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Eastern Environmental
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Montgomery, AL 36109

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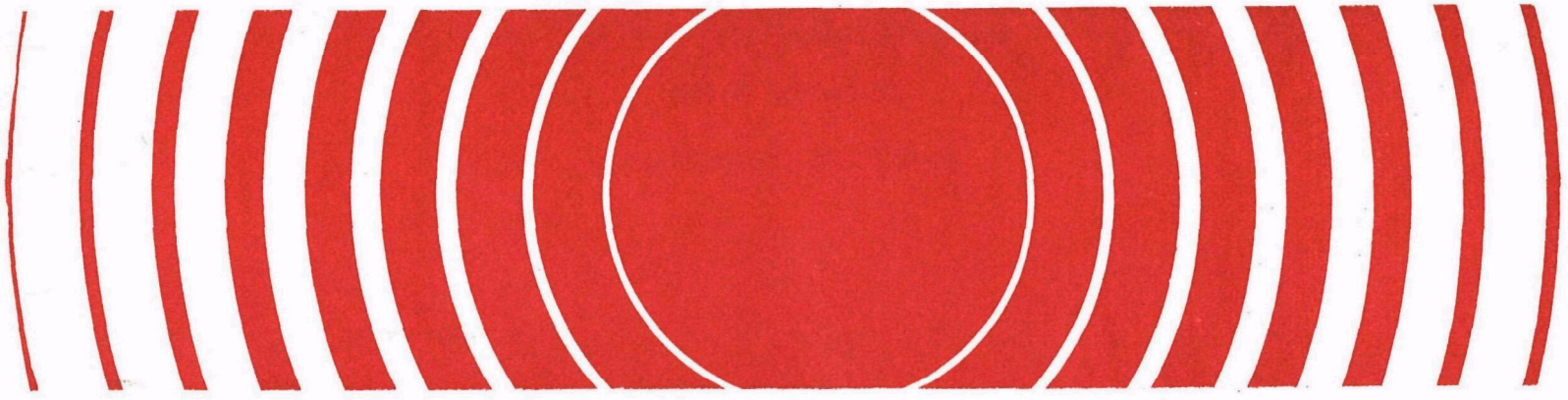
Radiological Survey of Kings Bay Submarine Support Facility



Radiological Survey
of
Kings Bay Submarine Support Facility

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Table of Contents

List of Illustrations

Figures

Tables

Preface

The Office of Radiation Programs identifies and evaluates environmental public health impacts of both natural and man-made radiation sources. The Eastern Environmental Radiation Facility (EERF) is a fully integrated participant with other components of the Office in these efforts. The Facility provides comprehensive capability for evaluating radiation sources through planning and conducting environmental studies, nationwide surveillance, and laboratory analysis. The EERF also provides special analytical support for Environmental Protection Agency Regional Offices and other Federal government agencies, as requested, as well as technical assistance to the radiological health programs of State and local health departments.

This report presents results of the survey conducted by EERF personnel to assess levels of environmental radioactivity resulting from maintenance and operation of nuclear-powered warships at the Kings Bay Submarine Support Facility, Kingsland, Georgia. The purpose of the survey was to determine if activities related to nuclear-powered warship resulted in release of radionuclides which may contribute to significant population exposure or contamination of the environment.

Readers of our reports are encouraged to bring comments, omissions or errors to our attention.

