Final
Decision Document for
Federal Scout Readiness Center
Gambell, Alaska

Prepared For:

Alaska Army National Guard
PO Box B, Camp Denali
Ft Richardson, Alaska 99505-2610

January 2020

Prepared By:
Brice Engineering, LLC
3800 Centerpoint Drive, Suite 417
Anchorage, Alaska 99503
907.275.2896 PH

This page intentionally left blank

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
µg/L	microgram(s) per liter
AAC	Alaska Administrative Code
ACL	alternative cleanup level
ADEC	Alaska Department of Environmental Conservation
AKARNG	Alaska Army National Guard
AST	aboveground storage tank
ATG	Alaska Territorial Guard
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
COC	contaminant of concern
CUL	cleanup level
DD	Decision Document
DRO	diesel range organics
FSRC	Federal Scout Readiness Center
Hoefler	Hoefler Consulting Group
ID	identification number
mg/kg	milligram(s) per kilogram
N/A	not applicable
POL	petroleum, oil, and lubricants
SI	Site Investigation
USACE	U.S. Army Corps of Engineers

This page intentionally left blank

PART I: DECLARATION

1.0 SITE NAME AND LOCATION

Facility Name: Gambell Federal Scout Readiness Center (FSRC), Gambell, Alaska.

Alaska Department of Environmental Conservation (ADEC) Hazard ID: 4276 ADEC File Number: 660.38.007

ADEC Site Name: AKARNG Gambell Federal Scout Armory

Site Location: The Gambell FSRC is located approximately ¼ mile northeast of the Gambell Airport in Gambell, Alaska (Figure 1). The city of Gambell is located on a gravel spit on the northwestern tip of Saint Lawrence Island in the Bering Sea, 36 miles from the coast of Siberia.

Latitude and Longitude: 63.7783386 degrees north and -171.3400335 degrees west (1984 World Geodetic System datum, revised 2004) and in Section 03 of Township 020S, Range 0670W of the Kateel River Meridian.

Facility Owner and Point of Contact: The Gambell FSRC property is owned by Sivuqaq Incorporated and licensed to the Alaska Army National Guard (AKARNG) until June 30, 2020, with a 30-year renewal option. The point of contact is Lieutenant Colonel Eric Marcellus, CFMO/Environmental, Building 57024, Joint Base Elmendorf-Richardson, Alaska, 99505.

2.0 STATEMENT OF BASIS AND PURPOSE

This Decision Document (DD) presents the selected remedy for the Gambell FSRC, Alaska, which was chosen in accordance with Alaska State law. This decision complies with 18 Alaska Administration Code (AAC) 75 *Oil and Other Hazardous Substances Pollution Control* (ADEC 2018) and is based on the information contained within the site record; documents used in the selection of the remedy are listed in Section 8.0.

3.0 ASSESSMENT OF THE SITE

The response action selected in this DD is necessary to protect human health or welfare or the environment from actual or threatened releases of petroleum into the environment.

4.0 DESCRIPTION OF THE SELECTED REMEDY

The overall cleanup strategy for the Gambell FSRC is to reduce hazardous substances, pollutants, and contaminants (petroleum products and fractions thereof) to achieve the ADEC site closure status of "Cleanup Complete." The selected remedy for Gambell FSRC addresses all contaminated media exposure pathways (soil and porewater), achieves all applicable cleanup levels, and is cost effective.

The Gambell FSRC site resulted primarily from an estimated 3,000-gallon spill of heating oil from a single-walled aboveground storage tank (AST) in 1983. The AST has since been removed. Several other potential source areas have been identified during investigation (Eagle Eye 2017).

The AKARNG-selected remedial alternative for the Gambell FSRC site includes alternative cleanup levels (ACLs) for remaining soil contamination. Groundwater in the central gravel spit is subject to saltwater intrusion, is difficult to recover, and is located in an active lens above permafrost. It is therefore unsuitable as a drinking water source. This supra-permafrost groundwater is hereinafter referred to as "porewater."

Therefore, the remaining contamination in supra-permafrost porewater that has been previously identified (Eagle Eye 2017) will no longer be an exceedance of the ADEC groundwater cleanup levels and the site is eligible for a "Cleanup Complete" determination. Section 14.0 provides additional discussion of the site porewater.

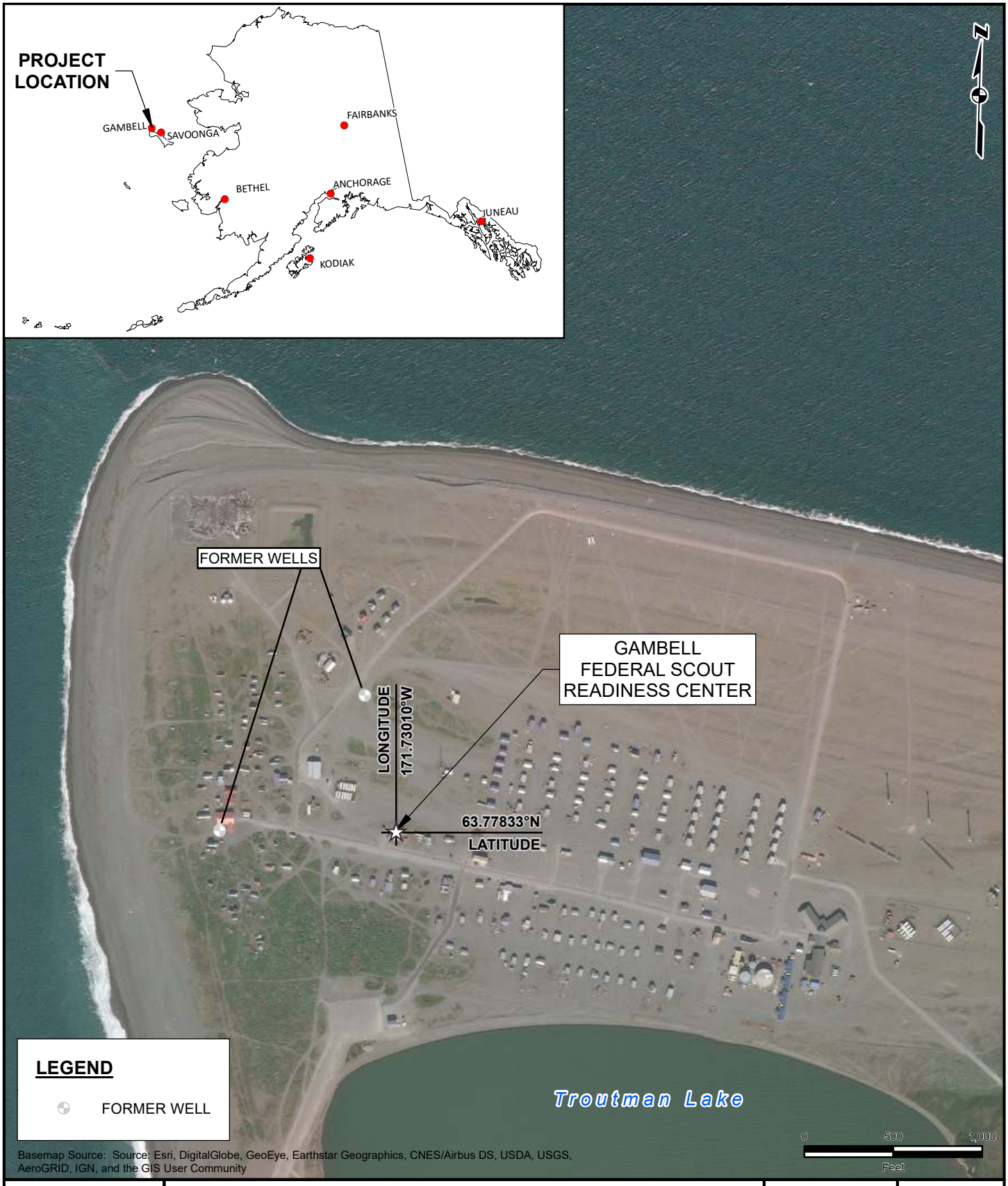
The major components of the selected remedy include the following:

- No Action for soil as approved ACLs are met in soil.
- No Action for site porewater as it is unsuitable as a current or future drinking water source, and site conditions mitigate the migration of contamination to surface water, sediment, and unimpacted areas.
- Decommission monitoring wells remaining onsite.

5.0 STATUTORY DETERMINATIONS

The selected remedy satisfies the requirements of 18 AAC 75. The selected remedy for the Gambell FSRC is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and uses permanent solutions and alternative treatment technologies to the maximum extent practicable.

1 INCH



Document Path: Q:\BES Anchorage\GEOSPATIAL_PROJECTS\BENG\USACE\Gambell_GIS\1_MXD\WORK_PLANF1_Location_and_Site Vicinity.mxd

GAMBELL FEDERAL SCOUT READINESS CENTER
GAMBELL, ALASKA

LOCATION AND SITE VICINITY

DATE: 2/19/2019
PROJECT No.: W55050
DRAWN: R.D.

FIGURE: 1

This page intentionally left blank

6.0 AUTHORIZING SIGNATURES

The following signatures document the approval by the Alaska Army National Guard of the selected remedy described in this DD for the Gambell FSRC, Gambell, Alaska. It also indicates ADEC agreement that the selected remedy, when properly implemented, will comply with state law. These decisions will be reviewed and modified in the future if information becomes available that indicates the presence of contaminants or exposure that may cause unacceptable risk to human health or the environment.

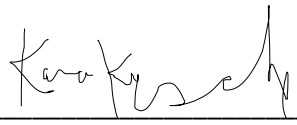
HAMMETT.ANTHONY.SCOTT.1116575562

Digitally signed by HAMMETT.ANTHONY.SCOTT.1116575562
Date: 2020.06.09 11:51:22 -04'00'

___09 JUNE 2020_____

Anthony Hammett
Colonel, U.S. Army
Chief, Installations & Environment
Army National Guard

Date



04/16/2020

Kara Kusche
Environmental Program Manager
Division of Spill Response Contaminated Sites Program
Alaska Department of Environmental Conservation

Date

This page intentionally left blank

PART II: DECISION SUMMARY

This decision summary provides a description of the Gambell FSRC and summarizes legal and public involvement issues, site risks, remedial alternatives, the rationale for remedy selection, and how the selected remedy satisfies statutory and regulatory requirements.

7.0 SITE DESCRIPTION

The city of Gambell is located on a gravel spit on the northwestern tip of Saint Lawrence Island in the Bering Sea, 36 miles from the coast of Siberia (Figure 1). The climate is maritime with continental influences in winter (Eagle Eye 2017). Precipitation falls 300 days of the year with an annual precipitation of 17.6 inches and an average annual snowfall of 70.5 inches. Average monthly temperatures range from 1.8 to 45.9 degrees Fahrenheit (°F) with an annual mean temperature of 25.1 °F (Western Regional Climate Center 2019).

According to the 2010 Census, Gambell City, Alaska, has a population of 681. The only other community on St. Lawrence Island is Savoonga (population 671), located approximately 40 miles east of Gambell. Beyond local access, Gambell is only accessible by air, as there is no harbor.

Gambell FSRC is a known petroleum-contaminated soil source area, resulting primarily from an estimated 3,000-gallon spill of heating oil from a single-walled AST in 1983. The AST has since been removed. Several other potential source areas have been identified during previous investigations (Section 10.2).

7.1 Surface Features and Topography

Sevuokuk Mountain lies approximately 1 mile to the east of the city, rising to an elevation of 614 feet above sea level. West of Sevuokuk Mountain, the topography of the area is relatively flat. The three major surface water features in the area are the Bering Sea, Kittilngook Bay, and Troutman Lake. Troutman Lake, the nearest body of surface water, is approximately 1,200 feet south of the site. The lake water is considered slightly brackish because of influences from the Bering Sea (U.S. Army Corps of Engineers [USACE] 2005). The level of the lake is approximately 2 feet above sea level. Surface water flow direction from the site is estimated to be toward the north, away from Troutman Lake, with localized variations because of mounded gravel.

7.2 Geology and Hydrogeology

The dominant soil lithologies underlying the Gambell area are unconsolidated, poorly to well-sorted gravels with sand and poorly to well-sorted sand with gravels. The gravels are underlain by bedrock consisting of granitic Cretaceous plutonic rocks. The bedrock also forms the bluff and Sevuokuk Mountain, which bounds Gambell to the east.

Permafrost is commonly encountered at depths ranging from 3 to 15 feet below ground surface (bgs) (USACE 2005). An investigation in 1985 found permafrost to be discontinuous throughout the area. Where permafrost was present in 1985, it was found at depths from 7 to 10 feet bgs (RZA Inc. 1985). However, further investigations in 1992 indicated that permafrost at that time was discontinuous nearest the sea, becoming continuous to the south and east across the gravel spit toward the bluff (Munter and Williams 1992). During a 2011 investigation at the Gambell FSRC site, which is located on the gravel spit, permafrost was encountered in all soil borings at depths as shallow as 7 feet bgs, but as deep as 9.5 feet bgs

(CH2M HILL 2013). The Gambell FSRC is located approximately 2,000 feet from the Sevuokuk Mountain bluffs, which have a seasonally varying areal extent of shallow permafrost.

Groundwater resources are limited at Gambell. Groundwater is often saline, difficult to recover in usable quantities, and located in an active lens over permafrost, where it may be referred to as supra-permafrost porewater (USACE 2005). At the Gambell FSRC property, previous investigations have encountered supra-permafrost porewater in monitoring wells installed to depths of approximately 10 feet bgs. Documented wells located off the Gambell FSRC property include one former water well located approximately 1,000 feet west of the FSRC in the old village site and drilled to a depth of 35.1 feet bgs; and another located approximately 750 feet northwest of the FSRC, next to the former elementary school and drilled to a depth of 39.2 feet bgs (Figure 1). In the units above the screened interval, well logs indicate both wells penetrated frozen gravel interlayered with thawed gravel (Appendix A). Both wells were eventually abandoned because of low discharge rates and poor water quality, which likely included saltwater intrusion during storm surge events. As both wells were located seaside, neither of the well logs are completely representative of the Gambell FSRC site subsurface, which is underlain by shallower continuous permafrost.

Currently, drinking water for the school and village is obtained from an infiltration gallery placed within the shallow aquifer (10 to 14 feet bgs) at the base of the Sevuokuk Mountain bluff, located approximately 2,000 feet east of the FSRC (Figure 2) (Alaska Drinking Water System No. AK2340751). That shallow aquifer occurs in a thaw bulb in the permafrost and is hydrologically disconnected from the supra-permafrost porewater observed at Gambell FSRC. Most of the water entering the aquifer comes from two springs that flow from the steep bluffs of the mountain into the gravel. The relatively warm water from these springs effectively thaws the permafrost where the mountain bedrock meets the primarily unconsolidated gravel spit. As the permafrost expands or recedes, the aquifer dimensions vary accordingly. The shallow aquifer does not appear to be continuous across the gravel spit because of the presence of shallow permafrost (Agency for Toxic Substances and Disease Registry [ATSDR] 2017). The ADEC Drinking Water Protection Map also indicates that the drinking water protection area is primarily along the Sevuokuk Mountain Bluff, rather than from the gravel spit (ADEC 2019).

A 1992 report, Analysis of Potable Water-Supply Options (Munter and Williams 1992), describes a resistivity survey performed in Gambell to investigate alternative drinking water sources from the infiltration gallery that was used at the time (Appendix B). Many of the soundings indicated layers of brackish water and frozen soils at various depths. Soundings 7, 9, and 14 were the closest points to the FSRC site. These soundings indicated brackish water at 26, 48, and 17 feet bgs, respectively. Troutman Lake, the predominant surface water body in the area, is considered slightly brackish from Bering Sea influence. Given the history of failed water wells in the area of the Gambell FSRC, it is unlikely that active layer supra-permafrost porewater in the vicinity of the gravel spit will be used in the future. The conceptual hydrology for the gravel spit is illustrated on Figure 3.

7.3 Land Use

Figure 1 shows the general location of the Gambell FSRC. The Gambell FSRC is currently inoperative, with a vacant/commercial land use and is outside of the main residential area of Gambell. The Gambell FSRC property is owned by Sivuqaq Incorporated and is licensed to the AKARNG until June 30, 2020, with a 30-year renewal option. Land use is unlikely to change in the near future. A residential scenario was considered as a conservative potential future scenario for purposes of developing the selected remedy.

1 INCH

DECISION DOCUMENT
GAMBELL FEDERAL SCOUT
READINESS CENTER

GAMBELL, ALASKA

TOPOGRAPHY AND FEATURES

Notes:

1. Map not to scale.

References:

1. Map produced using ESRI ArcMap v. 10.5.
2. Image from Google Earth, 2018. Image Date: 08, 2006.

PROJECT No.:	DATE:	FIGURE:
W55050	7/24/2019	2
P.M.:	DRAWN:	
MO	JC	

Document Path: G:_PROJECTS\BENGUSACE\Gambell_GIS\1_MXD\REPORT\F2_Topography_and_Features.mxd

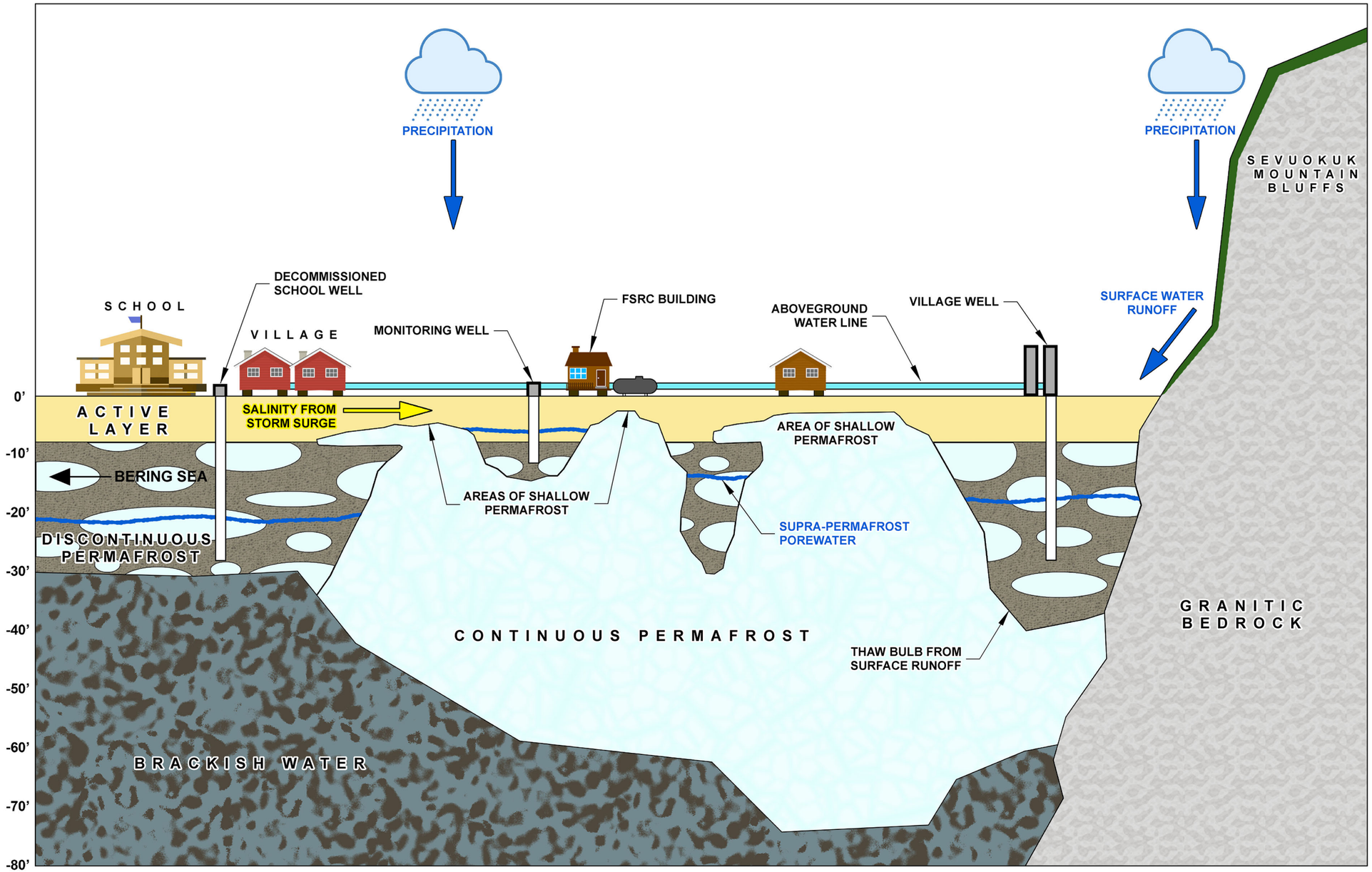
This page intentionally left blank

1 INCH

DECISION DOCUMENT
GAMBELL FEDERAL SCOUT READINESS CENTER

GAMBELL, ALASKA

CONCEPTUAL HYDROLOGY MODEL



Notes:

1. Map not to scale.
2. Conceptual model adapted from Montgomery Watson, 1995.
3. This conceptual hydrology model is based on a composite of well logs from multiple AKARNG and USACE FUDS investigations, public information provided in the Gambell USACE FUDS 2005 Decision Document question and answer section, public water system well logs, and the Muntner and Williams 1992 Resistivity Survey. See References, Appendix A, and Appendix B for supporting information.

PROJECT No.:	DATE:	FIGURE:
W55050	8/2/2019	3
P.M.: MO	DRAWN: JC	

Document Path: G:_PROJECTS\BENG\USACE\Gambell_GIS\1_MXD\REPORT\F3_Conceptual_Hydrology_Model.mxd

This page intentionally left blank

8.0 RELEVANT GUIDANCE AND POLICY

Reports documenting previous investigations in Gambell and relevant to this DD include:

- *Analysis of Potable Water-Supply Options Gambell, Alaska* (Munter and Williams 1992)
- *Geotechnical, Geophysical, and Soil/Groundwater Quality Studies, Defense Environmental Restoration Program, Gambell, St. Lawrence Island, Alaska* (RZA, Inc. 1985)
- *Decision Document Gambell Formerly Used Defense Site F10AK0690, St. Lawrence Island, Alaska* (USACE 2005)
- *Site Investigation Report, Site Characterization and Restoration-Related Activities Project, Gambell Federal Scout Readiness Center* (Hoefler 2008)
- *Gambell Federal Scout Readiness Center Data Gap Investigation Report* (CH2M HILL 2013)
- *Gambell Site Characterization Report, Federal Scout Readiness Center, Alaska* (Eagle Eye 2017)
- *Evaluation of Environmental Exposures at the Gambell Formerly Used Defense Site, Native Village of Gambell, Gambell, Alaska* (ATSDR 2017)

Regulations and guidance documents relevant to this DD include:

- *ADEC Site Closure/Cleanup Complete Memorandum* (ADEC 2016)
- *ADEC Guidance on Developing Conceptual Site Models* (ADEC 2017a)
- ADEC Technical Memorandum – *Establishing Arctic Zone Cleanup Levels* (ADEC 2017b)
- 18 AAC 75 *Oil and Other Hazardous Substances Pollution Control* (ADEC 2018)

9.0 REGULATORY AUTHORITY

As the regulatory agency, ADEC provides primary oversight of the cleanup of petroleum-contaminated soil and groundwater in accordance with State of Alaska contaminated sites regulations (18 AAC 75*, Oil and Other Hazardous Substances Pollution Control*) (ADEC 2018).

10.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

This section provides background information and summarizes the series of investigations that led to the DD. No enforcement activities have been initiated for the Gambell FSRC site.

10.1 Site History

The AKARNG predates statehood, beginning in the 1940s as the Alaska Territorial Guard (ATG). The first ATG armory program began around 1945, with 20 western Alaskan villages erecting buildings for the ATG, including the communities of Gambell and Savoonga. Guard activity at the St. Lawrence Island villages of Gambell and Savoonga increased during the Cold War.

Federal Scout Readiness Centers were built at AKARNG sites from 1959 throughout the Cold War era. There were two FSRC buildings constructed at the Gambell facility (Figure 4). The Old FSRC building was built in 1970, and the New FSRC building was constructed in 1979. The FSRC is currently inoperable.

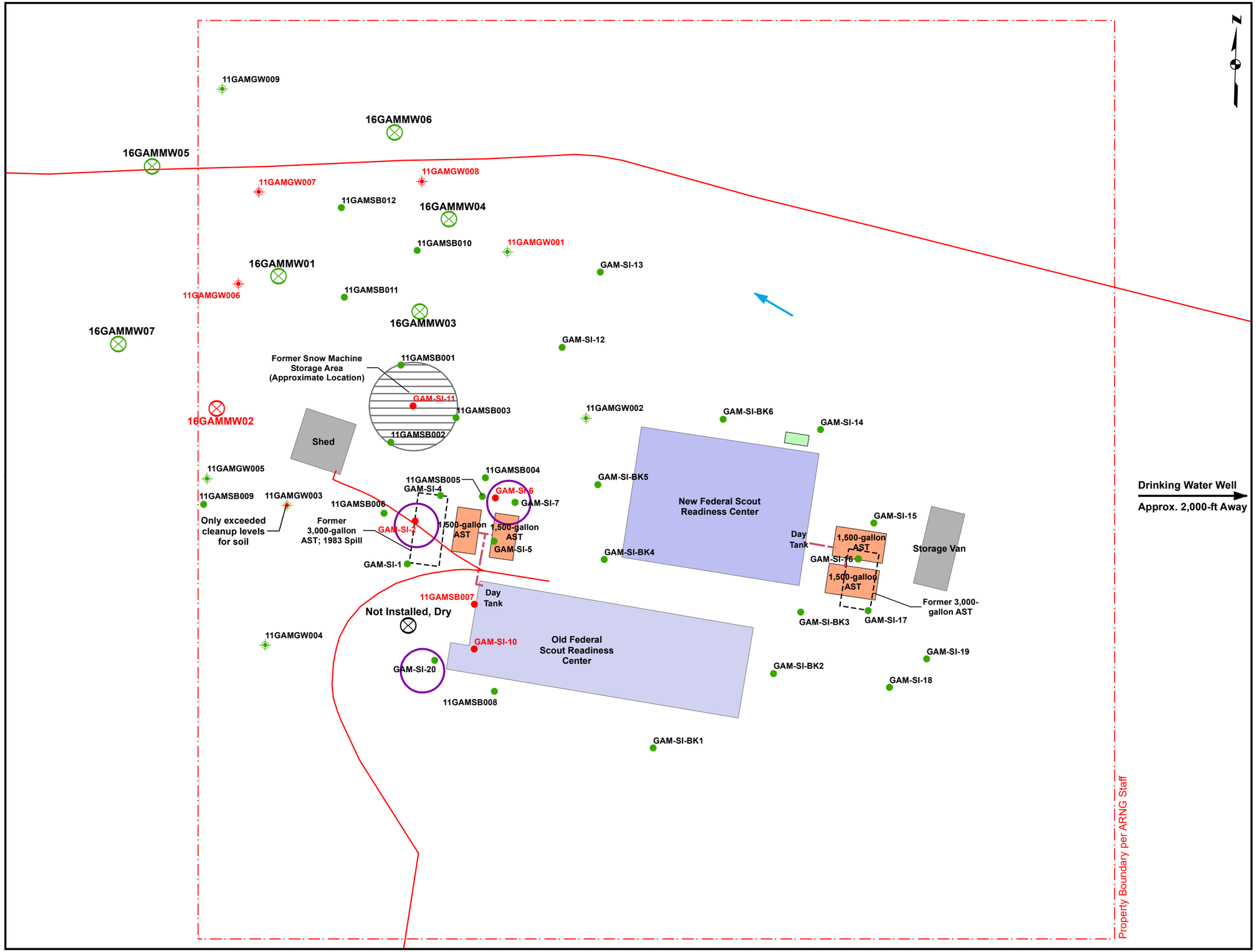
There was a documented 3,000-gallon heating oil spill at the FSRC in 1983, when the entirety of a 3,000-gallon AST (Figure 4) leaked onto the surface soil. In 1990, two suspected "recent" small spill areas were identified based on observations of stained soil. At the same time, 14 other potential spill sources were identified at the site. A slight depression in the ground with petroleum, oil, and lubricants (POL) staining near the northwest corner of the Old FSRC building near the former 3,000-gallon single-wall AST was observed in 1997. This staining may have been a remnant of the 1983 spill, the "recent" stain noted in 1990, or a new spill. A standpipe by the west entrance ramp to the Old FSRC building was also listed as having POL staining in 1997.

