Overview of Environmental and Hydrogeologic Conditions at Saint Marys, Alaska

By Allan S. Nakanishi and Joseph M. Dorava

U.S. GEOLOGICAL SURVEY

Open-File Report 94-481

Prepared in cooperation with the

FEDERAL AVIATION ADMINISTRATION

Anchorage, Alaska
1994

U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
Gordon P. Eaton, Director

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FIGURES

TABLE

CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATIONS

Multiply	By	To obtain
millimeter (mm)	0.03937	inch
centimeter (cm)	0.3937	inch
meter (m)	3.281	foot
kilometer (km)	0.6214	mile
liter per day (L/d)	0.2642	gallon per day
degree Celsius (°C)	°F = 1.8 x °C + 32	degree Fahrenheit (°F)

Sea level:

In this report "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Other abbreviation used in this report:

mg/L, milligram per liter

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Abstract

The Federal Aviation Administration (FAA) owns or operates airway support facilities near Saint Marys along the Yukon River in west-central Alaska. The FAA is evaluating the severity of environmental contamination and options for remediation of environmental contamination at their facilities. Saint Marys is on a flood plain near the confluence of the Yukon and Andreafsky Rivers and has long cold winters and short summers. Residents obtain their drinking water from an infiltration gallery fed by Alstrom Creek, which is near the village. Surface spills and disposal of hazardous materials combined with potential flooding may affect the quality of the surface and ground water. Alternative drinking-water sources are available, but would likely cost more than existing supplies to develop.

INTRODUCTION

The Federal Aviation Administration (FAA) owns and (or) operates airway support and navigational facilities throughout Alaska. At many of these sites, fuels and potentially hazardous materials such as solvents, polychlorinated biphenyls, and pesticides may have been used and (or) disposed of. To determine if environmentally hazardous materials have been spilled or disposed of at the sites, the FAA is conducting environmental studies mandated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund Act") and the Resource Conservation and Recovery Act (RCRA). To complete these environmental studies, the FAA requires information on the hydrology and geology of areas surrounding the sites. This report is the product of a compilation, review, and summary of existing hydrologic and geologic data by the U.S. Geological Survey, in cooperation with the FAA, for the FAA facilities and nearby areas at Saint Marys, Alaska.

BACKGROUND

Location

Saint Marys is within the Yukon Delta National Wildlife Refuge in southwestern Alaska at latitude 62°03'42" N., longitude 163°10'00" W. It is approximately 300 km southeast of Nome and approximately 720 km west of Anchorage by air. The Saint Marys Airport, which has a 1,800-m asphalt runway, is approximately 4 km northwest of the village (fig. 1). The FAA facilities are concentrated at the airport (fig. 2). The village of Saint Marys lies on the west bank of the Andreafsky River approximately 5 km upstream from the confluence with the Yukon River. The remote location of Saint Marys makes it dependent on the airport or the river for transportation. Saint Marys is a subregional center for air transportation for the Yukon Kuskokwim region (Darbyshire and Associates, 1979).

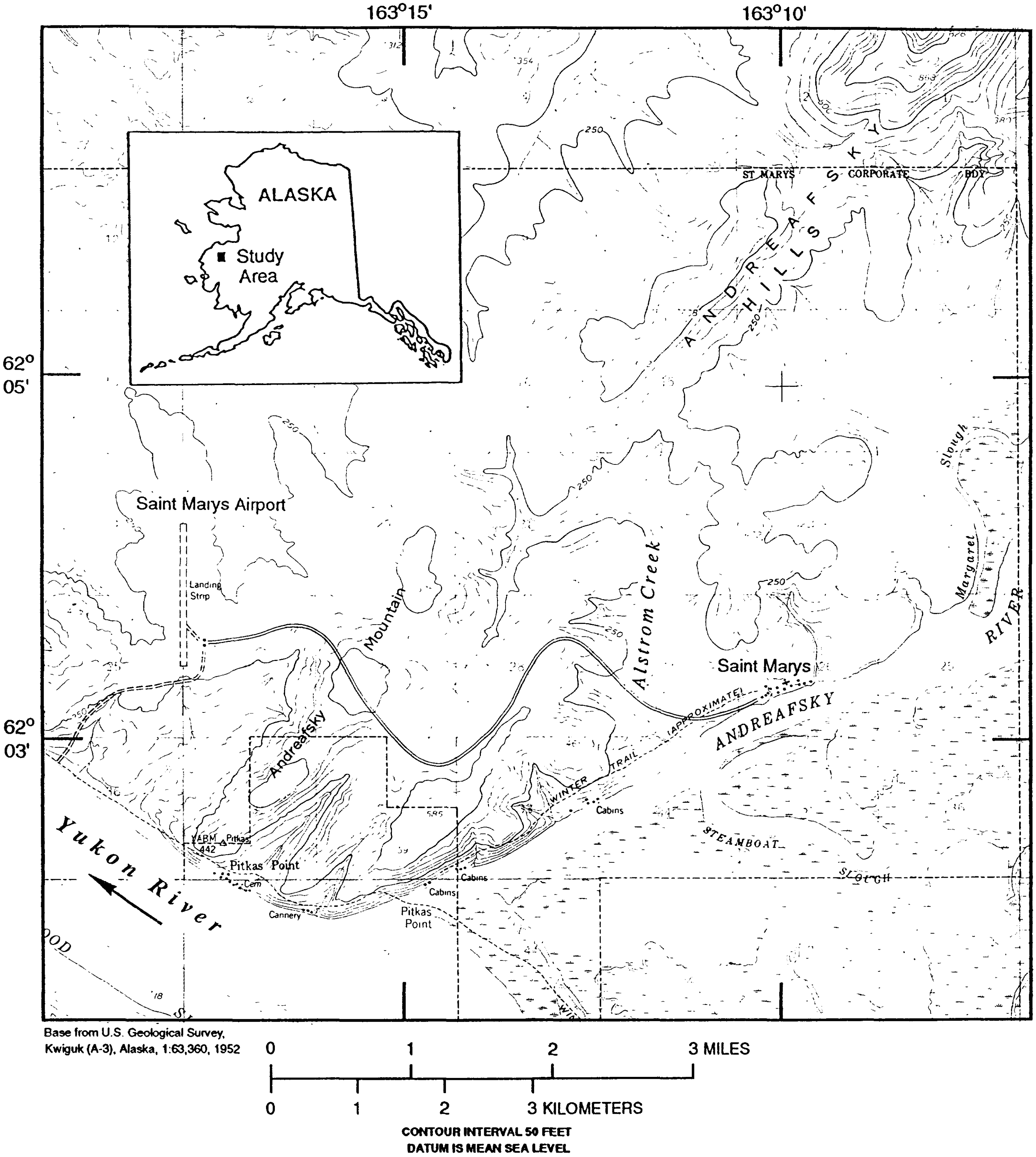

Figure 1. Location of village of Saint Marys and Saint Marys Airport.

