Bristol
ENGINEERING
SERVICES COMPANY, LLC

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Site Inspection Trip Report
Native Village of Kongiganak, Water Treatment Plant
Existing Piling Assessment

This trip report summarizes a site visit completed August 11th and 12th, 2021, to Kongiganak, AK. Findings from this report will be incorporated into a Design Analysis Report (DAR) detailing reuse of existing piling that remain from the former 572,000-gallon water tank that was demolished in 2008.

ITINERARY

REPORT DATE:	Tuesday September 08, 2021 - FINAL
INSPECTION DATE:	Wednesday August 11 – Thursday August 12, 2021
PROJECT:	Kongiganak WTP / Washeteria, Bristol # 32190078
LOCATION:	Kongiganak, AK
VSW PROJECT LEAD:	Susan Randlett, PE, VSW
PERFORMED BY:	Richard Mitchells, PE; Kraig Hughes, PE, SE, PLS
OTHERS PRESENT	Joseph Mute <tribal chief>; Sigfrid Kaufman sigskimo@yahoo.com (907) 557-2208 20-year resident of Kong; Roderick Phillip Kong6@gmail.com (907) 557-2121 Powerplant and ADOT contact
WEATHER:	Partly cloudy, 55 °

Wednesday 11 August 2021

09:07 am Arrive at Anchorage International Airport.
10:35 am Depart Anchorage for Bethel on AK Air.
1:30 pm Depart Bethel on Grant Aviation.
1:55 pm Arrive Kongiganak
2:00–8:00pm Field Inspections

Thursday 12 August 2021

8:00 am–6:00 pm Field Inspections
06:10 pm Leave Kongiganak Grant Aviation
06:55 pm Arrive Bethel, proceed to AK Air Terminal
08:55 pm Leave Bethel AK Air
10:59 pm Depart Anchorage International Airport Parking Terminal

SCOPE

Bristol Engineering Services Company, LLC (Bristol) was contracted through the State of Alaska, Village Safe Water Program (VSW) to develop a design for needed upgrades to the Water Treatment Plant (WTP) and Washeteria serving the Native Village of Kongiganak. This site inspection was conducted specifically to evaluate the existing 88 wooden piling that served as the foundation for the 572,000-gallon water storage tank that was demolished in 2008. The purpose was to evaluate the piling for reuse in supporting the new water treatment tanks, decking, and supporting structure.

TRAVEL

The team arrived in Bethel as indicated above, and then proceeded directly to the Grant terminal for the flight to Kongiganak. We met Joseph Mute (Native Village of Kongiganak Tribal Chief) once in Kongiganak to obtain prearranged lodging in the Washeteria lodging facility. The room was occupied by a team from ADEC and therefore Kraig stayed in the WTP lodging room on the first floor.

Kraig and Rick evaluated the condition of the piling, taking measurements, observing their individual conditions and having discussions with local residents to assess the piling performance. Once complete, the team returned to Bethel the following afternoon and back to Anchorage that evening.

INSPECTION

The following findings address the piling conditions and specifically their ability to serve as a foundation for a new deck to support two 40,000-gallon water storage tanks and an additional building structure as shown in **Appendix C**. Photos of the inspection are found in **Appendix B**. The supporting geotechnical technical memorandum from Richard Mitchells, PE with Golder is found in **Appendix A**. In addition to assessing the piling, observations were made on where the walkway from the second floor of the WTP can easily enter the building.

Piling Construction and Capacity History

The existing 88 circular 55-foot diameter, wooden piling grid configuration located approximately 40 feet east of the Water Treatment Plant (WTP) main building and Washeteria and approximately 20 feet north of the existing water storage tank were visually inspected for structural integrity, alignment, spacing, plumbness and relative levelness. Although obvious, only the visible, above grade portion of each pile was inspected. It is important to keep in mind that these piling have served in their current location since approximately 1981, some forty years ago (QUADRA ENGINEERING, INC, NOVEMEBER 1981). The intent of the original design was a 30-year life.

The piling were originally set in a predrilled hole to a reported depth of approximately 23 to 28 feet below the surface. According to the report, some perimeter piles were embedded shallower than field piles. The piling were held firm in place via a silt/water backfill slurry placed against the piling and the predrilled hole annular space. The actual makeup of the slurry was not clearly identified, nor the means to densify the slurry during placement. This slurry became frozen in the surrounding permafrost sub-surface soils. Prior to placement, the piles were reportedly fitted with 17-inch diameter end bearing plates to provide for an original pile capacity of 63 kips each. There is no discussion of safety factor for this pile capacity value. Initial consideration of settlement in the range of up to one-half inch per year was assumed, according to the QUADRA report (pg. 7). The complete QUADRA Report can be found in **Appendix D**. No construction drawings have been obtained from the original project. The tank was decommissioned and removed in 2008.

Discussions with Joe Mute during the site inspection provided that the piling were actually constructed from redwood. If the piles are Redwood, it has relatively high mechanical properties, medium weight, low shrinkage, ease of working, and high resistance to decay. Photo 24 shows bark from the pile, removed during the site inspection. Although not definitive, a comparison with known redwood bark images supports that the pile are redwood. A comparison of National Design Specifications for Wood Construction design values for multiple species can be found in **Appendix E**, and shows that redwood has comparable values with other more common species used in Alaska..

Piling Capacity and General Assessment

The piles are in relatively good condition, considering their age. Their relative alignment is acceptable in the north-south alignment, not as uniform in the east-west direction. Piling shows no signs of decay or rot at the time of inspection. The top relative levelness of the piling is not good, with some piling showing obvious signs of frost jacking (presumably since the tank was removed in 2008). The capacity of the piling is more governed by the deteriorating soil conditions (see Appendix A) than the sizing and placement of the piling. The piles are in an approximately 5.5-foot spacing pattern having a tributary area of approximately 30.25 square feet (SF). The piles are acceptably plumb, but have individually moved some since their original placement. Accumulation of water around the piling was noted, especially on the south and west side of the pile group, and to depths as great as two feet deep.

