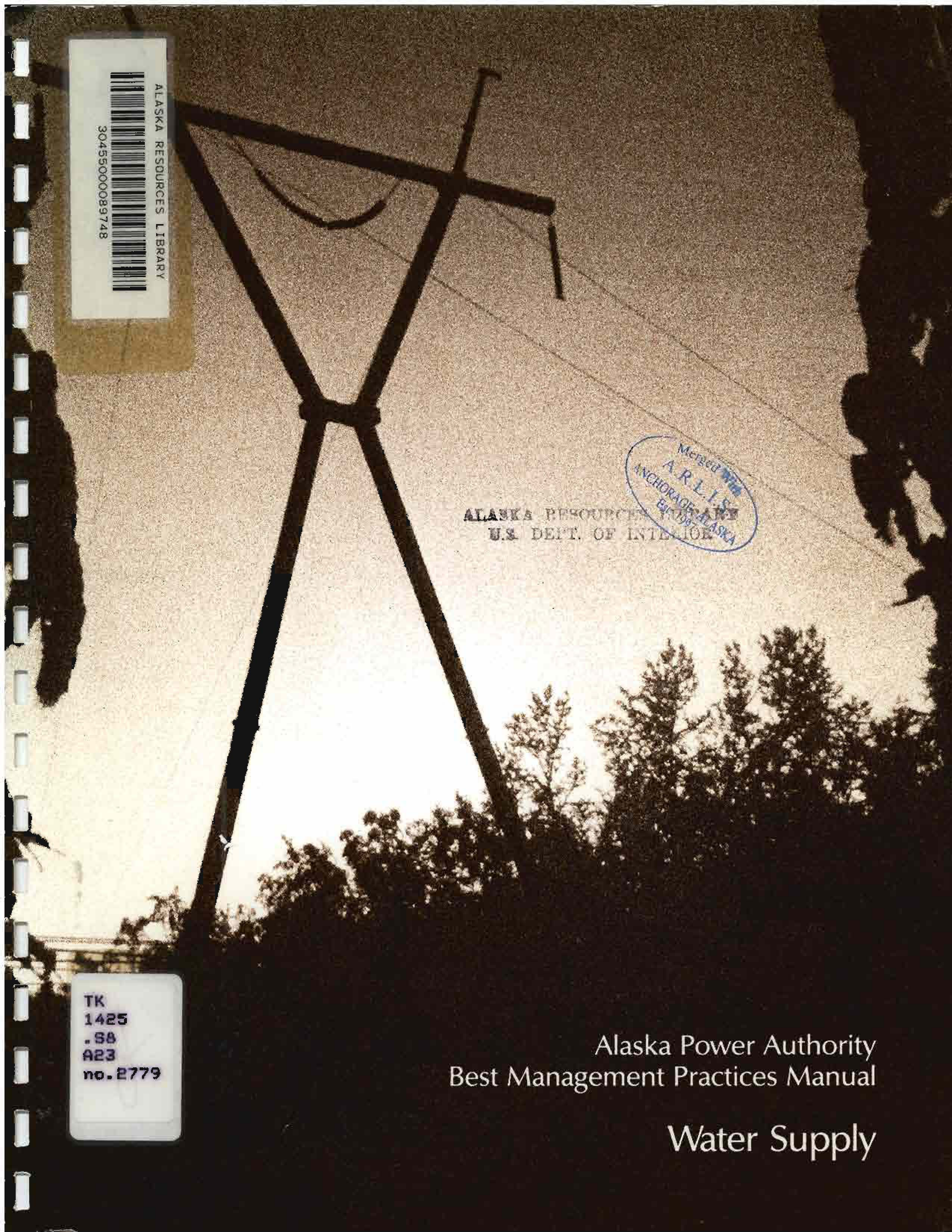

Alaska Power Authority
Best Management Practices Manual

Water Supply

ALASKA POWER AUTHORITY

BEST MANAGEMENT PRACTICES MANUAL

WATER WITHDRAWAL AND STORAGE

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PREFACE

This manual is one of a series of "best management practices" manuals to be used in the design, construction, and maintenance of Alaska Power Authority projects. It presents a coordinated effort involving federal, state and local government agencies, and special interest groups.