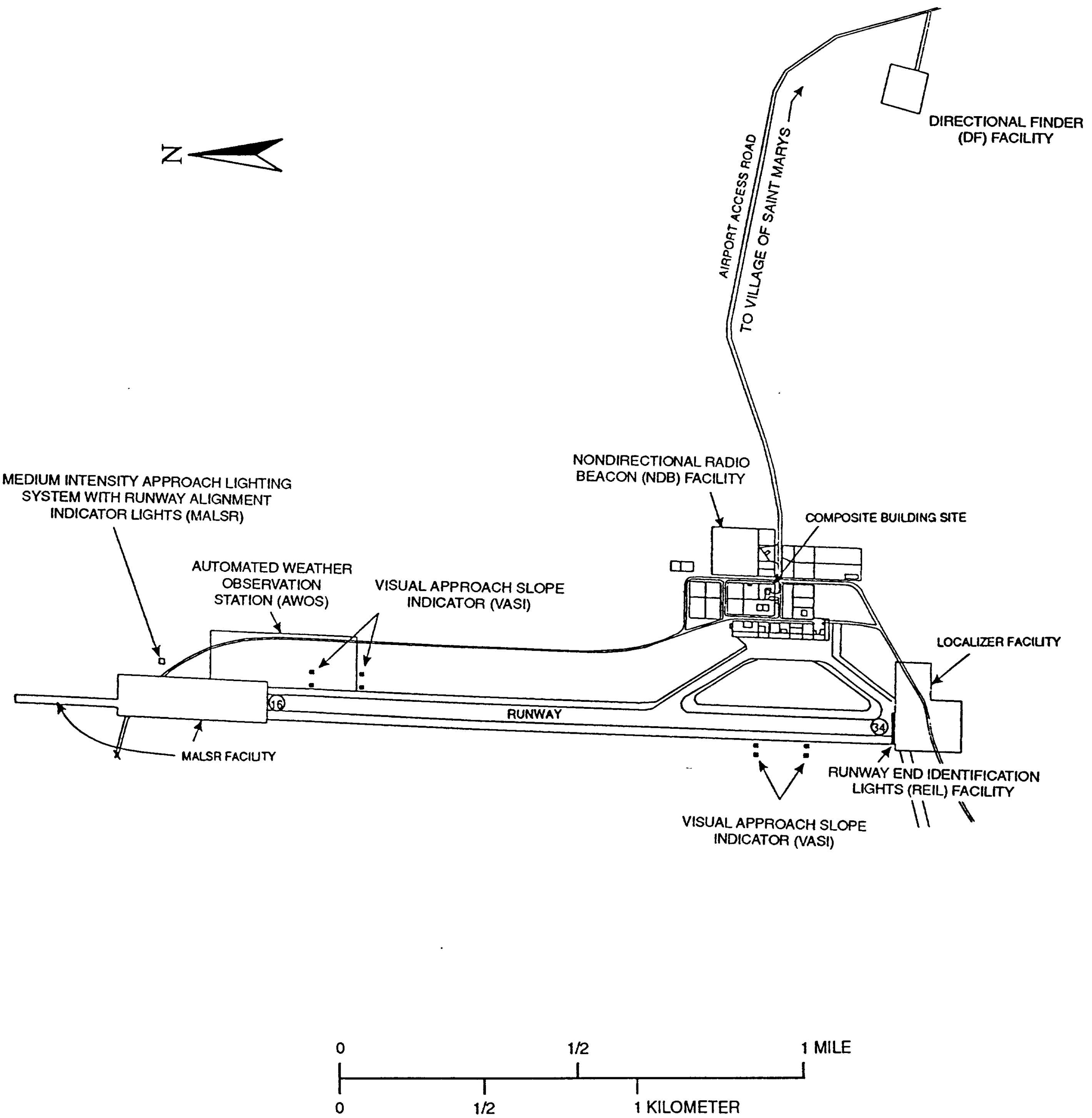

Figure 2. Location of Federal Aviation Administration (FAA) facilities near the Saint Marys Airport (modified from Ecology and Environment Inc., 1992).

History and Socioeconomics

The village of Andreafsky was established near the present site of Saint Marys in 1899. In 1948, a Jesuit mission moved to Andreafsky after abandoning a site which it had established in 1903, about 140 km downstream. Today, Andreafsky is an unincorporated community physically surrounded by the boundaries of the larger village of Saint Marys (Darbyshire and Associates, 1979). Saint Marys was incorporated as a first-class city in 1967 (Alaska Department of Community and Regional Affairs, 1993). The village is managed by a mayor-council form of government and a village manager (Darbyshire and Associates, 1979).

In 1990, the population of Saint Marys was 477 of which 83 percent are American Indian, Eskimo, or Aleut (Alaska Department of Community and Regional Affairs, 1993). The economy in Saint Marys is subject to seasonal fluctuation. Employment peaks during the summer fishing season when about 70 percent of the village residents are involved in some form of commercial fishing activity (Darbyshire and Associates, 1979). Cash income is supplemented by public assistance payments and subsistence activities. The subsistence lifestyle of the Native residents makes them dependent on a sustainable environment.

PHYSICAL SETTING

Climate

The climate of Saint Marys is a combination of transitional and continental climatic zones (Hartman and Johnson, 1984). Saint Marys experiences great diurnal and annual temperature variations, low precipitation, low cloudiness, low humidity, and light surface winds. Freezing of the Yukon and Andreafsky Rivers typically occurs in mid- to late October and break-up typically occurs in mid-May (Fountain, 1984; Fountain and Vaughn, 1984). The mean annual temperature is - 1.3 °C, but temperatures range from a July mean maximum of 17.6 °C to a February mean minimum of about -18.2 °C. Mean annual precipitation is about 483 mm; approximately 1,885 mm of snow falls annually (Leslie, 1989). Most rainfall occurs in July and August. Mean monthly temperature, precipitation, and snowfall for the periods 1922-76 and 1985-87 are summarized in table 1.

Vegetation

The forest in the Saint Marys area is generally a closed spruce hardwood type concentrated along the riverbanks (Viereck and Little, 1972). Well-drained, high-relief areas contain aspen, birch, poplar, and white spruce (Rieger and others, 1979; Hartman and Johnson, 1984). The flat, poorly drained areas away from the riverbank consist predominantly of black spruce, birch, and alder. The forest floors in both well- and poorly drained areas have undergrowths that include mosses, grasses, sedges, alder, willow, wild rose, high and low bush cranberry, blueberry, Labrador tea and equisetum (Rieger and others, 1979). Poorly drained, wet areas contain extensive growths of muskeg, sedges, tussock grasses, dwarf birch, and larch (Rieger and others, 1979).

Table 1. Mean monthly temperature, precipitation, and snowfall for the combined periods 1922-76 and 1985-87, Saint Marys

[Modified from Leslie (1989); °C, degree Celsius; mm, millimeter]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Temperature (°C)													
Mean maximum	-9.8	-9.3	-4.7	0.2	10.6	15.4	17.6	16.6	11.9	2.5	-4.8	-10.3	3.0
	(Record maximum, 28.9 °C, August 1977)												
Mean minimum	-16.6	-18.2	-14.2	-8.0	0.8	5.4	8.3	7.2	2.2	-4.7	-11.8	-18.1	-5.7
	(Record minimum, -42.2 °C, January 1971)												
Mean	-12.9	-13.8	-9.4	-3.7	5.7	10.4	12.9	11.8	7.1	-1.0	-8.3	-14.3	-1.3
Precipitation (mm of moisture)	23.9	16.5	20.6	20.6	21.3	53.1	69.9	78.5	58.4	40.6	42.2	37.6	483.1
Snowfall (mm)	309.9	134.6	218.4	147.3	30.5	20.3	0.0	0.0	25.4	147.3	434.3	416.6	1884.7

Bedrock and Surficial Geology

The bedrock in the Saint Marys area consists primarily of Cretaceous age sandstone which forms well-defined northeast-trending hills (Hoare and Condon, 1966). These hills are composed of a thick sequence of interbedded marine and nonmarine deposits. The thickness of the sandstone sequence is unknown, but Hoare and Condon (1966) suggest a thickness of about 4,600 to 7,600 m, on the basis of stratigraphic correlation with similar sequences. Structurally, the sandstone sequence forms a southwest-plunging, northwest-dipping, overturned anticline (Hoare and Condon, 1966).

The village and the airport are underlain by fine- to medium-grained calcareous sandstone interbedded with non-calcareous siltstone, which occurs about 15 m below the surface as indicated by well-log data (appendix). Bedrock at the airport and FAA facilities is at shallow depths or is exposed at the ground surface (Ecology and Environment, 1992).