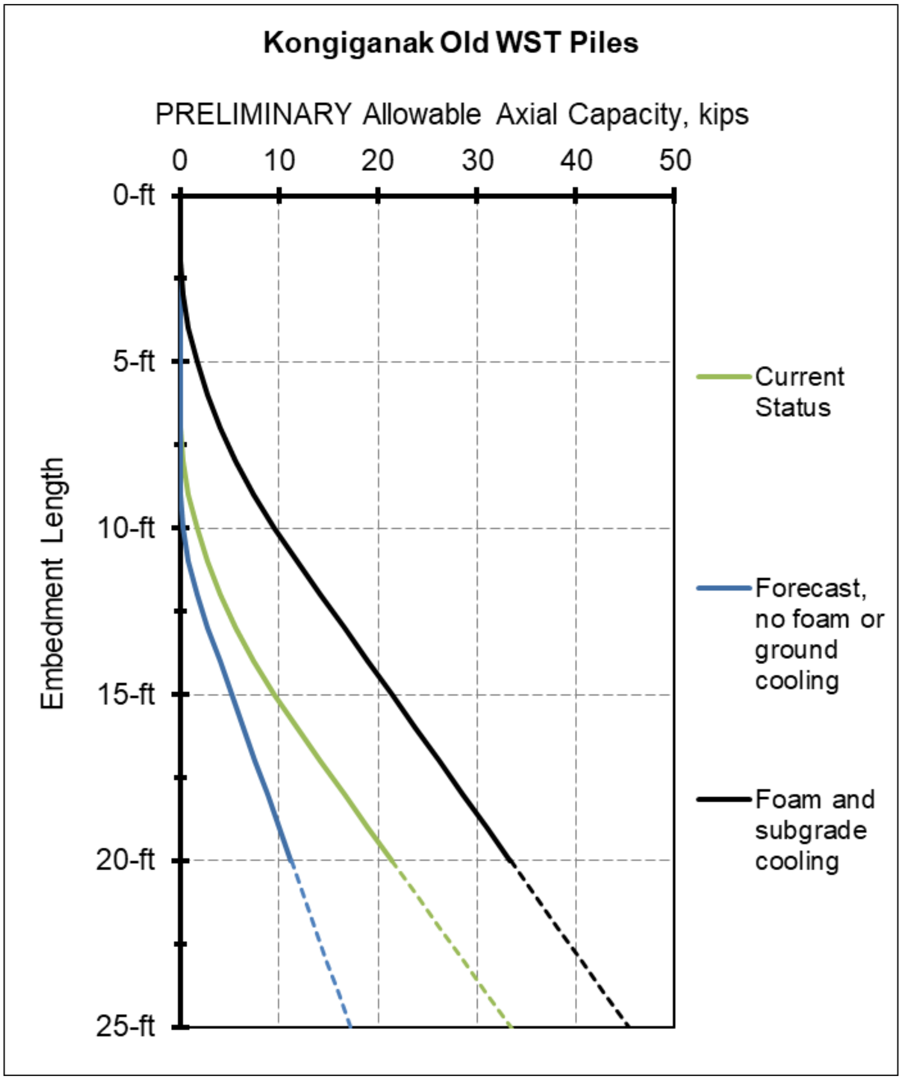

TABLE 1.0 PILE CAPACITY CURVES

While the original intent of the inspection and analysis was to determine capacity for two 40,000-gallon tanks with tank heights of 17 feet, and 20-foot diameters, this analysis resulted in a loading that exceeded the projected capacity of the piling at an assumed 20-foot embedment (conservative). See Appendix A. It is assumed that this tank configuration would weigh approximately 19,000 lbs (60 psf) and the water load will be 1,061 psf for a total/tributary area of 35,413 pounds. After a flat loop cooling system and surface insulation is added around the piling, the estimated capacity for each pile will be approximately 33 kips – see Table 1.0 above.

Discussions with the design team for this project allowed for adjustment of the tank capacity and adjustment of their sizing. The new tanks will be 22 feet in diameter and 12 feet high, having a capacity of approximately 34,100 gallons. The resulting load, including the estimated 18,000-pound tank is approximately 26 kips/pile, providing for a 1.27 safety factor above the allowable pile capacity after improvements have successfully been accomplished (subgrade passive cooling system and insulation). The pile capacity curves have an intrinsic geotechnical factor of safety of 2.0.

Snow loading in the area has been ignored, due to the pile capacity actually increasing in the winter months and therefore cancelling out the extra load during winter. It is assumed that the piling that have jacked will likely settle to their original elevation after loads are reintroduced. The amount of settlement and duration over which they may settle are unknown. Consideration for pile height adjustments over time should be incorporated into the deck design, along with an accurate level survey and establishment of a well-defined and stable benchmark. The piling will require the top surfaces to be adjusted to provide an initial uniform level from which to start construction.

CONCLUSION

It is believed that the existing wooden pilling can be used to support a deck that supports two 34,100-gallon water tanks and a small structure to house water treatment equipment, provided appropriate site improvements are completed, including providing adequate drainage and backfill of low-lying areas, adding passive subgrade cooling and rigid insulation at the ground level. Initial relative leveling will be required at time of deck construction and after a thorough and accurate level survey is completed. Regardless, the area will require subgrade cooling and insulation in accordance with recommendations provided by Golder Associates for these piling to be used for anything structural in the future. Furthermore, the maximum remaining design life for the new deck on existing piling is estimated to be 20 to 25 years with adequate consideration for vertical adjustment incorporated in the deck design. Review of the technical memorandum in Appendix A should also be completed, and is made part of this trip report.

While on site, I inspected the temporary bracing under the Water Treatment Plant that was placed in 2020 to provide a safe load path for the vessels on the second floor to be supported to ground. There is a three-inch gap between the top of the dunnage support and the bottom of the floor facia under the building – see photos 22 and 23. The dunnage was placed in the winter and it should be monitored in the winter to see if the gap closes in winter conditions. We don't want to shim this in summer to have it push the floor system up in winter if the soils are dynamic. If, during the winter, it is found that the gap persists, then adequate shimming should be installed.

APPENDIX A – TECHNICAL MEMORANDUM FROM RICHARD MITCHELLS, PE (9/08/21)
APPENDIX B – PHOTO LOG
APPENDIX C – REVISED DECK LAYOUT
APPENDIX D - QUADRA Report – NOVEMBER 1981
APPENDIX E – NATIONAL DESIGN SPECIFICATIONS FOR WOOD CONSTRUCTION–TABLE 4A

END OF REPORT

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APPENDIX A – TECHNICAL MEMORANDUM FROM RICHARD MITCHELLS, PE (9/08/21)

TECHNICAL MEMORANDUM

DATE September 08, 2021 19125467

TO Kraig Hughes, PE, SE, PLS
Bristol Engineering Services Company

CC Vanessa Wike, PE (BESC)

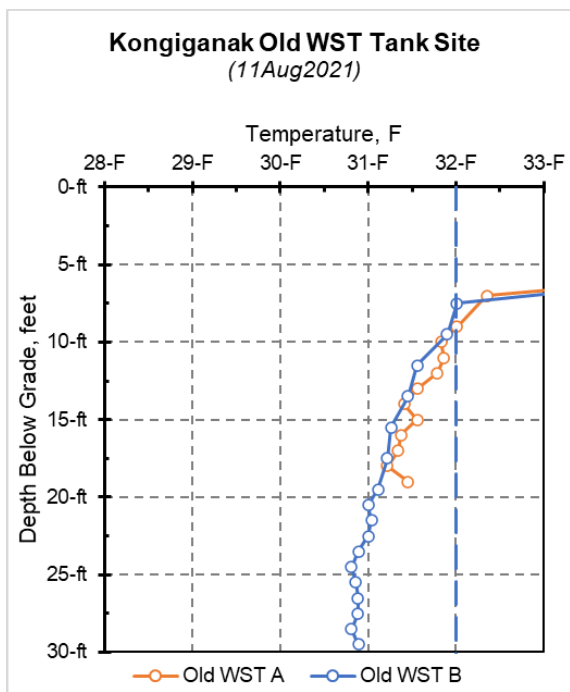
FROM Richard Mitchells, PE **EMAIL rmitchells@golder.com**

KONGIGANAK FORMER WST FOUNDATION PILES, AUGUST 2021 RECONNAISSANCE SUMMARY

Kraig:

I have reviewed our August 11-12, 2021 field reconnaissance findings related to the former Water Storage Tank (WST) foundation piles for planned reuse as load bearing elements. You and I conducted a visual assessment of the existing timber piles, measured ground temperatures in PVC standpipes previously installed along select timber foundation piles, and measured general pile layout using a cloth tape. You requested I develop my opinion on the allowable axial capacity for these existing timber piles using the original design or as-built data developed by QUADRA and our recent field findings.