The Alaska Power Authority intends that applicable guidelines and state-of-the-art techniques contained in the manuals will be incorporated where appropriate into the contractual documents for projects constructed, maintained, or operated by or under the direction of the Alaska Power Authority.

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CHAPTER 1 - INTRODUCTION

The Alaska Power Authority has prepared a series of best management practices manuals for projects constructed or operated by the Power Authority in Alaska. This manual discusses the environmental guidelines and highlights regulatory criteria that should be considered in locating and appropriating water with emphasis on potable water for domestic use. This manual has been prepared primarily in response to agency concerns regarding impacts of water withdrawal on aquatic organisms. Actual design, plans, and specifications will be dictated by specific site conditions, regulatory requirements, and water demand. Federal, state and local laws in addition to those set out in this manual may impose specific requirements on Power Authority projects or activities. This manual is not a substitute for case-by-case identification and compliance with all laws and regulations applicable to the construction and operation of Power Authority projects. Included in this manual are discussions on water availability, demand and quality (Chapter 2), sources of water supply (Chapter 3), and water withdrawal and storage (Chapter 4). Chapter 5 lists applicable permits and regulatory authorities.

CHAPTER 2 - WATER AVAILABILITY, DEMAND, AND QUALITY

The availability of water for a project is not solely a function of the physical presence of a water source. The Alaska Constitution reserves the waters of Alaska for the people of the state for common use. All proposed water appropriations are reviewed and evaluated for possible adverse effects on the water rights of other persons or the public interest. Therefore, applicants for a water appropriation must consider impacts on fish and wildlife habitat, recreation, navigation, sanitation and water quality, and prior appropriators.

A review of project permit requirements is also important in planning for project water supply. Applicable regulations and permitting requirements may determine the kind of water sources and supplies selected for individual projects. The following are important factors that should be an integral part of Power Authority water supply planning.

- Identify project goals and describe proposed construction and other activities to implement goals.

- Determine project impact on environment.

- Identify statutes, regulations and agencies which regulate either the proposed activity or its impacts. In particular, determine whether existing Power Authority permits control the activities or impacts involved.

- Compare burdens imposed by regulations and/or permits for proposed activities and alternatives (including costs associated with modifying activities to reduce or eliminate requirements).

- Develop and implement permitting strategy to obtain timely issuance of permits.

Water demand at a power project site will depend upon the size of the camp population, exploratory and construction uses, and fire protection requirements. The domestic water demand at construction camps in Alaska is conservatively computed at 100 gallons per capita per day. Construction uses could include mixing concrete, vehicular and construction equipment washing, and road and work site watering for dust suppression. The volume of water required for fire suppression is dependent upon the type of installation to be protected and the project location (remote, adjacent to an established project water supply system, adjoining buildings, etc.).

The Alaska Drinking Water Standards (18 AAC 80.050) specify both primary and secondary maximum contaminant concentrations (Tables 1 and 2) pertaining to public drinking water systems. Exceedence of the primary maximum contaminant concentrations is a violation of Alaska law and the Federal Safe Drinking Water Act. The secondary standards are recommended contaminant levels, but are not mandatory unless imposed upon a specific public water supply system by the Alaska Department of Environmental Conservation. Where appropriate, water quality must also be considered for other water uses such as making concrete, hydrostatic testing, and equipment maintenance. Unsuitable concentrations or

TABLE 1

PRIMARY MAXIMUM CONTAMINANT CONCENTRATIONS

INORGANIC CHEMICAL CONTAMINANTS

Contaminant	Maximum Contaminant Concentration (mg/l)
Arsenic	0.05
Barium	1.
Cadmium	0.010
Chromium	0.05
Fluoride	2.4
Lead	0.05
Mercury	0.002
Nitrate (as Nitrogen)	10.
Selenium	0.01
Silver	0.05