Soils

The local area is underlain by a layer of discontinuous permafrost (Ferrians, 1965), and several well drillers' logs indicate the presence of ice or frozen soils at depths of 1 to 6 m (appendix). The Saint Marys area has three basic soil types: poorly drained mineral soils, organic-rich soils, and well-drained mineral soils (Rieger and others, 1979).

Poorly drained mineral soils are found in meander scars on the flood plain, broad valley bottoms, and stream terraces. In the flood plain, these soils have thick organic surface horizons composed primarily of sedges or sphagnum moss having a texture that varies from silt loam to sandy loam. Above a shallow permafrost table, these soils are usually saturated, but some are dry in the upper horizons in midsummer. Valley bottoms contain thick, poorly drained deposits of colluvium consisting of silt loam to gravelly silt loam. The depth to permafrost ranges from 25 to 50 cm from the surface (Rieger and others, 1979). Poorly drained stream terraces consist of gravelly silt to sandy loam that usually contains permafrost below a depth of 50 to 100 cm.

Organic-rich soils are found on flood plains in areas that are slightly lower than the poorly drained mineral soils. They consist of thick deposits of very acidic moss peat in the upper layer and fibrous sedge peat in the lower layer. The soils are commonly underlain by permafrost at depths of 12 to 75 cm.

Well-drained mineral soils are found on natural levees along existing and former river channels and on rounded hills and ridges. In the natural levees and former river channels, the soil texture generally consists of stratified silt loam and fine sand. Thin seams of organic material occur throughout the soil, and permafrost may occur at depths greater than 150 cm. Well-drained soils on rounded hills and ridges consist of gravels with silt-loam over weathered bedrock.

HYDROLOGY

Surface Water

The major surface-water bodies near the village and the FAA facilities are the Yukon River and the Andreafsky River, which flows into the Yukon. The mouth of the Andreafsky River is 5 km southeast of the airport (fig. 1). The airport, situated on a broad ridge, is surrounded by the headwaters of unnamed creeks that discharge into the Yukon River downstream from the mouth of the Andreafsky River.

Three streams run through the village: Alstrom Creek and two smaller, unnamed streams. Alstrom Creek flows southward through the west side of the village and drains the east side of Andreafsky Mountain and the south side of the Andreafsky Hills. The unnamed creeks both flow southward through the center and eastern sides of the village and drain the south side of the hills north of Saint Marys (fig. 1).

The surface drainages at the airport are separated from the surface drainages at the village by a southwest-to-northeast-trending bedrock ridge of Andreafsky Mountain and the Andreafsky Hills (fig. 1). The airport is located on the west side of the drainage divide where flow is towards the northwest and discharge is into the Yukon River. The village is east of the divide, and surface-water generally flows in a southeast direction and discharges into the Andreafsky River.

Floods

The Saint Marys airport and FAA facilities are not subject to frequent seasonal flooding from the Yukon River. The maximum observed stage of the Yukon River near Saint Marys was 20 m above sea level and the elevation of the Saint Marys FAA Station is approximately 94 m above sea level (Ecology and Environment, 1992). Small streams near the airport flow in well-defined valleys that typically confine normal flows within their streambanks.

Flood hazard in the village is considered moderate by the U.S. Army Corps of Engineers (1993). Flooding at the village occurred in 1971, 1985, and 1989. The primary causes of floods are ice jams and subsequent stream overflow of the Yukon River (U.S. Army Corps of Engineers, 1993). Ice-jam flooding occurs when river ice broken during spring thawing is transported downstream and its downstream movement is blocked in locations where a constriction, a sandbar, or other obstruction such as a sharp meander bend exists (Beltaos, 1990). The blockage prevents ice movements and restricts water flow as the ice jam builds in thickness and length. This subsequently slows the water velocity and produces a rise in water level, or backwater effect, that propagates upstream from the ice jam. When the ice jam releases, a flood wave propagates downstream.

The village of Saint Marys is not a participant in the National Flood Insurance Program and detailed studies of flooding in the area have not been undertaken. Computations by the U.S. Army Corps of Engineers (1987), which were based on historical flood records, determined that the 50-year flood elevation is approximately 9.1 m and the 100-year flood elevation is approximately 9.8 m.

Ground Water

Ground-water resources have not been explored in the area of the Saint Marys airport and FAA facilities. Ground water occurring beneath the airport is probably influenced by the presence of shallow permafrost; however, the thickness and continuity of the permafrost in the area is unknown. Ground-water flow direction near the airport should reflect the local topography of the area and should follow surface-water flow into the Yukon River.

In the village, wells have been installed in both alluvium and bedrock. Exploration for ground-water supplies conducted by the U.S. Public Health Service (USPHS) in 1972 (appendix) indicates that bedrock underlying the village contains a minimal amount of fractures that yield ground water. Ground water obtained from most wells is from an alluvial aquifer overlying the bedrock. Ground-water flow in the village probably follows the topography and flows in a southeast direction towards the Andreafsky River. The surface-water divide between the airport and the village probably acts as a ground-water divide, keeping the aquifer beneath the village separated from the aquifer beneath the airport.

Ground-Water and Surface-Water Interaction

Adjacent to the local rivers, shallow ground water can flow into and out of the banks depending on the elevation of water in the river relative to the water table. Seasonally, the discharge of the river will fluctuate from a maximum in late May or early June to a minimum in late April or early May. The river also rises during late-summer rainstorms. The water table generally rises and falls in response to these river fluctuations, but the rise is attenuated with distance from the river. This flow of water into and out of the aquifer in response to changing stage of the river is termed "bank storage effects" (Linsley and others, 1982). Bank storage effects have not been studied at the village of Saint Marys, but probably have a significant influence on the ground water in the village. Ground water at the Saint Marys airport and FAA facilities are not influenced by bank storage effects because of the significant difference in elevation between the airport and the maximum river stage and the distance from the airport to the river.

DRINKING WATER

Present Drinking-Water Supplies

Saint Marys is served by a community water distribution system installed by the USPHS in 1976 (Darbyshire and Associates, 1979). The village operates and maintains the water system which it shares with the community of Andreafsky. Water is supplied from a buried pipe infiltration gallery on Alstrom Creek, where it is pumped to a storage tank above Saint Marys and then to the Public Health Service pumphouse for distribution. Water is also obtained from individual wells and directly from nearby streams and rivers. The village drinking water is filtered and treated with chlorine and fluoride. Water is distributed from a central watering point or is piped to individual homes (Alaska Department of Community and Regional Affairs, 1993). The water-distribution system consists of a buried, 10-cm insulated pipe that serves most of the village houses (Alaska Department of Community and Regional Affairs, 1993). A U.S. Army Corps of Engineers (1987) regional assessment reports that the community water-distribution system has severe leakage problems, which lower the maximum capacity of the system.

The airport does not have its own water-supply system; potable water is hauled from the village and stored in storage tanks (Ecology and Environment, 1992). The hauled water at the airport is not used for residential purposes as there are no permanent residents living within 2 km of the airport.

The average water use in the State of Alaska for self-supplied water is about 150 L/d per person (Solley and others, 1993). The Saint Marys airport facilities and about 100 people in the village of Saint Marys utilize water from a self-supplied source (Alaska Department of Community and Regional Affairs, 1993). According to Solley and others (1993), the average water use per person for public water systems is approximately 300 L/d. Using the 1990 population of 477 and the various water sources described above the average water use for the village of Saint Marys would be about 128,000 L/d.

Quality of Present Supply

Information on the quality of drinking water in Saint Marys is very sparse. One 24-m deep well along the banks of the Andreafsky River near the village dock was sampled in 1974, and water-quality analyses indicate that this water may be acceptable for human consumption (appendix). The iron content was below the 0.30 mg/L secondary maximum contaminant level (SMCL) regulations set by the U.S. Environmental Protection Agency (USEPA) (1993) for drinking water. Although iron content may affect the taste of the water or cause staining in plumbing fixtures, it does not prohibit the water from being used for drinking.

