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COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY (CLEAN II)
Northern and Central California, Nevada, and Utah
Contract No. N62474-94-D-7609
Contract Task Order No. 0022

Prepared For

DEPARTMENT OF THE NAVY
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Naval Facilities Engineering Command
San Bruno, California

Radiation Survey and Field Sampling Work Plan
Naval Air Station, Alameda, California

FINAL

December 1996

Prepared By

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Naval Air Station Alameda, California

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Health and Safety Plan Approval

PRC Approvals		Date
Conrad I. Sherman, CHP, CSP, CIH No. 4133 Health and Safety Program Manager (HSPM):	Conrad I. Sherman	12/24/96
Duane Balch Installation Coordinator:	Duane C. Balch	12/24/96

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1.0 INTRODUCTION

On June 22, 1995, PRC Environmental Management, Inc. received Contract Task Order (CTO) No. 0022 from the Naval Facilities Engineering Command, Engineering Field Activity, West (EFA West) under Comprehensive Long-Term Environmental Action Navy (CLEANII) Contract No. N62474-94-D-7609. CTO 0022 directed PRC to prepare this work plan for conducting radiological surveys at NAS Alameda under Task 4 of the statement of work. This document describes the field work to be performed to characterize radioactive contamination at several locations at NAS Alameda.

1.1 PURPOSE

The purpose of this work plan is to describe the field procedures and analytical methods that will be used to conduct a radiological investigation at various suspect locations at NAS Alameda. To the extent practicable, the radiological investigation will develop data to (1) confirm or refute the existence of radioactive materials in concentrations greater than background, (2) determine the degree of contamination, and (3) identify potential hazards related to exposure to such materials at NAS Alameda.

This work plan describes the procedures that PRC will use to identify and locate low level radioactive materials and contamination at several locations at NAS Alameda. The locations include the following:

- Frequently occupied areas within Sites 1 and 2
- Interior rooms of Building 5 and associated drain lines and storm sewer Line F
- Interior rooms of Building 400 and associated drain lines and storm sewer Line FF
- Storm sewer line R
- Location of a reported release at Pier 3
- Location of a former radioactive waste storage shack near the Site 2 landfill
- Ramp 1 of the Seaplane Lagoon and Parking Apron 4 adjacent to Ramp 1

The objectives for each location are as follows:

- Northwest point area of Site 1 and the jogging trail that passes through Sites 1 and 2

  - Identify and semi-quantify all near-surface radiological hazards or areas of activity which are significantly above site-specific background levels

  - If practicable, remove near-surface radiological hazards using hand excavation tools

  - For sub-surface radiation sources which are identified but cannot be removed within the restrictions of this work plan, refer the locations to the Navy for the evaluation of administrative controls to restrict access

- Pier 3

  - Confirm or refute the existence of a previously documented location of elevated beta activity

  - If identified, semi-quantify the beta activity and determine the boundary of the affected area

- Building 5

  - Survey rooms that are potentially contaminated with radium-226 (affected rooms) and identify areas of activity which are significantly above site-specific background levels

  - Survey the building drain lines and the storm sewer drain line associated with the affected rooms for radium-226 and identify areas of activity which are significantly above site-specific background levels

- Building 400

  - Survey the equipment currently residing in the affected rooms and, if possible, remove or isolate any radium-226 found

  - Survey affected rooms for radium-226 and identify areas of activity which are significantly above site-specific background levels

  - Survey the building drain lines associated with the affected rooms for radium-226 and identify areas of activity which are significantly above site-specific background levels

- Survey the storm sewer drain line associated with Building 400 for radium-226 and identify areas of activity which are significantly above site-specific background levels

- Ramp 1 and adjacent Parking Apron 4

    - Survey these areas, which lie behind Building 400 along the northwest edge of the Seaplane Lagoon, for radium-226 and identify areas of activity which are significantly above site-specific background levels

The surveys for Building 400 will be final surveys conducted to release the property for unrestricted use. Limited cleanup of the radium-affected rooms within Building 400 was performed in 1980 (U.S. Navy 1980); however, a detailed survey is needed to verify that any residual radioactivity found is below removal guidelines. The extent of the previously documented alpha contamination within Building 5 and the associated storm sewer lines has not been assessed. Therefore, the surveys for Building 5 and the associated storm sewer lines are designed to characterize the extent of contamination. Although the associated storm sewer lines that empty into the Seaplane Lagoon are suspected of being contaminated with radium-226, no investigation will be made of the sediments in the Seaplane Lagoon within the scope of this work plan. The sediments in the Seaplane Lagoon will be investigated for chemical and radiological contamination under CTO 014.

During the surveys and where practicable, PRC personnel will remove sources of low level contamination and place associated wastes in an appropriate radioactive waste storage container. Where PRC finds areas of elevated radioactivity for which removal is impractical, PRC will recommend postings of locations at which public doses of 100 millirems per year (based on an occupational occupancy of 2,000 hours per year) could be exceeded. The Navy will review these recommendations and base its final posting decisions on internal Navy criteria, worker and public occupancy factors, and other criteria.

1.2 PROJECT PERSONNEL

The following is a list of PRC and Navy personnel, and NAS Alameda points-of-contact for this project.

PRC Personnel	Office Phone	Field Phone
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NAS Alameda Points-of-Contact	Office Phone
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1.3 SITE BACKGROUND

Radioactive contamination and buried radioactive materials have been identified at several locations at NAS Alameda, including drain lines and landfill soils (PRC 1996). Several other areas are suspected of being contaminated with radioactive material. The suspect radioactive contaminants of concern for this survey are radium-226 and strontium-90. Radium-226 is a component of radioluminescent paint, which was commonly used, stored, and disposed of at NAS Alameda. To a lesser extent, strontium-90 was also used in radioluminescent paints that may have been disposed of on site.

Radioluminescent paints are a combination of phosphorescent compounds and radioactive isotopes mixed into a paint base. The interaction of the radioactive particles with the phosphorescent compound prompts the emission of a small but constant source of light. This type of paint was used to enhance low-light visibility of indicator needles, knobs, gunsites, and numerals on gauges, and on metal deck markers that lined the edges of ship decks. These deck markers were used to preserve the crew's night vision and provide uninterrupted lighting.

The following sections describe the operational history of the survey locations as it relates to radiological concerns.

1.3.1 Site 1 and Site 2 Landfills

The Navy has used Sites 1 and 2 at NAS Alameda for disposal of industrial and municipal waste. Radioactive materials may have been a minor component of the industrial waste that was disposed of in the landfills. During a previous radiological survey of the Site 1 and Site 2 landfills, several near-surface sources of radium-226 were located and other areas of increased radioactivity related to radium-226 sources were identified (PRC 1996). The previous survey covered only a 20-meter-square grid that represented approximately 10 percent of the surface area of the sites (Figures 1 and 2). Because of these findings and the small percentage of area that was surveyed, a more thorough investigation of areas frequented by NAS Alameda personnel is necessary. These areas requiring further investigation are (1) the northwest point of Site 1, (2) the jogging trail that

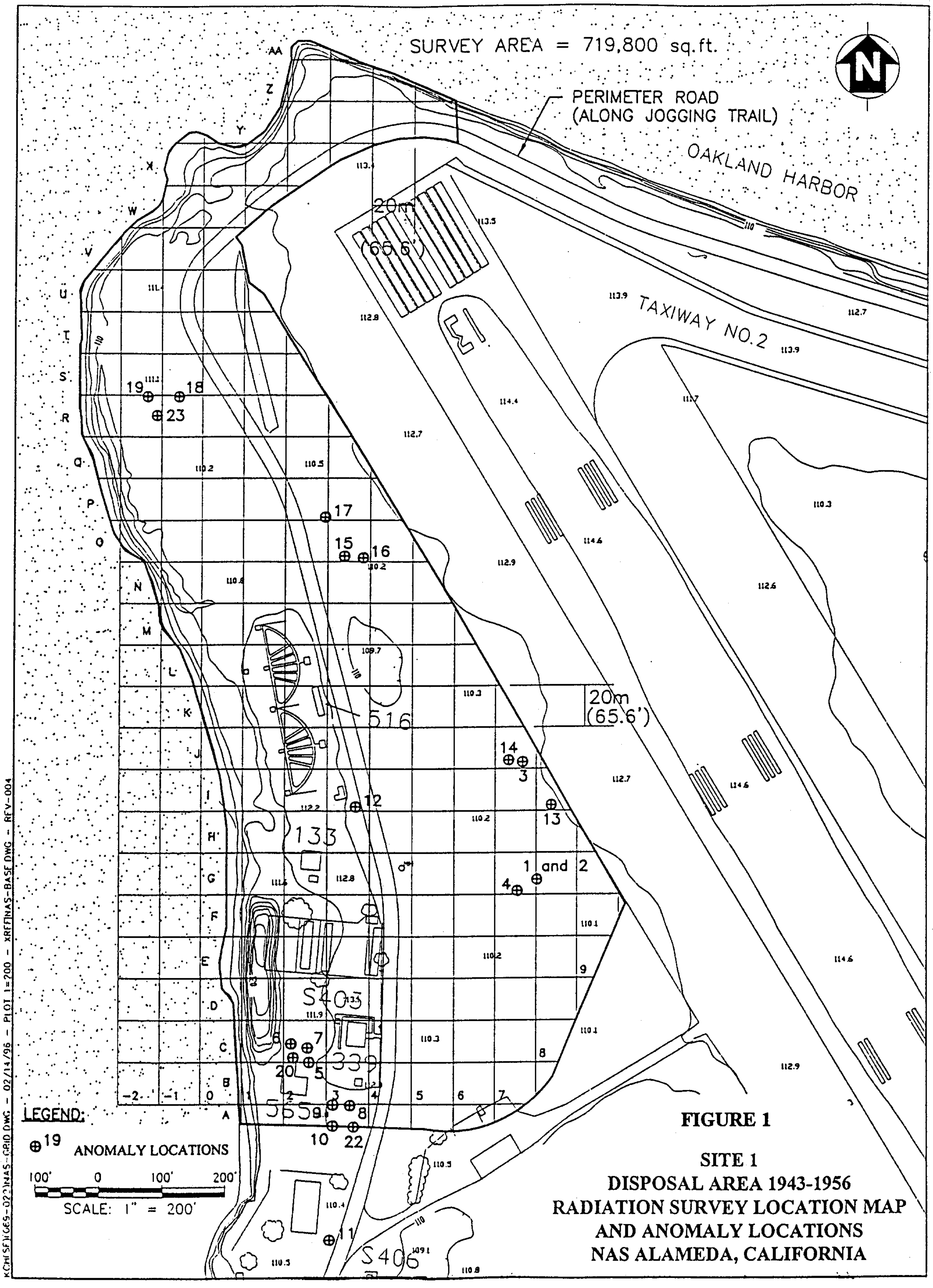

FIGURE 1

SITE 1
DISPOSAL AREA 1943-1956
RADIATION SURVEY LOCATION MAP
AND ANOMALY LOCATIONS
NAS ALAMEDA, CALIFORNIA

FIGURE 2

SITE 2
WEST BEACH LANDFILL
RADIATION SURVEY LOCATION MAP
AND ANOMALY LOCATIONS
NAS ALAMEDA, CALIFORNIA

runs through Site 1, and (3) the jogging trail in Site 2, which runs atop and immediately outside the berm that surrounds the landfill.

1.3.2 Building 5 and Building 400

The following areas are known or suspected to contain radioactive contamination: (1) The Bearing Shop in Building 5, (2) the Small Parts Paints Shop in Building 5, and (3) Rooms 203, 204, 210, and 213 in Building 400. (Attachment A provides a detailed description of the locations of the Bearing Shop and the Small Parts Paint Shop within Building 5). Radium was processed and radioluminescent paints were stored or used in some or all of these areas. PRC will survey these areas to identify the presence and extent of fixed and removable surface radium contamination. Equipment and fixtures in the affected rooms of Building 400 will also be surveyed so that they may be removed from the areas if they are free of contamination. All equipment must be surveyed and removed from the affected rooms in Building 400 in order to perform the room surveys which require 100 percent coverage of the floor areas and up to 2 meters in height on the walls.

Site history suggests that radium-containing paints were disposed of in industrial waste sinks and possibly other plumbing fixtures in Building 5, which emptied into the storm sewer drainage system. At one time, the building drain line servicing the Bearing Shop on the second floor of Building 5 was connected directly to storm sewer line F, which empties into the Seaplane Lagoon. The drain line in Building 5 starts above the Small Parts Paint Shop where it previously serviced several industrial waste sinks in the Bearing Shop. (The Bearing Shop is believed to have been a radium paint shop in the 1950s). In the process of redirecting the flow of these sinks to the sanitary sewer system, the drain line was found to be contaminated with radium-226 (U.S. Navy 1995a). It is suspected that the sinks were used as a disposal location for radium-containing paint waste. Figures 3 and 4 present diagrams of the contaminated drain lines in Building 5.

Radioluminescent paints were stored or used in Rooms 203, 204, 210, and 213 of Building 400. PRC has confirmed that low level radium contamination exists on several work tables and in cabinet drawers in Rooms 203, 210, and 213. Several drain lines associated with Rooms 203, 204, and 213 are known to be connected to the industrial waste drainage system. Although no known