RADIOACTIVE CONTAMINANTS

Contaminant	Maximum Contaminant Concentration (pCi/l)
Gross Alpha	15
Gross Beta	50
Strontium-90	8
Combined Radium-226 and 228	5
Tritium	20,000

ORGANIC CHEMICAL CONTAMINANTS

Contaminant	Maximum Contaminant Concentration (mg/l)
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Total Trihalomethanes	0.10
Toxaphene	0.005
2,4-D	0.1
2,3,5-TP Silvex	0.01

MAXIMUM TOTAL COLIFORM BACTERIA CONTAMINANT CONCENTRATION

Test Method	Maximum Contaminant Concentration
Membrane Filter Technique	The coliform density may not exceed one per 100 milliliters in any routine sample.
Fermentation Tube Method with 10 ml portions	Coliform may not be present in more than one 10 milliliter portion in any routine sample.

PHYSICAL CONTAMINANTS

Contaminant	Maximum Contaminant Concentration
Turbidity	One[1)] nephelometric turbidity unit as a monthly average of samples required, or taken by the department, and five nephelometric turbidity units as an average for two consecutive days.

[1)] A maximum concentration of up to five nephelometric turbidity units will be allowed if the person who owns or operates a public water system can demonstrate to the department that the higher turbidity does not

1. interfere with disinfection;
2. prevent maintenance of an effective disinfecting agent throughout the distribution system; or
3. interfere with microbiological determinations.

Source: 18 AAC 80

TABLE 2

SECONDARY MAXIMUM CONTAMINANT CONCENTRATIONS

CONTAMINANT	MAXIMUM CONTAMINANT CONCENTRATIONS
Chloride......................	250 mg/l
Color.........................	15 units
Copper........................	1 mg/l
Corrosivity...................	Noncorrosive
Foaming Agents................	0.5 mg/l
Iron..........................	0.3 mg/l
Manganese.....................	0.05 mg/l
Odor..........................	3 threshold odor number
pH............................	6.5-8.5
Sodium........................	250 mg/l
Sulfate.......................	250 mg/l
Total Dissolved Solids.......	500 mg/l
Zinc..........................	5 mg/l

Source: 18 AAC 80

levels of sediment, pH, chlorides, and ions could preclude the use of a water source for certain project activities.

CHAPTER 3 - SOURCES OF WATER SUPPLY

The following sections discuss some of the considerations associated with developing surface and groundwater sources in Alaska. Surface or groundwater sources should be adequate to supply the water demands for the project (including a reasonable surplus for project changes). Sources to be used for potable water supplies must be separated, by the minimum distances shown on Table 3, from potential sources of contamination. Greater separation may be appropriate in individual cases.

3.1 SURFACE WATERS

Surface water sources include streams, natural lakes, artificial impoundments, the oceans, and water collected from a depth of less than 30 feet below the ground surface. Because of the high probability of contamination by animals and other discharges, surface waters in Alaska may require special treatment such as filtration and disinfection prior to use as drinking water.

Water must not be withdrawn from fish spawning, rearing, or over-wintering areas or from waters that replenish these areas unless specifically approved by the appropriate state and federal agencies. Unless specifically authorized by appropriate federal and state agencies, in-stream flow in these waters must not be reduced below that necessary to support fish spawning, incubation, rearing, migration, or overwintering. During frozen conditions, water withdrawal must be approved by the appropriate agencies on a site-specific basis. Water withdrawal from lakes supporting fish re-

TABLE 3

MINIMUM SEPARATIONS BETWEEN WATER SOURCE AND POTENTIAL SOURCES OF CONTAMINATION

Wastewater Treatment and Disposal Systems, Sewage Pump Stations, Sewer Main Cleanouts, Sewer Line Manholes, and Privies [1]	Community Sewer Lines, Holding Tanks, and Other Potential Sources of Contamination [2]	Private Sewer Lines and Petroleum Storage Tanks [3]
200 feet	200 feet	100 feet

[1] Distance is measured from the nearest edge of the soil absorption system, seepage pit, septic tank, holding tank, or privy to the water source.