10.2 Summary of Previous Investigations

Several investigations have been completed at the Gambell FSRC to determine the nature and extent of contamination, the results of which are shown on Figure 4. The following bullets present a summary of the investigations at the site:

- A Site Investigation (SI) conducted in 2006 (Hoefler 2008) included sampling in potentially contaminated areas where previous spills had occurred and where surface stains had been observed. A total of 25 soil samples were collected from 23 soil borings and surface sample locations at depths ranging from 0.5 to 3.5 feet bgs. Diesel range organics (DRO) was the only contaminant detected in surface and subsurface soils at concentrations that exceeded the most stringent (migration to groundwater) cleanup level, with a maximum detected concentration of 420 milligrams per kilogram (mg/kg). Supra-permafrost porewater was not encountered during the investigation due to limited investigation depths.

1 INCH



DECISION DOCUMENT
GAMBELL FEDERAL SCOUT READINESS CENTER

GAMBELL, ALASKA

PREVIOUS SOIL AND GROUNDWATER SAMPLE LOCATIONS AND EXCEEDANCES

LEGEND:

- AST
- Day Tank
- Federal Scout Readiness Center (FSRC)
- Former AST
- Hazardous Material Storage Locker
- Historical Staining
- Old FSRC
- Property Boundary
- Storage Facility
- Tank Piping
- Easement Line
- Electric Line
- Fuel Line
- Presumed Groundwater Flow Direction

Monitoring Well Locations Installed and Sampled in 2016

- Not Installed, Dry
- DRO < 1.5 mg/L
- DRO ≥ 1.5 mg/L

Previous Groundwater Sample Location

- DRO < 1.5 mg/L
- DRO ≥ 1.5 mg/L

Previous Soil Sample Location

- DRO < 250 mg/kg
- DRO ≥ 250 mg/kg, but < 10,250 mg/kg

Abbreviations:

AST ..... aboveground storage tank
DRO ..... diesel-range organics
mg/kg ..... milligrams per kilogram

Notes:

1. Location of historical samples is approximate based on historical figures and on orthophotography courtesy of Alaska Department of Commerce, Division of Community & Regional Affairs (DCRA), 1-foot pixels.
2. All prior wells have been abandoned/removed

References:

1. Map produced using ESRI ArcMap v. 10.5.

ALASKA STATE PLANE ZONE 9
HORIZONTAL DATUM: NAD83 (2011)
VERTICAL DATUM: NAVD88

20 10 0 20

SCALE IN FEET

PROJECT No.:	DATE:	FIGURE:
W55050	7/24/2019	4
P.M.: MO	DRAWN: RD	

Document Path: G:_PROJECTS\BENGUSACE\Gambell_GIS\1_MXD\REPORT\F4_Gambell_Soil_and_Groundwater_Sample_Locations_Summer2016.mxd

This page intentionally left blank

- A Data Gap Investigation was conducted in 2011 (CH2M HILL 2013) to fill data gaps at the site and support recommendations for remedial actions. No new sources of contamination or evidence of stained soil or recent spills were identified during the investigation. A total of 23 soil samples were collected from 13 soil borings. Permafrost was encountered in all soil borings at depths between 7 and 9.5 feet bgs. DRO was the only contaminant detected in surface and sub-surface soil samples at concentrations exceeding the most stringent (ADEC migration to groundwater) screening level. DRO exceeded the screening level in six samples; 600 mg/kg was the highest concentration. Twelve temporary monitoring wells were installed during this effort and samples of supra-permafrost porewater were collected from 10 of the wells. DRO was the only contaminant detected in supra-permafrost porewater that exceeded ADEC groundwater cleanup levels in effect at the time, with a maximum concentration of 33,000 micrograms per liter (µg/L). DRO exceeded the groundwater cleanup level in four monitoring wells. The report recommended no further action as soil results were less than applicable ACLs and the supra-permafrost porewater is not considered a viable drinking water aquifer. ADEC did not concur with the recommendation due to lack of well development prior to sampling and other data quality issues and recommended further delineation of site porewater to confirm migration off the property was not occurring.
- Additional site characterization was conducted in 2016 (Eagle Eye 2017) to address data gaps remaining from the 2011 investigation and to define the nature and extent of supra-permafrost porewater contamination. Surface soil staining was not observed onsite during the 2016 site characterization. Seven new permanent monitoring wells were installed to depths of approximately 10 feet bgs, developed, and supra-permafrost porewater samples were collected from each well. Indications of permafrost were not recorded during well installation in 2016. During well installation, boreholes were advanced to depths of approximately 10 feet bgs and confirming the presence of permafrost or seasonally frozen soils was not an objective of the investigation. One well, MW03, purged dry after 15 liters of water was removed. Four wells (MW02, MW04, MW06, MW07) of the six installed did not stabilize during development and were purged until the maximum purge volume was reached. During the purge and sampling of the seven new wells, six reached the maximum purge volume rather than stabilizing, and several were highly turbid; indicating that “dirty” water samples were submitted and that the laboratory results included contributions from suspended solids (soil). Well MW02 was the most turbid, with 50.68 Nephelometric Turbidity Units, and it was the only well sampled which contained contaminant concentrations that exceeded the current ADEC Table C groundwater cleanup levels. This well contained DRO (14,000 µg/L) and naphthalene (11 µg/L) at concentrations greater than the cleanup levels. The supra-permafrost porewater flow direction was confirmed to be to the northwest, and the porewater contamination was bound by three wells to the north, west, and northwest.

11.0 COMMUNITY PARTICIPATION

AKARNG assessed community interest for establishing a Restoration Advisory Board in 2016. The City of Gambell, Native Village of Gambell, and Sivuqaq, Incorporated were contacted. AKARNG has not received input from the village entities. Draft and final reports associated with the investigation and cleanup of the Gambell FSRC have been sent to village entities as they are completed.

12.0 CONFIRMED ROUTES OF EXPOSURE

The site-specific conceptual site model for potential human exposures is depicted on Figure 5 and is formulated according to applicable guidance (including ADEC 2017a), with the use of professional judgment and site-specific information on land use, water use, contaminant sources, release mechanisms, routes of migration, potential exposure points, potential routes of exposure, and potential receptor groups associated with the site. A human health conceptual site model scoping form is included in Appendix C. No areas of archaeological or historical importance have been identified at the site. Potentially affected media are primarily surface and subsurface soil and porewater. The model takes into account past and current sources of contamination, chemical release mechanisms, transport/exposure media, potential exposure points, and potential receptors. The assessed routes of exposure are as follows:

- Direct Contact – Incidental Soil Ingestion is a potentially complete pathway but is considered insignificant because the remaining concentrations do not exceed ingestion cleanup levels.
- Direct Contact – Dermal Absorption of Contaminants from Soil is considered incomplete as DRO is not a soil contaminant that permeates the skin, according to Appendix B of the ADEC *Guidance on Developing Conceptual Site Models* (ADEC 2017a).
- Ingestion of Groundwater is currently an incomplete pathway, as the only viable water source for the village is within an unconnected aquifer topographically upgradient of the remaining contamination; furthermore, the supra-permafrost porewater beneath the site is not a likely source of drinking water in the future and is therefore incomplete in the future (see Section 14.0).
- Ingestion of Surface Water is an incomplete pathway, as site contamination is not present in surface water nor is it expected to migrate to surface water in the future.
- Outdoor and Indoor Air inhalation pathways are considered complete but insignificant due to the small quantities and low concentrations of volatile contamination.
- Ingestion of Wild and Farmed Foods is an incomplete pathway. None of the contaminants are bioaccumulative, and the site is located within the developed area of the village of Gambell.

HUMAN HEALTH CONCEPTUAL SITE MODEL GRAPHIC FORM

Site: AKARNG Gambell Federal Scout Readiness Center

Completed By: Brice Engineering, LLC

Date Completed: January 2020

***Instructions*: Follow the numbered directions below. Do not consider contaminant concentrations or engineering/land use controls when describing pathways.**

(1) *Check the media that could be directly affected by the release.*

(2) *For each medium identified in (1), follow the top arrow and check possible transport mechanisms. Check additional media under (1) if the media acts as a secondary source.*

Media	Transport Mechanisms
☑ Surface Soil (0-2 ft bgs)	☑ Direct release to surface soil → check soil
	☑ Migration to subsurface → check soil
	☑ Migration to groundwater → check groundwater
	☑ Volatilization → check air
	☐ Runoff or erosion → check surface water
	☐ Uptake by plants or animals → check biota
	☐ Other (list):
☐ Subsurface Soil (2-15 ft bgs)	☐ Direct release to subsurface soil → check soil
	☐ Migration to groundwater → check groundwater
	☐ Volatilization → check air
	☐ Uptake by plants or animals → check biota
	☐ Other (list):
☐ Ground-water	☐ Direct release to groundwater → check groundwater
	☐ Volatilization → check air
	☐ Flow to surface water body → check surface water
	☐ Flow to sediment → check sediment
	☐ Uptake by plants or animals → check biota
	☐ Other (list):
☐ Surface Water	☐ Direct release to surface water → check surface water
	☐ Volatilization → check air
	☐ Sedimentation → check sediment
	☐ Uptake by plants or animals → check biota
	☐ Other (list):
☐ Sediment	☐ Direct release to sediment → check sediment
	☐ Resuspension, runoff, or erosion → check surface water
	☐ Uptake by plants or animals → check biota
	☐ Other (list):

(3) *Check all exposure media identified in (2).*

(4) *Check all pathways that could be complete. The pathways identified in this column **must** agree with Sections 2 and 3 of the Human Health CSM Scoping Form.*

(5) *Identify the receptors potentially affected by each exposure pathway: Enter "C" for current receptors, "F" for future receptors, "C/F" for both current and future receptors, or "I" for insignificant exposure.*

Current & Future Receptors

Exposure Media	Exposure Pathway/Route	Residents (adults or children)	Commercial or industrial workers	Site visitors, trespassers, or recreational users	Construction workers	Farmers or subsistence harvesters	Subsistence consumers	Other
☑ soil	☑ Incidental Soil Ingestion	I	I	I	I	I	I	
	☑ Dermal Absorption of Contaminants from Soil	I	I	I	I	I	I	
	☐ Inhalation of Fugitive Dust							
☑ groundwater	☐ Ingestion of Groundwater							
	☐ Dermal Absorption of Contaminants in Groundwater							
	☐ Inhalation of Volatile Compounds in Tap Water							
☑ air	☑ Inhalation of Outdoor Air	I	I	I	I	I	I	
	☑ Inhalation of Indoor Air	I	I	I	I	I	I	
	☐ Inhalation of Fugitive Dust							
☐ surface water	☐ Ingestion of Surface Water							
	☐ Dermal Absorption of Contaminants in Surface Water							
	☐ Inhalation of Volatile Compounds in Tap Water							
☐ sediment	☐ Direct Contact with Sediment							
☐ biota	☐ Ingestion of Wild or Farmed Foods							

Revised, 10/01/2010

This page intentionally left blank

13.0 NATURE AND EXTENT OF CONTAMINATION

The only confirmed source of contamination at the Gambell FSRC stems from an estimated 3,000-gallon spill of heating oil from a single-walled AST in 1983. The AST has since been removed. Due to the high permeability of the well-drained, gravelly soils beneath the tank, the fuel likely migrated downward to the permafrost, which is less than 15 feet bgs. Analytical samples collected from site soil indicate DRO concentrations in soil are greater than the most stringent screening levels, and site porewater samples indicate DRO and naphthalene exceed the ADEC Table C groundwater cleanup levels.

Soil: Data collected in 2006 as part of the SI identified a maximum concentration of DRO in site soil at 420 mg/kg. A Data Gap Analysis performed in 2011 identified a maximum concentration of DRO in site soil at 600 mg/kg. This concentration was used in the risk calculations, which resulted in a Method Three ACL of 11,870 mg/kg for DRO in soil (CH2M HILL 2013). Based on the information gathered during the site work, it was determined that the lateral extent of DRO contaminated soil had been adequately delineated, with all samples collected at a concentration less than the ADEC approved ACL. Therefore, soil samples have not been collected or sampled since the 2011 field effort.

Supra-permafrost Porewater: Gambell FSRC supra-permafrost porewater results were screened against ADEC groundwater cleanup levels per 18 AAC 75.345 Table C (ADEC 2018). During the 2011 Data Gap Analysis (porewater samples were not collected in 2006), the maximum detected concentration of DRO in site supra-permafrost porewater was 33,000 µg/L (CH2M HILL 2013). In 2016, analytical results from a highly turbid sample indicated DRO (14,000 µg/L) and naphthalene (11 µg/L) exceedances of ADEC cleanup levels in site supra-permafrost porewater (Eagle Eye 2017). No other analytes were detected at concentrations greater than the ADEC groundwater cleanup levels during the 2011 or 2016 sample events.

Porewater contamination exceeding ADEC groundwater cleanup levels is bound to an area approximately 20 feet wide by 65 feet long, oriented generally northeast at 11GAMGW008 to the southwest at 16GAMMW02 (Figure 4). Porewater contamination is bound downgradient to the west/northwest by four wells. Contaminated porewater was not detected in wells located west of the former 3,000-gallon AST source area. A well installed directly south of the former 3,000-gallon AST was dry and could not be sampled. Table 1 presents the historical maximum onsite contaminant concentrations detected in site soil and porewater compared to screening or cleanup levels.

Table 1 Summary of Contaminant Concentrations by Medium

Analyte	Maximum Detected Concentration (Sample ID)	ADEC-Approved Alternative Soil CULs (mg/kg)[1]	ADEC Table C Groundwater CULs (µg/L)[2]
Soil			
DRO	600 mg/kg(11GAMGW003)	11,870	N/A
Porewater			
DRO	33,000 µg/L(11GAMGW007)	N/A	1,500
Naphthalene	38 µg/L(16GAM02MW02)	N/A	1.7

Notes:
[1]Approved by ADEC on February 4, 2013.
[2]ADEC 18 AAC 75.345 Table C (ADEC 2018).

µg/L = microgram(s) per liter
ADEC = Alaska Department of Environmental Conservation
CUL = cleanup level
DRO = diesel-range organics
mg/kg = milligram(s) per kilogram
N/A = not applicable

14.0 CLEANUP GOALS AND APPLICATION OF THE ARCTIC ZONE

The soil cleanup level for the Gambell FSRC is the ACL approved for DRO on February 4, 2013 (CH2M HILL 2013). This cleanup level approval was reiterated in a 2017 letter (ADEC 2017c), confirming that the approval was current. The only previously identified contaminant of concern (COC) for soil at Gambell FSRC was DRO, but with the ACL as the applicable cleanup goal, there is no soil contamination that exceeds the applicable cleanup levels.

If supra-permafrost porewater were considered a current or reasonably expected potential future use as a drinking water source, the applicable cleanup levels for porewater at Gambell FSRC would be the ADEC 18 AAC 75.345 Table C Groundwater cleanup levels: 1,500 µg/L for DRO and 1.7 µg/L for naphthalene (ADEC 2018). However, as approved in the USACE 2005 *Decision Document Gambell Formerly Used Defense Site F10AK0690, St. Lawrence Island, Alaska*, the presence of continuous permafrost which acts as a barrier to contaminant migration, the sporadic presence of supra-permafrost porewater, the poor recharge rates, and occasional salinity from storm surge events indicates that the site groundwater is not suitable as a drinking water source. Among other water quality issues, the Gambell FSRC site meets the definition of an "Arctic Zone" site, based on the term's definition and the ADEC *Establishing Arctic Zone Cleanup Levels Technical Memorandum* (ADEC 2017b). Per 18 AAC 75.990(4), "'Arctic Zone' means areas north of latitude 68° North; and areas south of that latitude will be considered an 'Arctic Zone' on a site-specific basis, based on a demonstration that the site is underlain by continuous permafrost (ADEC 2018).

Although regional maps will indicate St. Lawrence Island has discontinuous permafrost (Jorgensen et al. 2008), and a previous investigation at Gambell found permafrost to be discontinuous throughout the general area (RZA Inc. 1985), investigations in 1992 (Munter and Williams 1992) indicated that permafrost was discontinuous nearest the sea but became continuous to the south and east across the gravel spit toward the bluff. Additionally, the resistivity survey performed in 1992 (Appendix B) indicated brackish water was present at depth in all areas of the gravel spit. The Gambell FSRC is located on the gravel spit, over ½ mile from the ocean. During the 2011 Data Gap Investigation, permafrost was encountered in all 13 soil borings drilled at the site at depths as shallow as 7 feet bgs but as deep as 9.5 feet bgs (CH2M HILL 2013). Although permafrost was not observed during the 2016 investigation, the drilling depths were limited to 10 feet bgs and confirming the presence of permafrost was not an objective of the investigation (Eagle Eye 2017).

The ADEC *Establishing Arctic Zone Cleanup Levels Technical Memorandum* (ADEC 2017b) states that, in areas where permafrost is continuous:

1. *Seasonal groundwater above the permafrost is not normally considered a current or reasonably expected potential source of drinking water. Therefore, the migration to groundwater cleanup levels are not applicable in areas of the state where these conditions are found.*

2. *[However] porewater present in manmade gravel pads or active layer groundwater (above the permafrost) can act as a transport medium to the surrounding soil; to sediment or surface water where it may pose a risk to ecological receptors; or to a sub-permafrost aquifer or other zones of saturation that may have a current or reasonably expected potential future use as drinking water.*

3. *[Also] a demonstration must be made that the selected soil cleanup level(s) and cleanup remedy address the migration of contamination to surface water, sediment and any unimpacted areas.*

To those points, the Gambell FSRC meets the definition of an Arctic Zone site for the following reasons:

1. The groundwater encountered at Gambell FSRC has been determined to be supra-permafrost porewater. This seasonal porewater is not a current or reasonably expected potential source of drinking water.

2. DRO and naphthalene in supra-permafrost porewater exceeding ADEC cleanup levels is limited in extent as defined by downgradient wells at the site. There is no risk of transport to a location where it may impact surface water, ecological receptors, or the shallow aquifer used as drinking water in Gambell. The supra-permafrost porewater at Gambell FSRC is topographically downgradient and hydrologically disconnected from the only viable drinking water source in Gambell. Further, there has been no indication that an accessible sub-permafrost aquifer exists in any investigation, either geological or environmental. It is also unclear whether the areas exceeding groundwater cleanup levels are from dissolved concentrations or a result of suspended solids being analyzed in highly turbid samples collected from the poorly producing wells.

3. Soil contamination does not exceed the applicable cleanup levels.

The observed continuity of permafrost in the site area, the relatively inland disposition of the Gambell FSRC, and the limited migration of porewater contamination serves as a demonstration that the site meets the definition of an Arctic Zone site, and that the porewater is unsuitable as a drinking water source. Therefore, DRO and naphthalene are COCs in supra-permafrost porewater, but there will be no remedial action to address these COCs; it is not necessary for a "Cleanup Complete" determination because the supra-permafrost porewater exposure pathways are incomplete or insignificant.

Table 2 presents a summary of COCs and cleanup goals.

Table 2 Summary of Contaminants of Concern and Cleanup Goals

COC	ADEC-Approved Alternative Soil CULs (mg/kg)[1]	ADEC Table C Groundwater CULs (µg/L)[2]	Comments
Soil			
DRO	11,870	N/A	No Exceedances
Porewater			
DRO	N/A	1,500	Supra-permafrost porewater, no remediation required
Naphthalene	N/A	1.7	

Notes:
[1]Approved by ADEC on February 4, 2013.
[2]ADEC 18 AAC 75.345 Table C (ADEC 2018).

µg/L = microgram(s) per liter
ADEC = Alaska Department of Environmental Conservation
COC = contaminant of concern
CUL = cleanup level
DRO = diesel-range organics
mg/kg = milligram(s) per kilogram
N/A = not applicable

15.0 BASIS FOR ACTION

Surface soil staining was not visible onsite during the two most recent investigations conducted at the Gambell FSRC; the 2011 investigation (CH2M HILL 2013) and the 2016 site characterization (Eagle Eye 2017). Therefore, stained soil is not present at the Gambell FSRC, and no additional action is necessary to address stained soil.

Data collected during the 2011 Data Gap Investigation identified a maximum detected concentration of DRO in site soil at 600 mg/kg. This concentration does not exceed the site-specific ACL of 11,870 mg/kg. The lateral extent of DRO-contaminated soil has been adequately delineated, and the vertical extent is limited by permafrost. Therefore, no additional action will be taken regarding soil at the site.

Data collected from porewater in 2011 and 2016 indicate that DRO and naphthalene concentrations in porewater exceeded the ADEC groundwater cleanup levels. All other analytes were non-detect or at concentrations less than the cleanup levels. DRO and naphthalene are present in site supra-permafrost porewater within a well-defined, confined area. However, the supra-permafrost porewater is not a current or reasonably expected potential future use as a drinking water source because of the presence of continuous permafrost acting as a barrier to migration, the presence of saline water in the groundwater in areas beneath the measured site porewater (Munter and Williams 1992; Appendix B), the poor recharge rates and water quality from former (decommissioned) drinking water wells in the area, and the poor production and high turbidity of wells in the site porewater (Eagle Eye 2017). In accordance with the determinations for several similar sites on the Gambell gravel spit identified in the USACE 2005 *Decision Document Gambell Formerly Used Defense Site F10AK0690, St. Lawrence Island, Alaska*, ADEC groundwater cleanup levels should not apply at the Gambell FSRC site. No additional action will be taken regarding site porewater.

16.0 SELECTED REMEDIES

AKARNG is committed to implementing, monitoring, and maintaining all components of the selected remedies to ensure that site conditions remain protective of human health.

- Petroleum-contaminated soil – No further remedial action is necessary as contaminant concentrations in surface and sub-surface soil currently meet ADEC's approved site-specific ACL for DRO-contaminated soil, and stained soil is not present onsite.
- Petroleum-contaminated water – No further remedial action is necessary as the supra-permafrost porewater is not considered a current or reasonably anticipated future source of drinking water; therefore the ADEC groundwater cleanup levels do not apply.
- Decommission monitoring wells remaining onsite.

17.0 POST-CLOSURE REMEDIAL REVIEW

Following decommissioning of the monitoring wells, in accordance with 18 AAC 75.380 (ADEC 2018) the ADEC *Site Closure/Cleanup Complete Memorandum* (ADEC 2016), Gambell FSRC will be issued a "Cleanup Complete" determination subject to the following conditions:

- Under 18 AAC 75.380(d)(1), ADEC may require additional site characterization or remedial action if new information is discovered that leads ADEC to make a determination that the cleanup action described in this DD is not protective of human health, safety, and welfare and the environment.

- Information becomes available that demonstrates that characterization was incomplete, resulting in the presence of hazardous substances above applicable cleanup levels.
- Any proposal to transport soil or groundwater offsite requires Contaminated Sites Program approval in accordance with 18 AAC 75.325(i). A “site” as defined by 18 AAC 75.990 (115) means an area that is contaminated, including areas contaminated by migration of hazardous substances from a source area, regardless of property ownership.
- Movement or use of contaminated material in a manner that results in a violation of 18 AAC 70 water quality standards is prohibited.

This page intentionally left blank

18.0 REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR). 2017 (July). *Evaluation of Environmental Exposures at the Gambell Formerly Used Defense Site (FUDS), Native Village of Gambell, Gambell, Alaska.*

Alaska Department of Environmental Conservation (ADEC). 2016 (July). *Site Closure/Cleanup Complete Memorandum*.

ADEC. 2017a (January). *Guidance on Developing Conceptual Site Models.*

ADEC. 2017b (March). *Establishing Arctic Zone Cleanup Levels Technical Memorandum.*

ADEC. 2017c (December). *Final Gambell Federal Scout Readiness Center (FSRC) Record of Decision for Petroleum Contamination.* Letter Correspondence to Alaska Army National Guard.

ADEC. 2018 (March). Title 18 Alaska Administrative Code 75 *Oil and Other Hazardous Substances Pollution Control.*

ADEC. 2019 (July). Division of Environmental Health Drinking Water Program Drinking Water Protection Map. https://dec.alaska.gov/eh/dw/dwp/protection-areas-map/. Accessed July 1, 2019.

CH2M HILL. 2013 (January). *Gambell Federal Scout Readiness Center Data Gap Investigation Report.* Prepared for Alaska Army National Guard.

Eagle Eye. 2017 (March). *Gambell Site Characterization Report, Federal Scout Readiness Center, Alaska,* Army National Guard FY15 Defense Environmental Restoration Program (DERP).

Hoefler Consulting Group (Hoefler). 2008 (January). *Final Site Investigation and Restoration-Related Activities Project Report, Gambell Federal Scout Readiness Center.*

Jorgenson, M.T., Yoshikawa, K., Kanevskiy, M., Shur, Y., Romanovsky, V., Marchenko, S., Grosse, G., Brown, J. and Jones, B. 2008 (June). Permafrost characteristics of Alaska. In *Proceedings of the Ninth International Conference on Permafrost* (Vol. 3, pp. 121-122). University of Alaska Fairbanks.

Munter, J.A., and Williams, Jerry. 1992. *Analysis of Potable Water-Supply Options Gambell, Alaska*. Alaska Division of Geological & Geophysical Surveys Public Data File 92-10, 41 p.

RZA, Inc. 1985. Geotechnical, Geophysical, and Soil/Groundwater Quality Studies, Defense Environmental Restoration Program, Gambell, St. Lawrence Island, Alaska. Unpublished report for URS Engineers, Inc., Anchorage, Alaska, 22 p. plus figures and appendix.

U.S. Army Corps of Engineers (USACE). 2005 (June). *Decision Document Gambell Formerly Used Defense Site F10AK0690, St. Lawrence Island, Alaska.*

Western Regional Climate Center (WRCC). 2019. https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?akgamb Gambell, Alaska (503226), Period of Record General Climate Summary - Temperature, Period of Record: 9/1/1949 to 8/31/1997. Accessed January 2019.

APPENDIX A

WELL LOGS

This page intentionally left blank

2854

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINING, LAND & WATER
Alaska Hydrologic Survey

WATER WELL LOG Revised 08/18/2016

Drilling Started: ____/____/_____ Completed: 7 / 13 / 1962 Pump Install: ____/____/_____

City/Borough	Subdivision	Block	Lot	Property Owner Name & Address
Gambell				US BIA, GAMBELL SCHOOL ,

Well location: Latitude _____ **Longitude** _____
Meridian K Township 020S Range 067W Section 3 , NW 1/4 of SE 1/4 of SW 1/4 of _____ 1/4

BOREHOLE DATA: (from ground surface)
Suggest T.**M. Hanna's hydrogeologic classification system***
https://my.ngwa.org/NC__Product?id=a185000000BYub3AAD

	Depth From	Depth To

Include description or sketch of well location (include road names, buildings, etc.):

North

Drilling method: ☐ Air rotary, ☐ Cable tool, ☐ Other _____
Well use: ☐ Public supply, ☐ Domestic, ☐ Reinjection, ☐ Hydrofracking
☐ Commercial, ☐ Observation/Monitoring, ☐ Test/Exploratory, ☐ Cooling,
☐ Irrigation/Agriculture, ☐ Grounding, ☐ Recharge/Aquifer Storage,
☐ Heating, ☐ Geothermal Exploration, ☐ Other _____
Fluids used: _____

Depth of hole: 39 ft Casing stickup: _____ft
Casing type: _____ Casing thickness: _____ inches
Casing diameter: _____ inches Casing depth: _____ ft
Liner type: _____ Depth: _____ ft Diameter: _____inches
Note: _____

Well intake opening type: ☐ Open end, ☐ Open hole, ☐ Other _____
Screen type: _____, Screen mesh size: _____
Screen start: _____ ft, Screen stop:_____ ft, Perforated ☐ Yes ☒ No
Perforation description:_____ Perf from: _____ ft, Perf to: _____ft, Perf from: _____ ft, Perf to: _____ ft
Gravel packed ☐ Yes ☐ No Gravel start: _____ ft , Gravel stop:_____ ft
Note: _____

Static water (from top of casing): _____ ft on____/____/_____ Artesian well ☐
Pumping level & yield: _____ feet after _____ hours at _____ gpm
Method of testing:_____
Development method:_____ Duration: _____
Recovery rate: _____ gpm

Grout type: _____ Volume _____
Depth: From _____ft, To _____ft

Final pump intake depth: _____ ft Model: _____
Pump size: _____ hp Brand name: _____

Was well disinfected upon completion? ☐ Yes ☐ No
Method of disinfection: _____
Was water quality tested? ☐ Yes ☐ No
Water quality parameters tested: _____

Well driller name: .....
Company name: US BIA .....
Mailing address:.....
City: _____ State: AK Zip: _____
Phone number: (_____) _____- _____
Driller's signature: _____
Date: _____/_____/_____

AS 41.08.020(b)(4) and AAC 11 AAC 93.140(a) require that a copy of the well log be submitted to the Department of Natural Resources within **45 days of well completion**. Well logs may be submitted using the online well log reporting system available at:

https://dnr.alaska.gov/welts/

OR email electronic well logs to

dnr.water.reports@alaska.gov

Anchorage Municipal Code 15.55.060(I) and North Pole Ordinance 13.32.030(D) require that a copy of this well log be submitted to the Development Services Department/City within **30 days of well completion**.