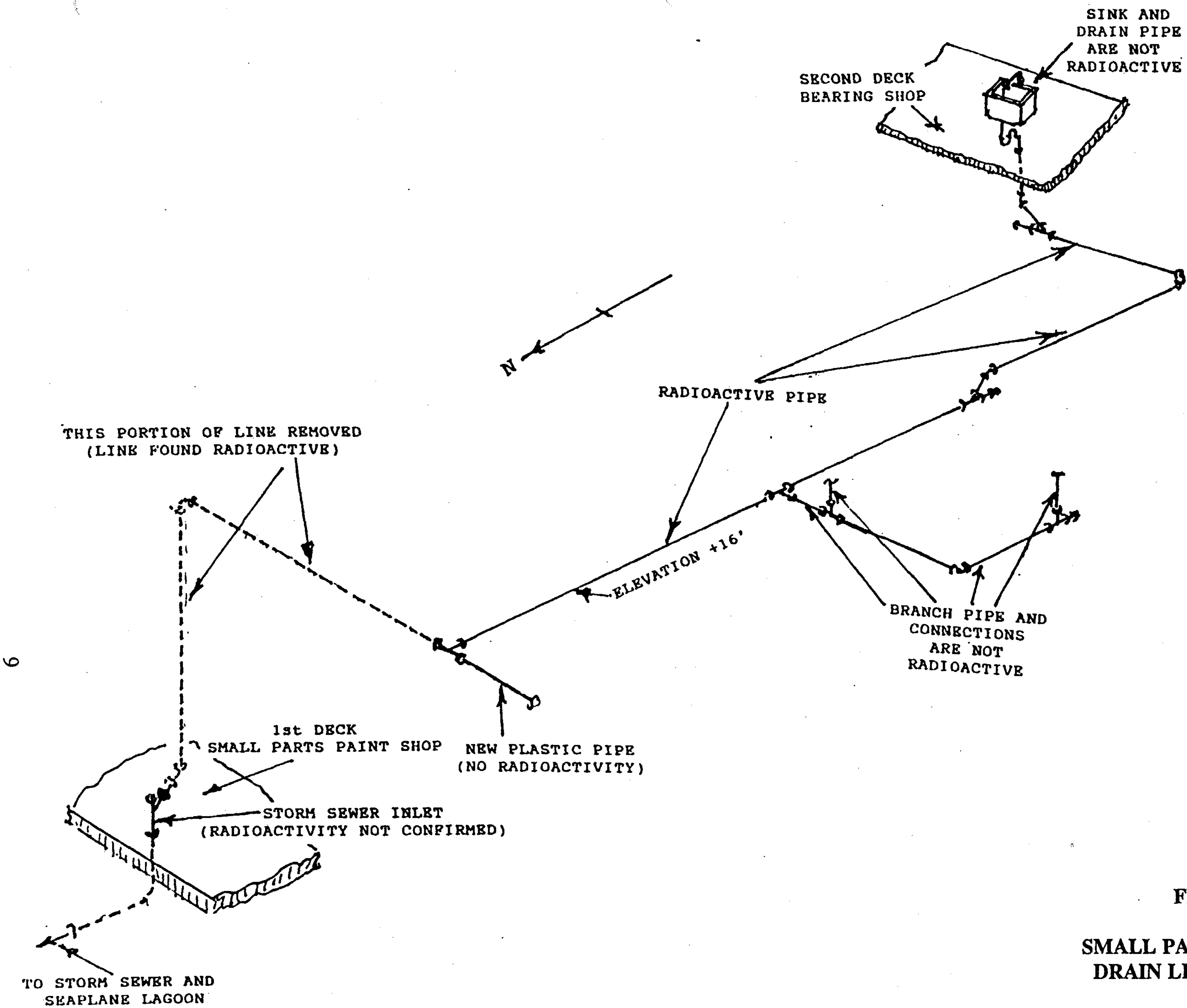

FIGURE 3

SMALL PARTS PAINT SHOP
DRAIN LINE, BUILDING 5

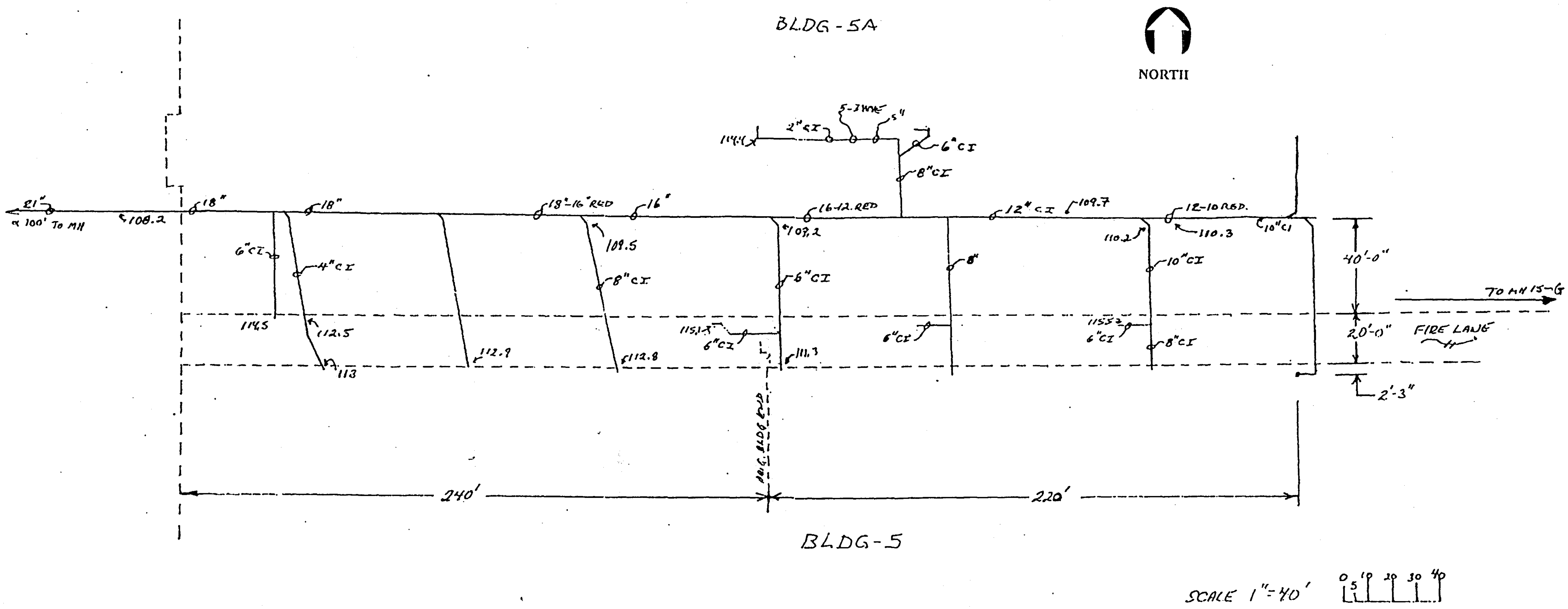

FIGURE 4

DRAIN LINE
BUILDING 5

releases have occurred in any of these drain lines, they will be investigated. The women's restroom (Room 214), men's restroom (Room 211), and a janitor's closet are located next to Room 210. The plumbing fixtures in the restroom facilities are connected to the sanitary sewer system. As at other Navy facilities where radium painting was performed, it is suspected that personnel may have disposed of radium-containing paint waste in the sinks and toilets within these facilities. Although no known releases have occurred in any of these fixtures, they will also be investigated. Figures 5 through 7 present diagrams of the above listed rooms and associated drain lines within Building 400.

1.3.3 Storm Sewer Line FF

Storm sewer line FF associated with Building 400A (hanger portion of Building 400) is also suspected of being contaminated with radioactive materials (Kinnetic Laboratories Incorporated [KLI] 1996 and Radian Corporation [Radian] 1996). This storm sewer line services a water collection trough within Building 400A, which runs along the south side of the interior building wall. Four roof drains, located on the south side of Building 400A, also connect to this water collection trough. Although no known releases of radioactive contamination have occurred in the roof drain lines or the water collection trough that connect to this storm sewer line, a previous perfunctory survey of the interior of the manhole in this section of storm sewer piping showed elevated activity (KLI 1996 and Radian 1996). Figure 8 presents a diagram of the Building 400A drain lines.

1.3.4 Storm Sewer Line R

Storm sewer line R is also suspected of being contaminated with radioactive material. Although no known releases of radioactive material have occurred in the drain lines or storm sewer drains that connect to this line, a previous perfunctory survey of the interior of one of the manholes in this section of storm sewer piping showed elevated activity (KLI 1996 and Radian 1996). Figure 9 presents a diagram of storm sewer lines F, FF, and R.

NADEP Alameda
Building 400 - Second Deck

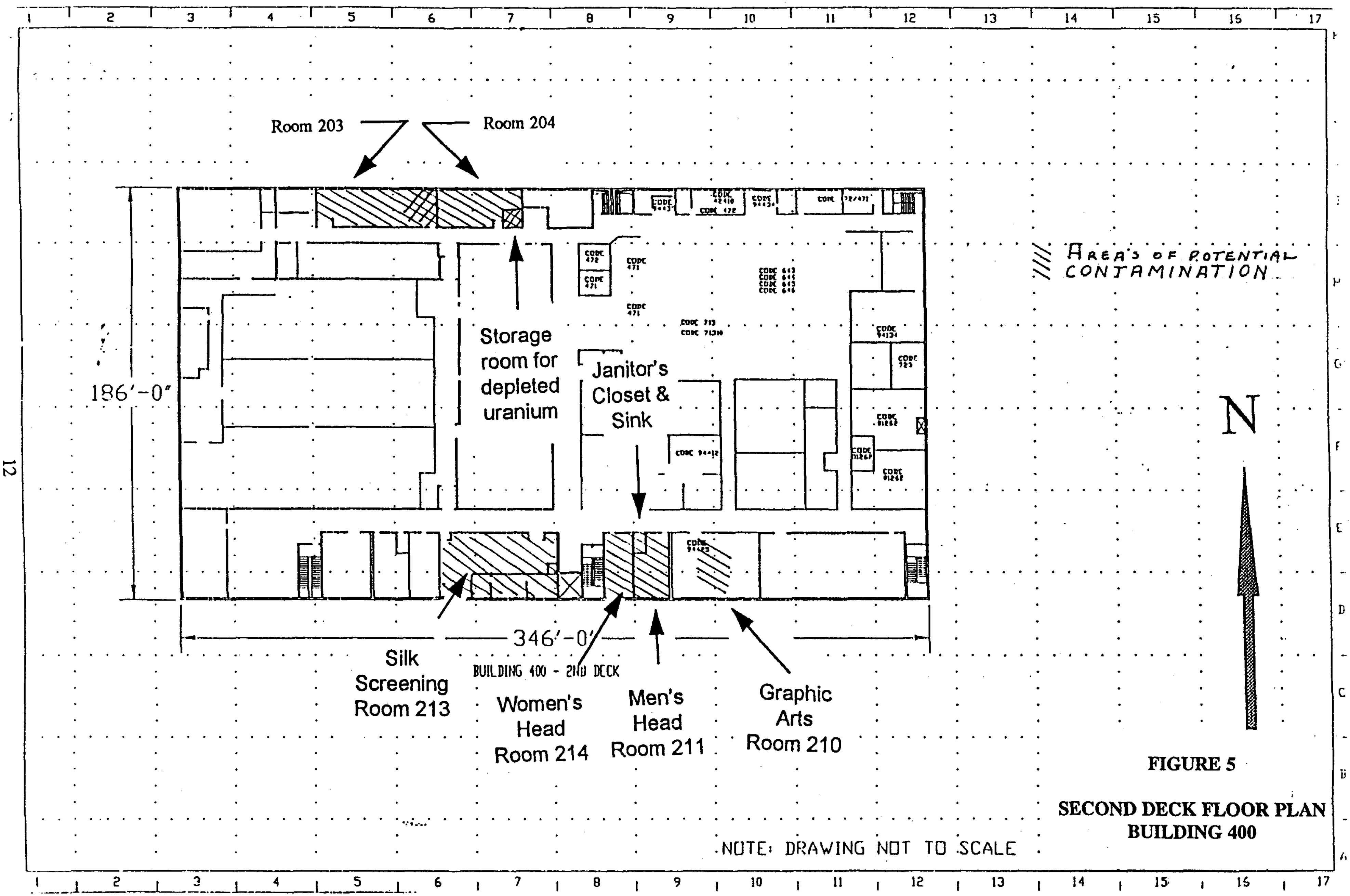

FIGURE 5

SECOND DECK FLOOR PLAN BUILDING 400

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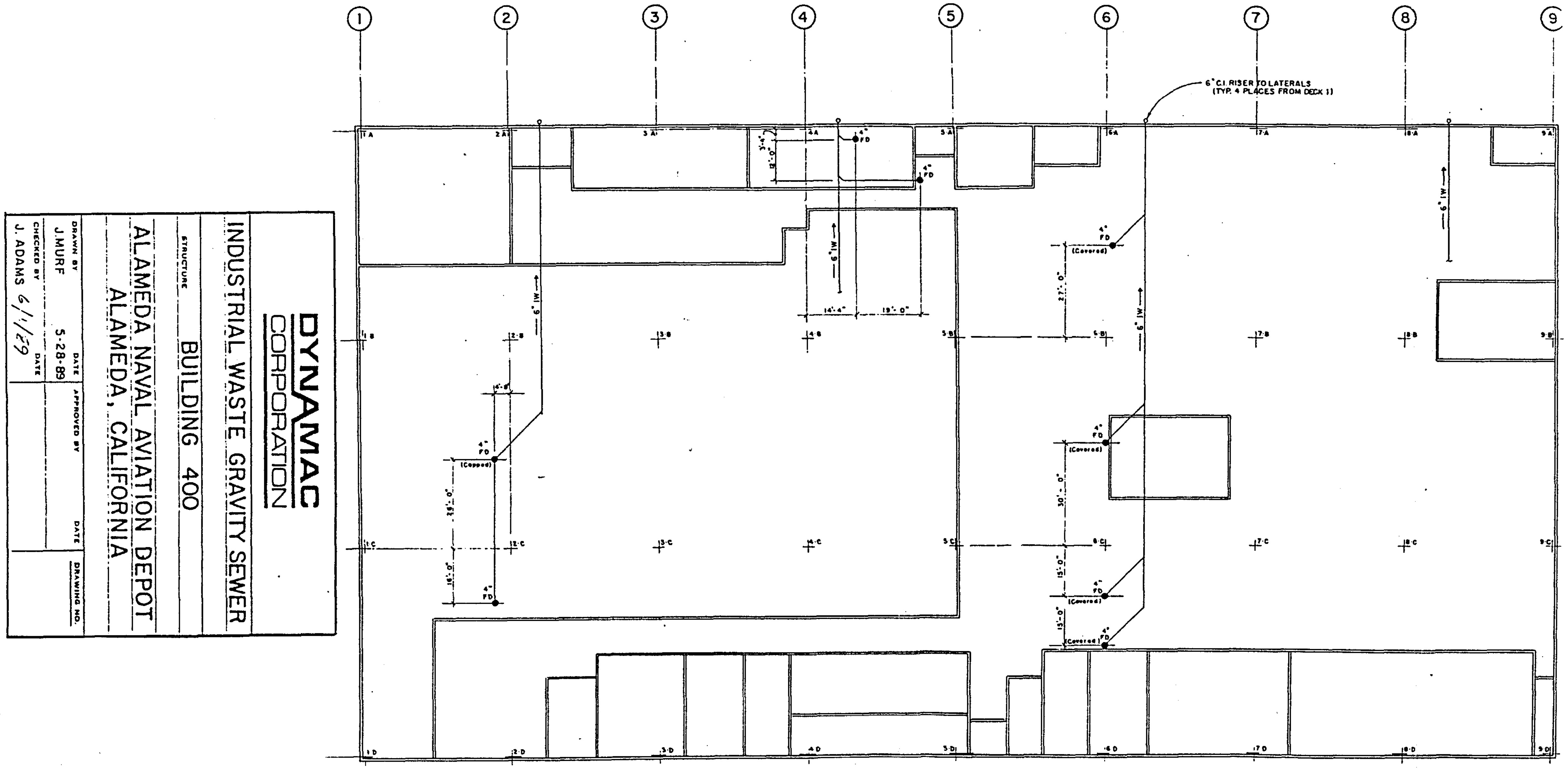