The observed above grade portions of existing timber piles appear to be in reasonable shape for their age. The piles are round timber with an expected taper that widens to the embedded base of the pile. The existing piles are about 40 years old, well in excess of the originally intended geotechnical service life, assumed to be abut 20 years. The former WST was demolished and removed. Currently, the piles do not have any former WST pile caps or above grade structural elements.



Measured ground temperatures measured during our August reconnaissance along select existing foundation piles are summarized in the adjacent plot. Based on our review of the original QUADRA design data, the August measured ground temperatures are about 2 to 3°F warmer than the ground temperatures reported by QUADRA in the late 1970's and about 0.5°F warmer than the design ground temperatures used in early 1980's by QUADRA for their pile capacity analysis. Based on our August 2021 field findings, the permafrost temperatures at depth have increased about 0.5°F and the depth of seasonal thaw has advanced deeper than the baseline design used by QUADRA.

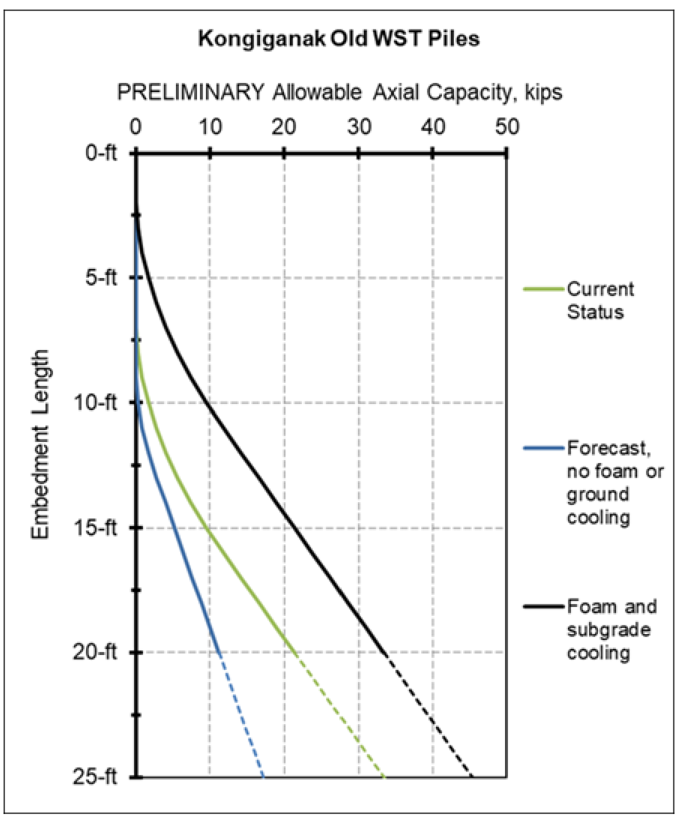
Golder Associates Inc.
2121 Abbott Road, Suite 100 Anchorage, Alaska, USA 99507 T: +1 907 344-6001 +1 907 344-6011

For preliminary adfreeze pile capacities for your planning I assumed an average 14-inch nominal diameter timber piles with silt cuttings used for slurry backfill. I did not include any end bearing contribution, but there is probably some end bearing contribution. I also assumed 20 foot pile embedment. However, the QUADRA report indicates deeper pile embedment, possibly to 28 feet, may have been used. We do not have reliable as-built records to verify the current pile embedment depths. The adjacent Water Treatment Plant (WTP) foundation records indicate 25 foot total embedment for those piles. For a conservative design approach, I applied a 20 foot embedment for the former WST piles but for planning purposes noted the incremental allowable axial capacities for deeper embedment similar to the WST pile foundations. Please note, the attached allowable capacities include a geotechnical Factor of Safety of 2.

In addition, I applied my estimated ground thermal impacts for a 20 year forecast based on historic trends and forecast air temperature warming trends for the area. However, I advise using these estimated allowable capacities with caution as climate impacts in Kong are rapidly accelerating.

There is evidence of possible frost heave on a few piles along the western side of the existing pile footprint. Numerous existing piles have deep thaw and subsidence of the slurry around the piles that will need to be properly filled. Also, about 50-percent of the pile footprint area has standing water, some areas over 1 foot deep at the time of our August reconnaissance. This surface water must be removed from the site with the earthwork improvements for my allowable capacities note below. Based on the planned new water storage tank configuration on the site, the currently proposed new tank locations appear to be located in a slightly elevated terrain area that had less standing water when Kraig and I were on-site.

Please consider the below allowable capacities as preliminary for your initial planning and design approach.



