habitat, and some candidate species that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Please note that candidate species are not included on this list. We encourage you to visit the following website to learn more about candidate species in your area: http://www.fws.gov/alaska/fisheries/fieldoffice/anchorage/endangered/candidate_conservation.htm

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Anchorage Fish And Wildlife Conservation Office
4700 Blm Road
Anchorage, AK 99507
(907) 271-2888

Project Summary

Consultation Code: 07CAAN00-2019-SLI-0229

Event Code: 07CAAN00-2019-E-00629

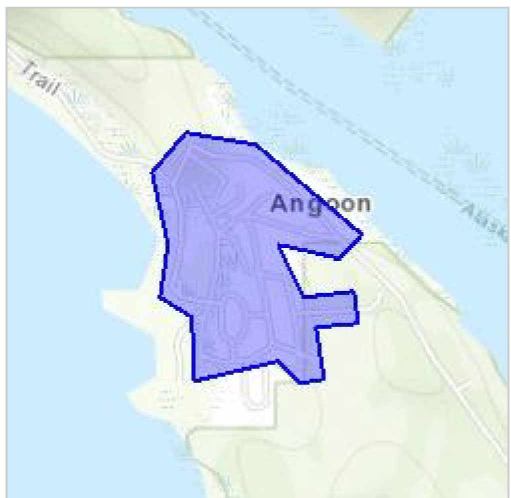
Project Name: Angoon Streets Repaving Project

Project Type: TRANSPORTATION

Project Description: The project involves repaving downtown community streets, including new sidewalks and underground utility rehabilitation.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/57.50115524982641N134.5865518570432W



Counties: Hoonah-Angoon, AK

Endangered Species Act Species

There is a total of 0 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

---

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

IPaC **U.S. Fish & Wildlife Service**

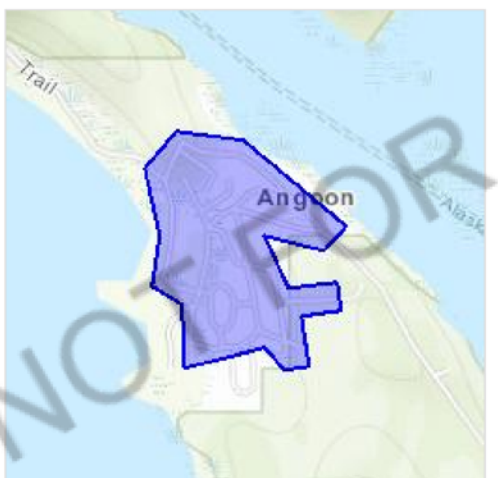
IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Hoonah-Angoon County, Alaska



Local office

Anchorage Fish And Wildlife Conservation Office

(907) 271-2888
(907) 271-2786

4700 Blm Road
Anchorage, AK 99507

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

---

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

THERE ARE NO ENDANGERED SPECIES EXPECTED TO OCCUR AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

THERE ARE NO MIGRATORY BIRDS OF CONSERVATION CONCERN EXPECTED TO OCCUR AT THIS LOCATION.

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

Wildlife refuges and fish hatcheries

REFUGE AND FISH HATCHERY INFORMATION IS NOT AVAILABLE AT THIS TIME

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

ESTUARINE AND MARINE DEEPWATER

- E1UBL

ESTUARINE AND MARINE WETLAND

- E2AB1/RSN
- E2AB1/USN

A full description for each wetland code can be found at the National Wetlands Inventory website

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

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CONTAMINATED SITES

Alaska DEC Solid Waste Sites

Solid waste sites (landfills) in the State of Alaska

0.3mi

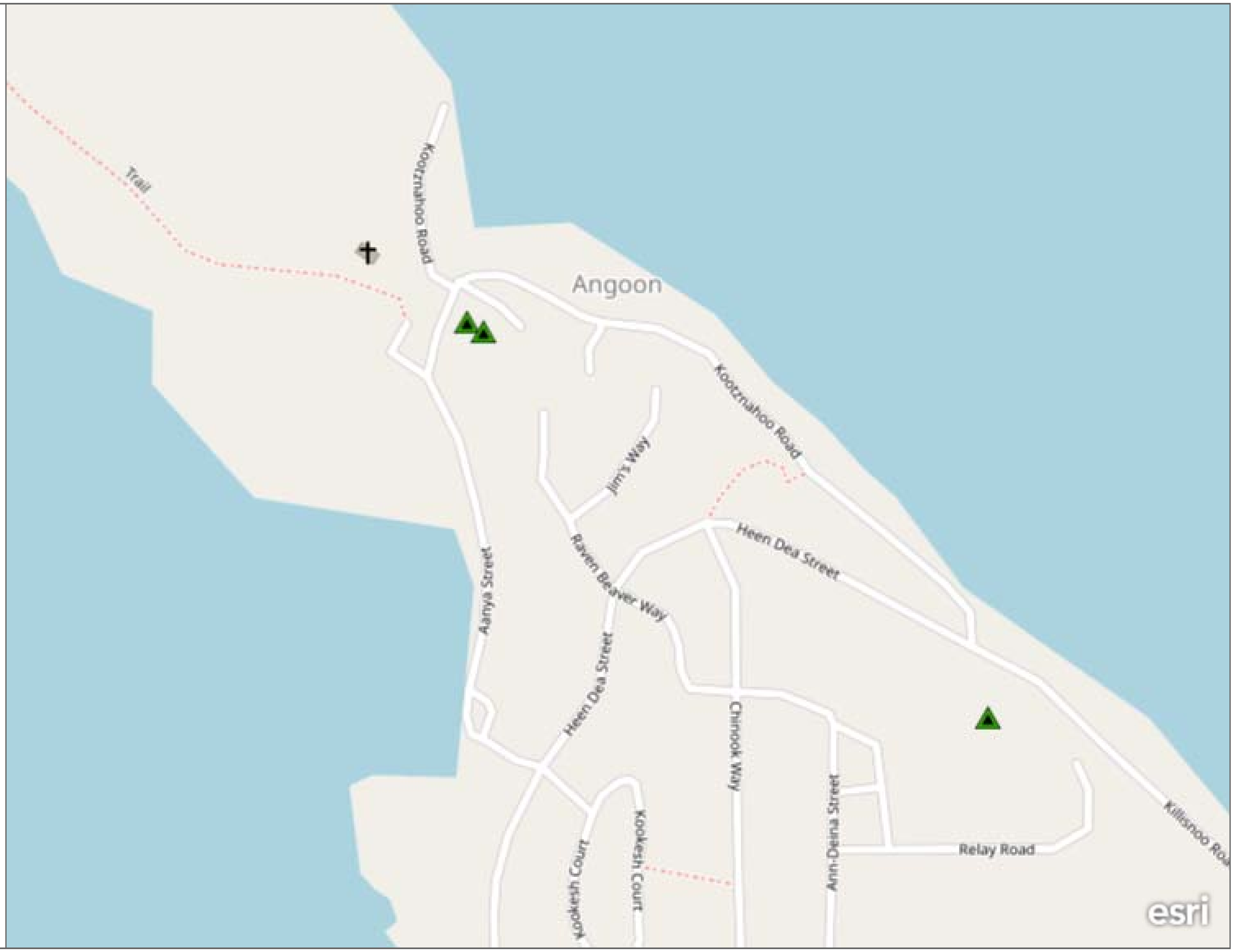
SOA DCCED DCRA | Alaska Department of Environmental Conservation - Contaminated Sites Program | be Alaska Department of Environmental Conservation – Division of Environmental Health – Solid Waste Program | Earthstar Geographics | State of Alaska Department of Environmental Conservation - Environmental Health - Drinking Water Program | DigitalGlobe, Fed GIS, GeoEye, Earthstar Geographics

Alaska DEC Contaminated Sites

Contaminated Sites

- Active
- Cleanup Complete
- Cleanup Complete - Institutional Controls
- Informational

Groundwater Plumes



Contaminated Site Locations with Cleanup Chronology Reports from Alaska DEC

400ft

Site Report: Angoon Elementary School UST

SITE NAME:	Angoon Elementary School UST
ADDRESS:	Shoreline Drive, Angoon, AK 99820
FILE NUMBER:	1500.38.009
HAZARD ID:	3985
STATUS:	Cleanup Complete
STAFF:	,
LATITUDE:	57.503056
LONGITUDE:	-134.585833
HORIZONTAL DATUM:	NAD83

We make every effort to ensure the data presented here is accurate based on the best available information currently on file with DEC. It is therefore subject to change as new information becomes available. We recommend contacting the assigned project staff prior to making decisions based on this information.

Problems/Comments

Underground fuel storage tank (UST) for the school generator failed releasing an unknown quantity of diesel fuel to subsurface soil and groundwater. Decommissioning of the UST involved five companies in a series of subcontractors that included a haphazard Release Investigation; monitoring of the site is ongoing and additional site investigation has been requested.

Action Information

ACTION DATE	ACTION	DESCRIPTION	DEC STAFF
4/15/2004	Update or Other Action	Letter sent to RP requesting site investigation and status of the contaminated soil stockpile.	Bruce Wanstall
3/4/2005	Spill Transferred from Prevention Preparedness and Response Program	RP notified of case transfer by letter this date. PERP Spill Number 03119918901 of 100 gallons. Former Spill Manager was Scot Tiernan. There was also another historic spill at this site - 02119922802 (2,000 gallons of diesel -- Lester Leatherberry's case) but it was not transferred to CS.	Bruce Wanstall
3/16/2005	Site Added to	UST failed releasing free product to subsurface soil and groundwater.	Bruce Wanstall

	Database		
3/16/2005	Site Ranked Using the AHRM	School on-site; diesel release.	Bruce Wanstall
4/21/2005	Update or Other Action	File review; contact RP consultant to request additional site data on the UST removal.	Bruce Wanstall
5/3/2005	Update or Other Action	Received and reviewed UST Closure Report.	Bruce Wanstall
6/29/2005	Update or Other Action	Comment letter on UST Closure Report sent to RP requesting additional site investigation. Posted at G:\SPAR\Spar-Contaminated Sites\38 Case Files (Contaminated Sites)\1500 Angoon (CS)\1500.38.009 Angoon Elementary School HOT.	Bruce Wanstall
7/26/2005	GIS Position Updated	Lat Long GIS data recorded. Metadata include Topozone Pro web utility map projection calibrated for NAD 83 projected on 1:63,000 topographic map set at 1:24,000 scale. Map saved at ‘jnsvr’ G:\SPAR\Spar-Contaminated Sites\38 Case Files (Contaminated Sites)\1500 Angoon (CS)\1500.38.009 Angoon Elementary School HOT.	Bruce Wanstall
8/4/2005	Update or Other Action	File review for discussion with the new superintendent for the Angoon Schools. Modular building in the oil migration path are for sale and will not be occupied this school year.	Bruce Wanstall
8/16/2005	Update or Other Action	File review for Spill #02119922802; 2,000 gallon diesel spill at the site.	Bruce Wanstall
3/16/2006	Update or Other Action	Corrective Action approach recieved and reviewed. Standpipe in UST excavation will be used for assessment sampling, then for addition of nutrients to promote natural breakdown of heating oil contamination that remains in the subsurface from the underground storage tank leakage. Tentative approval sent by email.	Bruce Wanstall
6/28/2006	Update or Other Action	Recieved the Carson Dorn Inc. Report; sampling strategy accetable; schedule additonal review for Decision Letter.	Bruce Wanstall
7/28/2006	Update or Other Action	Quality Assurance review of Water Sampling Report laboratory data found no anomolies and is acceptable with Contaminated Sites Program standards.	Bruce Wanstall
8/3/2006	Site Closure Approved	No Further Action letter sent to the Chatham School district based on results below instrument PQL for all contaminants of concern in groundwater samples. Letter posted at jnu-svrfileG:\SPAR\Spar-Contaminated Sites\38 Case Files (Contaminated Sites)\1500 Angoon (CS)\1500.38.009 Angoon Elementary School UST	Bruce Wanstall
4/1/2010	Update or Other Action	Check Received $693.82 from Law 03/25/10	Traci Nebeker

Site Report: Angoon Oil and Gas Company

SITE NAME:	Angoon Oil and Gas Company
ADDRESS:	Box 126; , Angoon, AK 99820
FILE NUMBER:	1500.26.001
HAZARD ID:	24503
STATUS:	Cleanup Complete
STAFF:	,
LATITUDE:	57.502992
LONGITUDE:	-134.585623
HORIZONTAL DATUM:	NAD83

We make every effort to ensure the data presented here is accurate based on the best available information currently on file with DEC. It is therefore subject to change as new information becomes available. We recommend contacting the assigned project staff prior to making decisions based on this information.

Problems/Comments

Approximately 50 cubic yards treated with aeration.Farnell was last staff assigned.

Action Information

ACTION DATE	ACTION	DESCRIPTION	DEC STAFF
4/23/1992	Underground Storage Tank Site Characterization or Assessment	SA1; 2 5,000gal diesel UST's and one 4,000 gallon UST were removed. 50 cy soil excavated and stockpiled, 3 cy oily soil remain in pit and cannot be removed.	* Not Assigned
4/23/1992	Release Investigation	RELR; Cause of release was probably an overfill. 3 cy of soil in pit had a max. of 1000ppm gas range hydrocarbons.	* Not Assigned
4/26/1992	Leaking Underground Storage Tank Release Confirmed - Petroleum	LUST Site created in CSP for source area ID 77049 ADD;	* Not Assigned

4/26/1992	Site Added to Database		* Not Assigned
4/27/1992	Leaking Underground Storage Tank Cleanup Initiated - Petroleum	LCAU; Tanks removed and most contaminated soil excavated and stockpiled. CAP pending. : LCAU date changed DB conversion	* Not Assigned
4/27/1992	Update or Other Action	NOR; Vapors detected in pit during tank removal.	* Not Assigned
12/4/1992	Leaking Underground Storage Tank Corrective Action Underway	CAPR; 50 cy soil sealed in lines on site. Soil aerated and tilled on dry days throughout summer. Lab results dated 6/28/93 showed no detectable levels of gas or benzene.	* Not Assigned
5/1/1993	Update or Other Action	UPD; Additional cleanup of in-situ contamination. 30cy of oily soil, mixed with large rocks and overburden were removed and stockpiled. Sample analysis showed 1800ppm gas range and 4300ppb benzene.	* Not Assigned
7/14/1993	Leaking Underground Storage Tank Corrective Action Underway	CAPR; Soil to be aerated during hot, dry weather.	* Not Assigned
1/12/1994	Site Closure Approved	CLOS;	* Not Assigned

Site Report: AT&T Alascom Angoon Repeater

SITE NAME:	AT&T Alascom Angoon Repeater
ADDRESS:	Admiralty Island, West Side, Angoon, AK 99820
FILE NUMBER:	1500.38.001
HAZARD ID:	3129
STATUS:	Cleanup Complete
STAFF:	,
LATITUDE:	57.500612
LONGITUDE:	-134.577260
HORIZONTAL DATUM:	

We make every effort to ensure the data presented here is accurate based on the best available information currently on file with DEC. It is therefore subject to change as new information becomes available. We recommend contacting the assigned project staff prior to making decisions based on this information.

Problems/Comments

Diesel contamination from above ground storage tanks. Last staff assigned was Palmieri.

Action Information

ACTION DATE	ACTION	DESCRIPTION	DEC STAFF
6/26/2000	Voluntary Cleanup Program	Application to VCP accepted.	Anne Marie Palmieri
6/27/2000	Site Ranked Using the AHRM	Initial ranking.	Anne Marie Palmieri
6/30/2000	Site Added to Database	Diesel contamination.	No Longer Assigned
11/29/2001	Site Closure Approved	Site closed as all confirmation samples met method two cleanup levels.	Anne Marie Palmieri

1/22/2004	GIS Position Updated	Updated Lat/Long using site intake tool	Cliff Walden

SITE REPORT: AT&T ALASCOM ANGOON REPEATER

SITE NAME:	AT&T Alascom Angoon Repeater
ADDRESS:	Admiralty Island, West Side, Angoon, AK 99820
FILE NUMBER:	1500.38.001
HAZARD ID:	3129
STATUS:	Cleanup Complete
STAFF:	No Longer Assigned, 9074655229
LATITUDE:	57.500612
LONGITUDE:	-134.577260
HORIZONTAL DATUM:	

View CS Map · New Search · Print Report · Glossary/Acronyms

We make every effort to ensure the data presented here is accurate based on the best available information currently on file with DEC. It is therefore subject to change as new information becomes available. We recommend contacting the assigned project staff prior to making decisions based on this information.

Site Chronology · IC / Closure Details · Documents

Problems/Comments

Diesel contamination from above ground storage tanks. Last staff assigned was Palmieri.

Action Information

ACTION DATE	ACTION	DESCRIPTION	DEC STAFF
6/26/2000	Voluntary Cleanup Program	Application to VCP accepted.	Anne Marie Palmieri
6/27/2000	Site Ranked Using the AHRM	Initial ranking.	Anne Marie Palmieri
6/30/2000	Site Added to Database	Diesel contamination.	No Longer Assigned
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1/22/2004	GIS Position Updated	Updated Lat/Long using site intake tool	Cliff Walden

State of Alaska Department of Environmental Conservation

P.O. Box 111800
Juneau, AK 99811-1800
Phone: 907-465-5066
Fax: 907-465-5245
TDD: 800-770-8973
Physical Location: 410 Willoughby

SITE REPORT: USFS APPLETON COVE LTF

SITE NAME:	USFS Appleton Cove LTF
ADDRESS:	Rodman Bay, on Baranof I., 27 MI. West of Angoon, Angoon, AK 99820
FILE NUMBER:	1525.38.019
HAZARD ID:	3126
STATUS:	Cleanup Complete
STAFF:	IC Unit, 9074655229 dec.icunit@alaska.gov
LATITUDE:	57.467629
LONGITUDE:	-135.278880
HORIZONTAL DATUM:	NAD83

View CS Map | New Search | Print Report | Glossary/Acronyms

We make every effort to ensure the data presented here is accurate based on the best available information currently on file with DEC. It is therefore subject to change as new information becomes available. We recommend contacting the assigned project staff prior to making decisions based on this information.

Site Chronology | IC / Closure Details | Documents

Problems/Comments

Stained soils from 4 Areas Of Concern (AOCs) were analyzed and found to contain GRO at30,000ppm, DRO at 30,000ppm, and RRO at 35,000ppm. Spills considered historical and soil not analyzed for BTEX and PAH. Fuel handling practices problematic where AOCs include sort yard, fuel depot, drum storage and shop.

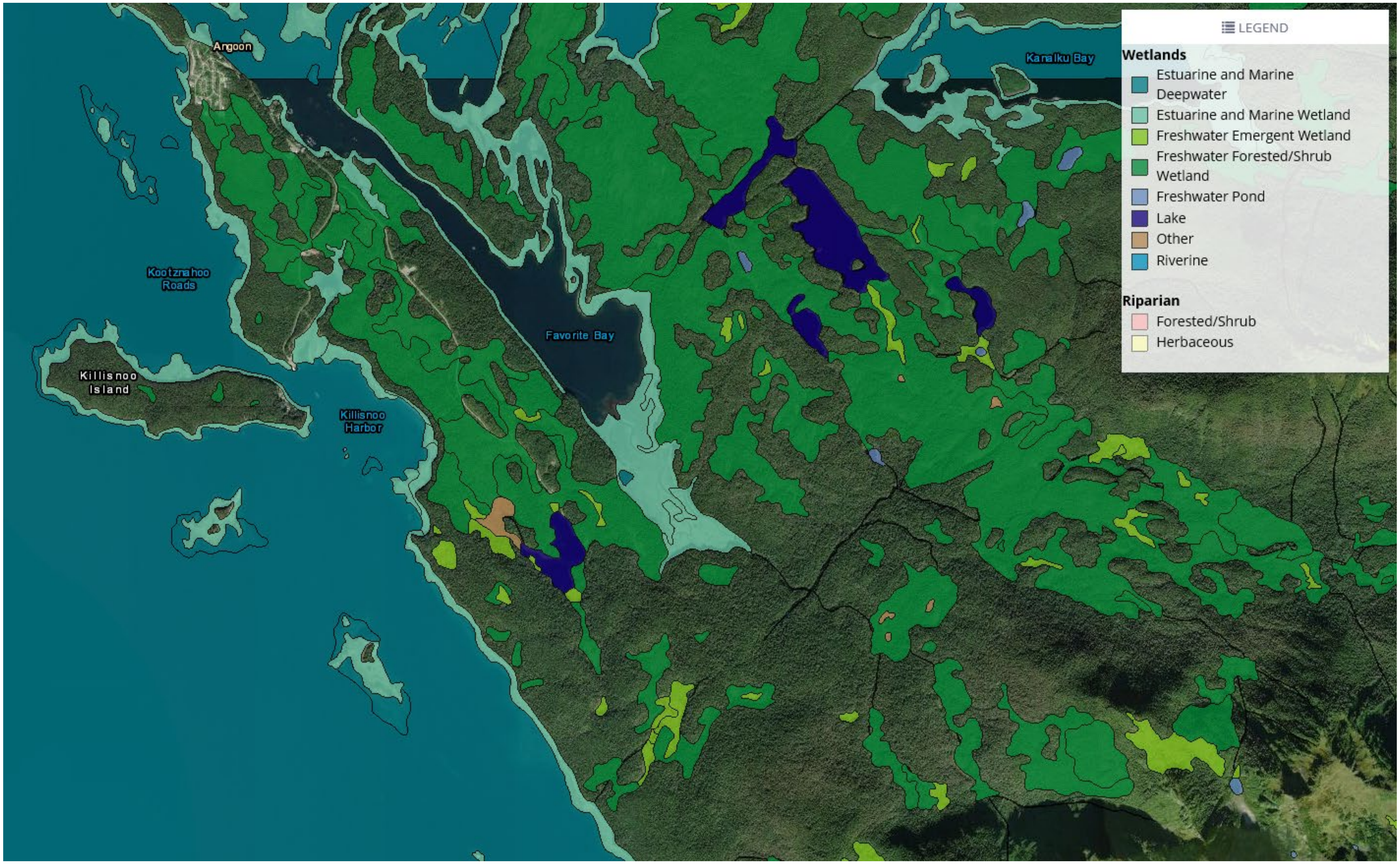
Action Information

ACTION DATE	ACTION	DESCRIPTION	DEC STAFF
8/16/2001	Site Added to Database	GRO, DRO, RRO in soils at high concentrations.	Bruce Wanstall
8/16/2001	Site Ranked Using the AHRM	Preliminary ranking.	Bruce Wanstall
8/27/2001	Update or Other Action	Teleconference with Carson Dorn (Schlicting) regarding possibility of addressing site under VCP.	Bill Janes
8/27/2001	Site Ranked Using the AHRM	Population Density Value changed to 0 and Population Proximity Value changed to 0.5.	Bill Janes
11/7/2001	Voluntary Cleanup Program	Wanstall sent acceptance letter to Silver Bay Logging this date.	Bill Janes
1/2/2002	Update or Other Action	Site tickler status check: FS sent comments 12/11 to Silver Bay Logging on its VCP workplan. Carson Dorn has not yet seen them.	Bill Janes
5/16/2002	Site Characterization Workplan Approved	Workplan approved this date.	Anne Marie Palmieri

State of Alaska Department of Environmental Conservation
P.O. Box 111800
Juneau, AK 99811-1800
Phone: 907-465-5066
Fax: 907-465-5245
TDD: 800-770-8973
Physical Location: 410 Willoughby

WETLANDS

Angoon Wetlands Map: https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/



CLIMATE

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Back to:

State Map | Western U.S. map | Home Page

NOTE:
To print data frame (right side), click on right frame before printing.

1981 - 2010

- Daily Temp. & Precip.
- Daily Tabular data (~23 KB)
- Monthly Tabular data (~1 KB)
- NCDC 1981-2010 Normals (~3 KB)

1971 - 2000

- Daily Temp. & Precip.
- Daily Tabular data (~23 KB)
- Monthly Tabular data (~1 KB)
- NCDC 1971-2000 Normals (~3 KB)

1961 - 1990

- Daily Temp. & Precip.
- Daily Tabular data (~23 KB)
- Monthly Tabular data (~1 KB)
- NCDC 1961-1990 Normals (~3 KB)

Period of Record

- Station Metadata
- Station Metadata Graphics

General Climate Summary Tables

- Temperature
- Precipitation
- Heating Degree Days
- Cooling Degree Days
- Growing Degree Days

Temperature

- Daily Extremes and Averages
- Spring 'Freeze' Probabilities
- Fall 'Freeze' Probabilities

ANGOON, ALASKA (500310)

Period of Record Monthly Climate Summary

Period of Record : 04/01/1932 to 02/28/2011

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	N
Average Max. Temperature (F)	31.9	36.8	40.9	47.1	53.4	58.8	62.0	61.5	56.6	48.4	3
Average Min. Temperature (F)	23.5	27.1	29.7	33.9	39.8	45.6	49.8	49.8	45.2	39.1	3
Average Total Precipitation (in.)	3.39	2.70	2.42	2.21	1.92	1.90	2.26	3.76	4.89	7.71	4
Average Total SnowFall (in.)	16.6	12.7	8.1	2.0	0.0	0.0	0.0	0.0	0.0	0.3	
Average Snow Depth (in.)	7	8	4	1	0	0	0	0	0	0	

Percent of possible observations for period of record.
Max. Temp.: 81% Min. Temp.: 80.9% Precipitation: 83.7%
Snowfall: 85.2% Snow Depth: 85.3%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

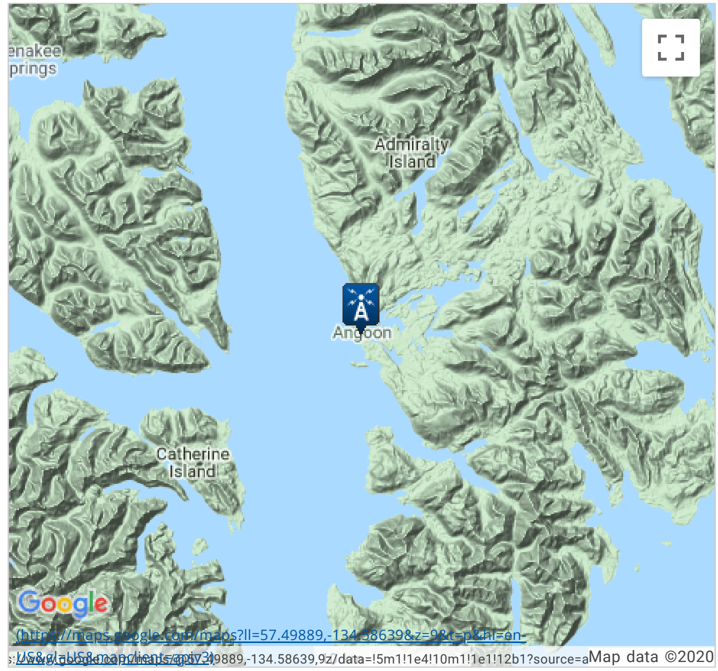
Local Climatological Data Station Details

Cart (Free Data) 1 item
(https://www.ncdc.noaa.gov/cdo-web/cart)

STATION DETAILS	
Name	ANGOON, AK US
Network:ID	WBAN:25310
Latitude/Longitude	57.49889°, -134.58639°
Elevation	8.5 m

PERIOD OF RECORD	
Start Date¹	1948-07-24
End Date¹	2020-12-07
Data Coverage²	35%

ADD TO CART



Station Data Inventory, Access & History

Data & Inventory

View Data

General History

1941 to 2011

Location History

1941 to 2011

Equipment History

1941 to 2011

Documentation

Documents

General History

See the full location history for this station using the Historical Observing Metadata Repository (https://www.ncdc.noaa.gov/homr/#ncdcstnid=20021853&tab=MSHR).

Status History

STATUS	BEGIN DATE¹	END DATE¹
CLOSED	2011-05-01	Present

Network History

NETWORK	BEGIN DATE¹	END DATE¹
COOP	2003-06-01	2011-05-01
COOP	1989-03-01	1989-05-01
COOP	1986-10-01	1988-11-01
COOP	1984-03-16	1986-06-01
COOP	1970-02-01	1983-06-17
COOP	1949-09-01	1969-03-31
COOP	1941-06-06	1948-03-17
COOP	1941-04-04	1941-05-31

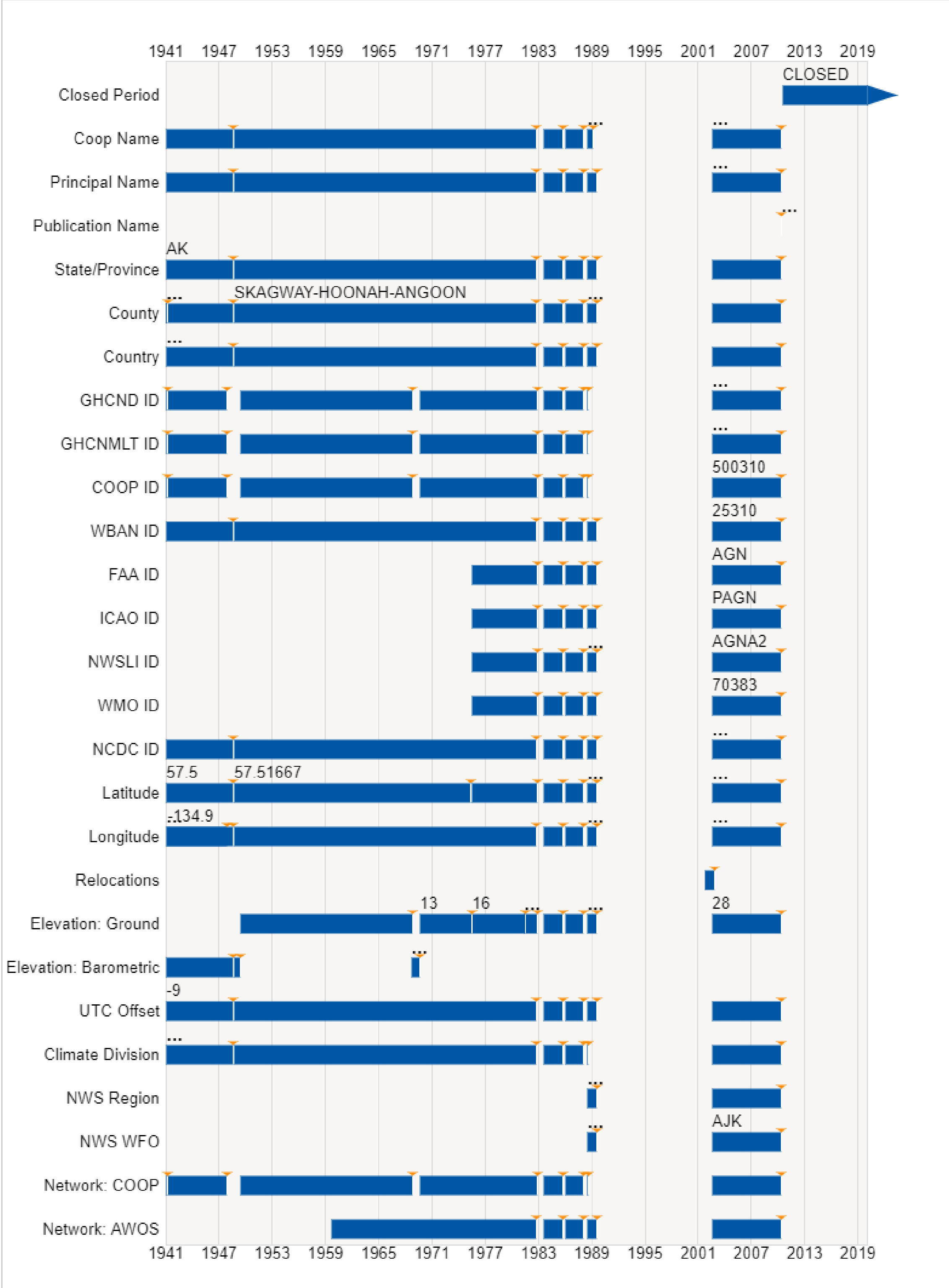
NETWORK	BEGIN DATE¹	END DATE¹
AWOS	2003-06-01	2011-05-01
AWOS	1989-03-01	1990-03-31
AWOS	1986-10-01	1988-11-01
AWOS	1984-03-16	1986-06-01
AWOS	1960-02-04	1983-06-17

Backup Stations

NAME	DISTANCE	ELEMENTS	BEGIN DATE¹	END DATE¹
-	-	-	-	-

Visual History

Below is a visual presentation of the history of this station. The graph visualizes station information over the history and shows if and when any of this information has changed. This is useful when stations have moved their location, changed instrumentation, or have even changed ID.



¹ Dates are in standard ISO format (yyyy-mm-dd)

² Coverage is an approximation of total completeness based on the most complete data element, and the overall data range.

SHPO

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Wander, Jackie

From:	Chambers, Robert - RD, Anchorage, AK <robert.chambers@usda.gov>
Sent:	Monday, June 24, 2019 2:17 PM
To:	Wander, Jackie
Cc:	Pearson, Isaac; cityclerk@cityofangoon.com
Subject:	FW: Notification of Intent to Initiate Section 106 Review
Attachments:	RUS 1970-H Section 106 Consultation_Angoon.pdf

[External Email]

Hi Jackie-

Please see the attached section 106 initiation and email thread. RD can make a determination on the water/sewer infrastructure for the project. However, we are not certain if DOT has conducted any determination / scoping for the paving and pedestrian walkway. SHPO may come back requesting if DOT conducted consultation. Just a heads up.

ROBERT CHAMBERS
WEP Programs Specialist | Rural Development
United States Department of Agriculture
510 L Street, Suite 410; Anchorage, AK 99501
Office: (907) 271-2424, Ext. 101
Fax: (855) 201-1074
www.rurdev.usda.gov/AKHome.html | "Committed to the future of rural communities"

United States Department of Agriculture
USDA is an equal opportunity provider and employer.

From: Chambers, Robert - RD, Anchorage, AK
Sent: Monday, June 24, 2019 2:08 PM
To: thomas.llanos@bia.gov
Cc: John Skan <jskan85@gmail.com>
Subject: FW: Notification of Intent to Initiate Section 106 Review

Hi Thomas-

It was nice meeting you last week. Thanks for taking the time to meet with RD and the city to discuss the proposed project. The attached scoping letter was sent to the Tribe and SHPO for consultation. We want to ensure that you have a copy of this for comment. Since DOT will be involved with the paving and pedestrian walkways, we would like to know if DOT has made any determination of historical properties effected in the APE. If so, we would appreciate if you would send that to us.

ROBERT CHAMBERS
WEP Programs Specialist | Rural Development
United States Department of Agriculture

510 L Street, Suite 410; Anchorage, AK 99501
Office: (907) 271-2424, Ext. 101
Fax: (855) 201-1074
www.rurdev.usda.gov/AKHome.html | "Committed to the future of rural communities"

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From: Chambers, Robert - RD, Anchorage, AK
Sent: Thursday, June 6, 2019 2:52 PM
To: SHPO (oha.revcomp@alaska.gov) <oha.revcomp@alaska.gov>
Cc: 'Joshua Bowen' <mayor@cityofangoon.com>; 'tribaltrans.agn@gmail.com' <tribaltrans.agn@gmail.com>
Subject: Notification of Intent to Initiate Section 106 Review

Good afternoon,

The City of Angoon is seeking federal funding for a transportation repaving project and water/sewer infrastructure replacement. The project will take place along existing road ways and within previously disturbed ground. Please see the attached letter for review and comments. Given the extremely narrow timeline for this project we would sincerely appreciate a quick and through response.

Thanks

ROBERT CHAMBERS
WEP Programs Specialist | Rural Development
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Rural Development

Alaska field office

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99501

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Fax 855.201.1074

June 6, 2019

Judith Bittner
State Historic Preservation Officer
550 West 7th Avenue, Suite 1310
Anchorage, AK 99501-3357

RE: Notification of Intent to Initiate Section 106 Review – The Angoon Street Repaving, Pedestrian Pathways and Water & Sewer Infrastructure Improvements Project

Dear Ms. Bittner:

The City of Angoon is seeking financial assistance from the USDA Rural Development under the Water and Waste Disposal Systems for Rural Communities for the Angoon Streets Paving & Pedestrian Pathways and Water & Sewer Infrastructure Replacement Project as shown on the enclosed map.

If Rural Development elects to fund the Project, it will become an undertaking subject to review under Section 106 of the National Historic Preservation Act, 54 U.S.C. 306108, and its implementing regulations, 36 CFR Part 800. Pursuant to 36 CFR § 800.2(c)(4), and 7 CFR § 1970.5(b)(2) of the regulations, "Environmental Policies and Procedures" (7 CFR Part 1970), Rural Utilities Service (RUS) has issued a blanket delegation for its applicants to initiate and proceed through Section 106 review. In accordance with this blanket delegation, The City of Angoon is initiating Section 106 review on behalf of RUS. In delegating this authority, RUS is advocating for the direct interaction between its borrowers and the State Historic Preservation Office (SHPO). Rural Utilities Service believes this interaction, prior to direct agency involvement, will support and encourage the consideration of impacts to historic properties earlier in project planning.

The City of Angoon proposes that the area of potential effects (APE) for the referenced project consists of repaving 15 existing roads in Angoon (approximately 2.5 miles), construct a pedestrian walkway near the Elementary School and Middle/High to improve transportation safety. Prior to the repaving efforts, the project will replace the existing aging water and sewer lines, replace fire hydrants, lift station improvements and service lines as shown on the enclosed map. All construction work pertaining to the project will take place within previously disturbed ground and within the rights-of-way and easements that currently exist. The geographic scope of the APE will not be final until a determination is made by RUS pursuant to 36 CFR § 800.4(a)(1).

At the direction of RUS, the City of Angoon has notified and is seeking information about possibly affected historic properties in the APE from the following Indian tribes – Angoon Community Association.

Identification Efforts:

A search of the Alaska Heritage Resource Survey (AHRS) was conducted on June 6, 2019 to identify previously recorded sites. The AHRS has one site listed in Angoon, the St. John the Baptist Church built possibly in the 19^{th} century. The actual original build date is unknown, and the church was also reportedly built in three separate projects. The National Register of Historic Places shows this church is located northwest of Beaver Trail Street over 750 feet away from the proposed lift station (outside the project area) and is not expected to be impacted by this project.

Please review the project and enclosed maps. After completing your review, please provide the City of Angoon with your recommendation(s) about whether or not study of the APE is needed to identify affected historic properties. If you recommend study, please explain the nature and scope of the proposed investigation specifically in reference to those factors identified in 36 CFR § 800.4(b)(1).

Submit your recommendations within thirty (30) days of your receipt of this request to Robert Chambers, USDA Rural Development, 510 L Street, Suite 410 Anchorage, AK 99501 or robert.chambers@usda.gov . If no timely response is received, The City of Angoon will notify RUS, so the federal agency may determine how to proceed with Section 106 review in accordance with 36 CFR § 800.3(b)(4). Should you have any questions, please contact the under signed at Robert.chambers@usda.gov or (907) 271-2424 extension 101.

Sincerely,

Robert Chambers

ROBERT CHAMBERS
WEP Programs Specialist

Cc: Joshua Bowen, Mayor City of Angoon
Jeanette Kookesh, President Angoon Community Association
John Skan, Transportation Director Angoon Community Association

Drawing: K:\JOBS\32190055 ANG PAVE DSR\ACAD-DESIGN\32190055_ANGOON_DFR_FIG_2-3.DWG - Layout: FIG 2
User: JWANDER May 08, 2019 - 4:16pm Xrefs: ANGOON_BRTB 11X17L.DWG - Images: ANGOON_1FT.TIF ANGOON_2FT.TIF

LEGEND

- NEW PAVEMENT (ALTERNATIVES 1 & 2) (COLOR VARIES BY ROADWAY)
- NEW PEDESTRIAN PATHWAYS (ALTERNATIVES 2 & 3)
- EXISTING ROADS NOT INCLUDED IN PROJECT

NOTES

1. TOTAL IMPROVEMENTS = ~2.5 MILES
2. IMAGE SOURCE: ANGOON COMMUNITY PROFILE MAP 2003, ALASKA DIVISION OF COMMUNITY AND REGIONAL AFFAIRS

0 100 200
SCALE IN FEET

FIGURE 2
ANGOON, ALASKA
ANGOON STREETS REPAVING & PEDESTRIAN PATHWAYS PROJECT
PROJECT AREA & ALTERNATIVES

Bristol
ENGINEERING SERVICES COMPANY, LLC

DATUM: NAD 83 STP Z1	DATE MAY 2019	SHEET
PROJECTION: -	DWN. JDW	2
	SCALE SHOWN	of
PROJECT No. 32190055	APPRVD. IPP	8

Drawing: K:\JOBS\32190055 ANG PAVE DSR\ACAD-DESIGN\32190055_ANGOON_DFR_FIG_2-3.DWG - Layout: FIG 3
User: JWANDER May 13, 2019 - 2:34pm Xrefs: ANGOON_BRTB 11X17L.DWG - Images: ANGOON_1FT.TIF ANGOON_2FT.TIF

LEGEND

- UNDERGROUND WATER LINE
- S — UNDERGROUND SEWER LINE
- P&T— OVERHEAD POWER / TELEPHONE LINE
- POWER POLE

NOTES

1. UTILITY LOCATIONS AND AERIAL IMAGE DERIVED FROM ANGOON COMMUNITY PROFILE MAP 2003, ALASKA DIVISION OF COMMUNITY AND REGIONAL AFFAIRS. UTILITIES NEWER THAN 2003 ARE NOT SHOWN ON THIS MAP, INCLUDING FIRE HYDRANTS AND STORM DRAINS.

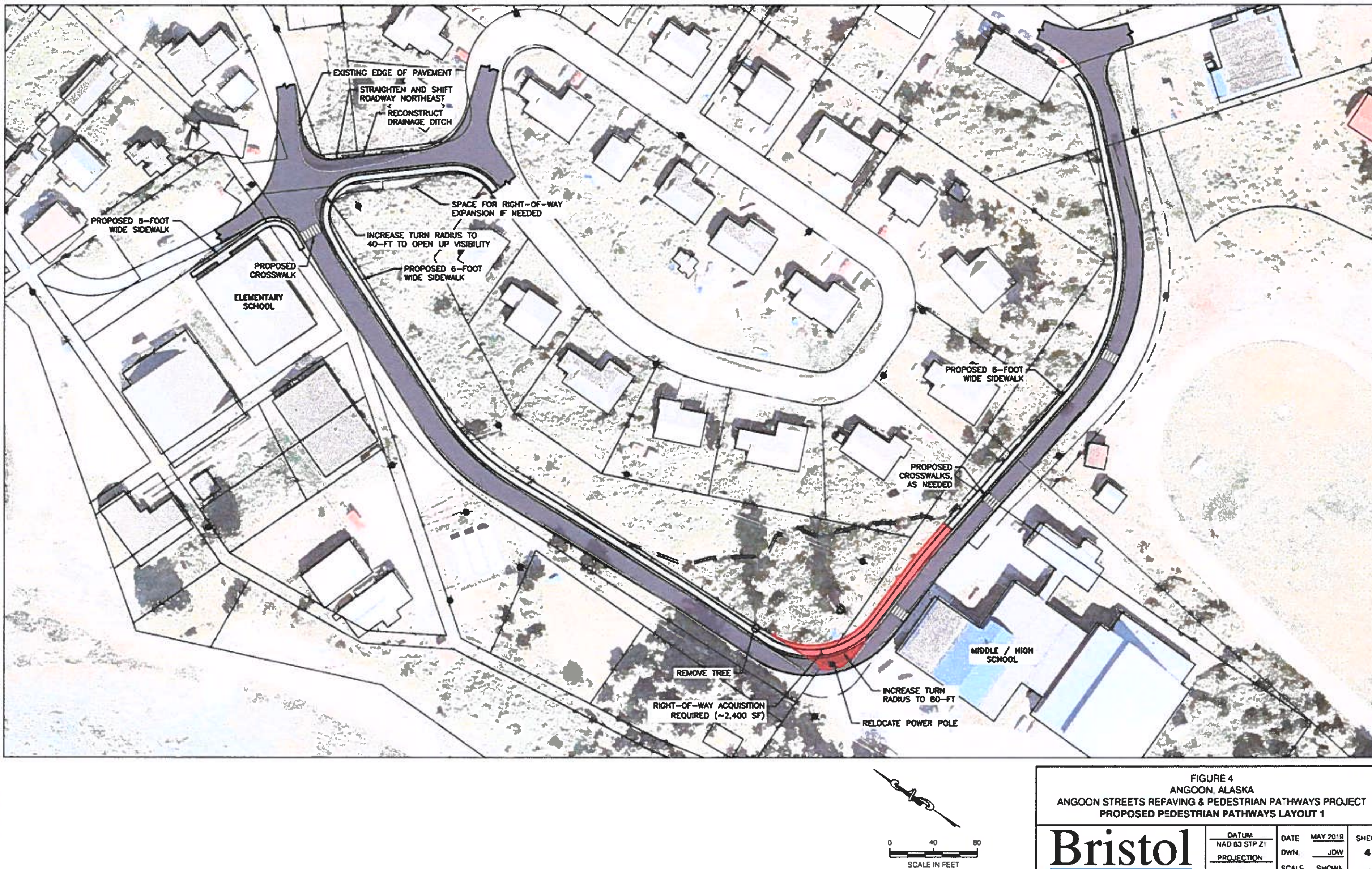
0 100 200
SCALE IN FEET

FIGURE 3
ANGOON, ALASKA
ANGOON STREETS REPAVING & PEDESTRIAN PATHWAYS PROJECT
EXISTING UTILITIES

Bristol
ENGINEERING SERVICES COMPANY, LLC

DATUM: NAD 83 STP Z1	DATE MAY 2019	SHEET
PROJECTION: -	DWN. JDW	3
PROJECT No. 32190055	SCALE SHOWN	of
	APPRVD. IPP	8

Drawing: K:\JOBS\32190055 ANG PAVE DSR\ACAD-DESIGN\32190055_ANGOON_DFR_FIG_4-5.DWG - Layout: FIG 4
User: JWANDER May 13, 2019 - 1:00pm Xrefs: ANGOON_BRTB 11X17L.DWG - Images: ANGOON AREA CLOSE.PNG ANGOON_1FT.TIF ANGOON_2FT.TIF



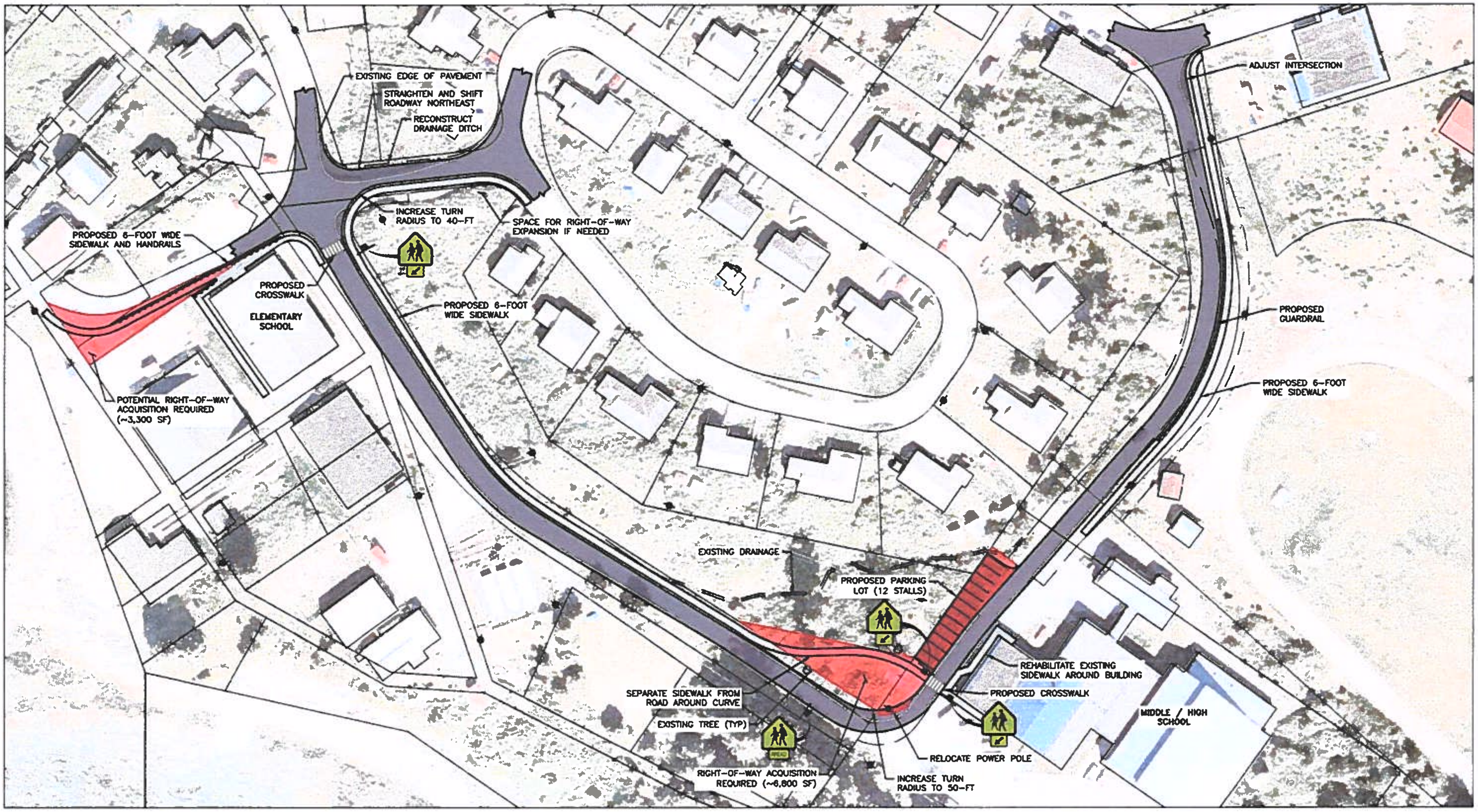
NOTE: IMAGE SOURCE - DCCED 2004

FIGURE 4
ANGOON, ALASKA
ANGOON STREETS REPAVING & PEDESTRIAN PATHWAYS PROJECT
PROPOSED PEDESTRIAN PATHWAYS LAYOUT 1

Bristol
ENGINEERING SERVICES COMPANY, LLC

DATUM NAD 83 STP Z1	DATE MAY 2019	SHEET 4	
PROJECTION	DWN. JDW	of	
PROJECT No 32190055	SCALE SHOWN		
	APPRVD IPP	8	

Drawing: K:\JOBS\32190055 ANG PAVE DSR\ACAD-DESIGN\32190055_ANGOON_DFR_FIG_4-5.DWG - Layout: FIG 5
User: JNANDER May 13, 2019 - 12:56pm Xrefs: ANGOON_BRTB 11X17L.DWG - Images: ANGOON AREA CLOSE.PNG ANGOON_1FT.TIF ANGOON_2FT.TIF



NOTE: IMAGE SOURCE - DCCED 2004

FIGURE 5
ANGOON, ALASKA
ANGOON STREETS REFAVING & PEDESTRIAN PATHWAYS PROJECT
PROPOSED PEDESTRIAN PATHWAYS LAYOUT 2

Bristol
ENGINEERING SERVICES COMPANY, LLC

DATUM NAD 83 STP Z1	DATE MAY 2019	SHEET 5
PROJECTION .	DWN. JDW	of
PROJECT No 32190055	SCALE SHOWN	8
	APPRVD IPP	

An Archaeological Survey of the Angoon-Kootznahoo and Seaplane Base Roads Paving Project, Admiralty Island, Alaska

by
Chris R. Campbell

under contract to the
Alaska Department of Transportation and Public Facilities

January 8, 1996

C.R.C. Cultural Resources Consultant
601 Pittinger Street,
Ketchikan, Alaska 99901

TABLE OF CONTENTS

Introduction

An archaeological survey was performed by Chris R. Campbell along the route of the proposed Angoon-Kootznahoo and Seaplane Base Roads paving project on April 17 and 18, 1995. The project is 4 km (2.5 miles) long and transects Admiralty Island from the outskirts of the community of Angoon to the west coast at the ferry terminal, in the vicinity of the old village site of Killisnoo. At the outset, the road corridor was hiked by Campbell and Ruben Yost, Environmental Engineer with the Alaska Department of Transportation and Public Facilities (ADOT&PF). This cursory examination determined that high potential areas would be located at the intersection of the seaplane base road with the main road, the seaward side of the road corridor, or east side of the main road just south of the intersection with the seaplane road, and the opposite end of the project, at "Japantown" near the ferry terminal. All of these areas were fairly level and well timbered. Areas of lessor importance or no probability were determined to be muskegs, low value timber stands skirting the muskegs, and steep embankments or cliffs.

Cultural resources management for any project located wholly or in part on federal lands, or funded and licensed wholly or in part by a federal agency is authorized by a number of laws, including but limited to the following: the Antiquities Act of 1906 (Public Law [PL] 59-209; the Historic Sites Act of 1935 (PL 74-292); the Reservoir Salvage Act of 1960 (PL 86-523); the National Historic Preservation Act of 1966 (PL 89-665, as amended in 1976, 1980, and 1992); 12the National Environment Policy Act of 1974 (PL 93-291); the Archaeological Resources Protection Act of 1979 (PL 96-95); and the Native American Graves Protection and Repatriation Act (PL 101-601: 104 STA 3048). The regulations most relevant to field investigations are 36 Code of Federal Regulation (CFR) 60, which authorizes the National Register of Historic Places, and 36 CFR 800, which executes Section 106 of the National Historic Preservation Act through the definition of the review procedure for any cultural resource affected by a project located wholly or in part on federal lands, funded wholly or in part with federal monies, or licensed wholly or in part by a federal agency.

Prior Archaeological Work

Admiralty Island has received intensive archaeological research in the past. The first archaeologist to conduct work on Admiralty Island was Dr. Frederica de Laguna in 1949-1950. De Laguna combined ethnographic, historical, and archaeological methods in her landmark study of Tlingit occupancy of Admiralty Island (1960). She interviewed Tlingit elders in Angoon to ascertain site locations, clan affiliation at the sites, the number of houses there, a history of the sites, and the activities of the people when there. De Laguna's direct historical approach did not disclose a relationship with northern artifact assemblages or even an ancient Tlingit assemblage. Her excavations yielded artifacts that were decidedly of Tlingit derivation. De Laguna did not employ the newly discovered radiocarbon techniques. She concluded instead that since no archaeological material had been recovered that could definitely predate the historic period, the collection was no older than 150 years (ibid.: 203).

After a hiatus of approximately 30 years, archaeologists once again set foot on Admiralty Island, this time as employees of the United States Forest Service (USFS). Eventually, USFS hired Madonna Moss as the Admiralty Island National Monument archaeologist.

Moss, upon returning to graduate school, decided to focus her dissertation work on prehistory of Admiralty Island. It was her desire to "build upon the pioneering archaeological and ethnographic research of Frederica de Laguna near Angoon" (Moss 1989:359). She also wanted to investigate the diet of the Tlingit as reflected in the faunal record embodied in archaeological sites. Moss identified seven research goals having to do with the prehistory and cultural ecology of the area in the vicinity of the community of Angoon. Four of the goals had to do with absolute dating to determine an accurate chronology (1989:10):

- Establish the antiquity of human settlement in the Angoon area;
- Place de Laguna's research in an absolute chronological framework;
- Establish how sites functioned within the settlement system(s) using chronological and faunal data; and
- Establish the time depth and trace the development of the ethnographic pattern of subsistence and settlement.

Moss obtained column samples from ten sites. Many of these previously had been tested by de Laguna. She analyzed the faunal remains and ran radiocarbon dates. Moss also identified and mapped fish weirs comprised of wooden stakes. She radiocarbon dated several of the stakes. Excluding the Favorite Bay Fish weir, which was dated at 3015 $\pm$ 60 (C_{14} Date years BP), the remainder of the dates clustered within the past 1900 years (C_{14} date years BP) (ibid:360). These dates far exceeded those postulated by de Laguna. Wrote Moss (ibid: 363, 359):

> The radiocarbon series . . . suggests [sic.] that local shorelines have been largely static for at least 3000 years. This continuity in shorelines is reflected by the similarity of most shellfish assemblages to modern intertidal habitats . . . Sites situated along the modern shoreline, in many cases containing historic features, often are thought to be of recent origin, but this study demonstrates considerable antiquity to the ethnohistoric pattern of selection.

Ethnohistory of the Xutsnoowu kwan

The Tlingit of Admiralty Island are collectively referred to as the Xutsnoowu kwan, or People of the Brown Bear Fort (Olson 1967:2). They are divided into two exogamous phratries, which are subdivided into clans (or "tribes").

The clans are patrilocal, matrilineal, and exogamous. Clans own both tangible and intangible properties (the former including "real estate," such as rights to fishing streams, halibut banks, carvings and wealth, the latter including histories, songs, and crests) (Olson 1967:12).

Management and acquisition of property were performed by the individual households. Each household contained an extended family comprised of at least three ascending generations of males, their wives, and children. Sons would be sent to live with the mother's brother during childhood, where he would stay for the remainder of his life as an heir to the position as the head of the household (or "chief") (Oberg 1973, Olson 1967).

The kwan represented all of the lineages within the a specific territory, and included at least one winter village. Affiliation to the community commanded lessor loyalty than affiliation with the clan and phratry (Oberg 1973, Olson 1967).

Socio-political administration was conducted by the heads of the households. During times of conflict, all efforts would be made to avert warfare and its concomitant loss of people and property. The Tlingit developed a formalized system for indemnification. If a person was injured or killed while in the company of the opposite clan, that clan was responsible for making restitution with either tangible and intangible property. If the opposite clans could not afford to make compensation in property, it was expected that they would pay in human life. If they became intransigent, the injured party would take hostages. In the future, these hostages would be referred to as slaves. They would be held until the opposite clan made payment. If the opposite clan did not redeem them, the hostages would truly become enslaved, and could be traded to others, killed, set free, or retained indefinitely to perform mundane daily tasks (Olson 1967).

When warfare did break out, the rule of thumb was to obtain property of equal value to that lost. Because the society was highly stratified, this meant that if someone of high rank were killed on one side, two or more people of lower rank would be killed on the other. During the feud, the all of the opposites within a kwan would retreat to a fortress, usually located on a promontory, island, or lands beyond a reef or salt chuck, or some other easily defensible site. Wars stretched out over years, requiring a vast amount of energy, wealth, and commitment. When wars were settled, formalized procedures were strictly followed, and any inequalities inflicted between the opposite sides would then be settled through payment of tangible or intangible property or loss of life (Olson 1967)..

By the turn of the century, the Tlingit of Admiralty Island were comprised of six clans, three belonging to the raven phratry, and three belonging to the eagle phratry. In addition, some clans, considered "outsiders," had migrated to Admiralty Island. These included at least two clans belonging to the eagle phratry, the Kagwantan and the Was' ineidi (Garfield 1947:452; de Laguna 1960:169; Swanton 1908:399).

A decade after the United States purchased the rights of the Russian American Company in Alaska, commercial endeavors began on Admiralty Island. In 1878, the Northwest Trading Company established a trading post on Killisnoo Island, near the traditional winter village of Killisnoo. In 1879, a herring reduction factory was built. In 1880, a whaling station was developed (Moss 1989:65). Unfortunately, in October of 1882 a noted Tlingit was killed in an accident while in the employ of the Northwest Trading Company. The Tlingit demanded indemnity. They requested that compensation be made in the form of blankets. The Northwest Trading Company refused. The Tlingit then seized two white men as hostages and bore them across Admiralty Island to Garnes Point where other Tlingit were fishing for herring in Favorite Bay (de Laguna 1960:162, 168,170). Up to this point, it can be seen that the Tlingit were behaving in a decorous, highly prescribed manner according to the strictures of their culture.

What followed was a disaster. The Northwest Trading Company called upon assistance from the U.S. Navy stationed in Sitka. The U.S. Navy gunboat, the *Corwin*, and a tugboat belonging to the Northwest Trading Company, the *Favorite*, opened fire on the winter village of Angoon. All of the large, permanent communal houses and forty canoes were destroyed. The Tlingit were devastated. They made temporary shelters and gathered seafood at low tide every day. It took five years for them to recover (Reckley in Moss 1989:66). However, by the time of the 1890 census, the rebuilt community of Angoon was described as being a "model" on the coast (Porter 1893:51). Interestingly, the Northwest Trading Company did not abandon its holdings on Admiralty Island. They diversified to produce cod liver oil, and in 1886 experimented in salting salmon. By 1890, the Alaska Oil and Guano Company had purchased the herring reduction plant (ibid.). Apparently, the company hired Japanese workers: a site called "Japantown" or "Little Tokyo" is located near the ferry terminal (Moss 1989:243; Harold Frank: pers. comm.). In 1928, the factory burned down (Moss 1989:243).

Results of Field Work

The survey was comprised of walking transects using subsurface soil probes spaced no further apart than 20 m. Additionally, the archaeologist examined root wads and other erosional exposures that lay within the corridor. The archaeologist was alert for any vegetational or surficial anomalies, as these are often indications of past land use. It was noted that the forests along the road were comprised of even aged growth.

A total of five sites was identified warranting AHRS numbers. They shall be described from the north to the south.

SIT-488: This site was found in what had been assigned as a low probability area, since the slopes are very steep and drop sharply into the salt chuck. It is comprised of two features (fig. 2, 3, and 4). Both are rectangular excavations. The easternmost is 3.8 m x 2.37 m. It is 60 cm deep at the eastern end and is 80 cm deep at the western end. The rectangle is oriented East-West. It is located right above the rapids of the salt chuck. Tests and probes revealed no cultural material. It is 3.10 m east of the shoulder of the road. The second feature is also a rectangular pit. It is located 1.66 m north of pole #1506-1 (fig. 4). It measures 2.0 m x 2.70 m, and is 80 cm deep. The pit is very well defined. It is also oriented E-W. Probes revealed no cultural material. The west wall is abutting the toe of the shoulder, and gravel from the road partially covers the bottom of the pit. Elders at Angoon suggested these pits may have been used as emergency food storage caches after the village had been bombarded by the US Navy. They recalled of being told how the people had hidden along the banks above the salt chuck of Favorite Bay for safety.

The Tlingit of Admiralty Island used cache pits. Moss (1989:411) described cache pits as a frequently occurring surface feature in the Angoon project area, although all discovered were culturally sterile except those that had been excavated into subsurface archaeological sites. Some cache pits were used into the twentieth century.

At this point, the road is to be widened on the uphill side, opposite of the features. The net effect will be to move the road further away from them than it is at present. This project is not anticipated to impact the features.

SIT-489. This site was located in what had been predetermined to be a low probability area, as it is found below the road along a steep embankment. It appears to be a traditional grave house that has collapsed (fig. 5). The wood is milled lumber and the nails are very corroded. The condition of the wood is very dilapidated and covered with moss. The exposed wood measures 1.6 m x 1.44 m. The feature is 6.97 m from the edge of the shoulder of the road. It is due west of the end of the boat ramp that runs from the north side of Garnes Point. It is located 13.96 m north of the north end of the southern guard rail on the east side of the road (fig. 6). The archaeologist and the engineers mutually agreed not to dismantle the planks or probe within the feature to verify the presence of human skeletal material because of the sensitive nature and because the feature is identical to collapsed grave houses the archaeologist has found elsewhere in Southeast. Through the process of elimination it seems as though the sole function of the feature would have been as a grave house. Elders in Angoon could not recall having seen or heard about the grave as children, although none were surprised by its discovery. One person suggested that it had been associated with a fort that had been located at Garnes Point which was occupied after the bombardment of Angoon by the U.S. Navy. Another said that a lineage that has since become extinct had a summer fish camp at Garnes Point . It was suggested that the grave was probably associated with the summer camp. In any event, no road work will be taking place. The feature will not be impacted by this project.

SIT-487: This feature is comprised of shell that fans out downslope from the road (fig. 8 and 9). It appears that it is eroding from a cut made by the road. Alternatively, it first appeared that the erosion from the road side may have been from gravels and sand dredged from the harbor near the ferry terminal. Testing in the vicinity of the shells suggests that they are found *in situ*. Shell was located in the subsurface soils in a sandy gravel beach context. The spill of shell, primarily comprised of smooth Washington clam (*Saxidomus gigantea*), is 7.4 m long and extends to a bench that is 1.8 wide and is located 4 m below the road, on the eastward, or seaward side. A small test square was excavated in the bench and a cockle shell (*Clinocardium sp.*) was found in a gravel matrix. Also, the bluff was faced off and shell was found embedded in the gravels of the bluff. Shell was collected for C_{14} and $_{13/12}$ analysis. Results are as follows:

Sample Data	Measured C14 Age	C13/12 Ratio	Conventional C14 Age (*)
CRC-95-2/ Beta-82686	2600 $\pm$ 60 BP	+ 3.0 o/oo	3010 $\pm$ 60 BP

The gravel context in which the shell was found suggests a natural as opposed to cultural origin. This appears to represent a raised beach from an earlier time when sea levels stood higher than at present. The shell was collected c. 7 m above sea level. As stated above, the shell is visible from the edge of the road. It is located 3.2 m south of the south end of the guard rail. No one recalled having seen this site, although one person suggested that the bench is actually part of a trail that used to run from Angoon to Killisnoo that was used before the Civilian Conservation

Corps (CCC) built the road during the depression. (It should be noted that according to a map of Beardslee's made in 1882, the trail terminated near Garnes Point [de Laguna 1960:50].) The bench does run downslope to the beach near Garnes Point. At this point, no road improvements will be made. It is not anticipated that the project will impact the feature.

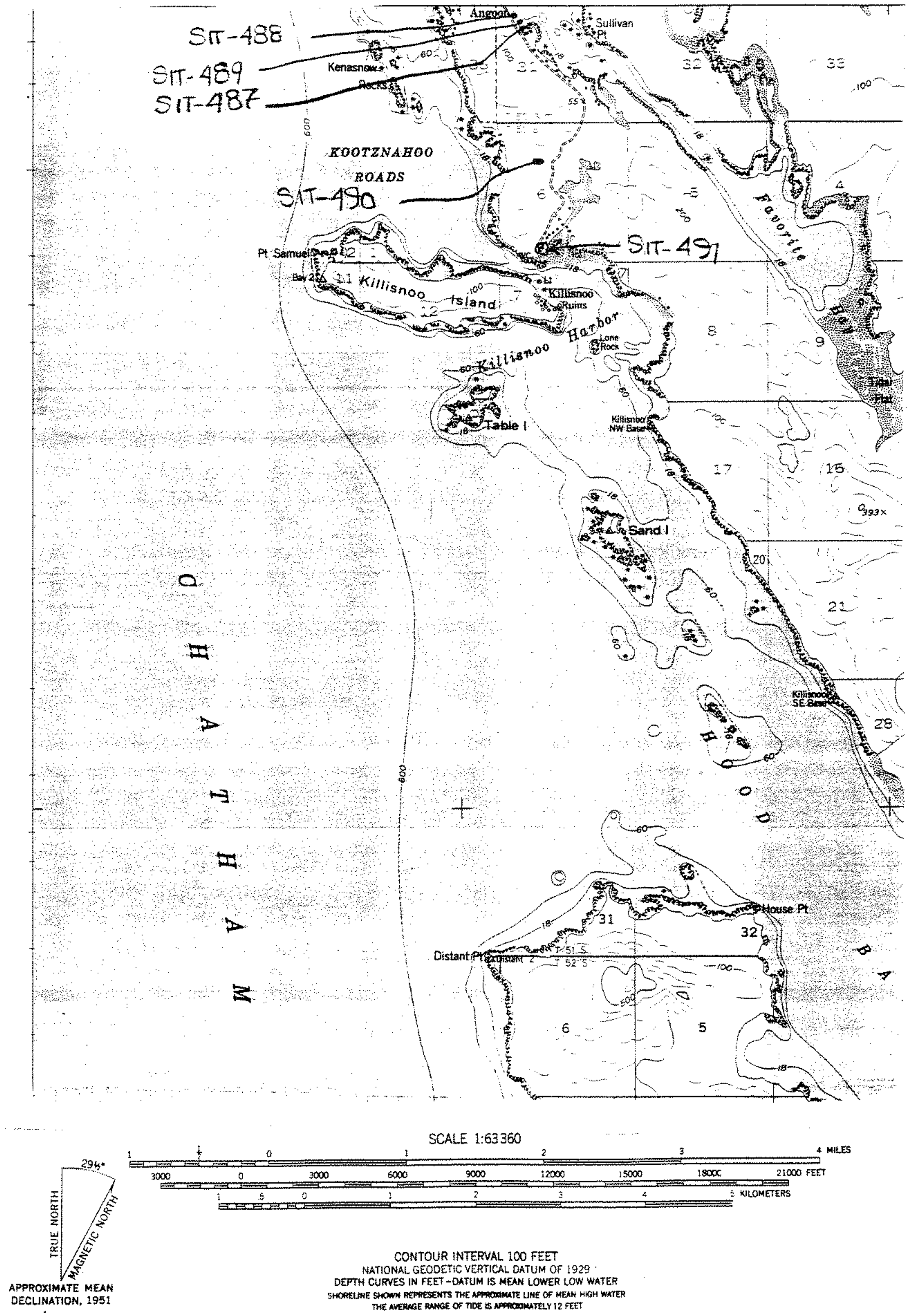
SIT-490: This feature is a three sided shelter that was constructed by the CCC. Since then, it appears as though it has been used as a drying rack, since galvanized nails are located about 2 cm apart along every horizontal bar of the structure. It is constructed of peeled wood poles with a hand made cedar shake or bark roof. The roof is badly deteriorated. It is situated in forest scrub.

An informant had described a fish drying shelter to Moss (1989:297) as being a "rectangular, open-sided shelter where circulating air dried the sliced fish. As many as 400 fish were dried on the racks in the sun." This sounds just like the CCC three-sided shelter, and it is interesting that in the second quarter of the twentieth century, the Tlingit modified the shelter from its recreation purposes to suit subsistence needs.

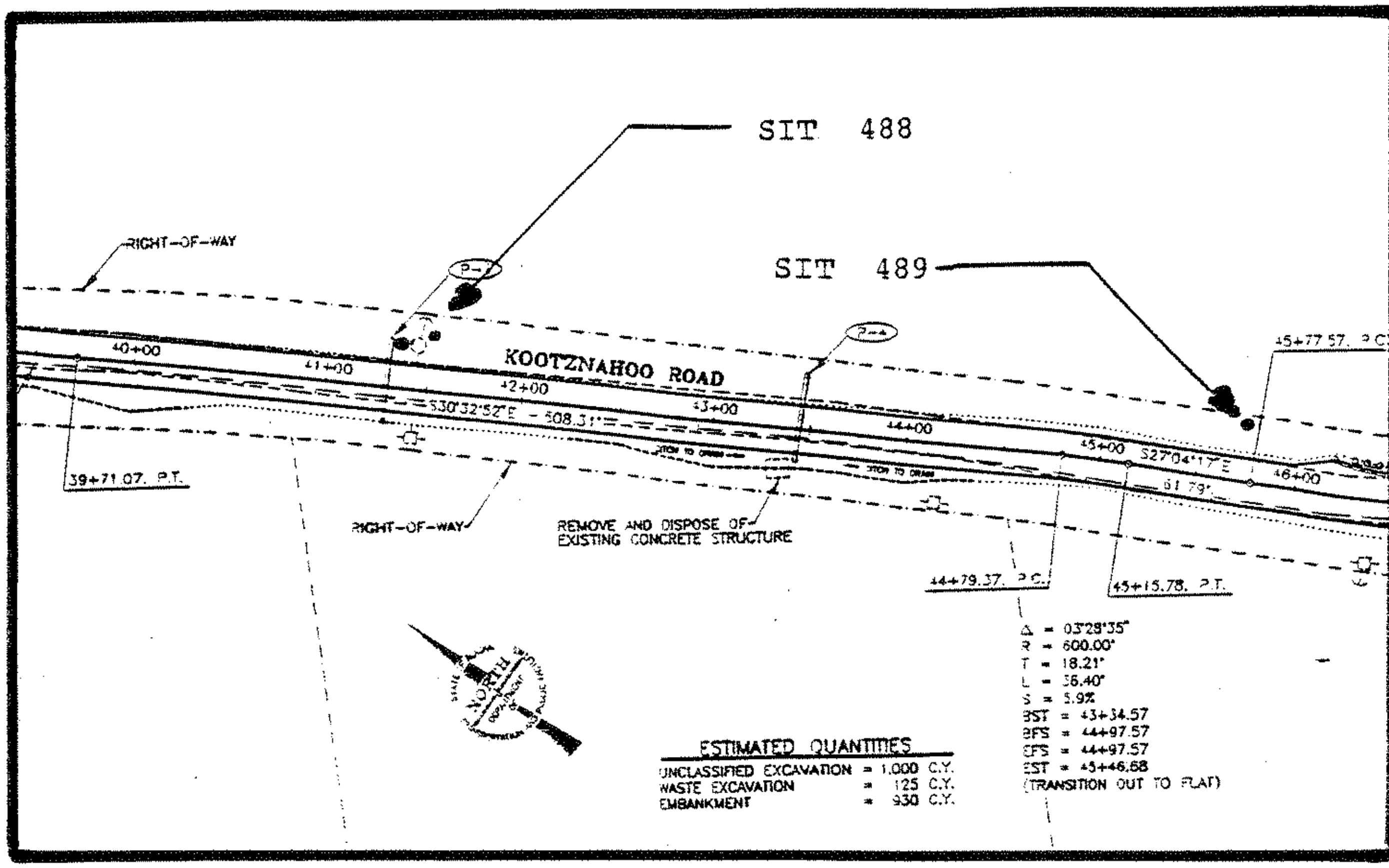
The shelter is located along the old road, just beyond the shooting range some distance from the present road. It is not anticipated that the paving project will impact this structure.

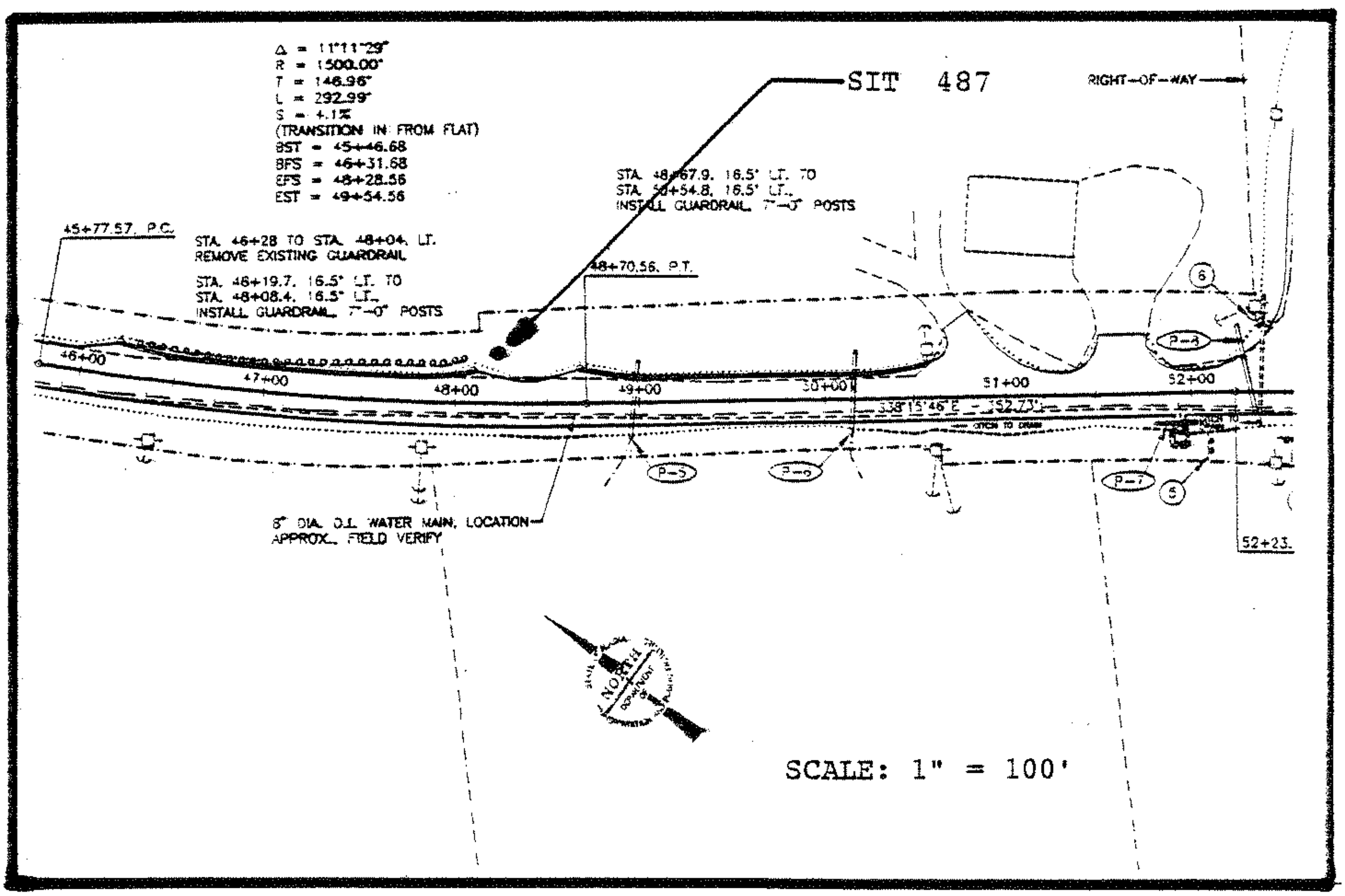
SIT-491: This is a complex of structures, locally called "Japantown," situated just north of the southern terminus of the project. The cluster of buildings is visible on the east side just below the road. It appears that the structures include a traditional, old cabin and a smoke house. Other structures range from craftsman style to more recent, incorporating modern siding and materials. The complex of buildings is situated on two well-defined terraces. A section of the lower terrace has well-defined garden furrows running at right angles to the shore line. They are

SITKA (B-2) QUADRANGLE
ALASKA
1:63 360 SERIES (TOPOGRAPHIC)



CONTOUR INTERVAL 100 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES IN FEET—DATUM IS MEAN LOWER LOW WATER
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE AVERAGE RANGE OF TIDE IS APPROXIMATELY 12 FEET





SITE LOCATION MAP

overgrown with salmon berry bushes and regenerative growth. Because this complex of structures and features is privately owned, no subsurface probes were made, although there is high potential for a subsurface site to be located here.

In fact, de Laguna (1960:245) described her discovry of a shell midden at this site underlying the garden, and that the owners (Sumatos) had found a barbed harpoon pont, a pestle or maul, and a stone mortar in their gardens. According to de Laguna (ibid.), this site was called qadasax^{w} -ayik, meaning "Inside of sand island."

The historic water supply was found on the opposite side of the road. Here a rill had been dammed by boards, and plastic pipe lay near by. Road improvements will not affect SIT-491.

Other Features

Besides these sites, it appears as though house pits are located near the end of the sea plane road on the north side in an even-aged stand of old growth timber. No tests were made since they lie beyond the right-of-way and the project corridor. Still, it appears that they are associated with SIT-304. Other features associated with Garnes Point are stone alignments visible at low tide on the shore above the boat harbor (fig. 9). Some of the alignments are hemispherical, fish trap like shapes, and another is a parallel alignment of stone like a canoe landing.

Discussion

It is probably not coincidental that the aboriginal sites discovered in the course of this survey were located in the vicinity of Garnes Point, even though this area was initially determined to have little or no probability for containing archaeological sites. This is because after the U.S. Navy destroyed the community of Angoon, the people "hid in the forest" above the salt chuck at the entrance to Favorite Bay (Harold Frank: pers. comm.). (According to Lydia George [pers. comm.], the fort belonged to the Wuckitan and was located where the market is now.) This was considered to be a safe place because boats would have a difficult time landing on the shores of this area. Access was difficult. Here were found two cache pits and a grave. Additional features identified at Garnes Point include stone alignments in the intertidal zone on the north shore of Garnes Point that include a possible canoe landing and possible stone fish traps, and possible house pits in the forest floor on the south side of Garnes Point. The presence of the cache pits suggests that during the time of hardship following the destruction of the community, people were able to obtain enough food to store for winter use. Perhaps the storage pits represent root cellars where harvested potatoes were stored for consumption during the winter months. Perhaps the people were able to store some of the harvested herring for their own use, or dog salmon or winter kings. In any event, the cache pits were attributed to this era of hardship and deprivation.

Although people interviewed were not acquainted with a cemetery site situated so near the road north of Garnes Point, neither were they surprised. Lineages have passed on since the advent of the twentieth century, and customs have changed. It was not at all unusual for a person to request burial at a favorite spot, perhaps his or her birth place or locale of special significance. In this case, a person may well have requested internment near Garnes Point, where people had lived after their community was bombarded. In fact, one elder suggested that the grave site is contemporaneous with occupation in the fort (Lydia George: pers. comm.).

Other observed features in the vicinity of Garnes Point, including intertidal stone alignments and house depressions in the forest are to be expected in an area that was an important resource site used annually which also served as a fort.

The marine shell, dating to 3010 $\pm$ 60, found within a terrace comprised of beach gravels c. 7 m above sea level no doubt represents an elevated marine terrace. This probably reflects differential movement as opposed to uniform movement, since a coeval feature had been found in the intertidal zone on the opposite side of Admiralty Island. It is interesting that the basal dates of shell middens found along the modern shoreline are, at a minimum, 1,100 years younger. Since these sites are located on opposite shores of Admiralty Island, it probably means that shorelines here have stabilized only within the last millennium. This conflicts with Moss' (1989:363) statement that shorelines have been largely static for at least 3,000 years. Moss attributed this, in part, to a similarity of most shellfish assemblages to modern intertidal habitats. However, elsewhere in Southeast Alaska, "fossil" shell dating as old as 9920 $\pm$ 60 (Beta-80706), discovered in Black Bear Creek on the west coast of Prince of Wales Island, is identical with those found in modern shell beds (Campbell 1995:12-13).

The discovery of the three-sided shelter, modified to function as a fish drying shelter, illustrates the continuation of traditional subsistence practices into the twentieth century. It also signifies opportunistic adaptive reuse of a foreign feature to serve better the residents of Admiralty Island.

"Japantown" had previously been identified as a subsurface archaeological site by de Laguna. Today, the cluster of buildings on the site appears to have historic integrity. Not only do they embody diverse styles ranging from a traditional Tlingit smokehouse to early Craftsmen style homes, they also represent the means by which an alien people adapted to a new world.

It may be remembered that the forests fringing the road transecting Admiralty Island were comprised of even-aged second growth stands. According to K. J. Metcalf (pers. comm.)

explained that the trees had been harvested to provide for the Northwest Trading Company's endeavors.

Conclusions

It does not appear as though any of the sites found within the project corridor will qualify for the National Register of Historic Places. The cache pits do not, in and of themselves, constitute National Register quality features. Graves and cemeteries are exempted from the NRHP. The shell appears to be a paleontological site, and as such would not qualify for the NRHP. The CCC shelter may qualify for the NRHP, but lies beyond the project corridor. SIT-491, Japantown, may also qualify for the NRHP, but it also lies outside the project corridor. In closing, it does not appear that the Angoon-Kootznahoo and Seaplane Base Roads paving project will impact any archaeological sites. If any sites are identified during the construction phase, it will be necessary to suspend ground disturbance in the vicinity of the find until consultation and mitigation procedures, as outlined in 36 CFR 800, are completed.

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Fig. 2: View of SIT-488, Cache Pit Depression, Admiralty Island, Alaska.

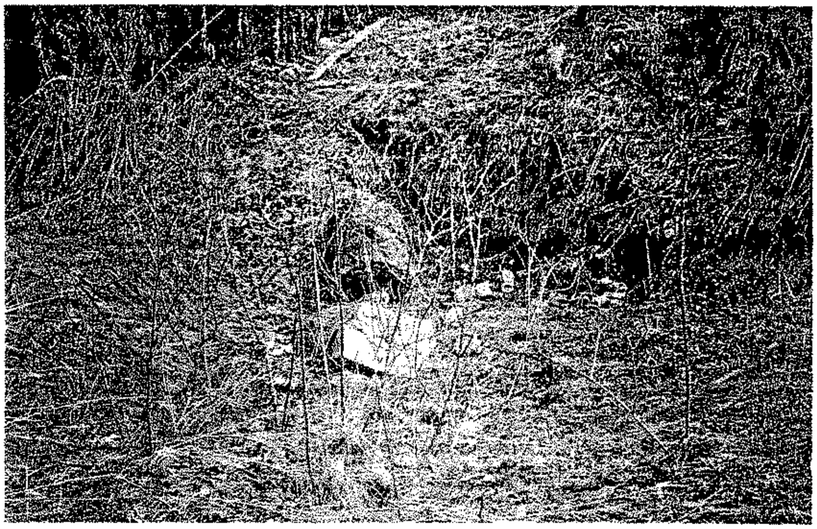


Fig. 3: Another view of SIT-488, corner of Cache Pit nearest the Road, Admiralty Island, Alaska.

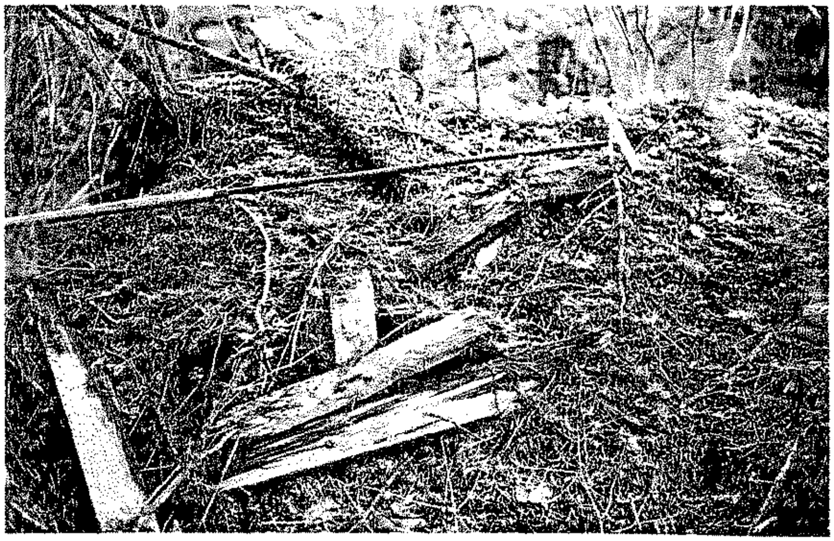


Fig. 5: View SIT-489, collapsed grave, Admiralty Island, Alaska. Note soil probe for scale.

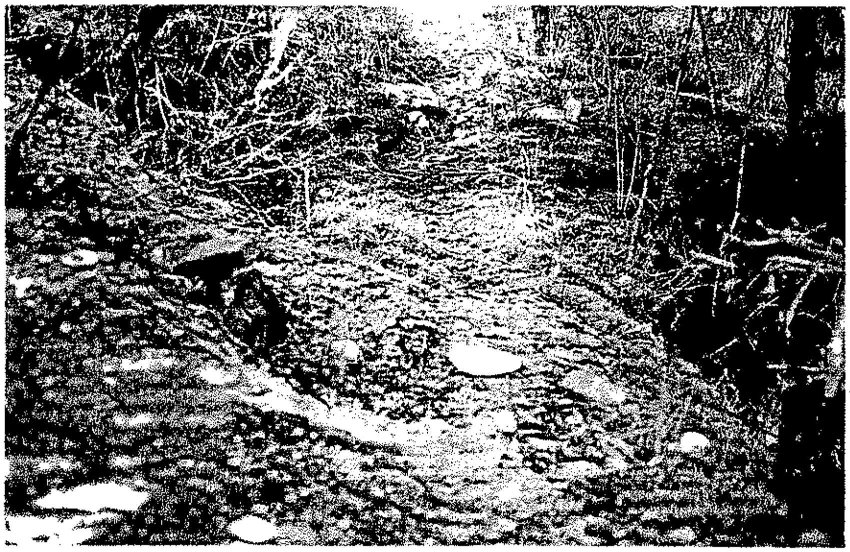


Fig. 7: SIT-487, shell on terrace, remnants of paleontological site, Admiralty Island, Alaska.

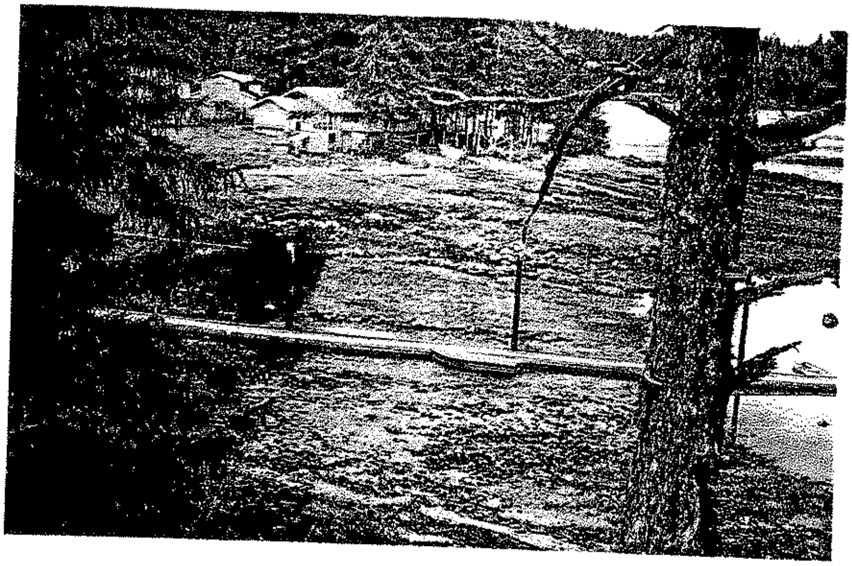
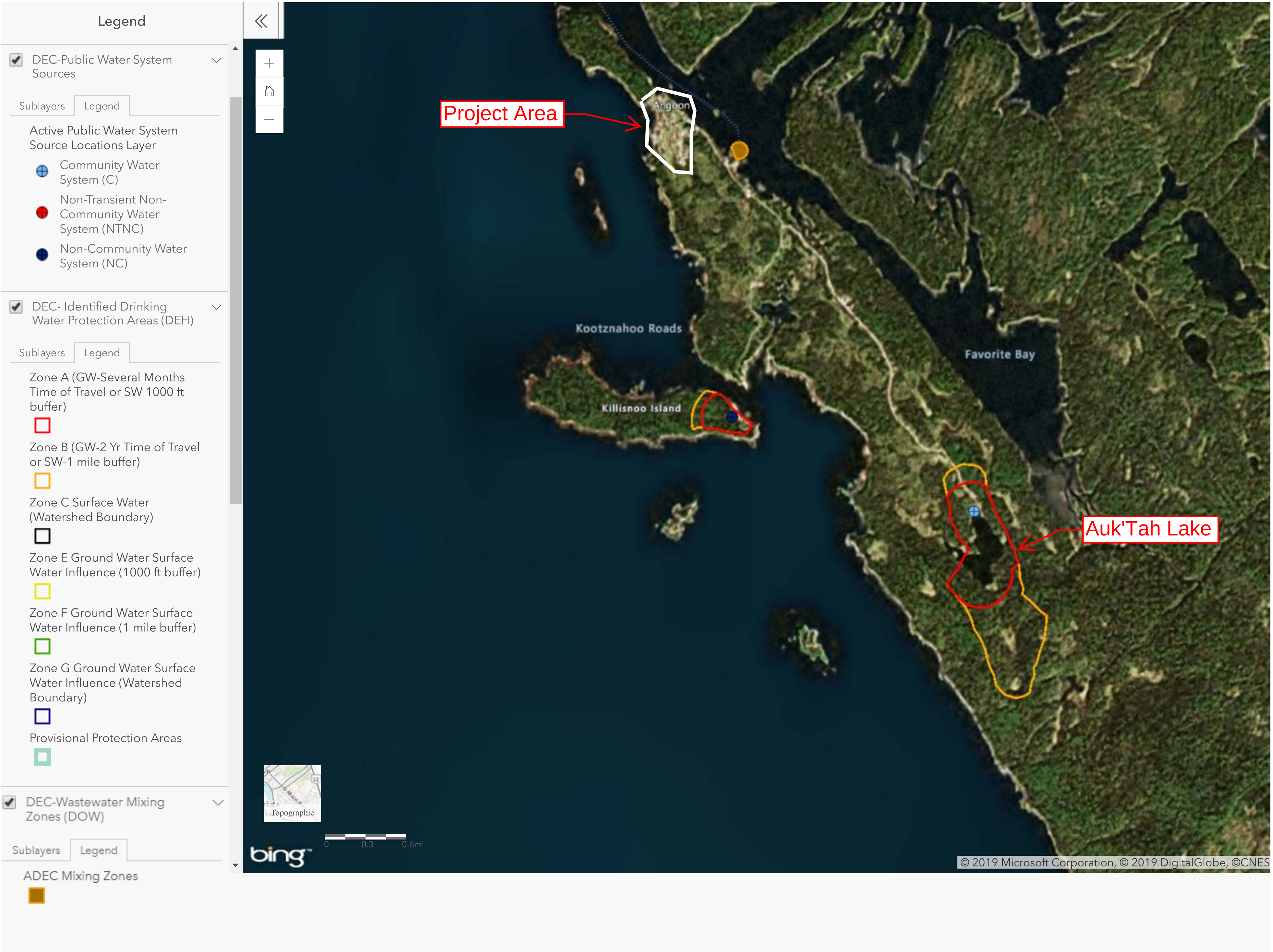


Fig. 9: View of some stone alignments at Garnes Point. Note rock alignments parallel to and above the boat ramp. These appear to be a canoe landing. (Image reversed at photo lab.)

WATER RESOURCES


Legend
DEC-Public Water System Sources
Sublayers
Legend
Active Public Water System Source Locations Layer
Community Water System (C)
Non-Transient Non-Community Water System (NTNC)
Non-Community Water System (NC)
DEC- Identified Drinking Water Protection Areas (DEH)
Sublayers
Legend
Zone A (GW-Several Months Time of Travel or SW 1000 ft buffer)
Zone B (GW-2 Yr Time of Travel or SW-1 mile buffer)
Zone C Surface Water (Watershed Boundary)
Zone E Ground Water Surface Water Influence (1000 ft buffer)
Zone F Ground Water Surface Water Influence (1 mile buffer)
Zone G Ground Water Surface Water Influence (Watershed Boundary)
Provisional Protection Areas
DEC-Wastewater Mixing Zones (DOW)
Sublayers
Legend
ADEC Mixing Zones
Project Area
Angoon
Kootznahoo Roads
Favorite Bay
Killisnoo Island
Auk'Tah Lake
Topographic
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APPENDIX C: AUDITS AND FINANCIAL INFORMATION

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NPV ESTIMATES

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ANGOON SOURCE WATER IMPROVEMENTS PER

DESCRIPTION		NET PRESENT VALUE LIFE-CYCLE COST
ALTERNATIVE 1 - NO ACTION	$	3,388,991.87
ALTERNATIVE 2- NEW SOURCE IMPOUNDMENT AT FAVORITE CREEK	$	10,454,116.92
ALTERNATIVE 3 -NEW SOURCE INTAKES, VERTICAL INFILTRATION GALLERIES AT AUK'TAH LAKE	$	4,550,720.38
ALTERNATIVE 4 - UPGRADE EXISTING INTAKE SYSTEM Recommended Alternative	**$**	**5,134,954.50**

ALTERNATIVE 1 - NO ACTION

O&M COSTS DESCRIPTION	ANNUAL COST	NOTES (from City 2020 WTP Budget)
Personal Services	$ 38,880	<all based on FY20 budget)
Travel & Per Diem	$ 2,000	
Electricity	$ 30,000	
Fuel Oil	$ 750	
Vehicle Fuel	$ 2,000	
Materials and Supplies	$ 2,000	
Freight	$ 7,500	
Water Testing	$ 3,000	
Chemicals	$ 30,000	
Misc	$ -	
	$ -	
TOTAL ANNUAL	**$ 116,130**	**$ 3,352,426 PRESENT WORTH**

ASSUMPTIONS UTILITY	RATE	UNIT	NOTES
Electricity	$ 0.6100	/kWh	Inside Passage Electric Company
Electricity PCE	$ (0.3900)	/kWh	(NIEC)
Electricity Net	$ 0.2200	/kWh	(no current PCE)
Fuel Oil	$ 3.48	/gal	
i= 0.25%			
n= 30		years	Federal Discount Rate (10/2020)
			(heavily discounted with COVID)

Based on proposed FY20 Water Budget

SCHEDULE OF SHORT LIVED ASSETS DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST	SERVICE LIFE	ANNUAL COST
Raw water pumps (2) 10 HP ea	2	ea	$ 2,000	$ 4,000	15	$ 267
Pump control panel	1	ea	$ 20,000	$ 20,000	20	$ 1,000
WTP equipment would not be included in this project.						
TOTAL SHORT LIVED ASSETS ANNUAL COST						**$ 1,267**
						$ 116,130 annual O&M
						$ 117,397 total for ANTHC

SUMMARY DESCRIPTION	PRESENT WORTH	NOTES
Capital Costs	$ -	
Salvage Value	$ -	components are assumed to have no value at end of design life
O&M Costs	$ 3,352,426	
Short Lived Assets	$ 36,566	Combined with O&M in table for ANTHC
NPV / TOTAL LIFE-CYCLE COST	**$ 3,388,992**	

ALTERNATIVE 2- NEW SOURCE IMPOUNDMENT AT FAVORITE CREEK

O&M COSTS

DESCRIPTION	ANNUAL COST	NOTES	*Change Compared to No Action*
Personal Services	$ 41,472	<added 2 hours per week for impoundment inspection/maintenance>	$ 2,592
Travel & Per Diem	$ 2,000		$ -
Electricity	$ 10,000		$ (20,000)
Fuel Oil	$ 750		$ -
Vehicle Fuel	$ 2,400	<added 20% to current vehicle fuel>	$ 400
Materials and Supplies	$ 2,000		$ -
Freight	$ 7,500		$ -
Water Testing	$ 3,000		$ -
Chemicals	$ 30,000		$ -
			$ -
Misc			$ -
New Road Maintenance	$ 11,625	<based on current road maintance cost of $31k/8 mi, over 5 miles of new road>	$ 11,625
TOTAL ANNUAL	**$ 110,747**	**$ 3,197,030 PRESENT WORTH**	**$ (5,383)**

ASSUMPTIONS

UTILITY	RATE	UNIT	NOTES
Electricity	$ 0.6100	/kWh	Inside Passage Electric Company
Electricity PCE	$ (0.3900)	/kWh	(NIEC)
Electricity Net	$ 0.2200	/kWh	(no current PCE)
Fuel Oil	$ 3.48	/gal	
	i= 0.25%		
	n= 30	years	Federal Discount Rate (10/2020)
			(heavily discounted with COVID)

SCHEDULE OF SHORT LIVED ASSETS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST	SERVICE LIFE	ANNUAL COST	*Change Compared to No Action*
Impoundment	1	ea	$ 941,723	$ 941,723	50	$ 18,834	
(only included the impoundment, not road)							
WTP equipment would not be included in this project.							
				TOTAL SHORT LIVED ASSETS ANNUAL COST		**$ 18,834**	***$ 17,568***
						$ 110,747 annual O&M	
						$ 129,581 total for ANTHC	***$ 12,185***

SUMMARY

DESCRIPTION	PRESENT WORTH	NOTES
Capital Costs	$ 6,713,376	
Salvage Value	$ -	components are assumed to have no value at end of design life
O&M Costs	$ 3,197,030	
Short Lived Assets	$ 543,711	Add to O&M for ANTHC Table
NPV / TOTAL LIFE-CYCLE COST	**$ 10,454,117**	

ALTERNATIVE 3 -NEW SOURCE INTAKES, VERTICAL INFILTRATION GALLERIES AT AUK'TAH LAKE

O&M COSTS

DESCRIPTION	ANNUAL COST	NOTES	*Change Compared to No Action*
Personal Services	$ 38,880	<all based on FY20 budget, no substantial change from current operation>	$ -
Travel & Per Diem	$ 2,000		$ -
Electricity	$ 30,000		$ -
Fuel Oil	$ 750		$ -
Vehicle Fuel	$ 2,000		$ -
Materials and Supplies	$ 2,000		$ -
Freight	$ 7,500		$ -
Water Testing	$ 3,000		$ -
Chemicals	$ 30,000		$ -
			$ -
Misc	$ -		$ -
	$ -		$ -
TOTAL ANNUAL	**$ 116,130**	**$ 3,352,426 PRESENT WORTH**	**$ -**

ASSUMPTIONS

UTILITY	RATE	UNIT	NOTES
Electricity	$ 0.6100	/kWh	Inside Passage Electric Company
Electricity PCE	$ (0.3900)	/kWh	(NIEC)
Electricity Net	$ 0.2200	/kWh	(no current PCE)
Fuel Oil	$ 3.48	/gal	
i=	0.25%		
n=	30	years	Federal Discount Rate (10/2020)
			(heavily discounted with COVID)

SCHEDULE OF SHORT LIVED ASSETS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST	SERVICE LIFE	ANNUAL COST		*Change Compared to No Action*
New Well Pumps, (2) @ 20 HP ea	2	ea	$ 2,750	$ 5,500	15	$ 367		
Pump Control Panel	1	ea	$ 32,000	$ 32,000	20	$ 1,600		
WTP equipment would not be included in this project.								
					TOTAL SHORT LIVED ASSETS ANNUAL COST	**$ 1,967**		***$ 700***
						$ 116,130	annual O&M	
						$ 118,097	total for ANTHC	***$ 700***

SUMMARY

DESCRIPTION	PRESENT WORTH	NOTES
Capital Costs	$ 1,141,521	
Salvage Value	$ -	components are assumed to have no value at end of design life
O&M Costs	$ 3,352,426	
Short Lived Assets	$ 56,773	Add to O&M for ANTHC Table
NPV / TOTAL LIFE-CYCLE COST	**$ 4,550,720**	

ALTERNATIVE 4 - UPGRADE EXISTING INTAKE SYSTEM

Change Compared to No Action

O&M COSTS DESCRIPTION		ANNUAL COST	NOTES	Change Compared to No Action	
Personal Services	$	38,880	<all based on FY20 budget, no substantial change from current operation>	$	-
Travel & Per Diem	$	2,000		$	-
Electricity	$	30,000		$	-
Fuel Oil	$	750		$	-
Vehicle Fuel	$	2,000		$	-
Materials and Supplies	$	2,000		$	-
Freight	$	7,500		$	-
Water Testing	$	3,000		$	-
Chemicals	$	30,000		$	-
				$	-
Misc	$	-		$	-
	$	-		$	-
TOTAL ANNUAL	**$**	**116,130**	**$ 3,352,426 PRESENT WORTH**	**$**	**-**

SCHEDULE OF SHORT LIVED ASSETS DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST	SERVICE LIFE	ANNUAL COST	Change Compared to No Action
New Well Pumps, (2) @ 20 HP ea	2	ea	$ 4,518	$ 9,036	15	$ 602	
Pump Control Panel	1	ea	$ 32,000	$ 32,000	20	$ 1,600	
WTP equipment would not be included in this project.							
				TOTAL SHORT LIVED ASSETS ANNUAL COST		**$ 2,202**	***$ 936***
						$ 116,130 annual O&M	
						$ 118,332 total for ANTHC	***$ 936***

SUMMARY DESCRIPTION		PRESENT WORTH	NOTES
Capital Costs	$	1,718,950	
Salvage Value	$	-	components are assumed to have no value at end of design life
O&M Costs	$	3,352,426	
Short Lived Assets	$	63,579	Add to O&M for ANTHC Table
NPV / TOTAL LIFE-CYCLE COST	**$**	**5,134,954**	

ASSUMPTIONS UTILITY		RATE	UNIT	NOTES
Electricity	$	0.6100	/kWh	Inside Passage Electric Company
Electricity PCE	$	(0.3900)	/kWh	(NIEC)
Electricity Net	$	0.2200	/kWh	(no current PCE)
Fuel Oil	$	3.48	/gal	
	i=	0.25%		
	n=	30	years	Federal Discount Rate (10/2020)
				(heavily discounted with COVID)

Replacement pumps and rebuilt lift station should make system more efficient. In worst case scenario, efficiency gains are offset by increased water use, due to increased availability.
Therefore, to be conservative, no savings were included in estimate of O&M.

ANGOON O&M ESTIMATE

Rough Order of Magnitude O&M Estimate Summary

	Monthly Total	Annual Total
Alternative 1: No Action	$9,615	$116,130
Alternative 2: New Source Impoundment on Favorite Creek	$9,229	$110,747
Alternative 3: New Infiltration Galleries at Existing Source	$9,615	$116,130
Alternative 4: Upgrade Existing Intake System (Recommended Alternative)	$9,615	$116,130

Elec Rate 0.61 (by Inside Passage Electric Cooperative, no PCE which would reduce cost to 0.22 per kWh)
Fuel 3.34

Rough Order of Magnitude O&M Cost Estimate
Alternative 1: No Action

Item	Quantity	Demand	Monthly Quantity	Unit Cost ($)	Monthly Cost ($)	Annual Cost ($)
Power						
Submersible Well Pump (10 HP, 80 gpm), 2 well pumps, run in continuously in parallel (both needed to fill WST)		26,513.00 kW/yr			1,666.67	20,000.00
All Other WTP Electric		13,669.00 kW/yr			833.33	10,000.00
				Power Subtotal	**$2,500.00**	**$30,000.00**
The current pump use is 80 gpm (not the rated design use for the pump) In order to meet demand at this rate, the pumps would need to run continuously. This type of pump operation may result in less efficiency and diminished design life for the pump. Power usage per year is based on 2016 Energy Audit (ANTHC). It is included to show the ration of power usage in the WTP. Total electric is based on FY20 budget, prorated based on ratio (pumps are 2/3 of electric costs).						
Heating						
Fuel Oil		750.00 gal/yr	gal	gal	62.50	750.00
				Consumable Subtotal	**$62.50**	**$750.00**
Based on FY20 budget.						
Treatment Consumables (Chemical Addition)						
Calcium Hypochlorite						
Polymer						
					2,500.00	30,000.00
				Consumable Subtotal	**$2,500.00**	**$30,000.00**
Based on FY20 budget. Freight included separately.						
Operator						
Lead Operator	4 hrs/day	20 hrs/wk	80 hours	27.00 hour	2,160.00	25,920.00
Backup Operator	4 hrs/day	20 hrs/wk	80 hours	13.50 hour	1,080.00	12,960.00
				Operator Subtotal	**$3,240.00**	**$38,880.00**
Based on FY20 budget. Assume current operator splits time with wastewater (so 20 hours per week at WTP at approx $27/hr).						
Compliance/Monitoring/Testing						
Estimated average annual cost for Community Public Water System with Surface Water Source					250.00	3,000.00
				Monitoring/Compliance/Testing Subtotal	**$250.00**	**$3,000.00**
Based on FY20 budget.						

MISC Costs						
Freight					625.00	7,500.00
Materials and Supplies					166.67	2,000.00
Travel and Per Diem					166.67	2,000.00
Vehicle Fuel					166.67	2,000.00
				MISC Subtotal	**$1,125.00**	**$13,500.00**
Total Road Maintenance cost for 2020 estimated at $31,000. This covers all roads in Angoon. This is considered "0" baseline for the alternatives.						
				TOTAL ESTIMATED O&M ALTERNATIVE 1	**$9,615.00**	**$116,130.00**

Rough Order of Magnitude O&M Cost Estimate
Alternative 2: New Source Impoundment on Favorite Creek

Item	Quantity	Demand	Monthly Quantity	Unit Cost ($)	Monthly Cost ($)	Annual Cost ($)
Power						
All Other WTP Electric		13,669.00 kW/yr			833.33	10,000.00
				Power Subtotal	**$833.33**	**$10,000.00**
The impoundment would provide sufficient elevation head such that no intake pumps would be needed. However, small pumps may be needed for intitial start up. It is assumed that the small hydraulic overflow would be sufficient to power small power needs at the impoundment.						
Heating						
Fuel Oil		750.00 gal/yr	gal	gal	62.50	750.00
				Consumable Subtotal	**$62.50**	**$750.00**
No change in heating cost for WTP anticipated. It is assumed sufficient power will be generated in impoundment to supply electric heater.						
Treatment Consumables (Chemical Addition)						
Calcium Hypochlorite						
Polymer						
					2,500.00	30,000.00
				Consumable Subtotal	**$2,500.00**	**$30,000.00**
Based on FY20 budget. Freight included separately.						
Operator						
Lead Operator - WTP	4 hrs/day	20 hrs/wk	80 hours	27.00 hour	2,160.00	25,920.00
Backup Operator - WTP	4 hrs/day	20 hrs/wk	80 hours	13.50 hour	1,080.00	12,960.00
Impoundment Inspection		2 hrs/wk	8 hours	27.00 hours	216.00	2,592.00
				Operator Subtotal	**$3,456.00**	**$41,472.00**
Based on FY20 budget, with addtional hours to oversee impoundment. Assume current operator splits time with wastewater (so 20 hours per week at WTP). Assume weekly impoundment inspection and maintenance at 2 hours per week.						
Compliance/Monitoring/Testing						
Estimated average annual cost for Community Public Water System with Surface Water Source					250.00	3,000.00
				Monitoring/Compliance/Testing Subtotal	**$250.00**	**$3,000.00**

Based on FY20 budget. No changes in routine compliance monitoring.						
MISC Costs						
Freight					625.00	7,500.00
Materials and Supplies					166.67	2,000.00
Travel and Per Diem					166.67	2,000.00
Vehicle Fuel (current usage + 20%)					200.00	2,400.00
New Road Maintenance	3,875 /mi/yr	3 miles			968.75	11,625.00
				MISC Subtotal	**$2,127.08**	**$25,525.00**
Total road maintenance cost for 2020 estimated at $31,000 for 8 miles of road. This covers all roads in Angoon. Additional 5 miles of road and pipeline to impoundment would need to be serviced/maintained.						
				TOTAL ESTIMATED O&M ALTERNATIVE 2	**$9,228.92**	**$110,747.00**

Rough Order of Magnitude O&M Cost Estimate
Alternative 3: New Vertical Infiltration Galleries at Auk'tah Lake

Item	Quantity	Demand	Monthly Quantity	Unit Cost ($)	Monthly Cost ($)	Annual Cost ($)
Power						
Submersible Well Pump (10 HP, 80 gpm), 2 well pumps, run in continuously in parallel (both needed to fill WST)		26,513.00 kW/yr			1,666.67	20,000.00
All Other WTP Electric		13,669.00 kW/yr			833.33	10,000.00
				Power Subtotal	**$2,500.00**	**$30,000.00**
New well pumps would be run within their efficiency curves. This should cost no more than current pump costs.						
Heating						
Fuel Oil		750.00 gal/yr	gal	gal	62.50	750.00
				Consumable Subtotal	**$62.50**	**$750.00**
No change in heating cost for WTP anticipated. It is assumed sufficient power will be generated in impoundment to supply electric heater.						
Treatment Consumables (Chemical Addition)						
Calcium Hypochlorite						
Polymer						
					2,500.00	30,000.00
				Consumable Subtotal	**$2,500.00**	**$30,000.00**
Based on FY20 budget. Freight included separately.						
Operator						
Lead Operator	4 hrs/day	20 hrs/wk	80 hours	27.00 hour	2,160.00	25,920.00
Backup Operator	4 hrs/day	20 hrs/wk	80 hours	13.50 hour	1,080.00	12,960.00
				Operator Subtotal	**$3,240.00**	**$38,880.00**
Based on FY20 budget. Operation should take less effort with improved infiltration gallery (less clearing of screen/intake line)						
Compliance/Monitoring/Testing						
Estimated average annual cost for Community Public Water System with Surface Water Source					250.00	3,000.00

Monitoring/Compliance/Testing Subtotal					**$250.00**	**$3,000.00**
Based on FY20 budget. No changes in routine compliance monitoring.						

MISC Costs						
Freight					625.00	7,500.00
Materials and Supplies					166.67	2,000.00
Travel and Per Diem					166.67	2,000.00
Vehicle Fuel					166.67	2,000.00
MISC Subtotal					**$1,125.00**	**$13,500.00**
No additional road or pipeline maintenance costs assumed.						
TOTAL ESTIMATED O&M ALTERNATIVE 3					**$9,615.00**	**$116,130.00**

Rough Order of Magnitude O&M Cost Estimate
Alternative 4: Upgrade Intake at Auk'tah Lake

Item	Quantity	Demand	Monthly Quantity	Unit Cost ($)	Monthly Cost ($)	Annual Cost ($)
Power						
Submersible Well Pump (10 HP, 80 gpm), 2 well pumps, run lead / lag		26,513.00 kW/yr			1,666.67	20,000.00
All Other WTP Electric		13,669.00 kW/yr			833.33	10,000.00
Power Subtotal					**$2,500.00**	**$30,000.00**
New well pumps would be run within their efficiency curves. This should cost no more than current pump costs.						
Heating						
Fuel Oil		750.00 gal/yr	gal	gal	62.50	750.00
Consumable Subtotal					**$62.50**	**$750.00**
No change in heating cost for WTP anticipated. It is assumed sufficient power will be generated in impoundment to supply electric heater.						
Treatment Consumables (Chemical Addition)						
Calcium Hypochlorite						
Polymer						
					2,500.00	30,000.00
Consumable Subtotal					**$2,500.00**	**$30,000.00**
Based on FY20 budget. Freight included separately.						
Operator						
Lead Operator	4 hrs/day	20 hrs/wk	80 hours	27.00 hour	2,160.00	25,920.00
Backup Operator	4 hrs/day	20 hrs/wk	80 hours	13.50 hour	1,080.00	12,960.00
Operator Subtotal					**$3,240.00**	**$38,880.00**
Based on FY20 budget. Operation should take less effort with improved infiltration gallery (less clearing of screen/intake line)						
Compliance/Monitoring/Testing						

Estimated average annual cost for Community Public Water System with Surface Water Source						250.00	3,000.00
					Monitoring/Compliance/Testing Subtotal	**$250.00**	**$3,000.00**
Based on FY20 budget. No changes in routine compliance monitoring.							

MISC Costs							
Freight						625.00	7,500.00
Materials and Supplies						166.67	2,000.00
Travel and Per Diem						166.67	2,000.00
Vehicle Fuel						166.67	2,000.00
					MISC Subtotal	**$1,125.00**	**$13,500.00**
No additional road or pipeline maintenance costs assumed.							
					TOTAL ESTIMATED O&M ALTERNATIVE 4	**$9,615.00**	**$116,130.00**

2016 ANTHC ENERGY AUDIT

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Comprehensive Energy Audit
For

Angoon Water Treatment Plant

Prepared For
City of Angoon

August 9, 2016

Prepared By:

ANTHC-DEHE
4500 Diplomacy Dr.
Anchorage, AK 99508

Table of Contents

PREFACE

This energy audit was conducted using funds from the United States Department of Agriculture Rural Utilities Service as well as the State of Alaska Department of Environmental Conservation. Coordination with the State of Alaska Remote Maintenance Worker (RMW) Program and the associated RMW for each community has been undertaken to provide maximum accuracy in identifying audits and coordinating potential follow up retrofit activities.

The Rural Energy Initiative at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for The City of Angoon, Alaska. The author of this report is Kevin Ulrich, Energy Manager-in-Training (EMIT).

The purpose of this report is to provide a comprehensive document of the findings and analysis that resulted from an energy audit conducted in May of 2016 by the Rural Energy Initiative of ANTHC. This report analyzes historical energy use and identifies costs and savings of recommended energy conservation measures. Discussions of site-specific concerns, non-recommended measures, and an energy conservation action plan are also included in this report.

ACKNOWLEDGMENTS

The ANTHC Rural Energy Initiative gratefully acknowledges the assistance of Water Treatment Plant Operator Danny Frederickson, Water Treatment Plant Operator Paul Thomas, Mayor Albert Howard, and City Clerk Lawrence George.

1. EXECUTIVE SUMMARY

This report was prepared for the City of Angoon. The scope of the audit focused on the Angoon Water Treatment Plant and the associated water and wastewater systems. The scope of this report is a comprehensive energy study, which included an analysis of building shell, interior and exterior lighting systems, HVAC systems, and plug loads.

In the near future, a representative of ANTHC will be contacting the City of Angoon to follow up on the recommendations made in this report. Funding has been provided to ANTHC through a Rural Alaska Village Grant to provide the community with assistance in understanding the report and implementing the recommendations. ANTHC will work to complete the recommendations within the 2016 calendar year.

The total predicted energy cost for the Angoon Water Treatment Plant is $26,292. Electricity represents the largest portion with an annual cost of approximately $24,511. Fuel oil represents the remaining portion with an annual cost of approximately $1,781.

The Angoon Water Treatment Plant does not receive assistance from the Power Cost Equalization (PCE) program through the State of Alaska, according to the city office. The residents of the community receive assistance from the program but the Angoon Water Treatment Plant pays the full price for electricity. The cost of electricity with PCE is $0.22 per kWh and the cost of electricity without PCE is $0.61 per kWh. The Angoon Water Treatment Plant is eligible for the PCE program and participation in the program would reduce the estimated electricity cost by $15,671 annually. ANTHC will work with the community to extend their PCE program coverage to the Angoon Water Treatment Plant.

Table 1.1 lists the total usage of electricity and #1 heating oil before and after the proposed retrofits.

Table 1.1: Predicted Annual Fuel Usage for Each Fuel Type

Predicted Annual Fuel Use		
Fuel Use	**Existing Building**	**With Proposed Retrofits**
Electricity	40,182 kWh	28,025 kWh
#2 Oil	533 gallons	416 gallons

Benchmark figures facilitate comparing energy use between different buildings. The table below lists several benchmarks for the audited building. More details can be found in section 3.2.2.

Table 1.2: Building Benchmarks for the Angoon Water Treatment Plant

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	106.2	12.57	$13.25
With Proposed Retrofits	77.1	9.13	$9.32
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area. EUI/HDD: Energy Use Intensity per Heating Degree Day.			

ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.

Table 1.3 below summarizes the energy efficiency measures analyzed for the Angoon Water Treatment Plant. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return.

Table 1.3: Summarized Priority List of All Energy Recomendations for the Angoon Water Treatment Plant

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**[1]	**Simple Payback (Years)**[2]	**CO_2 Savings**
1	Lighting: Intake Gallery	Replace with direct-wire LED replacement bulbs.	$113	$50	26.54	0.4	314.9
2	Lighting: Process Room	Replace with direct-wire LED replacement bulbs.	$738	$800	10.67	1.1	1,786.7
3	Lighting: Office	Replace with direct-wire LED replacement bulbs.	$239	$320	8.63	1.3	574.3
4	Setback Thermostat: Water Treatment Plant and Office	Program the Toyo stove with an unoccupied setback to 50.0 deg F for the water treatment plant and office spaces.	$493	$1,000	6.69	2.0	3,261.1
5	Other Electrical: Lift Station Pump	Clean the pumps out of debris for more efficient operation and to keep the pumps from breaking.	$321 + $250 Maintenance Savings	$1,000	4.83	1.8	894.1
6	Other Electrical: Chlorine Room Electric Heater	Lower thermostat setting to 50 deg. F.	$125	$500	2.89	4.0	305.8
7	Lighting: Hallway	Replace with direct-wire LED replacement bulbs.	$55	$240	2.68	4.3	134.8
8	Other Electrical: Generator Room Electric Heater	Shut off electric heater and use only in extreme winter conditions.	$165	$1,000	1.91	6.1	402.8

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR[1]	Simple Payback (Years)[2]	CO_2 Savings
9	Other Electrical: Water Intake Pumps	Conduct a leak detection study, repair minor leaks in the distribution system, replace VFD controllers, lower the water usage to appropriate community levels, and install a cooling device inside the VFD electric panel at the intake gallery.	$5,478 + $500 Maintenance Savings	$40,000	1.76	6.7	15,267.3
10	Lighting: Chemical Room	Replace with direct-wire LED replacement bulbs.	$28	$240	1.33	8.7	66.5
11	Lighting: Generator Room	Replace with direct-wire LED replacement bulbs.	$15	$240	0.74	15.6	36.8
12	Lighting: Chlorine Room	Replace with direct-wire LED replacement bulbs.	$9	$160	0.66	17.6	21.8
13	Air Tightening	Add weatherization around door edges.	$23	$500	0.43	21.7	152.0
14	Exterior Door: Generator Room	Replace existing door with a new door that includes functioning doorknobs and latches.	$7	$1,064	0.15	162.2	43.4
	TOTAL, all measures		**$7,808 + $750 Maintenance Savings**	**$47,114**	**2.11**	**5.5**	**23,262.2**

Table Notes:

[1] Savings to Investment Ratio (SIR) is a life-cycle cost measure calculated by dividing the total savings over the life of a project (expressed in today's dollars) by its investment costs. The SIR is an indication of the profitability of a measure; the higher the SIR, the more profitable the project. An SIR greater than 1.0 indicates a cost-effective project (i.e. more savings than cost). Remember that this profitability is based on the position of that Energy Efficiency Measure (EEM) in the overall list and assumes that the measures above it are implemented first.

[2] Simple Payback (SP) is a measure of the length of time required for the savings from an EEM to payback the investment cost, not counting interest on the investment and any future changes in

energy prices. It is calculated by dividing the investment cost by the expected first-year savings of the EEM.

With all of these energy efficiency measures in place, the annual utility cost can be reduced by $7,808 per year, or 29.7% of the buildings' total energy costs. These measures are estimated to cost $47,114, for an overall simple payback period of 5.5 years.

Table 1.4 below is a breakdown of the annual energy cost across various energy end use types, such as Space Heating and Water Heating. The first row in the table shows the breakdown for the building as it is now. The second row shows the expected breakdown of energy cost for the building assuming all of the retrofits in this report are implemented. Finally, the last row shows the annual energy savings that will be achieved from the retrofits.

Table 1.4: Annual Energy Cost Estimate Broken Down by Usage Category

Annual Energy Cost Estimate					
Description	**Space Heating**	**Water Heating**	**Lighting**	**Other Electrical**	**Total Cost**
Existing Building	$1,781	$328	$2,196	$21,987	**$26,292**
With Proposed Retrofits	$1,388	$328	$895	$15,872	**$18,484**
Savings	$393	$0	$1,301	$6,114	**$7,808**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Angoon Water Treatment Plant. The scope of this project included evaluating building shell, lighting and other electrical systems, and HVAC equipment, motors and pumps. Measures were analyzed based on life-cycle-cost techniques, which include the initial cost of the equipment, life of the equipment, annual energy cost, annual maintenance cost, and a discount rate of 3.0%/year in excess of general inflation.

2.2 Audit Description

Preliminary audit information was gathered in preparation for the site survey. The site survey provides critical information in deciphering where energy is used and what opportunities exist within a building. The entire site was surveyed to inventory the following to gain an understanding of how each building operates:

- Building envelope (roof, windows, etc.)
- Heating, ventilation, and air conditioning equipment (HVAC)
- Lighting systems and controls
- Building-specific equipment
- Water consumption, treatment (optional) & disposal

The building site visit was performed to survey all major building components and systems. The site visit included detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs provided by the building manager were collected along with the system and components to determine a more accurate impact on energy consumption.

Details collected from the Angoon Water Treatment Plant enable a model of the building's energy usage to be developed, highlighting the building's total energy consumption, energy consumption by specific building component, and equivalent energy cost. The analysis involves distinguishing the different fuels used on site, and analyzing their consumption in different activity areas of the building.

The Angoon Water Treatment Plant is made up of the following activity areas:

1) Water Treatment Plant and Office: 1,243 square feet
2) New Expansion: 741 square feet

In addition, the methodology involves taking into account a wide range of factors specific to the building. These factors are used in the construction of the model of energy used. The factors include:

- Occupancy hours
- Local climate conditions
- Prices paid for energy

2.3. Method of Analysis

Data collected was processed using AkWarm© Energy Use Software to estimate energy savings for each of the proposed energy efficiency measures (EEMs). The recommendations focus on the building envelope; HVAC; lighting, plug load, and other electrical improvements; and motor and pump systems that will reduce annual energy consumption.

EEMs are evaluated based on building use and processes, local climate conditions, building construction type, function, operational schedule, existing conditions, and foreseen future plans. Energy savings are calculated based on industry standard methods and engineering estimations.

Our analysis provides a number of tools for assessing the cost effectiveness of various improvement options. These tools utilize **Life-Cycle Costing**, which is defined in this context as a method of cost analysis that estimates the total cost of a project over the period of time that includes both the construction cost and ongoing maintenance and operating costs.

Savings to Investment Ratio (SIR) = **Savings** divided by **Investment**

Savings includes the total discounted dollar savings considered over the life of the improvement. When these savings are added up, changes in future fuel prices as projected by the Department of Energy are included. Future savings are discounted to the present to account for the time-value of money (i.e. money's ability to earn interest over time). The **Investment** in the SIR calculation includes the labor and materials required to install the measure. An SIR value of at least 1.0 indicates that the project is cost-effective—total savings exceed the investment costs.

Simple payback is a cost analysis method whereby the investment cost of a project is divided by the first year's savings of the project to give the number of years required to recover the cost of the investment. This may be compared to the expected time before replacement of the system or component will be required. For example, if a boiler costs $12,000 and results in a savings of $1,000 in the first year, the payback time is 12 years. If the boiler has an expected life to replacement of 10 years, it would not be financially viable to make the investment since the payback period of 12 years is greater than the project life.

The Simple Payback calculation does not consider likely increases in future annual savings due to energy price increases. As an offsetting simplification, simple payback does not consider the need to earn interest on the investment (i.e. it does not consider the time-value of money). Because of these simplifications, the SIR figure is considered to be a better financial investment indicator than the Simple Payback measure.

Measures are implemented in order of cost-effectiveness. The program first calculates individual SIRs, and ranks all measures by SIR, higher SIRs at the top of the list. An individual measure must have an individual SIR>=1 to make the cut. Next the building is modified and re-simulated with the highest ranked measure included. Now all remaining measures are re-evaluated and ranked, and the next most cost-effective measure is implemented. AkWarm goes through this iterative process until all appropriate measures have been evaluated and installed.

It is important to note that the savings for each recommendation is calculated based on implementing the most cost effective measure first, and then cycling through the list to find the next most cost effective measure. Implementation of more than one EEM often affects the savings of other EEMs. The savings may in some cases be relatively higher if an individual EEM is implemented in lieu of multiple recommended EEMs. For example implementing a reduced operating schedule for inefficient lighting will result in relatively high savings. Implementing a reduced operating schedule for newly installed efficient lighting will result in lower relative savings, because the efficient lighting system uses less energy during each hour of operation. If multiple EEM's are recommended to be implemented, AkWarm calculates the combined savings appropriately.

Cost savings are calculated based on estimated initial costs for each measure. Installation costs include labor and equipment to estimate the full up-front investment required to implement a change. Costs are derived from Means Cost Data, industry publications, and local contractors and equipment suppliers.

2.4 Limitations of Study

All results are dependent on the quality of input data provided, and can only act as an approximation. In some instances, several methods may achieve the identified savings. This report is not intended as a final design document. The design professional or other persons following the recommendations shall accept responsibility and liability for the results.

3. Angoon Water Treatment Plant

3.1. Building Description

The 1,984 square foot Angoon Water Treatment Plant was constructed in 1976, with a normal occupancy of one person for approximately 3-4 hours per day. An expansion was added to the water treatment plant in 2011 to include additional space for chemical storage and processes.

The Angoon Water Treatment Plant serves as the central facility for the water intake, treatment, and distribution processes. The plant has four large sand filters that process the water that is fed from the Auk'tah Lake. Raw water is pumped from the lake by two 10 HP VFD smart pumps and injected with polymer and chlorine before going through the filters and getting transported to the 500,000 gallon water storage tank. Auk'tah Lake is approximately 750 ft. from the water treatment plant. After the water has been given enough contact time with the chemicals, it is gravity-fed down the four-mile long road to the main part of town. A water tower present in the main part of town with a booster pump to help supply water to the upper townsite.

Figure 3.1: 500,000 gallon water storage tank in Angoon

There are two lift stations in town that are used to collect sewage and pump it away from town to the ocean away from shore. One lift station is in the downtown region on Aanya Street and has two 5HP pumps that consume 3,156 kWh annually. These pumps will occasionally get clogged with trash and other foreign objects that will impede the operations of the lift station. Proper maintenance and cleaning are necessary to maintain the station. A second lift station is located near the store in the northwest section of town and is completely inoperable. A project to replace this lift station is currently in development and this will increase the energy usage of the wastewater treatment processes.