City Permit Number: _____
Date of Issue: _____/____/_____

Parcel Identification Number: _____-_____-_____

*Guide for Using the Hydrogeologic Classification System for Logging Water Well Boreholes by Thomas M. Hanna NGWA Press

WELL DRILLING LOG

2854

PROJECT NO BU300-300 TITLE Gambell School Water Well No 2
SITE Gambell, Alaska WELL NO.
LOCATION 15 ft. South of New School Bldg.
CONTRACTOR Otto H. Kockritz , BIA TYPE OF RIG Cable

DATE	STARTING DEPTH FEET	STOPING DEPTH FEET	DEPTH TO WATER FEET	SOIL CLASSIFICATION
July 12, 1962	0	6.5		Small Gravel
	6.5	10.5		Small Gravel (Frozen, seasonal frost)
	10.5	19.6	19.6	Small Gravel (Thawed)
	19.6	20.0		Water Bearing Gravel
	20.0	25.9	25.9	Frozen Small Gravel
	25.9	33.6		Bottom of Casing. Water Bearing Small Gravel
July 13, 1962	33.6	39.2		Bottom of Screen. Water Bearing, Small Gravel

INSTALLED IN WELL

	OPENING	DIA	LENGTH IN FEET	MATERIAL
SCREEN	60 Slot	4"	5' - 8"	
INNER CASING		None		
OUTER CASING		4"	36.6' (3" Projects Above Surface).	

TEST OF WELL

HOURS PUMPED	CAPACITY gpm	STATIC WATER LEVEL	DRAW DOWN	REMARKS
2	2 gpm per ft. of D.D.			Determined by bailing. Time includes surging.

2858

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINING, LAND & WATER
Alaska Hydrologic Survey

WATER WELL LOG Revised 08/18/2016

Drilling Started: ____/____/_____ Completed: 7 / 14 / 1962 Pump Install: ____/____/_____

City/Borough	Subdivision	Block	Lot	Property Owner Name & Address
Gambell				US BIA, GAMBELL SCHOOL ,

Well location: Latitude _____ **Longitude** _____
Meridian K Township 020S Range 067W Section 3 , NW 1/4 of SE 1/4 of SW 1/4 of _____ 1/4

BOREHOLE DATA: (from ground surface)
Suggest T.**M. Hanna's hydrogeologic classification system***
https://my.ngwa.org/NC__Product?id=a185000000BYub3AAD

	Depth From	Depth To

Include description or sketch of well location (include road names, buildings, etc.):

North

AS 41.08.020(b)(4) and AAC 11 AAC 93.140(a) require that a copy of the well log be submitted to the Department of Natural Resources within **45 days of well completion**. Well logs may be submitted using the online well log reporting system available at:

https://dnr.alaska.gov/welts/

OR email electronic well logs to

dnr.water.reports@alaska.gov

*Guide for Using the Hydrogeologic Classification System for Logging Water Well Boreholes by Thomas M. Hanna NGWA Press

Drilling method: ☐ Air rotary, ☐ Cable tool, ☐ Other _____
Well use: ☐ Public supply, ☐ Domestic, ☐ Reinjection, ☐ Hydrofracking
☐ Commercial, ☐ Observation/Monitoring, ☐ Test/Exploratory, ☐ Cooling,
☐ Irrigation/Agriculture, ☐ Grounding, ☐ Recharge/Aquifer Storage,
☐ Heating, ☐ Geothermal Exploration, ☐ Other _____
Fluids used: _____

Depth of hole: 35 ft Casing stickup: _____ft
Casing type: _____ Casing thickness: _____ inches
Casing diameter: _____ inches Casing depth: _____ ft
Liner type: _____ Depth: _____ ft Diameter: _____inches
Note: _____

Well intake opening type: ☐ Open end, ☐ Open hole, ☐ Other _____
Screen type: _____, Screen mesh size: _____
Screen start: _____ ft, Screen stop:_____ ft, Perforated ☐ Yes ☒ No
Perforation description:_____ Perf from: _____ ft, Perf to: _____ft, Perf from: _____ ft, Perf to: _____ ft
Gravel packed ☐ Yes ☐ No Gravel start: _____ ft , Gravel stop:_____ ft
Note: _____

Static water (from top of casing): _____ ft on____/____/_____ Artesian well ☐
Pumping level & yield: _____ feet after _____ hours at _____ gpm
Method of testing:_____
Development method:_____ Duration: _____
Recovery rate: _____ gpm

Grout type: _____ Volume _____
Depth: From _____ft, To _____ft

Final pump intake depth: _____ ft Model: _____
Pump size: _____ hp Brand name: _____

Was well disinfected upon completion? ☐ Yes ☐ No
Method of disinfection: _____
Was water quality tested? ☐ Yes ☐ No
Water quality parameters tested: _____

Well driller name: .....
Company name: US BIA .....
Mailing address:.....
City: _____ State: AK Zip: _____
Phone number: (_____) _____- _____
Driller's signature: _____
Date: _____/_____/_____

Anchorage Municipal Code 15.55.060(I) and North Pole Ordinance 13.32.030(D) require that a copy of this well log be submitted to the Development Services Department/City within **30 days of well completion**.

City Permit Number: _____
Date of Issue: _____/____/_____

Parcel Identification Number: _____-_____-_____

2858

WELL DRILLING LOG

PROJECT NO. BU300-300 TITLE Gambell Village Well
SITE Gambell, Alaska WELL NO.
LOCATION
CONTRACTOR BIA Driller - Otto H. Kockritz TYPE OF RIG Cable

DATE	STARTING DEPTH FEET	STOPING DEPTH FEET	DEPTH TO WATER FEET	SOIL CLASSIFICATION
July 14, 1962	0	6.5		Small Gravel
	6.5	12.5		Small Gravel, Frozen (Seasonal)
	12.5	25.5		Small Gravel, Thawed
	25.5	35.1	26.4	Small Gravel, Frozen. Bottom of Casing at 26.4
				Bottom of Screen at 35.1

INSTALLED IN WELL

	OPENING	DIA	LENGTH IN FEET	MATERIAL
SCREEN	18 Slot	4"	5' - 8"	
INNER CASING		None		
OUTER CASING		4"	26.4' (3' Projects above ground).	

TEST OF WELL

HOURS PUMPED	CAPACITY GPM	STATIC WATER LEVEL	DRAW DOWN	REMARKS
	2 gpm per ft. of drawdown			Determined by bailing.

TC20-67-3000-1

APPENDIX B

RESISTIVITY SURVEY FOR GROUND WATER, VILLAGE OF GAMBELL, ST. LAWRENCE ISLAND, ALASKA – FROM MUNTER AND WILLIAMS 1992 ANALYSIS OF POTABLE WATER-SUPPLY OPTIONS AT GAMBELL ALASKA

This page intentionally left blank

APPENDIX A

Resistivity Survey for Ground Water
Village of Gambell, St. Lawrence Island, Alaska

RESISTIVITY SURVEY FOR GROUND WATER

VILLAGE OF GAMBELL, ST. LAWRENCE ISLAND, ALASKA

A direct-current resistivity survey was conducted at 14 locations in Gambell, Alaska. The purpose of the survey was to locate a year-round source of fresh water. Soundings were taken using both Schlumberger and Wenner array configurations at all of the following locations except for location no 9. See Figure 1 for sounding locations.

Sounding No.	Approximate Sounding Location
1, 2, 8	In the vicinity of the existing PHS Infiltration Gallery and VSW emergency gallery.
3, 4	In the watershed south of the existing gallery watershed.
5, 6	In the watershed north of the existing gallery watershed.
10, 11	A gravel area at the base of Sevuokok Mountain in between archaeological sites Ayveghyaget and Mayughaq.
12, 13	North of the Gambell High School on the crest and trough of a relict beach line.
7	In the vicinity of the elementary school well.
9, 14	North of Subdivision A.

Data were reduced in the field to evaluate their quality and provide a rough idea of the subsurface. Modeling of the data was completed in Anchorage using the resistivity modeling program RESIX Plus, published in 1988 by Interplex Limited of Golden, Colorado. RESIX Plus is a forward and inverse modeling program for interpreting resistivity sounding data in terms of a layered earth. Forward modeling calculates a synthetic curve with up to ten layers using linear filters. Direct inversion allows estimation of the layered model and a Ridge regression provides a fit to the curve. Inverse modeling provides a best fit model in a least squares sense through iterative Ridge regressions to adjust the parameters of the starting model. Parameters of the layered model (depth, thickness and resistivity) can be fixed where physical data are available for control. Equivalence analysis allows generation of equivalent or alternative models which fit the data nearly as well as the best fit model and determines the allowable range of each model parameter. The model was not able to resolve the data within the parameters of the model for the Wenner array configurations at locations 13 and 14. Raw data sheets containing apparent resistivities are included for those locations in lieu of model outputs.

The range of a typical apparent resistivities for the materials encountered in this investigation are as follows:

Frozen sediment - $3*10^4$ to $3*10^8$ ohm feet

Brackish sediment - 1 to 3,000 ohm feet

Wet to saturated sediment - 1,000 to $3*10^4$ ohm feet

Wet organics and fine sediment - 300 to 3,000 ohm feet

Dry gravel - 10^4 ohm feet

Saturated rock - $3*10^3$ to $3*10^6$ ohm feet

The wet saturated sediments are interpreted to consist of mostly sand and gravel with some layers of fine grained material. An interpreted lithologic profile was sketched for each array and is shown with the model outputs.

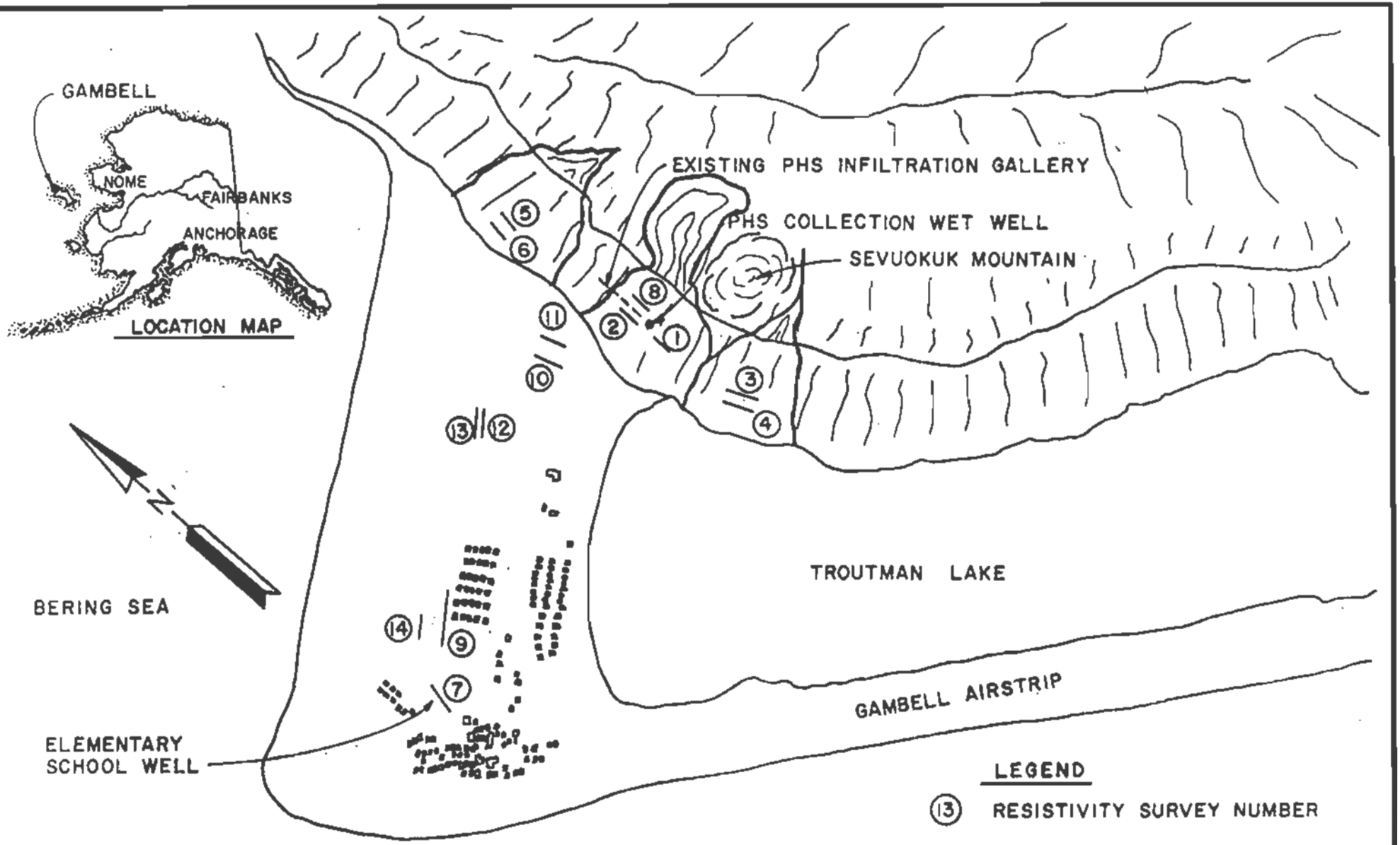
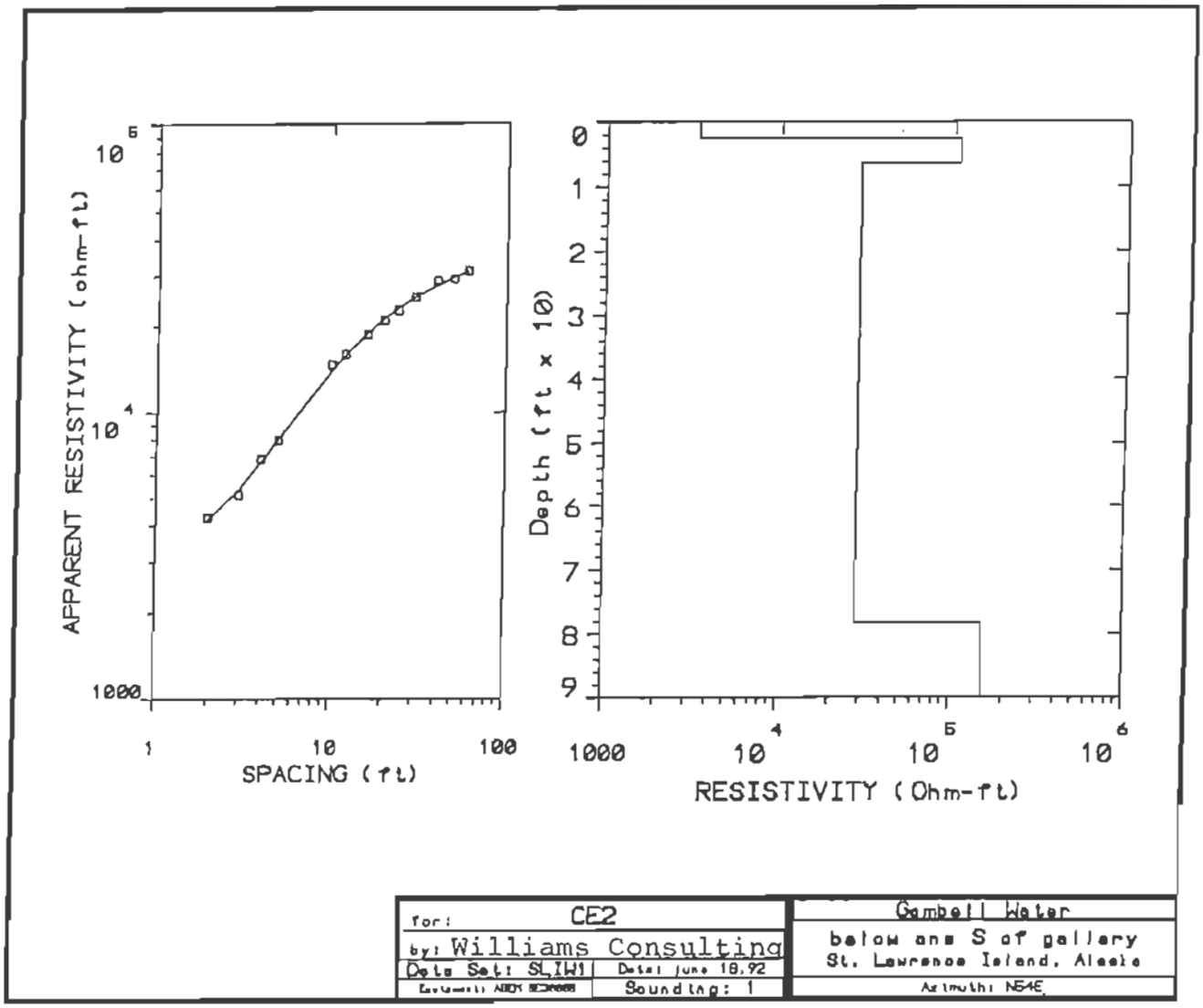


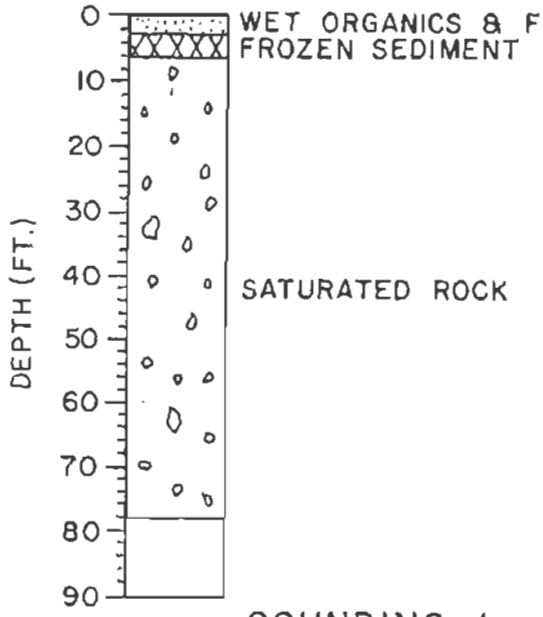
FIGURE 1

GAMBELL RESISTIVITY SURVEY LOCATIONS

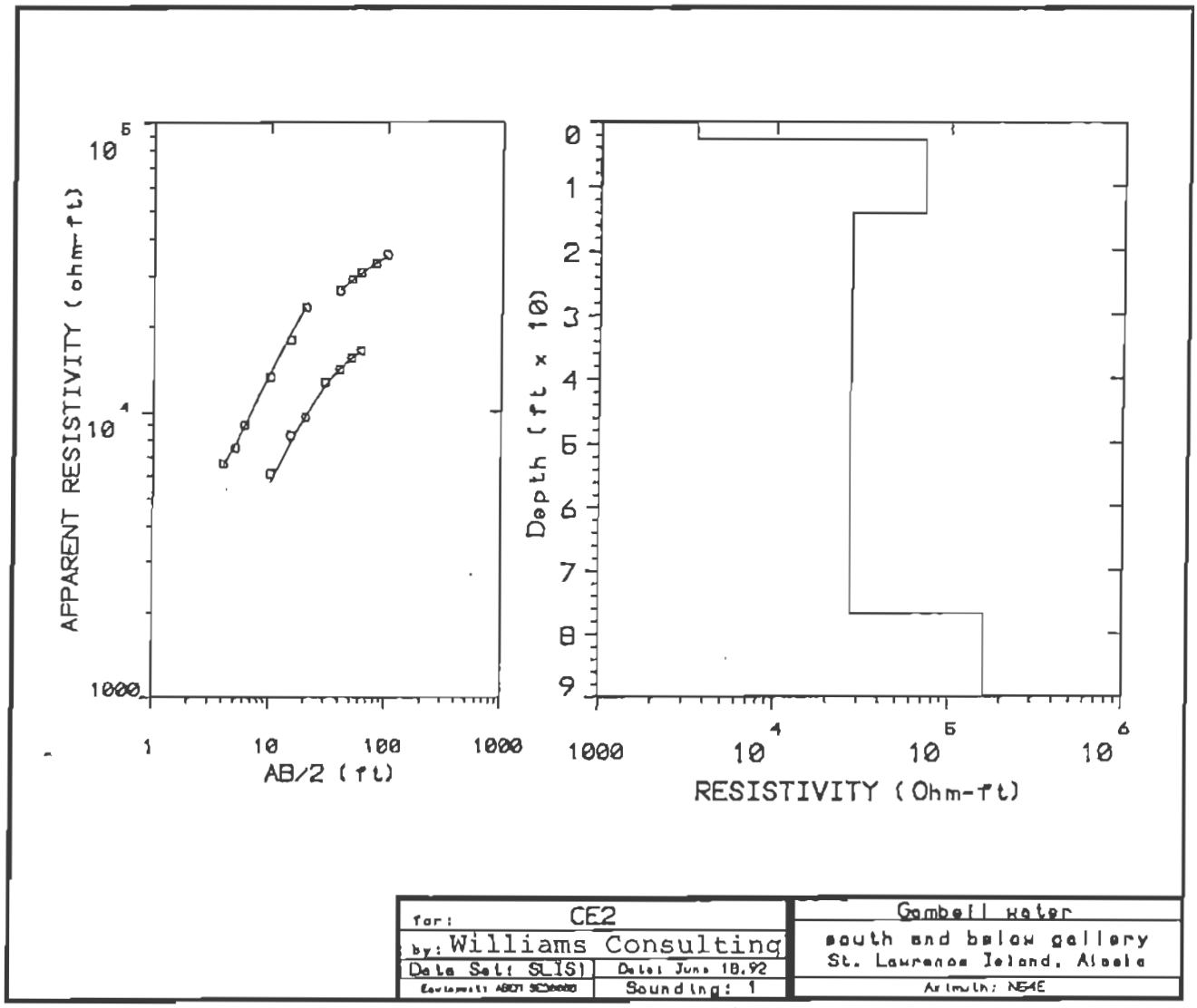
SCALE: 1" ≅ 1575'

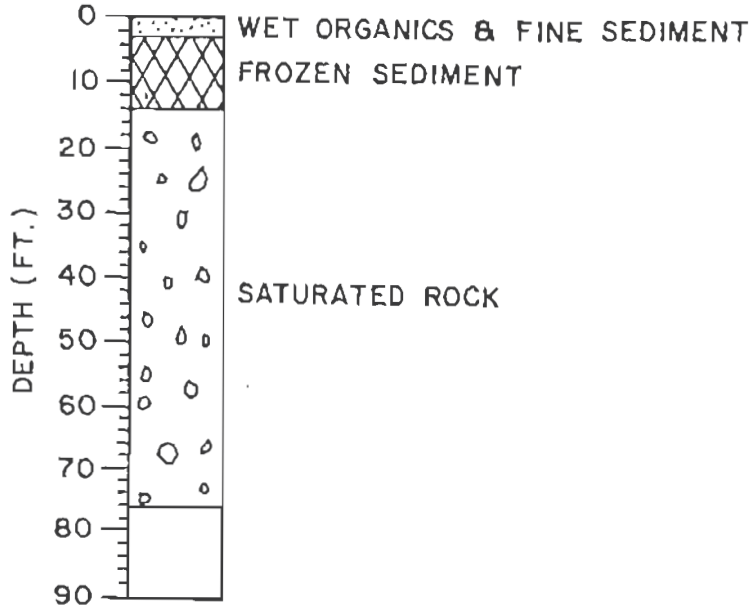
NOTE: BASE MAP IS 7-19-80 AERIAL PHOTO


APPARENT RESISTIVITY (ohm-ft)
SPACING (ft)
Depth (ft x 10)
RESISTIVITY (Ohm-ft)
for: CE2
by: Williams Consulting
Data Set: SLIW1
Data: June 18,92
Sounding: 1
Gambell Water
below and S of gallery
St. Lawrence Island, Alaska
Azimuth: NE-SE

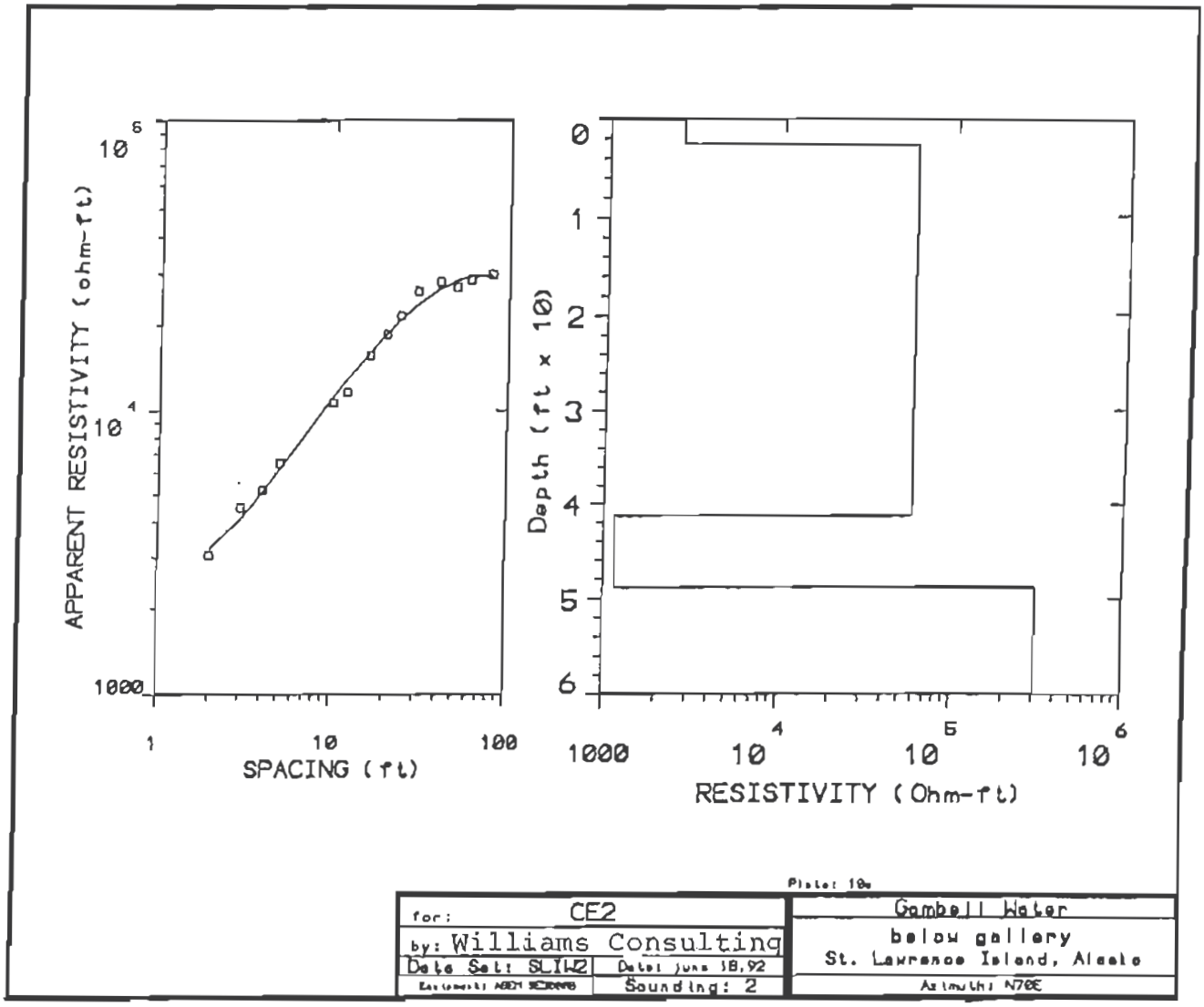

WET ORGANICS & FINE SEDIMENT
FROZEN SEDIMENT
SATURATED ROCK
DEPTH (FT.)