FIGURE 6

INDUSTRIAL WASTE GRAVITY SEWER
SECOND DECK, BUILDING 400

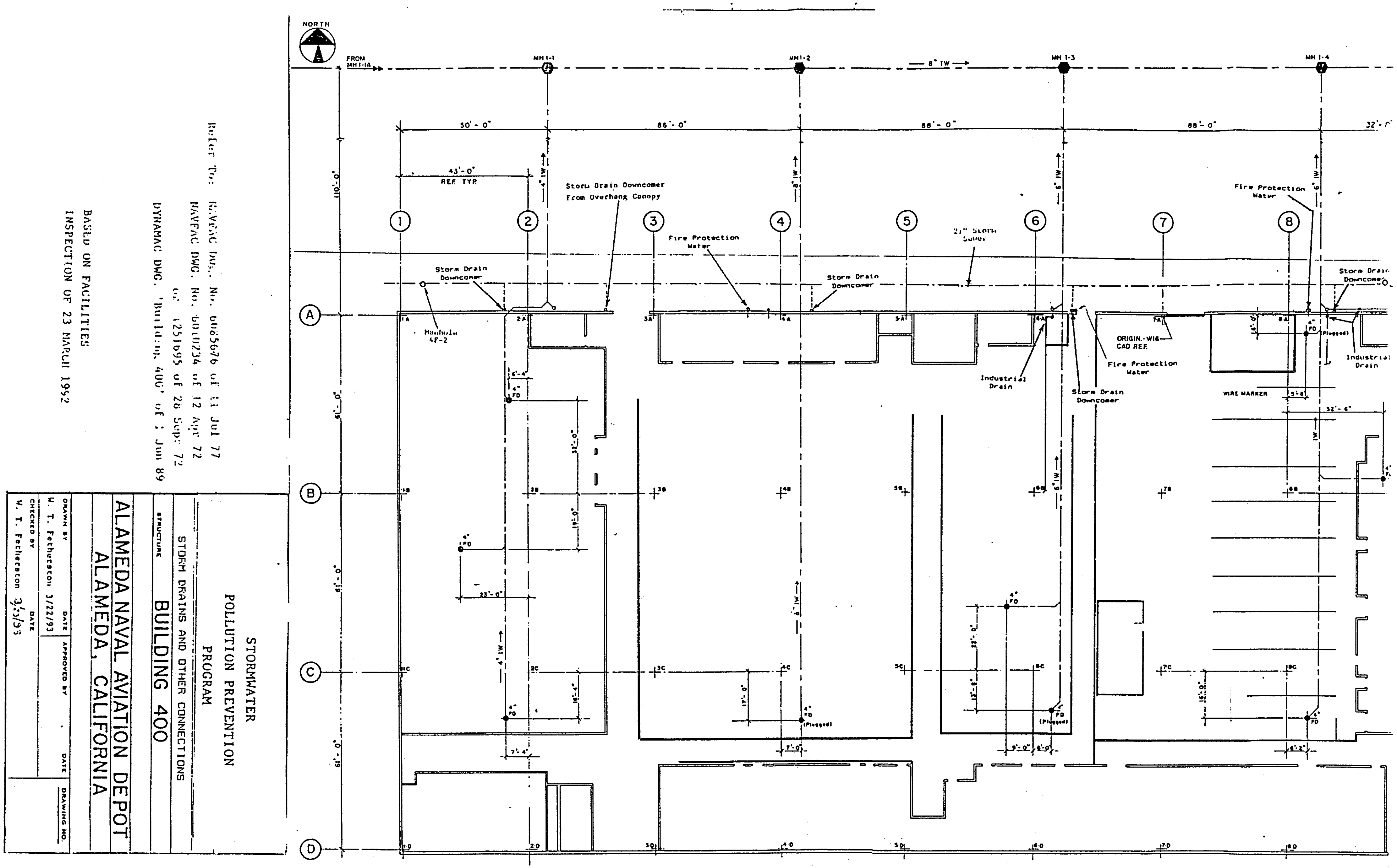


FIGURE 7

INDUSTRIAL WASTE GRAVITY SEWER
FIRST DECK, BUILDING 400

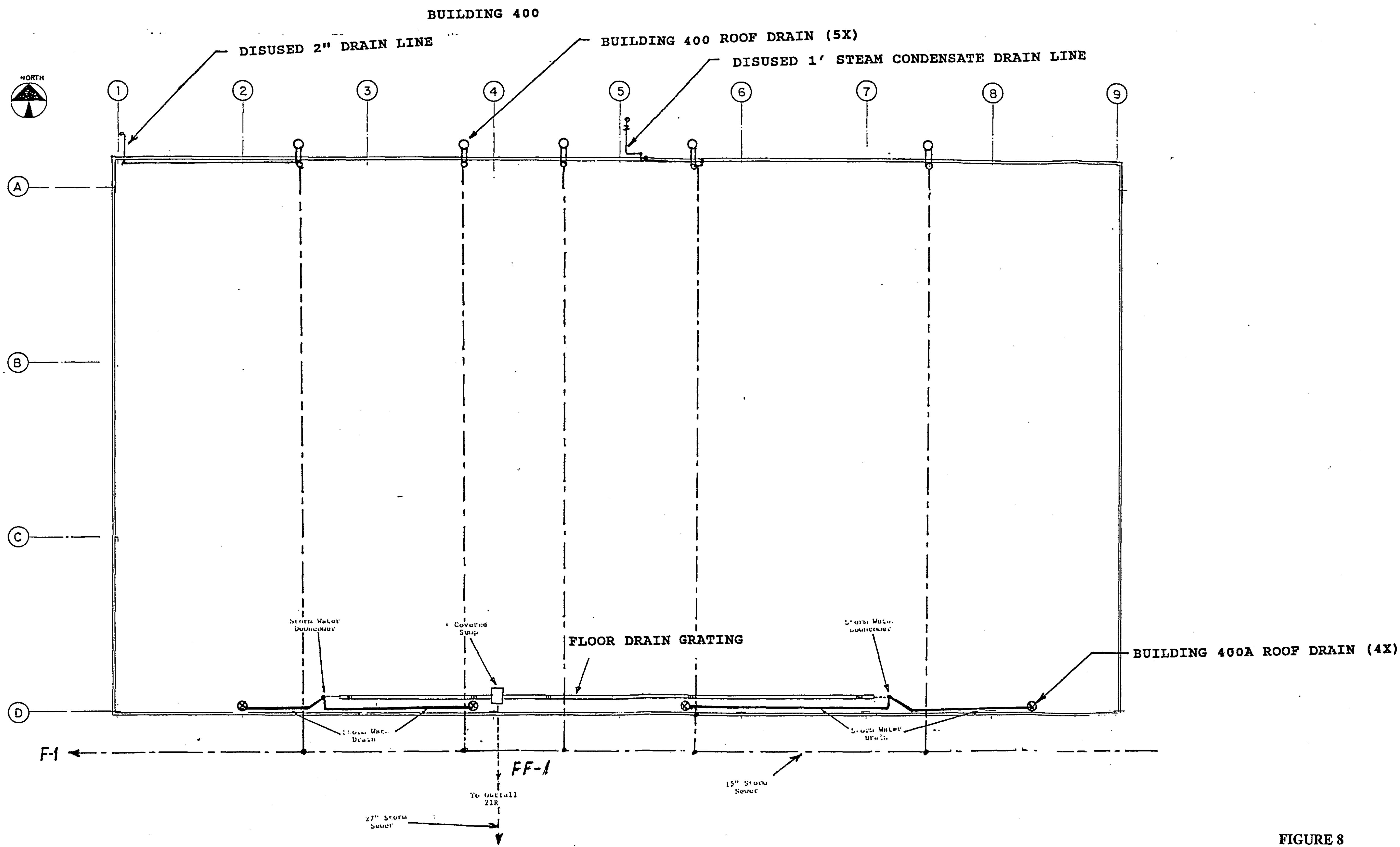


FIGURE 8

STORM SEWER LINES
HANGER AREA
BUILDING 400A

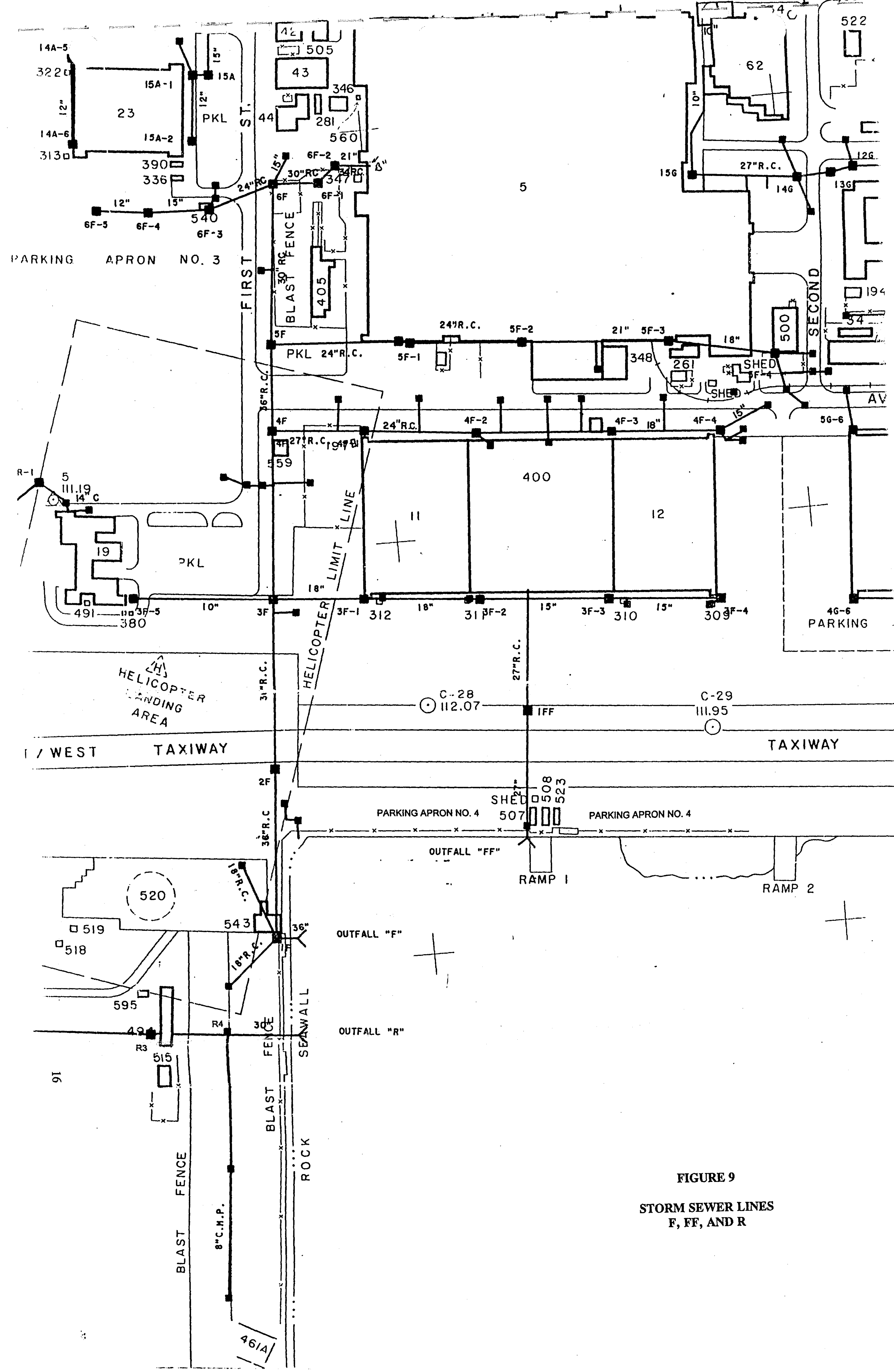


FIGURE 9

STORM SEWER LINES F, FF, AND R

1.3.5 Pier 3 Strontium-90 Release

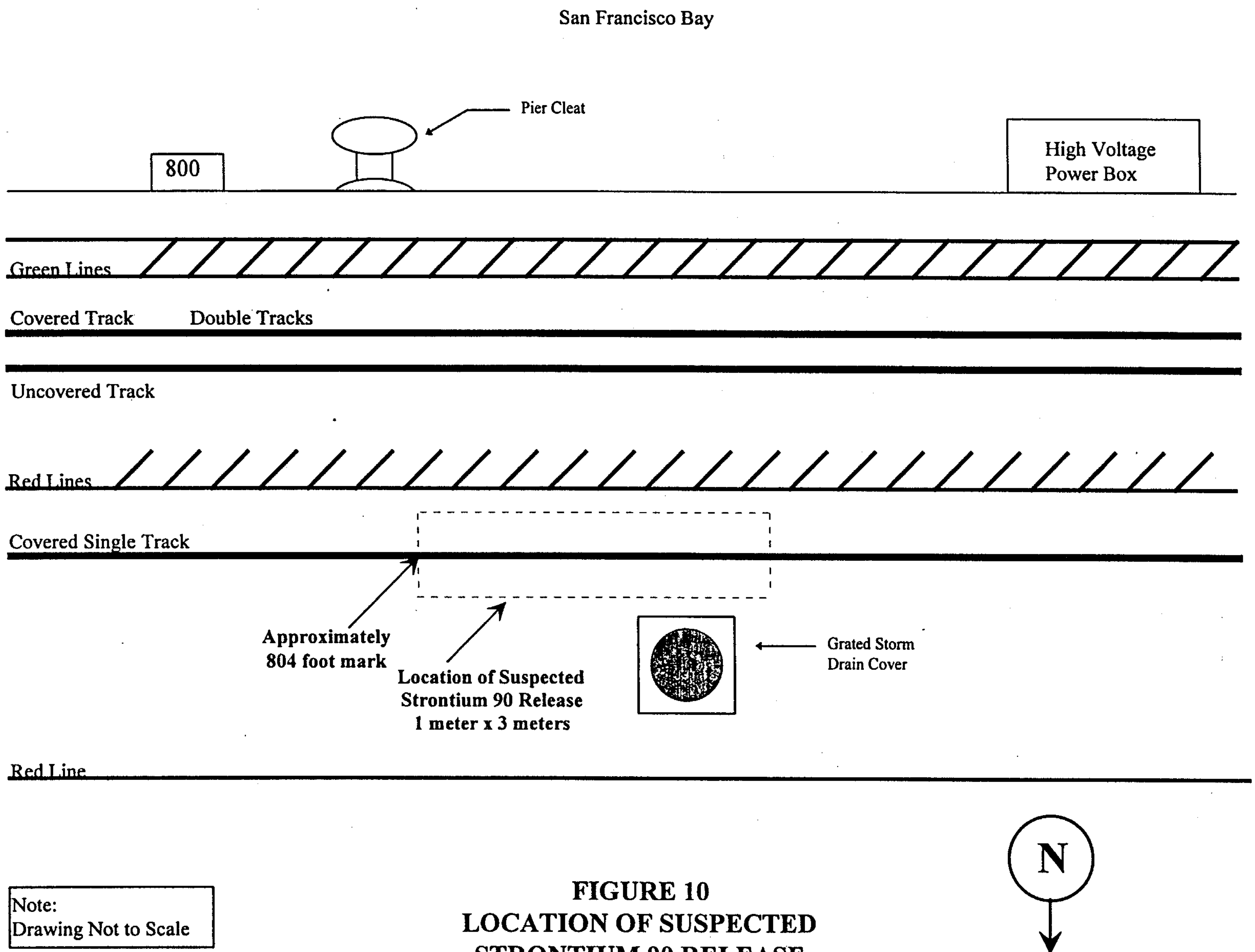
Contamination is suspected on Pier 3 because of a reported strontium-90 release. Figure 10 shows the suspected release point being near the 800-foot mark, approximately 30 feet from the outside edge (south side) of the pier, as identified by Navy personnel in 1991 (U.S. Navy 1991). According to Navy personnel (PRC 1995d), the source of the release may have been a crushed deck marker coated with paint which contained strontium-90.

1.3.6 Radioactive Waste Storage Shack

The Radioactive Waste Storage Shack was used to store radioactive waste materials. The shack was located within a 14- by 16-foot cyclone fence inside Site 2. A previous survey of the shack and the immediate surrounding area established the presence of radium dials buried just below the ground surface (U.S. Navy 1995b). The shack was dismantled in 1995 and the building materials disposed of off base. The fence posts remain and will serve as the area boundary. PRC will survey the surface of the site for radium-226 contamination. Gamma exposure rates will also be measured and evaluated.

1.3.7 Ramp 1 and Parking Apron 4

Ramp 1 of the Seaplane Lagoon and adjacent parking apron 4 (which lie directly behind Building 400, along the northwest border of the Seaplane Lagoon) are areas suspected to have been impacted by the release of radioluminescent paints containing radium-226 (see Figure 9). The paints are suspected of being dumped into the Seaplane Lagoon near these areas. These areas will be surveyed for radium-226 contamination that may be fixed on, or imbedded in, the ramp and parking apron surfaces. The survey will establish any external radiation hazards in these areas. PRC will also survey the beach area around ramp 1 and the supporting members of the ramp to the extent that the low tide allows.



Note:
Drawing Not to Scale

FIGURE 10
LOCATION OF SUSPECTED STRONTIUM 90 RELEASE
PIER 3, NAS ALAMEDA

1.4 RADIOLUMINESCENT COMPONENTS

Before the 1970s, most radioluminescent components used by the military contained radium-226 mixed into a phosphorescent paint base. A few components, such as ship deck markers, contained strontium-90. The light-emitting paint was applied to numerals and markers on some equipment so that they could be read in the dark.

Radium-226, which has a half-life of approximately 1,600 years, decays by emission of an alpha particle, with associated gamma emissions (principally a 186 kiloelectron volt [keV] transition with a 4-percent probability). However, radium-226 decay products emit gamma radiations that are more abundant and of higher energy, thereby permitting detection of radium sources. Where radioluminescent devices produce gamma radiation that can usually be detected if covered by less than 1 foot of soil, lead-214 and bismuth-214 are the primary gamma-emitting radium decay products.

The dials and illuminators that may have been disposed of at Sites 1 and 2 can have radiation activities that range from less than 1 microcurie (μCi), or 37,000 disintegrations per second (dps), to 25 μCi, or about 925,000 dps. The Navy Sea Systems Command Detachment, Radiological Affairs Support Office (RASO) suggests, however, that most of the sources should have an activity of about 1 μCi. In addition, these buried devices may corrode, thereby releasing radium-containing materials into the surrounding soil. It is possible that some soil in Sites 1 and 2 may contain elevated amounts of radium-226 and its decay products.

Strontium-90 was also used, to a limited extent, in radioluminescent instrumentation. It has a half-life of approximately 29 years and decays by the emission of a beta particle. According to Navy records, strontium-90 was used predominantly as a radioluminescent source in deck markers on ships. Unrelated to the radioluminescence of the deck markers, the interaction of the beta particles (electrons) with the high-atomic-weight steel housing of these devices produces bremsstrahlung radiation, which is similar to x-ray and gamma radiation. Detection of bremsstrahlung radiation during a radiation survey indicates the possible presence of a deck marker or other metallic device containing strontium-90. Previous investigations have shown that using a 2- by 2-inch sodium-iodide (NaI) gamma scintillation detector can detect bremsstrahlung radiation from a strontium-90 deck marker that is buried up to 12 inches (U.S. Navy 1994).

Strontium-90 sources unassociated with heavy metals are not likely to be present at Sites 1 and 2. If, however, strontium-90 were present below the ground surface in a form unassociated with heavy metals and not producing bremsstrahlung radiation, field survey instruments would not be likely to detect the contamination from the emission of strontium-90's beta radiation.

1.5 BACKGROUND RADIATION

Naturally occurring radiation sources in soils include, among others, uranium, thorium, and potassium isotopes. The soils at NAS Alameda include arkosic sands, clays, and silts. The predominant source of naturally occurring radioactive isotopes in these soils is the arkosic sand fraction, which contains feldspars, a natural source of gamma-emitting potassium-40. The arkosic sand fraction may also contain some granitic rock. Granitic rock contains small amounts of uranium isotopes that decay into other radioisotopes, including radium-226.

Other important sources of background radiation in soils are anthropogenic, or man-made. As the result of hundreds of atmospheric tests of nuclear weapons conducted primarily in the western United States, North Pacific Islands, China, and the former Soviet Union, cesium-137 and strontium-90 are man-made radioisotopes that are widely spread throughout the environment. The quantities of radioactive fallout material in soils depends on the extent of surface soil erosion or tilling since deposition, and can, therefore, vary widely from site to site.