Figure 3.2: Downtown lift station on Aanya Street

Figure 3.3: Kootznahoo lift station. This lift station is not in operation. Pictured is operator Danny Frederickson

There are two old water towers that are used for water storage for the upper regions of town. A boost pump is used to fill the tall standpipe for the upper townsite from the main distribution. Water is then gravity-fed from the water towers to the residents. The other metal tank is specifically for the school. A third tank made entirely of wood is present but it has not been in use for many years.

Figure 3.4 (left): Water tower for the school in Angoon.

Figure 3.5 (above): Water towers for the upper region of town in Angoon

Description of Building Shell

The walls are built with single stud standard lumber construction with 2 x 6 framing and approximately 5.5 inches of R-21 batt insulation. The average wall height is approximately 15 ft. high with the north and south walls averaging around 12 ft. tall and the east and west walls peaking at approximately 15 ft. high.

The building has a cathedral ceiling with standard 2 x 6 framing and 16-inch spacing. The roof has approximately 5.5 inches of R-21 batt insulation and there is approximately 2,030 square feet of roof space.

The building foundation is on grade with a concrete slab directly on top of the ground with no gravel pad or insulation necessary. There is approximately 1,984 square feet of floor space in the building.

The office has two double-pane windows that are approximately 69.75” x 38.5” each. The chemical room has two double-pane windows that are approximately 38” x 34.75” each. The hallway by the process room has one double-pane window that is approximately 46.5” x 34.5”.

There are five entrances in the building. The main entrance has two double-doors that are weatherized and insulated. The chemical room has one metal door that has had foam insulation installed around the edges, effectively rendering the door non-useable. The hallway by the process room has a single metal door. The chlorine room has a single metal door with a quarter-lite window. The generator room has a metal door with no doorknob or locking mechanism present, presenting a large hole in the door and allowing the door to swing open freely.

Figure 3.6: Generator Room door with no doorknob.

Figure 3.7: Chemical Room door with foam insulation sealing the spaces around the door frame.

Description of Heating Plants

The heating plants used in the building are:

Toyo Laser 56

Fuel Type:	#2 Oil
Input Rating:	22,000 BTU/hr
Steady State Efficiency:	95 %
Idle Loss:	0.5 %
Heat Distribution Type:	Air

There are two Toyotomi stoves that are used to provide space heat to the building. One is a Toyotomi Laser 56 located in the chemical room. This heater was set at 49 deg. F during the site visit with an actual room temperature of 52 deg. F. The heater is set for 50-60 deg. F during the winter months. There is a Toyotomi Laser 73 stove in the process room that is not used because of a fuel leak.

Figure 3.8: Toyotomi Laser 56 in the chemical room of the water treatment plant.

Figure 3.9: Toyotomi Laser 73 in the process room of the water treatment plant. This unit is not used.

Hot Water Heater

Nameplate Information: Promax EJCS 20 200
Fuel Type: Electricity
Input Rating: 0 BTU/hr
Steady State Efficiency: 100 %
Idle Loss: 0.5 %
Heat Distribution Type: Water

Boiler Operation: All Year
Notes: Used for hot water purposes

There is an electric hot water heater that is used to provide hot water for the sinks in the building. The heater is rated for 2500 Watts and is constantly heated to 120 deg. F.

Figure 3.10: Electric hot water heater in the water treatment plant.

Lighting

The building lighting is comprised entirely of T8 and T12 4-ft. fluorescent light bulbs on the interior of the building. There is no exterior lighting present at the facility. The water treatment plant has a total of 28 T8 light bulbs and 52 T12 light bulbs. All T12 light bulbs are super-saver 34 Watt models rather than the standard 40 Watt version.

There is a 60 Watt incandescent light bulb at the water intake site.
There is a high pressure sodium light bulb at the water intake site.

Plug Loads

The water treatment plant has a variety of power tools, a telephone, and some other miscellaneous loads that require a plug into an electrical outlet. The use of these items is infrequent and consumes a small portion of the total energy demand of the building.

Major Equipment

There are two water intake pumps that are used to pump water from the Auk'tah Lake into the facility for water treatment. Each pump is a 10 HP variable frequency drive (VFD) smart pump. During the site visit, both pumps were running together, though one pump was not operating in good condition. In a later trip, this pump was not in operation. This was due to the VFD controller not functioning, causing the pump to stop running. Additionally, the panel with the controls was unusually warm, possibly causing errors with the controller operation. These pumps combine to consume approximately 26,513 kWh annually.

Figure 3.11: Water intake gallery near the Auk'tah Lake.

Figure 3.12: Water intake pumps in the gallery near Auk'tah Lake.

There are electric heaters in the chlorine room and the generator room. The chlorine room has a Trane electric heater rated for 3.3 kW. The unit also has a 1/20 HP motor attached. The space had a set point of 70 deg. F during the site visit. This heater consumes approximately 669 kWh annually. The generator room has a small electric heater that keeps the space warm. This is used more than necessary because of the air leakage through the generator door. The heater is estimated to consume approximately 320 kWh annually.

Figure 3.13: Electric heater in the chlorine room.

Figure 3.14: Electric heater in the generator room.

There is an air scour that is used to aerate the filters during the backwash process. The backwash occurs once per week for approximately 20 minutes. The air scour is rated for 10 HP and consumes approximately 391 kWh annually.

There are three pumps and a mixer used in the chemical processing of the plant. Two pumps and a mixer are used for polymer and one pump is used for chlorine. The pumps details are shown in Table 3.1.

Table 3.1: Chemical Pump Information

Pump	Rating (Watts)	Annual Consumption (kWh)
Dilute Polymer er	185	34
Dilute Polymer Injection Pump	375	3,287
Neat Polymer Injection Pump	23	202
Chlorine Pump	168	1,473

The chlorine pump had major operational problems during the site visit where the pump could not overcome air pressure in the line to inject chlorine into the water. This was repaired temporarily onsite, but this pump needs replacement as well as additional spare parts for sanitation purposes.

3.2 Predicted Energy Use

3.2.1 Energy Usage / Tariffs

The electric usage profile charts (below) represents the predicted electrical usage for the building. If actual electricity usage records were available, the model used to predict usage was calibrated to approximately match actual usage. The electric utility measures consumption in kilowatt-hours (kWh) and maximum demand in kilowatts (kW). One kWh usage is equivalent to 1,000 watts running for one hour. One KW of electric demand is equivalent to 1,000 watts running at a particular moment. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges.

The fuel oil usage profile shows the fuel oil usage for the building. Fuel oil consumption is measured in gallons. One gallon of #1 Fuel Oil provides approximately 132,000 BTUs of energy.

The Inside Passage Electric Cooperative (IPEC) provides electricity to the residents of Angoon as well as all commercial and public facilities.

The average cost for each type of fuel used in this building is shown below in Table 3.1. This figure includes all surcharges, subsidies, and utility customer charges:

Table 3.1: Energy Rates for Each Fuel Source in Angoon

Average Energy Cost	
Description	**Average Energy Cost**
Electricity	$ 0.61/kWh
#2 Oil	$ 3.34/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, City of Angoon pays approximately $26,292 annually for electricity and other fuel costs for the Angoon Water Treatment Plant.

Figure 3.15 below reflects the estimated distribution of costs across the primary end uses of energy based on the AkWarm© computer simulation. Comparing the “Retrofit” bar in the figure to the “Existing” bar shows the potential savings from implementing all of the energy efficiency measures shown in this report.

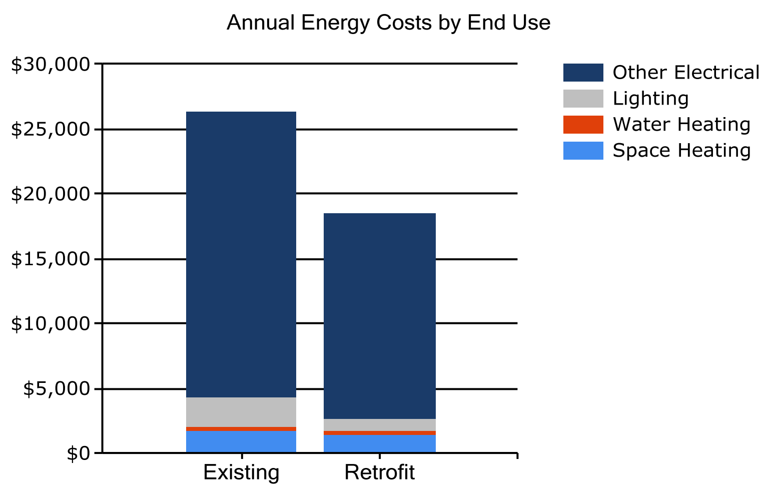


Figure 3.15: Annual Energy Costs by End Use

Figure 3.16 below shows how the annual energy cost of the building splits between the different fuels used by the building. The “Existing” bar shows the breakdown for the building as it is now; the “Retrofit” bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

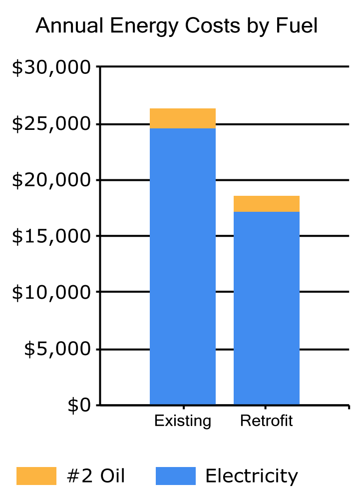


Figure 3.16: Annual Energy Costs by Fuel Type

Figure 3.17 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing building is shown (blue bar) and the space heating cost assuming all retrofits are implemented (yellow bar) are shown.

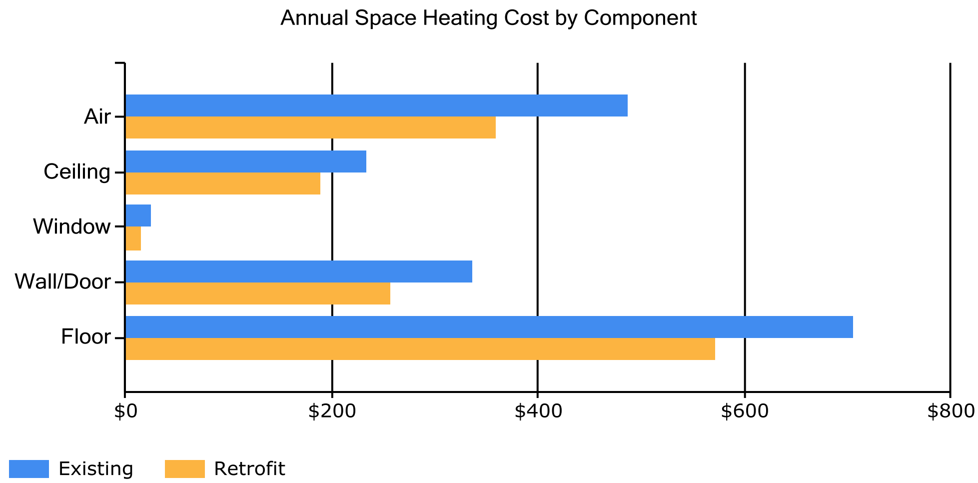


Figure 3.17: Annual Space Heating Cost by Component

The tables below show AkWarm's estimate of the monthly fuel use for each of the fuels used in the building. For each fuel, the fuel use is broken down across the energy end uses. Note, in the tables below "DHW" refers to Domestic Hot Water heating.

Table 3.2: Electrical Concumption by Category

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Domestic Hot Water	46	42	46	44	46	44	46	46	44	46	44	46
Lighting	306	278	306	296	306	296	306	306	296	306	296	306
Other Electrical	3059	2788	3059	2960	3059	2960	3059	3059	2960	3059	2960	3059

Table 3.3: Fuel Oil Consumption by Category

Fuel Oil #2 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	122	84	74	36	9	1	1	1	5	32	69	101

3.2.2 Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's annual energy utilization per square foot of building. This calculation is completed by converting all utility usage consumed by a building for one year, to British Thermal Units (Btu) or kBtu, and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance for similar building types. The Oak Ridge National Laboratory (ORNL) Buildings Technology Center under a contract with the U.S. Department of Energy maintains a Benchmarking Building Energy Performance Program. The ORNL website determines how a building's energy use compares with similar facilities throughout the U.S. and in a specific region or state.

Source use differs from site usage when comparing a building's energy consumption with the national average. Site energy use is the energy consumed by the building at the building site only. Source energy use includes the site energy use as well as all of the losses to create and distribute the energy to the building. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, which allows for a complete assessment of energy efficiency in a building. The type of utility purchased has a substantial impact on the source energy use of a building. The EPA has determined that source energy is the most comparable unit for evaluation purposes and overall global impact. Both the site and source EUI ratings for the building are provided to understand and compare the differences in energy use.
The site and source EUIs for this building are calculated as follows. (See Table 3.4 for details):

Building Site EUI = <u>*(Electric Usage in kBtu + Fuel Oil Usage in kBtu)*</u>
Building Square Footage

Building Source EUI = <u>*(Electric Usage in kBtu X SS Ratio + Fuel Oil Usage in kBtu)*</u>
Building Square Footage
where "SS Ratio" is the Source Energy to Site Energy ratio for the particular fuel.

Table 3.4: Angoon Water Treatment Plant EUI Calculations

Energy Type	Building Fuel Use per Year	Site Energy Use per Year, kBTU	Source/Site Ratio	Source Energy Use per Year, kBTU
Electricity	40,182 kWh	137,141	3.340	458,050
#2 Oil	533 gallons	73,582	1.010	74,318
Total		**210,723**		**532,368**
BUILDING AREA		1,984	Square Feet	
BUILDING SITE EUI		106	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		268	**kBTU/Ft²/Yr**	
* Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued March 2011.				

Table 3.5: Angoon Water Treatment Plant Building Benchmarks

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	**106.2**	**12.57**	**$13.25**
With Proposed Retrofits	**77.1**	**9.13**	**$9.32**
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area. **EUI/HDD: Energy Use Intensity per Heating Degree Day.** **ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.**			

3.3 AkWarm© Building Simulation

An accurate model of the building performance can be created by simulating the thermal performance of the walls, roof, windows and floors of the building. The HVAC systems and central plant are modeled as well, accounting for the outside air ventilation required by the building and the heat recovery equipment in place.

The model uses local weather data and is trued up to historical energy use to ensure its accuracy. The model can be used now and in the future to measure the utility bill impact of all types of energy projects, including improving building insulation, modifying glazing, changing air handler schedules, increasing heat recovery, installing high efficiency boilers, using variable air volume air handlers, adjusting outside air ventilation and adding cogeneration systems.

For the purposes of this study, the Angoon Water Treatment Plant was modeled using AkWarm© energy use software to establish a baseline space heating energy usage. Climate data from Angoon was used for analysis. From this, the model was be calibrated to predict the impact of theoretical energy savings measures. Once annual energy savings from a particular measure were predicted and the initial capital cost was estimated, payback scenarios were approximated.

Limitations of AkWarm© Models

• The model is based on typical mean year weather data for Angoon. This data represents the average ambient weather profile as observed over approximately 30 years. As such, the gas and electric profiles generated will not likely compare perfectly with actual energy billing information from any single year. This is especially true for years with extreme warm or cold periods, or even years with unexpectedly moderate weather.
• The heating load model is a simple two-zone model consisting of the building's core interior spaces and the building's perimeter spaces. This simplified approach loses accuracy for buildings that have large variations in heating loads across different parts of the building.

The energy balances shown in Section 3.1 were derived from the output generated by the AkWarm© simulations.

4. ENERGY COST SAVING MEASURES

4.1 Summary of Results

The energy saving measures are summarized in Table 4.1. Please refer to the individual measure descriptions later in this report for more detail.

Table 4.1: List of Energy Efficiency Recommendations by Economic Priority

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**	**CO_2 Savings**
1	Lighting: Intake Gallery	Replace with direct-wire LED replacement bulbs.	$113	$50	26.54	0.4	314.9
2	Lighting: Process Room	Replace with direct-wire LED replacement bulbs.	$738	$800	10.67	1.1	1,786.7

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**	**CO_2 Savings**
3	Lighting: Office	Replace with direct-wire LED replacement bulbs.	$239	$320	8.63	1.3	574.3
4	Setback Thermostat: Water Treatment Plant and Office	Program the Toyo stove with an unoccupied setback to 50.0 deg. F for the water treatment plant and office spaces.	$493	$1,000	6.69	2.0	3,261.1
5	Other Electrical: Lift Station Pump	Clean the pumps out of debris for more efficient operation and to keep the pumps from breaking.	$321 + $250 Maintenance Savings	$1,000	4.83	1.8	894.1
6	Other Electrical: Chlorine Room Electric Heater	Lower thermostat setting to 50 deg. F.	$125	$500	2.89	4.0	305.8
7	Lighting: Hallway	Replace with direct-wire LED replacement bulbs.	$55	$240	2.68	4.3	134.8
8	Other Electrical: Generator Room Electric Heater	Shut off electric heater and use only in extreme winter conditions.	$165	$1,000	1.91	6.1	402.8
9	Other Electrical: Water Intake Pumps	Conduct a leak detection study, repair minor leaks in the distribution system, replace VFD controllers, lower the water usage to appropriate community levels, and install a cooling device inside the VFD electric panel at the intake gallery.	$5,478 + $500 Maintenance Savings	$40,000	1.76	6.7	15,267.3
10	Lighting: Chemical Room	Replace with direct-wire LED replacement bulbs.	$28	$240	1.33	8.7	66.5
11	Lighting: Generator Room	Replace with direct-wire LED replacement bulbs.	$15	$240	0.74	15.6	36.8

PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)	CO_2 Savings
12	Lighting: Chlorine Room	Replace with direct-wire LED replacement bulbs.	$9	$160	0.66	17.6	21.8
13	Air Tightening	Add weatherization around door edges.	$23	$500	0.43	21.7	152.0
14	Exterior Door: Generator Room	Replace existing door with a new door that includes functioning doorknobs and latches.	$7	$1,064	0.15	162.2	43.4
	TOTAL, all measures		**$7,808 + $750 Maintenance Savings**	**$47,114**	**2.11**	**5.5**	**23,262.2**

4.2 Interactive Effects of Projects

The savings for a particular measure are calculated assuming all recommended EEMs coming before that measure in the list are implemented. If some EEMs are not implemented, savings for the remaining EEMs will be affected. For example, if ceiling insulation is not added, then savings from a project to replace the heating system will be increased, because the heating system for the building supplies a larger load.

In general, all projects are evaluated sequentially so energy savings associated with one EEM would not also be attributed to another EEM. By modeling the recommended project sequentially, the analysis accounts for interactive affects among the EEMs and does not "double count" savings.

Interior lighting, plug loads, facility equipment, and occupants generate heat within the building. Lighting-efficiency improvements are anticipated to slightly increase heating requirements. Heating penalties were included in the lighting project analysis.

4.3 Building Shell Measures

4.3.1 Door Measures

Rank	Location	Size/Type, Condition	Recommendation
14	Exterior Door: Generator Room	Door Type: Entrance, Metal, EPS core, metal edge, no glass Modeled R-Value: 2.7	Replace existing door with a new door that includes functioning doorknobs and latches..

Installation Cost	$1,064	**Estimated Life of Measure (yrs)**	30	**Energy Savings (/yr)**	$7
Breakeven Cost	$156	**Savings-to-Investment Ratio**	0.1	**Simple Payback yrs**	162

Auditors Notes: The existing door is missing a doorknob and locking mechanism, causing the door to have holes in it and allowing air to penetrate into the room. Replace with a functioning door to allow the space to close.

4.3.2 Air Sealing Measures

Rank	Location		Existing Air Leakage Level (cfm@50/75 Pa)		Recommended Air Leakage Reduction (cfm@50/75 Pa)	
13			Air Tightness estimated as: 3000 cfm at 50 Pascals		Add weatherization around door edges.	
Installation Cost	$500	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$23	
Breakeven Cost	$214	**Savings-to-Investment Ratio**	0.4	**Simple Payback yrs**	22	
Auditors Notes: Add weather stripping around door edges. This also includes the reduction in air leakage from the generator room door replacement.						

4.4 Mechanical Equipment Measures

4.4.1 Night Setback Thermostat Measures

Rank	Building Space			Recommendation	
4	Water Treatment Plant and Office			Program the Toyo stove with an unoccupied setback to 50.0 deg F for the water treatment plant and office spaces.	
Installation Cost	$1,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$493
Breakeven Cost	$6,693	**Savings-to-Investment Ratio**	6.7	**Simple Payback yrs**	2
Auditors Notes: The Toyotomi Laser 56 was set at 49 deg. F during the site visit. The operator stated that the set point is around 50-60 deg. F in the winter. Program the stove to allow the space to be heated to 50 degrees all year since the plant is only occupied three hours per day.					

4.5 Electrical & Appliance Measures

4.5.1 Lighting Measures

The goal of this section is to present any lighting energy conservation measures that may also be cost beneficial. It should be noted that replacing current bulbs with more energy-efficient equivalents will have a small effect on the building heating and cooling loads. The building cooling load will see a small decrease from an upgrade to more efficient bulbs and the heating load will see a small increase, as the more energy efficient bulbs give off less heat.

4.5.1a Lighting Measures – Replace Existing Fixtures/Bulbs

Rank	Location		Existing Condition		Recommendation
1	Intake Gallery		Incandescent 60 Watt StdElectronic		Replace with direct-wire LED replacement bulbs.
Installation Cost	$50	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$113
Breakeven Cost	$1,327	**Savings-to-Investment Ratio**	26.5	**Simple Payback yrs**	0
Auditors Notes: There is a single fixture with one light bulb to be replaced.					

Rank	Location		Existing Condition		Recommendation
2	Process Room		10 FLUOR (4) T12 4' F40T12 34W Energy-Saver StdElectronic		Replace with direct-wire LED replacement bulbs.
Installation Cost	$800	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$738
Breakeven Cost	$8,536	**Savings-to-Investment Ratio**	10.7	**Simple Payback yrs**	1
Auditors Notes: There are ten fixtures with four light bulbs in each fixture to be replaced with two new LED light bulbs for a total of 20 lights to be replaced by LED equivalent lighting.					

Rank	Location	Existing Condition	Recommendation
3	Office	4 FLUOR (4) T8 4' F32T8 30W Energy-Saver Instant StdElectronic	Replace with direct-wire LED replacement bulbs.

Installation Cost	$320	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$239
Breakeven Cost	$2,760	**Savings-to-Investment Ratio**	8.6	**Simple Payback yrs**	1

Auditors Notes: There are four fixtures with four light bulbs in each fixture to be replaced with two new LED light bulbs for a total of eight lights to be replaced by LED equivalent lighting.

Rank	Location	Existing Condition	Recommendation
7	Hallway	3 FLUOR (2) T12 4' F40T12 34W Energy-Saver StdElectronic	Replace with direct-wire LED replacement bulbs.

Installation Cost	$240	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$55
Breakeven Cost	$642	**Savings-to-Investment Ratio**	2.7	**Simple Payback yrs**	4

Auditors Notes: There are three fixtures with two light bulbs in each fixture for a total of six lights to be replaced by LED equivalent lighting.

Rank	Location	Existing Condition	Recommendation
10	Chemical Room	3 FLUOR (2) T8 4' F32T8 30W Energy-Saver Instant StdElectronic	Replace with direct-wire LED replacement bulbs.

Installation Cost	$240	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$28
Breakeven Cost	$319	**Savings-to-Investment Ratio**	1.3	**Simple Payback yrs**	9

Auditors Notes: There are three fixtures with two light bulbs in each fixture for a total of six lights to be replaced by LED equivalent lighting

Rank	Location	Existing Condition	Recommendation
11	Generator Room	3 FLUOR (2) T12 4' F40T12 34W Energy-Saver StdElectronic	Replace with direct-wire LED replacement bulbs.

Installation Cost	$240	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$15
Breakeven Cost	$178	**Savings-to-Investment Ratio**	0.7	**Simple Payback yrs**	16

Auditors Notes: There are three fixtures with two light bulbs in each fixture for a total of six lights to be replaced by LED equivalent lighting.

Rank	Location	Existing Condition	Recommendation
12	Chlorine Room	2 FLUOR (2) T8 4' F32T8 30W Energy-Saver Instant StdElectronic	Replace with direct-wire LED replacement bulbs.

Installation Cost	$160	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$9
Breakeven Cost	$105	**Savings-to-Investment Ratio**	0.7	**Simple Payback yrs**	18

Auditors Notes: There are two fixtures with two light bulbs in each fixture for a total of four lights to be replaced by LED equivalent lighting.

4.5.2 Other Electrical Measures

Rank	Location		Description of Existing		Efficiency Recommendation	
5	Lift Station Pump		Lift Station Pump		Clean the pumps out of debris for more efficient operation and to keep the pumps from breaking	
Installation Cost		$1,000	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$321
					Maintenance Savings (/yr)	$250
Breakeven Cost		$4,834	**Savings-to-Investment Ratio**	4.8	**Simple Payback yrs**	2
Auditors Notes: The pumps were clogged with garbage and foreign objects that damage the motor and make the lift station operations less efficient. Regular cleaning will reduce maintenance costs and preserve the life of the pumps.						

Rank	Location		Description of Existing		Efficiency Recommendation	
6	Chlorine Room Electric Heater		Electric Heater		Lower thermostat settings to 50 deg. F.	
Installation Cost		$500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$125
Breakeven Cost		$1,447	**Savings-to-Investment Ratio**	2.9	**Simple Payback yrs**	4
Auditors Notes: The heater was set to 70 deg. F and would have to turn on when the operator occupied the space because the door would be open. This only needs to be set to 50 deg. F for freeze protection purposes.						

Rank	Location		Description of Existing		Efficiency Recommendation	
8	Generator Room Electric Heater		Electric Heater		Shut off electric heater and use only in extreme winter conditions.	
Installation Cost		$1,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$165
Breakeven Cost		$1,908	**Savings-to-Investment Ratio**	1.9	**Simple Payback yrs**	6
Auditors Notes: This heater runs more than necessary in part because of the extra air penetration through the holes in the door. The door replacement as well as better controls of the heater will reduce excess energy use in this room.						

Rank	Location		Description of Existing		Efficiency Recommendation	
9	Water Intake Pumps		2 Water Intake Pumps		Conduct a leak detection study, repair minor leaks in the distribution system, replace VFD controllers, lower the water usage to appropriate community levels, and install a cooling device inside the VFD electric panel at the intake gallery	
Installation Cost		$40,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$5,478
					Maintenance Savings (/yr)	$500
Breakeven Cost		$70,319	**Savings-to-Investment Ratio**	1.8	**Simple Payback yrs**	7
Auditors Notes: The community uses approximately 244 gallons/person/day with an average intake of 80 gpm. This is partly because the pumps are controlled improperly and partly because of leaks and excess usage by the community. Conduct a leak detection study and repair leaks where found. This assumes approximately 10% of the leaks will be repaired. At the time of the site visit, both pumps were in operation together with pump 1 operating inefficiently because of motor problems within the pump and problems with the VFD controller. This operation is reflected in the electricity usage values. Since the site visit, the VFD controller for pump 1 is not functioning and the pump is inoperable. Replace the VFD controller so that the pumps can be operated with better controls and not in constant operation. This assumes a reduction of 33% of electricity usage due to the VFD controls. Also, the panel by the intake gallery has been over heating and a radiant cooling device can be installed to prevent overheating. $30,000 for the leak detection and repair, $8000 for the VFD controllers, and $2000 for the cooling device.						

5. ENERGY EFFICIENCY ACTION PLAN

Through inspection of the energy-using equipment on-site and discussions with site facilities personnel, this energy audit has identified several energy-saving measures. The measures will reduce the amount of fuel burned and electricity used at the site. The projects will not degrade the performance of the building and, in some cases, will improve it.

Several types of EEMs can be implemented immediately by building staff, and others will require various amounts of lead time for engineering and equipment acquisition. In some cases, there are logical advantages to implementing EEMs concurrently. For example, if the same electrical contractor is used to install both lighting equipment and motors, implementation of these measures should be scheduled to occur simultaneously.

In the near future, a representative of ANTHC will be contacting the City of Angoon to follow up on the recommendations made in this report. Funding has been provided to ANTHC through a Rural Alaska Village Grant to provide the community with assistance in understanding the report and implementing the recommendations. ANTHC will work to complete the recommendations within the 2016 calendar year.

APPENDICES

Appendix A – Energy Audit Report – Project Summary

ENERGY AUDIT REPORT – PROJECT SUMMARY	
General Project Information	
PROJECT INFORMATION	**AUDITOR INFORMATION**
Building: Angoon Water Treatment Plant	**Auditor Company:** ANTHC-DEHE
Address: Water Treatment Plant	**Auditor Name:** Kevin Ulrich
City: Angoon	**Auditor Address:** 4500 Diplomacy Dr. Anchorage, AK 99508
Client Name: Danny Frederickson and Paul Thomas	
Client Address: PO Box 189 Angoon, AK 99820	**Auditor Phone:** (907) 729-3237 **Auditor FAX:**
Client Phone: (907) 788-3653	**Auditor Comment:**
Client FAX:	
Design Data	
Building Area: 1,984 square feet	**Design Space Heating Load:** Design Loss at Space: 36,869 Btu/hour with Distribution Losses: 36,869 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 56,203 Btu/hour Note: Additional Capacity should be added for DHW and other plant loads, if served.
Typical Occupancy: 0 people	**Design Indoor Temperature:** 55.9 deg F (building average)
Actual City: Angoon	**Design Outdoor Temperature:** 1 deg F
Weather/Fuel City: Angoon	**Heating Degree Days:** 8,450 deg F-days
Utility Information	
Electric Utility: Inside Passage Electric Cooperative	**Average Annual Cost/kWh:** $0.61/kWh

Annual Energy Cost Estimate					
Description	**Space Heating**	**Water Heating**	**Lighting**	**Other Electrical**	**Total Cost**
Existing Building	$1,781	$328	$2,196	$21,987	**$26,292**
With Proposed Retrofits	$1,388	$328	$895	$15,872	**$18,484**
Savings	$393	$0	$1,301	$6,114	**$7,808**

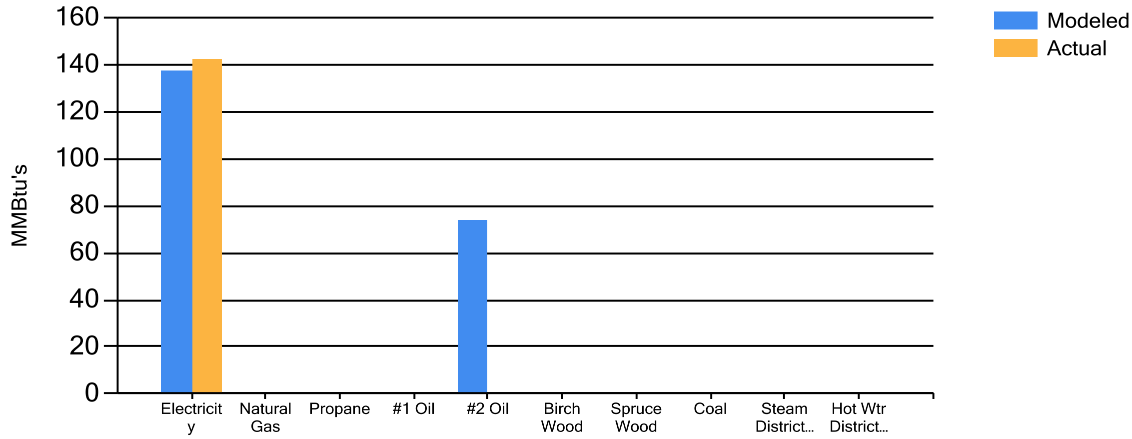
Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	106.2	12.57	$13.25
With Proposed Retrofits	77.1	9.13	$9.32

EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area.
EUI/HDD: Energy Use Intensity per Heating Degree Day.
ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.

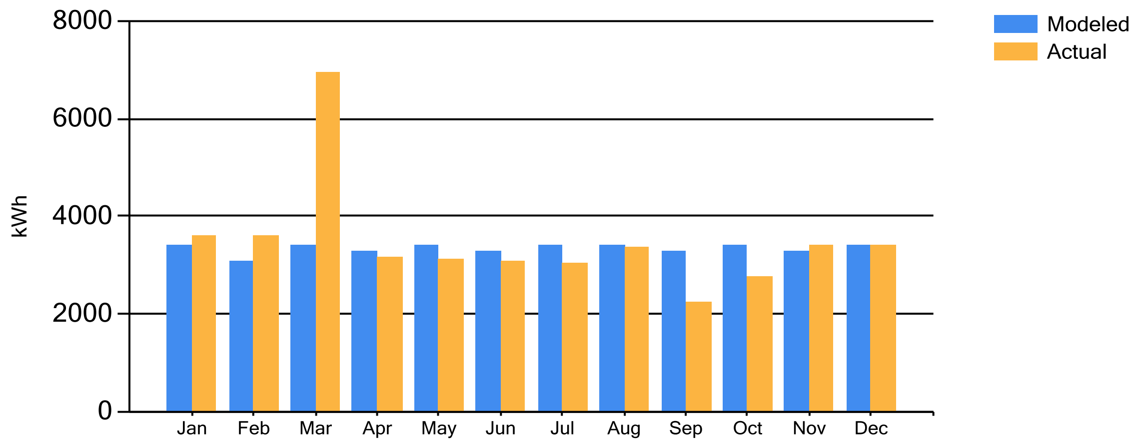
Appendix B – Actual Fuel Use versus Modeled Fuel Use

The graphs below show the modeled energy usage results of the energy audit process compared to the actual energy usage report data. The model was completed using AkWarm modeling software. The orange bars show actual fuel use, and the blue bars are AkWarm's prediction of fuel use.

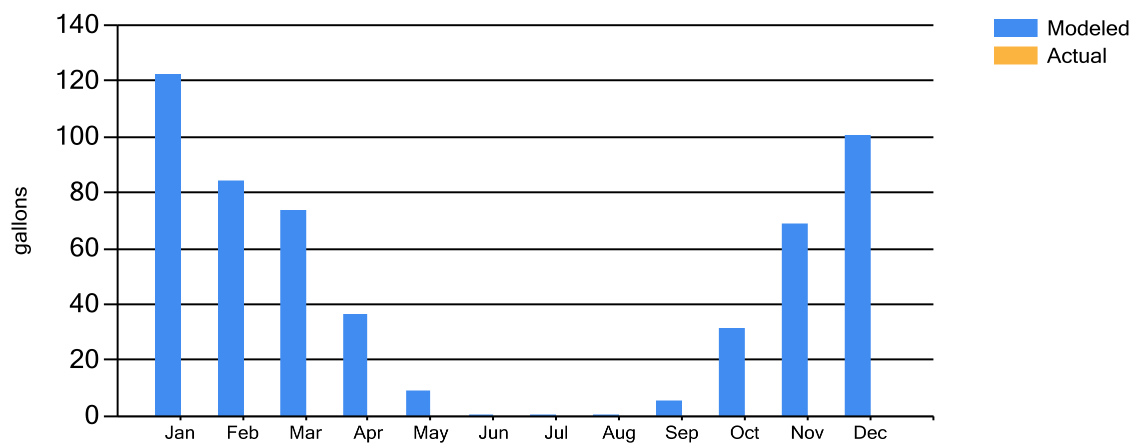
Annual Fuel Use



Electricity Fuel Use



#2 Fuel Oil Fuel Use



Appendix C - Electrical Demands

Estimated Peak Electrical Demand (kW)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Current	8.8	8.7	8.7	8.6	8.5	8.4	8.3	8.3	8.2	8.1	8.0	7.9
As Proposed	7.7	7.6	7.5	7.4	7.3	7.2	7.2	7.1	7.0	6.9	6.8	6.8

AkWarmCalc Ver 2.5.3.0, Energy Lib 3/7/2016

FLOW RATE STUDIES

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Water Utility Rate Study
City of Angoon Water Utility
February, 2013

I want to start by thanking Jeremy Martin, Minnie Merculief, and Roseanna Williams for helping me to collect the information vital to this study. I know you are all very busy, and I appreciate your time and attention to so many details. Thank you all!!

These are preliminary figures. We need more work to get at final numbers, some of which may be higher than these. However, I think the numbers below can help in figuring out the cost of the water utility, and the impact customers choosing not to pay.

Important Points (All figures are MONTHLY)

You are currently charging <u>$32/month residential</u>; <u>$80/month commercial</u>.

The total cost of water per customer per month is actually **<u>$57.81</u>**
(This is very low compared with most other communities.)

However, because only **<u>26%</u>** of your customers are paying their water bills, those customers who pay would have to pay **<u>$221.63</u>**/month in order to cover all water costs.

Total cost of water per month: **<u>$10,638.00</u>**
If everyone in your community was paying, you would be receiving: **<u>$6,864.67</u>**
This creates a monthly shortfall of: **<u>$3,773</u>**

However, only **<u>26%</u>** of your customers are actually paying their bills.
At this rate, you would bring in: **<u>$1,784.81</u>**
This rate creates a shortfall of: **<u>$8,853.19 per month! ($106,238.28 per year!)</u>**

- How are you currently paying for that shortfall? CRS? PILT? SFBT?...
- What else could you spend that money on? Programs for youth? City employees? Road maintenance? Housing development?...
- How long are you guaranteed to be receiving that money?

The key points here are two-fold:
- ✓ **The water utility is not currently charging customers enough to survive.**
- ✓ **The water utility is not collecting enough of what they are charging to survive.**

I hope on my next visit to discuss some of the things that can be done to increase your collection rate, and to explore the possibility of increasing your utility rates, if you choose to.

Water Utility Statistics for the City of Angoon Water Utility
February, 2013

Gallons per Minute: **80.386479** (525,949 Minutes Per year)
Gallons per Day: 117,442
Gallons per Month: 3,523,266
Gallons per Year: 42,279,188
Cost of sanitation services per year: $127,656.05/year
Amount of water produced per year: 42,279,188 gallons
Cost of Water per gallon: $.00301936 /gallon
Cost of Water per 1,000 gallons: $3.019359 /1,000 gallons
Total number of customers: 184 customers
Total cost per year per customer: $693.78 /customer/year (100% collection)
Total cost per month per customer: $57.81 /customer/month (100% collection)
Percentage of water customers paying their water bill: 26% customers paying
Number of customers paying their water bill: 48 customers paying
Number of customers not paying their water bill: 136 customers not paying
Total cost per month per paying customer: $221.63 per paying customer

Current charges (water and wastewater):
Residential: $32
Commercial: $80
Seniors: $16
Churches: $42
Schools (winter): $320
Customers on water only: $20
Customers have septic tanks pumped approximately yearly: $150/load
Schools (summer): $160
School Gyms: 160
Angoon Trading Post: $75
IPEC (water only): $50
THRHA: $???

Customers in each Customer Class:
Residential: 153
Commercial: 10
Seniors:
Churches: 2
Schools: 2
School Gym: 2
Angoon Trading Post: 1
IPEC (water only): 1
THRHA: 4

Customers on water only: 9
Customers have septic tanks pumped approximately yearly: 9

At current water rates, if 100% of customers were paying, you would be bringing in: __ _$82,376____ per year.
This means you would be subsidizing your utility at a rate of:_35%__or___$45,280____
Annual collections with your current collection rate of 26%: $21,417.76

Angoon Utility Rate Study, 2013

Annual Expense Worksheets

Below is a worksheet for adding up the **annual** costs of sanitation services. Enter the annual totals for the utilities' expenses in the spaces provided. There are blank spaces at the bottom for categories not listed in this worksheet.

Tips to remember:

- Expenses must be for an entire fiscal year.
- Only include expenses for the utilities.
- Do not mix in totals from other departments.

Operations and Maintenance (O&M) Costs July 1 – Feb 1, 2013 (7/12 of the year)	
Chemicals & Testing	$13,584.45
Contractual Labor	$1,065.76
Dues & Regulatory Costs	$2,254.04
Electricity	$15,976.84
Materials & Supplies	$2,177.68
Freight	$2,180.18
Heating Fuel Oil	$266.50
Vehicle Fuel Oil	$1,057.19
Office Supplies	$965.97
Payroll Benefits	$1,499.80
Payroll Wages	$13,497.96
Payroll Taxes	$2,452.80
Repairs & Maintenance	$35.75
Telephone & Internet	$683.93
Travel & Training	$1,275.76
Vehicle & Insurance	$2,703.50
Workers' Comp. Insurance	$993.80
Administration Misc	$9,615.37
7/12 of the year O&M Costs Total:	**$72,287.28**
Annual O&M Costs Total:	**$123,921.05**

Next, it's necessary to calculate repair and replacement (R&R) costs for the utilities. Because some parts are expensive and will eventually need to be replaced, it's important to save up enough funds for replacing them before they wear out or break. The amount of R&R costs depends on the cost of the parts in the system and how often they need to be replaced. The worksheet below will help to figure out how much money should be set aside **each year** to cover the repair and replacement of critical parts.

Tips to remember:

- Only consider parts worth more than $1,000 and with a useful life greater than one year, but less than seven years.
- Work with the operator and/or RMW to determine a full list of replacement parts.
- Example parts include circulation pumps, boilers, and filter media.

Repair and Replacement (R&R) Costs

Name of Part	Cost of Part		Years of Life		Yearly Amount
CL 17 Chlorine Analyzer (1)	$3,323	÷	15	=	$222
1720 E Turbidimeter - Low Range (6)	$1,010 x 6	÷	15	=	$404
Honeywell Multitread SX – Data Logger (1)	$100	÷	10	=	$10
Variable Frequency Drives – Allen Bradley Powerflex 70 (2)	$1,400 x 2	÷	15	=	$187
Pumps – Grundfos Model B (2)	$150 x 2	÷	10	=	$30
Streaming Current Detectors – Milton Roy SC5200-D4FJ000	$15,000	÷	15	=	$1,000
SCD Hydrocyclone Separator – Milton Roy 247-0990-000 (1)	$400	÷	10	=	$40
Milton Roy A (duplex 60 gpm) dual head dosage pump (1)	$500	÷	20	=	$25
Neat Polymer – 35 Gal Vertical Close Tank Top (1)	$250	÷	10	=	$25
Dilute Polymer – 55 Gal Vertical Open Top Tank (1)	$250	÷	10	=	$25
Neat Polymer Pump – BT5A-0713 w/ High Viscosity Head (1)	$500	÷	20	=	$25
Turbidimeter Controllers – Hach sc100 (4)	$1,000 x 4	÷	15	=	$267
PD6000 Analog Input Process Meter (5)	$400 x 5	÷	15	=	$133
Airblower – Unimac Model TT-5H-10 (1)	$1,400	÷	20	=	$70
WMX101 – Flow Meter (3)	$2,000 x 3	÷	20	=	$300
Chlorine Pump – LMI AA941-D50HI (1)	$500	÷	20	=	$25
Fox Thermal Mass Flowmeter – Model 10A (1)	2,000	÷	20	=	$100
Capsuhelic (2)	$400 x 2	÷	15	=	$53
Toyostoves (2)	$1,500 x 2	÷	25	=	$120
Electric Storage Tank Water Heater (1)	$1,000	÷	20	=	$50
Rolair 8422HK30 9HP Wheeld Gas Belt Drive Compressor (1)	$2,000	÷	15	=	$133
Distribution Line Parts	Various	÷	Varies	=	$500

Total amount to be set aside for R&R costs each year: $3744.00

Finally, to calculate the annual cost of sanitation services in Angoon, add the annual O&M costs to the total amount to the annual R&R costs:

	Annual O&M Costs:	$123,912.05
+	Annual R&R Costs:	$ 3,744.00
	Total Cost of Sanitation Services:	**$127,656.05**

Sewer Flow Study Summary

ANTHC conducted wastewater system flow monitoring at two sites in February 2017. The goal was to measure wastewater system flows for sizing replacement settling tank(s) and Kootznahoo lift station pumps. A Teledyne Isco 2150 Area-Veolocity meter was used for the flow monitoring study. The average flow into the Kootznahoo lift station was measured at 6.2 gallons per minute (gpm) during the study. The average flow into the settling tanks was 55 gpm.

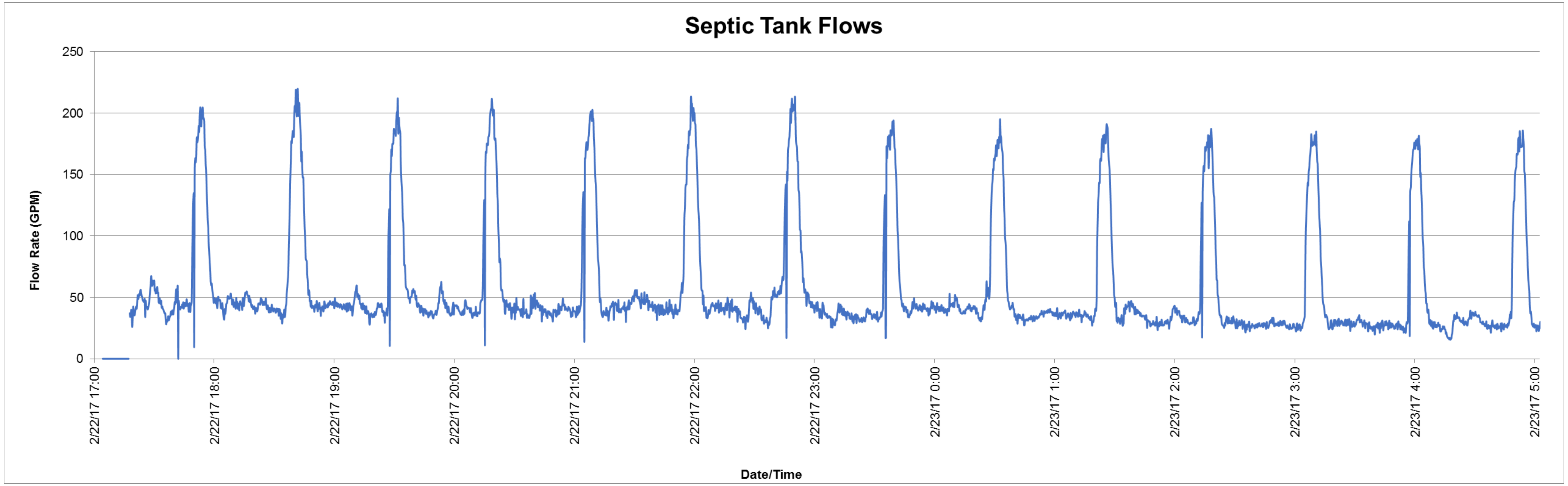
Flows into the Kootznahoo lift station were measured at the emergency overflow outfall line. Efforts to collect data upstream of the lift station were unsuccessful due to depth of the manholes and problems with the street level installation tool. At the time of the site visit, the lift station was not operational and all flows into the lift station were being discharged through the emergency outfall. Access to the emergency outfall was only possible during low tides. Data was collected during two low tides, for a total of 4.5 hours.

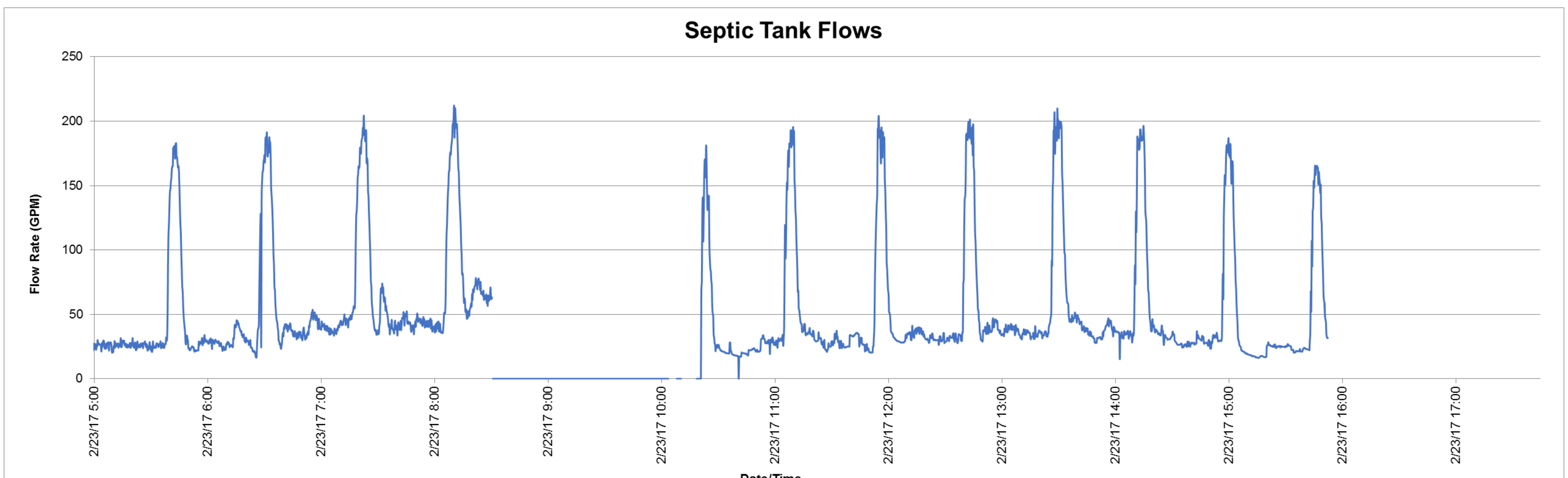

Figure 1: Flow Monitoring for Kootznahoo Lift Station

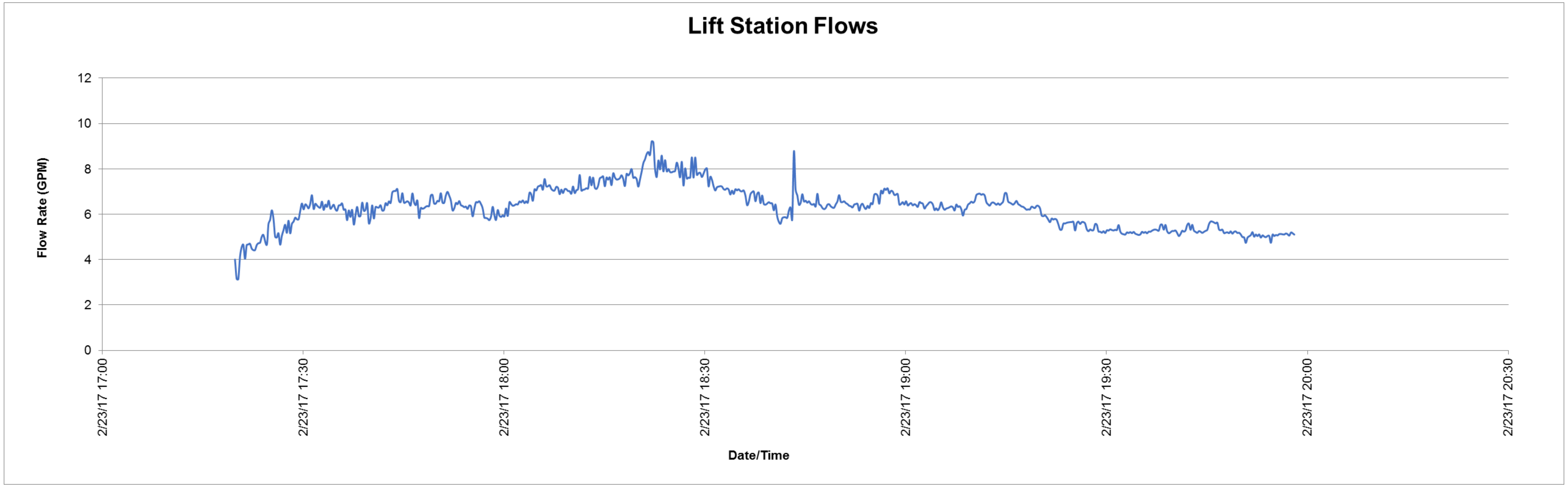
Flows into the community settling tanks were monitored for a total of 14 hours. These flows were intended to capture total flows in Angoon. However, since the Kootznahoo lift station was non-functional, the sum of the settling tank and lift station flows are considered to be total flow in the system. Peak flows of up to 217 gpm were seen every hour, when the Chatham lift station was discharging into the gravity system.

Figure 2: Flow Monitoring Upstream of Settling Tanks

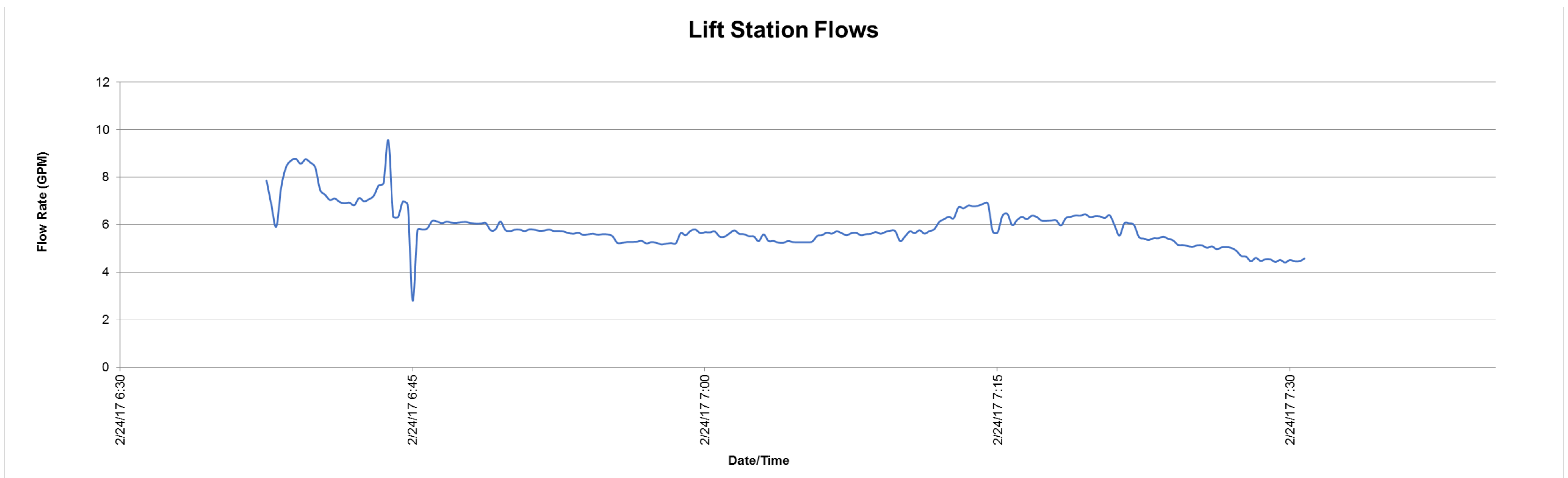
A typical average per capita water usage rate used for design purposes is 100 gallons per capita per day (gpcpd). For Angoon's population, this would equate to approximately 41,000 gpd. However, based on measured flows during the flow study, average daily flows are more than double the expected value, at 89,000 gpd. This data indicates that Angoon may have significant inflow/infiltration (I/I) into the sewer lines. Since the study was conducted during the winter, the higher flows could be partially attributable to residents wasting water in the winter to prevent pipes from freezing.


Septic Tank Flows
Flow Rate (GPM)
250
200
150
100
50
0
2/22/17 17:00
2/22/17 18:00
2/22/17 19:00
2/22/17 20:00
2/22/17 21:00
2/22/17 22:00
2/22/17 23:00
2/23/17 0:00
2/23/17 1:00
2/23/17 2:00
2/23/17 3:00
2/23/17 4:00
2/23/17 5:00
Date/Time


Septic Tank Flows
Flow Rate (GPM)
250
200
150
100
50
0
2/23/17 5:00
2/23/17 6:00
2/23/17 7:00
2/23/17 8:00
2/23/17 9:00
2/23/17 10:00
2/23/17 11:00
2/23/17 12:00
2/23/17 13:00
2/23/17 14:00
2/23/17 15:00
2/23/17 16:00
2/23/17 17:00
Date/Time



Lift Station Flows
Flow Rate (GPM)
12
10
8
6
4
2
0
2/23/17 17:00
2/23/17 17:30
2/23/17 18:00
2/23/17 18:30
2/23/17 19:00
2/23/17 19:30
2/23/17 20:00
2/23/17 20:30
Date/Time



Lift Station Flows
Flow Rate (GPM)
12
10
8
6
4
2
0
2/24/17 6:30
2/24/17 6:45
2/24/17 7:00
2/24/17 7:15
2/24/17 7:30
Date/Time

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ANGOON FY 2019 BUDGET

City of
Angoon

P. O. Box 189
Angoon, Alaska
99820
Telephone:
907-788-3653
Fax:
907-788-3821

AN ORDINANCE OF THE CITY OF ANGOON

ORDINANCE NO. 2018-17

AN ORDINANCE OF THE CITY OF ANGOON, ALASKA, PROVIDING FOR THE ESTABLISHMENT AND ADOPTION OF THE BUDGET FOR FISCAL YEAR 2019

BE IT ORDAINED BY THE COUNCIL OF THE CITY OF ANGOON, ALASKA:

Section 1. Classification. This is a Non-Code Ordinance

Section 2. General Provisions. The attached document is the authorized budget of revenues and expenditures for the period July 1st through June 30th and is made a matter of public record.

Section 3. Penalty. Violations of the sections herein enumerated shall be punishable as specified in the Angoon Municipal Code.

Section 4. Enactment. Now, therefore be it enacted by the council of the City of Angoon adopt Ordinance 2018-17 providing for the establishment and adopting the Budget for the Fiscal Year 2019.

Section 5. Effective Date. This ordinance becomes effective upon its adoption by the city council.

Introduction 11/20/2018   Public Hearing 11/27/2018

PASSED AND APPROVED BY A DULY CONSTITUDED QUORUM OF THE CITY COUNCIL THIS 27th DAY OF November, 2018.

Joshua Bowen

Joshua Bowen, Mayor

Albert Kookesh III

Albert Kookesh, III, City Clerk

RECEIVED
NOV 2[illegible] 2018
Alaska Dept of Commerce
DCRA
Grants Section

Roll Call Vote;

Edward Jack, Sr.	Yes
Gail Tharpe-Lucero	Yes
Albert Howard	Yes
Jesse Daniels	Yes
Joshua Bowen	Yes

CITY OF:	ANGOON	PAGE _______ of _______	
BUDGETED OPERATING EXPENDITURES		**ADMINISTRATION & FINANCE**	
		draft budget FY19 (draft)	FY___BUDGET
Personal Services:	Salaries	$70,000.00	$
	Stipends	$	$
	Payroll Taxes	$6,000.00	$
	Workers Compensation	$	$
	Retirement / Pension	$	$
	Other:	$	$
	Other:	$	$
	Total Personal Services	**$76,000.00**	**$**
Travel:	Airfare	$2,000.00	$
	Per Diem	$2,000.00	$
	Training, Workshop & Conference Fees	$1,500.00	$
	Other:	$	$
	Other:	$	$
	Total Travel	**$5,500.00**	**$**
Facility Expenses:	Telephone	$2,500.00	$
	Rent	$	$
	Electricity	$3,000.00	$
	Water & Sewer	$	$
	Fuel Oil	$4,500.00	$
	Other: Extinguisher Services	$600.00	$
	Other Energy Costs/Source:	$	$
	Other:	$	$
	Total Facility Expenses	**$10,600.00**	**$**
Supplies:	Office & Clerical Supplies	$2,500.00	$
	Postage Supplies	$720.00	$
	Copier Supplies	$	$
	Other:	$	$
	Other:	$	$
	Total Supplies	**$3,220.00**	**$**
Equipment:	Equipment	$400.00	$
	Vehicle / Equipment Maintenance	$	$
	Fuel:	$	$
	Other:	$	$
	Total Equipment	**$400.00**	**$**
Other Operating Expenses:	Interest & Late Charges	$	$
	Insurance & Bonding	$	$
	Donations	$2,000.00	$
	Bank Charges	$	$
	Contractual: Legal Services	$15,000.00	$
	Contractual: Accounting / Audit Services	$25,000.00	$
	Other: Elections	$1,200.00	$
	Other: AMLJIA insurance	$16,000.00	$
	Total Other	**$59,200.00**	**$**
TOTAL ADMINISTRATION & FINANCE BUDGET		**$154,920.00**	**$**
		Enter on line 23 of Budget Summary	

CITY OF:	ANGOON	PAGE ____ of ____	
BUDGETED OPERATING EXPENDITURES			**COUNCIL**
		FY19 Draft budget (draft)	FY___BUDGET
Personal Services:	Salaries	$16,800.00	$
	Stipends	$	$
	Payroll Taxes	$3,000.00	$
	Workers Compensation	$	$
	Retirement / Pension	$	$
	Other:	$	$
	Other:	$	$
	Total Personal Services	**$19,800.00**	**$**
Travel:	Airfare	$	$
	Per Diem	$	$
	Training, Workshop & Conference Fees	$	$
	Other:	$	$
	Other:	$	$
	Total Travel	**$**	**$**
Facility Expenses:	Telephone	$	$
	Rent	$	$
	Electricity	$	$
	Water & Sewer	$	$
	Fuel Oil	$	$
	Other Heating Costs	$	$
	Other Energy Costs/Source:	$	$
	Other:	$	$
	Total Facility Expenses	**$**	**$**
Supplies:	Office & Clerical Supplies	$	$
	Postage Supplies	$	$
	Copier Supplies	$	$
	Other:	$	$
	Other:	$	$
	Total Supplies	**$**	**$**
Equipment:	Equipment	$	$
	Vehicle / Equipment Maintenance	$	$
	Fuel:	$	$
	Other:	$	$
	Total Equipment	**$**	**$**
Other Operating Expenses:	Interest & Late Charges	$	$
	Insurance & Bonding	$	$
	Membership Dues & Fees / Subscriptions	$200.00	$
	Bank Charges	$	$
	Other Contractual:	$	$
	Other:	$	$
	Other:	$	$
	Total Other	**$200.00**	**$**
TOTAL COUNCIL BUDGET		**$20,000**	**$**
		Enter on line 24 of Budget Summary	

CITY OF:	ANGOON	PAGE _______ of _______	
BUDGETED OPERATING EXPENDITURES			**POLICE**

		Draft Budget FY19 (draft)	FY___BUDGET
Personal Services:	Salaries	$	$
	Stipends	$	$
	Payroll Taxes	$	$
	Workers Compensation	$	$
	Retirement / Pension	$	$
	Other: Housing	$6,000.00	$
	Other:	$	$
	Total Personal Services	**$6,000.00**	**$**
Travel:	Airfare	$	$
	Per Diem	$	$
	Training, Workshop & Conference Fees	$	$
	Other:	$	$
	Other:	$	$
	Total Travel	**$**	**$**
Facility Expenses:	Telephone	$4,800.00	$
	Rent	$	$
	Electricity	$2,500.00	$
	Water & Sewer	$	$
	Fuel Oil	$1,200.00	$
	Other Heating Costs	$	$
	Other Energy Costs/Source:	$	$
	Other:	$	$
	Total Facility Expenses	**$8,500.00**	**$**
Supplies:	Office & Clerical Supplies	$50.00	$
	Postage Supplies	$	$
	Copier Supplies	$	$
	Other:	$	$
	Other:	$	$
	Total Supplies	**$50.00**	**$**
Equipment:	Equipment	$	$
	Vehicle / Equipment Maintenance	$	$
	Fuel:	$900.00	$
	Other:	$	$
	Total Equipment	**$900.00**	**$**
Other Operating Expenses:	Interest & Late Charges	$	$
	Insurance & Bonding	$	$
	Membership Dues & Fees / Subscriptions	$	$
	Bank Charges	$	$
	Other Contractual:	$	$
	Other:	$	$
	Total Other	**$**	**$**
TOTAL POLICE BUDGET		**$15,450.00**	**$**
			Enter on line 25 of Budget Summary

CITY OF:	ANGOON	PAGE _______ of _______
BUDGETED OPERATING EXPENDITURES		**FIRE**

		Draft Budget FY19 (draft)	FY___BUDGET
Personal Services:	Salaries	$	$
	Stipends	$	$
	Payroll Taxes	$	$
	Workers Compensation	$	$
	Retirement / Pension	$	$
	Other:	$	$
	Other:	$	$
	Total Personal Services	$	$
Travel:	Airfare	$	$
	Per Diem	$	$
	Training, Workshop & Conference Fees	$	$
	Other:	$	$
	Other:	$	$
	Total Travel	$	$
Facility Expenses:	Telephone	$	$
	Rent	$	$
	Electricity	$	$
	Water & Sewer	$	$
	Fuel Oil	$	$
	Other Heating Costs	$	$
	Other Energy Costs/Source:	$	$
	Other:	$	$
	Total Facility Expenses	$	$
Supplies:	Office & Clerical Supplies	$	$
	Postage Supplies	$	$
	Copier Supplies	$	$
	Other:	$	$
	Other:	$	$
	Total Supplies	$	$
Equipment:	Equipment	$1,500.00	$
	Vehicle / Equipment Maintenance	$	$
	Fuel:	$300.00	$
	Other:	$	$
	Total Equipment	**$1,800.00**	$
Other Operating Expenses:	Interest & Late Charges	$	$
	Insurance & Bonding	$	$
	Membership Dues & Fees / Subscriptions	$	$
	Bank Charges	$	$
	Other Contractual:	$	$
	Other:	$	$
	Other:	$	$
	Total Other	$	$
TOTAL FIRE BUDGET		**$1,800.00**	$

Enter on line 26 of Budget Summary

CITY OF:	ANGOON	PAGE ____ of ____
BUDGETED OPERATING EXPENDITURES		**STREETS & ROADS**

		Draft Budget FY19 (draft)	FY___BUDGET
Personal Services:	Salaries	$6,100.00	$
	Stipends	$	$
	Payroll Taxes	$500.00	$
	Workers Compensation	$	$
	Retirement / Pension	$	$
	Other:	$	$
	Other:	$	$
	Total Personal Services	**$6,600.00**	**$**
Travel:	Airfare	$	$
	Per Diem	$	$
	Training, Workshop & Conference Fees	$	$
	Other:	$	$
	Other:	$	$
	Total Travel	**$**	**$**
Facility Expenses:	Telephone	$	$
	Rent	$	$
	Electricity	$3,000.00	$
	Water & Sewer	$	$
	Fuel Oil	$	$
	Other Heating Costs	$	$
	Other Energy Costs/Source:	$	$
	Other:	$	$
	Total Facility Expenses	**$3,000.00**	**$**
Supplies:	Office & Clerical Supplies	$500.00	$
	Postage Supplies	$	$
	Copier Supplies	$	$
	Other:	$	$
	Other:	$	$
	Total Supplies	**$500.00**	**$**
Equipment:	Equipment	$	$
	Vehicle / Equipment Maintenance	$2,000.00	$
	Fuel:	$1,200.00	$
	Other:	$	$
	Total Equipment	**$3,200.00**	**$**
Other Operating Expenses:	Interest & Late Charges	$	$
	Insurance & Bonding	$	$
	Membership Dues & Fees / Subscriptions	$	$
	Bank Charges	$	$
	Other Contractual:	$	$
	Other:	$	$
	Other:	$	$
	Total Other	**$**	**$**
TOTAL STREETS AND ROADS BUDGET		**$13,300.00**	**$**
		Enter on line 27 of Budget Summary	

CITY OF: ____________________		PAGE ______ of ______	
BUDGETED OPERATING EXPENDITURES			**WATER**
		Draft Budget FY19 (draft)	FY___BUDGET
Personal Services:	Salaries	$28,000.00	$
	Stipends	$	$
	Payroll Taxes	$	$
	Workers Compensation	$2,400.00	$
	Retirement / Pension	$	$
	Other:	$	$
	Other:	$	$
	Total Personal Services	**$30,400.00**	**$**
Travel:	Airfare	$	$
	Per Diem	$	$
	Training, Workshop & Conference Fees	$	$
	Other:	$	$
	Other:	$	$
	Total Travel	**$**	**$**
Facility Expenses:	Telephone	$	$
	Rent	$	$
	Electricity	$22,000.00	$
	Water & Sewer	$	$
	Fuel Oil	$200.00	$
	Other Heating Costs	$	$
	Other: Chemicals	$20,000.00	$
	Other: Water Testing	$5,000.00	$
	Total Facility Expenses	**$47,200.00**	**$**
Supplies:	Supplies	$250.00	$
	Postage Supplies	$	$
	Copier Supplies	$	$
	Other: Freight	$2,000.00	$
	Other:	$	$
	Total Supplies	**$2,250.00**	**$**
Equipment:	Equipment	$300.00	$
	Vehicle / Equipment Maintenance	$	$
	Fuel:	$1,600.00	$
	Other:	$	$
	Total Equipment	**$1,900.00**	**$**
Other Operating Expenses:	Interest & Late Charges	$	$
	Insurance & Bonding	$	$
	Membership Dues & Fees / Subscriptions	$2,500.00	$
	Bank Charges	$	$
	Other Contractual:	$	$
	Other:	$	$
	Total Other	**$2,500.00**	**$**
TOTAL WATER BUDGET		**$84,250.00**	**$**
		Enter on line 28 of Budget Summary	

CITY OF:	ANGOON	PAGE _______ of _______	
BUDGETED OPERATING EXPENDITURES		**DOCKS & HARBOR**	
		Draft Budget FY19 (draft)	FY___BUDGET
Personal Services:	Salaries	$9,000.00	$
	Stipends	$	$
	Payroll Taxes	$800.00	$
	Workers Compensation	$	$
	Retirement / Pension	$	$
	Other:	$	$
	Total Personal Services	**$9,800.00**	**$**
Travel:	Airfare	$	$
	Per Diem	$	$
	Training, Workshop & Conference Fees	$	$
	Other:	$	$
	Other:	$	$
	Total Travel	**$**	**$**
Facility Expenses:	Telephone	$	$
	Rent	$	$
	Electricity	$1,000.00	$
	Water & Sewer	$	$
	Fuel Oil	$	$
	Other Heating Costs	$	$
	Other Energy Costs/Source:	$	$
	Other:	$	$
	Total Facility Expenses	**$1,000.00**	**$**
Supplies:	Office & Clerical Supplies	$	$
	Postage Supplies	$	$
	Copier Supplies	$	$
	Other:	$	$
	Other:	$	$
	Total Supplies	**$**	**$**
Equipment:	Equipment	$150.00	$
	Vehicle / Equipment Maintenance	$	$
	Fuel:	$500.00	$
	Other:	$	$
	Total Equipment	**$650.00**	**$**
Other Operating Expenses:	Interest & Late Charges	$	$
	Insurance & Bonding	$	$
	Membership Dues & Fees / Subscriptions	$	$
	Bank Charges	$	$
	Other Contractual:	$	$
	Other:	$	$
	Total Other	**$**	**$**
TOTAL HARBOR BUDGET		**$11,450.00**	**$**
		Enter on line 29 of Budget Summary	

CITY OF: ____________		PAGE ____ of ____
BUDGETED OPERATING EXPENDITURES		**Ambulance**

		Draft Budget FY19 (draft)	FY___BUDGET
Personal Services:	Salaries	$	$
	Stipends	$	$
	Payroll Taxes	$	$
	Workers Compensation	$	$
	Retirement / Pension	$	$
	Other:	$	$
	Other:	$	$
	Total Personal Services	$	$
Travel:	Airfare	$	$
	Per Diem	$	$
	Training, Workshop & Conference Fees	$	$
	Other:	$	$
	Other:	$	$
	Total Travel	$	$
Facility Expenses:	Telephone	$	$
	Rent	$	$
	Electricity	$	$
	Water & Sewer	$	$
	Fuel Oil	$	$
	Repairs / Maintenance (buildings)	$	$
	Other:	$	$
	Other:	$	$
	Total Facility Expenses	$	$
Supplies:	Office & Clerical Supplies	$	$
	Postage Supplies	$	$
	Copier Supplies	$	$
	Other:	$	$
	Other:	$	$
	Total Supplies	$	$
Equipment:	Equipment	$	$
	Vehicle fuel	$150.00	$
	Other:	$	$
	Other:	$	$
	Total Equipment	$150.00	$
Other Operating Expenses:	Interest & Late Charges	$	$
	Insurance & Bonding	$	$
	Membership Dues & Fees / Subscriptions	$	$
	Bank Charges	$	$
	Other Contractual:	$	$
	Other:	$	$
	Total Other	$	$
TOTAL AMBULANCE BUDGET		$150.00	$

Enter on line 30 of Budget Summary

CITY OF:	ANGOON	PAGE ______ of ______

BUDGETED OPERATING EXPENDITURES — **SEWER**

☐ Check if City Budget includes water service
☐ Check if City Budget includes sewer or honeybucket service

		Draft Budget FY19 (draft)	FY___BUDGET
Personal Services:	Salaries	$6,600.00	$
	Stipends	$	$
	Payroll Taxes	$700.00	$
	Workers Compensation	$	$
	Retirement / Pension	$	$
	Other:	$	$
	Other:	$	$
	Total Personal Services	**$7,300.00**	**$**
Travel:	Airfare	$	$
	Per Diem	$	$
	Training, Workshop & Conference Fees	$	$
	Other:	$	$
	Other:	$	$
	Total Travel	**$**	**$**
Facility Expenses:	Telephone	$	$
	Rent	$	$
	Electricity	$2,200.00	$
	Water & Sewer	$	$
	Fuel Oil	$	$
	Repairs / Maintenance (buildings)	$	$
	Other:	$	$
	Other:	$	$
	Total Facility Expenses	**$2,200.00**	**$**
Supplies:	Supplies	$300.00	$
	Postage Supplies	$	$
	Copier Supplies	$	$
	Other:	$	$
	Other:	$	$
	Total Supplies	**$300.00**	**$**
Equipment:	Equipment	$	$
	Vehicle fuel	$400.00	$
	Other:	$	$
	Other:	$	$
	Total Equipment	**$400.00**	**$**
Other Operating Expenses:	Interest & Late Charges	$	$
	Insurance & Bonding	$	$
	Membership Dues & Fees / Subscriptions	$	$
	Bank Charges	$	$
	Other Contractual:	$	$
	Other:	$	$
	Total Other	**$**	**$**
TOTAL SEWER BUDGET		**$10,200.00**	**$**

Enter on line 31 of Budget Summary

CITY OF:	ANGOON	PAGE ______ of ______	
BUDGETED OPERATING EXPENDITURES		**GARBAGE & LANDFILL**	
		2019 draft FY19 (draft)	FY___BUDGET
Personal Services:	Salaries	$6,650.00	$
	Stipends	$	$
	Payroll Taxes	$700.00	$
	Workers Compensation	$	$
	Retirement / Pension	$	$
	Other:	$	$
	Other:	$	$
	Total Personal Services	**$7,350.00**	**$**
Travel:	Airfare	$	$
	Per Diem	$	$
	Training, Workshop & Conference Fees	$	$
	Other:	$	$
	Other:	$	$
	Total Travel	**$**	**$**
Facility Expenses:	Telephone	$	$
	Rent	$	$
	Electricity	$2,000.00	$
	Water & Sewer	$	$
	Fuel Oil	$	$
	Other Heating Costs	$	$
	Other Energy Costs/Source:	$	$
	Other:	$	$
	Total Facility Expenses	**$2,000.00**	**$**
Supplies:	Office & Clerical Supplies	$	$
	Postage Supplies	$	$
	Copier Supplies	$	$
	Other: materials	$100.00	$
	Other:	$	$
	Total Supplies	**$100.00**	**$**
Equipment:	Equipment	$	$
	Vehicle / Equipment Maintenance	$	$
	Fuel:	$350.00	$
	Other:	$	$
	Total Equipment	**$350.00**	**$**
Other Operating Expenses:	Interest & Late Charges	$	$
	Insurance & Bonding	$	$
	Membership Dues & Fees / Subscriptions	$	$
	Bank Charges	$	$
	Other Contractual:	$	$
	Other:	$	$
	Total Other	**$**	**$**
TOTAL GARBAGE & LANDFILL BUDGET		**$9,800.00**	**$**
			Enter on line 33 of Budget Summary

FY 19 BUDGET SUMMARY - EXPENDITURES

CITY OF ANGOON PAGE ______ of ______

		Line reference
Administration and Finance	$154,920.00	23
Council	$20,000.00	24
Planning and Zoning	$	
Police	$15,450.00	25
Fire	$1,800.00	26
Ambulance	$150.00	
Other Public Safety	$	
Streets and Roads	$13,300.00	27
Airport	$84,250.00	28
Harbor and Dock	$11,450.00	29
Ambulance	$150.00	30
Sewer	$10,200.00	31
Washeteria	$	32
Garbage and Landfill	$9,800.00	33
Fuel Sales	$	
Cable TV	$	
Bingo and Pull Tabs	$	
Mass Transit	$	
Phone Utility	$	
Other Enterprise:______________	$	
Other Enterprise:______________	$	
Other Public Works	$	
Health Facility	$	34
Other Health and Welfare Services	$	
Parks and Recreation	$	
Library	$	
Museum and Cultural	$	
Other Public Service:______________	$	
Other:______________	$	
Other:______________	$	
TOTAL FY ___ OPERATING EXPENDITURES	**$321,470.00**	**35 Total**

CAPITAL / SPECIAL PROJECT EXPENDITURES:

State-Funded Capital/Special Projects	$	36
Federal Capital/Special Projects	$	37
Total Capital / Special Projects Expenditures	$	**Subtotal**

TOTAL ALL FY ___ EXPENDITURES	$321,470.00	TOTAL

FY 19 BUDGET SUMMARY - REVENUES

CITY OF Angoon **PAGE** ____ **of** ____

		Line reference
LOCALLY GENERATED REVENUES:		
Tax Revenues	$44,756.33	1
Bed Tax Revenues	$16,784.53	2
Utilities Income	$3,140.00	3
Building Income	$1,238.83	4
Land Lease Revenues	$8,000.00	5
Service Charges	$	6
Enterprise Revenues	$	7
Rentals	$	8
Leases	$	9
Sales	$516.00	10
Other Local Revenues	$23,924.74	11
Total Locally Generated Revenues	$98,360.43	**12 Subtotal**
OUTSIDE REVENUE SOURCES:		
State of Alaska Forrest Receipts	$13,398.96	13
State PILT	$78,635.24	14
State CRS *(pending passed budget)*	$	15
Other Outside Revenues	$51,807.69	16
Total Outside Revenues	$242,202.32	**17 Subtotal**
TOTAL FY ___ OPERATING REVENUES	$	**18 Total**
CAPITAL / SPECIAL PROJECT REVENUE SOURCES:		
State-Funded Capital/Special Projects	$	19
Federal Capital/Special Projects	$	20
Total Revenues for Capital / Special Projects	$	**21 Subtotal**
TOTAL ALL FY ___ REVENUES	$	**22 Total**
Prior-Year Cash Balance	$	
TOTAL CASH AVAILABLE FY ___	$	**Total**

ANGOON FY 2020
BUDGET

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Ordinance 20-01

A Non-Code Ordinance Establishing the FY20 Budget for the City of Angoon

BE IT ENACTED BY THE CITY OF ANGOON, ALASKA AS FOLLOWS:

Section 1: This is a Non-Code Ordinance Establishing the FY2020 Budget.

Section 2: For the FY19, the budget is established as follows on the attached budget forms.

Section 3: Effective Date: This ordinance becomes effective upon its adaption

Date Introduced: July 3, 2019

Date Published: July 3, 2019

Public Hearing: July 10, 2019

PASSED and APPROVED by the City Council of Angoon, Alaska this day, the 10th of July 2019.

Joshua Bowen, Mayor

Albert Kookesh III, City Clerk

	Yea	Nay
Jess Daniels	✓	
Gail Tharpe-Lucero	✓	
Crystal Parkin	✓	
Peter Duncan		
Ed Jack		
Albert Howard		
Joshua Bowen	✓	

Attached: 14 Pages of FY2020 Budget

Local Revenues	FY19 Actuals	FY20 Proposed	FY20 Final Budget	Line #
Sales Tax	50,616.29	200,000.00		1.1
Bed Tax	56.76	20,000.00		1.2
Fish Box Tax	0.00	10,000.00		1.3
Vendor Permit Fees	50.00	2,100.00		1.4
Sanding/Plowing	600.00	2,000.00		1.5
Tire Change	285.00	300.00		1.6
ATM Service Fees	0.00	2,000.00		1.7
Fax/Copies	3.75	10.00		1.8
Airport Timber Sale	0.00	50,000.00		1.9
Vehicle Rentals	105.00	500.00		1.10
Land/Office Leases	23,065.96	23,000.00		1.11
Water User Fees	37,803.60	40,000.00		1.12
Garbage User Fees	19,001.73	25,000.00		1.13
Sewer User Fees	21,744.67	25,000.00		1.14
Harbor User Fees	6,249.00	10,000.00		1.15
Landfill Permit Fees	0.00	2,000.00		1.16
Total Local Revenues	**159,581.76**	**411,910.00**		1.17

Outside Revenues	FY19 Estimated Actuals	FY20 Proposed	FY20 Final Budget	Line #
P.I.L.T	79,587.58	50,212.76		1.18
State Road Maintenance Contract	29,328.00	30,000.00		1.19
Shared Fisheries Tax	1,518.61	1,500.00		1.20
National Forest Reciepts	13,536.28	15,000.00		1.21
Community Revenue Sharing	82,769.15	80,000.00		1.22
Electric Coop Tax Revenue Sharing	778.76	800.00		1.23
Total Outside Revenues	**207,518.38**	**177,512.76**		1.24
Total All Revenues	**367,100.14**	**589,422.76**		1.25

s

Admin Operating Expenses	FY19 Actuals	FY20 Proposed	FY20 Final Budget	Line #
Mayor Salary	16,800.00	30,000.00		2.1
City Clerk Wages	17,561.67	25,920.00		2.2
Janitor Wages	2,042.50	6,480.00		2.3
Admin Labor Wages	3,771.17	2,000.00		2.4
Mayor Travel	817.15	2,000.00		2.5
Mayor Per Diem	992.73	2,000.00		2.6
Staff Travel	1,200.00	2,000.00		2.7
Staff Per Diem	130.00	2,000.00		2.8
Training Fees	0.00	1,000.00		2.9
City Office Telephone	3,348.28	3,500.00		2.10
City Office Electricity	3,317.80	3,500.00		2.11
City Office Fuel Oil	4,547.21	3,000.00		2.12
Municode Fees	0.00	4,000.00		2.13
City Website Fees	200.00	300.00		2.14
Office Software Fees	350.00	900.00		2.15
Office Supplies	6,874.61	2,000.00		2.16
Postage Supplies	1,276.67	200.00		2.17
Freight	290.24	200.00		2.18
Donations	3,001.18	3,000.00		2.19
Elections	654.55	1,200.00		2.20
Total Admin Expenses	32,814.09	95,200.00		2.21

s

Council Operating Expenses	FY19 Actuals	FY20 Proposed	FY20 Final Budget	Line #
Council Stipends	7,254.55	7,500.00		3.1
Southeast Conference Dues	350.00	350.00		3.2
Alaska Municipal Leauge Dues	824.00	908.00		3.3
Total Council Expenses	8,428.55	8,758.00		3.4

Finance Operating Expenses	FY19 Actuals	FY20 Proposed	FY20 Final Budget	Line #
Accounts Payable Clerk Wages	15,786.35	24,300.00		4.1
Accounts Receivable Clerk Wages	12,836.05	22,680.00		4.2
Grant Manager Wages	0.00	16,200.00		4.3
Finance Labor	0.00	2,000.00		4.4
Travel	817.15	1,000.00		4.5
Per Diem	992.73	1,000.00		4.6
Training Fees	0.00	500.00		4.7
Office Supplies	0.00	2,000.00		4.8
Postage Supplies	0.00	1,000.00		4.9
Freight	0.00	500.00		4.10
Accounting and Audit	25,000.00	15,000.00		4.11
Legal Fees	11,312.60	20,000.00		4.12
Bank Service Charges	1,177.70	1,000.00		4.13
Equipment Rental	47.13	480.00		4.14
AMLJIA Insurance	16,363.00	17,000.00		4.15
Payroll Taxes	14,103.00	34,900.00		4.16
Total Finance Expenses	98,435.71	159,560.00		4.17

Garbage/Landfill Operating Expenses	FY19 Actuals	FY20 Proposed	FY20 Final Budget	Line #
Garbageman Wages	11,290.91	11,664.00		5.1
Landfill Attendant Wages	0.00	15,120.00		5.2
Garbage Truck Fuel	2,293.58	2,000.00		5.3
Total Garbage/Landfill Expenses	13,584.49	28,784.00		5.4

Harbor Operating Expenses	FY19 Actuals	FY20 Proposed	FY20 Final Budget	Line #
Harbormaster Wages	9,469.20	17,820.00		6.1
Harbor Labor	539.47	2,000.00		6.2
Vehicle Fuel	885.74	1,000.00		6.3
Electricity	1,098.60	1,500.00		6.4
Security Cameras	0.00	1,500.00		6.5
Materials and Supplies	744.34	2,000.00		6.6
Maintenance and Repair	540.04	2,000.00		6.7
Total Harbor Expenses	13,277.39	27,820.00		6.8

Planning and Zoning Operating Expenses	FY19 Actuals	FY20 Proposed	FY20 Final Budget	Line #
P&Z Clerk Wages	0.00	15,120.00		7.1
P&Z Labor Wages	0.00	2,000.00		7.2
Office Supplies	0.00	500.00		7.3
Postage Supplies	0.00	200.00		7.4
Freight	0.00	250.00		7.5
P&Z Commission Stipend	0.00	5,000.00		7.6
Survey Fees	0.00	10,000.00		7.7
Recorders Office Fees	0.00	500.00		7.8
Total P&Z Expenses	0.00	33,570.00		7.9

Public Safety Operating Expenses	FY19 Actuals	FY20 Proposed	FY20 Final Budget	Line #
Phone - VPSO	4,369.33	1,200.00		8.1
Housing - VPSO	4,800.00	4,800.00		8.2
Vehicle Fuel - VPSO	1,567.03	2,000.00		8.3
Office Supplies - VPSO	211.60	500.00		8.4
Complex Fuel Oil - VPSO	1,207.35	1,500.00		8.5
Vehicle Fuel - EMS	109.09	250.00		8.6
Vehicle Fuel - S&R	0.00	1,000.00		8.7
Vehicle Fuel - FIRE	423.36	500.00		8.8
Supplies - FIRE	225.07	500.00		8.9
Stipends - FIRE	0.00	4,000.00		8.10
Total Public Safety Expenses	12,912.83	16,250.00		8.11

Roads Operating Expenses	FY19 Actuals	FY20 Proposed	FY20 Final Budget	Line #
Roads Labor Wages	8,886.42	5,000.00		9.1
Sander Driver Wages	0.00	1,500.00		9.2
Sander Labor Wages	0.00	1,500.00		9.3
Electricity - City Shop	873.36	1,000.00		9.4
Tools and Equipment	1,192.07	1,500.00		9.5
Materials and Supplies	2,725.46	1,000.00		9.6
Lube and Fluids - Fleet	0.00	1,000.00		9.7
Maintenance and Repair - Fleet	1,307.76	10,000.00		9.8
Road Sand	5,025.85	5,000.00		9.9
Road Patch	0.00	2,000.00		9.10
Snowplow Maintenance	0.00	1,500.00		9.11
Total Roads Expenses	20,010.92	31,000.00		9.12

Sewer Operating Expenses	FY19 Actuals	FY20 Proposed	FY20 Final Budget	Line #
Sewer Operator Wages	0.00	8,100.00		10.1
Laborer Wages	8,192.04	2,000.00		10.2
Wastewater Discharge Permit	7,920.00	7,920.00		10.3
Electricity	3,818.69	4,000.00		10.4
Pumper Truck Fuel	337.58	500.00		10.5
Equipment Fuel	0.00	200.00		10.6
Supplies	709.34	1,000.00		10.7
Freight	211.42	500.00		10.8
Total Sewer Expenses	21,189.07	16,120.00		10.9

Water Operating Expenses	FY19 Actuals	FY20 Proposed	FY20 Final Budget	Line #
Hourly Wages	27,882.54	0.00		11.1
Lead Water Operator Wages	0.00	25,920.00		11.2
Backup Water Operator Wages	0.00	12,960.00		11.3
Travel	2,205.51	1,000.00		11.4
Per Diem	910.00	1,000.00		11.5
Electricity	27,928.20	30,000.00		11.6
Fuel Oil	666.00	750.00		11.7
Vehicle Fuel	2,795.07	2,000.00		11.8
Materials and Supplies	4,450.11	2,000.00		11.9
Freight	7,322.10	7,500.00		11.1
Water Testing	2,730.00	3,000.00		11.11
Chemicals	27,132.24	30,000.00		11.12
Total Water Expenses	76,139.23	116,130.00		11.13

Fund Balances	7/1/2019	EST FY20 Surplus	Remaining Balance
General Fund	448,000.00	74,050.76	522,050.76
Harbor Fund	1,409,000.00		

General Fund Summary	FY19 Actuals	FY20 Proposed	FY20 Final Budget	Line #
Local Government Revenue	153,332.76	401,910.00		1.17
Outside Government Revenue	207,518.38	177,512.76		1.24
Total All Revenues	360,851.14	579,422.76		1.25
Total Admin Expenses	32,814.09	95,200.00		2.21
Total Council Expenses	8,428.55	8,758.00		3.4
Total Finance Expenses	98,435.71	159,560.00		4.17
Total Garbage/Landfill Expenses	13,584.49	28,784.00		5.4
Total P&Z Expenses	0.00	33,570.00		7.9
Total Public Safety Expenses	25,000.00	16,250.00		8.11
Total Roads Expenses	20,010.92	31,000.00		9.12
Total Sewer Expenses	25,770.89	16,120.00		10.9
Total Water Expenses	100,000.00	116,130.00		11.13
Total All Expenses	324,044.65	505,372.00		
Difference	36,806.49	74,050.76		

Harbor Fund Summary	FY19 Actuals	FY20 Proposed	FY20 Final Budget	
Local Government Revenue	6,249.00	10,000.00		1.15
Interest Income Revenue	23,885.86	25,000.00		
Total Harbor Revenue	30,134.86	35,000.00		
Total Harbor Expenses	13,277.39	29,008.00		6.8
Harbor Surplus	16,857.47	5,992.00		

FY2019
Capital Budget

Proposed Capital Project	Estimated FY20 Cost	Note	Line #
Replace Lighting in City Office with Energy Efficient LED Lights	4,000.00	Will result in long term operating expense savings on electricity.	C1
Purchase Mini-Excavator and Trailer	60,000.00	Repair Hydrants, Broken Lines, and assist w/ Landfill Maint.	C2
Survey and mark Shareholder Subdivision ROW's for Roads to provide access to shareholder lots.	20,000.00	None	C3
Basketball Court Cover Project Completion Funds	8,000.00	Concrete, Erection of Structure, Labor, ETC	C4
Down Payment on Large Excavator for Landfill and Road Creation	30,000.00	Looking into financing options. 30k Should be enough for a down payment and transport.	C5
Water Tank Cleanup Project	10,000.00	Long Overdue	C6
Water Treatment Plant Filter Media Replacement	25,000.00	Long Overdue	C7

Total: 157,000.00

APPENDIX D: CALCULATIONS

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ANGOON PRELIMINARY ENGINEERING REPORT
WATER SOURCE IMPROVEMENTS
ANTHC PROJECT: 21-D-94254/6000646
BRISTOL PROJECT: 32210031

SCOPE:

THE COMMUNITY OF ANGOON UTILIZES A SURFACE WATER SOURCE THAT IS DEPENDENT ON A BEAVER DAM TO MAINTAIN WATER SURFACE ELEVATION. THE COMMUNITY HAS EXPERIENCED WATER SHORTAGES ASSOCIATED WITH WARM SUMMER CONDITIONS. THE INABILITY TO MEET COMMUNITY DEMAND HAS INTERFERED WITH THE COMMUNITIES EFFORTS TO EXPAND HOUSING. ADDITIONALLY, THE COMMUNITY IS CONCERNED THAT THE EXISTING SOURCE MAY BE AT AN INCREASED RISK OF PROTOZOAL CONTAMINATION BECAUSE OF THE BEAVER POPULATION.

THIS PRELIMINARY ENGINEERING REPORT (PER) EVALUATES THE FOLLOWING ALTERNATIVES TO IMPROVE THE WATER SOURCE:

1. NO ACTION
2. CONSTRUCT A NEW IMPOUNDMENT ON FAVORITE CREEK
3. CONSTRUCT NEW VERTICAL INFILTRATION GALLERIES NEAR EXISTING INTAKE ON AUK' TAH LAKE

EXISTING SYSTEM DESCRIPTION:

THE COMMUNITY WATER SYSTEM SERVING THE CITY OF ANGOON CONSISTS OF A SURFACE WATER INTAKE IN AUK' TAH LAKE (TILLINGHAST LAKE), FOLLOWED BY A DIRECT FILTRATION SYSTEM, CHLORINATION, AND A 500,000 GALLON WATER STORAGE TANK (250,000 GALLONS IS RESERVED FOR DISINFECTION CONTACT TIME). TWO WATER TOWERS ARE CONNECTED TO THE DISTRIBUTION SYSTEM WHICH PROVIDE AN ADDITIONAL 650,000 GALLONS (TOTAL) OF STORAGE.

THE WATER TREATMENT PLANT WAS ORIGINALLY CONSTRUCTED IN 1976. THE CURRENT TREATMENT SYSTEM IS THE RESULT OF UPGRADES COMPLETED IN 2007 BY THE ALASKA NATIVE TRIBAL HEALTH CONSORTIUM (ANTHC PROJECT AN-05-RA5). INTAKE SYSTEM UPGRADES WERE COMPLETED IN 2011 (ANTHC PROJECT AN-09-NK3).

AUK'TAH LAKE (TILLINGHAST LAKE) CONSISTS OF TWO LAKES THAT ARE INTERCONNECTED BECAUSE OF A WELL ESTABLISHED BEAVER DAM CONSTRUCTED ON THE OUTLET. RECENTLY THE WATER LEVEL IN THE LAKE HAS DROPPED TO LOW LEVELS DURING THE WARMER SUMMER MONTHS, LIMITING ACCESS TO RAW WATER. AN INADEQUATE RAW WATER SUPPLY IS IMPACTING COMMUNITY DEVELOPMENT.

THE CURRENT SURFACE WATER SOURCE HAS BEEN DESIGNATED AS "BIN 1" UNDER THE LONG TERM 2 ENHANCED SURFACE WATER TREATMENT RULE, INDICATING THAT THE SOURCE IS CLASSIFIED IN THE LOWEST RISK CATEGORY FOR CRYPTOSPORIDIUM CONTAMINATION.

ECONOMIC UNCERTAINTIES IN THE COMMUNITY HAS RESULTED IN AN OVERALL DECLINE IN THE POPULATION FROM A HIGH POINT OF 638 IN 1990, TO THE CURRENT POPULATION OF 399.

A PIPED WATER DISTRIBUTION SYSTEM IS PROVIDED THROUGHOUT THE CITY. HOWEVER PARTS OF THE DISTRIBUTION SYSTEM ARE OVER 50 YEARS OLD. DETERIORATION HAS RESULTED IN ONGOING WATER MAIN AND SERVICE LINE FAILURES, RESULTING IN CHRONIC LEAKAGE AND AN INFLATED AVERAGE WATER USE RATE OF 244 GALLONS PER CAPITA PER DAY. A PRELIMINARY ENGINEERING REPORT EVALUATING NEEDED UTILITY / PIPELINE REPAIRS WAS SUBMITTED TO THE UNITED STATES DEPARTMENT OF AGRICULTURE, RURAL DEVELOPMENT (USDA RD), APRIL 2020.

SIGNIFICANT PRIOR PROJECTS:

1976 ORIGINAL SYSTEM CONSTRUCTION

DIRECT FILTRATION SYSTEM WITH (4) 84" DIAMETER PRESSURE FILTERS, WITH A DESIGN FLOW OF 308 GPM, FOR A LOADING RATE OF 2 GPM/SQFT.

2005-2009 ANTHC PROJECT AN 05-RA5

A WTP RENOVATION PROJECT THAT RETROFITTED THE (4) ORIGINAL FILTER VESSELS WITH NEW UNDERDRAINS AND AN AIR SCOUR SYSTEM, PROVIDED NEW INSTRUMENTATION (TURBIDIMETERS), COAGULANT CONTROL (STREAMING CURRENT DETECTOR), AND IMPROVED CHEMICAL STORAGE AND HANDLING FACILITIES. THE DESIGN FLOW WAS REDUCED TO 225 GPM FOR A LOADING RATE OF 1.5 GPM/SQFT (HOWEVER NEW PUMPS WERE NOT INSTALLED UNTIL THE SUBSEQUENT INTAKE RENOVATION).

2009-2011: ANTHC PROJECT AN-09-NK3

A SOURCE WATER INTAKE RENOVATION PROJECT THAT REPLACED THE DETERIORATED BOARDWALK AND INTAKE BOX, AND PROVIDED (2) NEW WELL PUMPS AT 10 HP EA, AND COMPRESSED AIR / PIGGING SYSTEMS, TO MANAGE DEBRIS/ALGAE ACCUMULATION IN THE INTAKE LINE. NEW INTAKE PUMPS PROVIDED AN INTAKE FLOW OF 225 GPM (AT A TOTAL DYNAMIC HEAD OF 266 FT).

RENOVATED SYSTEM DESIGN CRITERIA

(BASED ON PROJECTED 2030 DESIGN LIFE, ANTHC AN-05-RA5)

DESIGN POPULATION	675
DAILY AVERAGE DEMAND (GPD)	81,000
DOCK FACILITY DEMAND (GPD)	7,000
DISTRIBUTION LOSSES (GPD)	100,000
TOTAL DESIGN DEMAND (GPD)	188,000
AVERAGE DESIGN FLOW RATE (GPM)	130
PEAKING FACTOR	2
MAX DAILY DEMAND (GPD)	276,000
DESIGN FLOW RATE (GPM)	225

2020 CURRENT SYSTEM SUMMARY:

PUBLIC WATER SYSTEM ID (PWSID)	2130017
PUBLIC WATER SYSTEM DESIGNATION	COMMUNITY
SOURCE DESIGNATION:	SURFACE WATER, BIN 1
PRIMARY SOURCE:	AUK' TAH LAKE
WATER RIGHTS (DATE/NUMBER)	11/22/1988 LAS 12057
1988 WATER RIGHTS (GPD)	432,000
2020 WATER RIGHTS (GPD)	0 (EXPIRED 1993, LAS 12057)
POPULATION SERVED	404
AVERAGE ANNUAL POPULATION GROWTH RATE (2020, ADOL&WD)	-1.2%
SERVICE CONNECTIONS (ADEC)	159
TOTAL DAILY DEMAND (ALL USES AND LOSSES, GPD)	100,000
TOTAL AVERAGE DAILY USER DEMAND (GPCD)	244
WTP OPERATIONAL FLOW RATE (INTAKE AND FILTRATION RATE, GPM)	80
WST-1: TOTAL WTP WATER STORAGE AND CT (GALLONS)	500,000
WST-1: MINIMUM WATER STORAGE RESERVED FOR CT (GALLONS)	250,000
WST-2: MID TOWN WATER TOWER WATER STORAGE (GALLONS)	500,000
WST-3: SCHOOL WATER STORAGE (GALLONS)	150,000

2040 DESIGN CRITERIA

(BASED ON 2020 GROWTH RATE OF -1.2% PER YEAR)

POPULATION	314
AVERAGE DAILY DEMAND (GPCD)	244
TOTAL PROJECTED DAILY DEMAND BASED ON POP (GPD)	76,616
DESIGN PRODUCTION RATE (GPM)	225
TOTAL DYNAMIC HEAD (FT)	266

THE ACCURACY OF FUTURE POPULATION PROJECTIONS IS IMPACTED BY THE CURRENT ECONOMIC SITUATION IN THE COMMUNITY, AS WELL AS DEVELOPMENT LIMITATIONS IMPOSED BY LIMITED ABILITY TO EXPAND WATER SERVICES. PLANS FOR IMPROVED SITE ACCESS (INCLUDING AIRPORT DEVELOPMENT), AND AN IMPROVED SOURCE WATER INTAKE SYSTEM, WOULD HAVE A BENEFICIAL IMPACT ON FUTURE POPULATION GROWTH.

THE 2040 DESIGN CRITERIA ASSUMED NO CHANGE IN WATER DEMAND OR LEAKAGE RATE. ADDRESSING THE DISTRIBUTION SYSTEM DETERIORATION, AND SYSTEM LEAKS, WOULD DECREASE DAILY DEMAND, AND HAVE A SIGNIFICANT IMPACT ON FUTURE DEMAND PROJECTIONS. FOR THE PURPOSES OF THIS REPORT, THE CURRENT TOTAL WATER USE RATE PER CAPITA (244 GPD), WHICH INCLUDES LOSSES, WAS USED WITH A FUTURE PROJECTED POPULATION BASED ON THE CURRENT GROWTH RATE OF -1.2% PER YEAR.

DESIGN OF SYSTEM PROCESSES IN THE 2007 WTP RENOVATION WAS BASED ON A TREATMENT DESIGN FLOW RATE OF 225 GPM. THIS RATE EQUATES TO A FILTER LOADING RATE OF 1.5 GPM/SQFT. THIS DESIGN FLOW RATE IS BASED ON TREATMENT EFFICACY AND IS ASSUMED FOR THE SOURCE WATER PRODUCTION RATE FOR 2040. THE CURRENT PUMPING RATE OF 80 GPM WAS NOT USED.

AFTER THE WTP AND INTAKE SYSTEM RENOVATIONS WERE COMPLETED, VARIABLE SPEED CONTROLLERS WERE ADDED TO THE INTAKE PUMP SYSTEM. THE SYSTEM THEN REDUCED THE INTAKE PUMP RATE TO APPROXIMATELY 80 GPM OPERATING CONTINUOUSLY. THIS EQUATES TO A FILTER LOADING RATE OF 0.5 GPM/SQFT. THIS LOADING RATE IS MUCH LESS THAN THE FILTER DESIGN AND COULD RESULT IN ISSUES WITH FILTER PERFORMANCE. THIS INTAKE PUMP RATE WAS NOT ASSUMED IN THE PRELIMININARY ESTIMATES FOR A NEW INTAKE.

ANGOON WATER SOURCE PER AN 19-1UR

NEW IMPOUNDMENT CRITERIA*

CONSTRUCTION TYPE	STEEL REINFORCED CONCRETE	
FOUNDATON	CONCRETE EMBEDMENT INTO BEDROCK	
MIN DEPTH FOUNDATION EMBEDMENT	3-5	FT
HEIGHT AT CENTER (WITH FREEBOARD)	16	FT
FREEBOARD	2	FT
TOP SPAN LENGTH	150	LF
BASE SPAN LENGTH	50	FT
TOP WIDTH	2	FT
BASE WIDTH	10	FT
OVERFLOW	ARMORED	
PRESSURE RELIEF WELLS	6	
PRESSURE RELIEF WELL DIAMETER	6	INCHES
PRESSURE RELIEF WELL SPACING	8-10	ON CENTER
PRESSURE RELIFE WELL DEPTH	20	FT

OVERLOW ARMORED, SEASONAL SLUICE GATES, DIVERSION STRUCTURE, PRESSURE RELIEF WELLS (10 FT SLOTTED SCREEN AT BASE, SCREENED TOP), INTAKE SCREEN FOR SEDIMENT CONTROL.

NEW ACCESS ROAD*

CONSTRUCTION TYPE	GRAVEL	
LENGTH	15000	LF
WIDTH	14	FT
MAX GRADE	10	%
CROWN (TYPICAL)	2	%
PULL-OUT INTERVAL	0.5	MILE

ALIGNMENT AND PROFILE TO MINIMIZE BEDROCK EXCAVATION. CONNECT TO EXISTING GRAVEL ROAD AT WTP. PROVIDE ROADSIDE DITCHES, CULVERTS AS NECESSARY. PROVIDE GRAVEL PARKING / TURNAROUND (40 FT X 40 FT) AT IMPOUNDMENT.

NEW RAW WATER TRANSMISSION LINE*

CONSTRUCTION TYPE	HDPE SDR 11	
LENGTH		
ALT 2 FROM IMPOUNDMENT, OR	15,000	LF
ALT 3 FROM INFILTRATION GALLERY	240	LF

DIAMETER	10 IN	
DESIGN FLOW	225 GPM	
VELOCITY	1-2 FT/SEC	
MAX HEADLOSS	2.0 FT/1,000 FT	
MAX STATIC PRESSURE	155 PSI	
ISOLATION VALVES	EVERY 1,000 FT	
CLEANOUTS AND DRAINS	EVERY 2,000 FT	
AIR RELEASE VACUUM VALVES	HIGH POINTS / GRADE BREAKS	
MIN DEPTH OF BURY	4 FT	

ALT 2 INSTALLED ALONG ROAD.
ALT 3 INSTALLED FROM NEW INFILTRATION GALLERIES ON AUK'TAH LAKE.
MARKERS ALONG ALIGNMENT. BEDDING AS PER MANUFACTURER.

VERTICAL INFILTRATION GALLERY (SHALLOW WELL) **

NUMBER OF WELLS (20 HP EA)	2	Operate in series, lead/lag, each sufficient to meet treatment flow
DEPTH	30 FT	Approx depth of Lake
TOTAL DYNAMIC HEAD	266 FT	To fill WST behind WTP
DESIGN FLOW	225 GPM	
MIN HORIZONTAL SEPARATION TO WW	200 FT	The backwash pond is across the street from the WTP counts
WATER LINE HEADER TO TRANSMISSION	HDPE SDR 11	
HEADER DIAM	8 IN	
HEADER FLOW	225 GPM	
HEADER LENGTH (EA)	20 LF	
MIN BURIED DEPTH	4 FEET	

INFILTRATION GALLERIES INSTALLED NEAR EXISTING INTAKE, ON EDGE OF AUK'TAH LAKE. INSTALLED APPROX 40 FEET APART. EACH FEEDS INTO TRANSMISSION LINE VIA 20 FT (8 IN DIAM) BURIED HEADER LINE.

SURFACE WATER INTAKE DESIGN - CHANNEL MOUNTED (NOT USED)***

MAX ENTRANCE VELOCITY	0.10 FPS	Max entrance velocity through screen openings
MAX AXIAL VELOCITY INSIDE SCREEN	3.00 FPS	So head loss is less than 1 foot, $V_A=2.228 * 10^{-3} * Q \text{ (gpm)} / \Pi * r(ft)^2$
RATE OF WATER ENTERING PACK	3 GPM/SQFT	3-5 gpm/sqft of surface area (Groundwater and Wells, 1987)
NUMBER OF INTAKE PIPES	1	Assume flow split equally if there are multiple intake pipes
INTAKE SCREEN DIAMETER	1 FEET	Screen diameter
AXIAL VELOCITY	0.64 FPS	$V_A=2.228 * 10^{-3} * Q \text{ (gpm)} / \Pi * r(ft)^2$
SCREEN SLOT SIZE	LESS THAN FILTER PACK GRAIN SIZE	retain 100% filter pack
FILTER PACK SURFACE AREA NEEDED	75 SQFT	

LENGTH OF SCREEN DEPENDS ON BANK MOUNT (PARALLEL TO STREAM / PERPENDICULAR TO GW FLOW) OR BED MOUNT (3'-5' BELOW BED)

THIS METHOD DOESN'T NOT PROVIDE ANY RAW WATER STORAGE AND IS DEPENDENT ON UN-INTERRUPTED, YEAR-ROUND STREAM FLOW. QUALITY OF WATER LIKELY IMPACTED BY STREAM BED ORGANICS/DEBRIS. CONSIDER VERTICAL INFILTRATION GALLERY ON EDGE OF CURRENT LAKE, TO ENSURE ADEQUATE RAW WATER QUANTITY IS AVAILABLE.

* INCLUDES INFORMATION FROM FAVORITE CREEK HYDROLOGY STUDY, CRW/GOLDER, 2010; ANTHC DESIGN DRAWINGS FOR SAXMAN WATER SOURCE, SAX-16-006 (2019, JOSEPH HESS PE), ANGOON WATER SOURCE GEOTECHNICAL CONSIDERATIONS, GOLDER, 2020.
** INCLUDES INFORMATION FROM ANTHC PROJECTS AN 05-RA5 AND AN-09-NK3.
*** INCLUDES INFORMATION FROM ANGOON WATER SOURCE GEOTECHNICAL CONSIDERATIONS, GOLDER, 2020.

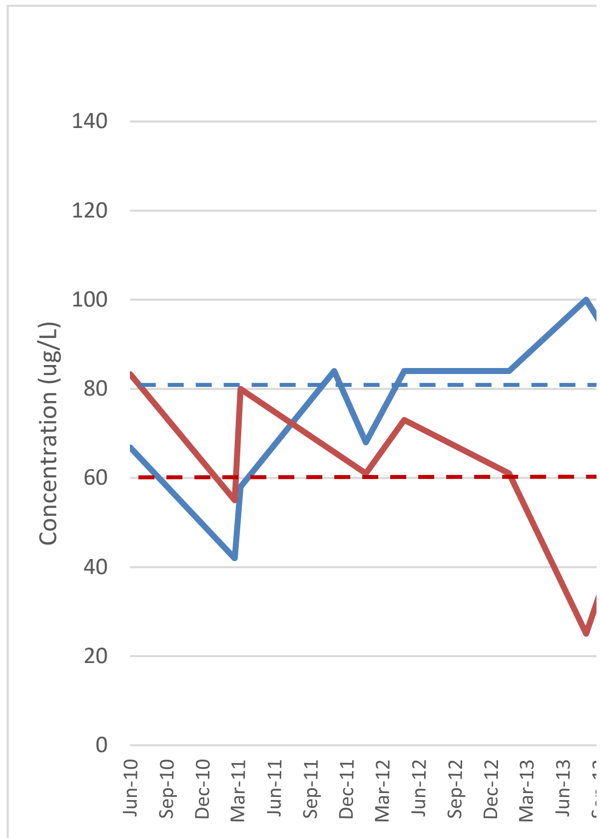
Angoon CT

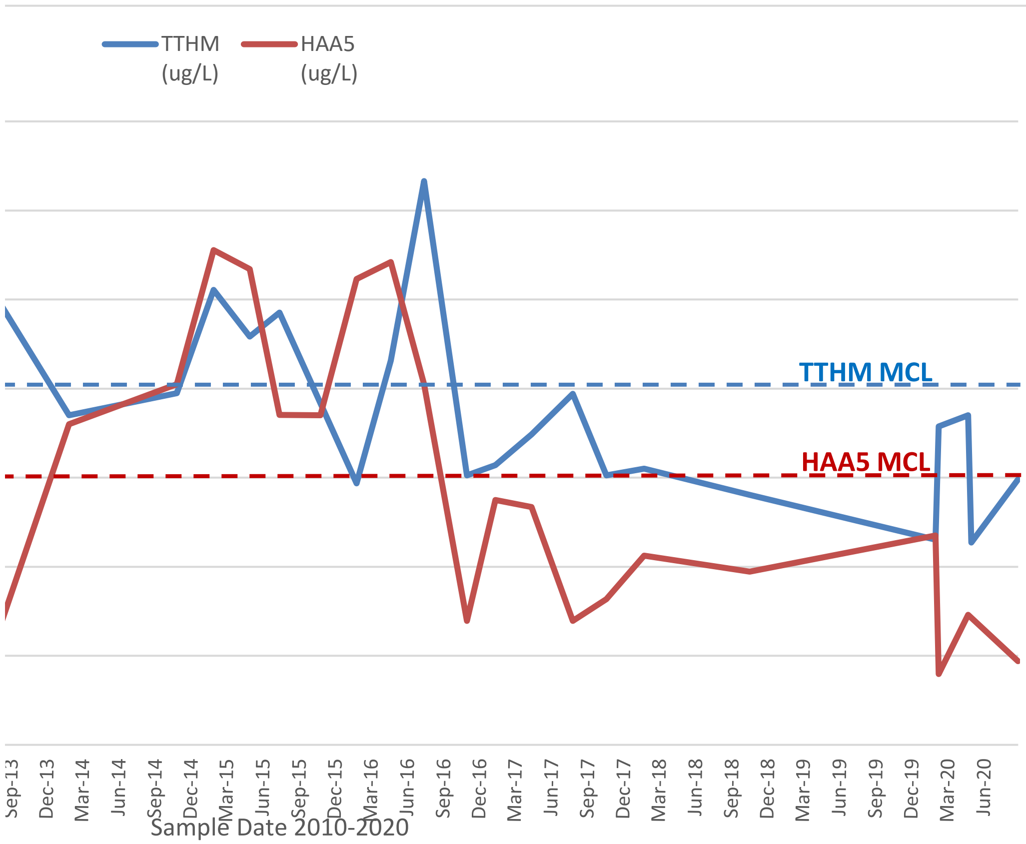
		CASE 1	CASE 2	CASE 3
	CT CALCULATOR *ENTER DATA IN SHADED CELLS*			
(0 to 25° C)	**Water Temperature** (° C)	**5.0**	**5.0**	**5.0**
(6.5-8.5)	**pH**	**7.3**	**7.3**	**7.3**
(NLT .2)	**Free Chlorine Residual** (mg/l)	**0.20**	**0.20**	**0.20**
(0 to 3)	**Log Inactivation** Required	**1.0**	**1.0**	**1.0**
	CT = Log Inactivation* 5.057 * $e^{(a+b+c)}$			
	a = -0.0693 *temp	(0.35)	(0.35)	(0.35)
	b = 0.361* pH	2.64	2.64	2.64
	c = 0.113 * Free Cl Residual	0.02	0.02	0.02
	REQUIRED CT (min*(mg /liter))=	**51**	**51**	**51**
	Required Contact Time (min) = CT / (Free Cl Residual) =	**255**	**255**	**255**
	Achieved CT	25	7	50
	Design Flow Rate (gpm)	**200**	**200**	**200**
	CT Storage Volume (gal)	**250,000**	**7,300**	**500,000**
	Baffle Factor (0.1 to 1.0)	**0.1**	**0.9**	**0.1**
Effective Storage (gal) = (Storage * Baffle Factor)		25,000	6,570	50,000
Storage Time (min) @ Flow Rate = Eff. Storage / Des Flow Rate		125	33	250
Excess contact time (mins) = (Storage Time - Contact Time)		(130)	(222)	(5)
Achieved Inactivation		0.49	0.13	0.98

Note: Excess Contact Time must be positive under all operating conditions!

Angoon DBP Data Dump, provided by DEC (Charity Bare) 12/8/20

Sample Date	TTHM (ug/L)	HAA5 (ug/L)
9/24/2020	59.6	18.8
5/29/2020	45.4	
2/28/2020	46.1	47
5/21/2020	74	29.2
3/7/2020	71.5	15.9
11/14/2018	56.1	38.9
2/20/2018	62	42.5
11/16/2017	60.5	32.7
8/23/2017	78.8	27.8
5/11/2017	69.7	53.4
2/8/2017	62.8	55
11/28/2016	60.5	27.8
8/11/2016	126.6	81
5/19/2016	86.3	108.4
2/22/2016	58.7	104.6
11/23/2015		74
8/11/2015	97.1	74.1
5/28/2015	91.7	106.8
2/25/2015	102.2	111.1
11/24/2014	79	81
2/24/2014	74	72
8/27/2013	100	25
2/13/2013	84	61
5/23/2012	84	73
2/16/2012	68	61
11/28/2011	84	
4/4/2011	58	80
3/21/2011	42	55
3/20/2011	42	
6/29/2010	66.8	83.3



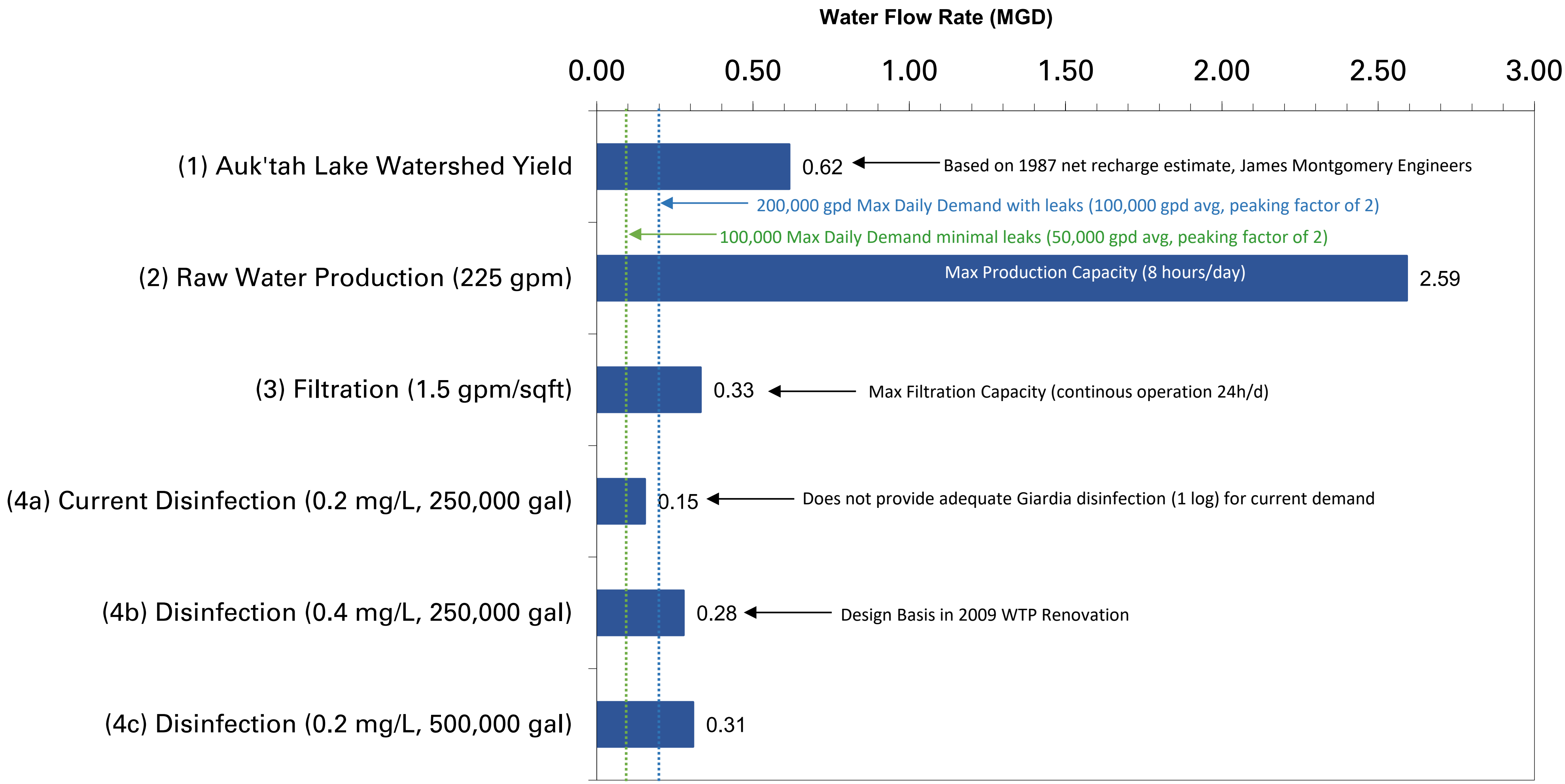


TTHM (ug/L)
HAA5 (ug/L)
TTHM MCL
HAA5 MCL
Sep-13
Dec-13
Mar-14
Jun-14
Sep-14
Dec-14
Mar-15
Jun-15
Sep-15
Dec-15
Mar-16
Jun-16
Sep-16
Dec-16
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18
Jun-18
Sep-18
Dec-18
Mar-19
Jun-19
Sep-19
Dec-19
Mar-20
Jun-20
Sample Date 2010-2020

Lowest and highest values from MORs (provided by DEC)

	CFE		Chlorine	
	lowest NTU	highest NTU	lowest	highest
1/1/2019	0.02	0.08	0.20	0.25
2/1/2019				
3/1/2019	0.03	0.08	0.20	0.25
4/1/2019	0.02	0.08	0.20	0.24
5/1/2019	0.02	0.07	0.20	0.25
6/1/2019				
7/1/2019	0.03	0.07	0.20	0.25
8/1/2019				
9/1/2019	0.03	0.06	0.22	0.25
10/1/2019	0.03	0.07	0.20	0.26
11/1/2019	0.03	0.07	0.21	0.25
12/1/2019	0.04	0.07	0.21	0.25
1/1/2020	0.05	0.08	0.21	0.24
2/1/2020	0.05	0.08	0.25	0.27
3/1/2020	0.05	0.07	0.21	0.30
4/1/2020	0.04	0.07	0.21	0.25
5/1/2020	0.03	0.08	0.21	0.26
6/1/2020	0.04	0.08	0.21	0.25
7/1/2020	0.04	0.07	0.21	0.25
8/1/2020	0.04	0.07	0.21	0.25
9/1/2020	0.03	0.06	0.21	0.25
10/1/2020	0.03	0.07	0.21	0.26

Major Unit Process Evaluation - Angoon Water Treatment Plant



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APPENDIX E: COST ESTIMATE

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Angoon Alaska
New Water Source
ANTHC Project No. 21-D-94328

Construction Cost Estimate
100% PER Estimate
April 6, 2021

Prepared for:
Bristol Engineering Service Company, LLC
Anchorage, AK 99501-5109
907.743.9356

ESTIMATIONS
1225 E. International Airport Road, Suite 205
Anchorage, Alaska 99518
907.561.0790

ANTHC Angoon Water Source 100% PER Estimate
ESTIMATIONS, INC

Description	Cost
Option 2 - New Water Source	$8,956,449
Option 3 - Infiltration Galleries	$1,233,408
Option 4 - Rebuild Intake	$1,718,950

Option 2 - New Water Source

SUMMARY
ANTHC Angoon Water Source PER 100% Submittal - Option 2 - New Water Source
Angoon Water Source Option 2 New Water Source Final PER
ESTIMATIONS, INC

Line No.	Pay Item No.	Description Subtotal Description	Quantity	Unit of Measure	Unit Price	Total Price
		Proposal				
01	01	General Requirements	1.00	MTH	1,374,665.87	1,374,665.87
02	02	Equipment	1.00	EA	636,982.56	636,982.56
03	03	Design Phase 10%	1.00	EA	736,950.00	736,950.00
04	04	Geotechnical Investigation	1.00	EA	350,000.00	350,000.00
05	05	EIS	1.00	EA	500,000.00	500,000.00
06	06	Construction Contingency 14% of Construction	1.00	EA	759,864.00	759,864.00
07	07	Estimating Contingency 12% of Construction	1.00	EA	651,312.00	651,312.00
08	08	Escalation for Inflation 9.0%	1.00	EA	488,484.00	488,484.00
09	09	Impoundment	1.00	LS	942,372.92	942,372.92
10	10	Pressure Relief Wells	6.00	EA	30,000.00	180,000.00
11	11	Raw Water Transmission Line	16,500.00	LF	76.68	1,265,220.00
12	12	Gravel Road, 14' W	15,000.00	LF	67.45	1,011,750.00
13	13	Gravel Parking/Turnaround area at Dam	1,600.00	SF	36.78	58,848.00
					GRAND TOTAL:	8,956,449.35

Pay Item Assignment	Description	Forecast (T/O) Quantity	Unit of Measure	Unit Cost	Total Cost (Forecast)	Man-Hours (Total)	Labor Total Cost	Owned Equipment Total Cost	Rented Equipment Total Cost	Materials Total Cost	Subcontract Total Cost
01 (General Requirements)					$1,374,665.87	5,039.00	$625,051.32	$4,028.55	$0.00	$745,586.00	$0.00
01	SWPPP BMPs	500.00	LF	$5.00	$2,500.00	0.00	$0.00	$0.00	$0.00	$2,500.00	$0.00
01	ANTHC Construction Manager	7.00	MTH	$37,800.00	$264,600.00	1,470.00	$264,600.00	$0.00	$0.00	$0.00	$0.00
01	Shipping and Receiving - Construction	1.00	Each	$3,960.00	$3,960.00	220.00	$3,960.00	$0.00	$0.00	$0.00	$0.00
01	Freight	1,979,200.00	LB	$0.32	$636,208.60	650.00	$44,540.04	$4,028.55	$0.00	$587,640.00	$0.00
01	O&M Training	1.00	Each	$24,229.15	$24,229.15	269.00	$24,229.15	$0.00	$0.00	$0.00	$0.00
01	Travel - Construction Closout	4.00	Each	$934.00	$3,736.00	0.00	$0.00	$0.00	$0.00	$3,736.00	$0.00
01	Contracting and Purchasing	1.00	Each	$5,509.48	$5,509.48	50.00	$5,509.48	$0.00	$0.00	$0.00	$0.00
01	Travel - Construction	61.00	Each	$934.00	$56,974.00	0.00	$0.00	$0.00	$0.00	$56,974.00	$0.00
01	Freight - Demobilization (Equip. and M	480,100.00	LB	$0.30	$145,043.55	150.00	$10,043.55	$0.00	$0.00	$135,000.00	$0.00
01	Post Construction	1.00	Each	$42,243.38	$42,243.38	469.00	$42,243.38	$0.00	$0.00	$0.00	$0.00
01	Survey	1.00	Each	$20,569.32	$20,569.32	360.00	$20,569.32	$0.00	$0.00	$0.00	$0.00
01	ANTHC Project Superintendent	7.00	Month	$34,804.16	$243,629.09	1,820.00	$243,629.09	$0.00	$0.00	$0.00	$0.00
01	Freight - Mobilization (Equip and Mat	1,499,100.00	LB	$0.33	$491,165.05	500.00	$34,496.50	$4,028.55	$0.00	$452,640.00	$0.00
01	Final Inspection - On Site	1.00	Each	$18,014.24	$18,014.24	200.00	$18,014.24	$0.00	$0.00	$0.00	$0.00
01	Housing & Utilities	7.00	MTH	$13,000.00	$91,000.00	0.00	$0.00	$0.00	$0.00	$91,000.00	$0.00
01	Travel - Early	4.00	Each	$934.00	$3,736.00	0.00	$0.00	$0.00	$0.00	$3,736.00	$0.00
01	Freight Equipment	480,100.00	LB	$0.30	$145,043.55	150.00	$10,043.55	$0.00	$0.00	$135,000.00	$0.00
01	Freight Materials	1,019,000.00	LB	$0.34	$346,121.50	350.00	$24,452.95	$4,028.55	$0.00	$317,640.00	$0.00
01	Pre Construction	1.00	Each	$93,500.00	$93,500.00	0.00	$0.00	$0.00	$0.00	$93,500.00	$0.00
01	Shipping and Receiving	1.00	Each	$3,960.00	$3,960.00	220.00	$3,960.00	$0.00	$0.00	$0.00	$0.00
01	Contracting & Purchasing	1.00	Each	$5,509.48	$5,509.48	50.00	$5,509.48	$0.00	$0.00	$0.00	$0.00
01	Travel	46.00	Each	$1,401.00	$64,446.00	0.00	$0.00	$0.00	$0.00	$64,446.00	$0.00
02 (Equipment)					$636,982.56	1,820.00	$245,686.86	$278,768.09	$23,467.60	$89,060.00	$0.00
02	Equipment	1.00	Each	$597,922.56	$597,922.56	1,820.00	$245,686.86	$278,768.09	$23,467.60	$50,000.00	$0.00
02	Fuel	7,000.00	Gallon	$5.58	$39,060.00	0.00	$0.00	$0.00	$0.00	$39,060.00	$0.00
02	Equipment Maintenance Labor	7.00	MTH	$35,098.12	$245,686.86	1,820.00	$245,686.86	$0.00	$0.00	$0.00	$0.00
02	ANTHC Equipment Cost	3.00	MTH	$117,411.90	$352,235.69	0.00	$0.00	$278,768.09	$23,467.60	$50,000.00	$0.00
03 (Design Phase 10%)		1.00			$736,950.00	0.00	$736,950.00	$0.00	$0.00	$0.00	$0.00
03	Design	1.00	Each	$736,950.00	$736,950.00	0.00	$736,950.00	$0.00	$0.00	$0.00	$0.00
03	**Design Phase**	1.00	Each	$1,586,950.00	$1,586,950.00	0.00	$736,950.00	$0.00	$0.00	$0.00	$850,000.00
03	Design Complete	1.00	Each	$1,586,950.00	$1,586,950.00	0.00	$736,950.00	$0.00	$0.00	$0.00	$850,000.00
04 (Geotechnical Investigation)		1.00			$350,000.00	0.00	$0.00	$0.00	$0.00	$0.00	$350,000.00
04	Geotech	1.00	Each	$350,000.00	$350,000.00	0.00	$0.00	$0.00	$0.00	$0.00	$350,000.00
05 (EIS)		1.00			$500,000.00	0.00	$0.00	$0.00	$0.00	$0.00	$500,000.00
05	EIS	1.00	Each	$500,000.00	$500,000.00	0.00	$0.00	$0.00	$0.00	$0.00	$500,000.00
06 (Construction Contingency 14%		1.00			$759,864.00	0.00	$379,932.00	$0.00	$0.00	$379,932.00	$0.00

Pay Item Assignment	Description	Forecast (T/O) Quantity	Unit of Measure	Unit Cost	Total Cost (Forecast)	Man-Hours (Total)	Labor Total Cost	Owned Equipment Total Cost	Rented Equipment Total Cost	Materials Total Cost	Subcontract Total Cost
06	Construction Contingency 14% of C	1.00	Each	$759,864.00	$759,864.00	0.00	$379,932.00	$0.00	$0.00	$379,932.00	$0.00
07 (Estimating Contingency 12% (		1.00			$651,312.00	0.00	$325,656.00	$0.00	$0.00	$325,656.00	$0.00
07	Design Contingency 12% of Constru	1.00	Each	$651,312.00	$651,312.00	0.00	$325,656.00	$0.00	$0.00	$325,656.00	$0.00
08 (Escalation for Inflation 9.0%)		1.00			$488,484.00	0.00	$244,242.00	$0.00	$0.00	$244,242.00	$0.00
08	Inflation 9.0% of Construction	1.00	Each	$488,484.00	$488,484.00	0.00	$244,242.00	$0.00	$0.00	$244,242.00	$0.00
09 (Impoundment)					$942,372.92	4,055.57	$357,826.40	$112,314.36	$75,880.00	$396,352.16	$0.00
09	Custom Aluminum Weir (Waterman	1.00	Each	$71,000.00	$71,000.00	0.00	$6,000.00	$5,000.00	$0.00	$60,000.00	$0.00
09	Access Hatch 36x48	1.00	Each	$4,100.00	$4,100.00	0.00	$600.00	$0.00	$0.00	$3,500.00	$0.00
09	Haul/Place	200.00	CY	$66.09	$13,217.11	66.67	$4,785.17	$8,431.93	$0.00	$0.00	$0.00
09	Purchase/Deliver	200.00	CY	$230.50	$46,100.00	0.00	$0.00	$0.00	$0.00	$46,100.00	$0.00
09	Divit Crane	1.00	Each	$7,500.00	$7,500.00	0.00	$1,500.00	$0.00	$0.00	$6,000.00	$0.00
09	Earthwork	12.00	LF	$425.00	$5,100.00	0.00	$1,600.00	$3,000.00	$0.00	$500.00	$0.00
09	Anchor Bolts	13.00	Each	$381.95	$4,965.38	9.00	$690.38	$375.00	$0.00	$3,900.00	$0.00
09	Lid	96.00	SF	$25.09	$2,408.44	0.00	$0.00	$0.00	$0.00	$2,408.44	$0.00
09	Railings	50.00	LF	$326.55	$16,327.71	33.50	$1,327.71	$0.00	$0.00	$15,000.00	$0.00
09	Concrete	1.33	CY	$2,642.08	$3,513.97	20.00	$1,614.94	$843.43	$0.00	$1,055.60	$0.00
09	Vault	1.00	Each	$99,730.34	$99,730.34	480.00	$47,399.33	$11,567.02	$9,291.43	$31,472.57	$0.00
09	Overflow Wall	320.00	SF	$124.04	$39,692.89	240.00	$20,399.66	$5,783.51	$4,645.71	$8,864.00	$0.00
09	Base	100.00	SF	$17.68	$1,768.13	0.00	$0.00	$0.00	$0.00	$1,768.13	$0.00
09	Walls	640.00	SF	$121.02	$77,453.77	480.00	$40,799.33	$11,567.02	$9,291.43	$15,796.00	$0.00
09	Excavation for Cutoff Walls	8.00	CY	$89.21	$713.69	6.40	$513.69	$200.00	$0.00	$0.00	$0.00
09	Riprap Class IV Overtopping Protect	200.00	CY	$296.59	$59,317.11	66.67	$4,785.17	$8,431.93	$0.00	$46,100.00	$0.00
09	Piping, Valves, and Screens	1.00	Each	$14,000.00	$14,000.00	0.00	$6,000.00	$0.00	$0.00	$8,000.00	$0.00
09	Stairway	12.00	LF	$717.83	$8,613.97	20.00	$3,214.94	$3,843.43	$0.00	$1,555.60	$0.00
09	Impoundment	1.00	Each	$3,458,203.04	$3,458,203.04	6,833.56	$564,629.59	$1,136,395.86	$75,880.00	$1,501,297.60	$180,000.00
09	Concrete Cutoff Wall	1,600.00	SF	$396.57	$634,511.83	3,200.00	$271,995.51	$77,113.46	$61,942.86	$223,460.00	$0.00
10 (Pressure Relief Wells)		6.00			$180,000.00	0.00	$0.00	$0.00	$0.00	$0.00	$180,000.00
10	Pressure Relief Wells	6.00	Each	$30,000.00	$180,000.00	0.00	$0.00	$0.00	$0.00	$0.00	$180,000.00
11 (Raw Water Transmission Line)		16,500.00			$1,265,238.38	0.00	$0.00	$857,838.38	$0.00	$407,400.00	$0.00
11	Raw Water Transmission Line 10" H	16,500.00	LF	$76.68	$1,265,238.38	0.00	$0.00	$857,838.38	$0.00	$407,400.00	$0.00
12 (Gravel Road, 14' W)					$1,011,750.05	2,684.81	$199,824.30	$160,620.82	$0.00	$651,304.93	$0.00
12	Surface Course	1,125.00	CY	$88.54	$99,610.67	123.75	$9,323.73	$9,286.94	$0.00	$81,000.00	$0.00
12	Subbase	60.00	CY	$24.29	$1,457.27	4.40	$331.51	$405.76	$0.00	$720.00	$0.00
12	Subbase	12,567.00	CY	$24.29	$305,225.78	921.58	$69,434.84	$84,986.94	$0.00	$150,804.00	$0.00
12	Creek Crossings	3.00	EA	$10,697.72	$32,093.15	210.00	$14,968.36	$12,774.79	$0.00	$4,350.00	$0.00
12	Geofabric	15,000.00	SY	$11.93	$178,941.67	900.00	$66,283.92	$16,407.76	$0.00	$96,249.99	$0.00
12	Turnouts	3,000.00	SF	$36.78	$110,328.18	174.73	$13,085.43	$10,541.81	$0.00	$86,700.94	$0.00

Pay Item Assignment	Description	Forecast (T/O) Quantity	Unit of Measure	Unit Cost	Total Cost (Forecast)	Man-Hours (Total)	Labor Total Cost	Owned Equipment Total Cost	Rented Equipment Total Cost	Materials Total Cost	Subcontract Total Cost
12	Surface Course	4,350.00	CY	$88.54	$385,161.26	478.50	$36,051.75	$35,909.51	$0.00	$313,200.00	$0.00
12	Geofabric	776.25	SY	$11.93	$9,260.23	46.58	$3,430.19	$849.10	$0.00	$4,980.94	$0.00
12	Gravel Road 14'W	15,000.00	LF	$67.45	$1,011,750.05	2,684.81	$199,824.30	$160,620.82	$0.00	$651,304.93	$0.00
13 (Gravel Parking/Turnaround ar					$58,841.69	93.19	$6,978.90	$5,622.30	$0.00	$46,240.50	$0.00
13	Geofabric	414.00	SY	$11.93	$4,938.79	24.84	$1,829.44	$452.85	$0.00	$2,656.50	$0.00
13	Surface Course	600.00	CY	$88.54	$53,125.69	66.00	$4,972.66	$4,953.04	$0.00	$43,200.00	$0.00
13	Subbase	32.00	CY	$24.29	$777.21	2.35	$176.81	$216.41	$0.00	$384.00	$0.00
13	Gravel Parking/Turnaround area at	1,600.00	SF	$36.78	$58,841.69	93.19	$6,978.90	$5,622.30	$0.00	$46,240.50	$0.00
					$8,956,461.47	13,692.56	$3,122,147.77	$1,419,192.51	$99,347.60	$3,285,773.60	$1,030,000.00

Overview

Job Code: Angoon Water Source Option 2 New Water Source Final PER
Job Description: ANTHC Angoon Water Source PER 100% Submittal - Option 2 - New Water Source
Notes: Documents

Angoon Water Source
Preliminary Engineering Report
ANTHC Porject Number ANTHC 21-D-94328
100% Submittal
April 2021

Schedule
Construction - Spring 2024
Duration - 7 Months

Notes & Assumptions
Local Labor
Force Account
Equipment will be barged to and from the project site from Anchorage

Estimator
Jay Lavoie, Estimations, Inc.
jay@estimations.com, 907-561-0755

Methodology
Estimate is priced with current material prices
Labor and production based on estimators experience
Labor rates provided by ANTHC
Lodging assumed to be a rental house budgeted at $2500/month plus $19/md incidentals.

