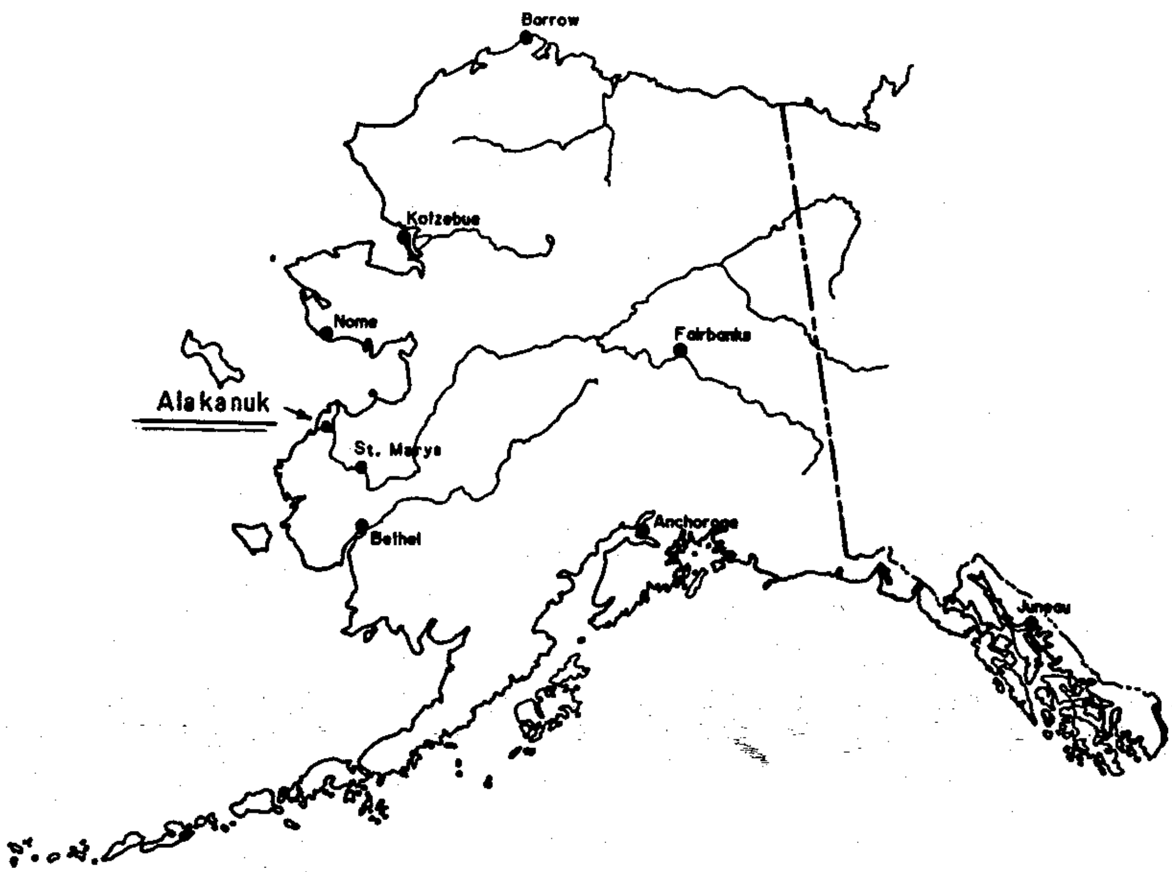
ALAKANUK, Alaska

WATER AND WASTEWATER SYSTEM
Feasibility and Cost Study

Prepared for the City of Alakanuk



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
INDIAN HEALTH SERVICE
ALASKA AREA NATIVE HEALTH SERVICE
ENVITONMENTAL HEALTH AND ENGINEERING BRANCH
ANCHORAGE ALASKA

DECEMBER 1989

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November 1989

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SUMMARY

December 1988, the Public Health Service received a request from the City of Alakanuk for assistance in investigating available alternatives for water and sewer facilities and determining their feasibility. It was determined that the study scope would be to evaluate the technical and economic issues of providing the City of Alakanuk with varying levels of sanitation service. The alternatives considered included expansion of the existing water delivery system with the addition of wastewater haul, additional watering points, a honeybucket haul system, and a piped water and wastewater system. Particular attention was given to the estimated cost for construction of each alternative, as well as the level of economic and technical support required at the community level to provide for long term operation and maintenance of the completed facilities.

This report discusses the background, evaluations and findings developed through the sanitation facility planning process. Its intent is to provide sufficiently detailed engineering information to allow local residents to make informed and knowledgeable decisions about their future utility systems.

Piped water and sewer is feasible, and may be the best solution to the community's sanitation problems, but it would be very expensive. The capital cost to provide the entire city with service would be approximately $10 million, though the cost could be lowered if some outlying areas were not served. The cost to operate this type of system would exceed $100 per family per month. This fee is in excess of what a survey of the community's residents indicated they could pay.

An alternative to a piped system would be a water and wastewater haul system to service the entire community for approximately $1.9 million.It is recommended that sanitation facilities be developed in a phased approach. Phase schedules are included in this report. The phasing can be scheduled to permit the work to be accomplished as a logical expansion of services throughout the community.

INTRODUCTION AND HISTORY

Community location

The City of Alakanuk is located near the mouth of the Lower Yukon River, 162 air miles from Bethel, Alaska.

Project History & Need

In 1976, the Alaska Department of Environmental Conservation's Village Safe Water Program (VSW) funded the construction of a centrally located washeteria with water supply, wastewater treatment, laundry, shower, and sauna facilities.

In 1977, the Indian Health Service (IHS) undertook well drilling project AN-77-625b to put in a well for the BIA school in Alakanuk. No producing aquifer was found.

PHS project AN-81-237A implemented a small honeybucket haul system. The system consisted of honeybuckets, 16 polyethylene collection containers, and haul trailers. A dump site was fenced for the disposal of solid waste and honeybucket wastes. Operational problems with this system resulted in sewage being spilled out while being hauled to the dump site. This resulted in sewage all over the city's roads, an unsanitary and undesirable situation. Also there were problems accessing the homes in the winter and handling the frozen waste. The city abandoned the honeybucket haul system in 1985.

In 1984, Alakanuk received $840,000 from the State of Alaska under Senate Bill 162 for water and sewer improvements. The city used this money to improve the washeteria facilities and build a sewage lagoon to serve the washeteria and school facilities.

The City of Alakanuk has a definite need for an improvement in their sanitation facilities. Last winter there were several illnesses such as hepatitis reported in the city, which are related to poor sanitary conditions. Presently, the residents are dumping their honeybucket wastes in the Alakanuk slough, in holes dug behind individual homes, or among the alders along the roadside. The spring floods tend to spread the sewage around the village, exposing villagers to diseases.

COMMUNITY PROFILE

Origin

Yup'ik Eskimos have lived in the vicinity of the modern village of Alakanuk since prehistoric times. The area was chosen because of the diverse subsistence resources of the Yukon Delta. In recent years, commercial fishing, a cannery at the mouth of the slough, the establishment of schools, and federal housing construction have played an important role in the growth of the village. The village is 94% Yup'ik Eskimo.

Location

The City of Alakanuk is located at the mouth of the Lower Yukon River, 162 air miles from Bethel, Alaska. A majority of the community extends approximately 3 miles along the south side of Alakanuk Pass (a channel of the Yukon River) near its juncture with Kwikluak Pass, a major channel of the river. Alakanuk is approximately 15 miles upstream from the Bering Sea. Nearby communities of the Yukon Delta area include Emmonak and Sheldon's Point. St. Mary's, a transportation hub for the Lower Yukon area, is 80 miles upstream.

Climate

Alakanuk is located in a zone of transitional climate, with marine influences causing moderately cool summers, and ice pack in the winter providing for more continental conditions. High winds are frequent. The last day of freezing temperature in the spring is usually in late May, and the first freezing temperature in the autumn is usually in early September.

Approximate Climatic Data

Mean Annual Precipitation, inches	19
Mean Annual Snowfall, inches	60
Mean Annual Temperature, F	28
Mean Daily Maximum Temperature, July, F	65
Mean Daily Minimum Temperature, December, F	0
Thawing Index, days	2,000
Freezing Index, days	3,750
Design Freezing Index, 1 year in 10	4,750

Topography

The topography is fairly flat with only slight variations in local relief within the surrounding village site. Elevations range from about five to ten feet above sea level. The terrain is characterized by numerous thaw lakes and interconnecting slough channels.

Regional Geology

The Yukon-Kuskokwim Delta region is an alluvial plain built up of deposited silts, sands, and gravels. The deposits which may be up to 300 feet thick, are underlain by interbedded marine and terrestrial deltaic and eolian deposits. Bedrock crops out in isolated areas. The most common rock types are mafic volcanics deposited as lava sheets or cinder cones.

Soil & Water Table Conditions

Soils in the area are characterized as poorly drained peat or peaty surface layer with a shallow permafrost table preventing drainage. In addition, the area usually floods each spring. As a result, the area can be generally classified as wetlands. Surficial organics average about one foot in depth in the vicinity of the village, but have been generally scraped off in the village site itself. Soils are clay, silts, and sand with a high organic and moisture content (Appendix A).

Well logs for Alakanuk and test holes indicate the presence of surface frost rather than the permafrost expected in the area, though some pockets of permafrost do exist (see soil logs in Appendix A). The frost depth is reported to be less than 4 feet. Test holes dug in the harbor and airport area in early March had an average water depth of 6 ft with the minimum 3 ft. The average frost depth was 3 ft with a maximum of 6 ft. The community is likely on the thaw bulb of the Yukon River. Well logs from the drilling attempt at the high school show a frost depth of 2 feet, and water at 15 feet at the end of May. The well log for the abandoned BIA school well indicates a static water level of 3.5 feet. Well logs are included in the appendix.

Flood & Seismic Evaluation

The U.S. Army Corps of Engineers Flood Plain Management Services Branch rates the flood hazard at Alakanuk as very high, with flooding over the entire community anticipated on a frequency greater than once every five years. In reality, the community has flooded at least once or twice every year in the historic past. Typically, flood waters cover the community to a depth of three to four feet. Flooding is of major importance because of the damage it can cause by floating pipes that are not anchored down. Design consideration must be given to design systems that can withstand flooding. The airport, located on higher ground, is rarely flooded. Alakanuk is located in seismic zone 2, as defined by the Uniform Building Code, and considered to have a risk of moderate damage to structures due to earthquakes. No earthquakes have been reported in the area.

Flora and Fauna

The wet tundra of Alakanuk is characterized by an almost continuous cover of grasses and sedges rooted in mosses and lichens. Berries and low shrubs are also typical. Birds and waterfowl are the most important fauna in the area; the Yukon-Kuskokwim Delta is one of the two largest waterfowl breeding grounds in North America. Moose may be present within the general area, but large mammals are generally absent from the wet tundra of the Yukon Delta. Smaller mammals, including shrews, hares, squirrels, foxes, and wolves can be found around Alakanuk.

Population

Alakanuk's present population is approximately 573, with 119 Native families, and 10 Non-Native families. In past years, the population has grown steadily as can be seen in Table 1 below. From 1940-1970, there was substantial immigration from smaller camps and villages in the area. The attractions were the opening of the Yukon River to commercial fishing, the cannery established in 1941, and the BIA school in 1967. Corporation statistics indicate that the true population in 1970 was closer to 440, rather than the figure of 265 given below. More recently, the village has also experienced emigration as the youth leave to attend school or work, many of these, don't return to live in Alakanuk. In spite of this, the village continues to slowly grow, due to high birth rates, improved health care and lower mortality among the elderly and infants. Another fact that must be considered is that about 10 percent of the population of Alakanuk live across the river, and would be difficult to serve by any new sanitation facilities.

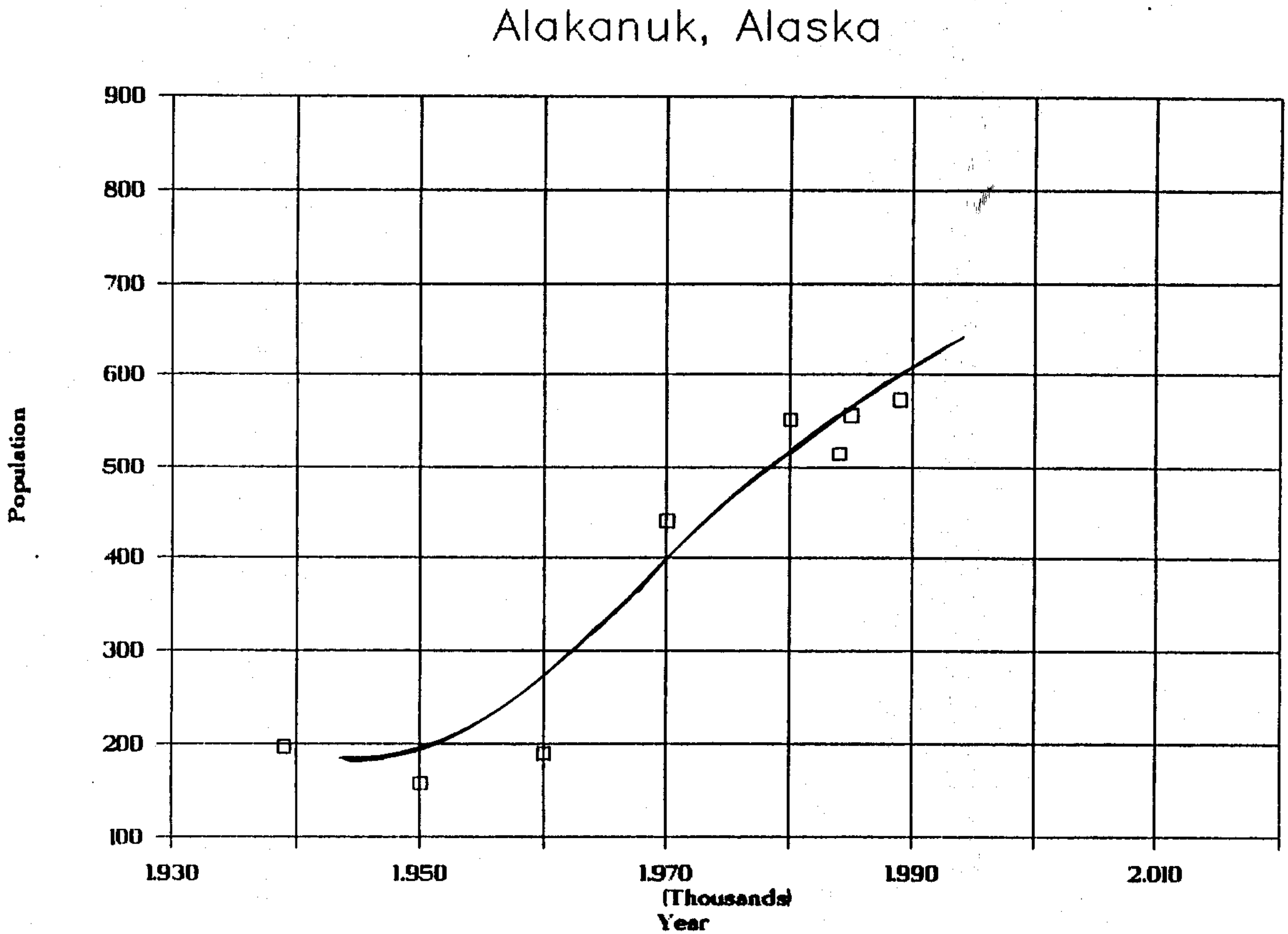
A plot of the past population (Figure 1) yielded a prediction of 750 people for the 20 year design population.

Table 1
Population, Household, and Family Characteristics

(Sources: U.S. Dept. of Commerce, Bureau of the Census, Special Tabulations, 1980; Alaska Dept. of Labor, Alaska Population Overview, 1985 Estimates, April 1987.)

	Population			Households		Families	
Year	Total	Native	Other	Total	Avg. size	Total	Avg. size
1939	197						
1950	158						
1960	190						
1970	265*	247	18	45	6	41	6.5
1980	522	491	31	105	5	95	5.5
1984	515						
1985	556						
1989*	573						

**1970 population really closer to 440; 1989 population estimated*



PLOT OF PREDICTED POPULATION

FIGURE 1

Structure & Buildings

Alakanuk has 131 homes, 123 of these are inhabited full time, 25 are HUD homes, 16 are BIA renovated homes, and 9 are teacher's trailers with water and sewer hook-up. Across the river are 11 homes, which will be difficult to serve with any new sanitation facilities. There are 12 non-residential buildings. The following public, commercial, and government facilities exist in Alakanuk:

LYSD High School
LYSD Headstart School
LYSD Elementary School
Alakanuk Native Corp. Store
Airstrip Shelter
Alakanuk City Office
Alakanuk City Police
Alakanuk Village Health Clinic
Alascom, Inc.
Alaskan Village Electric Cooperative Power Plant
Alstrom's Store
Assembly of God Church
Catholic Church
Community Hall
DF Jorgensen Co. (store)
Recreation Hall
U.S. Postal Service
United Utilities Inc.
Yupik Star Fisheries

In 1989, there are approximately 167 students and 14 teachers in Alakanuk.

Planned Capital Improvements

The only known plans that will effect sanitation improvements are the sewer and water hook-up at the clinic, which is almost done, and the planned hook-up of the Headstart school. Recently, a garage near the clinic was attached to the water line.

Income & Economy

Alakanuk's economy is predominately subsistence based, though a significant cash income results from commercial fishing and cannery employment during the fishing season. Regulations prevent the commercial salmon fishing from expanding to employ more of the village's residents. Nearly all families are represented at subsistence fish camps. Hunting, fishing and gathering activities provide a significant portion of most residents' diets. Year round employment is available to very few and is largely dependent on public sector funding. While the population is growing, employment opportunities in Alakanuk are not increasing significantly, causing an increase in unemployment. Government transfer payments make up a large portion of the community's income.

Average Household Income by Source, 1986
(Sources: Field Protocol; U.S. Department of Commerce, Bureau of Economic Analysis)

	Dollars
Earned Income	
Nonwage Self Employment	3,089
Private Sector	2,757
Government:	
Federal	1,109
State	2,188
Local	2,466
Institutional	557
Subtotal	12,166
Unearned Income	
Governmental Transfers:	
Permanent Fund	2,805
Other	3,982
Interest/Dividends/Rent	24
TOTAL	$18,977

Average Household Consumption Expenditures, 1986
(Sources: Field Protocol; 1987 Statistical Abstract)

	Dollars
Housing	272
Utilities:	
Heating Oil	537
Electricity	376
Water	391
Other	88
Groceries	4008
Transportation	2022
Hunting/Fishing Gear	335
Insurance	20
Medical	7
Clothing & Accessories	780
TOTAL	8736

Local Government & Corporation

Alakanuk, a member of the Calista Native Corporation, was incorporated as a second class city in 1969, and is governed by a mayor/5 member city council. The community has a 5 member traditional council which is elected to serve terms ranging from 2-4 years. The city assesses a two percent sales tax.
See Appendix C for planned city set aside funds.