APPENDIX B – PHOTO LOG

 2 – looking west	 3 - looking southeast

4 – looking westerly

5 – Looking south

6 – east wall of WTP

7 – walkway btwn WTP & Washeteria

8 - Looking west

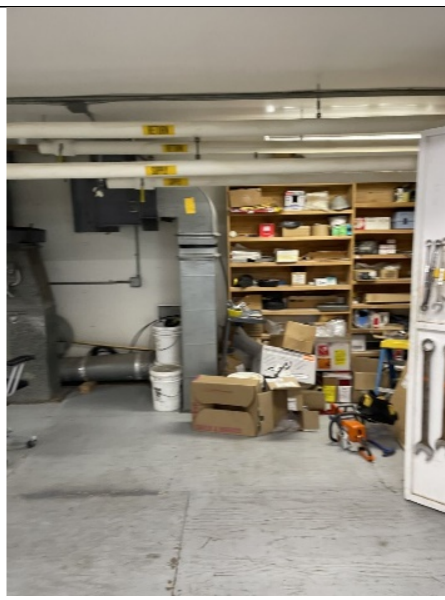
9 – looking west

10 – looking north – east side

11 – looking northeastly

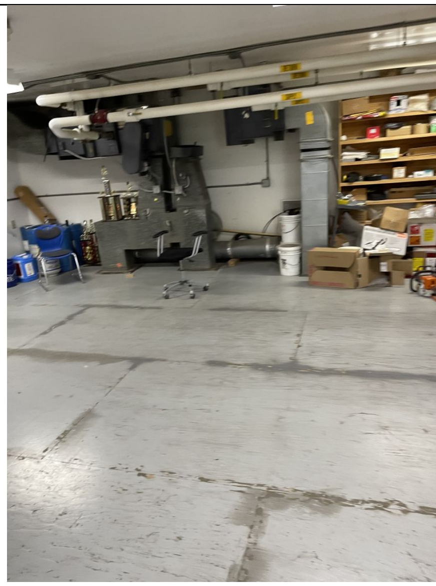
12 – looking northeasterly

13 – Rick Mitchells, PE



14 – WTP second floor, entrance location

15 – WTP second floor east wall



16 – WTP Entrance location

17 – WTP Entrance Location

18 – Jacked pile

19 – Water Storage Tank

20 – measurements on piling

21 – bobcat on boardroad

22 - Temp. Support under vessels – 3 inches low

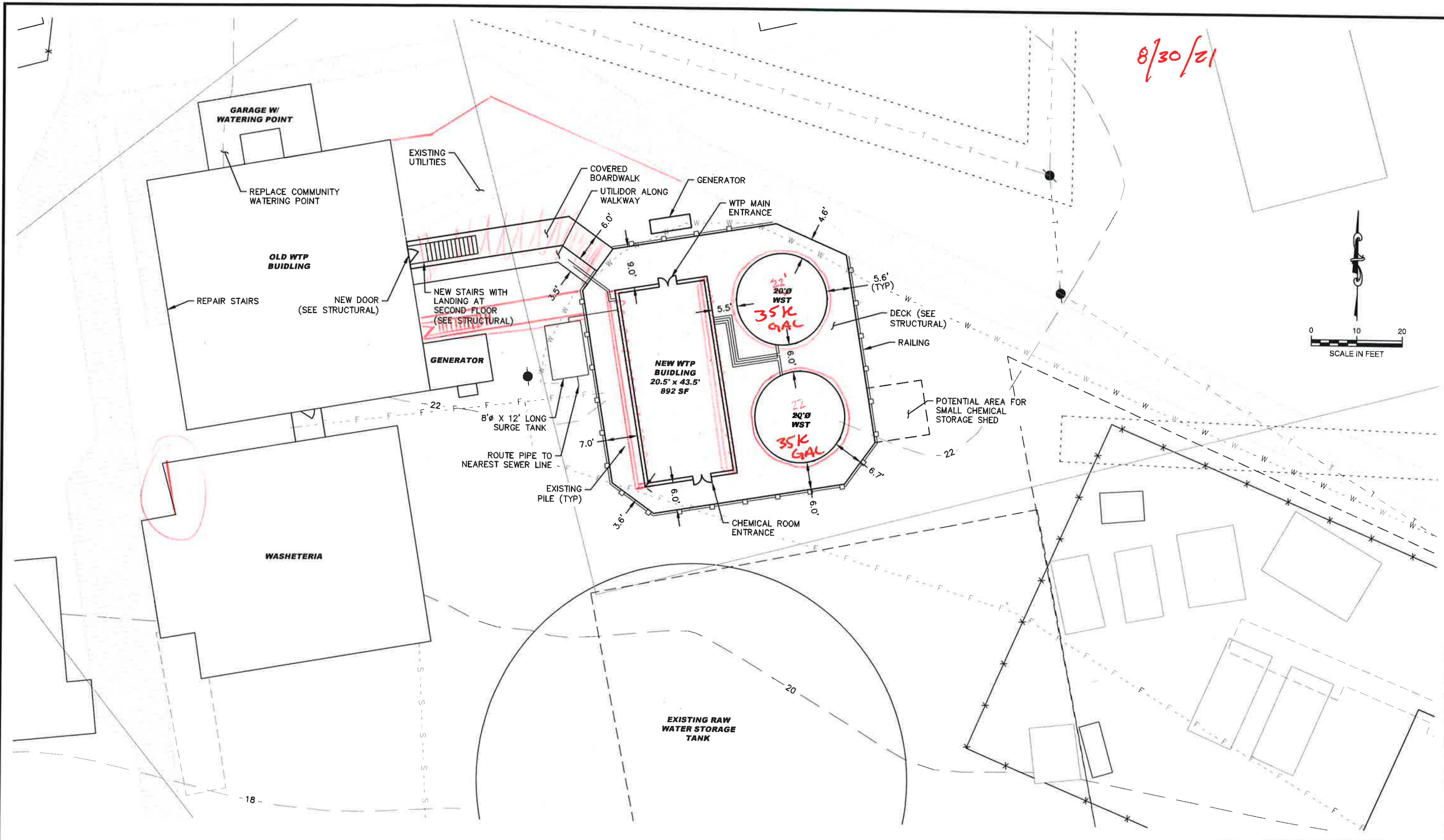
23, Dunnage Support for temporary support under vessel

24 Bark from pile - redwood

25 existing well on north side of 1.2 MM gallon water tank.

END OF PHOTOS

APPENDIX C – REVISED DECK LAYOUT



35% PRELIMINARY DESIGN

REVISIONS			
NO.	DATE	BY	DESCRIPTION

REVISIONS			
NO.	DATE	BY	DESCRIPTION

Project No. 32190078
AECC No. 697

Bristol ENGINEERING SERVICES COMPANY, LLC
Phone (907) 563-0013 Fax (907) 563-6713

VILLAGE SAFE WATER

NOT FOR CONSTRUCTION

KONGIGANAK WATER TREATMENT PLANT
KONGIGANAK, ALASKA

SITE PLAN

SHEET NO.
C-301

SCALE: SHOWN | DESIGNED: JDW | CHECKED: VBW | DRAWN: JDW | DATE: MAR 2021 | SHEET X OF X

User: JWANDER Mar 17, 2021 – 1:22pm Layout: C-301
Drawing: K:\JOBS\32190078_KONGIGANAK VSW\ACAD-DESIGN\DAR PHASE II\32190078_KONG_C-301_SITE PLAN.DWG
Xrefs: BR22X34REV.DWG KONGIGANAK_NAD_83.DWG KONGIGANAK_100.DWG – Images: KONG_1FT.TIF KONG_2FT.TIF

APPENDIX D - QUADRA Report – NOVEMBER 1981

DESIGN REPORT

WATER SUPPLY AND STORAGE
PROJECT

KONGIGANAK VSW FACILITY

KONGIGANAK, ALASKA

Prepared By
QUADRA Engineering, Inc.
November, 1981

CONTENTS

INTRODUCTION

In May of 1981, QUADRA Engineering was retained by the Village Safe Water (VSW) program, a division of the Alaska Department of Environmental Conservation, to design improvements for the previously constructed public laundry facility in Kongiganak, Alaska. The improvements desired included: 1) selection of a surface water source appropriate for operation of the facility, 2) selection of a preferred routing for a VSW designed raw water transmission line from the selected water source, 3) design of a foundation and structural deck system for a VSW selected 572,000 gallon water storage tank, 4) design of modifications to the existing water treatment system to accomplish treatment of raw water from the selected water source, and 5) design of miscellaneous electrical and mechanical modifications within the existing laundry facility to facilitate ease of operation.

The intent of the proposed project was to mitigate water supply and treatment difficulties which had continually plagued the facility since it was opened for public use in late 1978. The original water supply and treatment design utilized a well, located several hundred feet from the facility. The raw water from this well was high in several objectionable contaminants, notably total dissolved solids, and elaborate, sophisticated treatment was required to produce potable water.

In July of 1977, the barge carrying project construction materials from Anchorage to Kongiganak encountered rough weather in Bristol

Bay, and ultimately sank with the loss of all project materials. At this point further consideration was given to the intended water source and treatment, with the ultimate decision to abandon the well, and instead utilize water from the river fronting the village. The water treatment design was modified to accomplish treatment of the river water, but was never completely successful in actual operation. While excellent quality water could be produced during certain times of the year, high total dissolved solids and/or suspended organic loading rendered the treatment system ineffective at other times of the year.

With the recognition that neither the well nor the river was a long term acceptable water source, VSW secured an appropriation of $480,000 during the 1981 Alaska legislative session. This appropriation was the funding available for the water supply improvement project herein described. Early in the design process, QUADRA Engineering realized that the appropriation secured was insufficient to construct the project within the parameters established by VSW, and VSW was so advised in August of 1981.

With the foundation design complete, and the remainder of the design essentially complete, the majority of required construction materials were purchased in August of 1981 and delivered to Bethel on the last barge of the surface transportation season. Upon arrival in Bethel, project materials were offloaded and reloaded onto a local barge which was chartered from Bethel to Kongiganak. As of this writing all materials are located on the river bank, to be moved to the construction site after complete freezeup, at which time the pile foundation will be drilled in place. QUADRA Engineering has been retained to provide construction management for installation of the pile foundation, erection of the structural deck, and installation of the raw water transmission line. The work which remains thereafter may be managed by QUADRA or internally by VSW, depending on the severity of budget limitations. The decision on future required project management activities has not been made as of this writing.