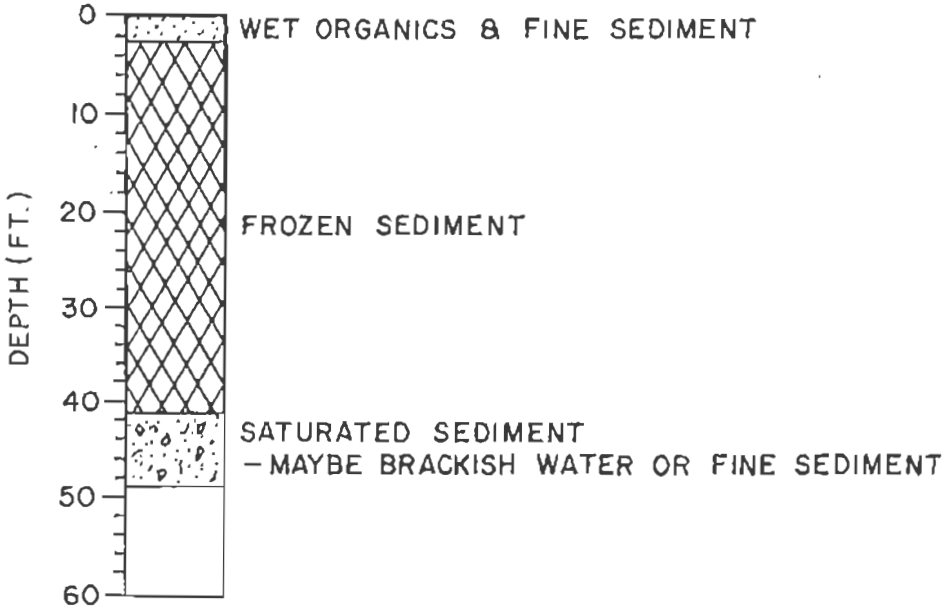
SOUNDING 1


APPARENT RESISTIVITY (ohm-ft)
10^5
10^4
1000
1
10
100
1000
AB/2 (ft)
Depth (ft x 10)
0
1
2
3
4
5
6
7
8
9
1000
10^4
10^5
10^6
RESISTIVITY (Ohm-ft)
for: CE2
by: Williams Consulting
Data Set: SLIS1
Date: June 18,92
Sounding: 1
Gambell Water
south and below gallery
St. Lawrence Island, Alaska
Azimuth: NE4E

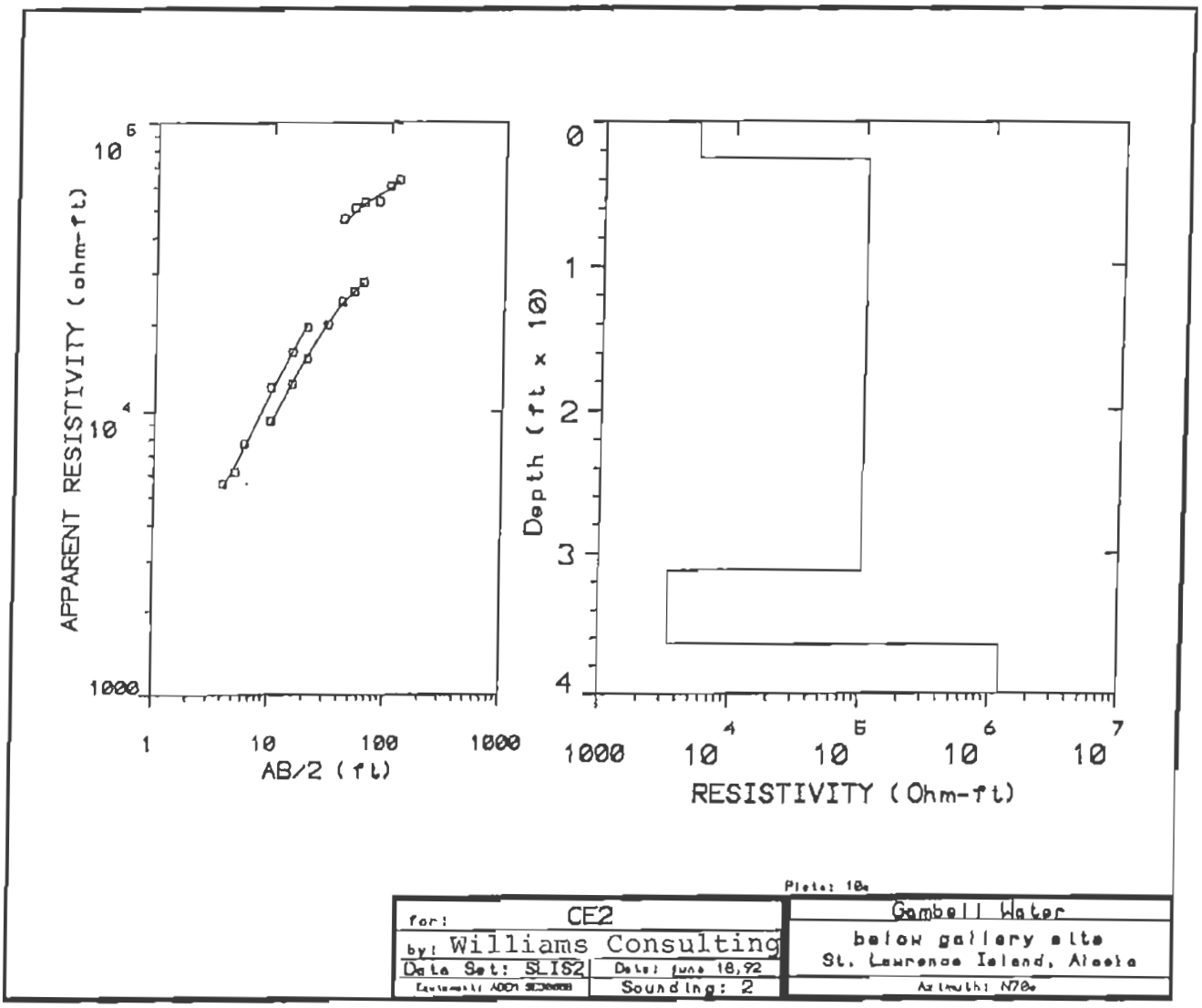

0
10
20
30
40
50
60
70
80
90
DEPTH (FT.)
WET ORGANICS & FINE SEDIMENT
FROZEN SEDIMENT
SATURATED ROCK

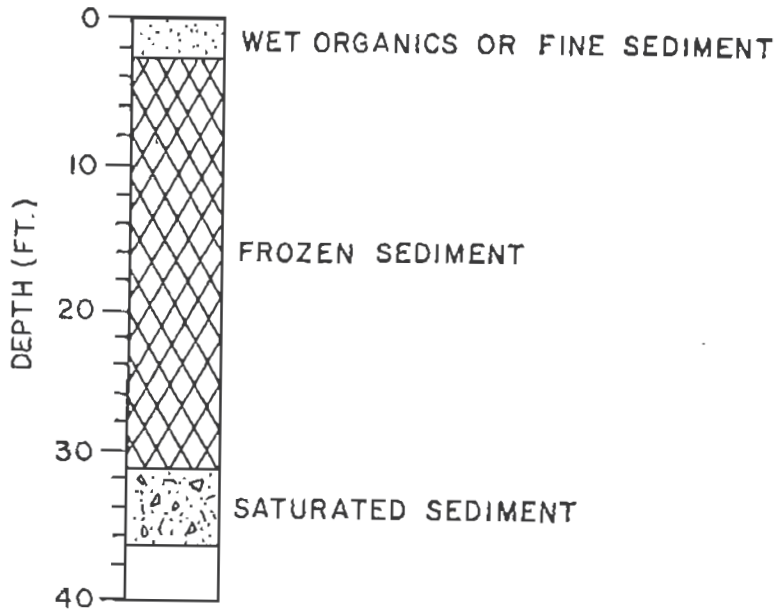
SOUNDING 1


APPARENT RESISTIVITY (ohm-ft)
SPACING (ft)
Depth (ft x 10)
RESISTIVITY (Ohm-ft)
Plate: 10a
for: CE2
by: Williams Consulting
Date Set: SLIW2
Date: June 18,92
Sounding: 2
Gambell Water
below gallery
St. Lawrence Island, Alaska
Azimuth: N70E

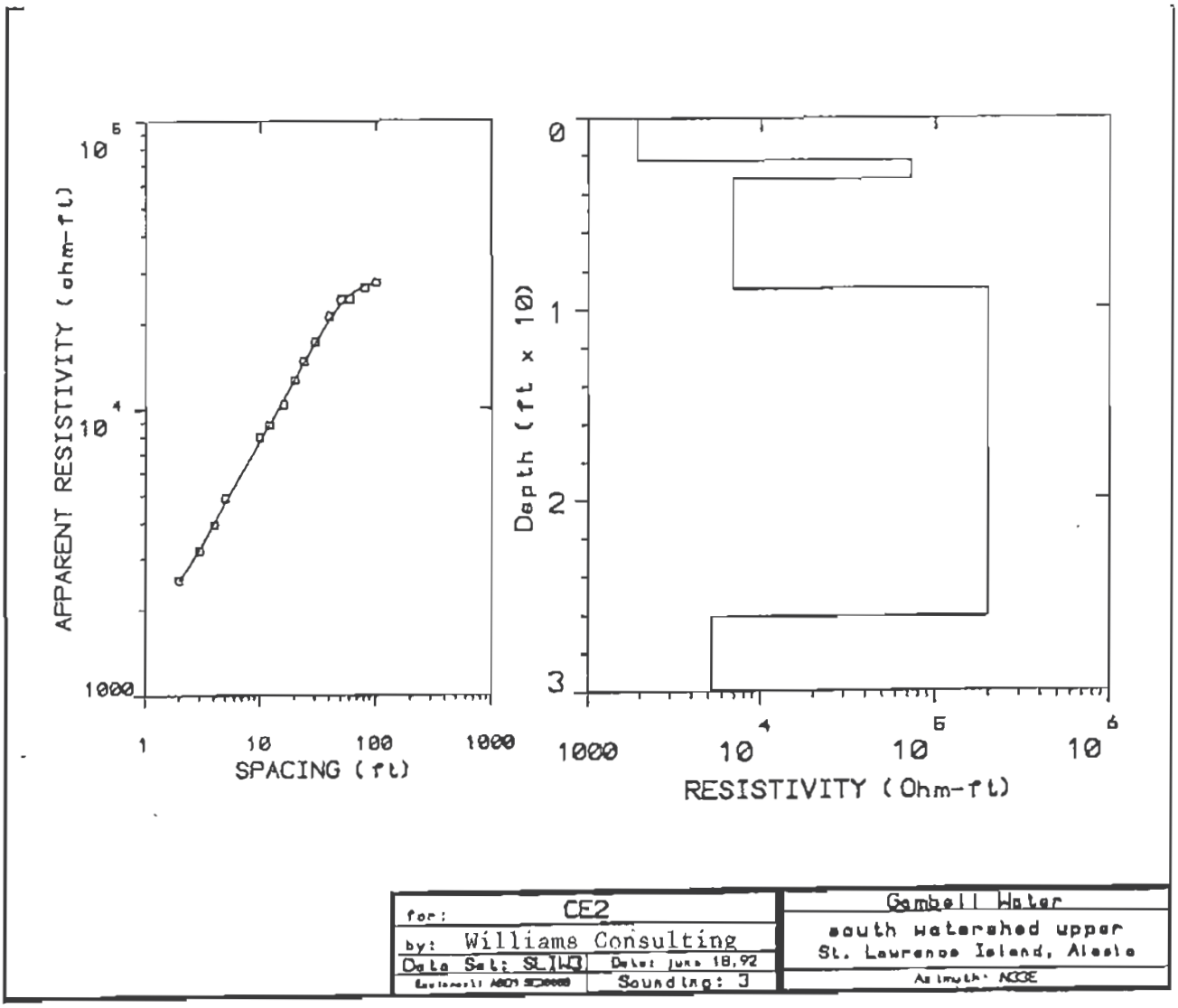

DEPTH (FT.)
WET ORGANICS & FINE SEDIMENT
FROZEN SEDIMENT
SATURATED SEDIMENT
– MAYBE BRACKISH WATER OR FINE SEDIMENT

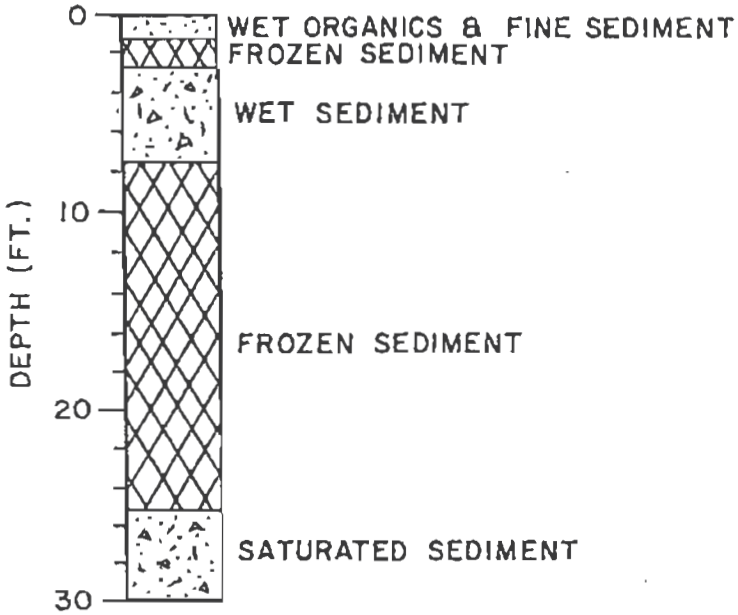
SOUNDING 2


APPARENT RESISTIVITY (ohm-ft)
10^5
10^4
1000
1
10
100
1000
AB/2 (ft)
Depth (ft x 10)
0
1
2
3
4
1000
10^4
10^5
10^6
10^7
RESISTIVITY (Ohm-ft)
Plate: 10a
for: CE2
by: Williams Consulting
Data Set: SLIS2
Date: June 18,92
Sounding: 2
Gambell Water
below gallery site
St. Lawrence Island, Alaska
Azimuth: N70°

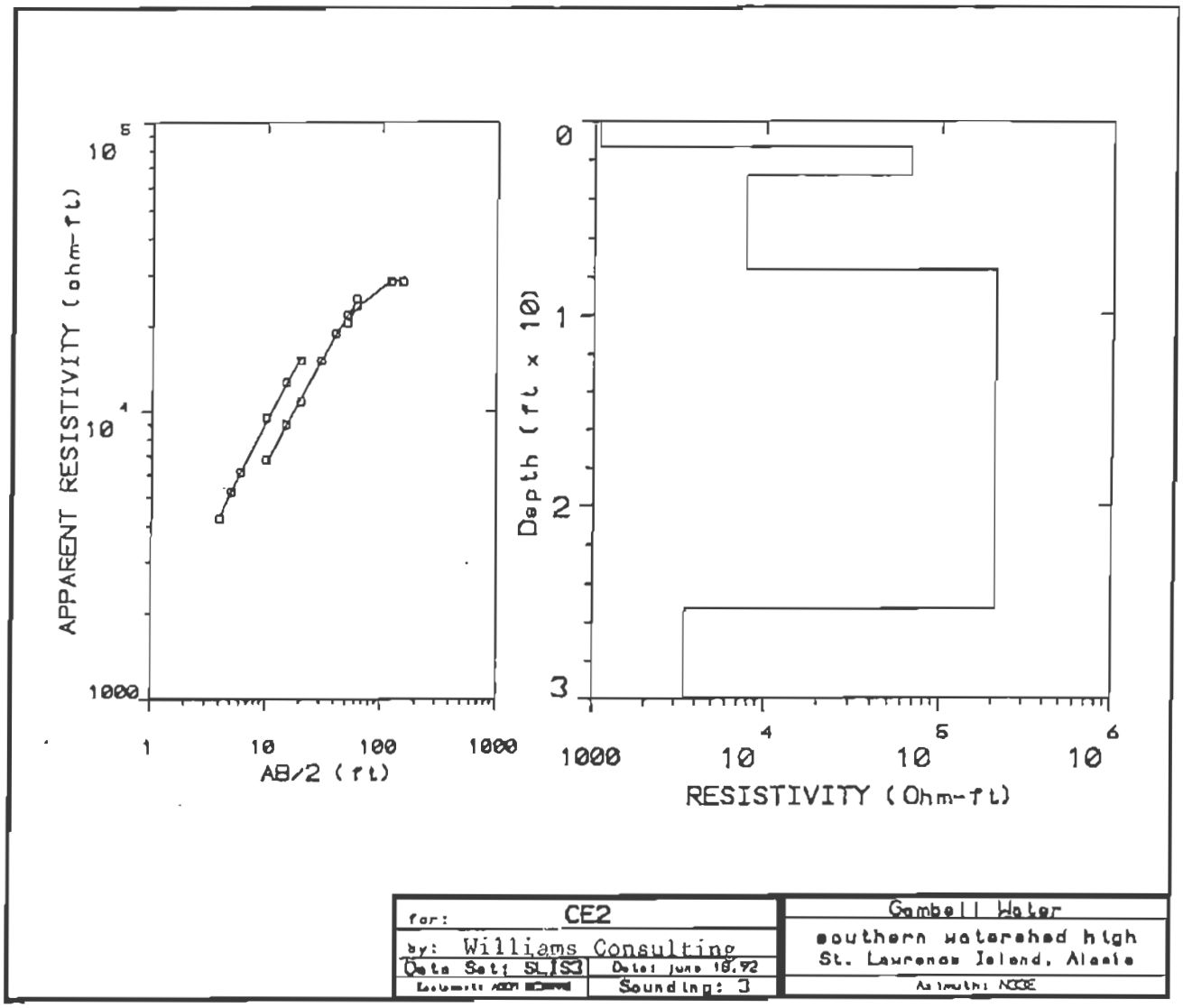

0
10
20
30
40
DEPTH (FT.)
WET ORGANICS OR FINE SEDIMENT
FROZEN SEDIMENT
SATURATED SEDIMENT

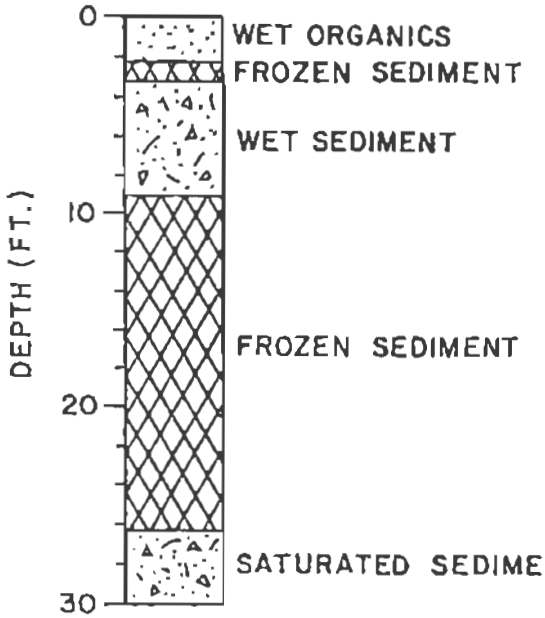
SOUNDING 2


APPARENT RESISTIVITY (ohm-ft)
10^5
10^4
1000
1
10
100
1000
SPACING (ft)
Depth (ft x 10)
0
1
2
3
1000
10^4
10^5
10^6
RESISTIVITY (Ohm-ft)
for: CE2
by: Williams Consulting
Data Set: SL1H3
Date: June 18,92
Sounding: 3
Gambell Water
south watershed upper
St. Lawrence Island, Alaska
Azimuth: NCGE

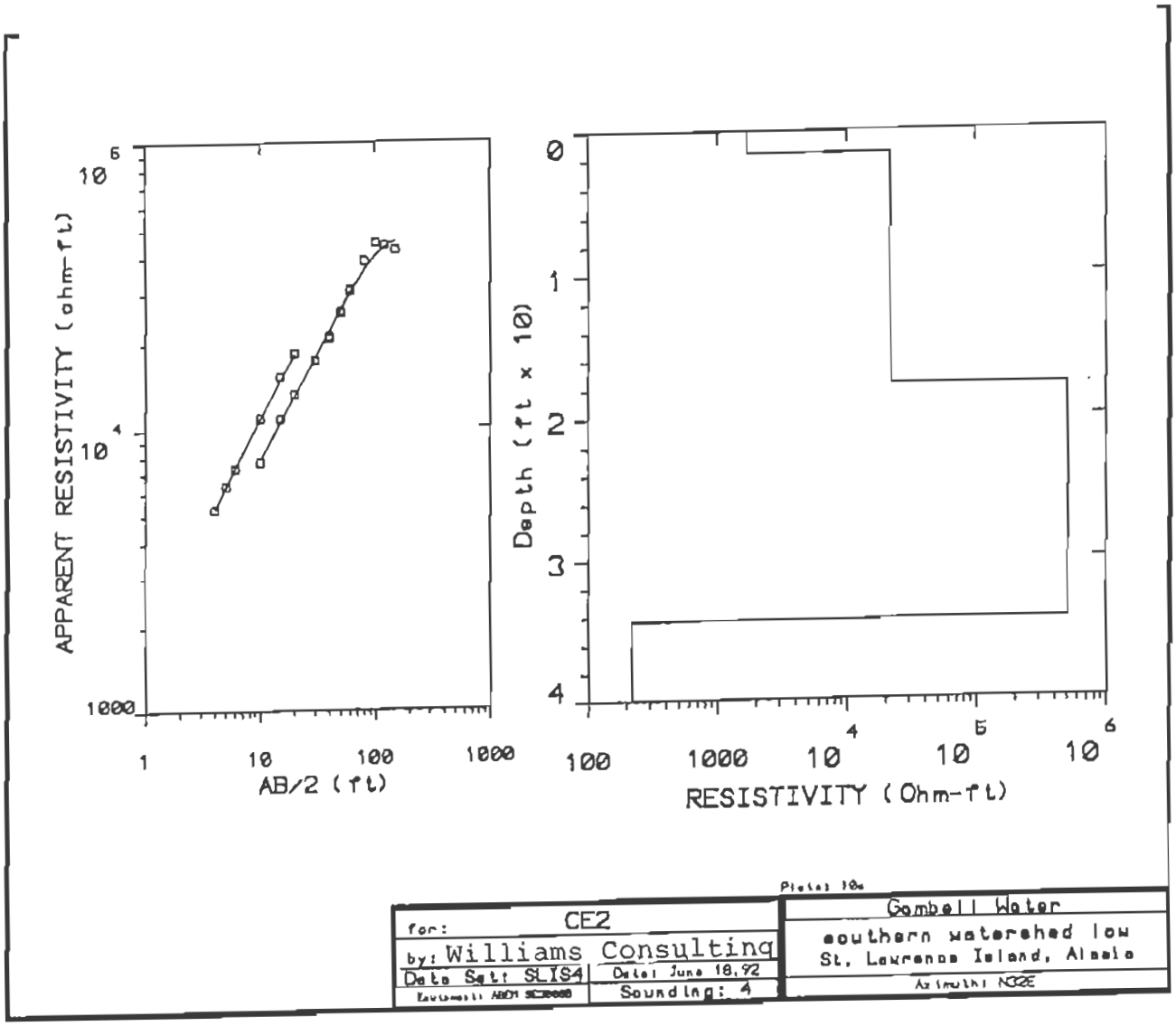

0
10
20
30
DEPTH (FT.)
WET ORGANICS & FINE SEDIMENT
FROZEN SEDIMENT
WET SEDIMENT
FROZEN SEDIMENT
SATURATED SEDIMENT

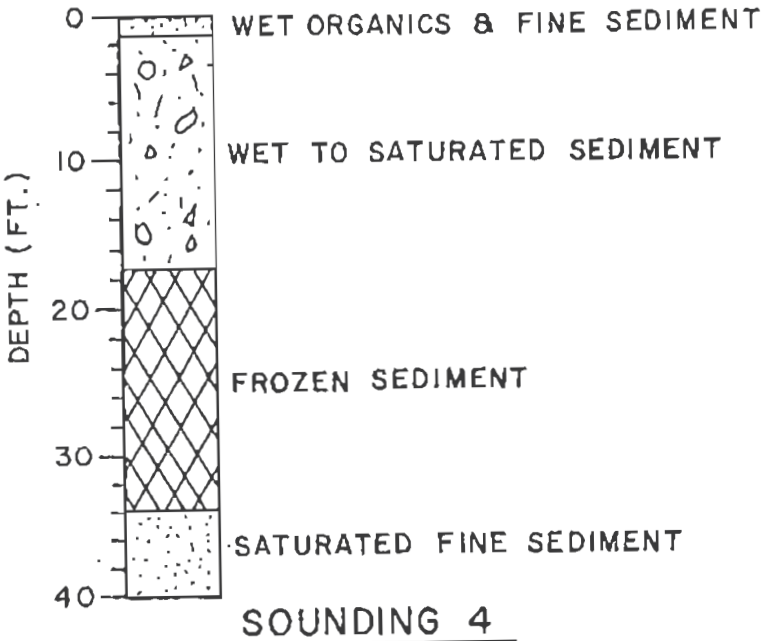
SOUNDING 3


APPARENT RESISTIVITY (ohm-ft)
10^5
10^4
1000
1
10
100
1000
AB/2 (ft)
Depth (ft x 10)
0
1
2
3
1000
10^4
10^5
10^6
RESISTIVITY (Ohm-ft)
for: CE2
by: Williams Consulting
Data Set: SLIS3
Date: June 10,92
Sounding: 3
Gambell Water
southern watershed high
St. Lawrence Island, Alaska
Azimuth: NOSE