Project Scope
Impoundment (approx 1 month storage)
Steel reinforced, cast-in-place concrete, armored overflow weir, inlet and outlet armoring with energy dissipation, seasonal sluice gates, diversion structure and wells to allow pressure relief. See attached description and figures.
16' tall (includes 2' freeboard)
150' long crest at top, 50' long at base
2' wide at top, 10' wide at base
6 ea Pressure relief wells along downstream base (6" Diameter, 8-10 feet OC, set 20 feet into rock surface with 10' slotted screen at bottom and top of casing screened)

Raw Water Transmission Line, connect to existing raw water line near current source
16,500 LF Raw Water Transmission Line and Power (along road easement, closest power is at WTP)
10 inch, HDPE SDR 11, NSF 61, isolation valves every 1,000 ft, cleanouts/drains every 2,000 ft, buried 4' deep

Gravel road to impoundment, connect to existing roadway at WTP (roadway to current intake is narrow, will need to be rebuilt)

15,000	LF	Gravel road, 14' wide (crosses 3 creeks)
1,600	SQFT	Gravel parking / turnaround area at dam (approx 40' x 40')

Documents
vw 005 32210029_Angoon PER_Figs1-10_12042020.pdf
Angoon Cost Estimate Summary.xlsx
Date: December 2020

Estimate Class - 4 - Based on 1-15% project definition and estimating methodology is primarily Stochastic.

Time on site 7 months.
Labor rates are based on 2020 ANTHC labor rates.
Materials will be subject to Buy American.
Project work hours - 6 day - 10 hours per week.
Project delivery method - Force Account
Project Construction Year - 2024
Travel - 61 Trips and per diem for 2 day per trip.
Inflation - 3.5%/year x 2.5 year = 9.0% (Construction 2024/Design 2023)
Construction Contingency - 14% of Construction cost.
Estimating Contingency - 12% of Construction.

Cost Item CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
3	1.00	Each	Design Phase	0.00	0.00	Detail	U.S. Dollar	1,586,950.00	1,586,950.00
3.3	1.00	Each	IFC (95 to IFC)	0.00	0.00	Detail	U.S. Dollar	1,586,950.00	1,586,950.00
3.3.7	1.00	Each	Design Complete	0.00	0.00	Detail	U.S. Dollar	1,586,950.00	1,586,950.00
3.3.7.1	1.00	Each	Design	0.00	0.00	Plug	U.S. Dollar	736,950.00	736,950.00
3.3.7.2	1.00	Each	Geotech	0.00	0.00	Plug	U.S. Dollar	350,000.00	350,000.00
3.3.7.3	1.00	Each	EIS	0.00	0.00	Plug	U.S. Dollar	500,000.00	500,000.00
4	1.00	Each	Construct Phase	932.91	0.00	Detail	U.S. Dollar	7,369,511.47	7,369,511.47
4.3	1.00	Each	Construction	886.01	0.00	Detail	U.S. Dollar	7,327,268.09	7,327,268.09
4.3.1	1.00	Each	General Conditions	365.00	0.00	Detail	U.S. Dollar	2,428,458.41	2,428,458.41
4.3.1.1	1.00	Each	Key Personnel	365.00	0.00	Detail	U.S. Dollar	528,798.41	528,798.41
4.3.1.1.2	7.00	MTH	ANTHC Construction Manager	147.00	0.05	Detail	U.S. Dollar	37,800.00	264,600.00

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
CONSTMGR4	Construction Manager 4	1,470.00	1.00	Each (hourly)	U.S. Dollar	180.00	264,600.00

Notes: 1 FTE

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.1.1.3	7.00	Month	ANTHC Project Superintendent	182.00	0.04	Detail	U.S. Dollar	34,804.16	243,629.09

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
SUPER3	Superintendent 3	1,820.00	1.00	Each (hourly)	U.S. Dollar	133.86	243,629.09

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.1.1.5	1.00	Each	Survey	36.00	0.03	Detail	U.S. Dollar	20,569.32	20,569.32

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
SURV4	Surveyor 4	360.00	1.00	Each (hourly)	U.S. Dollar	57.14	20,569.32

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.1.4	1.00	Each	Contingency	0.00	0.00	Detail	U.S. Dollar	1,899,660.00	1,899,660.00
4.3.1.4.1	1.00	Each	Construction Contingency 14% of Construction	0.00	0.00	Plug	U.S. Dollar	759,864.00	759,864.00
4.3.1.4.2	1.00	Each	Design Contingency 12% of Construction	0.00	0.00	Plug	U.S. Dollar	651,312.00	651,312.00
4.3.1.4.3	1.00	Each	Inflation 9.0% of Construction	0.00	0.00	Plug	U.S. Dollar	488,484.00	488,484.00

Notes: Assume construction in spring of 2022, basing on start of project not midpoint as start will be the buy out that is 1.5 year out. Inflation = (1+interest rate) raised to the n years, using interest rate of 3.5% annual = 1.035^1.5 = 1.053 or 5.3% inflation

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.2	1,979,200.00	LB	Freight	11.00	179,927.27	Detail	U.S. Dollar	0.32	636,208.60

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.2.1	1,499,100.00	LB	Freight - Mobilization (Equip and Materials)	8.00	187,387.50	Detail	U.S. Dollar	0.33	491,165.05
4.3.2.1.1	480,100.00	LB	Freight Equipment	3.00	160,033.33	Detail	U.S. Dollar	0.30	145,043.55

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
LLCL1	Crew Leader 1	30.00	1.00	Each (hourly)	U.S. Dollar	71.58	2,147.55
LLTD1	Truck Driver 1	30.00	1.00	Each (hourly)	U.S. Dollar	18.00	540.00
LLALAB	Local Labor	60.00	2.00	Each (hourly)	U.S. Dollar	77.14	4,628.22
BARGE	Barging		9.00	Day	U.S. Dollar	15,000.00	135,000.00
LLEO3	Equipment Operator 3	30.00	1.00	Each (hourly)	U.S. Dollar	90.93	2,727.78

Notes: Freight Equipment

Air Compressor		1	Each	5000	5,000
ATV Side By Side		1	Each	2000	2,000
ATV Trailer	1	Each	1000	1,000	
Cat 330 Excavator		1	Each	65000	65,000
De-Watering Pump		1	Each	1500	1,500
Dozer D6T	1	Each	57600	57,600	
Dump Truck	5	Each	16800	84,000	
Compactor	1	Each	20000	20,000	
ElectroFusion Machine	1	Each	500	500	
Four Jaw Fusion Machine	1	Each	500	500	
Four Wheeler	1	Each	2000	2,000	
Grader 14G	1	Each	47100	47,100	
Hydraulic Crane 25 Ton	1	Each	50000	50,000	
Hydraulic Excavator Mini	1	Each	7500	7,500	
Loader 980	1	Each	68900	68,900	
Pickup 4x4	1	Each	7000	7,000	
Rock Drill		1	Each	20000	20,000
Skid Steer - Bobcat 630	1	Each	5000	5,000	
Small Concrete Mixer	1	Each	10000	10,000	
Small dozer	1	Each	15500	15,500	
Misc Small Tool Connex	1	EA	10000	10,000	
Total					480,100

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.2.1.2	1,019,000.00	LB	Freight Materials	5.00	203,800.00	Detail	U.S. Dollar	0.34	346,121.50

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
FRT	Freight to Nondalton		193,000.00	LB	U.S. Dollar	0.48	92,640.00
BARGE	Barging Juneau - Angoon		15.00	Day	U.S. Dollar	15,000.00	225,000.00
LLCL1	Crew Leader 1	50.00	1.00	Each (hourly)	U.S. Dollar	71.58	3,579.25
LLTD1	Truck Driver 1	50.00	1.00	Each (hourly)	U.S. Dollar	18.00	900.00
LLALAB	Local Labor	200.00	4.00	Each (hourly)	U.S. Dollar	77.14	15,427.40
EL950	Loader 950	50.00	1.00	Each (hourly)	U.S. Dollar	75.56	3,778.00
LLEO3	Equipment Operator 3	50.00	1.00	Each (hourly)	U.S. Dollar	90.93	4,546.30

CBS Position Code	Quantity UM	Description		Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
		Cost Item							
FPLUM4	Plumber 4		0.83	1.00	Each (hourly)	U.S. Dollar		43.08	35.90
FPLUM4	Plumber 4		0.83	1.00	Each (hourly)	U.S. Dollar		43.08	35.90
FELEC3	Electrician 4		0.83	1.00	Each (hourly)	U.S. Dollar		18.00	15.00
LL2999	Laborer 3		1.67	2.00	Each (hourly)	U.S. Dollar		76.71	127.85
FPLUM4	Plumber 4		0.83	1.00	Each (hourly)	U.S. Dollar		43.08	35.90

Notes: Materials - freight

Anchor Bolts 13	EA	20	260		
Vault formwork	1376	SF	4	5,504	
Vault Concrete Agg/Cement34		CY	3500	119,000	
Vault Resteel 3400	LBS	1	3,400		
Access Hatch 1	EA	500	500		
Piping and Valves	1	LS	2500	2,500	
Overflow Wall - Forms	640	SF	4	2,560	
Overflow Wall - Resteel	1400	LBS	1	1,400	
Overflow Wall - Conc Agg/Cement		14	CY	3500	49,000
Weir 1	LS	10000	10,000		
Divit Crane 1	EA	1000	1,000		
Stair - Forms 68	SF	4	272		
Stair - Resteel	150	LBS	1	150	
Stair - Conc Agg/Cement	14	CY	3500	49,000	
Railings		50	LF	100	5,000
Rip Rap		200	CY	3000	600,000
Relief Wells	6	EA	2000	12,000	
Raw Water Line 4"		16500	LF	6	99,000
Geofabric 16000	SY	3	48,000		
Subtotal			1,009,546		
Allow for Misc			10,000		
Total (Rounded)				1,019,000	

Rip Rap and Conc from Juneau 817K
From Seattle 193K

Allow 250k per barge. 5 barge trips at 3 day/round trip

CBS Position Code	Quantity UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.2.3	480,100.00 LB	Freight - Demobilization (Equip. and Materials)	3.00	160,033.33	Detail	U.S. Dollar	0.30	145,043.55

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
LLALAB	Local Labor	60.00	2.00	Each (hourly)	U.S. Dollar	77.14	4,628.22
LLCL1	Crew Leader 1	30.00	1.00	Each (hourly)	U.S. Dollar	71.58	2,147.55
LLTD1	Truck Driver 1	30.00	1.00	Each (hourly)	U.S. Dollar	18.00	540.00
BARGE	Barging		9.00	Day	U.S. Dollar	15,000.00	135,000.00
LLEO3	Equipment Operator 3	30.00	1.00	Each (hourly)	U.S. Dollar	90.93	2,727.78

CBS Position Code	Quantity UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.3	46.00 Each	Travel	0.00	0.00	Detail	U.S. Dollar	1,401.00	64,446.00
4.3.3.1	4.00 Each	Travel - Early	0.00	0.00	Detail	U.S. Dollar	934.00	3,736.00

Estimate Details
ANTHC Angoon Water Source PER 100% Submittal - Option 2 - New Water Source
Angoon Water Source Option 2 New Water Source Final PER
ESTIMATIONS, INC

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
Resource Code	**Description**	**Hours**	**Quantity UM**		**Currency**	**Unit Cost**	**Total Cost**
AFARE	Air Fare - Anchorage to Angoon		4.00 Each		U.S. Dollar	500.00	2,000.00
PERDIEM	Per Diem		8.00 Each		U.S. Dollar	217.00	1,736.00
4.3.3.3	4.00 Each	Travel - Construction Closout	0.00	0.00 Detail	U.S. Dollar	934.00	3,736.00
Resource Code	**Description**	**Hours**	**Quantity UM**		**Currency**	**Unit Cost**	**Total Cost**
AFARE	Air Fare - Anchorage to Angoon		4.00 Each		U.S. Dollar	500.00	2,000.00
PERDIEM	Per Diem		8.00 Each		U.S. Dollar	217.00	1,736.00
4.3.3.4	61.00 Each	Travel - Construction	0.00	0.00 Detail	U.S. Dollar	934.00	56,974.00
Resource Code	**Description**	**Hours**	**Quantity UM**		**Currency**	**Unit Cost**	**Total Cost**
AFARE	Air Fare - Anchorage to Angoon		61.00 Each		U.S. Dollar	500.00	30,500.00
PERDIEM	Per Diem		122.00 Each		U.S. Dollar	217.00	26,474.00

Notes: Crew - 6 x 4 rt
Super 1 x 7 rt
CM 1 x 7 rt
eng 1 x 7 rt
Mechanic 1 x 4 rt
Survey 2 x 2 rt = 4 rt
Prefinal inspection 4 rt
Final inspection 4 rt
Total = 61 trips

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.4	1.00 Each	Shipping and Receiving	22.00	0.05 Detail	U.S. Dollar	3,960.00	3,960.00
4.3.4.3	1.00 Each	Shipping and Receiving - Construction	22.00	0.05 Detail	U.S. Dollar	3,960.00	3,960.00
Resource Code	**Description**	**Hours**	**Quantity UM**		**Currency**	**Unit Cost**	**Total Cost**
LL4000	Laborer 5	220.00	1.00 Each (hourly)		U.S. Dollar	18.00	3,960.00
4.3.5	1.00 Each	Contracting and Purchasing	5.00	0.20 Detail	U.S. Dollar	5,509.48	5,509.48
4.3.5.1	1.00 Each	Contracting & Purchasing	5.00	0.20 Detail	U.S. Dollar	5,509.48	5,509.48
Resource Code	**Description**	**Hours**	**Quantity UM**		**Currency**	**Unit Cost**	**Total Cost**
MATCOOR	Materials Coordinator	50.00	1.00 Each (hourly)		U.S. Dollar	110.19	5,509.48
4.3.6	1.00 Each	Fuel	0.00	0.00 Detail	U.S. Dollar	39,060.00	39,060.00
4.3.6.1	7,000.00 Gallon	Fuel	0.00	0.00 Detail	U.S. Dollar	5.58	39,060.00
Resource Code	**Description**	**Hours**	**Quantity UM**		**Currency**	**Unit Cost**	**Total Cost**
FUEL	Fuel		7,000.00 Gallon		U.S. Dollar	5.58	39,060.00

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
		Notes: Fuel for Misc. Most fuel in Equipment Rates					
4.3.7	1.00 Each	Pre Construction	0.00	0.00 Detail	U.S. Dollar	93,500.00	93,500.00
4.3.7.6	7.00 MTH	Housing & Utilities	0.00	0.00 Plug	U.S. Dollar	13,000.00	91,000.00
		Notes: $13k per month based on advice from ANTHC on other projects.					
4.3.7.7	500.00 LF	SWPPP BMPs	0.00	0.00 Detail	U.S. Dollar	5.00	2,500.00

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
SILTFENCE	Silt Fence & BMPs		500.00 LF	U.S. Dollar	5.00	2,500.00

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.8	1.00 Each	Equipment	206.00	0.00 Detail	U.S. Dollar	597,922.56	597,922.56
4.3.8.1	3.00 MTH	ANTHC Equipment Cost	24.00	0.13 Detail	U.S. Dollar	117,411.90	352,235.69

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
ATVSS	ATV Side By Side	240.00	1.00 Each (hourly)	U.S. Dollar	10.27	2,465.02
AIR COMPRESS	Air Compressor	240.00	1.00 Each (hourly)	U.S. Dollar	14.88	3,571.20
4J-FUSION	Four Jaw Fusion Machine	240.00	1.00 Each (hourly)	U.S. Dollar	1.14	272.73
E-FUSION	ElectroFusion Machine	240.00	1.00 Each (hourly)	U.S. Dollar	0.00	0.00
EXC-CAT330C	Cat 330 Excavator	240.00	1.00 Each (hourly)	U.S. Dollar	97.78	23,467.60
SKIDSTEER	Skid Steer - Bobcat 630	240.00	1.00 Each (hourly)	U.S. Dollar	28.81	6,915.36
PUMP	De-Watering Pump	240.00	1.00 Each (hourly)	U.S. Dollar	31.86	7,646.40
EQREPAIR ALLOW	Equipment Repair Allowance		1.00 EA	U.S. Dollar	50,000.00	50,000.00
ATVTRAILER	ATV Trailer	240.00	1.00 Each (hourly)	U.S. Dollar	5.00	1,200.00
DOZER D6	Dozer D6T	240.00	1.00 Each (hourly)	U.S. Dollar	94.88	22,770.00
END DUMP	Dump Truck	960.00	4.00 Each (hourly)	U.S. Dollar	92.17	88,483.20
ATV	Four Wheeler	240.00	1.00 Each (hourly)	U.S. Dollar	7.18	1,723.20
EG14G	Grader 14G	240.00	1.00 Each (hourly)	U.S. Dollar	68.48	16,435.20
ECRHC	Hydraulic Crane 25 Ton	240.00	1.00 Each (hourly)	U.S. Dollar	128.64	30,873.60
EXCAVATOR MINI	Hydraulic Excavator Mini	240.00	1.00 Each (hourly)	U.S. Dollar	27.48	6,595.36
ELOADER 980	Loader 980	240.00	1.00 Each (hourly)	U.S. Dollar	195.38	46,891.20
PICKUP	Pickup 4x4	240.00	1.00 Each (hourly)	U.S. Dollar	8.80	2,112.00
ROCKDRILL	Rock Drill	240.00	1.00 Each (hourly)	U.S. Dollar	125.00	30,000.00
CEMENT MIXER SM	Small Concrete Mixer	240.00	1.00 Each (hourly)	U.S. Dollar	35.03	8,408.31
DOZER	local small dozer no Rental fee.	240.00	1.00 Each (hourly)	U.S. Dollar	0.00	0.00
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	240.00	1.00 Each (hourly)	U.S. Dollar	0.00	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00

		Cost Item						
CBS Position Code	**Quantity UM**	**Description**	**Days**	**UM/Day**	**Cost Source**	**Currency**	**Unit Cost**	**Total Cost**
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar		18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar		76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar		18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar		76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FPLUM4	Plumber 4	4.00	1.00	Each (hourly)	U.S. Dollar		43.08	172.33
FPLUM4	Plumber 4	4.00	1.00	Each (hourly)	U.S. Dollar		43.08	172.33
FELEC3	Electrician 4	4.00	1.00	Each (hourly)	U.S. Dollar		18.00	72.00
LL2999	Laborer 3	8.00	2.00	Each (hourly)	U.S. Dollar		76.71	613.67
FPLUM4	Plumber 4	4.00	1.00	Each (hourly)	U.S. Dollar		43.08	172.33
FPLUM4	Plumber 4	4.00	1.00	Each (hourly)	U.S. Dollar		43.08	172.33
FPLUM4	Plumber 4	4.00	1.00	Each (hourly)	U.S. Dollar		43.08	172.33
FELEC3	Electrician 4	4.00	1.00	Each (hourly)	U.S. Dollar		18.00	72.00
LL2999	Laborer 3	8.00	2.00	Each (hourly)	U.S. Dollar		76.71	613.67
FPLUM4	Plumber 4	4.00	1.00	Each (hourly)	U.S. Dollar		43.08	172.33
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar		18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar		76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar		18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar		76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar		18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar		76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00

Notes: 2 month for mob/demob, 1 for standby

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.8.2	7.00	MTH	Equipment Maintenance Labor	182.00	0.04	Detail	U.S. Dollar	35,098.12	245,686.86

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
LLMECH3	Mechanic 3	1,820.00	1.00	Each (hourly)	U.S. Dollar	134.99	245,686.86

Notes: 1 FTE

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9	1.00	Each	Construction	277.01	0.00	Detail	U.S. Dollar	3,458,203.04	3,458,203.04
4.3.9.13	1.00	Each	Impoundment	277.01	0.00	Detail	U.S. Dollar	3,458,203.04	3,458,203.04
4.3.9.13.1	8.00	CY	Excavation for Cutoff Walls	0.16	50.00	Detail	U.S. Dollar	89.21	713.69

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
BLASTING	Blasting Supplies		0.00	CY	U.S. Dollar	5.00	0.00
ROCKDRILL	Rock Drill	1.60	1.00	Each (hourly)	U.S. Dollar	125.00	200.00
LL2999	Laborer 3	4.80	3.00	Each (hourly)	U.S. Dollar	76.71	368.20
EXCAVATOR CAT330	Hydraulic Excavator Cat 330	0.00	0.00	Each (hourly)	U.S. Dollar	157.80	0.00
END DUMP	Dump Truck	0.00	0.00	Each (hourly)	U.S. Dollar	92.17	0.00
LLEO3	Equipment Operator 3	1.60	1.00	Each (hourly)	U.S. Dollar	90.93	145.48
LLATRK	Local Truck Driver	0.00	0.00	Each (hourly)	U.S. Dollar	67.09	0.00

Notes: 50*2x2 = 200 cf/27 = 8 cy

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.2	13.00	Each	Anchor Bolts	0.30	43.33	Detail	U.S. Dollar	381.95	4,965.38

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
ROCKANCHORS	Rock Anchors 6'L Nominal		13.00	Each	U.S. Dollar	300.00	3,900.00
ROCKDRILL	Rock Drill	3.00	1.00	Each (hourly)	U.S. Dollar	125.00	375.00
LL2999	Laborer 3	9.00	3.00	Each (hourly)	U.S. Dollar	76.71	690.38

Notes: 50 lf /4 = 13 each

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.3	1,600.00	SF	Concrete Cutoff Wall	45.71	35.00	Detail	U.S. Dollar	396.57	634,511.83

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
RESTEEL	Reinforcing Steel 150 lb/cy		61,200.00	LB	U.S. Dollar	0.80	48,960.00
CEMENT MIXER SM	Small Concrete Mixer	457.14	1.00	Each (hourly)	U.S. Dollar	35.03	16,015.82
LLCARP3	Carpenter 3	914.29	2.00	Each (hourly)	U.S. Dollar	90.15	82,422.49
LLCL3	Crew Leader 3	457.14	1.00	Each (hourly)	U.S. Dollar	78.99	36,110.99
LL2999	Laborer 3	457.14	1.00	Each (hourly)	U.S. Dollar	76.71	35,067.06
LLALAB	Local Labor	457.14	1.00	Each (hourly)	U.S. Dollar	77.14	35,262.63
FORM WALLS	Formwork, Walls		3,200.00	SF	U.S. Dollar	3.50	11,200.00

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
CONC	Concrete - Rural, Presacked, Gravel and Cement		408.25 CY	U.S. Dollar	400.00	163,300.00
CONCPUMP	Concrete Pump	114.29	0.25 Each (hourly)	U.S. Dollar	350.00	40,000.00
RTP	Trash Pumps	914.29	2.00 Each (hourly)	U.S. Dollar	24.00	21,942.86
LLEO3	Equipment Operator 3	914.29	2.00 Each (hourly)	U.S. Dollar	90.93	83,132.35
ECRHC	Hydraulic Crane 25 Ton	457.14	1.00 Each (hourly)	U.S. Dollar	128.64	58,806.86
FPLUM4	Plumber 4	7.62	1.00 Each (hourly)	U.S. Dollar	43.08	328.25
FPLUM4	Plumber 4	7.62	1.00 Each (hourly)	U.S. Dollar	43.08	328.25
FELEC3	Electrician 4	7.62	1.00 Each (hourly)	U.S. Dollar	18.00	137.14
LL2999	Laborer 3	15.24	2.00 Each (hourly)	U.S. Dollar	76.71	1,168.90
FPLUM4	Plumber 4	7.62	1.00 Each (hourly)	U.S. Dollar	43.08	328.25

Notes: 150' Top / 50' Bottom, 16'H, 2'w top, 10'w bottom, avge width = 6'

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.4	1.00 Each	Vault	6.86	0.15 Detail	U.S. Dollar	99,730.34	99,730.34
4.3.9.13.4.1	100.00 SF	Base	0.00	0.00 Detail	U.S. Dollar	17.68	1,768.13

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
RESTEEL	Reinforcing Steel		53.91 LB	U.S. Dollar	0.80	43.12
CEMENT MIXER SM	Small Concrete Mixer	0.00	1.00 Each (hourly)	U.S. Dollar	35.03	0.00
LLCARP3	Carpenter 3	0.00	2.00 Each (hourly)	U.S. Dollar	90.15	0.00
LLCL3	Crew Leader 3	0.00	1.00 Each (hourly)	U.S. Dollar	78.99	0.00
LL2999	Laborer 3	0.00	1.00 Each (hourly)	U.S. Dollar	76.71	0.00
LLALAB	Local Labor	0.00	1.00 Each (hourly)	U.S. Dollar	77.14	0.00
CONC	Concrete - Rural, Presacked, Gravel and Cement		4.31 CY	U.S. Dollar	400.00	1,725.00
CONCPUMP	Concrete Pump	0.00	0.25 Each (hourly)	U.S. Dollar	350.00	0.00
RTP	Trash Pumps	0.00	2.00 Each (hourly)	U.S. Dollar	24.00	0.00
LLEO3	Equipment Operator 3	0.00	2.00 Each (hourly)	U.S. Dollar	90.93	0.00
ECRHC	Hydraulic Crane 25 Ton	0.00	1.00 Each (hourly)	U.S. Dollar	128.64	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00 Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00 Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.4.2	640.00 SF	Walls	6.86	93.33 Detail	U.S. Dollar	121.02	77,453.77

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost

Estimate Details
ANTHC Angoon Water Source PER 100% Submittal - Option 2 - New Water Source
Angoon Water Source Option 2 New Water Source Final PER
ESTIMATIONS, INC

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
RESTEEL	Reinforcing Steel		345.00 LB	U.S. Dollar	0.80	276.00
CEMENT MIXER SM	Small Concrete Mixer	68.57	1.00 Each (hourly)	U.S. Dollar	35.03	2,402.37
LLCARP3	Carpenter 3	137.14	2.00 Each (hourly)	U.S. Dollar	90.15	12,363.37
LLCL3	Crew Leader 3	68.57	1.00 Each (hourly)	U.S. Dollar	78.99	5,416.65
LL2999	Laborer 3	68.57	1.00 Each (hourly)	U.S. Dollar	76.71	5,260.06
LLALAB	Local Labor	68.57	1.00 Each (hourly)	U.S. Dollar	77.14	5,289.39
FORM WALLS	Formwork, Walls		1,280.00 SF	U.S. Dollar	3.50	4,480.00
CONC	Concrete - Rural, Presacked, Gravel and Cement		27.60 CY	U.S. Dollar	400.00	11,040.00
CONCPUMP	Concrete Pump	17.14	0.25 Each (hourly)	U.S. Dollar	350.00	6,000.00
RTP	Trash Pumps	137.14	2.00 Each (hourly)	U.S. Dollar	24.00	3,291.43
LLEO3	Equipment Operator 3	137.14	2.00 Each (hourly)	U.S. Dollar	90.93	12,469.85
ECRHC	Hydraulic Crane 25 Ton	68.57	1.00 Each (hourly)	U.S. Dollar	128.64	8,821.03
FPLUM4	Plumber 4	1.14	1.00 Each (hourly)	U.S. Dollar	43.08	49.24
FPLUM4	Plumber 4	1.14	1.00 Each (hourly)	U.S. Dollar	43.08	49.24
FELEC3	Electrician 4	1.14	1.00 Each (hourly)	U.S. Dollar	18.00	20.57
LL2999	Laborer 3	2.29	2.00 Each (hourly)	U.S. Dollar	76.71	175.34
FPLUM4	Plumber 4	1.14	1.00 Each (hourly)	U.S. Dollar	43.08	49.24

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.4.3	96.00 SF	Lid	0.00	0.00 Detail	U.S. Dollar	25.09	2,408.44

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
RESTEEL	Reinforcing Steel		307.05 LB	U.S. Dollar	0.80	245.64
CEMENT MIXER SM	Small Concrete Mixer	0.00	1.00 Each (hourly)	U.S. Dollar	35.03	0.00
LLCARP3	Carpenter 3	0.00	2.00 Each (hourly)	U.S. Dollar	90.15	0.00
LLCL3	Crew Leader 3	0.00	1.00 Each (hourly)	U.S. Dollar	78.99	0.00
LL2999	Laborer 3	0.00	1.00 Each (hourly)	U.S. Dollar	76.71	0.00
LLALAB	Local Labor	0.00	1.00 Each (hourly)	U.S. Dollar	77.14	0.00
FORM WALLS	Formwork, Walls		192.00 SF	U.S. Dollar	3.50	672.00
CONC	Concrete - Rural, Presacked, Gravel and Cement		2.05 CY	U.S. Dollar	400.00	818.80
CONCPUMP	Concrete Pump	0.00	0.25 Each (hourly)	U.S. Dollar	350.00	0.00
RTP	Trash Pumps	0.00	2.00 Each (hourly)	U.S. Dollar	24.00	0.00
LLEO3	Equipment Operator 3	0.00	2.00 Each (hourly)	U.S. Dollar	90.93	0.00
ECRHC	Hydraulic Crane 25 Ton	0.00	1.00 Each (hourly)	U.S. Dollar	128.64	0.00
FORMSLABELV	Formwork, Elevated		96.00 SF	U.S. Dollar	7.00	672.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.4.4	1.00	Each	Access Hatch 36x48	0.00	0.00	Plug	U.S. Dollar	4,100.00	4,100.00
4.3.9.13.4.5	1.00	Each	Piping, Valves, and Screens	0.00	0.00	Plug	U.S. Dollar	14,000.00	14,000.00
4.3.9.13.5	320.00	SF	Overflow Wall	3.43	93.33	Detail	U.S. Dollar	124.04	39,692.89

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
RESTEEL	Reinforcing Steel		1,380.00	LB	U.S. Dollar	0.80	1,104.00
CEMENT MIXER SM	Small Concrete Mixer	34.29	1.00	Each (hourly)	U.S. Dollar	35.03	1,201.19
LLCARP3	Carpenter 3	68.57	2.00	Each (hourly)	U.S. Dollar	90.15	6,181.69
LLCL3	Crew Leader 3	34.29	1.00	Each (hourly)	U.S. Dollar	78.99	2,708.32
LL2999	Laborer 3	34.29	1.00	Each (hourly)	U.S. Dollar	76.71	2,630.03
LLALAB	Local Labor	34.29	1.00	Each (hourly)	U.S. Dollar	77.14	2,644.70
FORM WALLS	Formwork, Walls		640.00	SF	U.S. Dollar	3.50	2,240.00
CONC	Concrete - Rural, Presacked, Gravel and Cement		13.80	CY	U.S. Dollar	400.00	5,520.00
CONCPUMP	Concrete Pump	8.57	0.25	Each (hourly)	U.S. Dollar	350.00	3,000.00
RTP	Trash Pumps	68.57	2.00	Each (hourly)	U.S. Dollar	24.00	1,645.71
LLEO3	Equipment Operator 3	68.57	2.00	Each (hourly)	U.S. Dollar	90.93	6,234.93
ECRHC	Hydraulic Crane 25 Ton	34.29	1.00	Each (hourly)	U.S. Dollar	128.64	4,410.51
FPLUM4	Plumber 4	0.57	1.00	Each (hourly)	U.S. Dollar	43.08	24.62
FPLUM4	Plumber 4	0.57	1.00	Each (hourly)	U.S. Dollar	43.08	24.62
FELEC3	Electrician 4	0.57	1.00	Each (hourly)	U.S. Dollar	18.00	10.29
LL2999	Laborer 3	1.14	2.00	Each (hourly)	U.S. Dollar	76.71	87.67
FPLUM4	Plumber 4	0.57	1.00	Each (hourly)	U.S. Dollar	43.08	24.62

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.6	1.00	Each	Custom Aluminum Weir (Waterman Slide Gate AWW C-562)	0.00	0.00	Plug	U.S. Dollar	71,000.00	71,000.00
4.3.9.13.7	1.00	Each	Divit Crane	0.00	0.00	Plug	U.S. Dollar	7,500.00	7,500.00
4.3.9.13.8	12.00	LF	Stairway	0.50	24.00	Detail	U.S. Dollar	717.83	8,613.97
4.3.9.13.8.1	12.00	LF	Earthwork	0.00	0.00	Plug	U.S. Dollar	425.00	5,100.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.8.2	1.33	CY	Concrete	0.50	2.66	Detail	U.S. Dollar	2,642.08	3,513.97

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
CONC	Concrete - Rural, Presacked, Gravel and Cement		2.00	CY	U.S. Dollar	400.00	800.00
FORMSLAB	Formwork, Slab/Stairs		68.00	SF	U.S. Dollar	2.00	136.00
RESTEEL	Reinforcing Steel		149.50	LB	U.S. Dollar	0.80	119.60
CEMENT MIXER SM	Small Concrete Mixer	5.00	1.00	Each (hourly)	U.S. Dollar	35.03	175.17
ECRHC	Hydraulic Crane 25 Ton	5.00	1.00	Each (hourly)	U.S. Dollar	128.64	643.20
LLCARP3	Carpenter 3	5.00	1.00	Each (hourly)	U.S. Dollar	90.15	450.75
LLCL3	Crew Leader 3	5.00	1.00	Each (hourly)	U.S. Dollar	78.99	394.96
LL2999	Laborer 3	5.00	1.00	Each (hourly)	U.S. Dollar	76.71	383.55
LLALAB	Local Labor	5.00	1.00	Each (hourly)	U.S. Dollar	77.14	385.69
FPLUM4	Plumber 4	0.08	1.00	Each (hourly)	U.S. Dollar	43.08	3.59
FPLUM4	Plumber 4	0.08	1.00	Each (hourly)	U.S. Dollar	43.08	3.59
FELEC3	Electrician 4	0.08	1.00	Each (hourly)	U.S. Dollar	18.00	1.50
LL2999	Laborer 3	0.17	2.00	Each (hourly)	U.S. Dollar	76.71	12.78
FPLUM4	Plumber 4	0.08	1.00	Each (hourly)	U.S. Dollar	43.08	3.59

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.9	50.00	LF	Railings	1.68	29.85	Detail	U.S. Dollar	326.55	16,327.71

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
GUARDRAIL	Guardrail, Stainless		50.00	LF	U.S. Dollar	300.00	15,000.00
LIW2	Iron Worker Foreman	16.75	1.00	Each (hourly)	U.S. Dollar	42.85	717.68
LIW1	Iron Worker	16.75	1.00	Each (hourly)	U.S. Dollar	36.42	610.03

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.10	200.00	CY	Riprap Class IV Overtopping Protection	1.33	150.00	Detail	U.S. Dollar	296.59	59,317.11
4.3.9.13.10.1	200.00	CY	Purchase/Deliver	0.00	0.00	Detail	U.S. Dollar	230.50	46,100.00

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
RIPRAP	Rip Rap - Purchase Juneau		230.00	CY	U.S. Dollar	70.00	16,100.00
BARGE	Barging		2.00	Day	U.S. Dollar	15,000.00	30,000.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.10.2	200.00	CY	Haul/Place	1.33	150.00	Detail	U.S. Dollar	66.09	13,217.11

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
DOZER D6	Dozer D6T	13.33	1.00	Each (hourly)	U.S. Dollar	94.88	1,265.00

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost

END DUMP	Dump Truck	26.67	2.00 Each (hourly)	U.S. Dollar	92.17	2,457.87
EXCAVATOR CAT330	Hydraulic Excavator Cat 330	13.33	1.00 Each (hourly)	U.S. Dollar	157.80	2,104.00
ELOADER 980	Loader 980	13.33	1.00 Each (hourly)	U.S. Dollar	195.38	2,605.07
LLEO3	Equipment Operator 3	26.67	2.00 Each (hourly)	U.S. Dollar	90.93	2,424.69
LL3	Labor Foreman	13.33	1.00 Each (hourly)	U.S. Dollar	42.85	571.29
LLATRK	Local Truck Driver	26.67	2.00 Each (hourly)	U.S. Dollar	67.09	1,789.19

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.11	6.00 Each	Pressure Relief Wells	0.00	0.00 Plug	U.S. Dollar	30,000.00	180,000.00
4.3.9.13.12	16,500.00 LF	Raw Water Transmission Line 10" HDPE	183.33	90.00 Detail	U.S. Dollar	76.68	1,265,238.38

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
HYDRANT	Hydrant - American Darline B-62-B-5		9.00 Each	U.S. Dollar	3,300.00	29,700.00
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	1,833.33	1.00 Each (hourly)	U.S. Dollar	0.00	0.00
4J-FUSION	Four Jaw Fusion Machine	1,833.33	1.00 Each (hourly)	U.S. Dollar	1.14	2,083.33
E-FUSION	ElectroFusion Machine	1,833.33	1.00 Each (hourly)	U.S. Dollar	0.00	0.00
2J-FUSION	Two Jaw Fusion Machine	1,833.33	1.00 Each (hourly)	U.S. Dollar	0.76	1,385.42
PUMP	De-Watering Pump	1,833.33	1.00 Each (hourly)	U.S. Dollar	31.86	58,410.00
END DUMP	Dump Truck	3,666.67	2.00 Each (hourly)	U.S. Dollar	92.17	337,956.67
EXCAVATOR	Hydraulic Excavator Cat 320	1,833.33	1.00 Each (hourly)	U.S. Dollar	116.25	213,128.30
PICKUP	Pickup 4x4	1,833.33	1.00 Each (hourly)	U.S. Dollar	8.80	16,133.33
LOADER	Wheeled Loader Cat 950	1,833.33	1.00 Each (hourly)	U.S. Dollar	88.95	163,082.33
DATALOGGER	Data Logger	1,833.33	1.00 Each (hourly)	U.S. Dollar	7.00	12,833.33
SKIDSTEER	Skid Steer - Bobcat 630	1,833.33	1.00 Each (hourly)	U.S. Dollar	28.81	52,825.67
DOZER	local small dozer no Rental fee.	1,833.33	1.00 Each (hourly)	U.S. Dollar	0.00	0.00
PIPEHDPE10	10" HDPE Pipe SDR17 American Made		18,150.00 LF	U.S. Dollar	18.00	326,700.00
MPD10GV RISER	Pipe DI 10 In Gate Valve with Riser - American Made		17.00 Each	U.S. Dollar	3,000.00	51,000.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00 Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00 Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00

CBS Position Code	Quantity UM	Description	Cost Item Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost

FELEC3	Electrician 4	0.00	1.00 Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00 Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00 Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00 Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.13	15,000.00 LF	Gravel Road 14'W	32.67	459.15 Detail	U.S. Dollar	67.45	1,011,750.05

Notes: Profile is 14'w top 3:1 Slopes, 6" Surface Course (E1) assumed, 30" minimum Fill, using 36" for S.Factor, Geofabric, over existing ground

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.13.1	12,567.00 CY	Subbase	8.38	1,500.00 Detail	U.S. Dollar	24.29	305,225.78

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
GRAVELLOCAL	Locally Sourced Gravel - Screened with Grissly		15,080.40 CY	U.S. Dollar	10.00	150,804.00
EXCAVATOR CAT330	Hydraulic Excavator Cat 330	83.78	1.00 Each (hourly)	U.S. Dollar	157.80	13,220.48
LL3	Labor Foreman	83.78	1.00 Each (hourly)	U.S. Dollar	42.85	3,589.69
LL2999	Laborer 3	83.78	1.00 Each (hourly)	U.S. Dollar	76.71	6,426.70
PICKUP	Pickup 4x4	83.78	1.00 Each (hourly)	U.S. Dollar	8.80	737.26
ETDT	Dump Truck	502.68	6.00 Each (hourly)	U.S. Dollar	113.24	56,923.48
LLEO3	Equipment Operator 3	335.12	4.00 Each (hourly)	U.S. Dollar	90.93	30,471.12
EG14G	Grader 14G	83.78	1.00 Each (hourly)	U.S. Dollar	68.48	5,737.25
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	83.78	1.00 Each (hourly)	U.S. Dollar	0.00	0.00
LLALAB	Local Labor	83.78	1.00 Each (hourly)	U.S. Dollar	77.14	6,462.54
DOZER D6	Dozer D6T	83.78	1.00 Each (hourly)	U.S. Dollar	94.88	7,948.63
LLATRK	Local Truck Driver	335.12	4.00 Each (hourly)	U.S. Dollar	67.09	22,484.80
FPLUM4	Plumber 4	1.40	1.00 Each (hourly)	U.S. Dollar	43.08	60.16
FPLUM4	Plumber 4	1.40	1.00 Each (hourly)	U.S. Dollar	43.08	60.16
FELEC3	Electrician 4	1.40	1.00 Each (hourly)	U.S. Dollar	18.00	25.13
LL2999	Laborer 3	2.79	2.00 Each (hourly)	U.S. Dollar	76.71	214.22
FPLUM4	Plumber 4	1.40	1.00 Each (hourly)	U.S. Dollar	43.08	60.16
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00 Each (hourly)	U.S. Dollar	18.00	0.00

CBS Position Code	Quantity UM	Description	Cost Item Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
LL2999	Laborer 3	0.00	2.00 Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00

CBS Position Code	Quantity UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.13.2	4,350.00 CY	Surface Course	4.35	1,000.00	Detail	U.S. Dollar	88.54	385,161.26

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
LL3	Labor Foreman	43.50	1.00 Each (hourly)	U.S. Dollar	42.85	1,863.83
LL2999	Laborer 3	43.50	1.00 Each (hourly)	U.S. Dollar	76.71	3,336.85
PICKUP	Pickup 4x4	43.50	1.00 Each (hourly)	U.S. Dollar	8.80	382.80
ETDT	Dump Truck	174.00	4.00 Each (hourly)	U.S. Dollar	113.24	19,703.76
LLEO3	Equipment Operator 3	174.00	4.00 Each (hourly)	U.S. Dollar	90.93	15,821.12
EG14G	Grader 14G	43.50	1.00 Each (hourly)	U.S. Dollar	68.48	2,978.88
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	43.50	1.00 Each (hourly)	U.S. Dollar	0.00	0.00
LLALAB	Local Labor	43.50	1.00 Each (hourly)	U.S. Dollar	77.14	3,355.46
DOZER D6	Dozer D6T	43.50	1.00 Each (hourly)	U.S. Dollar	94.88	4,127.06
LLATRK	Local Truck Driver	174.00	4.00 Each (hourly)	U.S. Dollar	67.09	11,674.49
CRUSHED AGG D-1	D-1 Crushed Aggregate Purchase		5,220.00 CY	U.S. Dollar	60.00	313,200.00
ELOADER 980	Loader 980	43.50	1.00 Each (hourly)	U.S. Dollar	195.38	8,499.03
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00 Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00 Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.73	1.00 Each (hourly)	U.S. Dollar	43.08	31.23
FPLUM4	Plumber 4	0.73	1.00 Each (hourly)	U.S. Dollar	43.08	31.23
FELEC3	Electrician 4	0.73	1.00 Each (hourly)	U.S. Dollar	18.00	13.05
LL2999	Laborer 3	1.45	2.00 Each (hourly)	U.S. Dollar	76.71	111.23
FPLUM4	Plumber 4	0.73	1.00 Each (hourly)	U.S. Dollar	43.08	31.23

CBS Position Code	Quantity UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.13.3	15,000.00 SY	Geofabric	15.00	1,000.00	Detail	U.S. Dollar	11.93	178,941.67

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
GEOTEX	Geotextile Fabric Filter		64,166.66 SY	U.S. Dollar	1.50	96,249.99
EL950	Loader 950	150.00	1.00 Each (hourly)	U.S. Dollar	75.56	11,334.00
SKIDSTEER	Skid Steer - Bobcat 630	150.00	1.00 Each (hourly)	U.S. Dollar	28.81	4,322.10
LLEO3	Equipment Operator 3	150.00	1.00 Each (hourly)	U.S. Dollar	90.93	13,638.90

Cost Item

CBS Position Code	Quantity UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost

LL3	Labor Foreman	150.00	1.00 Each (hourly)	U.S. Dollar	42.85	6,426.99
LL2999	Laborer 3	150.00	1.00 Each (hourly)	U.S. Dollar	76.71	11,506.38
LLALAB	Local Labor	450.00	3.00 Each (hourly)	U.S. Dollar	77.14	34,711.65
FPLUM4	Plumber 4	2.50	1.00 Each (hourly)	U.S. Dollar	43.08	107.71
FPLUM4	Plumber 4	2.50	1.00 Each (hourly)	U.S. Dollar	43.08	107.71
FELEC3	Electrician 4	2.50	1.00 Each (hourly)	U.S. Dollar	18.00	45.00
LL2999	Laborer 3	5.00	2.00 Each (hourly)	U.S. Dollar	76.71	383.55
FPLUM4	Plumber 4	2.50	1.00 Each (hourly)	U.S. Dollar	43.08	107.71

4.3.9.13.13.4	3.00 EA	Creek Crossings	3.00	1.00	Detail	U.S. Dollar	10,697.72	32,093.15

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
CMP24	24" CMP Pipe		102.00 LF	U.S. Dollar	25.00	2,550.00
CMP24 END	24" CMP Pipe Flared End		6.00 EA	U.S. Dollar	300.00	1,800.00
EXCAVATOR	Hydraulic Excavator Cat 320	30.00	1.00 Each (hourly)	U.S. Dollar	116.25	3,487.55
END DUMP	Dump Truck	60.00	2.00 Each (hourly)	U.S. Dollar	92.17	5,530.20
EXCAVATOR MINI	Hydraulic Excavator Mini	30.00	1.00 Each (hourly)	U.S. Dollar	27.48	824.42
LOADER	Wheeled Loader Cat 950	30.00	1.00 Each (hourly)	U.S. Dollar	88.95	2,668.62
PICKUP	Pickup 4x4	30.00	1.00 Each (hourly)	U.S. Dollar	8.80	264.00
DOZER	local small dozer no Rental fee.	30.00	1.00 Each (hourly)	U.S. Dollar	0.00	0.00
LLEO3	Equipment Operator 3	30.00	1.00 Each (hourly)	U.S. Dollar	90.93	2,727.78
LL3	Labor Foreman	30.00	1.00 Each (hourly)	U.S. Dollar	42.85	1,285.40
LL2999	Laborer 3	30.00	1.00 Each (hourly)	U.S. Dollar	76.71	2,301.28
LLALAB	Local Labor	60.00	2.00 Each (hourly)	U.S. Dollar	77.14	4,628.22
LLATRK	Local Truck Driver	60.00	2.00 Each (hourly)	U.S. Dollar	67.09	4,025.69
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00 Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00 Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00 Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00 Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.13.5	3,000.00	SF	Turnouts	1.94	1,545.40	Detail	U.S. Dollar	36.78	110,328.18

Notes: Allow for Turnouts at 5000 ft intervals, 3 each 100'L x 10'w

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.13.5.1	60.00	CY	Subbase	0.04	1,500.00	Detail	U.S. Dollar	24.29	1,457.27

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
GRAVELLOCAL	Locally Sourced Gravel - Screened with Grissly		72.00	CY	U.S. Dollar	10.00	720.00
EXCAVATOR CAT330	Hydraulic Excavator Cat 330	0.40	1.00	Each (hourly)	U.S. Dollar	157.80	63.12
LL3	Labor Foreman	0.40	1.00	Each (hourly)	U.S. Dollar	42.85	17.14
LL2999	Laborer 3	0.40	1.00	Each (hourly)	U.S. Dollar	76.71	30.68
PICKUP	Pickup 4x4	0.40	1.00	Each (hourly)	U.S. Dollar	8.80	3.52
ETDT	Dump Truck	2.40	6.00	Each (hourly)	U.S. Dollar	113.24	271.78
LLEO3	Equipment Operator 3	1.60	4.00	Each (hourly)	U.S. Dollar	90.93	145.48
EG14G	Grader 14G	0.40	1.00	Each (hourly)	U.S. Dollar	68.48	27.39
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	0.40	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
LLALAB	Local Labor	0.40	1.00	Each (hourly)	U.S. Dollar	77.14	30.85
DOZER D6	Dozer D6T	0.40	1.00	Each (hourly)	U.S. Dollar	94.88	37.95
LLATRK	Local Truck Driver	1.60	4.00	Each (hourly)	U.S. Dollar	67.09	107.35
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.01	1.00	Each (hourly)	U.S. Dollar	43.08	0.29
FPLUM4	Plumber 4	0.01	1.00	Each (hourly)	U.S. Dollar	43.08	0.29
FELEC3	Electrician 4	0.01	1.00	Each (hourly)	U.S. Dollar	18.00	0.12
LL2999	Laborer 3	0.01	2.00	Each (hourly)	U.S. Dollar	76.71	1.02
FPLUM4	Plumber 4	0.01	1.00	Each (hourly)	U.S. Dollar	43.08	0.29

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.13.5.2	1,125.00	CY	Surface Course	1.13	1,000.00	Detail	U.S. Dollar	88.54	99,610.67

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
LL3	Labor Foreman	11.25	1.00	Each (hourly)	U.S. Dollar	42.85	482.02
LL2999	Laborer 3	11.25	1.00	Each (hourly)	U.S. Dollar	76.71	862.98

CBS Position Code	Quantity UM	Description	Cost Item Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost

PICKUP	Pickup 4x4	11.25	1.00 Each (hourly)	U.S. Dollar	8.80	99.00
ETDT	Dump Truck	45.00	4.00 Each (hourly)	U.S. Dollar	113.24	5,095.80
LLEO3	Equipment Operator 3	45.00	4.00 Each (hourly)	U.S. Dollar	90.93	4,091.67
EG14G	Grader 14G	11.25	1.00 Each (hourly)	U.S. Dollar	68.48	770.40
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	11.25	1.00 Each (hourly)	U.S. Dollar	0.00	0.00
LLALAB	Local Labor	11.25	1.00 Each (hourly)	U.S. Dollar	77.14	867.79
DOZER D6	Dozer D6T	11.25	1.00 Each (hourly)	U.S. Dollar	94.88	1,067.34
LLATRK	Local Truck Driver	45.00	4.00 Each (hourly)	U.S. Dollar	67.09	3,019.26
CRUSHED AGG D-1	D-1 Crushed Aggregate Purchase		1,350.00 CY	U.S. Dollar	60.00	81,000.00
ELOADER 980	Loader 980	11.25	1.00 Each (hourly)	U.S. Dollar	195.38	2,198.03
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00 Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00 Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.19	1.00 Each (hourly)	U.S. Dollar	43.08	8.08
FPLUM4	Plumber 4	0.19	1.00 Each (hourly)	U.S. Dollar	43.08	8.08
FELEC3	Electrician 4	0.19	1.00 Each (hourly)	U.S. Dollar	18.00	3.38
LL2999	Laborer 3	0.38	2.00 Each (hourly)	U.S. Dollar	76.71	28.77
FPLUM4	Plumber 4	0.19	1.00 Each (hourly)	U.S. Dollar	43.08	8.08

CBS Position Code	Quantity UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.13.5.3	776.25 SY	Geofabric	0.78	1,000.00	Detail	U.S. Dollar	11.93	9,260.23

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
GEOTEX	Geotextile Fabric Filter		3,320.62 SY	U.S. Dollar	1.50	4,980.94
EL950	Loader 950	7.76	1.00 Each (hourly)	U.S. Dollar	75.56	586.53
SKIDSTEER	Skid Steer - Bobcat 630	7.76	1.00 Each (hourly)	U.S. Dollar	28.81	223.67
LLEO3	Equipment Operator 3	7.76	1.00 Each (hourly)	U.S. Dollar	90.93	705.81
LL3	Labor Foreman	7.76	1.00 Each (hourly)	U.S. Dollar	42.85	332.60
LL2999	Laborer 3	7.76	1.00 Each (hourly)	U.S. Dollar	76.71	595.46
LLALAB	Local Labor	23.29	3.00 Each (hourly)	U.S. Dollar	77.14	1,796.33
FPLUM4	Plumber 4	0.13	1.00 Each (hourly)	U.S. Dollar	43.08	5.57
FPLUM4	Plumber 4	0.13	1.00 Each (hourly)	U.S. Dollar	43.08	5.57
FELEC3	Electrician 4	0.13	1.00 Each (hourly)	U.S. Dollar	18.00	2.33
LL2999	Laborer 3	0.26	2.00 Each (hourly)	U.S. Dollar	76.71	19.85

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
FPLUM4	Plumber 4	0.13	1.00	Each (hourly)	U.S. Dollar	43.08	5.57

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.14	1,600.00	SF	Gravel Parking/Turnaround area at Dam	1.04	1,545.40	Detail	U.S. Dollar	36.78	58,841.69
4.3.9.13.14.1	32.00	CY	Subbase	0.02	1,500.00	Detail	U.S. Dollar	24.29	777.21

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
GRAVELLOCAL	Locally Sourced Gravel - Screened with Grissly		38.40	CY	U.S. Dollar	10.00	384.00
EXCAVATOR CAT330	Hydraulic Excavator Cat 330	0.21	1.00	Each (hourly)	U.S. Dollar	157.80	33.66
LL3	Labor Foreman	0.21	1.00	Each (hourly)	U.S. Dollar	42.85	9.14
LL2999	Laborer 3	0.21	1.00	Each (hourly)	U.S. Dollar	76.71	16.36
PICKUP	Pickup 4x4	0.21	1.00	Each (hourly)	U.S. Dollar	8.80	1.88
ETDT	Dump Truck	1.28	6.00	Each (hourly)	U.S. Dollar	113.24	144.95
LLEO3	Equipment Operator 3	0.85	4.00	Each (hourly)	U.S. Dollar	90.93	77.59
EG14G	Grader 14G	0.21	1.00	Each (hourly)	U.S. Dollar	68.48	14.61
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	0.21	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
LLALAB	Local Labor	0.21	1.00	Each (hourly)	U.S. Dollar	77.14	16.46
DOZER D6	Dozer D6T	0.21	1.00	Each (hourly)	U.S. Dollar	94.88	20.24
LLATRK	Local Truck Driver	0.85	4.00	Each (hourly)	U.S. Dollar	67.09	57.25
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.15
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.15
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.06
LL2999	Laborer 3	0.01	2.00	Each (hourly)	U.S. Dollar	76.71	0.55
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.15

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.14.2	600.00	CY	Surface Course	0.60	1,000.00	Detail	U.S. Dollar	88.54	53,125.69

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
LL3	Labor Foreman	6.00	1.00	Each (hourly)	U.S. Dollar	42.85	257.08
LL2999	Laborer 3	6.00	1.00	Each (hourly)	U.S. Dollar	76.71	460.26

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13.14.3	414.00	SY	Geofabric	0.41	1,000.00	Detail	U.S. Dollar	11.93	4,938.79

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
PICKUP	Pickup 4x4	6.00	1.00	Each (hourly)	U.S. Dollar	8.80	52.80
ETDT	Dump Truck	24.00	4.00	Each (hourly)	U.S. Dollar	113.24	2,717.76
LLEO3	Equipment Operator 3	24.00	4.00	Each (hourly)	U.S. Dollar	90.93	2,182.22
EG14G	Grader 14G	6.00	1.00	Each (hourly)	U.S. Dollar	68.48	410.88
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	6.00	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
LLALAB	Local Labor	6.00	1.00	Each (hourly)	U.S. Dollar	77.14	462.82
DOZER D6	Dozer D6T	6.00	1.00	Each (hourly)	U.S. Dollar	94.88	569.25
LLATRK	Local Truck Driver	24.00	4.00	Each (hourly)	U.S. Dollar	67.09	1,610.27
CRUSHED AGG D-1	D-1 Crushed Aggregate Purchase		720.00	CY	U.S. Dollar	60.00	43,200.00
ELOADER 980	Loader 980	6.00	1.00	Each (hourly)	U.S. Dollar	195.38	1,172.28
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.10	1.00	Each (hourly)	U.S. Dollar	43.08	4.31
FPLUM4	Plumber 4	0.10	1.00	Each (hourly)	U.S. Dollar	43.08	4.31
FELEC3	Electrician 4	0.10	1.00	Each (hourly)	U.S. Dollar	18.00	1.80
LL2999	Laborer 3	0.20	2.00	Each (hourly)	U.S. Dollar	76.71	15.34
FPLUM4	Plumber 4	0.10	1.00	Each (hourly)	U.S. Dollar	43.08	4.31

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
GEOTEX	Geotextile Fabric Filter		1,771.00	SY	U.S. Dollar	1.50	2,656.50
EL950	Loader 950	4.14	1.00	Each (hourly)	U.S. Dollar	75.56	312.82
SKIDSTEER	Skid Steer - Bobcat 630	4.14	1.00	Each (hourly)	U.S. Dollar	28.81	119.29
LLEO3	Equipment Operator 3	4.14	1.00	Each (hourly)	U.S. Dollar	90.93	376.43
LL3	Labor Foreman	4.14	1.00	Each (hourly)	U.S. Dollar	42.85	177.38
LL2999	Laborer 3	4.14	1.00	Each (hourly)	U.S. Dollar	76.71	317.58
LLALAB	Local Labor	12.42	3.00	Each (hourly)	U.S. Dollar	77.14	958.04
FPLUM4	Plumber 4	0.07	1.00	Each (hourly)	U.S. Dollar	43.08	2.97
FPLUM4	Plumber 4	0.07	1.00	Each (hourly)	U.S. Dollar	43.08	2.97
FELEC3	Electrician 4	0.07	1.00	Each (hourly)	U.S. Dollar	18.00	1.24
LL2999	Laborer 3	0.14	2.00	Each (hourly)	U.S. Dollar	76.71	10.59

CBS Position Code	Quantity UM	Description		Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
FPLUM4	Plumber 4		0.07	1.00 Each (hourly)		U.S. Dollar	43.08	2.97
4.4	1.00 Each	Post Construction		46.90	0.02 Detail	U.S. Dollar	42,243.38	42,243.38
4.4.11	1.00 Each	O&M Training		26.90	0.04 Detail	U.S. Dollar	24,229.15	24,229.15
Resource Code	**Description**		**Hours**	**Quantity UM**		**Currency**	**Unit Cost**	**Total Cost**
PMENG4	Project Manager Engineer 4		269.00	1.00 Each (hourly)		U.S. Dollar	90.07	24,229.15
4.4.15	1.00 Each	Final Inspection - On Site		20.00	0.05 Detail	U.S. Dollar	18,014.24	18,014.24
Resource Code	**Description**		**Hours**	**Quantity UM**		**Currency**	**Unit Cost**	**Total Cost**
PMENG4	Project Manager Engineer 4		200.00	1.00 Each (hourly)		U.S. Dollar	90.07	18,014.24
Report Total:				932.91				8,956,461.47

Category	Total
Labor	3,122,147.77
Owned Equipment	1,419,192.51
Rented Equipment	99,347.60
Materials	3,285,773.60
Subcontract	1,030,000.00

Code	Description	Quantity	Unit of Measure	Awardee	Awarded Rate	Total Cost
AFARE	Air Fare - Anchorage to Angoon	69.00	Each			34,500.00
BARGE	Barging	35.00	Day			525,000.00
BLASTING	Blasting Supplies	0.00	CY			0.00
CMP24	24" CMP Pipe	102.00	LF			2,550.00
CMP24 END	24" CMP Pipe Flared End	6.00	EA			1,800.00
CONC	Concrete - Rural, Presacked, Gravel and Cement	458.01	CY			183,203.80
CRUSHED AGG D-1	D-1 Crushed Aggregate Purchase	7,290.00	CY			437,400.00
FORM WALLS	Formwork, Walls	5,312.00	SF			18,592.00
FORMSLAB	Formwork, Slab Edges	68.00	SF			136.00
FORMSLABELV	Formwork, Elevated	96.00	SF			672.00
FRT	Freight to Nondalton	193,000.00	LB			92,640.00
GEOTEX	Geotextile Fabric Filter	69,258.29	SY			103,887.43
GRAVELLOCAL	Locally Sourced Gravel - Screened with Grissly	15,190.80	CY			151,908.00
GUARDRAIL	Guardrail, Stainless	50.00	LF			15,000.00
HYDRANT	Hydrant - American Darline B-62-B-5	9.00	Each			29,700.00
MPD10GV RISER	Pipe DI 10 In Gate Valve with Riser - American Made	17.00	Each			51,000.00
PIPEHDPE10	10" HDPE Pipe SDR17 American Made	18,150.00	LF			326,700.00
RESTEEL	Reinforcing Steel	63,435.46	LB			50,748.36
RIPRAP	Rip Rap - Purchase Juneau	230.00	CY			16,100.00
ROCKANCHORS	Rock Anchors 6'L Nominal	13.00	Each			3,900.00
SILTFENCE	Silt Fence & BMPs	500.00	LF			2,500.00
	Grand Totals					**2,047,937.60**

Resource Utilization: Labor
ANTHC Angoon Water Source PER 100% Submittal - Option 2 - New Water Source
Angoon Water Source Option 2 New Water Source Final PER
ESTIMATIONS, INC

Code	Description	Wage Scale 1 Rate/Hr	Hours	Wage Scale 2 Rate/Hr	Hours	Wage Scale 3 Rate/Hr	Hours	Total Work Hours	Total Pay Hours	Total Costs
CAD 5	CAD 5	55.10	0.00	70.65	0.00	70.65	0.00	0.00	0.00	0.00
CIVIL5	Civil 5	59.03	0.00	68.71	0.00	79.54	0.00	0.00	0.00	0.00
CONSTMGR4	Construction Manager 4	180.00	970.20	180.00	499.80	180.00	0.00	1,470.00	1,470.00	264,600.00
ENVIRMGR	Environmental Manager	98.56	0.00	135.84	0.00	135.84	0.00	0.00	0.00	0.00
FELEC3	Electrician 4	18.00	15.42	18.00	7.94	18.00	0.00	23.37	23.37	420.61
FPLUM4	Plumber 4	40.31	46.27	48.46	23.83	48.46	0.00	70.10	70.10	3,020.17
LIW1	Iron Worker	31.13	11.06	46.69	5.70	62.26	0.00	16.75	16.75	610.03
LIW2	Iron Worker Foreman	36.62	11.06	54.93	5.70	73.24	0.00	16.75	16.75	717.68
LL2999	Laborer 3	69.05	635.30	91.58	327.28	91.58	0.00	962.58	962.58	73,838.78
LL3	Labor Foreman	36.62	231.25	54.93	119.13	73.24	0.00	350.38	350.38	15,012.55
LL4000	Laborer 5	18.00	145.20	18.00	74.80	18.00	0.00	220.00	220.00	3,960.00
LLALAB	Local Labor	77.14	1,040.06	77.14	535.79	77.14	0.00	1,575.85	1,575.85	121,556.41
LLATRK	Local Truck Driver	60.83	440.38	79.25	226.86	79.25	0.00	667.24	667.24	44,768.31
LLCARP3	Carpenter 3	80.54	742.50	108.81	382.50	108.81	0.00	1,125.00	1,125.00	101,418.30
LLCL1	Crew Leader 1	64.67	72.60	85.01	37.40	85.01	0.00	110.00	110.00	7,874.34
LLCL3	Crew Leader 3	78.99	372.90	78.99	192.10	78.99	0.00	565.00	565.00	44,630.92
LLEO3	Equipment Operator 3	81.20	1,340.29	109.80	690.45	109.80	0.00	2,030.74	2,030.74	184,647.30
LLMECH3	Mechanic 3	134.99	1,201.20	134.99	618.80	107.21	0.00	1,820.00	1,820.00	245,686.86
LLTD1	Truck Driver 1	18.00	72.60	18.00	37.40	18.00	0.00	110.00	110.00	1,980.00
MATCOOR	Materials Coordinator	97.67	33.00	134.50	17.00	134.50	0.00	50.00	50.00	5,509.48
PMENG4	Project Manager Engineer 4	98.99	309.54	72.75	159.46	98.99	0.00	469.00	469.00	42,243.38
QIM	Quality Improvement Manager	110.33	0.00	153.50	0.00	153.50	0.00	0.00	0.00	0.00
SUPER3	Superintendent 3	123.13	1,201.20	154.70	618.80	154.70	0.00	1,820.00	1,820.00	243,629.09
SURV4	Surveyor 4	57.14	237.60	57.14	122.40	57.14	0.00	360.00	360.00	20,569.32
	Grand Totals		9,129.62		4,703.14		0.00	13,832.76	13,832.76	1,426,693.54

Code	Description	Owned Equipment Rate/Hr	Total Pay Hours	Total Costs	Fuel Type	Fuel Amount	Fuel Cost	Fuel Unit of Measure	Maintenance Man-Hour Factor	Total Maintenance
2J-FUSION	Two Jaw Fusion Machine	0.76	1,833.33	1,385.42			0.00		0.00	0.00
4J-FUSION	Four Jaw Fusion Machine	1.14	2,073.33	2,356.06			0.00		0.00	0.00
AIR COMPRESS	Air Compressor	14.88	240.00	3,571.20			0.00		0.00	0.00
ATV	Four Wheeler	7.18	240.00	1,723.20	Unleaded	240.00	1,423.20	Gallon	0.00	0.00
ATVSS	ATV Side By Side	10.27	240.00	2,465.02	Unleaded	240.00	1,423.20	Gallon	0.00	0.00
ATVTRAILER	ATV Trailer	5.00	240.00	1,200.00			0.00		0.00	0.00
CEMENT MIXER SM	Small Concrete Mixer	35.03	805.00	28,202.87	Unleaded	4,025.00	23,868.25	Gallon	0.00	0.00
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	0.00	2,218.48	0.00			0.00		0.00	0.00
DATALOGGER	Data Logger	7.00	1,833.33	12,833.33			0.00		0.00	0.00
DOZER	local small dozer no Rental fee.	0.00	2,103.33	0.00			0.00		0.00	0.00
DOZER D6	Dozer D6T	94.88	398.48	37,805.47	Diesel	2,490.48	13,896.87	Gallon	0.00	0.00
ECRHC	Hydraulic Crane 25 Ton	128.64	805.00	103,555.20	Diesel	6,440.00	35,935.20	Gallon	0.10	4,033.92
E-FUSION	ElectroFusion Machine	0.00	2,073.33	0.00			0.00		0.00	0.00
EG14G	Grader 14G	68.48	385.14	26,374.62	Diesel	2,310.86	12,894.60	Gallon	0.10	1,929.99
EL950	Loader 950	75.56	211.90	16,011.35	Diesel	2,330.93	13,006.58	Gallon	0.10	1,061.86
ELOADER 980	Loader 980	195.38	314.08	61,365.60	Diesel	3,454.92	19,278.44	Gallon	0.10	0.00
END DUMP	Dump Truck	92.17	4,713.33	434,427.93	Diesel	28,280.00	157,802.40	Gallon	0.00	0.00
ETDT	Dump Truck	113.24	749.36	84,857.53	Diesel	5,994.88	33,451.43	Gallon	0.00	0.00
EXCAVATOR	Hydraulic Excavator Cat 320	116.25	1,863.33	216,615.85	Diesel	11,571.30	64,567.85	Gallon	0.00	0.00
EXCAVATOR CAT330	Hydraulic Excavator Cat 330	157.80	97.73	15,421.27	Diesel	977.27	5,453.15	Gallon	0.00	0.00
EXCAVATOR MINI	Hydraulic Excavator Mini	27.48	270.00	7,419.78	Diesel	553.50	3,088.53	Gallon	0.00	0.00
LOADER	Wheeled Loader Cat 950	88.95	1,863.33	165,750.95	Diesel	10,807.33	60,304.92	Gallon	0.00	0.00
PICKUP	Pickup 4x4	8.80	2,248.48	19,786.59	Unleaded	0.00	0.00	Gallon	0.00	0.00
PUMP	De-Watering Pump	31.86	2,073.33	66,056.40	Unleaded	4,146.67	24,589.73	Gallon	0.00	0.00
ROCKDRILL	Rock Drill	125.00	244.60	30,575.00			0.00		0.00	0.00
SKIDSTEER	Skid Steer - Bobcat 630	28.81	2,235.24	64,406.09	Diesel	4,023.42	22,450.71	Gallon	0.00	0.00
	Grand Totals		32,373.48	1,404,166.73			493,435.06			7,025.77

Fuel Summary

Fuel Type	Unit of Measure	Account Code	Total Amount	Unit Cost	Total Cost
Diesel	Gallon		79,234.89	5.58	442,130.67
Unleaded	Gallon		8,651.67	5.93	51,304.38

Resource Utilization: Rented Construction Equipment
ANTHC Angoon Water Source PER 100% Submittal - Option 2 - New Water Source
Angoon Water Source Option 2 New Water Source Final PER
ESTIMATIONS, INC

Code	Description	Rented Equipment Plug Rate/Hr	RE Rented Plug Rate/Hr	RE Oper. Plug Rate/Hr	Total Pay Hours	Awarded Rate/Hr	Tax Rate on RE Rented	Tax Amount on RE Rented	Total Costs	Fuel Type	Fuel Amount	Fuel Costs	Fuel Unit of Measure	Maintenance Man-Hour Factor	Total Maintenance
CONCPUMP	Concrete Pump	350.00	0.00	0.00	140.00		0.00%	0.00	49,000.00			0.00		0.00	0.00
EXC-CAT330C	Cat 330 Excavator	97.78	40.04	57.74	240.00		0.00%	0.00	23,467.60	Diesel	720.00	4,017.60	Gallon	0.00	0.00
RTP	Trash Pumps	24.00	19.00	5.00	1,120.00		0.00%	0.00	26,880.00			0.00		0.00	0.00
	Grand Totals				1,500.00			0.00	99,347.60			4,017.60			0.00

Fuel Summary

Fuel Type	Unit of Measure	Account Code	Total Amount	Unit Cost	Total Cost
Diesel	Gallon		720.00	5.58	4,017.60

Option 3 - Infiltration Galleries

SUMMARY
ANTHC Angoon Water Source PER 100% Submittal - Option 3 - Infiltration Galleries
Angoon Water Source Option 3 Infiltration Gallery Final PER
ESTIMATIONS, INC

Line No.	Pay Item No.	Description Subtotal Description	Quantity	Unit of Measure	Unit Price	Total Price
		Proposal				
01	01	General Requirements	1.00	EA	452,410.67	452,410.67
02	02	Equipment	1.00	EA	196,293.12	196,293.12
13	03	Design Phase 10%	1.00	EA	112,128.00	112,128.00
14	04	Construction Contingency 14%	1.00	EA	111,900.00	111,900.00
15	05	Design Contingency 12% of Design	1.00	EA	95,914.00	95,914.00
16	06	Escalation for Inflation 9.0%	1.00	EA	71,936.00	71,936.00
7	07	Vertical Infilation Galleries 12" 30'	2.00	EA	71,184.97	142,369.94
8	08	Pump Control Panel	1.00	EA	31,200.00	31,200.00
9	09	6" HDPE Water Supply Connection	40.00	LF	172.40	6,896.00
10	10	10" HDPE Raw Water Transmission	240.00	LF	51.50	12,360.00
					GRAND TOTAL:	1,233,407.73

Pay Item Assignment	Description	Forecast (T/O) Quantity	Unit of Measure	Unit Cost	Total Cost (Forecast)	Man-Hours (Total)	Labor Total Cost	Owned Equipment Total Cost	Rented Equipment Total Cost	Materials Total Cost	Subcontract Total Cost
01 (General Requirements)					$452,410.67	1,984.00	$182,155.82	$402.86	$0.00	$269,852.00	$0.00
01	SWPPP BMPs	560.00	LF	$5.00	$2,800.00	0.00	$0.00	$0.00	$0.00	$2,800.00	$0.00
01	ANTHC Construction Manager	2.00	MTH	$12,600.00	$25,200.00	140.00	$25,200.00	$0.00	$0.00	$0.00	$0.00
01	Shipping and Receiving - Construction	1.00	Each	$3,960.00	$3,960.00	220.00	$3,960.00	$0.00	$0.00	$0.00	$0.00
01	Freight	474,600.00	LB	$0.47	$221,028.18	225.00	$15,065.32	$402.86	$0.00	$205,560.00	$0.00
01	O&M Training	1.00	Each	$24,229.15	$24,229.15	269.00	$24,229.15	$0.00	$0.00	$0.00	$0.00
01	Travel - Construction Closout	4.00	Each	$934.00	$3,736.00	0.00	$0.00	$0.00	$0.00	$3,736.00	$0.00
01	Contracting and Purchasing	1.00	Each	$5,509.48	$5,509.48	50.00	$5,509.48	$0.00	$0.00	$0.00	$0.00
01	Travel - Construction	30.00	Each	$934.00	$28,020.00	0.00	$0.00	$0.00	$0.00	$28,020.00	$0.00
01	Freight - Demobilization (Equip. and M	226,300.00	LB	$0.43	$96,695.70	100.00	$6,695.70	$0.00	$0.00	$90,000.00	$0.00
01	Post Construction	1.00	Each	$42,243.38	$42,243.38	469.00	$42,243.38	$0.00	$0.00	$0.00	$0.00
01	Survey	1.00	Each	$20,569.32	$20,569.32	360.00	$20,569.32	$0.00	$0.00	$0.00	$0.00
01	ANTHC Project Superintendent	2.00	MTH	$34,804.16	$69,608.31	520.00	$69,608.31	$0.00	$0.00	$0.00	$0.00
01	Freight - Mobilization (Equip and Mat	248,300.00	LB	$0.50	$124,332.48	125.00	$8,369.62	$402.86	$0.00	$115,560.00	$0.00
01	Final Inspection - On Site	1.00	Each	$18,014.24	$18,014.24	200.00	$18,014.24	$0.00	$0.00	$0.00	$0.00
01	Housing & Utilities	2.00	MTH	$13,000.00	$26,000.00	0.00	$0.00	$0.00	$0.00	$26,000.00	$0.00
01	Travel - Early	4.00	Each	$934.00	$3,736.00	0.00	$0.00	$0.00	$0.00	$3,736.00	$0.00
01	Freight Equipment	226,300.00	LB	$0.43	$96,695.70	100.00	$6,695.70	$0.00	$0.00	$90,000.00	$0.00
01	Freight Materials	22,000.00	LB	$1.26	$27,636.78	25.00	$1,673.92	$402.86	$0.00	$25,560.00	$0.00
01	Pre Construction	1.00	Each	$28,800.00	$28,800.00	0.00	$0.00	$0.00	$0.00	$28,800.00	$0.00
01	Shipping and Receiving	1.00	Each	$3,960.00	$3,960.00	220.00	$3,960.00	$0.00	$0.00	$0.00	$0.00
01	Contracting & Purchasing	1.00	Each	$5,509.48	$5,509.48	50.00	$5,509.48	$0.00	$0.00	$0.00	$0.00
01	Travel	38.00	Each	$934.00	$35,492.00	0.00	$0.00	$0.00	$0.00	$35,492.00	$0.00
02 (Equipment)					$196,293.12	260.00	$35,098.12	$126,056.60	$15,645.07	$19,493.33	$0.00
02	Equipment	1.00	Each	$185,133.12	$185,133.12	260.00	$35,098.12	$126,056.60	$15,645.07	$8,333.33	$0.00
02	Fuel	2,000.00	Gallon	$5.58	$11,160.00	0.00	$0.00	$0.00	$0.00	$11,160.00	$0.00
02	Equipment Maintenance Labor	2.00	MTH	$17,549.06	$35,098.12	260.00	$35,098.12	$0.00	$0.00	$0.00	$0.00
02	ANTHC Equipment Cost	2.00	MTH	$75,017.50	$150,035.00	0.00	$0.00	$126,056.60	$15,645.07	$8,333.33	$0.00
03 (Design Phase 10%)		1.00			$112,128.00	0.00	$112,128.00	$0.00	$0.00	$0.00	$0.00
03	Design	1.00	Each	$112,128.00	$112,128.00	0.00	$112,128.00	$0.00	$0.00	$0.00	$0.00
03	**Design Phase**	1.00	Each	$112,128.00	$112,128.00	0.00	$112,128.00	$0.00	$0.00	$0.00	$0.00
03	Design Complete	1.00	Each	$112,128.00	$112,128.00	0.00	$112,128.00	$0.00	$0.00	$0.00	$0.00
04 (Construction Contingency 14%		1.00			$111,900.00	0.00	$55,950.00	$0.00	$0.00	$55,950.00	$0.00
04	Construction Contingency 14% of C	1.00	Each	$111,900.00	$111,900.00	0.00	$55,950.00	$0.00	$0.00	$55,950.00	$0.00
05 (Design Contingency 12% of D		1.00			$95,914.00	0.00	$47,957.00	$0.00	$0.00	$47,957.00	$0.00
05	Design Contingency 12% of Constru	1.00	Each	$95,914.00	$95,914.00	0.00	$47,957.00	$0.00	$0.00	$47,957.00	$0.00
06 (Escalation for Inflation 9.0%)		1.00			$71,936.00	0.00	$35,968.00	$0.00	$0.00	$35,968.00	$0.00

Pay Item Assignment	Description	Forecast (T/O) Quantity	Unit of Measure	Unit Cost	Total Cost (Forecast)	Man-Hours (Total)	Labor Total Cost	Owned Equipment Total Cost	Rented Equipment Total Cost	Materials Total Cost	Subcontract Total Cost
06	Inflation 9.0% of Construction	1.00	Each	$71,936.00	$71,936.00	0.00	$35,968.00	$0.00	$0.00	$35,968.00	$0.00
07 (Vertical Infilation Galleries 12"					$142,369.94	253.00	$24,910.43	$1,563.51	$0.00	$35,896.00	$80,000.00
07	Power to Pumps	2.00	Each	$28,466.35	$56,932.70	233.00	$23,073.19	$1,563.51	$0.00	$32,296.00	$0.00
07	Transformer	1.00	Each	$27,471.38	$27,471.38	40.00	$4,318.67	$152.71	$0.00	$23,000.00	$0.00
07	Vertical Infiltration Galleries	2.00	Each	$71,184.97	$142,369.94	253.00	$24,910.43	$1,563.51	$0.00	$35,896.00	$80,000.00
07	Wells 30'D	2.00	Each	$40,000.00	$80,000.00	0.00	$0.00	$0.00	$0.00	$0.00	$80,000.00
07	Power to Pumps	700.00	LF	$37.86	$26,504.98	168.00	$16,411.94	$1,197.04	$0.00	$8,896.00	$0.00
07	Transformer Pad	1.00	Each	$2,956.34	$2,956.34	25.00	$2,342.58	$213.76	$0.00	$400.00	$0.00
07	Pumps	2.00	Each	$2,718.62	$5,437.24	20.00	$1,837.24	$0.00	$0.00	$3,600.00	$0.00
08 (Pump Control Panel)		1.00			$31,200.00	0.00	$1,200.00	$0.00	$0.00	$30,000.00	$0.00
08	Pump Control Panel	1.00	Each	$31,200.00	$31,200.00	0.00	$1,200.00	$0.00	$0.00	$30,000.00	$0.00
09 (6" HDPE Water Supply Connec					$6,895.98	0.00	$0.00	$5,705.98	$0.00	$1,190.00	$0.00
09	Connect to 10" Main	2.00	EA	$1,618.00	$3,235.99	0.00	$0.00	$2,535.99	$0.00	$700.00	$0.00
09	6" HDPE Water Line	40.00	LF	$91.50	$3,659.99	0.00	$0.00	$3,169.99	$0.00	$490.00	$0.00
09	Water Supply Connection	40.00	LF	$172.40	$6,895.98	0.00	$0.00	$5,705.98	$0.00	$1,190.00	$0.00
10 (10" HDPE Raw Water Transmi		240.00			$12,359.98	0.00	$0.00	$7,607.98	$0.00	$4,752.00	$0.00
10	Raw Water Transmission Line 10" HDP	240.00	LF	$51.50	$12,359.98	0.00	$0.00	$7,607.98	$0.00	$4,752.00	$0.00
					$1,233,407.69	2,497.00	$495,367.37	$141,336.92	$15,645.07	$501,058.33	$80,000.00

Overview

Job Code:	Angoon Water Source Option 3 Infiltration Gallery Final PER
Job Description:	ANTHC Angoon Water Source PER 100% Submittal - Option 3 - Infiltration Galleries

Notes: Documents

Angoon Water Source

Preliminary Engineering Report
ANTHC Porject Number ANTHC 21-D-94328
100% Submittal
April 2021

Schedule

Construction - Spring 2024
Duration - 7 Months

Notes & Assumptions

Local Labor
Force Account
Equipment will be barged to and from the project site from Anchorage

Estimator

Jay Lavoie, Estimations, Inc.
jay@estimations.com, 907-561-0755

Methodology

Estimate is priced with current material prices
Labor and production based on estimators experience
Labor rates provided by ANTHC
Lodging assumed to be a rental house budgeted and Incidentals at $13,000 per month

Project Scope

Install upstream, near entrance of pond. See attached figures.

2 EA New Vertical Infiltration Galleries, 12" steel casing, 30' deep, bottom 10 feet slotted, 6" submersible pump (20 HP, variable speed, 225 gpm ea, assume TDH about 250')
1 EA Pump control panel (in WTP, with pressure transducer for WST)
40 LF 6" hdpe water supply connection to 10" hdpe header (2 - 20 LF connections, one from each infiltration gallery)
240 LF 10 " hdpe raw water transmission line connection to existing 10" DIP line, buried min 4' deep (will cut gravel road)

Documents

vw 005 32210029_Angoon PER_Figs1-10_12042020.pdf
Angoon Cost Estimate Summary.xlsx
Date: December 2020

Estimate Class - 4 - Based on 1-15% project definition and estimating methodology is primarily Stochastic.

Time on site 7 months.
Labor rates are based on 2020 ANTHC labor rates.
Materials will be subject to Buy American.
Project work hours - 6 day - 10 hours per week.
Project delivery method - Force Account
Project Construction Year - 2024
Inflation - 3.5%/year x 2.5 year = 9.0%
Construction Contgingency - 14% of Construction cost.
Estimating Contingency - 12% of Construction cost.

CBS Position Code	Quantity	UM	Description (Cost Item)	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
3	1.00	Each	Design Phase	0.00	0.00	Detail	U.S. Dollar	112,128.00	112,128.00
3.3	1.00	Each	IFC (95 to IFC)	0.00	0.00	Detail	U.S. Dollar	112,128.00	112,128.00
3.3.7	1.00	Each	Design Complete	0.00	0.00	Detail	U.S. Dollar	112,128.00	112,128.00
3.3.7.1	1.00	Each	Design	0.00	0.00	Plug	U.S. Dollar	112,128.00	112,128.00
4	1.00	Each	Construct Phase	231.90	0.00	Detail	U.S. Dollar	1,121,279.69	1,121,279.69
4.3	1.00	Each	Construction	185.00	0.01	Detail	U.S. Dollar	1,079,036.31	1,079,036.31
4.3.1	1.00	Each	General Conditions	102.00	0.01	Detail	U.S. Dollar	395,127.63	395,127.63
4.3.1.1	1.00	Each	Key Personnel	102.00	0.01	Detail	U.S. Dollar	115,377.63	115,377.63
4.3.1.1.2	2.00	MTH	ANTHC Construction Manager	14.00	0.14	Detail	U.S. Dollar	12,600.00	25,200.00

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
CONSTMGR4	Construction Manager 4	140.00	1.00	Each (hourly)	U.S. Dollar	180.00	25,200.00

Notes: 1/3 FTE

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.1.1.3	2.00	MTH	ANTHC Project Superintendent	52.00	0.04	Detail	U.S. Dollar	34,804.16	69,608.31

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
SUPER3	Superintendent 3	520.00	1.00	Each (hourly)	U.S. Dollar	133.86	69,608.31

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.1.1.5	1.00	Each	Survey	36.00	0.03	Detail	U.S. Dollar	20,569.32	20,569.32

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
SURV4	Surveyor 4	360.00	1.00	Each (hourly)	U.S. Dollar	57.14	20,569.32

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.1.4	1.00	Each	Contingency	0.00	0.00	Detail	U.S. Dollar	279,750.00	279,750.00
4.3.1.4.1	1.00	Each	Construction Contingency 14% of Construction	0.00	0.00	Plug	U.S. Dollar	111,900.00	111,900.00
4.3.1.4.2	1.00	Each	Design Contingency 12% of Construction	0.00	0.00	Plug	U.S. Dollar	95,914.00	95,914.00
4.3.1.4.3	1.00	Each	Inflation 9.0% of Construction	0.00	0.00	Plug	U.S. Dollar	71,936.00	71,936.00

Notes: Assume construction in spring of 2022, basing on start of project not midpoint as start will be the buy out that is 1.5 year out. Inflation = (1+interest rate) raised to the n years, using interest rate of 3.5% annual = 1.035^1.5 = 1.053 or 5.3% inflation

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.2	474,600.00	LB	Freight	4.50	105,466.67	Detail	U.S. Dollar	0.47	221,028.18
4.3.2.1	248,300.00	LB	Freight - Mobilization (Equip and Materials)	2.50	99,320.00	Detail	U.S. Dollar	0.50	124,332.48
4.3.2.1.1	226,300.00	LB	Freight Equipment	2.00	113,150.00	Detail	U.S. Dollar	0.43	96,695.70

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
LLCL1	Crew Leader 1	20.00	1.00 Each (hourly)	U.S. Dollar	71.58	1,431.70
BARGE	Barging		6.00 Day	U.S. Dollar	15,000.00	90,000.00
LLTD1	Truck Driver 1	20.00	1.00 Each (hourly)	U.S. Dollar	18.00	360.00
LLALAB	Local Labor	40.00	2.00 Each (hourly)	U.S. Dollar	77.14	3,085.48
LLEO3	Equipment Operator 3	20.00	1.00 Each (hourly)	U.S. Dollar	90.93	1,818.52

Notes:

Mob Well Driller		1	Each	35000	35,000
ATV Side By Side		1	Each	2000	2,000
ATV Trailer	1	Each	1000	1,000	
Cat 320 Excavator		1	Each	47400	47,400
De-Watering Pump		1	Each	1500	1,500
Dump Truck	2	Each	16800	33,600	
Compactor	1	Each	20000	20,000	
ElectroFusion Machine	1	Each	500	500	
Four Jaw Fusion Machine	1	Each	500	500	
Four Wheeler	1	Each	2000	2,000	
Hydraulic Excavator Mini	1	Each	7500	7,500	
Loader 950	1	Each	42800	42,800	
Pickup 4x4	1	Each	7000	7,000	
Small dozer	1	Each	15500	15,500	
Misc Small Tool Connex	1	EA	10000	10,000	
Total					226,300

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.2.1.2	22,000.00 LB	Freight Materials	0.50	44,000.00 Detail	U.S. Dollar	1.26	27,636.78

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
FRT	Freight to Nondalton		22,000.00 LB	U.S. Dollar	0.48	10,560.00
BARGE	Barging Juneau - Angoon		1.00 Day	U.S. Dollar	15,000.00	15,000.00
LLCL1	Crew Leader 1	5.00	1.00 Each (hourly)	U.S. Dollar	71.58	357.92
LLTD1	Truck Driver 1	5.00	1.00 Each (hourly)	U.S. Dollar	18.00	90.00
LLALAB	Local Labor	10.00	2.00 Each (hourly)	U.S. Dollar	77.14	771.37
EL950	Loader 950	5.00	1.00 Each (hourly)	U.S. Dollar	75.56	377.80
LLEO3	Equipment Operator 3	5.00	1.00 Each (hourly)	U.S. Dollar	90.93	454.63
FPLUM4	Plumber 4	0.08	1.00 Each (hourly)	U.S. Dollar	43.08	3.59
FPLUM4	Plumber 4	0.08	1.00 Each (hourly)	U.S. Dollar	43.08	3.59
FELEC3	Electrician 4	0.08	1.00 Each (hourly)	U.S. Dollar	18.00	1.50
LL2999	Laborer 3	0.17	2.00 Each (hourly)	U.S. Dollar	76.71	12.78
FPLUM4	Plumber 4	0.08	1.00 Each (hourly)	U.S. Dollar	43.08	3.59

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost

Notes: Materials - freight

Wells	2	EA	4500	9,000
6" Water Line 40	LF	10	400	
10" Water Line	240	LF	10	2,400
Subtotal				11,800
Allow for Misc			10,000	
Total (Rounded)				22,000

Allowing 0.33 Barge Trip, Assumed combined with Equipment, 1 day

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.2.3	226,300.00 LB	Freight - Demobilization (Equip. and Materials)	2.00	113,150.00 Detail	U.S. Dollar	0.43	96,695.70

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
LLALAB	Local Labor	40.00	2.00 Each (hourly)	U.S. Dollar	77.14	3,085.48
LLCL1	Crew Leader 1	20.00	1.00 Each (hourly)	U.S. Dollar	71.58	1,431.70
LLTD1	Truck Driver 1	20.00	1.00 Each (hourly)	U.S. Dollar	18.00	360.00
BARGE	Barging		6.00 Day	U.S. Dollar	15,000.00	90,000.00
LLEO3	Equipment Operator 3	20.00	1.00 Each (hourly)	U.S. Dollar	90.93	1,818.52

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.3	38.00 Each	Travel	0.00	0.00 Detail	U.S. Dollar	934.00	35,492.00
4.3.3.1	4.00 Each	Travel - Early	0.00	0.00 Detail	U.S. Dollar	934.00	3,736.00

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
AFARE	Air Fare - Anchorage to Angoon		4.00 Each	U.S. Dollar	500.00	2,000.00
PERDIEM	Per Diem		8.00 Each	U.S. Dollar	217.00	1,736.00

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.3.3	4.00 Each	Travel - Construction Closout	0.00	0.00 Detail	U.S. Dollar	934.00	3,736.00

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
AFARE	Air Fare - Anchorage to Angoon		4.00 Each	U.S. Dollar	500.00	2,000.00
PERDIEM	Per Diem		8.00 Each	U.S. Dollar	217.00	1,736.00

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.3.4	30.00 Each	Travel - Construction	0.00	0.00 Detail	U.S. Dollar	934.00	28,020.00

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
AFARE	Air Fare - Anchorage to Angoon		30.00 Each	U.S. Dollar	500.00	15,000.00
PERDIEM	Per Diem		60.00 Each	U.S. Dollar	217.00	13,020.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost

Notes: Crew - 6 x 2 rt
Super 1 x 2 rt
CM 1 x 2 rt
eng 1 x 2 rt
Mechanic 1 x 4 rt
Survey 2 x 2 rt = 4 rt
Prefinal inspection 2 rt
Final inspection 2 rt
Total = 30 trips

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.4	1.00	Each	Shipping and Receiving	22.00	0.05	Detail	U.S. Dollar	3,960.00	3,960.00
4.3.4.3	1.00	Each	Shipping and Receiving - Construction	22.00	0.05	Detail	U.S. Dollar	3,960.00	3,960.00

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
LL4000	Laborer 5	220.00	1.00	Each (hourly)	U.S. Dollar	18.00	3,960.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.5	1.00	Each	Contracting and Purchasing	5.00	0.20	Detail	U.S. Dollar	5,509.48	5,509.48
4.3.5.1	1.00	Each	Contracting & Purchasing	5.00	0.20	Detail	U.S. Dollar	5,509.48	5,509.48

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
MATCOOR	Materials Coordinator	50.00	1.00	Each (hourly)	U.S. Dollar	110.19	5,509.48

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.6	1.00	Each	Fuel	0.00	0.00	Detail	U.S. Dollar	11,160.00	11,160.00
4.3.6.1	2,000.00	Gallon	Fuel	0.00	0.00	Detail	U.S. Dollar	5.58	11,160.00

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
FUEL	Fuel		2,000.00	Gallon	U.S. Dollar	5.58	11,160.00

Notes: Fuel for Misc. Most fuel in Equipment Rates

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.7	1.00	Each	Pre Construction	0.00	0.00	Detail	U.S. Dollar	28,800.00	28,800.00
4.3.7.6	2.00	MTH	Housing & Utilities	0.00	0.00	Plug	U.S. Dollar	13,000.00	26,000.00

Notes: $13k per month based on advice from ANTHC on other projects.

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.7.7	560.00	LF	SWPPP BMPs	0.00	0.00	Detail	U.S. Dollar	5.00	2,800.00

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
SILTFENCE	Silt Fence & BMPs		560.00	LF	U.S. Dollar	5.00	2,800.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.8	1.00	Each	Equipment	42.00	0.02	Detail	U.S. Dollar	185,133.12	185,133.12
4.3.8.1	2.00	MTH	ANTHC Equipment Cost	16.00	0.13	Detail	U.S. Dollar	75,017.50	150,035.00

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost

CBS Position Code	Quantity UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
		Cost Item						
ATVSS	ATV Side By Side	160.00	1.00	Each (hourly)	U.S. Dollar		10.27	1,643.35
AIR COMPRESS	Air Compressor	160.00	1.00	Each (hourly)	U.S. Dollar		14.88	2,380.80
4J-FUSION	Four Jaw Fusion Machine	160.00	1.00	Each (hourly)	U.S. Dollar		1.14	181.82
E-FUSION	ElectroFusion Machine	160.00	1.00	Each (hourly)	U.S. Dollar		0.00	0.00
EXC-CAT330C	Cat 330 Excavator	160.00	1.00	Each (hourly)	U.S. Dollar		97.78	15,645.07
SKIDSTEER	Skid Steer - Bobcat 630	160.00	1.00	Each (hourly)	U.S. Dollar		28.81	4,610.24
PUMP	De-Watering Pump	160.00	1.00	Each (hourly)	U.S. Dollar		31.86	5,097.60
EQREPAIR ALLOW	Equipment Repair Allowance		0.17	EA	U.S. Dollar		50,000.00	8,333.33
ATVTRAILER	ATV Trailer	0.00	0.00	Each (hourly)	U.S. Dollar		5.00	0.00
DOZER D6	Dozer D6T	160.00	1.00	Each (hourly)	U.S. Dollar		94.88	15,180.00
END DUMP	Dump Truck	0.00	0.00	Each (hourly)	U.S. Dollar		92.17	0.00
ATV	Four Wheeler	160.00	1.00	Each (hourly)	U.S. Dollar		7.18	1,148.80
EG14G	Grader 14G	160.00	1.00	Each (hourly)	U.S. Dollar		68.48	10,956.80
ECRHC	Hydraulic Crane 25 Ton	160.00	1.00	Each (hourly)	U.S. Dollar		128.64	20,582.40
EXCAVATOR MINI	Hydraulic Excavator Mini	160.00	1.00	Each (hourly)	U.S. Dollar		27.48	4,396.91
ELOADER 980	Loader 980	160.00	1.00	Each (hourly)	U.S. Dollar		195.38	31,260.80
PICKUP	Pickup 4x4	160.00	1.00	Each (hourly)	U.S. Dollar		8.80	1,408.00
ROCKDRILL	Rock Drill	160.00	1.00	Each (hourly)	U.S. Dollar		125.00	20,000.00
CEMENT MIXER SM	Small Concrete Mixer	160.00	1.00	Each (hourly)	U.S. Dollar		35.03	5,605.54
DOZER	local small dozer no Rental fee.	160.00	1.00	Each (hourly)	U.S. Dollar		0.00	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar		18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar		76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar		18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar		76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar		43.08	0.00
FPLUM4	Plumber 4	2.67	1.00	Each (hourly)	U.S. Dollar		43.08	114.89
FPLUM4	Plumber 4	2.67	1.00	Each (hourly)	U.S. Dollar		43.08	114.89
FELEC3	Electrician 4	2.67	1.00	Each (hourly)	U.S. Dollar		18.00	48.00
LL2999	Laborer 3	5.33	2.00	Each (hourly)	U.S. Dollar		76.71	409.12
FPLUM4	Plumber 4	2.67	1.00	Each (hourly)	U.S. Dollar		43.08	114.89

CBS Position Code	Quantity UM	Description	Cost Item Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
FPLUM4	Plumber 4	2.67	1.00 Each (hourly)	U.S. Dollar	43.08	114.89
FPLUM4	Plumber 4	2.67	1.00 Each (hourly)	U.S. Dollar	43.08	114.89
FELEC3	Electrician 4	2.67	1.00 Each (hourly)	U.S. Dollar	18.00	48.00
LL2999	Laborer 3	5.33	2.00 Each (hourly)	U.S. Dollar	76.71	409.12
FPLUM4	Plumber 4	2.67	1.00 Each (hourly)	U.S. Dollar	43.08	114.89
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00 Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00 Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00 Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00 Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00 Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00 Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00

Notes: 2 month for mob/demob, 1 for standby

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.8.2	2.00 MTH	Equipment Maintenance Labor	26.00	0.08 Detail	U.S. Dollar	17,549.06	35,098.12

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
LLMECH3	Mechanic 3	260.00	1.00 Each (hourly)	U.S. Dollar	134.99	35,098.12

Notes: 1/2 FTE

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.9	1.00 Each	Construction	9.50	0.11 Detail	U.S. Dollar	192,825.90	192,825.90
4.3.9.12	2.00 Each	Vertical Infiltration Galleries	5.30	0.38 Detail	U.S. Dollar	71,184.97	142,369.94
4.3.9.12.1	2.00 Each	Wells 30'D	0.00	0.00 Plug	U.S. Dollar	40,000.00	80,000.00
4.3.9.12.2	2.00 Each	Pumps	1.00	2.00 Detail	U.S. Dollar	2,718.62	5,437.24

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
WELLPUMP 5HP	Well Pumps 5 HP with Cables		2.00 Each	U.S. Dollar	1,800.00	3,600.00
FPLUM3	Plumber 3	20.00	2.00 Each (hourly)	U.S. Dollar	91.86	1,837.24

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.12.3	2.00	Each	Power to Pumps	4.30	0.47	Detail	U.S. Dollar	28,466.35	56,932.70
4.3.9.12.3.1	700.00	LF	Power to Pumps	2.80	250.00	Detail	U.S. Dollar	37.86	26,504.98

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
TELEC3	Electrician 3	84.00	3.00	Each (hourly)	U.S. Dollar	117.62	9,880.47
LLCL3	Crew Leader 3	28.00	1.00	Each (hourly)	U.S. Dollar	78.99	2,211.80
LLALAB	Local Labor	56.00	2.00	Each (hourly)	U.S. Dollar	77.14	4,319.67
ATVSS	ATV Side By Side	28.00	1.00	Each (hourly)	U.S. Dollar	10.27	287.59
ATVTRAILER	ATV Trailer	28.00	1.00	Each (hourly)	U.S. Dollar	5.00	140.00
EXCAVATOR MINI	Hydraulic Excavator Mini	28.00	1.00	Each (hourly)	U.S. Dollar	27.48	769.46
DOZERJD450	JD 450 Dozer	28.00	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
GRAVELLOCAL	Locally Sourced Gravel - Screened with Grissly		119.60	CY	U.S. Dollar	10.00	1,196.00
MV CABLE	MV Cable		770.00	LF	U.S. Dollar	10.00	7,700.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.12.3.2	1.00	Each	Transformer	1.00	1.00	Detail	U.S. Dollar	27,471.38	27,471.38

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
TELEC3	Electrician 3	30.00	3.00	Each (hourly)	U.S. Dollar	117.62	3,528.74
LLCL3	Crew Leader 3	10.00	1.00	Each (hourly)	U.S. Dollar	78.99	789.93
ATVSS	ATV Side By Side	10.00	1.00	Each (hourly)	U.S. Dollar	10.27	102.71
ATVTRAILER	ATV Trailer	10.00	1.00	Each (hourly)	U.S. Dollar	5.00	50.00
EL XFMR150KVA	15 kVA Medium Voltage Transformer		1.00	Each	U.S. Dollar	23,000.00	23,000.00
BOOM TRUCK	Boom Truck	10.00	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.12.3.3	1.00	Each	Transformer Pad	0.50	2.00	Detail	U.S. Dollar	2,956.34	2,956.34

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
TELEC3	Electrician 3	10.00	2.00	Each (hourly)	U.S. Dollar	117.62	1,176.25
LLCL3	Crew Leader 3	5.00	1.00	Each (hourly)	U.S. Dollar	78.99	394.96
LLALAB	Local Labor	10.00	2.00	Each (hourly)	U.S. Dollar	77.14	771.37
ATVSS	ATV Side By Side	5.00	1.00	Each (hourly)	U.S. Dollar	10.27	51.35
ATVTRAILER	ATV Trailer	5.00	1.00	Each (hourly)	U.S. Dollar	5.00	25.00
EXCAVATOR MINI	Hydraulic Excavator Mini	5.00	1.00	Each (hourly)	U.S. Dollar	27.48	137.40
DOZERJD450	JD 450 Dozer	5.00	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
CONC	Concrete - Rural, Presacked, Gravel and Cement		1.00	CY	U.S. Dollar	400.00	400.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.13	1.00	Each	Pump Control Panel	0.00	0.00	Plug	U.S. Dollar	31,200.00	31,200.00
4.3.9.14	40.00	LF	Water Supply Connection	1.80	22.22	Detail	U.S. Dollar	172.40	6,895.98
4.3.9.14.1	40.00	LF	6" HDPE Water Line	1.00	40.00	Detail	U.S. Dollar	91.50	3,659.99

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
FTG FLG HDPE 6	6" HDPE Flange and Bolt Kit		2.00	Each	U.S. Dollar	85.00	170.00
HDPE6 SDR17	6" HDPE Pipe - Buy American		40.00	LF	U.S. Dollar	8.00	320.00
EXCAVATOR	Hydraulic Excavator Cat 320	10.00	1.00	Each (hourly)	U.S. Dollar	116.25	1,162.52
DOZERJD450	JD 450 Dozer	10.00	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	10.00	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
4J-FUSION	Four Jaw Fusion Machine	10.00	1.00	Each (hourly)	U.S. Dollar	1.14	11.36
E-FUSION	ElectroFusion Machine	10.00	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
ATVSS	ATV Side By Side	10.00	1.00	Each (hourly)	U.S. Dollar	10.27	102.71
ATVTRAILER	ATV Trailer	10.00	1.00	Each (hourly)	U.S. Dollar	5.00	50.00
END DUMP	Dump Truck	20.00	2.00	Each (hourly)	U.S. Dollar	92.17	1,843.40
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.14.2	2.00	EA	Connect to 10" Main	0.80	2.50	Detail	U.S. Dollar	1,618.00	3,235.99

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
EXCAVATOR	Hydraulic Excavator Cat 320	8.00	1.00	Each (hourly)	U.S. Dollar	116.25	930.01
DOZERJD450	JD 450 Dozer	8.00	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
4J-FUSION	Four Jaw Fusion Machine	8.00	1.00	Each (hourly)	U.S. Dollar	1.14	9.09
E-FUSION	ElectroFusion Machine	8.00	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
ATVSS	ATV Side By Side	8.00	1.00	Each (hourly)	U.S. Dollar	10.27	82.17
HDPE FTG TEE 6X10	HDPE Tee 6x10		2.00	Each	U.S. Dollar	350.00	700.00
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	8.00	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
ATVTRAILER	ATV Trailer	8.00	1.00	Each (hourly)	U.S. Dollar	5.00	40.00
END DUMP	Dump Truck	16.00	2.00	Each (hourly)	U.S. Dollar	92.17	1,474.72
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.15	240.00	LF	Raw Water Transmission Line 10" HDPE	2.40	100.00	Detail	U.S. Dollar	51.50	12,359.98

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
HDPE10	10" HDPE Pipe - Buy American		264.00	LF	U.S. Dollar	18.00	4,752.00
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	24.00	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
ATVTRAILER	ATV Trailer	24.00	1.00	Each (hourly)	U.S. Dollar	5.00	120.00
END DUMP	Dump Truck	48.00	2.00	Each (hourly)	U.S. Dollar	92.17	4,424.16
EXCAVATOR	Hydraulic Excavator Cat 320	24.00	1.00	Each (hourly)	U.S. Dollar	116.25	2,790.04
DOZERJD450	JD 450 Dozer	24.00	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
4J-FUSION	Four Jaw Fusion Machine	24.00	1.00	Each (hourly)	U.S. Dollar	1.14	27.27
E-FUSION	ElectroFusion Machine	24.00	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
ATVSS	ATV Side By Side	24.00	1.00	Each (hourly)	U.S. Dollar	10.27	246.50
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00

Estimate Details
ANTHC Angoon Water Source PER 100% Submittal - Option 3 - Infiltration Galleries
Angoon Water Source Option 3 Infiltration Gallery Final PER
ESTIMATIONS, INC

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.4	1.00	Each	Post Construction	46.90	0.02	Detail	U.S. Dollar	42,243.38	42,243.38
4.4.11	1.00	Each	O&M Training	26.90	0.04	Detail	U.S. Dollar	24,229.15	24,229.15

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
PMENG4	Project Manager Engineer 4	269.00	1.00	Each (hourly)	U.S. Dollar	90.07	24,229.15

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.4.15	1.00	Each	Final Inspection - On Site	20.00	0.05	Detail	U.S. Dollar	18,014.24	18,014.24

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
PMENG4	Project Manager Engineer 4	200.00	1.00	Each (hourly)	U.S. Dollar	90.07	18,014.24

Report Total:	Days	Total Cost
	231.90	1,233,407.69

Category	Total
Labor	495,367.37
Owned Equipment	141,336.92
Rented Equipment	15,645.07
Materials	501,058.33
Subcontract	80,000.00

Code	Description	Quantity	Unit of Measure	Awardee	Awarded Rate	Total Cost
AFARE	Air Fare - Anchorage to Angoon	38.00	Each			19,000.00
BARGE	Barging	13.00	Day			195,000.00
CONC	Concrete - Rural, Presacked, Gravel and Cement	1.00	CY			400.00
EL XFMR150KVA	15 kVA Medium Voltage Transformer	1.00	Each			23,000.00
FRT	Freight to Nondalton	22,000.00	LB			10,560.00
FTG FLG HDPE 6	6" HDPE Flange and Bolt Kit	2.00	Each			170.00
GRAVELLOCAL	Locally Sourced Gravel - Screened with Grissly	119.60	CY			1,196.00
HDPE FTG TEE 6X10	HDPE Tee 6x10	2.00	Each			700.00
HDPE10	10" HDPE Pipe - Buy American	264.00	LF			4,752.00
HDPE6 SDR17	6" HDPE Pipe - Buy American	40.00	LF			320.00
MV CABLE	MV Cable	770.00	LF			7,700.00
SILTFENCE	Silt Fence & BMPs	560.00	LF			2,800.00
WELLPUMP 5HP	Well Pumps 5 HP with Cables	2.00	Each			3,600.00
	Grand Totals					**269,198.00**

Resource Utilization: Labor
ANTHC Angoon Water Source PER 100% Submittal - Option 3 - Infiltration Galleries
Angoon Water Source Option 3 Infiltration Gallery Final PER
ESTIMATIONS, INC

Code	Description	Wage Scale 1 Rate/Hr	Hours	Wage Scale 2 Rate/Hr	Hours	Wage Scale 3 Rate/Hr	Hours	Total Work Hours	Total Pay Hours	Total Costs
CAD 5	CAD 5	55.10	0.00	70.65	0.00	70.65	0.00	0.00	0.00	0.00
CIVIL5	Civil 5	59.03	0.00	68.71	0.00	79.54	0.00	0.00	0.00	0.00
CONSTMGR4	Construction Manager 4	180.00	92.40	180.00	47.60	180.00	0.00	140.00	140.00	25,200.00
ENVIRMGR	Environmental Manager	98.56	0.00	135.84	0.00	135.84	0.00	0.00	0.00	0.00
FELEC3	Electrician 4	18.00	3.58	18.00	1.84	18.00	0.00	5.42	5.42	97.50
FPLUM3	Plumber 3	81.13	13.20	112.70	6.80	112.70	0.00	20.00	20.00	1,837.24
FPLUM4	Plumber 4	40.31	10.73	48.46	5.53	48.46	0.00	16.25	16.25	700.09
LL2999	Laborer 3	69.05	7.15	91.58	3.68	91.58	0.00	10.83	10.83	831.02
LL4000	Laborer 5	18.00	145.20	18.00	74.80	18.00	0.00	220.00	220.00	3,960.00
LLALAB	Local Labor	77.14	102.96	77.14	53.04	77.14	0.00	156.00	156.00	12,033.37
LLCL1	Crew Leader 1	64.67	29.70	85.01	15.30	85.01	0.00	45.00	45.00	3,221.32
LLCL3	Crew Leader 3	78.99	28.38	78.99	14.62	78.99	0.00	43.00	43.00	3,396.69
LLEO3	Equipment Operator 3	81.20	29.70	109.80	15.30	109.80	0.00	45.00	45.00	4,091.67
LLMECH3	Mechanic 3	134.99	171.60	134.99	88.40	107.21	0.00	260.00	260.00	35,098.12
LLTD1	Truck Driver 1	18.00	29.70	18.00	15.30	18.00	0.00	45.00	45.00	810.00
MATCOOR	Materials Coordinator	97.67	33.00	134.50	17.00	134.50	0.00	50.00	50.00	5,509.48
PMENG4	Project Manager Engineer 4	98.99	309.54	72.75	159.46	98.99	0.00	469.00	469.00	42,243.38
QIM	Quality Improvement Manager	110.33	0.00	153.50	0.00	153.50	0.00	0.00	0.00	0.00
SUPER3	Superintendent 3	123.13	343.20	154.70	176.80	154.70	0.00	520.00	520.00	69,608.31
SURV4	Surveyor 4	57.14	237.60	57.14	122.40	57.14	0.00	360.00	360.00	20,569.32
TELEC3	Electrician 3	101.12	81.84	149.67	42.16	149.67	0.00	124.00	124.00	14,585.45
	Grand Totals		1,669.47		860.03		0.00	2,529.50	2,529.50	243,792.97

Code	Description	Owned Equipment Rate/Hr	Total Pay Hours	Total Costs	Fuel Type	Fuel Amount	Fuel Cost	Fuel Unit of Measure	Maintenance Man-Hour Factor	Total Maintenance
4J-FUSION	Four Jaw Fusion Machine	1.14	202.00	229.55			0.00		0.00	0.00
AIR COMPRESS	Air Compressor	14.88	160.00	2,380.80			0.00		0.00	0.00
ATV	Four Wheeler	7.18	160.00	1,148.80	Unleaded	160.00	948.80	Gallon	0.00	0.00
ATVSS	ATV Side By Side	10.27	245.00	2,516.37	Unleaded	245.00	1,452.85	Gallon	0.00	0.00
ATVTRAILER	ATV Trailer	5.00	85.00	425.00			0.00		0.00	0.00
BOOM TRUCK	Boom Truck	0.00	10.00	0.00			0.00		0.00	0.00
CEMENT MIXER SM	Small Concrete Mixer	35.03	160.00	5,605.54	Unleaded	800.00	4,744.00	Gallon	0.00	0.00
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	0.00	42.00	0.00			0.00		0.00	0.00
DOZER	local small dozer no Rental fee.	0.00	160.00	0.00			0.00		0.00	0.00
DOZER D6	Dozer D6T	94.88	160.00	15,180.00	Diesel	1,000.00	5,580.00	Gallon	0.00	0.00
ECRHC	Hydraulic Crane 25 Ton	128.64	160.00	20,582.40	Diesel	1,280.00	7,142.40	Gallon	0.10	801.77
E-FUSION	ElectroFusion Machine	0.00	202.00	0.00			0.00		0.00	0.00
EG14G	Grader 14G	68.48	160.00	10,956.80	Diesel	960.00	5,356.80	Gallon	0.10	801.77
EL950	Loader 950	75.56	5.00	377.80	Diesel	55.00	306.90	Gallon	0.10	25.06
ELOADER 980	Loader 980	195.38	160.00	31,260.80	Diesel	1,760.00	9,820.80	Gallon	0.10	0.00
END DUMP	Dump Truck	92.17	84.00	7,742.28	Diesel	504.00	2,812.32	Gallon	0.00	0.00
EXCAVATOR	Hydraulic Excavator Cat 320	116.25	42.00	4,882.58	Diesel	260.82	1,455.38	Gallon	0.00	0.00
EXCAVATOR MINI	Hydraulic Excavator Mini	27.48	193.00	5,303.77	Diesel	395.65	2,207.73	Gallon	0.00	0.00
PICKUP	Pickup 4x4	8.80	160.00	1,408.00	Unleaded	0.00	0.00	Gallon	0.00	0.00
PUMP	De-Watering Pump	31.86	160.00	5,097.60	Unleaded	320.00	1,897.60	Gallon	0.00	0.00
ROCKDRILL	Rock Drill	125.00	160.00	20,000.00			0.00		0.00	0.00
SKIDSTEER	Skid Steer - Bobcat 630	28.81	160.00	4,610.24	Diesel	288.00	1,607.04	Gallon	0.00	0.00
	Grand Totals		3,030.00	139,708.32			45,332.61			1,628.60

Fuel Summary

Fuel Type	Unit of Measure	Account Code	Total Amount	Unit Cost	Total Cost
Diesel	Gallon		6,503.47	5.58	36,289.36
Unleaded	Gallon		1,525.00	5.93	9,043.25

Resource Utilization: Rented Construction Equipment
ANTHC Angoon Water Source PER 100% Submittal - Option 3 - Infiltration Galleries
Angoon Water Source Option 3 Infiltration Gallery Final PER
ESTIMATIONS, INC

Code	Description	Rented Equipment Plug Rate/Hr	RE Rented Plug Rate/Hr	RE Oper. Plug Rate/Hr	Total Pay Hours	Awarded Rate/Hr	Tax Rate on RE Rented	Tax Amount on RE Rented	Total Costs	Fuel Type	Fuel Amount	Fuel Costs	Fuel Unit of Measure	Maintenance Man-Hour Factor	Total Maintenance
DOZERJD450	JD 450 Dozer	0.00	0.00	0.00	75.00		0.00%	0.00	0.00			0.00		0.00	0.00
EXC-CAT330C	Cat 330 Excavator	97.78	40.04	57.74	160.00		0.00%	0.00	15,645.07	Diesel	480.00	2,678.40	Gallon	0.00	0.00
	Grand Totals				235.00			0.00	15,645.07			2,678.40			0.00

Fuel Summary

Fuel Type	Unit of Measure	Account Code	Total Amount	Unit Cost	Total Cost
Diesel	Gallon		480.00	5.58	2,678.40

Option 4 - Rebuild Intake

SUMMARY
ANTHC Angoon Water Source PER 100% Submittal - Option 4 - Rebuild Intake
Angoon Water Source Option 4 Rebuild Intake Final PER
ESTIMATIONS, INC

Line No.	Pay Item No.	Description Subtotal Description	Quantity	Unit of Measure	Unit Price	Total Price
		Proposal				
01	01	General Requirements	1.00	MTH	599,793.51	599,793.51
02	02	Equipment	1.00	EA	299,231.68	299,231.68
03	03	Design Phase 10%	1.00	EA	156,268.00	156,268.00
04	04	Construction Contingency 14% of Construction	1.00	EA	160,188.00	160,188.00
05	05	Estimating Contingency 12% of Construction	1.00	EA	137,304.00	137,304.00
06	06	Escalation for Inflation 7.1%	1.00	EA	102,977.74	102,977.74
07	07	Demolition	1.00	EA	40,680.77	40,680.77
08	08	Wetwell	1.00	LS	101,321.62	101,321.62
09	09	Site Piping	1.00	EA	54,708.72	54,708.72
10	10	Intake	1.00	EA	35,881.02	35,881.02
11	11	Auto Strainer	1.00	EA	30,594.87	30,594.87
					GRAND TOTAL:	1,718,949.93

Pay Item Assignment	Description	Forecast (T/O) Quantity	Unit of Measure	Unit Cost	Total Cost (Forecast)	Man-Hours (Total)	Labor Total Cost	Owned Equipment Total Cost	Rented Equipment Total Cost	Materials Total Cost	Subcontract Total Cost
01 (General Requirements)					$599,793.51	2,845.00	$347,610.65	$402.86	$0.00	$139,280.00	$112,500.00
01	SWPPP BMPs	200.00	LF	$5.00	$1,000.00	0.00	$0.00	$0.00	$0.00	$1,000.00	$0.00
01	ANTHC Construction Manager	4.00	MTH	$37,800.00	$151,200.00	840.00	$151,200.00	$0.00	$0.00	$0.00	$0.00
01	Shipping and Receiving - Construction	1.00	Each	$3,960.00	$3,960.00	220.00	$3,960.00	$0.00	$0.00	$0.00	$0.00
01	Freight	525,800.00	LB	$0.29	$152,283.85	135.00	$9,140.99	$402.86	$0.00	$30,240.00	$112,500.00
01	O&M Training	1.00	Each	$9,007.12	$9,007.12	100.00	$9,007.12	$0.00	$0.00	$0.00	$0.00
01	Travel - Construction Closout	4.00	Each	$934.00	$3,736.00	0.00	$0.00	$0.00	$0.00	$3,736.00	$0.00
01	Contracting and Purchasing	1.00	Each	$5,509.48	$5,509.48	50.00	$5,509.48	$0.00	$0.00	$0.00	$0.00
01	Travel - Construction	52.00	Each	$934.00	$48,568.00	0.00	$0.00	$0.00	$0.00	$48,568.00	$0.00
01	Freight - Demobilization (Equip. and M	231,400.00	LB	$0.21	$48,347.85	50.00	$3,347.85	$0.00	$0.00	$0.00	$45,000.00
01	Post Construction	1.00	Each	$18,014.24	$18,014.24	200.00	$18,014.24	$0.00	$0.00	$0.00	$0.00
01	Survey	1.00	Each	$20,569.32	$20,569.32	360.00	$20,569.32	$0.00	$0.00	$0.00	$0.00
01	ANTHC Project Superintendent	4.00	Month	$34,804.16	$139,216.62	1,040.00	$139,216.62	$0.00	$0.00	$0.00	$0.00
01	Freight - Mobilization (Equip and Mat	249,400.00	LB	$0.42	$103,936.00	85.00	$5,793.14	$402.86	$0.00	$30,240.00	$67,500.00
01	Final Inspection - On Site	1.00	Each	$9,007.12	$9,007.12	100.00	$9,007.12	$0.00	$0.00	$0.00	$0.00
01	Housing & Utilities	4.00	MTH	$13,000.00	$52,000.00	0.00	$0.00	$0.00	$0.00	$52,000.00	$0.00
01	Travel - Early	4.00	Each	$934.00	$3,736.00	0.00	$0.00	$0.00	$0.00	$3,736.00	$0.00
01	Freight Equipment	231,400.00	LB	$0.21	$48,347.85	50.00	$3,347.85	$0.00	$0.00	$0.00	$45,000.00
01	Freight Materials	63,000.00	LB	$0.88	$55,588.15	35.00	$2,445.29	$402.86	$0.00	$30,240.00	$22,500.00
01	Pre Construction	1.00	Each	$53,000.00	$53,000.00	0.00	$0.00	$0.00	$0.00	$53,000.00	$0.00
01	Shipping and Receiving	1.00	Each	$3,960.00	$3,960.00	220.00	$3,960.00	$0.00	$0.00	$0.00	$0.00
01	Contracting & Purchasing	1.00	Each	$5,509.48	$5,509.48	50.00	$5,509.48	$0.00	$0.00	$0.00	$0.00
01	Travel	60.00	Each	$934.00	$56,040.00	0.00	$0.00	$0.00	$0.00	$56,040.00	$0.00
02 (Equipment)					$299,231.68	520.00	$70,196.25	$183,247.83	$23,467.60	$22,320.00	$0.00
02	Equipment	1.00	Each	$276,911.68	$276,911.68	520.00	$70,196.25	$183,247.83	$23,467.60	$0.00	$0.00
02	Fuel	4,000.00	Gallon	$5.58	$22,320.00	0.00	$0.00	$0.00	$0.00	$22,320.00	$0.00
02	Equipment Maintenance Labor	4.00	MTH	$17,549.06	$70,196.25	520.00	$70,196.25	$0.00	$0.00	$0.00	$0.00
02	ANTHC Equipment Cost	3.00	MTH	$68,905.14	$206,715.43	0.00	$0.00	$183,247.83	$23,467.60	$0.00	$0.00
03 (Design Phase 10%)		1.00			$156,268.00	0.00	$156,268.00	$0.00	$0.00	$0.00	$0.00
03	Design	1.00	Each	$156,268.00	$156,268.00	0.00	$156,268.00	$0.00	$0.00	$0.00	$0.00
03	**Design Phase**	1.00	Each	$156,268.00	$156,268.00	0.00	$156,268.00	$0.00	$0.00	$0.00	$0.00
03	Design Complete	1.00	Each	$156,268.00	$156,268.00	0.00	$156,268.00	$0.00	$0.00	$0.00	$0.00
04 (Construction Contingency 14%		1.00			$160,188.00	0.00	$80,094.00	$0.00	$0.00	$80,094.00	$0.00
04	Construction Contingency 14% of C	1.00	Each	$160,188.00	$160,188.00	0.00	$80,094.00	$0.00	$0.00	$80,094.00	$0.00
05 (Estimating Contingency 12% c		1.00			$137,304.00	0.00	$68,652.00	$0.00	$0.00	$68,652.00	$0.00
05	Estimating Contingency 12% of Con	1.00	Each	$137,304.00	$137,304.00	0.00	$68,652.00	$0.00	$0.00	$68,652.00	$0.00
06 (Escalation for Inflation 7.1%)		1.00			$102,977.74	0.00	$51,488.87	$0.00	$0.00	$51,488.87	$0.00

Pay Item Assignment		Description	Forecast (T/O) Quantity	Unit of Measure	Unit Cost	Total Cost (Forecast)	Man-Hours (Total)	Labor Total Cost	Owned Equipment Total Cost	Rented Equipment Total Cost	Materials Total Cost	Subcontract Total Cost
	06	Inflation 9.0% of Construction	1.00	Each	$102,977.74	$102,977.74	0.00	$51,488.87	$0.00	$0.00	$51,488.87	$0.00
07 (Demolition)			1.00			$40,680.77	270.00	$22,533.42	$16,147.35	$0.00	$2,000.00	$0.00
	07	Demolition	1.00	Each	$40,680.77	$40,680.77	270.00	$22,533.42	$16,147.35	$0.00	$2,000.00	$0.00
08 (Wetwell)			3.00			$101,321.62	450.00	$40,943.39	$31,472.22	$0.00	$28,906.00	$0.00
	08	Power to Wetwell	1.00	Each	$8,500.00	$8,500.00	0.00	$3,500.00	$0.00	$0.00	$5,000.00	$0.00
	08	Interior Piping & Equipment	1.00	Each	$24,383.26	$24,383.26	90.00	$7,398.84	$5,598.42	$0.00	$11,386.00	$0.00
	08	Wetwell Structure	1.00	Each	$68,438.36	$68,438.36	360.00	$30,044.55	$25,873.80	$0.00	$12,520.00	$0.00
	08	Wetwell	1.00	Each	$101,321.62	$101,321.62	450.00	$40,943.39	$31,472.22	$0.00	$28,906.00	$0.00
09 (Site Piping)			1.00			$54,708.72	320.00	$26,705.92	$14,487.80	$0.00	$13,515.00	$0.00
	09	Site Piping	1.00	Each	$54,708.72	$54,708.72	320.00	$26,705.92	$14,487.80	$0.00	$13,515.00	$0.00
10 (Intake)						$35,881.02	196.00	$18,382.00	$7,874.02	$0.00	$9,625.00	$0.00
	10	Intake, Trenched	40.00	LF	$565.34	$22,613.47	136.00	$13,779.45	$7,874.02	$0.00	$960.00	$0.00
	10	Intake Piping	110.00	LF	$310.20	$34,121.84	176.00	$16,847.82	$7,874.02	$0.00	$9,400.00	$0.00
	10	Intake, Weighted	70.00	LF	$164.41	$11,508.37	40.00	$3,068.37	$0.00	$0.00	$8,440.00	$0.00
	10	Intake Reconstruction	1.00	Each	$35,881.02	$35,881.02	196.00	$18,382.00	$7,874.02	$0.00	$9,625.00	$0.00
	10	Intake	1.00	EA	$1,759.18	$1,759.18	20.00	$1,534.18	$0.00	$0.00	$225.00	$0.00
11 (Auto Strainer)			1.00			$30,594.87	20.00	$2,094.87	$0.00	$0.00	$28,500.00	$0.00
	11	Auto Strainer	1.00	Each	$30,594.87	$30,594.87	20.00	$2,094.87	$0.00	$0.00	$28,500.00	$0.00
						$1,718,949.92	4,621.00	$884,969.36	$253,632.09	$23,467.60	$444,380.87	$112,500.00

Overview

Job Code: Angoon Water Source Option 4 Rebuild Intake Final PER

Job Description: ANTHC Angoon Water Source PER 100% Submittal - Option 4 - Rebuild Intake

Notes: Documents

Angoon Water Source
Preliminary Engineering Report
ANTHC Porject Number ANTHC 21-D-94328
100% Submittal
April 2021

Schedule

Construction - Spring 2024
Duration - 4 Months

Notes & Assumptions

Local Labor
Force Account
Equipment will be barged to and from the project site from Anchorage

Estimator

Jay Lavoie, Estimations, Inc.
jay@estimations.com, 907-561-0755

Methodology

Estimate is priced with current material prices
Labor and production based on estimators experience
Labor rates provided by ANTHC
Lodging assumed to be a rental house budgeted at $2500/month plus $19/md incidentals.