SITE SOILS AND THERMAL CONDITIONS

The investigations done for the existing VSW Facility and State school show that the area considered for the water storage tank is composed of fine grained delta deposits. These soils are typically peats, organic silts, silts, fine sands, and clayey silts. The VSW Facility, which is the closest to the proposed tank location, has the following soil profile:

0- 4 feet	Peat, 50% visible ice	(pt)
4- 8 feet	Organic silt, 30% visible ice	(ol)
8-12 feet	Silt with some organic, 20% visible ice	(ml)
12-20 feet	Grey green silt with some clay, no visible ice, 40% w/c	(cl-ml)
20 feet	Brown silt with some clay trace organic, no visible ice, 35% w/c	(ml)

Permafrost appears to be continuous in the vicinty of the village. All borings in the area encountered frozen ground at a depth of up to three-feet in late fall. All of the piling installed for the VSW Facility had ABS tubes embedded so that temperature readings could be obtained using thermistor strings. Several readings were taken in 1976 and 1977. This data is shown on the As-Built drawing for the VSW facility, Sheet S-1, a copy of which is included in the Appendix. In May of 1981, additional readings were taken to determine if the existence of the facility had modified the ground temperatures to any significant extent. This data is also included in the Appendix, and is plotted on Figure 1.

Analysis of the data shows that the mean annual soil surface temperature, as indicated by readings below 20-feet, was 29 degrees Fahrenheit in 1976-1977. Readings taken in May of 1981 show an average of 29.7 degrees Fahrenheit.

PRELIMINARY FOUNDATION DESIGN

DESIGN PARAMETERS

Based on an analysis of the data available, the following conditions were established for design:

Soil Profile

Similar to that shown at the VSW Facility. See Site Soils And Thermal Conditions.

Thermal Profile

Assume three foot active layer, temperature decreases from 32 degrees Fahrenheit at three feet, to 30.5 degrees Fahrenheit at 23 feet. See Figure 1.

Design Loads

Tank - 55 feet diameter x 33 feet 3 inches high

Tank Weight - 93,000 lbs.

Storage - 572,000 gallons @ 8.35 lb/gal = 4,776,000 lbs.

Snow Load = 40 PSF

Wind Load = 8 PSF

DESIGN OPTIONS

A timber mat foundation was considered, but rejected, due to the considerable settlement which would occur as the warm tank melted the permafrost. A refrigerated mat foundation was also considered, but rejected also, since it would require some maintenance and would use considerable high cost energy. A pile foundation was selected as being able to provide the stability required, at a cost which appeared to be realistic, given funding limitations.

PRELIMINARY FOUNDATION LAYOUT

The basic pre-layout was dictated primarily by the maximum pile capacity which could be obtained. Equipment which is available in the area could only drill to approximately 28 feet. Using this limit and the design procedure recommended by F.J. Sanger in "Foundations of Structures in Cold Regions", CRREL monograph 111-C4, a maximum pile capacity of 60 kips was used. This design required that a clean sand/water slurry be used to backfill the annular space between the pile and the hole. This lead to a grid of 5 feet by 6 feet for the piles, since the total deck load was 2 KSF. Based on a 56 foot square deck, 119 piles would be required.

A cost estimate of this design was done and it was determined that it could not be built within the project budget. A major cost would be involved in shipping 215,000 lbs. of sand from Bethel to Kongiganak, since there is not a source available locally. This had been done for the VSW Facility, as well as for the school. A cost was obtained from Erv Long, of Arctic Foundations, for supplying thermal piles which would give higher capacities without sand. However, the cost of obtaining these was also prohibitive.

An analysis was done using local silt as backfill material. The ultimate capacity of this type pile would be 75 kips, for a safety factor of 1.25. This was judged too low for a structure of this cost and importance to the community.

FINAL FOUNDATION DESIGN

MODIFICATION OF DESIGN CRITERIA

The preliminary design showed that a foundation could not be constructed at this location, within budget limits, with the criteria used, i.e. that the tank have essentially no settlement over its 30 year life. This is the presumptive inherent in the Sanger analysis. The pre-capacity was analyzed using two other design procedures, both of which are based on the assumption that some long term creep (settlement) of the piles will occur. These procedures are documented in the following papers.

"A Design Approach for Pile Foundations in Permafrost", J.F. Nixon and E.C. Mc Roberts, Canadian Geotechnical Journal, Volume 13, 1976.

"The Behavior of Friction Piles in Ice and Ice-Rich Soils", N.R. Morgansteinn, et.al., Canadian Geotechnical Journal, Volume 17, 1980.

Prior to using these methods, a meeting was held with Ed Jacobsen of Village Safe Water to establish if a design based on allowing some movement would be acceptable. Since the structure could not otherwise be constructed, it was decided to allow a maximum of one-half inch per year settlement.

Using this figure, a maximum capacity of 56 kips per pile was calculated. Since this was still somewhat low, it was decided to place 17-inch diameter end bearing plates on the piles, which would increase the capacity to 63 kips.

FINAL FOUNDATION LAYOUT

Since the design assumes that the platform will settle one-half inch per year, the pile grid was recalculated assuming that all piles were evenly loaded. The resulting layout gave a smaller deck and reduced the number of piles to 88. Some edge piles have reduced embedment to equalize pile stress. The glulam beams spanning the piles were deepened, so that in the event one pile begins to settle more than those adjacent, the load will be redistributed and settlement equalized. The final pile layout is depicted on Sheet 3 of the project construction drawings, to be forwarded under seperate cover.

VSW also requested that QUADRA conduct a site survey sufficient to describe the parcel of land upon which the entire project, the existing facility as well as the new water storage tank, is to be located. This survey was conducted in June of 1981 by a land surveyor registered in Alaska. The resultant legal description is included in the Appendix, as well as on the project construction drawings.

PRELIMINARY WATER SOURCE INVESTIGATION

Prior to initiating the investigation to locate an acceptable surface water source within reasonable proximity of the village, VSW established several parameters which were to be given consideration prior to final source selection. These parameters included: 1) distance from the existing facility, 2) estimated quantity of water available considering recharge potential, 3) water quality improvement or degradation over a period of time based on analytical laboratory results, 4) acceptability of the water source to local consumers, and 5) history of salt water encroachment if available. The contaminants which were to be considered of major significance included color, turbidity, iron, manganese and total dissolved solids. It was also considered advisable to conduct analytical tests sufficient to detect gross amounts of heavy metals.

During the late spring and early summer of 1981, four potential surface sources were selected for consideration. Three of these lakes, designated as Lake 1, Lake 2 and Lake 3 were selected relatively independently by QUADRA Engineering, based on the estimated quantity of water available and proximity to the facility. Village residents and VSW personnel later requested a lake known as Contractor's Lake also be considered, as it had previously been used as a water source by contractors working in the village. This lake was also seen to be advantageous in that it was far enough removed from the village to avoid significant contamination by local residents. The location of these four lakes relative to the facility is shown on an aerial photograph (approximate scale 1 inch = 600 feet) included in the Appendix.

Water samples were collected from each of the four lakes in June, July and October of 1981 and analyzed by Chemical & Geological Laboratories of Alaska. Additional samples were collected from Lake 1, Lake 2 and Lake 3 in May of 1981 and also analyzed. All water quality analysis reports are included in the Appendix.

LAKE 1

The body of water designated as Lake 1 is approximately 27.5

acres in size and lies immediately east of the Kongiganak airstrip. The most probable and acceptable transmission line routing would follow the boardwalk from the VSW facility to the airstrip, continue past the south end of the airstrip and follow the bluff to the south edge of the lake, with a total length of about 2300 feet.