Charles R. Porter, Director
Eastern Environmental Radiation Facility

Introduction

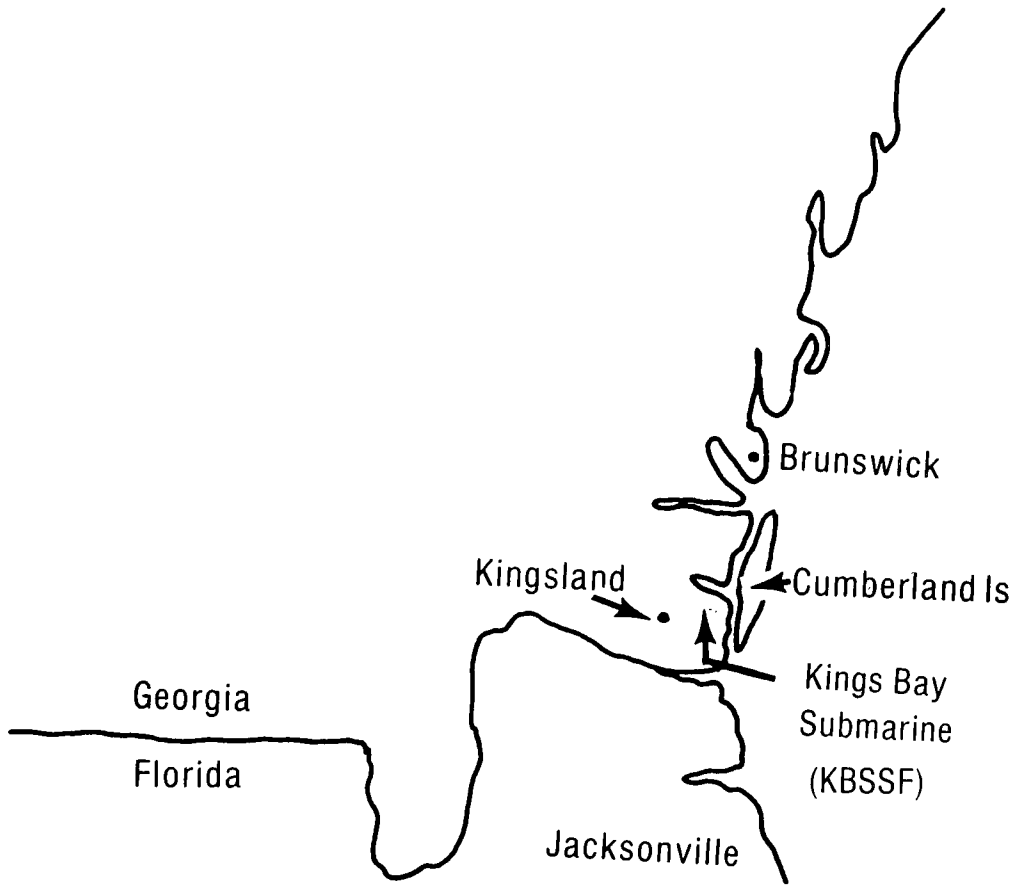
Since 1963, the Eastern Environmental Radiation Facility (EERF), U.S. Environmental Protection Agency (USEPA), in cooperation with the U.S. Naval Sea Systems Command (NAVSEA) has surveyed facilities serving nuclear-powered warships on the Atlantic and Pacific coasts and the Gulf of Mexico. These surveys assess whether the operation of nuclear-powered warships, during construction, maintenance, overhaul, or refueling, have created elevated levels of radioactivity. The surveys emphasize sampling those areas and pathways that could expose the public.

In 1984, NAVSEA requested that all active facilities servicing nuclear-powered warships be resurveyed over the next three years. Kings Bay Submarine Support Facility (KBSSF), located adjacent to St. Marys, Georgia and approximately 10 miles east of Kingsland, Georgia, was surveyed by EERF personnel in August 1985. The KBSSF has not been previously surveyed by the EERF or its predecessor (the U.S. Public Health Service) since the area had not been visited by nuclear-powered warships until approximately 1980 (Go86).

Characteristics of Kings Bay Submarine Support Facility

The KBSSF is located in southeast Georgia adjacent to St. Marys and approximately 10 miles from Kingsland and about 30 miles north of Jacksonville, Florida. The facility is on Kings Bay just off Cumberland Sound which is created by Cumberland Island, a barrier island on Georgia's Atlantic coast (see site location map, Figure 1). The facility consists of three primary areas of work; a floating dry dock located to the southeast near the entrance to Kings Bay; a central pier which presently is the center of most activity; and a new pier area located to the northwest into Kings Bay.