Project Scope

Demolition of Existing wetwell
New Wetwell with pumps (2)
Intake Piping into lake
Site piping in area of wetwell
Auto Strainer and controller in WTP

Estimate Class - 4 - Based on 1-15% project definition and estimating methodology is primarily Stochastic.

Time on site 4 months.
Labor rates are based on 2020 ANTHC labor rates.
Materials will be subject to Buy American.
Project work hours - 6 day - 10 hours per week.
Project delivery method - Force Account
Project Construction Year - 2024
Inflation - 3.5%/year x 2.5 year = 9.0% (Construction 2024/Design 2023)
Construction Contingency - 14% of Construction cost.
Estimating Contingency - 12% of Construction.

NOTE: The existing pump control panel has reportedly been updated. No record drawings were available. This estimate does not include a new pump control panel. If needed, this would add aprpoximately $32,000 to the estimate (see Alt 2).

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
3	1.00	Each	Design Phase	0.00	0.00	Detail	U.S. Dollar	156,268.00	156,268.00
3.3	1.00	Each	IFC (95 to IFC)	0.00	0.00	Detail	U.S. Dollar	156,268.00	156,268.00
3.3.7	1.00	Each	Design Complete	0.00	0.00	Detail	U.S. Dollar	156,268.00	156,268.00
3.3.7.1	1.00	Each	Design	0.00	0.00	Plug	U.S. Dollar	156,268.00	156,268.00
4	1.00	Each	Construct Phase	368.10	0.00	Detail	U.S. Dollar	1,562,681.92	1,562,681.92
4.3	1.00	Each	Construction	348.10	0.00	Detail	U.S. Dollar	1,544,667.68	1,544,667.68
4.3.1	1.00	Each	General Conditions	224.00	0.00	Detail	U.S. Dollar	711,455.69	711,455.69
4.3.1.1	1.00	Each	Key Personnel	224.00	0.00	Detail	U.S. Dollar	310,985.95	310,985.95
4.3.1.1.2	4.00	MTH	ANTHC Construction Manager	84.00	0.05	Detail	U.S. Dollar	37,800.00	151,200.00

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
CONSTMGR4	Construction Manager 4	840.00	1.00	Each (hourly)	U.S. Dollar	180.00	151,200.00

Notes: 1 FTE

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.1.1.3	4.00	Month	ANTHC Project Superintendent	104.00	0.04	Detail	U.S. Dollar	34,804.16	139,216.62

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
SUPER3	Superintendent 3	1,040.00	1.00	Each (hourly)	U.S. Dollar	133.86	139,216.62

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.1.1.5	1.00	Each	Survey	36.00	0.03	Detail	U.S. Dollar	20,569.32	20,569.32

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
SURV4	Surveyor 4	360.00	1.00	Each (hourly)	U.S. Dollar	57.14	20,569.32

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.1.4	1.00	Each	Contingency	0.00	0.00	Detail	U.S. Dollar	400,469.74	400,469.74
4.3.1.4.1	1.00	Each	Inflation 9.0% of Construction	0.00	0.00	Plug	U.S. Dollar	102,977.74	102,977.74

Notes: Assume construction in spring of 2022, basing on start of project not midpoint as start will be the buy out that is 1.5 year out. Inflation = (1+interest rate) raised to the n years, using interest rate of 3.5% annual = 1.035^1.5 = 1.053 or 5.3% inflation

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.1.4.2	1.00	Each	Construction Contingency 14% of Construction	0.00	0.00	Plug	U.S. Dollar	160,188.00	160,188.00
4.3.1.4.3	1.00	Each	Estimating Contingency 12% of Construction	0.00	0.00	Plug	U.S. Dollar	137,304.00	137,304.00
4.3.2	525,800.00	LB	Freight	2.50	210,320.00	Detail	U.S. Dollar	0.29	152,283.85
4.3.2.1	249,400.00	LB	Freight - Mobilization (Equip and Materials)	1.50	166,266.67	Detail	U.S. Dollar	0.42	103,936.00
4.3.2.1.1	231,400.00	LB	Freight Equipment	1.00	231,400.00	Detail	U.S. Dollar	0.21	48,347.85

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
LLCL1	Crew Leader 1	10.00	1.00 Each (hourly)	U.S. Dollar	71.58	715.85
LLTD1	Truck Driver 1	10.00	1.00 Each (hourly)	U.S. Dollar	18.00	180.00
LLALAB	Local Labor	20.00	2.00 Each (hourly)	U.S. Dollar	77.14	1,542.74
LLEO3	Equipment Operator 3	10.00	1.00 Each (hourly)	U.S. Dollar	90.93	909.26
BARGE	Barges (Days)		3.00 Each	U.S. Dollar	15,000.00	45,000.00

Notes: Freight Equipment

ATV Side By Side		1	Each	2000	2,000
ATV Trailer	1	Each	1000	1,000	
Cat 330 Excavator		1	Each	65000	65,000
De-Watering Pump		1	Each	1500	1,500
Dump Truck	2	Each	16800	33,600	
Compactor	1	Each	20000	20,000	
ElectroFusion Machine	1	Each	500	500	
Four Jaw Fusion Machine	1	Each	500	500	
Four Wheeler	1	Each	2000	2,000	
Tractor/Lowboy		1	Each	30000	30,000
Loader 950	1	Each	42800	42,800	
Pickup 4x4	1	Each	7000	7,000	
Small dozer	1	Each	15500	15,500	
Misc Small Tool Connex	1	EA	10000	10,000	
Total					231,400

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.2.1.2	63,000.00 LB	Freight Materials	0.50	126,000.00 Detail	U.S. Dollar	0.88	55,588.15

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
FRT	Freight		63,000.00 LB	U.S. Dollar	0.48	30,240.00
BARGE SM	Barge SM		3.00 Each	U.S. Dollar	7,500.00	22,500.00
LLCL1	Crew Leader 1	5.00	1.00 Each (hourly)	U.S. Dollar	71.58	357.92
LLTD1	Truck Driver 1	5.00	1.00 Each (hourly)	U.S. Dollar	18.00	90.00
LLALAB	Local Labor	20.00	4.00 Each (hourly)	U.S. Dollar	77.14	1,542.74
EL950	Loader 950	5.00	1.00 Each (hourly)	U.S. Dollar	75.56	377.80
LLEO3	Equipment Operator 3	5.00	1.00 Each (hourly)	U.S. Dollar	90.93	454.63
FPLUM4	Plumber 4	0.08	1.00 Each (hourly)	U.S. Dollar	43.08	3.59
FPLUM4	Plumber 4	0.08	1.00 Each (hourly)	U.S. Dollar	43.08	3.59
FELEC3	Electrician 4	0.08	1.00 Each (hourly)	U.S. Dollar	18.00	1.50
LL2999	Laborer 3	0.17	2.00 Each (hourly)	U.S. Dollar	76.71	12.78
FPLUM4	Plumber 4	0.08	1.00 Each (hourly)	U.S. Dollar	43.08	3.59

CBS Position Code	Quantity UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost

Notes: Materials

Wet Well	1	EA	40000	40,000
Site Piping 1	LS	7000	7,000	
Intake Pipe 40	LF	25	1,000	
Intake Pipe wgt'd	70	LF	35	2,450
Intake	1	EA	300	300
Auto Strainer 1	EA	2000	2,000	
	subtotal			52,750
	Allow for Misc		10,000	
	Total (Rounded)			63,000

Allow 250k per barge. 1 barge trips at 3 day/round trip

CBS Position Code	Quantity UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.2.3	231,400.00 LB	Freight - Demobilization (Equip. and Materials)	1.00	231,400.00	Detail	U.S. Dollar	0.21	48,347.85

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
LLALAB	Local Labor	20.00	2.00 Each (hourly)	U.S. Dollar	77.14	1,542.74
LLCL1	Crew Leader 1	10.00	1.00 Each (hourly)	U.S. Dollar	71.58	715.85
LLTD1	Truck Driver 1	10.00	1.00 Each (hourly)	U.S. Dollar	18.00	180.00
LLEO3	Equipment Operator 3	10.00	1.00 Each (hourly)	U.S. Dollar	90.93	909.26
BARGE	Barges (Days)		3.00 Each	U.S. Dollar	15,000.00	45,000.00

CBS Position Code	Quantity UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.3	60.00 Each	Travel	0.00	0.00	Detail	U.S. Dollar	934.00	56,040.00
4.3.3.1	4.00 Each	Travel - Early	0.00	0.00	Detail	U.S. Dollar	934.00	3,736.00

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
AFARE	Air Fare - Anchorage to Angoon		4.00 Each	U.S. Dollar	500.00	2,000.00
PERDIEM	Per Diem		8.00 Each	U.S. Dollar	217.00	1,736.00

CBS Position Code	Quantity UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.3.3	4.00 Each	Travel - Construction Closout	0.00	0.00	Detail	U.S. Dollar	934.00	3,736.00

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
AFARE	Air Fare - Anchorage to Angoon		4.00 Each	U.S. Dollar	500.00	2,000.00
PERDIEM	Per Diem		8.00 Each	U.S. Dollar	217.00	1,736.00

CBS Position Code	Quantity UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.3.4	52.00 Each	Travel - Construction	0.00	0.00	Detail	U.S. Dollar	934.00	48,568.00

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
AFARE	Air Fare - Anchorage to Angoon		52.00 Each	U.S. Dollar	500.00	26,000.00
PERDIEM	Per Diem		104.00 Each	U.S. Dollar	217.00	22,568.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost

Notes: Crew - 6 x 4 rt
Super 1 x 4 rt
CM 1 x 4 rt
eng 1 x 4 rt
Mechanic 1 x 4 rt
Survey 2 x 2 rt = 4 rt
Prefinal inspection 4 rt
Final inspection 4 rt
Total = 52 trips

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.4	1.00	Each	Shipping and Receiving	22.00	0.05	Detail	U.S. Dollar	3,960.00	3,960.00
4.3.4.3	1.00	Each	Shipping and Receiving - Construction	22.00	0.05	Detail	U.S. Dollar	3,960.00	3,960.00

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
LL4000	Laborer 5	220.00	1.00	Each (hourly)	U.S. Dollar	18.00	3,960.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.5	1.00	Each	Contracting and Purchasing	5.00	0.20	Detail	U.S. Dollar	5,509.48	5,509.48
4.3.5.1	1.00	Each	Contracting & Purchasing	5.00	0.20	Detail	U.S. Dollar	5,509.48	5,509.48

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
MATCOOR	Materials Coordinator	50.00	1.00	Each (hourly)	U.S. Dollar	110.19	5,509.48

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.6	1.00	Each	Fuel	0.00	0.00	Detail	U.S. Dollar	22,320.00	22,320.00
4.3.6.1	4,000.00	Gallon	Fuel	0.00	0.00	Detail	U.S. Dollar	5.58	22,320.00

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
FUEL	Fuel		4,000.00	Gallon	U.S. Dollar	5.58	22,320.00

Notes: Fuel for Misc. Most fuel in Equipment Rates

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.7	1.00	Each	Pre Construction	0.00	0.00	Detail	U.S. Dollar	53,000.00	53,000.00
4.3.7.6	4.00	MTH	Housing & Utilities	0.00	0.00	Plug	U.S. Dollar	13,000.00	52,000.00

Notes: $13k per month based on advice from ANTHC on other projects.

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.7.7	200.00	LF	SWPPP BMPs	0.00	0.00	Detail	U.S. Dollar	5.00	1,000.00

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
SILTFENCE	Silt Fence & BMPs		200.00	LF	U.S. Dollar	5.00	1,000.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.8	1.00	Each	Equipment	76.00	0.01	Detail	U.S. Dollar	276,911.68	276,911.68
4.3.8.1	3.00	MTH	ANTHC Equipment Cost	24.00	0.13	Detail	U.S. Dollar	68,905.14	206,715.43

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost

CBS Position Code	Cost Item Quantity UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
ATVSS	ATV Side By Side	240.00	1.00	Each (hourly)		U.S. Dollar	10.27	2,465.02
AIR COMPRESS	Air Compressor	240.00	1.00	Each (hourly)		U.S. Dollar	14.88	3,571.20
4J-FUSION	Four Jaw Fusion Machine	240.00	1.00	Each (hourly)		U.S. Dollar	1.14	272.73
E-FUSION	ElectroFusion Machine	240.00	1.00	Each (hourly)		U.S. Dollar	0.00	0.00
EXC-CAT330C	Cat 330 Excavator	240.00	1.00	Each (hourly)		U.S. Dollar	97.78	23,467.60
SKIDSTEER	Skid Steer - Bobcat 630	240.00	1.00	Each (hourly)		U.S. Dollar	28.81	6,915.36
PUMP	De-Watering Pump	240.00	1.00	Each (hourly)		U.S. Dollar	31.86	7,646.40
ATVTRAILER	ATV Trailer	240.00	1.00	Each (hourly)		U.S. Dollar	5.00	1,200.00
DOZER D6	Dozer D6T	240.00	1.00	Each (hourly)		U.S. Dollar	94.88	22,770.00
END DUMP	Dump Truck	960.00	4.00	Each (hourly)		U.S. Dollar	92.17	88,483.20
ATV	Four Wheeler	240.00	1.00	Each (hourly)		U.S. Dollar	7.18	1,723.20
EXCAVATOR MINI	Hydraulic Excavator Mini	240.00	1.00	Each (hourly)		U.S. Dollar	27.48	6,595.36
PICKUP	Pickup 4x4	240.00	1.00	Each (hourly)		U.S. Dollar	8.80	2,112.00
CEMENT MIXER SM	Small Concrete Mixer	240.00	1.00	Each (hourly)		U.S. Dollar	35.03	8,408.31
DOZER	Small dozer	240.00	1.00	Each (hourly)		U.S. Dollar	48.95	11,748.00
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	240.00	1.00	Each (hourly)		U.S. Dollar	0.00	0.00
EL950	Loader 950	240.00	1.00	Each (hourly)		U.S. Dollar	75.56	18,134.40
FPLUM4	Plumber 4	4.00	1.00	Each (hourly)		U.S. Dollar	43.08	172.33
FPLUM4	Plumber 4	4.00	1.00	Each (hourly)		U.S. Dollar	43.08	172.33
FELEC3	Electrician 4	4.00	1.00	Each (hourly)		U.S. Dollar	18.00	72.00
LL2999	Laborer 3	8.00	2.00	Each (hourly)		U.S. Dollar	76.71	613.67
FPLUM4	Plumber 4	4.00	1.00	Each (hourly)		U.S. Dollar	43.08	172.33
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)		U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)		U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)		U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)		U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)		U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)		U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)		U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)		U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)		U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)		U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)		U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)		U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)		U.S. Dollar	18.00	0.00

CBS Position Code	Quantity UM	Description	Cost Item Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
LL2999	Laborer 3	0.00	2.00 Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00 Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00 Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00 Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00 Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00

Notes: 2 month for mob/demob, 1 for standby

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.8.2	4.00 MTH	Equipment Maintenance Labor	52.00	0.08 Detail	U.S. Dollar	17,549.06	70,196.25

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
LLMECH3	Mechanic 3	520.00	1.00 Each (hourly)	U.S. Dollar	134.99	70,196.25

Notes: 1/2 FTE

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
4.3.9	1.00 Each	Construction	18.60	0.05 Detail	U.S. Dollar	263,186.99	263,186.99
4.3.9.12	1.00 Each	ALT4 - Rebuild Intake	18.60	0.05 Detail	U.S. Dollar	263,186.99	263,186.99
4.3.9.12.1	1.00 Each	Demolition	3.00	0.33 Detail	U.S. Dollar	40,680.77	40,680.77

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
LLEO3	Equipment Operator 3	90.00	3.00 Each (hourly)	U.S. Dollar	90.93	8,183.34
LL2999	Laborer 3	120.00	4.00 Each (hourly)	U.S. Dollar	76.71	9,205.10
EXCAVATOR CAT330	Hydraulic Excavator Cat 330	30.00	1.00 Each (hourly)	U.S. Dollar	157.80	4,734.00
PUMP	De-Watering Pump	30.00	1.00 Each (hourly)	U.S. Dollar	31.86	955.80
PICKUP	Pickup 4x4	30.00	1.00 Each (hourly)	U.S. Dollar	8.80	264.00
SKIDSTEER	Skid Steer - Bobcat 630	30.00	1.00 Each (hourly)	U.S. Dollar	28.81	864.42
EL950	Loader 950	30.00	1.00 Each (hourly)	U.S. Dollar	75.56	2,266.80
END DUMP	Dump Truck	60.00	2.00 Each (hourly)	U.S. Dollar	92.17	5,530.20
ECOMP1	Compactor Smooth Drum	30.00	1.00 Each (hourly)	U.S. Dollar	46.06	1,381.80
LLTD3	Truck Driver 3	60.00	2.00 Each (hourly)	U.S. Dollar	85.75	5,144.97
DISPOSAL	Disposal		20.00 TN	U.S. Dollar	100.00	2,000.00
FPLUM4	Plumber 4	0.00	1.00 Each (hourly)	U.S. Dollar	43.08	0.00

Cost Item								
CBS Position Code	Quantity UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost

FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.50	1.00	Each (hourly)	U.S. Dollar	43.08	21.54
FPLUM4	Plumber 4	0.50	1.00	Each (hourly)	U.S. Dollar	43.08	21.54
FELEC3	Electrician 4	0.50	1.00	Each (hourly)	U.S. Dollar	18.00	9.00
LL2999	Laborer 3	1.00	2.00	Each (hourly)	U.S. Dollar	76.71	76.71
FPLUM4	Plumber 4	0.50	1.00	Each (hourly)	U.S. Dollar	43.08	21.54

CBS Position Code	Quantity UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.12.2	1.00 Each	Wetwell	7.00	0.14	Detail	U.S. Dollar	101,321.62	101,321.62
4.3.9.12.2.3	1.00 Each	Wetwell Structure	4.00	0.25	Detail	U.S. Dollar	68,438.36	68,438.36

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
LS WET WELL 2	Pre Cast Wet Well 8' ID with Lid x 10'H		1.00	Each	U.S. Dollar	10,800.00	10,800.00
MH GRADE RINGS 6"	Manhole Grade Rings 25.5"ID x 6"		3.00	Each	U.S. Dollar	60.00	180.00
MH HATCH	Manhole Hatch, Hinged		1.00	Each	U.S. Dollar	400.00	400.00
MH RISER4	Manhole Riser and Cone 4'dia to 25.5" 4'H		1.00	Each	U.S. Dollar	600.00	600.00
BUTYLTIGHT	Butyl Tight MH Sealant		120.00	LF	U.S. Dollar	2.00	240.00
ALOK	A Lok Pipe Penetrations		2.00	Each	U.S. Dollar	150.00	300.00
LLEO3	Equipment Operator 3	120.00	3.00	Each (hourly)	U.S. Dollar	90.93	10,911.12
LL2999	Laborer 3	160.00	4.00	Each (hourly)	U.S. Dollar	76.71	12,273.47
EXCAVATOR CAT330	Hydraulic Excavator Cat 330	40.00	1.00	Each (hourly)	U.S. Dollar	157.80	6,312.00
PUMP	De-Watering Pump	40.00	1.00	Each (hourly)	U.S. Dollar	31.86	1,274.40
PICKUP	Pickup 4x4	40.00	1.00	Each (hourly)	U.S. Dollar	8.80	352.00
SKIDSTEER	Skid Steer - Bobcat 630	40.00	1.00	Each (hourly)	U.S. Dollar	28.81	1,152.56
EL950	Loader 950	40.00	1.00	Each (hourly)	U.S. Dollar	75.56	3,022.40
END DUMP	Dump Truck	80.00	2.00	Each (hourly)	U.S. Dollar	92.17	7,373.60
ECOMP1	Compactor Smooth Drum	40.00	1.00	Each (hourly)	U.S. Dollar	46.06	1,842.40
LLTD3	Truck Driver 3	80.00	2.00	Each (hourly)	U.S. Dollar	85.75	6,859.96

CBS Position Code	Quantity	UM	Description (Cost Item)	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost

TRACTOR	5th wheel tractor	40.00	1.00	Each (hourly)	U.S. Dollar	75.00	3,000.00
ETLT	Lowboy Trailer	40.00	1.00	Each (hourly)	U.S. Dollar	33.60	1,344.00
FPLUM4	Plumber 4	0.67	1.00	Each (hourly)	U.S. Dollar	43.08	28.72
FPLUM4	Plumber 4	0.67	1.00	Each (hourly)	U.S. Dollar	43.08	28.72
FELEC3	Electrician 4	0.67	1.00	Each (hourly)	U.S. Dollar	18.00	12.00
LL2999	Laborer 3	1.33	2.00	Each (hourly)	U.S. Dollar	76.71	102.28
FPLUM4	Plumber 4	0.67	1.00	Each (hourly)	U.S. Dollar	43.08	28.72
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00

4.3.9.12.2.4	1.00	Each	Interior Piping & Equipment	3.00	0.33	Detail	U.S. Dollar	24,383.26	24,383.26

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
WELLPUMP 20HP	Well Pumps 20 HP with Cables		2.00	Each	U.S. Dollar	4,518.00	9,036.00
HDPE 3 SDR11	HDPE 3" SDR11		20.00	LF	U.S. Dollar	6.00	120.00
PIPE GALV3	Short Spool 3" Galv with Flg x Threaded		2.00	Each	U.S. Dollar	150.00	300.00
HDPE FTG 3TO4 90	Reducing 90 Ell - 3"x4" HDPE - Flg		2.00	Each	U.S. Dollar	90.00	180.00
HDPE FTG FLG3	3" butt fused Flange and Bolt Kit		2.00	Each	U.S. Dollar	40.00	80.00
VALVE CV3	Check Valve 3" flg'd		2.00	Each	U.S. Dollar	630.00	1,260.00
HDPE 4 SDR11	HDPE 4" SDR 11		40.00	LF	U.S. Dollar	7.50	300.00
HDPE FTG FLG4	HDPE Butt Fused Flange 4" with Bolt Kit		2.00	Each	U.S. Dollar	55.00	110.00
LL2999	Laborer 3	30.00	1.00	Each (hourly)	U.S. Dollar	76.71	2,301.28
LLCL3	Crew Leader 3	30.00	1.00	Each (hourly)	U.S. Dollar	78.99	2,369.78
SKIDSTEER	Skid Steer - Bobcat 630	30.00	1.00	Each (hourly)	U.S. Dollar	28.81	864.42
LLEO3	Equipment Operator 3	30.00	1.00	Each (hourly)	U.S. Dollar	90.93	2,727.78
EXCAVATOR CAT330	Hydraulic Excavator Cat 330	30.00	1.00	Each (hourly)	U.S. Dollar	157.80	4,734.00

4.3.9.12.2.5	1.00	Each	Power to Wetwell	0.00	0.00	Plug	U.S. Dollar	8,500.00	8,500.00

CBS Position Code	Quantity UM	Description	Days	UM/Day Cost Source	Currency	Unit Cost	Total Cost
Notes: Connect to Existing Power							
4.3.9.12.3	1.00 Each	Site Piping	4.00	0.25 Detail	U.S. Dollar	54,708.72	54,708.72

Resource Code	Description	Hours	Quantity UM	Currency	Unit Cost	Total Cost
HDPE 4 SDR11	HDPE 4" SDR 11		20.00 LF	U.S. Dollar	7.50	150.00
HDPE FTG FLG4	HDPE Butt Fused Flange 4" with Bolt Kit		5.00 Each	U.S. Dollar	55.00	275.00
VALVE GV4	4" Iron Gate Valve with Box		2.00 Each	U.S. Dollar	550.00	1,100.00
HDPE FTG WYE 4	HDPE 4" Wye, Flg'd		1.00 Each	U.S. Dollar	200.00	200.00
HDPE FTG RED4X10	HDPE Reducer 4x10 flanged		1.00 Each	U.S. Dollar	200.00	200.00
HDPE8	8" HDPE Pipe		60.00 LF	U.S. Dollar	11.00	660.00
HDPE10	10" HDPE Pipe		120.00 LF	U.S. Dollar	14.00	1,680.00
HDPE FTG TEE 10	HDPE 10" Tee, Flanged		1.00 Each	U.S. Dollar	600.00	600.00
HDPE FTG TEE 8	HDPE 8" Tee, Butt Fused		1.00 Each	U.S. Dollar	500.00	500.00
HDPE FTG TEE 8X10	HDPE 10x10x8" Tee, Butt Fused		1.00 Each	U.S. Dollar	650.00	650.00
HDPE FTG ELL10	HDPE 10" Ell		1.00 Each	U.S. Dollar	350.00	350.00
VALVE GV10	Valve Gate Valve 10" with Box and Riser		1.00 Each	U.S. Dollar	1,400.00	1,400.00
VALVE GV8	Gate Valve 8" with Box and Riser		2.00 Each	U.S. Dollar	1,200.00	2,400.00
HDPE FTG AIRPORT	HDPE Air Port		1.00 Each	U.S. Dollar	350.00	350.00
HDPE SPOOL 8X12	HDPE Spool 8x12 Flanged		1.00 Each	U.S. Dollar	1,200.00	1,200.00
PRECAST PAD	Precased conc pad for Pig Catcher		1.00 Each	U.S. Dollar	1,000.00	1,000.00
BOLLARDS	Pipe Bollards 4" Concrete Filled		2.00 Each	U.S. Dollar	400.00	800.00
LL2999	Laborer 3	120.00	3.00 Each (hourly)	U.S. Dollar	76.71	9,205.10
LLCL3	Crew Leader 3	40.00	1.00 Each (hourly)	U.S. Dollar	78.99	3,159.71
LLEO3	Equipment Operator 3	120.00	3.00 Each (hourly)	U.S. Dollar	90.93	10,911.12
SKIDSTEER	Skid Steer - Bobcat 630	40.00	1.00 Each (hourly)	U.S. Dollar	28.81	1,152.56
EXCAVATOR CAT330	Hydraulic Excavator Cat 330	40.00	1.00 Each (hourly)	U.S. Dollar	157.80	6,312.00
LLTD3	Truck Driver 3	40.00	1.00 Each (hourly)	U.S. Dollar	85.75	3,429.98
ECOMP1	Compactor Smooth Drum	40.00	1.00 Each (hourly)	U.S. Dollar	46.06	1,842.40
DOZER	Small dozer	40.00	1.00 Each (hourly)	U.S. Dollar	48.95	1,958.00
EL950	Loader 950	40.00	1.00 Each (hourly)	U.S. Dollar	75.56	3,022.40
FPLUM4	Plumber 4	0.67	1.00 Each (hourly)	U.S. Dollar	43.08	28.72
FPLUM4	Plumber 4	0.67	1.00 Each (hourly)	U.S. Dollar	43.08	28.72
FELEC3	Electrician 4	0.67	1.00 Each (hourly)	U.S. Dollar	18.00	12.00
LL2999	Laborer 3	1.33	2.00 Each (hourly)	U.S. Dollar	76.71	102.28
FPLUM4	Plumber 4	0.67	1.00 Each (hourly)	U.S. Dollar	43.08	28.72

Estimate Details
ANTHC Angoon Water Source PER 100% Submittal - Option 4 - Rebuild Intake
Angoon Water Source Option 4 Rebuild Intake Final PER
ESTIMATIONS, INC

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.12.4	1.00	Each	Intake Reconstruction	3.60	0.28	Detail	U.S. Dollar	35,881.02	35,881.02
4.3.9.12.4.1	110.00	LF	Intake Piping	2.60	42.31	Detail	U.S. Dollar	310.20	34,121.84
4.3.9.12.4.1.1	40.00	LF	Intake, Trenched	1.60	25.00	Detail	U.S. Dollar	565.34	22,613.47

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
LCL2999	Local Crew Leader to 2999	16.00	1.00	Each (hourly)	U.S. Dollar	104.51	1,672.10
4J-FUSION	Four Jaw Fusion Machine	16.00	1.00	Each (hourly)	U.S. Dollar	1.14	18.18
AIR COMPRESS	Air Compressor	16.00	1.00	Each (hourly)	U.S. Dollar	14.88	238.08
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	16.00	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
DOZER	Small dozer	16.00	1.00	Each (hourly)	U.S. Dollar	48.95	783.20
E-FUSION	ElectroFusion Machine	16.00	1.00	Each (hourly)	U.S. Dollar	0.00	0.00
END DUMP	Dump Truck	32.00	2.00	Each (hourly)	U.S. Dollar	92.17	2,949.44
EXCAVATOR	Hydraulic Excavator Cat 320	16.00	1.00	Each (hourly)	U.S. Dollar	116.25	1,860.03
LOADER	Wheeled Loader Cat 950	16.00	1.00	Each (hourly)	U.S. Dollar	88.95	1,423.26
PICKUP	Pickup 4x4	16.00	1.00	Each (hourly)	U.S. Dollar	8.80	140.80
SKIDSTEER	Skid Steer - Bobcat 630	16.00	1.00	Each (hourly)	U.S. Dollar	28.81	461.02
LLTD3	Truck Driver 3	32.00	2.00	Each (hourly)	U.S. Dollar	85.75	2,743.99
LAOP1	Operator	32.00	2.00	Each (hourly)	U.S. Dollar	119.45	3,822.41
LL1999	Laborer 2	16.00	1.00	Each (hourly)	U.S. Dollar	68.81	1,100.91
LL2999	Laborer 3	16.00	1.00	Each (hourly)	U.S. Dollar	76.71	1,227.35
SUPER3	Superintendent 3	24.00	1.50	Each (hourly)	U.S. Dollar	133.86	3,212.69
PIPE HDPE 8 SDR9	SDR 9 HDPE 8"		40.00	LF	U.S. Dollar	24.00	960.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00
FELEC3	Electrician 4	0.00	1.00	Each (hourly)	U.S. Dollar	18.00	0.00
LL2999	Laborer 3	0.00	2.00	Each (hourly)	U.S. Dollar	76.71	0.00
FPLUM4	Plumber 4	0.00	1.00	Each (hourly)	U.S. Dollar	43.08	0.00

Notes: Allowance to connect new force main and reconfigure interior piping as needed.

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.12.4.1.2	70.00	LF	Intake, Weighted	1.00	70.00	Detail	U.S. Dollar	164.41	11,508.37

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
LL2999	Laborer 3	40.00	4.00	Each (hourly)	U.S. Dollar	76.71	3,068.37
BOATRENTAL	Boat(s)		1.00	LS	U.S. Dollar	5,000.00	5,000.00
PIPE HDPE 8 SDR9	SDR 9 HDPE 8"		70.00	LF	U.S. Dollar	24.00	1,680.00
OUTFALL ANCHORS CASTIRON	Outfall Anchors		8.00	Each	U.S. Dollar	220.00	1,760.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.12.4.2	1.00	EA	Intake	1.00	1.00	Detail	U.S. Dollar	1,759.18	1,759.18

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
BUOY21	Marine Buoy 21"		1.00	Each	U.S. Dollar	115.00	115.00
BALLAST 200	200 LB Concrete Ballast		1.00	Each	U.S. Dollar	75.00	75.00
BUOY ROPE	Nylon Rope Braided 3/8"dia x 25' with Thimbles		1.00	Each	U.S. Dollar	35.00	35.00
INTAKESCREEN12DX14	Johnson Intake screen 12"dia x 14"		0.00	Each	U.S. Dollar	200.00	0.00
LL2999	Laborer 3	20.00	2.00	Each (hourly)	U.S. Dollar	76.71	1,534.18

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.3.9.12.5	1.00	Each	Auto Strainer	1.00	1.00	Detail	U.S. Dollar	30,594.87	30,594.87

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
FPLUM3	Plumber 3	10.00	1.00	Each (hourly)	U.S. Dollar	91.86	918.62
TELEC3	Electrician 3	10.00	1.00	Each (hourly)	U.S. Dollar	117.62	1,176.25
AUTOSTRAINER8	8" Auto Strainer and Controller		1.00	Each	U.S. Dollar	28,500.00	28,500.00

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.4	1.00	Each	Post Construction	20.00	0.05	Detail	U.S. Dollar	18,014.24	18,014.24
4.4.11	1.00	Each	O&M Training	10.00	0.10	Detail	U.S. Dollar	9,007.12	9,007.12

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
PMENG4	Project Manager Engineer 4	100.00	1.00	Each (hourly)	U.S. Dollar	90.07	9,007.12

CBS Position Code	Quantity	UM	Description	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost
4.4.15	1.00	Each	Final Inspection - On Site	10.00	0.10	Detail	U.S. Dollar	9,007.12	9,007.12

Resource Code	Description	Hours	Quantity	UM	Currency	Unit Cost	Total Cost
PMENG4	Project Manager Engineer 4	100.00	1.00	Each (hourly)	U.S. Dollar	90.07	9,007.12

Report Total:				368.10					1,718,949.92

CBS Position Code	Quantity	UM	Description (Cost Item)	Days	UM/Day	Cost Source	Currency	Unit Cost	Total Cost

Category	Total
Labor	884,969.36
Owned Equipment	253,632.09
Rented Equipment	23,467.60
Materials	444,380.87
Subcontract	112,500.00

Code	Description	Quantity	Unit of Measure	Awardee	Awarded Rate	Total Cost
AFARE	Air Fare - Anchorage to Angoon	60.00	Each			30,000.00
ALOK	A Lok Pipe Penetrations	2.00	Each			300.00
AUTOSTRAINER8	8" Auto Strainer and Controller	1.00	Each			28,500.00
BALLAST 200	200 LB Concrete Ballast	1.00	Each			75.00
BOATRENTAL	Boat(s)	1.00	LS			5,000.00
BOLLARDS	Pipe Bollards 4" Concrete Filled	2.00	Each			800.00
BUOY ROPE	Nylon Rope Braided 3/8"dia x 25' with Thimbles	1.00	Each			35.00
BUOY21	Marine Buoy 21"	1.00	Each			115.00
BUTYLTIGHT	Butyl Tight MH Sealant	120.00	LF			240.00
FRT	Freight	63,000.00	LB			30,240.00
HDPE 3 SDR11	HDPE 3" SDR11	20.00	LF			120.00
HDPE 4 SDR11	HDPE 4" SDR 11	60.00	LF			450.00
HDPE FTG 3TO4 90	Reducing 90 Ell - 3"x4" HDPE - Flg	2.00	Each			180.00
HDPE FTG AIRPORT	HDPE Air Port	1.00	Each			350.00
HDPE FTG ELL10	HDPE 10" Ell	1.00	Each			350.00
HDPE FTG FLG3	3" butt fused Flange and Bolt Kit	2.00	Each			80.00
HDPE FTG FLG4	HDPE Butt Fused Flange 4" with Bolt Kit	7.00	Each			385.00
HDPE FTG RED4X10	HDPE Reducer 4x10 flanged	1.00	Each			200.00
HDPE FTG TEE 10	HDPE 10" Tee, Flanged	1.00	Each			600.00
HDPE FTG TEE 8	HDPE 8" Tee, Butt Fused	1.00	Each			500.00
HDPE FTG TEE 8X10	HDPE 10x10x8" Tee, Butt Fused	1.00	Each			650.00
HDPE FTG WYE 4	HDPE 4" Wye, Flg'd	1.00	Each			200.00
HDPE SPOOL 8X12	HDPE Spool 8x12 Flanged	1.00	Each			1,200.00
HDPE10	10" HDPE Pipe	120.00	LF			1,680.00
HDPE8	8" HDPE Pipe	60.00	LF			660.00
INTAKESCREEN12DX14	Johnson Intake screen 12"dia x 14"	0.00	Each			0.00
LS WET WELL 2	Pre Cast Wet Well 8' ID with Lid x 10'H	1.00	Each			10,800.00
MH GRADE RINGS 6"	Manhole Grade Rings 25.5"ID x 6"	3.00	Each			180.00
MH HATCH	Manhole Hatch, Hinged	1.00	Each			400.00
MH RISER4	Manhole Riser and Cone 4'dia to 25.5" 4'H	1.00	Each			600.00
OUTFALL ANCHORS CASTIRON	Outfall Anchors	8.00	Each			1,760.00
PIPE GALV3	Short Spool 3" Galv with Flg x Threaded	2.00	Each			300.00
PIPE HDPE 8 SDR9	SDR 9 HDPE 8"	110.00	LF			2,640.00
PRECAST PAD	Precased conc pad for Pig Catcher	1.00	Each			1,000.00

Code	Description	Quantity	Unit of Measure	Awardee	Awarded Rate	Total Cost
SILTFENCE	Silt Fence & BMPs	200.00	LF			1,000.00
VALVE CV3	Check Valve 3" flg'd	2.00	Each			1,260.00
VALVE GV10	Valve Gate Valve 10" with Box and Riser	1.00	Each			1,400.00
VALVE GV4	4" Iron Gate Valve with Box	2.00	Each			1,100.00
VALVE GV8	Gate Valve 8" with Box and Riser	2.00	Each			2,400.00
WELLPUMP 20HP	Well Pumps 20 HP with Cables	2.00	Each			9,036.00
	Grand Totals					**136,786.00**

Resource Utilization: Labor
ANTHC Angoon Water Source PER 100% Submittal - Option 4 - Rebuild Intake
Angoon Water Source Option 4 Rebuild Intake Final PER
ESTIMATIONS, INC

Code	Description	Wage Scale 1 Rate/Hr	Hours	Wage Scale 2 Rate/Hr	Hours	Wage Scale 3 Rate/Hr	Hours	Total Work Hours	Total Pay Hours	Total Costs
CAD 5	CAD 5	55.10	0.00	70.65	0.00	70.65	0.00	0.00	0.00	0.00
CIVIL5	Civil 5	59.03	0.00	68.71	0.00	79.54	0.00	0.00	0.00	0.00
CONSTMGR4	Construction Manager 4	180.00	554.40	180.00	285.60	180.00	0.00	840.00	840.00	151,200.00
ENVIRMGR	Environmental Manager	98.56	0.00	135.84	0.00	135.84	0.00	0.00	0.00	0.00
FELEC3	Electrician 4	18.00	3.91	18.00	2.01	18.00	0.00	5.92	5.92	106.50
FPLUM3	Plumber 3	81.13	6.60	112.70	3.40	112.70	0.00	10.00	10.00	918.62
FPLUM4	Plumber 4	40.31	11.72	48.46	6.04	48.46	0.00	17.75	17.75	764.71
LAOP1	Operator	105.58	21.12	146.37	10.88	146.37	0.00	32.00	32.00	3,822.41
LCL2999	Local Crew Leader to 2999	92.81	10.56	127.21	5.44	127.21	0.00	16.00	16.00	1,672.10
LL1999	Laborer 2	62.30	10.56	81.45	5.44	81.45	0.00	16.00	16.00	1,100.91
LL2999	Laborer 3	69.05	341.77	91.58	176.06	91.58	0.00	517.83	517.83	39,722.57
LL4000	Laborer 5	18.00	145.20	18.00	74.80	18.00	0.00	220.00	220.00	3,960.00
LLALAB	Local Labor	77.14	39.60	77.14	20.40	77.14	0.00	60.00	60.00	4,628.22
LLCL1	Crew Leader 1	64.67	16.50	85.01	8.50	85.01	0.00	25.00	25.00	1,789.62
LLCL3	Crew Leader 3	78.99	46.20	78.99	23.80	78.99	0.00	70.00	70.00	5,529.49
LLEO3	Equipment Operator 3	81.20	254.10	109.80	130.90	109.80	0.00	385.00	385.00	35,006.51
LLMECH3	Mechanic 3	134.99	343.20	134.99	176.80	107.21	0.00	520.00	520.00	70,196.25
LLTD1	Truck Driver 1	18.00	16.50	18.00	8.50	18.00	0.00	25.00	25.00	450.00
LLTD3	Truck Driver 3	75.91	139.92	104.86	72.08	104.86	0.00	212.00	212.00	18,178.90
MATCOOR	Materials Coordinator	97.67	33.00	134.50	17.00	134.50	0.00	50.00	50.00	5,509.48
PMENG4	Project Manager Engineer 4	98.99	132.00	72.75	68.00	98.99	0.00	200.00	200.00	18,014.24
QIM	Quality Improvement Manager	110.33	0.00	153.50	0.00	153.50	0.00	0.00	0.00	0.00
SUPER3	Superintendent 3	123.13	702.24	154.70	361.76	154.70	0.00	1,064.00	1,064.00	142,429.31
SURV4	Surveyor 4	57.14	237.60	57.14	122.40	57.14	0.00	360.00	360.00	20,569.32
TELEC3	Electrician 3	101.12	6.60	149.67	3.40	149.67	0.00	10.00	10.00	1,176.25
	Grand Totals		3,073.29		1,583.21		0.00	4,656.50	4,656.50	526,745.43

Code	Description	Owned Equipment Rate/Hr	Total Pay Hours	Total Costs	Fuel Type	Fuel Amount	Fuel Cost	Fuel Unit of Measure	Maintenance Man-Hour Factor	Total Maintenance
4J-FUSION	Four Jaw Fusion Machine	1.14	256.00	290.91			0.00		0.00	0.00
AIR COMPRESS	Air Compressor	14.88	256.00	3,809.28			0.00		0.00	0.00
ATV	Four Wheeler	7.18	240.00	1,723.20	Unleaded	240.00	1,423.20	Gallon	0.00	0.00
ATVSS	ATV Side By Side	10.27	240.00	2,465.02	Unleaded	240.00	1,423.20	Gallon	0.00	0.00
ATVTRAILER	ATV Trailer	5.00	240.00	1,200.00			0.00		0.00	0.00
CEMENT MIXER SM	Small Concrete Mixer	35.03	240.00	8,408.31	Unleaded	1,200.00	7,116.00	Gallon	0.00	0.00
COMPACTOR	Local Community Compactor VM106D - No Rental Fee	0.00	256.00	0.00			0.00		0.00	0.00
DOZER	Small dozer	48.95	296.00	14,489.20	Diesel	740.00	4,129.20	Gallon	0.00	0.00
DOZER D6	Dozer D6T	94.88	240.00	22,770.00	Diesel	1,500.00	8,370.00	Gallon	0.00	0.00
ECOMP1	Compactor Smooth Drum	46.06	110.00	5,066.60	Diesel	770.00	4,296.60	Gallon	0.00	0.00
E-FUSION	ElectroFusion Machine	0.00	256.00	0.00			0.00		0.00	0.00
EL950	Loader 950	75.56	355.00	26,823.80	Diesel	3,905.00	21,789.90	Gallon	0.10	1,778.94
END DUMP	Dump Truck	92.17	1,132.00	104,336.44	Diesel	6,792.00	37,899.36	Gallon	0.00	0.00
ETLT	Lowboy Trailer	33.60	40.00	1,344.00			0.00		0.00	0.00
EXCAVATOR	Hydraulic Excavator Cat 320	116.25	16.00	1,860.03	Diesel	99.36	554.43	Gallon	0.00	0.00
EXCAVATOR CAT330	Hydraulic Excavator Cat 330	157.80	140.00	22,092.00	Diesel	1,400.00	7,812.00	Gallon	0.00	0.00
EXCAVATOR MINI	Hydraulic Excavator Mini	27.48	240.00	6,595.36	Diesel	492.00	2,745.36	Gallon	0.00	0.00
LOADER	Wheeled Loader Cat 950	88.95	16.00	1,423.26	Diesel	92.80	517.82	Gallon	0.00	0.00
PICKUP	Pickup 4x4	8.80	326.00	2,868.80	Unleaded	0.00	0.00	Gallon	0.00	0.00
PUMP	De-Watering Pump	31.86	310.00	9,876.60	Unleaded	620.00	3,676.60	Gallon	0.00	0.00
SKIDSTEER	Skid Steer - Bobcat 630	28.81	396.00	11,410.34	Diesel	712.80	3,977.42	Gallon	0.00	0.00
TRACTOR	5th wheel tractor	75.00	40.00	3,000.00			0.00		0.00	0.00
	Grand Totals		5,641.00	251,853.15			105,731.10			1,778.94

Fuel Summary

Fuel Type	Unit of Measure	Account Code	Total Amount	Unit Cost	Total Cost
Diesel	Gallon		16,503.96	5.58	92,092.10
Unleaded	Gallon		2,300.00	5.93	13,639.00

Code	Description	Rented Equipment Plug Rate/Hr	RE Rented Plug Rate/Hr	RE Oper. Plug Rate/Hr	Total Pay Hours	Awarded Rate/Hr	Tax Rate on RE Rented	Tax Amount on RE Rented	Total Costs	Fuel Type	Fuel Amount	Fuel Costs	Fuel Unit of Measure	Maintenance Man-Hour Factor	Total Maintenance
EXC-CAT330C	Cat 330 Excavator	97.78	40.04	57.74	240.00		0.00%	0.00	23,467.60	Diesel	720.00	4,017.60	Gallon	0.00	0.00
	Grand Totals				240.00			0.00	23,467.60			4,017.60			0.00

Fuel Summary

Fuel Type	Unit of Measure	Account Code	Total Amount	Unit Cost	Total Cost
Diesel	Gallon		720.00	5.58	4,017.60

APPENDIX F: REGULATORY DOCUMENTATION

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ADEC OPERATOR CERTIFICATION

Alaska Certified Water/Wastewater Operator Database

Regulated System Record

The current classification scoring system for the selected facility is shown below. You may also return to search results.

Facility Name:	Angoon Water Distribution System
Community:	Angoon
Owner/Employer:	Angoon, City of
Type of Facility:	Water Distribution
Classification Level:	Class 1

Number of Service Connections:	158
Number of Pressure Zones:	3
Circulating System:	no

Water distribution systems are initially classified according to the number of service connections served:

Service Connections	**Initial System Class**
15 to 500	Class 1
501 to 5,000	Class 2
5,001 to 15,000	Class 3
15,001 or more	Class 4

The initial classification will increase if one of two conditions is met. First, the classification will increase one class if a system has five or more pressure zones. Second, the classification will increase one class if water in the distribution system is circulated or heated to prevent freezing. The initial classification will only increase once, even if both conditions are met.

Operators:

Name	Role	Cert. Level	Expiration Date	CEU Req. Met
Daniel Fredrickson	Primary	WD-1	12/31/2021	No
Erik Larson	Backup			

For more information, please review the Water and Wastewater Operator Certification and Training Regulation (18 AAC 74).

Operator Certification Home Page

Commissioner Public Notices Regulations Statutes Press Releases

Department of Environmental Conservation
Division of Water
410 Willoughby Ave., Ste. 303, P.O. Box 111800, Juneau, AK 99811-1800
Phone: (907) 465-5180 || Fax: (907) 465-5177 || TDD: Alaska Relay: 1 (800) 770-8973

State of Alaska myAlaska My Government Resident Business in Alaska Visiting Alaska State Employees

Alaska Certified Water/Wastewater Operator Database

Regulated System Record

The current classification scoring system for the selected facility is shown below. You may also return to search results.

Facility Name: Angoon Water Treatment System
Community: Angoon
Owner/Employer: Angoon, City of
Type of Facility: Water Treatment
Classification Level: Class 2

Water treatment systems are classified according to a point rating system. Point values are recognized for each of the various components found in a treatment plant. Points are totaled once all components have been recognized. The total number of points determines the classification of the water treatment system. Click here to view the entire list of components for which points can be counted for water treatment. The specific components that have been recognized toward the classification of this water treatment system are as follows:

Score Category	Score
Size (Peak day design capacity, gallons per day) - 100,001 - 500,000	9
Water Supply Source - Surface water	6
Coagulation - Primary coagulant	5
Mixing - In-line static mixers	0
Filtration - Granular media	8
Disinfection - Liquid and powdered hypochlorites	3
Sludge Treatment - Discharge to on-site pond, septic tank, or lagoon	2
Storage - Water storage tank, for achieving CT	3
Total	***36***

Total Score	System Classification
1-30	Class 1
31-55	Class 2
56-75	Class 3
>75	Class 4

Operators:

Name	Role	Cert. Level	Expiration Date	CEU Req. Met
Daniel Fredrickson	Primary	WT-1	12/31/2021	No
Erik Larson	Backup			

For more information, please review the Water and Wastewater Operator Certification and Training Regulation (18 AAC 74).

Operator Certification Home Page

Commissioner Public Notices Regulations Statutes Press Releases

Department of Environmental Conservation
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ADEC OPERATOR CERTIFICATION

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Public Water System Summary

AK2130017 ANGOON PUBLIC WATER

Public Water System Information

Local Name	City Served	Region Served	Active	Primary Source	Facility Count	PWS Type	Service Connections
CITY OF ANGOON	ANGOON	SKAGWAY-HOONAH-ANGOON	A	SW	7	C	159

Comments: **Sanitary Survey Date:** 5/29/2019 **Surveyor:** GRAY, ANDREW

LT2 Bin1 for both round 1 & 2 per 10/17/2018 letter.

AK2130017 ANGOON PUBLIC WATER

Estimated Use by Population Type

Average Daily Count	Population Type	Annual Operating Period Starts	Annual Operating Period Ends	Effective Begin Date	Effective End Date
75	NT	1 / 1	12 / 31	3/11/2008	
375	R	1 / 1	12 / 31	3/11/2008	

AK2130017 ANGOON PUBLIC WATER

Public Water System Facilities

Facility Name	Facility Code	Active	Water Type	Available
DS AUK'TAH LAKE	DS001	A	SW	P
INACTIVE / UNUSED FACILITY TYPE	I-SS001	I	SW	P
IN AUK'TAH LAKE	IN001	A	SW	P
ST AUK'TAH LAKE	SF001	A	SW	P
ST 500,000 GAL TOWN TANK	SF002	A	SW	P
ST 150,000 GAL TOWN STANDPIPE	SF003	A	SW	P
TP FOR AUK'TAH LAKE	TP001	A	SW	P

AK2130017 ANGOON PUBLIC WATER

Sampling Points

Facility Code	Sampling Pt Code	Description	Type	Src Type	Active
DS001	I-SPDS001DBP	ANGOON PUBLIC WATER	DS		I
DS001	SPDS001PC	AUK'TAH LAKE	DS		A
DS001	SPDS001TCR	AUK'TAH LAKE	DS		A
DS001	SPDS1DBP2-H	LOWER- 332 AANYA ST.	DS		A
DS001	SPDS1DBP2-T	UPPER-811 XOOTZ RD. #3B	DS		A
I-SS001	I-SPSS001	INACTIVE	UP		I
IN001	SPIN001	AUK'TAH LAKE	RW		A
SF001	SPSF001	AUK'TAH LAKE	WS		A
SF002	SPSF002	ST 500,000 GAL TOWN TANK	WS		A
SF003	SPSF003	ST 150,000 GAL TOWN STANDPIPE	WS		A
TP001	SPEP001	DS EP FOR AUK'TAH LA	EP	FN	A
TP001	SPTP001	AUK'TAH LAKE	EP		A

AK2130017 ANGOON PUBLIC WATER

Facility Treatment Information

PWS Facility: TP001

Objective: DISINFECTION

Treatment Process
HYPOCHLORINATION, POST

Objective: PARTICULATE REMOVAL

Treatment Process
COAGULATION
FILTRATION, PRESSURE SAND
FLOCCULATION

AK2130017 ANGOON PUBLIC WATER

Administrative/Owner Information

Owner Type	Owner Name	Address	Phone	Fax
OW	CITY OF ANGOON	BOX 189 ANGOON, AK 99820	907-788-3653	
OW	BOWEN, JOSH	PO Box 189 ANGOON, AK 99820		
OP	FREDRICKSON, DANIEL	PO Box 189 ANGOON, AK 99820	907-738-0100	
DO	FREDRICKSON, DANIEL	PO Box 189 ANGOON, AK 99820	907-738-0100	
AC	BOWEN, JOSH	PO Box 189 ANGOON, AK 99820		

AK2130017 ANGOON PUBLIC WATER

Last Sample Date by Analyte Group for Compliance

Old Inorganics	New Inorganics	Nitrates	Nitrites	Arsenic	VOC	Gross Alpha	Coliform
06/28/2019	06/28/2019	03/27/2019	08/01/2001	03/21/2011	06/28/2019	11/28/2011	10/29/2020
Lead/Copper	**Asbestos**	**SOC**	**TTHM**	**HAA5**	**TOC**	**DPRE**	
09/28/2017	**NSF	08/01/2006	09/24/2020	09/24/2020	**NSF	**NSF	

AK2130017 ANGOON PUBLIC WATER

Sample Schedule

Facility Number	Analyte Group	Analyte Code	Begin Date	End Date	Sample Type	Sample Frequency	Sample Count
AK2130017	COLIFORM (TCR)	3100	8/1/2015		RT	MN	1
DS001	HAA5 (HALOACETIC)	HAA5	10/1/2013		RT	QT	1
DS001	LEAD AND COPPER	PBCU	1/1/2012		RT	3Y	5
DS001	TOTAL TRIHALOMETHANE	TTHM	10/1/2013		RT	QT	1
TP001	ARSENIC - SINGLE	ARSN	1/1/2011		RT	9Y	1
TP001	INORGANICS	IN25	1/1/2002		RT	9Y	1
TP001	NITRATE - SINGLE	NIT3	1/1/2002		RT	YR	1
TP001	RADIUM 226 AND 228	RADC	1/1/2008		RT	9Y	1
TP001	SOC	SO25	1/1/2022	12/31/2022	RT	QT	1
TP001	TOTAL GROSS ALPHA	RAD3	1/1/2008		RT	9Y	1
TP001	VOC	VC25	1/1/2012		RT	YR	1

AK2130017 ANGOON PUBLIC WATER

Facility Analyte Levels (FANLs)

PWS Facility: DS001

Analyte Name	Summary Type Code	Control Level Type	UOM	Days to Monitor Per Month	Samples Required per Day	Effective Begin Date
CHLORINE	MRDL	MAX	4.0 MG/L	0	0	1/1/2004
CHLORINE	DSRD	MIN	.01 MG/L	0	0	6/30/1993

PWS Facility: TP001

Analyte Name	Summary Type Code	Control Level Type	UOM	Days to Monitor Per Month	Samples Required per Day	Effective Begin Date
CHLORINE	EPRD	MIN	0.2 MG/L	20	1	1/1/2016
TURBIDITY	95PT	95P	0.3 NTU	20	6	1/1/2005
TURBIDITY	MAXT	MAX	1.49 NTU	20	1	1/1/2005

Sample Results 1/1/2010 - 12/8/2020

EPA MCLs:
TTHM = 80 ug/L
HAA5 = 60 ug/L

AK2130017 ANGOON PUBLIC WATER

Total Trihalomethanes (TTHM) and Total Haloacetic Acids (HAA5) Sample Results

Lab Assigned ID	Analyte Name	Sample Location	Sample Type*	Comp	Code	Concentration	UOM	Collection Date
4736556	TTHM	UPPER-811 XOOTZ #3B	RT	Y	2950	59.600	UG/L	9/24/2020
4736558	TOTAL HALOACETIC ACIDS (HAA5)	LOWER - 322 AANYA ST	RT	Y	2456	18.800	UG/L	9/24/2020
4641671	TTHM	UPPER - APARTMENTS	RT	Y	2950	45.400	UG/L	5/29/2020
4641673	TOTAL HALOACETIC ACIDS (HAA5)	LOWER - HOUSE	RT	Y	2456	0.000		5/29/2020
4578871	TTHM	UPPER APT-JOSH BOWEN	RT	Y	2950	46.100	UG/L	2/28/2020
4578873	TOTAL HALOACETIC ACIDS (HAA5)	LOWER-D. FREDRICKSON	RT	Y	2456	47.000	UG/L	2/28/2020
4306083	TTHM	UPPER-JOSH BROWN	RT	Y	2950	74.000	UG/L	5/21/2019
4306085	TOTAL HALOACETIC ACIDS (HAA5)	LOWER-ERIKS HOUSE	RT	Y	2456	29.200	UG/L	5/21/2019
4223331	TTHM	UPPER - APARTMENTS	SP	N	2950	71.500	UG/L	3/7/2019
4223333	TOTAL HALOACETIC ACIDS (HAA5)	LOWER - HOUSE	SP	N	2456	15.900	UG/L	3/7/2019
DT*4128424	TTHM	UPPER-P THOMAS-APTS	RT	Y	2950	56.100	UG/L	11/14/2018
DH*4128426	TOTAL HALOACETIC ACIDS (HAA5)	LWR-JOHN SILVA HOUSE	RT	Y	2456	38.900	UG/L	11/14/2018
DT*3881009	TTHM	PAUL THOMAS APTS	RT	Y	2950	62.000	UG/L	2/20/2018

DH*3881010	TOTAL HALOACETIC ACIDS (HAA5)	JOHN SILVAS HOUSE	RT	Y	2456	42.500	UG/L	2/20/2018
DT*3824965	TTHM	PAUL THOMAS APTS	RT	Y	2950	58.200	UG/L	11/16/2017
DH*3824967	TOTAL HALOACETIC ACIDS (HAA5)	JOHN SILVAS HOUSE	RT	Y	2456	32.700	UG/L	11/16/2017
DT*3767883	TTHM	PAUL THOMAS APTS	RT	Y	2950	78.800	UG/L	8/23/2017
DH*3767884	TOTAL HALOACETIC ACIDS (HAA5)	JOHN SILVAS HOUSE	RT	Y	2456	27.800	UG/L	8/23/2017
DT*3694937	TTHM	PAUL THOMAS APTS	RT	Y	2950	69.700	UG/L	5/11/2017
DH*3694938	TOTAL HALOACETIC ACIDS (HAA5)	JOHN SILVAS HOUSE	RT	Y	2456	53.400	UG/L	5/11/2017
DT*3637612	TTHM	PAUL THOMAS APTS	RT	Y	2950	62.800	UG/L	2/8/2017
DH*3637613	TOTAL HALOACETIC ACIDS (HAA5)	JOHN SILVAS HOUSE	RT	Y	2456	55.000	UG/L	2/8/2017
DT*3596840	TTHM	UPPER-P THOMAS-APTS	RT	Y	2950	60.500	UG/L	11/28/2016
DH*3596842	TOTAL HALOACETIC ACIDS (HAA5)	JOHN SILVAS HOUSE	RT	Y	2456	27.800	UG/L	11/28/2016
DT*3523295	TTHM	PAUL THOMAS APTS	RT	Y	2950	126.600	UG/L	8/11/2016
DH*3523297	TOTAL HALOACETIC ACIDS (HAA5)	JOHN SILVAS HOUSE	RT	Y	2456	81.000	UG/L	8/11/2016
DT*3455801	TTHM	PAUL THOMAS APTS	RT	Y	2950	86.300	UG/L	5/19/2016
DH*3455802	TOTAL HALOACETIC ACIDS (HAA5)	JOHN SILVAS HOUSE	RT	Y	2456	108.400	UG/L	5/19/2016
DT*3405665	TTHM	UPPER-P THOMAS-APTS	RT	Y	2950	58.700	UG/L	2/22/2016
DH*3405667	TOTAL HALOACETIC ACIDS (HAA5)	JOHN SILVAS HOUSE	RT	Y	2456	104.600	UG/L	2/22/2016
DH*3367099	TOTAL HALOACETIC ACIDS (HAA5)	JOHN SILVAS HOUSE	RT	Y	2456	74.000	UG/L	11/23/2015
DT*3299542	TTHM	PAUL THOMAS APTS	RT	Y	2950	97.100	UG/L	8/11/2015
DH*3299544	TOTAL HALOACETIC ACIDS (HAA5)	JOHN SILVAS HOUSE	RT	Y	2456	74.100	UG/L	8/11/2015
DT*3255631	TTHM	UP-PAUL THOMAS APTS	RT	Y	2950	91.700	UG/L	5/28/2015
DH*3255633	TOTAL HALOACETIC ACIDS (HAA5)	LOWER	RT	Y	2456	106.800	UG/L	5/28/2015
DT*3197769	TTHM	UPPER-P THOMAS-APTS	RT	Y	2950	102.200	UG/L	2/25/2015
DH*3197771	TOTAL HALOACETIC ACIDS (HAA5)	LOWER-JSILVA"S HOUS	RT	Y	2456	111.100	UG/L	2/25/2015
DT*3147385	TTHM	UPPER-PAUL THOMAS-AP	RT	Y	2950	79.900	UG/L	11/24/2014
DH*3147386	TOTAL HALOACETIC ACIDS (HAA5)	LOWER-JOHN SILVA"S	RT	Y	2456	81.000	UG/L	11/24/2014
DT*201402260895	TTHM	UPPER	RT	Y	2950	74.000	UG/L	2/24/2014
DH*201402260896	TOTAL HALOACETIC ACIDS (HAA5)	LOWER	RT	Y	2456	72.000	UG/L	2/24/2014
VO*201312130127	TTHM	EP	RT	Y	2950	0.000		12/3/2013
DB*201309040493	TTHM	UPPER	RT	Y	2950	100.000	UG/L	8/27/2013
DB*201309040493	TOTAL HALOACETIC ACIDS (HAA5)	UPPER	RT	Y	2456	25.000	UG/L	8/27/2013
DB*201302200282	TTHM	LOWER	RT	Y	2950	84.000	UG/L	2/13/2013
DB*201302200282	TOTAL HALOACETIC ACIDS (HAA5)	LOWER	RT	Y	2456	61.000	UG/L	2/13/2013
DB*201205260073	TTHM	ANGOON	RT	Y	2950	84.000	UG/L	5/23/2012
DB*201205260073	TOTAL HALOACETIC ACIDS (HAA5)	ANGOON	RT	Y	2456	73.000	UG/L	5/23/2012
DB*201202240235	TTHM		RT	Y	2950	68.000	UG/L	2/16/2012

DB*201202240235	TOTAL HALOACETIC ACIDS (HAA5)	RT	Y	2456	61.000	UG/L	2/16/2012
DB*201112020113	TTHM	RT	Y	2950	84.000	UG/L	11/28/2011
DB*201112020113	TOTAL HALOACETIC ACIDS (HAA5)	RT	Y	2456	80.000	UG/L	11/28/2011
VO*201104080310	TTHM	RT	Y	2950	58.000	UG/L	4/4/2011
201103240105	TTHM	RT	Y	2950	42.000	UG/L	3/21/2011
201103240105	TOTAL HALOACETIC ACIDS (HAA5)	RT	Y	2456	55.000	UG/L	3/21/2011
VO*201103240105	TTHM	RT	Y	2950	42.000	UG/L	3/20/2011
DT*J1006202-02A	TTHM	RT	Y	2950	66.800	UG/L	6/29/2010
DH*J1006202-01A	TOTAL HALOACETIC ACIDS (HAA5)	RT	Y	2456	83.300	UG/L	6/29/2010

AK2130017 ANGOON PUBLIC WATER

*Sample Type

RT = Routine CO = Confirmation

SP = Special PE = Performance Evaluation

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ADEC DRINKING WATER
COMPLIANCE DATA

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THE STATE of ALASKA
GOVERNOR MICHAEL J. DUNLEAVY

Department of Environmental Conservation
DIVISION OF ENVIRONMENTAL HEALTH
Drinking Water Program

43335 Kalifornsky Beach Rd., Ste. 11
Soldotna, Alaska 99669
Main: 907.262.5210
Fax: 907.262.2294
dec.alaska.gov

July 15, 2019

Mr. Josh Bowen
PO Box 189
Angoon, AK 99820

Re: The City of Angoon Public Water System Sanitary Survey Response Letter
PWSID #: 130017 Class: Community; Source: Surface Water

Dear Mr. Bowen:

This letter is the follow-up to the sanitary survey conducted by Andrew Gray on May 29, 2019 at the Angoon public water system. Based on the information included in the sanitary survey report, which we received on July 01, 2019, it has been determined that your public water system has one or more deficiencies. Deficiencies are summarized on the following pages with the required timelines for them to be resolved. Documentation with written verification that the listed deficiencies have been corrected (include photo documentation where appropriate) is required within the timelines given for each type of deficiency. Contact our office within 30 days of receipt of this letter to discuss the corrective actions required to resolve the deficiencies. If you are unable to correct one or more of the deficiencies within the timeframe specified, please submit a written corrective action plan and schedule (which includes a reason why the item cannot be addressed in the timeframe allotted) for Department review.

Please be advised that modifications to the drinking water system, other than routine maintenance, may first require approval by the DEC. Please contact a Drinking Water Program engineer before making any changes to determine if you need to submit engineered plans for approval.

Drinking Water Regulation 18 AAC 80.430 establishes that a Community Public Water System must have a sanitary survey conducted at least every 3 years. Your next sanitary survey will be due during the 2022 calendar year. This survey only covers what was inspected during the site visit, and although due diligence was instituted; the attached report may not adequately address all deficiencies in this system.

Significant Deficiencies

(Must be corrected or a corrective action plan with a timeline must be submitted to DEC within 30 days)

- The surveyor noted that at the time of the survey, some of the steel water lines serving the harbor were being replaced with 2" HDPE pipe. These changes to the water system require DEC engineer review.

  - Please contact our DEC Drinking Water Program Engineer Charity Bare at 907-262-3400 or via email charity.bare@alaska.gov to discuss these modifications and the requirements for a plan review submittal.
- Images in the photo log indicate that a check valve has been installed on the main harbor service line. This check valve/shutoff valve does not provide adequate protection against backflow. For high hazard conditions (where a boat's water system is connected to the harbor section of main water line) a reduced pressure zone valve assembly (RPZ) should be installed on this main service line.
  - Backflow prevention devices should also be installed on all possible points of connection to the water system provided in the harbor (i.e. individual service lines). Please provide photo documentation to verify that these have been installed.
- The surveyor noted that the vents on the top of the treated water storage tanks in town (standpipe and the 500,000 gallon tank) did not have screens.
  - Please ensure that vents are screened to prevent contaminants and debris from entering the tank and provide photos to verify this has been completed.
- The surveyor noted that the electrical cord for the heat tape at the standpipe pump station is plugged into a non-GFCI (ground fault circuit interrupter) outlet, which could create the risk of electric shock.
  - To eliminate this potential electrical hazard, please contact a registered electrician to install a GFCI outlet at this location and provide photos to verify this has been completed.

Minor Deficiencies

(Must be corrected or a corrective action plan with a timeline must be submitted to DEC within 120 days)

- The surveyor noted that the backflow prevention devices at the water treatment plant have not been tested since their installation in 2010.
  - Backflow prevention devices should be tested each year. Please have a certified backflow assembly tester inspect and test these backflow prevention devices as soon as possible, and annually thereafter. Please provide documentation that verifies that testing has been completed.
- The surveyor noted that the access hatch and ladders for the Auk'Tah Lake storage tank and 500,000 gallon storage tank in town were not locked.
  - Please ensure that all water storage tank access hatches are adequately secured and locked, and provide photos to verify that this has been completed.

Recommendations

- Although not noted in the survey, Angoon's water system operators are not adequately certified to the correct classification level. Angoon is classified as a Level 2 water system. This means that the operators should be certified at or above WT-2 level. For more information on attaining the correct level of certification, please contact the Operator Certification and Training Program at 907-465-1139 or via email at dec.opcert@alaska.gov.
- Please contact our Drinking Water Program Engineer Charity Bare (907-262-3400 or via email charity.bare@alaska.gov) for more information on requirements for the following projects:
  - Two engineering projects (Water Intake Upgrade and Water Treatment Plan Improvements) do not have DEC Final Approval to Operate.
  - It was noted that the water pressure at the City Office and the Clinic may be lower than 20 psi. Please have a registered engineer evaluate the system and submit a report verifying that 20 psi is maintained at all mains.

- The surveyor noted that water system records were not being retained per DEC regulations. The current operator (Mr. Fredrickson) and Mayor (Mr. Bowen) began overseeing the operation/management of the water system in 2018 and are now keeping electronic copies of the required records.
  - Please continue to maintain a file/record of the water system's routine sample testing, reports, written communications, etc. The retention time required for these items is listed on page 9 and 10 of the sanitary survey question set provided by Mr. Gray.
- Please refer to the surveyor's enclosed letter for additional recommendations and other noted items.

If you have any questions about the survey, please contact me at amanda.millay@alaska.gov or at 907-262-341

Sincerely,

Amanda M Millay

Amanda Millay
Environmental Program Specialist
Drinking Water Program, Soldotna Office

Enclosures: Survey Inspector's List of Findings

Cc via email: DEC, Operator Training and Certification Program
Charity Bare, DEC, Drinking Water Program
Daniel Fredrickson, Operator, Angoon Water System
Andrew Gray, P.E., Safewater Alaska

Safewater Alaska
Sanitary Surveying, Technical Services

July 1, 2019

City of Angoon, C/O Josh Bowen, Mayor
P.O. Box 189
Angoon, AK 99820
mayor@cityofangoon.com

RE: Sanitary Survey of Angoon Public Water System (AK PWSID #2130017

This report is being generated to notify you of submittal to ADEC of my report. I have attached the generated deficiency report, survey questions, photo log and other material for you to review. I am concurrently submitting the same information to the ADEC as required by 18 AAC 70.

Deficiency Report:

- Significant Deficiencies:
  - Backflow Prevention/Cross Connections: Without individual backflow preventers at the water service lines at the harbor, boats could backfeed and introduce contamination into the harbor sector of the water system.
  - Vent Screens: The two 500,000-gallon water storage tanks did not have screens on their top vents. This allows contamination by animal entry.
  - Backup Disinfection: There is no backup disinfection unit.
  - Electrical Hazard: The pump station at the standpipe has an electrical cord plugged in to a non-GFCI outlet to supply the heat tape in the pump chamber. This presents a dangerous situation to staff working on or near this pump station.

- Deficiencies:
  - Locked Hatches on Tank: The access hatch and ladders to the 500,000 gallon storage tanks were not locked and could be accessed by untrained personnel.
  - Records Retention: There were several records which have not been retained per ADEC regulations. The operator and management should retain all documentation relating to the water system per ADEC requirements.
  - Backflow Prevention Device Testing: Backflow prevention devices should be tested by a certified BPD tester in accordance with the manufacturer's recommendations.

- Recommendations:
  - Security: It is recommended that locks, fencing or gates be installed to prevent access to the water storage tanks and standpipe.
  - Access: The standpipe is 10 stories tall and is a safety hazard for climbing to staff not equipped with climbing harnesses and/or proper training.
  - Leaks: Leaking was evident at both storage tanks and the standpipe. Corrective actions may include tightening bolts but many of these leaks may be typical of the age of these tanks and not able to be addressed except by replacement. I recommend staff routinely inspect leakage, in particular if any location suddenly changes or increases its leaks.

Safewater Alaska
Sanitary Surveying, Technical Services

Deficiency Statement to Owner:

This report, its findings and all deficiencies or suspected deficiencies are based upon my knowledge and interpretation of the applicable ADEC regulations. All findings and deficiencies are subject to review by the ADEC, who will contact you with official findings of deficiencies and official requirements for correction of deficiencies. If anything is unclear, feel free to contact me, but the ADEC is the final authority who will issue official determinations regarding deficiencies and requirements.

Thank you for your time and consideration.

Andrew J. Gray, P.E.
Alaska Civil Engineer #119410
New Hampshire Civil Engineer #15856
Certified Professional in Erosion & Sediment Control #8985
safewaterak@gmail.com
907-301-6007

July 1, 2019

City of Angoon, C/O Josh Bowen, Mayor
P.O. Box 189
Angoon, AK 99820
mayor@cityofangoon.com

RE: Sanitary Survey of Angoon Public Water System (AK PWSID #2130017

This report is being generated to notify you of submittal to ADEC of my report. I have attached the generated deficiency report, survey questions, photo log and other material for you to review. I am concurrently submitting the same information to the ADEC as required by 18 AAC 70.

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  - Backup Disinfection: There is no backup disinfection unit.
  - Electrical Hazard: The pump station at the standpipe has an electrical cord plugged in to a non-GFCI outlet to supply the heat tape in the pump chamber. This presents a dangerous situation to staff working on or near this pump station.

- Deficiencies:
  - Locked Hatches on Tank: The access hatch and ladders to the 500,000 gallon storage tanks were not locked and could be accessed by untrained personnel.
  - Records Retention: There were several records which have not been retained per ADEC regulations. The operator and management should retain all documentation relating to the water system per ADEC requirements.
  - Backflow Prevention Device Testing: Backflow prevention devices should be tested by a certified BPD tester in accordance with the manufacturer's recommendations.

- Recommendations:
  - Security: It is recommended that locks, fencing or gates be installed to prevent access to the water storage tanks and standpipe.
  - Access: The standpipe is 10 stories tall and is a safety hazard for climbing to staff not equipped with climbing harnesses and/or proper training.
  - Leaks: Leaking was evident at both storage tanks and the standpipe. Corrective actions may include tightening bolts but many of these leaks may be typical of the age of these tanks and not able to be addressed except by replacement. I recommend staff routinely inspect leakage, in particular if any location suddenly changes or increases its leaks.

Safewater Alaska
Sanitary Surveying, Technical Services

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Thank you for your time and consideration.

Andrew J. Gray, P.E.
Alaska Civil Engineer #119410
New Hampshire Civil Engineer #15856
Certified Professional in Erosion & Sediment Control #8985
safewaterak@gmail.com
907-301-6007

Public Water System Sanitary Survey Certification

Please find attached the completed Sanitary Survey for

PWS Name: ANGOON PUBLIC WATER SS - 2019

PWSID: AK2130017

I certify that I have completed this sanitary survey addressing the eight components of a sanitary survey set out in EPA's Guidance Manual for Conducting Sanitary Surveys of Public Water Systems; Surface Water and Ground Water Under the Direct Influence of Surface Water (GWUDI), Chapter 3 and/or in EPA's Sanitary Survey Guidance Manual for Ground Water Systems, Chapter 4, and that the report is complete and accurate to the best of my knowledge.

I also certify that I have provided the Public Water System owner and DEC Drinking Water Program a complete copy of this survey in accordance with 18 AAC 80.430(d), to include all documented findings.

Date site visit was conducted: 5/29/2019

Date report sent to PWS owner and DEC: 7/1/2019

____

(Sanitary Survey Inspector Signature)

Andrew Gray

(Sanitary Survey Inspector Printed Name)

7/1/2019

(Date)

Sanitary Survey - Deficiency Report

PWS Number: AK2130017 **Survey Date:** 6/29/2019

Survey Name: ANGOON PUBLIC WATER SS - 2019 **User Name:** Andrew Gray

Sanitary Survey Category: DS

SDWIS Severity Code: Recommendation

DS AUK'TAH LAKE - (Active) / Pumps

Is the electrical wiring maintained properly? (If no, describe in notes.)

Answer Recorded No

Comments:

Notes: Heat tape on pumps is plugged in to a non-GFCI outlet. Should be hard piped to pump well by a licensed electrician.

Days to Correct Deficiency:

SDWIS Deficiency Description: EWMP

SDWIS Severity Code: Significant Deficiency

DS AUK'TAH LAKE - (Active) / Cross Connections

Are there any other cross-connections in the system with inadequate protection? (i.e. air gaps or backflow prevention not installed at all appropriate locations, such as boiler make-up water, hose bibbs where backflow prevention is required, etc. Describe in detail and provide well labeled photo(s).)

Answer Recorded Yes

Comments:

Notes: Backflow preventers should be installed at individual water service connections at the harbor. The harbor section of the water system was out of commission for upgrades at time of inspection.

Days to Correct Deficiency: 30

SDWIS Deficiency Description: CCDD

Sanitary Survey Category: DS

SDWIS Severity Code: Significant Deficiency

DS AUK'TAH LAKE - (Active) / Cross Connections

If the water system has a water haul fill point, do the water supply lines have appropriate backflow prevention? (List backflow prevention type in notes.)

Answer Recorded No

Comments:

Notes: See previous note about harbor. Harbor was only public water fill point witnessed.

Days to Correct Deficiency: 30

SDWIS Deficiency Description: CCDD

Sanitary Survey Category: FW

SDWIS Severity Code: Deficiency

Storage / ST AUK'TAH LAKE - (Active)

Is the hatch locked?

Answer Recorded No

Comments:

Notes:

Days to Correct Deficiency: 120

SDWIS Deficiency Description: STWL

Sanitary Survey Category: FW

SDWIS Severity Code: Deficiency

Storage / ST 500,000 GAL TOWN TANK - (Active)

Is the hatch locked?

Answer Recorded No

Comments:

Notes:

Days to Correct Deficiency: 120

SDWIS Deficiency Description: STWL

SDWIS Severity Code: Significant Deficiency

Storage / ST 150,000 GAL TOWN STANDPIPE - (Active)

Is storage tank(s) safely accessible to inspector?

Answer Recorded No

Comments:

Notes: Tank is 10 stories tall.

Days to Correct Deficiency: 30

SDWIS Deficiency Description: STSA

Sanitary Survey Category: FW

SDWIS Severity Code: Significant Deficiency

Storage / ST AUK'TAH LAKE - (Active)

Are vents screened or covered, and turned downward; and do the lines terminate a minimum of 2 times the diameter of the water outlet pipe above the ground or storage? (If no, describe in notes.)

Answer Recorded No

Comments:

Notes: No screen on top vent.

Days to Correct Deficiency: 30

SDWIS Deficiency Description: SCRN

Storage / ST 500,000 GAL TOWN TANK - (Active)

Are vents screened or covered, and turned downward; and do the lines terminate a minimum of 2 times the diameter of the water outlet pipe above the ground or storage? (If no, describe in notes.)

Answer Recorded No

Comments:

Notes:

Days to Correct Deficiency: 30

SDWIS Deficiency Description: SCRN

Sanitary Survey Category: MR

SDWIS Severity Code: **Deficiency**

Regulations/Monitoring/Data Verification / General

Bacteriological/Microbiological Analysis - 5 years retention.

Answer Recorded No

Comments:

Notes: New operator and mayor have kept electronic records since taking oversight of system.

Days to Correct Deficiency: 120

SDWIS Deficiency Description: OMRC

Chemical Analysis - 10 years retention. Lead and Copper (all analyses, reports, surveys, letters, evaluations, schedules, determinations, etc.) - 12 years retention.

Answer Recorded No

Comments:

Notes:

Days to Correct Deficiency: 120

SDWIS Deficiency Description: OMRC

Records of actions taken to correct violations - 3 years retention.

Answer Recorded No

Comments:

Notes:

Days to Correct Deficiency: 120

SDWIS Deficiency Description: OMRC

Sanitary Survey Category: MR

SDWIS Severity Code: Deficiency

Regulations/Monitoring/Data Verification / General

Reports, summaries, communications, and corrective action documentation related to sanitary surveys - 10 years retention.

Answer Recorded No

Comments:

Notes:

Days to Correct Deficiency: 120

SDWIS Deficiency Description: OMRC

Sanitary Survey Category: SM

SDWIS Severity Code: Deficiency

TP FOR AUK'TAH LAKE - (Active) / General / Cross Connections

If backflow preventers are installed, are they tested? (Describe testing schedule or frequency. Include the date they were last tested and the name of the tester.)

Answer Recorded No

Comments:

Notes: Last test date on all BPD was 2010.

Days to Correct Deficiency: 120

SDWIS Deficiency Description: NCRM

Sanitary Survey Category: SM

SDWIS Severity Code: Deficiency

DS AUK'TAH LAKE - (Active) / Cross Connections

If backflow preventers are installed, are they tested? (Describe testing schedule or frequency. Include the date they were lasted tested and the name of the tester.)

Answer Recorded No

Comments:

Notes:

Days to Correct Deficiency: 120

SDWIS Deficiency Description: NCRM

SDWIS Severity Code: Recommendation

General / Background Info / Current Survey Info

Is standby or auxiliary power available?

Answer Recorded No

Comments:

Notes:

Days to Correct Deficiency:

SDWIS Deficiency Description: BKPW

Sanitary Survey Category: SM

SDWIS Severity Code: Recommendation

Management / General

Is the system secured as appropriate (i.e. locks, lighting, fences, etc.)?

Answer Recorded No

Comments:

Notes: Several locations need padlocks or gates.

Days to Correct Deficiency: 0

SDWIS Deficiency Description: SECU

Storage / ST 150,000 GAL TOWN STANDPIPE - (Active)

Are leaks evident at the time of inspection?

Answer Recorded Yes

Comments:

Notes: Small leaks and rust streaks.

Days to Correct Deficiency:

SDWIS Deficiency Description: LEAK

Storage / ST AUK'TAH LAKE - (Active)

Are leaks evident at the time of inspection?

Answer Recorded Yes

Comments:

Notes:

Days to Correct Deficiency:

SDWIS Deficiency Description: LEAK

Sanitary Survey Category: SM

SDWIS Severity Code: Recommendation

Storage / ST 500,000 GAL TOWN TANK - (Active)

Are leaks evident at the time of inspection?

Answer Recorded Yes

Comments:

Notes: Typical of all tanks, small leaks, rust streaking.

Days to Correct Deficiency:

SDWIS Deficiency Description: LEAK

DS AUK'TAH LAKE - (Active) / General

Is system adequately protected from freezing? (If no, explain in notes.)

Answer Recorded No

Comments:

Notes: Some customers have reported freezing issues. Most can be chalked up to inactivity or lack of burial cover/insulation beyond the service valve.

Days to Correct Deficiency:

SDWIS Deficiency Description: FREZ

Sanitary Survey Category: SM

SDWIS Severity Code: Significant Deficiency

DS AUK'TAH LAKE - (Active) / Pumps

Does wiring pose an immediate safety hazard? (If yes, describe in notes.)

Answer Recorded Yes

Comments:

Notes: Wet conditions could easily cause an arc or shock hazard with a non-GFCI outlet.

Days to Correct Deficiency: 1

SDWIS Deficiency Description: EWBA

Sanitary Survey Category: TR

SDWIS Severity Code: Significant Deficiency

TP FOR AUK'TAH LAKE - (Active) / Chlorination / Hypochlorination

Is there a back-up disinfection unit? (Describe in notes if it is on-line and operational. Filtration avoidance systems cannot have an NA answer; all other types of systems that do not have back-up disinfection should be NA.)

Answer Recorded No

Comments:

Notes:

Days to Correct Deficiency: 5

SDWIS Deficiency Description: SWTD

Sanitary Survey - Survey Responses

PWS Number: AK2130017 **Survey ID:** 935 **Survey Date:** 6/29/2019

Survey Name: ANGOON PUBLIC WATER SS - 2019 **User Name:** Andrew Gray

Question Number

General / SDWIS Site Visit Info

1 Reason for the visit: ☑ SNSV - Sanitary Survey

2 Date of the survey: 05/29/2019

3 Status of the survey: ☑ C - Completed

4 Last name of inspector: Gray

5 First name of inspector: Andrew

6 Inspector organization: Safewater Alaska

7 Name of system representative participating in survey: Daniel Frederickson

8 Other parties participating: Erik Larson

General / SS Organization

Pre-Inspection:

1 **Checklist of pre-inspection tasks:**

Notes: -

2 Phone contact with responsible party? ☑ Yes ☐ No

Question Number

3	Reviewed correspondence relative to the system to be inspected, including current Boil Water Notices and Public Notifications?	☑ Yes ☐ No
4	Reviewed previous sanitary survey report, including all deficiencies?	☑ Yes ☐ No
5	Reviewed previous Level 1 and Level 2 Assessments (if applicable)?	☐ Yes ☐ No ☑ NA
6	Obtained a copy of the RTCR sample siting plan from DEC to be used during the site visit for the RTCR special monitoring evaluation?	☑ Yes ☐ No
7	Reviewed compliance monitoring results and compliance records?	☑ Yes ☐ No
8	Reviewed approved plans/letters on file? (Note CT (concentration X contact time); operational requirements specified in engineering approval letters; separation distance waivers; number of storage tanks; specifications on well construction, grouting, an approved alternative to grouting, and an impervious surface; etc.) Notes: Reviewed plans that were included in previous sanitary survey documentation.	☐ Yes ☑ No
9	Obtained a copy of the well log(s) (if applicable) to field verify that it is for the PWS's current source(s)? Notes: Surface water system, no well log.	☐ Yes ☐ No ☑ NA
10	Reviewed Source Water Assessment and delineated protection area, if available?	☑ Yes ☐ No ☐ Not Available
11	Verified both the certification level required for the water system and the certification level of the operator(s) online at the DEC Operator Certification Program? http://dec.alaska.gov/water/opcert/index.htm	☑ Yes ☐ No
12	Obtained data dump to review and provide to the water system for reference?	☑ Yes ☐ No
13	Obtained a copy of the water haul vehicle questions for each vehicle?	☐ Yes ☐ No ☑ NA
14	Obtained a copy of the chemical storage guidance?	☐ Yes ☑ No
15	Obtained full sanitary survey question set to record items on site that are not covered by this sanitary survey question set?	☑ Yes ☐ No

General / SS Organization

Post-Inspection:

1 Date official notification provided to DEC regarding potential deficiencies: 07/01/2019

2 Date inspector notified water system regarding potential deficiencies: 07/01/2019

3 If applicable, date inspector notified water system of any variance between the written evaluation and the verbal de-briefing or any draft version of the report: 07/01/2019

4 **Checklist of items needed for a complete survey:**

Notes: -

5 Cover letter:
- [x] Yes
- [ ] No

6 Deficiency Report:
- [x] Yes
- [ ] No

7 Completed survey questions:
- [x] Yes
- [ ] No

8 Photo log:
- [x] Yes
- [ ] No

9 System site plan map (include source location and vicinity map):
- [x] Yes
- [ ] No

10 System schematic(s) (i.e. treatment, distribution, etc.):
- [x] Yes
- [ ] No
- [ ] NA

11 Lat/Long form for all new sources or if the current source is a different source than the one in the last sanitary survey:

Notes: Lat/Long already recorded for source
- [ ] Yes
- [ ] No
- [x] NA

12 Well log (required for all new sources and when well log is available but not in the DW Program file; not required if the inspector has verified that the well log is in the file and is the correct well log for the source. This verification must be noted here if the well log is not included.)
- [ ] Yes
- [ ] No
- [x] NA

13 Please comment on any issues that are not addressed through the questions (i.e. additional deficiencies or findings). See Report

General / Background Info

Name / Location:

1	Name of public water system:	ANGOON PUBLIC WATER
2	PWSID:	AK2130017
3	Physical address:	Auk'Tah Lake Road
4	Total system design water production/treatment capacity in gallons per day (gpd):	302400
5	Average daily production (gpd):	100000

Notes: Per operator at time of survey, ~70gpm flow rate

General / Background Info

Classification:

1 SDWIS activity status:

- [x] Active

2 Primary water source:

- [ ] GW - Groundwater
- [ ] SW - Surface Water
- [ ] GWP - Groundwater Purchase
- [x] SWP - Surface Water Purchase
- [ ] GWUDISW- Ground water und

3	Transient population:	0
4	Residential population:	375
5	Non-transient population (i.e. workers, students, etc.):	75
6	Number of service connections:	158
7	How many services are metered?	0

Question Number

8	Is water obtained from another PWS? (If yes, list in notes the name of the water system or business and the PWSID, if applicable.)	☐ Yes ☑ No
9	Does the system sell/provide water to another water system or business? (If yes, list in notes the name of the water system or business and PWSID, if applicable.) Notes: All business in the town area.	☑ Yes ☐ No
10	Have there been modifications to the system since the last survey? (Include all changes to the water system from the source through the distribution and additional water haul vehicles.)	☐ Yes ☑ No
11	Date(s) and description of modification(s):	N/A
12	Have these modifications been approved by DEC? (List approvals obtained.)	☐ Yes ☐ No ☑ NA ☐ Unknown
13	Is the system only open on a seasonal basis? (If yes, list the dates of operation in notes.)	☐ Yes ☑ No
14	If seasonal system, does the entire distribution system stay pressurized throughout the year? (If no, explain in notes.)	☐ Yes ☐ No ☑ NA
15	If seasonal system, list off-season point of contact information, including: name(s), address(es), and phone number(s). Notes: Year-round system	N/A

General / Background Info

Owner:

1	Owner type:	☐ F - Federal ☑ L - Local ☐ M - Mixed ☐ N - Native American ☐ P - Private ☐ S - State Government
2	Legal owner first name/entity name:	City of Angoon
3	Legal owner last name (NA if entity):	N/A
4	Owner's mailing street address:	BOX 189
5	Owner's mailing address city:	ANGOON

6	Owner's mailing address state:	AK
7	Owner's mailing address zip code:	99820
8	Owner's telephone number (daytime):	907-788-3653
9	Owner's telephone number (emergency):	See operator info
10	Owner's fax number:	N/A
11	Owner's email address:	mayor@cityofangoon.com

General / Background Info

Operator/Contact Info and Certification:

1	Does this PWS require a certified operator?	☑ Yes ☐ No
2	Primary operator's first name:	Daniel
3	Primary operator's last name:	Frederickson
4	Primary operator's street address:	Box 189
5	Primary operator's address city:	Angoon
6	Primary operator's address state:	AK
7	Primary operator's address zip code:	99820

8 Primary operator's telephone: 907-788-6205

9 Primary operator's email address: fredericksonjrd@yahoo.com

10 Primary operator's certification level(s): (Specify all that apply and list WT, WD, etc. and expiration date(s) in notes.)

- [ ] Small - Untreated
- [ ] Small - Treated
- [ ] Provisional
- [x] Level 1
- [ ] Level 2
- [ ] Level 3
- [ ] Level 4
- [ ] No Certification

11 List all secondary operators and their certification level(s): (Include WT, WD, etc. and expiration date(s) in notes.) Erik Larson - provisional

12 Is at least one operator adequately certified for the system classification level? (Specify system level in notes for Water Treatment and/or Water Distribution as required by the Operator Certification Program.)

- [x] Yes
- [ ] No

13 Does the system have an alternate method of system supervision? (i.e. maintenance contract, remote supervision, etc. If yes, describe in notes.)

- [ ] Yes
- [x] No

14 If yes, does the system have a DEC approved Alternate Method of System Supervision (AMOSS) plan? (If yes, describe in notes.)

- [ ] Yes
- [ ] No
- [x] NA

15 Emergency contacts: Day - name(s) and telephone number(s): Daniel Frederickson, see previous cell number

16 Emergency contacts: Night - name(s) and telephone number(s): same as day contact

General / Background Info

Previous Survey Info:

1 Date of last sanitary survey: 12/03/2014

2 Last survey conducted by: (Name and Organization) James Clare, P.E. - SEARHC

3 Have all deficiencies noted during the previous survey been corrected?

- [ ] Yes
- [x] No
- [ ] NA

4 Have all defects from Level 1 and Level 2 Assessments conducted since the last sanitary survey, been corrected?

- [ ] Yes
- [ ] No
- [x] NA

5 If the answer to either of the previous two questions is "no" list the remaining uncorrected deficiencies and defects:
(During the site visit, the survey inspector must document the status of unresolved deficiencies/defects; use photo documentation where applicable.)

Electrical hazard at standpipe

General / Background Info

Current Survey Info:

1 Is standby or auxiliary power available?

- [ ] Yes
- [x] No
- [ ] NA

2 If standby or auxiliary power is available is it in operable condition and well maintained (i.e. tested and noted in a log book)?

- [ ] Yes
- [ ] No
- [x] NA

3 What parts of the system does the auxiliary power supply?

N/A

4 Does the system have a master meter? (Describe the master meter or system of meters used to comply with the master meter requirement: meters measuring treated, wasted, and distributed water. Provide photos with locational labels of these meter(s).)

- [x] Yes
- [ ] No
- [ ] NA
- [ ] Unknown

Notes: Meters account for raw water, filtered water, backwash water.

5 Is the master meter operable? (Explain, i.e. flow through meter, etc.)

- [x] Yes
- [ ] No
- [ ] NA

6 If the system is under a current Boil Water Notice or other Public Notification requirement, is the notice posted on-site as required?

- [ ] Yes
- [ ] No
- [x] NA

Management / General

1 Does the management keep separate financial records reflecting the costs of operating and maintaining this system?

- [x] Yes
- [ ] No

2 Are the finances and budget satisfactory to cover costs of operating the water system in a safe manner (i.e. water samples, energy costs, operations, maintenance, staff training, etc.)?

- [x] Yes
- [ ] No

3 Are routine operations and maintenance records being kept?

- [x] Yes
- [ ] No

4 Are routine maintenance schedules established and adhered to for all components of the water system?

- [ ] Yes
- [x] No

Notes: New operator is developing maintenance schedules for plant and distribution system.

5 Is there a fee schedule? (If yes, describe in notes.)
- [x] Yes
- [ ] No

Notes: Flat rates for residential or business customers.

6 Is there sufficient personnel?
- [x] Yes
- [ ] No

7 Are supplies and maintenance parts inventories adequate?
- [x] Yes
- [ ] No

8 Are complaints logged in and responded to? (If any major complaints have been received since the last sanitary survey, describe in notes.)
- [x] Yes
- [ ] No

Notes: There was a main blowout which was isloated and repaired. Heavy rainfall caused dicoloration, lines were flushed in response.

9 Does the system have an alternate source of water in the event that the system's primary source of water is contaminated or shut down? (If yes, list the source(s) in the notes field.)
- [ ] Yes
- [x] No
- [ ] NA

10 Is the system secured as appropriate (i.e. locks, lighting, fences, etc.)?
- [ ] Yes
- [x] No

Notes: Several locations need padlocks or gates.

Regulations/Monitoring/Data Verification / General

1 Are all components and chemicals used in contact with the water certified to ANSI/NSF standards for drinking water; include treatment chemicals, filters/housings, etc.? (List any that are not ANSI/NSF certified, in notes.)
- [x] Yes
- [ ] No
- [ ] Unknown

2 Does the system have a DEC-approved total coliform sample siting plan available for review? (If no, use the sample siting plan obtained from the DW Program to answer the following questions.)
- [x] Yes
- [ ] No

3 Does the sample siting plan accurately represent the entire distribution system's current configuration? (Include addition or removal of distribution lines, pressure zones, system loops, or sample locations, etc. If no, explain in notes.)
- [x] Yes
- [ ] No

4 For a seasonal system on quarterly monitoring, do the time periods listed on the sample siting plan match the actual periods of highest demand? Explain in notes.
- [ ] Yes
- [ ] No
- [x] NA

Notes: Monthly monitoring.

5 Does the system have a supply of extra total coliform sample bottles available? (Minimum of 4 bottles for systems with a groundwater source and 3 for systems with surface water or GWUDISW sources.)
- [x] Yes
- [ ] No

6 **Does the water system maintain the following records? (Please review these records.)**

Notes: -

7 Bacteriological/Microbiological Analysis - 5 years retention.
- [ ] Yes
- [x] No

Notes: New operator and mayor have kept electronic records since taking oversight of system.

8 Chemical Analysis - 10 years retention. Lead and Copper (all analyses, reports, surveys, letters, evaluations, schedules, determinations, etc.) - 12 years retention.
- [ ] Yes
- [x] No

9 Turbidity Data (monthly operator reports) - 5 years retention. Turbidity values exceeding 5 NTU - 10 years retention. Conventional or direct systems: continuous, individual (3 or more filters) or combined filter effluent readings - 3 years retention.
- [x] Yes
- [ ] No
- [ ] NA

Notes: SCD system records turbidity data.

10 Disinfection Residual Data (monthly operator reports) - 5 years retention. Groundwater systems, if applicable, DEC-specified minimum disinfection residual - 10 years retention.
- [x] Yes
- [ ] No
- [ ] NA

11 Records of actions taken to correct violations - 3 years retention.
- [ ] Yes
- [x] No
- [ ] NA

12 Groundwater systems: documentation of corrective actions following a source water fecal positive sample result - 10 years retention.
- [ ] Yes
- [ ] No
- [x] NA

13 Reports, summaries, communications, and corrective action documentation related to sanitary surveys - 10 years retention.
- [ ] Yes
- [x] No

14 Reports, summaries, or communications related to Public Notifications, including CCRs as applicable - 3 years retention.
- [x] Yes
- [ ] No
- [ ] NA

15 Variances and/or exemptions - 5 years retention after the expiration date.
- [ ] Yes
- [ ] No
- [x] NA

16 Monitoring Plans (as applicable): Microbiological and Turbidity - 5 years retention. Chemical, IDSE, System Specific Study Plan, Stage 2 DBP, etc. - 10 years retention.
- [ ] Yes
- [ ] No
- [x] NA

17 Disinfection Profile and Benchmark - 10 years retention.
- [x] Yes
- [ ] No
- [ ] NA

18 Records of both DEC-specified requirements for membranes and failures in membrane integrity/operations - 5 years retention.
- [ ] Yes
- [ ] No
- [x] NA

Sources / General

General:

1 Are there any abandoned wells in the delineated protection area? (If yes, note the location(s) on the system site plan map.)
- [ ] Yes
- [ ] No
- [x] Unknown

Notes: Surface water system.

2 If yes, are they properly decommissioned?
- [ ] Yes
- [ ] No
- [ ] NA
- [x] Unknown

3 Are there any unused wells in the delineated protection area? (If yes, note the location(s) on the system site plan map.)

- [ ] Yes
- [ ] No
- [x] Unknown

4 If yes, are they maintained in a safe and sanitary condition?

- [ ] Yes
- [ ] No
- [ ] NA
- [x] Unknown

5 Does the system have a Source Water Protection Plan and is it being implemented properly to protect the source? (Explain in notes.)

- [x] Yes
- [ ] No

Notes: Access to lake is restricted by gates. No boating or logging is permitted on lake.

Sources / Surface Water

IN AUK'TAH LAKE - (Active) / General:

1 What is the name of this intake? (List local and DEC name/number.)

IN Auk'Tah Lake

2 List latitude and longitude reading in decimal degrees. (Must be in WGS 84 datum. Example +56.234230, -136.23423.) Note proximity of reading to the source, for example, "at the intake" or "5 feet east of the intake".

+57.458767, -134.52132

3 List the available Lat/Long accuracy (in meters) displayed on the device (Example, Accuracy = 13 meters).

3 meters

Notes: Lat long recorde by previous surveyor.

4 Is the intake screened to prevent entry of debris?

- [x] Yes
- [ ] No

5 Are the screens maintained?

- [x] Yes
- [ ] No
- [ ] NA

6 Are intake works properly protected against ice buildup and silt?

- [x] Yes
- [ ] No

7 How often is the intake inspected by the operator or owner?

Weekly or more often

8 Is there a source water sample tap or other means present to sample source water? (Note location on system schematic. Describe sampling method if not from a sample tap.)

- [x] Yes
- [ ] No

9 Describe all conditions that cause fluctuation in water quality?

Heavy rain, lake rolling

10 Have operational controls been put in place to deal with these conditions? (If no, describe in notes.)

- [ ] Yes
- [ ] No
- [x] NA

11 Have significant changes occurred in the watershed or source that could lead to increased contamination by cryptosporidium. Describe in notes any of the following examples:

Industrial, domestic or other types of pollution (i.e. accidental or illegal waste discharge or spills);
Unrestricted human activity;
Hydrological change;
Severe natural event (i.e. flood, forest fire, earthquake, landslide, etc.);
Drought conditions allowing waste to accumulate in the watershed that could be washed into source waters when precipitation returns;
Change in animal migration paths;
Changes resulting in excess standing water in the watershed.

- [ ] Yes
- [ ] No
- [x] Unknown

Notes: Recommended that operator keeo tabs on beaver population and consider controlling them if they were to cause water degredation or blockages.

Sources / Surface Water

IN AUK'TAH LAKE - (Active) / Pumps:

1 What type of pump(s) does the system have (i.e. centrifugal, hand pump, jet, positive displacement, submersible, vertical turbine, etc.)?

Dual submersible

Notes: Grundfos 85S

2 Are pumps and pump controls in good operating condition?

- [x] Yes
- [ ] No

3 Is the electrical wiring maintained properly? (If no, describe in notes.)

- [x] Yes
- [ ] No

4 Does the electrical wiring pose an immediate safety hazard? (If yes, describe in notes.)

- [ ] Yes
- [x] No

5 Are there spare pumps or critical pump parts readily available?

- [x] Yes
- [ ] No

TP FOR AUK'TAH LAKE - (Active) / General

Monitoring:

1 Are compliance and process monitoring sample taps in the correct location(s) (i.e. entry point to distribution, after filtration, etc.)? (List any missing sample taps and show location of all sample taps on the system schematic.)

- [x] Yes
- [ ] No

2 List test equipment in the treatment plant. (List make, model, and use; include on-line and hand held testing equipment.)

Hach Chlorimeter

3 Are testing facilities and equipment orderly and well maintained?

- [x] Yes
- [ ] No

4 Are proper calibration standards and reagents used for analyses?

- [x] Yes
- [ ] No
- [ ] NA

5 Are the reagents used in testing past the expiration date?

- [ ] Yes
- [x] No
- [ ] NA

6 **Did the operator demonstrate competence with standard testing methods for the following: (Operator must demonstrate all control tests applicable to the system.)**

Notes: -

7 Turbidity: (In the notes section, document results and units of operator's readings taken at the time of the sanitary survey.)

- [x] Yes
- [ ] No
- [ ] NA

8 pH/Temperature: (In the notes section, document results and units of operator's readings taken at the time of the sanitary survey.)

- [x] Yes
- [ ] No
- [ ] NA

9 Fluoride: (In the notes section, document results and units of operator's readings taken at the time of the sanitary survey.)

Notes: No flouride used in this system

- [ ] Yes
- [ ] No
- [x] NA

10 Disinfection Residual: (In the notes section, document results and units of operator's readings taken at the time of the sanitary survey.)

- [x] Yes
- [ ] No
- [ ] NA

11 Other (i.e. orthophosphate, jar testing, etc.): (In the notes section, document results and units of operator's readings taken at the time of the sanitary survey.)

- [ ] Yes
- [ ] No
- [x] NA

12 CT (concentration X contact time) readings: (In the notes section, document results and units of operator's readings taken at the time of the sanitary survey.)

Notes: CT readings not required. Operator was familiar with CT calculations.

- [ ] Yes
- [ ] No
- [x] NA

TP FOR AUK'TAH LAKE - (Active) / General

Cross Connections:

1 Are there any unprotected cross-connections in the treatment system that pose an immediate health risk? (Describe in detail and provide well labeled photo(s).)

- [ ] Yes
- [x] No

2 Does the system have any high hazard cross-connections with inadequate protection (i.e. check valve on the filter supply line, solo valve, etc.)? (Describe in detail and provide well labeled photo(s).)

- [ ] Yes
- [x] No

3 Are there any other cross-connections in the system with inadequate protection (i.e. air gaps or backflow prevention not installed at all appropriate locations, such as treatment drain lines, backwash lines, instrument waste lines, etc.)? (Describe in detail and provide well labeled photo(s).)

- [ ] Yes
- [x] No

4 If system has air gaps, are there any less than 2 times the diameter of the drain or waste line? (Describe in detail and provide well labeled photo(s).)

- [ ] Yes
- [x] No
- [ ] NA

5	If backflow preventers are installed, are there any problems that may hinder operation or testing (i.e. leaking, improper installation, etc.)? (Describe in detail and provide well labeled photo(s).)	☐ Yes ☑ No ☐ NA
6	If backflow preventers are installed, are they tested? (Describe testing schedule or frequency. Include the date they were last tested and the name of the tester.) Notes: Last test date on all BPD was 2010.	☐ Yes ☑ No ☐ NA
7	Are any backflow prevention devices installed in a pit? (If yes, describe in detail and provide well labeled photo(s).)	☐ Yes ☑ No ☐ NA
8	Are backflow prevention device drains provided with a suitable air gap?	☑ Yes ☐ No ☐ NA
9	Has the system operator been trained to identify and control cross-connections?	☑ Yes ☐ No
10	Is there a written cross-connection control plan or program?	☐ Yes ☑ No

TP FOR AUK'TAH LAKE - (Active) / General

Other Treatment Chemicals:

1	Does the system add chemicals that are not listed on the data dump?	☐ Yes ☑ No
2	What additional chemicals are added? (List manufacturer and product for each and document point of injection on the system treatment schematic.)	N/A
3	Is chemical feed equipment maintained and in operable condition? (If no, describe in notes.)	☑ Yes ☐ No ☐ NA
4	Are critical spare parts for chemical feed equipment readily available?	☐ Yes ☐ No ☑ NA
5	Are there adequate means of mixing the chemicals into the water downstream of chemical feed points (i.e. adequate line distance after chemical addition, static or mechanical mixers, etc.)? (Describe in notes.)	☐ Yes ☐ No ☑ NA
6	Are records maintained for quantity of each chemical used?	☑ Yes ☐ No ☐ NA
7	Are dosages for each chemical calculated on at least a daily basis? (If no, how often is this done?) Notes: SCD system calculates dosage constantly.	☑ Yes ☐ No ☐ NA

Question Number

8 Are concentrations for each chemical added monitored at appropriate locations on at least a daily basis? (Examples: chlorine residual at outlet of CT tank and/or entry point to the distribution, fluoride at the entry point to the distribution, etc.)

☑ Yes ☐ No ☐ NA

Notes: SCD system constantly monitors dosage.

9 Are backflow prevention devices installed on water lines used for mixing chemical dilutions?

☑ Yes ☐ No ☐ NA

10 Are the chemicals properly stored to prevent risk of contamination, fire or explosion? (If not, list the chemicals and potential hazard, and provide photo documentation.)

☑ Yes ☐ No ☐ NA

11 Is chemical feed equipment connected to flow switches?

☐ Yes ☐ No ☑ NA

Notes: SCD system constantly controls dosages.

12 Are flow switches installed in the correct location?

☐ Yes ☐ No ☑ NA

13 Are flow switches periodically checked to ensure chemical feed equipment does not operate without water flowing? (If yes, list how often in notes.)

☐ Yes ☐ No ☑ NA

TP FOR AUK'TAH LAKE - (Active) / Chlorination

Hypochlorination:

1 What type of disinfectant is used (i.e. calcium or sodium hypochlorite)? (Also list manufacturer, product name, and NSF certification information.)

Sodium hypochlorite 12.5%

2 Is the disinfection equipment operated and maintained properly?

☑ Yes ☐ No

3 If hypochlorite is used, are the solutions being made to the proper concentration and in a safe manner? (Describe in notes.)

☑ Yes ☐ No ☐ NA

4 Are proper residual test kits available and are they being maintained?

☑ Yes ☐ No ☐ NA

5 Is the operator trained to use and conduct monitoring of disinfectant?

☑ Yes ☐ No ☐ NA

6 Is there adequate chlorine residual at the entry point to the distribution system? (The higher of 0.2 mg/L or level required to meet CT.)

☑ Yes ☐ No ☐ NA

7 Are disinfectant residual measurements being made and recorded at the same time and location in the distribution system as the total coliform bacteria sample is collected?

☑ Yes ☐ No ☐ NA

Question Number

8	Is there a detectable disinfectant residual being maintained throughout the distribution system?	☑ Yes ☐ No ☐ NA
9	If the system is required to meet CT, is the system operated such that CT is being met (i.e. according to designated flow rates, disinfection residual levels, temperature, pH, tank volume/level, etc.)? (From system's operation monitoring records record the readings of the parameters necessary to calculate CT for one day that is representative of normal operation: pH, disinfection residual, peak flow rate, tank volume/level, etc. If monitoring data is not available, answer question as "No" with a note regarding this.)	☑ Yes ☐ No ☐ NA
10	Is there a back-up disinfection unit? (Describe in notes if it is on-line and operational. Filtration avoidance systems cannot have an NA answer; all other types of systems that do not have back-up disinfection should be NA.)	☐ Yes ☑ No ☐ NA
11	Is there an auto switch-over for disinfection units to prevent a break in disinfection? (Filtration avoidance systems cannot have an NA answer; all other types of systems that do not have auto switch-over should be NA.)	☐ Yes ☐ No ☑ NA
12	If there is not a back-up disinfection unit, are critical spare parts for disinfection equipment readily available?	☑ Yes ☐ No ☐ NA
13	Are disinfection units hooked up to flow switches that prevent the addition of disinfectant when no water is flowing? (If yes, note how often they are checked.) Notes: SCD system cuts off dose if flow stops or changes to backwashing.	☑ Yes ☐ No
14	Is disinfectant feed proportional to water flow?	☑ Yes ☐ No ☐ NA
15	Is there an adequate quantity of disinfectant readily available?	☑ Yes ☐ No
16	Is the disinfectant properly stored?	☑ Yes ☐ No ☐ NA

TP FOR AUK'TAH LAKE - (Active) / Coagulation

Coagulation:

1	Is a coagulant used whenever water is being filtered by media?	☑ Yes ☐ No
2	What primary coagulant is being used? (Provide in notes the manufacturer and product name for the primary coagulant and all other chemicals used as coagulants, filter aids, and flocculation aids.) Notes: Ultrion 8185 - Aluminum Chloride Hydroxide	☐ Alum ☐ Ferric chloride ☐ Polyaluminum chloride ☑ Other
3	Is chemical feed equipment maintained and in operable condition?	☑ Yes ☐ No

4 Are critical spare parts for chemical feed equipment readily available?

- ☑ Yes
- ☐ No

5 How are coagulant feed rates determined?

- ☐ Jar testing
- ☑ Streaming current detector
- ☐ Other: explain in notes

6 Is coagulant dose adjusted based on changes in raw water quality?

- ☑ Yes
- ☐ No

7 What kind of mixing is provided after the injection point?

- ☑ Static
- ☐ Mechanical
- ☐ In-line mixing

TP FOR AUK'TAH LAKE - (Active) / Filtration

General:

1 Is filtration equipment maintained and in operable condition? (List make and model of turbidimeter.)

- ☑ Yes
- ☐ No

2 Are turbidimeters calibrated with primary standards following manufacturer's recommendations as to frequency and method? (List frequency and/or schedule in notes.)

- ☑ Yes
- ☐ No

TP FOR AUK'TAH LAKE - (Active) / Filtration

Pressure Sand:

1 What is the treatment objective?

See plan engineering plans w/ treatment objective

2 How many filters are there?

4

Notes: Filter #4 was out of service for maintenance.

3 What is the filter media type?

Mixed media

4 What is the combined surface area of all filters in ft²?

154

5 If there is a view port, describe condition of the media (i.e. media height, visible mud packing, etc.).

Acceptable condition

Notes: Filters were schedule for backwash on the day of the survey.

6 How often is the media inspected? (Note findings of the last inspection, if available.)

Monthly

7 What is the flow rate through the filters in gpm?

70

Notes: 70gpm at time of inspection

8 Is there equal flow through all filters?

- [ ] Yes
- [ ] No
- [x] Unknown

Notes: With all 4 operational, flow would be equal.

9 Is flow to the filter(s) controlled with a device such as a rate of flow controller?

- [ ] Yes
- [x] No

Notes: Hard-piped manifold.

10 How is backwash frequency determined (i.e. turbidity, time in service, pressure differential, etc.)?

Weekly

Notes: Or more often based upon differential pressure numbers.

11 Is backwash flow measured? (If yes, document flow rate(s) in notes.)

- [x] Yes
- [ ] No

12 Can backwash rate of flow be adjusted?

- [x] Yes
- [ ] No

13 What is the source of water used for backwashing?

Finished water from contact tank.

14 Is there a surface wash?

- [ ] Yes
- [x] No

15 Can surface wash arm rotation be verified?

- [ ] Yes
- [ ] No
- [x] NA

16 Is there air assisted backwash capability/air scour?

- [x] Yes
- [ ] No

17 Is the source of air provided by an oil-less compressor/blower or one that uses food grade lubricants?

- [x] Yes
- [ ] No
- [ ] NA

18 How is it determined that backwash is complete and the filters can be returned to service (i.e. turbidity, grab sample, visual check, time, etc.)?

Visual sampling of backwash water.

19 Does the system filter water to waste after backwash and before returning the filter to service?

- [x] Yes
- [ ] No

20 If the system filters to waste, is a sufficient air gap or backflow prevention provided?

- [x] Yes
- [ ] No
- [ ] NA

21 Is pressure drop monitored across the filter(s)?

- [x] Yes
- [ ] No

TP FOR AUK'TAH LAKE - (Active) / Flocculation

Flocculation:

1 Are the flocculators equipped with variable speed controls?

- [ ] Yes
- [x] No

Notes: N/A

2 Is there an SOP for adjusting flocculator speed?

- [ ] Yes
- [ ] No
- [x] NA

Notes: N/A

3 Is there evidence of short-circuiting resulting in poor floc formation? (Note observations.)

- [ ] Yes
- [x] No
- [ ] Unknown

Notes: N/A

4 Is baffling incorporated into the units to enhance the flocculation process?

- [ ] Yes
- [x] No

Notes: N/A

5 Is there adequate floc formation? (Note observations of floc size and any issues with flow-through velocity, detention time, etc.)

- [ ] Yes
- [ ] No
- [x] Unknown

Notes: N/A

Storage / ST 150,000 GAL TOWN STANDPIPE - (Active)

1 What is the name of this storage facility? (List local and DEC name/number.)

ST Town Standpipe

2 How many storage tank(s) make up this storage facility? (Describe in notes.)

1

3 List all other type(s) of structure(s)/tank(s) that are present in the system that are not listed on the data dump (i.e. bladder, elevated, ground, hydropneumatic, reservoir, underground).

none

4 What does this storage tank hold?

- [ ] Raw Water
- [ ] Filtered Water
- [ ] Disinfected Water
- [x] Filtered and Disinfected Water

5 Is this storage facility used to meet disinfectant contact time?

- [ ] Yes
- [x] No

6 Is the water in the tank(s), at the time of the inspection, enough to meet applicable demand and/or disinfection contact time requirements? (Note the volume or water level in tank, if possible.)

- [x] Yes
- [ ] No
- [ ] Unknown

7 Date initially put into service?

unknown

Notes: Approximately late 1970's?

8 What is the volume of the tank(s) in gallons?

150000

9 On what date was the tank(s) last inspected?

unknown

10 On what date was the tank(s) last cleaned?

unknown

11 Does surface run-off drain away from the storage tank(s)?

- [x] Yes
- [ ] No

12 Are overflow and drain lines screened or covered, and do the lines terminate a minimum of 2 times the diameter of the water outlet pipe above the ground or storage? (If no, describe in notes.)

- [ ] Yes
- [ ] No
- [x] NA

Notes: Drains were screened. Due to safety concerns, surveyor did not climb tower to inspect vent screen.

13 Are vents screened or covered, and turned downward; and do the lines terminate a minimum of 2 times the diameter of the water outlet pipe above the ground or storage? (If no, describe in notes.)

- [ ] Yes
- [ ] No
- [ ] NA

Notes: Unknown.

14 Is the storage tank(s) structurally sound?

- [x] Yes
- [ ] No

Notes: Appears to be. Evidence of past leaks was obvious on exterior.

15 Can the storage tank(s) be isolated from the system?

- [x] Yes
- [ ] No

16 Are leaks evident at the time of inspection?

- [x] Yes
- [ ] No

Notes: Small leaks and rust streaks.

17 Is storage tank(s) safely accessible to inspector?

- [ ] Yes
- [x] No

Notes: Tank is 10 stories tall.

Storage / ST AUK'TAH LAKE - (Active)

1 What is the name of this storage facility? (List local and DEC name/number.)

ST Auk'Tah Lake

Question Number

2	How many storage tank(s) make up this storage facility? (Describe in notes.)	1
3	List all other type(s) of structure(s)/tank(s) that are present in the system that are not listed on the data dump (i.e. bladder, elevated, ground, hydropneumatic, reservoir, underground).	none
4	What does this storage tank hold?	☐ Raw Water ☐ Filtered Water ☐ Disinfected Water ☑ Filtered and Disinfected Water
5	Is treated water storage covered?	☑ Yes ☐ No ☐ NA
6	Is this storage facility used to meet disinfectant contact time?	☑ Yes ☐ No
7	Is the water in the tank(s), at the time of the inspection, enough to meet applicable demand and/or disinfection contact time requirements? (Note the volume or water level in tank, if possible.)	☑ Yes ☐ No ☐ Unknown
8	Date initially put into service? Notes: Late 1970's?	unknown
9	What is the volume of the tank(s) in gallons?	500000
10	On what date was the tank(s) last inspected?	unknown
11	On what date was the tank(s) last cleaned? Notes: per operator	2007
12	Does surface run-off drain away from the storage tank(s)?	☑ Yes ☐ No
13	Are overflow and drain lines screened or covered, and do the lines terminate a minimum of 2 times the diameter of the water outlet pipe above the ground or storage? (If no, describe in notes.)	☑ Yes ☐ No
14	Are vents screened or covered, and turned downward; and do the lines terminate a minimum of 2 times the diameter of the water outlet pipe above the ground or storage? (If no, describe in notes.) Notes: No screen on top vent.	☐ Yes ☐ No

15 Is the hatch watertight? (If no, describe in notes.)
- [x] Yes
- [ ] No
- [ ] NA

16 Is the hatch locked?
- [ ] Yes
- [x] No
- [ ] NA

17 Is the storage tank(s) clean and free from contamination? (If no, describe in notes.)
- [ ] Yes
- [ ] No
- [x] Unknown

18 Is the storage tank(s) structurally sound?
- [x] Yes
- [ ] No

Notes: Appears to be.

19 Can the storage tank(s) be isolated from the system?
- [x] Yes
- [ ] No

20 Are leaks evident at the time of inspection?
- [x] Yes
- [ ] No

21 Is the storage tank(s) lined or coated? (If yes, describe in notes.)
- [ ] Yes
- [ ] No
- [x] Unknown

22 Is the storage tank(s) interior coating or liner peeling or cracking? (If yes, describe in notes.)
- [ ] Yes
- [ ] No
- [ ] NA
- [x] Unknown

23 Is storage tank(s) safely accessible to inspector?
- [x] Yes
- [ ] No

Storage / ST 500,000 GAL TOWN TANK - (Active)

1 What is the name of this storage facility? (List local and DEC name/number.)

ST Town Tank

2 How many storage tank(s) make up this storage facility? (Describe in notes.)

1

3 List all other type(s) of structure(s)/tank(s) that are present in the system that are not listed on the data dump (i.e. bladder, elevated, ground, hydropneumatic, reservoir, underground).

Water standpipe is downstream from tank.

Notes: Pump station fill standpipe.

4 What does this storage tank hold?
- [ ] Raw Water
- [ ] Filtered Water
- [ ] Disinfected Water
- [x] Filtered and Disinfected Water

Question Number

5	Is treated water storage covered?	☑ Yes ☐ No ☐ NA
6	Is this storage facility used to meet disinfectant contact time?	☐ Yes ☑ No
7	Is the water in the tank(s), at the time of the inspection, enough to meet applicable demand and/or disinfection contact time requirements? (Note the volume or water level in tank, if possible.)	☑ Yes ☐ No ☐ Unknown
8	Date initially put into service? Notes: Approximately late 1970's?	unknown
9	What is the volume of the tank(s) in gallons?	500000
10	On what date was the tank(s) last inspected?	unknown
11	On what date was the tank(s) last cleaned?	unknown
12	Does surface run-off drain away from the storage tank(s)?	☑ Yes ☐ No
13	Are overflow and drain lines screened or covered, and do the lines terminate a minimum of 2 times the diameter of the water outlet pipe above the ground or storage? (If no, describe in notes.)	☑ Yes ☐ No
14	Are vents screened or covered, and turned downward; and do the lines terminate a minimum of 2 times the diameter of the water outlet pipe above the ground or storage? (If no, describe in notes.)	☐ Yes ☐ No
15	Is the hatch watertight? (If no, describe in notes.)	☑ Yes ☐ No ☐ NA
16	Is the hatch locked?	☐ Yes ☑ No ☐ NA
17	Is the storage tank(s) clean and free from contamination? (If no, describe in notes.)	☐ Yes ☐ No ☑ Unknown

Question Number

18 Is the storage tank(s) structurally sound?

- [x] Yes
- [ ] No

Notes: Appears to be

19 Can the storage tank(s) be isolated from the system?

- [x] Yes
- [ ] No

20 Are leaks evident at the time of inspection?

- [x] Yes
- [ ] No

Notes: Typical of all tanks, small leaks, rust streaking.

21 Is the storage tank(s) lined or coated? (If yes, describe in notes.)

- [ ] Yes
- [ ] No
- [x] Unknown

22 Is the storage tank(s) interior coating or liner peeling or cracking? (If yes, describe in notes.)

- [ ] Yes
- [ ] No
- [ ] NA
- [x] Unknown

23 Is storage tank(s) safely accessible to inspector?

- [x] Yes
- [ ] No

DS AUK'TAH LAKE - (Active) / General

1 Describe any problems that have occurred in the distribution system since the last sanitary survey.

See below

Notes: Water main blowout was repaired, 6 fire hydrants are inoperable from lack of exercising, several isolation valves are seized.

2 Are fire hydrants connected to the distribution system? (If yes, describe in notes any problems or cross-connections related to the hydrants and if they are used for flushing.)

- [x] Yes
- [ ] No

Notes: See previous notes regarding fire hydrant issues. Hydrants are used to flush the system annually.

3 Is there any portion of the distribution system that has a pressure less than 20 psi?

- [ ] Yes
- [x] No

4 Are there any materials used in the distribution system that should not be in contact with drinking water? (If yes, explain in notes.)

- [ ] Yes
- [ ] No
- [x] Unknown

Notes: No aberrant material was witnessed by inspector.

5 Is there a leak detection program? (If yes, describe in notes.)

- [ ] Yes
- [x] No

Notes: System has been inspected for leaks previously.

6 Was asbestos cement pipe used in the system?

- [ ] Yes
- [ ] No
- [x] Unknown

Notes: Unlikely. Distribution piping all appeared to be HDPE or ductile iron.

7 Is there a routine main and dead-end water flushing program? (If yes, describe in notes.)

- [x] Yes
- [ ] No
- [ ] NA

Notes: Annual main flushing.

Question Number

8	Are the check valves, water meters, etc., maintained and operating properly? (If no, explain in notes.)	☑ Yes ☐ No
9	Is system adequately protected from freezing? (If no, explain in notes.) Notes: Some customers have reported freezing issues. Most can be chalked up to inactivity or lack of burial cover/insulation beyond the service valve.	☐ Yes ☑ No
10	Are heat exchangers used in conjunction with the water system?	☐ Yes ☑ No
11	If heat exchangers are used, what type?	☐ Single Walled ☐ Double Walled ☑ NA
12	Is glycol used? (If yes, list type in notes.)	☐ Yes ☑ No
13	For circulating systems, what is the temperature of the water leaving from and returning to the plant? Notes: Not a recirculating system.	N/A

DS AUK'TAH LAKE - (Active) / Cross Connections

1	Are there any unprotected cross-connections in the distribution system that pose an immediate health risk? (Describe in detail and provide well labeled photo(s).)	☐ Yes ☑ No ☐ Unknown
2	Does the system have any high hazard cross-connections with inadequate protection? (Describe in detail and provide well labeled photo(s) of all high hazard connections to industry, wastewater treatment plants, clinics, etc., that are not adequately protected.)	☐ Yes ☑ No ☐ Unknown
3 **Potential Deficiency**	Are there any other cross-connections in the system with inadequate protection? (i.e. air gaps or backflow prevention not installed at all appropriate locations, such as boiler make-up water, hose bibbs where backflow prevention is required, etc. Describe in detail and provide well labeled photo(s).) Notes: Backflow preventers should be installed at individual water service connections at the harbor. The harbor section of the water system was out of commission for upgrades at time of inspection.	☑ Yes ☐ No
4	If system has air gaps, are any less than 2 times the diameter of the drain or waste line? (Describe in detail and provide well labeled photo(s).)	☐ Yes ☑ No ☐ NA
5	If backflow preventers are installed, are there any problems that may hinder operation or testing? (i.e. leaking, improper installation, etc. Describe in detail and provide well labeled photo(s).) Notes: Backflow preventer was installed at the main harbor service line entrance.	☐ Yes ☑ No ☐ NA
6 **Potential Deficiency**	If backflow preventers are installed, are they tested? (Describe testing schedule or frequency. Include the date they were lasted tested and the name of the tester.)	☐ Yes ☑ No ☐ NA

7 Are any backflow preventers installed in a pit? (If yes, describe in detail and provide well labeled photo(s).)

- [ ] Yes
- [x] No
- [ ] NA

8 Are backflow preventer drains provided with a suitable air gap?

- [x] Yes
- [ ] No
- [ ] NA

9 If the water system has a water haul fill point, do the water supply lines have appropriate backflow prevention? (List backflow prevention type in notes.)