Because of radioisotopes present in some construction materials, background radiation may also be present inside the buildings at NAS Alameda. This background radiation will vary from building to building, depending on the construction materials that were used.

2.0 RADIOLOGICAL SURVEY METHODS

PRC will use five radiation detection methods during the radiological surveys: (1) gamma exposure rate measurements, (2) gamma count rate measurements, (3) beta-gamma activity measurements, (4) fixed and removable alpha activity measurements, and (5) interior drain line characterization measurements. Sections 2.1 through 2.5 discuss these methods. Survey methods are outlined in Sections 6.4 and 6.5 of the U.S. Nuclear Regulatory Commission (U.S. NRC) guidance document "Manual for Conducting Radiological Surveys in Support of License Termination" (U.S. NRC 1993).

Background radiation levels for each detection method used at a site will be measured at appropriate unaffected locations identified within the survey area. For outside surface surveys, PRC will take background measurements near the survey location in an area that is unlikely to contain any radioactive materials at activities above background levels. These background measurements will be made on the same type of surface as the survey measurements (such as soil or concrete). PRC will establish background levels for room interiors and drain lines that are constructed of similar materials to the rooms and drain lines of interest.

2.1 MEASUREMENTS OF GAMMA EXPOSURE RATE

PRC will screen sites for low level gamma activity and determine whole-body human gamma exposure rates at anomaly locations using a micro-Roentgen exposure rate meter with a range of at least 0 to 5,000 micro-Roentgens (μR) per hour, such as a Ludlum Instruments Model 19 or equivalent. Although the response for the micro-Roentgen exposure rate meter varies with the radioisotope being detected, its use for screening sites and for determining whole-body human exposure rates is preferable in this survey because it provides rapid results in the field.

For site screening to detect low level gamma activity, the detector probe will be moved along a grid line in a serpentine pattern while advancing at a speed of about 0.5 meters per second. The distance between the surface and the probe will be maintained at less than 2 centimeters. For whole-body human gamma exposure rates, all measurements will be taken at 1 meter from the ground or floor surface. Whole-body human exposure rates typically provide information to assist in determining whether levels of gamma activity are within human exposure limits, as provided in Chapter 10 of the Code of Federal Regulations (CFR), Part 20, Standards for Protection Against Radiation.

2.2 MEASUREMENTS OF GAMMA COUNT RATE

PRC will use gamma count rate responses to determine whether specific areas exhibit activity levels that are significantly above site-specific background. Gross gamma count rates will be measured using a 2- by 2-inch NaI gamma scintillation detector system (a Ludlum Instruments Model 2221 rate/scaler analyzer coupled to a Ludlum Instruments Model 44-10 or the equivalent). This radiation detection system measures energies in the range of about 80 to 3,000 keV. This energy range includes gamma rays emitted by radium-226 and its decay products, and bremsstrahlung x-rays emitted by radioluminescent deck markers that contain strontium-90. The vendor will calibrate the instrument in a radium field and PRC will source-check it by using a 1 μCi cesium-137 reference standard source. The scaler gamma energy threshold will be set at 100, and the window function will be disabled.

PRC will take static measurements at each location. The counting time for each measurement will be 1 minute; background measurements will also be counted for at least 1 minute. For scanning measurements made with the 2- by 2-inch NaI gamma scintillation detector, the detector probe will be moved in a serpentine pattern while advancing at a speed of about 0.5 meters per second. The distance between the surface being measured and the probe will be maintained at less than 2 centimeters.

2.3 MEASUREMENTS OF BETA-GAMMA ACTIVITY

PRC will measure beta-gamma activity at the location of the suspected strontium-90 release by using a pancake-style Geiger-Müeler (G-M) beta-gamma detection system (a Ludlum Instruments Model 44-9, coupled to the Ludlum Model 2221 rate/scaler single-channel analyzer, or the equivalent). The detection sensitivity of this type of detection system is (1) about 2,000 to 3,000 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) for scanning measurements and (2) 500 to 1,000 dpm/100 cm^2 for static 1-minute counts. Sensitivity for this measurement can be increased by increasing the counting duration.

For the purpose of these measurements, the beta-gamma activity, expressed in disintegrations per minute per 100 square centimeters, is calculated by the following equation given in Section 8.1 of the guidance document (U.S. NRC 1993):

$$\frac{dpm}{100\ cm^2} = \frac{(c-B)}{t \cdot E}\frac{100}{A} \qquad (1)$$

where

c	=	total integrated counts recorded by the instrument (total counts)
B	=	counts resulting from background (background counts)
t	=	counting period (minutes)
E	=	detection efficiency (counts per disintegration)
A	=	active surface area of the detector probe (square centimeters)

The former U.S. Atomic Energy Commission (USAEC) established regulatory guidance concerning acceptable levels of surface activity (USAEC 1974). For strontium-90, the acceptable levels for total surface activity are (1) an average of 1,000 dpm/100 cm^2 over an area not greater than 1 square meter and (2) a maximum of 3,000 dpm/100 cm^2 in an area not greater than 100 square centimeters. Methods for comparing surface activity with guideline values are given in Section 8.5 of the guidance document (U.S. NRC 1993).

For beta radiations, which have limited ranges in air, the distance between the detector probe and the surface being measured will be maintained at less than 2 centimeters. The scan speed will not exceed one detector width per second. Calibration methods for beta-gamma count rate meters are discussed in Section 6.3.1

2.4 MEASUREMENTS OF ALPHA ACTIVITY

PRC will measure alpha activity on the interior surfaces of the rooms and equipment and fixtures in the rooms. A zinc sulfide (ZnS) alpha scintillation probe (Ludlum Instruments Model 43-65, or the equivalent) coupled to a rate/scaler single channel analyzer (Ludlum Model 2221, or the equivalent) will be used for these measurements. The detection sensitivity for this type of detector system is approximately (1) 200 dpm/100 cm^2 for scanning measurements and (2) 100 dpm/100 cm^2 for static 1 minute counts. Sensitivity for this measurement can be increased by increasing the counting duration.

For the purpose of these measurements, the alpha activity, in dpm/cm^2, is calculated by Equation 1 above. For surface swipe samples collected to measure removable contamination, the alpha activity is calculated by the following equation, which is stated in Section 8.1 of the guidance document (U.S. NRC 1993):

$$\frac{dpm}{100\ cm^2} = \frac{(c-B)}{t \cdot E} \qquad (2)$$

where

c	=	total integrated counts recorded by the instrument (total counts)
B	=	counts resulting from background (background counts)
t	=	counting period (minutes)
E	=	detection efficiency (counts per disintegration)

The "100/A" term from equation 1 has been dropped because the sample is collected from an area of 100 square centimeters.

The regulatory guidance (USAEC 1974) defines acceptable total surface radium-226 activity as (1) an average of 100 dpm/100 cm^2 over an area not greater than 1 square meter, and (2) a maximum of 300 dpm/100 cm^2 in an area not greater than 100 square centimeters. The acceptable activity for removable radium-226 contamination is 20 dpm/100 cm^2 from an area not greater than 100 square centimeters. Methods for comparing surface activity with guideline values are given in Section 8.5 of the guidance document (U.S. NRC 1993).

For alpha particle emissions, which have very limited ranges, the distance between the ZnS alpha scintillation probe and the surface being measured will be maintained at less than 1 centimeter. The scan speed will not exceed one-half of the probe width per second. Calibration methods for alpha scintillation detector systems are discussed in Section 6.3.1

2.5 CHARACTERIZATION MEASUREMENTS OF DRAIN LINE CONTAMINATION

To characterize the extent of radium-226 contamination in the drain lines originating in suspect areas of Buildings 5 and 400, PRC will employ the services of a subcontractor that possesses the technology to perform surveys within the interior of drain lines and pipes. The subcontractor will utilize a gamma scintillation detector to safely and effectively characterize radioactive contamination resulting from the presence of radium-226 in the drain lines. The technology applied will be capable of surveying lengths of pipe of up to 250 feet with diameters as small as 2 inches.

The subcontractor will also externally survey all exposed drain lines associated with the contaminated rooms within Building 400 using a 2-inch by 2-inch NaI gamma scintillation detector or equivalent.

2.6 MINIMUM DETECTABLE ACTIVITY

Minimum detectable activity (MDA) is a measure of the least activity that could be present and not be detected and is specific to each detection system. The MDA of a detection system is a function of the counting time, background count rate, detector efficiency, and the surface area of the detector probe.

PRC will calculate MDA for activity measurements for each detection system by using the following equations from the guidance document (U.S. NRC 1993). For rate/scaler detection systems (detectors that record an integrated measurement over a preset time) such as the NaI gamma scintillation detector, the pancake-style G-M beta-gamma detector, and the ZnS alpha scintillation detector, the MDA for outside or inside surface activity measurements can be approximated as follows:

$$MDA = \frac{2.71 + 4.65\sqrt{(B_R \cdot t)}}{t \cdot E \cdot \frac{A}{100}} \qquad (3)$$

where

MDA	=	minimum detectable activity (dpm/100 cm^2)
B_R	=	background count rate (counts per minute)
t	=	counting time (minutes)
E	=	detector efficiency (counts per disintegration)
A	=	active probe area (square centimeters)

The MDA of a rate meter instrument (such as the micro-Roentgen exposure rate meter) for surface activity measurements can be approximated by taking twice the time constant of the meter as the counting time and applying the following relationship:

$$MDA = \frac{2.71 + 4.65\sqrt{(B_R/2t_c)}}{t \cdot E \cdot \frac{A}{100}} \qquad (4)$$

where

MDA	=	minimum detectable activity (dpm/100 cm^2)
B_R	=	background count rate (counts per minute)
t_c	=	meter time constant (minutes)
E	=	detector efficiency (counts per disintegration)
A	=	active probe area (square centimeters)

3.0 TASKS

The radiological survey has been divided into the following tasks:

- Establish site-specific radiation background levels
- Survey specified areas of Sites 1 and 2
- Survey specified drain lines of Buildings 5 and 400 and associated storm sewer lines
- Survey specified areas of Buildings 5 and 400, including equipment and fixtures
- Survey suspected strontium-90 release point on Pier 3
- Survey the location of the former radioactive waste storage shack
- Survey Ramp 1 and adjacent parking apron 4 at the Seaplane Lagoon

The following sections describe how each of these tasks will be performed.

3.1 ESTABLISHING SITE-SPECIFIC RADIATION BACKGROUND

Before beginning any of the radiological surveys, PRC will determine an area-specific background count rate using instruments specific to each survey. The background survey area will depend on the radiological survey task; therefore, a background count rate will be determined for each task location. Background surveys will be taken in areas of the base unaffected by radiation and at locations having similar soil types or similar materials of construction.

PRC will determine background levels for gamma exposure rates, gamma count rates, and alpha count rates using methods and procedures outlined in the recent draft guidance document of the U.S. NRC, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys" (1995). Additional guidance was obtained from methods outlined in the guidance document for radiation surveys in support of license termination (U.S. NRC 1993).

When reporting survey results, PRC will report levels of radioactivity to be "above background" if the value (in counts per minute) is greater than the critical detection level (L_C), and "significantly above background" if the value (in counts per minute) is greater than the lower limit of detection (L_D). The L_C is the level at which there is a 5 percent chance of calling a background sample value "greater than background" (that is, the probability of a false positive). This value will be used when counting samples or making direct radiation measurements. Any response above the L_C will be considered above background (or a net positive result). The L_D is the level at which the smallest amount of radioactivity will statistically yield a net result above method background. (For a detection system, the L_D is equal to the MDA when the units are converted from counts per minute to disintegrations per minute per 100 square centimeters.) Any response above this level will be considered significantly above background. This will ensure a 95 percent detection capability for L_D. A 95 percent confidence interval will also be calculated for all responses greater than Lc. For a detailed explanation of how L_C, L_D, and MDA limits are determined, see Appendix A.

PRC will evaluate the health impact of radiation levels significantly above background, as required, on the basis of the intended use of the facility or location. The power of the statistical methodology is tested against the data needs. For example, to ensure that gamma exposure levels less than 50 μR per hour above background are distinguishable within the specified confidence level with a mean background of 10 mR per hour, the L_D must provide adequate sensitivity. Therefore, for a normally distributed background population with a mean gamma exposure rate of 10 mR per hour and a 20-percent standard deviation (s_b = 2.0) and a 95 percent confidence level, the L_D would equal 19 μR per hour.

3.2 SURVEY SPECIFIED AREAS OF SITES 1 AND 2

The areas to be surveyed within Sites 1 and 2 include (1) the northwest point of Site 1 and (2) the jogging trail that runs through Site 1 along Perimeter Road and the jogging trail in Site 2, which runs atop and next to the berm surrounding the landfill area. PRC will survey these areas because (1) they are uncontrolled and frequently used by site personnel, (2) near-surface sources were found nearby, and (3) the previous survey scanned only a small percentage of the areas. If PRC locates radioactive sources in an area and cannot readily recover them within the scope of this work plan, PRC will assist the Navy in preparing administration controls, such as the posting of warning signs, until removal or established controls can be implemented.

The previous survey of Sites 1 and 2 identified all anomalous sources as radium-226 (PRC 1996). No strontium-90 sources were identified. For the purpose of this survey, it is not necessary to determine the isotopic source of the anomalies that are detected. The surveys of the jogging trails and the northwest point area will only quantify external exposure to ionizing radiation and attempt to identify the locations of the near-surface radioactive sources.

3.2.1 *Site 1 Northwest Point*

The northwest point of Site 1 (Figure 11) is an area frequented by base personnel and visitors to the base. During the previous survey, anomalies were identified in the area near the shore; however, only a small percentage of this area was surveyed. Because base personnel frequently use the area, the area was recommended for a more thorough survey (PRC 1995e).

The northwest point survey area will be the region north of transect Q and east of Perimeter Road, which is an area of approximately 12,800 square meters. The survey area will include the locations of anomalies 18, 19, and 23 of the previous survey (PRC 1996) conducted southeast of the northwest point shoreline. For convenience, PRC may divide the survey area into smaller regions. PRC will establish a 1-meter grid for the survey.

PRC will conduct the walkover survey for low level gamma activity by using the micro-Roentgen exposure rate meter, at a pace of about 0.5 meter per second. The surveyor will sweep the

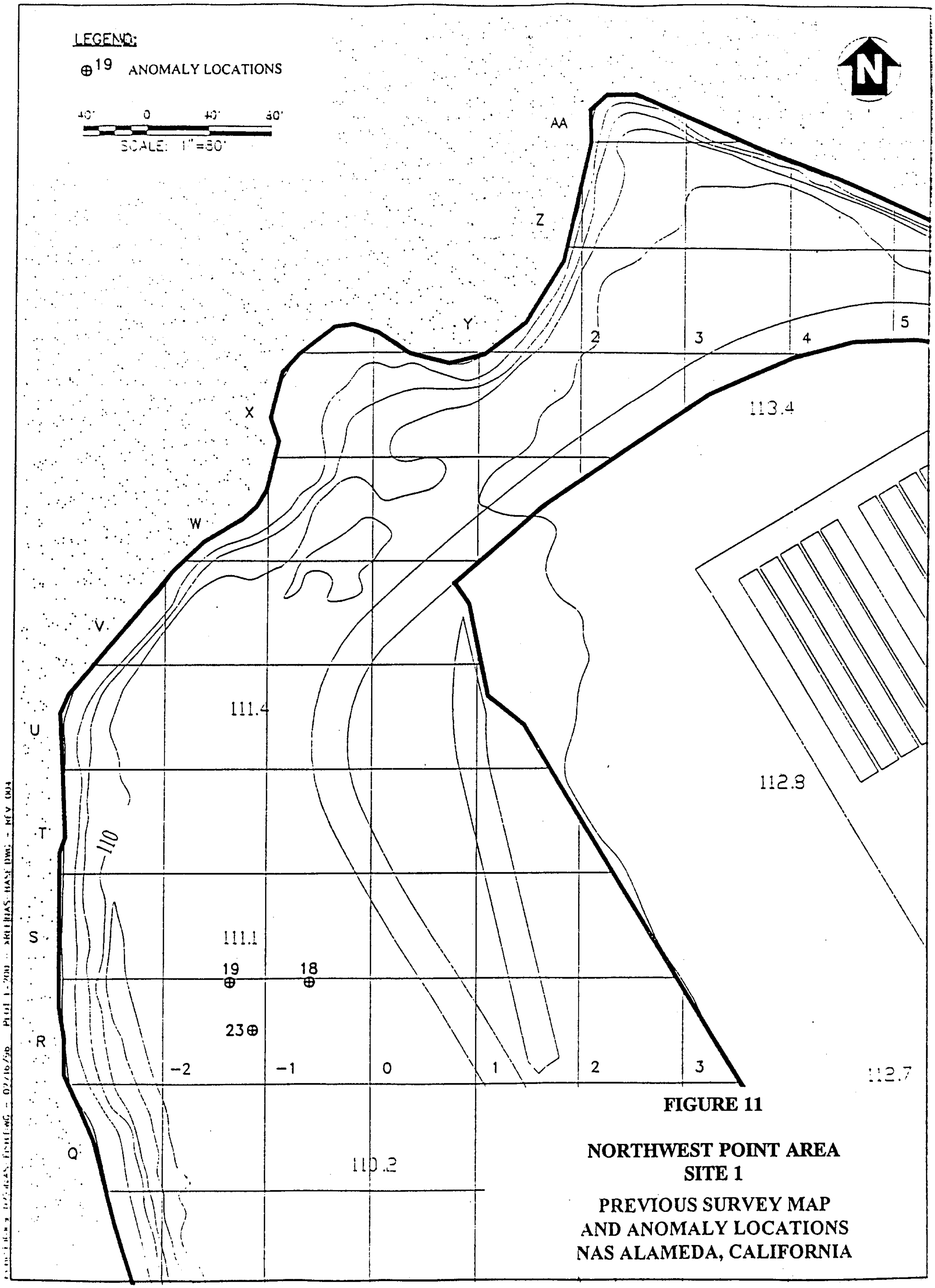


FIGURE 11

NORTHWEST POINT AREA
SITE 1

PREVIOUS SURVEY MAP
AND ANOMALY LOCATIONS
NAS ALAMEDA, CALIFORNIA

instrument in a serpentine pattern across the grid transect, covering 0.5 meter on each side. This method will ensure that the entire survey area is scanned. This method has been successful in locating near-surface sources of radium-226 (PRC 1996).