Land Status

The land from the airport to the end of the village is owned by several entities. The land belongs to the city, individuals (both restricted and unrestricted parcels) and the State of Alaska. The Department of Education owns several lots for the School, and the Department of Transportation owns several lots as well. The Townsite Trustee still retains title to Block 11 of Tract "B" and Block 5 of Tract "A". Before any construction begins Right-Of-Ways would have to be obtained. A good place to start researching land status is the Bureau Of Land Management's Townsite Trustees Office in Anchorage, telephone # (907) 271-3788.

Communication

Telephone service is provided by Alascom, Inc., based in Anchorage. The city office telephone number is 238-3313.
Alakanuk receives KICK and KNOB radio stations from Nome and television stations from the State Satellite System. Cable television is also available for hook-up.
Mail is delivered to Alakanuk an average of 5 days per week by one of the local air carriers.

Transportation

Alakanuk is dependent on air and boat transportation in the summer months. The village also has several gravel roads within the city limits. Once winter arrives, snowmobiles, three-wheelers, and plane service become the main forms of transportation. Air travel from Bethel is available year-round through scheduled and charter air services. The community is equipped with a 2,470 foot sand and gravel airstrip and receives barge service an average of twice a year from Seattle and Nenana.

Power

Houses are supplied with electricity through connection to the community's Alaska Village Electrical Cooperative (AVEC) generating system. AVEC operates a 695 kW diesel generator with 124,000 gallons of fuel storage capacity. They use 80,000 gallons each year. In 1978, total village fuel storage, including AVEC, was 332,000 gallons. In 1989 the City Manager reported 153,000 gallons of total storage, while another city resident reported 284,000 gallons. This discrepancy should be investigated further before a fuel intensive sanitation facility is installed. Residents heat their homes with wood or fuel oil. Fuel oil costs $1.50 per gallon. The average household expenditure in 1986 for electricity was $376 and $537 for heating oil (Sources: Field Protocol; 1987 Statistical Abstract). The washeteria facility used approximately $10,000 of heating fuel in the first half of fiscal year 1989.

Community Contacts

Alakanuk City Council

Mr. Peter Black, Mayor 238-3621
Mr. Ray Oney, Voce Mayor 238-3714
Ms. Elizabeth Chikagak, Secretary/Treasurer 238-3415
Mr. Paul Phillip, Council Member 238-3624
Ms. Mary Ayunerak, Council Member 238-3622
Ms. Zita Chikigak, Council Member 238-3315
Ms. Paula Ayunerak, Council Member 238-2312

Traditional Council

Mr. Dennis Shelden, President
Mr. Paul Ayunerak, Vice-President
Ms. Mary Augustine, Secretary/Treasurer
Mr. Charles Harry, Council Member
Ms. Monica Murphy, Council Member
Ms. Paula Ayunerak, Administrator

City Manager

Mr. Dave Morgan, 238-3313

City Clerk

Ms. Martina Post, 238-3313

Community Health Aides

Ms. Theresa Edmund, Primary
Ms. Ida Duny
Ms. Alma Hanson
Ms. Rose Kameroff, Alt.
Ms. Martha Joseph, Alt.

Village Public Safety Officer/Lay Vaccinator

Mr. Tony Simmons, 238-3324

Village Police Officer

Mr. Ralph Teeluk
Mr. Thomas Okitkun

Water Plant Operators

Mr. Charles Smith, Manager
Mr. Cyprian Augline

Advisory School Board

Seven Member Board

Community Sanitation Priorities

All city council members and residents attending a July 1989 meeting with PHS engineers, indicated that they would like to have piped water and sewer service in Alakanuk. Realizing that this would take several years even after funds are found, the city emphasized that some kind of immediate solution to the health problems caused by honeybucket waste disposal is needed. To better understand the desires and attitudes of all the village's residents concerning sanitation facilities improvements, a survey was taken in July 1989. A summary of this survey appears below, and the actual questions with results are included in Appendix B. See Appendix C for City resolutions and supporting documents regarding sanitation facilities development.

Survey Results

Most of the residents responding to the survey indicated a desire for piped water and sewer, and want to pay less than $35/month for it. Few wanted the honeybucket haul system restarted. Many would like year-round watering points, because the existing watering point is so far from their homes. Many people also expressed concerns about bad road conditions and snow hindering water delivery and the honeybucket haul if it is restarted.

Existing Sanitation Facilities

Water Supply

Traditional water sources used include rainwater, snow and ice. The city water treatment plant and washeteria facility get water from the Alakanuk Slough via a 3 inch copper pipe encased in arctic pipe. The intake floats on the water surface in summer and is placed through the ice during the winter. The original water treatment facility constructed under a 1976 VSW project. In 1984, the system was renovated by Quadra Engineering (now merged with Montgomery) and a Neptune Microfloc SWB-50 unit was installed. This package plant will treat 50,000 gallons of water per day, or 35 gpm. Presently the city treats approximately 5,000-6,000 gallons per day, so it is operating far below its capacity. As water enters the two-compartment mechanical flocculator, alum is added to clarify the raw water by providing a hydrous floc which entraps suspended matter. A polyelectrolyte is added as a flocculent aid to make the coagulated particles larger and enhance settling. From the flocculator, the water flows through a settling chamber and then a mixed media gravity filter containing anthracite coal, silica sand and garnet sand. In the final steps, dense soda ash is added to stabilize pH levels and reduce pipe corrosion, along with chlorine and fluoride.

The city washeteria is equipped with a toilet, showers, washers, dryers, two saunas, a 200,000 gallon water storage tank and a watering point. The plant has three pressure pumps, hot water heaters, a backup furnace to heat air, and two Well McLain boilers with 1,380,000 BTU/hr output. The 400 gallon water delivery truck delivers water to the residents three times per week, but has problems getting to some areas because of muddy roads and deep snow in the winter.

The City of Alakanuk charges residents for water service and washeteria use based on the following schedule:

Water delivery	$.08 per gallon, plus $2.00 delivery charge
Water at watering point	$.05 per gallon
Clothes washers	$3.00 per 30 pounds, $2.00 per 18 pounds
Showers and sauna	$1.50 per child, $2.50 per adult

During the first half of the 1989 fiscal year, the washeteria facility spent $67,268 and collected $84,624 for a net revenue of $17,356.
Some of the 25 HUD homes have piped water from collected rainwater; most others in the village have no plumbing. Of the 40 households responding to the July 1989 survey, 60% have room for a 6 by 10 foot bathroom.
The water treatment plant seems to be in good condition and should be able to meet the future needs of the village if properly maintained and operated.

Sewage
The laundry, sauna, and shower facility and the school and teacher's housing have piped water service, and discharge wastewater into a single cell total retention sewage lagoon. The clinic hook-up to the system is underway and should be finished soon. The 125 ft x 265 ft sewage lagoon was designed in 1983 by Peratrovich, Nottingham and Drage, Inc., with provisions for the addition of a second cell of the same size. The excavation depth elevation is 4 ft, with the berm height above the 15 foot flood level. The operating depth is 5 ft.
The lagoon easily meets present needs because of its limited use, but it is not large enough to accommodate all of the village's waste. If it is to be used in conjunction with a honeybucket haul or piped sewer system, it would need to be enlarged.

Solid Waste
PHS project AN-81-237 provided the city with a fenced solid waste disposal site, a haul vehicle, and 250 individual garbage cans. The city operates the garbage collection and disposal service with no direct charge to residents. Although the dumpsters, which are dispersed throughout the city, became even more dispersed during the spring floods of 1989, they were retrieved and the system seems to be working well. If the system is managed well, it should meet existing and future needs.

Design and Construction Considerations

Permafrost

It appears that there is minimal permafrost in Alakanuk, although pockets of permafrost do exist between 4-15 ft (see soil logs in appendix A). March test holes in the airport and port area had an average seasonal frost depth of 3 ft and a maximum of 6 ft.

Foundations

One of the most important aspects of designing a piped system or any other structure is choosing an appropriate foundation. Soils in the Alakanuk area are wet silts and sandy silts (see Appendix A). Typically, wet silty soil has very low bearing capacity, high settlement potential, and high frost susceptibility. Foundation loads should be as light and dispersed as possible. Large structures should have the capability to withstand substantial settlement and to be releveled as required. Large pads of non-frost susceptible material could be used for foundations but these can be prohibitively expensive. Gravel is not locally available in Alakanuk and the price of gravel delivered to Alakanuk is approximately $35/ton. Surcharge loads with drainage structures are also a possibility. Piling foundations are generally the foundation of choice in this type of soil, however, the expense of piling construction maybe prohibitive. Typical soil logs from the Alakanuk area are included in Appendix A.

Piping Materials

The recommended piping material for buried lines in all sanitation facilities discussed is insulated high density polyethylene (HDPE). See Figure 2 for a typical pipe section. This pipe is excellent because it is able to expand and contract with the freeze-thaw cycles without breaking. Heat tracing can be used, but provisions should be made for hot water thawing should the system freeze.

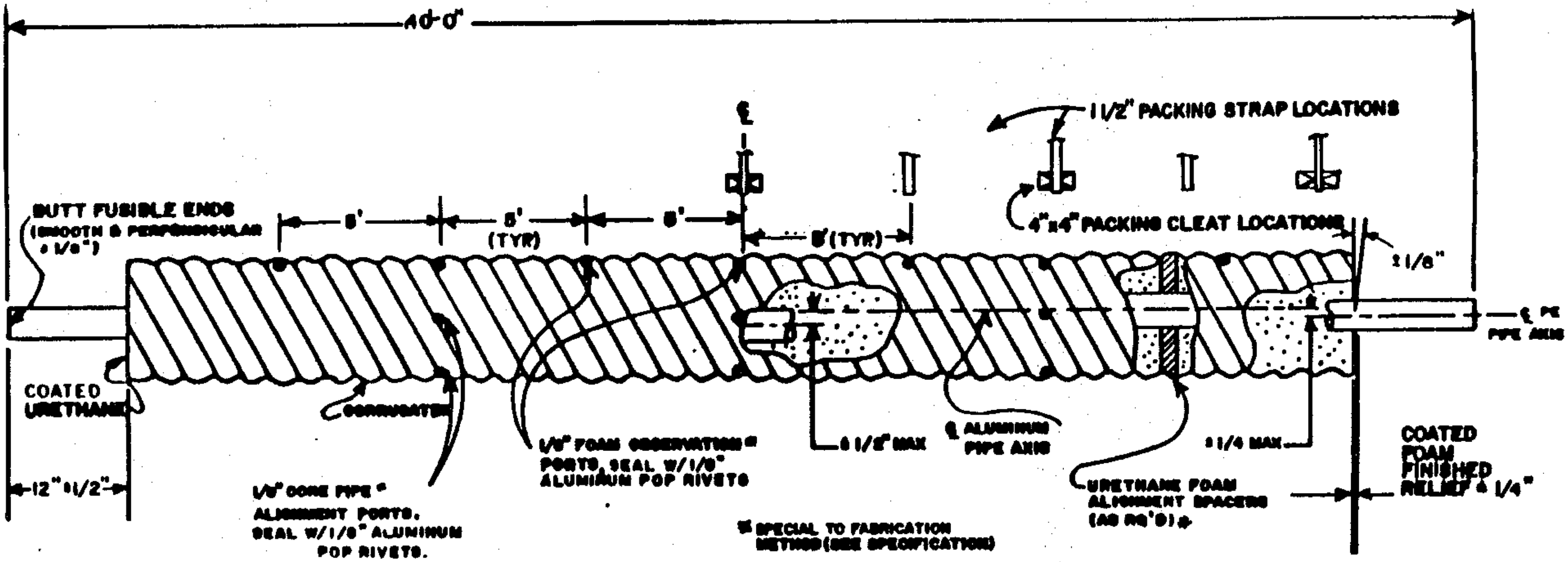
Pipe Placement

In other arctic and sub-arctic areas, burial of pipes is the accepted method of system installation, but in Alakanuk, it is an unlikely choice because it would be extremely difficult to bury any system in the wet fine grained soils that are found in Alakanuk. Buried utilities in these type of soils are subject to substantial ground movement during annual freeze/thaw cycles.

Since the soil conditions in Alakanuk won't allow for a buried pipe system, an above ground pipe or utilidor system could be considered. Foundation possibilities are as follows:

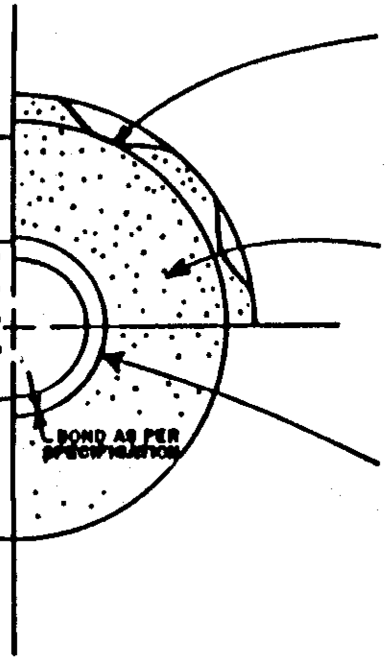
1. Laying the Pipe or Utilidor on the Ground

The advantage of this foundation is that it could be constructed with minimal disturbance of the existing ground surface and vegetation (Figures 3 and 4). It would also be accessible for maintenance and, due to the low profile, would not be as obtrusive as an above ground utilidor system on sills or piles. The pipe could be buried at road crossings and ramps or mounds could be provided to allow snowmobiles and other off-road vehicles to cross at various locations. Disadvantages are that the pipe is exposed to view and is subject to vandalism, frost movement, vehicular damage, and would require maintenance to maintain grade. Also, due to its buoyant characteristic, the pipe would float during a flood. System damage because of this problem could be minimized by anchoring the pipe. Laying the utilidor or pipe on the ground would also impede surface



PE ARCTIC PIPE SERIES CLASSIFICATION	INNER CORE † PIPE O.D	MINIMUM OUTER JACKET I.D
SIX - INCH	6.625"	12" ± 1/4"
FOUR-INCH	4.5"	12" ±1/4"
THREE-INCH	3.5"	12" ±1/4"
TWO - INCH	2.375"	10" ±1/4"

† LRS. TOLERANCES



OUTER JACKET

- 16 GAGE ALUMINUM
- WATER TIGHT HELICAL SEAMS (UNDER 5 FT HEAD)
- CORRUGATED AS PER SPECIFICATIONS

INSULATION

- LOW DENSITY CLOSED CELL RIGID URETHANE
- K = 0.13 BTU-IN/HR FT^2 °F INITIAL
- ASTM D 2341 70= 550674970034

INNER CORE PIPE

- HIGH DENSITY POLYETHYLENE
- ASTM D-2837 76 PRESSURE RATING MINIMUM OF 160 psi (+73° F, SERVICE FACTOR 0.5)
- CAPABLE OF WITHSTANDING CYCLIC PRESSURE FREEZE-THAW TESTING AS PER THIS SPECIFICATION
- NSF APPROVED FOR POTABLE WATER USE

NOTE: DRAWINGS NOT TO SCALE

FIGURE 2

HDPE PIPE

UTIDOR SECTIONS BEFORE CONNECTION

FIGURE 3

SMALL (0.4 m by 0.5 m) UTILIDOR PLACED DIRECTLY ON THE TUNDRA SURFACE CARRYING WATER, SEWER AND GLYCOL LINES, NOORVIK, ALASKA

FIGURE 4

water movement and cause damming of water behind the pipe during annual floods. This alternative is the least "permanent" of any system and can be easily relocated, altered, or repaired if needed. It is the least expensive alternative.

2. Sill Supported Pipe or Utilidor

Sills would provide support for the utilidor or pipe system. The sills may be either of wood construction or be an earthen or gravel berm. Wood sill construction is easier and faster to install, does not create substantial dams which hinder drainage, and normally has a lower profile compared to a gravel sill. Gravel berms are less susceptible to frost jacking or settlement problems than is wood sill construction. The primary disadvantage to both sill systems is that they impede pedestrian and vehicular travel and would require transition zones where crossing under or over roads. Also, a gravel sill creates water drainage problems. Both types of sills would be susceptible to flood damage.

3. Pile Supported

The pile supported pipeline or utilidor system would offer the best protection against flood damage to the system. It would also offer good access to the pipelines for maintenance and repairs if it were designed with this in mind. However, the piles, utilidors and/or pipes can have high construction and maintenance costs. The primary disadvantage to utilidor on piles is that they are extremely conspicuous and impede travel within the community (Figure 5). The piles can be of steel, wood, or even thermal piles. Thermal piles are the most effective against frost heaving, but are expensive to construct and maintain. Any pile system is "permanent" and not easily moved or rerouted.

Flood Considerations

The U.S. Army Corp of Engineers rates the flood hazard in Alakanuk "very high". The villagers report that floods occur every year. A recent flood (1989) in near-by Emmonak caused by an ice jam has caused damage to their piped system. Design considerations such as the following must be made to protect the sanitation facilities from flood damage.