- [ ] Yes
- [x] No
- [ ] NA

Notes: See previous note about harbor. Harbor was only public water fill point witnessed.

10 Has the system operator been trained in identifying and controlling cross-connections?

- [x] Yes
- [ ] No

11 Is there a written cross-connection control program?

- [ ] Yes
- [x] No

DS AUK'TAH LAKE - (Active) / Pumps

1 Are pumps used in the distribution system? (i.e. pressure, circulation, etc. List use of each pump or group of pumps.)

- [x] Yes
- [ ] No

Notes: To fill standpipe which provides pressure to the 'hill' district.

2 Are pumps and pump controls in good operating condition?

- [x] Yes
- [ ] No
- [ ] NA

3 Are there spare pumps or critical spare pump parts readily available?

- [x] Yes
- [ ] No
- [ ] NA

4 Is the electrical wiring maintained properly? (If no, describe in notes.)

- [ ] Yes
- [x] No
- [ ] NA

Notes: Heat tape on pumps is plugged in to a non-GFCI outlet. Should be hard piped to pump well by a licensed electrician.

5 Does wiring pose an immediate safety hazard? (If yes, describe in notes.)

- [x] Yes
- [ ] No
- [ ] NA

Notes: Wet conditions could easily cause an arc or shock hazard with a non-GFCI outlet.

DS AUK'TAH LAKE - (Active) / Hydropneumatic tanks

1 Does the system have a hydropneumatic tank(s)?

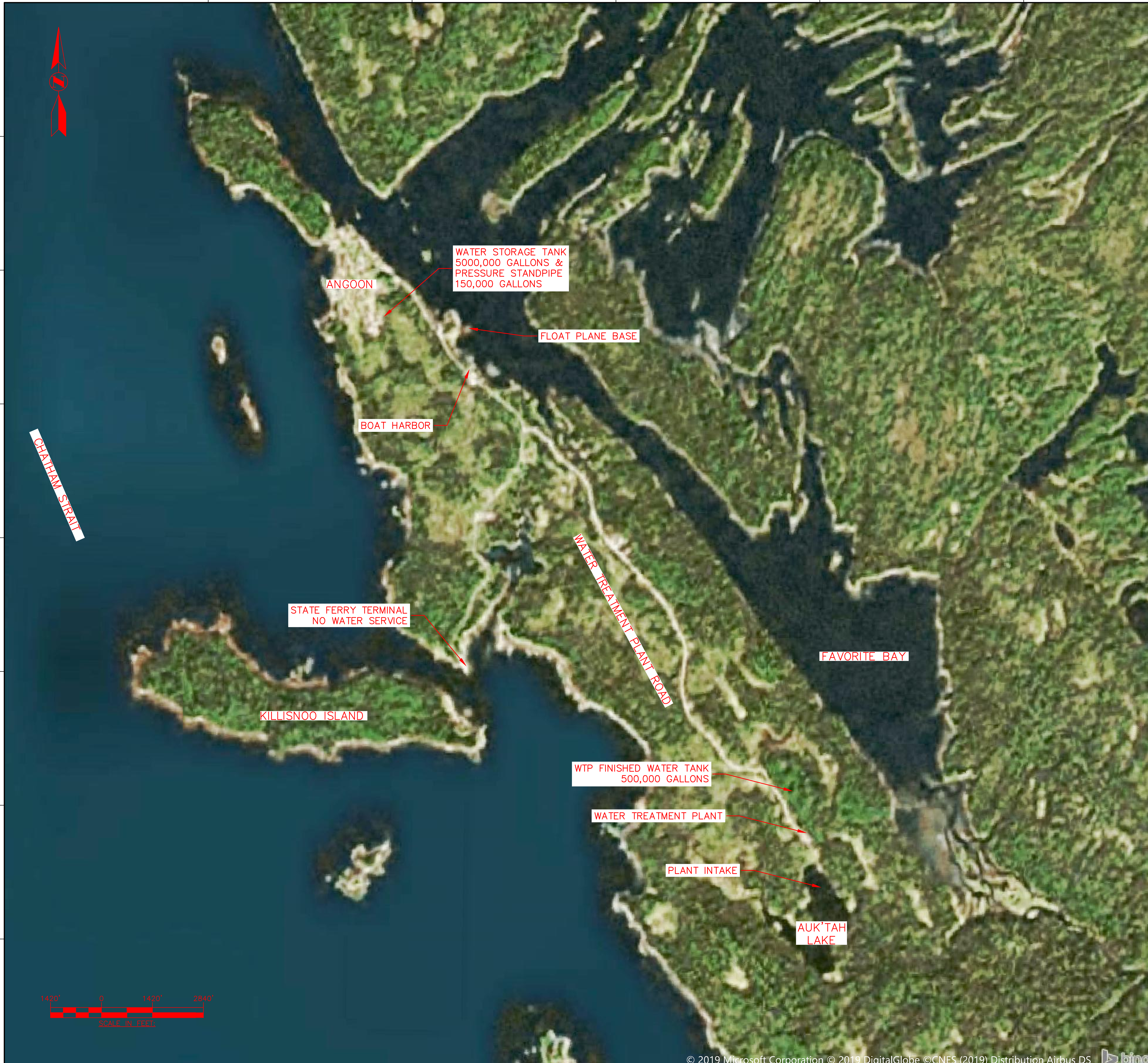
- [ ] Yes
- [x] No

2 At the time of inspection, are all tanks water tight? (i.e. not leaking)

- [ ] Yes
- [ ] No
- [x] NA

3	Are the exterior surfaces and tank supports in good condition? (If no, explain condition in notes and include photo.)	☐ Yes ☐ No ☑ NA
4	Are the hydropneumatic tanks in a condition that represents an immediate threat to health or safety, or are in danger of failure? (Describe in notes.)	☐ Yes ☐ No ☑ NA

ANGOON PUBLIC WATER SYSTEM, AKPWSID #2130017
2019 SANITARY SURVEY, ATTACHED PLANS
OVERALL SITE PLAN



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6/29/2019 11:04 PM ANDREW GRAY

ANGOON PUBLIC WATER SYSTEM, AKPWSID #2130017
2019 SANITARY SURVEY, ATTACHED PLANS
DISTRIBUTION SCHEMATIC

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6/29/2019 11:05 PM ANDREW GRAY

ANGOON PUBLIC WATER SYSTEM, AKPWSID #2130017
2019 SANITARY SURVEY, ATTACHED PLANS
DISTRIBUTION SCHEMATIC

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6/29/2019 11:05 PM ANDREW GRAY

Raw water intake structure.

Raw water wet well with submersible pumps.

Pump controls center.

Treatment plant building.

Coagulant mixing structure and Filter #1 in background.

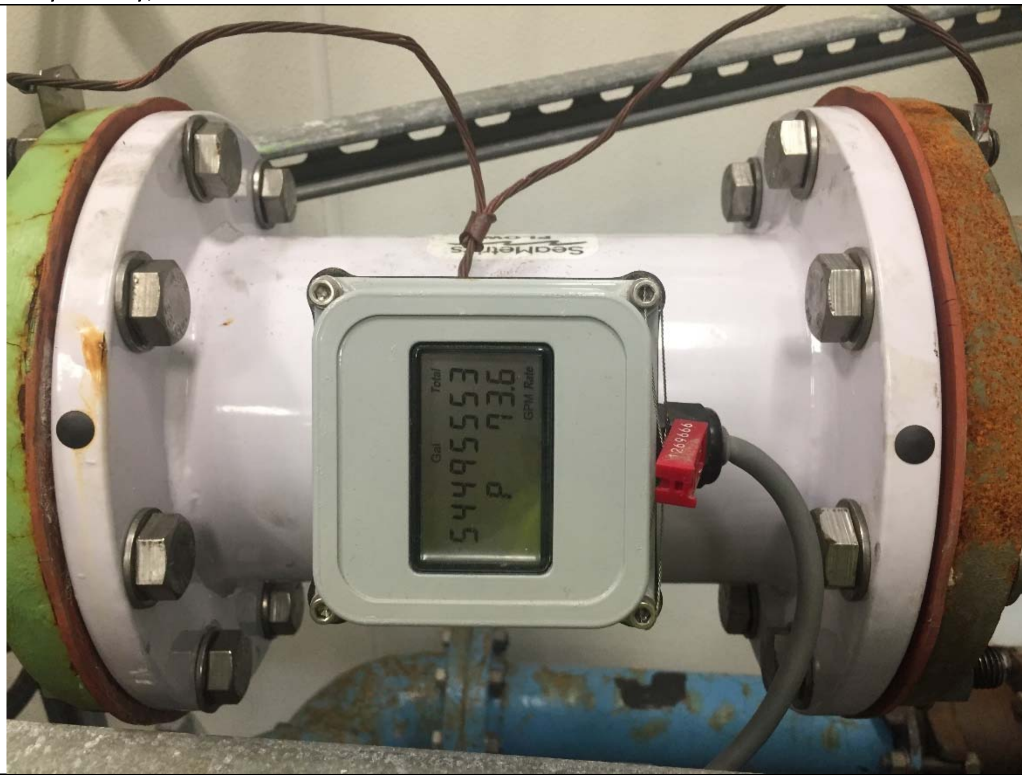
Streaming current detector and raw water turbidimeter.

Filter #4 in foreground was out of service during survey for maintenance.

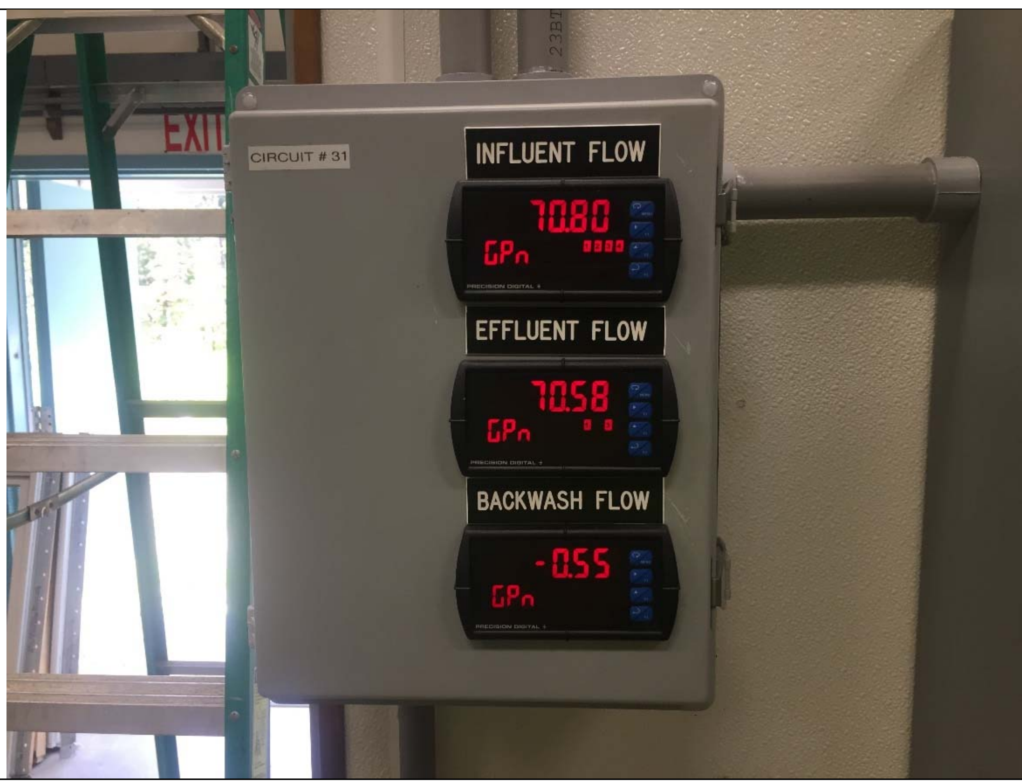
Backwash scour compressor.

Backwash backflow prevention device.

Backflow preventers all appear to have not been tested since installation.



Raw water flow meter.



Master flow meter.

Data logger.

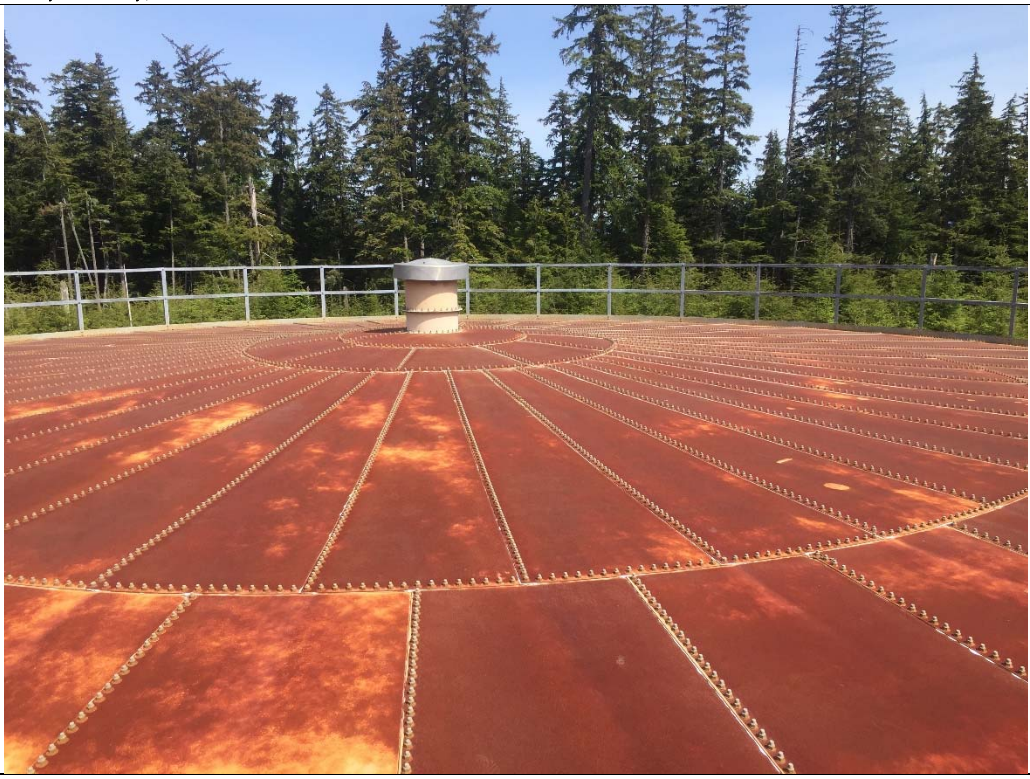
Polymer supply system.

Finished water turbidimeter.

Finished water chlorimeter, out of service but the parts to put it back in service had arrived.

Backwash lagoon.

500,000 gallon finished water storage/contact tank.



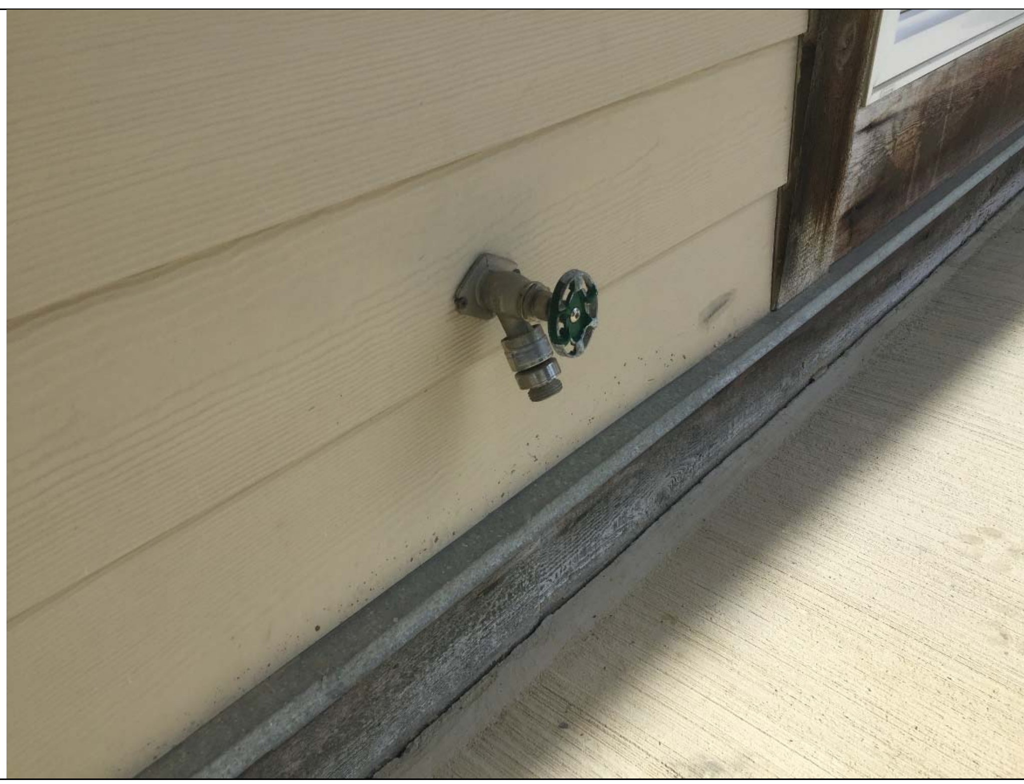
No vent screen on first 500,000 gallon storage tank.

Pressure reducer vault between first storage tank and town.

150,000 gallon standpipe, viewed from roof of second 500,000 gallon tank.

Pump basin to fill standpipe (note electrical cord running to heat trace).

All tanks and standpipe showed rust streaking and evidence of leaks.



Vacuum breakers on hose bibs, typical at city offices, school and clinic.

Old steel line at harbor was being replaced with 2” HDPE at time of survey.

Backflow preventer has been installed on main harbor service line.

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ADEC LT2 SAMPLING RESULTS

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Department of Environmental Conservation
DIVISION OF ENVIRONMENTAL HEALTH
Drinking Water Program

43335 Kalifornsky Beach Rd., Ste. 11
Soldotna, Alaska 99669
Main: 907.262.5210
Fax: 907.262.2294
www.dec.alaska.gov

October 17, 2018

Mr. Daniel Fredrickson
City of Angoon
PO Box 189
Angoon, AK 99820

Re: Long Term 2 Enhanced Surface Water Treatment Rule Second Round Bin Classification
Angoon Public Water System, PWSID: AK2130017, Water Source: Auk'Tah Lake Source

Dear Mr. Fredrickson:

The Angoon Public Water System has satisfied the initial *E. coli* source water monitoring requirements of the Long Term 2 Enhanced Surface Water Treatment Rule (LT2). Based on the calculated mean *E.coli* concentration for your water source, the Drinking Water Program assigned a "**Bin 1**" classification on October 29, 2009.

LT2 requires two rounds of sampling, the purpose of the second round of LT2 monitoring is to confirm whether the initial Bin classification is still appropriate or if a new Bin determination is required. Outlined below are the results of your second round of LT2 sampling.

Source Sampled: Auk'Tah Lake Source
Total number of E.coli samples collected: 18
Sample collection dates: January 2018 to October 2018
Mean *E.coli* concentration: 0.22 *E. coli*/100 mL
Trigger Level: 100 *E. coli*/100 mL

Bin Classification: Bin 1

Water systems serving less than 10,000 people that do not exceed the *E. coli* trigger level are NOT required to conduct source water monitoring for *Cryptosporidium*, and are given a "Bin 1" classification. A **Bin 1** classification establishes that the Angoon Public Water System is not required to add additional treatment for *Cryptosporidium* at this time. If you disagree with the mean *E.coli* concentration calculation or Bin determination please contact me as soon as possible.

If a significant change or addition in surface water source is planned (i.e., a new surface water source) for your public water system, contact the Drinking Water Program as this may entail new source monitoring requirements.

Please feel free to contact me with any questions or concerns you may have in regards to this decision. My contact information is (907) 262-3410 and amanda.millay@alaska.gov.

Sincerely,

Amanda Millay

Amanda Millay
Environmental Program Specialist

Cc: Jeri Forgue, DEC/DW Kenai/Southeast Program Coordinator, via email
Scott Forgue, DEC/DW Engineer, via email
Pauline Jim, Mayor, City of Angoon, via email

ADEC DRINKING WATER
ENGINEERING PLAN REVIEW

THE STATE
of ALASKA
GOVERNOR SEAN PARNELL

Department of Environmental Conservation

DIVISION OF ENVIRONMENTAL HEALTH
Drinking Water Program
Kenai/Southeast Area Office

43335 Kalifornsky Beach Rd. Suite 11
Soldotna, Alaska 99669
Main: 907.262.5210
Fax: 907.262.2294

December 12, 2012

Mr. Richard George
Mayor
City of Angoon
P.O. Box 189
Angoon, AK 99820

RE: City of Angoon Community Public Water System (PWS) PWS ID# 130017
Water Treatment Plant Improvements (PR # 6861)
Raw Water Intake Upgrade (PR # 7997)

Dear Mr. George:

On August 18, 2011 this office received engineering record drawings and a request for final approval to operate the Angoon Raw Water Intake upgrades (PR # 7997) and the Treatment Plant improvements (PR # 6861). A review of these plans has been completed. At this time, additional information is needed to complete the review process.

To allow the review process to continue, please address the following concerns/comments:

1. The conditional construction approval letter dated July 17, 2008 requested assurance that adequate signage is posted in the water treatment plant to designate the water in the building as 'non-potable'. Also, confirmation was requested that non-potable water is acceptable for use with the eye wash station. Please confirm these two points.

2. The same letter dated July 17, 2008 required copies of the test reports to verify the system is free from coliform bacteria. Please submit copies of these Coliform test results.

3. The letter dated August 18, 2011 should be signed, sealed and dated by the engineer within two inches of the seal. Please resubmit the letter. Also, please confirm that only lead-free pipe, flux, and solder were used during construction, that the system was pressure tested, and that all potable water materials were certified by NSF, UL or an equivalent organization.

4. In an email to Seametrics (see attachment), Steve Madden replied that the WMX-101

magmeter is in the process of being NSF approved, but is not yet. In order to accept this part, please list the materials in contact with water and state why these materials are safe for use in a water treatment system.

Submit the requested information within thirty (30) days of the receipt of this letter. Upon receipt of this information the plan review will be continued.

If you have any questions, please feel free to contact me at 907-262-3417.

Sincerely:

Charity Bare for:

Scott Forgue, P.E.
Regional Engineering Coordinator

cc: Michael Soltis, P.E, ANTHC, via email

Bare, Charity M (DEC)

From: Steve Madden [stevem@seametrics.com]
Sent: Friday, November 30, 2012 6:47 AM
To: Bare, Charity M (DEC)
Subject: FW: Form submission from: Contact

Charity,
NSF approval for this meter is in process, but is not complete.

Steve Madden
Project Manager - New Business

Seametrics
19026 72nd Avenue South
Kent, Washington 98032
253-872-0284 Main
253-872-0285 Fax

Steve Madden
Project Manager - New Business

Seametrics
19026 72nd Avenue South
Kent, Washington 98032
253-480-2979 Direct
253-872-0284 Main
253-872-0285 Fax

this email. Please notify the sender of the delivery error by replying to this message and then deleting this e-mail.

-----Original Message-----
From: Karin Grinzel
Sent: Thursday, November 29, 2012 3:35 PM
To: Steve Madden
Subject: FW: Form submission from: Contact

Name: Charity
Email: charity.bare@alaska.gov
Phone: 907-262-3400
Message:

Hello,
We're trying to approve a water system that is using a Seametrics WMX-101 magmeter. Can you tell us if this is NSF certified? If so we could use a datasheet indicating so.
Thank you,
Charity B

The results of this submission may be viewed at:
http://www.seametrics.com/node/222/submission/1987

Karin Grinzel
Marketing Supervisor

Seametrics
19026 72nd Avenue South
Kent, Washington 98032
253-480-2972 Direct
253-872-0284 Main
253-872-0285 Fax

ADNR DAM SAFETY

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Print Form

DIVISION OF MINING, LAND & WATER
DAM SAFETY AND CONSTRUCTION UNIT

Alaska Department of NATURAL RESOURCES

Action	550 West 7th Avenue, Suite 1020 Anchorage, AK 99501-3577 (907) 269-8636 Fax: 269-8904	***Office Use Only*** ***Date/Time Stamp***
☐ Construction ☐ Removal ☐ Modification ☐ Abandonment ☐ Repair ☐ Other________________	***Office Use Only*** ***Receipt Type: DM***	

APPLICATION FOR CERTIFICATE OF APPROVAL TO CONSTRUCT, MODIFY, REPAIR, REMOVE OR ABANDON A DAM

Instructions

- *Complete one application for each dam – **Incomplete applications will not be accepted***
- *Include cover letter with notice of intent [see 11 AAC 93.171(f)(1)(A)]*
- *Attach additional required information [see 11 AAC 93.171 or 11 AAC 93.172]*
- *Contact Dam Safety and Construction Unit for specific requirements*
- *Submit non-refundable filing fee deposit – **Minimum fee = $1,500** [see 11 AAC 05.260(c)(2)]*

Dam Owner Information

Name of Dam and Reservoir ____________ Identification Number (if assigned) ____________

Owner Name ____________ Authorized Representative ____________ Title ____________

Mailing Address ____________ City ____________ State ____________ Zip Code ____________

Phone Number ____________ Fax Number ____________ E-mail Address ____________

Engineer Information

Company ____________

Engineer of Record ____________ Alaska Registration ____________

Mailing Address ____________ City ____________ State ____________ Zip Code ____________

Phone Number ____________ Fax Number ____________ E-mail Address ____________

Is dam located on anadromous fish stream? ☐ Yes ☐ No ☐ Unknown

Has application been submitted for water rights? ☐ Yes ☐ No ☐ Unknown

Is dam or reservoir located on state land? ☐ Yes ☐ No ☐ Unknown

Is dam or reservoir located on federal land? ☐ Yes ☐ No ☐ Unknown

Location and Land Owner Information

Water Body	River Mile	Tributary To

Region	Meridian	Township	Range	Section	USGS quad map	GPS Coordinates	
						Latitude	Longitude

Land Owner (for land under dam and reservoir) ________ Contact Name and Title ________ Phone Number ________

Mailing Address ________ City ________ State ________ Zip Code ________

Dam Information

Purpose of Dam	Type of Dam	Proposed Hazard Potential Classification (attach HPCJR Form)	Dam Length (feet)

Maximum Dam Height (feet) (dam crest to lowest point in original streambed)	Storage Capacity (acre-feet)		Surface Area (acres)
	at Spillway elevation	at Dam Crest elevation	

Project Description

Application Submittals: Are the following required?

Water Rights Application ☐ Yes ☐ No
Design Scope Proposal ☐ Yes ☐ No
Financial Demonstration ☐ Yes ☐ No

Feasibility Study ☐ Yes ☐ No
Siting Study ☐ Yes ☐ No

Fee Deposit Calculation – Make checks payable to *"Alaska Department of Natural Resources"*

Total estimated project cost $________________

First $100,000	=	$________	X	.02	=	$________
Next $400,000	=	$________	X	.01	=	$________
Next $500,000	=	$________	X	.005	=	$________
Over $1,000,000	=	$________	X	.0025	=	$________

Total Fee Deposit = $________

Signature ________ Title ________

Name (please print) ________ Date ________

AS 38.05.035(a) authorizes the director to decide what information is needed to process an application for the sale or use of state land and resources. This information is made a part of the state public land records and becomes public information under AS 40.25.110 and 40.25.120 (unless the information qualifies for confidentiality under AS 38.05.035(a)(8) and confidentiality is requested, AS 43.05.230, or AS 45.48). Public information is open to inspection by you or any member of the public. A person who is the subject of the information may challenge its accuracy or completeness under AS 44.99.310, by giving a written description of the challenged information, the changes needed to correct it, and a name and address where the person can be reached. False statements made in an application for a benefit are punishable under AS 11.56.210. In submitting this form, the applicant agrees with the Department to use "electronic" means to conduct "transactions" (as those terms are used in the Uniform Electronic Transactions Act, AS 09.80.010 – AS 09.80.195) that relate to this form and that the Department need not retain the original paper form of this record: the department may retain this record as an electronic record and destroy the original.

ALASKA DAM SAFETY PROGRAM

VISUAL INSPECTION CHECKLIST

NID ID#________
SHEET __ OF __

GENERAL INFORMATION

NAME OF DAM:	POOL ELEVATION:
NATIONAL INVENTORY OF DAMS ID#:	TAILWATER ELEVATION:
OWNER:	CURRENT WEATHER:
HAZARD POTENTIAL CLASSIFICATION:	PREVIOUS WEATHER:
SIZE CLASSIFICATION:	INSPECTED BY:
PURPOSE OF DAM:	INSPECTION FIRM:
O & M MANUAL REVIEWED:	DATE OF INSPECTION:
EMERGENCY ACTION PLAN REVIEWED:	

ITEM	YES	NO	REMARKS
RESERVOIR			
1. Any upstream development?			
2. Any upstream impoundments?			
3. Shoreline slide potential?			
4. Significant sedimentation?			
5. Any trash boom?			
6. Any ice boom?			
7. Operating procedure changes?			

DOWNSTREAM CHANNEL			
1. Channel			
a. Eroding or Backcutting			
b. Sloughing?			
c. Obstructions?			
2. Downstream Floodplain			
a. Occupied housing?			
b. Roads or bridges?			
c. Businesses, mining, utilities?			
d. Recreation Area?			
e. Rural land?			
f. New development?			

EMERGENCY ACTION PLAN			
1. Class I or Class II Dam?			
2. Emergency Action Plan Available?			
3. Emergency Action Plan current?			
4. Recent emergency action plan exercise?			**DATE:**

INSTRUMENTATION			
1. Are there			
a. Piezometers?			
b. Weirs?			
c. Observation wells?			
d. Settlement Monuments?			
e. Horizontal Alignment Monuments?			
f. Thermistors?			
2. Are readings			
a. Available?			
b. Plotted?			
c. Taken periodically?			

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

SAFETY

ITEM	YES	NO	REMARKS
SAFETY			
1. ACCESS			**TYPE:**
a. Road access?			
b. Trail access?			
c. Boat access?			
d. Air access?			
e. Access safe?			
f. Security gates and fences?			
g. Restricted access signs?			
2. PERSONNEL SAFETY			
a. Safe access to maintenance and operation areas?			
b. Necessary handrails and ladders available?			
c. All ladders and handrails in safe condition?			
d. Life rings or poles available?			
e. Limited access and warning signs in place?			
f. Safe walking surfaces?			
3. DAM EMERGENCY WARNING DEVICES			
a. Emergency Action Plan required?			
b. Emergency warning devices required by EAP?			**TYPE(S):**
c. Emergency warning devices available?			
d. Emergency warning devices operable?			
e. Emergency warning devices tested?			
f. Emergency warning devices tested by owner?			**WHEN:**
g. Emergency procedures available at dam?			
h. Dam operating staff familiar with EAP?			
4. OPERATION AND MAINTENANCE MANUAL			
a. O & M Manual reviewed?			
b. O & M Manual current?			**DATE:**
c. Contains routine inspection schedule?			
c. Contains routine inspection checklist?			

NID ID#__________
SHEET __ OF __

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

EMBANKMENT DAMS

ITEM	YES	NO	REMARKS
EMBANKMENT DAMS			**TYPE:**
1. CREST			
a. Any settlement?			
b. Any misalignment?			
c. Any cracking?			
d. Adequate freeboard?			
2. UPSTREAM SLOPE			
a. Adequate slope protection?			
b. Any erosion or beaching?			
c. Trees or brush growing on slope?			
d. Deteriorating slope protection?			
e. Visual settlement?			
f. Any sinkholes?			
3. DOWNSTREAM SLOPE			**TYPE:**
a. Adequate slope protection?			
b. Any erosion?			
c. Trees or brush growing on slope?			
d. Animal burrows?			
e. Sinkholes?			
f. Visual settlement?			
g. Surface seepage?			
h. Toe drains dry?			
i. Relief wells flowing?			
j. Slides or slumps?			
4. ABUTMENT CONTACTS			
a. Any erosion?			
b. Seepage present?			
c. Boils or springs downstream?			
5. FOUNDATION			**TYPE:**
a. If dam is founded on permafrost			
(1) Is fill frozen?			
(2) Are internal temperatures monitored?			
b. If dam is founded on bedrock			**TYPE:**
(1) Is bedrock adversely bedded?			
(2) Does rock contain gypsum?			
(3) Weak strength beds?			
c. If dam founded on overburden			**TYPE:**
(1) Pipeable?			
(2) Compressive?			
(3) Low shear strength?			

ALASKA DAM SAFETY PROGRAM

VISUAL INSPECTION CHECKLIST

TIMBER DAMS

ITEM	YES	NO	REMARKS
TIMBER DAMS			**TYPE:**
1. CREST			
a. Any settlement?			
b. Any misalignment?			
c. Adequate freeboard?			
d. Deck timbers sound?			
2. ABUTMENT AND FOUNDATION CONTACTS			
a. Any erosion?			
b. Seepage present?			
c. Boils or springs downstream?			
d. Exposed bedrock?			
e. Is bedrock deteriorating?			
f. Visible displacements?			
3. STRUCTURAL AND CRIB TIMBERS			**TYPE:**
a. Any deterioration?			
b. Are ends broomed or checked?			
c. Are timbers preservation treated?			
d. Are timbers pinned or bolted?			
4. CRIBS			
a. Are cribs filled with rock fill?			
b. Is rock fill sound rock?			

NID ID#_________
SHEET __ OF __

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

SPILLWAYS

ITEM	YES	NO	REMARKS
SPILLWAYS			**TYPE(S):**
1. CREST			**TYPE(S):**
a. Any settlement?			
b. Any misalignment?			
c. Any cracking?			
d. Any deterioration?			
e: Exposed reinforcement?			
f. Erosion?			
g. Silt deposits upstream?			
2. CONTROL STRUCTURES			
a. Mechanical equipment operable?			
b. Are gates maintained?			
c. Will flashboards trip automatically?			
d. Are stanchions trippable?			
e. Are gates remotely controlled?			
3. CHUTE			
a. Any cracking?			
b. Any deterioration?			
c. Erosion?			
d. Seepage at lines or joints?			
4. ENERGY DISSIPATERS			
a. Any deterioration?			
b. Erosion?			
c. Exposed reinforcement?			
5. METAL APPURTENANCES			
a. Corrosion?			
b. Breakage?			
c. Secure anchorages?			
6. EMERGENCY SPILLWAY			
a. Adequate grass cover?			
b. Clear approach channel?			
c. Erodible downstream channel?			
d. Erodible fuse plug?			
e. Stable side slopes?			
f. Beaver dams present?			

NID ID#_________
SHEET __ OF __

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

LOW LEVEL OUTLET

ITEM	YES	NO	REMARKS
LOW LEVEL OUTLET			**TYPE**
1. GATES			
a. Mechanical equipment operable?			
b. Are gates remotely operated?			
c. Are gates maintained?			
2. CONCRETE CONDUITS			
a. Any cracking?			
b. Any deterioration?			
c. Erosion?			
d. Exposed reinforcement?			
e. Are joints displayed?			
f. Are joints leaking?			
3. METAL CONDUITS			
a. Is metal corroded?			
b. Is conduit cracked?			
c. Are joints displaced?			
d. Are joints leaking?			
4. ENERGY DISSIPATERS			
a. Any deterioration?			
b. Exposed reinforcement?			
5. METAL APPURTENANCES			
a. Corrosion?			
b. Breakage?			
c. Secure anchorages?			

NID ID#_________
SHEET __ OF __

ALASKA DAM SAFETY PROGRAM

VISUAL INSPECTION CHECKLIST

INTAKES

ITEM	YES	NO	REMARKS
INTAKES			
1. EQUIPMENT			
a. Trash racks			
b. Trash rake?			
c. Mechanical equipment operable?			
d. Intake gates?			
e. Are racks and gates operable?			
f. Are gate operators operable?			
2. CONCRETE SURFACES			
a. Any cracking?			
b. Any deterioration?			
c. Erosion?			
d. Exposed reinforcement?			
e. Are joints displaced?			
f. Are joints leaking?			
3. CONCRETE CONDUITS			
a. Any cracking?			
b. Any deterioration?			
c. Erosion?			
d. Exposed reinforcement?			
e. Are joints displaced?			
f. Are joints leaking?			
4. METAL CONDUITS			
a. Is metal corroded?			
b. Is conduit damaged?			
c. Are joints displaced?			
d. Are joints leaking?			
5. METAL APPURTENANCES			
a. Corrosion?			
b. Breakage?			
c. Secure anchorages?			
6. PENSTOCKS			**TYPE MATERIAL:**
a. Material deterioration?			
b. Joints leaking?			
c. Supports adequate?			
d. Anchor blocks stable?			

NID ID#__________
SHEET __ OF __

ALASKA DAM SAFETY PROGRAM
VISUAL INSPECTION CHECKLIST

CONCRETE DAMS

ITEM	YES	NO	REMARKS
CONCRETE DAMS			**TYPE OF DAM:**
1. CREST			
a. Any settlement?			
b. Any misalignment?			
c. Any cracking?			
d. Any deterioration?			
e. Exposed reinforcement?			
d. Adequate freeboard?			
2. UPSTREAM FACE			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Deterioration?			
e. Exposed reinforcement?			
f. Displacement?			
g. Loss of joint fillers?			
h. Damage to membranes?			
i. Silt deposits upstream?			
3. DOWNSTREAM FACE			**TYPE:**
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Deterioration?			
e. Exposed reinforcement?			
f. Inspection gallery?			
g. Foundation drains?			
h. Foundation drains clear and flowing?			
i. Seepage from joints?			
j. Seepage from lift lines?			
4. ABUTMENT & FOUNDATION CONTACTS			
a. Exposed bedrock?			
b. Erosion?			
c. Visible displacement?			
d. Seepage from contact?			
e. Boils or springs downstream?			

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ADNR WATER RIGHTS

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Results - Case File Abstract

Summary

File: LAS 12057

Customer: 000124760 ANGOON CITY OF
PO BOX 189
ANGOON AK 99820

Case Type: 801 WATER RIGHTS

DNR Unit: 800 WATER

File Location: WJNO WATER MGT-JUNEAU

Case Status: 35 PERMIT ISSUED

Status Date: 11/22/1988

Total Acres: 0.000

Date Initiated: 09/07/1988

Office of Primary Responsibility: WJNO WATER MGT-JUNEAU

Last Transaction Date: 03/24/2010

Case Subtype: SUR SURFACE

Last Transaction: COMMENTS COMMENTS

Land Records

Meridian: C **Township:** 051S **Range:** 068E **Section:** 16 **Section Acres:** 0

Case Actions

_09-12-1988_ REQUEST DTS PLAT UPDATE		
ACTION	ADD	ADD POINT

_11-04-1988_ PLOTTED BY DTS		
REQUEST DATE	09-12-1988	
REQUEST ACTION	ADD	ADD POINT
PLOT RESULT	COM	COMPLETED
PLOTTED BY	CB	
CHAINS NORTH PLOTTED	79	
CHAINS WEST PLOTTED	68	

_11-22-1988_ PERMIT ISSUED		
STATUS 11	11	PERMT ISSD
PERMIT SIGNED BY	A PEKOVICH	

_11-22-1988_ REQUEST DTS PLAT UPDATE		
ACTION	COM	COMMENT
PERMIT ISSUED		

_01-10-1989_ PLOTTED BY DTS		
REQUEST DATE	11-22-1988	
REQUEST ACTION	ADD	ADD POINT
PLOT RESULT	COM	COMPLETED
PLOTTED BY	CA	
CHAINS NORTH PLOTTED	79	
CHAINS WEST PLOTTED	68	

_12-30-2002_ STATUS CODE STANDARDIZED

STATUS CODE 35 ISS/APPRV/ACTV AUTH
****** STATUS CODE STANDARDIZATION ******
STATUS CODE CHANGED BY BATCH UPDATE

***04-14-2003* SUMMARY RECORD DATA CHANGED/CORRECTED**
OFF PRIM RESPONS WJNO WATER MGT-JUNEAU
CHANGED THE OFFICE OF PRIMARY RESPONSIBILITY TO NEW CODES

***05-25-2006* FIELD INSPECTED**
INSPECTED BY V. DELAUNE
NEED WATER USE DATA

***11-20-2007* COMMENTS**
HAVE REQUESTED SBU, WATER USE DATA, FILING FEE, ROW'S A COUPLE TIMES.
CANNOT CERTIFY. PERMIT EXPIRED 9/6/1993.

***03-24-2010* COMMENTS**
TILLINGHAST LAKE AKA AUKTAH LAKE IS POINT OF TAKE FOR ANGOON PWS

***03-24-2010* COMMENTS**
ANTHC (ALASKA NATIVE TRIBAL HEALTH CONSORTIUM) HAS CONTACTED DNR IN
EFFORT TO BRING ANGOON WATER RIGHT UPTODATE AND GET IT CERTIFIED.

Legal Description

TILLINGHAST LAKE, WITHIN LOT 3 OF SECTION 16, WITHIN THE NW1/4NW1/4 OF
SAID SECTION, TOWNSHIP 51 SOUTH, RANGE 68 EAST, COPPER RIVER MERIDIAN
AND THE WATER RIGHT GRANTED SHALL BE APPURTENANT TO THAT CERTAIN TRACT
OF REAL PROPERTY DESCRIBED AS FOLLOWS:
THE CITY OF ANGOON, ALASKA PUBLIC WATER SUPPLY SYSTEM.

We are now accepting payments online for case agreements and mining claims bills! To make a payment by credit card or from your bank account, click here.

Results - Case File Detail

Summary

File: LAS 12057

Customer: 000124760 ANGOON CITY OF
PO BOX 189
ANGOON AK 99820

Case Type: 801 WATER RIGHTS **DNR Unit:** 800 WATER

File Location: WJNO WATER MGT-JUNEAU

Case Status: 35 PERMIT ISSUED **Status Date:** 11/22/1988

Total Acres: 0.000 **Date Initiated:** 09/07/1988

Office of Primary Responsibility: WJNO WATER MGT-JUNEAU

Last Transaction Date: 03/24/2010 **Case Subtype:** SUR SURFACE

Last Transaction: COMMENTS COMMENTS

Land Records

Meridian: C **Township:** 051S **Range:** 068E **Section:** 16 **Section Acres:** 0

Case Actions

Transaction: *INITIATE* INITIATE CASE

Transaction Date: 09-07-1988	**Time:** 102224	**SubSystem ID:** CAS
Input Date: 09-12-1988	**User:** NRSCOBR	**Terminal:** NJBV
STATUS DATE	09-07-1988	
LOCATION FROM	SEDOWS	SEDO FILES
LOCATION TO	SEDOWS	SEDO FILES
CASE STATUS	10	APP ACCPTD
OFFICE PRI RESP	WSER	WATER-SOUTHEAST RE
SPECIAL CODE	SUR	SURFACE
CUSTOMER NUMBER	000124760	ANGOON, CITY OF
UNIT CODE	800	WATER
RELATIONSHIP CODE	10	OWNER
C051S068E16		

Transaction: *REQPLT* REQUEST DTS PLAT UPDATE

Transaction Date: 09-12-1988	**Time:** 103156	**SubSystem ID:** CAS
Input Date: 09-12-1988	**User:** NRSCOBR	**Terminal:** NJBV
ACTION	ADD	ADD POINT

Transaction: *ADDTEXT* CHANGE LEGAL TEXT

Transaction Date: 10-11-1988	**Time:** 114259	**SubSystem ID:** CAS
Input Date: 10-11-1988	**User:** NRSCOBR	**Terminal:** NJBH

Transaction: *PLT* PLOTTED BY DTS

Transaction Date: 11-04-1988	**Time:** 144905	**SubSystem ID:** CAS
Input Date: 11-07-1988	**User:** NCSCCBA	**Terminal:** NAXP

REQUEST DATE	09-12-1988	
REQUEST ACTION	ADD	ADD POINT
PLOT RESULT	COM	COMPLETED
PLOTTED BY	CB	
CHAINS NORTH PLOTTED	79	
CHAINS WEST PLOTTED	68	

Transaction: *PI* PERMIT ISSUED

Transaction Date: 11-22-1988	**Time:** 162507	**SubSystem ID:** CAS
Input Date: 11-23-1988	**User:** NRSCOBR	**Terminal:** NJBV
STATUS 11	11	PERMT ISSD
PERMIT SIGNED BY	A PEKOVICH	

Transaction: *REQPLT* REQUEST DTS PLAT UPDATE

Transaction Date: 11-22-1988	**Time:** 162600	**SubSystem ID:** CAS
Input Date: 11-23-1988	**User:** NRSCOBR	**Terminal:** NJBV
ACTION	COM	COMMENT

PERMIT ISSUED

Transaction: *PLT* PLOTTED BY DTS

Transaction Date: 01-10-1989	**Time:** 114837	**SubSystem ID:** CAS
Input Date: 01-23-1989	**User:** NCSCCAM	**Terminal:** NAXP
REQUEST DATE	11-22-1988	
REQUEST ACTION	ADD	ADD POINT
PLOT RESULT	COM	COMPLETED
PLOTTED BY	CA	
CHAINS NORTH PLOTTED	79	
CHAINS WEST PLOTTED	68	

Transaction: *CDESTAND* STATUS CODE STANDARDIZED

Transaction Date: 12-30-2002	**Time:** 160306	**SubSystem ID:** CAS
Input Date: 12-30-2002	**User:** BATCH	**Terminal:** X246
STATUS CODE	35	ISS/APPRV/ACTV AUTH

****** STATUS CODE STANDARDIZATION ******
STATUS CODE CHANGED BY BATCH UPDATE

Transaction: *SUMCHG* SUMMARY RECORD DATA CHANGED/CORRECTED

Transaction Date: 04-14-2003	**Time:** 135522	**SubSystem ID:** CAS
Input Date: 04-14-2003	**User:** BATCH	**Terminal:** XX23
OFF PRIM RESPONS	WJNO	WATER MGT-JUNEAU

CHANGED THE OFFICE OF PRIMARY RESPONSIBILITY TO NEW CODES

Transaction: *FLD* FIELD INSPECTED

Transaction Date: 05-25-2006	**Time:** 131205	**SubSystem ID:** CAS
Input Date: 10-06-2006	**User:** NWRCVDE	**Terminal:** X5NQ
INSPECTED BY	V. DELAUNE	

NEED WATER USE DATA

Transaction: *COMMENTS* COMMENTS

Transaction Date: 11-20-2007	**Time:** 104623	**SubSystem ID:** CAS
Input Date: 11-20-2007	**User:** NWRCVDE	**Terminal:** X57L

HAVE REQUESTED SBU, WATER USE DATA, FILING FEE, ROW'S A COUPLE TIMES.
CANNOT CERTIFY. PERMIT EXPIRED 9/6/1993.

Transaction: *COMMENTS* COMMENTS

Transaction Date: 03-24-2010	**Time:** 85635	**SubSystem ID:** CAS
Input Date: 03-24-2010	**User:** NRSCDBU	**Terminal:** X2Z6

TILLINGHAST LAKE AKA AUKTAH LAKE IS POINT OF TAKE FOR ANGOON PWS

Transaction: *COMMENTS* COMMENTS

Transaction Date: 03-24-2010	**Time:** 85931	**SubSystem ID:** CAS
Input Date: 03-24-2010	**User:** NRSCDBU	**Terminal:** X2Z6

ANTHC (ALASKA NATIVE TRIBAL HEALTH CONSORTIUM) HAS CONTACTED DNR IN
EFFORT TO BRING ANGOON WATER RIGHT UPTODATE AND GET IT CERTIFIED.

Legal Description

TILLINGHAST LAKE, WITHIN LOT 3 OF SECTION 16, WITHIN THE NW1/4NW1/4 OF SAID SECTION, TOWNSHIP 51 SOUTH, RANGE 68 EAST, COPPER RIVER MERIDIAN AND THE WATER RIGHT GRANTED SHALL BE APPURTENANT TO THAT CERTAIN TRACT OF REAL PROPERTY DESCRIBED AS FOLLOWS:
THE CITY OF ANGOON, ALASKA PUBLIC WATER SUPPLY SYSTEM.

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APPENDIX G: SITE VISITS AND CORRESPONDENCE

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September 10, 2020 Kickoff Meeting

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Water Source Improvements, Angoon, AK
Preliminary Engineering Report
Kickoff Meeting Minutes

ANTHC 18-TC-161146

Thursday, September 10, 2020 9:30 AM - 10:30 AM

Join Skype Meeting or Join by phone: +1 907-313-2185, 298007188#

Attendees

P	John Blees	Bristol	jblees@bristol-companies.com	907-360-6046
P	Vanessa Wike	Bristol	vwike@bristol-companies.com	907-306-9507
P	Jackie Wander	Bristol	jwander@bristol-companies.com	907-743-9314
P	Rick Mitchells	Golder	richard_mitchells@golder.com	907-830-3171
P	Robert Sanders	Golder	robert_sanders@golder.com	907-344-6001
P	Kevin Ulrich	ANTHC	kculrich@anthc.org	907-440-2864
A	Russell Snyder	ANTHC	rasnyder@anthc.org	907-330-9777
P	John Warren	ANTHC	jwarren@anthc.org	907-729-3511
P	John Johnson	ADEC	john.johnson@alaska.gov	907-269-7605
P	Josh Bowen	Mayor, City of Angoon	mayor@cityofangoon.com	907-788-3653
P	Albert Kookesh	City of Angoon	cityclerk@cityofangoon.com	907-788-3653

Agenda

I. Background / Scope

The water source for the City of Angoon is a surface water pond, Auktah Lake, which is currently held intact by a beaver dam and is at risk of failure. The source has poor raw water quality and insufficient quantity to meet community demand. The community has recently experienced water shortages due to low water levels during warm summer conditions. The City of Angoon needs a water source with sufficient quantity and quality to provide safe drinking water for the community.

I. Assumptions

1. PER will conform with USDA RD 1780-2, and include a proposed project narrative and scope of work.
2. A 3rd Party AACE International Class 4 Project (Engineering and Construction) Cost Estimate with Basis of Estimate narrative for recommended alternative will be provided (65% and 100%, Estimations Inc.).
3. The PER will include an analysis of community water demand and storage capacity and Operator Certification requirements.
4. System leakage (which amplifies community demand) will not be addressed in this PER (a separate PER was completed on piping systems for the community). Final system demand estimates for the new source, and subsequent storage volumes, will include leakage. This can be revisited if leakage problems are addressed.

   DEC Water Watch (Sept 2020) indicates that there are some outstanding sanitary survey deficiencies (want RPZ at harbor main, screen on WST, heat tape on non-

GFCI outlet, replacement of steel water lines need DEC engineering review). These deficiencies may have been addressed (and not shown on Water Watch).

Water Watch indicates no lead/copper issues (all below action levels). Lead Action Level = 0.015 mg/L, Copper Action Level = 1.3 mg/L.

System has had Disinfection By-Product (DBP) exceedances in past. TTHM MCL = 80 ug/L, HAA5 MCL = 60 ug/L. Water Watch Sept 2020:

TTHMs	45.4 ug/L	5-29-2020
	46.1 ug/L	2-28-2020
	74.0 ug/L	5-21-2019
	56.1 ug/L	11-14-2018
	62.0 ug/L	2-20-2018
	58.2 ug/L	11-16-2017
	78.8 ug/L	8-23-2017
	69.7 ug/L	5-11-2017
	62.8 ug/L	2-08-2017
HAA5s	1.0 ug/L	5-29-2020 ???
	47.0 ug/L	2-28-2020
	29.2 ug/L	5-21-2019
	38.9 ug/L	11-14-2018
	42.5 ug/L	2-20-2018
	32.7 ug/L	11-16-2017
	27.8 ug/L	8-23-2017
	53.4 ug/L	5-11-2017
	55.0 ug/L	2-08-2017

5. No site visit, field work, or water quality testing will be completed under this PER.
   i. Existing system water quality data will be provided.

      Mostly compliance data is available (treated water data). Any raw water data would be helpful.

   ii. Aerial photography (Quantum Spatial) will be used for preliminary design estimates.

6. EIS will be held for the design stage, but an estimate for cost of the EIS will be included. ANTHC will provide confirmation of coverage area (by 35%).

II. Source Improvement Alternatives

1. Improve Existing Source Pond
   This alternative would include improving and expanding the existing pond.
   Existing pond has poor quality and inadequate quantity. Substantial power is required to pump water up through treatment system.

2. Develop New Source on Favorite Creek (approx. 6.5 miles for WTP)
   Favorite Creek has been identified (Tryk Nyman and Hayes, CH2MHill, Quadra, Montgomery) as a preferred location for a new source intake. Source development options include:

i. Impoundment

Prior studies estimate that the impoundment would be:

16' high, 150' wide, reinforced concrete

8,500-foot access road

18,000 feet of raw water pipe (10" hdpe)

The water quality of Favorite Creek is preferred over the water quality of the existing source pond. However, the water quality of a new impoundment will not be the water quality of Favorite Creek due to submerged vegetation and soils.

The most recent hydrologic study was done a decade ago. A detailed geotechnical / hydrologic study of the area for the impoundment would be needed to identify key design criteria (subsurface soils, leakage …).

Impoundments are substantial design and construction efforts, especially considering Seismic activity in the area. Want to lean toward a small diversion structure (Alternative 2) if possible.

ii. Partial Diversion Structure

Climate change and warming seem to be increasing the rate of organic decay. Saxman damn saw elevated levels of TOC (10 mg/L, cleared reservoir area). Built a new damn on a smaller creek (small diversion structure, cheaper, easier to maintain, easier to flush). The organic levels were much smaller at the diversion structure.

iii. Vertical/horizontal intake and raw water storage

Likely shallow bedrock. Need to consider geologic mapping (LIDAR would be very helpful to understand geologic controls and risks of the site but cost exceeded cost available for budget). Also considered drone, but access isn't sufficient. LIDAR and other studies will be recommended for the design stage.

Combination of infiltration gallery coupled with diversion structure.

3. Do Nothing

III. Design Considerations

1. The adaptability of the existing water treatment system to changes in raw water quality.
    i. impacts on treated water quality
    ii. treatment rate and system efficiency

    Leakage study is needed. Large volume of stored raw water increases risk of organics and increases maintenance costs.
    Recent piped water project hopefully will address the leakage issue. Include leakage demand at this time. Can reduce the costs if the leaks get addressed. Tanks also leaks (bolts etc), which are being addressed now (2020). Tanks will also be cleaned.

2. Safety concerns regarding impoundment and risk of failure

i. Dam Safety Guidelines (http://dnr.alaska.gov/mlw/water/dams/), Charles Cobb, Dam Safety Engineer (charles.cobb@alaska.gov , 907-269-8636), ADNR Alaska Hydrologic Survey, Kevin Petrone (kevin.petrone@alaska.gov, 269-8646).

   Consider Damn Hazard Class – Classes 2 and 3 damns require inspection which is expensive. Try to aim for Hazard Class 1 – Non-jurisdictional. An anadromous stream Favorite Bay Creek is downstream, will affect Hazard Class determination. Location of proposed impoundment could have been affected by Favorite Bay Creek (to get impoundment away from anadromous stream).

3. Impact of flooding on final impoundment water quality
   - **i.** Clear vegetation = more particulates
   - **ii.** Leave vegetation = more organics

   Use of a diversion structure or intake would avoid this issue.

4. Volume of water needed to meet community demand.
   Leakage demand will be considered in developing storage quantities at this time.

   A leak study is recommended as soon as possible. We want to try and coordinate the schedules of this project and the waterline replacement project, if possible.

   The mayor noted leakage coming from the 3 storage tanks in town due to leaky bolts. They have ordered the supplies and are working to get them cleaned and repaired, which will help reduce water loss as well as improve disinfection by-product formation in the tanks.

5. Cost of maintaining/operating new system
   - **i.** Power costs
   - **ii.** Operator certification requirements are not expected to be a factor in source development options.

6. Site Access
   Limited access to new site (no road/trail). Additional access improvements are planned at airport. No longer road planned at the airport. The Airport design documents and EIS may be helpful resources.

   No trail to current site. No plans to develop trail. ROW extends out towards source. May be included in roads inventory (if not, Bristol can assist with this process if desired). If there is at least a trail, it would help with needed geophysical data (non-invasive tools). The City said they can look into getting a trail started.

   It was recommended to walk the creek with an altimeter and look at topography and other conditions of the area. Bear activity may be a problem. A site visit is not included in the budget.

IV. Proposed Schedule and Deliverables

Project Kickoff and Data Collection	September 2020
65% PER Submittal and Cost Estimate	November 10, 2020
65% PER Design Review Meeting	November 30, 2020
65% PER Public Meeting - teleconference	November 2020
95% PER Submittal	February 8, 2021
95% PER Design Review Meeting	March 5, 2021
100% PER Submittal and Cost Estimate	April 1, 2021
PER Project Closeout	May 1, 2021

V. Other Discussion / Notes

Walking the creek, straight up the stream, would provide good info for preliminary design, but would be a brute force method. Bears would be an issue.

December 18, 2020 Community Meeting

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From:	Wike, Vanessa
To:	Ulrich, Kevin C
Subject:	Meeting Minutes - Community Meeting with Angoon re: Intake PER
Date:	Friday, December 18, 2020 3:55:00 PM
Attachments:	image001.emz image002.png

Hi Kevin,

Here are my minutes from todays meeting. Please let me know if there are any corrections additions.

Thanks,

v.

12/18/2020 – Community Meeting (Zoom)

Kevin Ulrich (ANTHC PM), Joshua Bowen (Angoon Mayor), Christina Joseph (Angoon Planning and Zoning Clerk), Vanessa Wike (Bristol Engineer)

(operator was busy)

Discussed the 65% PER and the alternatives for a surface water supply.

1. Impoundment
2. Infiltration Galleries (near existing source)

The alternatives would be evaluated based on:

1. Quantity of Water
2. Quality of Water
3. Cost (initial capital cost and ongoing O&M)
4. Permitting etc.

Discussed what an impoundment option would be like:

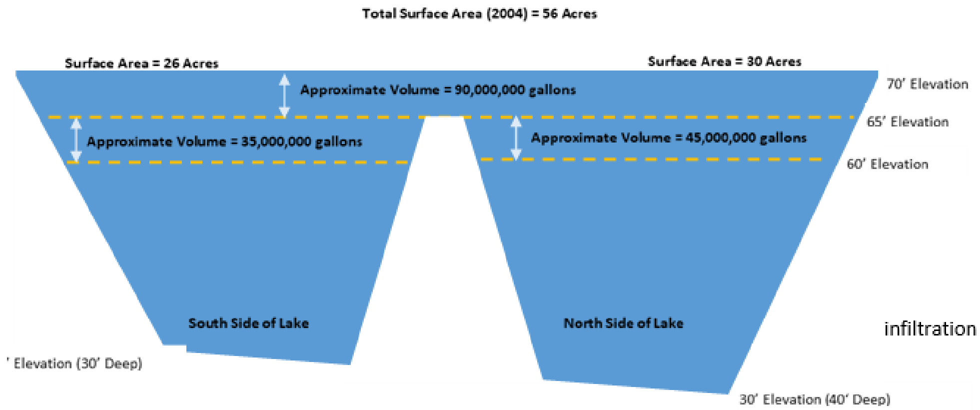
- Relatively small, holds about 700,000 gallons. Prior studies assumed the existing source would be retained as a back-up source.
- Would require a road and power
- The overflow from the dam will be fairly small (the creek is fairly small), so limited power generation likely. Would likely be enough to power lights and small fixtures at the dam, but not much extra.
- Ongoing maintenance and inspections would be needed
- A DNR submittal would be needed to determine the Hazard Level, and if the dam was regulated.
- An Environmental Impact Statement (EIS) would be needed for the impoundment area.
- A substantial geo-tech study would be needed for the Dam design.
- The water quality of the impounded water will take years to settle down following the filling of the impoundment. Initially would expect high organics, sediment.
- The dam is high enough in elevation so no additional pumping of the raw water would be needed.

Joshua indicated that the community knew about the prior studies on an impoundment. This alternative has a long history with the community. This could be the alternative that community members are expecting.

Discussed what an infiltration gallery would look like:

- Would replace existing wet well and pump system.
- Would be about 12” in diameter, and 30-40 feet deep (the depth of the Lake). It would look like a well. There would be two of them located on the bank of the Lake near the WTP.
- Each would have a pump that would be big enough to supply the entire treatment flow through the WTP. The design flow of the filters will dictate the intake flow.
- The pumps would be sized to be as efficient as possible.
- The water quality in an infiltration gallery should be better than the water quality in the Lake, because filtration through the native gravels/sands will help remove turbidity and organics.
- The Lake holds substantially more water than the impoundment. The top 5 feet of the Lake holds about 90 million gallons (the impoundment hold less than a million gallons).
- If the beaver dam ever went out, the lake would split into two lakes. The WTP would pull water from the northernmost part of the lake, which has over 45 million gallons in the top 5 feet.
- The Lake would be easier to permit (no EIS, no dam safety submittal).
- The Lake would require a geotechnical investigation, but it would be much smaller in scope than the

impoundment investigation, so it wouldn't take as long or be as expensive.



Joshua indicated that the impoundment had some good benefits and was open to considering the infiltration gallery alternative.

Discussed the existing system:

Leaks in the existing system result in pumping 2 -3 times extra water. This would provide a substantial cost savings if fixed.

A reference to solar panels will be included in the PER.

The Lake water level has dropped in recent years. The operator has records and has taken measurements.

The Water Storage Tanks are scheduled for cleaning in the near future.

The intake system includes a pigging system that is used regularly to clean out organics and debris that accumulate in the intake pipe.

The elevation in the wet-well is set at the elevation of the lake. When the lake level dropped, the water in the wet well dropped below the pump intakes, so the pumps couldn't pump water into the WTP. Had to pump water into the wet well.

Bristol will send questions about the water system to Joshua, who will forward them to the operator.

Discussed project schedule:

Most likely scenario would be:

Funding: 2021

Design: 2022

Construction: 2023

The potential pipeline repair project is also in process. If approved the two projects could go into construction at about the same time.

Kevin and Joshua will coordinate for a presentation regarding the intake at the next community meeting.

Remote Maintenance Worker Trip Reports

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RMW: Matt Bradbury
Region: DEC
Community: Angoon
Trip Dates: 6/3/2019 to 6/6/2019
Trip Type: Routine

Trip Contacts

Dan Fredrickson, Water Operator
Erik Larson, Water Operator Backup
Josh Bowen, Mayor

Trip Details

Trip Purpose: Routine visit, inspect plant, meet operators. Investigate flex 70 pumps not working correctly

Trip Summary: Tuesday June 4th, 2019

Met with WPO Danny Fredrickson and WPBO Erik Larson.

First issue we looked at was the Honeywell valve that opens up makeup water for polymer dilution. Danny installed a new Honeywell valve but it was a residential type valve only rated for 30psi of pressure. The pressure on the valve is around 65psi. Advised him to install a new valve of the correct pressure rating.

Next is some kind of programming issue with their 2 flex 70 raw water intake pumps. Pump 1 works in hand only and doesn't register GPM which initiate's a low flow warning. #2 seems to work fine. We went down to the control panels and switched leads. The problem reversed indicating some type of programing problem. We tried copying and installing one HIM to the other but that didn't work. I then scanned through the settings on both units and the settings were identical. I called ANTHC and Brian Menghini, TUS engineer will be traveling to Angoon and he said he can investigate the problem further.
While at the intake well I observed that it was only filling to about half capacity due to low levels of the lake. The operator's state that the wells draw down the well faster than it can recover. They are maintaining the intake screen and grate to make sure that as much flow as possible is attained. The current plan now is to pipe in another pump to supplement the one from the lake and only have it running while making water. The community will be seeking out funds to install another, deeper wet well while they wait on funding and construction of an alternate water source.

I walked the operators through the procedure of cleaning and calibrating their turbidimeters. They cleaned and calibrated all 6 turbidimeters. After calibration filter 3 was not showing up on the Honeywell multi trend. It was registering on the SC100 though. I tried resetting the SC100 and double checked the settings. Brian Menghini will check on the SC100 during his visit as well.

I met with Mayor Josh Bowen. He wanted to learn about the best practice score his community received and how he could improve it. I showed him that handing in preventative maintenance plans and encouraging his operators to achieve proper levels of certification were two major areas of improvement that I could assist them with. I also pointed out that they are overdue on several samples, I said I can help them order the appropriate kits.
Wednesday June 5th 2019

All 4 filters are showing heavy mud ball build up and filter run time is short between backwashes according to the operators. They walked me through the back wash procedure they normally follow, which was the printed instructions provided to the plant. Air scour did not seem to lift much material. 100 psi was reading on the gauge. 700 GPM was their standard backwash flow, observing through the sight glass this did not seem to lift much material. We ramped up the GPM's up to 970 and did an extended backwash. We periodically checked the backwash for signs of media discharge but there was negligible to no media present. I believe we got the media much cleaner than before but significant build up still appears in the observation windows. Media is 10 years old.

The SCD needed some attention. The bearing and pin had become worn out. The operators were having a hard time removing the bearing. I was able to fashion a bearing press of sorts out of 2 sockets on hand and removed and replaced the bearing. The jet wash on the SCD is not working. A seal is blown out. I advised the operators to call John Simms and order a new seal.

I did a facility walk through to check for other problems. I didn't see anything that required attention at the moment. The operators keep a very clean and organized plant.

Thursday June 6th, 2019

Went and looked at the condition of the water storage tanks. No leaks were visible. There is a lot of overgrown brush though surrounding the tanks making getting close for an inspection difficult.

On the Job Training Hours: 16

Critical Observations:
No Critical observations made.

Noted Deficiencies:
Wet well is not providing an adequate supply of water to maintain automatic flow for both intake pumps. This also sets of a low flow alarm at the control panel.
Reoccurring: Yes

A programming issue may exist with the flex 70 VFD pumps at the intake.
Reoccurring: Yes

Jet wash assembly for the SCD needs to be replaced
Reoccurring: Yes
Cost to Address: $500

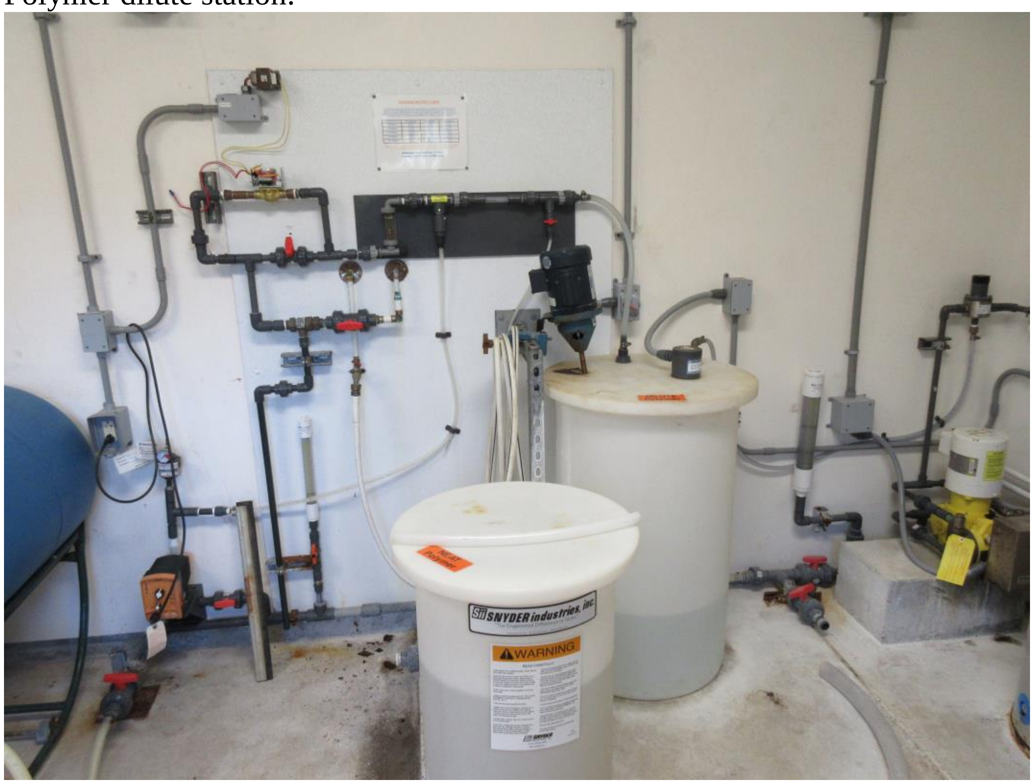
Brush needs to be cleared from WST.
Reoccurring: Yes

Follow Up Activities:
Program flex 70 intake pumps
Entity to Follow Up: Engineer

Replace jet wash on SCD
Entity to Follow Up: Operator

Replace automatic shutoff valve for polymer make up water
Entity to Follow Up: Operator

Polymer dilute station:



entrance to plant:

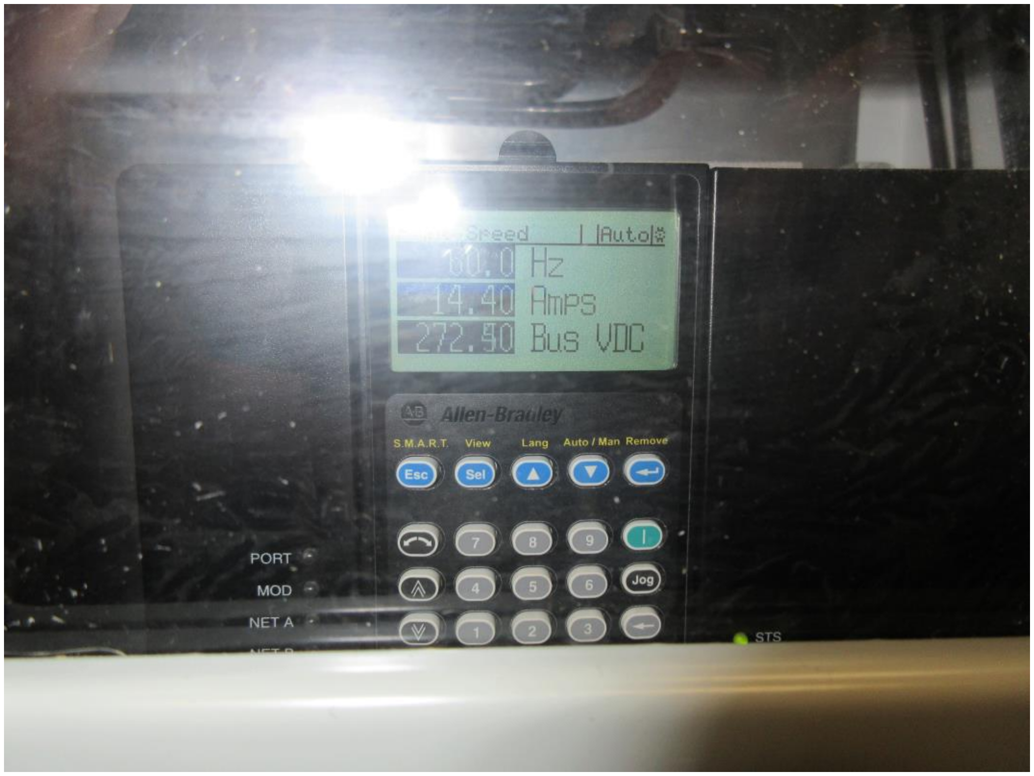
Wet well:

Mud ball formation:

changing pin and bearing on SCD:

Water storage Tank:

Smart controls for flex 70:



RMW: Kevin Schoneman
Region: DEC
Community: Angoon
Trip Dates: 2/21/2017 to 2/24/2017
Trip Type: Other

Trip Contacts

Brian Menghini, ANTHC Engineer
Dan Fredrickson, Wastewater Operator
Kevin Mitchell, Wastewater Operator Backup
Harriet Silva, Mayor
Albert Howard, City Council Member
Edward Jack, City Council Member
Paul Thomas, Water Operator
Albert Kookesh, City Council Member

Accompanied By:

Floyd Murphy, RMW
Brenton Alexander, ANTHC Engineer

Trip Details

Trip Purpose: Flush and inspect approximately 1400 feet of 8" gravity sewer main, and record the inspection for repairs or replacement purposes.

Trip Summary: I arrived at the airport in Anchorage @ 0630 Tuesday February 21 and check in for the 0800 flight to Juneau. I was joined by RMW, Floyd Murphy at the gate and we departed Anchorage on time. We arrived in Juneau at 1050, we both checked in at Alaska Seaplanes for our flight to Angoon at 1300. While we were waiting at the gate for our flight to Angoon we met up with Brenton Alexander, Project Manager for Angoon with ANTHC. We all departed Juneau for Angoon at 1315 and arrived in Angoon at about 1410 we were met at the seaplane terminal by Brian Menghini with ANTHC, we then proceeded directly to the City Office to attend a scheduled community meeting. When we arrived at the city office and immediately into the meeting that had just begun. We were all introduced to the City Council and the public in attendance. Brent gave a summary of the purpose of our visit the work we would be doing while we were in Angoon for the week. Several of the council members and a couple of people from the audience expressed concern as to the condition of the waste water gravity main on Front Street. Brent stated this would be our primary focus for the next few days. There was also some concern with several of the council members as to the condition of the water isolation valves and fire hydrants. We were all thank by several members of the council and public for coming to Angoon.

After the meeting was adjourned we met with the operators and labors that would be working with us on the Front Street line flushing and camera inspection. They showed us where they had stored our equipment that we had sent down to Angoon a week prior to our arrival. We briefly inspected the equipment to make sur all of it was there and intact. As a group we all decided to meet by the Kootznahoo Lift Station to look at the pumps that the operators and Brian Menghini had started working on the day before. The wastewater operators were looking at replacement of the ware plate in the right hand pump and they asked for directions on how to do so. There had also apparently had issues with priming the pumps in the past and they been working on an alternative method. We took a quick tour of town and checked in at the Kootznahoo Inlet Lodge. The next day we all met at the city office to get the equipment for the line flushing, we were met by Brent, Brian from ANTHC. From the city of Angoon operators, Paul Thomas, Dan Fredrickson, Kevin Mitchell and John the firetruck operator. Brian and Paul left to finish some electrical work at the water plant they started the day before. The rest of the group started the line flushing of the 8" Gravity Main that runs in the center of Front Street. We started flushing at Manhole MH-5 which is on the West end of Angoon and flushed downstream to MH-4 which is a length of 96 feet. We then proceeded from MH-4 to MH-3 which is a length of 285 feet. For this run of the gravity main we first flushed down stream approximately 150 feet then flushed up steam from MH-3 up to about half way to MH-4. This was done this way because of the weight and drag of the hose on a long run. After flushing the line we found a root ball approximately the size of a volleyball in the upstream invert of MH-3. We were able to grab it using a hose attached to the city vacuum truck that the operators were using to suck up any debris as we flushed the lines. We resumed flushing the line from MH-3 to MH-2 and then on from MH-2 to MH-1, MH-1 has an "emergency overflow outfall" which consists of an 8" that exits the manhole about half way up the barrel and serves as an overflow outfall line. This line would only be utilized in the event of a lift station failure or some sort of line blockage. There is normally there is no flow through this line and is for emergency only. It was also noted there was a considerable amount of grease build up between MH-2 and MH-1. We then flushed from MH-1 to MH-1A, the transition between the upstream invert and the downstream invert in MH-1A is very rough and stair stepped. This would most likely would collect solids and would interfere with velocity. We then proceeded to flush from MH-1A to MH-1B, MH-1B collects gravity flow from two directions then discharges into the Front Street Lift Station and from there pumped up to the community septic tanks.

After we completed flushing the lines to be inspected, we then returned to MH-5 to start the camera inspection of all the lines on Front Street. After picking up the sewer see snake equipment we set everything up at MH-5 and began the inspection and recording. We found it to be easier for one person to be inside the Manhole and one or two monitoring the camera and laptop computer. The city crew assisted with the manhole access and traffic control. We were able to inspect about half of the 1400 feet of sewer line when the battery on the laptop began to get low on power so we decided to shut down for the evening and pick up where we left off the next day.

The next morning we all met back at the city office to load up the equipment and resume the camera inspection. We completed the camera inspection of Front Street, this completed the scope of work requested. Approximately 1400 feet of gravity 8 inch sewer main and seven manholes. The work was saved on the RMW Sewer Cam Laptop and would later sent to ANTHC. After a short lunch break we met back with the city crew and started cleanup of the camera equipment and line flushing gear. After the gear was cleaned and disinfected we loaded everything up and drove to the airline office for shipment back to Anchorage. After we dropped everything off, Floyd drove me out to the Water Treatment Plant, Floyd gave me a tour of the plant and the source for the Village of Angoon.

The next morning Floyd and I met the float plane for our return to Juneau for the connection back to Anchorage. We arrived back in Anchorage at about 4:00 pm Friday the 24th.

On the Job Training Hours: 16

Critical Observations:
Annual sewer line flushing.

Noted Deficiencies:
Sewer nozzels
Reoccurring: No

Follow Up Activities:
Annually flush all of the sewer gravity mainlines.
Entity to Follow Up: Operator

Purchase hoses and nozzles for sewer line maintenance.
Entity to Follow Up: Community

RMW: Floyd Murphy
Region: DEC
Community: Angoon
Trip Dates: 2/21/2017 to 3/24/2017
Trip Type: Routine

Travel Costs

Transportation Cost: $1,087
Mode of Transportation: Airplane
Per Diem Cost: $210

Trip Contacts

Harriet Silva, Mayor
Albert Howard, City Council Member
Edward Jack, City Council Member
Albert Kookesh III, City Council Member
Kevin Frank, City Council Member
Paul Thomas, Water Operator
Daniel Fredrickson, Wastewater Operator
Kevin Mitchell, Wastewater Operator Backup
Brian Menghini, ANTHC Engineer
Brenton Alexander, ANTHC Engineer

Other Contact Information:

Agnes Marszalik, ANTHC Engineer, Leigh Miler, ANTHC Engineer,Sue Miskill, ANTHC Professional Land Surveyor, David "Brody" Shuck, ANTHC Assistant Surveyor, Martin Wortman, ANTHC Senior O & M Specialist.
These people were working on different parts of the water or wastewater systems and conducting land surveys.

Trip Details

Trip Purpose: Flush and inspect around 1400 feet of 8 inch gravity sewer main, Closed Circuit Television CCTV) inspection for replacement or repair before upgrades to Front Street in Angoon.

Trip Summary: 2/21/17 Upon arrival at Angoon around 2:00 pm, Kevin Schoneman, Brenton Alexander and I were met by Daniel Fredrickson, Paul Thomas, Angoon Water Plant Operators and Brian Menghini, ANTHC Utility Support Associate Engineer. We were brought to the city office to meet with the city council.The council meeting was in session on our arrival. During the meeting agenda where we were included, Kevin and I explained that we were there to assist with cleaning the sewer main on Front Street and to run a camera up it to access the condition of it. We explained that we would need a fire truck for flushing the sewer line using the fire hose and nozzle we had shipped down prior to our arrival. After the meeting we looked at Front Street to see what we would be working on. Kevin and I made arrangements to meet the flushing crew to meet at the city office at 8:00 am. After looking over the system and the Kootznoohoo lift station we went to our place of lodging at the Kootznoohoo Inlet Lodge.

2/22/17 Keven and I met the crew at the city office to gather our tools and fire truck driver John Howard. John was the past fire Chief and was familiar with running the fire truck. Paul, Kevin Mitchell, Danny and Kevin S and I along with Brent went started flushing at MH-5 as we were unable to locate MH 6 which is up line from MH – 5, we continued to flush to MH -1B. At MH - 3 we removed a root ball from the sewer line. Between MH – 1 and MH – 2 we removed a lot of grease and another root ball. After flushing the sewer line we started using the sewer camera to access its condition. Keven, Brent and I again started at MH – 5 and worked to MH – 1 with the CCTV. The computer battery got low when we were about half way through the sewer line CCTV. The city crew was able to observe and learn about operating the CCTV.

2/23/17 Keven, Brent and I continued with the closed –circuit television (CCTV) operation and the city crew worked with Agnes Marszalik, ANTHC Engineer, flushing by the Kootznoohoo lift station for Agnese's wastewater study. We wanted to complete the CCTV work before Brent departed on the afternoon flight. Once this was complete we cleaned our equipment in preparation for shipment. The firehoses were washed by the city crew and Kevin and I cleaned the sewer camera. Kevin and I delivered the equipment to Alaska Seaplane. I brought Keven to the water treatment plant and water storage tanks so that he would also be familiar with the Angoon water and wastewater facilities.
The Sewer line on Front Street should be replaced or rehabilitated. From observing the sewer line problems with the (CCTV). :
1) Large perforation at the top of the cast iron pipe near MH # 5.
2) By MH # 4, 19 feet from the MH, Inflow and Infiltration (I & I) Appears to be clean water.
3) From MH – 3, steady stream of water 3 to 4 gallons per minute (gpm), flowing through MH-3 and not through MH-4, water appears clean. A root ball was also found in MH-3.
4) From MH-1, Camera was under water most of the observation indicating a sag in the sewer line, not bedded properly.
5) Camera under water unable to see, possibly blockage around 10 feet from MH-2
6) MH-1 Pipe appears to be full of water. This 86 feet section of pipe appears to be not properly graded and is a long sagged line. This causes the fluid to flow slowly and solids to settle out in this section of line.
7) MH-1 at 67 feet on the top of the pipe appears to be another I & I around a service connection. This section of line also had sags in the line indicating improper bedding, causing water and debris to flow in slugs.

2/23/27 Keven and I departed Angoon on Alaska Seaplane for Juneau around 8: 45 am and arrived back in Anchorage around 4:00 pm.

On the Job Training Hours: 16

Critical Observations:
The sewer lines should have annual flushing done.

Noted Deficiencies:
1) Large perforation at the top of the cast iron pipe near MH # 5.
2) By MH # 4, 19 feet from the MH, Inflow and Infiltration (I & I) Appears to be clean water.
3) From MH – 3, steady stream of water 3 to 4 gallons per minute (gpm), flowing through MH-3 and not through MH-4, water appears clean. A root ball was also found in MH-3.
4) From MH-1, Camera was under water most of the observation indicating a sag in the sewer line, not bedded properly.
5) Camera under water unable to see, possibly blockage around 10 feet from MH-2
6) MH-1 Pipe appears to be full of water. This 86 feet section of pipe appears to be not properly graded and is a long sagged line. This causes the fluid to flow slowly and solids to settle out in this section of line.
7) MH-1 at 67 feet on the top of the pipe appears to be another I & I around a service connection. This section of line also had sags in the line indicating improper bedding, causing water and debris to flow in slugs.

Reoccurring: No

Follow Up Activities:
The sewer collection system should be flushed annually.

Entity to Follow Up: Community

Other Follow Up Information:
A 1 1/2 inch Whirlaway sewer cleaning Nozzle for flushing the collection system is available for purchased from:
Best Products
1590 Dutch Road
Dixon, Illinois 61021
Telephone: 1-800-323 - 1604 or through ANTHC, AUSC program:
John Sims at 907-729-3525
4 @ 50 foot sections of 1 1/2 inch fire hose will be needed for this flushing procedure.

RMW: Cody Uhlig
Region: ANTHC
Community: Angoon
Trip Dates: 7/27/2016 to 7/28/2016
Trip Type: Routine

Trip Contacts

Daniel Fredrickson, Water Operator

Accompanied By:

Martin Wortman, Other

Telephonic Contacts:

Lawrence George, City Clerk
Albert Kookesh III, Other
Paul Thomas, Water Operator Backup

Trip Details

Trip Purpose: 1. To meet with a representative from the City of Angoon to discuss the RAVG grant program, specifically the expectations and goals of the work and training.

2. To meet with the Angoon primary and backup water plant operators to discuss the efficiency and training program and to see what improvements can be made to simplify and maximize efficiency of water plant operations.

3. To tour the community and visit all water and sewer facilities to determine what upgrades and training would be beneficial.

4. To develop the energy efficiency work and training scope and parts list for work later this summer.

Trip Summary: Mr. Martin Wortman and I arrived in Angoon the afternoon of July 27 and discussed the RAVG requirements and goals. Mr. Thomas and I conducted the preliminary assessment and inspection of the water plant and the raw water intake. The second day started of with assessment. We began with the lift stations, community septic tanks and sewage sludge lagoon. After noon, we inspected the three community water tanks and the water plant. We departed Angoon the afternoon of July 28 and returned to Anchorage.

On the Job Training Hours: 16

Critical Observations:

While onsite, we discovered several items that need to be addressed with the Raw Water Intake:

• There are two lights – a panel area light and a wet well area light – that are not LED.
• Inside the panel, we discovered two problems. The first is that the VFD for pump No. 1 is inoperative. We tested the VFD and even inserted the human interface module from the VFD for pump No. 2 into pump No. 1's VFD and it did not work. Without the VFD operating, pump No. 1 cannot operate and thus the community is down to only one pump with which to make water. Additionally, we noted that when we first opened the panel it was extremely warm. The panel door was almost too hot to touch (by my estimate approximately 110oF), making the inside of the panel much hotter. This heat may have something to do with the malfunction of the VFD for pump No. 1.

While onsite, we discovered several items that need to be addressed for the Water Plant:
• Fluorescent lighting can be converted to LED.
• The Toyotomi space heaters need set-back temperatures programmed to cool down overnight.
• Both windows in the lab area are cracked.
• The vent fan in the chlorine room is not operational. The intake louver was corroded shut, but we were able to eventually work it open. The vent fan, however, is completely inoperative.
• The eyewash for the chlorine room was disconnected.
• The backflow preventer for the polymer make-up does not meet the definition of a reduced pressure principle assembly according to the 2009 Uniform Plumbing Code.
• One of the two differential pressure gauges for the pressure filters is inoperative.
• The large backwash flow indicator is not functional. This makes backwash difficult as the only other readouts are on the flow meter itself and the data logger.
• The operators requested help raising the start float for the polymer make-up system. It is currently set at approximately five gallons, however, this is extremely close to the polymer pump intake level and it is approximately 10 gallons below the bottom of the mixer.
• The chlorine pump flow pacing is not operating as designed. The operators must watch the chlorine level and manually change the pump settings to match the flow.

While onsite, we discovered several items that need to be addressed with the Water Storage Tanks and Distribution:
• There are several small leaks of approximately 1.5 gpm on the tall standpipe.
• The overflows on the lower townsite and the upper townsite water tanks are not covered.
• The lower townsite and upper townsite tank area is in need of clearing and grubbing. There is a large number of alders six feet and taller colonizing the site.
• There is evidence of leaks in the distribution system. Currently, the town uses roughly 80 gpm of treated water, however, based on generally accepted treated water use parameters, it should be closer to 30 gpm.

While onsite, we discovered several items that need to be addressed with the Wastewater:
• Lift station 1 needs pump No. 2 pulled and cleaned out. Pump No. 2 also needs a new contactor. The operators have agreed to pull pump No. 2 and clean it out.
• The community needs to implement a regular gravity main flush program and a lift station cleaning program.
• Lift station 2 is inoperative and has been for some time. The wastewater flows into the wet well

and into the overflow out into the channel. This is needs to be fixed.
• There are two fluorescent lights in lift station 2 that need to be upgraded to LED.
• According to the operators, the outfall is crushed, though wastewater still drains from the septic tanks.
• The operators need to be trained on the seasonal operation of the sludge lagoon to decant liquid.

Noted Deficiencies:
For the Water Plant

• The electric hot water heater does not have an automatic timer to shut off when the building is normally unoccupied. The hot water heater currently keeps water heated 24 hours a day, even though the operators work approximately four hours a day.
• The genset is not operational. It is missing its battery and Mr. Thomas said it has not run for more than three years. There is likely more wrong with it than a missing battery.
Reoccurring: No

Follow Up Activities:
Priority No. 1: Lighting Measures
1. Train on converting existing fluorescent and incandescent lighting fixtures, tubes, and bulbs to new energy-efficient LED lighting tubes and bulbs throughout the water and wastewater utility.
2. Train on converting exterior entrance lights to new energy-efficient LED wall packs with photocell light sensor.

Entity to Follow Up: Other

Priority No. 2: Raw Water
1. Train on installing and programming a new VFD for pump No. 1 in the wet well.
2. Train on installing a radiant cooling device or a fan to keep the panel cool during the summer.

Entity to Follow Up: Other

Priority No. 3: Water Plant
1. Train on programming the Toyotomi space heaters to set back temperatures during unoccupied periods.
2. Train on installing and programming a timer for operating the hot water heater intermittently.
3. Train on installing a new vent fan in the chlorine room
4. Train on getting the genset module operational again and provide a routine maintenance schedule for the generator.
5. Train on fixing and programming the large backwash display.
6. Train on raising the start float for the polymer make-up system.
7. Train on troubleshooting the chlorine pump flow pacing and get it operational again.

Priority No. 4: Water Tanks and Distribution

1. Train on installing mesh over the tank overflows
2. Perform a leak detection survey for the community to help them identify and locate leaks.
3. Train the city on clearing and grubbing the area around the water tanks on a regular basis.

Entity to Follow Up: Other

Priority No. 5: Wastewater
1. Train on repairing and priming the pumps in lift station 2 and getting the lift station back up and running.
2. Train on flushing the gravity sewer mains and provide a routine maintenance schedule for doing so.
3. Train on seasonal operation of the sludge lagoon decanting.

RMW: Brian Menghini
Region: DEC
Community: Angoon
Trip Dates: 9/28/2016 to 9/30/2016
Trip Type: Other

Trip Contacts

Timothy Eby, ANTHC Engineer
Paul Thomas, Water Operator Backup

Accompanied By:

Brian Menghini, ANTHC Engineer
Albert Howard, Mayor
Lawrence George, City Clerk
Daniel Fredrickson, Water Operator

Trip Details

Trip Purpose: • Water main leak detection throughout the community of Angoon.
• Training on items identified in the Angoon water treatment plant (WTP) RAVG training plan published August 2016.

Trip Summary: On the first day, Mr. Eby and Mr. Fredrickson began leak detection activities in the south stretch of town near the dock using an LD-12 leak detection device. That day approximately 35 percent of the planned investigation area was covered. Two locations were identified as being potential leaks in the water main. The positions of the leaks were captured using swing ties to known permanent features. In addition, two hydrants were found to exhibit sounds characteristic of a leak. At the time of the inspection, the leak detection team didn't have a hydrant wench, so they came back to the hydrants the next day to see if a flushing procedure would remedy the leak and remove any sediment trapped in the seal.

On Sept. 29, Mr. Eby and Mr. Fredrickson continued leak detection activities and covered the remaining 65 percent of the planned investigation area. There were no additional locations identified as having potential leaks in the water main, however two more hydrants were found to exhibit sounds characteristic of a leak.

Upon completion of leak detection activities, the hydrants with potential leaks were tightened and reexamined. Three of the four hydrants were found to be in working order after they were tightened. The last hydrant was re-inspected and it was determined that the sounds observed during the initial inspection were caused by a nearby service line that was in use at the time. All hydrants were determined to be in working order.

In summary, there were two potential subsurface water main leaks, no suspected hydrant leaks, and no suspected isolation valve leaks. Mr. Eby and I met with Mayor Howard following leak detection activities to discuss our findings and then completed training.

On the Job Training Hours: 0

Critical Observations:

• Training on converting exterior mid-wall lights with LED spotlights with photocell light sensors.
o Not applicable; no exterior mid-wall lights were encountered.

• Training on programming the water plant diesel-fired space heaters (Toyotomis) to maximize energy efficiency in the heating of the water plant.
o Complete. However, the diesel-fired heater in the filter room causes excessive condensation to form on the water pipes. A freezing event in the filter room is unlikely, but operation of the heater should be left to the discretion operator.

• Training on sealing all pipe penetrations with spray foam to reduce air leaks.
o Pipe penetrations will be sealed during a follow-up training trip.

• Supply and training on installation of a new door for the generator room.
o Door will be replaced during a follow-up training trip.

• Supply and training on installation of new windows for the water plant office.
o The windows will be replaced during a follow-up training trip.

• Training on installing and programming a new variable frequency drive (VFD) for pump 1 at the raw water intake.
o Partially complete. Operator is trained and will install the VFD.

• Training on flushing the gravity sewer mains and cleaning the lift station wet wells and provide a routine maintenance schedule for doing so.
o Partially complete. Discussed the importance of regular flushing and cleaning with the operators. A routine maintenance schedule will be provided during a follow-up training trip.

• Training on seasonal operation of the sludge lagoon decanting.
o Training will be provided during a follow-up training trip.
• Training on installing and programming a timer for operating the hot water heater intermittently.
o Complete. Discussed with the operators the energy demands associated with running the hot water heater. The operators stated that the hot water heater is rarely used, and that they only energize it temporarily when there is a need for hot water.

• Training on installing a new vent fan in the chlorine room.
o Complete. The old vent fan was removed and the new vent fan wiring was connected. The new fan is slightly larger, so minor modifications were required on the fan mounting surface. The operators were trained on the modification and will complete the installation.

• Training on raising the start float for the polymer make-up system.
o Partially complete. Upon investigation, the float switch was determined to be a multilevel switch with factory-set switch levels that cannot be modified. An alternative remedy is to install a longer impeller shaft to ensure the impeller is always submerged. This was discussed with the operators and will be completed during a follow-up training trip.

• Training on troubleshooting the chlorine pump flow pacing and restore the flow pacing functionality.
o Chlorine pump troubleshooting will be completed during a follow-up training trip.

• Training on repairing and programming the large backwash display.
o Partially complete. The backwash display electronics were investigated and found to be disconnected. The wiring was not reconnected because a comprehensive installation manual for the unit was not available onsite. In addition, a full plant shutdown is required prior to wiring hookup. The backwash display will be returned to service during a follow-up training trip.

Noted Deficiencies:
Two locations were identified as being potential leaks in the water main. The positions of the leaks were captured using swing ties to known permanent features. In addition, two hydrants were found to exhibit sounds characteristic of a leak. At the time of the inspection, the leak detection team didn’t have a hydrant wench, so they came back to the hydrants the next day to see if a flushing procedure would remedy the leak and remove any sediment trapped in the seal. On Sept. 29, Mr. Eby and Mr. Fredrickson continued leak detection activities and covered the remaining 65 percent of the planned investigation area. There were no additional locations identified as having potential leaks in the water main, however two more hydrants were found to exhibit sounds characteristic of a leak.

Upon completion of leak detection activities, the hydrants with potential leaks were tightened and reexamined. Three of the four hydrants were found to be in working order after they were tightened. The last hydrant was re-inspected and it was determined that the sounds observed during the initial inspection were caused by a nearby service line that was in use at the time. All hydrants were determined to be in working order.

In summary, there were two potential subsurface water main leaks, no suspected hydrant leaks, and no suspected isolation valve leaks. Mr. Eby and I met with Mayor Howard following leak detection activities to discuss our findings and then completed training.

Reoccurring: No

Follow Up Activities:
The WTP plant was in good working order and very clean when we arrived. The operators are very knowledgeable about the system and work to keep it tidy and well maintained. The operators were engaged throughout the training and eager to learn how to run their systems more efficiently.

Leak detection activities were successful in exposing a small number of deficiencies in the water main, some of which were rectified on site (e.g., flushing hydrants to clear debris). To aid in maintaining the water lines and searching for leaks in the future, it is recommended that the city evaluate the procurement of an LD-12 listening device. Retail price for an LD-12 unit is approximately $3,000.

The primary objectives for the site visit (LED lighting upgrades and leak-detection activities) were accomplished, as well as several of the remaining objectives. The operators are trained on many of the remaining tasks and are capable of implementing those upgrades. Any remaining audit priority activities will be satisfied during the follow-up training trip.

The following activities will be completed by the operators:
• Installing and programming a new VFD for pump 1 at the raw water intake.
• Completing installation of the chlorine room ventilation fan.
• Installing side and top door sweeps on the remaining WTP exterior doors.

The following activities will be completed with the assistance of ANTHC during a follow-up training trip:
• Sealing all pipe penetrations with spray foam to reduce air leaks.
• Supply and training on installation of a new door for the generator room.
• Supply and training on installation of new windows for the water plant office.
• Provide a routine maintenance schedule for flushing gravity sewer mains and cleaning the lift station wet wells.
• Training on seasonal operation of the sludge lagoon decanting.
• Additional training on scheduled operation of the hot water heater.
• Training on installing a longer impeller in the polymer mixing tank.
• Training on troubleshooting the chlorine pump flow pacing and restoring flow pacing operation.
• Training on programming the large backwash display.
• Training on restoring operation to the genset module and providing a routine maintenance schedule.
• Training on repairing and priming pumps in lift station 2 and restoring lift station operation.
• An additional outdoor LED light with photocell should be installed at the raw water intake.

Entity to Follow Up: Other

APPENDIX H: GEOTECHNICAL REPORT

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October 16, 2020 Project No. 20365522

Vanessa Wike, PE
Bristol Engineering Services Company, LLC
111 W. 16th Ave, Third Floor
Anchorage, AK 99501

GEOTECHNICAL CONSIDERATIONS, WATER SOURCE IMPROVEMENTS, ANGOON, ALASKA

Vanessa:

Golder Associates Inc. (Golder) is pleased to present our desktop data review and preliminary geotechnical considerations for the potential water source improvements for the community of Angoon, Alaska. Our services were provided as part of the Preliminary Engineering Report (PER) and engineering assistance scope of services for this project. This submittal is provided as a draft document for your review. We will provide a final submittal pending review comments. Our services are provided in general accordance with our professional services agreement with Bristol Engineering Services Company, LLC (BESC).

1.0 SUMMARY PROJECT UNDERSTANDING

BESC has been contracted by Alaska Native Tribal Health Consortium (ANTHC) for the design of a new surface water intake system for the City of Angoon, Alaska (Figure 1). The surface water intake system is proposed to be a public water source (PWS) located in the sub-basin in the Favorite Bay Creek watershed, southeast of Angoon (Figure 2). The current water source for the City of Angoon is a surface water pond, Auktah Lake. We understand the current water supply source currently held intact, at least partially, by a beaver dam that is considered to be at risk of failure. We also understand the current raw water source has relatively poor water quality. Reportedly, the community experienced water shortages due to low water levels during warm summer conditions. At times, we understand the current water source may not meet the community's water demand.

A preliminary assessment at the Favorite Creek location indicated a relatively small concrete dam structure could be constructed for a permanent raw water reservoir. Base on our recent discussions, and alternative intake structure as an infiltration gallery may be preferred to a concrete dam reservoir.

The purpose of this submittal is to provide geotechnical considerations for both the previous concrete dam concept and geotechnical considerations for an infiltration gallery using a small surface diversion structure. Both facilities will be located at Favorite Creek as a PWS for the City of Angoon.

Key elements of our scope of services included the following key items:

Golder Associates Inc.
2121 Abbott Road, Suite 100, Anchorage, Alaska, USA 99507 T: +1 907 344-6001 F: +1 907 344-6011

- Review ‘in-house' geotechnical data files, aerial imagery, and stereo pairs to aid in identifying geologic features near Favorite Creek that may impact the geotechnical considerations for both a small dam and an intake structure.
- Provide preliminary geotechnical considerations at the potential Favorite Creek location for a relatively small concrete dam and an infiltration galley for PER level cost estimating, scheduling and planning.

Dams and infiltration galley structures will require detailed, site specific geotechnical investigations to support engineering design. This submittal is not developed nor intended to meet the geotechnical standard of care for a final engineering design effort. This submittal is intended to provide summary a geologic and geotechnical conceptual model of the anticipated site conditions at the Favorite Creek location as a baseline document to support developing the scope and budget for the final engineering design once the selected raw water source structure is determined.

2.0 PROJECT LOCATION

Angoon is located on Admiralty Island, one of the major islands of the Alexander Archipelago of southeastern Alaska. It trends in a northerly direction. The island is bounded by Stephens Passage, Frederick Sound, Chatham Strait, and Lynn Canal, all inland waterways.

The City of Angoon, the only permanent settlement on Admiralty Island located on the southwest coast of Kootznahoo Inlet. Angoon is 55 miles south of Juneau and 41 miles northeast of Sitka. Favorite Bay is located to the southeast of Angoon and the Favorite Creek drainage lies to the southeast of Favorite Bay.

The Favorite Creek sub-basin, delineated to the proposed water source improvement location, is located at approximately 350 feet elevation with an estimated drainage area of 2.3 square miles. The sub-basin is densely vegetated with hemlock and spruce, with heavy ground bush cover. Limited site reconnaissance efforts have been conducted in the Favorite Creek sub-basin.

3.0 REVIEW OF EXISTING DATA

Available existing data was reviewed to develop our understanding of the local geology and the potential geotechnical site conditions. Neither a site-specific reconnaissance nor a geotechnical investigation were authorized for the current scope of services. Thus, we have relied extensively on existing site data to develop our baseline geologic and geotechnical model. The available data we reviewed included the following:

- **Angoon Landfill Geological and Hydrogeological Assessment**, **Golder Associates 2000**: Describes the surface and near surface geology for three prospective landfill locations and identified an existing material borrow site along the road to the current water treatment plant. According to the report, bedrock was generally shallow except in some boggy areas where peat had accumulated in excess of 10 feet thick.
- **Favorite Creek Watershed Hydrologic Evaluation, Golder 2010:** Evaluates the feasibility of using Favorite Creek as a PWS for the City of Angoon. Concluded that based on the gauge data and available period of record, and low-flow calculations performed, it appears Favorite Creek will meet the low flow requirements for the city’s expected needs.
- **Preliminary Site Reconnaissance for Bear Ridge Subdivision Roads, Golder 2012**: Reconnaissance-level effort that included visual observations and shallow hand probes in select areas along an undeveloped

alignment. Geologic hazards, ground conditions, drainages and road constructability were generally identified and provided to support the roadway alignment civil design concepts.

4.0 REGIONAL GEOLOGY

Admiralty Island was extensively glaciated during the Pleistocene Epoch resulting in glacial geomorphic U-shaped valleys, elongated lakes, and fiords. Since the last major glaciation the area has experienced over 300 feet of uplift related to rebound.

The island is comprised of sedimentary, metamorphic, and igneous rocks. Most of the bedrock in the vicinity of Angoon has been mapped as the Gambier Bay Formation consisting of Devonian age schist with thick marble lenses. The marble unit within the Gambier Bay Formation has the potential to form karst topography, which is characterized by sinkholes on the ground surface and solution channels within the bedrock that often include networks of caves and springs.

The area underlying Favorite Creek is mapped as undifferentiated metamorphic rocks. (Lathram, Pomeroy, Berg, and Loney, 1965). This creek displays unique stream geometry. There are multiple locations along the creek where the water courses abruptly change at nominal 90-degree angles. This is likely a result of the fault systems that are present throughout the island. The area is considered to be heavily faulted with two major fault sets that intersect at roughly 90 degrees to one another. One set of faults trends northeast to southwest and the other trends northwest to southeast. (Lathram, Pomeroy, Berg, and Loney, 1965).

It appears the local structural geology is influencing the drainage patterns along Favorite Creek. If the geologic structures controlling the surface water geometries are related to faults for regional discontinuities (rock joint systems), as we expect, fractured rock, gauge or other infilling materials along faults or rock joint planes can have a significant impact on surface and groundwater hydrology. Structural geologic conditions can also have significant impacts to the performance surface structures such as dam, reservoirs, and infiltration galleys. Careful attention to the area and local structural geology as well as rock mass characteristics will be critical design phase geotechnical evaluations.

5.0 SEISMIC DESIGN PARAMETERS

Based on the subsurface conditions of Angoon and Favorite Creek and the reasonably anticipated site development procedures, we recommend applying seismic “Site Class B” as an estimate of site response, which is defined as “rock” according to the AASHTO Design Specifications (AASHTO, 2018).

The parameters used in seismic design per current AASHTO standard specifications are determined based on the mapped spectral response associated with earthquake ground motions that have a seven percent probability of exceedance in 75 years (Approximately 1,000-year return period), and the site classification. Table 1 provides recommended seismic design parameters for the Angoon Water Resource Improvement (USGS, 2020).

Table 1: Seismic Design Parameters - Site Class B (USGS, 2020)

Seismic Design Parameter	**Value**
Peak Ground Acceleration (PGA)	0.238g
Zero-Period Site Factor (F_{PGA})	0.9
Peak Seismic Ground Surface Acceleration (A_S)	0.238g
Short Period Spectral Acceleration (S_S)	0.586g
One Second Period Spectral Acceleration (S_1)	0.416g
Design Short Period Spectral Acceleration (S_{DS})	0.351g
Design One Second Period Spectral Acceleration (S_{D1})	0.222g
Site Amplification Coefficient at 0.2 second (F_a)	0.9
Site Amplification Coefficient at 1.0 second (F_v)	0.8

6.0 DISCUSSION AND GEOTECHNICAL CONSIDERATIONS

We have developed preliminary geotechnical considerations for the infiltration galley and the concrete dam option. A shallow surface diversion structure may be included with the infiltration galley option. Based on our recent discussions, the infiltration galley option appears to be favored over a concrete dam and water impoundment reservoir option.

6.1 Infiltration Gallery

An infiltration galley concept would include one or more shallow vertical wells connected to a shallow water source, most likely in or adjacent to the Favorite Creek channel. Adjacent fill pads are anticipated for support infrastructure and connection to the raw water supply pipeline to the village.

For the geologic environment around the planned development area, existing near surface aquifer thickness are almost assuredly insufficient to supply the required volume of water to vertical wells on a consistent basis. A typical example occurs in a river valley where thin alluvial deposits overlie bedrock, as expected at this site. In this case, transmissivity is severely limited because the aquifer deposits are thin. Under these hydrologic conditions, infiltration galleries can be placed in permeable alluvial materials either adjacent to a water body or beneath its bed. Due to the observed shallow bedrock, rock blasting is expected to develop and adequate sized zone to the required supply well intake depth.

A significant quantity of water may be pumped from an infiltration gallery because the hydraulic conductivity of the natural material and the filter pack surrounding the well screens allows for recharge sufficient to meet the desired raw water pumping rate. Because the screens are placed in excavations with select backfill, the usual practical depth limitation is approximately 25 feet. Water entering the screen is often collected in a sump constructed beneath the end of the screens. A large sump can serve as a storage chamber if the infiltration rate is low.

The decision of whether to place the gallery adjacent to or under the riverbed depends on several factors:

- **Yield requirements:** Galleries places under a body of water initially produce twice the yield of galleries placed adjacent to the water body. As the disturbed riverbed assumes its normal sedimentation regime, however, the transmissivity values will fall as finer grained particles infiltrate the filter pack material surrounding the screens.
- **Water quality requirements:** Galleries located adjacent to a water body usually receive water that has a lower turbidity and fewer bacteria than bed-mounted galleries, because the water has been filtered more extensively.
- **Construction difficulties:** It is generally more difficult to install a gallery beneath a stream bed.
- **Maintenance considerations:** Maintenance and repairs are easier to perform on galleries installed adjacent to a water body. In general, more maintenance is required for bed-mounted galleries because fine material is continually added to the top of the filter pack by stream current.
- **Stability of the river channel:** Rivers may meander greater distances over relatively short periods, and either carry away a gallery placed on the bank or cover completely a bed-mounted gallery with less permeable material. Changes in the elevation of a water body can also affect where the gallery is placed. For example, the available head may drop considerably in intermittent streams during dry seasons of the year, but flow though the underlying sand and gravel usually continues. At the proposed site, we anticipate structural geology strongly influences the surface water drainage geometry. Based on our interpretation of the local geology, we do not anticipate significant water channel migration or morphology over time.

A major design principle for infiltration galleries involves the orientation of the screen relative to the surface water or groundwater flow directions. For bed-mounted galleries, the screen is oriented perpendicular to the stream flow. For bank-mounted galleries, the screen is placed perpendicular to the groundwater flow to minimize the head loss; that is, the screen is placed parallel to the stream or river.

For the Favorite Creek site, we envision and drill and blast approach to developing an appropriately sized infiltration galley. If the drainages are controlled by geologic faults or discontinuities, the infiltration design will need to consider seepage loss as part of the system design. Once excavated, the select backfill material, filter pack material, and infiltration system geometry is to be determined in coordination with the engineering team. General design criteria for infiltration galleries include the following:

1) Entrance velocity through the screen slope openings should be 0.1 foot/second or less.
2) Axial velocity inside the screen should be 3 feet/second or less, so that the head loss will be 1 foot or less.
3) Screen slot is predicated on the grain size distribution of the filter pack always retain 100-percent of the filter pack.
4) Construct the infiltration gallery with stainless steel in freshwater systems.
5) General filter pack recommendations include:
    a. The surface area of the filter pack material is determined based on water entering the pack at a rate of 2 to 5 gallons per minute (gpm) per sq. ft of surface area. The actual hydraulic conductivity of the pack is usually much higher.

b. Filter pack design is similar to that for vertical well, but with a slightly more liberal multiplier of 6 to 7 times the 70-percent-retanied size.

c. Filter pack material should be clean, siliceous, rounded, and uniform.

6.1.1 Infiltration Gallery Maintenance

Based on the controlling structural geology surrounding Angoon, maintenance may be a critical design factor due to system displacement or leakage into the subsurface. Maintenance may also be difficult depending on the configuration of the screen and where it is placed. Therefore, it is important to observe several operational criteria that will reduce or eliminate maintenance problems. These include the following:

1) Do not exceed the designed pumping rate. Higher pumping rates may cause finer grained sediments to enter the filter pack, reducing its permeability. Eventually, sand may enter the screens and block part of the intake openings, causing even more sand pumping.

2) Do not let the screens become aerated to reduce iron bacteria problems. Near-surface waters are often high in iron and the rapid growth of iron-ingesting bacteria can clog the gallery. Inorganic deposits of magnesium, calcium, and other ions may also form.

3) Do not let the gallery go unused for long periods. Inactivity tends to lower the hydraulic conductivity of the filter pack and surrounding materials.

6.2 Surface Diversion Structure

To complement an infiltration basin geometry and storage capacity, a surface diversion structure may be considered. This would aid with the infiltration gallery system, while allowing surface water to flow in order to reduce accumulated organic debris and sediment accumulation, therefore reducing maintenance and blockages. Climate change and general warming trends seem to be increasing the rate of organic decay.

A surface diversion structure would typically be engineered fill using appropriate sized and mass material for the stream velocity, seasonal icing and surge state hydraulics. We would work with the engineering team to develop geotechnical considerations for the diversion structure geometry, orientation, and fill material as part of the design phase.

6.3 Impoundment Structure

The current preliminary design included a cast-in-place concrete dam on Favorite Creek. A relatively small reservoir impoundment would be created behind the dam structure. Prior studies indicate this would be a 16-foot high, 150-foot wide reinforced concrete structure. There is no site specific geologic or geotechnical data at the proposed dam structure locations. Likewise, there is no site-specific geotechnical, geologic or hydrogeologic information at the impoundment site. Design for both the dam structure and the impoundment will require site and project specific geologic, geotechnical and hydrogeologic evaluations.

For conceptual phase effort, the impoundment geotechnical considerations should address:

1) Dam structure anchorages should be secured into competent bedrock along the impoundment base and sides. This would be expected to require rock blasting, scaling and cast-in-pace keying. Grouted anchors between the dam structure and the prepared rock will most likely be required for resistance to shear and uplift forces.

2) Determination of local structural geology and karst terrain are critical design elements. If karst terrain is expected or present, significant geologic and engineering controls may be required.

3) Seepage may occur beneath the impoundment that may required grouting as well as downstream pressure relief wells.

4) A spillway and energy dissipation at the toe of the spillway should be incorporated in order to protect the creek from erosion and deformation.

5) A side-slope stabilization assessment is recommended along the impoundment.

6) The impoundment design will need to follow all dam safety requirements, even if the dam structure falls outside the Alaska Department of Natural Resources (ADNR) regulatory control.

7) A detailed geotechnical and hydrogeologic assessment for Favorite Creek should be conducted for the final impoundment design in order to identify key design criteria.

An impoundment structure requires significant design and construction efforts, which are further intensified by the surrounding seismicity and fault-controlled geologic structure.

7.0 USE OF REPORT AND CLOSURE

This assessment has been prepared exclusively for Bristol Engineering Services Company for the water source improvements in Angoon, Alaska. As the project engineering is advanced, we should be retained to provide geologic and geotechnical consulting services. If there are significant changes in the nature, design, or location of the proposed development, we should be notified so that we may review our data findings in light of the proposed changes and provide a written modification or verification of the changes.

Reliance on historic geologic and geotechnical data developed by others should be reviewed and used by the project permitting, planning and design teams with appropriate caution. There are possible variations in subsurface conditions between explorations reviewed for this submittal and with time. Therefore, observation and testing by a qualified geotechnical engineer should be included during the design phase and construction to provide corrective recommendations adapted to the conditions revealed during the work. In addition, a contingency for unanticipated conditions should be included in the construction budget and schedule. The work program followed the standard of care expected of geotechnical professionals undertaking similar work in the State of Alaska under similar conditions. No warranty expressed or implied is made.

It has been a pleasure to assist you with this project. Please contact us if you have any questions or require additional information.

Sincerely,

Golder Associates Inc.

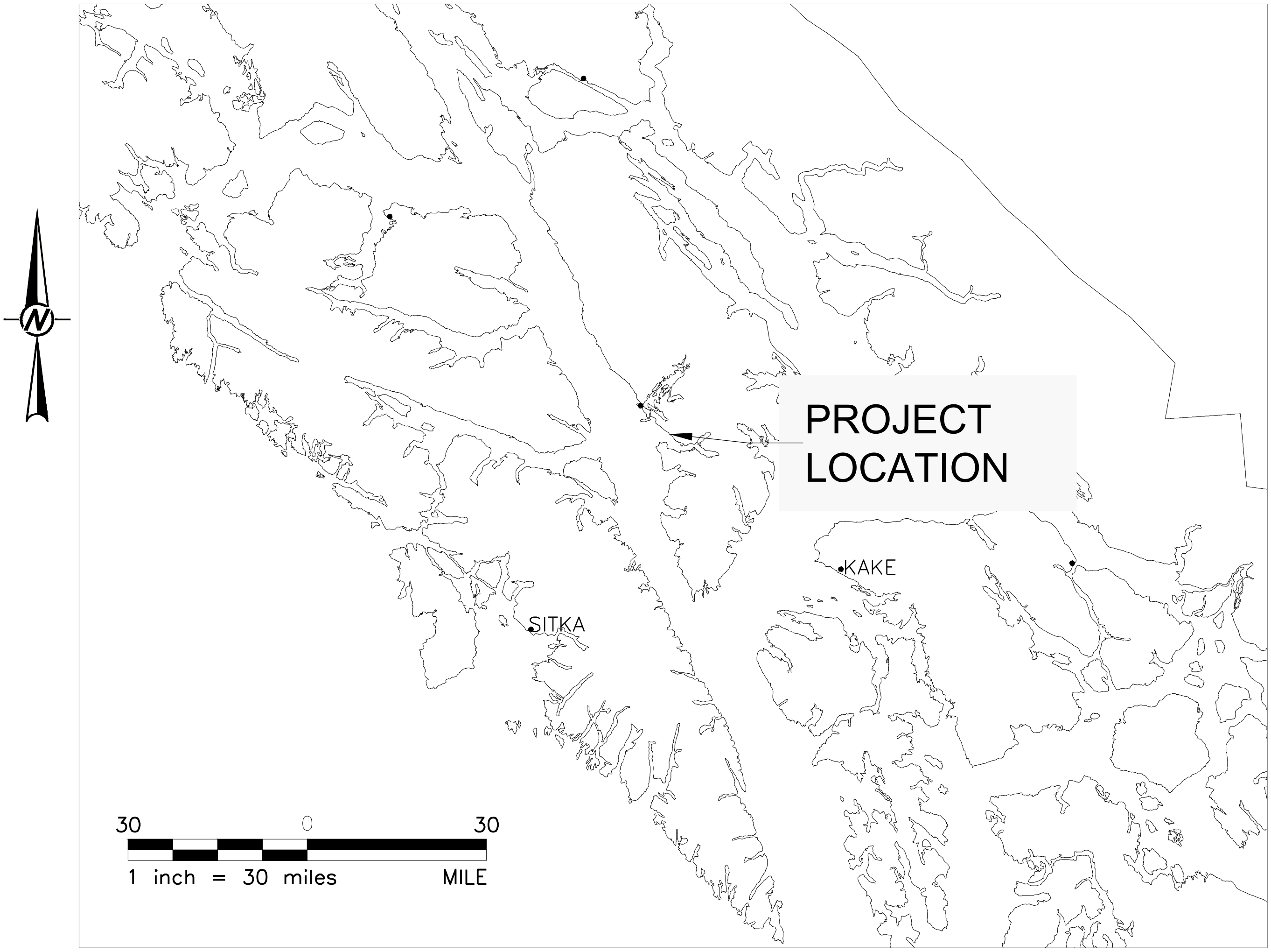
Draft submittal for BESC review, no signatures

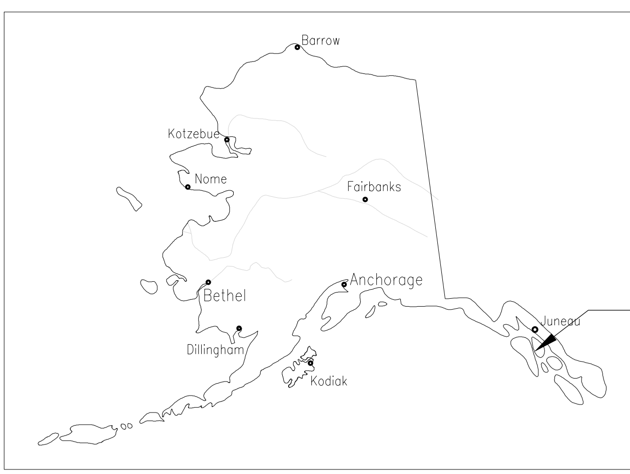
Robert Sanders, EIT
Geotechnical Engineer

Jessa Karp
Geologist

Richard Mitchells, PE
Principal

Attachments: Figure 1: Vicinity Map
Figure 2: Site Map





CLIENT
BRISTOL ENGINEERING SERVICES COMPAN,Y LLC

PROJECT
ANGOON WATER SOURCE

ANGOON, ALASKA

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-14
DESIGNED	-
PREPARED	APG
REVIEWED	RTS
APPROVED	-

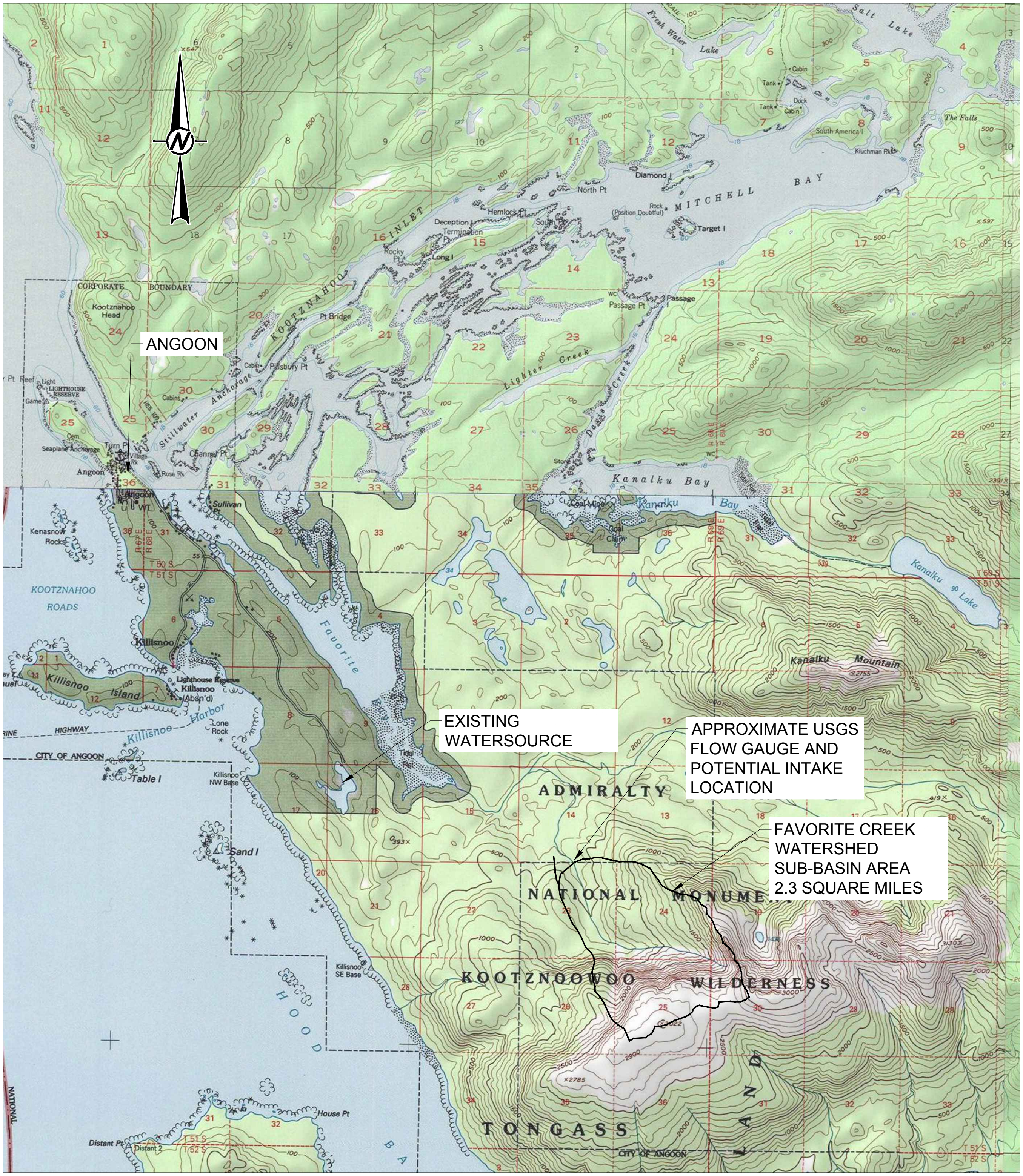
TITLE
VICINITY MAP

PROJECT NO.	CONTROL	REV.	FIGURE
20365522		A	1

Last Edited By: agarrigus Date: 2020-10-14 Time:12:49:10 PM | Printed By: AGarrigus Date: 2020-10-14 Time:12:51:28 PM
Path: \\Anchorage\Public\Geomatics\BESC\Angoon\99_PROJECTS\20365522 Bristol Angoon Water Source PER\0001\02_PRODUCTION\DWG\ | File Name: 20365522.001.001.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A
0
1 in

Draft for BESC Review 16Oct2020



8000 0 8000

1 inch = 8000 feet

Feet

REFERENCE: USGS TOPO MAP DEVELOPED BY AND DISTRIBUTED BY U.S.G.S.

CLIENT	PROJECT
BRISTOL ENGINEERING SERVICES COMPAN,Y LLC	ANGOON WATER SOURCE ANGOON, ALASKA

CONSULTANT

GOLDER

YYYY-MM-DD	2020-10-14
DESIGNED	-
PREPARED	APG
REVIEWED	RTS
APPROVED	-

TITLE
LOCATION MAP

PROJECT NO.	CONTROL	REV.	FIGURE
20365522		A	2

Draft for BESC Review 16Oct2020

APPENDIX I: EQUIPMENT INFORMATION

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INTAKE SCREEN

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Aqseptence Group, Inc.
1950 Old Hwy 8 NW
New Brighton, MN 55112
Tel no : 1-800-833-9473
Fax no : 651 - 638 - 3132

Aqseptence Group

Sold-to address
WATER PROCESS
NEW BRIGHTON MN

Ship-to address
WATER PROCESS
NEW BRIGHTON MN

Quotation

Number/Date 20093047 / 04/07/2021
Reference no./Date Angoon, AK
Sold-To 10004012
Validity period 04/07/2021 to 04/07/2021
Sales person name Todd Latchaw
Entered by Billy Emmers

We deliver according to the following conditions:
Currency USD
Terms of payment: Quote in Process
Terms of delivery: FCA New Brighton, MN
Shipping conditions : US: Collect

BUDGET QUOTE

Contact: Jay Lavoie
Email: jay@estimations.com
Tel: 907-280-9406

NOTE:

- Johnson Intake Screens are covered by one or more of the following patents - #6,05,131; #6,712,959; #8,297,448; other patents pending

- Price does not include taxes, fees or freight

- The quoted screen assembly does not have a hydroburst system or internal piping for air bursting, therefore the screen will have to be periodically cleaned by other means.

- Johnson will warranty their goods for 1 year from start up or 18 months from delivery – whichever date occurs first

- Due to site specific conditions - bolting and anchoring hardware is outside of Johnson Scope and will be provided by others.

- Johnson will take exception to all that is not explicitly stated in our offer.

- Intake has been sized with an assumed 0.125" Slot and 0.5 fps thru slot velocity. Deviations from these assumptions will affect intake size / pricing

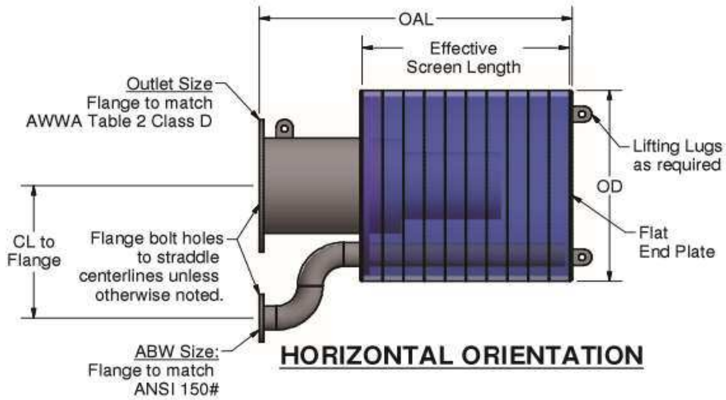
INTAKE MANUFACTURING LEAD TIME
2-3 weeks for drawing submittal
4-6 weeks after drawing approval, subject to manufacturing capacity and material availability at time of approval

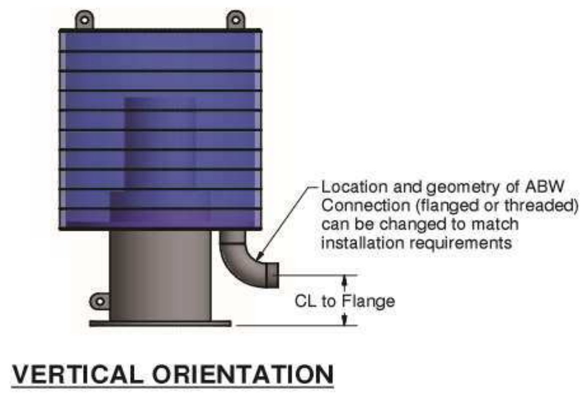
REV-A 4/7/2021

Item	Material Description	Qty	UoM	Price		Value
000010	240657 Johnson S12HC Intake Screen	1.000	EA	3,581.00	USD	3,581.00

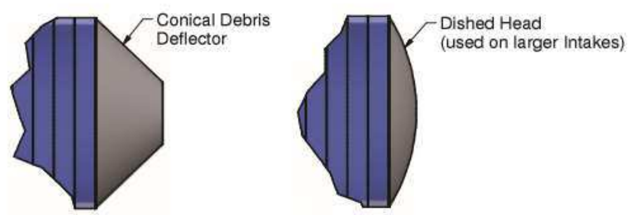
S12 High Capacity Intake Screen
Wire: #69
Slot: 0.125"
Material: 316L Stainless Steel
Air Backwash: NONE
Flow: 225 GPM / Screen has under 0.5 ft/sec max thru slot velocity @ 30% Blocked
Installation Depth: 10 ft
Collapse Rating: 4.33 PSI
Outlet: Outlet pipe with a Flange pattern to match AWWA C-207 class D 8" PS
End connection: Endplate x Flange

Items total			3,581.00
Tax Jur Code Level 1	0.000	3,581.00	0.00
Final amount			3,581.00





Optional End Closures



Dimension/Sizes	Value	Unit	Comments
Model	S12HC		
OD	12.50	in	Nominal See note 1
OAL	17.00	in	Nominal See note 1
CL to Flange	6.00	in	Nominal See note 1
Outlet Connection Size	8PS		See note 2
ABW Connection Size	none		See note 2
Estimated Weight	80	lbs	
Left End Closure	Plate		
Right End Closure	N/A		
Intake Orientation	Vertical		

Screen Specifications			
Slot Opening	0.125	in	
Open Area Percentage	63.78%		0% Blocked
L/D Ratio	0.750		Effective Screen Length / OD
Effective Screen Length	9.50	in	
Wire Type	69		

Design:			
Depth	10	Ft	Hydrostatic Load
Collapse Rating	4.34	psi	
Material	316L		SS or Z-Alloy

Flow Capacities:			
Flow/Screen	225	GPM	See note 3
Maximum Slot Velocity	0.33	fps	See note 3 0% Blocked
Average Slot Velocity	0.30	fps	See note 3 0% Blocked
Estimated DP/Screen	0.0009	psi	Thru clean screen surface only-See note 4
Estimated DP/Assy	0.0382	psi	Through entire clean assembly - See note 4

PATENT #
#6,051,131

Notes:

1 Dimensions shown are nominal. All screens are made to order and can be adapted to a wide variety of installation requirements.