Alternative Drinking-Water Sources

The aquifer system at the village has not been mapped in sufficient detail to define individual aquifers and confining layers; however, on the basis of the available data, it is unlikely that vertically separated alluvial aquifers exist. A bedrock aquifer may provide an alternative water supply, but a well-exploration program would be required to ascertain the existence of such an aquifer. Other alternative sources of drinking water are from the surface waters near the village.

The Andreafsky River is the closest surface-water source to the village. Water can be obtained from it either indirectly though infiltration wells or directly by intake systems at the riverbanks. Infiltration wells use the riverbank itself to filter out the sediment in the river water. Water taken directly from the Andreafsky River would require a filtering system for sediment removal. A direct intake system is also susceptible to damage during breakup from bank erosion and moving ice masses. The two unnamed creeks that flow near the village may be sources of drinking water. The unnamed creeks, however, have smaller drainage basins and likely carry less water than Alstrom Creek, the primary source of drinking water for the village. No ponds or lakes are near the village that would be capable of providing an adequate alternative source of drinking water.

The airport and FAA facilities do not have nearby natural surface-water sources that could supply continuous drinking water. The nearest perennial surface-water source is the Yukon River, where drinking water would have to be hauled more than 2 km to the airport. Because the airport is either on or very close to bedrock, ground water is not likely to be available from an alluvial source at the airport. If ground water is available, it would have to be obtained from a bedrock aquifer.

Quality of Alternative Sources

The quality of the Andreafsky River water was monitored near Saint Marys in June, July, and October 1954 (U.S. Geological Survey, 1958). Nothing was found in the river water to prevent it from being used for a drinking-water source. The iron concentrations were below the 0.30 mg/L SMCL USEPA regulations. Hardness as $CaCO_3$ had an average concentration of 49 mg/L. Hardness may create scale in plumbing or boilers but is generally of little concern to most users. Although sediment concentration has not been measured for the Andreafsky River, summer river flows, which tend to be much greater than winter flows, typically contain high concentrations of sediment from overland runoff (Smith, 1986).

SUMMARY

The remote location of Saint Marys makes it dependent on the airport or the river for transportation. The subsistence lifestyle of the Native residents makes them dependent on a sustainable environment. Flood hazard in the village is moderate but is not a problem near the FAA facility. The village obtains its potable water from an infiltration gallery near Alstrom Creek. Drinking water for the airport and FAA facilities is hauled from the village. Surface drainage and the aquifer below the village are distinct and separated from the airport site by a bedrock ridge which acts as a surface-water/ground-water divide. The Andreafsky River represents an alternative drinking-water source, but would likely be expensive to develop.

REFERENCES CITED

Alaska Department of Community and Regional Affairs, 1993, Alaska Department of Community and Regional Affairs database, St. Mary's, Alaska: Alaska Department of Community and Regional Affairs, Research and Analysis Section, Municipal and Regional Assistance Division, Juneau, Alaska, 14 p.

Beltaos, Spyridon, 1990, Breakup jams, *in* Ryan, R.L., and Crissman, R.D., eds., Cold regions hydrology and hydraulics: American Society of Civil Engineers Monograph, p. 485-510.

Darbyshire and Associates, 1979, St. Mary's: Alaska Department of Community and Regional Affairs Community Map--St. Mary's, 1 sheet.

Ecology and Environment, Inc., 1992, Environmental compliance investigation report, St. Mary's FAA Station, St. Mary's, Alaska: Anchorage [Draft report available from Federal Aviation Administration, Alaskan Region], variously paged.

Ferrians, O.J., Jr., 1965, Permafrost map of Alaska: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-445, 1 sheet (reprinted 1981).

Fountain, A.G., 1984, Yukon River breakup--The 82-year record: The Northern Engineer, v. 16, no. 1. p. 20-24.

Fountain, A.G., and Vaughn, B.H., 1984, Yukon River ice--Freeze up data (1883-1975): U.S. Geological Survey Open-File Report 84-601, 51 p.

Hartman, C.W., and Johnson, P.R., 1984, Environmental atlas of Alaska: University of Alaska Fairbanks, Institute of Water Resources/Engineering Experiment Station, 95 p.

Hoare, J.M., and Condon, W.H., 1966, Geologic map of the Kwiguk and Black quadrangles, western Alaska: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-469, 1 sheet, scale 1:250,000.

Leslie, L.D., 1989, Alaska climate summaries (2d ed.): University of Alaska Anchorage, Arctic Environmental Information and Data Center, Alaska Climate Center Technical Note 5.

Linsley, R.K., Kohler, M.A., and Paulhus, J.L., 1982, Hydrology for engineers (3rd ed.): New York, McGraw Hill Book Company, 508 p.

Rieger, Samuel, Schoephorster, D.B., and Furbush, C.E., 1979, Exploratory soil survey of Alaska: Soil Conservation Service report, 213 p.

Smith, D.W., 1986, Cold climate utilities manual: Canadian Society for Civil Engineering, variously paged.

Solley, W.B., Pierce, R.R., and Perlman, H.A., 1993, Estimated use of water in the United States in 1990: U.S. Geological Survey Circular 1081, 76 p.

U.S. Army Corps of Engineers, 1987, Interim water resources study, Yukon and Kuskokwim Rivers, Alaska: U.S. Army Corps of Engineers, Alaska District, 104 p.

_____1993, Alaskan communities flood hazard data: U.S. Army Corps of Engineers, Alaska District, 335 p.

U.S. Environmental Protection Agency, 1993, Drinking water regulations and health advisories: U.S. Environmental Protection Agency report, 11 p.

U.S. Geological Survey, 1958, Quantity and quality of surface waters of Alaska, October 1953 to September 1956: U.S. Geological Survey Water-Supply Paper 1486, 229 p.

Viereck, L.A., and Little, E.L. Jr., 1972, Alaska trees and shrubs: U.S. Department of Agriculture Handbook No. 410, 265 p.

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APPENDIX

U.S. Public Health Service water quality data, well drillers' logs, and pump test data for Saint Marys, Alaska

WATER WELL ANALYSIS

SANITATION FACILITIES CONSTRUCTION

ST. MARYS, ALASKA

APRIL 1977

PROJECT NO. AN-73-932 & 76-143

ENGINEER

Steve Bainbridge, P.E.
Sr. Asst. Sanitary Engineer
Field Engineer

ALASKA AREA NATIVE HEALTH SERVICE
Office of Environmental Health

CONTENTS:

PROJECT HISTORY

Drilling began in May of 1972 for a suitable water source for the village of St. Marys. Numerous holes were drilled but only nine well logs could be found for documentation in this report.

Of the nine wells that were drilled during 1972 to 1976, two produced small amounts of suitable water but only for a short period of time. Most of them were very high in iron content and couldn't be used.

The last well that was drilled by Charly Bordner in July of 1976 is a stand-by source for the infiltration gallery at Alstrom Creek. Both St. Marys and Andreafsky's residents receive their water from the existing infiltration gallery.