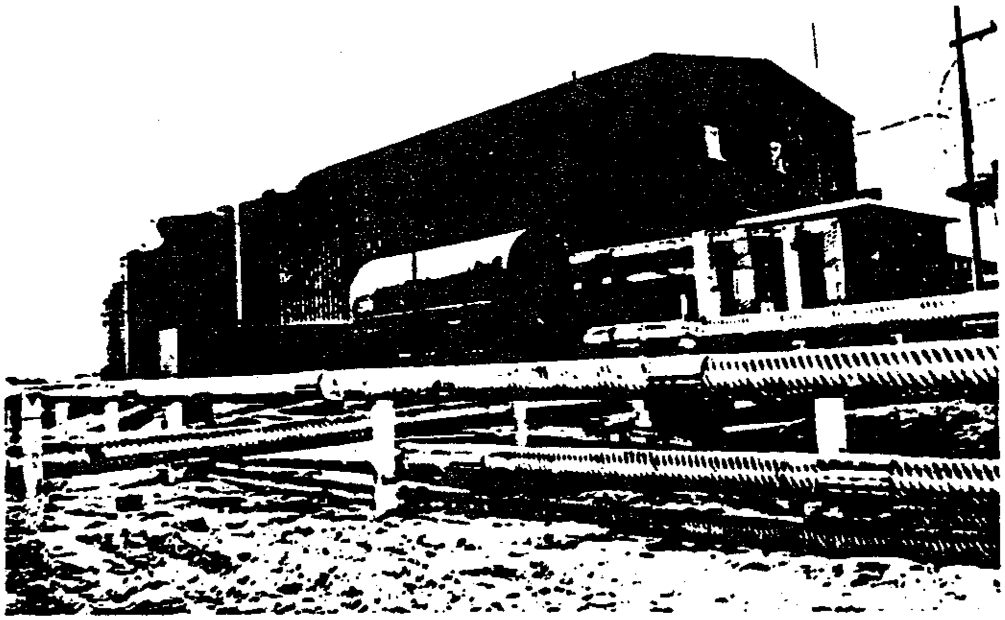
* An adequate anchoring system ought to be able to withstand at least the buoyant force of the pipe or utilidor and allow movement at hose connections.
* The utilidor could be placed above the seasonal flood level.
* Weak links could be built in the pipe or utilidor, allowing sections to break away in high hazard areas in case ice flow or of flood. This would help protect the rest of the system from being damaged.
* Any system should be designed to facilitate repairs if flood damage does occur. This can be done by using commonly available construction materials, a simple design, and modular construction.

Gravel/Select Fill

There is no gravel available in Alakanuk. In 1986, the village bought gravel from Pitkas Point for $34-$40 per ton. Gravel is also available from St. Mary's. The silty loam soil used to build the sewage lagoon was taken from the lagoon site itself.

Drainage

Drainage is poor, and flooding frequent.



SEWAGE COLLECTION LINES ON PILING,
BETHEL, ALASKA

FIGURE 5

Equipment
The following equipment is available for rental from the city, though the current prices would be somewhat higher than those listed:

14 C Dozer	$125/hr	or	$5000/week
75 A Loader	$55/hr	or	$2200/week
65 B Grader	$55/hr	or	$2200/week
480 C Backhoe	$45/hr	or	$1800/week
City Truck (10 yd)	$30/hr	or	$1200/week
City Lodge	$30/night		

The State of Alaska's Village Safe Water (VSW) and Matching Grants programs are directed to use specific equipment rental rates per Department of Environmental Conservation Policies and Procedures Manual Field Directive dated 2/1/89. Equipment rental rates should be discussed with VSW if State funds are used.

Labor
Labor is available in the village. The sewage lagoon was built primarily with local workers.

SANITATION IMPROVEMENT ALTERNATIVES

General

Water Systems:

If the existing treatment plant continues to be well maintained and operated, it can provide all needed water for any water distribution alternative selected.

Wastewater Systems:

Table 2 lists some of the possible wastewater collection systems and their characteristics and benefits to the community.

Regardless of which wastewater collection alternative is chosen, a treatment scheme needs to be developed, as the present wastewater lagoon is too small to serve the community. The best wastewater treatment facility for small isolated communities is one that has low operational costs, low maintenance requirements, and meets the standards established by regulatory agencies. In Alakanuk, a facultative lagoon would best fulfill these requirements. The present facultative lagoon will have to be expanded. A typical lagoon cross-section is shown in figure 6.

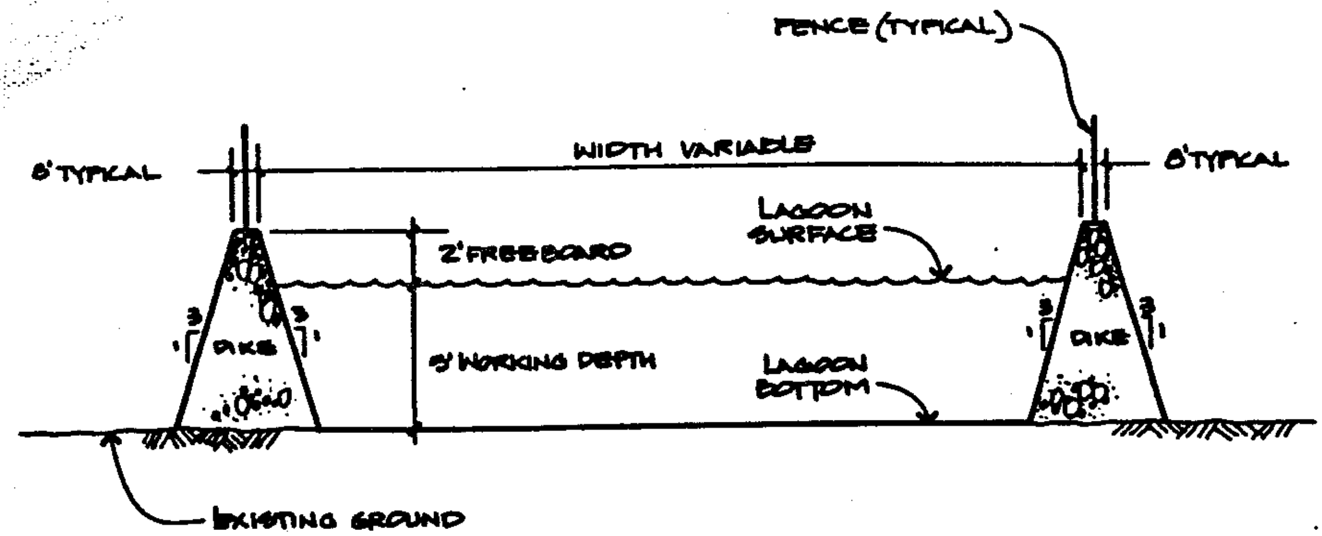
The following water and wastewater system alternatives are discussed in this report:

1. Watering Points & Honeybucket Haul
   - A. Summer watering points
   - B. Year-round Watering Points
2. Trucked Water & Sewer
3. Piped Water & Sewer
   - A. Piped water and vacuum sewer
   - B. Piped water and pressure sewer

TABLE 2

CHARACTERISTICS OF WASTEWATER COLLECTION SYSTEMS

Type	Soil Conditions	Topography	Economics	Other
Gravity	Non frost susceptible or Slightly frost susceptible with gravel backfilling material.	Gently sloping to prevent deep cuts and lift station.	Initial construction costs high but operational costs low unless above ground or lift stations used.	Low maintenance. High health and convenience improvements. Most hold grades. Flushing of low use lines may be necessary. Large diameter pipes necessary.
Vacuum	Most useful for frost susceptible or bedrock conditions, but can be used with any soil conditions.	Level or gently sloping.	Initial construction cost moderately high. Operational costs moderate.	Pipes laid in sawtooth profile to fit into utilidor. Can be used with any low flush toilet. One interface valve can serve a large school or motel. Requires a vacuum station for every 200 to 500 services. Pumps at vacuum station deliver sewage to treatment plant. Can separate blackwater and graywater. Uses 76-, 101-, and 152-mm pipe. No exfiltration.
Pressure	Most useful for frost susceptible or bedrock conditions, but can be used with any soil conditions.	Level, gently sloping or hilly.	Initial construction costs moderate. Operational costs costs moderately high.	Water saving if low water use fixtures are installed. High health and convenience improve- No central facility necessary - units are in individual buildings. No infiltration. Uses small pipes.
Vehicle-Haul	Year-round roads must be available.	Level, gently sloping or hilly.	Initial construction costs low. Operation costs very high.	Low water use and moderate health and convenience improvements. Operational costs must be subsidized.
Individual-Haul	Used with any soil conditions but boardwalks are necessary in some swampy conditions.	Level, gently sloping or hilly.	Initial construction cost and operation costs very low.	Low usage by inhabitants and thus low health and convenience improvements.



TYPICAL SEWAGE LAGOON SECTION

FIGURE 6

1. Watering Points and Honeybucket Haul

A. Summer Watering Points:

Water would be carried from the water treatment facility to seven remote watering points throughout the village by non-circulating uninsulated small diameter pipes. The watering points wouldn't be enclosed (figure 7), and the system would be drained for the winter. See figure 8 for one possible watering point placement scheme. There would need to be some plumbing and pumping modifications done at the water treatment plant.

TABLE 3
ESTIMATED COSTS FOR SUMMER WATERING POINTS

Capital Costs

Item	Quantity	Installed Unit Cost $	Total Cost $
Summer Watering Point	7ea	1000 each	7,000
2 inch PE Pipe	13,850 ft	7/ft	96,950
Pumphouse Modifications	1 job	10,000	10,000
Engineering at 12%			13,674
Contingency at 10%			11,395
TOTAL			**$ 139,019**

Increased Yearly Operation & Maintenance

Item	Quantity	Unit Cost	Total
Electric	2000 kw	.34/kw	680
Fuel	100 gallons	1.50/gal	150
Labor	49 hr	12/hr	588
Repairs	1	1000	1000
TOTAL			**$ 2,418**

B. Year-round Watering Points:

Unlike the summer watering points, these would be enclosed, and operate the whole year. Water would be circulated through insulated water pipes laid on top of the ground and anchored. If properly designed these pipes could later be incorporated into a piped water system, allowing phased development as money becomes available. Keeping this in mind, the pipes should be sized large enough to accommodate the future demand of a piped water system. With this option, there would also need to be some plumbing and pumping modifications done at the water treatment plant.

Watering point locations are shown in figure 9, but this is just one possible placement scheme. It would also be possible to have a system with some summer and some winter watering points. With either summer or year-round watering points, input from the village residents concerning locations of the watering points should be incorporated into the final design. Table 4 outlines the cost of the total system, but if not enough money is available to construct the whole system at once, table 5 breaks the costs down by watering point, so the cost of phased construction can be seen.

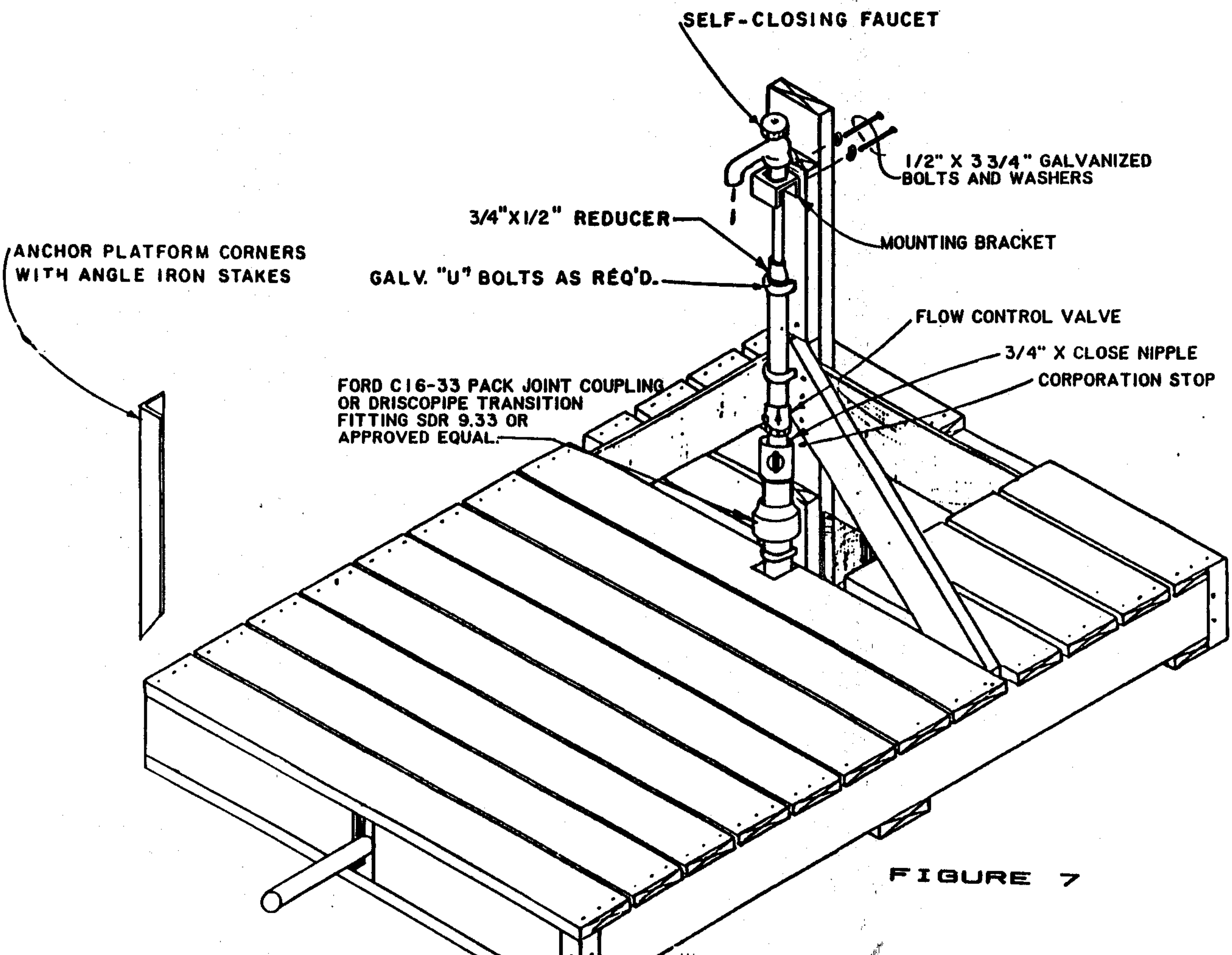
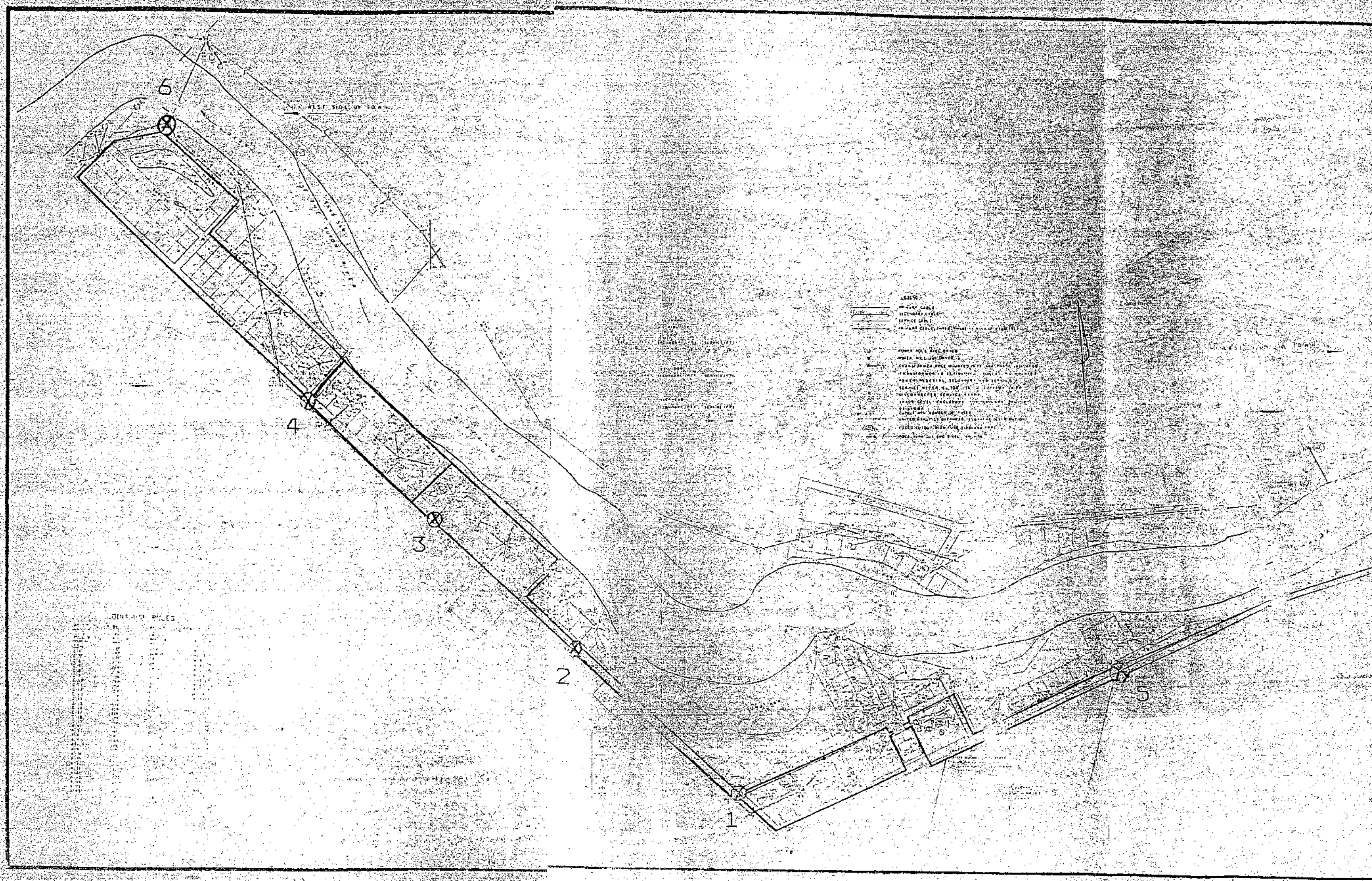