2 Outlet and ABW connections are based on the size of the connecting and abw pipe and may vary from the values listed in the technical brochure.

3 Flow capacities are based on use of the patented Johnson Screens flow modifier design.

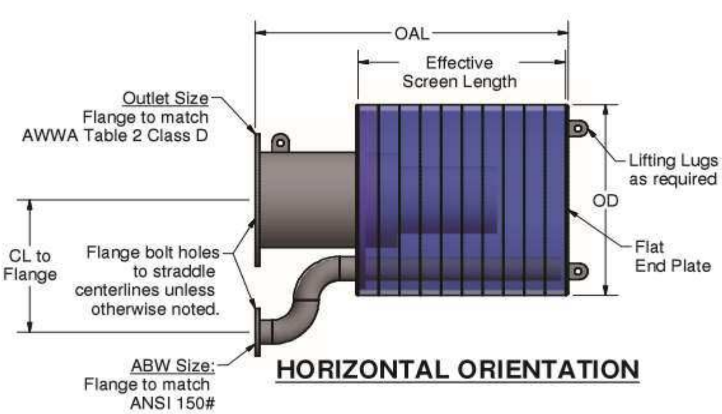
4 Pressure drops below 0.1 psi should be considered an order of magnitude only, as testing data for these low values is not available.

Johnson Screens
1950 Old Hwy. 8, New Brighton, MN 55112
(651)-638-3151 (Phone), (218)-206-9004 (Fax)

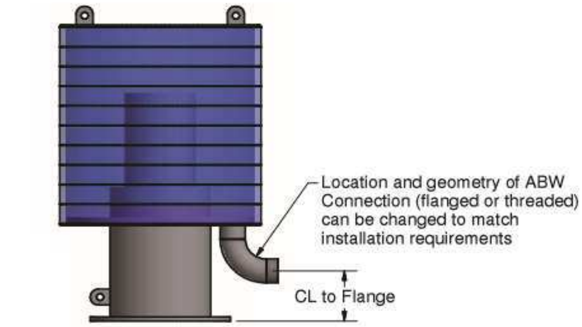
Model S12HC

Preliminary Intake Screen Specification
Angoon, AK
0% Blocked

Date:
4/7/2021

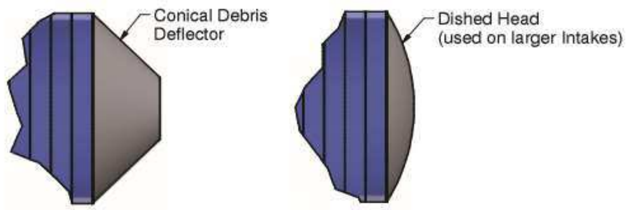


HORIZONTAL ORIENTATION



VERTICAL ORIENTATION

Optional End Closures



Dimension/Sizes	Value	Unit	Comments
Model	S12HC		
OD	12.50	in	Nominal See note 1
OAL	17.00	in	Nominal See note 1
CL to Flange	6.00	in	Nominal See note 1
Outlet Connection Size	8PS		See note 2
ABW Connection Size	none		See note 2
Estimated Weight	80	lbs	
Left End Closure	Plate		
Right End Closure	N/A		
Intake Orientation	Vertical		

Screen Specifications			
Slot Opening	0.125	in	
Open Area Percentage	44.64%		30% Blocked
L/D Ratio	0.750		Effective Screen Length / OD
Effective Screen Length	9.50	in	
Wire Type	69		

Design:			
Depth	10	Ft	Hydrostatic Load
Collapse Rating	4.34	psi	
Material	316L		SS or Z-Alloy

Flow Capacities:			
Flow/Screen	225	GPM	See note 3
Maximum Slot Velocity	0.48	fps	See note 3 30% Blocked
Average Slot Velocity	0.43	fps	See note 3 30% Blocked
Estimated DP/Screen	0.0018	psi	Thru clean screen surface only-See note 4
Estimated DP/Assy	0.0392	psi	Through entire clean assembly - See note 4

PATENT #
#6,051,131

Notes:

1 Dimensions shown are nominal. All screens are made to order and can be adapted to a wide variety of installation requirements.

2 Outlet and ABW connections are based on the size of the connecting and abw pipe and may vary from the values listed in the technical brochure.

3 Flow capacities are based on use of the patented Johnson Screens flow modifier design.

4 Pressure drops below 0.1 psi should be considered an order of magnitude only, as testing data for these low values is not available.

Johnson Screens
1950 Old Hwy. 8, New Brighton, MN 55112
(651)-638-3151 (Phone), (218)-206-9004 (Fax)

Model S12HC

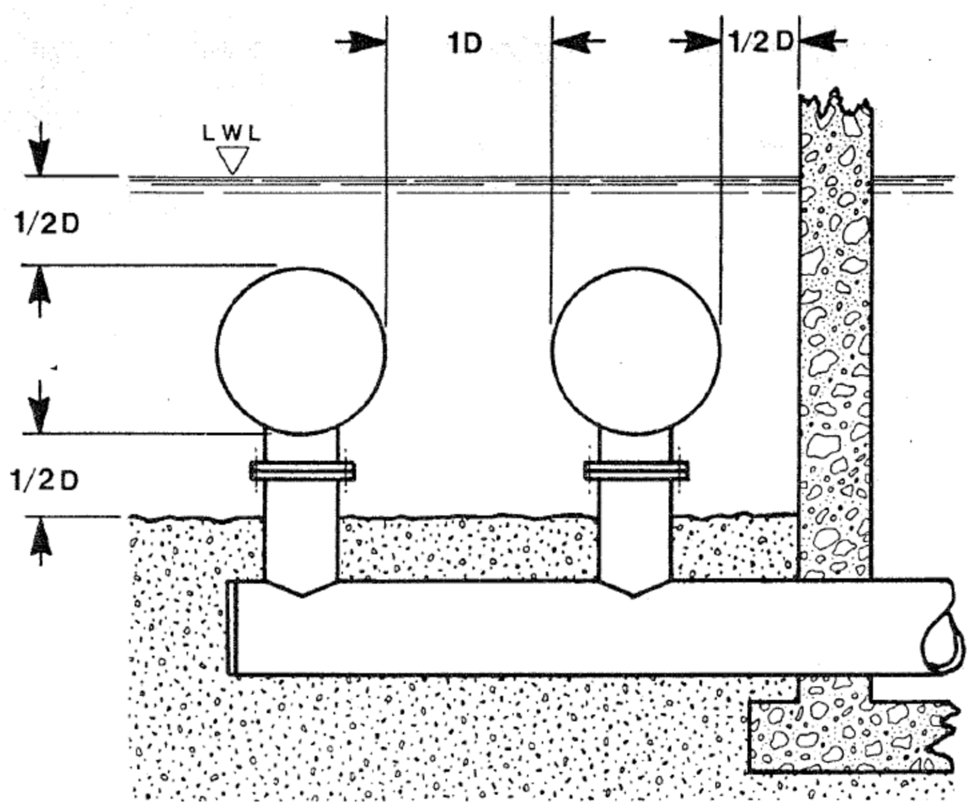
Preliminary Intake Screen Specification
Angoon, AK
30% Blocked

Date:
4/7/2021

Suggested manifold concepts for Intake Screens & General Design Conditions:

Boundary Clearances:

- The minimum distance between the screen and any boundary in a radial direction, included the water surface, should be one-half screen diameter.
- The minimum distance between adjacent screen surfaces should be one screen diameter.
- Clearances should be maintained and increased if site conditions are subject to icing or sedimentation.

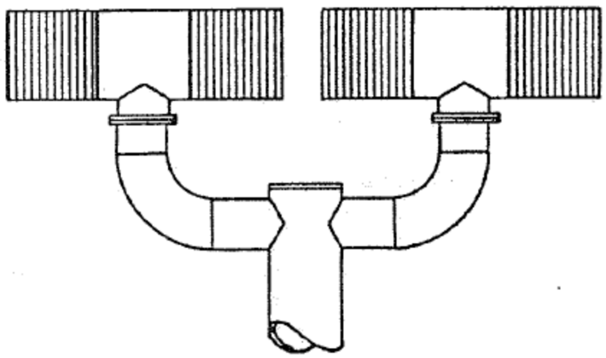


Manifolding:

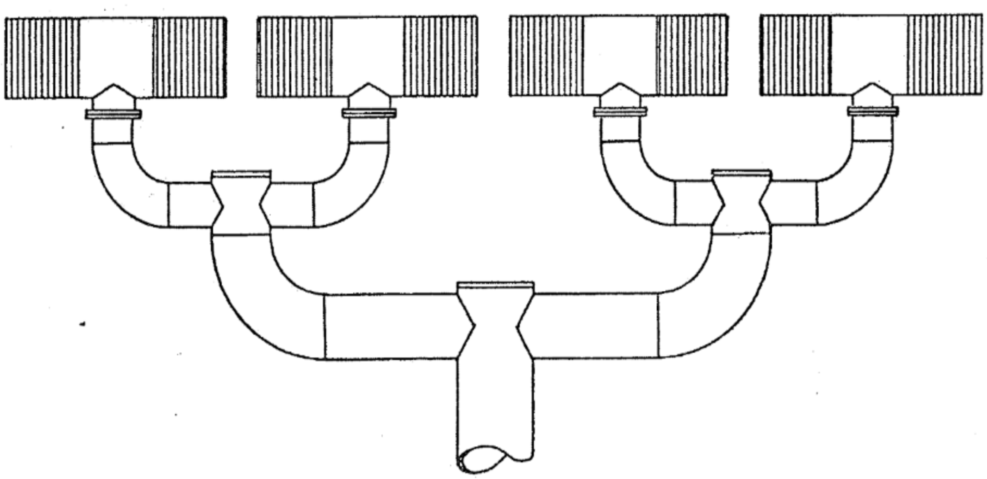
To establish equal flow and optimum performance from each screen in a multi-screen system, the intake manifold must be hydraulically balanced. This is accomplished when each path through the manifold results in the same head loss.

The simplest way of designing a balanced manifold is to use symmetry. In a manifold using symmetry the size, form and length of pipe traveled is the same for each path resulting in equivalent head loss and flow rate. The following are examples of manifolds which use symmetry.

Example 1.

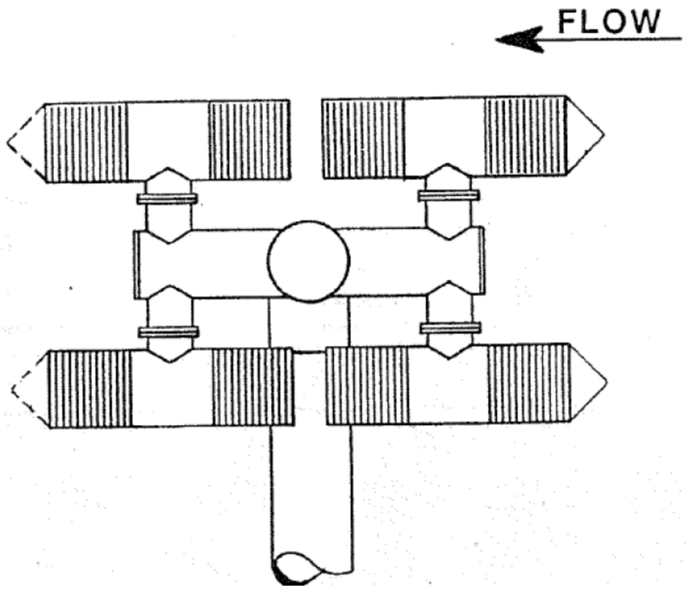


Example 2.

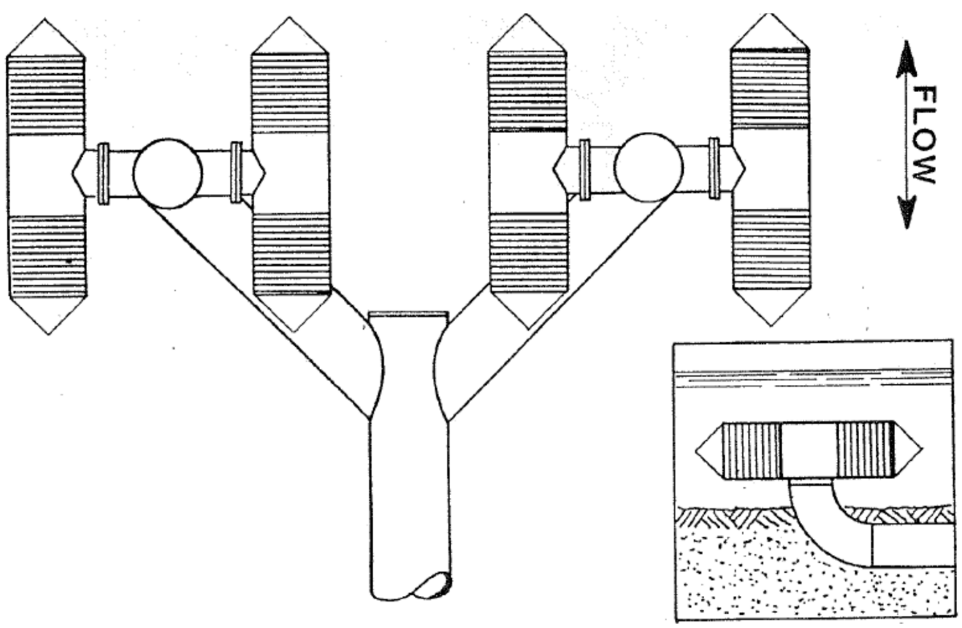


Note:
The optimum flow velocity through the intake pipe will vary, however < 0.5 fps is typically maintained.

Example 3. (River Tees)

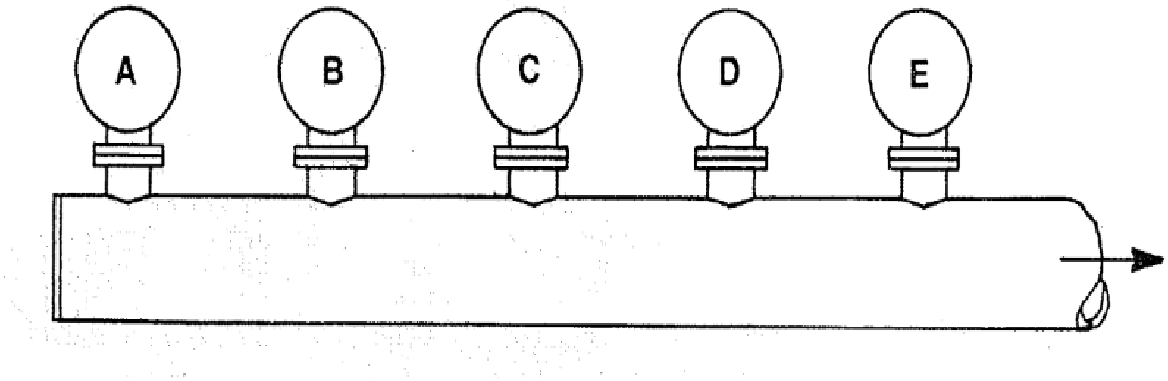


Example 4. (Tee array for alternating tidal currents)

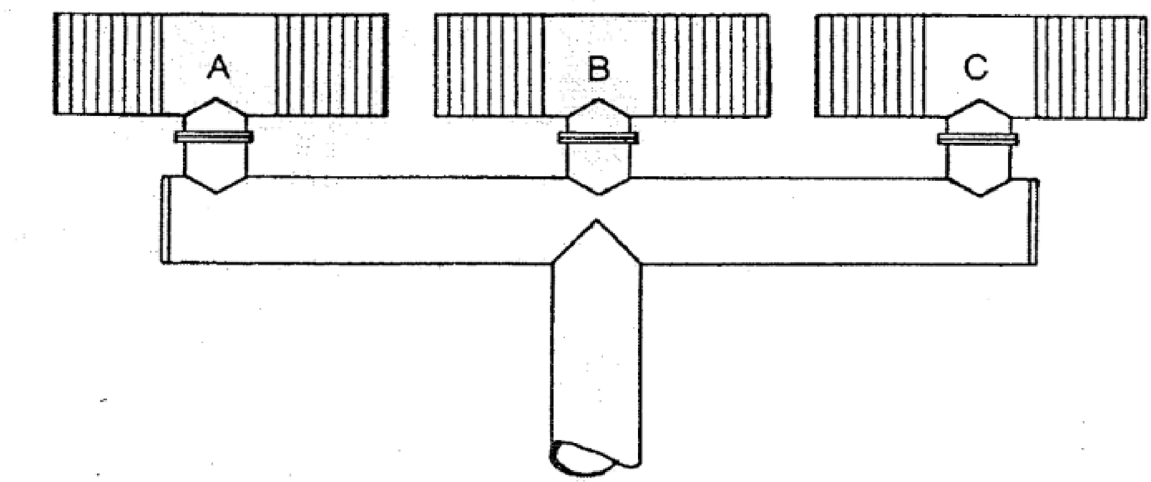


These manifolds are not symmetrical:

Example 1.

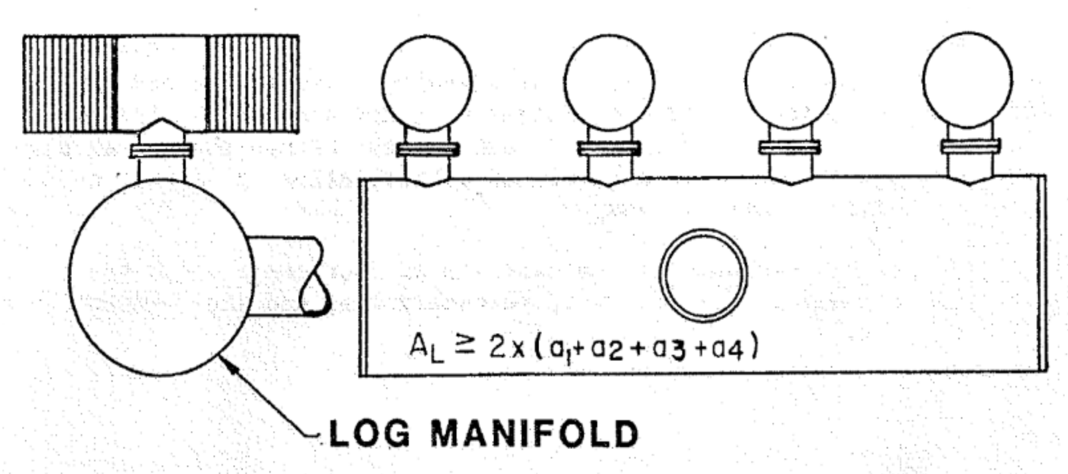


Example 2.



When symmetry is not possible the manifold may be balanced by the use of restrictive orifices. For the screens mounted on the header in example 1 above, acceptable balance may be obtained by orifices in screens “D” and “E”. In example 2 balance can be improved by an orifice in the outlet of screen “B”.

Another method of achieving system balance is by the use of a log manifold.



Imbalance can be reduced by making the diameter of the log chamber significantly larger than the riser pipes. A guideline for sizing the manifold is to make the cross sectional area of the log chamber, A_L, at least twice as large as the sum of the cross sectional areas of the individual risers, A_n.

SALES TERMS AND CONDITIONS

1. ENTIRE AGREEMENT, MODIFICATIONS – The terms, conditions and specifications contained in this agreement ("Terms") constitute the entire agreement between the parties for the provision of goods by Aqseptence Group, Inc. ("SELLER") at any time. No change in, addition to, or waiver of the Terms will be a binding obligation on SELLER unless approved in writing by its authorized representative. SELLER'S receipt, acknowledgement and/or acceptance of CUSTOMER'S purchase order form will not modify these Terms or become part of SELLER'S agreement to the extent it contradicts these Terms. SELLER is a material supplier and is not a party to CUSTOMER'S agreement with owner or others. CUSTOMER agrees to pay SELLER without reference to CUSTOMER'S contract with owner or others. It is understood the CUSTOMER has the ultimate obligation to pay SELLER on the terms and within the time period set forth herein, regardless of CUSTOMER'S payment status from the owner or others. If any provision of this agreement is held to be invalid or enforceable, the balance of this agreement will remain in force.

2. TITLE AND RISK OF LOSS – TITLE of the goods herein described shall pass to CUSTOMER upon full payment of said goods and any prior outstanding debt. RISK OF LOSS passes to CUSTOMER upon delivery of the goods to the carrier or appointed person at SELLER's facility. Unless otherwise specified, all sales are FCA SELLER'S plant.

3. PAYMENT AND PRICES – SELLER may, at its option, require CUSTOMER to pay for all goods at the time the order is placed or require CUSTOMER to obtain an irrevocable letter of credit in favor of SELLER from an issuer acceptable to SELLER. In the event SELLER does not require advance payment or require such letter of credit, payment by CUSTOMER will become due thirty (30) days from the date of SELLER'S invoice covering a particular shipment. No retainage or other deductions shall be made from such payments. In the event of failure by CUSTOMER to make any payment when due, SELLER may decline to make further shipments until such default is cured. SELLER may elect to continue to make shipments despite the continuance of such default, however such election by SELLER will in no way constitute a waiver of such default nor affect SELLER'S legal remedies thereof. CUSTOMER assumes full responsibility, including reporting and payment, of all taxes, however designated, or other governmental charges arising out of, levied or based upon, or in connection with the sale of the goods herein described, including state and local privilege, sales and use, or excise taxes based on gross revenue or any taxes or amount in lieu hereof paid or payable by SELLER in respect of the foregoing. In no event will any charges for engineering services imply a conveyance of any design and/or manufacturing rights as to the goods, unless such conveyance is expressly set forth in a separate written agreement signed by authorized representatives of both parties. In the event that CUSTOMER falls behind in payment, SELLER, without prejudice to any other right or remedy available to SELLER, shall, at its sole discretion, be entitled to: (i) terminate the order and/or suspend any further deliveries to CUSTOMER and/or (ii) charge the CUSTOMER interest on any unpaid portion of the purchase price at twelve percent (12%) per annum. Furthermore, the defaulting CUSTOMER shall bear all costs arising in connection with the recovery of the invoiced sums outstanding, including costs of reminders and seeking information, collection expenses, and reasonable attorney's fees.

4. SECURITY INTEREST – CUSTOMER hereby grants to SELLER a purchase money security interest in all goods purchased by CUSTOMER from SELLER until CUSTOMER has paid for such goods in full. CUSTOMER hereby authorizes SELLER to file UCC-1 financing statements in accordance with applicable law to perfect its security interest granted herein.

5. WARRANTIES – Provided that CUSTOMER subjects the goods only to operating conditions specified by CUSTOMER at the time the order is placed, and operates the goods in accordance with SELLER'S written operating instructions, SELLER warrants the goods to be free of defects in material and workmanship for a period of one (1) year after the date the goods are delivered to the CUSTOMER ("Warranty Period"). The above warranty does not apply to: (i) used goods or goods that have been repaired or refurbished; (ii) goods that have been modified or subjected to improper handling, storage, installation, operation or maintenance by CUSTOMER, including use of unauthorized replacement or spare parts; (iii) component parts not manufactured by SELLER; (iv) normal wear and tear; and (vi) models or samples furnished to CUSTOMER as illustrations only of general properties of equipment. This warranty is subject to the CUSTOMER, upon SELLER's request, returning the defective part to SELLER for inspection at CUSTOMER'S cost, and freight prepaid. If prior to the end of the Warranty Period any goods sold and delivered by SELLER to CUSTOMER fail to conform to the warranty set forth above, SELLER shall, at its sole discretion and as

CUSTOMER's sole and exclusive remedy, repair or replace the defective part. All parts repaired or replaced hereunder shall be repaired or replaced at SELLER'S facilities.

In the case that (field) services are rendered by SELLER in connection with the goods sold or the installation of a vacuum sewer project, SELLER'S warranty only applies the products and equipment sold and supplied. SELLER does not warrant or provide any guarantees for the planning, construction and installation of the system.

6. LIMITATION OF LIABILITY – NOTWITHSTANDING ANY OTHER PROVISION OF THESE TERMS, CUSTOMER EXPRESSLY AGREES THAT NEITHER SELLER ITS SUPPLIERS WILL UNDER ANY CIRCUMSTANCES BE LIABLE UNDER ANY THEORY OF RECOVERY, WHETHER BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE AND STRICT LIABILITY), UNDER WARRANTY, OR OTHERWISE, FOR ANY INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL LOSS OR DAMAGE OR PUNITIVE DAMAGES WHATSOEVER; DAMAGE TO OR LOSS OF PROPERTY OR EQUIPMENT; LOSS OF PROFITS OR REVENUE; LOSS OF POWER; LOSS OF USE OF CUSTOMER'S MATERIAL OR EQUIPMENT; LOSS OF INFORMATION AND DATA; LOSS OF INTEREST; INCREASED COSTS OF ANY KIND, INCLUDING BUT NOT LIMITED TO CAPITAL COST; BUSINESS INTERRUPTION; OR CLAIMS OF CUSTOMERS OF CUSTOMER.

CUSTOMER EXPRESSLY AGREES THAT THE REMEDIES PROVIDED IT HEREIN ARE EXCLUSIVE AND THAT UNDER NO CIRCUMSTANCES SHALL THE TOTAL AGGREGATE LIABILITY OF SELLER UNDER ANY THEORY OF RECOVERY, WHETHER BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE AND STRICT LIABILITY), UNDER WARRANTY, OR OTHERWISE, EXCEED THE LESSER OF ONE MILLION DOLLARS ($1,000,000) OR THE TOTAL PRICE PAID TO SELLER UNDER THESE TERMS.

THE WAIVERS AND DISCLAIMERS OF LIABILITY, RELEASES FROM LIABILITY, AND LIMITATIONS ON LIABILITY EXPRESSED IN THIS ARTICLE & - LIMITATION OF LIABILITY, SHALL EXTEND TO THE PARTNERS, PRINCIPALS, SHAREHOLDERS, DIRECTORS, OFFICERS, EMPLOYEES, AND AGENTS OF SELLER AND ITS AFFILIATES, SUCCESSORS, OR ASSIGNS.

ALL LIABILITY OF SELLER AND ITS SUPPLIERS UNDER THESE TERMS SHALL TERMINATE NO LATER THAN TWELVE (12) MONTHS AFTER THE EXPIRATION OF THE WARRANTY PERIOD.

THE PROVISIONS OF THIS ARTICLE & - LIMITATION OF LIABILITY, SHALL PREVAIL OVER ANY CONFLICTING OR INCONSISTENT PROVISIONS SET FORTH ELSEWHERE.

7. CATASTROPHIC LOSSES – Notwithstanding anything to the contrary contained herein, CUSTOMER hereby agrees to assume the liability for the following specified types of losses or events: (1) reservoir or underground damage, including loss of any mineral substance, or water or the wellbore itself; (2) control of a wild well, underground or above the surface; and (3) pollution, including clean-up and control of the pollutant or contamination.

8. CLAIMS – Within twenty (20) days after tender of delivery to or receipt by CUSTOMER of any shipment and before any part of such goods (except for reasonable test and inspection quantities) has been changed from its original condition, CUSTOMER will inform SELLER in writing if said goods are found defective in any respect. Failure to so inform SELLER or use of said goods (except for reasonable test and inspection quantities) will be conclusive that SELLER has satisfactorily performed.

9. MODIFICATION and INSPECTION – CUSTOMER may request changes within the scope of the initial order and, if accepted by SELLER, the price, performance, schedule and other pertinent provisions of the order will be adjusted by mutual agreement of the parties prior to implementation of the change. Expenses incurred by SELLER due to (i) delays, other than delays which are deemed to be within the reasonable control of SELLER, and (ii) changes in applicable laws and requirements after the date of the offer submitted by SELLER, as applicable, will be treated as changes to the scope of work and the scope of the order will be adjusted as set forth in the previous paragraph. SELLER may terminate the contract and demand full payment upon such delay exceeding six (6) months or non-payment of delay fees.

CUSTOMER shall retain the right to inspect the goods or works in progress, upon reasonable notice to SELLER, in accordance with the agreed contract terms.

10. PROPRIETARY INFORMATION – SELLER may have a proprietary interest in the information, goods, and technology supplied, as well as in the manner of performance of the work, including but not limited to the know-how, processes, methods and techniques employed by SELLER in connection therewith. CUSTOMER will keep in confidence and will not disclose any information related to such proprietary interest, other than to CUSTOMER's employees, without the prior written permission of SELLER or use any such information for other than the purpose for which it is supplied. CUSTOMER shall indemnify and hold SELLER harmless from and against any loss, damage or liability arising or resulting from non-compliance with the provisions of this Article 10:

11. TERMINATION – Any order may be terminated immediately by SELLER upon breach of this Agreement by CUSTOMER or breach of its financial obligations as they come due or in the case of proceedings of bankruptcy against the CUSTOMER. CUSTOMER may terminate the order at any time effective upon the date of notice and a termination payment for the percentage of the price of the Goods and/or Services reflecting the percentage of the work performed as of the effective date of termination, plus any additional proportions of the price based on unpreventable costs directly resulting from such termination.

12. FORCE MAJEURE – SELLER will not be liable for any loss or damage of any nature whatsoever incurred or suffered as a result of any failures or delays in performance due to any cause or circumstances beyond its control, including but not limited to any failures or delays in performance caused by any strikes, lockouts, or labor disputes, fires, acts of God or the public enemy, riots, incendiaries, interference by civil or military authorities, compliance with laws or with the orders or policies of any governmental authority, delays in transit or delivery on the part of the transportation companies or communication facilities, or failures of sources of materials. In the event of a shortage of goods, SELLER reserves the right to allocate available goods among all of its customers in its own discretion.

13. EXPORT OR IMPORT LICENSE – CUSTOMER will procure at its expense any export or import licenses required for any of the material included in the Quotation. For any goods being exported from the United States, CUSTOMER agrees to comply fully with all applicable economic sanctions and export control laws and regulations. CUSTOMER shall not – directly or indirectly – sell, provide, export, re-export, transfer, divert, loan, lease, consign, or otherwise dispose of any equipment, product, services, software, source code, technical data, or technology received from SELLER to or via any person, entity, or destination, or for any activity or end-use restricted by laws or regulations of the United States or any other applicable jurisdiction (including nuclear, missile, chemical or biological weapons proliferation, military, or money laundering activities) without obtaining all required government authorizations. CUSTOMER recognizes and agrees to comply with SELLER's policy to not support the use of its products for any operations in any country so prohibited under the export laws and regulations of the United States. As may be requested by SELLER, CUSTOMER shall provide SELLER with the relevant end-use, end-user and country of end- use information with respect to the goods, software or technology to be supplied hereunder. Based on and in reliance on such information, SELLER will supply such goods, software or materials in compliance with applicable law including that of the United States of America. SELLER cautions and CUSTOMER acknowledges that any change in end-use, end-user or country of end- use (including a shipment between countries other than the United States of America may be restricted or prohibited by applicable law, whether it is of the United States of America or other country.

14. ANTI-CORRUPTION – CUSTOMER represents and warrants that it and all of its affiliates and agents shall act in accordance with the principles described in the Convention on Combating Bribery of Foreign Public Officials in International Business Transactions, signed in Paris on December 17, 1997, as amended ("the Convention"), and the Convention's Commentaries (collectively "the OECD Principles"), and shall comply with all applicable laws implementing the OECD Principles (including the U.S. Foreign Corrupt Practices Act of 1977, as amended), as well as any applicable local laws related to anti-corruption, anti-kickbacks, and anti-money laundering.

15. DEFINITIONS – "CUSTOMER" means the person or company to whom the quotation is submitted. The "Quotation" means techno-commercial offer to which these terms and conditions are attached.

16. QUOTATION – The Quotation is subject to withdrawal or variation by SELLER, at any time prior to acceptance in writing by CUSTOMER.

17. PRICES AND VARIATION – Unless otherwise stated in writing, the quoted prices are net, in U.S. Dollars based upon labor and material cost at the date of Quotation. The Quotation is for supply of goods to be provided by SELLER for the CUSTOMER or purchased from another manufacturer. The prices quoted are calculated on the basis of the prices charged by the SELLER, the rate of exchange, duty, freight, insurance, clearance, and other similar charges, as applicable, ruling at the date of Quotation and any increase therein shall be to the account of the CUSTOMER. The prices quoted for the goods manufactured by SELLER are subject to rise and fall for variation in the cost of labor, material, or overhauls after the due date of quotation, unless otherwise specified in writing.

18. DISPUTE RESOLUTION – The laws of the State of Minnesota shall govern the validity, construction, interpretation, and effect of the transaction, without regard to its choice of law rules. The parties irrevocably consent to the personal jurisdiction of the state and federal courts of the State of Minnesota for any and all disputes arising out of or in connection with this agreement and expressly waive any defense of forum non convenience.

19. ALTERATION – The above terms and conditions may be modified by the SELLER from time to time in writing and such variations shall be binding on the CUSTOMER for any subsequent orders.

PUMP

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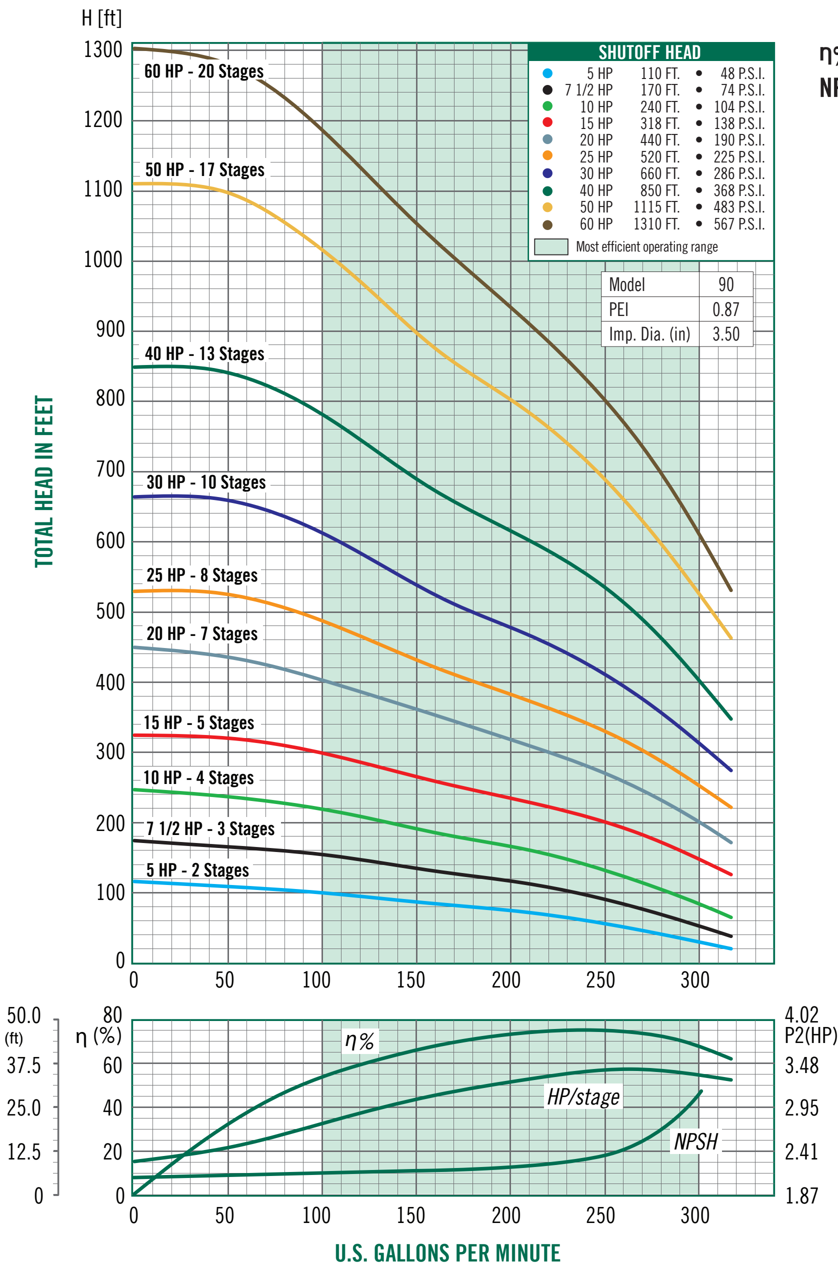
SUBMITTAL DATA SHEET

6", 8" & 10" Pump Ends
90 - 1100 GPM Stainless Steel Pumps

230 GPM

A.Y. McDonald stainless steel pump ends offer peak capacity performance in its 230 gallons per minute (GPM). Each pump end includes cable guard, bolts, and washers. The 230 gallons per minute (GPM) is a 6" Stainless Steel Pump End that ranges in size from 5 to 60 horsepower (HP).



SHUTOFF HEAD		
5 HP	110 FT.	48 P.S.I.
7 1/2 HP	170 FT.	74 P.S.I.
10 HP	240 FT.	104 P.S.I.
15 HP	318 FT.	138 P.S.I.
20 HP	440 FT.	190 P.S.I.
25 HP	520 FT.	225 P.S.I.
30 HP	660 FT.	286 P.S.I.
40 HP	850 FT.	368 P.S.I.
50 HP	1115 FT.	483 P.S.I.
60 HP	1310 FT.	567 P.S.I.

Model	90
PEI	0.87
Imp. Dia. (in)	3.50

η% - Effiency of motor
NPSH - Ft. of water above the pump

NO-LEAD: The weighted average of the wetted surface of this no-lead product contacted by consumable water contains less than one quarter of one percent (0.25%) lead.

A.Y. McDonald Mfg. Co.
P.O. Box 508
Dubuque, IA 52004-0508

Toll Free: 1-800-292-2737
Fax: 1-800-832-9296
Hours: 7:00 a.m. - 5:00 p.m., CST

sales@aymcdonald.com
www.aymcdonald.com

Submitted by:

SUBMITTAL DATA SHEET

6", 8" & 10" Pump Ends
90 - 1100 GPM Stainless Steel Pumps

230 GPM

Models Available

Model No.	HP	Stages	Motor Size	Disch. Size	A	B	Wt.
230S5HP64	5	2	4"	3"	19.53	5.75	20.33
230S7.5HP66	7.5	3	6"	3"	23.98	5.87	25.42
230S10HP66	10	4	6"	3"	28.43	5.87	30.28
230S15HP66	15	5	6"	3"	32.87	5.87	35.36
230S20HP66	20	7	6"	3"	41.77	5.87	45.53
230S25HP66	25	8	6"	3"	46.22	5.87	50.61
230S30HP66	30	10	6"	3"	55.12	5.87	60.55
230S40HP66	40	13	6"	3"	68.46	5.87	75.80
230S50HP66	50	17	6"	3"	86.26	5.87	95.91
230S60HP66	60	20	6"	3"	99.81	5.87	110.94

Component	Materials	Standard
Discharge	Stainless Steel	304
Valve Cone	Stainless Steel	304
Valve Seat	Stainless Steel / Rubber	304 / NBR
Top Diffuser	Stainless Steel	304
Upper Bearing	Stainless Steel / Rubber	304 / NBR
Neck Ring	Stainless Steel / Rubber	304 / NBR
Bottom Neck Ring	PTFE + CF	
Bearing	Rubber	NBR
Diffuser	Stainless Steel	304
Split Cone Nut	Stainless Steel	304
Nut for Stop Ring	Stainless Steel	304
Split Cone	Stainless Steel	304
Ring of Impeller	Stainless Steel	304
Impeller	Stainless Steel	304
Bottom Diffuser	Stainless Steel	304
Lower Bearing	Stainless Steel / Rubber	304 / NBR
Stop Ring	Stainless Steel	304
Spacing Washer for Stop Ring	PTFE / CF	
Strainer	Stainless Steel	304
Suction Interconnector	Stainless Steel	304
Pump Shaft	Stainless Steel	431
Coupling	Stainless Steel	304
Strap	Stainless Steel	304
Nut	Stainless Steel	304
Cable Guard	Stainless Steel	304
Strainer Cap	Stainless Steel	304

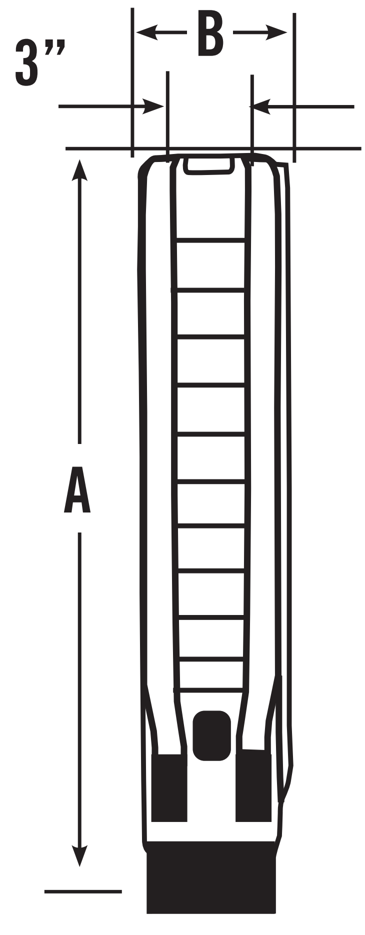


Fig. A

NO-LEAD: The weighted average of the wetted surface of this no-lead product contacted by consumable water contains less than one quarter of one percent (0.25%) lead.

A.Y. McDonald Mfg. Co.
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sales@aymcdonald.com
www.aymcdonald.com

Submitted by:

FE SELECT

DESIGN | SIZE | QUOTE

INTERNAL PRICE SHEET			
Company name		Size / Stages	Submersible Motors / -
		Pump speed	0 rpm
Line item number	001	Quote No.	1367865
Project name	Default	Date Last Saved	05 Apr 2021

Totals			
Total Extended Net	$ 4,518.00	Estimated Lead Time	1 days
Total Extended Sell	$ 4,518.00		

Pump

Qty	Description	Order No.	List Price	Multiplier	Net Price	Margin	Unit Sell Price	Extended Sell Price
	Poles: 2							

Item

Qty	Description	Order No.	List Price	Multiplier	Net Price	Margin	Unit Sell Price	Extended Sell Price
	Additional Equipment							
	Motor Electrical Construction : Any							
	Size: 6"							
	Hz: 60							
	Line Voltage: 200							
	Phase: 3							
	Product Family: Any							
	Lead Incl: Any							
	Thrust: 3500 LBS							
1	Motor: 6" Three-Phase, 20 HP, SAND FIGHTER, 200V, 60Hz, 1.15 SF, STK, DOL (3)	2366548120	$ 4,518.00	1.000	$ 4,518.00	0.00 %	$ 4,518.00	$ 4,518.00
	Lead Time: Ready to Ship							

QUOTATION

/ / /

Quote Information	
Quote No.	1367865
Quote Date	05 Apr 2021
Project name	Default
Est. Leadtime ARO	1 days

Customer Information	
To	
Street Address	
City/State/Zip	/ /
Phone No.	

Totals	
Total Extended Net	$ 4,518.00
Total Extended Sell	$ 4,518.00
Pump Total	$ 0.00

Pump

Order No.	Qty	Description	Unit Price	Extended Sell Price
		Motor Poles: 2		
Pump Total				$ 0.00

Item

Order No.	Qty	Description	Unit Price	Extended Sell Price
	1	*Additional Equipment* **Motor** Motor Electrical Construction : Any		
		Size: 6"		
		Hz: 60		
		Line Voltage: 200		
		Phase: 3		
		Product Family: Any		
		Thrust: 3500 LBS		
2366548120	1	Motor: 6" Three-Phase, 20 HP, SAND FIGHTER, 200V, 60Hz, 1.15 SF, STK, DOL (3)	$ 4,518.00	$ 4,518.00
		Lead Time: Ready to Ship		
Item Total				$ 4,518.00

QUOTATION

/ / /

Quote Information	
Quote No.	1367865
Quote Date	05 Apr 2021
Project name	Default
Est. Leadtime ARO	1 days

Customer Information	
To	
Street Address	
City/State/Zip	/ /
Phone No.	

Pump

Order No.	Qty	Description
1		**Motor** Poles: 2

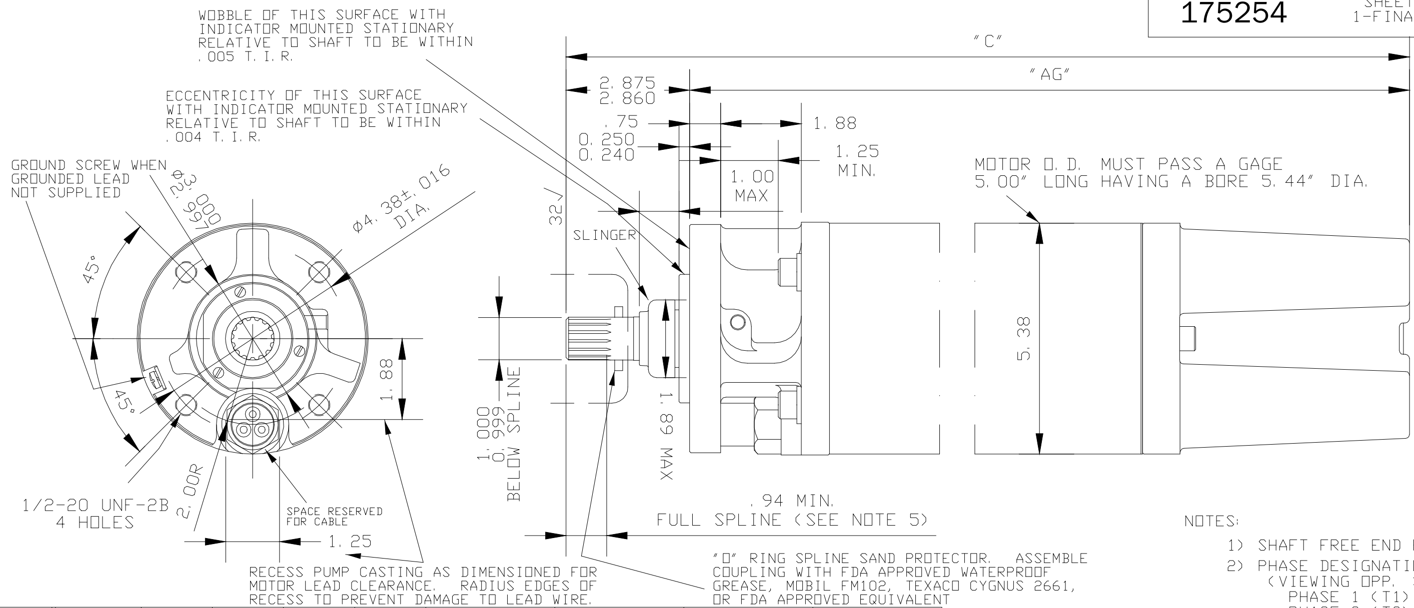
Item

Order No.	Qty	Description
	1	*Additional Equipment* **Motor** Motor Electrical Construction : Any
		Size: 6"
		Hz: 60
		Line Voltage: 200
		Phase: 3
		Product Family: Any
		Thrust: 3500 LBS
2366548120	1	Motor: 6" Three-Phase, 20 HP, SAND FIGHTER, 200V, 60Hz, 1.15 SF, STK, DOL (3)
		Lead Time: Ready to Ship

175254	SHEET 1-FINAL

DO NOT SCALE PRINT		
UNLESS OTHERWISE SPECIFIED TOLERANCE-DECIMAL		
BASIC DIM.	2 PLACES	3 PLACES
UNDER 6"	±.02	±.005
6" TO 24"	±.03	±.010
24" TO 72"	±.06	±.020
TOLERANCE-FRACTIONAL		
UNDER 6"	±1/64	ANGLE ±1/2°
6" TO 24"	±1/32	
24" TO 72"	±1/16	

PAR NO. ECN. NO.	FILM	NO.	CHANGE	DATE INITIALS
205934		23	1.875/2.860 WAS 2.875/2.869	CJC 4-2-07
211334		24	REMOVE NOTE 5	CJC 7-20-11
212901		25	1.000/.999 WAS 1.0000/.9995	CJC 8-15-12
213502		26	MODIFY NOTE 3	CJC 2-5-13



GR	HP	PH	HZ	AG	C	DOWN THRUST CAPACITY 60 CYCLE	DOWN THRUST CAPACITY 50 CYCLE	UP THRUST CAPACITY 60 CYCLE	UP THRUST CAPACITY 50 CYCLE
						CONTINUOUS		3 MIN. MAX.	
814	35	3	60/50	38.25	41.13	3500 LB.	15500 N.	300 LB.	1350 N.
813	17.5	3	60/50	29.28	32.16	3500 LB.	15500 N.	300 LB.	1350 N.
812	12.5	3	60/50	26.72	29.60	3500 LB.	15500 N.	300 LB.	1350 N.
811	OBSOLETE								
810	60	3	60/50	61.31	64.19	6000 LB.	27500 N.	300 LB.	1350 N.
809	50	3	60/50	55.31	58.19	6000 LB.	27500 N.	300 LB.	1350 N.
808	40	3	60/50	40.81	43.69	6000 LB.	27500 N.	300 LB.	1350 N.
807	30	3	60/50	35.69	38.56	3500 LB.	15500 N.	300 LB.	1350 N.
806	25	3	60/50	33.13	36.00	3500 LB.	15500 N.	300 LB.	1350 N.
	15	1	60						
805	20	3	60/50	30.56	33.44	3500 LB.	15500 N.	300 LB.	1350 N.
	10	1	60						
804	15	3	60/50	28.00	30.87	3500 LB.	15500 N.	300 LB.	1350 N.
	7 1/2	1	60			3500 LB.			
803	10	3	60/50	25.44	28.31	3500 LB.	15500 N.	300 LB.	1350 N.
	5	1	60			3500 LB.			
802	7 1/2	3	60/50	24.19	27.06	3500 LB.	15500 N.	300 LB.	1350 N.
801	5	3	60/50	22.88	25.75	3500 LB.	15500 N.	300 LB.	1350 N.

✳ FOR METRIC DIMENSIONS IN MM MULTIPLY DIMENSION SHOWN BY 25.4

NOTES:

1) SHAFT FREE END PLAY LIMITS .026MIN. - .050 MAX.
2) PHASE DESIGNATION OF LEADS FOR CW ROTATION (VIEWING OPP. SHAFT) ON 3 PHASE MOTORS
   PHASE 1 (T1) OR "A" BLACK LEAD
   PHASE 2 (T2) OR "B" WHITE, YELLOW OR BLACK LEAD
   PHASE 3 (T3) OR "C" RED OR BLACK LEAD.
3) STANDARD MODELS INCLUDE MINIMUM LEAD LENGTH OF 8 FEET. ADDITIONAL LEAD LENGTHS ARE AVAILABLE AND SOLD SEPARATELY.
4) 20,25 AND 30 HP 200 AND 230 VOLT; ALL 40,50 AND 60 3 PHASE; AND ALL 15 HP 1 PHASE USE #8 LEAD WIRE (.360 MAX. DIA.); ALL OTHERS USE #10 (.300 MAX. DIA.).
5) SPLINE DATA - 15 TOOTH 16/32 DIAMETRAL PITCH FILLET ROOT SIDEFIT, CLASS 5 SPLINE PER ANSI B.92.1-1996 SHORT DEDENDUM INTERNAL SPLINE. SPLINE DATA ON DRAWING 151560.
6) ANY ADDITIONAL LABELS ADDED TO THE STATOR SHELL MUST CLEAR THE WELDS BY A MINIMUM OF 1/4 INCH.

175254 SHEET 1-FINAL

SIMILAR TO 175238	
	6" REDESIGN
NEXT ASSY.	FIRST USED ON
APPLICATION	
DRAWN BY RC 2-4-85	CHECKED BY DLM 8-23-94
APPROVED WLN	RELEASE DATE 4-10-85

Franklin Electric
Bluffton, Indiana 46714 USA

TITLE OUTLINE 1985 6" REDESIGN

SIZE	CODE IDENT. NO.	DWG. NO.
B	7980	175254
SCALE AutoCAD		SHEET 1 OF FINAL

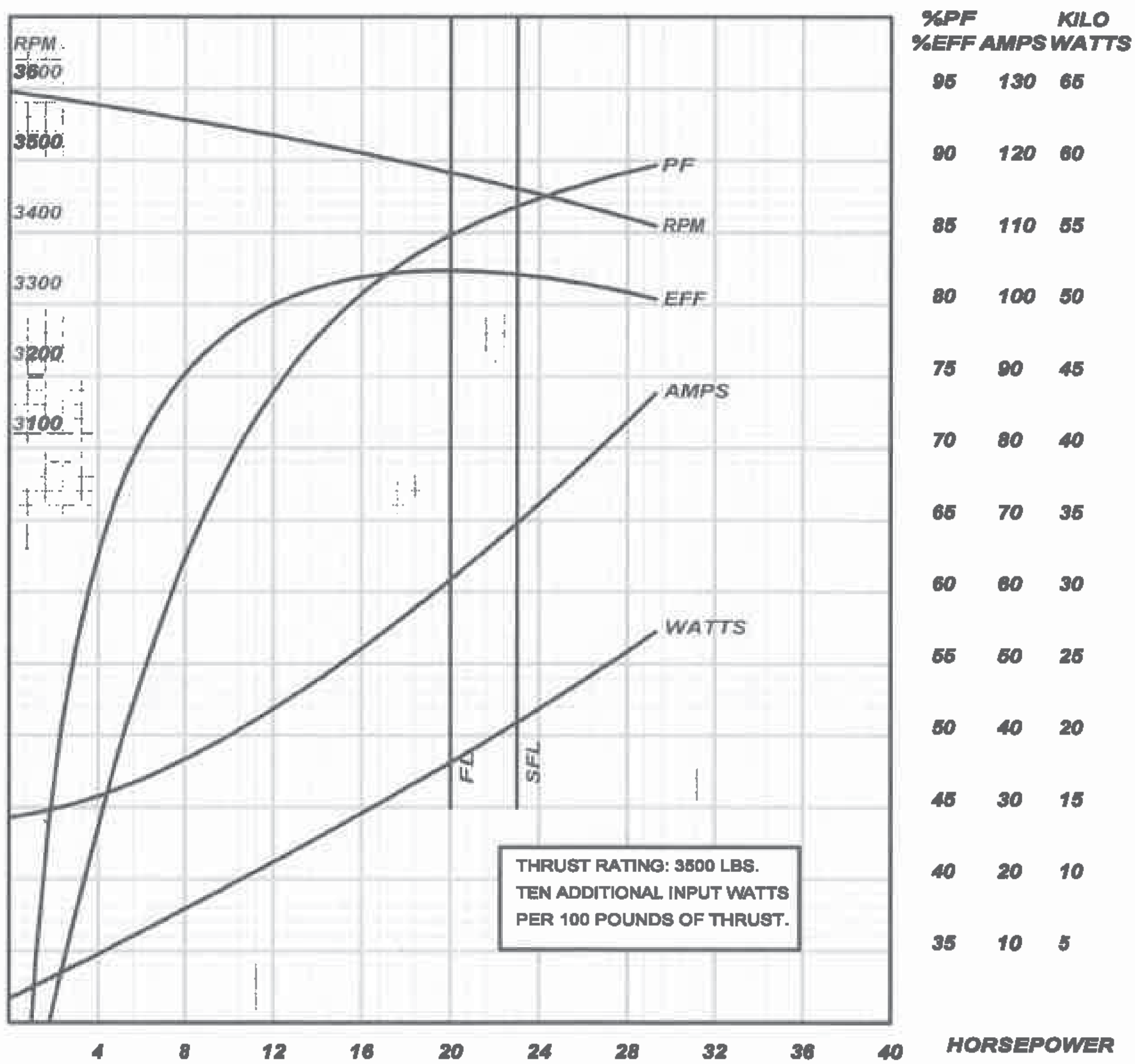
Franklin Electric

MOTOR PERFORMANCE CHARACTERISTICS

TEST				
	VOLTS	200	HERTZ	60
	ST.MFD		RUN MFD	
	TEST PR	8118	PAGE	1-A
	APPR BY		DATE	

RATING				
	FRAME	6 INCH SUB	HP	20
	MODEL	2366549020	VOLTS	200
	RPM	3450	PHASE	3
	S.F.	1.15	HERTZ	60
	TYPE	3 PHASE		

REMARKS: TESTED IN WATER, SHAFT UP, WITH NO APPLIED THRUST.
TYPICAL PERFORMANCE. NOT GUARANTEED AS MINIMUM PERFORMANCE.



FULL LOAD TORQUE	30.2	LB-FT
BREAKDOWN TORQUE	95.8	LB-FT
LOCKED ROTOR TORQUE	75.0	LB-FT
LOCKED ROTOR AMPS	416	

CURVE NO. 336618-201

2015 EDITION

AIM MANUAL

SUBMERSIBLE MOTORS

APPLICATION | INSTALLATION | MAINTENANCE

60 Hz, Single-Phase and Three-Phase Motors

franklinwater.com

Franklin Electric

COMMITMENT
TO QUALITY

FRANKLIN ELECTRIC GLOBAL HEADQUARTERS &
ENGINEERING DEVELOPMENT CENTER, FORT WAYNE, INDIANA

Franklin Electric is committed to provide customers with defect free products through our program of continuous improvement. Quality shall, in every case, take precedence over quantity.

ATTENTION!
IMPORTANT INFORMATION FOR INSTALLERS OF THIS EQUIPMENT!

THIS EQUIPMENT IS INTENDED FOR INSTALLATION BY TECHNICALLY QUALIFIED PERSONNEL. FAILURE TO INSTALL IT IN COMPLIANCE WITH NATIONAL AND LOCAL ELECTRICAL CODES, AND WITHIN FRANKLIN ELECTRIC RECOMMENDATIONS, MAY RESULT IN ELECTRICAL SHOCK OR FIRE HAZARD, UNSATISFACTORY PERFORMANCE, AND EQUIPMENT FAILURE. FRANKLIN INSTALLATION INFORMATION IS AVAILABLE FROM PUMP MANUFACTURERS AND DISTRIBUTORS, AND DIRECTLY FROM FRANKLIN ELECTRIC. CALL FRANKLIN TOLL FREE 800-348-2420 FOR INFORMATION.

WARNING

SERIOUS OR FATAL ELECTRICAL SHOCK MAY RESULT FROM FAILURE TO CONNECT THE MOTOR, CONTROL ENCLOSURES, METAL PLUMBING, AND ALL OTHER METAL NEAR THE MOTOR OR CABLE, TO THE POWER SUPPLY GROUND TERMINAL USING WIRE NO SMALLER THAN MOTOR CABLE WIRES. TO REDUCE RISK OF ELECTRICAL SHOCK, DISCONNECT POWER BEFORE WORKING ON OR AROUND THE WATER SYSTEM. DO NOT USE MOTOR IN SWIMMING AREAS.

ATTENTION!
INFORMATIONS IMPORTANTES POUR L'INSTALLATEUR DE CET EQUIPEMENT.

CET EQUIPEMENT DOIT ETRE INTALLE PAR UN TECHNICIEN QUALIFIE. SI L'INSTALLATION N'EST PAS CONFORME AUX LOIS NATIONALES OU LOCALES AINSI QU'AUX RECOMMANDATIONS DE FRANKLIN ELECTRIC, UN CHOC ELECTRIQUE, LE FEU, UNE PERFORMANCE NON ACCEPTABLE, VOIRE MEME LE NON-FONCTIONNEMENT PEUVENT SURVENIR. UN GUIDE D'INSTALLATION DE FRANKLIN ELECTRIC EST DISPONIBLE CHEZ LES MANUFACTURIERS DE POMPES, LES DISTRIBUTEURS, OU DIRECTEMENT CHEZ FRANKLIN. POUR DE PLUS AMPLES RENSEIGNEMENTS, APPELEZ SANS FRAIS LE 800-348-2420.

AVERTISEMENT

UN CHOC ELECTRIQUE SERIEUX OU MEME MORTEL EST POSSIBLE, SI L'ON NEGLIGE DE CONNECTER LE MOTEUR, LA PLOMBERIE METALLIQUE, BOITES DE CONTROLE ET TOUT METAL PROCHE DU MOTEUR A UN CABLE ALLANT VERS UNE ALIMENTATION D'ENERGIE AVEC BORNE DE MISE A LA TERRE UTILISANT AU MOINS LE MEME CALIBRE QUE LES FILS DU MOTEUR. POUR REDUIRE LE RISQUE DE CHOC ELECTRIQUE. COUPER LE COURANT AVANT DE TRAVAILLER PRES OU SUR LE SYSTEM D'EAU. NE PAS UTILISER CE MOTEUR DANS UNE ZONE DE BAIGNADE.

ATENCION!
INFORMACION PARA EL INSTALADOR DE ESTE EQUIPO.

PARA LA INSTALACION DE ESTE EQUIPO, SE REQUIERE DE PERSONAL TECNICO CALIFICADO. EL NO CUMPLIR CON LAS NORMAS ELECTRICAS NACIONALES Y LOCALES, ASI COMO CON LAS RECOMENDACIONES DE FRANKLIN ELECTRIC DURANTE SU INSTALACION, PUEDE OCASIONAR, UN CHOQUE ELECTRICO, PELIGRO DE UN INCENDIO, OPERACION DEFECTUOSA E INCLUSO LA DESCOMPOSTURA DEL EQUIPO. LOS MANUALES DE INSTALACION Y PUESTA EN MARCHA DE LOS EQUIPOS, ESTAN DISPONIBLES CON LOS DISTRIBUIDORES, FABRICANTES DE BOMBAS O DIRECTAMENTE CON FRANKLIN ELECTRIC. PUEDE LLAMAR GRATUITAMENTE PARA MAYOR INFORMACION AL TELEFONO 800-348-2420.

ADVERTENCIA

PUEDE OCURRIR UN CHOQUE ELECTRICO, SERIO O FATAL DEBIDO A UNA ERRONEA CONECCION DEL MOTOR, DE LOS TABLEROS ELECTRICOS, DE LA TUBERIA, DE CUALQUIER OTRA PARTE METALICA QUE ESTA CERCA DEL MOTOR O POR NO UTILIZAR UN CABLE PARA TIERRA DE CALIBRE IGUAL O MAYOR AL DE LA ALIMENTACION. PARA REDUCIR EL RIESGO DE CHOQUE ELECTRIC, DESCONECTAR LA ALIMENTACION ELECTRICA ANTES DE INICIAR A TRABAJAR EN EL SISTEMA HIDRAULICO. NO UTILIZAR ESTE MOTOR EN ALBERCAS O AREAS EN DONDE SE PRACTIQUE NATACION.

60 Hz, Single-Phase and Three-Phase

SUBMERSIBLE MOTOR

Application • Installation • Maintenance Manual

The submersible motor is a reliable, efficient and trouble-free means of powering a pump. Its needs for a long operational life are simple. They are:

1. A suitable operating environment
2. An adequate supply of electricity
3. An adequate flow of cooling water over the motor
4. An appropriate pump load

All considerations of application, installation, and maintenance of submersible motors relating to these four areas are presented in this manual. Franklin Electric's web page, www.franklin-electric.com, should be checked for the latest updates.

Contents

Application

Installation

Maintenance

Storage

Franklin Electric submersible motors are a water-lubricated design. The fill solution consists of a mixture of deionized water and Propylene Glycol (a non-toxic antifreeze). The solution will prevent damage from freezing in temperatures to -40 °F (-40 °C); motors should be stored in areas that do not go below this temperature. The solution will partially freeze below 27 °F (-3 °C), but no damage occurs. Repeated freezing and thawing should be avoided to prevent possible loss of fill solution.

There may be an interchange of fill solution with well water during operation. Care must be taken with motors removed from wells during freezing conditions to prevent damage.

When the storage temperature does not exceed 100 °F (37 °C), storage time should be limited to two years. Where temperatures reach 100° to 130 °F, storage time should be limited to one year.

Loss of a few drops of liquid will not damage the motor as an excess amount is provided, and the filter check valve will allow lost liquid to be replaced by filtered well water upon installation. If there is reason to believe there has been a considerable amount of leakage, consult the factory for checking procedures.

Frequency of Starts

The average number of starts per day over a period of months or years influences the life of a submersible pumping system. Excessive cycling affects the life of control components such as pressure switches, starters, relays, and capacitors. Rapid cycling can also cause motor spline damage, bearing damage, and motor overheating. All these conditions can lead to reduced motor life.

The pump size, tank size, and other controls should be selected to keep the starts per day as low as practical for longest life. The maximum number of starts per 24-hour period is shown in Table 3.

Motors should run a minimum of one minute to dissipate heat build up from starting current. Six inch and larger motors should have a minimum of 15 minutes between starts or starting attempts.

Table 3 Number of Starts

MOTOR RATING		MAXIMUM STARTS PER 24 HR PERIOD	
HP	KW	SINGLE-PHASE	THREE-PHASE
Up to 0.75	Up to 0.55	300	300
1 thru 5.5	0.75 thru 4	100	300
7.5 thru 30	5.5 thru 22	50	100*
40 and over	30 and over	-	100

* Keeping starts per day within the recommended numbers provides the best system life. However, when used with a properly configured Reduced Voltage Starter (RVS) or Variable Frequency Drive (VFD), 7.5 thru 30 hp three-phase motors can be started up to 200 times per 24 hour period.

Mounting Position

Franklin submersible motors are designed primarily for operation in the vertical, shaft-up position.

During acceleration, the pump thrust increases as its output head increases. In cases where the pump head stays below its normal operating range during startup and full speed condition, the pump may create upward thrust. This creates upward thrust on the motor upthrust bearing. This is an acceptable operation for short periods at each start, but running continuously with upthrust will cause excessive wear on the upthrust bearing.

With certain additional restrictions as listed in this section and the Inline Booster Pump Systems sections of this manual, motors are also suitable for operation in positions from shaft-up to shaft-horizontal. As the mounting position becomes further from vertical and closer to horizontal, the probability of shortened thrust bearing life increases. For normal motor life expectancy with motor positions other than shaft-up, follow these recommendations:

1. Minimize the frequency of starts, preferably to fewer than per 24-hour period. Six and eight inch motors should have a minimum of 20 minutes between starts or starting attempts
2. Do not use in systems which can run even for short periods at full speed without thrust toward the motor.

Transformer Capacity - Single-Phase or Three-Phase

Distribution transformers must be adequately sized to satisfy the kVA requirements of the submersible motor. When transformers are too small to supply the load, there is a reduction in voltage to the motor.

Table 4 references the motor horsepower rating, single-phase and three-phase, total effective kVA required, and the smallest transformer required for open or closed three-phase systems. Open systems require larger transformers since only two transformers are used.

Other loads would add directly to the kVA sizing requirements of the transformer bank.

Table 4 Transformer Capacity

MOTOR RATING		TOTAL EFFECTIVE KVA REQUIRED	SMALLEST KVA RATING-EACH TRANSFORMER	
HP	KW		OPEN WYE OR DELTA 2- TRANSFORMERS	CLOSED WYE OR DELTA 3- TRANSFORMERS
1.5	1.1	3	2	1
2	1.5	4	2	1.5
3	2.2	5	3	2
5	3.7	7.5	5	3
7.5	5.5	10	7.5	5
10	7.5	15	10	5
15	11	20	15	7.5
20	15	25	15	10
25	18.5	30	20	10
30	22	40	25	15
40	30	50	30	20
50	37	60	35	20
60	45	75	40	25
75	55	90	50	30
100	75	120	65	40
125	93	150	85	50
150	110	175	100	60
175	130	200	115	70
200	150	230	130	75

NOTE: Standard kVA ratings are shown. If power company experience and practice allows transformer loading higher than standard, higher loading values may be used to meet total effective kVA required, provided correct voltage and balance is maintained.

Effects of Torque

During starting of a submersible pump, the torque developed by the motor must be supported through the pump, delivery pipe or other supports. Most pumps rotate in the direction which causes unscrewing torque on right-handed threaded pipe or pump stages. All threaded joints, pumps and other parts of the pump support system must be capable of withstanding the maximum torque repeatedly without loosening or breaking. Unscrewing joints will break electrical cable and may cause loss of the pump-motor unit.

To safely withstand maximum unscrewing torques with a minimum safety factor of 1.5, tightening all threaded joints to at least 10 lb-ft per motor horsepower is recommended (Table 4A). It may be necessary to tack or strap weld pipe joints on high horsepower pumps, especially at shallower settings.

Table 4A Torque Required (Examples)

MOTOR RATING		MINIMUM SAFE TORQUE-LOAD
HP	KW	
1 hp & Less	0.75 kW & Less	10 lb-ft
20 hp	15 kW	200 lb-ft
75 hp	55 kW	750 lb-ft
200 hp	150 kW	2000 lb-ft

Use of Engine Driven Generators - Single-Phase or Three-Phase

Table 5 lists minimum generator sizes based on typical 80 °C rise continuous duty generators, with 35% maximum voltage dip during starting, for Franklin's three-wire motors, single- or three-phase.

This is a general chart. The generator manufacturer should be consulted whenever possible, especially on larger sizes.

There are two types of generators available: externally and internally regulated. Most are externally regulated. They use an external voltage regulator that senses the output voltage. As the voltage dips at motor start-up, the regulator increases the output voltage of the generator.

Internally regulated (self-excited) generators have an extra winding in the generator stator. The extra winding senses the output current to automatically adjust the output voltage.

Generators must be sized to deliver at least 65% of the rated voltage during starting to ensure adequate starting torque. Besides sizing, generator frequency is important as the motor speed varies with the frequency (Hz). Due to pump affinity laws, a pump running at 1 to 2 Hz below motor nameplate frequency design will not meet its performance curve. Conversely, a pump running at 1 to 2 Hz above may trip overloads.

Generator Operation

Always start the generator before the motor is started and always stop the motor before the generator is shut down. The motor thrust bearing may be damaged if the generator is allowed to coast down with the motor running. This same condition occurs when the generator is allowed to run out of fuel.

Follow generator manufacturer's recommendations for de-rating at higher elevations or using natural gas.

Table 5 Engine Driven Generators

NOTE: This chart applies to 3-wire or 3-phase motors. For best starting of 2-wire motors, the minimum generator rating is 50% higher than shown.

MOTOR RATING		MINIMUM RATING OF GENERATOR			
		EXTERNALLY REGULATED		INTERNALLY REGULATED	
HP	KW	KW	KVA	KW	KVA
1/3	0.25	1.5	1.9	1.2	1.5
1/2	0.37	2	2.5	1.5	1.9
3/4	0.55	3	3.8	2	2.5
1	0.75	4	5.0	2.5	3.13
1.5	1.1	5	6.25	3	3.8
2	1.5	7.5	9.4	4	5
3	2.2	10	12.5	5	6.25
5	3.7	15	18.75	7.5	9.4
7.5	5.5	20	25.0	10	12.5
10	7.5	30	37.5	15	18.75
15	11	40	50	20	25
20	15	60	75	25	31
25	18.5	75	94	30	37.50
30	22	100	125	40	50
40	30	100	125	50	62.5
50	37	150	188	60	75
60	45	175	220	75	94
75	55	250	313	100	125
100	75	300	375	150	188
125	93	375	469	175	219
150	110	450	563	200	250
175	130	525	656	250	313
200	150	600	750	275	344

WARNING: To prevent accidental electrocution, automatic or manual transfer switches must be used any time a generator is used as standby or back up on power lines. Contact power company for use and approval.

Use of Check Valves

It is recommended that one or more check valves always be used in submersible pump installations. If the pump does not have a built-in check valve, a line check valve should be installed in the discharge line within 25 feet of the pump and below the draw down level of the water supply. For deeper settings, check valves should be installed per the manufacturer's recommendations. More than one check valve may be required, but more than the recommended number of check valves should not be used.

Swing type check valves are **not** acceptable and should never be used with submersible motors/pumps. Swing type check valves have a slower reaction time which can cause water hammer (see next page). Internal pump check valves or spring loaded check valves close quickly and help eliminate water hammer.

Check valves are used to hold pressure in the system when the pump stops. They also prevent backspin, water hammer and upthrust. Any of these can lead to early pump or motor failure.

NOTE: Only positive sealing check valves should be used in submersible installations. Although drilling the check valves or using drain-back check valves may prevent back spinning, they create upthrust and water hammer problems.

A. **Backspin –** With no check valve or a failed check valve, the water in the drop pipe and the water in the system can flow down the discharge pipe when the motor stops. This can cause the pump to rotate in a reverse direction. If the motor is started while it is backspinning, an excessive force is placed across the pump-motor assembly that can cause impeller damage, motor or pump shaft breakage, excessive bearing wear, etc.

B. **Upthrust –** With no check valve, a leaking check valve, or drilled check valve, the unit starts under a zero head condition. This causes an uplifting or upthrust on the impeller-shaft assembly in the pump. This upward movement carries across the pump-motor coupling and creates an upthrust condition in the motor. Repeated upthrust can cause premature failure of both the pump and the motor.

C. **Water Hammer –** If the lowest check valve is more than 30 feet above the standing (lowest static) water level, or a lower check valve leaks and the check valve above holds, a vacuum is created in the discharge piping. On the next pump start, water moving at very high velocity fills the void and strikes the closed check valve and the stationary water in the pipe above it, causing a hydraulic shock. This shock can split pipes, break joints and damage the pump and/or motor. Water hammer can often be heard or felt. When discovered, the system should be shut down and the pump installer contacted to correct the problem.

Wells – Large Diameter, Uncased, Top Feeding and Screened Sections

Franklin Electric submersible motors are designed to operate with a cooling flow of water over and around the full length of the motor.

If the pump installation does not provide the minimum flow shown in Table 6, a flow inducer sleeve (flow sleeve) must be used. The conditions requiring a flow sleeve are:

- Well diameter is too large to meet Table 6 flow requirements
- Pump is in an open body of water
- Pump is in a rock well or below the well casing
- The well is “top-feeding” (a.k.a. cascading)
- Pump is set in or below screens or perforations

Water Temperature and Flow

Franklin Electric’s standard submersible motors, except Hi-Temp designs (see note below), are designed to operate up to maximum service factor horsepower in water up to 86 °F (30 °C). A flow of 0.25 ft/s for 4" motors rated 3 hp and higher, and 0.5 ft/s for 6" and 8" motors is required for proper cooling. Table 6 shows minimum flow rates, in gpm, for various well diameters and motor sizes.

If a standard motor is operated in water over 86 °F (30 °C), water flow past the motor must be increased to maintain safe motor operating temperatures. See HOT WATER APPLICATIONS on page 7.

NOTE: Franklin Electric offers a line of Hi-Temp motors designed to operate in water at higher temperatures or lower flow conditions. Consult factory for details.

Table 6 Required Cooling Flow

MINIMUM GPM REQUIRED FOR MOTOR COOLING IN WATER UP TO 86 °F (30 °C)			
CASING OR SLEEVE ID INCHES (MM)	4" MOTOR (3-10 HP) 0.25 FT/S GPM (L/M)	6" MOTOR 0.50 FT/S GPM (L/M)	8" MOTOR 0.50 FT/S GPM (L/M)
4 (102)	1.2 (4.5)	-	-
5 (127)	7 (26.5)	-	-
6 (152)	13 (49)	9 (34)	-
7 (178)	20 (76)	25 (95)	-
8 (203)	30 (114)	45 (170)	10 (40)
10 (254)	50 (189)	90 (340)	55 (210)
12 (305)	80 (303)	140 (530)	110 (420)
14 (356)	110 (416)	200 (760)	170 (645)
16 (406)	150 (568)	280 (1060)	245 (930)

0.25 ft/s = 7.62 cm/sec 0.50 ft/s = 15.24 cm/sec 1 inch = 2.54 cm

Flow Inducer Sleeve

If the flow rate is less than specified, then a flow inducer sleeve must be used. A flow sleeve is always required in an open body of water. FIG. 1 shows a typical flow inducer sleeve construction.

EXAMPLE: A 6" motor and pump that delivers 60 gpm will be installed in a 10" well.

From Table 6, 90 gpm would be required to maintain proper cooling. In this case adding an 8" or smaller flow sleeve provides the required cooling.

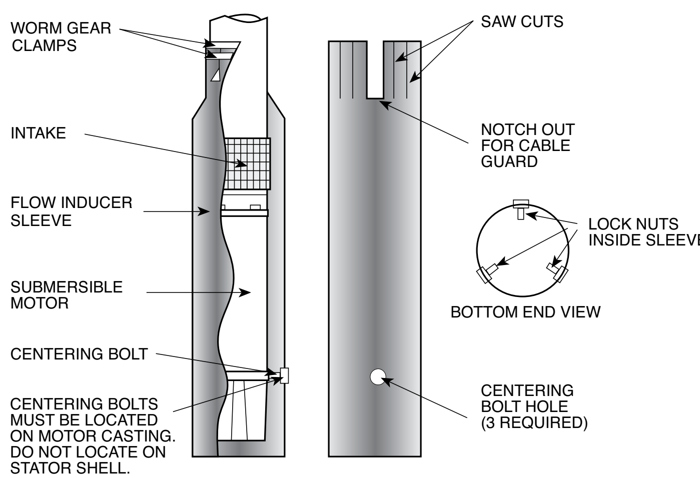


FIG. 1

Head Loss From Flow Past Motor

Table 7 lists the approximate head loss due to flow between an average length motor and smooth casing or flow inducer sleeve.

Table 7 Head Loss in Feet (Meters) at Various Flow Rates

	MOTOR DIAMETER	4"	4"	4"	6"	6"	6"	8"	8"
	CASING ID IN INCHES (MM)	4 (102)	5 (127)	6 (152)	6 (152)	7 (178)	8 (203)	8.1 (206)	10 (254)
Flow Rate in gpm (l/m)	25 (95)	0.3 (.09)							
	50 (189)	1.2 (.37)							
	100 (378)	4.7 (1.4)	0.3 (.09)		1.7 (.52)				
	150 (568)	10.2 (3.1)	0.6 (.18)	0.2 (.06)	3.7 (1.1)				
	200 (757)		1.1 (.34)	0.4 (.12)	6.3 (1.9)	0.5 (.15)		6.8 (2.1)	
	250 (946)		1.8 (.55)	0.7 (.21)	9.6 (2.9)	0.8 (.24)		10.4 (3.2)	
	300 (1136)		2.5 (.75)	1.0 (.30)	13.6 (4.1)	1.2 (.37)	0.2 (.06)	14.6 (4.5)	
	400 (1514)				23.7 (7.2)	2.0 (.61)	0.4 (.12)	24.6 (7.5)	
	500 (1893)					3.1 (.94)	0.7 (.21)	37.3 (11.4)	0.6 (0.2)
	600 (2271)					4.4 (1.3)	1.0 (.30)	52.2 (15.9)	0.8 (0.3)
	800 (3028)								1.5 (0.5)
	1000 (3785)								2.4 (0.7)

Hot Water Applications (Standard Motors)

Franklin Electric offers a line of Hi-Temp motors which are designed to operate in water with various temperatures up to 194 °F (90 °C) without increased flow. When a standard pump-motor operates in water hotter than 86 °F (30 °C), a flow rate of at least 3 ft/s is required. When selecting the motor to drive a pump in over 86 °F (30 °C) water, the motor horsepower must be de-rated per the following procedure.

1. Using Table 7A, determine pump gpm required for different well or sleeve diameters. If necessary, add a flow sleeve to obtain at least 3 ft/s flow rate.

Table 7A Minimum gpm (l/m) Required for 3 ft/s (.91 m/sec) Flow Rate

CASING OR SLEEVE ID		4" HIGH THRUST MOTOR		6" MOTOR		8" MOTOR	
INCHES	(MM)	GPM	(L/M)	GPM	(L/M)	GPM	(L/M)
4	(102)	15	(57)				
5	(127)	80	(303)				
6	(152)	160	(606)	52	(197)		
7	(178)			150	(568)		
8	(203)			260	(984)	60	(227)
10	(254)			520	(1970)	330	(1250)
12	(305)					650	(2460)
14	(356)					1020	(3860)
16	(406)					1460	(5530)

Continued on next page

2. Determine pump horsepower required from the pump manufacturer's curve.

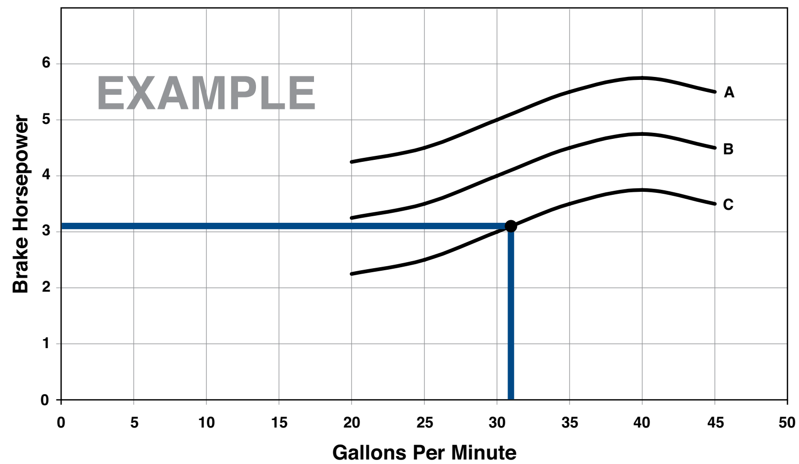


FIG. 2 MANUFACTURER'S PUMP CURVE

3. Multiply the pump horsepower required by the heat factor multiplier from Table 8.

Table 8 Heat Factor Multiplier at 3 ft/s (.91 m/sec) Flow Rate

MAXIMUM WATER TEMPERATURE	1/3 - 5 HP .25 - 3.7 KW	7 1/2 - 30 HP 5.5 - 22 KW	OVER 30 HP OVER 22 KW
140 °F (60 °C)	1.25	1.62	2.00
131 °F (55 °C)	1.11	1.32	1.62
122 °F (50 °C)	1.00	1.14	1.32
113 °F (45 °C)	1.00	1.00	1.14
104 °F (40 °C)	1.00	1.00	1.00
95 °F (35 °C)	1.00	1.00	1.00

4. Select a rated hp motor on Table 8A whose Service Factor Horsepower is at least the value calculated in Item 3.

Table 8A Service Factor Horsepower

HP	KW	SFHP	HP	KW	SFHP	HP	KW	SFHP	HP	KW	SFHP
1/3	0.25	0.58	3	2.2	3.45	25	18.5	28.75	100	75	115.00
1/2	0.37	0.80	5	3.7	5.75	30	22.0	34.50	125	93	143.75
3/4	0.55	1.12	7.5	5.5	8.62	40	30.0	46.00	150	110	172.50
1	0.75	1.40	10	7.5	11.50	50	37.0	57.50	175	130	201.25
1.5	1.10	1.95	15	11.0	17.25	60	45.0	69.00	200	150	230.00
2	1.50	2.50	20	15.0	23.00	75	55.0	86.25			

Hot Water Applications – Example

EXAMPLE: A 6" pump end requiring 39 hp input will pump 124 °F water in an 8" well at a delivery rate of 140 gpm. From Table 7A, a 6" flow sleeve will be required to increase the flow rate to at least 3 ft/s.

Using Table 8, the 1.62 heat factor multiplier is selected because the hp required is over 30 hp and water temperature is above 122 °F. Multiply 39 hp x 1.62 (multiplier), which equals 63.2 hp. This is the minimum rated service factor horsepower usable at 39 hp in 124 °F. Using Table 8A, select a motor with a rated service factor horsepower above 63.2 hp. A 60 hp motor has a service factor horsepower of 69, so a 60 hp motor may be used.

Drawdown Seals

Allowable motor temperature is based on atmospheric pressure or higher surrounding the motor. "Drawdown seals," which seal the well to the pump above its intake to maximize delivery are not recommended, since the suction created can be lower than atmospheric pressure.

Grounding Control Boxes and Panels

The National Electrical Code requires that the control box or panel-grounding terminal always be connected to supply ground. If the circuit has no grounding conductor and no metal conduit from the box to supply panel, use a wire at least as large as line conductors and connect as required by the National Electrical Code, from the grounding terminal to the electrical supply ground.

WARNING: Failure to ground the control frame can result in a serious or fatal electrical shock hazard.

Grounding Surge Arrestors

An above ground surge arrestor must be grounded, metal to metal, all the way to the lowest draw down water strata for the surge arrestor to be effective. GROUNDING THE ARRESTOR TO THE SUPPLY GROUND OR TO A DRIVEN GROUND ROD PROVIDES LITTLE OR NO SURGE PROTECTION FOR THE MOTOR.

Control Box, Pumptec Products, and Panel Environment

Franklin Electric control boxes, Pumptec products and three-phase panels meet UL requirements for NEMA Type 3R enclosures. They are suitable for indoor and outdoor applications within temperatures of +14 °F (-10 °C) to 122 °F (50 °C). Operating control boxes below +14 °F can cause reduced starting torque and loss of overload protection when overloads are located in control boxes.

Control boxes, Pumptec products, and three-phase panels should never be mounted in direct sunlight or high temperature locations. This will cause shortened capacitor life (where applicable) and unnecessary tripping of overload protectors. A ventilated enclosure painted white to reflect heat is recommended for an outdoor, high temperature location.

A damp well pit, or other humid location, accelerates component failure from corrosion.

Control boxes with voltage relays are designed for vertical upright mounting only. Mounting in other positions will affect the operation of the relay.

Equipment Grounding

WARNING: Serious or fatal electrical shock may result from failure to connect the motor, control enclosures, metal plumbing, and all other metal near the motor or cable to the power supply ground terminal using wire no smaller than motor cable wires.

The primary purpose of grounding the metal drop pipe and/or metal well casing in an installation is safety. It is done to limit the voltage between nonelectrical (exposed metal) parts of the system and ground, thus minimizing dangerous shock hazards. Using wire at least the size of the motor cable wires provides adequate current-carrying capability for any ground fault that might occur. It also provides a low resistance path to ground, ensuring that the current to ground will be large enough to trip any overcurrent device designed to detect faults (such as a ground fault circuit interrupter, or GFCI).

Normally, the ground wire to the motor would provide the primary path back to the power supply ground for any ground fault. There are conditions, however, where the ground wire connection could become compromised. One such example would be the case where the water in the well is abnormally corrosive or aggressive. In this example, a grounded metal drop pipe or casing would then become the primary path to ground. However, the many installations that now use plastic drop pipes and/or casings require further steps to be taken for safety purposes, so that the water column itself does not become the conductive path to ground.

When an installation has abnormally corrosive water AND the drop pipe or casing is plastic, Franklin Electric recommends the use of a GFCI with a 10 mA set-point. In this case, the motor ground wire should be routed through the current-sensing device along with the motor power leads. Wired this way, the GFCI will trip only when a ground fault has occurred AND the motor ground wire is no longer functional.

3-Wire Control Boxes

Single-phase three-wire submersible motors require the use of control boxes. Operation of motors without control boxes or with incorrect boxes can result in motor failure and voids warranty.

Control boxes contain starting capacitors, a starting relay, and, in some sizes, overload protectors, running capacitors, and contactors.

Ratings through 1 hp may use either a Franklin Electric solid state QD or a potential (voltage) type starting relay, while larger ratings use potential relays.

Potential (Voltage) Relays

Potential relays have normally closed contacts. When power is applied, both start and main motor windings are energized, and the motor starts. At this instant, the voltage across the start winding is relatively low and not enough to open the contacts of the relay.

As the motor accelerates, the increasing voltage across the start winding (and the relay coil) opens the relay contacts. This opens the starting circuit and the motor continues to run on the main winding alone, or the main plus run capacitor circuit. After the motor is started the relay contacts remain open.

CAUTION: The control box and motor are two pieces of one assembly. Be certain that the control box and motor hp and voltage match. Since a motor is designed to operate with a control box from the same manufacturer, we can promise warranty coverage only when a Franklin control box is used with a Franklin motor.

2-Wire Motor Solid State Controls

BIAC Switch Operation

When power is applied the bi-metal switch contacts are closed, so the triac is conducting and energizes the start winding. As rpm increases, the voltage in the sensor coil generates heat in the bi-metal strip, causing the bi-metal strip to bend and open the switch circuit. This removes the starting winding and the motor continues to run on the main winding alone.

Approximately 5 seconds after power is removed from the motor, the bi-metal strip cools sufficiently to return to its closed position and the motor is ready for the next start cycle. If, during operation, the motor speed drops, the lowered voltage in the sensor coil allows the bi-metal contacts to close, and bring the motor back to operating speed.

Rapid Cycling

The BIAC starting switch will reset within approximately 5 seconds after the motor is stopped. If an attempt is made to restart the motor before the starting switch has reset, the motor may not start; however, there will be current in the main winding until the overload protector interrupts the circuit. The time for the protector to reset is longer than the reset of the starting switch. Therefore, the start switch will have closed and the motor will operate.

A waterlogged tank will cause fast cycling. When a waterlogged condition does occur, the user will be alerted to the problem during the off time (overload reset time) since the pressure will drop drastically. When the waterlogged tank condition is detected, the condition should be corrected to prevent nuisance tripping of the overload protector.

Bound Pump (Sandlocked)

When the motor is not free to turn, as with a sandlocked pump, the BIAC switch creates a “reverse impact torque” in the motor in either direction. When the sand is dislodged, the motor will start and operate in the correct direction.

CAUTION: Restarting the motor within 5 seconds after power is removed may cause the motor overload to trip.

QD Relays (Solid State)

There are two elements in the relay: a reed switch and a triac. The reed switch consists of two tiny rectangular blade-type contacts, which bend under magnetic flux. It is hermetically sealed in glass and is located within a coil, which conducts line current. When power is supplied to the control box, the main winding current passing through the coil immediately closes the reed switch contacts. This turns on the triac, which supplies voltage to the start winding, thus starting the motor.

Once the motor is started, the operation of the QD relay is an interaction between the triac, the reed switch, and the motor windings. The solid state switch senses motor speed through the changing phase relationship between start winding current and line current. As the motor approaches running speed, the phase angle between the start current and the line current becomes nearly in phase. At this point, the reed switch contacts open, turning off the triac. This removes voltage from the start winding and the motor continues to run on the main winding only. With the reed switch contacts open and the triac turned off, the QD relay is ready for the next starting cycle.

2- or 3-Wire Cable, 60 Hz (Service Entrance to Motor - Maximum Length In Feet)

Table 11

60 °C

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE												
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000
115	1/2	.37	100	160	250	390	620	960	1190	1460	1780	2160	2630	3140	3770
230	1/2	.37	400	650	1020	1610	2510	3880	4810	5880	7170	8720			
	3/4	.55	300	480	760	1200	1870	2890	3580	4370	5330	6470	7870		
	1	.75	250	400	630	990	1540	2380	2960	3610	4410	5360	6520		
	1.5	1.1	190	310	480	770	1200	1870	2320	2850	3500	4280	5240		
	2	1.5	150	250	390	620	970	1530	1910	2360	2930	3620	4480		
	3	2.2	**120**	190	300	470	750	1190	1490	1850	2320	2890	3610		
	5	3.7	0	0	**180**	280	450	710	890	1110	1390	1740	2170	2680	
	7.5	5.5	0	0	0	**200**	310	490	610	750	930	1140	1410	1720	
	10	7.5	0	0	0	0	**250**	390	490	600	750	930	1160	1430	1760
	15	11	0	0	0	0	**170**	**270**	340	430	530	660	820	1020	1260

Table 11A

75 °C

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE												
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000
115	1/2	.37	100	160	250	390	620	960	1190	1460	1780	2160	2630	3140	3770
230	1/2	.37	400	650	1020	1610	2510	3880	4810	5880	7170	8720			
	3/4	.55	300	480	760	1200	1870	2890	3580	4370	5330	6470	7870	9380	
	1	.75	250	400	630	990	1540	2380	2960	3610	4410	5360	6520	7780	9350
	1.5	1.1	190	310	480	770	1200	1870	2320	2850	3500	4280	5240	6300	7620
	2	1.5	150	250	390	620	970	1530	1910	2360	2930	3620	4480	5470	6700
	3	2.2	**120**	190	300	470	750	1190	1490	1850	2320	2890	3610	4470	5550
	5	3.7	0	**110**	180	280	450	710	890	1110	1390	1740	2170	2680	3330
	7.5	5.5	0	0	**120**	200	310	490	610	750	930	1140	1410	1720	2100
	10	7.5	0	0	0	**160**	250	390	490	600	750	930	1160	1430	1760
	15	11	0	0	0	0	**170**	270	340	430	530	660	820	1020	1260

1 Foot = .3048 Meter

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors 60 °C or 75 °C in free air or water, not in magnetic enclosures, conduit or direct buried.

Lengths NOT in bold meet the NEC ampacity requirements for either individual conductors or jacketed 60 °C or 75 °C cable and can be in conduit or direct buried. Flat molded and web/ribbon cable are considered jacketed cable.

If any other cable is used, the NEC and local codes should be observed.

Cable lengths in Tables 11 & 11A allow for a 5% voltage drop running at maximum nameplate amperes. If 3% voltage drop is desired, multiply Table 11 and 11A lengths by 0.6 to get maximum cable length.

The portion of the total cable length, which is between the supply and single-phase control box with a line contactor, should not exceed 25% of total maximum allowable to ensure reliable contactor operation. Single-phase control boxes without line contactors may be connected at any point in the total cable length.

Tables 11 & 11A are based on copper wire. If aluminum wire is used, it must be two sizes larger than copper wire and oxidation inhibitors must be used on connections.

EXAMPLE: If Tables 11 & 11A call for #12 copper wire, #10 aluminum wire would be required.

Contact Franklin Electric for 90 °C cable lengths.

See pages 15, 50, and 51 for applications using 230 V motors on 208 V power systems.

Two or More Different Cable Sizes Can Be Used

Depending on the installation, any number of combinations of cable may be used.

For example, in a replacement/upgrade installation, the well already has 160 feet of buried #10 cable between the service entrance and the wellhead. A new 3 hp, 230-volt, single-phase motor is being installed to replace a smaller motor. The question is: Since there is already 160 feet of #10 AWG installed, what size cable is required in the well with a 3 hp, 230-volt, single-phase motor setting at 310 feet?

From Tables 11 & 11A, a 3 hp motor can use up to 300 feet of #10 AWG cable.

The application has 160 feet of #10 AWG copper wire installed.

Using the formula below, 160 feet (actual) ÷ 300 feet (max allowable) is equal to 0.533. This means 53.3% (0.533 x 100) of the allowable voltage drop or loss, which is allowed between the service entrance and the motor, occurs in this wire. This leaves us 46.7% (1.00 - 0.533 = 0.467) of some other wire size to use in the remaining 310 feet "down hole" wire run.

The table shows #8 AWG copper wire is good for 470 feet. Using the formula again, 310 feet (used) ÷ 470 feet (allowed) = 0.660; adding this to the 0.533 determined earlier; 0.533 + 0.660 = 1.193. This combination is greater than 1.00, so the voltage drop will not meet US National Electrical Code recommendations.

Tables 11 & 11A show #6 AWG copper wire is good for 750 feet. Using the formula, 310 ÷ 750 = 0.413, and using these numbers, 0.533 + 0.413 = 0.946, we find this is less than 1.00 and will meet the NEC recommended voltage drop.

This works for two, three or more combinations of wire and it does not matter which size wire comes first in the installation.

Formula: $$\frac{\text{Actual Length}}{\text{Max Allowed}} + \frac{\text{Actual Length}}{\text{Max Allowed}} = 1.00$$

EXAMPLE: 3 hp, 230-Volt, Single-Phase Motor

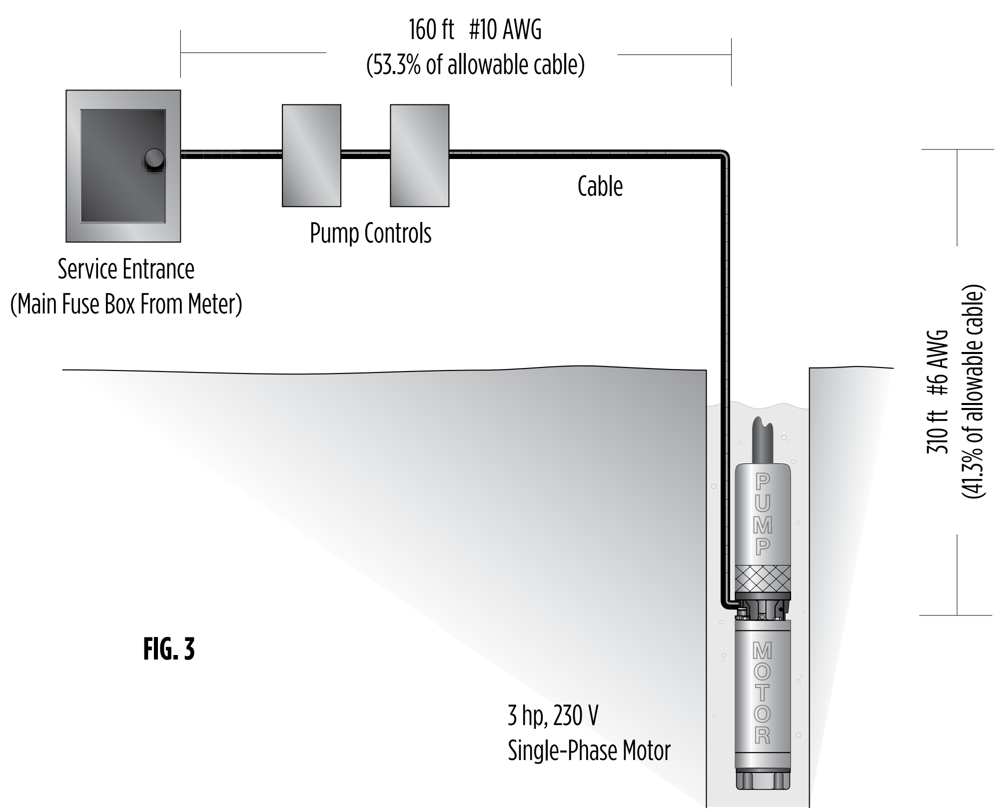


FIG. 3

Single-Phase Motors

APPLICATION

Table 13 Single-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		WINDING (1) RES. IN OHMS	EFFICIENCY %		POWER FACTOR %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	(2) AMPS	WATTS	(2) AMPS	WATTS	M=MAIN RES. S=START RES.	S.F.	F.L.	S.F.	F.L.		
4" 2-WIRE	244504	1/2	0.37	115	60	1.6	10.0	670	12.0	960	1.0-1.3	62	56	73	58	64.4	R
4" 2-WIRE	244505	1/2	0.37	230	60	1.6	5.0	670	6.0	960	4.2-5.2	62	56	73	58	32.2	R
4" 2-WIRE	244507	3/4	0.55	230	60	1.5	6.8	940	8.0	1310	3.0-3.6	64	59	74	62	40.7	N
4" 2-WIRE	244508	1	0.75	230	60	1.4	8.2	1210	10.4	1600	2.2-2.7	65	62	74	63	48.7	N
4" 2-WIRE	244309	1.5	1.1	230	60	1.3	10.6	1770	13.1	2280	1.5-2.1	64	63	83	76	66.2	M
4" 3-WIRE	214504	1/2	0.37	115	60	1.6	Y10.0 B10.0 R0	670	Y12.0 B12.0 R0	960	M1.0-1.3 S4.1-5.1	62	56	73	58	50.5	M
4" 3-WIRE	214505	1/2	0.37	230	60	1.6	Y5.0 B5.0 R0	670	Y6.0 B6.0 R0	960	M4.2-5.2 S16.7-20.5	62	56	73	58	23	M
4" 3-WIRE	214507	3/4	0.55	230	60	1.5	Y6.8 B6.8 R0	940	Y8.0 B8.0 R0	1310	M3.0-3.6 S10.7-13.1	64	59	74	62	34.2	M
4" 3-WIRE	214508	1	0.75	230	60	1.4	Y8.2 B8.2 R0	1210	10.4 10.4 R0	1600	M2.2-2.7 S9.9-12.1	65	62	74	63	41.8	L
4" 3-WIRE W/CRC CB	214505	1/2	0.37	230	60	1.6	Y3.2 B3.7 R2.0	655	Y4.3 B4.0 R2.0	890	M4.2-5.2 S16.7-20.5	67	57	90	81	23	M
4" 3-WIRE W/CRC CB	214507	3/4	0.55	230	60	1.5	Y4.4 B5.0 R3.2	925	Y5.7 B5.2 R3.1	1220	M3.0-3.6 S10.7-13.1	69	60	92	84	34.2	M
4" 3-WIRE W/CRC CB	214508	1	0.75	230	60	1.4	Y5.6 B5.7 R3.4	1160	Y8.1 B6.2 R3.3	1490	M2.2-2.7 S9.9-12.1	70	64	92	86	41.8	L
4" 3-WIRE	214508 W/1- 1.5 CB	1	0.75	230	60	1.4	Y6.6 B6.6 R1.3	1130	Y8.0 B7.9 R1.3	1500	M2.2-2.7 S9.9-12.1	70	66	82	72	43	L
4" 3-WIRE	224300	1.5	1.1	230	60	1.3	Y10.0 B9.9 R1.3	1620	Y11.5 B11.0 R1.3	2080	M1.7-2.1 S7.5-9.2	70	69	85	79	51.4	J
4" 3-WIRE	224301	2	1.5	230	60	1.25	Y10.0 B9.3 R2.6	2025	Y13.2 B11.9 R2.6	2555	M1.8-2.3 S5.5-7.2	73	74	95	94	53.1	G
4" 3-WIRE	224302 (3)	3	2.2	230	60	1.15	Y14.0 B11.2 R6.1	3000	Y17.0 B12.6 R6.0	3400	M1.1-1.4 S4.0-4.8	75	75	99	99	83.4	H
4" 3-WIRE	224303 (4)	5	3.7	230	60	1.15	Y23.0 B15.9 R11.0	4830	Y27.5 B19.1 R10.8	5500	M.71-.82 S1.8-2.2	78	77	100	100	129	G
6"	226110 (5)	5	3.7	230	60	1.15	Y23.0 B14.3 R10.8	4910	Y27.5 B17.4 R10.5	5570	M.55-.68 S1.3-1.7	77	76	100	99	99	E
6"	226111	7.5	5.5	230	60	1.15	Y36.5 B34.4 R5.5	7300	Y42.1 B40.5 R5.4	8800	M.36-.50 S.88-1.1	73	74	91	90	165	F
6"	226112	10	7.5	230	60	1.15	Y44.0 B39.5 R9.3	9800	Y51.0 B47.5 R8.9	11300	M.27-.33 S.80-.99	76	77	96	96	204	E
6"	226113	15	11	230	60	1.15	Y62.0 B52.0 R17.5	13900	Y75.0 B62.5 R16.9	16200	M.17-.22 S.68-.93	79	80	97	98	303	E

(1) Main winding - yellow to black Start winding - yellow to red

(2) Y = Yellow lead - line amps
B = Black lead - main winding amps
R = Red lead - start or auxiliary winding amps

(3) Control Boxes date coded 02C and older have **35 MFD** run capacitors. Current values should be Y14.0 @ FL and Y17.0 @ Max Load.
B12.2 B14.5
R4.7 R4.5

(4) Control Boxes date coded 01M and older have **60 MFD** run capacitors and the current values on a 4" motor will be Y23.0 @ FL - Y27.5 @ Max Load.
B19.1 B23.2
R8.0 R7.8

(5) Control Boxes date coded 01M and older have **60 MFD** run capacitors and the current values on a 6" motor will be Y23.0 @ FL -Y27.5 @ Max Load.
B18.2 B23.2
R8.0 R7.8

Performance is typical, not guaranteed, at specified voltages and specified capacitor values. Performance at voltage ratings not shown is similar, except amps vary inversely with voltage.

Table 14 Single-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
4" 2-WIRE	244504	1/2	0.37	115	35	20	30	30	15	30
	244505	1/2	0.37	230	20	10	15	15	8	15
	244507	3/4	0.55	230	25	15	20	20	10	20
	244508	1	0.75	230	30	20	25	25	11	25
	244309	1.5	1.1	230	35	20	30	35	15	30
4" 3-WIRE	214504	1/2	0.37	115	35	20	30	30	15	30
	214505	1/2	0.37	230	20	10	15	15	8	15
	214507	3/4	0.55	230	25	15	20	20	10	20
	214508	1	0.75	230	30	20	25	25	11	25
4" 3-WIRE W/CRC CB	214505	1/2	0.37	230	20	10	15	15	8	15
	214507	3/4	0.55	230	25	15	20	20	10	20
	214508	1	0.75	230	30	20	25	25	11	25
4" 3-WIRE	214508 W/ 1-1.5 CB	1	0.75	230	30	20	25	25	11	25
	224300	1.5	1.1	230	35	20	30	30	15	30
	224301	2	1.5	230	30	20	25	30	15	25
	224302	3	2.2	230	45	30	40	45	20	40
	224303	5	3.7	230	80	45	60	70	30	60
6"	226110	5	3.7	230	80	45	60	70	30	60
	226111	7.5	5.5	230	125	70	100	110	50	100
	226112	10	7.5	230	150	80	125	150	60	125
	226113	15	11	230	200	125	175	200	90	175

Auxiliary Running Capacitors

Added capacitors must be connected across "Red" and "Black" control box terminals, in parallel with any existing running capacitors. The additional capacitor(s) should be mounted in an auxiliary box. The values of additional running capacitors most likely to reduce noise are given below. The tabulation gives the **max.** S.F. amps normally in each lead with the added capacitor.

Although motor amps decrease when auxiliary run capacitance is added, the load on the motor does not. If a motor is overloaded with normal capacitance, it will still be overloaded with auxiliary run capacitance, even though motor amps may be within nameplate values.

Table 15 Auxiliary Capacitor Sizing

MOTOR RATING		NORMAL RUNNING CAPACITOR(S)	AUXILIARY RUNNING CAPACITORS FOR NOISE REDUCTION			MAXIMUM AMPS WITH RUN CAP		
HP	VOLTS	MFD	MFD	MIN. VOLTS	FRANKLIN PART	YELLOW	BLACK	RED
1/2	115	0	60(1)	370	TWO 155327101	8.4	7.0	4.0
1/2	230	0	15(1)	370	ONE 155328101	4.2	3.5	2.0
3/4		0	20(1)	370	ONE 155328103	5.8	5.0	2.5
1		0	25(1)	370	ONE EA. 155328101 155328102	7.1	5.6	3.4
1.5		10	20	370	ONE 155328103	9.3	7.5	4.4
2		20	10	370	ONE 155328102	11.2	9.2	3.8
3		45	NONE	370		17.0	12.6	6.0
5		80	NONE	370		27.5	19.1	10.8
7.5		45	45	370	ONE EA. 155327101 155328101	37.0	32.0	11.3
10		70	30	370	ONE 155327101	49.0	42.0	13.0
15		135	NONE			75.0	62.5	16.9

(1) Do not add running capacitors to 1/3 through 1 hp control boxes, which use solid state switches or QD relays. Adding capacitors will cause switch failure. If the control box is converted to use a voltage relay, the specified running capacitance can be added.

Buck-Boost Transformers

When the available power supply voltage is not within the proper range, a buck-boost transformer is often used to adjust voltage to match the motor. The most common usage on submersible motors is boosting a 208 volt supply to use a standard 230 volt single-phase submersible motor and control. While tables to give a wide range of voltage boost or buck are published by transformer manufacturers, the following table shows Franklin's recommendations. The table, based on boosting the voltage 10%, shows the minimum rated transformer kVA needed and the common standard transformer kVA.

Table 15A Buck-Boost Transformer Sizing

MOTOR HP	1/3	1/2	3/4	1	1.5	2	3	5	7.5	10	15
LOAD KVA	1.02	1.36	1.84	2.21	2.65	3.04	3.91	6.33	9.66	11.70	16.60
MINIMUM XFMR KVA	0.11	0.14	0.19	0.22	0.27	0.31	0.40	0.64	0.97	1.20	1.70
STANDARD XFMR KVA	0.25	0.25	0.25	0.25	0.50	0.50	0.50	0.75	1.00	1.50	2.00

Buck-Boost transformers are power transformers, not control transformers. They may also be used to lower voltage when the available power supply voltage is too high.

60 °C

Table 16 Three-Phase 60 °C Cable, 60 Hz (Service Entrance to Motor) Maximum Length in Feet

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	710	1140	1800	2840	4420													
	3/4	0.55	510	810	1280	2030	3160													
	1	0.75	430	690	1080	1710	2670	4140	5140											
	1.5	1.1	310	500	790	1260	1960	3050	3780											
	2	1.5	240	390	610	970	1520	2360	2940	3610	4430	5420								
	3	2.2	180	290	470	740	1160	1810	2250	2760	3390	4130								
	5	3.7	**110**	170	280	440	690	1080	1350	1660	2040	2490	3050	3670	4440	5030				
	7.5	5.5	0	0	200	310	490	770	960	1180	1450	1770	2170	2600	3150	3560				
	10	7.5	0	0	0	**230**	370	570	720	880	1090	1330	1640	1970	2390	2720	3100	3480	3800	4420
	15	11	0	0	0	**160**	**250**	390	490	600	740	910	1110	1340	1630	1850	2100	2350	2570	2980
	20	15	0	0	0	0	**190**	**300**	380	460	570	700	860	1050	1270	1440	1650	1850	2020	2360
	25	18.5	0	0	0	0	0	**240**	**300**	**370**	460	570	700	840	1030	1170	1330	1500	1640	1900
	30	22	0	0	0	0	0	0	**250**	**310**	**380**	470	580	700	850	970	1110	1250	1360	1590
230 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	930	1490	2350	3700	5760	8910												
	3/4	0.55	670	1080	1700	2580	4190	6490	8060	9860										
	1	0.75	560	910	1430	2260	3520	5460	6780	8290										
	1.5	1.1	420	670	1060	1670	2610	4050	5030	6160	7530	9170								
	2	1.5	320	510	810	1280	2010	3130	3890	4770	5860	7170	8780							
	3	2.2	240	390	620	990	1540	2400	2980	3660	4480	5470	6690	8020	9680					
	5	3.7	**140**	230	370	590	920	1430	1790	2190	2690	3290	4030	4850	5870	6650	7560	8460	9220	
	7.5	5.5	0	**160**	260	420	650	1020	1270	1560	1920	2340	2870	3440	4160	4710	5340	5970	6500	7510
	10	7.5	0	0	**190**	310	490	760	950	1170	1440	1760	2160	2610	3160	3590	4100	4600	5020	5840
	15	11	0	0	0	**210**	330	520	650	800	980	1200	1470	1780	2150	2440	2780	3110	3400	3940
	20	15	0	0	0	0	**250**	400	500	610	760	930	1140	1380	1680	1910	2180	2450	2680	3120
	25	18.5	0	0	0	0	0	**320**	400	500	610	750	920	1120	1360	1540	1760	1980	2160	2520
	30	22	0	0	0	0	0	**260**	**330**	**410**	510	620	760	930	1130	1280	1470	1650	1800	2110
380 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	2690	4290	6730															
	3/4	0.55	2000	3190	5010	7860														
	1	0.75	1620	2580	4060	6390	9980													
	1.5	1.1	1230	1970	3100	4890	7630													
	2	1.5	870	1390	2180	3450	5400	8380												
	3	2.2	680	1090	1710	2690	4200	6500	8020	9830										
	5	3.7	400	640	1010	1590	2490	3870	4780	5870	7230	8830								
	7.5	5.5	270	440	690	1090	1710	2640	3260	4000	4930	6010	7290	8780						
	10	7.5	**200**	**320**	510	800	1250	1930	2380	2910	3570	4330	5230	6260	7390	8280	9340			
	15	11	0	0	**370**	590	920	1430	1770	2170	2690	3290	4000	4840	5770	6520	7430	8250	8990	
	20	15	0	0	0	**440**	700	1090	1350	1670	2060	2530	3090	3760	4500	5110	5840	6510	7120	8190
	25	18.5	0	0	0	**360**	570	880	1100	1350	1670	2050	2510	3040	3640	4130	4720	5250	5740	6590
	30	22	0	0	0	0	**470**	730	910	1120	1380	1700	2080	2520	3020	3430	3920	4360	4770	5490
	40	30	0	0	0	0	0	**530**	660	820	1010	1240	1520	1840	2200	2500	2850	3170	3470	3990
	50	37	0	0	0	0	0	0	**540**	**660**	820	1000	1220	1480	1770	2010	2290	2550	2780	3190
	60	45	0	0	0	0	0	0	0	**560**	**690**	850	1030	1250	1500	1700	1940	2150	2350	2700
	75	55	0	0	0	0	0	0	0	0	**570**	**700**	**860**	1050	1270	1440	1660	1850	2030	2350
	100	75	0	0	0	0	0	0	0	0	0	**510**	**630**	**760**	910	1030	1180	1310	1430	1650
	125	93	0	0	0	0	0	0	0	0	0	0	0	**620**	**740**	**840**	**950**	1060	1160	1330
	150	110	0	0	0	0	0	0	0	0	0	0	0	0	**620**	**700**	**790**	**880**	**960**	1090
	175	130	0	0	0	0	0	0	0	0	0	0	0	0	0	**650**	**750**	**840**	**920**	1070
	200	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**630**	**700**	**760**	**880**

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

Continued on next page

60 °C

Table 17 Three-Phase 60 °C Cable (Continued)

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
460 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	3770	6020	9460															
	3/4	0.55	2730	4350	6850															
	1	0.75	2300	3670	5770	9070														
	1.5	1.1	1700	2710	4270	6730														
	2	1.5	1300	2070	3270	5150	8050													
	3	2.2	1000	1600	2520	3970	6200													
	5	3.7	590	950	1500	2360	3700	5750												
	7.5	5.5	420	680	1070	1690	2640	4100	5100	6260	7680									
	10	7.5	310	500	790	1250	1960	3050	3800	4680	5750	7050								
	15	11	0	**340**	540	850	1340	2090	2600	3200	3930	4810	5900	7110						
	20	15	0	0	**410**	650	1030	1610	2000	2470	3040	3730	4580	5530						
	25	18.5	0	0	0	**530**	830	1300	1620	1990	2450	3010	3700	4470	5430					
	30	22	0	0	0	**430**	680	1070	1330	1640	2030	2490	3060	3700	4500	5130	5860			
	40	30	0	0	0	0	**500**	790	980	1210	1490	1830	2250	2710	3290	3730	4250			
	50	37	0	0	0	0	0	**640**	800	980	1210	1480	1810	2190	2650	3010	3420	3830	4180	4850
	60	45	0	0	0	0	0	**540**	**670**	**830**	1020	1250	1540	1850	2240	2540	2890	3240	3540	4100
	75	55	0	0	0	0	0	0	0	**680**	**840**	1030	1260	1520	1850	2100	2400	2700	2950	3440
	100	75	0	0	0	0	0	0	0	0	**620**	**760**	**940**	1130	1380	1560	1790	2010	2190	2550
	125	93	0	0	0	0	0	0	0	0	0	0	**740**	**890**	**1000**	1220	1390	1560	1700	1960
	150	110	0	0	0	0	0	0	0	0	0	0	0	**760**	**920**	**1050**	**1190**	1340	1460	1690
	175	130	0	0	0	0	0	0	0	0	0	0	0	0	**810**	**930**	**1060**	**1190**	1300	1510
	200	150	0	0	0	0	0	0	0	0	0	0	0	0	0	**810**	**920**	**1030**	**1130**	1310
575 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	5900	9410																
	3/4	0.55	4270	6810																
	1	0.75	3630	5800	9120															
	1.5	1.1	2620	4180	6580															
	2	1.5	2030	3250	5110	8060														
	3	2.2	1580	2530	3980	6270														
	5	3.7	920	1480	2330	3680	5750													
	7.5	5.5	660	1060	1680	2650	4150													
	10	7.5	490	780	1240	1950	3060	4770	5940											
	15	11	**330**	530	850	1340	2090	3260	4060											
	20	15	0	**410**	650	1030	1610	2520	3140	3860	4760	5830								
	25	18.5	0	0	**520**	830	1300	2030	2530	3110	3840	4710								
	30	22	0	0	**430**	680	1070	1670	2080	2560	3160	3880	4770	5780	7030	8000				
	40	30	0	0	0	**500**	790	1240	1540	1900	2330	2860	3510	4230	5140	5830				
	50	37	0	0	0	0	**640**	1000	1250	1540	1890	2310	2840	3420	4140	4700	5340	5990	6530	7580
	60	45	0	0	0	0	0	**850**	1060	1300	1600	1960	2400	2890	3500	3970	4520	5070	5530	6410
	75	55	0	0	0	0	0	**690**	**860**	**1060**	1310	1600	1970	2380	2890	3290	3750	5220	4610	5370
	100	75	0	0	0	0	0	0	0	**790**	**970**	**1190**	1460	1770	2150	2440	2790	3140	3430	3990
	125	93	0	0	0	0	0	0	0	0	**770**	**950**	**1160**	1400	1690	1920	2180	2440	2650	3070
	150	110	0	0	0	0	0	0	0	0	0	**800**	**990**	**1190**	1440	1630	1860	2080	2270	2640
	175	130	0	0	0	0	0	0	0	0	0	0	**870**	**1050**	**1270**	**1450**	1650	1860	2030	2360
	200	150	0	0	0	0	0	0	0	0	0	0	0	**920**	**1110**	**1260**	**1440**	1620	1760	2050

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See 11 for additional details.