[2] Other potential sources of contamination include, but are not limited to, sanitary landfills and industrial discharge lines.

[3] The minimum separation distances listed for petroleum storage tanks do not apply to noncommercial quantities (less than 500 gallons) of fuel or lubricants, stored in above-ground storage tanks or drums, necessary for the operation and maintenance of pumps, power generation systems, or heating systems associated with a well or other water source.

Source: 18 AAC 80

sources must be evaluated on a site-specific basis. If withdrawal from waters supporting fish resources is approved, the intake structures must be designed to protect fish (see Section 4.2).

Water withdrawn from shallow lakes during the winter may not be of acceptable quality because of freeze-concentrate impurities in the water beneath the ice. Summer river flows, which frequently contain sediments from overland runoff or glacial flour, may require extensive treatment prior to use. While rivers are an excellent water source in winter, intakes must be designed to prevent freeze-up and damage from frazil ice and to protect the structure from ice flows during spring breakup.

In some areas, it may be appropriate to use a surface water source only on an intermittent basis and depend upon artificial storage during periods when the natural supply is low or during periods of highly turbid river water.

3.2 GROUNDWATER

Groundwater, as defined in regulations of the Alaska Department of Environmental Conservation, is water occupying a permeable saturated zone of soil 30 feet or more below ground surface, whether perched above impermeable strata, confined between impermeable strata, or unconfined. The quality of groundwater is usually higher than the quality of surface water because most impurities in the groundwater are filtered out as the water moves through the soil. In highly mineralized areas of Alaska, however, some groundwaters have been found to contain unacceptably high concentrations of arsenic. Extremely high concentrations of nitrates have been observed in other groundwaters near Fairbanks and on Nunivak Island. While subpermafrost groundwater is almost always a year-round source of supply, so that alternative or dual source systems need not be developed, these waters may contain high concentrations of iron (as high as 175 mg/l), magnesium, and calcium, as well as organics.

The cost of exploring, drilling, and developing wells in cold, remote areas can be high. A producing well is most successfully located through detailed examination of geologic conditions: kinds and permeabilities of soils and rocks; position of layers; characteristics of cracks, fissures, and other large openings; and a study of performance records of any other wells in the area.

CHAPTER 4 - WATER WITHDRAWAL AND STORAGE

Common means of water withdrawal include wells, intakes, infiltration galleries and pumping stations associated with these systems. Storage facilities at a Power Authority project would consist of tanks or earth reservoirs, depending on the climatic conditions of the project area.

4.1 WELLS

The minimum requirements (18 AAC 80) for a potable water well are as follows:

- The casing on all cased wells must have a sanitary seal.
- A cased well must have its casing terminate at least 1 foot above ground level or the level of the well house floor.
- Wells must be adequately protected against flooding.
- If there is an annular open space outside the well casing, it must be filled with a water-tight cement grout, sealing clay, bentonite, or equivalent material to a minimum depth of 10 feet below the ground surface.
- The surface, for 10 feet in all directions around the well, must be sloped or contoured to drain around or away from the well. Where there is potential for a well to become contaminated by

surface water, an impervious surface extending at least 2 feet in all directions from the well may be required by the Alaska Department of Environmental Conservation.

- A drain pipe from a well house to a sewerage system is prohibited.

- Newly constructed or reworked wells must be flushed of sediment and disinfected before use.