If elevated gamma exposure rates are detected, PRC will perform a static 1-minute count using the 2- by 2-inch NaI gamma scintillation detector. The measurement will be made by suspending the detector probe from a tripod so that the probe is approximately 3 inches from the ground surface. If a count rate is determined to be significantly above background levels, as defined in Section 3.1, the location of this measurement will be labeled as an anomalous reading. The location will be marked with a field marker or flag. A whole-body human gamma exposure rate will be determined at 1 meter above each anomalous location using the micro-Roentgen exposure rate meter.

If PRC determines that the count rate is greater than background, PRC will briefly search the ground surface for a radioactive source. A small metal trowel may be used to dig for the source. However, only the first 2 to 3 inches of surface soils will be disturbed. If a source is found and removed, another series of gamma count rate and exposure rate measurements will be recorded to reflect any changes in radiation levels.

Disturbed soils will not be collected and will remain at the anomalous site. If, however, it is apparent that the soils contain a measurable amount of dispersed radioactivity at activities above background levels, PRC will mark the anomalous location and note it in the field logbook.

Contamination of survey instruments from surface soils is unlikely; however, instruments will be kept free of dust and dirt. The instruments and equipment will be frisked with a clean beta-gamma G-M detector (Victoreen Model 190 survey and count rate meter, or equivalent). Section 5.1 provides health and safety information regarding instrument contamination.

3.2.2 Site 1 and Site 2 Jogging Trails

The jogging trails in Sites 1 and 2 are popular recreational areas that are accessible to base personnel. During the previous survey, no anomalies were identified on the trails; however, only a small percentage was surveyed. Several anomalies were identified within a few meters of the Site

1 trail, including a radium-226 source that was recovered (PRC 1996). Because base personnel frequently use the trails, a more thorough survey was recommended (PRC 1995e).

PRC will survey the jogging trails in Sites 1 and 2 by using the methods described in Section 3.2.1. The Site 1 trail is approximately 580 meters long, the trail on top of the berm in Site 2 is approximately 2,360 meters long, and the trail immediately outside the berm is approximately 1,575 meters long. Each trail is about 2 meters wide.

PRC will not use a grid system to survey the jogging trails. Instead, each trail will be scanned by sweeping the survey instrument across the trail, in a serpentine pattern, at ground surface. Each pass across the width of the trail will survey an area about 1 meter long. The survey will be complete when the entire length of the trails within Sites 1 and 2 have been scanned.

3.3 SURVEY DRAIN LINES, STORM SEWER LINES, AND STORM SEWER MANHOLES

The subcontractor will utilize methods, procedures, and specifications as described in the subcontractor statement of work (Attachment B) to characterize radioactive contamination resulting from the presence of radium-226 in the affected building drain lines and storm sewer lines. As described in the following sections, the subcontractor shall survey the interior of the affected drain lines inside of Building 5 and the associated storm sewer line F, the interior and exterior of the affected drain lines inside of Building 400 and the associated storm sewer line FF, and storm sewer line R.

3.3.1 Building 5 Drain Lines and Storm Sewer Line F

The subcontractor will survey the affected drain line of Building 5 and the associated section of storm sewer line F. The survey will be conducted from the manhole closest to the Seaplane Lagoon that is not tidally influenced, upstream into the drain line of Building 5. The subcontractor will discontinue the survey when the level of radioactivity measures 5 times the established background level. At this point, the remainder of the upstream pipe, where the radioactive contamination emanated, will be considered contaminated. The affected drain line in Building 5 and the affected section of storm sewer line F are described below.

Building 5 Drain Line

The affected drain line inside of Building 5 starts above the Small Parts Paint Shop on the east side of the room, runs along the ceiling and travels down the north wall where it enters the concrete floor. The remainder of the building drain line consists of over 500 feet of subterranean piping.

Where the drain line enters the concrete floor in the Small Parts Paint Shop, the pipe is 4 inches in diameter. The drain line travels north in Building 5 for 60 feet under the fire lane into Building 5A, where it turns 90 degrees to the west. At this point, the drain line is shown to be 10 inches in diameter. The drain line travels west under the concrete floor for approximately 460 feet, where it leaves the footprint of the building. Along this 460 foot section, access to the drain line is possible through four clean-outs. At this point, the diameter of the line has increased three times to a diameter of 18 inches. The line changes diameter again outside of the building footprint to 21 inches. The drain line travels another 100 feet outside of the building where it connects to the first storm sewer manhole, 6F-2, of storm sewer line F.

Storm Sewer Line F

Storm sewer line F starts at the point outside of Building 5 where the Building 5 drain line connects to manhole 6F-2. From this point, storm sewer line F travels west for 150 feet, then turns south for approximately 1,850 feet, where it ends at the Seaplane Lagoon. At the point where the storm sewer line leaves the footprint of Building 5, it is 21 inches in diameter. At the outfall in the Seaplane Lagoon, the pipe is 36 inches in diameter. Throughout the 1,850-foot north/south section of storm sewer line F, six east/west lateral sections of storm sewer line connect at or near manholes 1F through 6F. These lateral sections service areas of the base along the south wall of Building 5, the north and south walls of Building 400, and around Buildings 19, 23, 24, and 25 for a total of approximately 7,700 feet. Although the east/west running laterals of storm sewer line F are not suspected of being contaminated, some or all of the manholes for these sections will be surveyed.

3.3.2 Building 400 Drain Lines and Storm Sewer Line FF

Building 400 Drain Lines

The subcontractor will survey the interior or exterior of the drain lines within Rooms 203, 204, and 213 of Building 400, from the location at which the lines enter the floor to the locations where the drain lines connect to the industrial waste lines on the north and south sides of the building. All overhead drain lines associated with these rooms, which are accessible from the first floor, will be surveyed externally. Areas of the pipes which are not accessible externally will be surveyed internally. The subcontractor will utilize a scissor-lift to gain access to all exposed overhead drain lines in Building 400.

PRC personnel will survey the exterior and readily accessible interior of all accessible drain lines, traps, and clean-out points in the men's restroom, women's restroom, and the janitor's closet. If PRC identifies contamination in any of the plumbing fixtures, the subcontractor will be required to survey the interior of these lines as far down the lines as practicable.

Storm Sewer Line FF

For storm sewer line FF, because of severe tidal influence, the subcontractor will only be required to survey the interior of the storm sewer manholes and the collection sump inside of Building 400A. If the subcontractor identifies contamination in the manholes or the collection sump, the subcontractor will be required to survey the water collection trough within Building 400A and any other related drain lines feeding this storm sewer line.

3.3.3 Storm Sewer Line R

The subcontractor will be required to survey the interior of manhole R3 of storm sewer line R. If the subcontractor identifies contamination in manhole R3, the subcontractor will be required to survey additional manholes upstream and downstream of R3 to determine the extent of contamination within this section of storm sewer line.

3.4 SURVEY SPECIFIED AREAS OF BUILDINGS 5 AND 400

The following areas are known or suspected to contain radioactive contamination: (1) the Bearing Shop in Building 5, (2) the Small Parts Paint Shop in Building 5, and (3) Rooms 203, 204, 210, 213, and 214 of Building 400. PRC will survey these for the presence of radium-226 and its decay products. The survey areas for Buildings 5 and 400 are about 5,000 and 4,000 square feet, respectively. The Building 5 surveys will be characterization surveys and are not intended for use in the final release of the building areas or building materials. The Building 400 surveys are designed to allow free release of the affected rooms and the equipment that currently resides in the rooms, if all levels of contamination are below the required limits.

The Building 5 survey will provide 100 percent coverage of the floor and up to 2 meters on the walls of the Bearing Shop. The survey of the floors and walls in the adjacent rooms and hallway will use a systematic grid survey method to provide at least 10 percent coverage of the surface areas. The exterior of the exposed pipes in the Small Parts Paint Shop will also be surveyed in addition to 100 percent of the floor.

The Building 400 surveys will provide 100 percent coverage of the floors and up to 2 meters on the walls. Exposed drainage pipes and fixtures not removed from the rooms will also be surveyed.

Before beginning survey activities, PRC will establish a 1-meter grid system over the floor and wall surfaces of the survey areas. This method is described in Section 4.2 of the guidance document (U.S. NRC 1993). In affected areas that require 100 percent coverage, each grid square will be completely scanned by using a pancake-style G-M beta-gamma detector at a speed not greater than one-half of the probe width per second. Static measurements will also be taken at each of the grid nodes. In unaffected areas that require at least 10 percent coverage, the pancake-style G-M beta-gamma detector will be used to scan a 10-centimeter-wide area along the grid transects. At least 30 static measurements will be taken in each unaffected area. These measurements may be made on grid nodes, areas likely to collect contamination, or randomly selected locations. The counting times are to be determined on the basis of the background count rates and the efficiency of the detector.

For optimum detection sensitivity, changes in the instrument response will be monitored by visual and audible outputs. Locations of direct radiation, discernible above the ambient background level, will be noted in the field logbook, marked, and mapped. PRC will further survey these locations by using the ZnS alpha scintillation detector and the NaI gamma scintillation detector. Whole-body human gamma exposure rates will be measured at 1 meter above the floor at a frequency of one systematic measurement for every 4 square meters and at locations of elevated activity identified by radiation detection instruments.

PRC will also use the ZnS alpha scintillation detector to collect one systematic measurement for every 4 square meters for alpha contamination. Removable contamination measurements will be made by taking surface swipes at locations of elevated alpha activity and in areas that are likely to have trapped or pooled contaminated liquids, such as cracks and floor-wall joints. Swipes for surface activity will be obtained by using a dry filter paper, such as Whatman 50 or equivalent, to wipe an area of approximately 100 square centimeters, while applying moderate pressure. A 4-millimeter-diameter filter is typically used; however, for surveys of small penetrations, such as cracks or anchor bolt holes, cotton swabs will be used to wipe the area of concern. The swipes will be placed in sample containers, which will be surveyed using the ZnS alpha scintillation detector to determine removable alpha contamination levels.

Counting times for total and removable alpha activity measurements will be determined on the basis of guideline values (see Section 2.4) and the background activities using Equation 3. The counting time is obtained by substituting one-half of the guideline value for the MDA, inputting the appropriate background activity level, and solving for the counting time (t), or by substituting values of t until an MDA of less than or equal to one-half the guideline value is achieved.

In addition, PRC will conduct equipment surveys to clear equipment as it is being removed from the affected rooms in Building 400. In an attempt to detect gamma rays emitted by the decay of radium-226, the equipment will first be surveyed to provide 100-percent coverage of the accessible surface areas by using the pancake-style G-M beta-gamma detector. Beta-gamma scans will also be performed, as equipment is being removed from the room, on areas of the equipment that were not initially accessible. The ZnS alpha scintillation detector will be used to (1) scan at least 10 percent of exposed surfaces and suspect areas and (2) to perform static measurements at points of elevated gamma and alpha activities. Suspect areas include drains, work stations, screen printing tables, dusty areas, and cabinets. If an area of alpha activity is detected, a swipe sample will also be collected. Swipe samples will be counted by using the ZnS alpha scintillation detector. The counting times will be determined on the basis of background count rates and the efficiency of the detector. Survey results from fixed and removable contamination will be compared to guideline values (USAEC 1974) to determine whether the equipment can be removed from the rooms and stored in free access areas.

During the survey of the equipment within the affected rooms of Building 400, where practicable, PRC personnel will remove sources of low level contamination and place the associated wastes in an appropriate hazardous waste storage container. The decontaminated item will be resurveyed to determine whether all anomalous activity was removed, and the results compared to guideline values to determine whether the equipment can be removed from the rooms and stored in free access areas.

3.5 SURVEY SUSPECTED STRONTIUM-90 RELEASE

The suspected strontium-90 release point is near the 800-foot mark about 30 feet from the outside edge (south side) of Pier 1. PRC will use a pancake-style G-M beta-gamma detector, coupled to a scaler/ratemeter, to conduct a complete survey of approximately 100 square meters of the pier in the vicinity of the suspected release point. A 1-meter grid system will be set up, and static measurements will be taken at the nodes. A G-M beta-gamma detector will also be used to perform scanning measurements within each grid square, while scanning at a rate of about one probe width per second, as near as possible to the pier surface. Surface activity measurements will be compared to guideline values (USAEC 1974) as a basis for recommendations of remedial actions.

Counting times for total beta/gamma activity measurements will be determined on the basis of the guideline values (see Section 2.3) and the background activities, using Equation 3 (Section 2.6). The counting time is obtained by substituting one-half the guideline value for the MDA, inputting the appropriate background activity level, and solving for the counting time (t), or by substituting values of t until an MDA of less than or equal to one-half of the guideline value is achieved.

3.6 SURVEY SITE OF FORMER RADIOACTIVE WASTE STORAGE SHACK

The radioactive waste storage facility was within a 14- by 16-foot cyclone fence inside Site 2. The fence, which was not removed from the site when the building was dismantled, will serve as the boundary of the survey area. PRC will survey the enclosed area, about 21 square meters, by using the micro-Roentgen gamma exposure rate meter to scan the ground surface. Locations that show elevated gamma exposure rates will also be surveyed using the 2- by 2-inch NaI gamma scintillation detector to determine whether radiation levels are significantly above background levels. Any measurements that are above background levels will be investigated as described in Section 3.2.1. Whole-body human gamma exposure rates will be measured at 1 meter above the ground surface. PRC will recommend that warning signs be posted to control access if radiation levels exceed exposure guidelines.

3.7 SURVEY RAMP 1 AND ADJACENT PARKING APRON 4

Ramp 1 of the Seaplane Lagoon and adjacent parking apron 4 comprise an area of several hundred square meters. PRC will conduct the radiological survey of this area by establishing a 1-meter survey grid and scanning along the grid transects. The beach area around ramp 1 and the supporting members of the ramp will also be surveyed to the extent that the low tide allows.

PRC will conduct the walkover survey for low level gamma activity by using the micro-Roentgen gamma exposure rate meter. The surveyor will sweep the instrument across the grid transect at a pace of about 0.5 meter per second, in a serpentine pattern, covering 0.5 meter on each side. This method will ensure that the entire survey area is scanned.

If elevated gamma exposure rates are detected, a 1-minute count will be taken using the 2- by 2-inch NaI gamma scintillation detector. The measurement will be made by suspending the detector probe from a tripod so that the probe is approximately 3 inches from the ground surface. If a count rate is determined to be significantly above background, as defined in Section 3.1, the location of this measurement will be labeled as an anomalous reading. The location will be marked with a field marker or paint.

Whole-body human gamma exposure rates will be measured at 1 meter above the ground surface. PRC will recommend that warning signs be posted to control access if radiation levels exceed exposure guidelines.