Most of the Kings Bay area consists of shallow water and tidal marshes except for the area of the ship channels which have been deepened by dredging. Fishing and boating were noted in the local area, particularly on Cumberland Sound which is part of the intercoastal waterway.



General Site Location

Figure 1

Survey and Analytical Methods

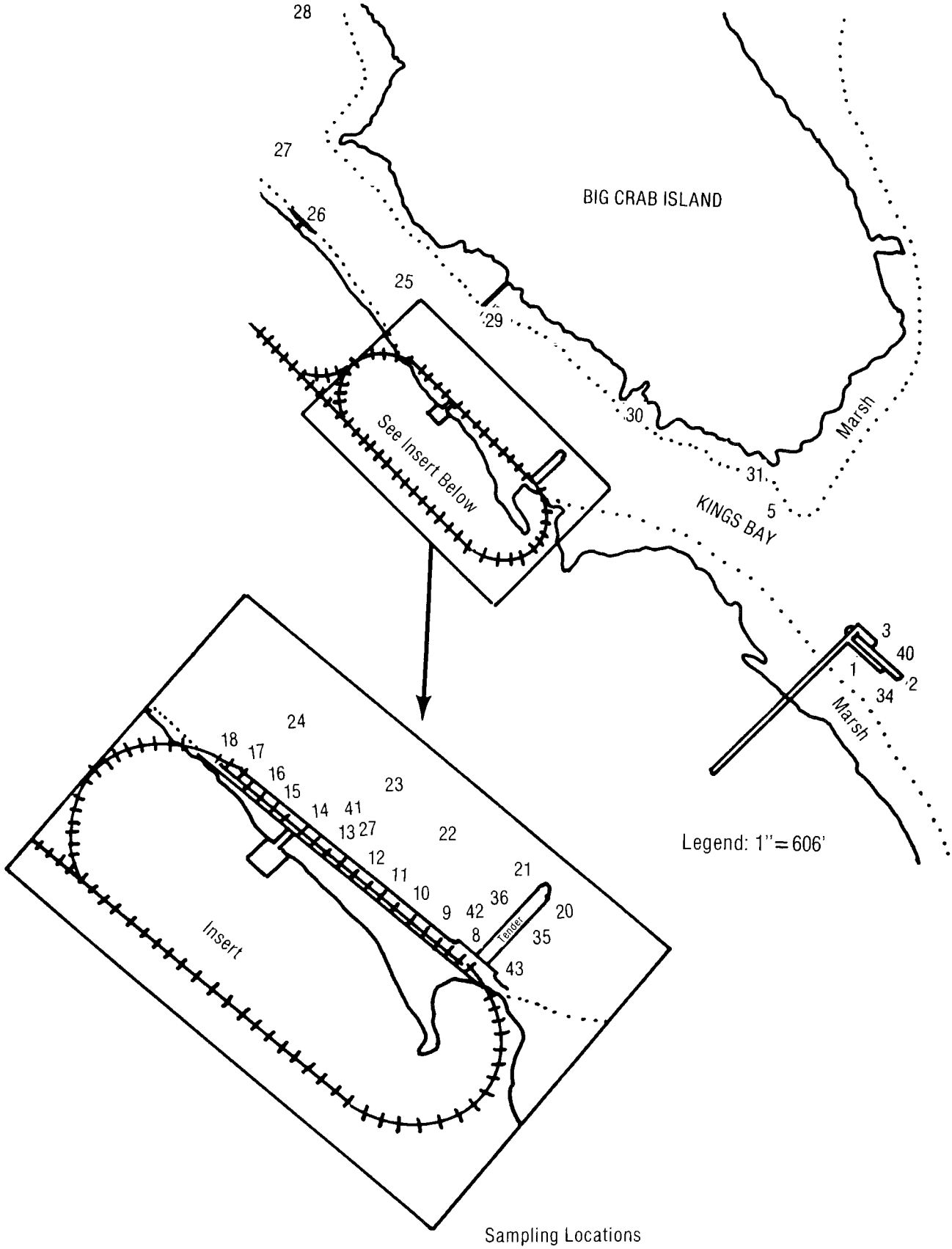
Navy personnel helped the EERF survey team identify the most probable sampling locations, those where radioactivity associated with Naval nuclear propulsion plants, if it were present, would most likely be detected. Extensive sampling was done near the dry dock; central pier; and the new pier areas where nuclear warships are or have been serviced. Sampling sites are shown in Figure 2. Samples of bottom sediment, water, and aquatic life were taken.