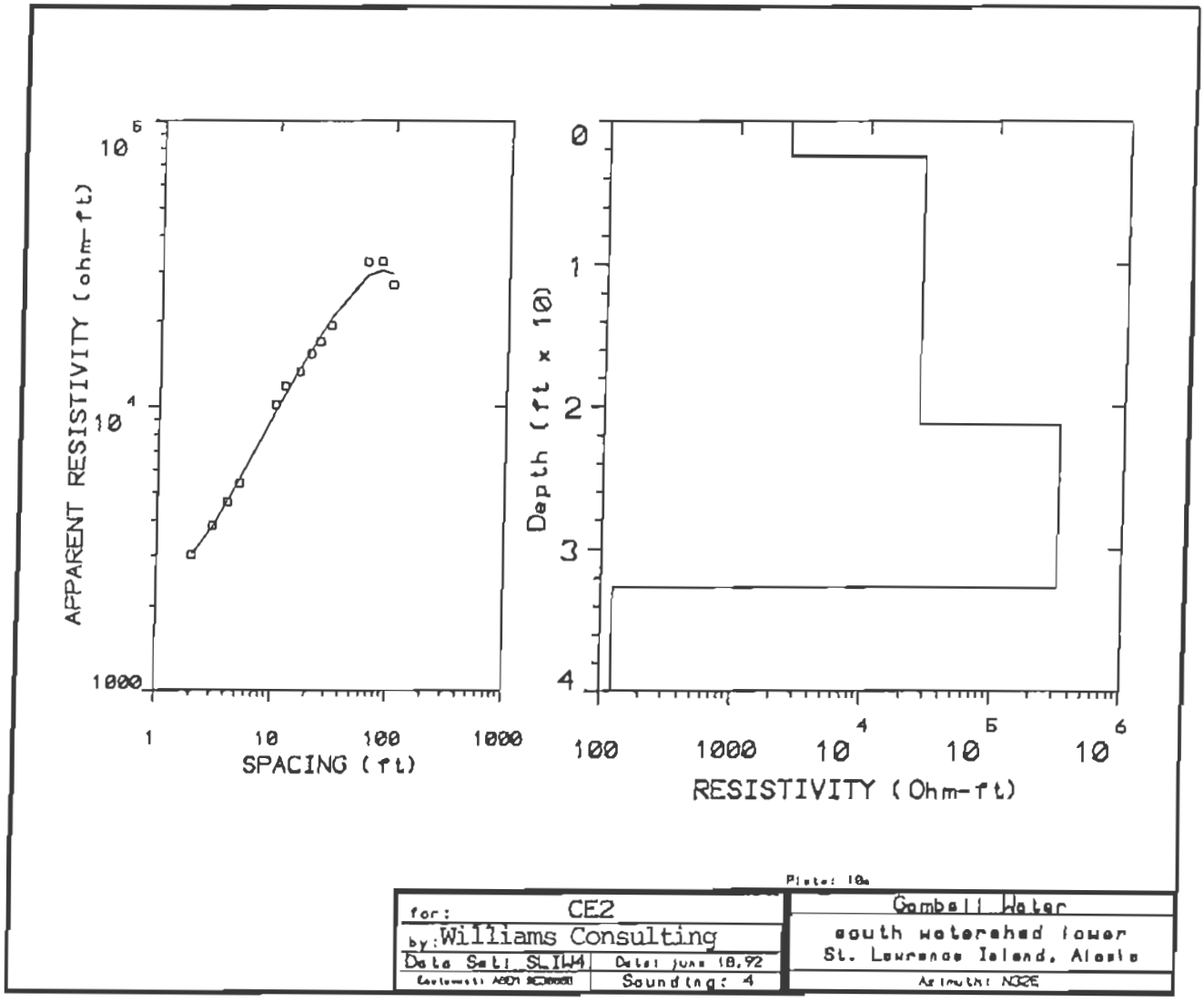

0
10
20
30
DEPTH (FT.)
WET ORGANICS
FROZEN SEDIMENT
WET SEDIMENT
FROZEN SEDIMENT
SATURATED SEDIMENT

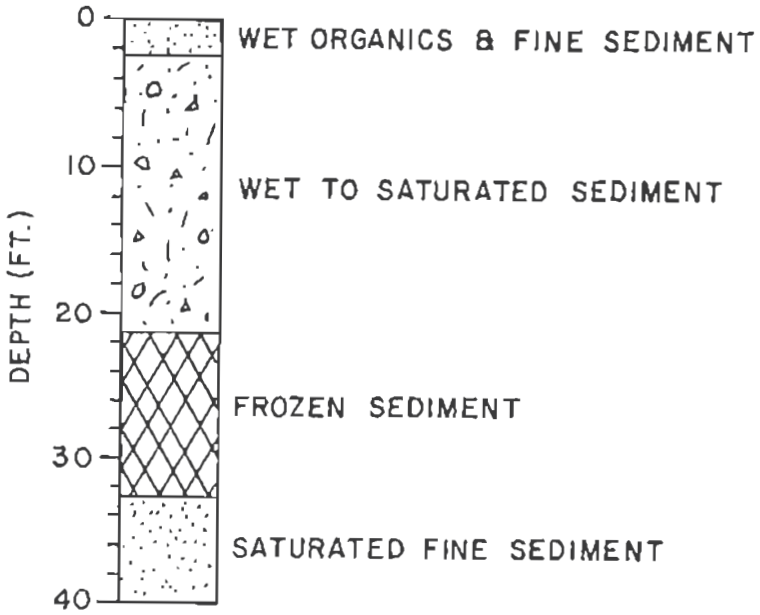
SOUNDING 3


APPARENT RESISTIVITY (ohm-ft)
10^5
10^4
1000
1
10
100
1000
AB/2 (ft)
Depth (ft x 10)
0
1
2
3
4
100
1000
10^4
10^5
10^6
RESISTIVITY (Ohm-ft)
for: CE2
by: Williams Consulting
Date Set: SLIS4
Date: June 18, 92
Sounding: 4
Gambell Water
southern watershed low
St. Lawrence Island, Alaska

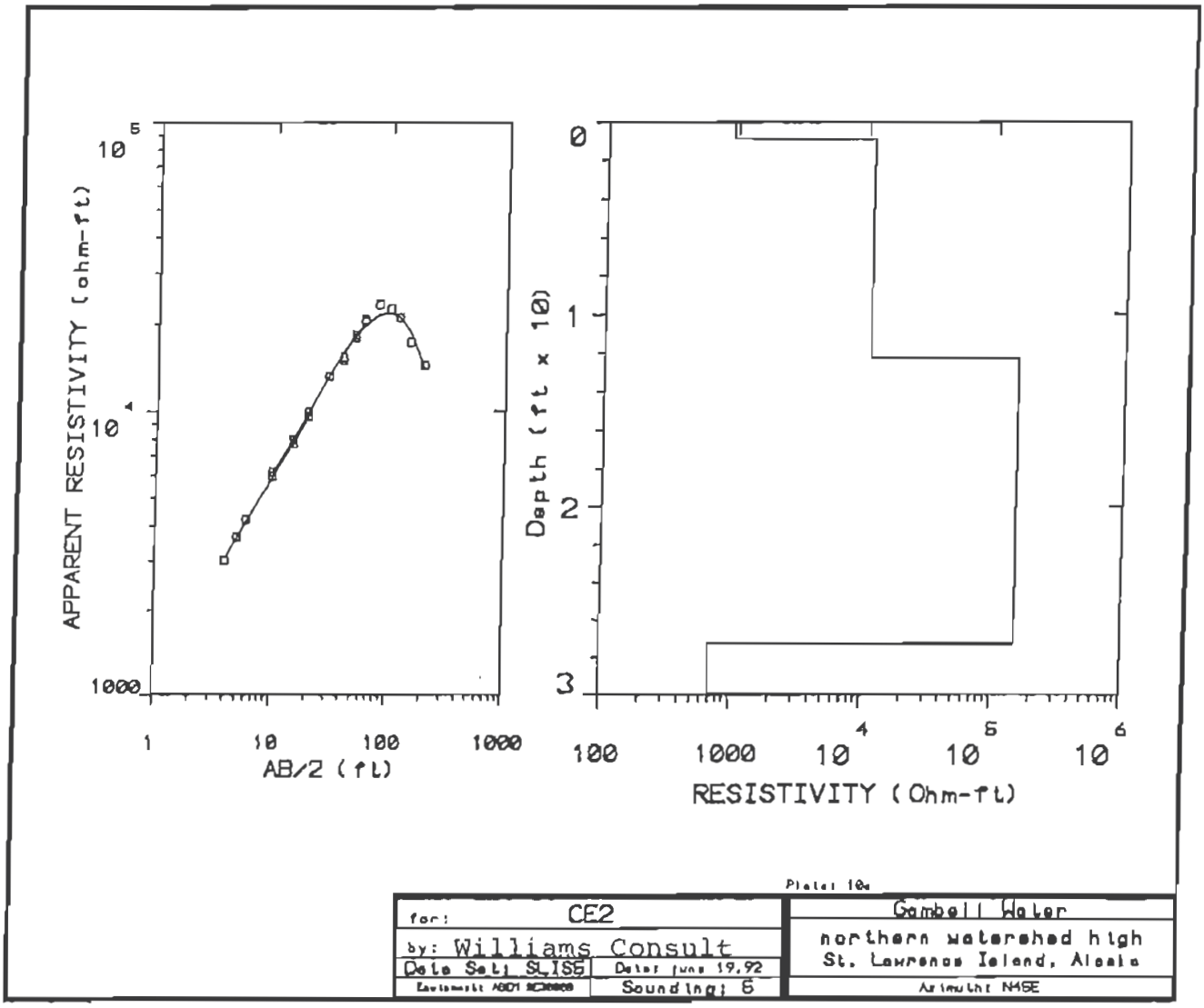

DEPTH (FT.)
0
10
20
30
40
WET ORGANICS & FINE SEDIMENT
WET TO SATURATED SEDIMENT
FROZEN SEDIMENT
SATURATED FINE SEDIMENT

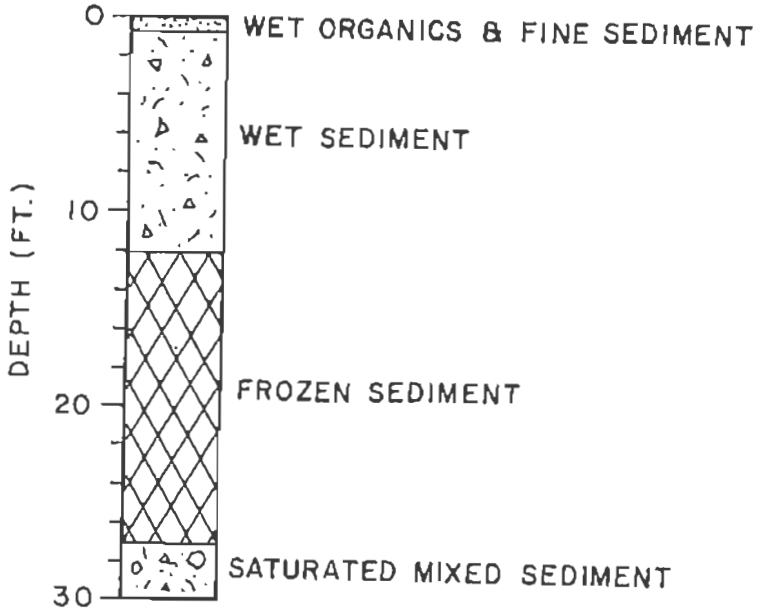
SOUNDING 4


APPARENT RESISTIVITY (ohm-ft)
SPACING (ft)
Depth (ft x 10)
RESISTIVITY (Ohm-ft)
Plate: 10a
for: CE2
by: Williams Consulting
Data Set: SLIH4
Date: June 18,92
Sounding: 4
Gambell Water
south watershed tower
St. Lawrence Island, Alaska
Azimuth: N32E

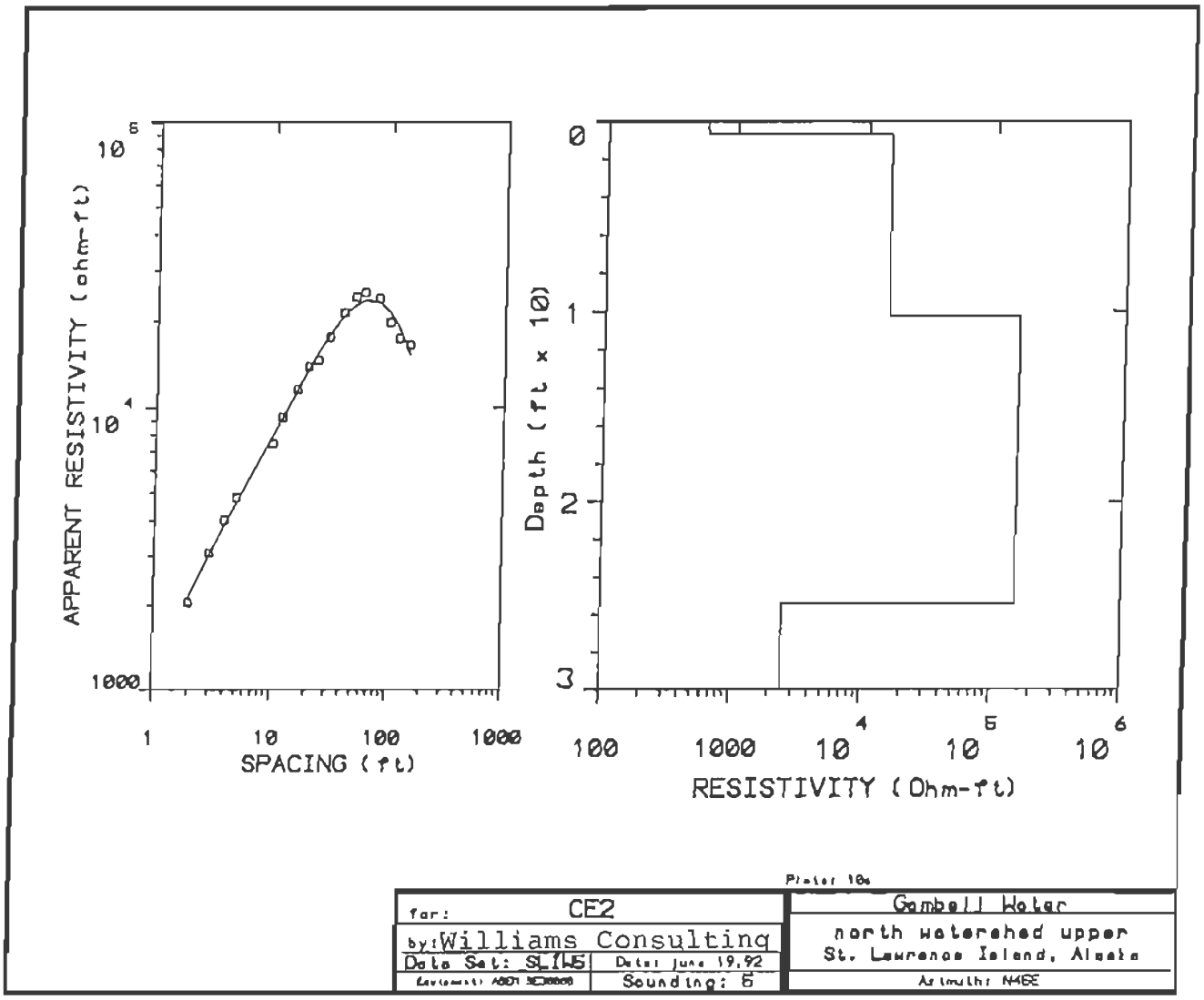

DEPTH (FT.)
WET ORGANICS & FINE SEDIMENT
WET TO SATURATED SEDIMENT
FROZEN SEDIMENT
SATURATED FINE SEDIMENT

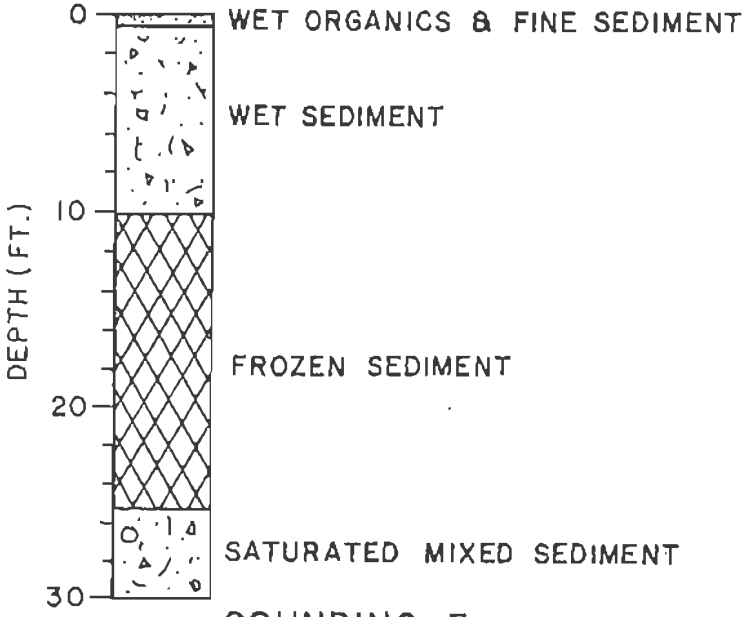
SOUNDING 4


APPARENT RESISTIVITY (ohm-ft)
10^5
10^4
1000
1
10
100
1000
AB/2 (ft)
Depth (ft x 10)
0
1
2
3
100
1000
10^4
10^5
10^6
RESISTIVITY (Ohm-ft)
Plate 10
for: CE2
by: Williams Consult
Date Set: 5/15/5
Date: June 19,92
Sounding: 5
Gambell Water
northern watershed high
St. Lawrence Island, Alaska
Azimuth N45E

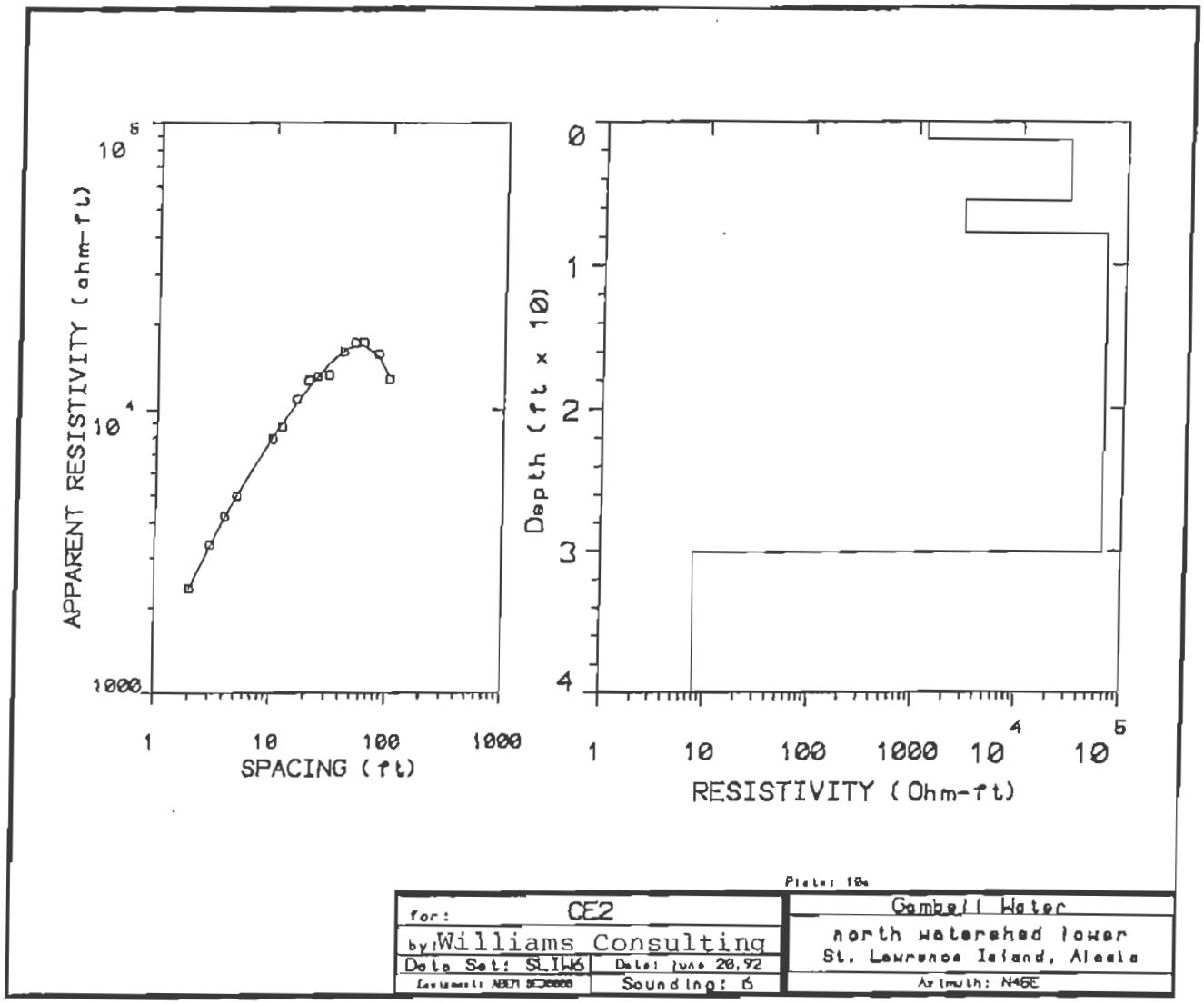

0
10
20
30
DEPTH (FT.)
WET ORGANICS & FINE SEDIMENT
WET SEDIMENT
FROZEN SEDIMENT
SATURATED MIXED SEDIMENT

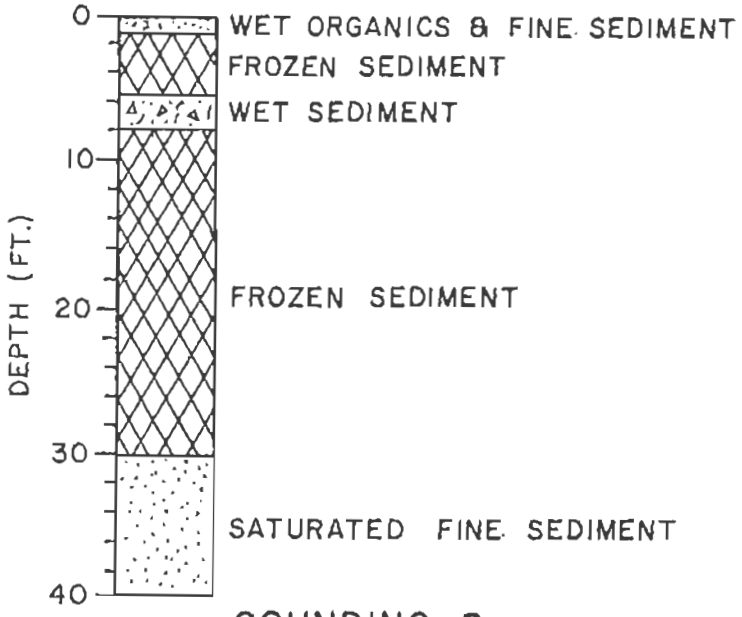
SOUNDING 5


APPARENT RESISTIVITY (ohm-ft)
SPACING (ft)
Depth (ft x 10)
RESISTIVITY (Ohm-ft)
for: CE2
by: Williams Consulting
Data Set: SL145
Date: June 19,92
Sounding: 5
Gambell Water
north watershed upper
St. Lawrence Island, Alaska
Azimuth: N45E

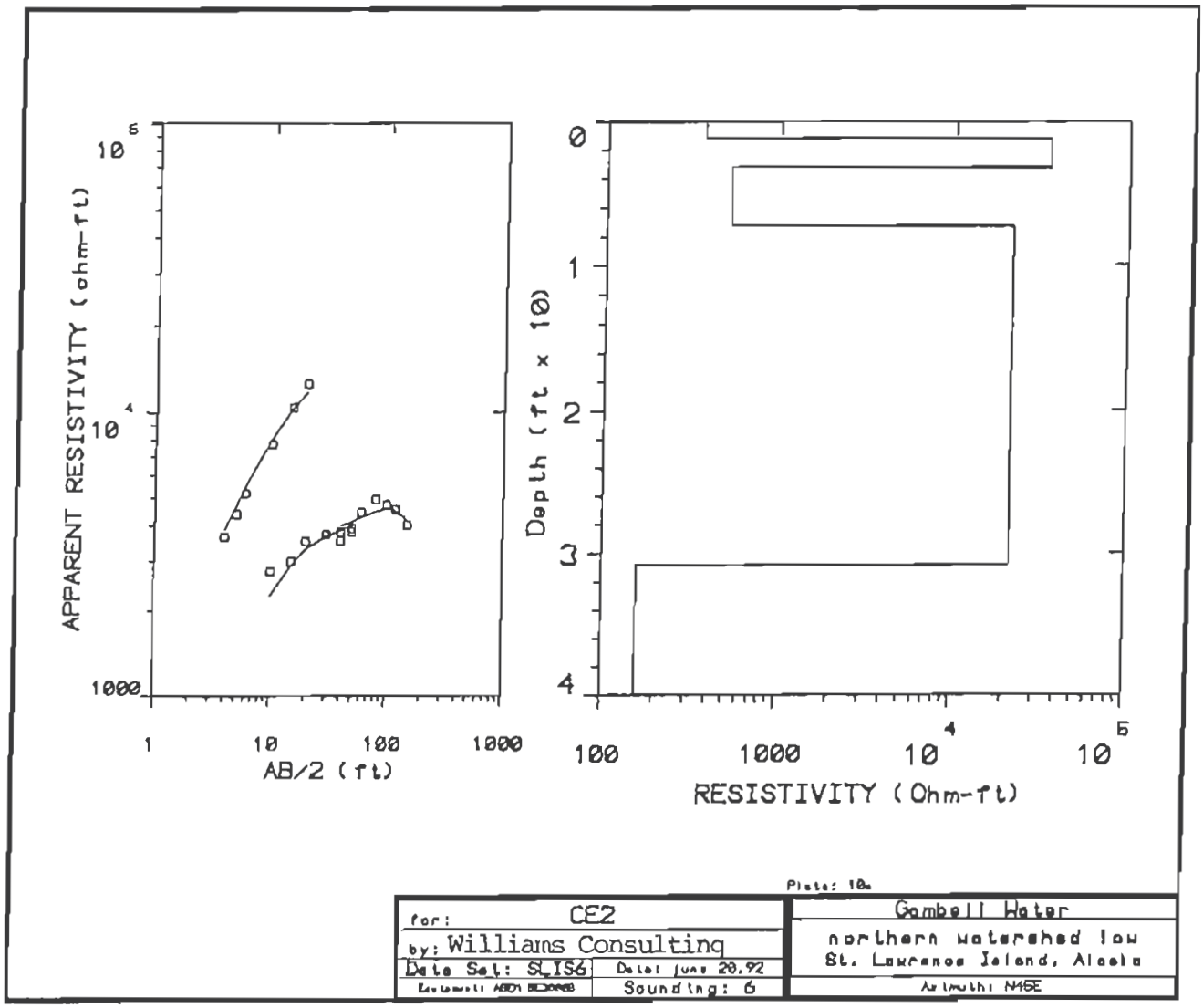

WET ORGANICS & FINE SEDIMENT
WET SEDIMENT
FROZEN SEDIMENT
SATURATED MIXED SEDIMENT
DEPTH (FT.)

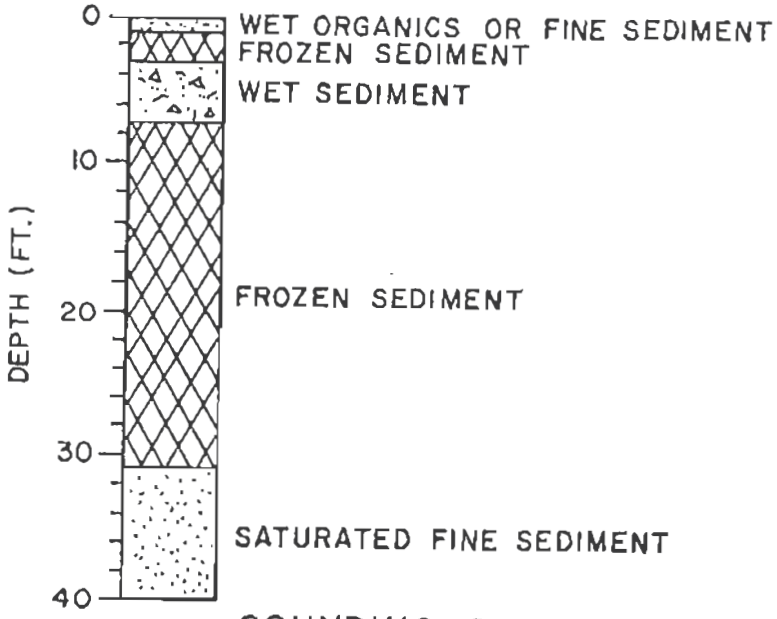
SOUNDING 5


APPARENT RESISTIVITY (ohm-ft)
SPACING (ft)
Depth (ft x 10)
RESISTIVITY (Ohm-ft)
Plate: 18a
for: CE2
by: Williams Consulting
Data Set: SLIW6
Date: June 20,92
Sounding: 6
Gambell Water
north watershed lower
St. Lawrence Island, Alaska
Azimuth: N45E

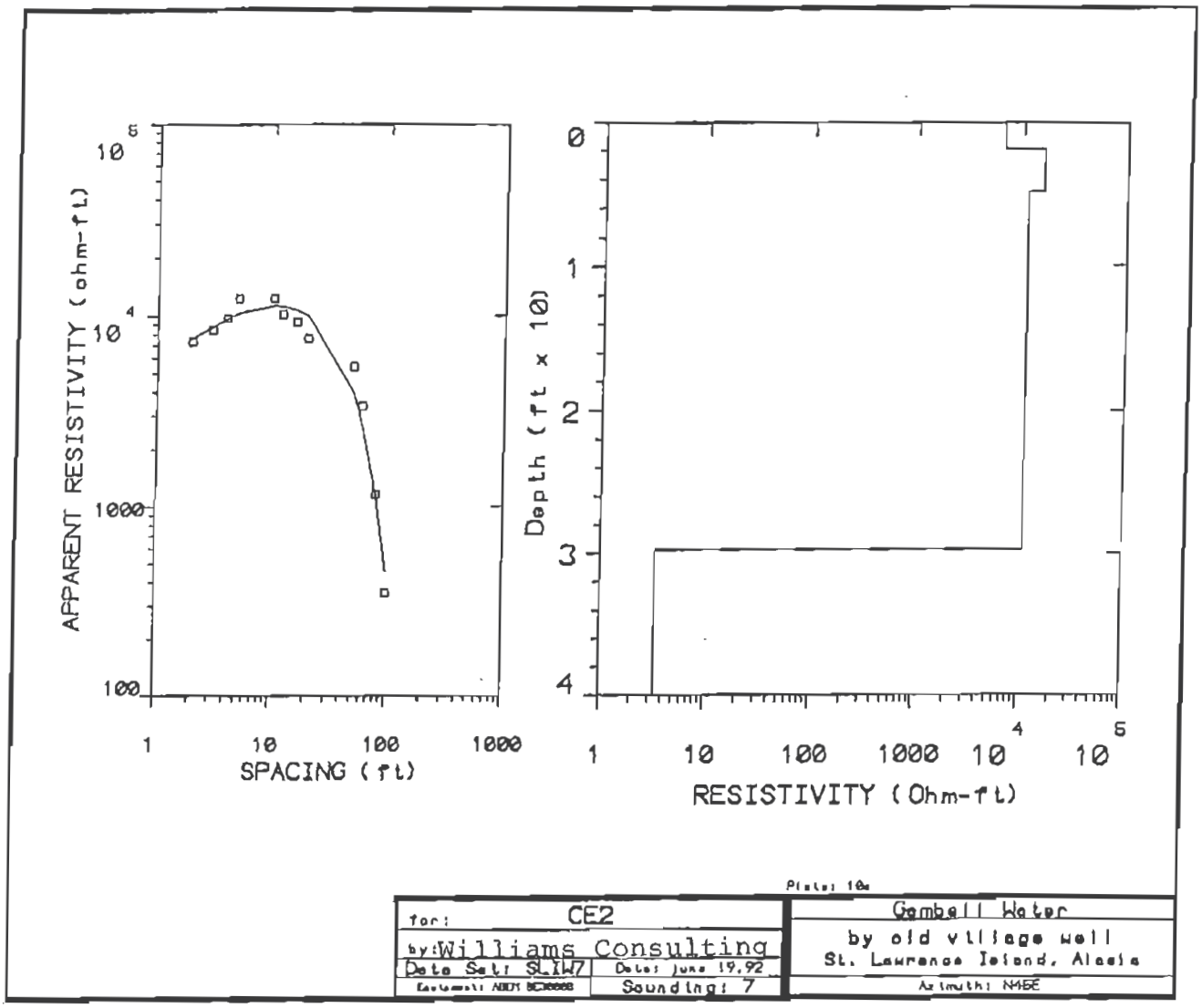

WET ORGANICS & FINE SEDIMENT
FROZEN SEDIMENT
WET SEDIMENT
FROZEN SEDIMENT
SATURATED FINE SEDIMENT
DEPTH (FT.)