4.2 SURFACE WATER INTAKE STRUCTURES

In streams or lakes supporting fish resources, water intake equipment must be centered in and enclosed by a screened box to minimize entrapment, entrainment, and impingement of fish. The effective screen opening may not exceed 0.04 inches. The screen, which must be attached to the outside of the box so that no inside angles are formed to trap fish, must be kept clear of debris to prevent localized, high through-screen velocities. Eight square feet of wetted screen area is required for each 450-gpm withdrawal to provide a 0.5-fps or less approach velocity with up to 50 percent of the wetted area fouled with debris. In anadromous fish streams where whitefish are present during water withdrawal pumping, a 0.1 fps approach velocity should not be exceeded. Withdrawal rates are likely to vary from 300 to 3000 gpm depending on pump size and pump capacity utilized.

Use of multiple intakes may enhance system reliability during periods of reduced flow. Entrainment of frazil ice into a pipeline system may be prevented by locating the intake in a reach of the river where surface ice forms before the water is supercooled (typically in a long calm reach).

Infiltration galleries (Figure 1) provide advantages over conventional intakes since the gallery is removed from the structural hazards associated with freezing and breakup of ice on surface waters by being placed below frost penetration or in the thaw bulb of streams. The gallery will collect water even though the stream appears solidly frozen. In Alaska, infiltration galleries must be protected from freezing.

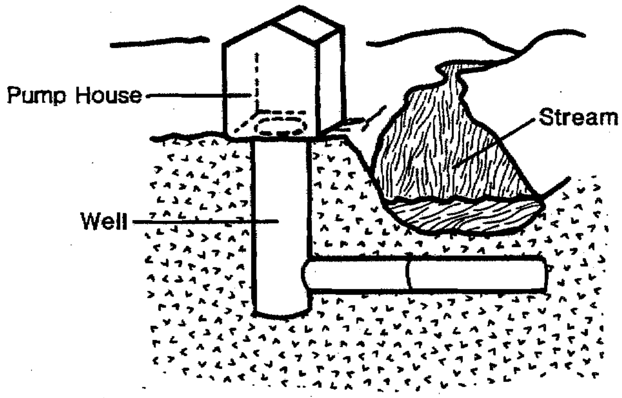
Another benefit offered by the infiltration gallery is the filtration of the water by the materials surrounding the collectors. This may be a very significant advantage in streams which carry a load of suspended material such as silt or glacial flour.

In areas where infiltration galleries are not practical, wind-screened gratings with self-contained heating units may be appropriate.

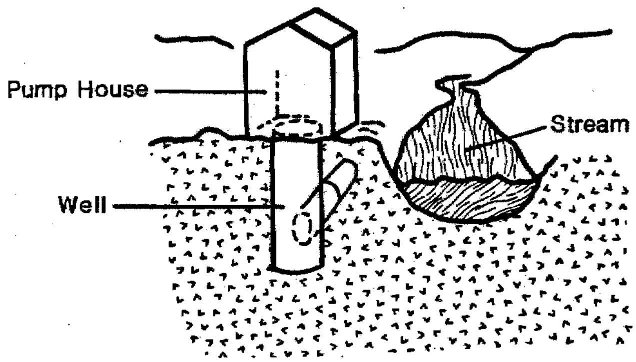
4.3 PUMPING STATIONS

Pumphouses can provide shelter for pumping equipment controls, boilers, treatment equipment and maintenance personnel who must operate and service the facility. While structural design will depend on the requirements of each location, all pumphouses should be designed with moisture-proof floors. Oversizing the original pumphouse at an installation should be