The color, turbidity and total dissolved solids of the water from Lake 1 generally increase from spring to late fall. Total dissolved solids decreased from July to October, but this may be a rare occurence because of the lack of fall storms during the fall of 1981. Usually the Kongiganak area is beset by strong onshore winds during the fall, with resultant high wind blown tides. The northeast edge of Lake 1 is in an area likely to be flooded. This lake is well drained, however, and would in all probability be usable again by the following spring. With the exception of moderately high TDS, the remaining objectionable contaminants can be successfully removed with the existing F-86 fed multimedia filters.

The volume of water available from Lake 1 is estimated to be between 55 acre-feet (17.9 million gallons) and 68.8 acre-feet (22.4 million gallons). Based on the hydrology of the area, total annual recharge of the lake can be expected with a normal amount of precipitation.

LAKE 2

The lake designated as Lake 2 is approximately 3.4 acres in size and lies to the southeast of the airstrip, approximately 1000 feet south of Lake 1. The most acceptable transmission line routing would be generally as described for Lake 1, except veer to the southeast after passing the airstrip and intercept the north edge of the lake, with a total length of about 2750 feet.

The water quality of Lake 2 is similar to that of Lake 1, although generally having a slightly higher color and lower turbidity. The total dissolved solids, however is much higher and does not meet preferable drinking water limits. From July through October the TDS concentration exceeds 1000 mg/l. For this reason, Lake 2 should not be considered an acceptable source for this project. With the exception of TDS, the water can be treated with existing equipment.

The volume of water available from Lake 2 is estimated to be between 6.8 acre-feet (2.2 million gallons) and 8.5 acre-feet (2.8 million gallons). This lake is not likely to be annually recharged and will not effectively drain in the event of gross contaminant intrusion.

LAKE 3

The lake designated as Lake 3 is approximately 1.4 acres in size and lies west of the north end of the airstrip. The most probable transmission line routing would be from the VSW facility past the south end of the airstrip, then along the east side of the airstrip as far as the north end, and then west to the east edge of the lake, with a total length of approximately 4100 feet.

The water quality of Lake 3 is much like that of Lake 2, although TDS concentrations are slightly lower. The TDS concentration exceeded 1000 mg/l in the July analysis and is in an area subject to tidal flooding. Lake 3 should not be considered an acceptable water source for this project.

The volume of water available from Lake 3 is estimated to be between 2.8 acre-feet (0.9 million gallons) and 3.5 acre-feet (1.1 million gallons). While the lake is moderately well drained, high tidal action will result in long lingering impacts on the water quality.

CONTRACTOR'S LAKE

Contractor's Lake is located approximately 5500 feet northeast of the north end of the airstrip, and is approximately 5.2 acres in size. The most practical transmission line route would be similar to that for Lake 3 until the north end of the airstrip is reached, at which point the line would veer to the northeast and follow a ridge line for about 2600 feet, cross a seasonally tidal influenced area for approximately 1600 feet, and cross another bluff to intercept the south edge of the lake. The total transmission line would be approximately 8700 feet long.

The water quality of Contractor's Lake is excellent relative to the other lakes considered. The June water quality analysis showed the water to meet Alaska Drinking Water Standards. From July through October the water quality deteriorates slightly with color and iron concentrations increasing above preferred limits.

Even in late fall the water is of sufficiently high quality to allow economical and effective treatment with existing equipment. Total dissolved solids are extremely low, and the lake's relatively high elevation will preclude tidal encroachment in the normal course of events.

The volume of water available from Contractor's Lake is estimated to be between 13 acre-feet (4.2 million gallons) and 15.6 acre-feet (5.1 million gallons). The area of recharge is considered sufficient to allow nearly total annual recharge with normal precipitation.

FINAL WATER SOURCE SELECTION

Based on the analysis of water from the four lakes under consideration and discussions with VSW personnel and village residents, Contractor's Lake was selected as the water source for this project. The transmission line route will be as previously described and as shown on the construction drawings. The existing raw water pump building, which houses the electrical controls for the existing raw water pump, will be relocated to the south edge of Contractor's Lake in early spring of 1982. It is envisioned that the existing building can be relocated using local snow machines. At such time as the building is relocated it will be necessary to terminate service at the VSW facility or arrange for a temporary river pumping facility. While relocation of the existing structure may result in closure of the facility for a period of time, it will also result in saving money in a strained budgetary situation.

Because the transmission line will cross an area subject to tidal influence on a seasonal basis, it is necessary to attach extra weight to the transmission pipeline in this area. Based on a worst case of an empty pipe and four feet of water, additional weight of approximately 3.5 pounds per lineal foot of pipe is required to prevent floating of the empty transmission line and potential damage. This additional weight will be supplied by securing concrete weights to the pipe at appropriate intervals.

Although Contractor's Lake is the best water source for this project, it is advisable that Lake 1 not be completely disregarded as a potential future water source. The transmission line route to Contractor's Lake was selected based on using Lake 1 as a contingency water source in the event that Contractor's Lake is unavailable at some point in the future. The conversion from the use of Contractor's Lake to the use of Lake 1 can be accomplished through relocation of the new gasoline driven water pump and a minimum amount of pipe work. Lake 1 should be viewed only as a contingency water source and used only in the early spring.

WATER TREATMENT MODIFICATIONS

The existing water treatment system consists of an F-86 fed multi-media filter, two potassium permanganate fed pressure greensand filters and two carbon filters. The existing treatment system will be extensively modified for the raw water quality which is anticipated based on water quality analysis reports for Contractor's Lake.

Past experience has shown that the F-86 fed multi-media filter is capable of the removal of significant concentrations of organic color, as well as moderate amounts of iron. As the iron concentration of the raw water is very low, the greedsand iron removal filters will be removed from service, the media removed and the filter bodies available for service at other sites, at the option of VSW personnel.

Experience has also shown that slight amounts of color and turbidity have no impact on the public service activities of the facility other than the use of the public drinking water service. Thus no additional treatment other than chlorination and fluoridation will be provided, except for drinking water dispensed to the public, and domestic water supplied to the LKSD operated high school. One of the existing carbon filters will be relocated to the downstairs mechanical area to provide carbon filtration just prior to distribution to the public (including the drinking fountain) and the school. This is considered advisable, not necessarily to provide additional water treatment, but to help "freshen" and reoxygenate the water after prolonged storage. Carbon filtration will also provide dechlorination, thus making the water more palatable for village residents.

The remaining carbon filter will be converted to a second multi-media filter, thus providing a standby filter in the event of a mechanical problem with the first filter, or to provide uninterrupted filtration when the first filter is in a backwash mode. Within the existing facility there is a flow rate controller downstream of the water treatment filters which limits the filtration flow rate to 15 gallons/minute. With improved raw water quality the acceptable filtration rate can vary between 15 gallons/minute (5 gpm/ft^2) and 30 gallons/minute (10 gpm/ft^2). It is suggested the actual filtration rate not be determined until operational experience has been obtained.

In October of 1981 jar tests were conducted on the "worst case" raw water from Contractor's Lake (Color @ ~125 PCU). Following the jar tests, vacuum filtration was conducted through filter paper. Based on these results, an F-86 feed rate of 30-40 mg/l is required to provide high quality water. However, past experience has shown that there is no well defined correlation between jar tests and actual filter operation. Also, the vast majority of the water used with the new storage tank will not require this chemical concentration for effective treatment. It is advised that the F-86 chemical solution be prepared to allow the chemical feed pump to inject between 10 and 30 mg/l, with the actual feed rate based on operational experience.