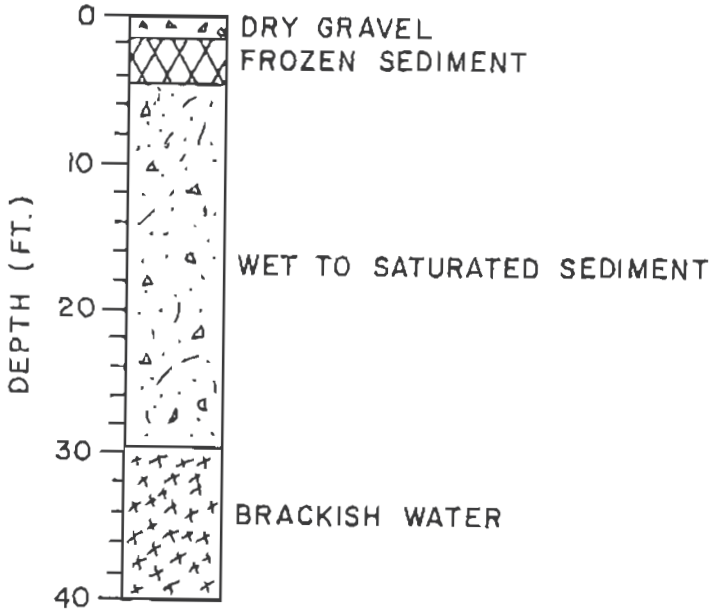
SOUNDING 6


APPARENT RESISTIVITY (ohm-ft)
10^5
10^4
1000
1
10
100
1000
AB/2 (ft)
Depth (ft x 10)
0
1
2
3
4
100
1000
10^4
10^5
RESISTIVITY (Ohm-ft)
Plate: 10a
for: CE2
by: Williams Consulting
Data Set: SLIS6
Date: June 20,92
Sounding: 6
Gambell Water
northern watershed low
St. Lawrence Island, Alaska
Azimuth: N45E

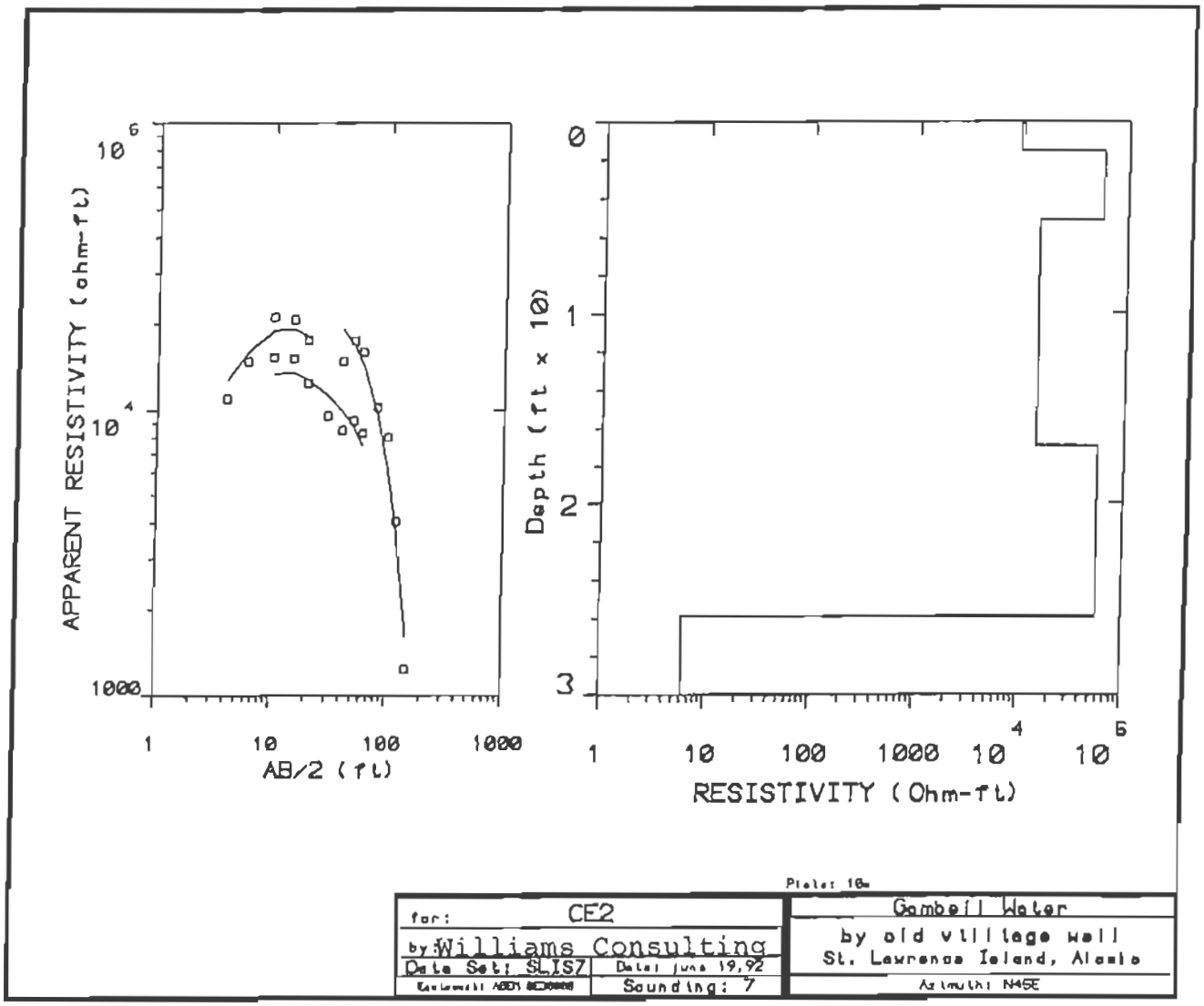

DEPTH (FT.)
0
10
20
30
40
WET ORGANICS OR FINE SEDIMENT
FROZEN SEDIMENT
WET SEDIMENT
FROZEN SEDIMENT
SATURATED FINE SEDIMENT

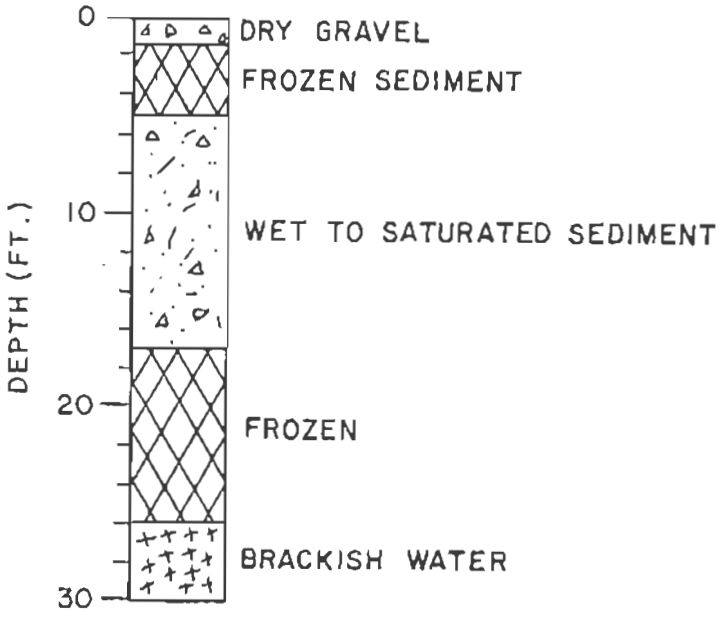
SOUNDING 6


APPARENT RESISTIVITY (ohm-ft)
SPACING (ft)
Depth (ft x 10)
RESISTIVITY (Ohm-ft)
Plate: 10a
for: CE2
by: Williams Consulting
Date Set: SLIW7
Date: June 19,92
Sounding: 7
Gambell Water
by old village well
St. Lawrence Island, Alaska
Azimuth: N45E

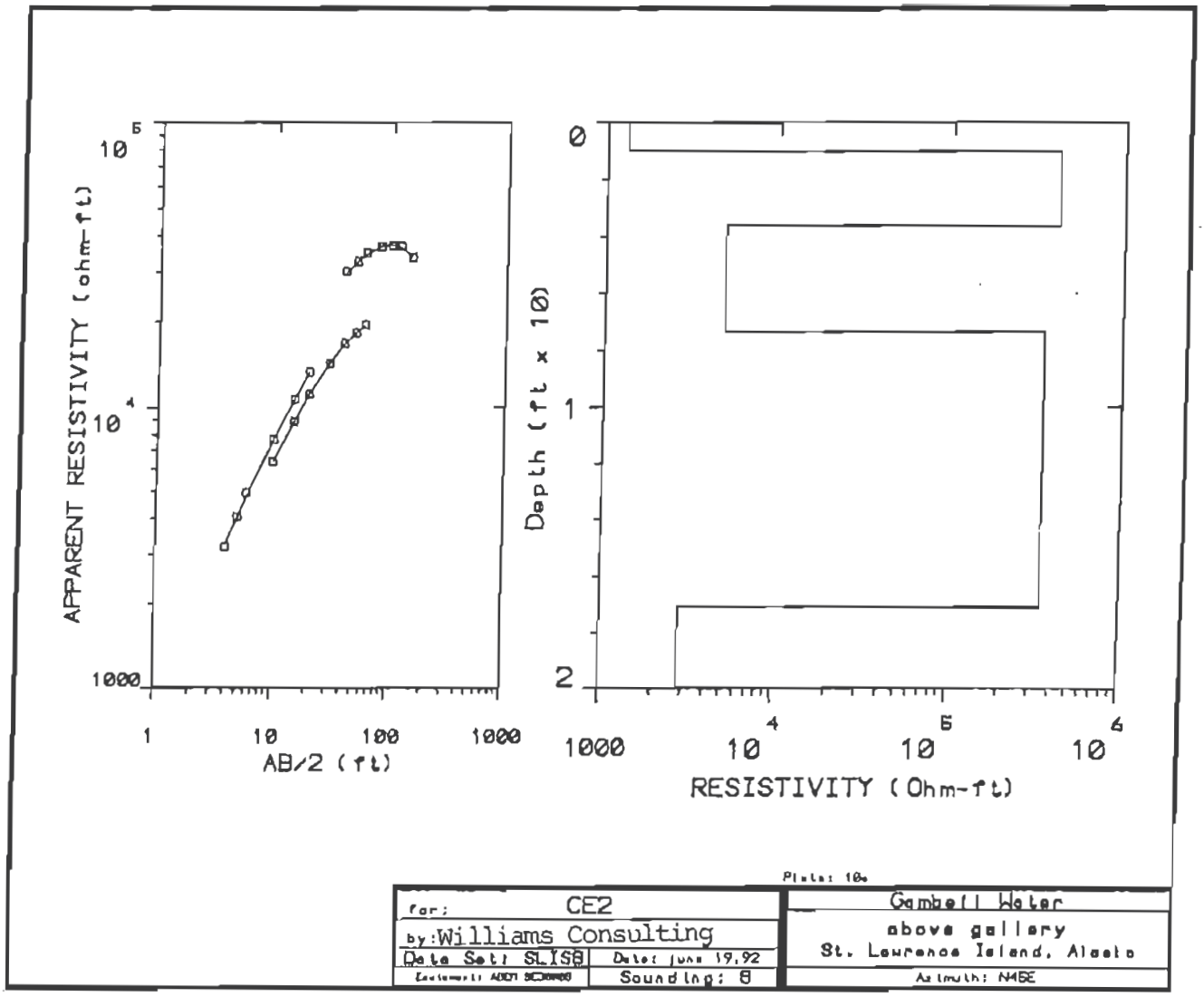

DEPTH (FT.)
DRY GRAVEL
FROZEN SEDIMENT
WET TO SATURATED SEDIMENT
BRACKISH WATER

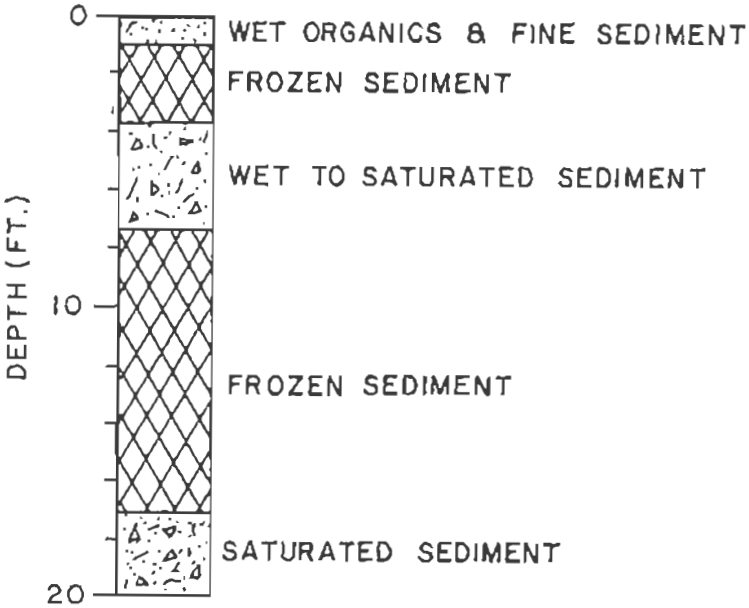
SOUNDING 7


APPARENT RESISTIVITY (ohm-ft)
10^6
10^4
1000
1
10
100
1000
AB/2 (ft)
Depth (ft x 10)
0
1
2
3
1
10
100
1000
10^4
10^5
RESISTIVITY (Ohm-ft)
Plotter 18
for: CE2
by: Williams Consulting
Date Set: SLIS7
Date: June 19,92
Sounding: 7
Gambell Water
by old village well
St. Lawrence Island, Alaska
Azimuth: N45E

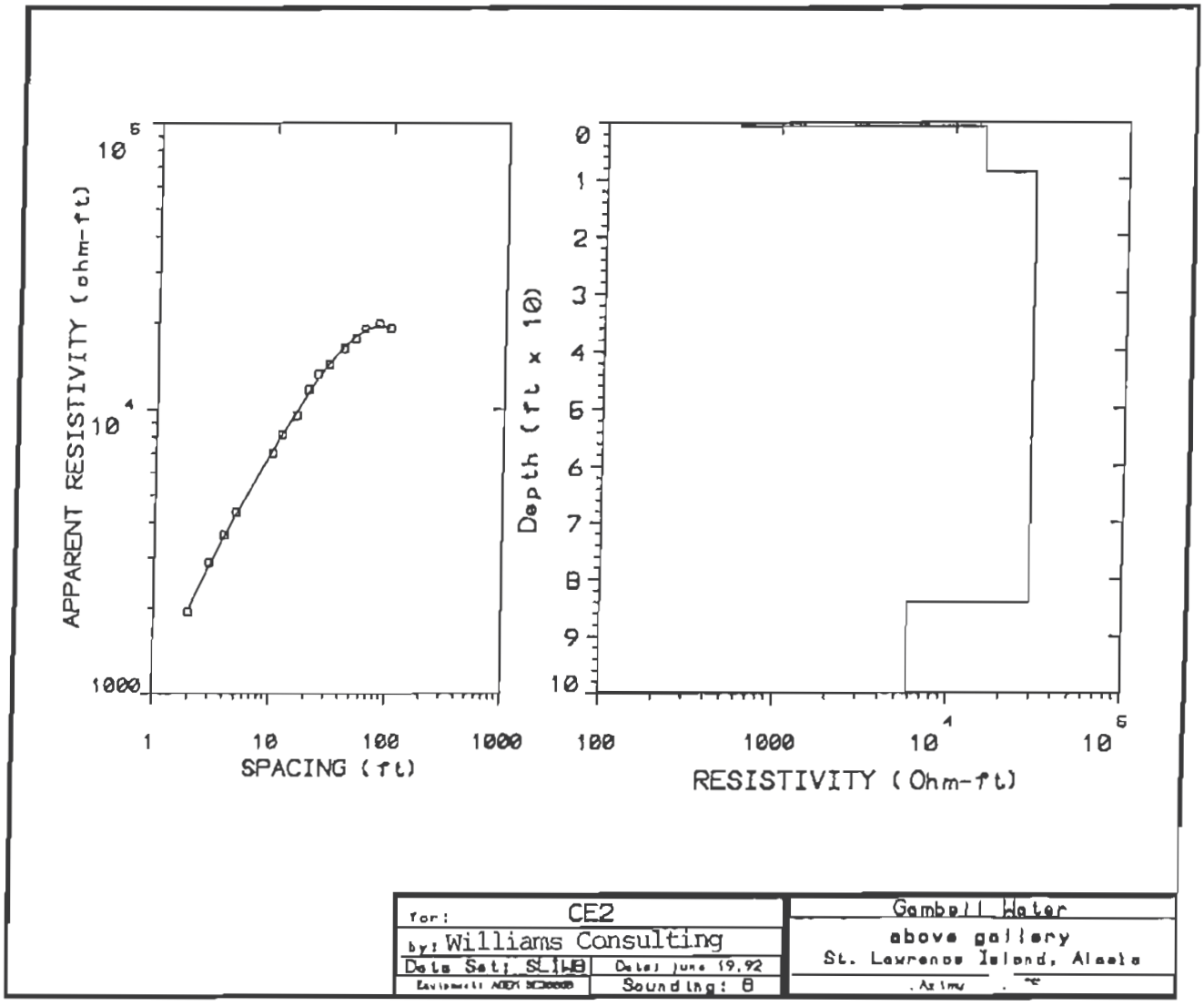

0
10
20
30
DEPTH (FT.)
DRY GRAVEL
FROZEN SEDIMENT
WET TO SATURATED SEDIMENT
FROZEN
BRACKISH WATER

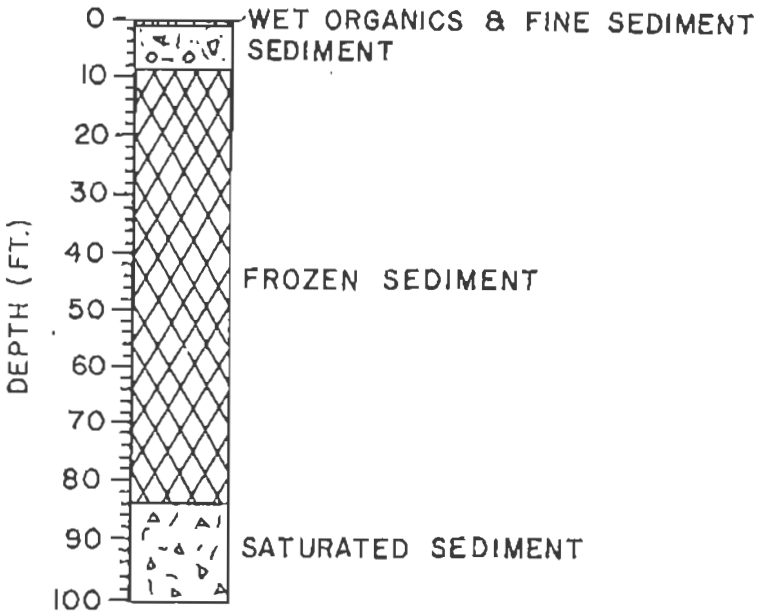
SOUNDING 7


APPARENT RESISTIVITY (ohm-ft)
10^5
10^4
1000
1
10
100
1000
AB/2 (ft)
Depth (ft x 10)
0
1
2
1000
10^4
10^5
10^6
RESISTIVITY (Ohm-ft)
Plate: 10a
for: CE2
by: Williams Consulting
Date Set: SLISB
Date: June 19,92
Sounding: 8
Gambell Water
above gallery
St. Lawrence Island, Alaska
Azimuth: N45E

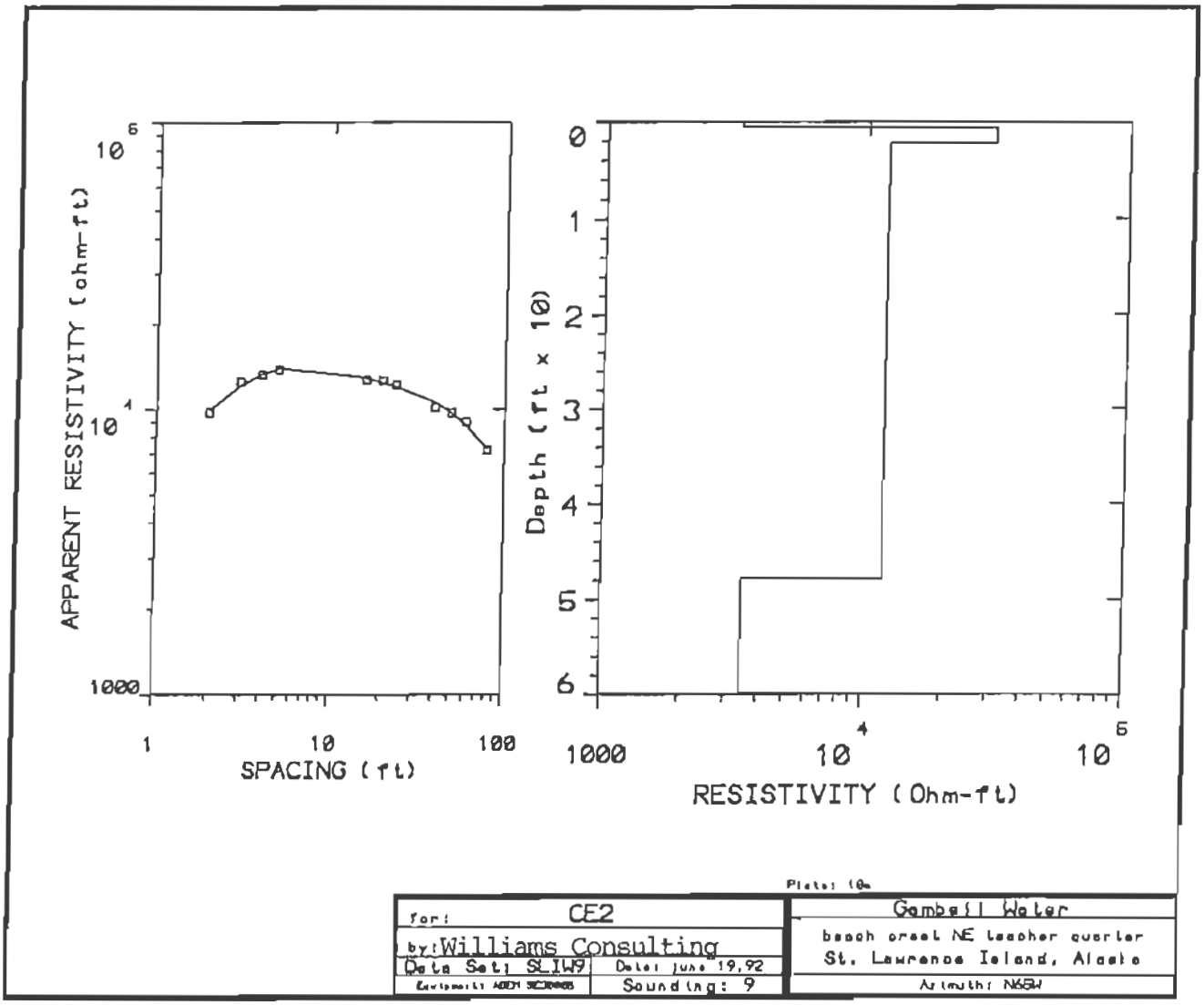

0
10
20
DEPTH (FT.)
WET ORGANICS & FINE SEDIMENT
FROZEN SEDIMENT
WET TO SATURATED SEDIMENT
FROZEN SEDIMENT
SATURATED SEDIMENT

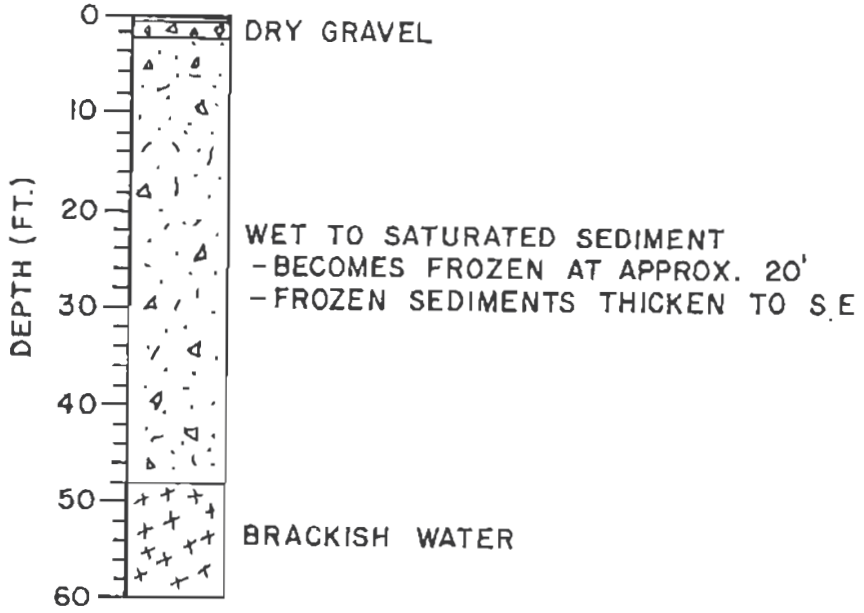
SOUNDING 8


APPARENT RESISTIVITY (ohm-ft)
SPACING (ft)
Depth (ft x 10)
RESISTIVITY (Ohm-ft)
for: CE2
by: Williams Consulting
Date Set: 5-1-92
Date: June 19,92
Sounding: 8
Gambell Water
above gallery
St. Lawrence Island, Alaska

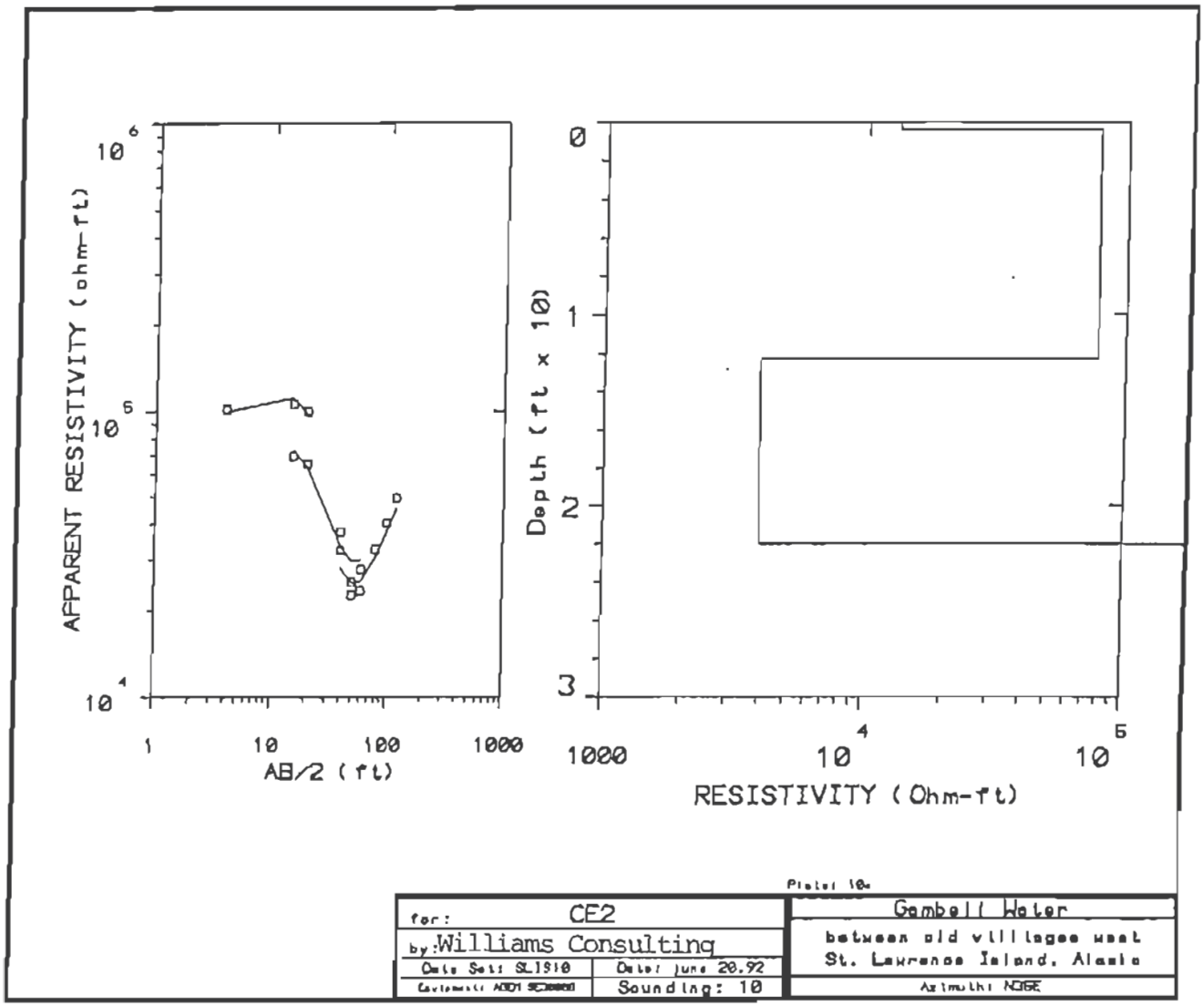

WET ORGANICS & FINE SEDIMENT
SEDIMENT
FROZEN SEDIMENT
SATURATED SEDIMENT
DEPTH (FT.)