4.0 EVALUATE DATA AND MAKE RECOMMENDATIONS

Specified PRC and RASO personnel will review the data collected from these surveys to determine whether any of the elevated radiation levels or contamination levels pose a threat to people coming into contact with the contaminated areas. The following table is a summary of the types of measurements that will be collected for each respective survey to be evaluated:

Location	Gamma Exposure Rate	Gamma Count Rate	Removable Radium-226 Activity	Total Radium-226 Activity	Beta/ Gamma Activity
Northwest point, Site 1	X	X	--	--	--
Jogging trails, Sites 1 and 2	X	X	--	--	--
Radiation waste storage shack, Site 2	X	X	--	--	--
Building 5 drain lines	X	X	--	X	--
Building 400 drain lines	X	X	--	X	--
Equipment, Building 400	--	--	X	X	X
Room surfaces, Building 400	X	X	X	X	X
Pier 3	--	--	--	--	X
Storm sewer lines and manholes	X	X	--	--	--
Ramp 1 and parking apron 4	X	X	--	--	--

Based on contamination and/or gamma exposure levels, PRC and RASO personnel will make recommendations concerning the implementation of administrative controls. At locations where data demonstrate no radiation levels significantly exceed background levels, PRC and RASO personnel may determine that administrative controls are not needed in these areas.

The survey data will be compiled in a formal report and submitted to EFA West. EFA West will present the report and recommendations to the BRAC Cleanup Team (BCT). Data will be accompanied by text describing the surveys and explaining the results in detail. Survey data necessary for the report will include, but not be limited to, the following:

- Anomalous locations
- Gamma count rates
- Whole-body human gamma exposure rates at 1 meter
- Beta surface activities
- Alpha surface activities
- Removable alpha surface activities
- Detection limits

All conclusions and recommendations reported will be thoroughly supported. The document will include maps, survey grids, data tables, summary figures, and necessary equations and calculations.

The BCT will notify the commanding officer of NAS Alameda of the recommendations outlined in the survey report. PRC will also submit copies of the final report to the following: RASO; Mare Island Naval Shipyard, Radiological Department; Naval Sea Systems Command 08 (NAVSEA 08); and the Naval Nuclear Propulsion Program.

PRC will assist the Navy with administrative controls by preparing and placing warning signs at locations, approved by the Navy, which contain one or more of the following:

- Surface contamination at levels exceeding the values set forth in Regulatory Guidance 1.86 (USAEC 1974)
- Gamma exposure rates above site-specific background, or criterion specified by the Navy
- Loose or uncontrolled discreet radioactive sources
- Surface contamination in surveyed buildings, drain lines, or outfalls

Where signs are not practical, PRC will recommend additional controls and prepare appropriate notices for NAS Alameda personnel, visitors, and the public. The proposed administrative control level for locations that may be occupied by the public (including civilian NAS Alameda personnel and members of the general public) is based on (1) a continuous occupational occupancy of 50 weeks per year for 40 hours per week, and (2) a radiation dose limit, as recommended by federal agencies, of 100 millirem per year. The proposed posting and administrative control level is 50μR per hour above site-specific background levels.

5.0 SITE-SPECIFIC RADIOLOGICAL HEALTH AND SAFETY PLAN

PRC will perform work on this project in accordance with the installation-wide health and safety plan, as presented in Appendix C of the NAS Alameda remedial investigation/feasibility study (RI/FS) work plan addendum (PRC 1993). In accordance with the Navy CLEAN II health and safety program (PRC 1995a), a site-specific health and safety plan (HSP) for CTO 0022 was prepared and is included in this section of the work plan. The following section describes the health and safety procedures that will be followed during radiological field and building surveys, and the collection of soil, sludge and swipe samples. Where appropriate in Section 5.1, the on-site radiation protection officer (ORPO) has checked the correct box for each site control specific to this project.

Proper training protocol and procedures will be followed if the drain line surveys present confined space issues. Only NAS Alameda personnel will lock-out or tag-out lines or break line connections. PRC will recommend that accessible pipes displaying high levels of radioactivity be posted or marked, based on gamma exposure rates, if occupational radiation controls are necessary.

5.1 SITE CONTROLS

The following sections describe all necessary safety requirements for personnel working at NAS Alameda under the site-specific radiological health and safety plan. A ✔ indicates the appropriate level of safety for each requirement. One or more ✔ may be indicated for a particular requirement.

5.1.1 Worker Orientation

Worker orientation shall be conducted before field work begins. At a minimum, workers will be trained to the following level as outlined in Title 29 of the Code of Federal Regulations (29 CFR), Section 1910.120(e) "Training."

- ☐ General
- ☐ Radiation Orientation
- ✔ Radiation Worker I
- ☐ Radiation Worker II

5.1.2 Site Access Control

Site control shall be established in accordance with PRC's standard operating procedure (SOP) SOP-011 as follows:

- ✔ Low Site Access Control
- ☐ Standard Access Site Control
- ☐ High Site Access Control

5.1.3 Personal Protective Equipment

- ☐ Level B
- ☐ Level C
- ✔ Level Modified D
- ☐ Level D

Personnel will wear street clothing, modified by shoe coverings in areas with removable contamination on floors, and gloves when handling contaminated equipment. Personnel will don coveralls when decontaminating equipment.

5.1.4 Decontamination Procedures

- ✔ Minimum - Hand and face wash only
- ❑ Basic - Single wash station
- ❑ Standard - Three station wash
- ✔ Special - Follow Ionizing Radiation Protection Program (PRC 1995c) for personnel decontamination in the event of contamination
- ❑ Shower required

Decontamination shall consist of washing hands and face prior to breaks, lunch, and at the end of the shift, unless contamination is detected.

5.1.5 Instrumentation Required

- ✔ Geiger counter - end-window beta-gamma pancake detector
- ✔ Alpha scintillation detector
- ❑ Gas proportional detector
- ❑ Gamma scintillation detector (2-inch by 2-inch)
- ❑ Dose rate instrument (pressurized ion chamber or ion chamber)

5.1.6 Survey Frequency

- ❑ Frequent checks
- ✔ Breaks, lunch, end-of-shift
- ✔ All equipment daily and before return to appropriate vendor
- ❑ Spot check equipment
- ❑ Written documentation of release (only if contamination detected)
- ✔ Written documentation of release (all equipment)

All personnel shall be trained to self-frisk.

5.1.7 Air Monitoring

- ✔ None required
- ❑ Site boundary
- ❑ Worker zone
- ❑ Personal breathing zone

5.1.8 Dosimetry

- ☐ Direct reading dosimeter
- ☐ Dosimeter of record (TLD)
- ☐ Whole Body Count (Before and After)
- ☐ In-vivo testing (specimen)
- ✔ Dose rate survey
    - ☐ Daily
    - ☐ Hourly
    - ☐ New locations
    - ✔ Other - Record background daily and at each new work area

Personal dosimetry is not required; however, the HSPM shall be notified of areas where background is exceeded on any detector by a factor of 10.

5.1.9 Waste Management

- ☐ Segregate all investigative derived waste from this work location
- ✔ Segregate only contaminated articles
- ☐ No investigative derived waste control unless site contamination detected

5.1.10 Sample Screening

- ✔ Geiger counter screen
- ☐ Scintillation detector screen
- ☐ Screen open cores

Screen all samples for off-site shipment.

5.1.11 Instrument Calibration

- ☐ Screening only - calibration not required
- ☐ Calibrated instrument for dose rate
- ✔ Calibrated for surface activity
- ☐ Calibrated for sample semi-quantitative

5.2 HAZARD ANALYSIS FOR RADIOLOGICAL HAZARDS

The following sections describe the potential radiological hazards present at NAS Alameda at the survey locations specified in this work plan.

5.2.1 Isotopes Present

- ✔ Radium
- ❑ Fission products
- ❑ Transuranic
- ❑ Natural, enriched, or depleted uranium
- ❑ Tritium
- ❑ Medical waste
- ❑ Radiography sources
- ❑ Unknown

5.2.2 Radionuclide Concentrations Expected

- ❑ Background
- ✔ Up to ten times background
- ❑ Greater than ten times background

5.2.3 Airborne Radioactivity Potential

- ✔ Low probability of airborne radioactivity in excess of action level
- ❑ Moderate probability of airborne radioactivity in excess of action level
- ❑ High probability of airborne radioactivity in excess of action level

5.2.4 High External Exposure Rate Potential

- ✔ Low probability of high exposure rates in excess of action level
- ❑ Moderate probability of high exposure rates in excess of action level
- ❑ High probability of high exposure rates in excess of action level

5.3 RADIOACTIVITY ACTION LEVELS

Field personnel will refer to the following action level tables while conducting radiation surveys at NAS Alameda. In all cases where it is required, field personnel will immediately notify the HSPM when levels of radiation are detected above the specified action limit. If the HSPM is unavailable, site personnel will discontinue work in the area until the HSPM has been consulted.

5.3.1 Surface Contamination

To comply with free release requirements, all survey equipment must be surveyed using the appropriate detector prior to the return of the equipment to the vendor. Surface contamination for alpha, beta-gamma, or gamma activities may not exceed the following levels:

Detector	Disintegrations per minute per 100 square centimeters ($dpm/100cm^2$)		
	Average[1]	Maximum	Removable
alpha scintillation detector	100	300	20
beta-gamma pancake detector	1,000	5,000	500
	Counts per minute above background		
gamma scintillation detector	three times background		

Notes:

1 - Measurements for average activity should not be made over areas greater than 1 square meter

5.3.2 Dose Rate

Personal dosimetry is not required; however, the HSPM shall be notified of areas where background is exceeded on any detector by a factor of 10, or the following levels are exceeded:

Area	Action Level	Action
Work areas	10 microrad per hour	notify HSPM-continue work
Work areas	20 microrad per hour	notify HSPM-mark off area, move to another work area
Isolated spots or sources	50 microrad per hour	notify HSPM-mark off area, establish boundary

5.3.3 Shipping of Samples

Samples known to contain radioactive material must be scanned before shipment. Based on values given in the following table, sample bottles and shipping containers must be labeled as follows:

Type reading	Instrument	Action Level	Action
Contact dose rate	Victoreen 450 P	$<10\ \mu R/hr$	note on custody sheet
Contact dose rate	Victoreen 450 P	$<50\ \mu R/hr$	label container with radiation symbol
Contact dose rate	Victoreen 450 P	$>50\ \mu R/hr$	package labeling may be required
Contact dose rate	Scintillation detector	<3 times background	note on custody sheet
Contact dose rate	Scintillation detector	<5 times background	label container with radiation symbol
Contact dose rate	Scintillation detector	>10 times background	package labeling may be required
Package at one meter	Victoreen 450 P	<0.1 mr/hr	ok, otherwise consult HSPM
Package at one meter	Scintillation detector	< 3 times background	ok, otherwise consult HSPM
Surface contamination	refer to table in Section 5.3.1	refer to table in Section 5.3.1	over-pack container and label internal package "sample container is contaminated"

5.3.4 Radionuclide Toxicology

Radionuclide	Target Organ	Radiation Emitted	Discussion	Annual Limit of Intake (Becquerel)	Derived Air Concentration ($\mu Ci/cm^3$)
Radium	bone	alpha	Radium is a carcinogen when taken into the body. Radium is a "bone-seeker," replacing calcium in metabolic processes. Radium may be present in a highly soluble form. Principle route of intake is inhalation.	1.9 (oral) 5.4×10^{-1} (inhalation)	2.7×10^{-10}
Strontium-90	--	--	No data available	--	--

Notes:

Annual Limit of Intake :	The total quantity of material which can be taken into the body in one calendar year by the specified route
Derived Air Concentration:	The air concentration equivalent to inhalation of one annual limit of intake over one year
Dose Conversion Factor:	The factor which converts an amount taken into the body into an effective dose equivalent

5.3.5 Radionuclides and Principal Emissions

Nuclide	Symbol	Emissions	Particle Energies (Particle or Gamma intensities) (MeV)		
			alpha	beta	gamma
Strontium	^{90}Sr	β	---	0.546 (100%)	---
Radium	^{226}Ra	α - γ	4.78 (94.5%) 4.59 (5.5%)	---	0.186 (100%)

Notes:
alpha = α
beta = β
gamma = γ

5.3.6 Minimum Detection Limits For Survey Instruments

Survey instruments used to measure surface contamination for the following radionuclides must provide the following detection capabilities:

Nuclide	Symbol	Total Activity (dpm/100 cm^2)	Removable Activity (dpm/100 cm^2)
Radium	^{226}Ra	50	15
Strontium	^{90}Sr	500	100

6.0 QUALITY ASSURANCE PROJECT PLAN ADDENDUM

This quality assurance project plan (QAPP) addendum identifies the project-specific components amended from the installation-wide QAPP presented in Section 3.0 of the NAS Alameda RI/FS work plan addendum (PRC 1993). The revised components address issues pertinent to the radiological survey that will be conducted at NAS Alameda under this CTO. The amended QAPP components include the following:

- Data quality objectives for radiological survey data
- Analytical methods and reporting limits
- Quality control (QC) methods
- Corrective actions for non-conformance in duplicate measurement data
- Preventive maintenance of survey equipment
- Data reduction, management, and reporting

Sampling procedures are discussed in other sections of this work plan and are not repeated here. QAPP components that have not been revised from the RI/FS work plan addendum QAPP and are applicable to this work plan include sample custody, internal QC checks and frequency, and quality assurance reports to management.

6.1 DATA QUALITY OBJECTIVES FOR RADIOLOGICAL SURVEY DATA

The data quality objective for this radiological survey is the production of field screening data of known quality and sufficient quantity to support the objectives described in Section 1.1 of this work plan. The data will be used to (1) determine whether there are radiation hazards at the specified sites at NAS Alameda, (2) determine the extent of radium-226 and strontium-90 radioactive contamination at known and suspected locations, and (3) support recommendations for implementing administrative controls and/or removing contamination at these sites.

6.2 ANALYTICAL METHODS AND REPORTING LIMITS

The methods that will be used to obtain radiological data are described in Section 2. The reporting limits will be the calculated MDAs for each analytical method. The equations used to calculate the MDAs for field surveys and swipe analyses are given in Section 2.6.

6.3 QUALITY CONTROL METHODS

General quality assurance/quality control (QA/QC) procedures for this project will be conducted in accordance with PRC's CLEAN II Quality Assurance Management Plan (PRC 1995b) and with installation-wide QAPP presented in Section 3.0 of the NAS Alameda RI/FS work plan addendum (PRC 1993). The following sections cover QA/QC procedures specific to the collection of radiological samples and data.

6.3.1 Measurements of Exposure Rates and Count Rates

All radiological measurement instruments proposed for this survey are calibrated annually by the vendor by using National Institute of Standards and Technology sources. Gamma survey instruments and alpha survey instruments will be calibrated by using a radium-226 source that will be directly applicable to the radiation being measured. Beta survey instruments will be calibrated using a strontium-90 source which will also be applicable to the radiation being measured. The annual calibrations will ensure that detection efficiencies are known for each instrument and are applicable to the radiation being measured at NAS Alameda. In addition, instrument calibrations will be checked daily by using appropriate source check samples.

QC methods for field surveys involving exposure and count rate measurements will be maintained by using source checks of field instruments and taking duplicate surveys. Duplicate count rates will be taken at every tenth survey location, beginning with the first location. If fewer than 10 measurements are made in 1 day or at one survey site, a duplicate count will be taken at the last measurement location. If returning to the location of the last measurement is not practical, a duplicate count will be taken at another measurement location. Duplicate measurement count rates should be within plus or minus 20 percent.

6.3.2 Collection of Swipe Samples

Swipe sample duplicates will be collected with the first swipe sample collected from each survey site. The duplicate swipe sample will be collected from as close as possible to the original swipe location. PRC will take duplicate count rate measurements while counting swipe samples at a rate of one every 10 samples, beginning with the first sample counted every day. About 10 to 15 percent of swipe samples demonstrating elevated activity levels will be sent to an outside laboratory for verification analysis. To determine swipe sample background levels, the outside laboratory will also analyze representative samples that demonstrate no activity.

6.3.3 Outside Analytical Laboratory Services

Outside laboratories performing analytical services for this project will follow all appropriate chain-of-custody procedures as outlined in the installation-wide QAPP. The laboratory must be certified by the California Department of Health Services Environmental Laboratory Accreditation Program and will use approved U.S. Environmental Protection Agency (U.S. EPA) 900 methods. Analyses may include gamma spectroscopy, specific isotopic radiochemical analysis, and gross alpha and gross beta measurements.

Because of the limited amount of removable material within the drain lines, insufficient sample volumes may preclude the submittal of field QC samples; however, the laboratory will be required to perform all QA/QC parameters as specified for the methods requested.

6.4 CORRECTIVE ACTIONS FOR NONCONFORMANCE

If source checks or duplicates do not conform with the QC limits established (see Section 6.3), several measurements may be taken. The following action items will apply if nonconforming data are obtained:

Situation: The duplicate count rates are not within plus or minus 20 percent.

Action: Measure the duplicate count by using the same counting time. If the recount is within plus or minus 20 percent, continue with the survey, and take another duplicate count with the next measurement.