The existing chemical solution tank and feed pump operation will also be modified for the proposed water treatment scenario. Two of the solution tanks and chemical feed pumps will be removed from service and should be left onsite for spare parts. The remaining four pumps will be used for F-86 solution (10-30 mg/l), backwash chlorine solution for the multi-media filter (20-30 mg/l), domestic water chlorination (0.5 mg/l) and domestic water fluoridation (1.2 mg/l).

MISCELLANEOUS FACILITY MODIFICATIONS

Several other facility modifications will be completed under this project. Some of these modifications are required for compatibility with the new water source and supply, while others are desirable to simplify the operational characteristics of the facility. The major items of work to be accomplished are as follows.

1) Installation of a foundation and structural deck, erection of a water storage tank, installation of a raw water transmission line and appurtenances, and modifications to the water treatment system, all as previously described.
2) Erection of a small insulated enclosure on the new structural deck adjacent to the water storage tank.
3) Insulation of and provisions for heating the newly erected water storage tank.
4) Removal and/or abandonment in place of the existing raw water transmission system, including the pump, transmission utilidor, buffer tank and related piping and controls.

APPENDIX E – NATIONAL DESIGN SPECIFICATIONS FOR WOOD CONSTRUCTION–TABLE 4A

2005 EDITION

ANSI/AF&PA NDS-2005

Approval Date: JANUARY 6, 2005

Approved American National Standard
ANSI

ASD/LRFD

NDS®

NATIONAL DESIGN SPECIFICATION® FOR WOOD CONSTRUCTION

WITH COMMENTARY AND SUPPLEMENT: DESIGN VALUES FOR WOOD CONSTRUCTION

American Forest & Paper Association

American Wood Council

Table 4A (Cont.) Reference Design Values for Visually Graded Dimension Lumber (2" - 4" thick)[1,2,3]

(All species except Southern Pine — see Table 4B) (Tabulated design values are for normal load duration and dry service conditions. See NDS 4.3 for a comprehensive description of design value adjustment factors.)

USE WITH TABLE 4A ADJUSTMENT FACTORS

Species and commercial grade	Size classification	Design values in pounds per square inch (psi)							Grading Rules Agency
		Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain F_c	Modulus of Elasticity E	Modulus of Elasticity E_{min}	
REDWOOD									
Clear Structural		1,750	1,000	160	650	1,850	1,400,000	510,000	
Select Structural		1,350	800	160	650	1,500	1,400,000	510,000	
Select Structural, open grain		1,100	625	160	425	1,100	1,100,000	400,000	
No.1		975	575	160	650	1,200	1,300,000	470,000	
No.1, open grain	2" & wider	775	450	160	425	900	1,100,000	400,000	
No.2		925	525	160	650	950	1,200,000	440,000	
No.2, open grain		725	425	160	425	700	1,000,000	370,000	RIS
No.3		525	300	160	650	550	1,100,000	400,000	
No.3, open grain		425	250	160	425	400	900,000	330,000	
Stud	2" & wider	575	325	160	425	450	900,000	330,000	
Construction		825	475	160	425	925	900,000	330,000	
Standard	2" - 4" wide	450	275	160	425	725	900,000	330,000	
Utility		225	125	160	425	475	800,000	290,000	
SPRUCE-PINE-FIR									
Select Structural		1,250	700	135	425	1,400	1,500,000	550,000	
No.1/No.2	2" & wider	875	450	135	425	1,150	1,400,000	510,000	
No.3		500	250	135	425	650	1,200,000	440,000	
Stud	2" & wider	675	350	135	425	725	1,200,000	440,000	NLGA
Construction		1,000	500	135	425	1,400	1,300,000	470,000	
Standard	2" - 4" wide	550	275	135	425	1,150	1,200,000	440,000	
Utility		275	125	135	425	750	1,100,000	400,000	
SPRUCE-PINE-FIR (SOUTH)									
Select Structural		1,300	575	135	335	1,200	1,300,000	470,000	
No.1		875	400	135	335	1,050	1,200,000	440,000	
No.2	2" & wider	775	350	135	335	1,000	1,100,000	400,000	NELMA
No.3		450	200	135	335	575	1,000,000	370,000	NSLB
Stud	2" & wider	600	275	135	335	625	1,000,000	370,000	WCLIB
Construction		875	400	135	335	1,200	1,000,000	370,000	WWPA
Standard	2" - 4" wide	500	225	135	335	1,000	900,000	330,000	
Utility		225	100	135	335	675	900,000	330,000	
WESTERN CEDARS									
Select Structural		1,000	600	155	425	1,000	1,100,000	400,000	
No.1		725	425	155	425	825	1,000,000	370,000	
No.2	2" & wider	700	425	155	425	650	1,000,000	370,000	
No.3		400	250	155	425	375	900,000	330,000	WCLIB
Stud	2" & wider	550	325	155	425	400	900,000	330,000	WWPA
Construction		800	475	155	425	850	900,000	330,000	
Standard	2" - 4" wide	450	275	155	425	650	800,000	290,000	
Utility		225	125	155	425	425	800,000	290,000	
WESTERN WOODS									
Select Structural		900	400	135	335	1,050	1,200,000	440,000	
No.1		675	300	135	335	950	1,100,000	400,000	
No.2	2" & wider	675	300	135	335	900	1,000,000	370,000	
No.3		375	175	135	335	525	900,000	330,000	WCLIB
Stud	2" & wider	525	225	135	335	575	900,000	330,000	WWPA
Construction		775	350	135	335	1,100	1,000,000	370,000	
Standard	2" - 4" wide	425	200	135	335	925	900,000	330,000	
Utility		200	100	135	335	600	800,000	290,000	

4 REFERENCE DESIGN VALUES

Table 4A (Cont.) Reference Design Values for Visually Graded Dimension Lumber (2" - 4" thick)[1,2,3]

(All species except Southern Pine — see Table 4B) (Tabulated design values are for normal load duration and dry service conditions. See NDS 4.3 for a comprehensive description of design value adjustment factors.)