WATER ANALYSIS REPORT FORM **C 232** 3/15/74

ail Report to: ARCH HAMMETT, ADMIN. OFFICER
OFFICE OF ENVIRONMENTAL HEALTH
P. O. BOX 7-741
ANCHORAGE, AK 99510

OR LOCATION: ST. MARYS DOCK WELL #5

OLLECTED BY: GEORGE ESTRABOOK DATE 8-22-74 HOUR: ____

WATER SYSTEM

Well Type DRILLED Depth 80 Gallons per minute 10 gpm

Surface Water: ____ Temporary [ ] Permanent [X]

Number of Homes Served: ____

Treatment: [ ] Yes [X] No New or Existing Source NEW

PURPOSE OF ANALYSIS

X 1. Water Approval for Building Permit. (Column 1)

2. Routine Analysis. (Column 1 & 2)

__ 3. Special: Check Specific Items for Analysis (Columns 1,2,3)

COLUMN 1

	Analysis	Limits
ro (Fe)	0.13	0.3
ride (F)	0.2	1.5
hloride (Cl)	22	250
phate (PO_4)	<0.01	.05 good 30 poor
l Hardness	183	50 soft 300 hard
rgents	0	0
H	7.5	6.5 8.5
cific luctance	420	

COLUMN 2

	Anal.	Limit
Magnesium (Mg)	36	125
Calcium (Ca)	41	300
Turbidity	3	5
Color	0	15
Bicarbonate (HCO_3)	240	25 good 500 poor
Carbonate	0	350
Alkalinity	197	350
Total Dissolved Solids	270	500

COLUMN 3

	Analysis	Limits
Sodium (Na)		200
Potassium (K)		
Sulfate (SO_4)		250
Sulfite **(SO_3)		5.0
Nitrate (NO_3)		10
Suspended Solids		
Arsenic (As)		0.01
Copper (Cu)		1.0
Cyanide (Cn)		0.01
Phenols		0.00
Zinc (Zn)		5.0
Barium (Ba)		1.0
Cadmium (Cd)		0.01
Lead Pb)		0.05
Silver (Ag)		0.05
Mercury (Hg)		0.05
Manganese (Mn)		0.05

MMENTS: 2 BOTTLES CONTAIN IDENTICAL WATER

ec'd 8/29/74

9/9/74 DP Gerber

INSTRUCTIONS:

Rinse container several times in water source to be sampled.

2. Place cap on sample container firmly.

3. Place sample in carton mailer, and forward to:

Public Health Laboratory
SRO, Medical Arts Bldg.
Pouch J
Juneau, AK 99801

OCT 9 ENTD

equires Special Container

16

WELL LOG

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

LOCATION ST. MARYS AVEC WELL #1 DATE STARTED 5-1-72

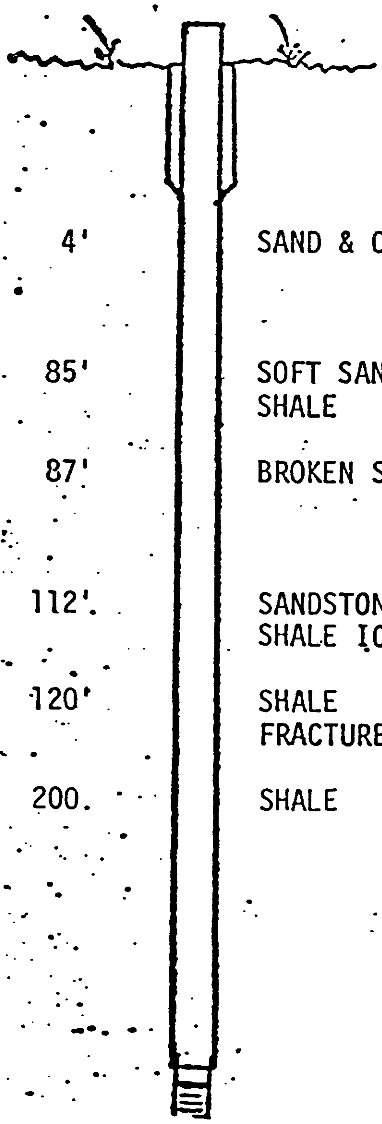
DATE COMPLETED 6-10-72 CREW ESTABROOK

TOTAL DEPTH OF WELL 200 FT. CASING INSTALLED 85' DIAMETER 6"

GROUT NONE SCREEN SIZE NONE MFG._____ LENGTH_____

STATIC WATER LEVEL 30 HRS. PUMPED 48 @ 15 GPM DRAWDOWN 100 FT.

DEVELOPMENT PROCEDURES_____



DATE	DEPTH FROM - TO	FORMATION
	0' - 4'	SAND & CLAY
	4' - 85'	SOFT SANDSTONE SHALE
	85' - 87'	BROKEN SANDSTONE
	87' -112'	SANDSTONE & SHALE - 112' ICE
	112' -120'	SHALE 120' FRACTURED AREA
	120' -200	SHALE

WATER DATA FIELD TEST

TASTE_____ APPEARANCE FRESH_____

AFTER 24 HOURS_____ IRON_____ CHLORIDES_____

TDS_____ ALKALINITY_____ pH_____

SPECIAL NOTES:

AFTER 48 HRS. OF CONTINOUS PUMPING @ 30 GPM IT WAS HOLDING 30 GPM WITH WATER LEVEL @ PUMP SUCTION THATS 130 ft.

WELL LOG

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

LOCATION St. Marys Well in City Dock # 2 DATE STARTED 11-4-72

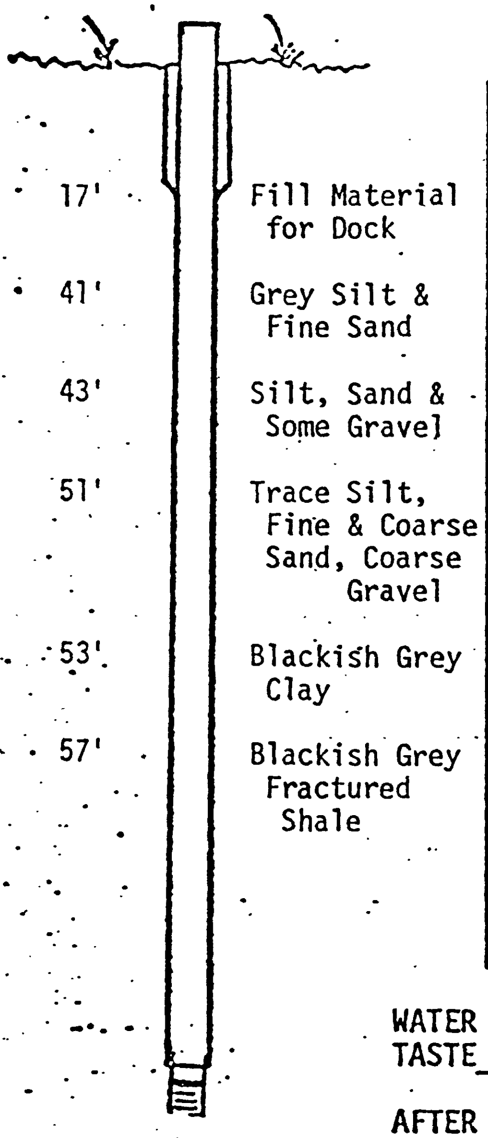
DATE COMPLETED 12-4-72 CREW Leo Brueggeman

TOTAL DEPTH OF WELL 57 FT. CASING INSTALLED 47 DIAMETER 6"

GROUT ______ SCREEN SIZE #60 MFG. Johnson LENGTH 5"

STATIC WATER LEVEL River Static HRS. PUMPED 20 @ 50 GPM DRAWDOWN 11 FT.
Dec. 1, 1972 - 20' From Dock Surface .4 .20 " " 2½
.25 " " 3¼

DEVELOPMENT PROCEDURES
2 Hrs Surling
7 Hrs Bailing



DATE	DEPTH FROM - TO	FORMATION
	0' - 17'	Fill Material for Dock
	17' - 41'	Grey Silt & Fine Sand
	41' - 43'	Silt, Sand & Some Gravel
	43' - 51'	Trace Silt, Fine & Coarse Sand, Coarse Gravel
	51' - 53'	Blackish Grey Clay
	53' - 57'	Blackish Grey Fractured Shale

WATER DATA FIELD TEST
TASTE ______ APPEARANCE FRESH ______

AFTER 24 HOURS ______ IRON ______ CHLORIDES ______

TDS ______ ALKALINITY ______ pH ______

SPECIAL NOTES:

Screen from 45' to 50'. Test Pump set at 45'. This Gravel Formation has some Silt, but the Water Cleans up okay after Pumping. There seems to be a lot of iron which will be Tested.