According to past surveys, cobalt-60 is the predominant radioisotope found in environmental media as a result of Naval nuclear propulsion plants; therefore, environmental sampling focused on detecting this radioiostope. Cobalt-60 content in all samples was determined by gamma analysis. All water samples were also analyzed for tritium since the nuclide is known to be produced in the coolant of light water nuclear reactors.

An underwater gamma scintillation probe with a 10 centimeter by 10 centimeter sodium iodide detector was used with a portable multichannel pulse height analyzer to help locate areas of radioactivity. All probe measurements were made for 10 minutes. The underwater probe has been useful in past surveys of other facilities to select areas for dredge sampling of bottom sediment and to delineate areas of radioactivity. However, due to the relatively low sensitivity (as compared to laboratory measurements) of the probe, sediment samples were collected at the locations of probe measurement for laboratory analysis. Probe measurements and sampling were duplicated for quality assurance purposes at approximately 10% of the sites.

A standard Peterson dredge was used to sample approximately the top 10 centimeters of sediment. These sediment samples were collected at locations 1 through 31 shown in Figure 2. At the laboratory these samples were dried, ground to a fine powder, placed in a 400 cm^3 sample counting container and counted on a Ge(Li) or intrinsic germanium detector for 1000 minutes. The minimum detectable activity for cobalt-60 in this geometry is approximately 0.01 picocuries per gram (pCi/g).

Sediment core samples are useful in determining the vertical distribution of radioactivity in harbor bottom sediment. If radioactive materials were present from past operations which were subsequently covered with sediment, it might be observed in the core samples. Core samples were taken with a 3.8 centimeter diameter by 61 centimeter long plastic tube. A diver pushed the tube into the sediment as far as possible and capped the ends. Core samples were collected at locations 34, 35, 36, and 37 shown in Figure 2. At the laboratory the cores were frozen and cut into 2.5 cm sections. The individual sections were



Sampling Locations
Figure 2

freeze-dried and counted on a Ge(Li) or intrinsic germanium detector to determine gamma emitting radioisotopes. The minimum detectable activity for cobalt-60 in the geometry is approximately 0.1 pCi/g.

Water samples were collected at two locations in the harbor (1 and 28) and from two public drinking water supplies (32 and 33). These samples were analyzed for gamma emitters (especially Co-60) and for tritium. The minimum detectable activity for tritium in water is 200 pCi/l.

Aquatic life samples were collected at 4 locations during the survey. Oysters collected at locations 34, 38, and 39 were the only marine samples available. Unfortunately upon opening the shells at the EERF, no oysters were inside. A vegetation sample was collected at site 29. At the laboratory the vegetation was dried and counted in a Ge(Li) or intrinsic germanium detector for 1000 minutes.

A shoreline gamma radiation survey was made using portable scintillation survey instruments that were periodically calibrated with a high pressure ionization chamber. All measurements were made 1 meter above the ground. The surveys were made on accessible shorelines in the KBSSF area and in publicly accessible areas nearby.

Results and Discussion

Harbor bottom sediment sampling was the most extensive since past surveys have shown that if radioactivity had been released it usually would be detectable in the sediment. Samples were collected at 31 locations. No cobalt-60 or other gamma emitting nuclides from nuclear-powered warship operations were found in any of the samples. Only naturally occurring nuclides and trace quantities of cesium-137, typically fallout from previous worldwide nuclear weapons testing, were found in the samples.