Continued on next page

60 °C

Table 18 Three-Phase 60 °C Cable (Continued)

MOTOR RATING			60 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	160	250	420	660	1030	1620	2020	2490	3060	3730	4570	5500	6660	7540				
	7.5	5.5	110	180	300	460	730	1150	1440	1770	2170	2650	3250	3900	4720	5340				
	10	7.5	**80**	130	210	340	550	850	1080	1320	1630	1990	2460	2950	3580	4080	4650	5220	5700	6630
	15	11	0	0	**140**	240	370	580	730	900	1110	1360	1660	2010	2440	2770	3150	3520	3850	4470
	20	15	0	0	0	**170**	280	450	570	690	850	1050	1290	1570	1900	2160	2470	2770	3030	3540
	25	18.5	0	0	0	**140**	**220**	360	450	550	690	850	1050	1260	1540	1750	1990	2250	2460	2850
	30	22	0	0	0	0	**180**	294	370	460	570	700	870	1050	1270	1450	1660	1870	2040	2380
230 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	210	340	550	880	1380	2140	2680	3280	4030	4930	6040	7270	8800	9970				
	7.5	5.5	150	240	390	630	970	1530	1900	2340	2880	3510	4300	5160	6240	7060	8010	8950	9750	
	10	7.5	**110**	180	280	460	730	1140	1420	1750	2160	2640	3240	3910	4740	5380	6150	6900	7530	8760
	15	11	0	0	**190**	310	490	780	970	1200	1470	1800	2200	2670	3220	3660	4170	4660	5100	5910
	20	15	0	0	**140**	230	370	600	750	910	1140	1390	1710	2070	2520	2860	3270	3670	4020	4680
	25	18.5	0	0	0	**190**	300	480	600	750	910	1120	1380	1680	2040	2310	2640	2970	3240	3780
	30	22	0	0	0	**150**	**240**	390	490	610	760	930	1140	1390	1690	1920	2200	2470	2700	3160
380 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	600	960	1510	2380	3730	5800	7170	8800										
	7.5	5.5	400	660	1030	1630	2560	3960	4890	6000	7390	9010								
	10	7.5	300	480	760	1200	1870	2890	3570	4360	5350	6490	7840	9390						
	15	11	210	340	550	880	1380	2140	2650	3250	4030	4930	6000	7260	8650	9780				
	20	15	**160**	260	410	660	1050	1630	2020	2500	3090	3790	4630	5640	6750	7660	4260	9760		
	25	18.5	0	**210**	330	540	850	1320	1650	2020	2500	3070	3760	4560	5460	6190	7080	7870	8610	9880
	30	22	0	0	**270**	430	700	1090	1360	1680	2070	2550	3120	3780	4530	5140	5880	6540	7150	8230
	40	30	0	0	0	**320**	510	790	990	1230	1510	1860	2280	2760	3300	3750	4270	4750	5200	5980
	50	37	0	0	0	**250**	**400**	630	810	990	1230	1500	1830	2220	2650	3010	3430	3820	4170	4780
	60	45	0	0	0	0	**340**	540	660	840	1030	1270	1540	1870	2250	2550	2910	3220	3520	4050
	75	55	0	0	0	0	0	**450**	550	690	855	1050	1290	1570	1900	2160	2490	2770	3040	3520
	100	75	0	0	0	0	0	0	**420**	**520**	640	760	940	1140	1360	1540	1770	1960	2140	2470
	125	93	0	0	0	0	0	0	0	**400**	**490**	**600**	730	930	1110	1260	1420	1590	1740	1990
	150	110	0	0	0	0	0	0	0	0	**420**	**510**	**620**	750	930	1050	1180	1320	1440	1630
	175	130	0	0	0	0	0	0	0	0	**360**	**440**	**540**	660	780	970	1120	1260	1380	1600
	200	150	0	0	0	0	0	0	0	0	0	0	**480**	**580**	**690**	790	940	1050	1140	1320
460 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	880	1420	2250	3540	5550	8620												
	7.5	5.5	630	1020	1600	2530	3960	6150	7650	9390										
	10	7.5	460	750	1180	1870	2940	4570	5700	7020	8620									
	15	11	310	510	810	1270	2010	3130	3900	4800	5890	7210	8850							
	20	15	**230**	380	610	970	1540	2410	3000	3700	4560	5590	6870	8290						
	25	18.5	**190**	310	490	790	1240	1950	2430	2980	3670	4510	5550	6700	8140					
	30	22	0	**250**	410	640	1020	1600	1990	2460	3040	3730	4590	5550	6750	7690	8790			
	40	30	0	0	**300**	480	750	1180	1470	1810	2230	2740	3370	4060	4930	5590	6370			
	50	37	0	0	0	**370**	590	960	1200	1470	1810	2220	2710	3280	3970	4510	5130	5740	6270	7270
	60	45	0	0	0	**320**	**500**	810	1000	1240	1530	1870	2310	2770	3360	3810	4330	4860	5310	6150
	75	55	0	0	0	0	**420**	660	810	1020	1260	1540	1890	2280	2770	3150	3600	4050	4420	5160
	100	75	0	0	0	0	0	**500**	**610**	760	930	1140	1410	1690	2070	2340	2680	3010	3280	3820
	125	93	0	0	0	0	0	0	**470**	**590**	**730**	880	1110	1330	1500	1830	2080	2340	2550	2940
	150	110	0	0	0	0	0	0	0	**510**	**630**	**770**	950	1140	1380	1570	1790	2000	2180	2530
	175	130	0	0	0	0	0	0	0	0	**550**	**680**	**830**	1000	1220	1390	1580	1780	1950	2270
	200	150	0	0	0	0	0	0	0	0	0	**590**	**730**	**880**	1070	1210	1380	1550	1690	1970
575 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	1380	2220	3490	5520	8620													
	7.5	5.5	990	1590	2520	3970	6220													
	10	7.5	730	1170	1860	2920	4590	7150	8910											
	15	11	490	790	1270	2010	3130	4890	6090											
	20	15	370	610	970	1540	2410	3780	4710	5790	7140	8740								
	25	18.5	**300**	490	780	1240	1950	3040	3790	4660	5760	7060								
	30	22	**240**	400	645	1020	1600	2500	3120	3840	4740	5820	7150	8670						
	40	30	0	**300**	480	750	1180	1860	2310	2850	3490	4290	5260	6340	7710	8740				
	50	37	0	0	**380**	590	960	1500	1870	2310	2830	3460	4260	5130	6210	7050	8010	8980	9790	
	60	45	0	0	0	**500**	**790**	1270	1590	1950	2400	2940	3600	4330	5250	5950	6780	7600	8290	9610
	75	55	0	0	0	**420**	**660**	1030	1290	1590	1960	2400	2950	3570	4330	4930	5620	6330	6910	8050
	100	75	0	0	0	0	**400**	**780**	960	1180	1450	1780	2190	2650	3220	3660	4180	4710	5140	5980
	125	93	0	0	0	0	0	**600**	**740**	920	1150	1420	1740	2100	2530	2880	3270	3660	3970	4600
	150	110	0	0	0	0	0	0	**650**	**800**	**990**	1210	1480	1780	2160	2450	2790	3120	3410	3950
	175	130	0	0	0	0	0	0	0	**700**	**860**	1060	1300	1570	1910	2170	2480	2780	3040	3540
	200	150	0	0	0	0	0	0	0	0	**760**	**930**	1140	1370	1670	1890	2160	2420	2640	3070

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

75 °C

Table 19 Three-Phase 75 °C Cable, 60 Hz (Service Entrance to Motor) Maximum Length in Feet

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	710	1140	1800	2840	4420													
	3/4	0.55	510	810	1280	2030	3160													
	1	0.75	430	690	1080	1710	2670	4140	5140											
	1.5	1.1	310	500	790	1260	1960	3050	3780											
	2	1.5	240	390	610	970	1520	2360	2940	3610	4430	5420								
	3	2.2	180	290	470	740	1160	1810	2250	2760	3390	4130								
	5	3.7	**110**	170	280	440	690	1080	1350	1660	2040	2490	3050	3670	4440	5030				
	7.5	5.5	0	0	200	310	490	770	960	1180	1450	1770	2170	2600	3150	3560				
	10	7.5	0	0	**150**	230	370	570	720	880	1090	1330	1640	1970	2390	2720	3100	3480	3800	4420
	15	11	0	0	0	**160**	250	390	490	600	740	910	1110	1340	1630	1850	2100	2350	2570	2980
	20	15	0	0	0	0	**190**	300	380	460	570	700	860	1050	1270	1440	1650	1850	2020	2360
	25	18.5	0	0	0	0	0	**240**	300	370	460	570	700	840	1030	1170	1330	1500	1640	1900
	30	22	0	0	0	0	0	**200**	**250**	310	380	470	580	700	850	970	1110	1250	1360	1590
230 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	930	1490	2350	3700	5760	8910												
	3/4	0.55	670	1080	1700	2580	4190	6490	8060	9860										
	1	0.75	560	910	1430	2260	3520	5460	6780	8290										
	1.5	1.1	420	670	1060	1670	2610	4050	5030	6160	7530	9170								
	2	1.5	320	510	810	1280	2010	3130	3890	4770	5860	7170	8780							
	3	2.2	240	390	620	990	1540	2400	2980	3660	4480	5470	6690	8020	9680					
	5	3.7	**140**	230	370	590	920	1430	1790	2190	2690	3290	4030	4850	5870	6650	7560	8460	9220	
	7.5	5.5	0	**160**	260	420	650	1020	1270	1560	1920	2340	2870	3440	4160	4710	5340	5970	6500	7510
	10	7.5	0	0	**190**	310	490	760	950	1170	1440	1760	2160	2610	3160	3590	4100	4600	5020	5840
	15	11	0	0	0	**210**	330	520	650	800	980	1200	1470	1780	2150	2440	2780	3110	3400	3940
	20	15	0	0	0	**160**	**250**	400	500	610	760	930	1140	1380	1680	1910	2180	2450	2680	3120
	25	18.5	0	0	0	0	**200**	320	400	500	610	750	920	1120	1360	1540	1760	1980	2160	2520
	30	22	0	0	0	0	0	**260**	330	410	510	620	760	930	1130	1280	1470	1650	1800	2110
380 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	2690	4290	6730															
	3/4	0.55	2000	3190	5010	7860														
	1	0.75	1620	2580	4060	6390	9980													
	1.5	1.1	1230	1970	3100	4890	7630													
	2	1.5	870	1390	2180	3450	5400	8380												
	3	2.2	680	1090	1710	2690	4200	6500	8020	9830										
	5	3.7	400	640	1010	1590	2490	3870	4780	5870	7230	8830								
	7.5	5.5	270	440	690	1090	1710	2640	3260	4000	4930	6010	7290	8780						
	10	7.5	**200**	320	510	800	1250	1930	2380	2910	3570	4330	5230	6260	7390	8280	9340			
	15	11	0	0	370	590	920	1430	1770	2170	2690	3290	4000	4840	5770	6520	7430	8250	8990	
	20	15	0	0	**280**	440	700	1090	1350	1670	2060	2530	3090	3760	4500	5110	2840	6510	7120	8190
	25	18.5	0	0	0	**360**	570	880	1100	1350	1670	2050	2510	3040	3640	4130	4720	5250	5740	6590
	30	22	0	0	0	**290**	470	730	910	1120	1380	1700	2080	2520	3020	3430	3920	4360	4770	5490
	40	30	0	0	0	0	0	**530**	660	820	1010	1240	1520	1840	2200	2500	2850	3170	3470	3990
	50	37	0	0	0	0	0	**440**	**540**	660	820	1000	1220	1480	1770	2010	2290	2550	2780	3190
	60	45	0	0	0	0	0	**370**	**460**	**560**	690	850	1030	1250	1500	1700	1940	2150	2350	2700
	75	55	0	0	0	0	0	0	0	**460**	**570**	700	860	1050	1270	1440	1660	1850	2030	2350
	100	75	0	0	0	0	0	0	0	0	**420**	**510**	**630**	760	910	1030	1180	1310	1430	1650
	125	93	0	0	0	0	0	0	0	0	0	0	**510**	**620**	**740**	840	950	1060	1160	1330
	150	110	0	0	0	0	0	0	0	0	0	0	0	**520**	**620**	**700**	**790**	880	960	1090
	175	130	0	0	0	0	0	0	0	0	0	0	0	0	**560**	**650**	**750**	**840**	920	1070
	200	150	0	0	0	0	0	0	0	0	0	0	0	0	0	**550**	**630**	**700**	**760**	880

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

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75 °C

Table 20 Three-Phase 75 °C Cable (Continued)

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
460 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	3770	6020	9460															
	3/4	0.55	2730	4350	6850															
	1	0.75	2300	3670	5770	9070														
	1.5	1.1	1700	2710	4270	6730														
	2	1.5	1300	2070	3270	5150	8050													
	3	2.2	1000	1600	2520	3970	6200													
	5	3.7	590	950	1500	2360	3700	5750												
	7.5	5.5	420	680	1070	1690	2640	4100	5100	6260	7680									
	10	7.5	310	500	790	1250	1960	3050	3800	4680	5750	7050								
	15	11	0	**340**	540	850	1340	2090	2600	3200	3930	4810	5900	7110						
	20	15	0	0	410	650	1030	1610	2000	2470	3040	3730	4580	5530						
	25	18.5	0	0	**330**	530	830	1300	1620	1990	2450	3010	3700	4470	5430					
	30	22	0	0	**270**	430	680	1070	1330	1640	2030	2490	3060	3700	4500	5130	5860			
	40	30	0	0	0	**320**	**500**	790	980	1210	1490	1830	2250	2710	3290	3730	4250			
	50	37	0	0	0	0	**410**	640	800	980	1210	1480	1810	2190	2650	3010	3420	3830	4180	4850
	60	45	0	0	0	0	0	**540**	**670**	830	1020	1250	1540	1850	2240	2540	2890	3240	3540	4100
	75	55	0	0	0	0	0	**440**	**550**	**680**	840	1030	1260	1520	1850	2100	2400	2700	2950	3440
	100	75	0	0	0	0	0	0	0	**500**	**620**	**760**	940	1130	1380	1560	1790	2010	2190	2550
	125	93	0	0	0	0	0	0	0	0	0	**600**	**740**	**890**	1000	1220	1390	1560	1700	1960
	150	110	0	0	0	0	0	0	0	0	0	0	**630**	**760**	**920**	1050	1190	1340	1460	1690
	175	130	0	0	0	0	0	0	0	0	0	0	0	**670**	**810**	**930**	1060	1190	1300	1510
	200	150	0	0	0	0	0	0	0	0	0	0	0	**590**	**710**	**810**	**920**	1030	1130	1310
575 V 60 Hz Three-Phase 3 - Lead	1/2	0.37	5900	9410																
	3/4	0.55	4270	6810																
	1	0.75	3630	5800	9120															
	1.5	1.1	2620	4180	6580															
	2	1.5	2030	3250	5110	8060														
	3	2.2	1580	2530	3980	6270														
	5	3.7	920	1480	2330	3680	5750													
	7.5	5.5	660	1060	1680	2650	4150													
	10	7.5	490	780	1240	1950	3060	4770	5940											
	15	11	**330**	530	850	1340	2090	3260	4060											
	20	15	0	**410**	650	1030	1610	2520	3140	3860	4760	5830								
	25	18.5	0	0	520	830	1300	2030	2530	3110	3840	4710								
	30	22	0	0	**430**	680	1070	1670	2080	2560	3160	3880	4770	5780	7030	8000				
	40	30	0	0	0	**500**	790	1240	1540	1900	2330	2860	3510	4230	5140	5830				
	50	37	0	0	0	**410**	**640**	1000	1250	1540	1890	2310	2840	3420	4140	4700	5340	5990	6530	7580
	60	45	0	0	0	0	**540**	850	1060	1300	1600	1960	2400	2890	3500	3970	4520	5070	5530	6410
	75	55	0	0	0	0	0	**690**	860	1060	1310	1600	1970	2380	2890	3290	3750	5220	4610	5370
	100	75	0	0	0	0	0	0	**640**	**790**	970	1190	1460	1770	2150	2440	2790	3140	3430	3990
	125	93	0	0	0	0	0	0	0	**630**	**770**	**950**	1160	1400	1690	1920	2180	2440	2650	3070
	150	110	0	0	0	0	0	0	0	0	**660**	**800**	**990**	1190	1440	1630	1860	2080	2270	2640
	175	130	0	0	0	0	0	0	0	0	0	**700**	**870**	**1050**	1270	1450	1650	1860	2030	2360
	200	150	0	0	0	0	0	0	0	0	0	0	**760**	**920**	**1110**	1260	1440	1620	1760	2050

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

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Three-Phase Motors

APPLICATION

75 °C

Table 21 Three-Phase 75 °C Cable

MOTOR RATING			75 °C INSULATION - AWG COPPER WIRE SIZE													MCM COPPER WIRE SIZE				
VOLTS	HP	KW	14	12	10	8	6	4	3	2	1	0	00	000	0000	250	300	350	400	500
200 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	160	250	420	660	1030	1620	2020	2490	3060	3730	4570	5500	6660	7540				
	7.5	5.5	110	180	300	460	730	1150	1440	1770	2170	2650	3250	3900	4720	5340				
	10	7.5	**80**	130	210	340	550	850	1080	1320	1630	1990	2460	2950	3580	4080	4650	5220	5700	6630
	15	11	0	0	140	240	370	580	730	900	1110	1360	1660	2010	2440	2770	3150	3520	3850	4470
	20	15	0	0	**120**	170	280	450	570	690	850	1050	1290	1570	1900	2160	2470	2770	3030	3540
	25	18.5	0	0	0	**140**	220	360	450	550	690	850	1050	1260	1540	1750	1990	2250	2460	2850
	30	22	0	0	0	**120**	**180**	294	370	460	570	700	870	1050	1270	1450	1660	1870	2040	2380
230 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	210	340	550	880	1380	2140	2680	3280	4030	4930	6040	7270	8800	9970				
	7.5	5.5	150	240	390	630	970	1530	1900	2340	2880	3510	4300	5160	6240	7060	8010	8950	9750	
	10	7.5	**110**	180	280	460	730	1140	1420	1750	2160	2640	3240	3910	4740	5380	6150	6900	7530	8760
	15	11	0	**130**	190	310	490	780	970	1200	1470	1800	2200	2670	3220	3660	4170	4660	5100	5910
	20	15	0	0	**140**	230	370	600	750	910	1140	1390	1710	2070	2520	2860	3270	3670	4020	4680
	25	18.5	0	0	**120**	190	300	480	600	750	910	1120	1380	1680	2040	2310	2640	2970	3240	3780
	30	22	0	0	0	**150**	240	390	490	610	760	930	1140	1390	1690	1920	2200	2470	2700	3160
380 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	600	960	1510	2380	3730	5800	7170	8800										
	7.5	5.5	400	660	1030	1630	2560	3960	4890	6000	7390	9010								
	10	7.5	300	480	760	1200	1870	2890	3570	4360	5350	6490	7840	9390						
	15	11	210	340	550	880	1380	2140	2650	3250	4030	4930	6000	7260	8650	9780				
	20	15	**160**	260	410	660	1050	1630	2020	2500	3090	3790	4630	5640	6750	7660	4260	9760		
	25	18.5	0	**210**	330	540	850	1320	1650	2020	2500	3070	3760	4560	5460	6190	7080	7870	8610	9880
	30	22	0	0	**270**	430	700	1090	1360	1680	2070	2550	3120	3780	4530	5140	5880	6540	7150	8230
	40	30	0	0	**210**	320	510	790	990	1230	1510	1860	2280	2760	3300	3750	4270	4750	5200	5980
	50	37	0	0	0	**250**	400	630	810	990	1230	1500	1830	2220	2650	3010	3430	3820	4170	4780
	60	45	0	0	0	0	**340**	540	660	840	1030	1270	1540	1870	2250	2550	2910	3220	3520	4050
	75	55	0	0	0	0	**290**	450	550	690	855	1050	1290	1570	1900	2160	2490	2770	3040	3520
	100	75	0	0	0	0	0	**340**	**420**	520	640	760	940	1140	1360	1540	1770	1960	2140	2470
	125	93	0	0	0	0	0	0	**340**	**400**	**490**	600	730	930	1110	1260	1420	1590	1740	1990
	150	110	0	0	0	0	0	0	0	**350**	**420**	**510**	620	750	930	1050	1180	1320	1440	1630
	175	130	0	0	0	0	0	0	0	0	**360**	**440**	**540**	660	780	970	1120	1260	1380	1600
	200	150	0	0	0	0	0	0	0	0	0	**410**	**480**	**580**	690	790	940	1050	1140	1320
460 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	880	1420	2250	3540	5550	8620												
	7.5	5.5	630	1020	1600	2530	3960	6150	7650	9390										
	10	7.5	460	750	1180	1870	2940	4570	5700	7020	8620									
	15	11	310	510	810	1270	2010	3130	3900	4800	5890	7210	8850							
	20	15	230	380	610	970	1540	2410	3000	3700	4560	5590	6870	8290						
	25	18.5	**190**	310	490	790	1240	1950	2430	2980	3670	4510	5550	6700	8140					
	30	22	0	**250**	410	640	1020	1600	1990	2460	3040	3730	4590	5550	6750	7690	8790			
	40	30	0	0	**300**	480	750	1180	1470	1810	2230	2740	3370	4060	4930	5590	6370			
	50	37	0	0	**250**	370	590	960	1200	1470	1810	2220	2710	3280	3970	4510	5130	5740	6270	7270
	60	45	0	0	0	**320**	500	810	1000	1240	1530	1870	2310	2770	3360	3810	4330	4860	5310	6150
	75	55	0	0	0	0	**420**	660	810	1020	1260	1540	1890	2280	2770	3150	3600	4050	4420	5160
	100	75	0	0	0	0	**310**	**500**	610	760	930	1140	1410	1690	2070	2340	2680	3010	3280	3820
	125	93	0	0	0	0	0	**390**	**470**	**590**	730	880	1110	1330	1500	1830	2080	2340	2550	2940
	150	110	0	0	0	0	0	0	**420**	**510**	**630**	770	950	1140	1380	1570	1790	2000	2180	2530
	175	130	0	0	0	0	0	0	0	**450**	**550**	**680**	830	1000	1220	1390	1580	1780	1950	2270
	200	150	0	0	0	0	0	0	0	0	**480**	**590**	**730**	880	1070	1210	1380	1550	1690	1970
575 V 60 Hz Three-Phase 6 - Lead Y-D	5	3.7	1380	2220	3490	5520	8620													
	7.5	5.5	990	1590	2520	3970	6220													
	10	7.5	730	1170	1860	2920	4590	7150	8910											
	15	11	490	790	1270	2010	3130	4890	6090											
	20	15	370	610	970	1540	2410	3780	4710	5790	7140	8740								
	25	18.5	**300**	490	780	1240	1950	3040	3790	4660	5760	7060								
	30	22	**240**	400	645	1020	1600	2500	3120	3840	4740	5820	7150	8670						
	40	30	0	**300**	480	750	1180	1860	2310	2850	3490	4290	5260	6340	7710	8740				
	50	37	0	0	**380**	590	960	1500	1870	2310	2830	3460	4260	5130	6210	7050	8010	8980	9790	
	60	45	0	0	**330**	500	790	1270	1590	1950	2400	2940	3600	4330	5250	5950	6780	7600	8290	9610
	75	55	0	0	0	**420**	660	1030	1290	1590	1960	2400	2950	3570	4330	4930	5620	6330	6910	8050
	100	75	0	0	0	0	**400**	780	960	1180	1450	1780	2190	2650	3220	3660	4180	4710	5140	5980
	125	93	0	0	0	0	0	**600**	740	920	1150	1420	1740	2100	2530	2880	3270	3660	3970	4600
	150	110	0	0	0	0	0	**520**	**650**	800	990	1210	1480	1780	2160	2450	2790	3120	3410	3950
	175	130	0	0	0	0	0	0	**570**	**700**	860	1060	1300	1570	1910	2170	2480	2780	3040	3540
	200	150	0	0	0	0	0	0	**500**	**610**	**760**	930	1140	1370	1670	1890	2160	2420	2640	3070

Lengths in **BOLD** only meet the US National Electrical Code ampacity requirements for individual conductors in free air or water. Lengths NOT in bold meet NEC ampacity requirements for either individual conductors or jacketed cable. See page 11 for additional details.

Table 22 Three-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	WATTS	AMPS	WATTS		S.F.	F.L.		
4"	234501	1/2	0.37	200	60	1.6	2.8	585	3.4	860	6.6-8.4	70	64	17.5	N
	234511			230	60	1.6	2.4	585	2.9	860	9.5-10.9	70	64	15.2	N
	234541			380	60	1.6	1.4	585	2.1	860	23.2-28.6	70	64	9.2	N
	234521			460	60	1.6	1.2	585	1.5	860	38.4-44.1	70	64	7.6	N
	234531			575	60	1.6	1.0	585	1.2	860	58.0-71.0	70	64	6.1	N
	234502	3/4	0.55	200	60	1.5	3.6	810	4.4	1150	4.6-5.9	73	69	24.6	N
	234512			230	60	1.5	3.1	810	3.8	1150	6.8-7.8	73	69	21.4	N
	234542			380	60	1.5	1.9	810	2.5	1150	16.6-20.3	73	69	13	N
	234522			460	60	1.5	1.6	810	1.9	1150	27.2-30.9	73	69	10.7	N
	234532			575	60	1.5	1.3	810	1.6	1150	41.5-50.7	73	69	8.6	N
	234503	1	0.75	200	60	1.4	4.5	1070	5.4	1440	3.8-4.5	72	70	30.9	M
	234513			230	60	1.4	3.9	1070	4.7	1440	4.9-5.6	72	70	26.9	M
	234543			380	60	1.4	2.3	1070	2.8	1440	12.2-14.9	72	70	16.3	M
	234523			460	60	1.4	2	1070	2.4	1440	19.9-23.0	72	70	13.5	M
	234533			575	60	1.4	1.6	1070	1.9	1440	30.1-36.7	72	70	10.8	M
	234504	1.5	1.1	200	60	1.3	5.8	1460	6.8	1890	2.5-3.0	76	76	38.2	K
	234514			230	60	1.3	5	1460	5.9	1890	3.2-4.0	76	76	33.2	K
	234544			380	60	1.3	3	1460	3.6	1890	8.5-10.4	76	76	20.1	K
	234524			460	60	1.3	2.5	1460	3.1	1890	13.0-16.0	76	76	16.6	K
	234534			575	60	1.3	2	1460	2.4	1890	20.3-25.0	76	76	13.3	K
	234305	2	1.5	200	60	1.25	7.7	1960	9.3	2430	1.8-2.4	76	76	50.3	K
	234315			230	60	1.25	6.7	1960	8.1	2430	2.3-3.0	76	76	45.0	K
	234345			380	60	1.25	4.1	1960	4.9	2430	6.6-8.2	76	76	26.6	K
	234325			460	60	1.25	3.4	1960	4.1	2430	9.2-12.0	76	76	22.5	K
	234335			575	60	1.25	2.7	1960	3.2	2430	14.6-18.7	76	76	17.8	K
	234306	3	2.2	200	60	1.15	10.9	2920	12.5	3360	1.3-1.7	77	77	69.5	K
	234316			230	60	1.15	9.5	2920	10.9	3360	1.8-2.2	77	77	60.3	K
	234346			380	60	1.15	5.8	2920	6.6	3360	4.7-6.0	77	77	37.5	K
	234326			460	60	1.15	4.8	2920	5.5	3360	7.2-8.8	77	77	31.0	K
	234336			575	60	1.15	3.8	2920	4.4	3360	11.4-13.9	77	77	25.1	K
	234307	5	3.7	200	60	1.15	18.3	4800	20.5	5500	.68-.83	78	78	116	K
	234317			230	60	1.15	15.9	4800	17.8	5500	.91-1.1	78	78	102	K
	234347			380	60	1.15	9.6	4800	10.8	5500	2.6-3.2	78	78	60.2	K
	234327			460	60	1.15	8.0	4800	8.9	5500	3.6-4.4	78	78	53.7	K
	234337			575	60	1.15	6.4	4800	7.1	5500	5.6-6.9	78	78	41.8	K
	234308	7.5	5.5	200	60	1.15	26.5	7150	30.5	8200	.43-.53	78	78	177	K
	234318			230	60	1.15	23.0	7150	26.4	8200	.60-.73	78	78	152	K
	234348			380	60	1.15	13.9	7150	16.0	8200	1.6-2.0	78	78	92.7	K
	234328			460	60	1.15	11.5	7150	13.2	8200	2.3-2.8	78	78	83.8	K
	234338			575	60	1.15	9.2	7150	10.6	8200	3.6-4.5	78	78	64.6	K
	234549	10	7.5	380	60	1.15	19.3	10000	21.0	11400	1.2-1.6	75	75	140	L
	234595			460	60	1.15	15.9	10000	17.3	11400	1.8-2.3	75	75	116.0	L
	234598			575	60	1.15	12.5	10000	13.6	11400	2.8-3.5	75	75	92.8	L
	234646	15	11	380	60	1.15	27.6	14600	31.2	16800	.86-1.1	77	76	178	J
	234626			460	60	1.15	22.8	14600	25.8	16800	1.2-1.5	77	76	147	J
	234636			575	60	1.15	18.2	14600	20.7	16800	1.9-2.4	77	76	118	J

Three-Phase Motors

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Table 23 Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
4"	234501	1/2	0.37	200	10	5	8	10	4	15
	234511			230	8	4.5	6	8	4	15
	234541			380	5	2.5	4	5	2	15
	234521			460	4	2.25	3	4	2	15
	234531			575	3	1.8	3	3	1.4	15
	234502	3/4	0.55	200	15	7	10	12	5	15
	234512			230	10	5.6	8	10	5	15
	234542			380	6	3.5	5	6	3	15
	234522			460	5	2.8	4	5	3	15
	234532			575	4	2.5	4	4	1.8	15
	234503	1	0.75	200	15	8	15	15	6	15
	234513			230	15	7	10	12	6	15
	234543			380	8	4.5	8	8	4	15
	234523			460	6	3.5	5	6	3	15
	234533			575	5	2.8	4	5	2.5	15
	234504	1.5	1.1	200	20	12	15	20	8	15
	234514			230	15	9	15	15	8	15
	234544			380	10	5.6	8	10	4	15
	234524			460	8	4.5	8	8	4	15
	234534			575	6	3.5	5	6	3	15
	234305	2	1.5	200	25	15	20	25	11	20
	234315			230	25	12	20	25	10	20
	234345			380	15	8	15	15	6	15
	234325			460	15	6	10	11	5	15
	234335			575	10	5	8	10	4	15
	234306	3	2.2	200	35	20	30	35	15	30
	234316			230	30	17.5	25	30	12	25
	234346			380	20	12	15	20	8	15
	234326			460	15	9	15	15	6	15
	234336			575	15	7	10	11	5	15
	234307	5	3.7	200	60	35	50	60	25	50
	234317			230	50	30	40	45	20	40
	234347			380	30	17.5	25	30	12	25
	234327			460	25	15	20	25	10	20
	234337			575	20	12	20	20	8	20
	234308	7.5	5.5	200	90	50	70	80	35	70
	234318			230	80	45	60	70	30	60
	234348			380	45	25	40	40	20	40
	234328			460	40	25	30	35	15	30
	234338			575	30	17.5	25	30	12	25
	234349	10	7.5	380	70	40	60	60	25	60
	234329			460	60	30	45	50	25	45
	234339			575	45	25	35	40	20	35
	234549			380	70	35	60	60	25	60
	234595			460	60	30	45	50	25	45
	234598			575	45	25	35	40	20	35
	234646	15	11	380	90	50	70	80	35	70
	234626			460	80	45	60	70	30	60
	234636			575	60	35	50	60	25	50

Three-Phase Motors

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Table 24 Three-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	WATTS	AMPS	WATTS		S.F.	F.L.		
6" STD.	236650	5	3.7	200	60	1.15	17.5	4700	20.0	5400	.77-.93	79	79	99	H
	236600			230	60	1.15	15	4700	17.6	5400	1.0-1.2	79	79	86	H
	236660			380	60	1.15	9.1	4700	10.7	5400	2.6-3.2	79	79	52	H
	236610			460	60	1.15	7.5	4700	8.8	5400	3.9-4.8	79	79	43	H
	236620			575	60	1.15	6	4700	7.1	5400	6.3-7.7	79	79	34	H
	236651	7.5	5.5	200	60	1.15	25.1	7000	28.3	8000	.43-.53	80	80	150	H
	236601			230	60	1.15	21.8	7000	24.6	8000	.64-.78	80	80	130	H
	236661			380	60	1.15	13.4	7000	15	8000	1.6-2.1	80	80	79	H
	236611			460	60	1.15	10.9	7000	12.3	8000	2.4-2.9	80	80	65	H
	236621			575	60	1.15	8.7	7000	9.8	8000	3.7-4.6	80	80	52	H
	236652	10	7.5	200	60	1.15	32.7	9400	37	10800	.37-.45	79	79	198	H
	236602			230	60	1.15	28.4	9400	32.2	10800	.47-.57	79	79	172	H
	236662			380	60	1.15	17.6	9400	19.6	10800	1.2-1.5	79	79	104	H
	236612			460	60	1.15	14.2	9400	16.1	10800	1.9-2.4	79	79	86	H
	236622			575	60	1.15	11.4	9400	12.9	10800	3.0-3.7	79	79	69	H
	236653	15	11	200	60	1.15	47.8	13700	54.4	15800	.24-.29	81	81	306	H
	236603			230	60	1.15	41.6	13700	47.4	15800	.28-.35	81	81	266	H
	236663			380	60	1.15	25.8	13700	28.9	15800	.77-.95	81	81	161	H
	236613			460	60	1.15	20.8	13700	23.7	15800	1.1-1.4	81	81	133	H
	236623			575	60	1.15	16.6	13700	19	15800	1.8-2.3	81	81	106	H
	236654	20	15	200	60	1.15	61.9	18100	69.7	20900	.16-.20	82	82	416	J
	236604			230	60	1.15	53.8	18100	60.6	20900	.22-.26	82	82	362	J
	236664			380	60	1.15	33	18100	37.3	20900	.55-.68	82	82	219	J
	236614			460	60	1.15	26.9	18100	30.3	20900	.8-1.0	82	82	181	J
	236624			575	60	1.15	21.5	18100	24.2	20900	1.3-1.6	82	82	145	J
	236655	25	18.5	200	60	1.15	77.1	22500	86.3	25700	.12-.15	83	83	552	J
	236605			230	60	1.15	67	22500	76.4	25700	.15-.19	83	83	480	J
	236665			380	60	1.15	41	22500	46	25700	.46-.56	83	83	291	J
	236615			460	60	1.15	33.5	22500	38.2	25700	.63-.77	83	83	240	J
	236625			575	60	1.15	26.8	22500	30	25700	1.0-1.3	83	83	192	J
	236656	30	22	200	60	1.15	90.9	26900	104	31100	.09-.11	83	83	653	J
	236606			230	60	1.15	79	26900	90.4	31100	.14-.17	83	83	568	J
	236666			380	60	1.15	48.8	26900	55.4	31100	.35-.43	83	83	317	J
	236616			460	60	1.15	39.5	26900	45.2	31100	.52-.64	83	83	284	H
	236626			575	60	1.15	31.6	26900	36.2	31100	.78-.95	83	83	227	J
	236667	40	30	380	60	1.15	66.5	35600	74.6	42400	.26-.33	83	83	481	J
	236617			460	60	1.15	54.9	35600	61.6	42400	.34-.42	83	83	397	J
	236627			575	60	1.15	42.8	35600	49.6	42400	.52-.64	83	83	318	H
	236668	50	37	380	60	1.15	83.5	45100	95	52200	.21-.25	82	83	501	H
	236618			460	60	1.15	67.7	45100	77	52200	.25-.32	82	83	414	H
	236628			575	60	1.15	54.2	45100	61.6	52200	.40-.49	82	83	331	H
	276668			380	60	1.15	82.4	45100	94.5	52200	.21 - .25	82	83	501	H
	276618			460	60	1.15	68.1	45100	78.1	52200	.25 - .32	82	83	414	H
	276628			575	60	1.15	54.5	45100	62.5	52200	.40 - .49	82	83	331	H
	276029	60/50	37/45	380	60	1.15	98.1	53500	111.8	61700	.15 - .18	84	84	627	H
	276009			460	60	1.15	81.0	53500	92.3	61700	.22 - .27	84	84	518	H
	276059			575	60	1.15	64.8	53500	73.9	61700	.35 - .39	84	84	414	H
	236669	60	45	380	60	1.15	98.7	53500	111	61700	.15-.18	84	84	627	H
	236619			460	60	1.15	80.5	53500	91	61700	.22-.27	84	84	518	H
	236629			575	60	1.15	64.4	53500	72.8	61700	.35-.39	84	84	414	H
	276669			380	60	1.15	98.1	53500	111.8	61700	.15 - .18	84	84	627	H
	276619			460	60	1.15	81.0	53500	92.3	61700	.22 - .27	84	84	518	H
	276629			575	60	1.15	64.8	53500	73.9	61700	.35 - .39	84	84	414	H

Model numbers above are for three-lead motors. Six-lead motors with different model numbers have the same running performance, but when Wye connected for starting have locked rotor amps 33% of the values shown. Six-lead individual phase resistance = table X 1.5.

Table 25 6″ Three-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	WATTS	AMPS	WATTS		S.F.	F.L.		
6″ HI-TEMP 90 °C	276650			200	60	1.15	17.2	5200	19.8	5800	.53 - .65	73	72	124	K
	276600			230	60	1.15	15.0	5200	17.2	5800	.68 - .84	73	72	108	K
	276660	5	3.7	380	60	1.15	9.1	5200	10.4	5800	2.0 - 2.4	73	72	66.0	K
	276610			460	60	1.15	7.5	5200	8.6	5800	2.8 - 3.4	73	72	54.0	K
	276620			575	60	1.15	6.0	5200	6.9	5800	4.7 - 5.7	73	72	43.0	K
	276651			200	60	1.15	24.8	7400	28.3	8400	.30 - .37	77	76	193	K
	276601			230	60	1.15	21.6	7400	24.6	8400	.41 - .50	77	76	168	K
	276661	7.5	5.5	380	60	1.15	13.1	7400	14.9	8400	1.1 - 1.4	77	76	102	K
	276611			460	60	1.15	10.8	7400	12.3	8400	1.7 - 2.0	77	76	84.0	K
	276621			575	60	1.15	8.6	7400	9.9	8400	2.6 - 3.2	77	76	67.0	K
	276652			200	60	1.15	32.0	9400	36.3	10700	.21 - .26	80	79	274	L
	276602			230	60	1.15	27.8	9400	31.6	10700	.28 - .35	80	79	238	L
	276662	10	7.5	380	60	1.15	16.8	9400	19.2	10700	.80 - .98	80	79	144	L
	276612			460	60	1.15	13.9	9400	15.8	10700	1.2 - 1.4	80	79	119	L
	276622			575	60	1.15	11.1	9400	12.7	10700	1.8 - 2.2	80	79	95.0	L
	276653			200	60	1.15	48.5	14000	54.5	15900	.15 - .19	81	80	407	L
	276603			230	60	1.15	42.2	14000	47.4	15900	.19 - .24	81	80	354	L
	276663	15	11	380	60	1.15	25.5	14000	28.7	15900	.52 - .65	81	80	214	L
	276613			460	60	1.15	21.1	14000	23.7	15900	.78 - .96	81	80	177	L
	276623			575	60	1.15	16.9	14000	19.0	15900	1.2 - 1.4	81	80	142	L
	276654			200	60	1.15	64.9	18600	73.6	21300	.10 - .12	80	80	481	K
	276604			230	60	1.15	56.4	18600	64.0	21300	.14 - .18	80	80	418	K
	276664	20	15	380	60	1.15	34.1	18600	38.8	21300	.41 - .51	80	80	253	K
	276614			460	60	1.15	28.2	18600	32.0	21300	.58 - .72	80	80	209	K
	276624			575	60	1.15	22.6	18600	25.6	21300	.93 - 1.15	80	80	167	K
	276655			200	60	1.15	80.0	22600	90.6	25800	.09 - .11	83	82	665	L
	276605			230	60	1.15	69.6	22600	78.8	25800	.11 - .14	83	82	578	L
	276665	25	18.5	380	60	1.15	42.1	22600	47.7	25800	.27 - .34	83	82	350	L
	276615			460	60	1.15	34.8	22600	39.4	25800	.41 - .51	83	82	289	L
	276625			575	60	1.15	27.8	22600	31.6	25800	.70 - .86	83	82	231	L
	276656			200	60	1.15	95.0	28000	108.6	31900	.07 - .09	81	80	736	K
	276606			230	60	1.15	82.6	28000	94.4	31900	.09 - .12	81	80	640	K
	276666	30	22	380	60	1.15	50.0	28000	57.2	31900	.23 - .29	81	80	387	K
	276616			460	60	1.15	41.3	28000	47.2	31900	.34 - .42	81	80	320	K
	276626			575	60	1.15	33.0	28000	37.8	31900	.52 - .65	81	80	256	K
	276667			380	60	1.15	67.2	35900	76.0	42400	.18 - .23	84	83	545	L
	276617	40	30	460	60	1.15	55.4	35900	62.8	42400	.23 - .29	84	83	450	L
	276627			575	60	1.15	45.2	35900	50.2	42400	.34 - .43	84	83	360	L

Model numbers above are for three-lead motors. Six-lead motors with different model numbers have the same running performance, but when Wye connected for starting have locked rotor amps 33% of the values shown. Six-lead individual phase resistance = table X 1.5.

Table 26 Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX		RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
	STD	HI-TEMP	HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
6" STD. & HI-TEMP	236650	276650	5	3.7	200	60	35	45	50	25	45
	236600	276600			230	45	30	40	45	20	40
	236660	276660			380	30	17.5	25	30	12	25
	236610	276610			460	25	15	20	25	10	20
	236620	276620			575	20	12	15	20	8	15
	236651	276651	7.5	5.5	200	80	45	70	80	35	70
	236601	276601			230	70	40	60	70	30	60
	236661	276661			380	45	25	35	40	20	35
	236611	276611			460	35	20	30	35	15	30
	236621	276621			575	30	17.5	25	25	11	25
	236652	276652	10	7.5	200	100	60	90	100	45	90
	236602	276602			230	90	50	80	90	40	80
	236662	276662			380	60	35	45	50	25	45
	236612	276612			460	45	25	40	45	20	40
	236622	276622			575	35	20	30	35	15	30
	236653	276653	15	11	200	150	90	125	150	60	125
	236603	276603			230	150	80	110	125	60	110
	236663	276663			380	80	50	70	80	35	70
	236613	276613			460	70	40	60	60	30	60
	236623	276623			575	60	30	45	50	25	45
	236654	276654	20	15	200	200	110	175	175	80	175
	236604	276604			230	175	100	150	175	70	150
	236664	276664			380	100	60	90	100	45	90
	236614	276614			460	90	50	70	80	35	70
	236624	276624			575	70	40	60	70	30	60
	236655	276655	25	18.5	200	250	150	200	225	100	200
	236605	276605			230	225	125	175	200	90	175
	236665	276665			380	125	80	110	125	50	110
	236615	276615			460	110	60	90	100	45	90
	236625	276625			575	90	50	70	80	35	70
	236656	276656	30	22	200	300	175	250	300	125	250
	236606	276606			230	250	150	225	250	100	200
	236666	276666			380	150	90	125	150	60	125
	236616	276616			460	125	70	110	125	50	100
	236626	276626			575	100	60	90	100	40	80
	236667	276667	40	30	380	200	125	175	200	90	175
	236617	276617			460	175	100	150	175	70	150
	236627	276627			575	150	80	110	125	60	110
	236668	276668	50	37	380	250	150	225	250	110	225
	236618	276618			460	225	125	175	200	90	175
	236628	276628			575	175	100	150	175	70	150
	236669	276669	60	45	380	300	175	250	300	125	250
	236619	276619			460	250	150	225	250	100	225
	236629	276629			575	200	125	175	200	80	175

Three-Phase Motors

APPLICATION

Table 27 Three-Phase Motor Specifications (60 Hz) 3525 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	KILOWATTS	AMPS	KILOWATTS		S.F.	F.L.		
8" STD.	239660			380	60	1.15	64	35	72	40	.16-.20	86	86	479	J
	239600	40	30	460	60	1.15	53	35	60	40	.24-.30	86	86	396	J
	239610			575	60	1.15	42	35	48	40	.39-.49	86	86	317	J
	239661			380	60	1.15	79	43	88	49	.12-.16	87	87	656	K
	239601	50	37	460	60	1.15	64	43	73	49	.18-.22	87	87	542	K
	239611			575	60	1.15	51	43	59	49	.28-.34	87	87	434	K
	239662			380	60	1.15	92	52	104	60	.09-.11	88	87	797	K
	239602	60	45	460	60	1.15	76	52	86	60	.14-.17	88	87	658	K
	239612			575	60	1.15	61	52	69	60	.22-.28	88	87	526	K
	239663			380	60	1.15	114	64	130	73.5	.06-.09	88	88	1046	L
	239603	75	55	460	60	1.15	94	64	107	73.5	.10-.13	88	88	864	L
	239613			575	60	1.15	76	64	86	73.5	.16-.21	88	88	691	L
	239664			380	60	1.15	153	85	172	97.5	.05-.06	89	89	1466	L
	239604	100	75	460	60	1.15	126	85	142	97.5	.07-.09	89	89	1211	L
	239614			575	60	1.15	101	85	114	97.5	.11-.13	89	89	969	L
	239165			380	60	1.15	202	109	228	125	.03-.04	87	86	1596	K
	239105	125	93	460	60	1.15	167	109	188	125	.05-.07	87	86	1318	K
	239115			575	60	1.15	134	109	151	125	.08-.11	87	86	1054	K
	239166			380	60	1.15	235	128	266	146	.02-.03	88	87	1961	K
	239106	150	110	460	60	1.15	194	128	219	146	.04-.05	88	87	1620	K
	239116			575	60	1.15	164	128	182	146	.06-.08	88	87	1296	K
	239167			380	60	1.15	265	150	302	173	.02-.04	88	88	1991	J
	239107	175	130	460	60	1.15	219	150	249	173	.04-.05	88	88	1645	J
	239117			575	60	1.15	175	150	200	173	.06-.08	88	88	1316	J
	239168			380	60	1.15	298	169	342	194	.02-.03	88	88	2270	J
	239108	200	150	460	60	1.15	246	169	282	194	.03-.05	88	88	1875	J
	239118			575	60	1.15	197	169	226	194	.05-.07	88	88	1500	J

Table 27A 8" Three-Phase Motor Specifications (60 Hz) 3525 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	KILOWATTS	AMPS	KILOWATTS		S.F.	F.L.		
8" HI-TEMP	279160			380	60	1.15	69.6	38	78.7	43	.11 - .14	79	78	616	M
	279100	40	30	460	60	1.15	57.5	38	65.0	43	.16 - .19	79	78	509	M
	279110			575	60	1.15	46.0	38	52.0	43	.25 - .31	79	78	407	M
	279161			380	60	1.15	84.3	47	95.4	53	.07 - .09	81	80	832	M
	279101	50	37	460	60	1.15	69.6	47	78.8	53	.11 - .14	81	80	687	M
	279111			575	60	1.15	55.7	47	63.0	53	.18 - .22	81	80	550	M
	279162			380	60	1.15	98.4	55	112	62	.06 - .07	83	82	1081	N
	279102	60	45	460	60	1.15	81.3	55	92.1	62	.09 - .11	83	82	893	N
	279112			575	60	1.15	65.0	55	73.7	62	.13 - .16	83	82	715	N
	279163			380	60	1.15	125	68	141	77	.05 - .06	83	82	1175	L
	279103	75	56	460	60	1.15	100	68	114	77	.07 - .09	83	82	922	L
	279113			575	60	1.15	80	68	92	77	.11 - .14	83	82	738	L
	279164			380	60	1.15	159	88	181	100	.04 - .05	86	85	1508	M
	279104	100	75	460	60	1.15	131	88	149	100	.05 - .07	86	85	1246	M
	279114			575	60	1.15	105	88	119	100	.08 - .10	86	85	997	M
	279165			380	60	1.15	195	109	223	125	.03 - .04	86	85	1793	L
	279105	125	93	460	60	1.15	161	109	184	125	.04 - .06	86	85	1481	L
	279115			575	60	1.15	129	109	148	125	.07 - .09	86	85	1185	L
	279166			380	60	1.15	235	133	269	151	.02 - .03	85	84	2012	K
	279106	150	110	460	60	1.15	194	133	222	151	.03 - .05	85	84	1662	K
	279116			575	60	1.15	155	133	178	151	.05 - .07	85	84	1330	K

Model numbers above are for three-lead motors. Six-lead motors with different model numbers have the same running performance, but when Wye connected for starting have locked rotor amps 33% of the values shown. Six-lead individual phase resistance = table X 1.5.

Table 28 Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
8" STD.	239660			380	200	125	175	200	80	175
	239600	40	30	460	175	100	150	175	70	150
	239610			575	150	80	110	125	60	110
	239661			380	250	150	200	225	100	200
	239601	50	37	460	200	125	175	200	80	175
	239611			575	175	90	150	150	70	150
	239662			380	300	175	250	300	125	250
	239602	60	45	460	250	150	200	225	100	200
	239612			575	200	110	175	175	80	175
	239663			380	350	200	300	350	150	300
	239603	75	55	460	300	175	250	300	125	250
	239613			575	250	150	200	225	100	200
	239664			380	500	275	400	450	200	400
	239604	100	75	460	400	225	350	400	175	350
	239614			575	350	200	300	300	125	300
	239165			380	700	400	600	600	250	600
	239105	125	93	460	500	300	450	500	225	450
	239115			575	450	250	350	400	175	350
	239166			380	800	450	600	700	300	600
	239106	150	110	460	600	350	500	600	250	500
	239116			575	500	300	400	450	200	400
	239167			380	800	500	700	800	350	700
	239107	175	130	460	700	400	600	700	300	600
	239117			575	600	350	450	600	225	450
	239168			380	1000	600	800	1000	400	800
	239108	200	150	460	800	450	700	800	350	700
	239118			575	600	350	500	600	250	500

Table 28A 8" Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
8" HI-TEMP	279160			380	225	125	175	200	90	175
	279100	40	30	460	175	110	150	175	70	150
	279110			575	150	90	125	125	60	125
	279161			380	250	150	225	225	110	225
	279101	50	37	460	200	125	175	200	90	175
	279111			575	175	100	150	150	70	150
	279162			380	300	175	250	300	125	250
	279102	60	45	460	275	150	225	250	100	225
	279112			575	200	125	175	175	80	175
	279163			380	400	200	350	350	150	350
	279103	75	56	460	300	175	275	300	125	275
	279113			575	275	150	225	225	100	225
	279164			380	500	300	450	450	200	450
	279104	100	75	460	400	250	350	400	175	350
	279114			575	350	200	300	300	125	300
	279165			380	700	400	600	600	250	600
	279105	125	93	460	500	300	450	500	225	450
	279115			575	450	250	350	400	175	350
	279166			380	800	450	600	700	300	600
	279106	150	110	460	600	350	500	600	250	500
	279116			575	500	300	400	450	200	400

Overload Protection of Three-Phase Submersible Motors

Class 10 Protection Required

The characteristics of submersible motors are different than standard motors and special overload protection is required.

If the motor is locked, the overload protection must trip within 10 seconds to protect the motor windings. Subtrol/ SubMonitor, a Franklin-approved adjustable overload relay, or a Franklin-approved fixed heater must be used.

Fixed heater overloads must be the ambient-compensated quick-trip type to maintain protection at high and low air temperatures.

All heaters and amp settings shown are based on total line amps. When determining amperage settings or making heater selections for a six-lead motor with a Wye-Delta starter, divide motor amps by 1.732.

Pages 29, 30 and 31 list the correct selection and settings for some manufacturers. Approval for other manufacturers' types not listed may be requested by calling Franklin's Technical Service Hotline at 800-348-2420.

Refer to notes on page 30.

Table 29 – 60 Hz 4" Motors

HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
				FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
1/2	0.37	200	00	K31	L380A	3.2	3.4
		230	00	K28	L343A	2.7	2.9
		380	00	K22	L211A	1.7	1.8
		460	00	-	L174A	1.4	1.5
		575	00	-	-	1.2	1.3
3/4	0.55	200	00	K34	L510A	4.1	4.4
		230	00	K32	L420A	3.5	3.8
		380	00	K27	L282A	2.3	2.5
		460	00	K23	L211A	1.8	1.9
		575	00	K21	L193A	1.5	1.6
1	0.75	200	00	K37	L618A	5.0	5.4
		230	00	K36	L561A	4.4	4.7
		380	00	K28	L310A	2.6	2.8
		460	00	K26	L282A	2.2	2.4
		575	00	K23	L211A	1.8	1.9
1.5	1.1	200	00	K42	L750A	6.3	6.8
		230	00	K39	L680A	5.5	5.9
		380	00	K32	L420A	3.3	3.6
		460	00	K29	L343A	2.8	3.0
		575	00	K26	L282A	2.2	2.4
2	1.5	200	0	K50	L111B	8.6	9.3
		230	0	K49	L910A	7.5	8.1
		380	0	K36	L561A	4.6	4.9
		460	00	K33	L463A	3.8	4.1
		575	00	K29	L380A	3.0	3.2
3	2.2	200	0	K55	L147B	11.6	12.5
		230	0	K52	L122B	10.1	10.9
		380	0	K41	L750A	6.1	6.6
		460	0	K37	L618A	5.1	5.5
		575	0	K34	L510A	4.1	4.4
5	3.7	200	1	K62	L241B	19.1	20.5
		230	1	K61	L199B	16.6	17.8
		380	0	K52	L122B	10.0	10.8
		460	0	K49	L100B	8.3	8.9
		575	0	K42	L825A	6.6	7.1
7.5	5.5	200	1	K68	L322B	28.4	30.5
		230	1	K67	L293B	24.6	26.4
		380	1	K58	L181B	14.9	16.0
		460	1	K55	L147B	12.3	13.2
		575	1	K52	L122B	9.9	10.6
10	7.5	380	1	K62	L241B	19.5	21.0
		460	1	K60	L199B	16.1	17.3
		575	1	K56	L165B	12.9	13.6
15	11	380	2 (1)	K70	L322B	29	31.2
		460	2 (1)	K67	L265B	24.0	25.8
		575	2 (1)	K62	L220B	19.3	20.7

Three-Phase Motors

APPLICATION

Table 30 - 60 Hz 6" Standard & Hi-Temp Motors

HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
				FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
5	3.7	200	1	K61	L220B	17.6	19.1
		230	1	K61	L199B	15.4	16.6
		380	0	K52	L122B	9.4	10.1
		460	0	K49	L100B	7.7	8.3
		575	0	K42	L825A	6.1	6.6
7.5	5.5	200	1	K67	L322B	26.3	28.3
		230	1	K64	L293B	22.9	24.6
		380	1	K57	L165B	13.9	14.9
		460	1	K54	L147B	11.4	12.3
		575	1	K52	L111B	9.1	9.8
10	7.5	200	2(1)	K72	L426B	34.4	37.0
		230	2(1)	K70	L390B	29.9	32.2
		380	1	K61	L220B	18.1	19.5
		460	1	K58	L181B	15.0	16.1
		575	1	K55	L147B	12.0	12.9
15	11	200	3(1)	K76	L650B	50.7	54.5
		230	2	K75	L520B	44.1	47.4
		380	2(1)	K68	L322B	26.7	28.7
		460	2(1)	K64	L265B	22.0	23.7
		575	2(1)	K61	L220B	17.7	19.0
20	15	200	3	K78	L787B	64.8	69.7
		230	3(1)	K77	L710B	56.4	60.6
		380	2	K72	L426B	34.1	36.7
		460	2	K69	L352B	28.2	30.3
		575	2	K64	L393B	22.7	24.4
25	18.5	200	3	K86	L107C	80.3	86.3
		230	3	K83	L866B	69.8	75.0
		380	2	K74	L520B	42.2	45.4
		460	2	K72	L426B	34.9	37.5
		575	2	K69	L352B	27.9	30.0
30	22	200	4(1)	K88	L126C	96.7	104.0
		230	3	K87	L107C	84.1	90.4
		380	3(1)	K76	L650B	50.9	54.7
		460	3(1)	K74	L520B	42.0	45.2
		575	3(1)	K72	L390B	33.7	36.2
40	30	380	3	K83	L866B	69.8	75.0
		460	3	K77	L710B	57.7	62.0
		575	3	K74	L593B	46.1	49.6
50	37	380	3	K87	L107C	86.7	93.2
		460	3	K83	L950B	71.6	77.0
		575	3	K77	L710B	57.3	61.6
60	45	380	4(1)	K89	L126C	102.5	110.2
		460	4(1)	K87	L107C	84.6	91.0
		575	4(1)	K78	L866B	67.7	72.8

Footnotes for Tables 29, 30, 31, and 31A

NOTE 1: Furnas intermediate sizes between NEMA starter sizes apply where (1) is shown in tables, size 1.75 replacing 2, 2.5 replacing 3, 3.5 replacing 4, and 4.5 replacing 5. Heaters were selected from Catalog 294, table 332 and table 632 (starter size 00, size B). Size 4 starters are heater type 4 (JG). Starters using these heater tables include classes 14, 17, and 18 (inNOVA), classes 36 and 37 (reduced voltage), and classes 87, 88, and 89 (pump and motor control centers). Overload relay adjustments should be set no higher than 100% unless necessary to stop nuisance tripping with measured amps in all lines below nameplate maximum. Heater selections for class 16 starters (Magnetic Definite Purpose) will be furnished upon request.

NOTE 2: General Electric heaters are type CR123 usable only on type CR124 overload relays and were selected from Catalog GEP-1260J, page 184. Adjustment should be set no higher than 100%, unless necessary to stop nuisance tripping with measured amps in all lines below nameplate maximum.

NOTE 3: Adjustable overload relay amp settings apply to approved types listed. Relay adjustment should be set at the specified SET amps. Only if tripping occurs with amps in all lines measured to be within nameplate maximum amps should the setting be increased, not to exceed the MAX value shown.

NOTE 4: Heaters shown for ratings requiring NEMA size 5 or 6 starters are all used with current transformers per manufacturer standards. Adjustable relays may or may not use current transformers depending on design.

Table 31 - 60 Hz 8" Motors

MOTOR MODEL PREFIX	HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS FURNAS (NOTE 1)	HEATERS FOR OVERLOAD RELAYS G.E. (NOTE 2)	ADJUSTABLE RELAYS (NOTE 3) SET	ADJUSTABLE RELAYS (NOTE 3) MAX.
239660			380	3	K78	L866B	68	73
239600	40	30	460	3	K77	L710B	56	60
239610			575	3	K73	L520B	45	48
239661			380	3	K86	L107C	81	87
239601	50	37	460	3	K78	L866B	68	73
239611			575	3	K77	L710B	56	60
239662			380	4(1)	K89	L126C	101	108
239602	60	45	460	4(1)	K86	L107C	83	89
239612			575	4(1)	K78	L787B	64	69
239663			380	4	K92	L142C	121	130
239603	75	55	460	4(1)	K89	L126C	100	107
239613			575	4(1)	K85	L950C	79	85
239664			380	5(1)	K28	L100B	168	181
239604	100	75	460	4	K92	L155C	134	144
239614			575	4	K90	L142C	108	116
239165			380	5	K32	L135B	207	223
239105	125	93	460	5(1)	K29	L111B	176	189
239115			575	5(1)	K26	L825A	140	150
239166			380	5	-	L147B	248	267
239106	150	110	460	5(1)	K32	L122B	206	221
239116			575	5(1)	K28	L100B	169	182
239167			380	6	K26	-	270	290
239107	175	130	460	5	K33	L147B	233	250
239117			575	5	K31	L111B	186	200
239168			380	6	K27	-	316	340
239108	200	150	460	5	K33	L165B	266	286
239118			575	5	K32	L135B	213	229

Table 31A - 60 Hz 8" Hi-Temp 75°C Motors

MOTOR MODEL PREFIX	HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS FURNAS (NOTE 1)	HEATERS FOR OVERLOAD RELAYS G.E. (NOTE 2)	ADJUSTABLE RELAYS (NOTE 3) SET	ADJUSTABLE RELAYS (NOTE 3) MAX.
279160			380	3	K83	L866B	73	79
279100	40	30	460	3	K77	L710B	60	65
279110			575	3	K74	L593B	48	52
279161			380	3	K87	L107C	89	95
279101	50	37	460	3	K83	L866B	73	79
279111			575	3	K77	L710B	59	63
279162			380	4(1)	K89	L126C	104	112
279102	60	45	460	4(1)	K87	L107C	86	92
279112			575	4(1)	K78	L866B	69	74
279163			380	4	K92	L155C	131	141
279103	75	56	460	4(1)	K89	L126C	106	114
279113			575	4(1)	K87	L950C	86	92
279164			380	5(1)	K28	L100B	168	181
279104	100	75	460	5(1)	K26	L825A	139	149
279114			575	4	K90	L142C	111	119
279165			380	5	K32	L135B	207	223
279105	125	93	460	5(1)	K29	L111B	171	184
279115			575	5(1)	K26	L825A	138	148
279166			380	5	-	L147B	250	269
279106	150	110	460	5(1)	K32	L122B	206	222
279116			575	5(1)	K28	L100B	166	178

Note: Other relay types from these and other manufacturers may or may not provide acceptable protection, and they should not be used without approval of Franklin Electric.

Some approved types may only be available for part of the listed motor ratings. When relays are used with current transformers, relay setting is the specified amps divided by the transformer ratio.

Recommended Adjustable Overload Relays

Advance Controls: MDR3 Overload

AEG Series: B17S, B27S, B27-2

ABB Type: RVH 40, RVH65, RVP160, T25DU, T25CT, TA25DU

AGUT: MT03, R1K1, R1L0, R1L3, TE set Class 5

Allen Bradley: Bulletin 193, SMP-Class 10 only

Automatic Switch Types: DQ, LR1-D, LR1-F, LR2 Class 10

Benshaw: RSD6 (Class 10) Soft Start

Bharita C-H: MC 305 ANA 3

Clipsal: 6CTR, 6MTR

Cutler-Hammer: C316F, C316P, C316S, C310-set at 6 sec max, Advantage Class10

Fanal Types: K7 or K7D through K400

Franklin Electric: Subtrol-Plus, SubMonitor, IPS, SSP, IPS-RV, and SPS-RV

Fuji Types: TR-0Q, TR-0QH, TR-2NQ, TR- 3NQ, TR-4NQ, TR-6NQ, RCa 3737-ICQ & ICQH

Furnas Types: US15 48AG & 48BG, 958L, ESP100-Class 10 only, 3RB10-Class 10

General Electric: CR4G, CR7G, RT*1, RT*2, RTF3, RT*4, CR324X-Class 10 only

Kasuga: RU Set Operating Time Code = 10 & time setting 6 sec max

Klockner-Moeller Types: Z00, Z1, Z4, PKZM1, PKZM3 & PKZ2

Lovato: RC9, RC22, RC80, RF9, RF25 & RF95

Matsushita: FKT-15N, 15GN, 15E, 15GE, FT-15N, FHT-15N

Mitsubishi: ET, TH-K12ABKP, TH-K20KF, TH-K20KP, TH-K20TAKF, TH-K60KF, TH-K60TAKF

Omron: K2CM Set Operating Timing Code = 10 & time setting 6 sec max, SE-KP24E time setting 6 sec max

Riken: PM1, PM3

Samwha: EOCRS Set for Class 5, EOCR-ST, EOCR-SE, EOCR-AT time setting 6 sec max

Siemens Types: 3UA50, -52, -54, -55, -58, -59, -60, -61, -62, -66, -68, -70, 3VUI3, 3VE, 3UB (Class 5)

Sprecher and Schuh Types: CT, CT1, CTA 1, CT3K, CT3-12 thru CT3-42, KTA3, CEF1 & CET3 set at 6 sec max, CEP 7 Class 10, CT4, 6, & 7, CT3, KT7

Square D/Telemecanique: Class 9065 Types: TD, TE, TF, TG, TJ, TK, TR, TJE &TJF (Class 10), LR1-D, LR1-F, LR2 Class 10, Types 18A, 32A, SS-Class 10, SR-Class 10 and 63-A-LB Series. Integral 18,32,63, GV2-L, GV2-M, GV2-P, GV3-M (1.6-10 amp only) LR9D, SF Class 10, ST Class 10, LT6 (Class 5 or 10), LRD (Class 10), Motor Logic (Class10)

Toshiba Type: 2E RC820, set at 8 sec max.

WEG: RW2

Westinghouse Types: FT13, FT23, FT33, FT43, K7D, K27D, K67D, Advantage (Class 10), MOR, IQ500 (Class 5)

Westmaster: OLWROO and OLWTOO suffix D thru P

Form 2207 – Action Facts

SUBMERSIBLE MOTOR INSTALLATION RECORD

INFORMATION SUPPLEMENT

1.0 MOTOR

1.1 Verify motor nameplate data meets the application – hp, voltage, phase, and Hertz.

1.2 Check that the motor shaft rotates freely by hand on the second of two complete rotations. (On large motors, this usually requires a motor coupling with a cheater handle welded to it.)

1.3 Check that the motor lead assembly is not damaged.

1.4 Measure insulation resistance to ground at 500 volts – BEFORE SUBMERGED. It should be a minimum of 200 megohms or 200,000,000 ohms.

1.5 Measure insulation resistance to ground at 500 volts – AFTER SUBMERGED. It should be a minimum of 0.5 megohms or 500,000 ohms.

1.6 Verify the system is operating within the ±10% of nameplate voltage requirement.

1.7 Verify the system will not ever operate in excess of the maximum amps indicated on the nameplate.

1.8 Verify the system is operating at 5% or less current unbalance.

Notice:

- If current unbalance exceeds 5%, the maximum operating amps must be derated to the nameplate Full Load Amps.
- Warning - System current unbalance can not exceed 10% without causing heating and mechanical wear issues.
- The submersible motor amperage % unbalance is typically 6x greater than its voltage % unbalance.
- Thus, 0.8% voltage unbalance = greater than 5% current unbalance, and 1.7% voltage unbalance = greater than 10% current unbalance.

2.0 PUMP

2.1 Verify the pump nameplate and curve data meets the application hp, rpm, and flow/TDH requirements.

2.2 Verify the pump NPSH requirement will be met at all times.

2.3 Check that the pump shaft rotates freely by hand before installation.

2.4 Check that the pump shaft moves up about ¼ inch when it is coupled to the motor.

2.5 Check that the pump guard is not pinching the motor leads, especially where it enters and exits the guard.

Notice:

- Pumps and motors 5 hp and above should be assembled in a vertical position to ensure correct alignment.
- A motor-pump assembly 5 hp and above should never be lifted from a non-vertical position by the pump discharge because it can bend the shaft in one or both of the products.

3.0 POWER SUPPLY (3-PHASE)

3.1 Verify the transformer kVA rating is adequate for the motor per the Franklin Application (AIM) manual requirement.

3.2 Verify that all transformers have the same kVA rating.

3.3 Verify the 3-Ph pump panel fuses or its circuit breaker are correctly sized per the Franklin Application (AIM) manual requirement.

3.4 Verify the 3-Ph pump panel motor contactor is correctly sized per the Franklin Application (AIM) manual requirement.

3.5 Verify the 3-Ph pump panel motor overload is ambient compensated.

3.6 Verify the 3-Ph pump panel motor overload has a NEMA Class 10 trip curve.

3.7 Verify the 3-Ph pump panel motor overload heaters or its dial setting are correctly selected based on the system's operating point and not just arbitrarily set at the maximum motor operating amps.

3.8 At no time should the system operating amps or the motor overload system running point setting be higher than the motor nameplate maximum amp rating.

Notice:

- Electronic overloads should be set at the normal system operation point.
- Electronic overloads have a built-in multiplier of 115-125% times the input amps to determine the overload trip point.

4.0 POWER SUPPLY (1-PHASE)

4.1 Verify the transformer kVA rating is adequate for the motor per the Franklin Application (AIM) manual requirement.

4.2 Verify the motor control box and the motor are made by the same manufacturer.

4.3 Verify the motor control box hp rating and its voltage match the motor rating exactly. If not, a premature failure of the control box or motor should be expected.

5.0 HIGH SURGE PROTECTION

5.1 Verify the submersible motor has a dedicated surge arrestor.
All submersible motors require a dedicated surge arrestor.
Motors 5 hp and smaller marked "Equipped with Lightning Arrestors", have a built-in surge arrestor.

5.2 Verify the surge arrestor is mounted as close to the motor as practical.
The location is usually in the pump panel, but sometimes it is placed at the well head in a separate electrical box.

5.3 Verify the surge arrestor is grounded below the lowest drawdown water level.
This is usually accomplished by attaching the drop cable ground wire to the motor lead or the motor ground lug.

5.4 Verify the ground conductor size meets the minimum requirements of the National Electric Code and all other relevant national, state, regional and local codes.

5.5 Verify the motor is connected to both the electrical system ground and the motor.

6.0 ELECTRICAL DROP CABLE

6.1 Verify the temperature rating of the drop cable – typically 60 °C, 75 °C, 90 °C or 125 °C.

6.2 Verify if the cable is single conductor or jacketed conductor. Web cable is considered jacketed cable by regulating agencies.

6.3 Verify the conductor size – typically AWG, MCM or mm^2.

6.4 Verify if the conductor material is copper; if not, determine the material and contact the factory for acceptability.

6.5 Verify the drop cable meets or exceeds the requirements of the Franklin Application (AIM) manual.

Notice:

- If the service entrance to pump panel or the pump panel to motor cable is not a copper material, contact the factory for the correct length derating factors.

7.0 MOTOR COOLING

7.1 Verify that the well water temperature does not exceed the maximum ambient temperature indicated on the nameplate of the motor.

7.2 Verify there is a minimum of 10 feet of clear water between the bottom of the motor and the bottom of the well.

7.3 Verify that all water entering the well is coming from below the lowest part of the motor.

7.4 Verify the system pumping rate will never deliver less flow than is required by the Franklin Application (AIM) manual to flow by-and-around the full length of the motor for cooling purposes.

7.5 Verify that 3-phase motors above 7.5 hp in a vertical potable water well should not exceed 100 starts in 24 hours and each start should include a minimum of 3 minutes ON and 10 minutes OFF.

Notice:

- If any water is entering the well above the lowest part of the motor, a flow sleeve is required.

8.0 MOTOR-PUMP INSTALLATION

8.1 Verify that the drop cable is supported to the drop pipe every 10 feet.

8.2 Verify at least one spring loaded (non-drilled) check valve is in the drop pipe.
Preferably, the first check valve should be located at the top of the first pipe joint above the pump discharge (~20 feet) if the pump does not have a check built in to its discharge.

8.3 Verify all pipe joints are as tight as practical.
The minimum torque should never be less than 10 foot-pounds times the motor nameplate hp rating.

8.4 Verify the rotation of the pump is correct.
It is preferable to do this by checking the flow and current in both directions on 3-phase motors.
This can be done by having the electrician swap any two leads.
This is considered "best practice" since pumps under some conditions can supply amp readings and a visual flow observation that can be extremely misleading.

Form 2207 – Page 1

SUBMERSIBLE MOTORS INSTALLATION RECORD

RMA Number ____________

KEY DEALER # ____________

DISTRIBUTOR

Name: ______________________________

City: ______________________________

State: __________ Zip: ______________

INSTALLER

Name: ______________________________

City: ______________________________

State: __________ Zip: ______________

END USER

Name: ______________________________

City: ______________________________

State: __________ Zip: ______________

Well ID or GPS: ________________ __________ ____________________________ Water Temperature: ____________________ ☐ °F ☐ °C

Application/Water Use (e.g. potable water, irrigation, municipal, fountain, etc.): ________________________________

Date Installed (mm/yy): ____________ Date Failed (mm/yy):____________ Motor Position Shaft-Up: ☐ Yes ☐ No

Operating Cycle: ON Time Per Start _____ ☐ Hrs. ☐ Mins. Time OFF Between Stop & Restart _____ ☐ Hrs. ☐ Mins.

MOTOR

Model: ____________________ Serial Number: ________________________ Date Code (if updated): _________

MOTOR OVERLOAD

System Typical Operating Current: ______________ Amps @ ______________ Volts

Overload: ☐ FE SubMonitor Input Amps _______ D3 Attached ☐ Yes ☐ No Fault Settings Attached ☐ Yes ☐ No

☐ Other Manufacturer Model: ____________________ Dial Set at: _________ or Heater# _________

NEMA Class: ☐ 10 ☐ 20 ☐ 30 Ambient Compensated: ☐ Yes ☐ No

Power to Motor by: ☐ Full Volt Starter ☐ VFD ☐ Soft Starter VFD or Soft Starter Mfr. & Model: _________________

PUMP

Manufacturer: ________________________________

Model: ________________________________

Stages: ________________________________

Design Rating: _______ gpm @ _______ ft TDH

Horsepower Required by Pump End: __________

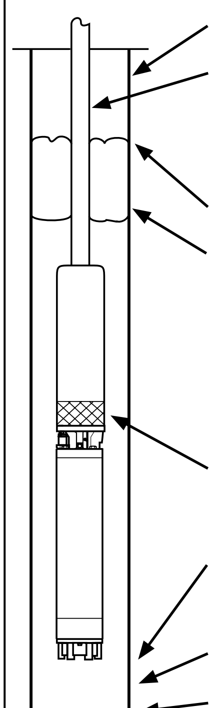
Actual Pump Delivery: _______ gpm @ _______ psi

What Controls When System Runs & Stops:

____

(e.g. pressure, level, flow, manual on/off, timer, time clock etc.)

WELL DATA (All measurements from well head down.)



Casing Diameter ______________________________ in

Drop Pipe Diameter ______________________________ in

Drop Pipe Material _____ PVC _____ Steel _____ Poly _____ Other

Number of Sticks of Drop Pipe ____________

Static Water Level ______________________________ ft

Drawdown (pumping) Water Level______________________ ft

Spring Assist Check Valves:
(Measured from Well Head Down)

#1 ______ #2______ #3 ______ #4______ ft

☐ Solid ☐ Drilled Poppet ☐ Break-Off Plug

Pump Inlet Setting ______________________________ ft

Flow Sleeve ☐ No ☐ Yes, Dia. ____________________ in

Case Ends ______________________________ ft

☐ Well Screen ☐ Perforated Casing

#1 from ____to____ft & #2 from ____to____ft

Well Depth______________________________ ft

YOUR NAME / DATE

________________________ / __________

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Franklin Electric

Form 2207 – Page 2

SUBMERSIBLE MOTORS INSTALLATION RECORD

RMA Number

TRANSFORMERS

Number of Transformers: ☐ Two ☐ Three   Transformers Supply Motor Only: ☐ Yes ☐ No ☐ Unsure

Transformer #1: __________ kVA Transformer #2: __________ kVA Transformer #3: __________ kVA

POWER CABLES & GROUND WIRE

1 **Service Entrance to Pump Control Panel:**

Length: __________ ft. & Gauge: __________ AWG/MCM

Material: ☐ Copper ☐ Aluminum   Construction: ☐ Jacketed ☐ Individual Conductors ☐ Web ☐ Twisted

Temperature Rating of Cable: ☐ 60C ☐ 75C ☐ 90C ☐ 125C or Insulation Type: ________________ (e.g. THHN)

2 **Pump Control Panel to Motor:**

Length: __________ ft. & Gauge: __________ AWG/MCM

Material: ☐ Copper ☐ Aluminum   Construction: ☐ Jacketed ☐ Individual Conductors ☐ Web ☐ Twisted

Temperature Rating of Cable: ☐ 60C ☐ 75C ☐ 90C ☐ 125C or Insulation Type: ________________ (e.g. THHN)

3 **Ground Wire Size:** From Control Panel to Motor: __________ AWG/MCM

Control Grounded to (mark all that apply):

☐ Well Head ☐ Metal Casing ☐ Motor ☐ Driven Rod ☐ Power Supply

INCOMING VOLTAGE

No Load   L1-L2 ______ L2-L3 ______ L1-L3 ______

Full Load   L1-L2 ______ L2-L3 ______ L1-L3 ______

RUNNING AMPS & CURRENT BALANCE

Full Load   L1 ________ L2 ________ L3 ________

% Unbalance: ______

CONTROL PANEL

1 **Pump Panel Manufacturer/Fabricator:** ____

2 **Short Circuit Protection – Fuses or Circuit Breaker**

Option #1 – Fuse

Manufacturer: __________________ Model: __________________ Rating: ____________ Amps

Type: ☐ Time-Delay ☐ Standard

Option #2 – Circuit Breaker

Manufacturer: __________________ Model: __________________ Rating: ___________ Amps Setting: __________

3 **Starter – Full Voltage, Reduced Voltage, Soft-Starter or VFD (Variable Frequency Drive)**

Option #1 – Full Voltage

Manufacturer: __________________ Model: ________________ Size: ____________ Contacts: ☐ NEMA ☐ IEC

Option #2 – Reduced Voltage

Manufacturer: __________________ Model: __________________ Ramp Time to Full Voltage: _____________ sec.

Option #3 – Soft-Starter or VFD

Manufacturer: __________________ Model: __________________ Max. Continuous Amp Output Rating: ____________

Min. Setting: ____________ Hz & GPM: ____________   Max. Setting: ____________ Hz & GPM: ________________

Start Ramp Time to 30 Hz: ________ sec.   Stop Mode: ☐ Power Off Coast ☐ 30-0 Hz Ramp ________ sec.

Special Output Filter Purchased: ☐ Yes ☐ No

Output Filter Manufacturer: ______________________ Model: ______________________ % Reactance: __________

4 **Surge Arrestor:** ☐ No ☐ Yes, Manufacturer: ____________________ Model: ____________________

Franklin Electric

Booster Install Record

SUBMERSIBLE MOTOR

RMA Number

Date ______ /______ /______ Filled In By ____________________

INSTALLATION

Owner/User ____________________ Telephone (______) ____________________

Address ____________________ City ____________ State ______ Zip __________

Installation Site, If Different ____________________

Contact ____________________ Telephone (______) ____________________

System Application ____________________

____

____

System Manufactured By ____________________ Model ____________ Serial No. ____________

System Supplied By ____________________ City ____________ State ______ Zip __________

Is this a "HERO" system (10.0 - 10.5 PH)? ☐ Yes ☐ No

MOTOR

Model No. ____________ Serial No. ____________ Date Code ________

Horsepower ________ Voltage ________ ☐ Single-Phase ☐ Three-Phase Diameter ________ in.

Slinger Removed? ☐ Yes ☐ No Check Valve Plug Removed? ☐ Yes ☐ No

Motor Fill Solution ☐ Standard ☐ DI Water Model No. ____________ Serial No. ____________ Date Code ________

PUMP

Manufacturer ____________ Model ____________ Serial No. ____________

Stages ______ Diameter ______ Flow Rate Of ______ gpm At ______ TDH

Booster Case Internal Diameter ______ Material ____________

CONTROLS AND PROTECTIVE DEVICES

SubMonitor? ☐ Yes ☐ No If Yes, Warranty Registration No. ____________________

If Yes, Overload Set? ☐ Yes ☐ No ______ Set At ____________________

Underload Sets? ☐ Yes ☐ No ______ Set At ____________________

VFD or Reduced Voltage Starter? ☐ Yes ☐ No If Yes, Type ____________________

Mfr. ____________ Setting ______ % Full Voltage In ______ sec

Pump Panel? ☐ Yes ☐ No If Yes, Mfr. ____________________ Size ____________

Magnetic Starter/Contactor Mfr. ____________________ Model ____________ Size ____________

Heaters Mfr. ____________ No. ________ If Adjustable Set At ____________________

Fuses Mfr. ____________ Size ________ Type ____________________

Surge Arrestor Mfr. ____________________ Model ____________________

Controls Are Grounded to ____________ with No. ______ Wire

Inlet Pressure Control ☐ Yes ☐ No If Yes, Mfr. ______ Model ______ Setting ______ psi Delay ____ sec

Inlet Flow Control ☐ Yes ☐ No If Yes, Mfr. ______ Model ______ Setting ______ gpm Delay ____ sec

Outlet Pressure Control ☐ Yes ☐ No If Yes, Mfr. ______ Model ______ Setting ______ psi Delay ____ sec

Outlet Flow Control ☐ Yes ☐ No If Yes, Mfr. ______ Model ______ Setting ______ gpm Delay ____ sec

Water Temperature Control ☐ Yes ☐ No If Yes, Mfr. ______ Model ____________________ Delay ____ sec

Set At ______ °F or ______ °C Located ____________________

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Franklin Electric

Booster Installation Record

SUBMERSIBLE MOTOR

INSULATION CHECK

Initial Megs: Motor & Lead Only Black (T1/U1)__________ Yellow (T2/V1)_________ Red (T3/W1)__________

Installed Megs: Motor, Lead, & Cable Black (T1/U1)__________ Yellow (T2/V1)_________ Red (T3/W1)__________

VOLTAGE TO MOTOR

Non-Operating: B-Y (T1/U1 - T2/V1)________ Y-R (T2/V1 - T3/W1)________ R-B (T3/W1 - T1/U1)________

At Rated Flow of ______________gpm B-Y (T1/U1 - T2/V1)________ Y-R (T2/V1 - T3/W1)________ R-B (T3/W1 - T1/U1)________

At Open Flow ________________gpm B-Y (T1/U1 - T2/V1)________ Y-R (T2/V1 - T3/W1)________ R-B (T3/W1 - T1/U1)________

AMPS TO MOTOR

At Rated Flow of ______________gpm Black (T1/U1)_____________ Yellow (T2/V1)___________ Red (T3/W1)_____________

At Open Flow ________________gpm Black (T1/U1)_____________ Yellow (T2/V1)___________ Red (T3/W1)_____________

At Shut-Off* Black (T1/U1)_____________ Yellow (T2/V1)___________ Red (T3/W1)_____________

*Do **NOT** run at Shut-Off more than two (2) minutes.

Inlet Pressure ______________psi Outlet Pressure ___________psi Water Temperature ________ °F or ________ °C

If you have any questions or problems, call the Franklin Electric Toll-Free Hot Line: 1-800-348-2420

Comments: ____

____

____

____

PLEASE SKETCH THE SYSTEM

Form No. 3655 11/14

Franklin Electric

SubMonitor Three-Phase Protection

Applications

SubMonitor is designed to protect 3-phase pumps/motors with service factor amp ratings (SFA) from 5 to 350 A (approx. 3 to 200 hp). Current, voltage, and motor temperature are monitored using all three legs and allows the user to set up the SubMonitor quickly and easily.

Protects Against

- Under/Overload
- Under/Overvoltage
- Current Unbalance
- Overheated Motor (if equipped with Subtrol Heat Sensor)
- False Start (Chattering)
- Phase Reversal

This product is lead free.

Power Factor Correction

In some installations, power supply limitations make it necessary or desirable to increase the power factor of a submersible motor. Table 32 lists the capacitive kVAR required to increase the power factor of large Franklin three-phase submersible motors to the approximate values shown at maximum input loading.

Capacitors must be connected on the line side of the overload relay, or overload protection will be lost.

Table 32 kVAR Required 60 Hz

MOTOR		KVAR REQUIRED FOR PF OF:		
HP	KW	0.90	0.95	1.00
5	3.7	1.2	2.1	4.0
7.5	5.5	1.7	3.1	6.0
10	7.5	1.5	3.3	7.0
15	11	2.2	4.7	10.0
20	15	1.7	5.0	12.0
25	18.5	2.1	6.2	15.0
30	22	2.5	7.4	18.0
40	30	4.5	11.0	24.0
50	37	7.1	15.0	32.0
60	45	8.4	18.0	38.0
75	55	6.3	18.0	43.0
100	75	11.0	27.0	60.0
125	93	17.0	36.0	77.0
150	110	20.0	42.0	90.0
175	130	9.6	36.0	93.0
200	150	16.0	46.0	110.0

Values listed are total required (not per phase).

Three-Phase Starter Diagrams

Three-phase combination magnetic starters have two distinct circuits: a power circuit and a control circuit.

The power circuit consists of a circuit breaker or fused line switch, contacts, and overload heaters connecting incoming power lines L1, L2, L3 and the three-phase motor.

The control circuit consists of the magnetic coil, overload contacts, and a control device such as a pressure switch. When the control device contacts are closed, current flows through the magnetic contactor coil, the contacts close, and power is applied to the motor. Hand-Off-Auto switches, start timers, level controls, and other control devices may also be in series in the control circuit.

Line Voltage Control

This is the most common type of control encountered. Since the coil is connected directly across the power lines L1 and L2, the coil must match the line voltage.

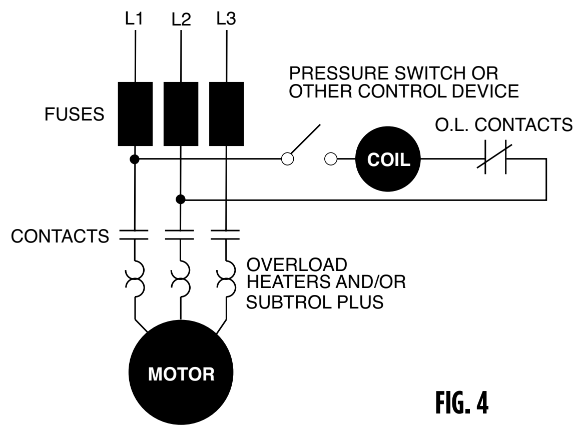


FIG. 4

Low Voltage Transformer Control

This control is used when it is desirable to operate push buttons or other control devices at some voltage lower than the motor voltage. The transformer primary must match the line voltage and the coil voltage must match the secondary voltage of the transformer.

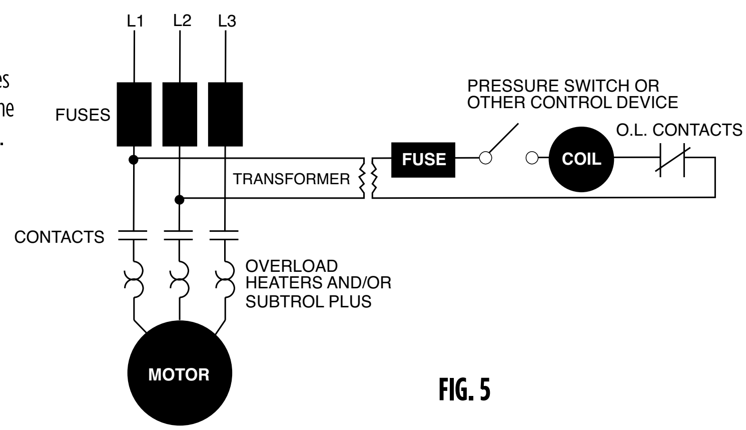


FIG. 5

External Voltage Controls

Control of a power circuit by a lower circuit voltage can also be obtained by connecting to a separate control voltage source. The coil rating must match the control voltage source, such as 115 or 24 volts.

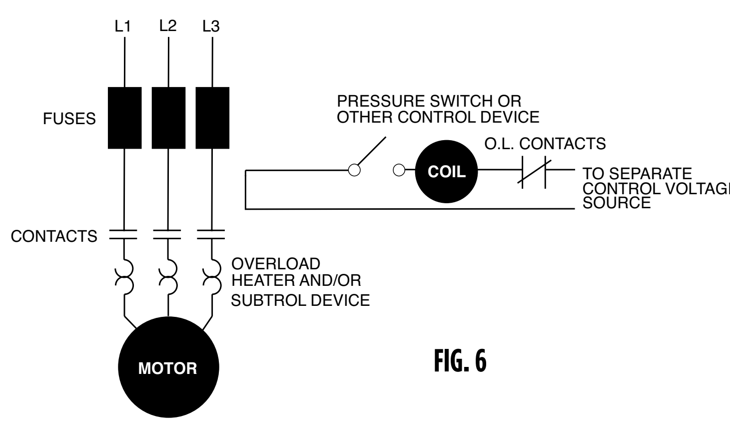


FIG. 6

Three-Phase Motors

APPLICATION

Three-Phase Power Unbalance

A full three-phase supply is recommended for all three-phase motors, consisting of three individual transformers or one three-phase transformer. So-called "open" Delta or Wye connections using only two transformers can be used, but are more likely to cause problems, such as poor performance, overload tripping or early motor failure due to current unbalance.

Transformer rating should be no smaller than listed in Table 4 for supply power to the motor alone.

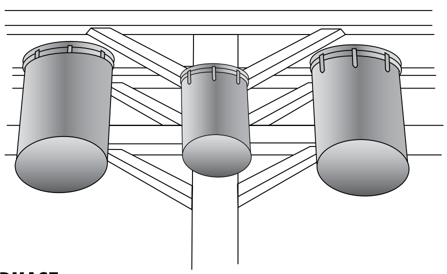


FIG. 7
FULL THREE-PHASE

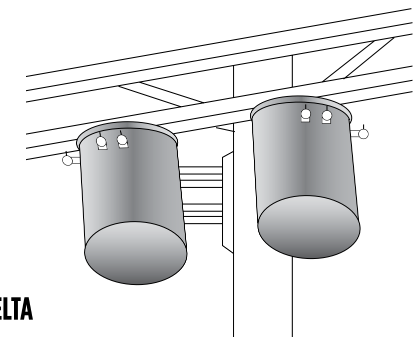


FIG. 8
OPEN DELTA

Checking and Correcting Rotation and Current Unbalance

1. Establish correct motor rotation by running the motor in both directions. Normal rotation is CCW viewing the shaft end. Rotation can be changed by interchanging any two of the three motor leads. The rotation that gives the most water flow is typically the correct rotation.
2. After correct rotation has been established, check the current in each of the three motor leads and calculate the current unbalance as explained in 3 below.

   If the current unbalance is 2% or less, leave the leads as connected.

   If the current unbalance is more than 2%, current readings should be checked on each leg using each of three possible hook-ups. Roll the motor leads across the starter in the same direction to prevent motor reversal.
3. To calculate percent of current unbalance:
   A. Add the three line amps values together
   B. Divide the sum by three, yielding average current
   C. Pick the amp value which is furthest from the average current (either high or low)
   D. Determine the difference between this amp value(furthest from average) and the average
   E. Divide the difference by the average. Multiply the result by 100 to determine percent of unbalance
4. Current unbalance should not exceed 5% at max amp load or 10% at rated input load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the "power side" of the system. If the reading farthest from average moves with the same motor lead, the primary source of unbalance is on the "motor side" of the starter. In this instance, consider a damaged cable, leaking splice, poor connection, or faulty motor winding.

Phase designation of leads for CCW rotation viewing shaft end.

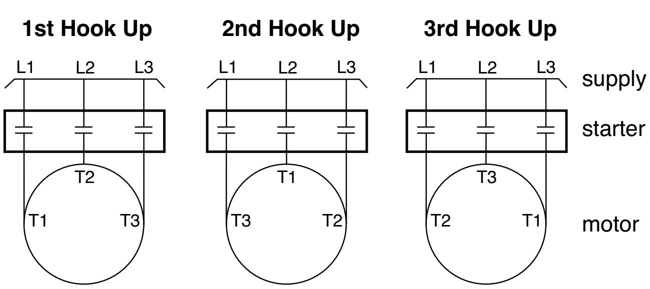
To reverse rotation, interchange any two leads.

Phase 1 or "A" - Black, T1, or U1

Phase 2 or "B" - Yellow, T2, or V1

Phase 3 or "C" - Red, T3, or W1

NOTICE: Phase 1, 2, and 3 may not be L1, L2, and L3.



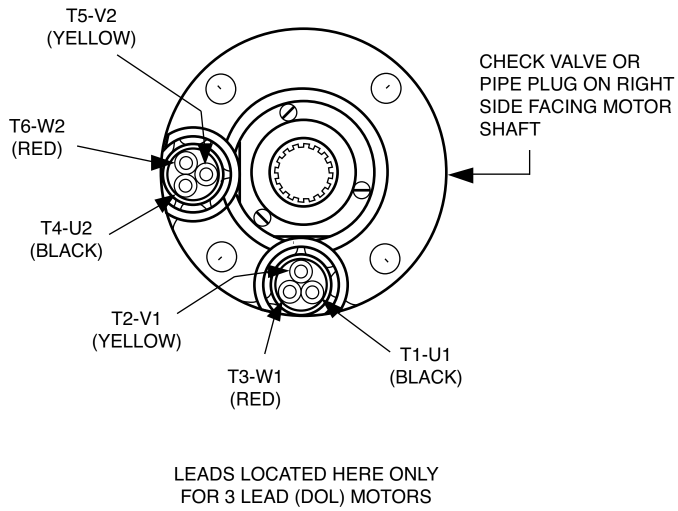
EXAMPLE:

T1 = 51 amps amps + amps	T3 = 50 amps T1 = 49 amps + T2 = 51 amps	T2 = 50 ampsT2 = 46 T3 = 48 ampsT3 = 53 + T1 = 52 amps
Total = 150 amps	Total = 150 amps	Total = 150 amps
$\frac{150}{3}$ = 50 amps	$\frac{150}{3}$ = 50 amps	$\frac{150}{3}$ = 50 amps
50 - 46 = 4 amps	50 - 49 = 1 amp	50 - 48 = 2 amps
$\frac{4}{50}$ = 0.08 or 8%	$\frac{1}{50}$ = 0.02 or 2%	$\frac{2}{50}$ = 0.04 or 4%

Three-Phase Motor Lead Identification

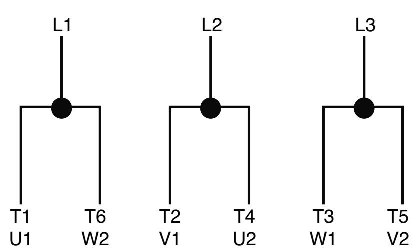
WARNING: When installing 6-lead motors extra care must be used to ensure lead identification at the surface. Leads must be marked and connected per diagram. Motor leads are not connected red to red, yellow to yellow, etc.

Line Connections — Six-Lead Motors

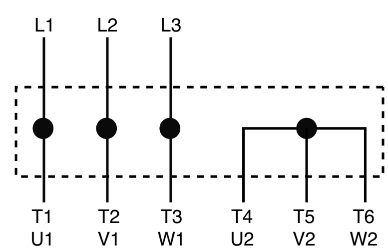


90° Lead Spacing

Connections for across-the-line starting, running, and any reduced voltage starting except WYE-DELTA type starters.



WYE-DELTA starters connect the motor as shown below during starting, then change to the running connection shown at the left.



Each motor lead is numbered with two markers, one near each end. To reverse rotation, interchange any two line connections.

Phase Converters

There are a number of different types of phase converters available. Each generates three-phase power from a single-phase power line.

In all phase converters, the voltage balance is critical to current balance. Although some phase converters may be well balanced at one point on the system-operating curve, submersible pumping systems often operate at differing points on the curve as water levels and operating pressures fluctuate. Other converters may be well balanced at varying loads, but their output may vary widely with fluctuations in the input voltage.

The following guidelines have been established for submersible installations to be warrantable when used with a phase converter.

1. Limit pump loading to rated horsepower. Do not load into motor service factor.
2. Maintain at least 3 ft/s flow past the motor. Use a flow sleeve when necessary.
3. Use time delay fuses or circuit breakers in pump panel. Standard fuses or circuit breakers do not provide secondary motor protection.
4. SubMonitor will not work with electronic solid state or electro mechanical phase converters.
5. Current unbalance must not exceed 10%.

Reduced Voltage Starters

All Franklin three-phase submersible motors are suitable for full-voltage starting. Under this condition the motor speed goes from zero to full speed within a half second or less. The motor current goes from zero to locked rotor amps, then drops to running amps at full speed. This may dim lights, cause momentary voltage dips to other electrical equipment, and shock power distribution transformers.

In some cases the power companies may require reduced-voltage starters to limit this voltage dip. There are also times when reduced-voltage starters may be desirable to reduce motor starting torque thus reducing the stress on shafts, couplings, and discharge piping. Reduced-voltage starters also slow the rapid acceleration of the water on start-up to help control upthrust and water hammer.

Reduced-voltage starters may not be required if the maximum recommended cable length is used. With maximum recommended cable length there is a 5% voltage drop in the cable at running amps, resulting in about 20% reduction in starting current and about 36% reduction in starting torque compared to having rated voltage at the motor. This may be enough reduction in starting current so that reduced-voltage starters are not required.

Three-Lead Motors: Autotransformer or solid-state reduced-voltage starters may be used for soft-starting standard three-phase motors.

When autotransformer starters are used, the motor should be supplied with at least 55% of rated voltage to ensure adequate starting torque. Most autotransformer starters have 65% and 80% taps. Setting the taps on these starters depends on the percentage of the maximum allowable cable length used in the system. If the cable length is less than 50% of the maximum allowable, either the 65% or the 80% taps may be used. When the cable length is more than 50% of allowable, the 80% tap should be used.

Six-Lead Motors: Wye-Delta starters are used with six-lead Wye-Delta motors. All Franklin 6" and 8" three-phase motors are available in six-lead Wye-Delta construction. Consult the factory for details and availability. Part winding starters are not compatible with Franklin Electric submersible motors and should not be used.

Wye-Delta starters of the open-transition type, which momentarily interrupt power during the starting cycle, are not recommended. Closed-transition starters have no interruption of power during the start cycle and can be used with satisfactory results.

Reduced-voltage starters have adjustable settings for acceleration ramp time, typically preset at 30 seconds. They must be adjusted so the motor is at full voltage within THREE SECONDS MAXIMUM to prevent excessive radial and thrust bearing wear.

If Subtrol-Plus or SubMonitor is used the acceleration time must be set to TWO SECONDS MAXIMUM due to the 3 second reaction time of the Subtrol-Plus or SubMonitor.

Solid-state starters AKA soft starts may not be compatible with Subtrol-Plus/ SubMonitor. However, in some cases a bypass contactor has been used. Consult the factory for details.

During shutdown, Franklin Electric's recommendation is for the power to be removed, allowing the pump/motor to coast down. Stopping the motor by ramping down the voltage is possible, but should be limited to three (3) seconds maximum.

Inline Booster Pump Systems

Franklin Electric offers three different types of motors for non-vertical applications.

1. The **Booster** motors are specifically designed for booster applications. They are the **"Best Choice" for sealed Reverse Osmosis applications.** These motors are the result of two years of focused development and bring additional value and durability to booster module systems. These motors are only available to OEMs or Distributors who have demonstrated capability in Booster Module systems design and operation and adhere to Franklin's Application Manual requirements.

2. The **Hi-Temp** motors have many of the internal design features of the Booster motor. It's additional length allows for higher temperature handling and the Sand Fighter sealing system provides greater abrasion resistance. One or both of these conditions are often experienced in open atmosphere applications such as lakes, ponds, etc.

3. The **Standard Vertical Water Well** (40-125 hp) motors can be adapted to non-vertical applications when applied per the below guidelines. However, they will be more sensitive to application variances than the other two designs.

All of the above motors must be applied per the guidelines listed below. In addition, for all applications where the motor is applied in a sealed system, a Submersible Motor Booster Installation Record (Form 3655) or its equivalent must be completed at start-up and received by Franklin Electric within 60 days. A sealed system is one where the motor and pump intake are mounted in a sleeve and the water feeding the pump intake is not open to the atmosphere.

Continued on next page

Inline Booster Pump Systems (Continued)

Design And Operational Requirements

1. **Non-Vertical Operation:** Vertical Shaft-up (0°) to Horizontal (90°) operation is acceptable as long as the pump transmits "down-thrust" to the motor within 3 seconds after start-up and continuously during operation. However, it is best practice to provide a positive slope whenever it is possible, even if it is only a few degrees.

2. **Motor, Sleeve, and Pump Support System:** The booster sleeve ID must be sized according to the motor cooling and pump NPSHR requirements. The support system must support the motor's weight, prevent motor rotation, and keep the motor and pump aligned. The support system must also allow for thermal axial expansion of the motor without creating binding forces.

3. **Motor Support Points:** A minimum of two support points are required on the motor. One in the motor/pump flange connection area and one in the bottom end of the motor area. The motor castings, not the shell area, are recommended as support points. If the support is a full length support and/or has bands in the shell area, they must not restrict heat transfer or deform the shell.

4. **Motor Support Material and Design:** The support system shall not create any areas of cavitation or other areas of reduced flow less than the minimum rate required by this manual. They should also be designed to minimize turbulence and vibration and provide stable alignment. The support materials and locations must not inhibit the heat transfer away from the motor.

5. **Motor and Pump Alignment:** The maximum allowable misalignment between the motor, pump, and pump discharge is 0.025 inch per 12 inches of length (2 mm per 1000 mm of length). This must be measured in both directions along the assembly using the motor/pump flange connection as the starting point. The booster sleeve and support system must be rigid enough to maintain this alignment during assembly, shipping, operation, and maintenance.

6. **Lubrication and Heat Resistance:** The best motor lubrication and heat resistance is obtained with the factory based propylene glycol fill solution. Only when an application MUST HAVE deionized (DI) water should the factory fill solution be replaced. When a deionized water fill is required, the motor must be derated as indicated on the below chart. The exchange of the motor fill solution to DI water must be done by an approved Franklin service shop or representative using a vacuum fill system per Franklin's Motor Service Manual instruction. The motor shell then must be permanently stamped with a D closely behind the Serial Number.

   The maximum pressure that can be applied to the motor internal components during the removal of the factory fill solution is 7 psi (0.5 bar.)

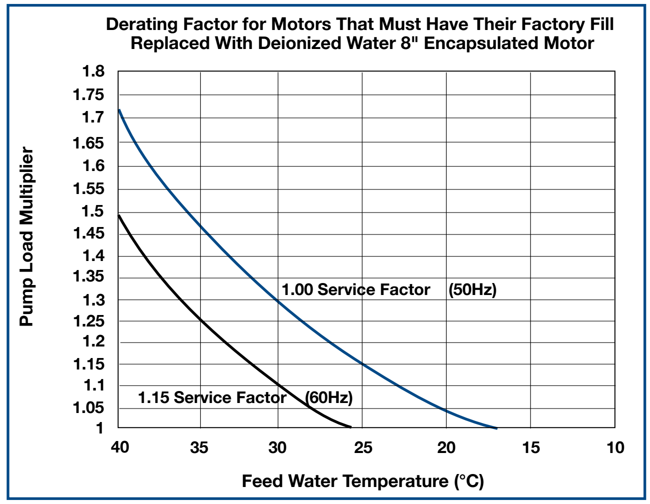


FIG. 9

First: Determine maximum Feed Water Temperature that will be experienced in this application. If the feed water exceeds the maximum ambient of the motor, both the DI water derating and a hot water application derating must be applied.

Second: Determine the Pump Load Multiplier from the appropriate Service Factor curve. (Typical 1.15 Service Factor is for 60 Hz ratings & 1.00 Service Factor for 50 Hz ratings).

Third: Multiply the Pump Load Requirement times the pump load multiplier number indicated on the vertical axis to determine the Minimum Motor Nameplate Rating.

Fourth: Select a motor with a nameplate equal or higher than the above calculated value.

7. **Motor Alterations – Sand Slinger & Check Valve Plug:** On 6" and 8" motors, the rubber sand slinger located on the shaft must be removed. If a pipe plug is covering the check valve, it must be removed. The special Booster motor already has these modifications.

8. **Frequency of Starts:** Fewer than 10 starts per 24-hour period are recommended. Allow at least 20 minutes between shutdown and start-up of the motor.

9. **Controls-Soft Starters and VFDs:** Reduced voltage starters and variable speed drives (inverter drives) may be used with Franklin three-phase submersible motors to reduce starting current, upthrust, and mechanical stress during start-up. The guidelines for their use with submersible motors are different than with normal air cooled motor applications. Refer to the Franklin Electric Application, Installation, and Maintenance (AIM) manual Reduced Voltage Starters section or Variable Speed Submersible Pump Operation, Inverter Drives sections for specific details including required filtering.

Continued on next page

Inline Booster Pump Systems (Continued)

10. **Motor Overload Protection:** Submersible motors require properly sized ambient compensated Class 10 quick-trip overloads per Franklin's AIM manual guidelines to protect the motor. Class 20 or higher overloads are NOT acceptable. Franklin's SubMonitor is strongly recommended for all large submersibles since it is capable of sensing motor heat without any additional wiring to the motor. Applications using Soft Starters with a SubMonitor require a start-up bypass - consult the factory for details. SubMonitor can not be used in applications using a VFD control.

11. **Motor Surge Protection:** Properly sized, grounded and dedicated motor surge arrestors must be installed in the supply line of the booster module as close to the motor as possible. This is required on all systems including those using soft-starters and variable speed drives (inverter drives).

12. **Wiring:** Franklin's lead assemblies are only sized for submerged operation in water to the motor nameplate maximum ambient temperature and may overheat and cause failure or serious injury if operated in air. Any wiring not submerged must meet applicable national and local wiring codes and Franklin Cable Chart Tables 16-21. (Notice: wire size, wire rating, and insulation temperature rating must be known when determining its suitability to operate in air or conduit. Typically, for a given size and rating, as the insulation temperature rating increases its ability to operate in air or conduit also increases.)

13. **Check Valves:** Spring-loaded check valves must be used on start-up to minimize motor upthrusting, water hammer, or in multiple booster (parallel) applications to prevent reverse flow.

14. **Pressure Relief Valves:** A pressure relief valve is required and must be selected to ensure that, as the pump approaches shut-off, it never reaches the point that the motor will not have adequate cooling flow past it.

15. **System Purge (Can Flooding):** An air bleeder valve must be installed on the booster sleeve so that flooding may be accomplished prior to booster start-up. Once flooding is complete, the booster should be started and brought up to operating pressure as quickly as possible to minimize the duration of an upthrust condition. At no time should air be allowed to gather in the booster sleeve because this will prevent proper cooling of the motor and permanently damage it.

16. **System Flush – Must Not Spin Pump:** Applications may utilize a low flow flushing operation. Flow through the booster sleeve must not spin the pump impellers and the motor shaft. If spinning takes place, the bearing system will be permanently damaged and the motor life shortened. Consult the booster pump manufacturer for maximum flow rate through the pump when the motor is not energized.

17. **Open Atmosphere Booster Pump Systems:** When an open booster is placed in a lake, tank, etc. that is open to atmospheric pressure, the water level must provide sufficient head pressure to allow the pump to operate above its NPSHR requirement at all times and all seasons. Adequate inlet pressure must be provided prior to booster start-up.

Table 38 Franklin Cable chart (See item 12 Wiring above)

CABLE TEMP. RATING (°C)	MOTOR NAMEPLATE RATED AMPS FULL LOAD	#10 AWG		#8 AWG		#6 AWG		#4 AWG		#2 AWG	
		IN AIR	IN CONDUIT	IN AIR	IN CONDUIT	IN AIR	IN CONDUIT	IN AIR	IN CONDUIT	IN AIR	IN CONDUIT
75	3-LEAD (DOL)	40A	28A	56A	40A	76A	52A	100A	68A	136A	92A
	6-LEAD (Y-Δ)	69A	48A	97A	69A	132A	90A	173A	118A	236A	159A
90	3-LEAD (DOL)	44A	32A	64A	44A	84A	60A	112A	76A	152A	104A
	6-LEAD (Y-Δ)	76A	55A	111A	76A	145A	104A	194A	132A	263A	180A
125	3-LEAD (DOL)	66A	46A	77A	53A	109A	75A	153A	105A	195A	134A
	6-LEAD (Y-Δ)	114A	80A	133A	91A	188A	130A	265A	181A	337A	232A

Based on 30 °C maximum ambient with cable length of 100 feet or less.

Continued on next page

Inline Booster Pump Systems (Continued)

Four Continuous Monitoring System Requirements for Sealed Booster Systems.

1. **Water Temperature:** Feed water on each booster must be continuously monitored and not allowed to exceed the motor nameplate maximum ambient temperature at any time. IF THE INLET TEMPERATURE EXCEEDS THE MOTOR NAMEPLATE MAXIMUM AMBIENT TEMPERATURE, THE SYSTEM MUST SHUTDOWN IMMEDIATELY TO PREVENT PERMANENT MOTOR DAMAGE. If feed water temperatures are expected to be above the allowable temperature, the motor must be derated. See Franklin's AIM manual Hot Water Applications section for derating guidelines. (The high temperature feed water derating is in addition to the exchange to DI water derating if the motor factory fill solution was exchanged to DI water.)

2. **Inlet Pressure:** The inlet pressure on each booster module must be continuously monitored. It must always be positive and higher than the NPSHR (Net Positive Suction Head Requirement) of the pump. A minimum of 20 PSIG (1.38 Bar) is required at all times, except for 10 seconds or less when the motor is starting and the system is coming up to pressure. Even during these 10 seconds the pressure must remain positive and be higher than the NPSHR (Net Positive Suction Head Requirement) of the pump.

   PSIG is the actual value displayed on a pressure gauge in the system piping. PSIG is the pressure above the atmospheric conditions. If at any time these pressure requirements are not being met, the motor must be de-energized immediately to prevent permanent damage to the motor. Once the motor is damaged, it is usually not immediately noticeable, but progresses and results in a premature motor failure weeks or months after the damage occurred.

   Motors that will be exposed to pressure in excess of 500 psi (34.47 Bar) must undergo special high pressure testing. Consult factory for details and availability.

3. **Discharge Flow:** The flow rate for each pump must not be allowed to drop below the motor minimum cooling flow requirement. IF THE MOTOR MINIMUM COOLING FLOW REQUIREMENT IS NOT BEING MET FOR MORE THAN 10 SECONDS, THE SYSTEM MUST BE SHUT DOWN IMMEDIATELY TO PREVENT PERMANENT MOTOR DAMAGE.

4. **Discharge Pressure:** The discharge pressure must be monitored to ensure that a downthrust load toward the motor is present within 3 seconds after start-up and continuously during operation. IF THE MOTOR DISCHARGE PRESSURE IS NOT ADEQUATE TO MEET THIS REQUIREMENT, THE SYSTEM MUST BE SHUT DOWN IMMEDIATELY TO PREVENT PERMANENT MOTOR DAMAGE.

Variable Frequency Drive Submersible Motor Requirements

Franklin Electric's three-phase, encapsulated submersible motors can be used with variable frequency drives (VFD) when applied within the guidelines below.

All three-phase, encapsulated submersible motors must have the VFD sized based on the motor's nameplate maximum amps, not horsepower. The continuous rated amps of the VFD must be equal to or greater than the motor's nameplate maximum amps or warranty will be void.

Franklin Electric's single-phase, 2- and 3-wire, encapsulated submersible motors can only be used with the appropriate Franklin constant pressure controller.

Franklin Electric's submersible motor Application, Installation, Maintenance (AIM) manual should be checked for the latest guidelines and can be found online at www.franklin-electric.com.

WARNING: There is a potential shock hazard from contact with and/or touching the insulated cables connected to the variable frequency drive output anytime the motor has energy applied.

Output Filter Requirement Test:

NOTICE: An incoming power supply or line-side filter for the drive does not replace the need for additional output filters.

An output filter is required if the answer is yes to one or both of the items below:

#1 - Does the peak voltage at the motor terminals exceed 1000-volts or is the rise time of the VFD's voltage less than 2 micro-seconds? Per NEMA MG 1-2011, the rise time is defined as the time between 10% and 90% of the steady-state voltage (i.e., DC bus voltage).

#2 - Is the motor nameplate voltage more than 379 Volts and is the cable from drive-to-motor more than 50 ft (15.2 m)?

NOTICE:
More than 99% of the drives applied on water well submersible motors will require the purchase of additional output filtering based on question #1.

Output filters can be expensive. However, when needed, it is required for the motor to be considered for warranty. Make sure this item is not overlooked when quoting a job.

PWM dV/dt value can be defined as: the rate at which voltage is changing with time or how fast the voltage is accelerating. This information can be supplied by the drive manufacturer or the manufacturer's drive specification sheet. The dV/dt value cannot be measured with typical field equipment, even when using a true-RMS voltage/amperage multi-meter.

Franklin Electric has a line of VFDs that are specifically designed for Franklin application systems. These VFDs are used in the MonoDrive and SubDrive constant pressure systems. Franklin drive systems have the required additional output filtering installed; however, the SubDrive HPX does not.

Types of Output Filters:

A resistor-inductor-capacitor (RLC) filter has both a high pass filter & a low pass filter section and are considered the best practice, but a high pass reactor filter is also acceptable.

Filters should be recommended by the drive manufacturer; for the correct recommendations provide them with answers to all five of the items below.

REQUIRED ITEMS FOR PROPER VFD FILTER SIZING:

(1) VFD model (2) Carrier frequency setting (3) Motor nameplate voltage (4) Motor nameplate max amps (5) Cable length from the drive output terminals to the motor

Input Current & Motor Overload Protection:

- Motor input current should be set at the system's typical operating current when running at nameplate rated voltage and frequency (Hz).
- Motor overload protection should be set to trip at 115% of the system's typical operating current.
- Motor overload protection must trip equal to or faster than NEMA Class 10 motor overload curve requirements.

Motor Maximum Load Limits:

- The system must never operate in excess of the motor nameplate maximum amps.
- On 50 Hz motors, nameplate amps are maximum amps as these motors have a 1.0 service factor.

Variable Frequency Drive Submersible Motor Requirements (Continued)

Motor Operating Hertz, Cooling Requirements, and Underload Settings:

- Standard practice for large VFD installations is to limit the operation to 60 Hz max. Operating at greater than 60 Hz requires special system design considerations.
- The motor must never operate below 30 Hz. This is the minimum speed required to provide correct bearing lubrication.
- The motor's operating speed must always operate so the minimum water flow requirements of 0.5 ft/sec for 6-inch & 8-inch motors and 0.25 ft/sec for 4-inch motors is supplied.
- The motor underload protection is normally set to trip at 80% of the system's typical operating current. However, the underload trip point must be selected so that minimum flow requirements are always met.

Starting and Stopping Ramp Settings:

- The motor must reach or pass the 30 Hz operating speed within 1 second of the motor being energized. If this does not occur, the motor bearings will be damaged and the motor life reduced.
- The best stopping method is to turn power off followed by a natural coast to stop.
- A controlled stop from 30 Hz to 0 Hz is allowed if the time does not exceed 1 second.

Drive Carrier Frequency:

- The carrier frequency is set in the field. The drive typically has a selectable range between 2k and 12k Hz. The higher the carrier wave frequency setting, the greater the voltage spikes; the lower the carrier wave frequency setting, the rougher/poorer the shape of the power curve.
- The carrier frequency should be set within the range of 4k to 5k Hz for encapsulated submersible motors.

Application Function Setting:

- If the VFD has a setting of centrifugal pump or propeller fan it should be used.
- Centrifugal pumps and fans have similar load characteristics.

VFD Frequency of Starts:

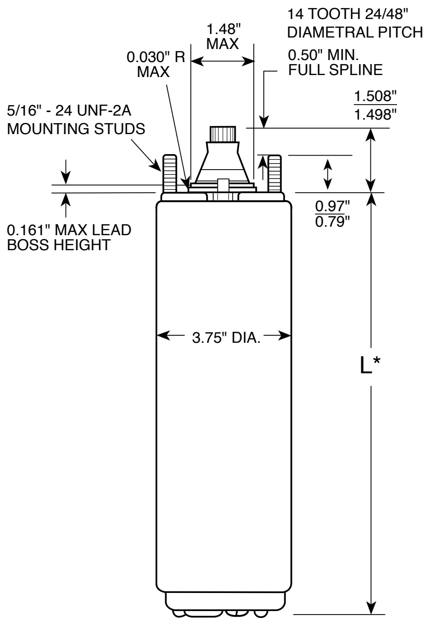
- Keeping the starts per day within the recommended numbers shown in the frequency of starts section of the AIM manual provides the best system life. However, since in-rush current is typically reduced when used with a properly configured VFD, large 3-phase submersible motors can be started more frequently. In all cases a minimum of 7 minutes must be allowed between a power off and the next restart attempt or consecutive restart attempts.

NEMA MG1 Above Ground Motor Standard Comments:

- Franklin Electric encapsulated submersible motors are not declared inverter duty motors by NEMA MG1 standards. The reason is NEMA MG1 standard part 31 does not include a section covering encapsulated winding designs.
- Franklin submersible motors can be used with VFDs without problems or warranty concerns providing Franklin's Application, Installation, Maintenance (AIM) manual guidelines are followed. See Franklin's on-line AIM manual for the latest guidelines.

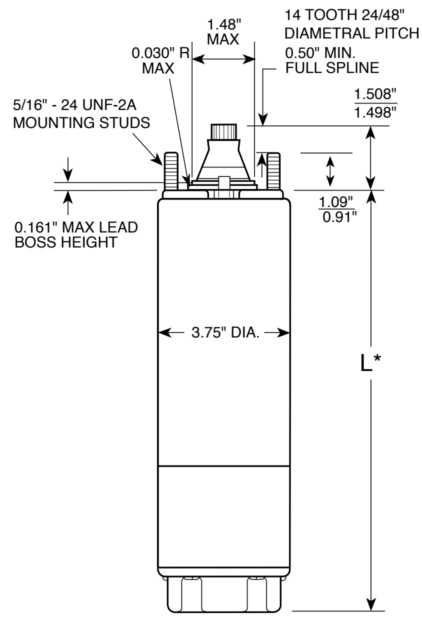
4″ Super Stainless — Dimensions

(Standard Water Well)



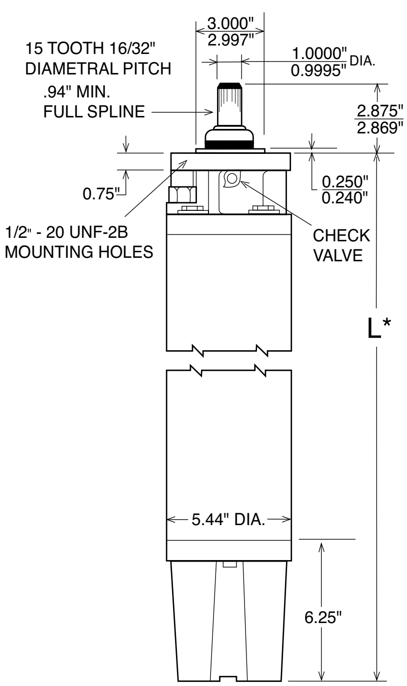
4″ High Thrust — Dimensions

(Standard Water Well)



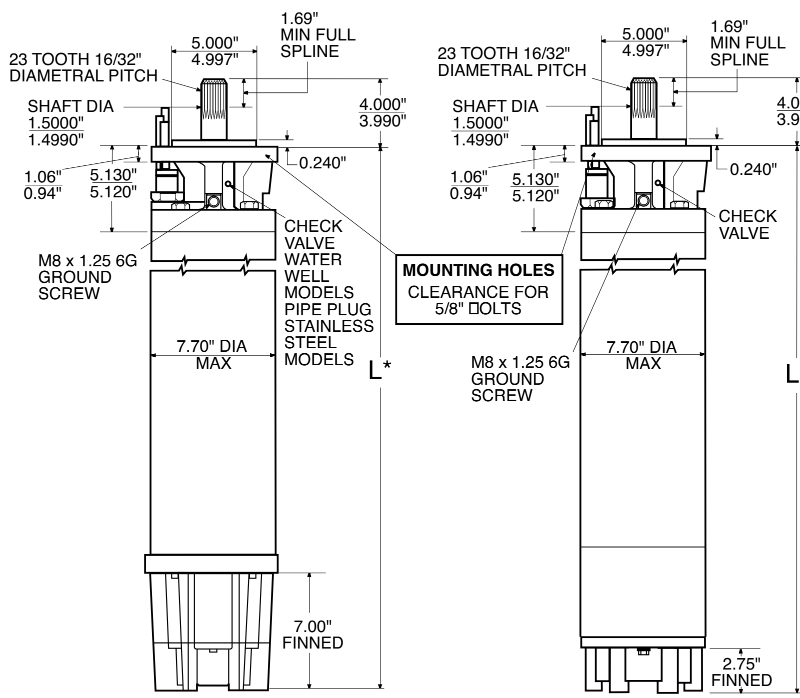
6″ — Dimensions

(Standard Water Well)



8″ — Dimensions

(Standard Water Well)



40 to 100 hp 75 to 200 hp

*** Motor lengths and shipping weights are available on Franklin Electric's web site (www.franklin-electric.com) or by calling Franklin's Technical Service Hotline (800-348-2420).**

Tightening Motor Lead Connector Jam Nut

4″ Motors with Jam Nut:
15 to 20 ft-lb (20 to 27 Nm)

4″ Motors with 2 Screw Clamp Plate:
35 to 45 in-lb (40 to 51 Nm)

6″ Motors:
40 to 50 ft-lb (54 to 68 Nm)

8″ Motors with 1-3/16″ to 1-5/8″ Jam Nut:
50 to 60 ft-lb (68 to 81 Nm)

8″ Motors with 4 Screw Clamp Plate:
Apply increasing torque to the screws equally in a criss-cross pattern until 80 to 90 in-lb (9.0 to 10.2 Nm) is reached.

Jam nut tightening torques recommended for field assembly are shown. Rubber compression set within the first few hours after assembly may reduce the jam nut torque. This is a normal condition which does not indicate reduced seal effectiveness. Retightening is not required, but is permissible and recommended if original torque was questionable.

A motor lead assembly should not be reused. A new lead assembly should be used whenever one is removed from the motor, because rubber set and possible damage from removal may prevent proper resealing of the old lead.

All motors returned for warranty consideration must have the lead returned with the motor.

Pump to Motor Coupling

Assemble coupling with non-toxic FDA approved waterproof grease such as Mobile FM222, Texaco CYGNUS2661, or approved equivalent. This prevents abrasives from entering the spline area and prolongs spline life.

Pump to Motor Assembly

After assembling the motor to the pump, torque mounting fasteners to the following:

4″ Pump and Motor: 10 lb-ft (14 Nm)

6″ Pump and Motor: 50 lb-ft (68 Nm)

8″ Pump and Motor: 120 lb-ft (163 Nm)

Shaft Height and Free End Play

Table 43

MOTOR	NORMAL SHAFT HEIGHT		DIMENSION SHAFT HEIGHT		FREE END PLAY	
					MIN.	MAX.
4″	1 1/2″	38.1 mm	1.508″ / 1.498″	38.30 / 38.05 mm	0.010″ 0.25 mm	0.045″ 1.14 mm
6″	2 7/8″	73.0 mm	2.875″ / 2.869″	73.02 / 72.88 mm	0.030″ 0.76 mm	0.050″ 1.27 mm
8″ TYPE 1	4″	101.6 mm	4.000″ / 3.990″	101.60 / 101.35 mm	0.008″ 0.20 mm	0.032″ 0.81 mm
8″ TYPE 2.1	4″	101.6 mm	4.000″ / 3.990″	101.60 / 101.35 mm	0.030″ 0.76 mm	0.080″ 2.03 mm

If the height, measured from the pump-mounting surface of the motor, is low and/or end play exceeds the limit, the motor thrust bearing is possibly damaged, and should be replaced.

Submersible Leads and Cables

A common question is why motor leads are smaller than specified in Franklin's cable charts.

The leads are considered a part of the motor and actually are a connection between the large supply wire and the motor winding. The motor leads are short and there is virtually no voltage drop across the lead.

In addition, the lead assemblies **operate under water**, while at least part of the supply cable must **operate in air.** Lead assemblies running under water operate cooler.

CAUTION: Lead assemblies on submersible motors are suitable only for use in water and may overheat and cause failure if operated in air.

System Troubleshooting

Motor Does Not Start

POSSIBLE CAUSE	CHECKING PROCEDURES	CORRECTIVE ACTION
A. No power or incorrect voltage	Check voltage at line terminals. The voltage must be ± 10% of rated voltage.	Contact power company if voltage is incorrect.
B. Fuses blown or circuit breakers tripped	Check fuses for recommended size and check for loose, dirty or corroded connections in fuse receptacle. Check for tripped circuit breakers.	Replace with proper fuse or reset circuit breakers.
C. Defective pressure switch	Check voltage at contact points. Improper contact of switch points can cause voltage less than line voltage.	Replace pressure switch or clean points.
D. Control box malfunction	For detailed procedure, see pages 48-57.	Repair or replace.
E. Defective wiring	Check for loose or corroded connections or defective wiring.	Correct faulty wiring or connections.
F. Bound pump	Check for misalignment between pump and motor or a sand bound pump. Amp readings will be 3 to 6 times higher than normal until the overload trips.	Pull pump and correct problem. Run new installation until the water clears.
G. Defective cable or motor	For detailed procedure, see pages 46 & 47.	Repair or replace.

Motor Starts Too Often

A. Pressure switch	Check setting on pressure switch and examine for defects.	Reset limit or replace switch.
B. Check valve - stuck open	Damaged or defective check valve will not hold pressure.	Replace if defective.
C. Waterlogged tank	Check air charge.	Clean or replace.
D. Leak in system	Check system for leaks.	Replace damaged pipes or repair leaks.

System Troubleshooting

Motor Runs Continuously

POSSIBLE CAUSE	CHECKING PROCEDURES	CORRECTIVE ACTION
A. Pressure switch	Check switch for welded contacts. Check switch adjustments.	Clean contacts, replace switch, or adjust setting.
B. Low water level in well	Pump may exceed well capacity. Shut off pump, wait for well to recover. Check static and drawdown level from well head.	Throttle pump output or reset pump to lower level. Do not lower if sand may clog pump.
C. Leak in system	Check system for leaks.	Replace damaged pipes or repair leaks.
D. Worn pump	Symptoms of worn pump are similar to those of drop pipe leak or low water level in well. Reduce pressure switch setting, if pump shuts off worn parts may be the fault.	Pull pump and replace worn parts.
E. Loose coupling or broken motor shaft	Check for loose coupling or damaged shaft.	Replace worn or damaged parts.
F. Pump screen blocked	Check for clogged intake screen.	Clean screen and reset pump depth.
G. Check valve stuck closed	Check operation of check valve.	Replace if defective.
H. Control box malfunction	See pages 48-57 for single-phase.	Repair or replace.

Motor Runs But Overload Protector Trips

A. Incorrect voltage	Using voltmeter, check the line terminals. Voltage must be within ± 10% of rated voltage.	Contact power company if voltage is incorrect.
B. Overheated protectors	Direct sunlight or other heat source can raise control box temperature causing protectors to trip. The box must not be hot to touch.	Shade box, provide ventilation or move box away from source.
C. Defective control box	For detailed procedures, see pages 48-57.	Repair or replace.
D. Defective motor or cable	For detailed procedures, see pages 45 & 46.	Repair or replace.
E. Worn pump or motor	Check running current, see tables 13, 22, 24, 25, & 27.	Replace pump and/or motor.

Table 46 Preliminary Tests - All Sizes Single- and Three-Phase

TEST	PROCEDURE	WHAT IT MEANS
Insulation Resistance (Fig. 10)	1. Open master breaker and disconnect all leads from control box or pressure switch (QD type control, remove lid) to avoid electric shock hazard and damage to the meter. 2. Use a megohmmeter set to 1000-volt (500-volt minimum). If using an ohmmeter, set to R X 100k. Zero the meter. 3. Connect one meter lead to any one of the motor leads and the other lead to the metal drop pipe. If the drop pipe is plastic, connect the meter lead to ground.	1. If the ohms value is normal (Table 47), the motor is not grounded and the cable insulation is not damaged. 2. If the ohms value is below normal, either the windings are grounded or the cable insulation is damaged. Check the cable at the well seal as the insulation is sometimes damaged by being pinched.
Winding Resistance (Fig 11.)	1. Open master breaker and disconnect all leads from control box or pressure switch (QD type control, remove lid) to avoid electric shock hazard and damage to the meter. 2. Use a multi-meter set to 20 ohms or an ohmmeter set to R X 1 for values under 10 ohms. Use next scale up for values over 10 ohms. Zero the meter. 3. On 3-wire motors measure the resistance of yellow to black (main winding) and yellow to red (start winding). On 2-wire motors: measure the resistance from line-to-line. Three-phase motors: measure the resistance line-to-line for all three combinations.	1. If all ohms values are normal (Tables 13, 22, 24, 25, & 27), the motor windings are neither shorted nor open, and the cable colors are correct 2. If any one value is less than normal, the motor is shorted. 3. If any one ohm value is greater than normal, the winding or the cable is open, or there is a poor cable joint or connection. 4. If some ohms values are greater than normal and some less on single-phase motors, the leads are mixed. See page 48 to verify cable colors.

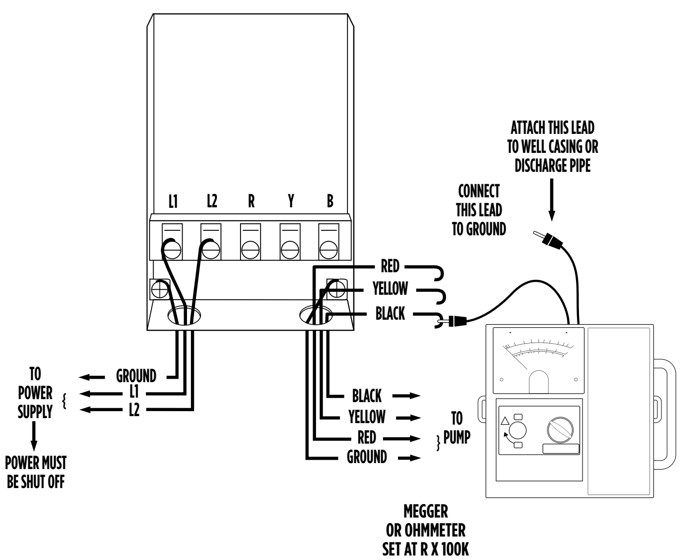


FIG. 10

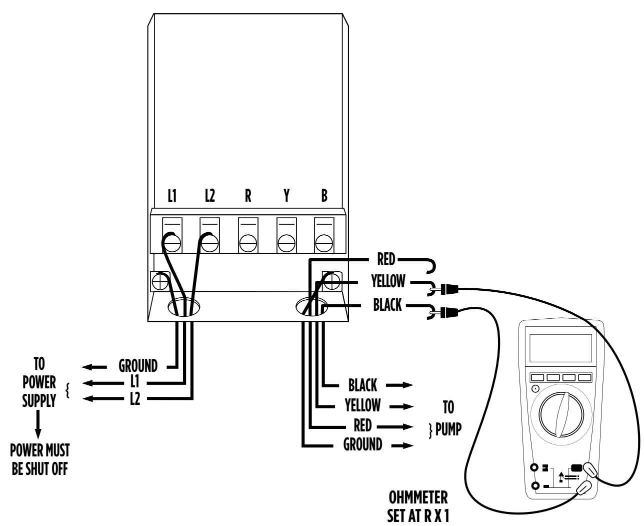


FIG. 11

Insulation Resistance Readings

Table 47 Normal ohm and Megohm Values Between All Leads and Ground

CONDITION OF MOTOR AND LEADS	MEGOHM VALUE	OHMS VALUE
A new motor (without drop cable)	200.0 (or more)	200,000,000 (or more)
A used motor which can be reinstalled in well	10.0 (or more)	10,000,000 (or more)
MOTOR IN WELL. READINGS ARE FOR DROP CABLE PLUS MOTOR.		
New motor	2.0 (or more)	2,000,000 (or more)
Motor in good condition	0.50 - 2.0	500,000 - 2,000,000
Insulation damage, locate and repair	Less than .50	Less than 500,000

Insulation resistance varies very little with rating. Motors of all hp, voltage, and phase rating have similar values of insulation resistance. The table above is based on readings taken with a megohm meter with a 500 VDC output. Readings may vary using a lower voltage ohmmeter; consult Franklin Electric if readings are in question.

Resistance of Drop Cable (ohms)

The values below are for copper conductors. If aluminum conductor drop cable is used, the resistance will be higher. To determine the actual resistance of the aluminum drop cable, divide the ohm readings from this chart by 0.61. This chart shows total resistance of cable from control to motor and back.

Winding Resistance Measuring

The winding resistance measured at the motor should fall within the values in Tables 13, 22, 24, 25, & 27. When measured through the drop cable, the resistance of the drop cable must be subtracted from the ohmmeter readings to get the winding resistance of the motor. See table below.

Table 47A DC Resistance in ohms per 100 ft of Wire (Two conductors) @ 50 °F

AWG OR MCM WIRE SIZE (COPPER)	14	12	10	8	6	4	3	2
OHMS	0.544	0.338	0.214	0.135	0.082	0.052	0.041	0.032

1	1/0	2/0	3/0	4/0	250	300	350	400	500	600	700
0.026	0.021	0.017	0.013	0.010	0.0088	0.0073	0.0063	0.0056	0.0044	0.0037	0.0032

Identification Of Cables When Color Code Is Unknown (Single-Phase 3-Wire Units)

If the colors on the individual drop cables cannot be found with an ohmmeter, measure:

Cable 1 to Cable 2
Cable 2 to Cable 3
Cable 3 to Cable 1

Find the highest resistance reading.

The lead not used in the highest reading is the yellow lead.

Use the yellow lead and each of the other two leads to get two readings:

Highest is the red lead.
Lowest is the black lead.

EXAMPLE:
The ohmmeter readings were:

Cable 1 to Cable 2 - 6 ohms
Cable 2 to Cable 3 - 2 ohms
Cable 3 to Cable 1 - 4 ohms

The lead not used in the highest reading (6 ohms) was

Cable 3—Yellow

From the yellow lead, the highest reading (4 ohms) was

To Cable 1—Red

From the yellow lead, the lowest reading (2 ohms) was

To Cable 2—Black

Single-Phase Control Boxes

Checking and Repairing Procedures (Power On)

WARNING: Power must be on for these tests. Do not touch any live parts.

A. VOLTAGE MEASUREMENTS

Step 1. Motor Off

1. Measure voltage at L1 and L2 of pressure switch or line contactor.
2. Voltage Reading: Should be ± 10% of motor rating.

Step 2. Motor Running

1. Measure voltage at load side of pressure switch or line contactor with pump running.
2. Voltage Reading: Should remain the same except for slight dip on starting. Excessive voltage drop can be caused by loose connections, bad contacts, ground faults, or inadequate power supply.
3. Relay chatter is caused by low voltage or ground faults.

B. CURRENT (AMP) MEASUREMENTS

1. Measure current on all motor leads.
2. Amp Reading: Current in red lead should momentarily be high, then drop within one second to values in Table 13. This verifies relay or solid state relay operation. Current in black and yellow leads should not exceed values in Table 13.
3. Relay or switch failures will cause red lead current to remain high and overload tripping.
4. Open run capacitor(s) will cause amps to be higher than normal in the black and yellow motor leads and lower than normal in the red motor lead.
5. A bound pump will cause locked rotor amps and overloading tripping.
6. Low amps may be caused by pump running at shut-off, worn pump, or stripped splines.
7. Failed start capacitor or open switch/relay are indicated if the red lead current is not momentarily high at starting.

CAUTION: The tests in this manual for components such as capacitors, relays, and QD switches should be regarded as indicative and not as conclusive. For example, a capacitor may test good (not open, not shorted) but may have lost some of its capacitance and may no longer be able to perform its function.

Ohmmeter Tests

QD, Solid State Control Box (Power Off)

A. START CAPACITOR AND RUN CAPACITOR IF APPLICABLE (CRC)

1. Meter Setting: R x 1,000.
2. Connections: Capacitor terminals.
3. Correct meter reading: Pointer should swing toward zero, then back to infinity.

B. Q.D. (BLUE) RELAY

Step 1. Triac Test

1. Meter setting: R x 1,000.
2. Connections: Cap and B terminal.
3. Correct meter reading: Infinity for all models.

Step 2. Coil Test

1. Meter Setting: R x 1.
2. Connections: L1 and B.
3. Correct meter reading: Zero ohms for all models.

C. POTENTIAL (VOLTAGE) RELAY

Step 1. Coil Test

1. Meter setting: R x 1,000.
2. Connections: #2 & #5.
3. Correct meter readings:

   For 115 Volt Boxes:
   0.7-1.8 (700 to 1,800 ohms).

   For 230 Volt Boxes:
   4.5-7.0 (4,500 to 7,000 ohms).

Step 2. Contact Test

1. Meter setting: R x 1.
2. Connections: #1 & #2.
3. Correct meter reading: Zero for all models.

Ohmmeter Tests

Integral Horsepower Control Box (Power Off)

A. OVERLOADS (Push Reset Buttons to make sure contacts are closed.)

1. Meter Setting: R x 1.
2. Connections: Overload terminals.
3. Correct meter reading: Less than 0.5 ohms.

B. CAPACITOR (Disconnect leads from one side of each capacitor before checking.)

1. Meter Setting: R x 1,000.
2. Connections: Capacitor terminals.
3. Correct meter reading: Pointer should swing toward zero, then drift back to infinity, except for capacitors with resistors which will drift back to 15,000 ohms.

C. POTENTIAL (VOLTAGE) RELAY

Step 1. Coil Test

1. Meter setting: R x 1,000.
2. Connections: #2 & #5.
3. Correct meter readings: 4.5-7.0 (4,500 to 7,000 ohms) for all models.

Step 2. Contact Test

1. Meter Setting: R x 1.
2. Connections: #1 & #2.
3. Correct meter reading: Zero ohms for all models.

D. CONTACTOR

Step 1. Coil

1. Meter setting: R x 100
2. Connections: Coil terminals
3. Correct meter reading:
   1.8-14.0 (180 to 1,400 ohms)

Step 2. Contacts

1. Meter Setting: R X 1
2. Connections: L1 & T1 or L2 & T2
3. Manually close contacts
4. Correct meter reading: Zero ohms

CAUTION: The tests in this manual for components such as capacitors, relays, and QD switches should be regarded as indicative and not as conclusive. For example, a capacitor may test good (not open, not shorted) but may have lost some of its capacitance and may no longer be able to perform its function.