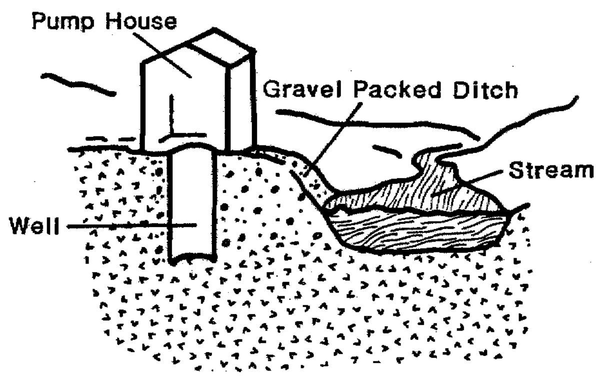
HORIZONTAL GALLERY



HORIZONTAL GALLERY



FRENCH DRAIN



ALASKA POWER AUTHORITY
INFILTRATION GALLERIES
FIGURE 1

considered carefully in relation to design life and the accuracy of demand predictions. Equipment housed within the shelter will also depend on the individual system and may vary from a simple pump to a complex system with boilers for heat addition, standby power, alarm systems to alert operators of malfunction and the like. All systems should provide the degree of redundancy and safeguards appropriate to the nature of the operation and location.

Heat addition at the source may be desirable if the water is very cold. Enough heat must be added to at least compensate for heat lost in transmission. It is generally accepted that water in transmission lines should be at least 39°F to provide an adequate margin for heat loss in the event of a pump failure.

4.4 STORAGE TANKS

Tanks in cold regions must be insulated, heated, or located within a heated building to prevent ice formation. Steel tanks must have an anti-corrosion lining.

Seasonal storage, where complete winter storage is required, can cause water quality changes, such as reduced oxygen. Chlorine residuals will also decrease with time, though less with colder waters. For long-term storage, treatment should occur after storage.

Elevated tanks can provide the necessary pressures in a distribution system; however, they can be a maintenance problem in cold weather. The large surface area and any high winds increase heat loss, and the standpipes must be protected against freezing. The foundation must be carefully designed. In camps, a pneumatic system or constant pressure pumps fed from a surface storage tank are generally more practical.

4.5 EARTH RESERVOIR

Dams may be constructed to raise the level of an existing lake or to create a reservoir on a stream or river. Overflow structures must be included in the design to provide for controlled release of high-flow waters during spring breakup or other flood events. Additional design considerations include the effects of floating ice and wave action in large reservoirs. Any dam constructed in a fish bearing stream or at the outlet of a fish bearing lake must be built with provisions that maintain in-stream flows below the dam and that do not block upstream or downstream fish passage.

Earth reservoirs may also be constructed as dug-out type (generally cut-and- fill) or diked impoundments which are periodically filled by pumping or siphoning water from a nearby source. The low head of dug-out structures reduces seepage and embankment stability design problems. In both types of impoundments, the effective reservoir volume will be reduced by any ice growth. The higher head of diked impoundments will increase the importance of seepage control and embankment stability.

Many techniques and types of natural and synthetic linings have been used to reduce or prevent seepage into or from water supply reservoirs. These include impervious soils, hypalon synthetic rubber, chlorinated polyethylene, and Dupont 3110 elasticized polyolefin. Impervious liners may be used within the embankment only, or to seal the entire reservoir. Folds may be left in synthetic liners to allow for settlement; however, differential settlements such as those occurring in high ice-content soils should be avoided by installing insulation under the reservoir lining or installing underdrains, well points, or pressure relief valves.

Because the quality of the water is influenced by the soils and vegetation that it comes into contact with, some reservoirs may require special clearing operations before filling. It is also normally desirable to dike the edges to prevent unwanted runoff from entering the reservoir.

CHAPTER 5 - REGULATORY AUTHORITIES

The following state and federal regulatory permits and approvals may apply to water withdrawal projects in Alaska.

Alaska Department of Environmental Conservation:

Alaska Drinking Water Standards (18 AAC 80)
Public Water System Plan Review
Certificate of Reasonable Assurance

Alaska Department of Fish and Game:

Title 16 Anadromous Fish Stream Permit

Alaska Department of Natural Resources:

Temporary Water Use Permit
Water Rights Permit
Application to Construct or Modify a Dam

Alaska Department of Public Safety:

Fire Safety Check and Approval

Governor's Office of Management and Budget:

Coastal Zone Consistency Determination

U.S. Army Corps of Engineers:

Sections 404 and 10 permit