Core samples collected at 4 locations were analyzed for gamma emitting radionuclides. None of the sections from any of the cores contained radionuclides other than naturally occurring and trace amounts of cesium-137.

Both water samples collected in the bay had tritium levels below the minimum detectable level of 200 pCi/l. Potassium-40, a naturally occurring radionuclide, was the only gamma emitting nuclide detected. Data are shown in Table 1. No detectable radioactivity was found in the drinking water samples from the water supplies of KBSSF and Kingsland, GA as shown in Table 2.

As noted previously, oyster samples collected were not suitable for analysis. A vegetation sample collected at location 29 had no detectable radioactivity other than naturally occurring nuclides. Data are presented in Table 3.

Data from the shoreline gamma radiation survey are summarized in Table 4 and Figure 3. No radiation levels above normal background which could be attributable to radioactivity associated with nuclear-powered warships could be detected. Only naturally occurring radiation was found; however, a shoreline area that was stabilized with stone did have radiation levels above the general background level. This is because this stone, which appears to be large pieces of granite, contains higher levels of naturally occurring radioactivity than the surrounding terrain. This stabilized shoreline area is not accessible to the general public and is not a health or environmental concern. A previous survey of the Kingsland, Georgia area was conducted in 1968, prior to operation of the KBSSF (Le68). Gamma radiation levels at the time of that survey averaged 9.2 μR/hr. The average radiation levels measured by EPA, except for the stone-stabilized shoreline, agree with this previously reported level.

Table 1
Results of Bay Water Analyses

Location	Radionuclide	Activity (pCi/L) ± 2 sigma error
KBW 1	K-40	260 ± 58%
KBW 28	K-40	270 ± 22%

Table 2
Results of Drinking Water Analyses

Location	Radionuclide	Activity (pCi/L) ± 2 sigma error
KBW 32 (KBSSF drinking water)	All	N.D.
KBW 33 (Kingsland, GA drinking water)	All	N.D.

N.D. - all radionuclides below detectable limits.

Table 3
Results of Vegetation Sample Analyses

Location	Radionuclide	Activity (pCi/g)[a] ± 2 sigma error
KBV 29	K-40	7.5 ± 8%
	Pb-214	.87 ± 8%
	Bi-214	.84 ± 10%
	Ra-226	1.0 ± 45%

[a]Activity per gram dry weight.