FIGURE 7

SEASONAL (SUMMER) REMOTE WATERING POINT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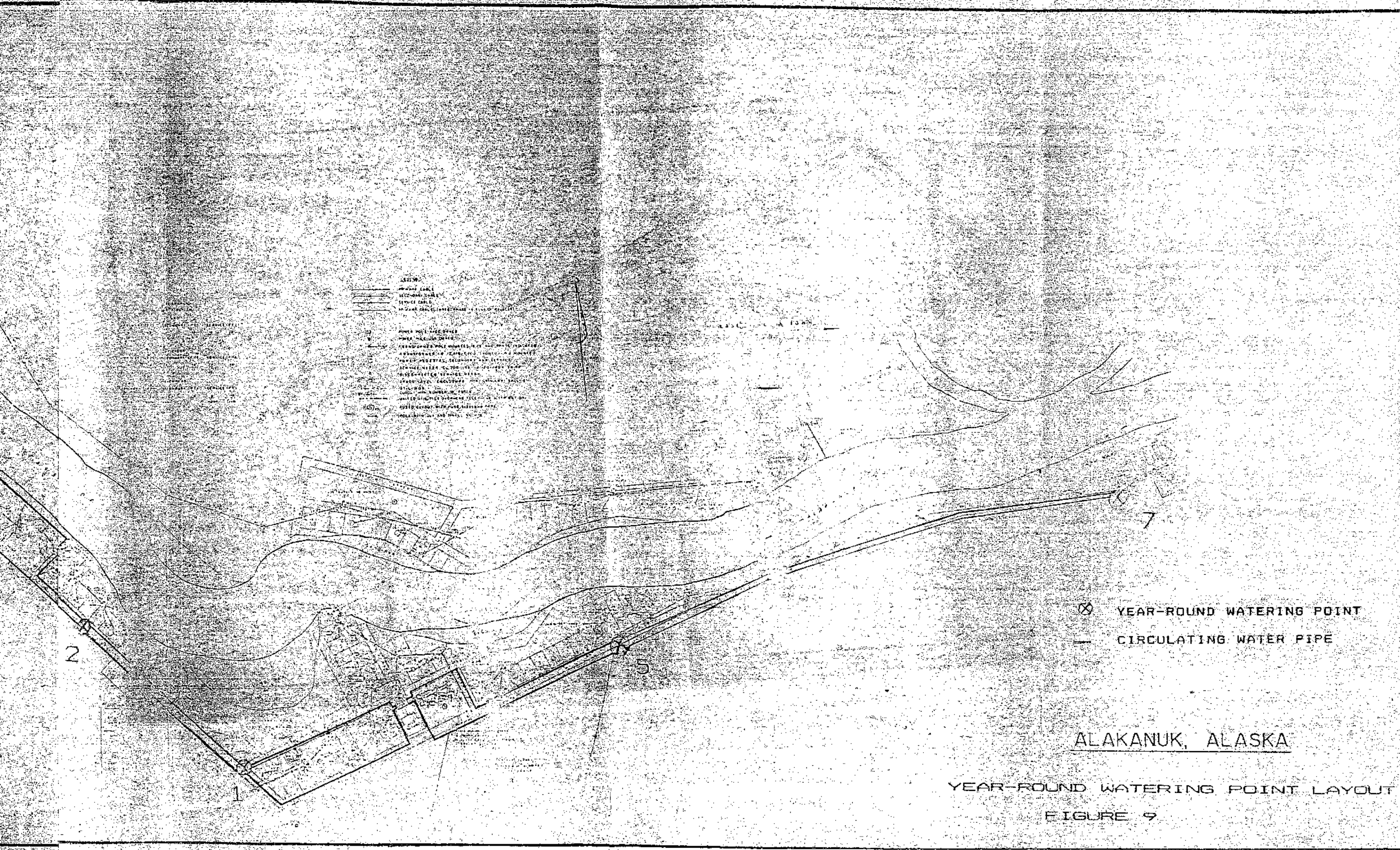
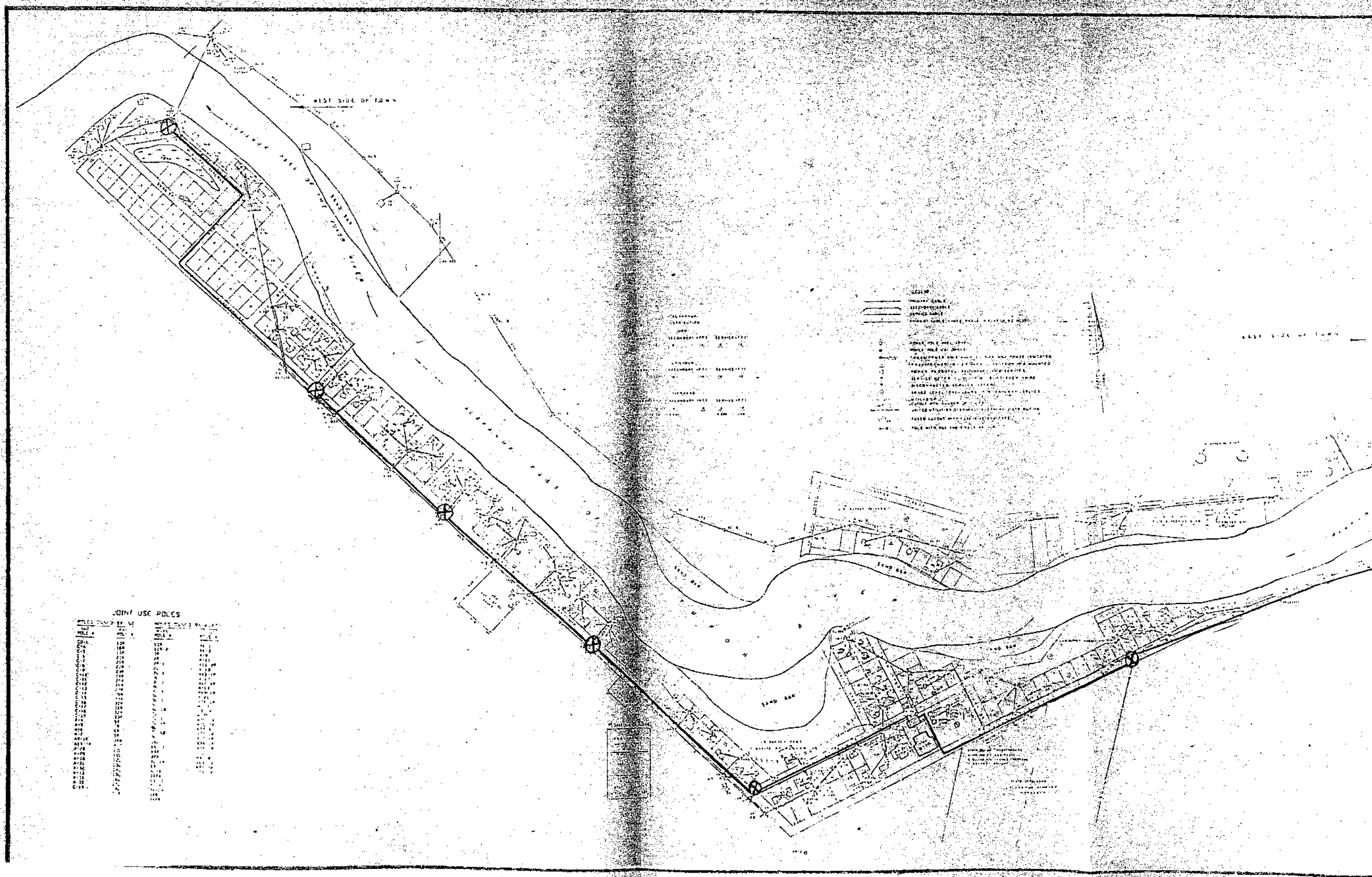
4
3
2
1
5

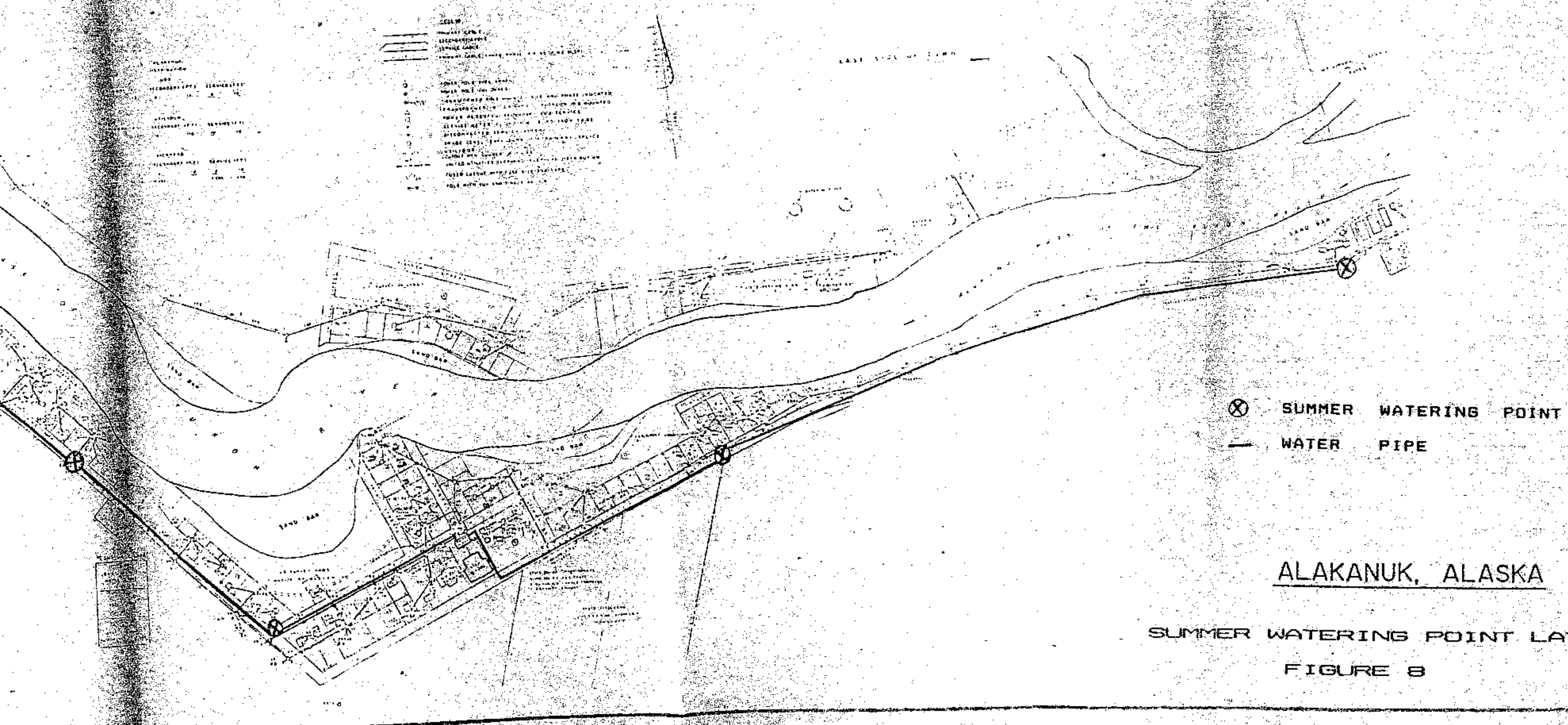


ALAKANUK, ALASKA

YEAR-ROUND WATERING POINT LAYOUT

FIGURE 9


WEST SIDE OF TOWN
EAST SIDE OF TOWN
JOINT USE POLES



ALAKANUK, ALASKA

SUMMER WATERING POINT LAYOUT

FIGURE 8

TABLE 4
ESTIMATED COSTS FOR YEAR-ROUND WATERING POINTS

Capital Costs

Item	Quantity	Installed Unit Cost $	Total Cost $
Pumphouse Modifications	1	25,000	25,000
Year-round Watering Point	7	6,400 each	44,800
4 inch insulated, anchored PE Pipe	29,540 ft	85/ft	2,510,900
Engineering at 12%			309,684
Contingency at 10%			289,038
TOTAL			$ 3,179,422

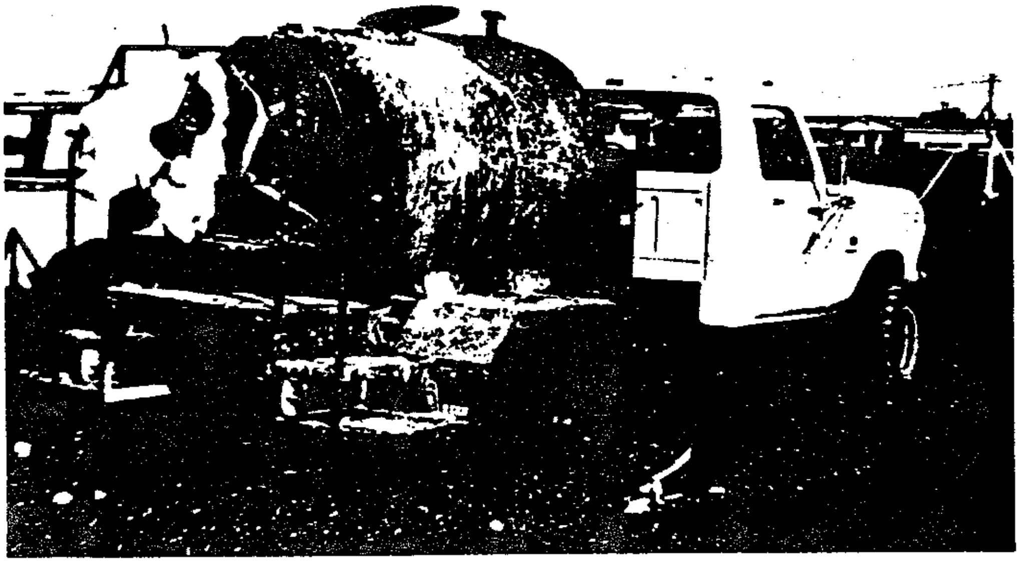
Increased Yearly Operation & Maintenance

Labor	300 hr	12/hr	3,600
Electricity	3,500 kWh	.34/kWh	1,190
Repairs	6	3,000	18,000
Fuel	700 gal	1.50/gal	1,050
Pump Replacement Fund	1	1,000	1,000
TOTAL			$ 24,840

TABLE 5
YEAR-ROUND WATERING POINT CAPITAL COSTS BROKEN DOWN BY POINTS

Watering Point	Pipe (ft)	Cost $	Cost with Eng.& Cont. $	Location
1	2880	251,605	308355	Osler & Anderson
2	3200	279,561	344419	Between Fourth & Fifth
3	3960	345,957	426219	Between Fifth & Sixth
4	2880	251,605	308355	Seventh & Anderson
5	3720	324,999	400396	Anderson & First?
6	5700	497,969	613498	West Bend St
7	7200	629,013	777758	Native Store East of town
TOTAL	29,540 ft	2,580,709	$3,179,422	

Honeybucket Haul:
For pickup of honeybucket wastes, a heavy duty four wheel drive truck with at least a 500 gallon tank is needed. The wastes would be picked up at each house and poured in the tanker truck (Figure 10). The use of a truck with a holding tank should eliminate the spillage problems that were the downfall of the first haul system tried in Alakanuk. The truck would dump the waste into the sewage lagoon, which would have to be enlarged. Completion of the second cell should provide sufficient lagoon surface area and volume. A new garage must be built or the old garage renovated.



TRUCK FOR COLLECTING HONEYBUCKET WASTES, BARROW, ALASKA

FIGURE 10

TABLE 6
ESTIMATED COSTS FOR HONEYBUCKET HAUL

Capital Costs

Item	Quantity	Installed Unit Cost $	Total Cost $
Honeybucket Haul Truck	1ea	50,000	50,000
Lagoon Modifications	1ea	70,000	125,000
Truck Garage	1job	75,000	75,000
Engineering at 12%			30,000
Contingency at 10%			25,000
TOTAL			**$ 305,000**

Yearly Operation & Maintenance

Item	Quantity	Installed Unit Cost $	Total Cost $
Truck Replacement Fund*	1	11,000	11,000
Labor	3800 hr	12/hr	45,600
Fuel	350 gal	2.00/gal	700
Repairs/maintenance	1	4000	4000
Insurance-Liability	1	1150	1150
TOTAL			**$ 62,500**

*Assumes truck replaced every 4 years.

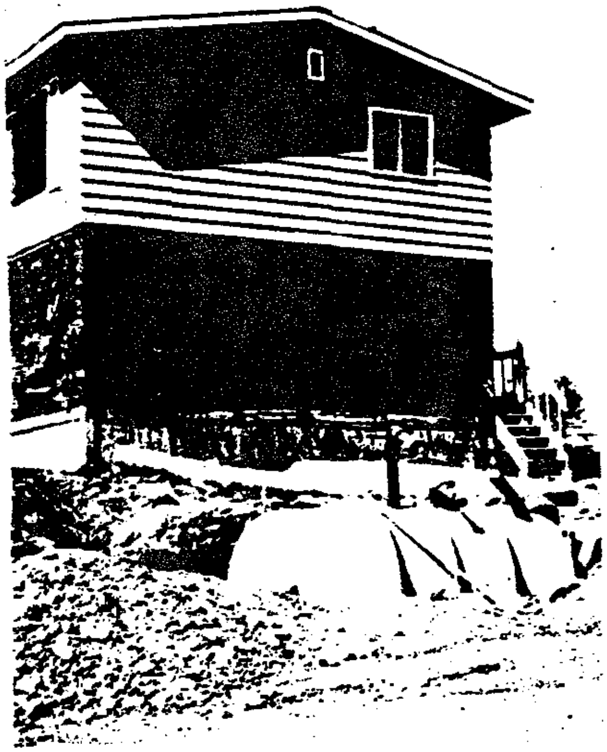
2. Trucked Water and Sewer:

General:

This option should be considered if the City of Alakanuk decides not to have piped water and sewer installed in the near future. The trucks and individual holding tanks represent a substantial investment which would be largely obsolete if a piped system was built.