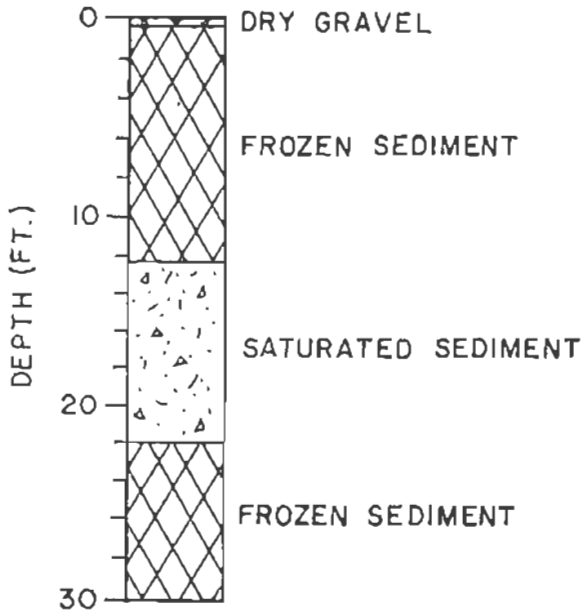
SOUNDING 8


APPARENT RESISTIVITY (ohm-ft)
10^5
10^4
1000
1
10
100
SPACING (ft)
Depth (ft x 10)
0
1
2
3
4
5
6
1000
10^4
10^5
RESISTIVITY (Ohm-ft)
Plate: 10
for: CE2
by: Williams Consulting
Data Set: SL1W9
Date: June 19,92
Sounding: 9
Gambell Water
beach crest NE teacher quarter
St. Lawrence Island, Alaska
Azimuth: N65W

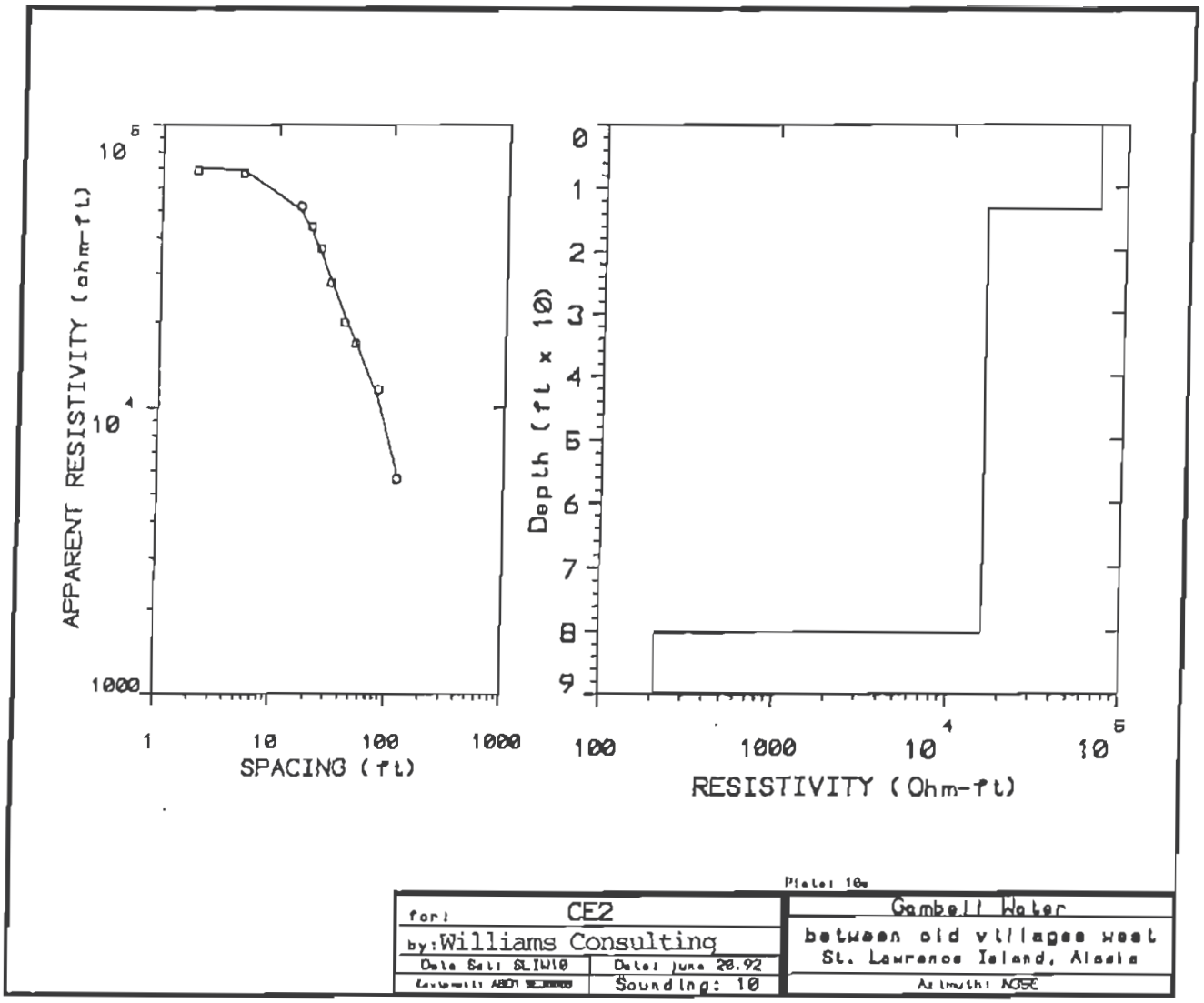

DEPTH (FT.)
0
10
20
30
40
50
60
DRY GRAVEL
WET TO SATURATED SEDIMENT
-BECOMES FROZEN AT APPROX. 20'
-FROZEN SEDIMENTS THICKEN TO S.E
BRACKISH WATER

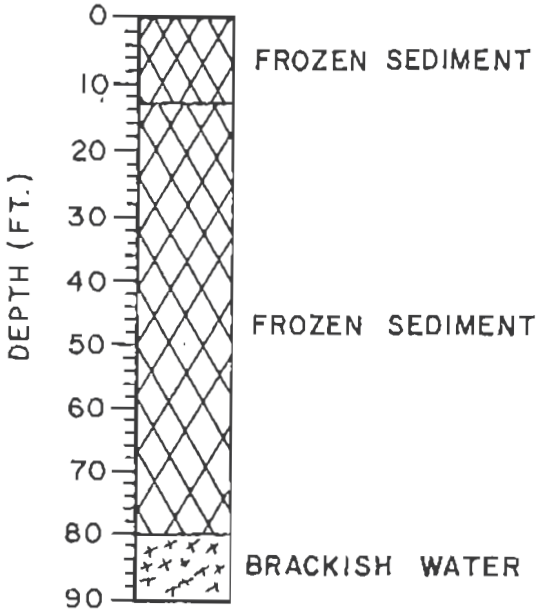
SOUNDING 9


APPARENT RESISTIVITY (ohm-ft)
10^6
10^5
10^4
1
10
100
1000
AB/2 (ft)
Depth (ft x 10)
0
1
2
3
1000
10^4
10^5
RESISTIVITY (Ohm-ft)
Plate 10
for: CE2
by: Williams Consulting
Date Set: SL1910
Date: June 20,92
Sounding: 10
Gambell Water
between old villages west
St. Lawrence Island, Alaska
Azimuth: NOSE

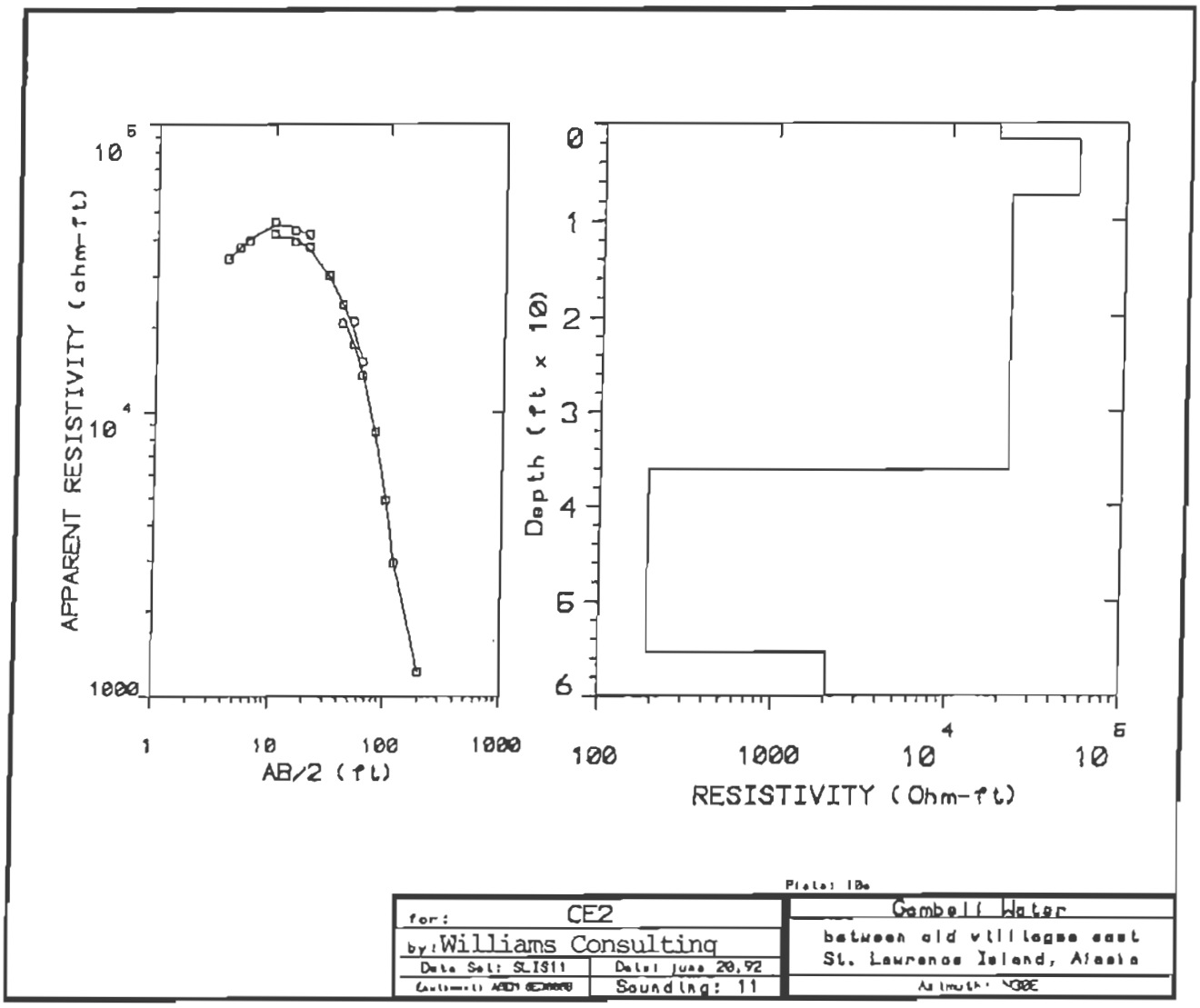

0
10
20
30
DEPTH (FT.)
DRY GRAVEL
FROZEN SEDIMENT
SATURATED SEDIMENT
FROZEN SEDIMENT

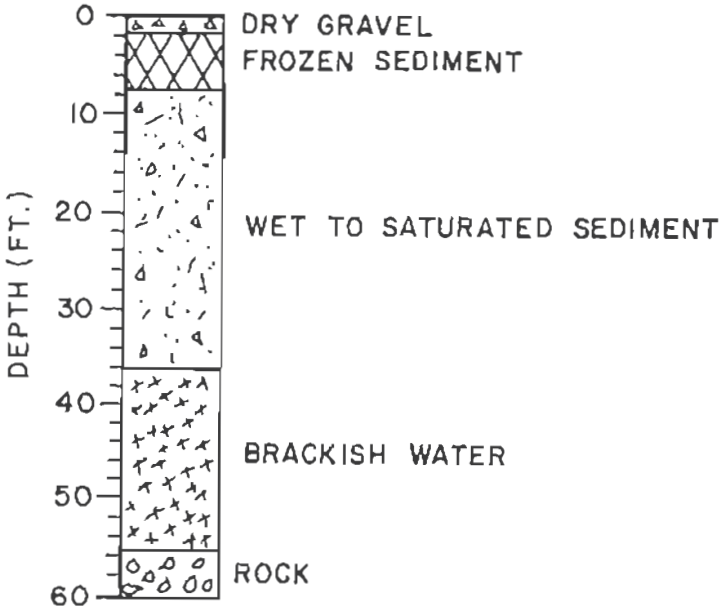
SOUNDING 10


APPARENT RESISTIVITY (ohm-ft)
SPACING (ft)
Depth (ft x 10)
RESISTIVITY (Ohm-ft)
Plate: 10a
for: CE2
by: Williams Consulting
Date Set: SLIW10
Date: June 20,92
Sounding: 10
Gambell Water
between old villages west
St. Lawrence Island, Alaska
Azimuth: N35E

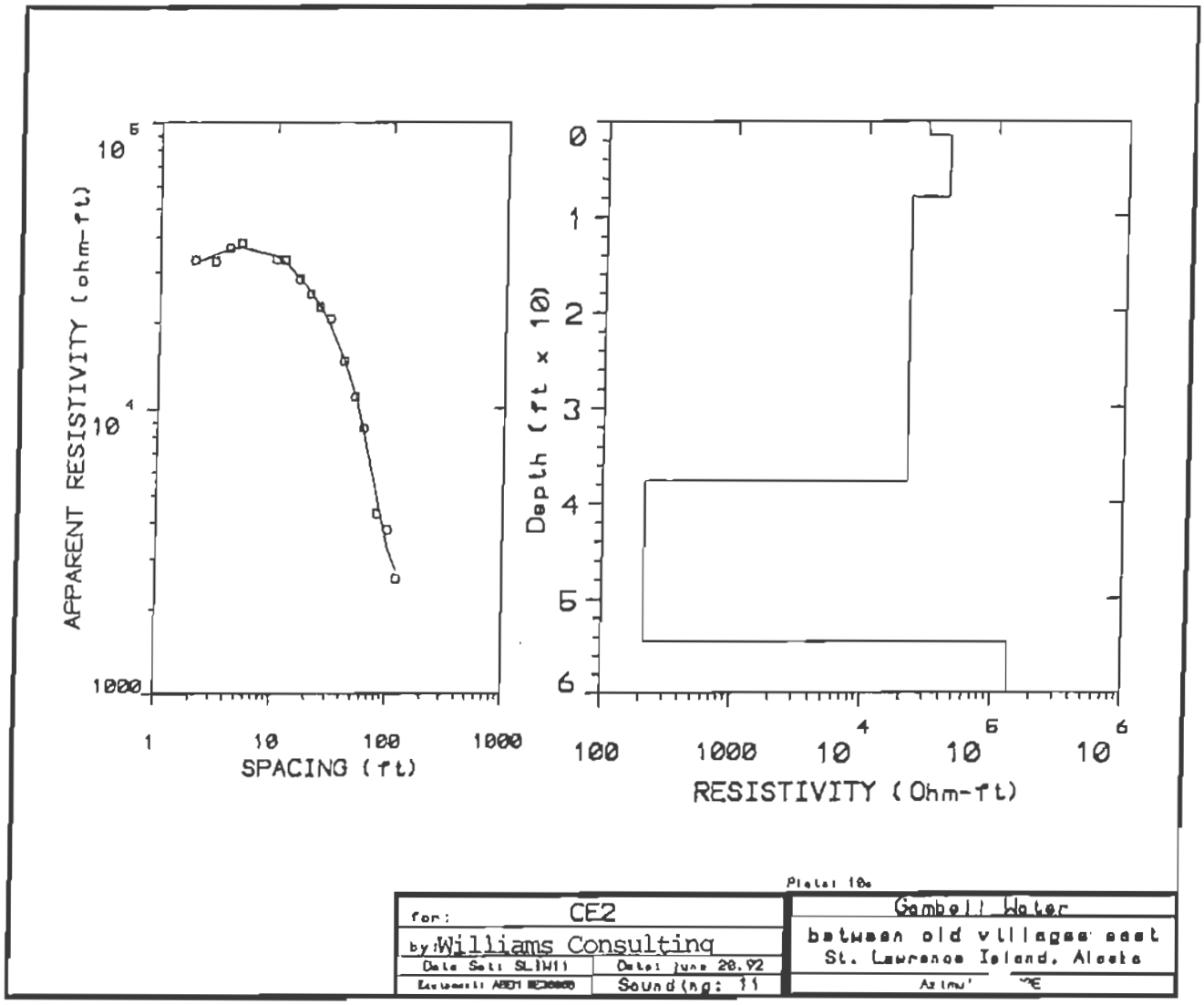

DEPTH (FT.)
FROZEN SEDIMENT
FROZEN SEDIMENT
BRACKISH WATER

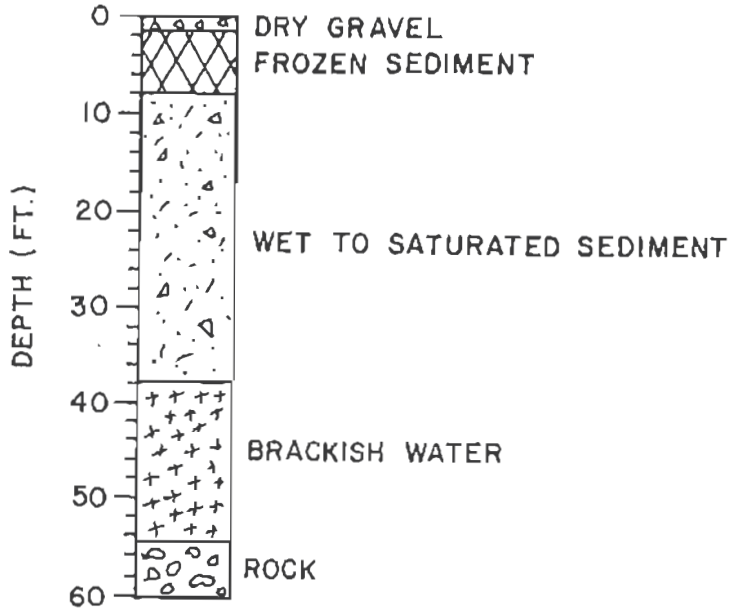
SOUNDING 10


APPARENT RESISTIVITY (ohm-ft)
10^5
10^4
1000
1
10
100
1000
AB/2 (ft)
Depth (ft x 10)
0
1
2
3
4
5
6
100
1000
10^4
10^5
RESISTIVITY (Ohm-ft)
Plate 18a
for: CE2
by: Williams Consulting
Date Sol: SLIS11
Date: June 20,92
Sounding: 11
Gambell Water
between old village east
St. Lawrence Island, Alaska
Azimuth: N30E

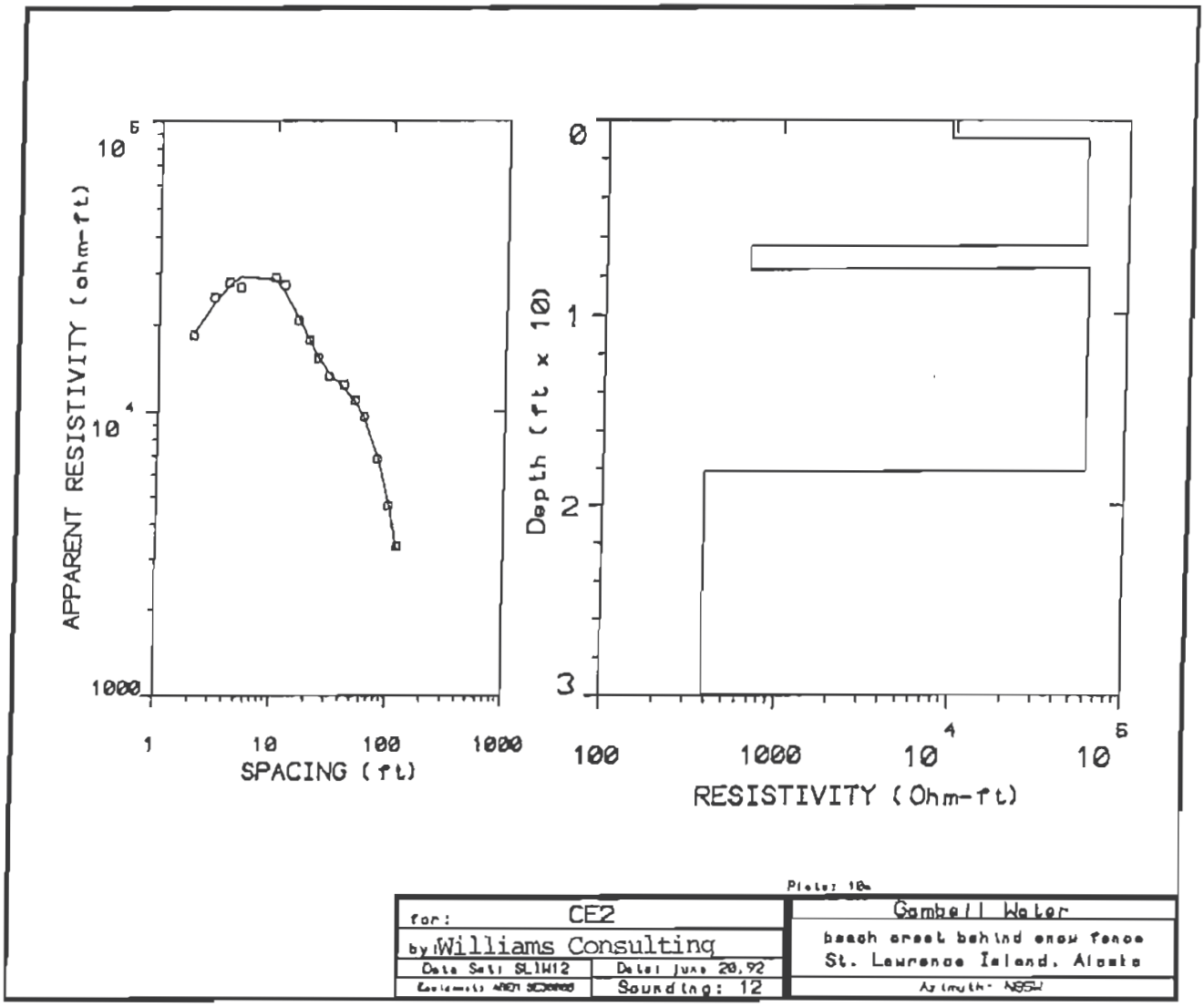

DEPTH (FT.)
0
10
20
30
40
50
60
DRY GRAVEL
FROZEN SEDIMENT
WET TO SATURATED SEDIMENT
BRACKISH WATER
ROCK

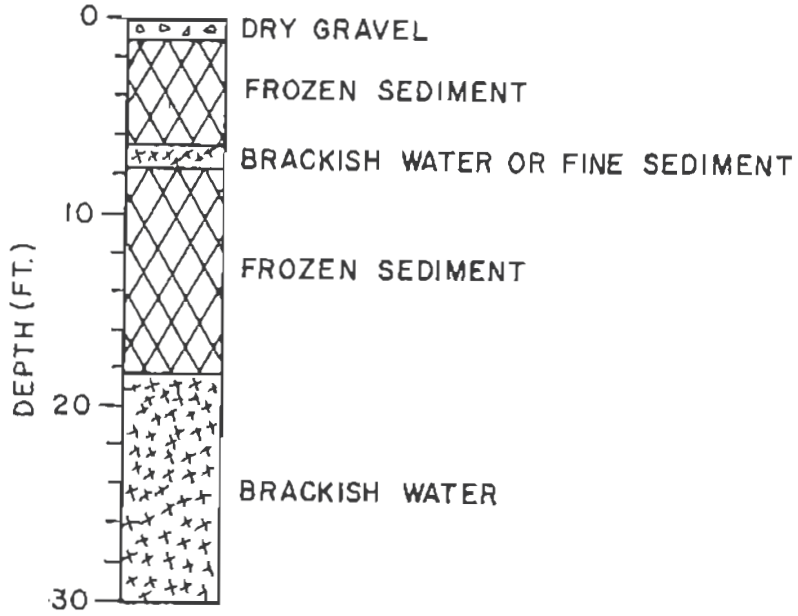
SOUNDING 11


APPARENT RESISTIVITY (ohm-ft)
SPACING (ft)
Depth (ft x 10)
RESISTIVITY (Ohm-ft)
Plate 10a
for: CE2
by: Williams Consulting
Date Sett SLIWII
Date: June 28, 92
Sounding: 11
Gambell Water
between old villages east
St. Lawrence Island, Alaska