WELL LOG

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

LOCATION ANDREAFSKY TOWNSITE WELL # 3 DATE STARTED 12-11-72

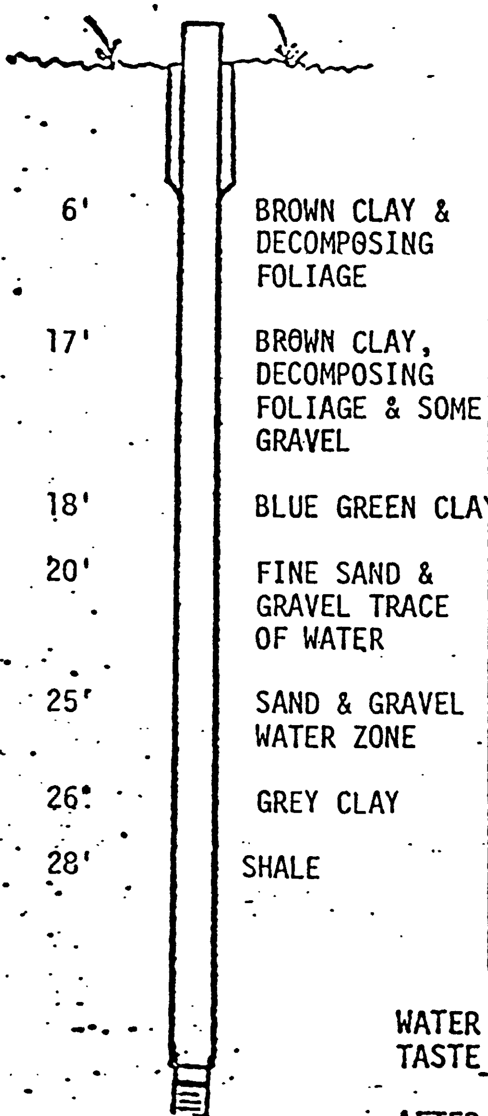
DATE COMPLETED 12-23-72 CREW LEO BRUEGGEMAN

TOTAL DEPTH OF WELL 28 FT. CASING INSTALLED 22' DIAMETER 6"

GROUT NONE SCREEN SIZE #20 MFG. JOHNSON LENGTH 5'

STATIC WATER LEVEL 7' FROM SURFACE HRS. PUMPED 4 1/2 @ 25 GPM DRAWDOWN 8 FT.

DEVELOPMENT PROCEDURES ____________



DATE	DEPTH FROM - TO	FORMATION
	0' - 6'	BROWN CLAY & DECOMPOSING FOLIAGE
	6' - 17'	BROWN CLAY, DECOMPOSING FOLIAGE AND SOME GRAVEL
	17' - 18'	BLUE GREEN CLAY
	18' - 20'	FINE SAND GRAVEL- TRACE OF WATER
	20' - 25'	SAND & GRAVEL - WATER ZONE
	25' - 26'	GREY CLAY
	26' - 28'	SHALE

WATER DATA FIELD TEST

TASTE ____________ APPEARANCE FRESH ____________

AFTER 24 HOURS ____________ IRON ____________ CHLORIDES ____________

TDS ____________ ALKALINITY ____________ pH ____________

SPECIAL NOTES:

SCREEN PACKER HAS BEEN BENT SIDEWAYS, AND ISN'T SEALING PROPERLY.

WELL LOG

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

LOCATION SHEPPARD'S TRADING POST WELL #4 DATE STARTED 5-10-73

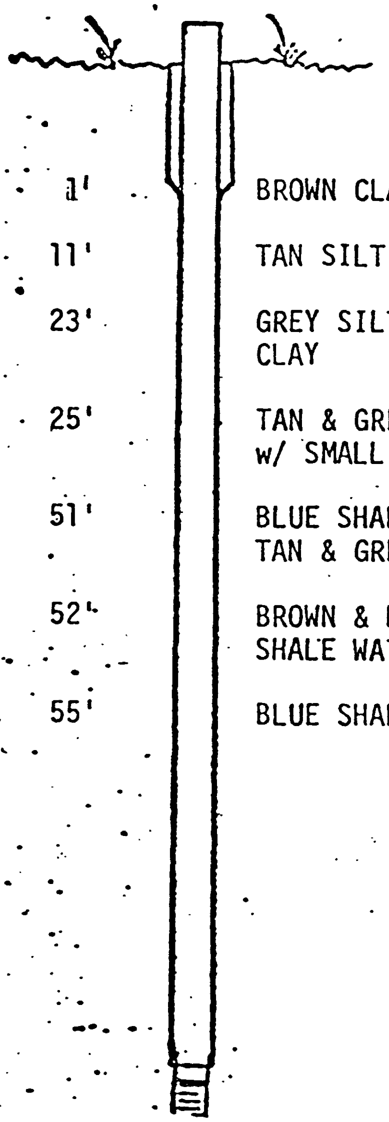
DATE COMPLETED 5-14-73 CREW LEO BRUEGGEMAN

TOTAL DEPTH OF WELL 55 FT. CASING INSTALLED 52' - 5" DIAMETER 6"

GROUT ____ SCREEN SIZE ____ MFG. ____ LENGTH ____

STATIC WATER LEVEL 30' FROM SURFACE HRS. PUMPED ____ @ ____ GPM DRAWDOWN ____ FT.

DEVELOPMENT PROCEDURES ____



DATE	DEPTH FROM - TO	FORMATION
	0' - 1'	BROWN CLAY
	1' - 11'	TAN SILT & CLAY
	11' - 23'	GREY SILT & CLAY
	23' - 25'	TAN & GREY CLAY w/ SMALL ROCKS
	25' - 51'	BLUE SHALE w/ TAN & GREY CLAY
	51' -52'	BROWN & BLUE SHALE - WATER BEARING
	52' - 55'	BLUE SHALE

WATER DATA FIELD TEST

TASTE ____ APPEARANCE FRESH ____

AFTER 24 HOURS ____ IRON ____ CHLORIDES ____

TDS ____ ALKALINITY ____ pH ____

SPECIAL NOTES:

WELL LOG

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

LOCATION St. Marys Well in City Dock # 5 DATE STARTED 5- 12- 74

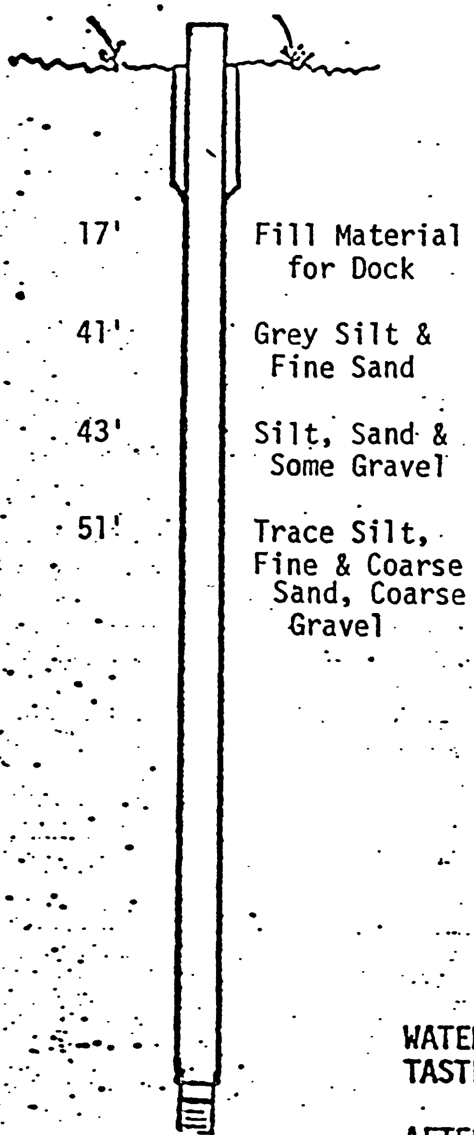
DATE COMPLETED 6-15-74 CREW Estabrook

TOTAL DEPTH OF WELL 83 FT. CASING INSTALLED 83' DIAMETER 6'

GROUT None PERFORATED SCREEN SIZE 20 3/8 Holes MFG. Johnson LENGTH 5'

STATIC WATER LEVEL 10' HRS. PUMPED 48 @ 15 GPM DRAWDOWN 50 FT.