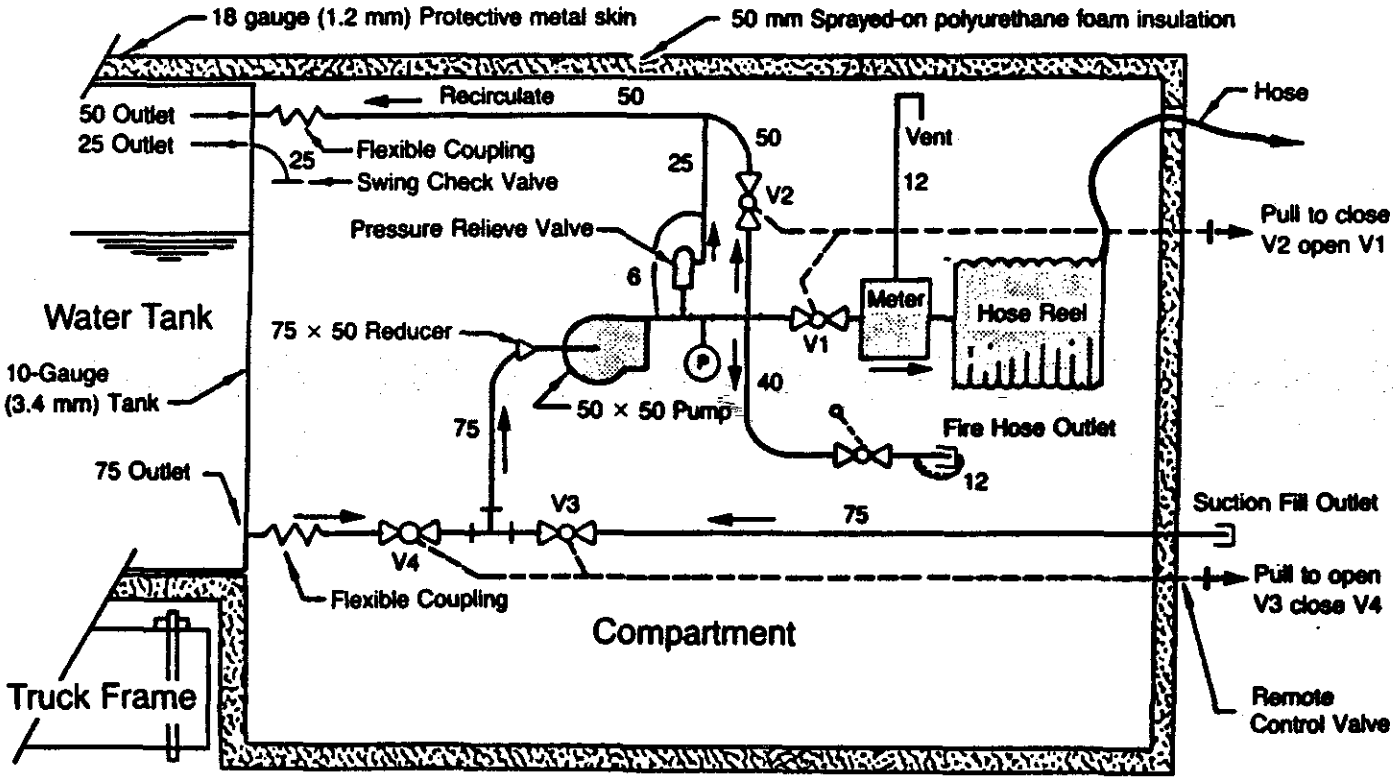
Under this system, each participating homeowner would have two insulated, heated tanks, one for water and one for wastewater (see Figure 11). The existing water truck could be used to get water from the washeteria and deliver it to the individual homeowners, pumping into their water tanks (Figure 12). Each home would be fitted with a low water use toilet, sink and shower. The wastewater would flow by gravity into the insulated holding tank and be pumped out periodically by the wastewater truck (Figures 13 and 14) into its tank and trucked to the sewage lagoon. Operation and maintenance costs for this type of system would tend to be high because the vehicles generally have a short life. There would probably be additional costs related to road improvement and maintenance. Garages must be built to house the vehicles.

Trucks: The efficiency and operation costs of this type of collection system depend on the size of the house and truck tanks, and on the hauling distance. The larger the truck tanks, the fewer trips, but the condition of the roads can limit the size of trucks used. The trucks should hold about 1000 gallons. Tanks on both trucks need to be insulated or surrounded by heated enclosures to keep the pump, piping and connections from freezing in the winter. The present water haul vehicle could be used as a back-up, but larger ones would probably be needed to do the bulk of the hauling.



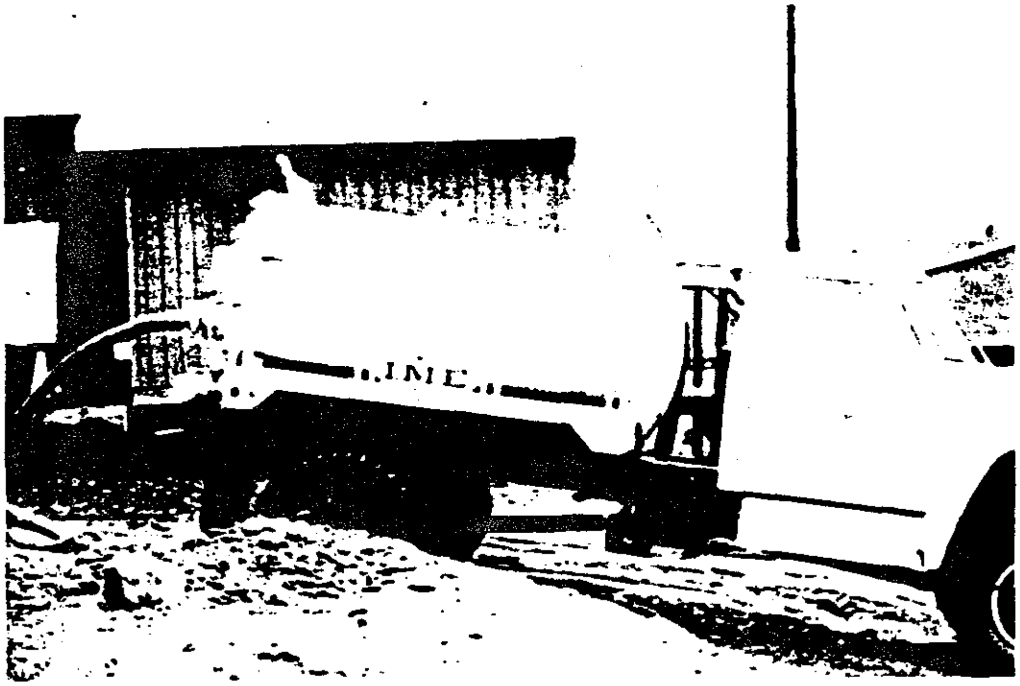
INDIVIDUAL HOUSE HOLDING TANK

FIGURE 11



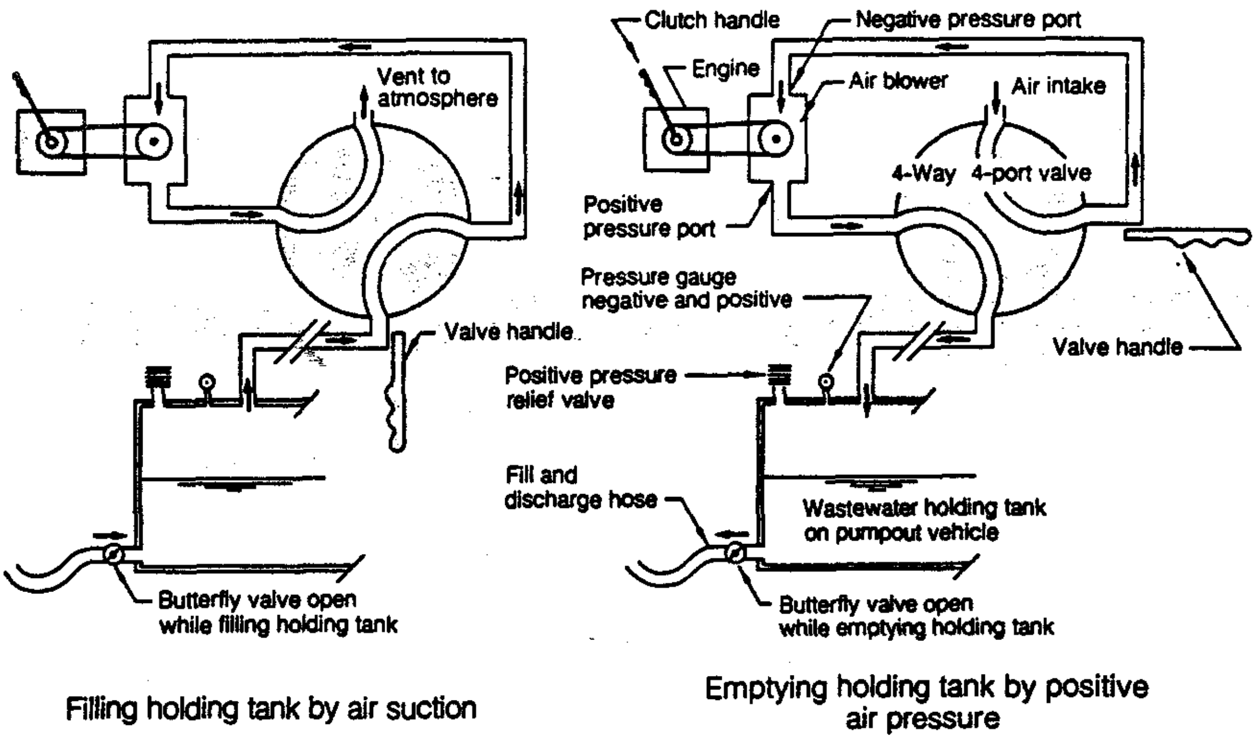
WATER DELIVERY TRUCK TANK PIPING AND EQUIPMENT DIAGRAM

FIGURE 12



VACUUM SEWAGE PUMPOUT VEHICLE

FIGURE 13



FILLING AND EMPTYING PROCEDURE FOR HOLDING TANK PUMPOUT TRUCKS

FIGURE 14

House Tanks: The house water tank should hold enough water for a 5 day supply and the sewage tank 7 days. The water and sewage tanks should have different sized hose connections to avoid mistaken cross connection. The extra structural support required in the house to carry the tank loads needs to be provided. The tank must have a large manhole with removable cover so that it can be easily removed and the tank cleaned out at least once a year to prevent buildup of solids in the bottom. The tanks must also be kept warm and well insulted to prevent freezing, either by being in or under a heated portion of the building, or by using heating coils.

Water Use and Lagoon Size: Water consumption would be no more than 35 gal/person/day and wastewater production no more than 25 gal/person/day. With a wastewater concentration of 200 mg/L, lagoon loading of 20 lb BOD/acre/day, and the design population of 750 people, the lagoon would need 1.8 acres of surface area. But for the lagoon to have enough volume for a 240 day retention, it would have to be 2.4 acres and 6 feet deep. This could be achieved by building a second, larger cell.

Costs: Costs for installing and running the system are shown in table 7. If funding isn't available for the full project, the city could start with just one water and one wastewater truck, serve only a portion of the city and expand as money becomes available.

TABLE 7
ESTIMATED COSTS FOR WATER AND WASTEWATER HAUL

Capital Costs

Item	Quantity	Installed Unit Cost $	Total Cost $
Water Haul Truck	2	50,000	100,000
Wastewater Haul Truck	2	50,000	100,000
House Water & Wastewater Tanks	110	4,500	500,000
Household Plumbing and Fixtures	110	4,000	440,000
Lagoon Modifications	1	170,000	170,000
Four Vehicle Garage	1	225,000	225,000
Engineering at 12%			184,200
Contingency at 10%			153,500
TOTAL			**$1,872,700**

Yearly Operation & Maintenance

Item	Quantity	Unit Cost	Total Cost
Truck Replacement Fund*	1	52,000	52,000
Labor	10,400 hr	12/hr	124,800
Fuel	2,400 gal	2.00/gal	4,800
Repairs/maintenance	4	2,500	10,000
Insurance-Liability	1	1500	1,500
TOTAL			**$193,150**

*Assumes trucks replaced every 4 years.

3. Piped Water and Sewer

A piped water and sewer system would provide the best level of service for the community, but it would also be the most expensive to install. The system could be installed in phases, as money is available. When water lines are installed, sewer lines need to be installed also.

Water consumption:
Water use in Alaska varies widely with the availability and cost of water, the type, size and location of the community, and the culture. Total community use ranges from 15 to 130 gallons per capita per day when a piped system is used. Water use in Alakanuk will probably be somewhere in the middle of that range. Initial water consumption will be lower, but increase as the residents become accustomed to a dependable, high quality water supply. Assuming that low water use fixtures will be installed and that few families own washing machines, the average daily per capita water consumption can be kept below 65 gallons. Water system design flows for both the present design population and the 20 year design population are shown in table 8.

Table 8
Piped Water System Demand

Period of Demand	Present		Future	
(Peak Factor)	gpm	MGD	gpm	MGD
Average (1.0)	26	.0374	34	.0488
Maximum Hour (3.0)	78	.1121	100	.1462
Maximum Day (2.0)	52	.0748	68	.0975

Sewage Production & Lagoon Size:
If the daily per capita consumptive use is 65 gallons, the daily per capita wastewater discharge would be about 55 gallons. Assuming a BOD concentration of 200 mg/L, and loading of 20 lb/acre/day, a minimum surface area of 3.5 acres is needed. But this wouldn't provide enough volume capacity for a 240 day retention time. For that, the lagoon would have to be 5 acres and 6 feet deep.

Water Distribution:
To keep water distribution systems from freezing when exposed to arctic environments, circulating water mains have been used successfully in many northern communities. This approach could be used for water delivery in Alakanuk. Circulating pumps would be necessary to circulate water through the mains and back to the pumphouse for reheating. The pumps are sized to circulate the water at a velocity that would return it to the pumphouse before its temperature drops to freezing. The water heating boiler is sized to provide enough heat to prevent the water from freezing during extremely cold temperatures and to remain efficient when only small amounts of heat are needed. The heat control system should be automatic and only add heat when absolutely necessary. Maintenance would in part consist of servicing and monitoring of boiler operation. The operator of the water plant could do these tasks.

Three types of house service connections have been installed in other communities having circulating water mains.

1. Dual-Pipe system (hi/low pressure lines):
This type of system consists of a large diameter water supply line and a small-diameter return line. Service lines tap into the main and water is returned via the return line of the service connection by the pressure differential between the two mains. Control mechanisms for this type of system tend to be difficult, because varying consumption in different locations results in fluctuating pressure and flow rates in the supply and return mains. See figure 15 for dual-pipe system with vacuum sewer utilidor.

2. Extended Mains:
In an extended main distribution system, the water main runs directly to every house. Service lines are short and do not circulate. The major advantages to this system are that water in the main doesn't have to be circulated as much as with the pitorifice system, therefore pumping costs are lower, and that the short service lines are usually within the heated subfloor of the house and are better protected from freezing. The disadvantages of the extended main system are that is requires cutting into the main and extending it for each new house connection and that in most cases, the main doesn't follow rights-of-ways, but must cross through each served lot. New construction can be planned to minimize the visual impact and the obstructiveness of the main.

3. Pitorifice Connections:
In a system using a pitorifice connection to the main, individual service lines are typically around 70 feet long. The water service connection is a loop of 3/4 or 1 inch line inside a utilidor or an insulated pipe that leads to the house from the main. The pitorifice is the special connection between the main and service line that allows circulating water to be driven from the main through the service line loop and back to the main. The primary advantage of this system is the ability to keep the water mains in designated city rights-of-ways, although above ground service lines would cut through the homeowner's property. Also, future connections are easily accomplished by merely adding service saddles to the main rather than by cutting and adding main for each new home served. The major disadvantage to using the pitorifice connection is that the circulation rate of the main must be much higher than that of the extended main in order to drive the water through the service line loop. If homeowners run water continuously rather than plug in electric heat traces, expensive treated water is wasted.