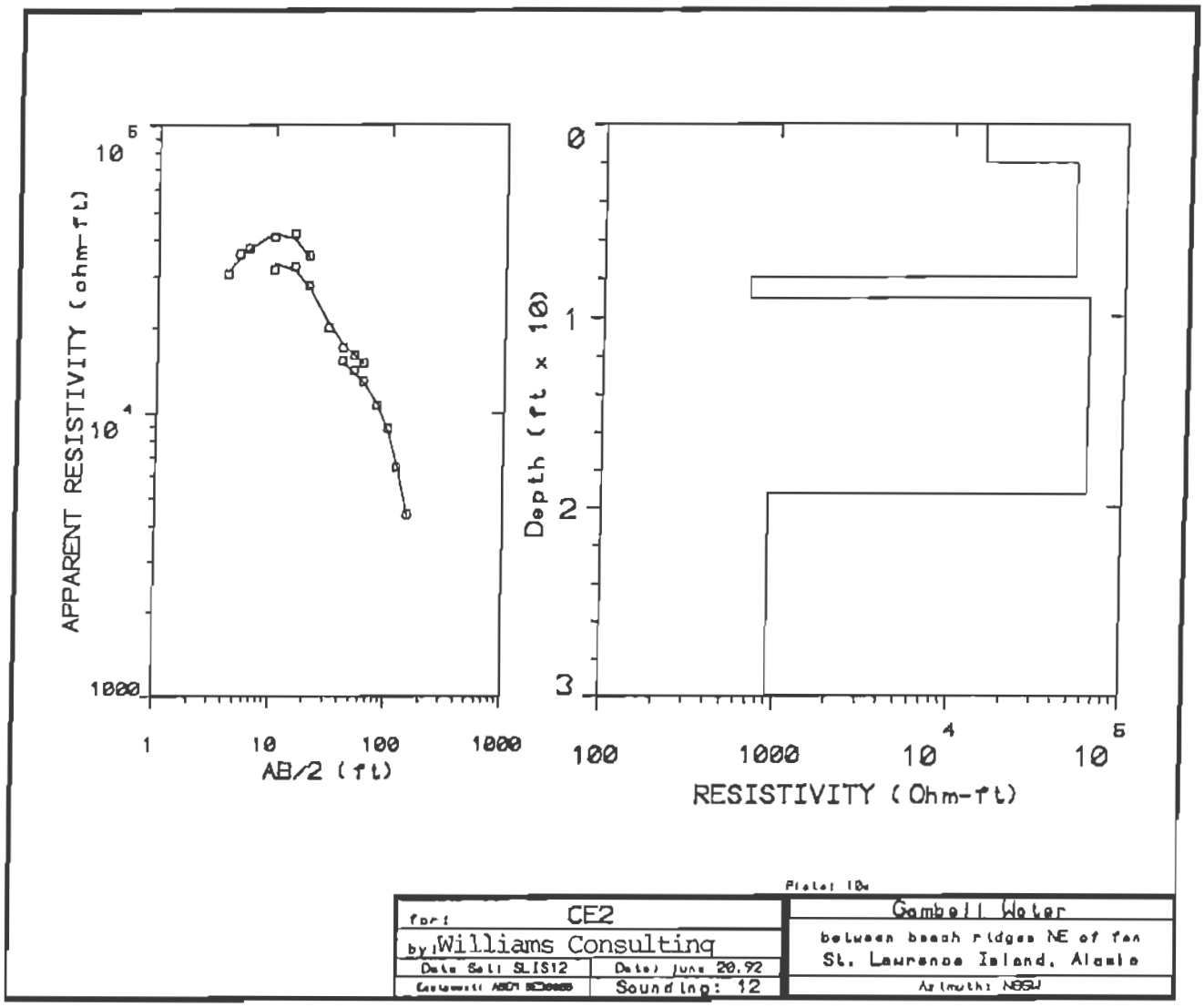

DEPTH (FT.)
DRY GRAVEL
FROZEN SEDIMENT
WET TO SATURATED SEDIMENT
BRACKISH WATER
ROCK

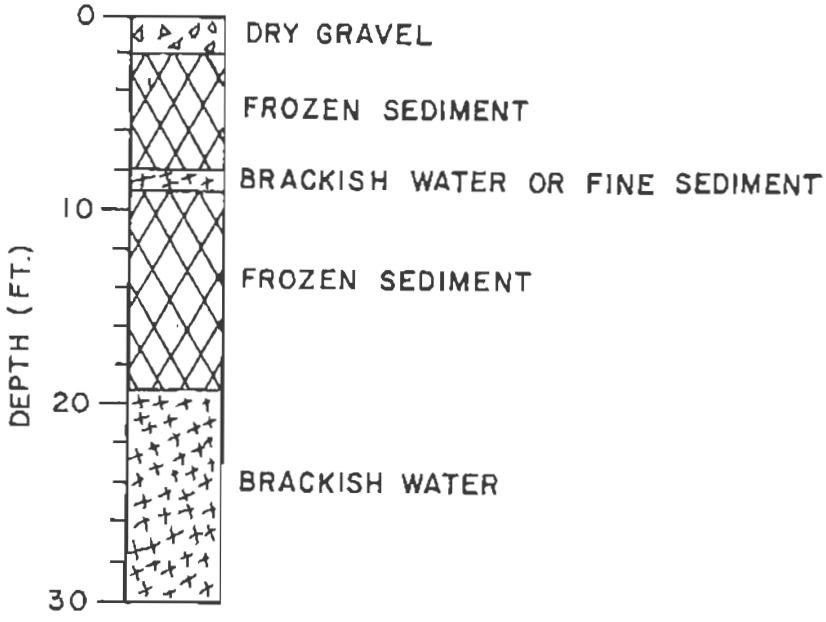
SOUNDING 11


APPARENT RESISTIVITY (ohm-ft)
SPACING (ft)
Depth (ft x 10)
RESISTIVITY (Ohm-ft)
for: CE2
by: Williams Consulting
Gambell Water
beach crest behind snow fence
St. Lawrence Island, Alaska
Sounding: 12

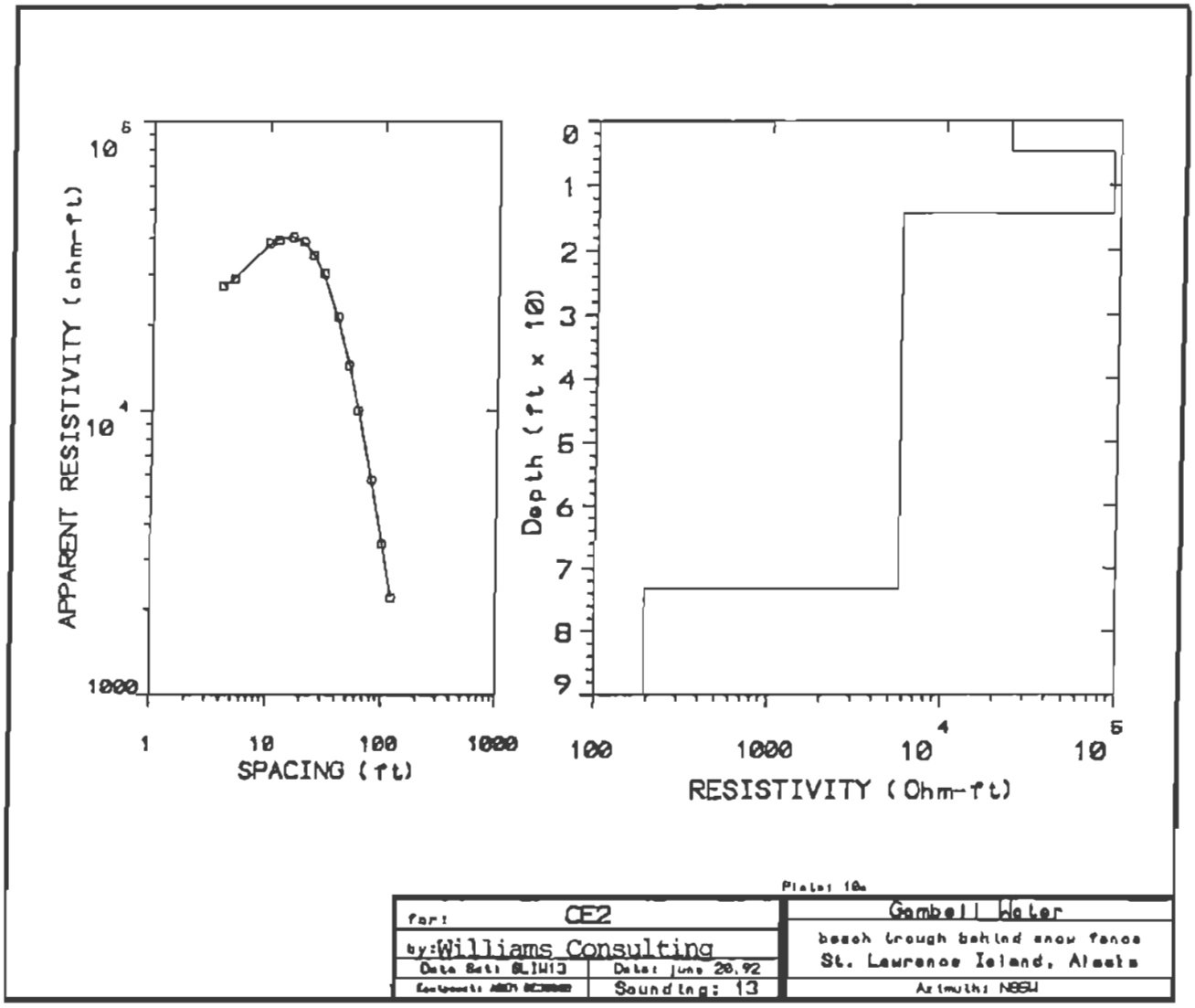

DEPTH (FT.)
DRY GRAVEL
FROZEN SEDIMENT
BRACKISH WATER OR FINE SEDIMENT
FROZEN SEDIMENT
BRACKISH WATER

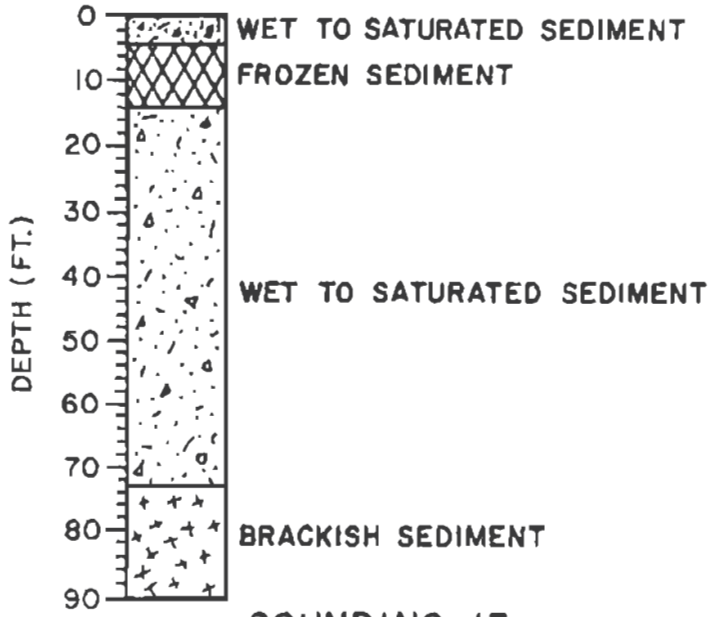
SOUNDING 12


APPARENT RESISTIVITY (ohm-ft)
10^5
10^4
1000
1
10
100
1000
AB/2 (ft)
Depth (ft x 10)
0
1
2
3
100
1000
10^4
10^5
RESISTIVITY (Ohm-ft)
for: CE2
by: Williams Consulting
Date Sell SL1S12
Date: June 20,92
Sounding: 12
Gambell Water
between beach ridges NE of fan
St. Lawrence Island, Alaska
Azimuth: N65W


0
10
20
30
DEPTH (FT.)
DRY GRAVEL
FROZEN SEDIMENT
BRACKISH WATER OR FINE SEDIMENT
FROZEN SEDIMENT
BRACKISH WATER

SOUNDING 12


APPARENT RESISTIVITY (ohm-ft)
SPACING (ft)
Depth (ft x 10)
RESISTIVITY (Ohm-ft)
Plate 10a
for: CE2
by: Williams Consulting
Date Set: 6/10/13
Date: June 20, 92
Sounding: 13
Gambell Water
beach trough behind snow fence
St. Lawrence Island, Alaska
Azimuth: N85W


DEPTH (FT.)
WET TO SATURATED SEDIMENT
FROZEN SEDIMENT
WET TO SATURATED SEDIMENT
BRACKISH SEDIMENT

SOUNDING 13

SCHLUMBERGER ARRAY

MN	AB/2	Resistivity
1	4	701 1 amp
1	5	492
1	6	373
1	10	173.9
1	15	92.9
1	20	54.2
3	10	363
3	15	192.2
3	20	112.9
3	30	5.60
3	40	11.56
3	50	10.41
3	60	4.39
10	40	66.4
10	50	59.9
10	60	85.6
10	80	88.9
10	100	153.9
10	120	149.7
10	150	51.8
10	200	63.1
30	120	
30	150	
30	200	
30	300	
30	400	
30	500	
30	600	
100	400	
100	500	
100	600	
100	800	
100	1000	
100	1200	
100	1500	
100	2000	

Sounding #: 13

Date: 6/20/92

Time Started: 13:15

Location: on flats behind high snow fence at tanks
top of old beach ridge

Elevation:

Coordinates:

Bearing: ~ 85°W

Comments:

MN=1, AB/2

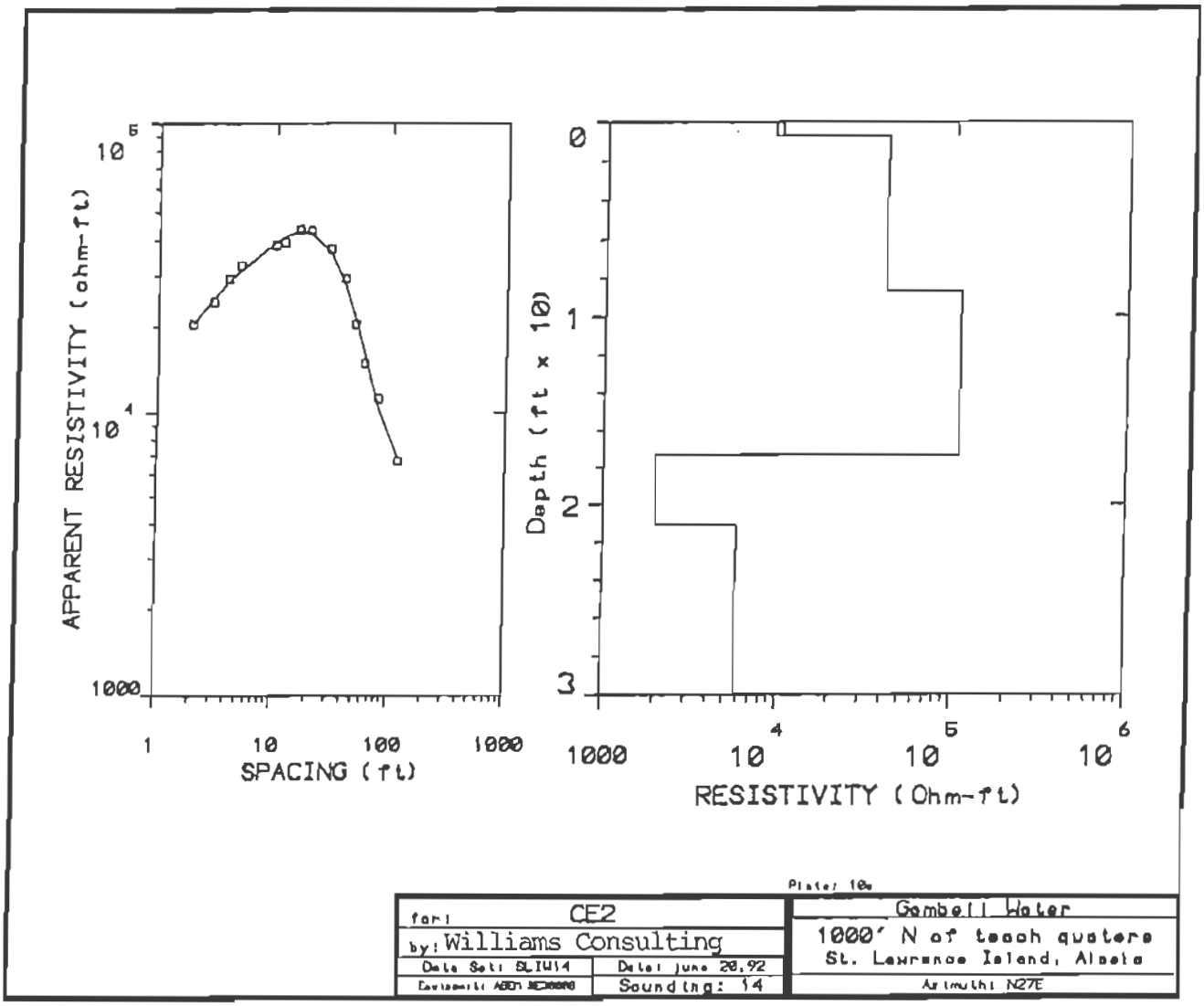
4	16,517
5	18,548
6	20,507
10	27,043
15	32,688
20	33,970

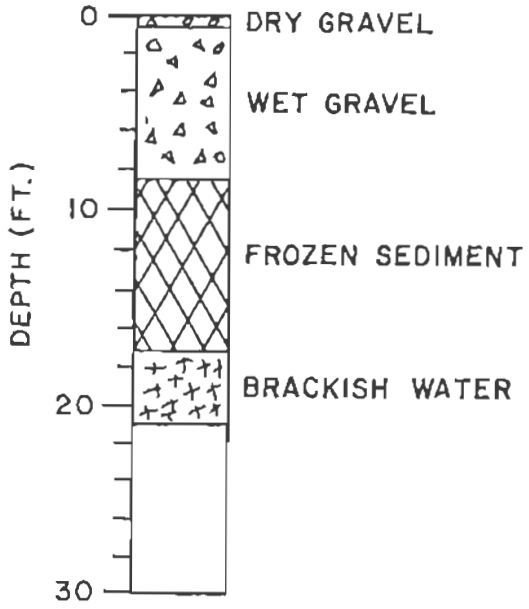
MN=3

10	17,296
15	21,737
20	23,114
30	2,613
40	9,630
50	13,578
60	8,254

MN=10

40	15,645
50	22,582
60	47,061
80	87,976
100	239,328
120	336,262
150	182,263
200	395,478


APPARENT RESISTIVITY (ohm-ft)
10^5
10^4
1000
1
10
100
1000
SPACING (ft)
Depth (ft x 10)
0
1
2
3
1000
10^4
10^5
10^6
RESISTIVITY (Ohm-ft)
Plate: 10a
for: CE2
by: Williams Consulting
Date Set: 8LIU14
Date: June 28,92
Sounding: 14
Gambell Water
1000' N of teach quaters
St. Lawrence Island, Alaska
Azimuth: N27E


DEPTH (FT.)
0
10
20
30
DRY GRAVEL
WET GRAVEL
FROZEN SEDIMENT
BRACKISH WATER

SOUNDING 14

SCHLUMBERGER ARRAY

MN	AB/2	Resistivity
1	4	636
1	5	465
1	6	369
1	10	16.78
1	15	88.5
1	20	56.0
3	10	385
3	15	201
3	20	126.8
3	30	58.7
3	40	27.5
3	50	20.7
3	60	11.34
10	40	80.1
10	50	58.7
10	60	31.1
10	80	11.41
10	100	6.05
10	120	4.04
10	150	1.59
10	200	1.58
30	120	
30	150	
30	200	
30	300	
30	400	
30	500	
30	600	
100	400	
100	500	
100	600	
100	800	
100	1000	
100	1200	
100	1500	
100	2000	

Sounding #: 14

Date: 6/20/92

Time Started: 14:50

Location: on flats ~ 1000' N of blue schoolhouse on east end of town

Elevation:

Coordinates:

Bearing: N 27°E

Comments:

MN=1 AB/2

AB/2	
4	14,985
5	17,530
6	20,287
10	2,609
15	31,139
20	35,098

MN=3

AB/2	
10	18,344
15	22,733
20	25,959
30	27,385
40	22,909
50	24,999
60	21,322

MN=10

AB/2	
40	18,873
50	22,129
60	17,098
80	11,291
100	9,408
120	9,075
150	5,595
200	9,903

This page intentionally left blank

APPENDIX C

HUMAN HEALTH CONCEPTUAL SITE MODEL SCOPING FORM

This page intentionally left blank

Print Form

Human Health Conceptual Site Model Scoping Form

Site Name: AKARNG Gambell Federal Scout Armory

File Number: 660.38.007

Completed by: Brice Engineering

Introduction

The form should be used to reach agreement with the Alaska Department of Environmental Conservation (DEC) about which exposure pathways should be further investigated during site characterization. From this information, summary text about the CSM and a graphic depicting exposure pathways should be submitted with the site characterization work plan and updated as needed in later reports.

General Instructions: Follow the italicized instructions in each section below.

1. General Information:

Sources *(check potential sources at the site)*

- ☐ USTs
- ☒ ASTs
- ☐ Dispensers/fuel loading racks
- ☐ Drums
- ☐ Vehicles
- ☐ Landfills
- ☐ Transformers
- ☐ Other:

Release Mechanisms *(check potential release mechanisms at the site)*

- ☒ Spills
- ☒ Leaks
- ☐ Direct discharge
- ☐ Burning
- ☐ Other:

Impacted Media *(check potentially-impacted media at the site)*

- ☒ Surface soil (0-2 feet bgs*)
- ☒ Subsurface soil (>2 feet bgs)
- ☒ Air
- ☐ Sediment
- ☒ Groundwater
- ☐ Surface water
- ☒ Biota
- ☐ Other:

Receptors *(check receptors that could be affected by contamination at the site)*

- ☒ Residents (adult or child)
- ☒ Commercial or industrial worker
- ☒ Construction worker
- ☒ Subsistence harvester (i.e. gathers wild foods)
- ☒ Subsistence consumer (i.e. eats wild foods)
- ☒ Site visitor
- ☒ Trespasser
- ☒ Recreational user
- ☐ Farmer
- ☐ Other:

* bgs - below ground surface

2. Exposure Pathways: *(The answers to the following questions will identify complete exposure pathways at the site. Check each box where the answer to the question is "yes".)*

a) Direct Contact -

1. Incidental Soil Ingestion

Are contaminants present or potentially present in surface soil between 0 and 15 feet below the ground surface? (Contamination at deeper depths may require evaluation on a site-specific basis.) ☒

If the box is checked, label this pathway complete: Complete

Comments:

DRO is present in soil, but below human health cleanup levels.

2. Dermal Absorption of Contaminants from Soil

Are contaminants present or potentially present in surface soil between 0 and 15 feet below the ground surface? (Contamination at deeper depths may require evaluation on a site specific basis.) ☒

Can the soil contaminants permeate the skin (see Appendix B in the guidance document)? ☐

If both boxes are checked, label this pathway complete: Incomplete

Comments:

DRO is not identified in Appendix B as a soil contaminant that permeates the skin.

b) Ingestion -

1. Ingestion of Groundwater

Have contaminants been detected or are they expected to be detected in the groundwater, or are contaminants expected to migrate to groundwater in the future? ☒

Could the potentially affected groundwater be used as a current or future drinking water source? Please note, only leave the box unchecked if DEC has determined the groundwater is not a currently or reasonably expected future source of drinking water according to 18 AAC 75.350. ☒

If both boxes are checked, label this pathway complete: Incomplete

Comments:

DRO and Naphthalene have been detected in the supra-permafrost porewater at concentrations exceeding ADEC Table C Cleanup levels. However, the supra-permafrost porewater is not a current or reasonably expected future drinking water source, per the Arctic Zone Tech Memo, and is downgradient and hydrologically disconnected from the only viable drinking water source, therefore,

2. Ingestion of Surface Water

Have contaminants been detected or are they expected to be detected in surface water, or are contaminants expected to migrate to surface water in the future? ☐

Could potentially affected surface water bodies be used, currently or in the future, as a drinking water source? Consider both public water systems and private use (i.e., during residential, recreational or subsistence activities). ☐

If both boxes are checked, label this pathway complete: Incomplete

Comments:

Contamination is not expected to migrate to surface water.

3. Ingestion of Wild and Farmed Foods

Is the site in an area that is used or reasonably could be used for hunting, fishing, or harvesting of wild or farmed foods? ☒

Do the site contaminants have the potential to bioaccumulate (see Appendix C in the guidance document)? ☐

Are site contaminants located where they would have the potential to be taken up into biota? (i.e. soil within the root zone for plants or burrowing depth for animals, in groundwater that could be connected to surface water, etc.) ☒

If all of the boxes are checked, label this pathway complete: Incomplete

Comments:

Site contaminants are not bioaccumulative.

c) Inhalation-

1. Inhalation of Outdoor Air

Are contaminants present or potentially present in surface soil between 0 and 15 feet below the ground surface? (Contamination at deeper depths may require evaluation on a site specific basis.) ☒

Are the contaminants in soil volatile (see Appendix D in the guidance document)? ☒

If both boxes are checked, label this pathway complete: Complete

Comments:

DRO is the only contaminant in soil, which is a volatile contaminant, but there is very little contamination remaining and it does not exceed outdoor air inhalation cleanup levels.

2. Inhalation of Indoor Air

Are occupied buildings on the site or reasonably expected to be occupied or placed on the site in an area that could be affected by contaminant vapors? (within 30 horizontal or vertical feet of petroleum contaminated soil or groundwater; within 100 feet of non-petroleum contaminted soil or groundwater; or subject to "preferential pathways," which promote easy airflow like utility conduits or rock fractures) ☒

Are volatile compounds present in soil or groundwater (see Appendix D in the guidance document)? ☒

If both boxes are checked, label this pathway complete: Complete

Comments:

DRO is the only contaminant in soil, which is a volatile contaminant, but there is very little contamination remaining and the buildings are elevated above the surface.

3. **Additional Exposure Pathways:** *(Although there are no definitive questions provided in this section, these exposure pathways should also be considered at each site. Use the guidelines provided below to determine if further evaluation of each pathway is warranted.)*

Dermal Exposure to Contaminants in Groundwater and Surface Water

Dermal exposure to contaminants in groundwater and surface water may be a complete pathway if:

- Climate permits recreational use of waters for swimming.
- Climate permits exposure to groundwater during activities, such as construction.
- Groundwater or surface water is used for household purposes, such as bathing or cleaning.

Generally, DEC groundwater cleanup levels in 18 AAC 75, Table C, are deemed protective of this pathway because dermal absorption is incorporated into the groundwater exposure equation for residential uses.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

Inhalation of Volatile Compounds in Tap Water

Inhalation of volatile compounds in tap water may be a complete pathway if:

- The contaminated water is used for indoor household purposes such as showering, laundering, and dish washing.
- The contaminants of concern are volatile (common volatile contaminants are listed in Appendix D in the guidance document.)

DEC groundwater cleanup levels in 18 AAC 75, Table C are protective of this pathway because the inhalation of vapors during normal household activities is incorporated into the groundwater exposure equation.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

Inhalation of Fugitive Dust

Inhalation of fugitive dust may be a complete pathway if:

- Nonvolatile compounds are found in the top 2 centimeters of soil. The top 2 centimeters of soil are likely to be dispersed in the wind as dust particles.
- Dust particles are less than 10 micrometers (Particulate Matter - PM_{10}). Particles of this size are called respirable particles and can reach the pulmonary parts of the lungs when inhaled.

DEC human health soil cleanup levels in Table B1 of 18 AAC 75 are protective of this pathway because the inhalation of particulates is incorporated into the soil exposure equation.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

Direct Contact with Sediment

This pathway involves people's hands being exposed to sediment, such as during some recreational, subsistence, or industrial activity. People then incidentally ingest sediment from normal hand-to-mouth activities. In addition, dermal absorption of contaminants may be of concern if the the contaminants are able to permeate the skin (see Appendix B in the guidance document). This type of exposure should be investigated if:

- Climate permits recreational activities around sediment.
- The community has identified subsistence or recreational activities that would result in exposure to the sediment, such as clam digging.

Generally, DEC direct contact soil cleanup levels in 18 AAC 75, Table B1, are assumed to be protective of direct contact with sediment.

Check the box if further evaluation of this pathway is needed: ☐

Comments:

4. Other Comments *(Provide other comments as necessary to support the information provided in this form.)*

This page intentionally left blank