DEVELOPMENT PROCEDURES Pump Set at 70'



DATE	DEPTH FROM - TO	FORMATION
	0' - 17'	Fill Material for Dock
	17' - 41'	Grey Silt & Fine Sand
	41' - 43'	Silt, Sand & Some Gravel
	43' - 51'	Trace Silt, Fine & Coarse Sand Coarse Gravel
	51' - 53'	Blackish Grey Clay
	53' - 57'	Blackish Grey Fractured Shale
	57' - 83'	Blackish Grey Fractured Shale

WATER DATA FIELD TEST

TASTE ______ APPEARANCE FRESH ______

AFTER 24 HOURS ______ IRON ______ CHLORIDES ______

TDS ______ ALKALINITY ______ pH ______

SPECIAL NOTES:

Screen is perforated from 77 Ft to 82 Ft .

WELL LOG

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

LOCATION St. Marys-Sewage Lagoon Well #6 DATE STARTED 8-26-74

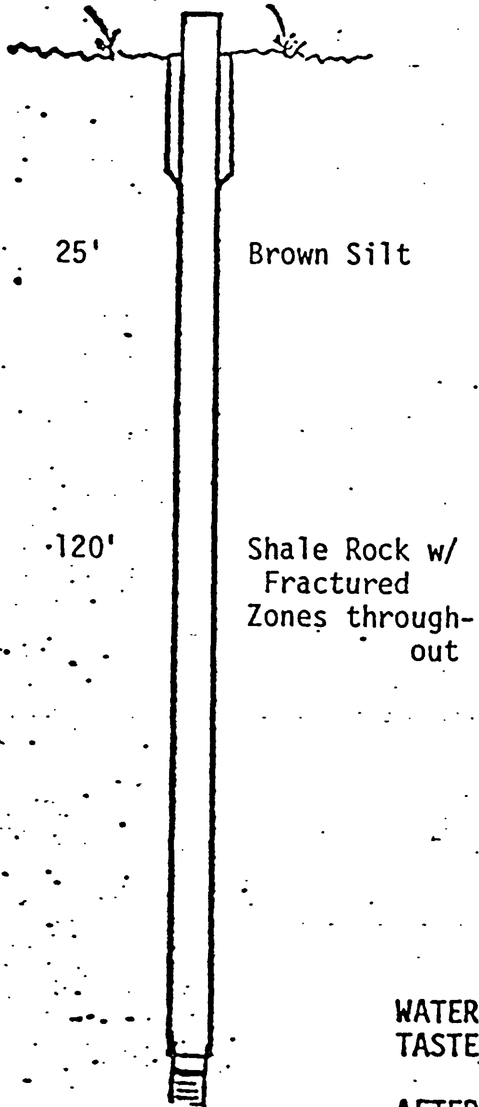
DATE COMPLETED 9-12-74 CREW Estabrook

TOTAL DEPTH OF WELL 120 FT. CASING INSTALLED 45' DIAMETER 6"

GROUT ______ SCREEN SIZE ______ MFG. ______ LENGTH ______

STATIC WATER LEVEL 8' HRS. PUMPED 72 @ 15 GPM DRAWDOWN 12 FT.

DEVELOPMENT PROCEDURES ______



DATE	DEPTH FROM - TO	FORMATION
	0'-25'	Brown Silt
	25'-120'	Shale Rock W/Fractured Zones Throughout

WATER DATA FIELD TEST

TASTE ______ APPEARANCE FRESH ______

AFTER 24 HOURS ______ IRON ______ CHLORIDES ______

TDS ______ ALKALINITY ______ pH ______

SPECIAL NOTES:

WELL LOG

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

LOCATION St. Marys-Pumphouse Well #7 DATE STARTED 10-18-74

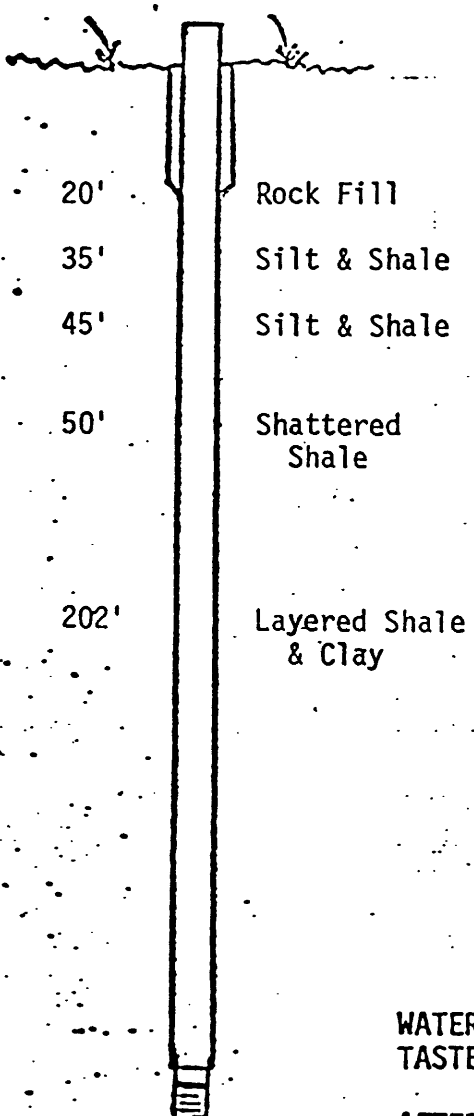
DATE COMPLETED 12-13-74 CREW Estabrook

TOTAL DEPTH OF WELL 202 FT. CASING INSTALLED 40' DIAMETER 6"

GROUT None SCREEN SIZE None MFG. ____ LENGTH ____

STATIC WATER LEVEL 16 ~~HRS.~~ MIN. PUMPED 15 @ 5 GPM DRAWDOWN 80 FT.