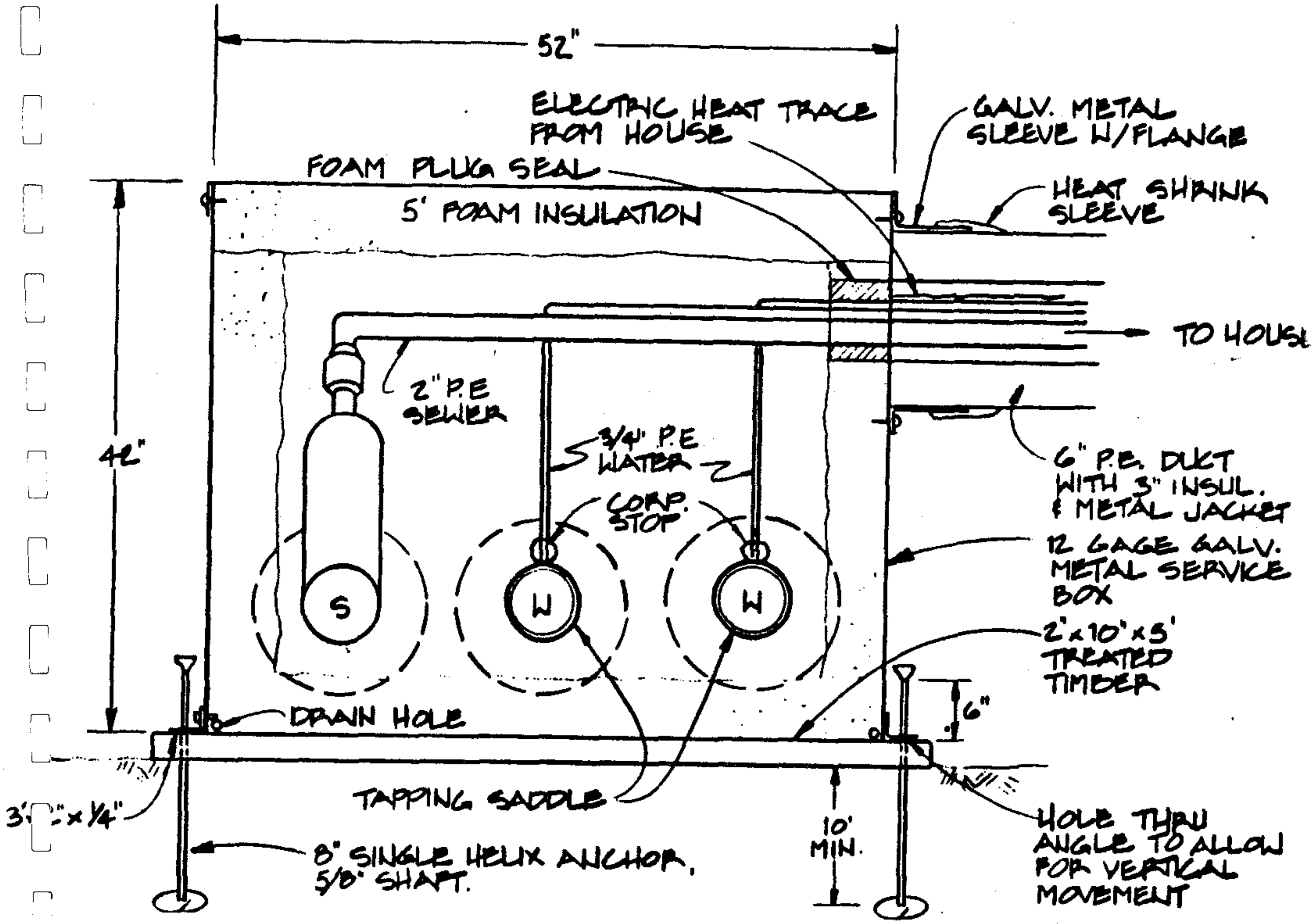


FIGURE 15 UTILIDOR CROSS-SECTION

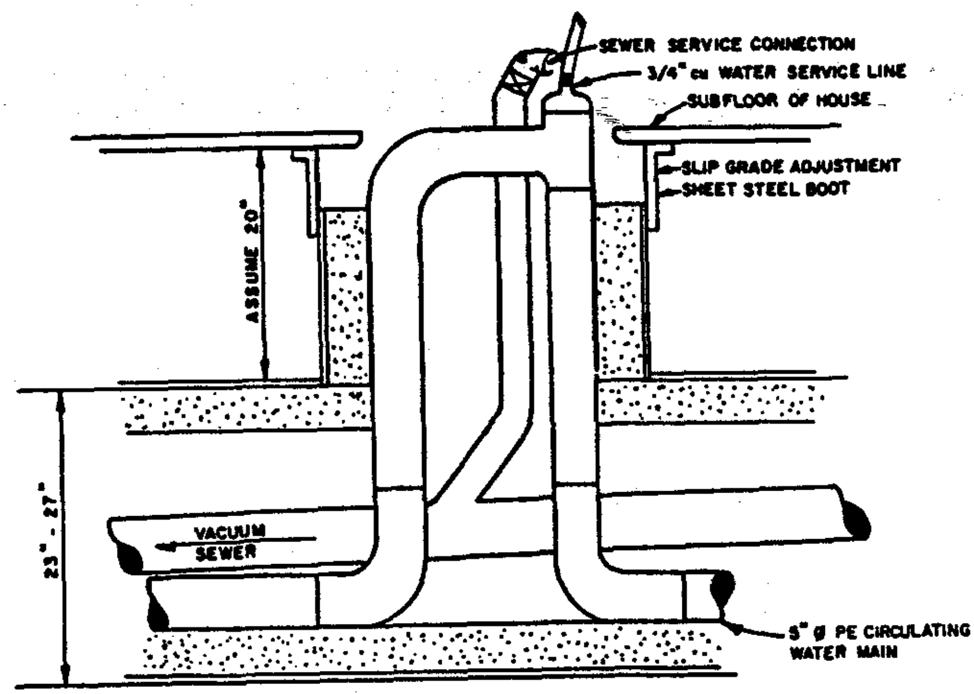
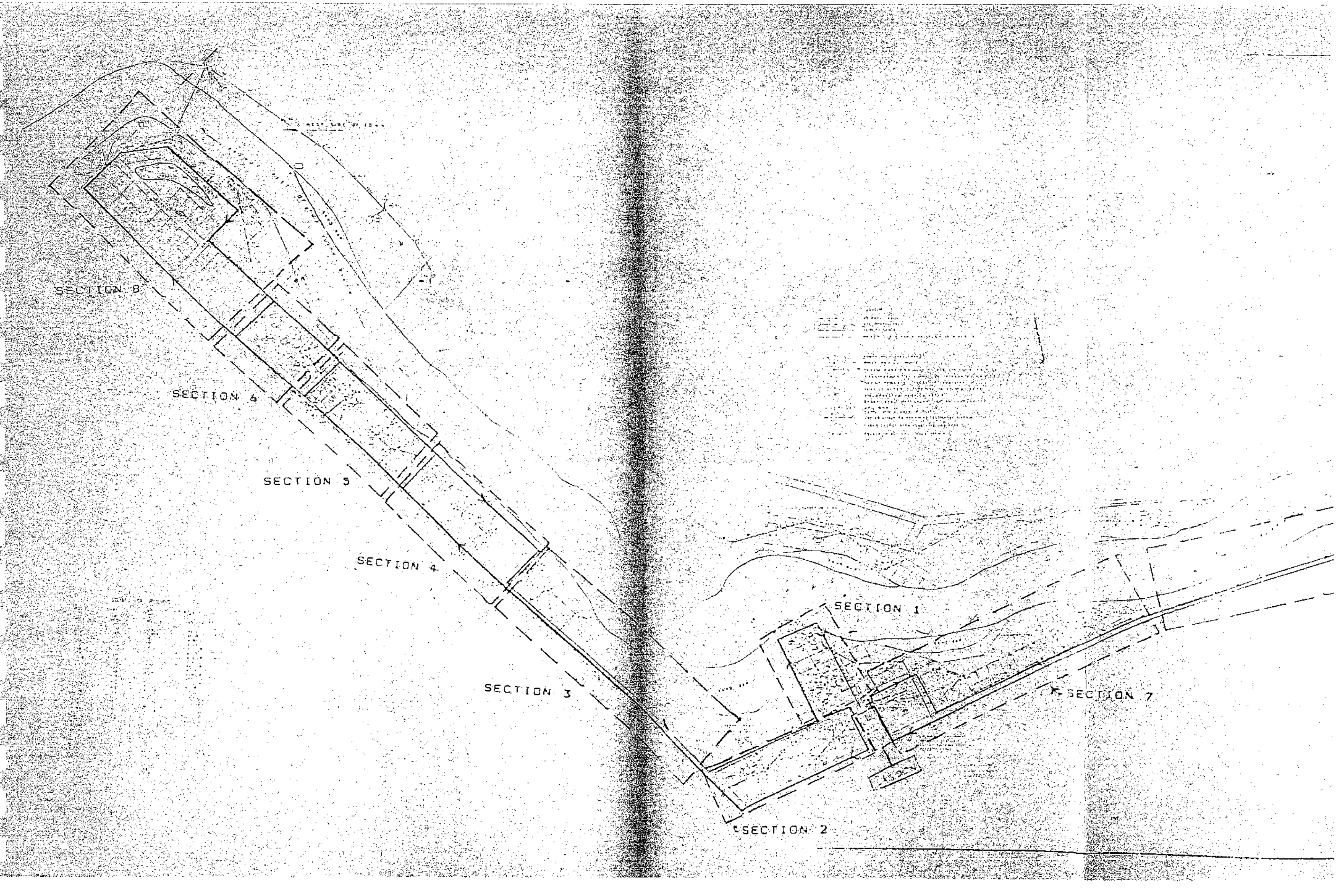


FIGURE 16 SERVICE CONNECTION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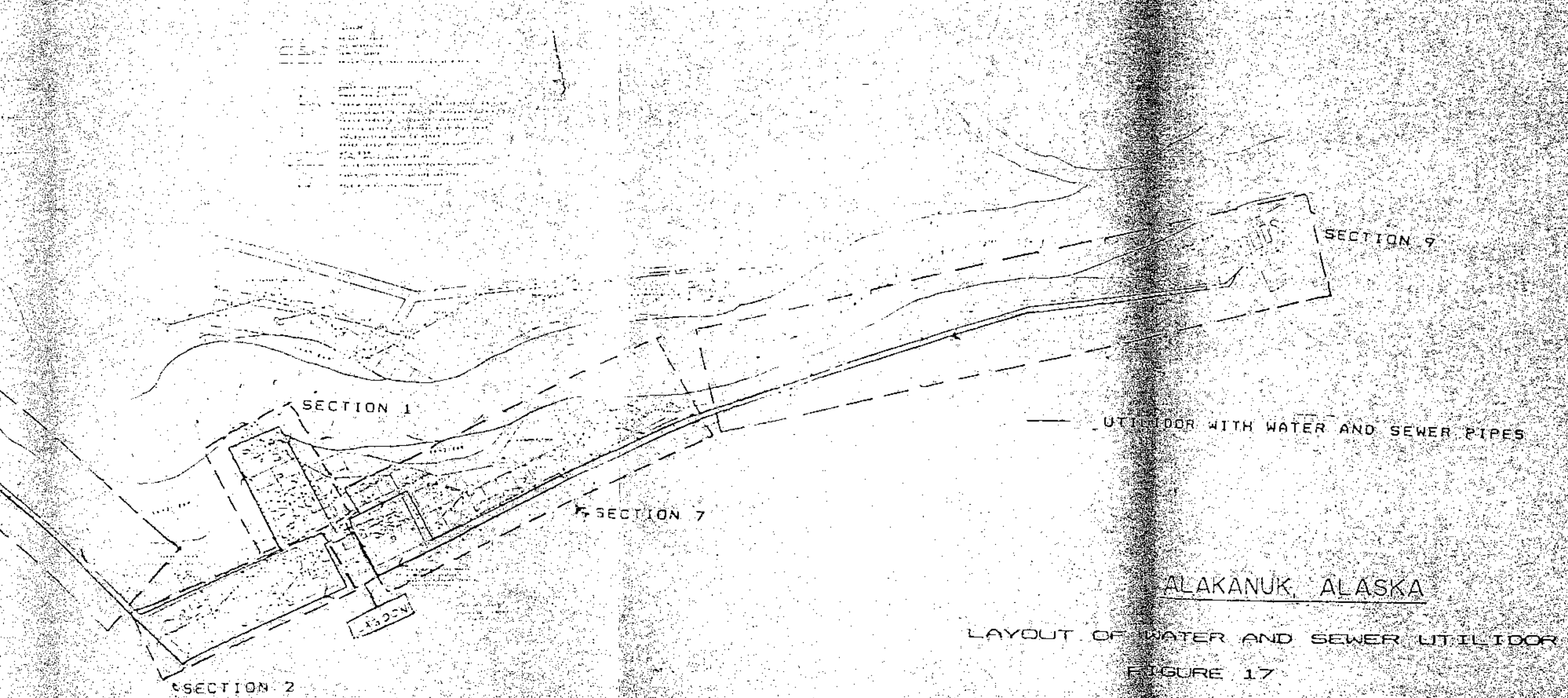


ALAKANUK, ALASKA

LAYOUT OF WATER AND SEWER UTILIDOR

FIGURE 17

Sewage Collection:

Due to the lack of topographical relief and poor soil conditions in Alakanuk, gravity dependent sewage collection is not feasible. There are two piped system alternatives; they are pressure and vacuum sewage collection. The relative advantages and disadvantages of each sewer system are shown in Table 10. One drawback to both of these systems is that they can't operate when the community power system fails.

A. Vacuum Sewage Collection:

In a vacuum collection system, the collection main is kept at a constant vacuum. Figures 15 and 16 show a typical utilidor cross-section and service connection. Household wastes are automatically released into the system through special vacuum seal valves along with a small charge of air. The air flows through the line, pushing the wastes along the main to a central collection point. Wastes are then pumped to the final treatment or disposal point. In Emmonak, close to Alakanuk, installation of a water system with a vacuum sewer system cost $10 million, and operation and maintenance costs $120/month/household. Approximate costs for the whole town are given in Table 9. The system could be built in phases as shown in Figure 17, and described in Table 12, with the costs broken down in Table 11. Even if built in phases, the initial costs of the vacuum station, and pumphouse and lagoon modifications wouldn't vary.

TABLE 9

ESTIMATED COSTS FOR PIPED WATER AND VACUUM SEWER

Capital Cost Item	Quantity	Installed Unit Cost $	Total Cost $
Pumphouse Modifications	1	50,000	50,000
Lagoon Modifications	1	430,000	430,000
Vacuum Station	1	250,000	350,000
Anchored Utilidor	31,000 ft	190/ft	5,890,000
Household Plumbing & Fixtures	115	8,800	1,012,000
House Service Connections	115	4,500	517,500
Sub-total			8,249,500
Engineering at 12%			989,940
Contingency at 10%			991,140
TOTAL			**$10,230,580**
Yearly Operation & Maintenance			
Water			
Labor	2080 hr	$12/hr	24,960
Utilidor Heating	9,600 gal	1.50/gal	14,400
Emergency Repairs	3 job	5,000	15,000
Electric	34,400 kWh	.34/kWh	11,696
Heating Fuel	7,130 gal	1.50/gal	10,700
Miscellaneous	1	3,500	3,500
Circulating Pump Replacement Fund	1	2,200	2,200
Sewer			
Labor	2080hr	$12/hr	24,960
Electric	18,000 kWh	.34kWh	6,120
Heating Fuel	400 gal	1.50/gal	600
Miscellaneous	1	3,500	3,500
Pump Replacement Fund	1	1,700	1,700
TOTAL			**$119,336**

PRESSURE SEWAGE COLLECTION		VACUUM SEWAGE COLLECTION	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
1. Operates independent of major grade changes compared to vacuum system	1. Structural modification may be required to support house lift station	1. Uses minimum amount of water for blackwater transport	1. Relatively complex community operational requirement
2. Will transport larger volumes of wastewater compared to vacuum system	2. Requires qualified operational personnel available to homeowner for pump maintenance	2. No power source is required in home for fixture operation-all valves are air operated	2. Requires qualified personnel to operate
3. Lower electrical operational cost compared to vacuum system	3. Power source required in each house to operate system	3. Complexity of operation is under community responsibility	3. Requires back-up power supply, pumps, and heating for community facilities
	4. Maximum complexity for individual homeowner	4. Sewer mains operate under vacuum and minimize danger of contamination of utilidor or water system in cross connection situation	4. System requires second pump station to discharge liquids from vacuum tank
	5. Requires back-up individual pumps and heating of utilidor	5. Structural modifications to existing homes are minimized	
	6. Water and sewer mains in common utilidor may not meet State codes	6. Vacuum valve components are easily changed	
		7. Sewage discharge lines can be surface mounted near ceiling of home if necessary	

Comparison of Vacuum and Pressure Sewage Collection Systems

TABLE 10

TABLE 11
BREAKDOWN OF PIPED WATER AND VACUUM SEWER SYSTEM COSTS BY SECTION OF CITY

Section of City	Number of Connections	Pipe (ft)	Pipe Cost $	Service Connect. $	All other non-eng. costs $	SUB-TOTAL $	TOTAL WITH ENG. & CONT. $
1	9	1910	372400	40500	168678	581,578	740,000
2	7	2560	486400	31500	151100	669,000	831,675
3	25	4200	798000	112500	309450	1,219,950	1,510,500
4	18	2880	547200	81000	247875	876,075	1,086,800
5	13	2450	465500	58500	203900	727,900	904,250
6	10	1660	315400	45000	177500	537,900	670,200
7	16	5030	955700	72000	230250	1,257,950	1,557,300
8	12	3990	758100	54000	195000	1,007,100	1,248,300
9	5	6400	1216000	22500	133547	1,372,047	1,681,555
TOTALS	115	31130	5914700	517500	1817300	8,249,500	10,230,580

TABLE 12
DESCRIPTION OF CITY BREAKDOWN FOR WATER AND SEWER

City Section Served	Description of Section
1	North of water plant, between Front and Third streets
2	West of Water Plant, to point where Anderson St turns
3	From turn at Anderson to Fifth St
4	Between Fifth and Sixth St
5	Between Sixth and Seventh St
6	Between Seventh and Eighth St
7	East of water plant, to houses just past First(?) St
8	Between Eighth and Tenth St
9	East to Native store

B. Pressure Sewage Collection:

In a pressure collection system, the collection main is under constant pressure. The primary cost of operating the positive pressure sewer system is heating the mains. Unlike the water system, the sewer mains wouldn't circulate, and the sewage must be kept above freezing by using a heat trace or a "bleed" system. Due to the cost of bleeding treated water, heat tracing is probably the most economical solution, and is assumed for the cost estimate. In the final design, both bleeding and heat tracing should be considered as should the possibility of using waste heat from the AVEC generators. Each household in Alakanuk would be equipped with a collection tank and small grinder pump (Figures 18-20). The pumps would activate individually when a large enough volume of wastewater had been collected in the sump. They must be installed lower than the building plumbing fixtures, and still be accessible for maintenance and repair. The grinder pumps must also well insulated and heated to protect them against freezing. Costs associated with the grinder pumps are the power requirement for daily operation, regular inspection, and repair every 5 to 10 years. Again, the system could be built in phases as shown in figure 17, with total costs in table 13, and broken down costs in table 14. The pumphouse and lagoon modifications must be included in phase 1, and homes not served should have honeybucket haul service.

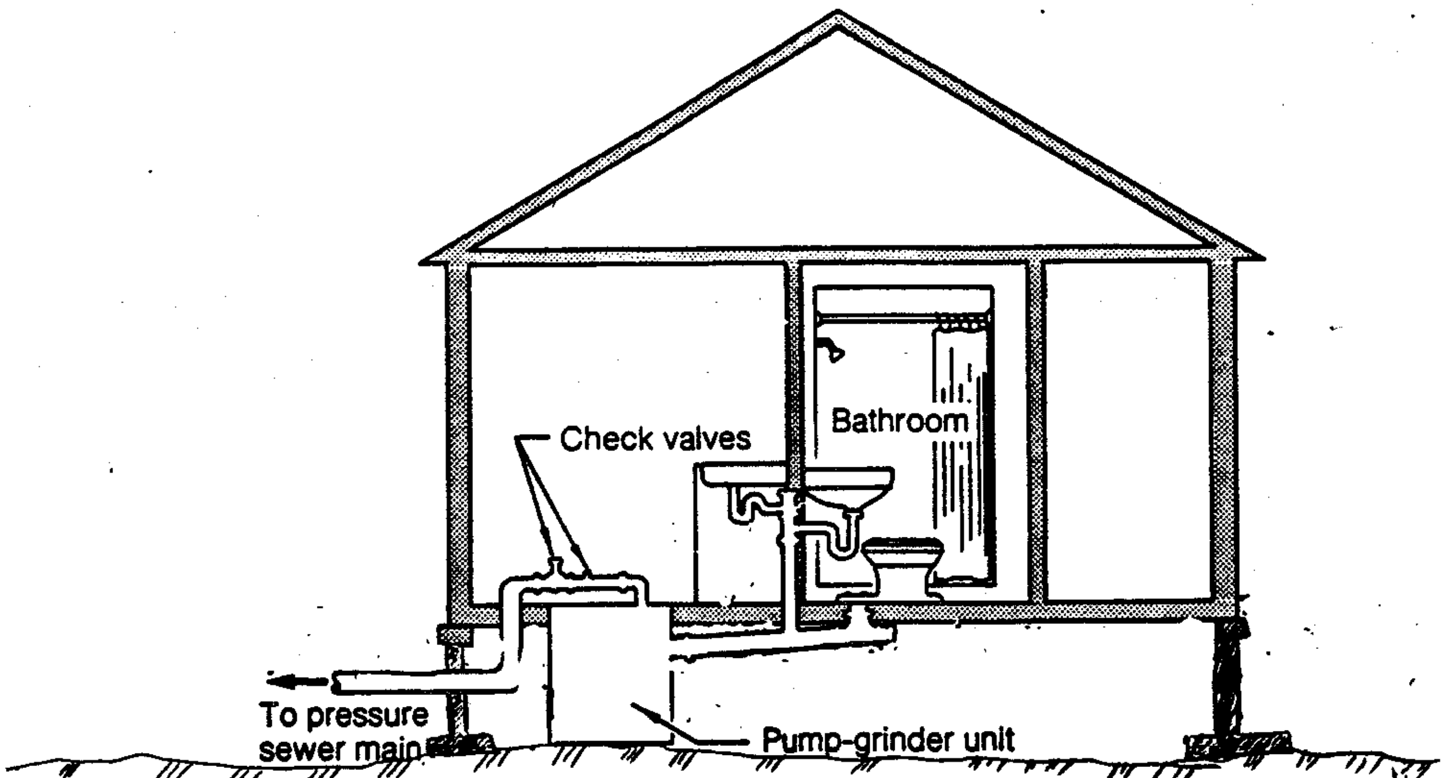
TABLE 13
ESTIMATED COSTS FOR PIPED WATER AND PRESSURE SEWER

Capital Costs

Item	Quantity	Installed Unit Cost $	Total Cost $
Lagoon Modifications	1 job	430,000	430,000
Pumphouse Modifications	1 job	50,000	50,000
Anchored Utilidor	31,000ft	190/ft	5,890,000
Sump/Grinder Pump	115ea	3,400/home	391,000
House Service Connection	115ea	4,500/home	517,500
Household Plumbing and Fixtures	115ea	4,000/home	460,000
Engineering at 12%			928,620
Contingency at 10%			866,712
TOTAL			**$9,533,832**