Table 50 QD Control Box Parts 60 Hz

HP	VOLTS	CONTROL BOX MODEL NUMBER	QD (BLUE) RELAY	START CAPACITOR	MFD	VOLTS	RUN CAPACITOR	MFD	VOLTS
1/3	115	280 102 4915	223 415 905	275 464 125	159-191	110			
	230	280 103 4915	223 415 901	275 464 126	43-53	220			
1/2	115	280 104 4915	223 415 906	275 464 201	250-300	125			
	230	280 105 4915	223 415 902	275 464 105	59-71	220			
	230	282 405 5015 (CRC)	223 415 912	275 464 126	43-53	220	156 362 101	15	370
3/4	230	280 107 4915	223 415 903	275 464 118	86-103	220			
	230	282 407 5015 (CRC)	223 415 913	275 464 105	59-71	220	156 362 102	23	370
1	230	280 108 4915	223 415 904	275 464 113	105-126	220			
	230	282 408 5015 (CRC)	223 415 914	275 464 118	86-103	220	156 362 102	23	370

Table 50A QD Capacitor Replacement Kits

CAPACITOR NUMBER	KIT
275 464 105	305 207 905
275 464 113	305 207 913
275 464 118	305 207 918
275 464 125	305 207 925
275 464 126	305 207 926
275 464 201	305 207 951
156 362 101	305 203 907
156 362 102	305 203 908

Table 50B Overload Kits 60 Hz

HP	VOLTS	KIT (1)
1/3	115	305 100 901
1/3	230	305 100 902
1/2	115	305 100 903
1/2	230	305 100 904
3/4	230	305 100 905
1	230	305 100 906

(1) For Control Boxes with model numbers that end with 4915.

Table 50C QD Relay Replacement Kits

QD RELAY NUMBER	KIT
223 415 901	305 101 901
223 415 902	305 101 902
223 415 903	305 101 903
223 415 904	305 101 904
223 415 905	305 101 905
223 415 906	305 101 906
223 415 912 (CRC)	305 105 901
223 415 913 (CRC)	305 105 902
223 415 914 (CRC)	305 105 903

FOOTNOTES:

(1) Control boxes supplied with QD Relays are designed to operate on 230-volt systems. For 208-volt systems or where line voltage is between 200 volts and 210 volts use the next larger cable size, or use a boost transformer to raise the voltage.

(2) Voltage relays kits for 115-volts (305 102 901) and 230-volts (305 102 902) will replace current, voltage or QD Relays, and solid state switches.

Table 51 Integral Horsepower Control Box Parts 60 Hz

MOTOR SIZE	MOTOR RATING HP	CONTROL BOX (1) MODEL NO.	CAPACITORS				OVERLOAD (2) PART NO.	RELAY (3) PART NO.	CONTACTOR (2) PART NO.
			PART NO. (2)	MFD.	VOLTS	QTY.			
4"	1 - 1.5 STANDARD	282 300 8110 (See Note 5)	275 464 113 S 155 328 102 R	105-126 10	220 370	1 1	275 411 107	155 031 102	
		282 300 8110 (See Note 5)	275 464 137 S 155 328 101 R	105-126 15	220 370	1 1	275 411 114 S 275 411 113 M	155 031 102	
		282 300 8610	275 464 113 S 155 328 101 R	105-126 15	220 370	1 1	None (See Note 4)	155 031 102	
4"	2 STANDARD	282 301 8110	275 464 137 S 155 328 103 R	105-126 20	220 370	1 1	275 411 117 S 275 411 113 M	155 031 102	
4"	2 DELUXE	282 301 8310	275 464 137 S 155 328 103 R	105-126 20	220 370	1 1	275 411 117 S 275 411 113 M	155 031 102	155 325 102 L
4"	3 STANDARD	282 302 8110	275 463 123 S 155 327 109 R	208-250 45	220 370	1 1	275 411 118 S 275 411 115 M	155 031 102	
4"	3 DELUXE	282 302 8310	275 463 123 S 155 327 109 R	208-250 45	220 370	1 1	275 411 118 S 275 411 115 M	155 031 102	155 325 102 L
4" & 6"	5 STANDARD	282 113 8110	275 468 119 S 155 327 114 R	270-324 40	330 370	1 2	275 411 119 S 275 406 102 M	155 031 601	
4" & 6"	5 DELUXE	282 113 9310	275 468 119 S 155 327 114 R	270-324 40	330 370	1 2	275 411 119 S 275 406 102 M	155 031 601	155 326 101 L
6"	7.5 STANDARD	282 201 9210	275 468 119 S 275 468 118 S 155 327 109 R	270-324 216-259 45	330 330 370	1 1 1	275 411 102 S 275 406 122 M	155 031 601	
6"	7.5 DELUXE	282 201 9310	275 468 119 S 275 468 118 S 155 327 109 R	270-324 216-259 45	330 330 370	1 1 1	275 411 102 S 275 406 121 M	155 031 601	155 326 102 L
6"	10 STANDARD	282 202 9210	275 468 119 S 275468 120 S 155 327 102 R	270-324 350-420 35	330 330 370	1 1 2	275 406 103 S 155 409 101 M	155 031 601	
6"	10 STANDARD	282 202 9230	275 463 120 S 275 468 118 S 275 468 119 S 155 327 102 R	130-154 216-259 270-324 35	330 330 330 370	1 1 1 2	275 406 103 S 155 409 101 M	155 031 601	
6"	10 DELUXE	282 202 9310	275 468 119 S 275468 120 S 155 327 102 R	270-324 350-420 35	330 330 370	1 1 2	275 406 103 S 155 409 101 M	155 031 601	155 326 102 L
6"	10 DELUXE	282 202 9330	275 463 120 S 275 468 118 S 275 468 119 S 155 327 102 R	130-154 216-259 270-324 35	330 330 330 370	1 1 1 2	275 406 103 S 155 409 101 M	155 031 601	155 326 102 L
6"	15 DELUXE	282 203 9310	275 468 120 S 155 327 109 R	350-420 45	330 370	2 3	275 406 103 S 155 409 102 M	155 031 601	155 429 101 L
6"	15 DELUXE	282 203 9330	275 463 122 S 275 468 119 S 155 327 109 R	161-193 270-324 45	330 330 370	1 2 3	275 406 103 S 155 409 102 M	155 031 601	155 429 101 L
6"	15 X-LARGE	282 203 9621	275 468 120 S 155 327 109 R	350-420 45	330 370	2 3	275 406 103 S 155 409 102 M	155 031 601 2 required	155 429 101 L

FOOTNOTES:

(1) Surge arrestors 150 814 902 are suitable for all control boxes.

(2) S = Start, M = Main, L = Line, R = Run
Deluxe = Control box with line contactor.

(3) For 208-volt systems or where line voltage is between 200 volts and 210 volts, a low voltage relay is required. On 3 hp and smaller control boxes use relay part 155 031 103 in place of 155 031 102 and use the next larger cable size than specified in the 230-volt table. On 5 hp and larger use relay 155 031 602 in place of 155 031 601 and next larger wire. Boost transformers per page 15 are an alternative to special relays and cable.

(4) Control box model 282 300 8610 is designed for use with motors having internal overload protectors. If used with a 1.5 hp motor manufactured prior to date code 06H18, Overload/Capacitor Kit 305 388 901 is required.

(5) Control box model 282 300 8110 with date code 11C19 (March 2011) and newer contain 15 MFD run capacitor and both start and run overloads. This box is designed for use with any Franklin 1.5 hp motor.

Table 52 Integral hp Capacitor Replacement Kits

CAPACITOR NUMBER	KIT
275 463 120	305 206 920
275 463 122	305 206 922
275 463 123	305 206 923
275 464 113	305 207 913
275 464 137	305 207 937
275 468 118	305 208 918
275 468 119	305 208 919
275 468 120	305 208 920
155 327 101	305 203 901
155 327 102	305 203 902
155 327 109	305 203 909
155 327 114	305 203 914
155 328 101	305 204 901
155 328 102	305 204 902
155 328 103	305 204 903

Table 52A Integral hp Overload Replacement Kits

OVERLOAD NUMBER	KIT
275 406 102	305 214 902
275 406 103	305 214 903
275 406 121	305 214 921
275 406 122	305 214 922
275 411 102	305 215 902
275 411 107	305 215 907
275 411 108	305 215 908
275 411 113	305 215 913
275 411 114	305 215 914
275 411 115	305 215 915
275 411 117	305 215 917
275 411 118	305 215 918
275 411 119	305 215 919

Table 52B Integral hp Voltage Relay Replacement Kits

RELAY NUMBER	KIT
155 031 102	305 213 902
155 031 103	305 213 903
155 031 601	305 213 961
155 031 602	305 213 962

Table 52C Integral hp Contactor Replacement Kits

CONTACTOR	KIT
155 325 102	305 226 902
155 326 101	305 347 903
155 326 102	305 347 902
155 429 101	305 347 901

FOOTNOTES:

(1) The following kit number changes were made for number consistency purposes only. Parts in the kit did not change.

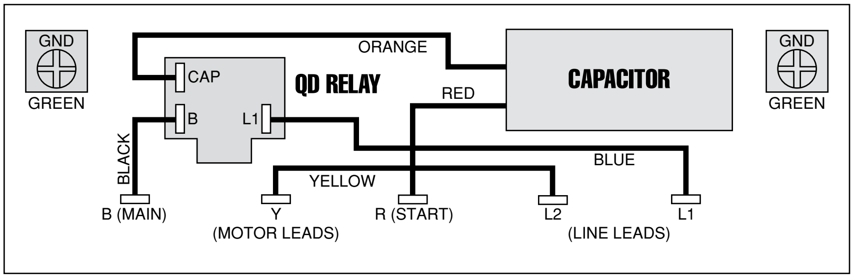
305 206 922 was 305 206 912

305 206 923 was 305 206 911

305 213 962 was 305 213 904

305 226 902 was 305 226 901

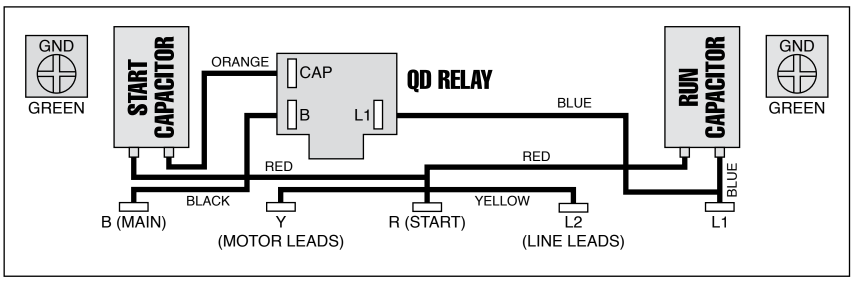
Control Box Wiring Diagrams



1/3 - 1 hp QD RELAY

280 10_ 4915

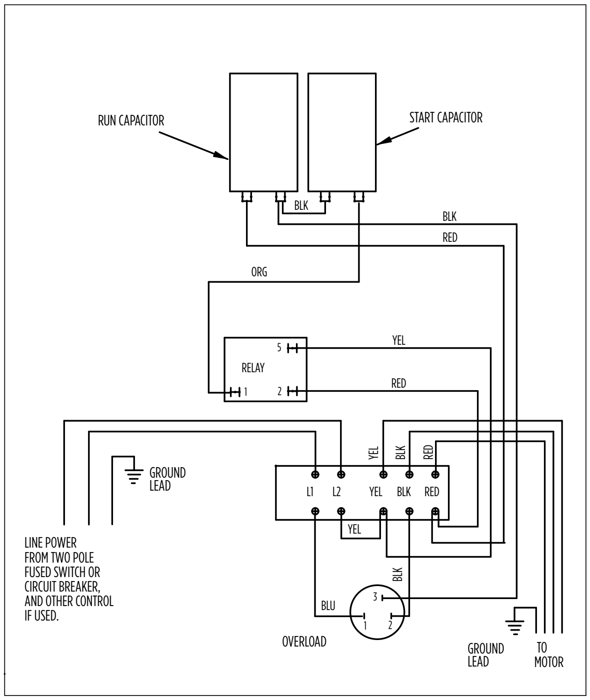
Sixth digit depends on hp



1/2 - 1 hp CRC QD RELAY

282 40_ 5015

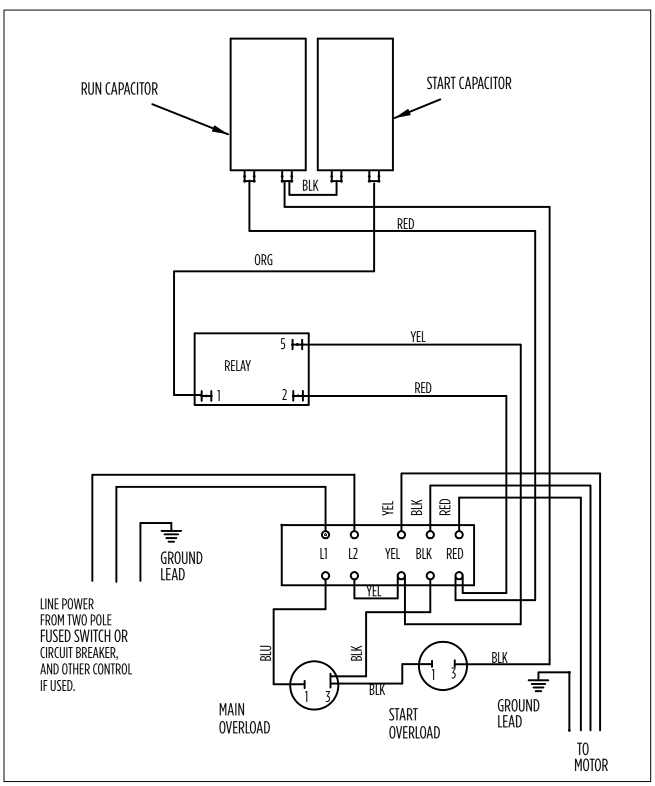
Sixth digit depends on hp



1 - 1.5 hp

282 300 8110

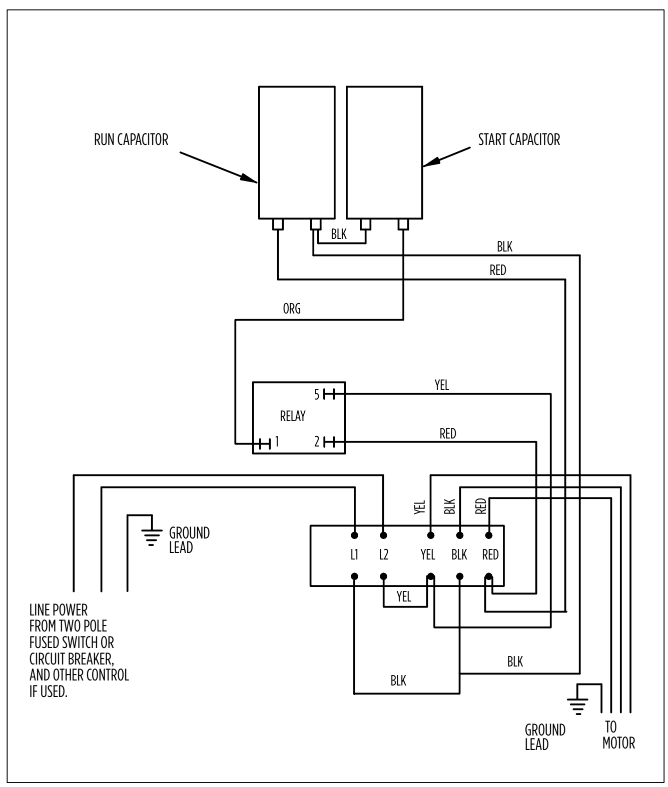
(Date Codes 11C19 & Older)



1 - 1.5 hp

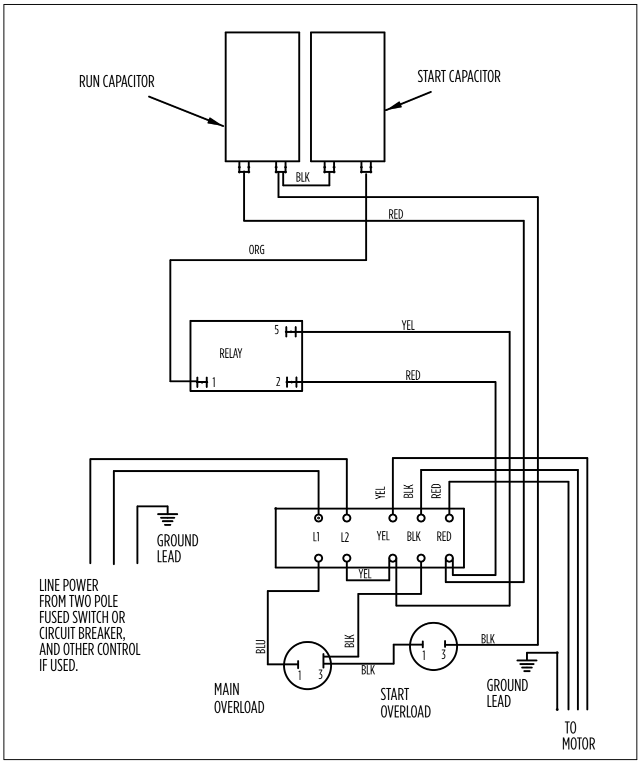
282 300 8110

(Date Codes 11C19 & Newer)

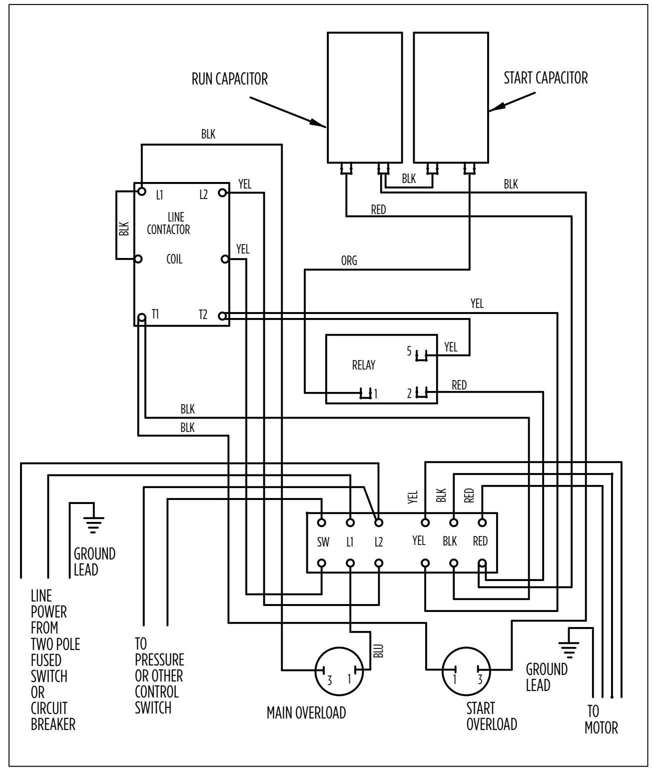


1 - 1.5 hp

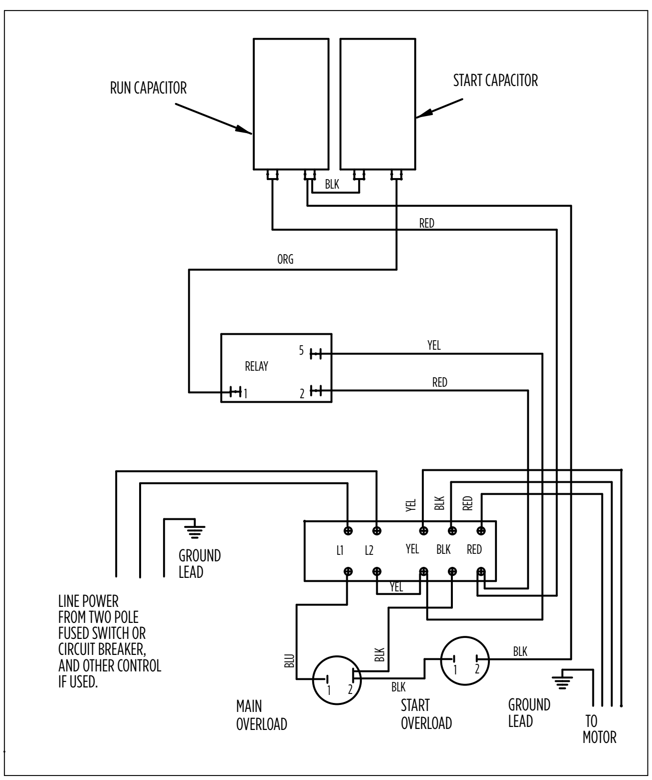
282 300 8610



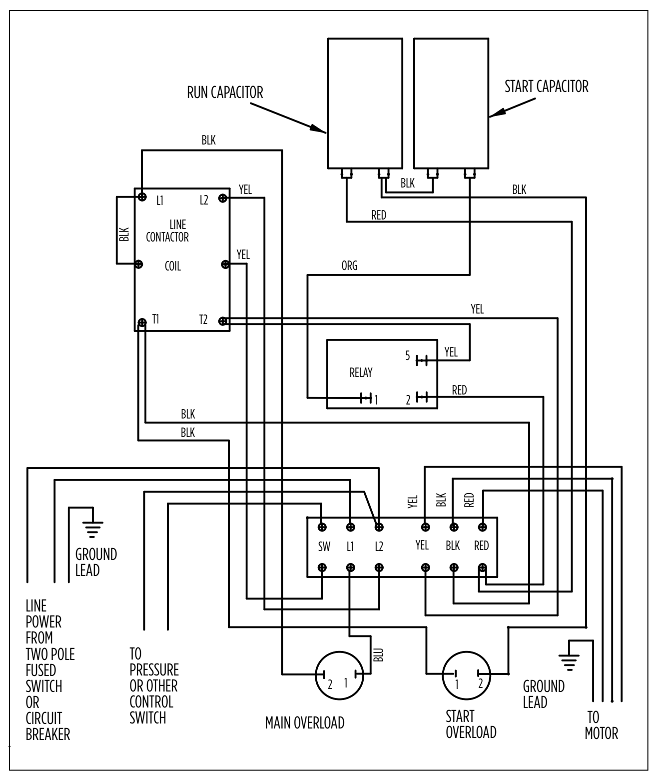
2 hp STANDARD
282 301 8110



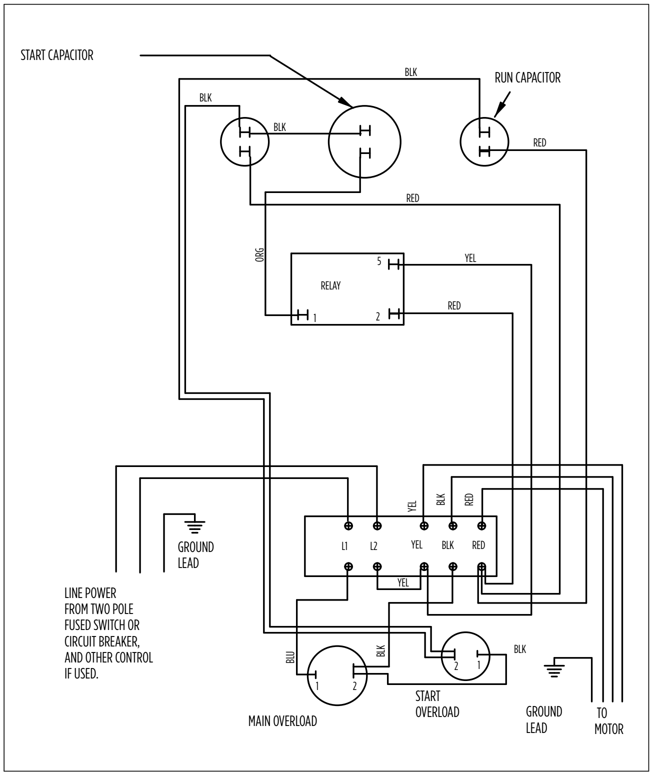
2 hp DELUXE
282 301 8310



3 hp STANDARD
282 302 8110

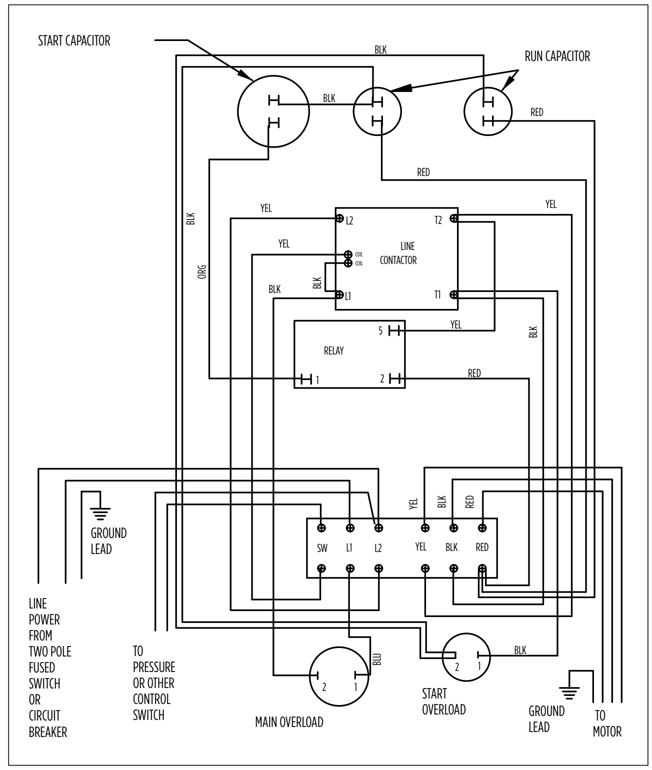


3 hp DELUXE
282 302 8310



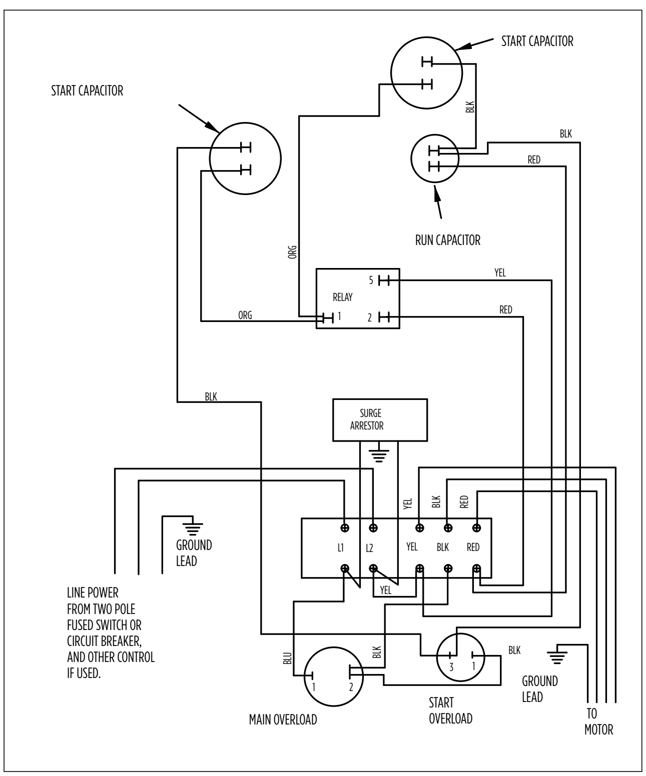
5 hp STANDARD

282 113 8110



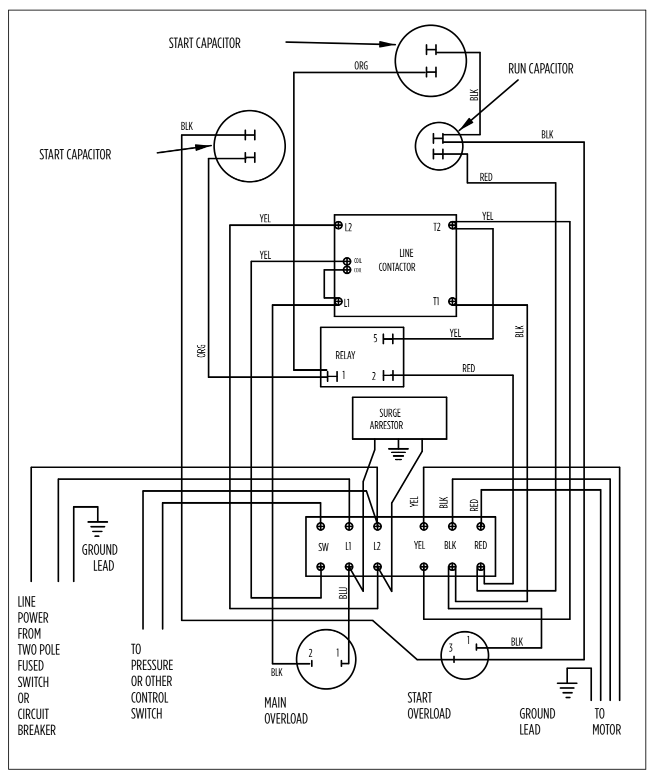
5 hp DELUXE

282 113 8310 or 282 113 9310



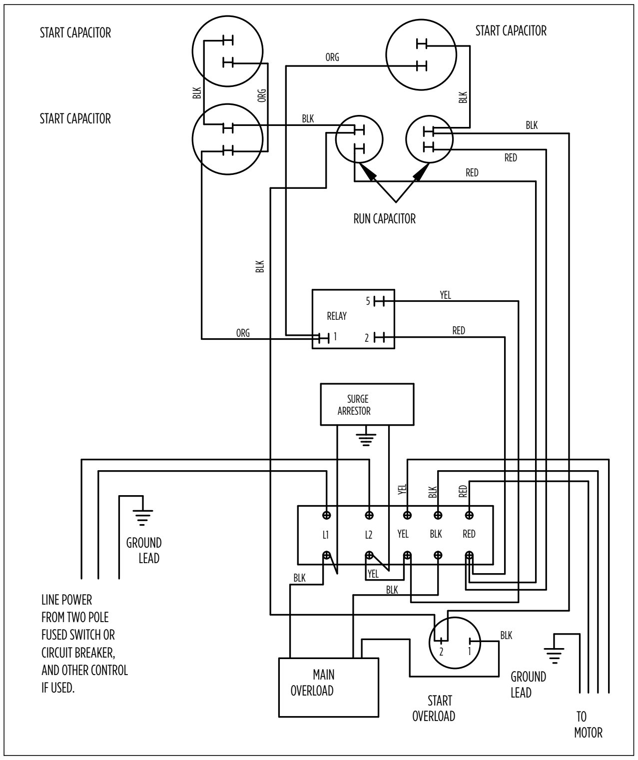
7.5 hp STANDARD

282 201 9210



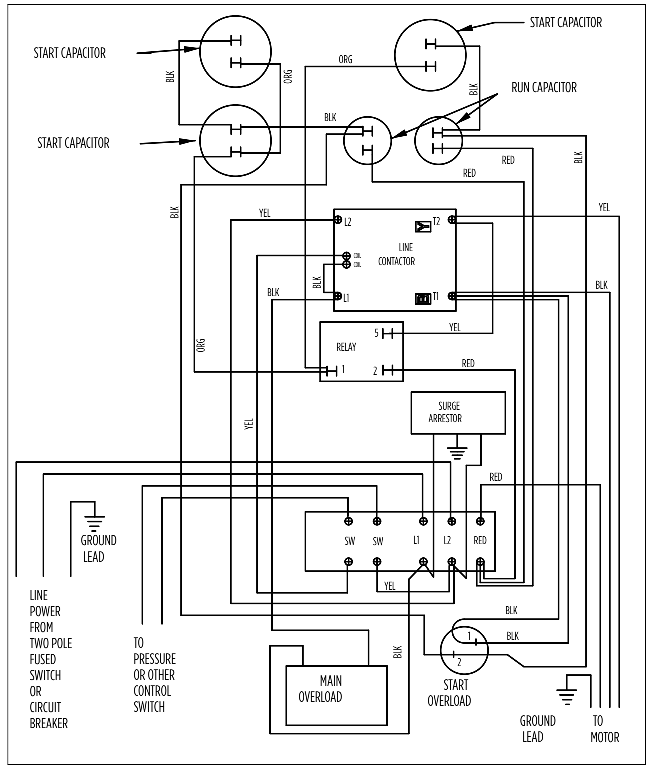
7.5 hp DELUXE

282 201 9310



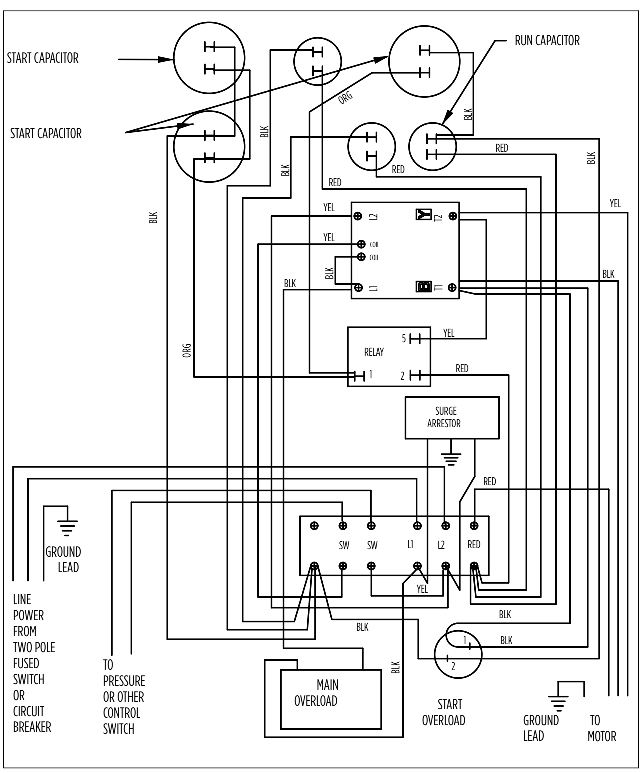
10 hp STANDARD

282 202 9210 or 282 202 9230



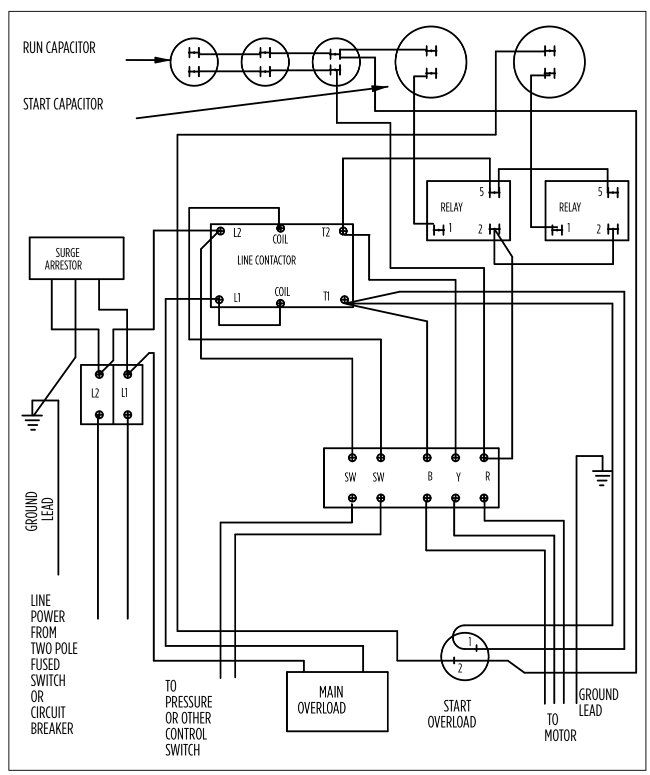
10 hp DELUXE

282 202 9230 or 282 202 9330



15 hp DELUXE

282 203 9310 or 282 203 9330



15 hp X-LARGE

282 203 9621

SubDrives & MonoDrives

The Franklin Electric SubDrive/MonoDrive controller is a variable-speed drive that delivers water at a constant pressure. MonoDrive and MonoDriveXT are designed to convert a conventional 3-wire 1/2 hp to 2 hp pump system to a variable speed constant pressure system by simply replaceing the 3-wire control box and pressure switch. The SubDrive 3-Phase models are designed for three-phase motors to provide constant pressure with three-phase performance using single-phase input power. The SubDrive2W is designed to convert a conventional 2-wire 1/2 hp, 3/4 hp and 1 hp pump system to a variable speed constant pressure system by simply replacing the pressure switch.

Applications

- Residential home
- Schools
- Restaurants
- Car washes
- Farms
- Landscape irrigation system

Protects Agianst

- Surge Protection
- Overheated Controller
- Locked pump
- Short Circuits
- Undervoltage
- Open Circuit
- Underload
- Broken pipe detection (NEMA 3R only excluding 2W)
- User-configuarable underload off time (NEMA 3R only excluding 2W)

WARNING: Serious or fatal electrical shock may result from failure to connect the motor, SubDrive/MonoDrive Controller, metal plumbing and all other metal near the motor or cable to the power supply ground terminal using wire no smaller than motor cable wires. To reduce the risk of electrical shock, disconnect power before working on or around the water system. Capacitors inside the SubDrive/MonoDrive Controller can still hold a lethal voltage even after power has been removed. Allow 10 minutes for dangerous internal voltage to discharge. Do not use motor in swimming areas.

Generator Sizing for SubDrive/MonoDrive

Basic generator sizing for the Franklin Electric SubDrive/MonoDrive system is 1.5 times maximum input Watts consumed by the drive, rounded up to the next normal sized generator.

Recommended minimum generator sizes:

MonoDrive

1/2 hp (0.37 kW) = 2000 Watts (2 kW)
3/4 hp (0.55 kW) = 3000 Watts (3 kW)
1 hp (0.75 kW) = 3500 Watts (3.5 kW)

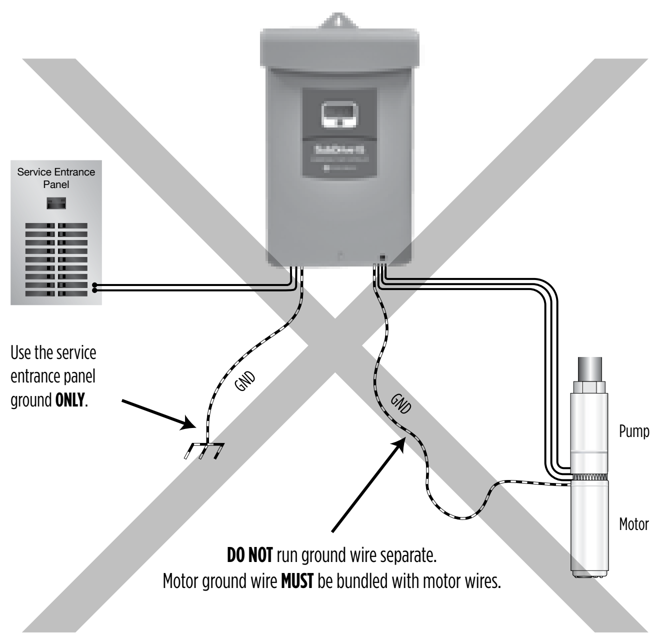
MonoDriveXT

1.5 hp (1.1kW) = 4000 Watts (4 kW)
2 hp (1.5 kW) = 5000 Watts (5 kW)

SubDrive15 = 3500 Watts (3.5 kW)
SubDrive20 = 5700 Watts (6 kW)
SubDrive30 = 7000 Watts (7 kW)
SubDrive2W = 6000 Watts (6 kW)

SubDrive75 = 3500 Watts (3.5 kW)
SubDrive100 = 5700 Watts (6 kW)
SubDrive150 = 7000 Watts (7 kW)
SubDrive300 = 11000 Watts (11 kW)
SubDrive2W = 6000 Watts (6 kW)

Note: Not to be used on a Ground Fault Circuit Interruptor (GFCI). If using an externally regulated generator, verify that the voltage and Hertz are appropriate to supply the drive.



Fuse/Circuit Breaker and Wire Sizing

The Listed fuse/Listed circuit breaker size and maximum allowable wire lengths for connection to the SubDrive/MonoDrive are given in the following tables:

Table 59: Circuit Breaker Sizing and Maximum Input Cable Lengths (in Feet)

Based on a 3% voltage drop

CONTROLLER MODEL	LISTED FUSE / LISTED CIRCUIT BREAKER AMPS	NOMINAL INPUT VOLTAGE	AWG COPPER WIRE SIZES, 167° F (75° C) INSULATION UNLESS OTHERWISE NOTED										
			14	12	10	8	6	4	3	2	1	1/0	2/0
MonoDrive	15	208	80	125	205	315	500	790	980	1290	1635	-	-
		230	95	150	250	385	615	970	1200	1580	2000	-	-
SubDrive15 / SubDrive75	15	208	70	110	185	280	450	710	880	1160	1465	-	-
		230	85	135	225	345	550	865	1075	1415	1795	-	-
SubDrive2W	20	230	-	125	205	315	505	795	985	1295	1645	-	-
MonoDriveXT	20	208	-	85	140	220	345	550	680	895	1135	-	-
		230	-	105	175	265	425	670	835	1095	1390	-	-
SubDrive20 / SubDrive100	25	208	-	-	115	180	285	450	555	730	925	-	-
	20	230	-	85	140	220	345	550	680	895	1130	-	-
SubDrive30 / SubDrive150	30	208	-	-	95	145	235	370	460	605	765	-	-
	25	230	-	-	115	180	285	455	560	740	935	-	-
SubDrive300	40	208	-	-	-	-	150	235	295	385	490	610	735
	40	230	-	-	-	115	185	290	360	470	600	745	895

XXXX Highlighted Numbers denote wire with 194° F (90° C) insulation only

Table 59A: Maximum Motor Cable Length (in feet)

CONTROLLER MODEL	FRANKLIN ELECTRIC MOTOR MODEL	HP	AWG COPPER WIRE SIZES, 140°F (60 °C) INSULATION					
			14	12	10	8	6	4
SubDrive15 / SubDrive75	234 514 xxxx	1.5 (1.1 kW)	420	670	1060	-	-	-
SubDrive20 / SubDrive100	234 315 xxxx	2.0 (1.5 kW)	320	510	810	1000	-	
SubDrive30 / SubDrive150	234 316 xxxx	3.0 (2.2 kW)	240	390	620	990	-	-
SubDrive300	234 317 xxxx	5.0 (3.7 kW)	-	230	370	590	920	-
SubDrive2W	244 505 xxxx	1/2 (.37 kW)	400	650	1000	-	-	-
	244 507 xxxx	3/4 (.55 kW)	300	480	760	1000	-	-
	244 508 xxxx	1.0 (.75 kW)	250	400	630	990	-	-
MonoDrive	214 505 xxxx	1/2 (.37 kW)	400	650	1020	-	-	-
	214 507 xxxx	3/4 (.55 kW)	300	480	760	1000	-	-
	214 508 xxxx	1.0 (.75 kW)	250	400	630	990	-	-
MonoDriveXT	214 508 xxxx	1.0 (0.75kW)	250	400	630	990	-	-
	224 300 xxxx	1.5 (1.1 kW)	190	310	480	770	1000	-
	224 301 xxxx	2.0 (1.5kW)	150	250	390	620	970	-

A 10-foot (3.05 m) section of cable is provided with the SubDrive/MonoDrive to connect the pressure sensor.

Notes:

- 1 ft = 0.305 m
- Maximum allowable wire lengths are measured between the controller and motor.
- Aluminum wires should not be used with the SubDrive/MonoDrive.
- All wiring to comply with the National Electrical Code and/or local codes.
- MonoDrive minimum breaker amps may be lower than AIM manual specifications for the motors listed due to the soft-starting characteristic of the MonoDrive controller.
- SubDrive minimum breaker amps may appear to exceed AIM manual specifications for the motors listed because SubDrive controllers are supplied from a single-phase service rather than three-phase.Amps (SFA). Motor overtemperature sensing is not provided by the drive.
- Motor Overload Portection: The drive electronics provide motor overload protection by preventing motor current from exceeding the maximum Service Factor Amps (SFA). Motor overtemperature sensing is not provided by the drive.

Pressure Tank

The SubDrive/MonoDrive needs only a small pressure tank to maintain constant pressure. (See Table X for recommended tank size.) For pumps rated 12 gpm (45.4 lpm) or more, a slightly larger tank is recommended for optimum pressure regulation. The SubDrive/MonoDrive can also use an existing tank with a much larger capacity.

Table 60: Minimum Pressure Tank Size (Total Capacity)

PUMP FLOW RATING	CONTROLLER MODEL	MINIMUM TANK SIZE
Less than 12 gpm (45.4 lpm)	SubDrive15, SubDrive 75 or MonoDrive	2 gallons (7.6 liters)
	SubDrive20 or SubDrive100	4 gallons (15.1 liters)
	SubDrive30, SubDrive150 or MonoDriveXT	4 gallons (15.1 liters)
	SubDrive300	8 gallons (30.3 liters)
12 gpm and higher (45.4 lpm)	SubDrive15, SubDrive 75 or MonoDrive	4 gallons (15.1 liters)
	SubDrive20 or SubDrive100	8 gallons (30.3 liters)
	SubDrive30, SubDrive150 or MonoDriveXT	8 gallons (30.3 liters)
	SubDrive300	20 gallons (75.7 liters)
All flows	SubDrive2W	20 gallons (75.7 liters)

Table 60A: Pressure Tank Pre-charge (PSI)

SYSTEM PRESSURE (AT PRESSURE SENSOR)	PRESSURE TANK SETTING (±2 PSI)
25	18
30	21
35	25
40	28
45	32
50 (Factory Set)	35
55	39
60	42
65	46
70	49
75	53
80	56

1 PSI = 0.068 bar
Note: Check tank pre-charge regularly to maintain optimum pressure regulation.

Table 60B: Minimum Pipe Diameter

MAXIMUM VELOCITY 8 FT/SEC. (2.4 M/S)	
MIN PIPE DIA	MAX GPM (LPM)
1/2"	4.9 (18.5)
3/4"	11.0 (41.6)
1"	19.6 (74.2)
1-1/4"	30.6 (115.8)
1-1/2"	44.1 (166.9)
2"	78.3 (296.4)
2-1/2"	176.3 (667.4)

Pumptec-Plus

Pumptec-Plus is a pump/motor protection device designed to work on any 230 V single-phase induction motor (PSC, CSCR, CSIR, and split phase) ranging in size from 1/2 to 5 horsepower. Pumptec-Plus uses a micro-computer to continuously monitor motor power and line voltage to provide protection against dry well, water logged tank, high and low voltage and mud or sand clogging.

Pumptec-Plus – Troubleshooting During Installation

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Unit Appears Dead (No Lights)	No Power to Unit	Check wiring. Power supply voltage should be applied to L1 and L2 terminals of the Pumptec-Plus. In some installations the pressure switch or other control devices is wired to the input of the Pumptec-Plus. Make sure this switch is closed.
Flashing Yellow Light	Unit Needs to Be Calibrated	Pumptec-Plus is calibrated at the factory so that it will overload on most pump systems when the unit is first installed. This overload condition is a reminder that the Pumptec-Plus unit requires calibration before use. See step 7 of the installation instructions.
	Miscalibrated	Pumptec-Plus should be calibrated on a full recovery well with the maximum water flow. Flow restrictors are not recommended.
Flashing Yellow Light During Calibration	2-Wire Motor	Step C of the calibration instructions indicate that a flashing green light condition will occur 2 to 3 seconds after taking the SNAPSHOT of the motor load. On some two-wire motors the yellow light will flash instead of the green light. Press and release the reset button. The green should start flashing.
Flashing Red and Yellow Lights	Power Interruption	During the installation of Pumptec-Plus power may be switched on and off several times. If power is cycled more than four times within a minute Pumptec-Plus will trip on rapid cycle. Press and release the reset button to restart the unit.
	Float Switch	A bobbing float switch may cause the unit to detect a rapid cycle condition on any motor or an overload condition on two-wire motors. Try to reduce water splashing or use a different switch.
Flashing Red Light	High Line Voltage	The line voltage is over 253 volts. Check line voltage. Report high line voltage to the power company.
	Unloaded Generator	If you are using a generator the line voltage may become too high when the generator unloads. Pumptec-Plus will not allow the motor to turn on again until the line voltage returns to normal. Overvoltage trips will also occur if line frequency drops too far below 60 Hz.
Solid Red Light	Low Line Voltage	The line voltage is below 207 volts. Check line voltage.
	Loose Connections	Check for loose connections which may cause voltage drops.
	Loaded Generator	If you are using a generator the line voltage may become too low when the generator loads. Pumptec-Plus will trip on undervoltage if the generator voltage drops below 207 volts for more than 2.5 seconds. Undervoltage trips will also occur if the line frequency rises too far above 60 Hz.

Pumptec-Plus and Pumptec with 3-lights

Pumptec-Plus and Pumptec with 3 lights - Troubleshooting After Installation

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Solid Yellow Light	Dry Well	Wait for the automatic restart timer to time out. During the time out period, the well should recover and fill with water. If the automatic reset timer of the Pumptec-Plus is set to the manual position, push the reset button to reactivate the unit. If the reset timer is set to manual in the Pumptec, turn off power for 5 seconds to reset the unit.
	Blocked Intake	Clear or replace pump intake screen.
	Blocked Discharge	Remove blockage in plumbing.
	Check Valve Stuck	Replace check valve.
	Broken Shaft	Replace broken parts.
	Severe Rapid Cycling	Machine gun rapid cycling can cause an underload condition. See flashing red and yellow lights section below.
	Worn Pump	Replace worn pump parts and recalibrate.
Flashing Yellow Light	Stalled Motor	Repair or replace motor. Pump may be sand or mud locked.
	Float Switch	A bobbing float switch can cause two-wire motors to stall. Arrange plumbing to avoid splashing water. Replace float switch.
	Ground Fault	Check insulation resistance on motor and control box cable.
Solid Red Light	Low Line Voltage	The line voltage is below 207 volts. Pumptec and Pumptec-Plus will try to restart the motor approximately every two minutes until the line voltage is normal.
	Loose Connections	Check for excessive voltage drops in the system electrical connections (i.e. circuit breakers, fuse clips, pressure switch, and Pumptec-Plus L1 and L2 terminals). Repair connections.
Flashing Red Light	High Line Voltage	The line voltage is over 253 volts. Check line voltage. Report high line voltage to the power company.
Flashing Red and Yellow Lights	Rapid Cycle	The most common cause for the rapid cycle condition is a waterlogged tank. Check for a ruptured bladder in the water tank. Check the air volume control or snifter valve for proper operation. Check setting on the pressure switch and examine for defects.
	Leaky Well System	Replace damaged pipes or repair leaks.
	Stuck Check Valve	Failed valve will not hold pressure. Replace valve.
	Float Switch	A bobbing float switch may cause the unit to detect a rapid cycle condition on any motor or an overload condition on 2-wire motors. To reset a Pumptec, remove power for 5 seconds. To reset a Pumptec-Plus, press and release the reset button. To eliminate float switch bounce, try to reduce water splash or use a different switch.

QD Pumptec and Pumptec with 2-lights or no lights

QD Pumptec and the old 2-light version of Pumptec are load sensing devices that monitor the load on submersible pumps/motors. If the load drops below a preset level for a minimum of 4 seconds the QD Pumptec or the Pumptec will shut off the motor.

The QD Pumptec is designed and calibrated expressly for use on Franklin Electric 230 V 3-wire motors (1/3 to 1 hp.) The QD Pumptec must be installed in QD relay boxes.

The Pumptec is designed for use on Franklin Electric 2- and 3-wire motors (1/3 to 1.5 hp) 115 and 230 V. The Pumptec is not designed for jet pumps.

QD Pumptec & Pumptec – Troubleshooting

SYMPTOM	CHECKS OR SOLUTION
If the QD Pumptec or Pumptec trips in about 4 seconds with some water delivery.	A. Is the voltage less than 90% of nameplate rating? B. Are the pump and motor correctly matched? C. Is the **QD Pumptec** or **Pumptec** wired correctly? For the **Pumptec** check the wiring diagram and pay special attention to the positioning of the power lead (230 V or 115 V). Pre-2006 Pumptec used different wiring guidelines. D. For **QD Pumptec** is your system 230 V 60 Hz or 220 V 50 Hz?
If the QD Pumptec or Pumptec trips in about 4 seconds with no water delivery.	A. The pump may be airlocked. If there ia a check valve on top of the pump, put another section of pipe between the pump and the check valve. B. The pump may be out of water. C. Check the valve settings. The pump may be dead-heading. D. Pump or motor shaft may be broken. E. Motor overload may be tripped. Check the motor current (amperage).
If the QD Pumptec or Pumptec will not timeout and reset.	A. Check switch position on side of circuit board on **Pumptec**. **QD Pumptec** check timer position on top/front of unit. Make sure the switch is not between settings. B. If the reset time switch is set to manual reset (position 0), **QD Pumptec** and **Pumptec** will not reset (turn power off for 5 sec. then back on to reset).
If your pump/motor will not run at all.	A. Check voltage. B. Check wiring. C. Remove the **QD Pumptec** from the control box. Reconnect wires in box to original state. If motor does not run the problem is not **QD Pumptec**. Bypass **Pumptec** by connecting L2 and motor lead with jumper. Motor should run. If not, the problem is not **Pumptec**. D. On **Pumptec** only check that **Pumptec** is installed between the control switch and the motor.
If your QD Pumptec or Pumptec will not trip when the pump breaks suction.	A. Be sure you have a Franklin motor. B. Check wiring connections. On **Pumptec** is lead power (230 V or 115 V) connected to correct terminal? Is motor lead connected to correct terminal? C. Check for ground fault in the motor and excessive friction in the pump. D. The well may be "gulping" enough water to keep **QD Pumptec** or **Pumptec** from tripping. It may be necessary to adjust the **QD Pumptec** or the **Pumptec** for these extreme applications. Call the Franklin Electric Service Hotline at 800-348-2420 for information. E. On **Pumptec** applications does the control box have a run capacitor? If so, **Pumptec** will not trip. (Except for Franklin 1.5 hp motors).
If your QD Pumptec or Pumptec chatters when running.	A. Check for low voltage. B. Check for waterlogged tank. Rapid cycling for any reason can cause the **QD Pumptec** or the **Pumptec** relay to chatter. C. On **Pumptec** make sure the L2 and motor wires are installed correctly. If they are reversed, the unit can chatter.

SubDrive2W, 75, 100, 150, 300, MonoDrive, and MonoDrive XT

Should an application or system problem occur, built-in diagnostics will protect the system. The "FAULT" light or digital display on the front of the SubDrive/MonoDrive Controller will flash a given number of times or display a number indicating the nature of the fault. In some cases, the system will shut itself off until corrective action is taken. Fault codes and their corrective actions are listed below. See SubDrive/MonoDrive Installation Manual for installation data.

Diagnostic Fault Codes

NUMBER OF FLASHES OR DIGITAL DISPLAY	FAULT	POSSIBLE CAUSE	CORRECTIVE ACTION
1	MOTOR UNDERLOAD	- Overpumped well - Broken shaft or coupling - Blocked screen, worn pump - Air/gas locked pump - SubDrive not set properly for pump end	- Frequency near maximum with less than 65% of expected load, 42% if DIP #3 is "on" - System is drawing down to pump inlet (out of water) - High static, light loading pump - reset DIP switch #3 to "on" for less sensitivity if not out of water - Check pump rotation (SubDrive only) reconnect if necessary for proper rotation - Air/gas locked pump - if possible, set deeper in well to reduce - Verify DIP switches are set properly
2	UNDERVOLTAGE	- Low line voltage - Misconnected input leads - Dragging or failed cooling fan	- Line voltage low, less than approximately 150 VAC (normal operating range = 190 to 260 VAC) - Check incoming power connection and correct or tighten if necessary correct incoming voltage - check circuit breaker of fuses, contact power company - Disconnect fan. Re-apply system power. If 2-flash goes away, replace fan. If 2-flash continues, replace controller. Check fan with 9-volt battery.
3	LOCKED PUMP	- Motor and/or pump misalignment - Dragging motor and/or pump - Abrasives in pump - Low Insulation to Ground	- Line voltage low, less than approximately 150 VAC (normal operating range = 190 to 260 VAC) - Amperage above max amps at 10 Hz - Remove and repair or replace as required - Check line to ground with a megohmmeter - Are output leads to motor longer than 1000 feet?
4 (MonoDrive & MonoDriveXT only)	INCORRECTLY WIRED	- MonoDrive only - Wrong resistance values on main and start	- Wrong resistance on DC test at start - Check wiring, check motor size, and DIP switch setting, adjust or repair as needed
5	OPEN CIRCUIT	- Loose connection - Failed motor or drop cable - Wrong motor - Damaged controller	- Open reading on DC test at start - Check drop cable and motor resistance, tighten output connections, repair or replace as necesssary, use "dry" motor to check drive functions, if drive will not run and exhibits open circuit fault, replace drive - Check ratings - Replace controller
6	OVER CURRENT	- When fault is indicated immediately after power-up, over current is due to short circuit. Check for loose connections, defective cable, defective splice or grounded motor.	- Amperage exceeded 50 amps on DC test at start or max amps during running - Incorrect output wiring, phase to phase short, phase to ground short in wiring or motor - If fault is present after resetting and removing motor leads, replace drive
		- When fault is indicated while motor is running, over current due to loose debris trapped in pump	- Check pump
7	OVERHEATED DRIVE	- High ambient temperature - Direct sunlight - Obstruction of airflow	- Drive heat sink has exceeded max rated temperature, needs to drop below 85 °C to restart - Fan blocked or inoperable, ambient above 125 °F, direct sunlight, air flow blocked - Replace fan or relocate drive as necessary
8 (SubDrive300 only)	OVER PRESSURE	- Improper pre-charge - Valve closing too fast - Pressure setting too close to relief valve rating	- Reset the pre-charge pressure to 70% of sensor setting. Reduce pressure setting well below relief valve rating. Use next size larger pressure tank. - Verify valve operation is within manufacturer's specifications. - Reduce system pressure setting to a value less than pressure relief rating.
RAPID	INTERNAL FAULT	- A fault was found internal to drive	- Unit may require replacement. Contact your supplier.
9 (SubDrive2W only)	OVER RANGE (Values outside normal operating range)	- Wrong hp/voltage - Internal fault	- Verify motor hp and voltage - Unit may require replacement. Contact your supplier.

SubDrive15, 20, 30, MonoDrive, and MonoDriveXT (NEMA 3R)

Diagnostic Fault Codes

NUMBER OF FLASHES	FAULT	POSSIBLE CAUSE	CORRECTIVE ACTION
F1	MOTOR UNDERLOAD	- Overpumped well - Broken shaft or coupling - Blocked screen, worn pump - Air/gas locked pump - SubDrive not set properly for pump end - Underload Sensitivity setting incorrect	- Frequency near maximum with load less than configured underload sensitivity (Potentiometer or Wi-Fi) - System is drawing down to pump inlet (out of water) - High static, light loading pump - reset Potentiometer for less sensitivity if not out of water - Check pump rotation (SubDrive only) reconnect if necessary for proper rotation - Air/gas locked pump - if possible, set deeper in well to reduce - Verify DIP switches are set properly - Check Underload Sensitivity Setting (Potentiometer or Wi-Fi setting, whichever is applicable)
F2	UNDERVOLTAGE	- Low line voltage - Misconnected input leads - Loose connection at breaker or panel	- Line voltage low, less than approximately 150 VAC (normal operating range = 190 to 260 VAC) - Check incoming power connections and correct or tighten if necessary - Correct incoming voltage - check circuit breaker or fuses, contact power company
F3	OVERCURRENT / LOCKED PUMP	- Motor and/or pump misalignment - Dragging motor and/or pump - Motor and/or pump locked - Abrasives in pump - Excess motor cable length	- Amperage above SFL at 30 Hz - Remove and repair or replace as required - Reduce motor cable length. Adhere to Maximum Motor Cable Length table.
F4 (MonoDrive & MonoDriveXT only)	INCORRECTLY WIRED	- MonoDrive only - Wrong resistance values on main and start	- Wrong resistance on DC test at start - Check wiring, check motor size and DIP switch setting, adjust or repair as needed
F5	OPEN PHASE	- Loose connection - Defective motor or drop cable - Wrong motor	- Open reading on DC test at start. - Check drop cable and motor resistance, tighten output connections, repair or replace as necessary, use “dry” motor to check drive functions. If drive will not run and exhibits underload fault replace drive
F6	SHORT CIRCUIT	- When fault is indicated immediately after power-up, short circuit due to loose connection, defective cable, splice or motor	- Amperage exceeded 25 amps on DC test at start or SF amps during running - Incorrect output wiring, phase to phase short, phase to ground short in wiring or motor - If fault is present after resetting and removing motor leads, replace drive
F7	OVERHEATED DRIVE	- High ambient temperature - Direct sunlight - Obstruction of airflow	- Drive heat sink has exceeded max rated temperature, needs to drop below 194 °F (90 °C) to restart - Fan blocked or inoperable, ambient above 122 °F (50 °C), direct sunlight, air flow blocked - Replace fan or relocate drive as necessary - Remove debris from fan intake/exhaust - Remove and clean optional air screen kit (if installed)
F9	INTERNAL PCB FAULT	- A fault was found internal to drive	- Contact your Franklin Electric Service Personnel - Unit may require replacement. Contact your supplier.
F12	OVERVOLTAGE	- High line voltage - Internal voltage too high	- Line voltage high - Check incoming power connections and correct or tighten if necessary - If line voltage is stable and measured below 260 VAC and problem persists, contact your Franklin Electric Service Personnel

Power down, disconnect leads to the motor and power up the SubDrive:

- If the SubDrive does not give an “open phase” fault (F5), then there is a problem with the SubDrive.

- Connect the SubDrive to a dry motor. If the motor goes through DC test and gives “underload” fault (F1), the SubDrive is working properly.

SubDrive15, 20, 30, MonoDrive, and MonoDriveXT (NEMA 3R)

Diagnostic Fault Codes

NUMBER OF FLASHES	FAULT	POSSIBLE CAUSE	CORRECTIVE ACTION
F14	BROKEN PIPE	- Broken pipe or large leak is detected in the system - Drive runs at full power for 10 minutes without reaching pressure setpoint - Large water draw, such as a sprinkler system, does not allow system to reach pressure setpoint	- Check system for large leak or broken pipe - If the system contains a sprinkler system or is being used to fill a pool or cistern, disable the Broken Pipe Detection
F15 (SD15/20/30 only)	PHASE IMBALANCE	- Motor phase currents differ by 20% or more. - Motor is worn internally - Motor cable resistance is not equal - Incorrect motor type setting (single- or three-phase)	- Check resistance of motor cable and motor windings - Verify motor type matched drive settings (single- or three-phase)
F16	GROUND FAULT	- Motor output cable is damaged or exposed to water - Phase to ground short	- Check motor cable insulation resistance with megger (while not connected to drive). Replace motor cable if needed.
F17	INVERTER TEMPERATURE SENSOR FAULT	- Internal temperature sensor is malfunctioning	- Contact your Franklin Electric Service Personnel - If problem persists, unit may require replacement. Contact your supplier.
F18 (SD20/30/MDXT only)	PFC TEMPERATURE SENSOR FAULT	- Internal temperature sensor is malfunctioning	- Contact your Franklin Electric Service Personnel - If problem persists, unit may require replacement. Contact your supplier.
F19	COMMUNICATION FAULT	- Cable connection between Display/Wi-Fi Board and Main Control Board is loose or disconnected - Internal circuit failure	- Check cable connection between Display/Wi-Fi Board and Main Control Board. - If problem persists, unit may require replacement. Contact your supplier.
F22	DISPLAY/WI-FI BOARD EXPECTED FAULT	- Connection between Display/Wi-Fi Board and Main Control Board was not detected at drive start-up	- Check cable connection between Display/Wi-Fi Board and Main Control Board. - If problem persists, unit may require replacement. Contact your supplier.
F23	MAIN BOARD STARTUP FAULT	- A fault was found internal to drive	- Contact your Franklin Electric Service Personnel - Unit may require replacement. Contact your supplier.
F24	INVALID DIP SWITCH SETTING	- No DIP Switch set or more than one (1) DIP Switch set for Motor size - No DIP Switch set or more than one (1) DIP Switch set for Pump size - Invalid combination of DIP switches for drive type (SD or MD mode), Motor hp, and Pump hp.	- Check DIP switch settings

Power down, disconnect leads to the motor and power up the SubDrive:

- If the SubDrive does not give an “open phase” fault (F5), then there is a problem with the SubDrive.

- Connect the SubDrive to a dry motor. If the motor goes through DC test and gives “underload” fault (F1), the SubDrive is working properly.

SubDrive2W, 75, 100, 150, 300, MonoDrive, and MonoDrive XT

Troubleshooting

CONDITION	INDICATOR LIGHT	POSSIBLE CAUSE	CORRECTIVE ACTION
NO WATER	NONE	- No supply voltage present	- If correct voltage is present, replace drive
	SOLID GREEN	- Pressure sensor circuit	- Verify water pressure is below system set point - Jumper wires together at pressure sensor, if pump starts, replace sensor - If pump doesn't start, check sensor connection at printed circuit board (PCB), if loose, repair - If pump doesn't start, jumper sensor connection at PCB, if pump starts, replace wire - If pump doesn't start with sensor PCB connection jumpered, replace drive
	SOLID RED OR SOLID RED AND GREEN	- Power surge, bad component	- Power system down to clear fault, verify voltage, if repetitive, replace drive
	FLASHING RED	- Fault detected	- Proceed to fault code description and remedy
	FLASHING GREEN	- Drive and motor are operating - Loose switch or cable connection - Gulping water at pump inlet	- Frequency max, amps low, check for closed valve, or stuck check valve - Frequency max, amps high, check for hole in pipe - Frequency max, amps erratic, check pump operation, dragging impellers - This is not a drive problem - Check all connections - Disconnect power and allow well to recover for short time, then retry
PRESSURE FLUCTUATIONS (POOR REGULATION)	FLASHING GREEN	- Pressure sensor placement and setting - Pressure gauge placement - Pressure tank size and pre-charge - Leak in system - Air entrainment into pump intake (lack of submergence)	- Correct pressure and placement as necessary - Tank may be too small for system flow - This is not a drive problem - Disconnect power and check pressure gauge for pressure drop - Set deeper in the well or tank; install a flow sleeve with airtight seal around drop pipe and cable - If fluctuation is only on branches before sensor, flip DIP switch #4 to "on" (07C and newer)
RUN ON WON'T SHUT DOWN	FLASHING GREEN	- Pressure sensor placement and setting - Tank pre-charge pressure - Impeller damage - Leaky system - Sized improperly (pump can't build enough head)	- Check frequency at low flows, pressure setting may be too close to pump max head - Verify precharge at 70% if tank size is larger than minimum, increase precharge (up to 85%) - Verify that the system will build and hold pressure
RUNS BUT TRIPS	FLASHING RED	- Check fault code and see corrective action	- Proceed to fault code description and remedy on reverse side
LOW PRESSURE	FLASHING GREEN	- Pressure sensor setting, pump rotation, pump sizing	- Adjust pressure sensor, check pump rotation - Check frequency at max flow, check max pressure
HIGH PRESSURE	FLASHING GREEN	- Pressure sensor setting - Shorted sensor wire	- Adjust pressure sensor - Remove sensor wire at PCB, if drive continues to run, replace drive - Verify condition of sensor wire and repair or replace if necessary
AUDIBLE NOISE	FLASHING GREEN	- Fan, hydraulic, plumbing	- For excessive fan noise, replace fan - If fan noise is normal, drive will need to be relocated to a more remote area - If hydraulic, try raising or lowering depth of pump - Pressure tank location should be at entrance of water line into house
NO LIGHTS	NONE	- Ribbon cable detached from LED printed circuit board	- Reattach cable - if cable is attached, replace drive
RFI-EMI INTERFERENCE	FLASHING GREEN	- See interference troubleshooting procedure	

SubDrive15, 20, 30, MonoDrive, and MonoDriveXT (NEMA 3R)

Troubleshooting

CONDITION	INDICATOR LIGHT	POSSIBLE CAUSE	CORRECTIVE ACTION
NO WATER	NONE	- No supply voltage present - Display board cable disconnected or loose	- Verify cable connection between main control board and display board - If correct voltage is present, replace drive
	GREEN "---" ON DISPLAY	- Pressure sensor circuit	- Verify water pressure is below system set point - If Pressure Input Board break-away tab is removed, ensure auxiliary device is connected and closed circuit - If Pressure Input Board break-away tab is removed and no auxiliary device is being used, manually short-circuit "AUX IN" connections - Jumper wires together at pressure sensor; if pump starts, replace sensor - If pump doesn't start, check sensor connection at Pressure Input Board;. if loose, repair - If pump doesn't start, jumper sensor connection at Pressure Input Board. If pump starts, replace wire - If pump doesn't start with sensor Pressure Input Board connection jumpered, replace Pressure Input Board - If pump doesn't start with new Pressure Input Board, replace drive
	RED FAULT CODE ON DISPLAY	- Fault detected	- Proceed to fault code description and remedy
	GREEN MOTOR FREQUENCY ON DISPLAY	- Drive and motor are operating - Loose switch or cable connection - Incorrect motor or pump settings - Motor may be running backwards - Gulping water at pump inlet	- Verify Maximum Frequency setting. If this setting was reduced below maximum value, increase - Verify motor/pump ratings and match to motor/pump settings on drive (DIP switch or Wi-Fi) - Verify motor connections - Frequency max, amps low, check for closed valve, or stuck check valve - Frequency max, amps high, check for hole in pipe - Frequency max, amps erratic, check pump operation, dragging impellers - This is not a drive problem - Check all connections - Disconnect power and allow well to recover for short time, then retry
PRESSURE FLUCTUATIONS (POOR REGULATION)	GREEN MOTOR FREQUENCY ON DISPLAY	- Pressure sensor placement and setting - Pressure gauge placement - Pressure tank size and pre-charge - Leak in system - Air entrainment into pump intake (lack of submergence)	- Correct pressure and placement as necessary - Tank may be too small for system flow - This is not a drive problem - Disconnect power and check pressure gauge for pressure drop - Change tank size configuration - Set deeper in the well or tank; install a flow sleeve with airtight seal around drop pipe and cable - If fluctuation is only on branches before sensor, enable Steady Flow
RUN ON WON'T SHUT DOWN	GREEN MOTOR FREQUENCY ON DISPLAY	- Pressure sensor placement and setting - Tank pre-charge pressure - Impeller damage - Leaky system - Sized improperly (pump can't build enough head)	- Check frequency at low flows, pressure setting may be too close to pump max head - Verify precharge at 70% if tank size is larger than minimum, increase precharge (up to 85%) - Verify that the system will build and hold pressure - Enable bump and/or aggressive bump - Increase minimum frequency
RUNS BUT TRIPS	FLASHING RED	- Check fault code and see corrective action	- Proceed to fault code description and remedy on reverse side

SubDrive15, 20, 30, MonoDrive, and MonoDriveXT (NEMA 3R)

Troubleshooting

CONDITION	INDICATOR LIGHT	POSSIBLE CAUSE	CORRECTIVE ACTION
LOW PRESSURE	GREEN MOTOR FREQUENCY ON DISPLAY	- Pressure sensor setting, pump rotation, pump sizing - High temperature	- Adjust pressure sensor, check pump rotation - Check frequency at max flow, check max pressure - High ambient and/or drive temperature will cause drive to foldback power and run with reduced performance
HIGH PRESSURE	GREEN MOTOR FREQUENCY ON DISPLAY	- Pressure sensor setting - Shorted sensor wire	- Adjust pressure sensor - Remove sensor wire at Pressure Input Board, if drive stops running, wire may be shorted - Remove sensor wire at Pressure Input Board, if drive continues to run, replace Pressure Input Board - Remove sensor wire at new Pressure Input Board, if drive continues to run, replace drive - Verify condition of sensor wire and repair or replace if necessary
AUDIBLE NOISE	GREEN MOTOR FREQUENCY ON DISPLAY	- Fan, hydraulic, plumbing	- For excessive fan noise, replace fan - If fan noise is normal, drive will need to be relocated to a more remote area - If hydraulic, try raising or lowering depth of pump - Pressure tank location should be at entrance of water line into house
NO DISPLAY	NONE	- Display board cable disconnected or loose	- Verify cable connection between main control board and display board
CANNOT CONNECT TO DRIVE WI-FI	FE CONNECT LIGHT ON SOLID	- Attempting to connect to incorrect drive - Out of Wi-Fi range of drive	- Ensure the Wi-Fi SSID (hotspot name) you are connecting to matches the drive you wish to connect to - Wi-Fi range is 100 feet line-of-site, must be closer to drive if walls or floors are between you and the drive - Wi-Fi module not responding, cycle power to drive - Cycle Wi-Fi radio on mobile device, refresh Wi-Fi connection list
	FE CONNECT LIGHT OFF	- Wi-Fi timeout expired	- If more than fifteen (15) minutes since last power cycle, cycle power to drive - If more than one (1) hour since last disconnection from Wi-Fi, cycle power to drive
RFI-EMI INTERFERENCE	GREEN MOTOR FREQUENCY ON DISPLAY	- Poor grounding - Wire routing	- Adhere to grounding and wire routing recommendations - An additional external filter may be needed. See Accessories section for ordering information

SubMonitor

SubMonitor Troubleshooting

FAULT MESSAGE	PROBLEM/CONDITION	POSSIBLE CAUSE
SF Amps Set Too High	SF Amps setting above 359 Amps.	Motor SF Amps not entered.
Phase Reversal	Reversed incoming voltage phase sequence.	Incoming power problem.
Underload	Normal line current.	Wrong SF Max Amps setting.
	Low line current.	Over pumping well. Clogged pump intake. Closed valve. Loose pump impeller. Broken shaft or coupling. Phase loss.
Overload	Normal line current.	Wrong SF Max Amps setting.
	High line current.	High or low line voltage. Ground fault. Pump or motor dragging. Motor stalled or bound pump.
Overheat	Motor temperature sensor has detected excess motor temperature.	High or low line voltage. Motor is overloaded. Excessive current unbalance. Poor motor cooling. High water temperature. Excessive electrical noise (VFD in close proximity).
Unbalance	Current difference between any two legs exceeds programmed setting.	Phase loss. Unbalanced power supply. Open Delta transformer.
Overvoltage	Line voltage exceeds programmed setting.	Unstable power supply.
Undervoltage	Line voltage below programmed setting.	Poor connection in motor power circuit. Unstable or weak power supply.
False Starts	Power has been interrupted too many times in a 10 second period.	Chattering contacts. Loose connections in motor power circuit. Arcing contacts.

A	Amp or amperage
AWG	American Wire Gauge
BJT	Bipolar Junction Transistor
°C	Degree Celsius
CB	Control Box
CRC	Capacitor Run Control
DI	Deionized
DOL	Direct on Line
Dv/dt	Rise Time of the Voltage
EFF	Efficiency
°F	Degree Fahrenheit
FDA	Food & Drug Administration
FL	Full Load
ft	Foot
ft-lb	Foot Pound
ft/s	Feet per Second
GFCI	Ground Fault Circuit Interrupter
gpm	Gallon per Minute
HERO	High Efficiency Reverse Osmosis
hp	Horsepower
Hz	Hertz
ID	Inside Diameter
IGBT	Insulated Gate Bipolar Transistor
in	Inch
kVA	Kilovolt Amp
kVAR	Kilovolt Amp Rating
kW	Kilowatt (1000 watts)
L1, L2, L3	Line One, Line Two, Line Three
lb-ft	Pound Feet
L/min	Liter per Minute
mA	Milliamp
max	Maximum
MCM	Thousand Circular Mils
mm	Millimeter
MOV	Metal Oxide Varister
NEC	National Electrical Code
NEMA	National Electrical Manufacturer Association
Nm	Newton Meter
NPSH	Net Positive Suction Head
OD	Outside Diameter
OL	Overload
PF	Power Factor
psi	Pounds per Square Inch
PWM	Pulse Width Modulation
QD	Quick Disconnect
R	Resistance
RMA	Return Material Authorization
RMS	Root Mean Squared
rpm	Revolutions per Minute
SF	Service Factor
SFhp	Service Factor Horsepower
S/N	Serial Number
TDH	Total Dynamic Head
UNF	Fine Thread
V	Voltage
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
VFD	Variable Frequency Drive
W	Watts
XFMR	Transformer
Y-D	Wye-Delta
Ω	ohms

2015 EDITION

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Call Franklin's toll free TECHNICAL SERVICE HOTLINE for answers to your pump and motor installation questions. When you call, a Franklin expert will offer assistance in troubleshooting and provide immediate answers to your system application questions. Technical support is also available online.

franklinwater.com | franklin-controls.com | solar.franklin-electric.com | constantpressure.com

Franklin Electric

6" ENCAPSULATED SUBMERSIBLE MOTORS

Single-phase 5-15 hp and three-phase 5-60 hp 200-575 volts 60 and 50 Hz

Application Data:

These motors are built for dependable operation in 6-inch diameter or larger water wells. Temperature and time ratings are continuous in 86 °F (30 °C) water at 1/2 ft./sec. flow past the motor. Rotation: single-phase, CCW facing shaft end; three-phase, electrically reversible.

Basic Features:

- Full 3450 RPM design point
- Maximum temperature winding wire NEMA class 200
- Anti-track, self-healing resin system
- Hermetically-sealed windings
- Removable Water-Bloc lead
- Double-flange design
- Stainless steel shell
- Kingsbury-type water lubricated thrust bearing
- Pressure-equalizing diapragm
- Sand slinger
- 3-lead and 6-lead (Wye Delta) configurations for 3-phase
- Copper bar rotor

Special Features:

- **316 Stainless Steel:** Special construction option for acid, low pH, and seawater applications. All 316 SS motors include a Subtrol-Plus heat sensor.
- **Sand Fighter™** models available for sandy wells. All Sand Fighter models include Subtrol-Plus heat sensor.

SUBMONITOR™ OVERLOAD OPTION FOR THREE-PHASE MOTORS
A field proven and contractor friendly premium motor protection system. It protects the motor against overload, underload, excessive winding temperature, and rapid cycling. It also extends the motor warranty to a full three years.* The motor must be manufactured with a Subtrol-Plus heat sensor.

*Contact factory for warranty details.

System Solutions

Franklin Electric

Availability

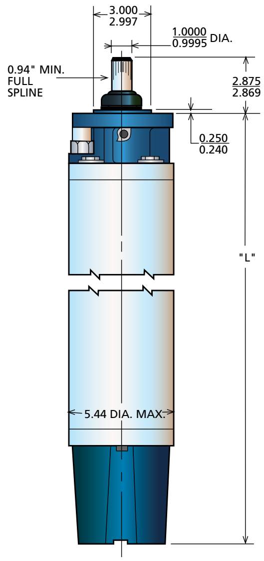
Single-Phase Capacitor start, Capacitor run (control box required)

HP	KW	"L" Dim		316 SS "L" Dim		Shipping Weight	
		IN	CM	IN	CM	LBS	KG
5	3.7	25.4	64.6	25.0	63.6	112	51
7.5	5.5	28.0	71.1	27.6	70.1	125	57
10	7.5	30.6	77.7	30.2	76.6	143	65
15	11.0	33.1	84.2	32.7	83.1	156	71

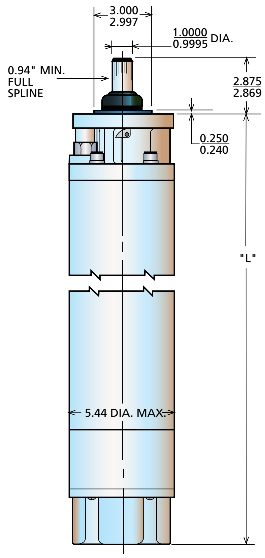
Three-Phase

HP	KW	"L" Dim		316 SS "L" Dim		Shipping Weight	
		IN	CM	IN	CM	LBS	KG
5	3.7	22.9	58.1	22.5	57.1	103	47
7.5	5.5	24.2	61.4	23.8	60.4	110	50
10	7.5	25.4	64.6	25.0	63.6	118	54
15	11.0	28.0	71.1	27.6	70.1	131	60
20	15.0	30.6	77.6	30.2	76.6	147	67
25	18.5	33.1	84.2	32.7	83.1	158	72
30	22.0	35.7	90.7	35.3	89.6	176	80
40	30.0	40.8	103.7	40.4	102.6	206	94
50	37	55.3	140.5	54.9	139.4	300	136
60	45	61.3	155.7	59.9	152.1	330	150

Note: 60 Hz - 3,450 RPM   50 Hz - 2,875 RPM



WATER WELL



316 SS

Construction Materials

Component	Standard Water Well	316 SS
Castings	Gray Iron	316 SS
Stator Shell	301 SS	316 SS
Stator Ends	Low Carbon Steel	316 SS
Shaft Extension	303 SS, Except 17-4 SS on 40 hp	17-4 SS
Fasteners	300 & 400 Series SS	316 SS
Seal Cover	304 SS & Sintered Bronze	316 SS
Seal	Carbon/Ceramic Face	Sand Fighter™ Seal System
Diaphragm	Nitrile Rubber	Nitrile Rubber
Diaphragm Plate	304 SS	316 SS
Diaphragm Spring	302 SS	17-7 SS
Slinger	Nitrile Rubber	Nitrile Rubber
Lead Wire (or Cable)	XLPE	XLPE
Lead Potting	Epoxy	Epoxy
Filter	Delrin & Polyester	316 SS Plug
Insulation	Class F	Class F

Note: Specifications subject to change without notice. Contact Franklin Electric if current material types are required for bid specifications.

Franklin Electric
9255 Coverdale Road, Fort Wayne, Indiana 46809
Tel: 260.824.2900 Fax: 260.824.2909
www.franklinwater.com

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AUTOMATIC STRAINER

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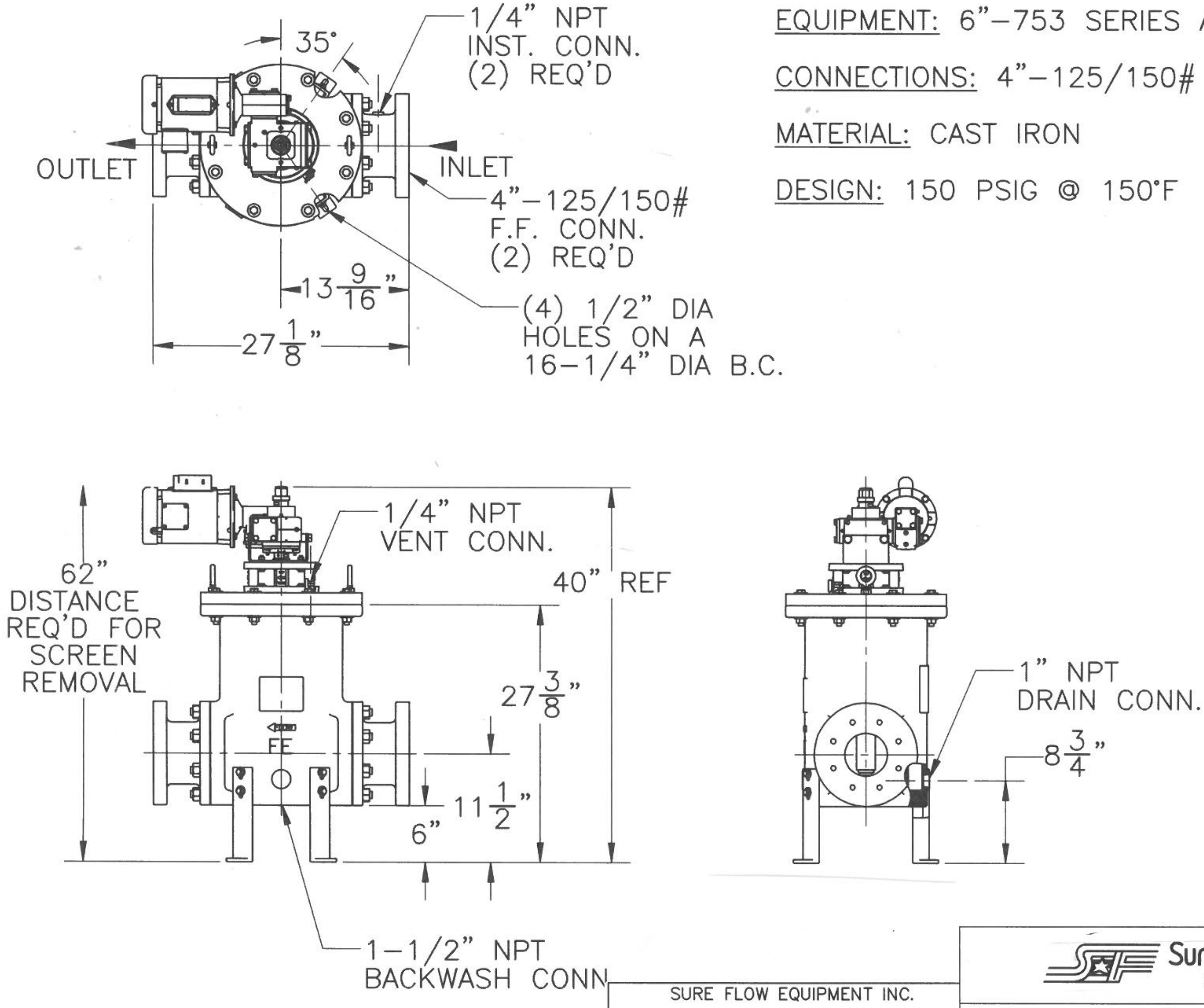
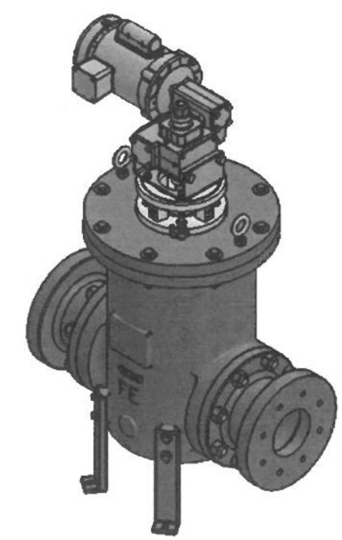
EQUIPMENT: 6"–753 SERIES AUTOMATIC STRAINER

CONNECTIONS: 4"–125/150# F.F.

MATERIAL: CAST IRON

DESIGN: 150 PSIG @ 150°F

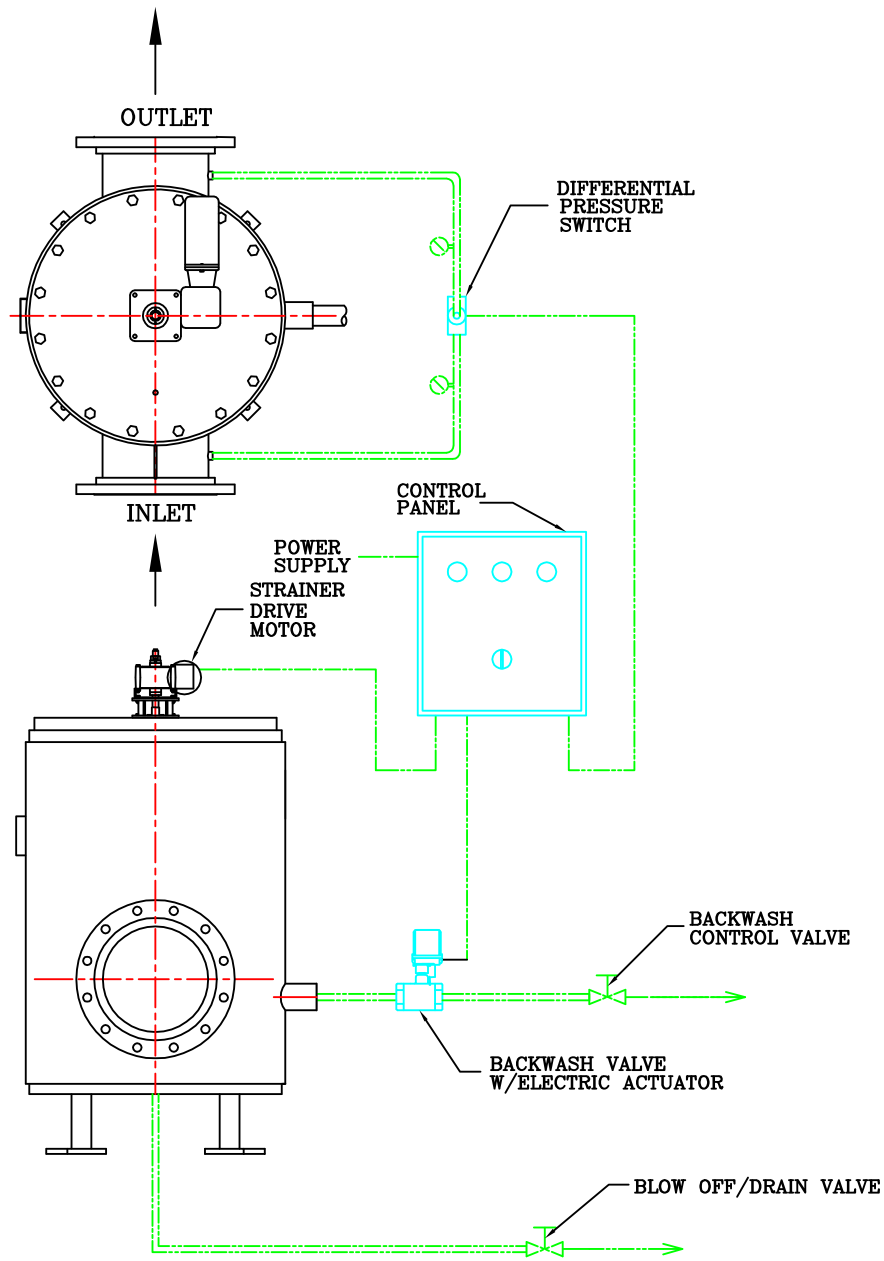




SURE FLOW EQUIPMENT INC.
This drawing is the property of Sure Flow Equipment Inc. It shall not be copied or duplicated in any manner and shall not be submitted to outside parties for examination without the written consent of Sure Flow Equipment Inc. It shall be used for reference to work under contract, or for proposals submitted by Sure Flow Equipment Inc. only.

Sure Flow Equipment Inc.
BURLINGTON, ONTARIO, CANADA

TITLE: AUTOMATIC STRAINER 6"–753 W/4"–150# F.F. CONN.			
03/31/14		03/31/14	PART NO. 753–04006–0236
RWG		MAR	DWG. NO. 753–04006
DWN BY	CHK	APPR.	
SCALE	1/16		



ITEMS SUPPLIED WITH AUTOMATIC BACKWASH STRAINER

- ONE (1) CONTROL PANEL, NEMA 4 ENCLOSURE
- ONE (1) BACKWASH VALVE WITH ELECTRIC OPERATOR
- ONE (1) DIFFERENTIAL PRESSURE SWITCH

CUSTOMER:
PROJECT:
P.O. #:
SURE FLOW FILE NO:

NOTE:
PHANTOM LINES INDICATE PIPING AND WIRING BY OTHERS
(-------------)

Ref.	Revision	Date:
SURE FLOW EQUIPMENT INC.		
Date: MAY10/02	Apprv'd. by G. B.	Scale NTS
Title: TYPICAL EXTERNAL PIPING AND WIRING		
Drawn by: GRACE P.	Drawing no.	

Automatic Strainers

ASME Section VIII, Div 1,
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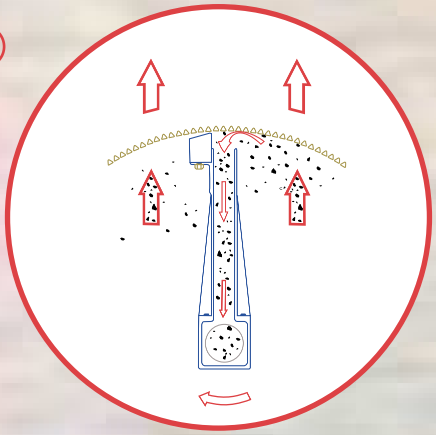
Available

The Eliminators

The Eliminator, motorized, automatic, self-cleaning strainer, provides continuous debris removal from fluid piping systems that demand full time uninterrupted flow.

The Eliminator is particularly effective in fluid applications where unattended service, high solids loading and/or uninterrupted flow requirements deem a basket strainer and its attendant maintenance problems impractical.

Any of the 700 Series Strainers, applied correctly, will prove efficient and cost effective compared to simplex/duplex strainers or other automatic straining systems.



Port/straining element interface during backwashing cycle.

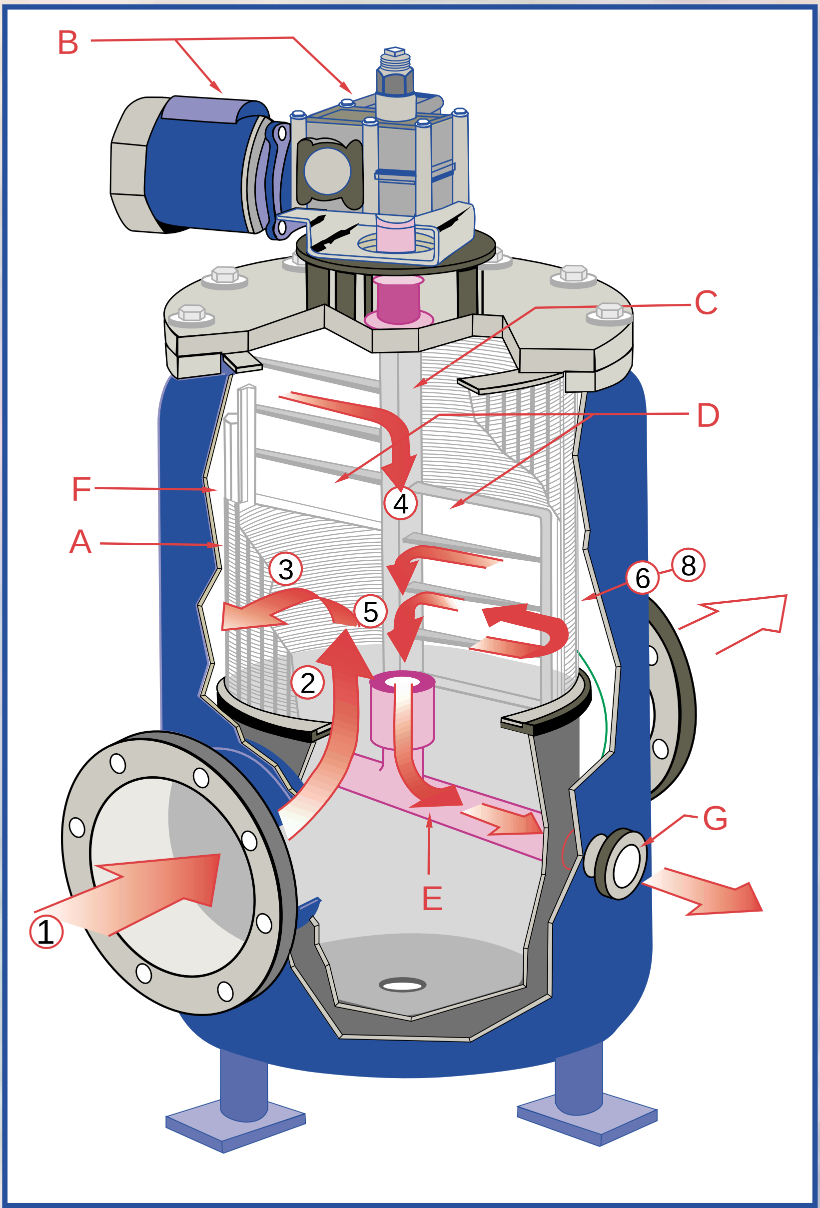


Figure 1 - Cut-away of Eliminator showing fluid flow during operation

Sequence of operation

1. Debris laden fluid enters through inlet to inner chamber. (Fig. 1)
2. Dirty fluid flows upward and outward through the strainer element (A).
3. Debris is retained on the flat face of the strainer element, while strained fluid continues to outer chamber and exits through strainer outlet. (See inset)
4. During backwash or cleaning cycle, the motor/gear reducer (B) is engaged and drives the hollow drive shaft (C) and hollow port (D) around the inner circumference of the strainer element.
5. The backwash assembly (E) is opened to atmospheric pressure by opening the backwash control valve (not shown).
6. Flow reversal occurs at the port/straining element (F) interface because of the pressure differential described in 5.
7. Debris is effectively vacuumed from the full length of the straining element by a vigorous reverse fluid flow and into the hollow port; down the hollow drive shaft and out the backwash outlet (G).
8. The hollow port continues to sweep the full length of the strainer element until the cleaning cycle has ended.
9. The strainer will provide continuous uninterrupted fluid flow during the cleaning operation.
10. The cleaning cycle can be set for continuous or intermittent backwash.

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Automatic Self-Cleaning Strainers

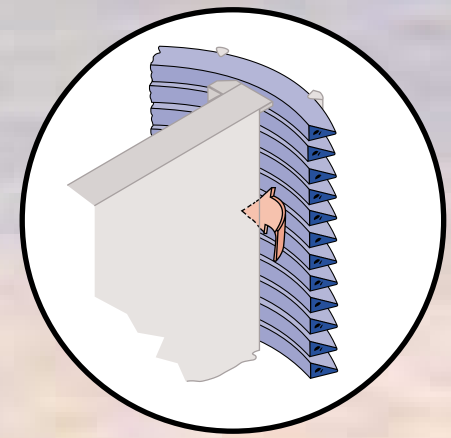

Figure 2 - Wedge Wire Straining Element Cross-Section

Application

The Eliminator's patented unique strainer element design permits installation in virtually any piping system operating at a positive pressure.

The Eliminators can operate through a wide range of operating pressures (5 psig minimum) and solids loading with effective debris removal and backwashing across the entire pressure range. Additionally, only one drain/backwash connection is required for installation, effectively eliminating the expense of a separate backwash pressure connection.

Strainers are used to protect equipment such as valves, pumps, meters, heat exchangers or spray nozzles, as well as in-feed water and process water applications or virtually any similar application.

The Eliminator 700 Series Automatic Self-Cleaning Strainers are fabricated in pipe sizes ranging from 1" to 48" to suit most application requirements.

Proven Features Include:

- Patented rugged screen and mechanical assist backwash mechanism extends useful service life.
- Unique clog-resistant straining element reduces maintenance downtime.
- All internal replacement parts supplied in corrosion resistant material.
- Efficient new design reduces maintenance requirements; requires fewer parts.
- Low rpm backwash mechanism provides more efficient cleaning, less wear of internals.

Straining Element

The Eliminators feature a revolutionary reverse rolled wedge-wire straining element (Fig. 2) that is extremely rugged and more clog-resistant than conventional strainer elements that use perforated plate or wire mesh screens.

This proven state-of-the-art straining media is fabricated by wrapping vertical rods with wedge shaped profile wire. Each intersection of rod and wire is welded to produce an extremely rugged one-piece element. This forms a continuous slot that allows only two point contact with debris particles to reduce clogging.

The wedge shaped profile wire reduces the possibility of retaining debris smaller than the screen opening which historically has been the cause of premature clogging or failure of competitive screen designs.

Advantages of Wedge Wire Straining Element

- Maximum effective flow area and maximum operating efficiency are maintained throughout service life.
- Maintenance costs are reduced drastically due to reduced clogging and stappling of fibrous material.
- Long-lived straining element provides reduced operating costs over entire service life.
- Rigid element prevents flexing which can cause premature element failure.
- Efficient, effective debris collection at media/screen interface.

Strainer Element Selection

Figure 3 - Wedge-Wire Straining Elements

Straining Element Selection

The 700 Series Straining Element (Fig. 3) is an extremely rugged, single-piece unit available in a variety of standard and custom openings and materials.

Screen opening should be selected based on the amount of protection necessary, and not on the smallest opening available. By specifying a smaller opening than needed, more debris will be retained and subsequently result in longer cleaning durations and increased backwash fluid loss. Also, smaller than necessary screen openings will reduce open screen area and increase pressure loss.

The screen opening should be approximately one-third (1/3) to one half (1/2) the largest size particle that can safely pass downstream. Example: A strainer protecting spray nozzles with a 1/16" orifice would be supplied with a 1/32" screen opening.

Straining Element Selection Guide

Slot Opening (inches)	Fraction Equivalent inches (mm.)	Mesh Equivalent	Micron Equivalent	% Open Area	Slot Opening (inches)	Fraction Equivalent inches (mm.)	Mesh Equivalent	Micron Equivalent	% Open Area
Standard					**Custom**				
0.015	1/64 (0.4)	40	385	24	0.003	- (0.08)	200	75	9
0.031*	1/32 (0.8)	20	795	40	0.006	- (0.15)	100	149	16.5
0.062*	1/16 (1.6)	10	1590	51	0.010	- (0.25)	50	250	17.5
0.125*	1/8 (3.2)	6	3205	67	0.020	- (0.5)	35	500	30
0.187	3/16 (4.8)	4	4795	72	0.040	- (1.0)	18	1000	46
					0.156	5/32 (4.0)	5	4000	69
					0.250	1/4 (6.4)	3	6410	78

* Available from stock

Standard screen material is 304 Stainless Steel.
316 Stainless Steel, 316L Stainless Steel, Monel and other materials are available upon request.

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The Hyper-Jet® Advantage

The Hyper-Jet™

The Hyper-Jet™ is the line of motorized, automatic self-cleaning strainers. It is very effective in system applications where operating pressure is low (under 5 psig) or where the debris is difficult to remove. The 721 Series strainer provides unattended service with the addition of external backwash to enhance the self-cleaning attribute over other automatic strainers.

Figure 2 - The innovative internals of the Hyper-Jet™ showing ease of maintenance.

Application:

The Hyper-Jet™'s unique patented backwash system permits installation in a broader range of applications. This range includes from relatively low pressure to very high pressure and from coarse, easily removed debris to fine, sticky debris.

In a low pressure mode (such as on the suction side of a pumping system), the Hyper-Jet™ system is mounted on the leading edge of the strainer backwash arm. External fluid is directed at an incident angle over the inside surface of the straining element through the high pressure nozzle assembly. The high velocity of this spray assists the cleaning of the straining element. **External source backwash pressure must be a minimum of 30 psi over operating pressure.**

Hyper-Jet™ strainers are used to protect equipment such as pumps, motors, heat exchangers or spray nozzles, as well as process applications such as cooling towers or virtually any similar application.

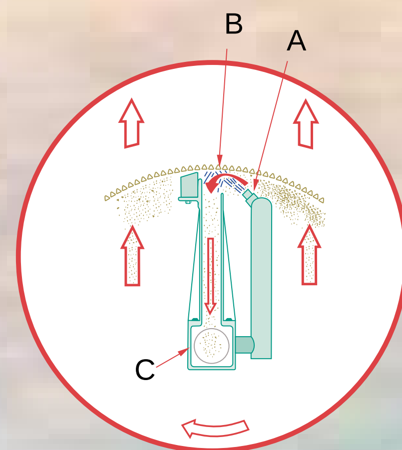
The Series 721 Hyper-Jet™ Self-Cleaning Strainers are fabricated in pipe sizes ranging from 1" to 36" to suit most applications' requirements. The Hyper-Jet™ System can also easily and economically be field installed in any Fluid Engineering Self-Cleaning Strainer (6" size and larger) in service as a retro-fit installation.

The Unique Hyper-Jet™ Advantage

The external source of backwash fluid is introduced by opening the control valve (not shown) connecting the spray nozzles (A) at the leading edge (B) of the backwash assembly.

A "Jet" spray action occurs at the straining element inside surface (see insert) in addition to the flow reversal at the port/straining element interface.

Debris is effectively removed from the full-length of the straining element by a vigorous "Hyper-Jet" fluid flow into the hollow port; down the hollow drive shaft and out the backwash outlet.



Cross-Sectional View of Port/Straining Element During Backwash Cycle

Series 721 Self-Cleaning Strainer
Typical Backwash Flow Requirement

Strainer Size	1", 1-1/2" 2" or 3"	4"	6"	8"	10/12"	14/16"	18/20"	24"	30"	36"
Backwash Line Size	1-1/2"`	1-1/2"	1-1/2"	1-1/2"	2"	3"	3"	4"	4"	6"
Backwash Flow in GPM (Gal. Per Minute)	8-12	15-20	30-40	60-75	110-150	170-210	250-310	400-490	550-700	750-900
External Backwash Source GPM	3-5	3-5	5-10	10-15	15-25	25-35	35-45	55-65	80-90	115-130
External Line Size	3/4"	3/4"	3/4"	1"	1"	1"	1-1/4"	1-1/2"	1-1/2"	2"

Specifications - Dimensions / Weight

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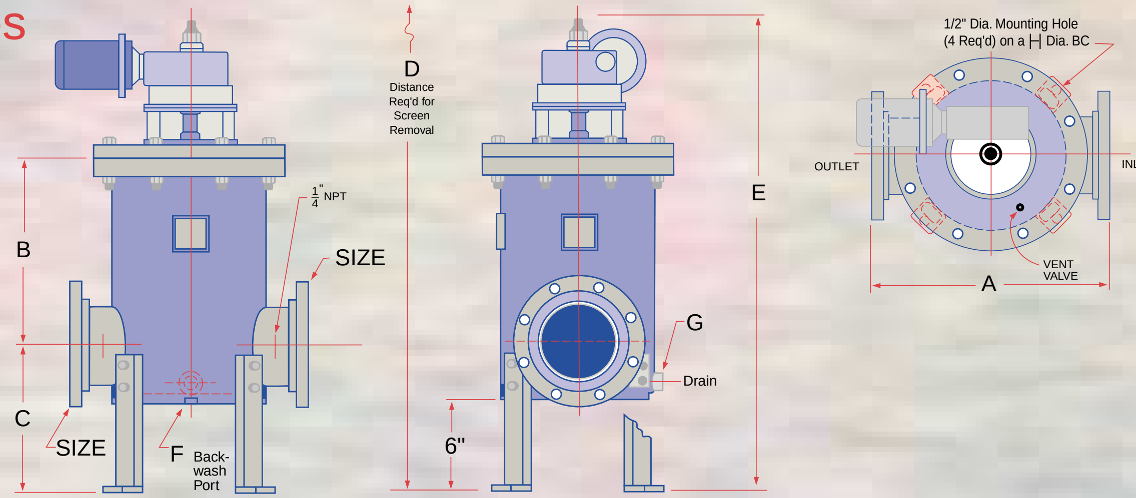
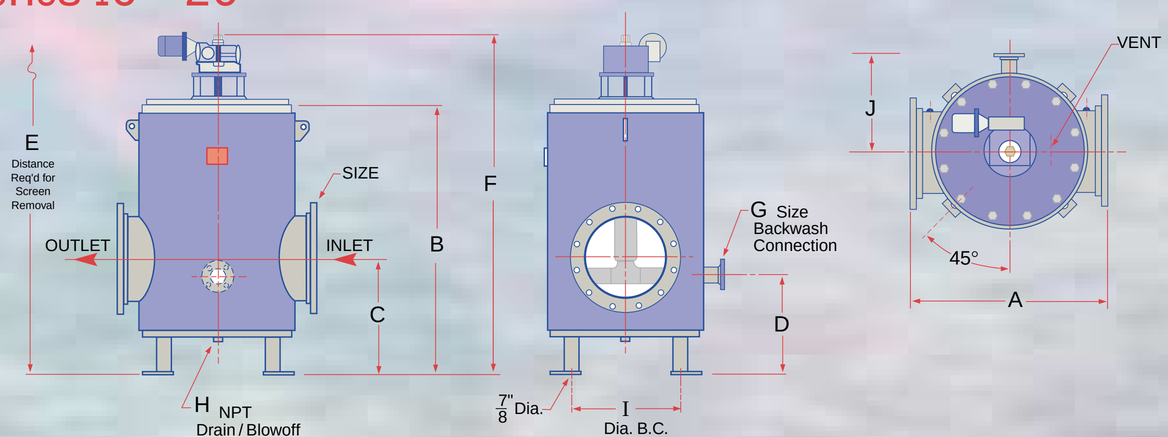
793 Series 1" -10"



Model No.	Size (In.)	A (In.)	B (In.)	C (In.)	D (In.)	E (In.)	F (In.)	G (In.)	H (In.)	Approx. Dry	Wts. Wet	Lbs. Cov.	Motor H.P.
010-793	1-150	16-1/2	14-1/4	10	53	30-1/2	1 NPT	1 NPT	11-1/4	320	466	142	1/4
015-793	1 1/2-150	16-1/2	14-1/4	10	53	30-1/2	1 NPT	1 NPT	11-1/4	323	469	142	1/4
020-793	2-150	16-1/2	14-1/4	10	53	30-1/2	1 NPT	1 NPT	11-1/4	327	473	142	1/4
025-793	2 1/2-150	16-1/2	14-1/4	10	53	30-1/2	1 NPT	1 NPT	11-1/4	336	482	142	1/4
030-793	3-150	16-1/2	14-1/4	10	53	30-1/2	1 NPT	1 NPT	11-1/4	338	484	142	1/4
040-793	4-150	16-1/2	14-1/4	10	53	30-1/2	1 NPT	1 NPT	11-1/4	348	494	142	1/4
060-793	6-150	20	15-5/8	11	58-5/8	32	1-1/2 NPT	1 NPT	15-1/2	511	700	176	1/4
080-793	8-150	28	18	16	74	41	1-1/2 NPT	1 NPT	20-3/4	797	1030	200	1/4
100-793	10-150	28	18	16	74	41	1-1/2 NPT	1 NPT	20-3/4	830	1060	200	1/4

THREADED (NPT) INLET/OUTLET CONNECTIONS AVAILABLE

723 Series 10" -20"



Model No.	Size (In.)	A (In.)	B (In.)	C (In.)	D (In.)	E (In.)	F (In.)	G (In.)	H (In.)	I (In.)	J (In.)	Approx. Dry	Wts. Wet	Lbs. Cov.	Motor H.P.
100-723	10-150	36	43	17 1/2	14 1/2	75	58 1/2	2 NPT	1 1/2 NPT	26	14 3/4	1450	2100	290	1/4
120-723	12-150	36	43	17 1/2	14 1/2	75	58 1/2	2 NPT	1 1/2 NPT	26	14 3/4	1520	2175	290	1/4
140-723	14-150	44	51 1/2	19 1/2	15 1/2	94	69	3-150	1 1/2 NPT	32	21 3/4	2375	3650	460	1/4
160-723	16-150	44	51 1/2	19 1/2	15 1/2	94	69	3-150	1 1/2 NPT	32	21 3/4	2450	3725	460	1/4
180-723	18-150	48	66	24	21	113	87	3-150	2 NPT	38	25 1/4	3290	5535	580	1/4
200-723	20-150	48	66	24	21	113	87	3-150	2 NPT	38	25 1/4	3375	5625	580	1/4

DIMENSIONS SUBJECT TO CHANGE WITHOUT NOTICE. APPLY FOR CERTIFIED DRAWINGS

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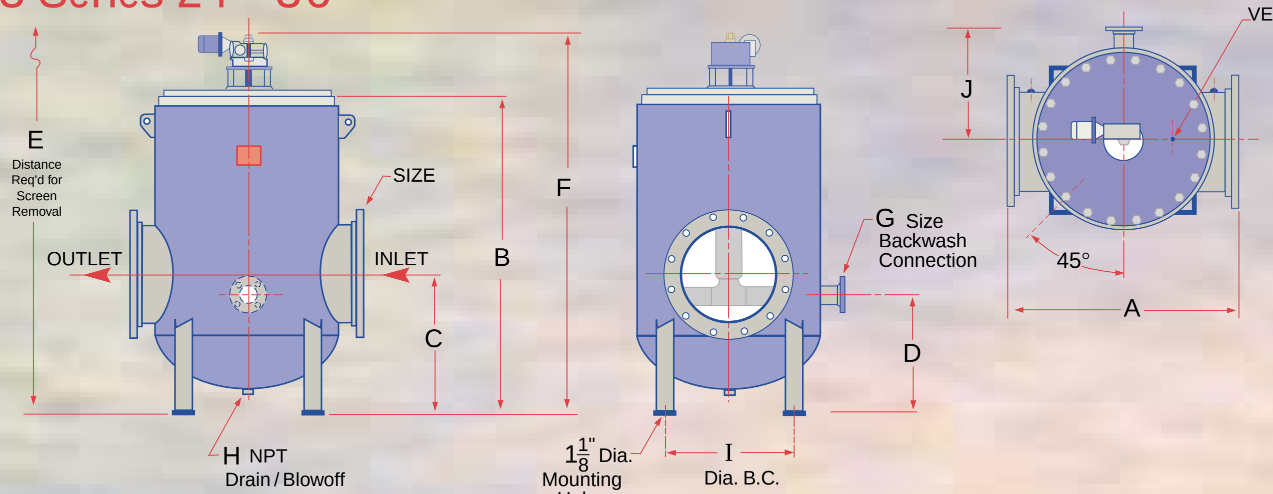
Specifications - Dimensions / Weight

723 Series 24" -36"

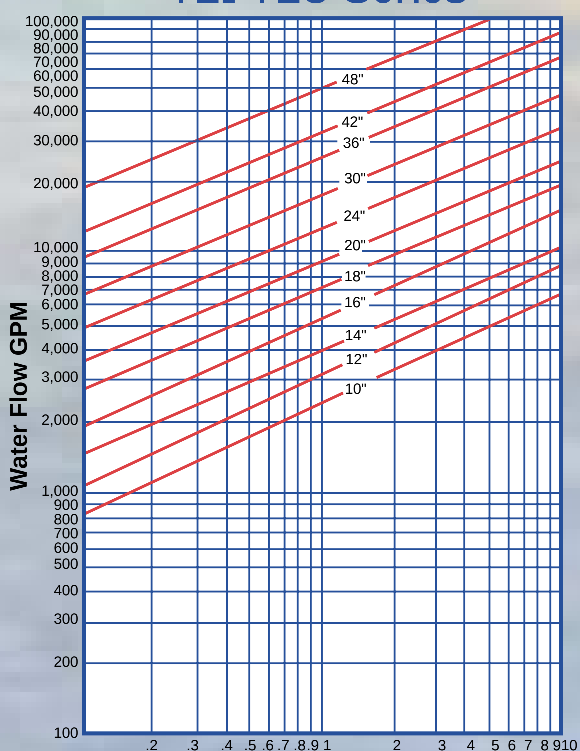


Model No.	Size (In.)	A (In.)	B (In.)	C (In.)	D (In.)	E (In.)	F (In.)	G (In.)	H (In.)	I (In.)	J (In.)	Approx. Dry	Wts. Wet	Lbs. Cov.	Motor H.P.
240-723	24-150	56	77	33	28	122	98	4-150	2 NPT	44	28	4,375	8,350	610	1/3
300-723	30-150	66	94	39	34	150	115	4-150	2 NPT	54	33	6,525	13,625	1,125	1/3
360-723	36-150	86	158-5/8	47-5/8	40-5/8	210	130	6-150	2 NPT	72	43	12,050	26,975	1,490	1/2

LARGER SIZES AVAILABLE UPON REQUEST
DIMENSIONS SUBJECT TO CHANGE WITHOUT NOTICE. APPLY FOR CERTIFIED DRAWINGS

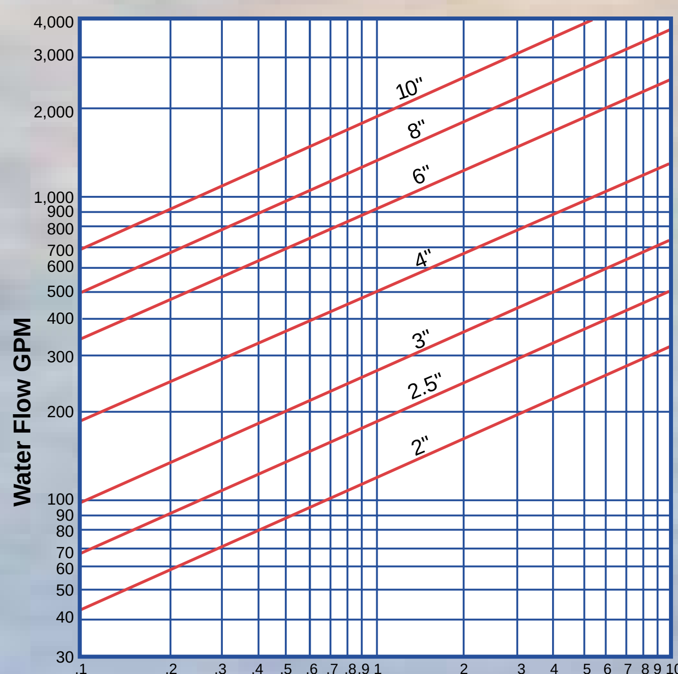
Specifications - Pressure Drop Charts

721-723 Series



Pressure Drop PSI 10"- 48"
with 1/32" or larger screen opening

793 Series



Pressure Drop PSI 2"-10"
with 1/32" or larger screen opening

Specifications and Options

Typical Strainer Specifications

The strainer shall be Series 723/793 Self-Cleaning, motorized type. (Fig. 4)

The body and cover shall be fabricated (carbon steel), designed, manufactured and tested generally to ASME Section VIII Standards, using qualified ASME Section IX welders.

Housing to be suitable for a design pressure of (150) psig. Inlet and outlet connections shall be flanged and conform to ANSI B16.5 standards. The strainer shall have a single backwash connection and large drain connections located in vessel bottom. Unit to be complete with factory supplied steel support legs for bolting to concrete or steel base.

Strainer shall be __________ size capable of handling _________________ gpm of fluid at a _________ psig pressure loss with clean straining elements.

The straining element will be manufactured from corrosion resistant (304 Stainless Steel) reverse rolled slotted wedge wire screen designed with ___________ inch openings. The wide or flat cross section of the wedge wire shall face the direction of flow providing for a continuous smooth flat surface to trap debris. The straining media shall be free of pockets, tubes, collector bars, etc. that accumulate and trap debris permanently.

All internal parts will be of corrosion resistant (304 Stainless Steel). The strainer shall be provided with drive shaft and hollow port assembly fitted with all necessary bearings and seals.

The drive arm and hollow port assembly will be free running at a maximum speed of two (2) rpm and not contact with screen surface. Port assembly shall be factory and field adjustable for positive effective cleaning and shear capability. Note: Sizes 1" thru 20" have (1) backwash hollow port. Sizes 24" and up will have (2) backwash hollow ports.

Drive shaft will be supported at the top with roller bearings located in a double reduction gear reducer and at the bottom with a water lubricated guide bearing.

The gear reducer shall be driven by a ___________hp, ___________ v, __________ Ph, 50/60 Hz, TEFC motor.

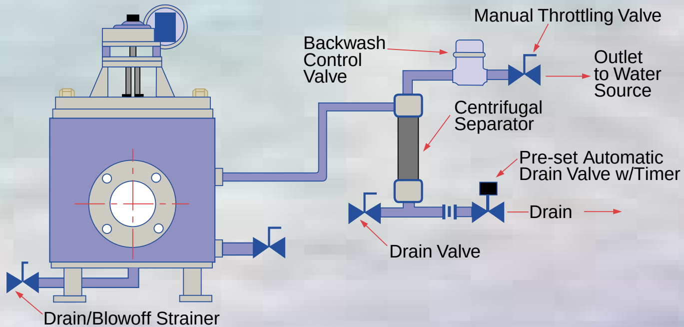


Fig. 5 - Series 723 - Water Saver Package

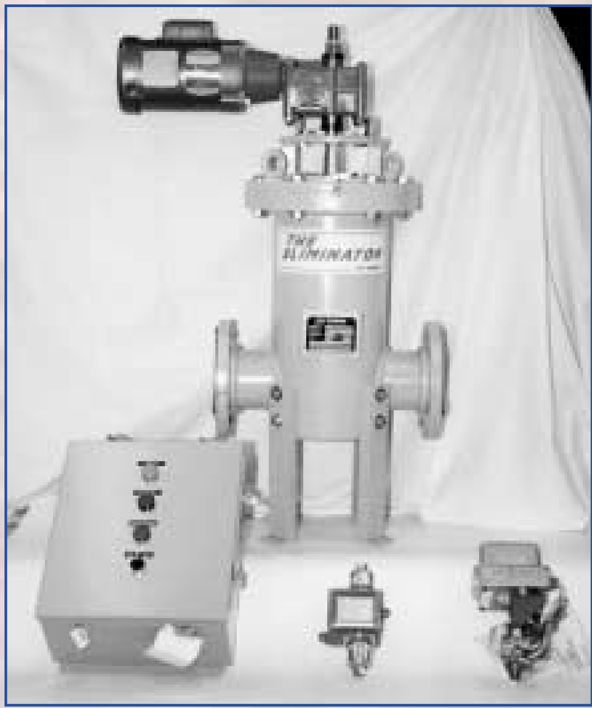


Fig. 4

Strainer Options Available

Cover Lift Assemblies - Recommended for remote locations.

ASME - ASME Section VIII and Code stamped.

Materials of Construction - Consult factory for stainless steel, copper, nickel, monel, or other requirements.

Control Package - Control Panel with Nema 4 Enclosure, Backwash Valve with Electric Operator, Single Element Differential Pressure Switch.

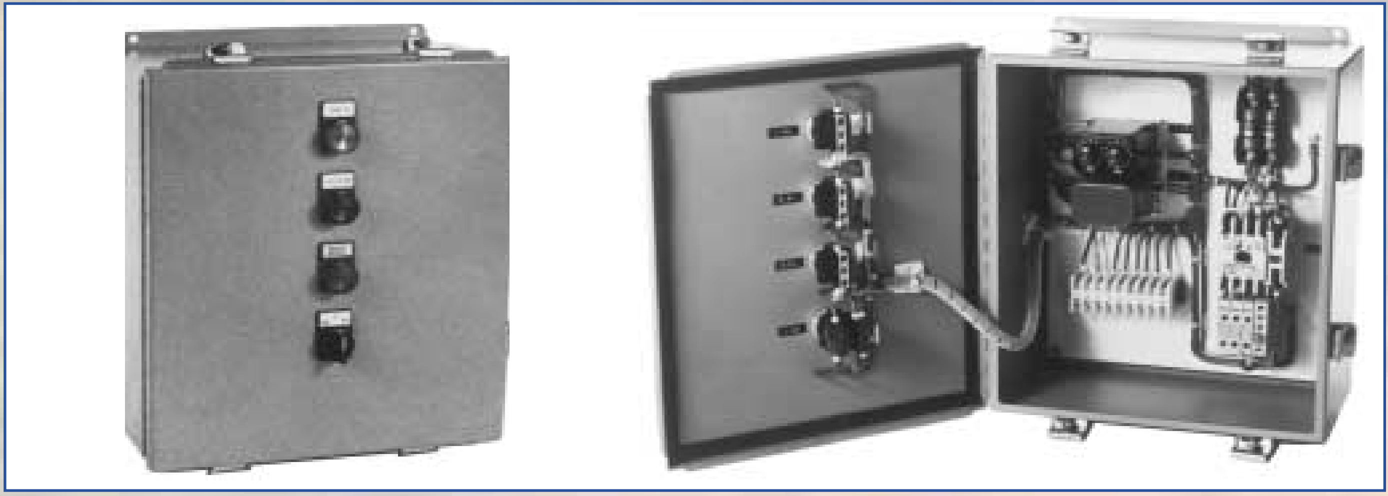
Design - High Pressure applications - Consult factory.

Hyper-Jet - Low Pressure and Special Application.

Skid Packages - All equipment desired, including strainers, valves, controls, wiring, piping and skids may be combined as a complete, custom package. Size of the project has no limitation.

Water Saver Package - The Water Saver Package (Fig. 5) can be used on most applications where the strained liquid is scarce or valuable. The strainer backwash fluid is directed to a centrifugal separator where only a fraction of the strainer backwash is discharged to waste. The separator backwash can be manually operated and/or automated with a pre-set timer controlled valve.

Sequence Controller



Design and Construction

The Sequence Controller is designed with the Customers' specific requirements in mind. The Sequence Controller provides an automatic, effective backwashing cycle with a minimum loss of water.

The Sequence Controllers are constructed with state-of-the-art industrial type components which permits replacing individual components without having to replace an entire circuit board. The industrial type components are more durable and reliable and adjustments can be made with ease.

Standard Features

- Enclosure - Nema 4
- Adjustable Cycle Timer
- Off-delay Timer
- Motor Starters with Auxiliary contact and overload relay
- Selector Switch
- Indicating Lights
- Fuses
- Terminal Block

Modes of Operation

There are basically two modes of operation - intermittent and continuous. By turning the selector switch, the mode of operation can be selected.

Automatic Intermittent Position

With the selector in the "Auto" position, the drive motor will start and the backwash valve opens as determined by the adjustable cycle timer or by the differential pressure switch.

The differential pressure switch is normally factory set at 1 - 1-1/2 psig over the anticipated clean pressure drop. Should a high differential pressure occur during the timed off period, the differential pressure switch will override the cycle timer and start or continue the backwash until the differential pressure is satisfied. After the differential pressure has been satisfied, the strainer will continue to backwash for an additional 60 seconds (time delay relay).

The Automatic Self-Cleaning Strainer would start a backwash cycle based on the timed sequence selected on the adjustable cycle timer. The timed sequence should be determined by each installation and the conditions experienced. The adjustable cycle timer can be programmed from 15 minutes to a 10-hour cycle (off) and for 1 to 10 minutes duration (on). Adjustments can be made as conditions warrant them.

Continuous Operation

The selector switch is adjusted to "Manual" thus permitting the continuous mode. In the continuous mode, the Automatic Self-Cleaning Strainer will be backwashing continuously with the backwash valve open and the drive motor running. This mode of operation may be necessary if the installation experiences high solid loadings.

In either Mode of Operation, the backwash assembly is specifically designed to rotate at 2 RPM to allow for effective backwashing in less time, thus decreasing the amount of backwash water lost.

Standard Control Package

The Sequence Controller Control Package consists of:

- Control Panel with Nema 4 Enclosure
- Backwash Valve with Electric Operator
- Single Element Differential Pressure Switch

Options

- 230V, 380V, 460V, 575V
- 50 or 60 hertz
- Dual Element Differential Pressure Switch
- Nema 4X (Fiberglass or Stainless Steel), Nema 7 or 9 (Explosion Proof), Nema 12, Nema 3 Enclosures
- Circuit Breakers, Disconnect Switch, Transformer
- Reset Buttons
- Alarms
- PLC Interface and/or Pump Interlock
- Extra Contact and Relays
- Backwash valve can be supplied with Pneumatic Operator
- Backwash Valve available in numerous materials
- Differential Pressure Switches available with Mercury, Snap Action, Diaphragm or piston contacts.

Codes/Standards

The Sequence Controller can be manufactured to UL Listings, CSA Approval, JIC, NEMA Standards.

Sure Flow Equipment Inc. – Limited Warranty

All products are warranted to be free of defects in material and workmanship for a period of one year from the date of shipment, subject to below. **All custom products are not subject to return, credit or refund.**

If the purchaser believes a product to be defective, the purchaser shall:

(a) Notify the manufacturer **within ten(10) days after receipt of merchandise**, state the alleged defect and request permission to return the product. Merchandise will not be accepted for return without a "Return Code" clearly marked on the outside of the package. Contact the office to obtain a return code. **Merchandise will not be accepted for return or credit later than six (6) months after invoicing.**

(b) If permission is given, return the product with the transportation prepaid. Collect shipments will not be accepted. Goods must be returned **prepaid.**

If a shipment is received in a damaged or deficient condition, a claim must be filed with the delivering carrier and noted on the freight bill before you accept the merchandise. All other claims must be made in writing and received by Sure Flow Equipment Inc. within ten (10) days after receipt of merchandise.

If the product is accepted for return and found to be defective, the manufacturer will, at its discretion, either repair or replace the product, F.O.B. factory, within 60 days of receipt, or issue credit for the purchase price.

Sure Flow Equipment Inc. shall not be liable for failure to deliver or delays in delivering occasioned by acts of God, war, labor difficulties, inability to obtain materials or any other causes whatsoever beyond our control.

Other than to repair, replace or credit as described above, purchaser agrees that manufacturer shall not be liable for any loss, costs, expenses, or damages of any kind arising out of the product, its use, installation or replacements, labeling, instructions, information or technical data of any kind, description of product use, sample or model, warnings or lack of any of the foregoing.

NO OTHER WARRANTIES, WRITTEN OR ORAL, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, ARE MADE OR AUTHORIZED. NO AFFIRMATION OF ACT, PROMISE, DESCRIPTION OF PRODUCT OR USE OR SAMPLE OR MODEL SHALL CREATE ANY WARRANTY FROM MANUFACTURER, UNLESS SIGNED BY THE PRESIDENT OF MANUFACTURER.

CANCELLATIONS: **Cancelled orders will be subject to a charge of at least 35%.**
Cancelled custom orders will be subject to a charge of 100% of quoted price.

MINIMUM BILLING: $50.00 NET

SPECIAL DOCUMENTATION: A charge will apply for non-standard, special documentation requests such as Material Test Reports (MTR's) and Certificates of Conformance (COC's).

Catalogs Available from Sure Flow Equipment