DEVELOPMENT PROCEDURES ____



DATE	DEPTH FROM - TO	FORMATION
	0'- 20'	Rock Fill
	20'-35'	Silt & Shale
	35'-45'	Silt & Shale
	45'-50'	Shattered Shale
	50'-202'	Layered Shale & Clay

WATER DATA FIELD TEST

TASTE ____ APPEARANCE FRESH ____

AFTER 24 HOURS ____ IRON ____ CHLORIDES ____

TDS ____ ALKALINITY ____ pH ____

SPECIAL NOTES:

WELL LOG

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

LOCATION SOS HIGH SCHOOL WELL # 8 DATE STARTED 9 - 1 - 75

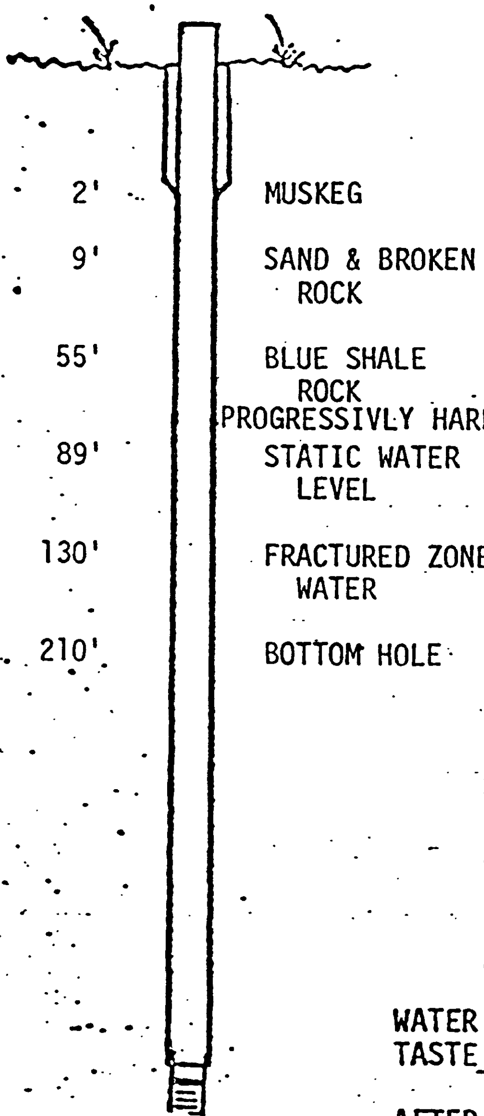
DATE COMPLETED 9-5-75 CREW Bordner & Waskey.

TOTAL DEPTH OF WELL 210 FT. CASING INSTALLED 55' DIAMETER 6"

GROUT None SCREEN SIZE None MFG. ______ LENGTH ______

STATIC WATER LEVEL 89 HRS. PUMPED 30 @ 55 GPM DRAWDOWN 90 FT.

DEVELOPMENT PROCEDURES Surge W/Air
Pump W/ Air



DATE	DEPTH FROM - TO	FORMATION
	0' - 2'	MUSKEG
	2' - 9'	SAND & BROKEN ROCK
	9' - 55'	BLUE SHALE - PROGRESSIVLY HARDER
	55'	BOTTOM CASING
	89'	STATIC WATER LEVEL
	89 - 130'	FRACTURED ZONE - WATER
	210'	BOTTOM HOLE
	55' - 210'	BLUE SHALE - PROGRESSIVLY HARDER

WATER DATA FIELD TEST

TASTE GOOD APPEARANCE FRESH GOOD

AFTER 24 HOURS GOOD IRON ______ CHLORIDES -

TDS ______ ALKALINITY ______ pH ______

SPECIAL NOTES:

WELL LOG

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

LOCATION St. Marys-By Infiltration Gallery#9 DATE STARTED 7-4-76

DATE COMPLETED 7-5-76 CREW Bordner & Horner.

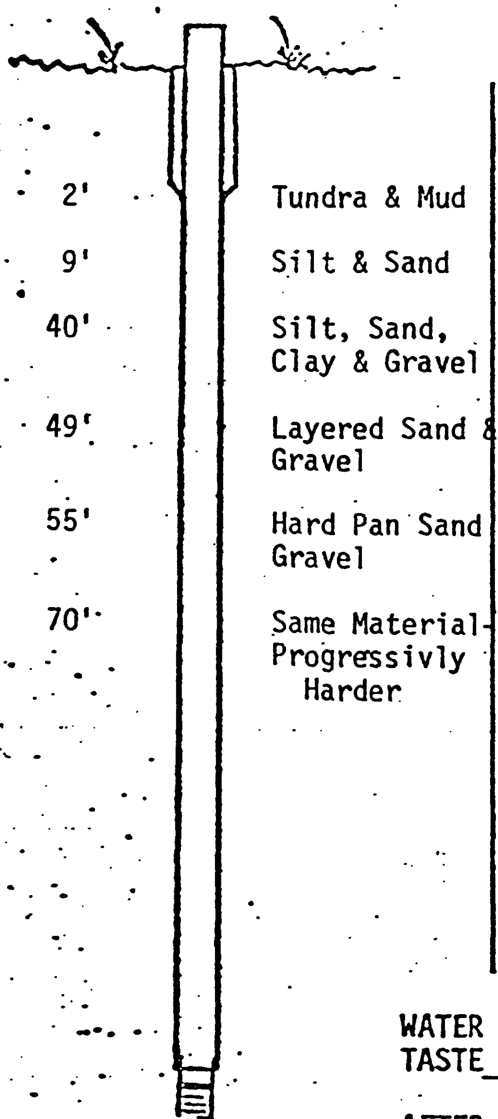
TOTAL DEPTH OF WELL 54 FT. CASING INSTALLED 50 DIAMETER 6"

GROUT None SCREEN SIZE #40 MFG. Johnson LENGTH 4'

STATIC WATER LEVEL 96 HRS. PUMPED 30 @ 37 GPM DRAWDOWN 41 FT.

DEVELOPMENT PROCEDURES AIR-BUILD UP SURGE 4 HR

PUMP w/ AIR 8 HR.



DATE	DEPTH FROM - TO	FORMATION
	0' - 2'	Tundra Mud
	2' - 9'	Silt & Sand
	9' - 40'	Silt, Sand, Clay & Gravel
	40' - 49'	Layered Sand & Gravel
	49' - 55'	Hard Pan Sand & Gravel
	55' -70'	Same Material - Progressivly Harder

WATER DATA FIELD TEST
TASTE Good APPEARANCE FRESH Clear

AFTER 24 HOURS Same IRON CHLORIDES

TDS ALKALINITY pH

SPECIAL NOTES:

Hole Back Filled with gravel up to 55 ft.

: No. 76 - 143 Project Name ST Marys Well # 9

tion of Well Next to infiltration gallery

of Well 54 ft. Length of Casing 50 ft. Pumped Well / ~~Observation Well~~

rvation Well, Dist. to Pumped Well ____ ft. Top of Casing to Static Level

Drilling Completed 7-2-76 Driller Bordner Date Tested ____

lapsed Time Since Pumping Started/Stopped	Depth to Water From TOC	Drawdown @ 30 gpm ~~or~~ Recovery	Clock Time	Elapsed Time Since Pumping Started/Stopped	Depth to Water From TOC	Drawdown @ 30 gp ~~or~~ Recovery
STATIC LEVEL	6' - 6"	----		31 MIN	28' - 10"	22' - 4"
1 MIN	16' - 2"	9' - 8"		35	29' - 6"	23'
2	20'	13' - 6"		40	29' - 3"	22' - 9"
3	22'	15 - 6"		45	29' - 3"	22' - 6"
4	23' - 5"	16' - 11"		50	29'	22' - 6"
5	24' - 4"	17' - 10"		60	29'	22' - 6"
6	25'	18' - 6"		2 HRS	29'	22' - 6"
7	25' - 6"	19'		3	29'	22' - 6"
8	26'	19' - 6"		4	28' - 11"	22' - 5"
9	26' - 5"	19' - 11"				
10	26' - 6"	20'				
11	26' - 9"	20' - 3"				
12	27"	20' - 6"				
13	27' - 1½"	20' - 7½"				
14	27' - 3"	20' - 9"				
15	27' - 5½"	20' -11½"				
16	27' - 8"	21' - 2"				
17	27' - 8½"	21' -2½"				
18	27' - 10"	21' - 4"				
19	27' - 11"	21' - 5"				
20	28'	21' - 6"				
21	28' - 1"	21' - 7"				
22	28' - 2"	21' - 8"				
23	28' - 3½"	21' - 9½"				
24	28' - 4"	21' - 10"				
25	28' - 5½"	21' - 11½"				
26	28' - 6"	22'				
27	28' - 7"	22' - 1"				
28	28' - 8"	22' - 2"				
29	28' - 9"	22' - 3"				
30	28' - 9½"	22' -3½"				