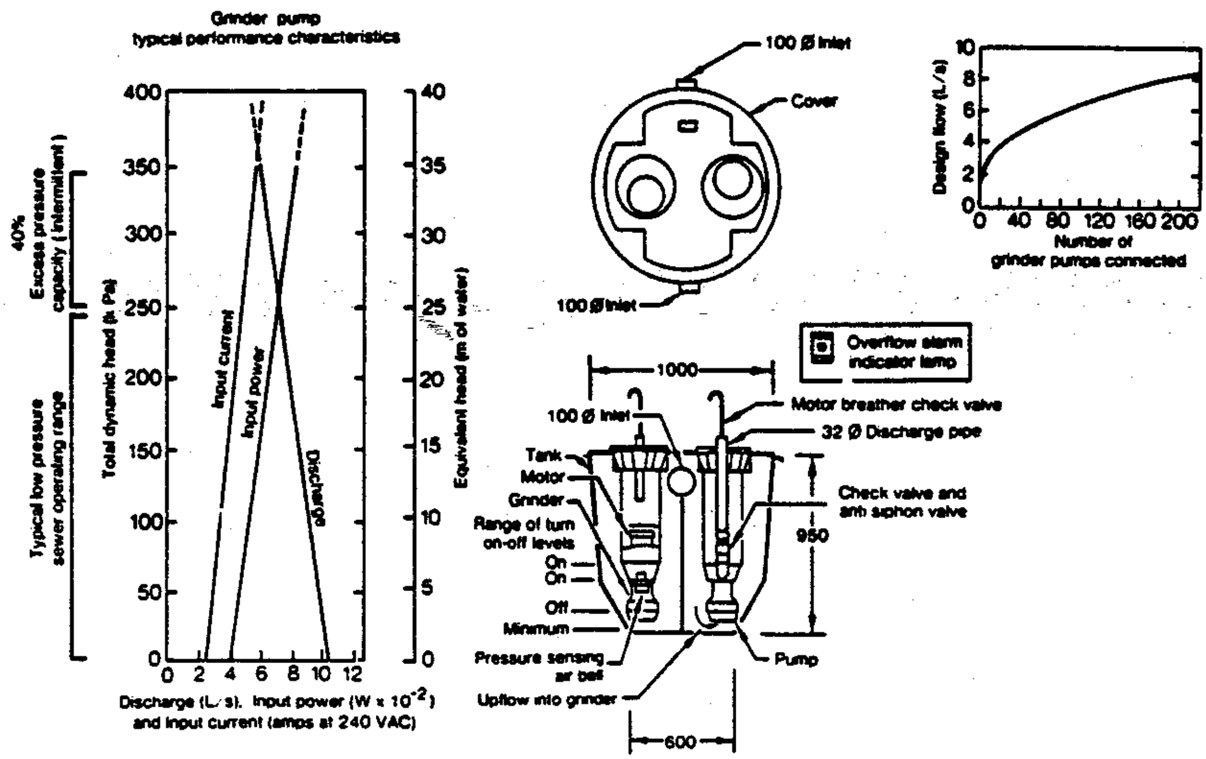
Yearly Operation & Maintenance

Item	Quantity	Unit Cost	Total
Water			
Labor	2080 hr	$12/hr	24,960
Utilidor Heating	9,600 gal	1.50/gal	14,400
Emergency Repairs	1 job	5,000	5,000
Electric	34,400 kWh	.34/kWh	11,696
Heating Fuel	7,130 gal	1.50/gal	10,700
Miscellaneous	1	3,500	3,500
Circulating Pump Replacement Fund	1	2,200	2,200
Sewer			
Labor	2080hr	$12/hr	24,960
Grinder Pump Operation & Maintenance	115 pumps	81/pump	9,315
Sewer Line Heating	31,000 ft	1.60/ft	49,600
TOTAL			**$156,331**



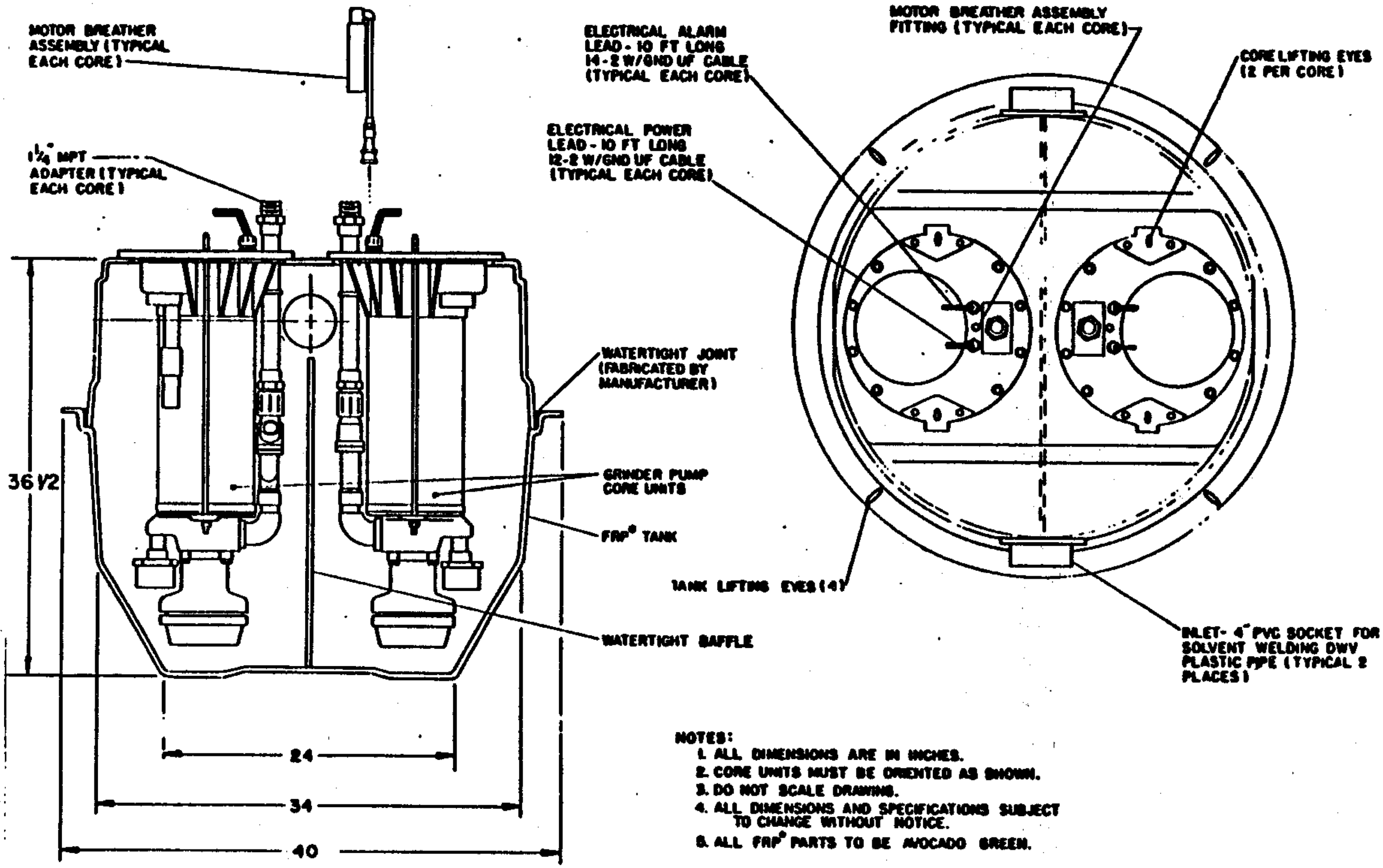
TYPICAL PUMP-GRINDER INSTALLATION

FIGURE 18



PUMP-GRINDER CHARACTERISTICS
(adapted from Environment/One Corp. Ltd.)

FIGURE 19



NOTES:

1. ALL DIMENSIONS ARE IN INCHES.
2. CORE UNITS MUST BE ORIENTED AS SHOWN.
3. DO NOT SCALE DRAWING.
4. ALL DIMENSIONS AND SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
5. ALL FRP* PARTS TO BE AVOCADO GREEN.

*FRP - FIBERGLASS REINFORCED POLYESTER

DIAGRAM SOURCE: Grinder Pumps for Low Pressure Sewer Systems, Environment One Corp., New York, 1978.

TYPICAL GRINDER PUMP UNIT

FIGURE 20

TABLE 14

BREAKDOWN OF PIPE WATER AND PRESSURE SEWER SYSTEM COSTS BY SECTION OF CITY

Section	Number of Connections	Pipe (ft)	Pipe Cost $	Service Connect. $	All other non-eng. costs $	Sump Pump $	TOTAL $	TOTAL WITH ENG.&CONT. $
1	9	1960	372400	40500	86600	30600	530100	652712
2	7	2560	486400	31500	78000	23800	619700	764087
3	25	4200	798000	112500	150500	85000	1146000	1401053
4	18	2880	547200	81000	122000	61200	811400	1001529
5	13	2450	465500	58500	102000	44200	670200	826037
6	10	1660	315400	45000	91000	34000	485400	597619
7	16	5030	955700	72000	111000	54400	1193100	1473095
8	12	3990	758100	54000	98500	40800	951400	1171854
9	5	6400	1216000	22500	75700	17000	1331200	1645846
TOTALS¦	115	31130	5914700	517500	915300	391000	7738500	9533832

Recommendations

The installation of a complete high level-of-service water and sewer facility may require a multi-step process and it is likely that all of the steps would take several years to accomplish. The steps are listed below could be undertaken by the City of Alakanuk.

1. At this point in time, the water delivery system seems to be working well, the most pressing problem that the city needs to address is indiscriminate honeybucket dumping. A honeybucket haul system would be the quickest and least expensive system that could be developed to address this problem. The other two wastewater disposal options, piped sewer or trucked haul service with individual holding tanks, could be built in sections as the need and funds dictate.

2. Piped water and sewer maybe the best solution for a city the size of Alakanuk from a sanitary point of view, but not necessarily from an economic standpoint. The community must establish this project as their priority for several years. They must determine if they can obtain the money necessary to install this type of system. If not, then the trucked water and wastewater is probably the best solution. The total cost of this type of system would be approximately $1.9 million (Table 7).

3. The community may elect to start a piped utility system by building year-round watering points with circulating water pipes that can later be incorporated into the water and sewer system. As stated earlier in this report there is a potential for flood and ice damage with above ground pipes. A detailed study would be required to aid in flood protection.

4. The next step would be to design and construct a portion of the proposed water and sewer improvements in an area having the highest development density and greatest number of potential customers. This would be section 1 shown in figure 17.

5. After an evaluation of the performance of this initial section, the system could be expanded into other areas having an adequate number of potential customers, starting with section 2, then section 3 and so on. The total cost of the system would be around $10 million if all sections of the city were developed (Tables 9-14).

Conclusions

Piped water and sewer is feasible, and may be the best solution to the community's sanitation problems, but it would be very expensive. The capital cost to provide the entire city with service would be approximately $10 million, though the cost could be lowered if some outlying areas were not served. The cost to operate this type of system would exceed $100 per family per month. This fee is in excess of what a survey of the community's residents indicated they could pay.

An alternative to a piped system would be a water and wastewater haul system to service the entire community for approximately $1.9 million.

Table 15 on the following page summarizes and compares the capital and operational costs of the systems covered in this report. The capital and operational cost estimates included in this report can be used to decide which option to pursue. Regardless of which option is chosen, a source of funding must be found to finance the sanitation facilities required for Alakanuk. The project could be done in phases as funding permits. Some phasing schemes have been included in the report, but other alternatives are certainly possible.

TABLE 15 TABLE OF SYSTEM SUMMARY/COMPARISON

SYSTEM DESCRIPTION	CAPITAL COST (rounded)	INCREASE ANNUAL O&M COST	INCREASED ANNUAL/ (MONTHLY) O&M COST PER HOUSEHOLD
Summer watering points	$139,000	$2,418	$24 ($2)

Advantages: Increased water distribution during the summer months. Residents would have easier access to water during the summer months.
Disadvantages: This option does not address the sewage disposal problem that exists in the community. Water distribution would not be improved in the winter months.
Summary this option: The slight increase in service provided under this option would not satisfy the community desire for upgraded service and does not address the pressing problem sewage disposal.

SYSTEM DESCRIPTION	CAPITAL COST	INCREASE ANNUAL O&M COST	PER HOUSEHOLD
Year-round watering points	$3,179,400	$24,840	$248 ($21)

Advantages: Improved year-round water distribution system would provide the community would easier access to water all year. Improvements made under this project could be used in future water development projects; the arctic pipe and the plumbing modifications in the pumphouse could be used in a piped system providing service to individual houses.
Disadvantages: This option does not address the sewage disposal problem that exists in the community.
Summary this option: This option would greatly improve the access most residents would have to their water supply and could be used as an intermediate step in a phased water development plan. Sewage disposal would continue to be a health problem in the community.

SYSTEM DESCRIPTION	CAPITAL COST	INCREASE ANNUAL O&M COST	PER HOUSEHOLD
Trucked honeybucket haul	$305,000	$62,500	$625 ($52)

Advantages: Addresses the sewage disposal problem that exists in the community. A tanker truck with a covered holding tank would eliminate the problem of sewage spillage as it is being hauled to the lagoon. This was a problem in the haul system that was previously operated in the community.
Disadvantages: Access to houses must be maintained year-round in order for the trucked service to operate properly. Snow removal would be essential in order for this system to operate properly. Truck maintenance would be required and is expensive. This option would not improve water distribution in the community
Summary this option: If properly operated this option could eliminate problems with sewage disposal in the community and could be used as a temporary measure until more funds are located for a higher level of service. This option does not improve the water distribution system in the community. Maintenance of the haul vehicles is expensive.

SYSTEM DESCRIPTION	CAPITAL COST	INCREASE ANNUAL O&M COST	PER HOUSEHOLD
Trucked delivery service for water and wastewater.	$1,873,000	$193,150	$1,932 ($161)

Advantages: Provides a relatively high level of service for a relatively low investment. This option would eliminate the sewage disposal problem.
Disadvantages: High operation and maintenance costs. Good road maintenance would be essential to effective operation of the system.
Summary this option: Operation and maintenance cost required for this option would be difficult to collect from the community. Phased development possible.

SYSTEM DESCRIPTION	CAPITAL COST	INCREASE ANNUAL O&M COST	PER HOUSEHOLD
Piped water and vacuum sewer	$10,231,000	$119,336	$1,193 ($99)

Advantages: Provides highest level of service. Phased development possible.
Disadvantages: Extremely expensive capital cost; approximately $100,000 per house.
Summary this option: Vacuum sewer technology is operating in near-by Emmonak. The villages could possibly share O&M responsibilities.

SYSTEM DESCRIPTION	CAPITAL COST	INCREASE ANNUAL O&M COST	PER HOUSEHOLD
Piped water and pressure sewer	$9,534,000	$156,331	$1,563 ($130)

Advantages: Provides highest level of service. Phased development possible.
Disadvantages: Extremely expensive capital cost; approximately $100,000 per house.
Summary this option: Slightly higher O&M costs than the vacuum sewer option.

REFERENCES

Ott Water Engineers, Inc., Alexander Lake Water and Sewer Study, Preliminary Report, Anchorage Alaska, August 1982, pp 17-22.

USPHS, Emmonak, Alaska. Conceptual design and cost study for piped community water and sewer service., Anchorage, Alaska, June 1983, pp 6-15.

Quadra Engineering, Inc., City of Goodnews Bay, Water Planning Study, Anchorage, Alaska, January 1985, pp 1,34-35,71-73.

Alaska DOT, Materials Section, Engineering Geology and Soils Report, Anchorage, Alaska, March 1988.

U.S. Dept of Interior, MMS, Village Economics in Rural Alaska, Anchorage, Alaska, November 1988, pp 23-45.

D.W. Smith et al, Cold Climate Utilities Manual, 1986, Sections 8 & 9.