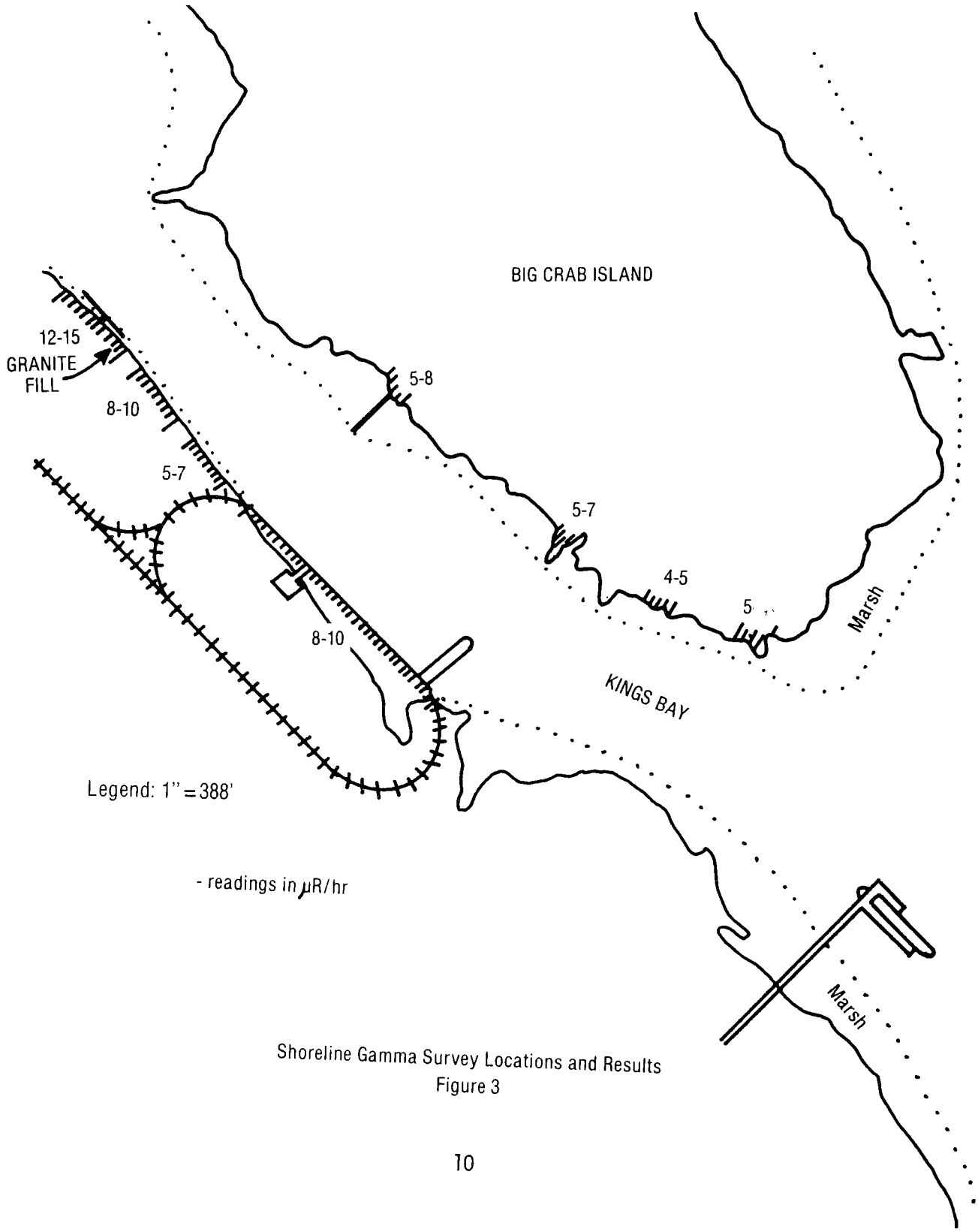
Table 4
Shoreline Radiation Measurements[a, b]

Location	Exposure μR/hr
- Near site 31 shoreline	5
- Between sites 30 and 31	4-5
- Near site 30 shoreline	5-7
- Near site 29 shoreline and toward 30	5-8
- Along pier between sites 43 and 18	8-10
- Shoreline NW of site 18 on unstabilized shore	5-10
- Shoreline stabilized with stone SE of new "T" pier	12-15[c]

[a]Survey was made while walking so the range values represent the least and greatest values encountered.

[b]Readings include background and were made at nominal high tide.

[c]As noted in the text, the stone contains higher levels of natural radioactivity than the surrounding terrain.



Shoreline Gamma Survey Locations and Results
Figure 3

Conclusions

The radiological survey of the Kings Bay Submarine Support Facility provided the basis for the following conclusions.

1. Only radionuclides of natural origin plus trace quantities of Cs-137 from previous nuclear weapons testing were found in any of the samples. No Co-60 or H-3, radionuclides associated with nuclear-powered warship operation, were found in any of the samples.

2. The only shoreline gamma radiation levels which were elevated above the local natural background resulted from stone which had been brought in to stabilize the shoreline. The stone contains levels of natural radioactivity slightly greater than the local terrain.

3. Bay water and drinking water samples contained no detectable levels of radioactivity other than naturally occurring.

4. Based on this survey, operations related to nuclear-powered warship activities at Kings Bay have resulted in no detectable increases in radioactivity that would result in significant population exposure or contamination of the environment.

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