USE WITH TABLE 4A ADJUSTMENT FACTORS

Species and commercial grade	Size classification	Design values in pounds per square inch (psi): Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain F_c	Modulus of Elasticity E	Modulus of Elasticity E_{min}	Grading Rules Agency
BEECH-BIRCH-HICKORY									
Select Structural		1,450	850	195	715	1,200	1,700,000	620,000	
No.1		1,050	600	195	715	950	1,600,000	580,000	
No.2	2" & wider	1,000	600	195	715	750	1,500,000	550,000	
No.3		575	350	195	715	425	1,300,000	470,000	NELMA
Stud	2" & wider	775	450	195	715	475	1,300,000	470,000	
Construction		1,150	675	195	715	1,000	1,400,000	510,000	
Standard	2" - 4" wide	650	375	195	715	775	1,300,000	470,000	
Utility		300	175	195	715	500	1,200,000	440,000	
COTTONWOOD									
Select Structural		875	525	125	320	775	1,200,000	440,000	
No.1		625	375	125	320	625	1,200,000	440,000	
No.2	2" & wider	625	350	125	320	475	1,100,000	400,000	
No.3		350	200	125	320	275	1,000,000	370,000	NSLB
Stud	2" & wider	475	275	125	320	300	1,000,000	370,000	
Construction		700	400	125	320	650	1,000,000	370,000	
Standard	2" - 4" wide	400	225	125	320	500	900,000	330,000	
Utility		175	100	125	320	325	900,000	330,000	
DOUGLAS FIR-LARCH									
Select Structural		1,500	1,000	180	625	1,700	1,900,000	690,000	
No.1 & Btr		1,200	800	180	625	1,550	1,800,000	660,000	
No.1	2" & wider	1,000	675	180	625	1,500	1,700,000	620,000	
No.2		900	575	180	625	1,350	1,600,000	580,000	WCLIB
No.3		525	325	180	625	775	1,400,000	510,000	WWPA
Stud	2" & wider	700	450	180	625	850	1,400,000	510,000	
Construction		1,000	650	180	625	1,650	1,500,000	550,000	
Standard	2" - 4" wide	575	375	180	625	1,400	1,400,000	510,000	
Utility		275	175	180	625	900	1,300,000	470,000	
DOUGLAS FIR-LARCH (NORTH)									
Select Structural		1,350	825	180	625	1,900	1,900,000	690,000	
No.1 & Btr		1,150	750	180	625	1,800	1,800,000	660,000	
No.1/No.2	2" & wider	850	500	180	625	1,400	1,600,000	580,000	
No.3		475	300	180	625	825	1,400,000	510,000	NLGA
Stud	2" & wider	650	400	180	625	900	1,400,000	510,000	
Construction		950	575	180	625	1,800	1,500,000	550,000	
Standard	2" - 4" wide	525	325	180	625	1,450	1,400,000	510,000	
Utility		250	150	180	625	950	1,300,000	470,000	
DOUGLAS FIR-SOUTH									
Select Structural		1,350	900	180	520	1,600	1,400,000	510,000	
No.1		925	600	180	520	1,450	1,300,000	470,000	
No.2	2" & wider	850	525	180	520	1,350	1,200,000	440,000	
No.3		500	300	180	520	775	1,100,000	400,000	WWPA
Stud	2" & wider	675	425	180	520	850	1,100,000	400,000	
Construction		975	600	180	520	1,650	1,200,000	440,000	
Standard	2" - 4" wide	550	350	180	520	1,400	1,100,000	400,000	
Utility		250	150	180	520	900	1,000,000	370,000	
EASTERN HEMLOCK-BALSAM FIR									
Select Structural		1,250	575	140	335	1,200	1,200,000	440,000	
No.1		775	350	140	335	1,000	1,100,000	400,000	
No.2	2" & wider	575	275	140	335	825	1,100,000	400,000	
No.3		350	150	140	335	475	900,000	330,000	NELMA
Stud	2" & wider	450	200	140	335	525	900,000	330,000	NSLB
Construction		675	300	140	335	1,050	1,000,000	370,000	
Standard	2" - 4" wide	375	175	140	335	850	900,000	330,000	
Utility		175	75	140	335	550	800,000	290,000	

able 4A Cont.) Reference Design Values for Visually Graded Dimension Lumber (2" - 4" thick)[1,2,3]

(All species except Southern Pine — see Table 4B) (Tabulated design values are for normal load duration and dry service conditions. See NDS 4.3 for a comprehensive description of design value adjustment factors.)

USE WITH TABLE 4A ADJUSTMENT FACTORS

Species and commercial grade	Size classification	Bending F_b	Tension parallel to grain F_t	Shear parallel to grain F_v	Compression perpendicular to grain $F_{c\perp}$	Compression parallel to grain F_c	Modulus of Elasticity E	Modulus of Elasticity E_{min}	Grading Rules Agency
EASTERN HEMLOCK-TAMARACK									
Select Structural	2" & wider	1,250	575	170	555	1,200	1,200,000	440,000	NELMA NSLB
No.1		775	350	170	555	1,000	1,100,000	400,000	
No.2		575	275	170	555	825	1,100,000	400,000	
No.3		350	150	170	555	475	900,000	330,000	
Stud	2" & wider	450	200	170	555	525	900,000	330,000	
Construction	2" - 4" wide	675	300	170	555	1,050	1,000,000	370,000	
Standard		375	175	170	555	850	900,000	330,000	
Utility		175	75	170	555	550	800,000	290,000	
EASTERN SOFTWOODS									
Select Structural	2" & wider	1,250	575	140	335	1,200	1,200,000	440,000	NELMA NSLB
No.1		775	350	140	335	1,000	1,100,000	400,000	
No.2		575	275	140	335	825	1,100,000	400,000	
No.3		350	150	140	335	475	900,000	330,000	
Stud	2" & wider	450	200	140	335	525	900,000	330,000	
Construction	2" - 4" wide	675	300	140	335	1,050	1,000,000	370,000	
Standard		375	175	140	335	850	900,000	330,000	
Utility		175	75	140	335	550	800,000	290,000	
EASTERN WHITE PINE									
Select Structural	2" & wider	1,250	575	135	350	1,200	1,200,000	440,000	NELMA NSLB
No.1		775	350	135	350	1,000	1,100,000	400,000	
No.2		575	275	135	350	825	1,100,000	400,000	
No.3		350	150	135	350	475	900,000	330,000	
Stud	2" & wider	450	200	135	350	525	900,000	330,000	
Construction	2" - 4" wide	675	300	135	350	1,050	1,000,000	370,000	
Standard		375	175	135	350	850	900,000	330,000	
Utility		175	75	135	350	550	800,000	290,000	
HEM-FIR									
Select Structural	2" & wider	1,400	925	150	405	1,500	1,600,000	580,000	WCLIB WWPA
No.1 & Btr		1,100	725	150	405	1,350	1,500,000	550,000	
No.1		975	625	150	405	1,350	1,500,000	550,000	
No.2		850	525	150	405	1,300	1,300,000	470,000	
No.3		500	300	150	405	725	1,200,000	440,000	
Stud	2" & wider	675	400	150	405	800	1,200,000	440,000	
Construction	2" - 4" wide	975	600	150	405	1,550	1,300,000	470,000	
Standard		550	325	150	405	1,300	1,200,000	440,000	
Utility		250	150	150	405	850	1,100,000	400,000	
HEM-FIR (NORTH)									
Select Structural	2" & wider	1,300	775	145	405	1,700	1,700,000	620,000	NLGA
No.1 & Btr		1,200	725	145	405	1,550	1,700,000	620,000	
No.1/No.2		1,000	575	145	405	1,450	1,600,000	580,000	
No.3		575	325	145	405	850	1,400,000	510,000	
Stud	2" & wider	775	450	145	405	925	1,400,000	510,000	
Construction	2" - 4" wide	1,150	650	145	405	1,750	1,500,000	550,000	
Standard		650	350	145	405	1,500	1,400,000	510,000	
Utility		300	175	145	405	975	1,300,000	470,000	
MIXED MAPLE									
Select Structural	2" & wider	1,000	600	195	620	875	1,300,000	470,000	NELMA
No.1		725	425	195	620	700	1,200,000	440,000	
No.2		700	425	195	620	550	1,100,000	400,000	
No.3		400	250	195	620	325	1,000,000	370,000	
Stud	2" & wider	550	325	195	620	350	1,000,000	370,000	
Construction	2" - 4" wide	800	475	195	620	725	1,100,000	400,000	
Standard		450	275	195	620	575	1,000,000	370,000	
Utility		225	125	195	620	375	900,000	330,000	

Design values in pounds per square inch (psi)

4 REFERENCE DESIGN VALUES