APPENDIX A

SOIL INFORMATION & WELL LOGS

Alakanuk, Alaska

WELL LOG

U.S. PUBLIC HEALTH SERVICE, DIVISION OF INDIAN HEALTH

LOCATION Abandoned BIA School Well DATE STARTED 8-13-62

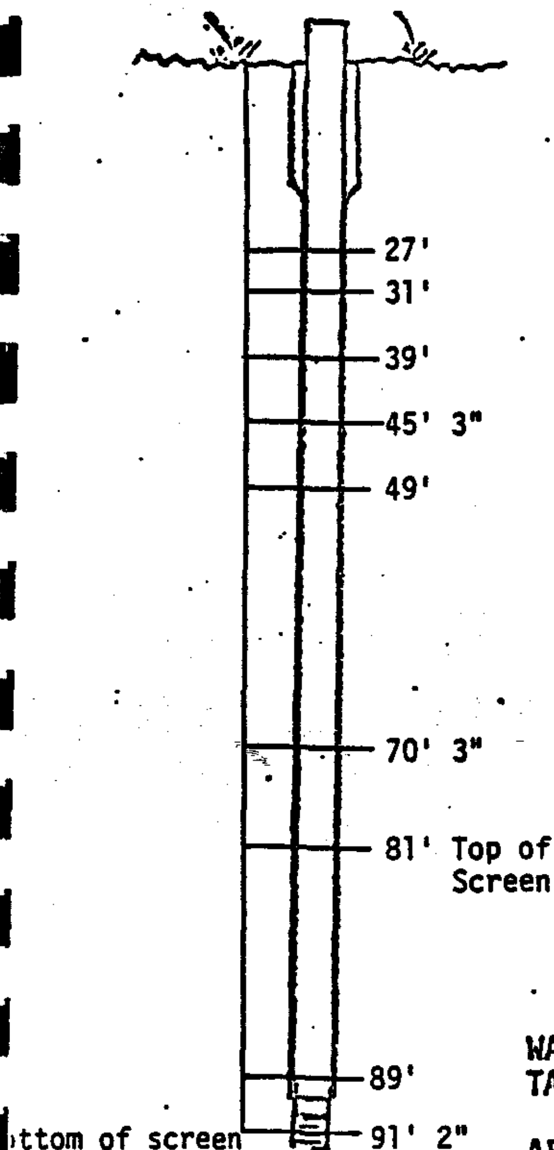
DATE COMPLETED 8-31-62 CREW Russell Cotten

TOTAL DEPTH OF WELL 89' FT. CASING INSTALLED 91' 2" DIAMETER 4"

GROUT - SCREEN SIZE .010 MFG. - LENGTH 10' 2'

STATIC WATER LEVEL 3'6" ground HRS. PUMPED - @ - GPM DRAWDOWN - FT

DEVELOPMENT PROCEDURES -



DATE	DEPTH FROM - TO	FORMATION
	0' - 27'	Thawed grey clay, hard sand
	27' - 31'	Fine sand
	31' - 39'	Pure grey sand
	39' - 45' 3"	Dark grey sandy mud
	45' 3" - 49'	Dark grey sandy mud
	49' - 70' 3"	Fine grey sand
	70' 3" - 89'	Fine sand

WATER DATA FIELD TEST

TASTE ____ APPEARANCE FRESH Dark Brown

AFTER 24 HOURS ____ IRON ____ CHLORIDES ____

TDS ____ ALKALINITY ____ pH ____

SPECIAL NOTES:

Test pumped at an unknown rate, but rate known to be greater than 5 gpm. Water dark brown when boiled, produced a dark brown, precipitate, greasy

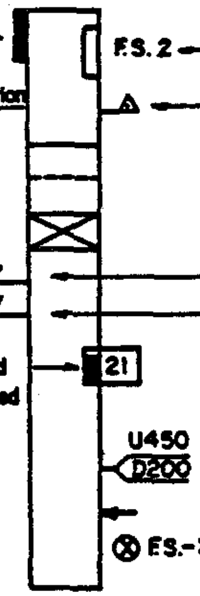
2/1/85

TEST PIT AND TEST HOLE LOG EXPLANATION

STATE OF ALASKA

DEPARTMENT OF TRANSPORTATION & PUBLIC FACILITIES   MATERIALS SECTION

- T.H. or T.P. — Test Hole or Test Pit Number
- Location — Sta. 15+00, 15'Rt — Offset from ℄
- Elev. 86.5' — Elevation
- 4/10/84 — Date drilled or excavated



- Frozen
- F.S. 2 — Field Sample — Grl Sa Si — ADOT & PF Laboratory Soil Classification
- Moisture Sample

Soil Size Distribution

22% Grl
35% Sa
43% Si/Cl

- Indicates strata contact
- Approximate strata contact
- Transitional soil change
- 7.0' — Water table depth while drilling
- 8.5' — Water table depth after drilling
- Interval Sampled w/recovery shaded — 21 — Standard Penetration Test "N" value given in blows/foot
- U450 — Undisturbed vane shear in lbs./sq.ft.
- D200 — Remolded vane shear in lbs./sq.ft.
- Denotes depth at which auger reaction indicates presence of cobbles /boulders
- ⊗ F.S.-2 — Similar to Field Sample 2
- B.O.H. or B.O.P. — Bottom of Test Pit or Test Hole

A-4(0)	AASHTO Classification
LL=19	Liquid Limit
PI=2	Plastic Index
P200=43	Percent Passing #200 sieve
M.C.=27.5%	Moisture Content
Org. Cont. =30%	Organic Content (Alaska T-6)

Note: All soils encountered are field-classified by the Geologist. Laboratory classifications are made on selected samples. The field classifications are adjusted, if necessary, to match the laboratory classification.

Abbreviations

Bk = Black	w/ = with
Bn = Brown	so. = some
Bl = Blue	tr. = trace
Gn = Green	sl. = slightly
Gr = Gray	G.S. = Grab Sample
Or = Orange	S.S. = Split Spoon
Rd = Red	S.T. = Shelby tube
Tn = Tan	M.S. = Modified Shelby Tube

Soil Size Distribution

Based on U.S. Standard Sieve Sizes:

Boulders	= >10"
Cobbles	= 3"–10"
Gravel	= #10–3"
Sand	= #200–#10
Silt/Clay	= < #200

Plan View Symbols

- Power Auger
- Hand Auger
- Surface Sample
- 4.5' Hand Probe Depth & Location
- Hand Dug Test Pit
- Dozer/Backhoe Pit
- xxxxx Berm
- Terrace or Bank
- Swamp

Graphic Symbols (Two or more soil symbols may be used together to indicate a combination of soil types.)

Organics	(Org)
Gravel	(Grl)
Sand	(Sa)
Silt	(Si)
Clay	(Cl)
Ice	(Ice)
Bedrock	(Bx)
Cobbles and/or Boulders	

LOG OF BORING 1

EQUIPMENT B-24 Track

ELEVATION Exist. Ground DATE 2/27/82

LABORATORY TESTS	GROUP	TEMP.	BLOWS/1 FT	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DEPTH (ft)	Description
	A			112.6		0	Brown SILT W/FIBROUS PEAT layering ML, F-4, saturated Frozen to 3.0'
	D	1.7°C		34.2		5	Grey SILT, ML, F-4 wet
	B	2.0°C		36.5		10	Grey coarse SILT W/AMORPHIC PEAT layering, M, F-4 wet to saturated ▼ Free water observed while drilling at 12.0'
	B	2.0°C		41.9		15	TOTAL DEPTH OF BORING - 15.0' Boring sloughed to 3.5' after drilling

LOG OF BORING 2

EQUIPMENT B-24 Track

ELEVATION Exist. Ground DATE 3/6/82

LABORATORY TESTS	GROUP	TEMP.	BLOWS/1 FT	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DEPTH (ft)	Description
Organic Content 2.47%	A			95.8		0	Brown SILT W/FIBROUS PEAT layering ML, F-4 wet to saturated
Organic Content 2.03%	A	-0.3°C		106.5			
	A	-0.2°C		63.7		5	Visible ice crystals
	D	-0.3°C		38.8			Grey SILT, ML, F-4
	G	-0.3°C		25.3		10	Grey SAND, SP-SM
							Grey SILT, ML, F-4
	E	-0.2°C		26.5		15	Grey SILTY SAND, SM, F-2, wet TOTAL DEPTH OF BORING - 15.5' PVC installed to 14.0'

JML LAMBE AND ASSOCIATES

Soils Laboratory and Geotechnical Engineering

Job no. 82-292.05 Appr. JML Date 3/19/82

LOG OF BORING

Alakanuk Road and Dock Project

Peratrovich & Nottingham

Anchorage Alaska

PLATE 2

LOG OF BORING 3

EQUIPMENT B-24 Track

ELEVATION Exist. Ground DATE 2/27/82

LABORATORY TESTS	GROUP	TEMP.	BLOWS/FOOT	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DEPTH (ft)	DESCRIPTION
	A			124.0		0	Frozen to 1.0' Brown SILT W/FIBROUS PEAT layering, ML F-4, wet to saturated. ▼ Free water observed after drilling at 3.0'
	A	0.2°C		53.9		5	
	B	0.5°C		36.8		10	Grey SILT W/AMORPHIC PEAT layering, ML F-4, saturated
	B	0.5°C		46.2		15	TOTAL DEPTH OF BORING - 15.0' Boring sloughed to 3.5' after drilling

LOG OF BORING 4

EQUIPMENT B-24 Track

ELEVATION Exist. Ground DATE 3/9/82

LABORATORY TESTS	GROUP	TEMP.	BLOWS/FOOT	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DEPTH (ft)	DESCRIPTION
	A			100.4		0	Brown-grey SILT W/FIBROUS PEAT layering ML, F-4, saturated Visible ice crystals
	A	-0.3°C		81.0		5	
	G	-0.5°C		25.5		10	Grey SAND, SP-SM, wet
							Grey SILT W/AMORPHIC PEAT LAYERING, ML F-4, wet to saturated
…chanical Analysis …anic Contents 5.19%	B	-0.5°C		38.5		15	TOTAL DEPTH OF BORING - 15.0' No free water observed PVC installed

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LOG OF BORING

Alakanuk Road and Dock Project

Peratrovich & Nottingham

Anchorage Alaska

PLATE 3

LOG OF BORING 5

EQUIPMENT B-24 Track

ELEVATION Exist. Ground DATE 3/27/82

LABORATORY TESTS	GROUP	TEMP.	BLOWS/FOOT	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DEPTH (ft)	DESCRIPTION
						0	Frozen to 1.5' Free water observed while drilling at 2.5' Free water observed after drilling at 3.4'
	A			99.7			
	A	0.0°C		85.0		5	Brown SILT W/FIBROUS PEAT layering, F-4, saturated
	B	0.1°C		42.7			
	B	0.2°C		46.0		10	Grey to brown SILT W/AMORPHIC PEAT layering, ML, F-4, saturated
	B	0.2°C		35.0		15	TOTAL DEPTH OF BORING - 15.0'

LOG OF BORING 6

EQUIPMENT B-24 Track

ELEVATION Exist. Ground DATE 3/9/82

LABORATORY TESTS	GROUP	TEMP.	BLOWS/FOOT	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DEPTH (ft)	DESCRIPTION
						0	Frozen to 1.75' /
	A	0.0°C		128.6			Grey SILT W/FIBROUS PEAT LAYERING, ML F-4, saturated
	A	0.2°C		58.5		5	
	B	3.5°C		49.7		10	Grey SILT W/AMORPHIC PEAT LAYERING, ML, F-4, saturated
	E	0.0°C		40.5		15	Stiff drilling at 13.0' Grey SILTY SAND, SM, F-2, saturated Frozen from 13.0 - 15.0' TOTAL DEPTH OF BORING 15.0' PVC installed

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LOG OF BORING

Alakanuk Road and Dock Project
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PLATE 4

LOG OF BORING 7

EQUIPMENT B-24 Track

ELEVATION Exist. Ground DATE 2/27/82

LABORATORY TESTS	GROUP	TEMP.	BLOWS/FOOT	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DEPTH (ft)	Description
						0	
	A			142.1			Brown-grey SILT W/FIBROUS PEAT layerin ML, F-4, wet to saturated
	A			126.4			
	A	-0.2°C		81.5		5	Frozen to 5.5'
	B	0.0°C		50.8			Grey SILT W/AMORPHIC PEAT layering, ML F-4, wet
	B	-0.5°C		58.7		10	Frozen from 8.5 to 10.5' TOTAL DEPTH OF BORING 10.5' No free water observed
						15	

LOG OF BORING 8

EQUIPMENT B-24 Track

ELEVATION Exist. Ground DATE 3/9/82

LABORATORY TESTS	GROUP	TEMP.	BLOWS/FOOT	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DEPTH (ft)	Description
						0	
	A			124.8			Brown SILT W/FIBROUS PEAT layering, ML F-4 Frozen to 1.5'
	B	-0.2°C		41.2		5	Grey coarse SILT W/AMORPHIC PEAT layering, ML, F-4, wet
	F	-0.1°C		35.1		10	Grey SANDY SILT, ML, F-4 wet to saturated
							Frozen from 4.0' to 15.0"
	F	-0.5°C		35.5		15	TOTAL DEPTH OF BORING - 15.0' PVC installed

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Job no. 82-292.05 Appr. JML Date 3/19/82

LOG OF BORING
Alakanuk Road and Dock Project
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PLATE 5

LOG OF BORING 9

EQUIPMENT B-24 Track

ELEVATION Exist. Ground DATE 2/27/82

LABORATORY TESTS	GROUP	TEMP.	BLOWS/FOOT	MOISTURE CONTENT (%)	DRY DENSITY (pcf)
	A			99.6	
	F	1.0°C		35.7	
...anical Analysis	D	0.7°C		35.7	
	F	1.2°C		42.8	
...nic Content 5.10% ...anical Analysis ...ific Gravity	B	0.2°C		45.4	

Depth (ft): 0, 5, 10, 15

Brown SILT W/FIBROUS PEAT layering ML, F-4
Frozen to 2.0'
Grey SANDY SILT TO SILT, ML, F-4, wet
Saturated below 6.5'
Free water observed at 6.5', after drilling
Free water observed at 7.0' while drilling
Grey SILT W/AMORPHIC PEAT layering, ML F-4
TOTAL DEPTH OF BORING 10.5'
Boring sloughed to 6.5' after drilling

LOG OF BORING 10

EQUIPMENT B-24 Track

ELEVATION Exist. Ground DATE 3/9/82

LABORATORY TESTS	GROUP	TEMP.	BLOWS/FOOT	MOISTURE CONTENT (%)	DRY DENSITY (pcf)
...anic Content ...51%	A	-0.5°C		70.0	
	B	1.0°C		36.5	
	B	2.5°C		38.8	
	B	2.0°C		46.3	

Depth (ft): 0, 5, 10, 15

Brown SILT W/FIBROUS PEAT layering, ML F-4
Frozen to 2.0'
Grey SILT W/AMORPHIC PEAT layering, ML, F-4, saturated
TOTAL DEPTH OF BORING 15.0'
PVC installed

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Soils Laboratory and Geotechnical Engineering
...no. 82-292.05 Appr. JML Date 3/19/82

LOG OF BORING
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PLATE 6

APPENDIX B

COMMUNITY SURVEY RESULTS

SANITARY SURVEY FOR ALAKANUK

This survey was developed by the Public Health Service in the summer of 1989. It was given to the City who distributed and then collected the survey forms in the city and then returned them to the Public Health Service. There were 40 responses from the approximately 130 households.

1) Do you think water supply improvements are needed?

Yes	40
No	0

2) Do you think sewer improvements are needed?

Yes	39
No	1

3) In general, do present water sources and waste disposal practices adequately protect the health of local residents?

Yes	12
No	28

4) Which of the following sanitation systems would you like to see constructed in Alakanuk?

Waste Disposal Bunkers	2
Honey Bucket Haul System	3
Piped Water and Sewer System	37
Summer only watering points	0
Year round watering points	14
Existing water delivery expanded or upgraded	5
All of the above	2
Other suggestions	

5) Do any of the following washeteria facilities need improvement?

Showers	11
Laundry	16
Watering point	12

Other Present facility too small; dryers not hot enough.

6) What were the problems with the honeybucket haul system which is no longer used?

Too expensive	3
Not collected regularly	13
Too inconvenient	14
Smells from lagoon in summer	12
Other Too small;spillage; health hazard.	6

7) Should the honeybucket haul system be restarted?

Yes	7
No	28

Reason why or why not:
Disease and smells caused by spillage; Never collected in some areas; Deep snow in winter doesn't allow pick-up.

8) Where do you presently dispose of human wastes?

Pits by home	25
Bunker	1
Outhouse	0
Slough	11
VSW Washeteria wastewater facility	1
On the ground near home	11
Fenced solid waste site	3
In alders along roadside	1
Other location Anywhere; trash bins.	2

9) What do you presently use as your source of drinking water?

Washeteria watering point	16
Water delivery	23
Slough	4
Rainwater	32
Ice melt	7
Other source School facilities; anything convenient.	

10) Describe any problems or suggestions concerning the water delivery system or watering point.

Delivery stops during the cold months; It is too expensive; Danger of contamination; Don't know when in operation; No delivery in some areas due to road conditions; Not enough water or personnel; Too much salt and chlorine in water; Not delivered often enough.

11) If you haul water, how much is collected each time?

5 gal	4
10 gal	6
15 gal	4
20 gal	6
30 gal	9
more than 30 gal	26

12) How often do you collect water?

1 - 2 times/week	15
3 times/ week	2
Daily	9
Twice daily	3
When it rains	1

13) How far is your house from the watering point?

2 - 3 miles	8
1 - 1.5 miles	8
.25 -.5 mile	9
Very close	2

14) If you don't use the water supply, please indicate why.

Traditional source more convenient	5
Water supply too expensive	5
Water from supply tastes bad	9
Consider water supply unhealthy	2
Conditions at water point unsanitary	3
Supply is unreliable	4
Supply point too far from home	12
Other Water from supply stains clothes.	1

15) Is your house large enough to install a 6 foot by 10 foot bathroom?

Yes	25
No	14

16) Which bathroom fixtures are installed in your home?

Kitchen sink	24
Bathroom sink	26
Tub/Shower	23
Water Closet	10
N/A	7

17) How many people live in your house?

2 - 3	4
4 - 5	13
6 - 7	11
8 - 9	6
10 - 11	3

18) How many months during the year is your whole family away from your house?

More than 3	5
2 - 3	0
1 - 2	1
Less than 1	33

19) How do you heat your house?

Oil	28
Wood	23

20) Once constructed, sanitation facilities are sometimes very expensive to operate and maintain. How much could you afford to spend to help operate and maintain sanitation facilities in Alakanuk?

Less than $20 per month	11
$21 - $35 per month	11
$36 - $50 per month	7
$51 - $65 per month	2
$66 - $79 per month	0
More than $80 per month	3
Don't know	3

21) How much do you presently spend for utilities (electricity, fuel oil etc.)?

$20 - $40 per month	3
$40 - $60 per month	6
$60 - $80 per month	6
$80 - $100 per month	10
More than $100 per month	16

22) Should the City of Alakanuk help pay to operate and maintain sanitation facilities?

Yes	33
No	5

23) Would you support a 1 - 2 percent increase in the City sales tax to help operate and maintain sanitation facilities in Alakanuk?

Yes	31
No	6
Don't know	2

24) Where do you dispose of your trash?

Fenced solid waste disposal site	20
Along river banks	2
Other Dumpsters	19

25) Please add any other problems or suggestions you have concerning sanitation facilities in Alakanuk.

The city should try to do something about indiscriminate honeybucket dumping. Something should be done about diseases. More trash dumpsters are needed, especially by the laundromat and pool hall. Water delivery needs improvement.