Situation: The second duplicate count from the first measurement, or the first duplicate from the second measurement, is not within plus or minus 20 percent.

Action: Source check the instrument. If the source check is within plus or minus 20 percent, record the duplicate counts as measured, and note the differences. If two of three source checks are not within plus or minus 20 percent, check the instrument calibration and, if necessary, return the instrument for service.

Situation: There is an unexpected exposure rate change at the same location.

Action: Source check the survey instrument. If two of three source checks are not within plus or minus 20 percent, check the calibration, and return the instrument for service, if necessary. If the source check is satisfactory, note the exposure rate change, and investigate a potential cause.

6.5 PREVENTIVE MAINTENANCE OF SURVEY EQUIPMENT

All equipment will be kept dry and stored in locked quarters. All maintenance will be arranged through the equipment supplier, with routine maintenance performed by the supplier before every rental period. If an instrument is rented for more than 4 consecutive weeks, the supplier will be asked whether the instrument should be returned for routine maintenance. If it is suggested by the supplier that an instrument be returned periodically for preventive maintenance, PRC will act accordingly.

6.6 DATA REDUCTION, MANAGEMENT, AND REPORTING

Field logbooks will be kept to record all field data and observations. Information recorded in the daily log will include the following:

- Weather
- Soil and surface conditions
- Names of personnel involved in the day's activities (including Navy personnel)
- Background and survey measurements
- Survey instruments and serial numbers
- Locations of all anomalous survey measurements and samples taken

Survey data will be input into Paradox® database and stored on both 3.5 inch computer diskettes and in hard copy format. Data calculations will be performed within the database. All calculations will be checked for correctness before any data is released for use. Data tables will be produced from the database and imported electronically into the final report. Back-up disks will be made of all data and data tables.

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APPENDIX A

DETERMINATION OF RADIOACTIVITY BACKGROUND AND DETECTION LIMITS

(5 Pages)

APPENDIX A

DETERMINATION OF RADIOACTIVITY BACKGROUND AND DETECTION LIMITS

Decisions regarding background will be formulated into statistical statements called hypotheses, which are tested with survey data. PRC will base its statistical testing on hypothesis testing found in the U.S. Nuclear Regulatory Commission (U.S. NRC) guidance document "A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys," (1995). Additional guidance was obtained from methods outlined in the "Manual for Conducting Radiological Surveys in Support of Licence Termination," (U.S. NRC 1993). The earlier guidance relies on a confidence interval approach, while the more recent U.S. NRC guidance relies on hypothesis testing, which is more consistent with EPA methods of statistical analysis. In addition, the hypothesis testing framework is more flexible because both Type I and Type II errors are explicitly considered. In constructing a confidence interval, only one of these errors is controlled.

The null hypotheses (H_0) is that there is no difference between the site and background. The alternative hypothesis (H_1) is that the site is elevated above background. Statistical methods will be used to control Type I and Type II error rates. For example, more samples will be needed to achieve lower error rates. Specifying error rates during survey design will be used to control uncertainty and to identify acceptable levels of uncertainty.

The lower limit of detection (L_D) is the smallest amount of radiation or radioactivity that statistically yields a net result above method background. The critical detection level (L_C) is the level at which there is a 5 percent chance of calling a background sample value "greater than background" (that is, the probability of a false positive or Type I error). This value will be used when counting samples or making direct radiation measurements. Any response above this level will be considered above background (or a net positive result). This will ensure a 95 percent detection capability for L_D. A 95 percent confidence interval will also be calculated for all responses greater than L_C.

Type II errors indicate false negatives, that is a background sample value will be considered to be background when it is actually greater than background. The power of the statistical test is equal to 1 - the Type II error rate. The Type II error rate can be calculated only when the hypothetical distribution of survey data that incorporates L_C and L_D is satisfied. As appropriate, this may include use of the Wilcoxon Rank Sum or Quantile tests to determine if the distributions of the site and background data differ. The variability of the count obtained from the sample is identified by σ. This value has a direct relationship to the detection limit.

Background will be established by hypothesis testing, where H_0 is there is no difference between background levels and site levels. PRC will establish acceptable levels for Type I and Type II errors, and will use this information to establish L_C and L_D. This will include determining the distribution of the data, the mean, the standard deviation, and the appropriate z-statistic.

The above concepts are demonstrated in the following example for testing whether a sample has radioactivity above background. The test statistic is the count obtained from the sample measurement. The Type I error rate depends on the variability of background, and is controlled by requiring the net counts exceed a certain multiple of the measurement standard deviation. Using H_0

and assuming a normal distribution, σ equals the square root of the background count (B). For a 95 percent detection capability, the probability of a Type I error is 0.05, and the corresponding z-statistic is 1.645.

The type II error rate depends on the variability of the added radioactivity, and is controlled by requiring that the total counts exceed a certain number of standard deviations above L_C. It is computed using the distribution of counts under H_1 and the appropriate test statistic. Therefore, the count detection limit (L_D) is dependant upon the appropriate z-statistic and L_C. If the Type II error is set to equal the Type I error, then L_D = the square of the appropriate z-statistic plus 2 times L_C.

PRC will establish background levels for exposure rate or gamma count rate, based on acceptable Type I and Type II error rates, and corresponding values for σ by using methods found in the U.S. NRC guidance documents (1993 and 1995). The number of samples is dependant on the acceptable values for Type I and Type II errors. Background locations will be in unaffected areas of the base having similar soil types or in areas having similar construction materials.

Overall, based on the approach provided above, values above L_C will be reported as above background. This will be based on hypothesis testing and associated acceptable levels of Type I and Type II errors and a 95 percent detection capability for L_D. In most cases this will correspond to a Type I error rate of 0.05 and a Type II error rate of 0.20.

MINIMUM DETECTABLE ACTIVITY

The minimum detectable activity (MDA) is calculated for each survey configuration and will be 25 to 50 percent of the guideline level. The following items describe the methodology for the determination of the MDA:

(a) Determination of Instrument Detection Capability. Each configuration of a detector and counting system has a unique detection capability determined by several variables. This discussion pertains to detector capability limitations based on counting statistics only.

(b) Definitions. The definitions relevant to a discussion of counting statistics as they pertain to field instrument detectability are outlined in the following subsections. This terminology is consistent with definitions published in the literature and applicable regulatory guidance (U.S. NRC 1995). The 95 percent confidence interval is used in all calculations. Capabilities may be reported in terms of counts and count rates or in terms converted to activity. Count data are converted to activity using a detector efficiency factor, area factor, and a term to account for errors. The correction factor is applied as a multiplier of the count data.

Detection Level. The detection level is the *a priori* limit and represents the measurement system sensitivity. Detection level is denoted "L_D" and is the value stated in describing a measurement system.

Critical Level. The critical level activity concentration (less than values) is the *a posteriori* statement of detection, which when exceeded, indicates to some desired degree of confidence that the sample is different from background.

Reporting Data. Each measurement is reported as a net count rate and an error term or standard deviation. When the net count is below the critical level, the sample net activity is reported as less than either sample net activity plus the value of the one-sided 95 percent confidence interval; or the critical level, whichever is greater.

Detection Limits Applied to the Field. The detection level and activity conversion factor yields the MDA in areal units with dimensions of activity per surface area. This value is used to set counting times, select detectors, and establish counting room shielding (as necessary).

The critical level or "detection limit" is used in reporting field data. Critical level activity concentration values will be no greater than 50 percent of the recommended limits as presented in the guidance document "Termination of Operating Licences for Nuclear Reactors," (U.S. Atomic Energy Commission [USAEC] 1974), typically they will be lower.

(c) Detection Levels for Scanning. Detection limits for scanning are estimated from a perceptible increase in the count rate for a careful surveyor. The product of the instrument background count rate and count to activity conversion factor provides an estimate of the detector-specific "activity background." The detection limit is estimated as a fractional increase above that value as follows using detector slow response:

Background Count Rate (cpm)	Factor (times background)
< 5	4
5 - <30	3
30 - <50	2.5

The product of the net perceptible increase above background and the activity conversion factor provides the net detection limit.

The net limit listed is the best detection limit for a careful observer using a typical rate meter in slow response mode, holding the probe stationary, and observing meter fluctuation. The limit for a slowly moving detector is higher.

EQUATIONS FOR CALCULATION OF DETECTION CAPABILITY

$$L_C = \left(\frac{K_a}{T_s}\right) x \sqrt{T_s r_b \left(1 + \frac{T_s}{T_b}\right)}$$

$$L_D = \frac{K_a^{\,2}}{T_s} + \left[\frac{2K_a}{T_s} x \sqrt{T_s r_b \left(1 + \frac{T_s}{T_b}\right)}\right]$$

$$\epsilon = \frac{r_{source} - r_b}{dpm}$$

$$\text{Sample cpm} = r_s - r_b \pm \sqrt{\frac{r_s}{T_s} + \frac{r_b}{T_b}}$$

$$A_{cf} = \frac{1}{\epsilon} x \frac{100}{a_d}$$

$$\text{MDA (probe measurement)} = A_{cf} \; x \; L_D$$

$$\textit{Less than value (for } r_s - r_b \le L_c) = (r_s - r_b) + 1.645\sqrt{\frac{r_s}{T_s} + \frac{r_b}{T_b}}$$

Where:

K_a	=	1.645 (one-sided value of the standard normal deviate for the 95 percent standard deviation)
T_s	=	Sample count time
T_b	=	Background count time (at least 10 T_s)

r_b	=	Background count rate
r_s	=	Sample count rate
a_d	=	Detector active area (cm^2)
ϵ	=	Efficiency (cpm/dpm)
cpm	=	Measured net count rate (count per minute)
dpm	=	Source activity or measurement result (disintegration/minute)
L_c	=	Critical level
L_D	=	Detection limit
MDA	=	Minimum detectable activity
A_{cf}	=	Activity conversion factor
r_{source}	=	Count rate of a standard source using contained activity from source certificate

ATTACHMENT A

DIAGRAMS SHOWING LOCATION OF BEARING SHOP
AND SMALL PARTS PAINT SHOP WITHIN BUILDING 5
(4 Pages)

6 August 1996

From: R. Caswell, NADEP
To: G. Kikugawa, EFAW

Subj: SPECIFIC BUILDING LOCATIONS FOR RADIOLOGICAL SURVEY

1. In NADEP comments about the radiological survey workplan, it was noted that the spaces in Building 5 were referred to as "Small Parts Paint" or "Code-----". Our concern was that in a few years time, nobody would know what these names meant. We requested that the room number be used which then could be consistent with drawings entrusted to ARRA.

Neal Hutchinson called me to find out what these room numbers were and I found that nobody here seems to know. So I looked all over the spaces and found PWC door numbers (which, in the main, don't correspond to the room numbers) and not much else.

To provide some sort of potentially long-lasting reference for the radiological work, I looked at all the room numbers around the Bearing Shop and figured out what the room numbers would likely be if they were there. As shown in the attached sketch, I have assigned these as 227A, B, and C and 223A, B, C, and D for the 7 Bearing Shop rooms. Designating one or more as "Room 225" was also considered but the 223 and 227 were consistent with "Dymo" labels above some of the doors.

In addition, I call out the column designations that encompass the rooms. These are most likely to be retained by future users and are on what drawings we have left.

For the "Small Parts Paint Shop", I found no numbers whatsoever, even on the 1948 drawings we have. For this space, I call out the column designations only. They are consistent with those above in the Bearing Shop but extend one more row to the northernmost side of the building.

Would you please FAX these sketches to Neal so he can properly respond to our comments.

Thanks

R

Roger

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL	# of pages ► 3
To Neal Hutchison	From G. Kikugawa
Dept./Agency PRC	Phone # (415) 244-2549
Fax # (916) 852-0307	Fax # (415) 244-2654

NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

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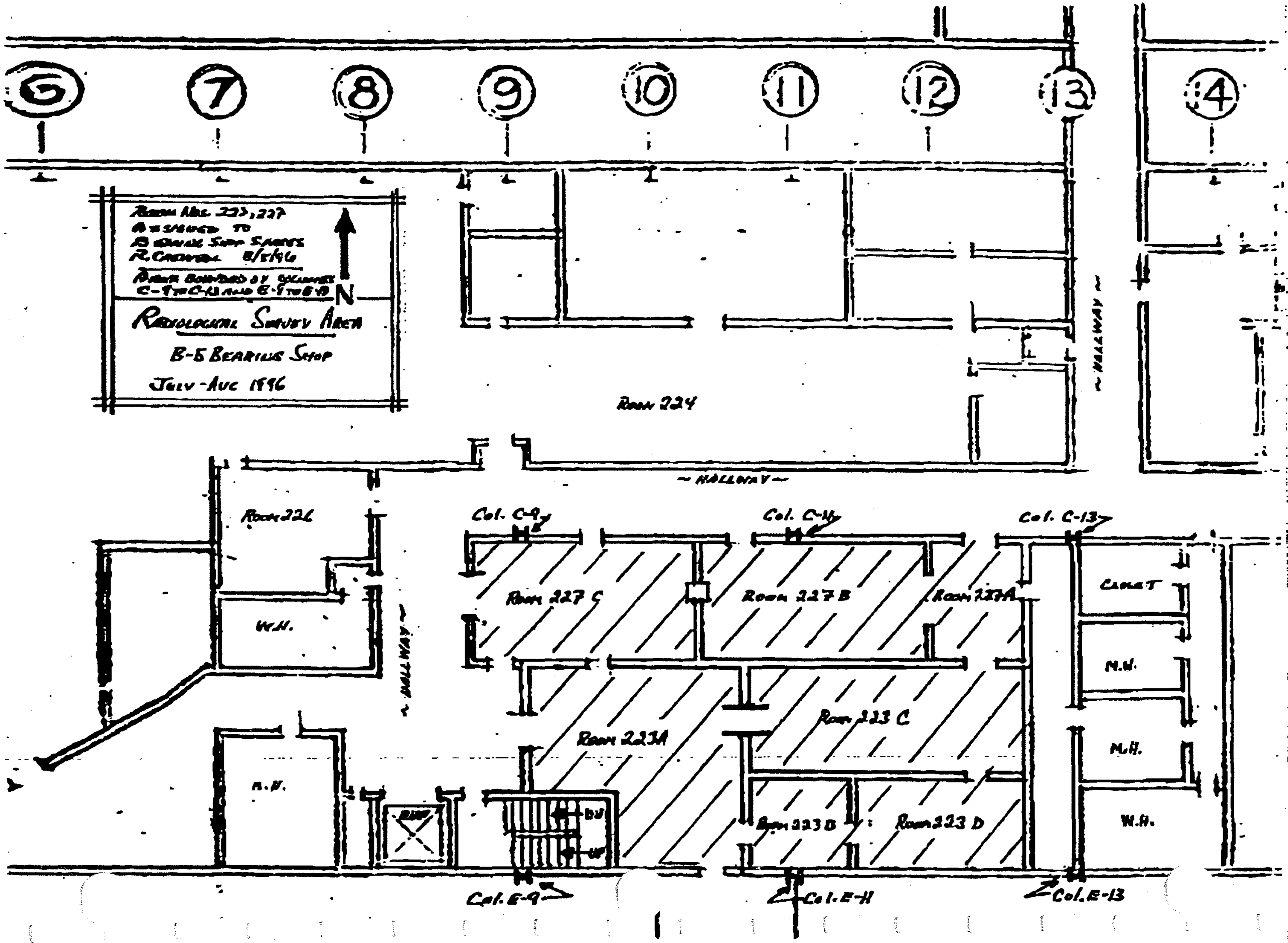
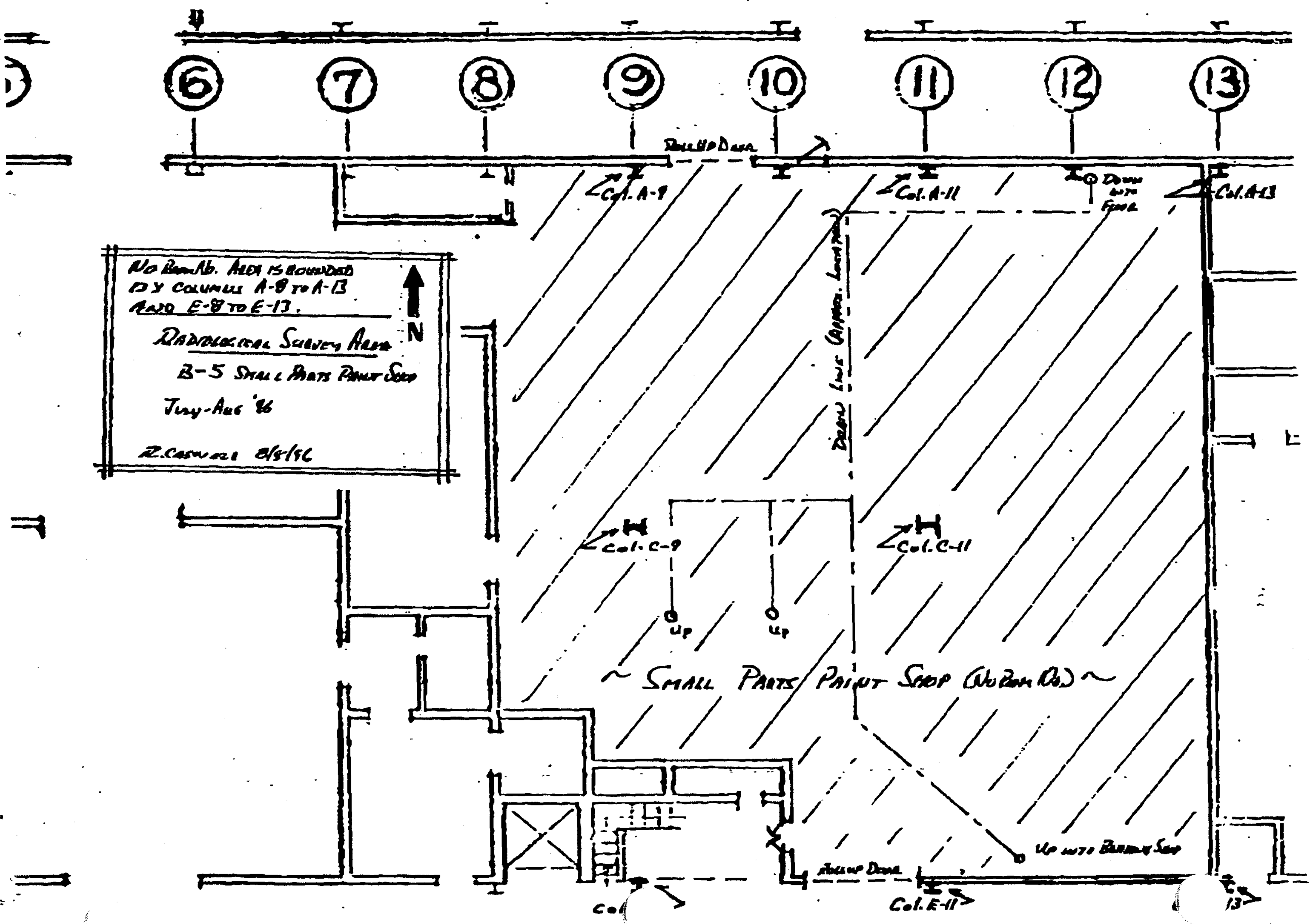
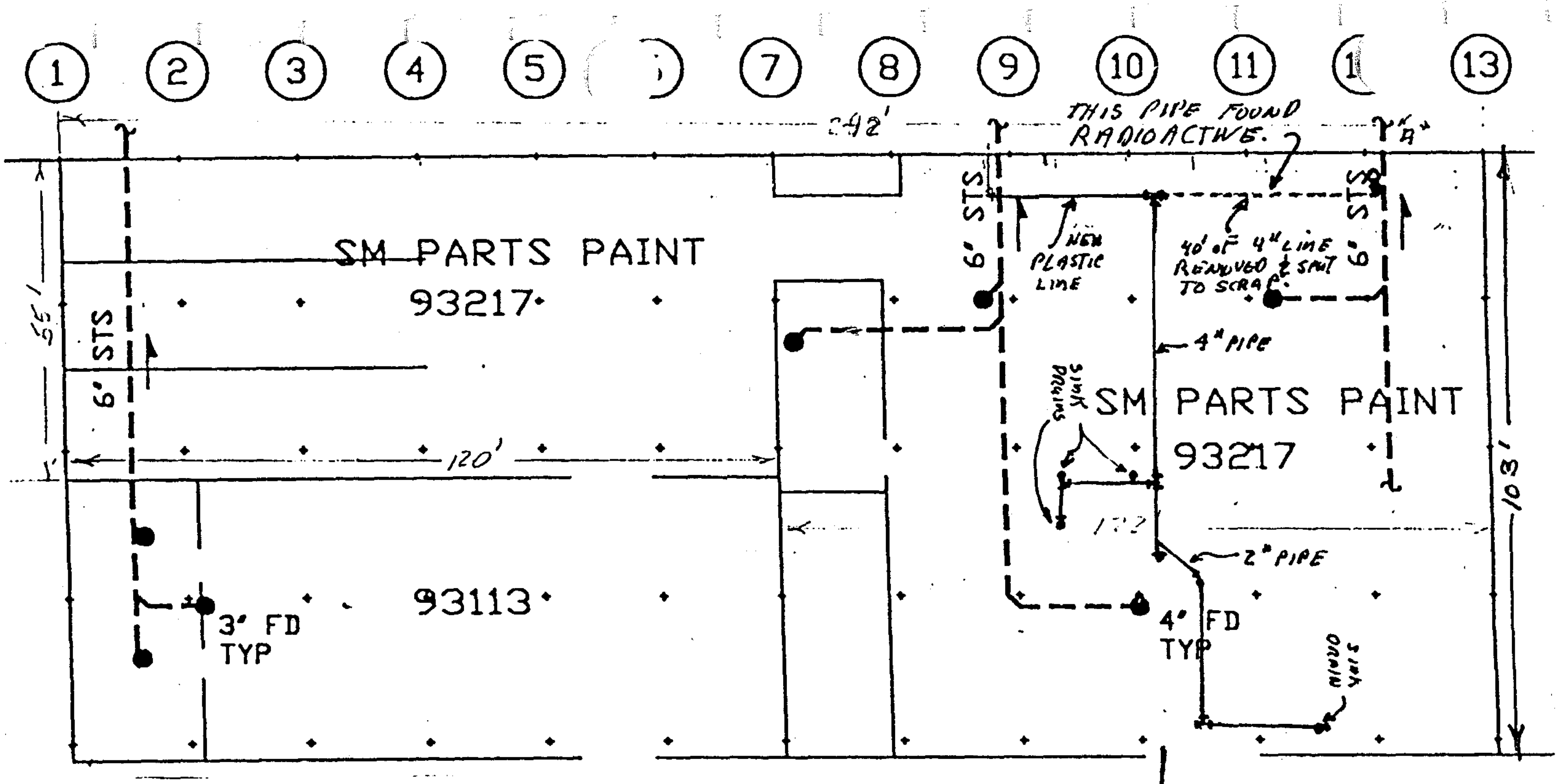
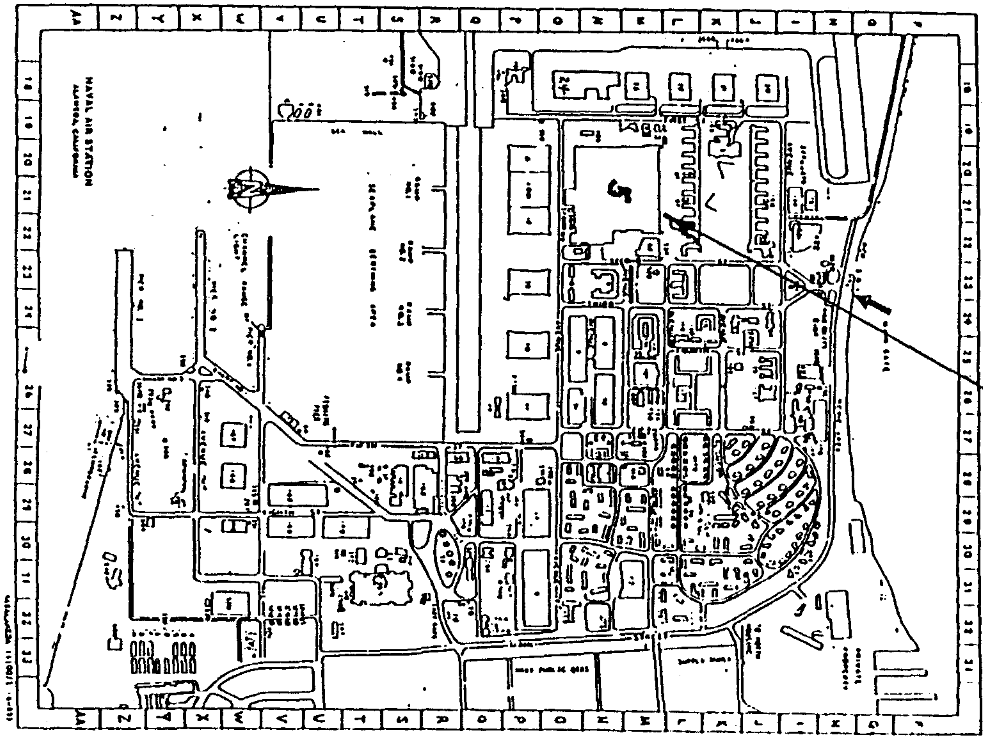
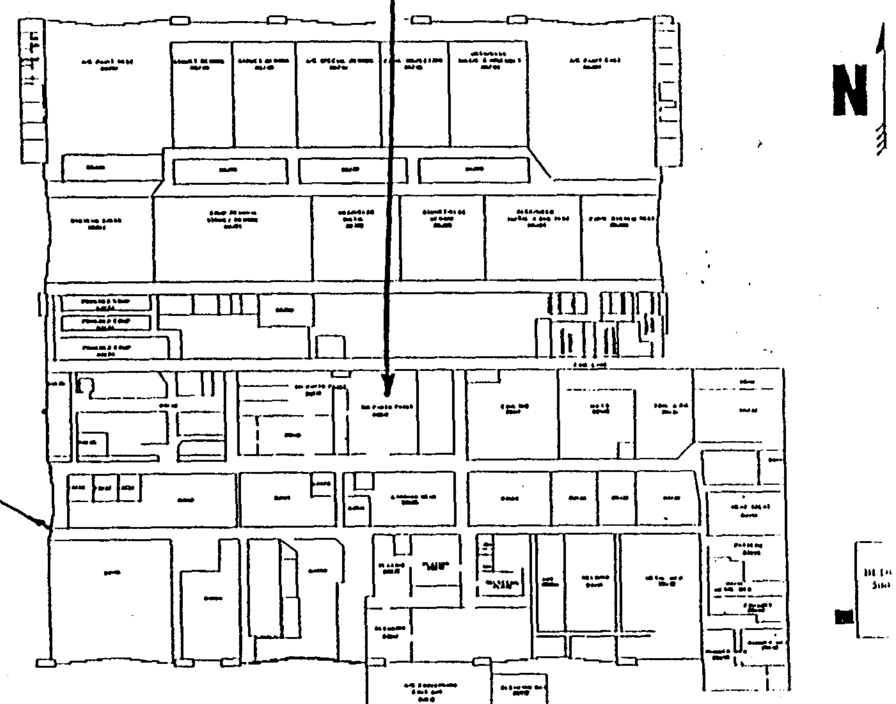



6
7
8
9
10
11
12
13
Roll Up Door
Col. A-9
Col. A-11
Down into Floor
Col. A-13
Drain Line (Approx. Location)
No Bom Ab. Area is bounded by columns A-8 to A-13 and E-8 to E-13.
N
Radiological Survey Area
B-5 Small Parts Paint Shop
July-Aug '96
R. Caswell 8/8/96
Col. C-9
Col. C-11
Up
Up
~ Small Parts Paint Shop (No Bom Ab) ~
Up into Blasting Shop
Roll Up Door
Col. E-11
13







BUILDING 5/5A – 1st Deck

ATTACHMENT B

RADIATION SURVEY STATEMENT OF WORK
(Figures have been excluded from Attachment)
(16 Pages)

RADIATION SURVEY
STATEMENT OF WORK
Revised August 20, 1996

Prime Contractor	**:**	**PRC Environmental Management, Inc.**
Technical Contact	**:**	**Neal Hutchison (916)-853-4501**
PRC's Client	**:**	**Department of the Navy, Western Division Engineering Field Activity, West**
Prime Contract Number	**:**	**N62474-94-D-7609, Contract Task Order 022**
Project Title	**:**	**Radiological Survey of Building Drain Lines and Storm Sewer Lines**
Site Name	**:**	**Buildings 5 and 400, NAS Alameda, Alameda, CA**
Subcontract Term	**:**	**August 26 through September 13, 1996**

1.0 INTRODUCTION

PRC Environmental Management, Inc. (PRC) requires a subcontractor to perform radiation characterization surveys of several exposed and subterranean interior building drain lines and down comers, and three sections of storm sewer piping at NAS Alameda, California. The objective of the survey is to determine the extent of radium-226 contamination and the levels of contamination within the building drain lines and storm sewer pipes. The data collected from this survey will be used to (1) evaluate the extent of contamination, (2) support recommendations for release for unrestricted use (with or without restrictions), and (3) support remedial actions to remove contamination or contaminated piping.

2.0 SITE HISTORY

The Bearing Shop and the Small Parts Paint Shop in Building 5 and several rooms in Building 400 at NAS Alameda are areas of known or suspected radioactive contamination. Radium was processed and radio luminescent paints were stored or used in some or all of these areas. Elevated levels of radium-226 contamination have been confirmed in the drain line of Building 5 and are suspected to be present in the drain lines of Building 400. At the time of use, the drain line in Building 5 was connected directly to the storm sewer drainage system that empties into the Seaplane Lagoon. The drain lines in

Building 400 are currently connected to either the sanitary sewer system or the industrial waste drainage system.

2.1 BUILDING 5

Site history suggests that radium-containing paints were disposed of in industrial waste sinks, and possibly other plumbing fixtures in Building 5, which emptied into the storm sewer drainage system. At one time, the building drain line servicing the Bearing Shop on the second floor of Building 5 was connected directly to storm sewer line F, which empties into the Seaplane Lagoon. The drain line in Building 5 starts above the Small Parts Paint Shop where it previously serviced several industrial waste sinks in the Bearing Shop. (The Bearing Shop is believed to have been a radium paint shop in the 1950s). In the process of redirecting the flow of these sinks to the sanitary sewer system, the drain line was found to be contaminated with radium-226. It is suspected that the sinks were used as a disposal facility for radium-containing paint waste. Figures 1 and 2 present diagrams of the contaminated drain lines in Building 5.

2.2 BUILDING 400

Radio luminescent paints were stored or used in Rooms 203, 204, 213, and the Graphic Arts Room (Room 210) of Building 400. PRC has confirmed that low level radium contamination exists on several work tables and in cabinet drawers in Rooms 210 and 213. The women's restroom (Room 214), men's restroom (Room 211), and a janitor's closet are located next to Room 210. As at other Navy facilities where radium painting was performed, it is suspected that personnel may have disposed of radium-containing paint waste down the sinks and toilets within these facilities. The plumbing fixtures in the restroom facilities are connected to the sanitary sewer system. Several drain lines associated with Rooms 203, 204, and 213 are known to be connected to the industrial waste drainage system. Although no known releases have occurred in any of these drain lines, they will also be investigated. Figures 3 through 5 present diagrams of the above listed rooms and associated drain lines.

Storm sewer line FF associated with Building 400A (hanger portion of Building 400) is also suspected of being contaminated with radioactive materials. This storm sewer line services a water collection trough within Building 400A, which runs along the south side of the interior building wall. Four roof drains, located on the south side of Building 400A, also connect to this water collection trough.

Although no known releases of radioactive contamination have occurred in the roof drain lines or the water collection trough that connect to this storm sewer line, a previous survey of the interior of the manhole in this section of storm sewer piping showed elevated activity. Figure 6 presents a diagram of Building 400A drain lines.

2.3 STORM SEWER LINE R

Storm sewer line R is also suspected of being contaminated with radioactive materials. Although no known releases of radioactive contamination have occurred in the drain lines or storm sewer drains that connect to this line, a previous survey of the interior of one of the manholes in this section of storm sewer piping showed elevated activity. Figure 7 presents a diagram of storm sewer lines F, FF, and R.

3.0 SCOPE

The subcontractor selected to perform this work will be required to survey the following building drain lines and storm sewer piping for radium-226 contamination: (1) Building 5 drain lines associated with the Bearing Shop and Small Parts Paint Shop; (2) Building 400 industrial waste drain lines associated with Rooms 203, 204, and 213; (3) Building 400 sanitary sewer drain lines associated with Rooms 211 and 214; and (4) Storm sewer lines F, FF, and R. PRC will identify all drain lines and storm sewer piping following award of a subcontract; however, for cost estimating purposes, the pipe runs are summarized in Table 1 and shown in Figures 1 through 7.

The subcontractor will access the various segments of building drain lines through floor drains and clean-outs. Access to the storm sewer lines will be made through manholes. The subcontractor will survey all drain lines and piping for radium-226 contamination and generate data consistent to support Nuclear Regulatory Commission (NRC) licence termination for facility decommissioning. The subcontractor shall submit a written quality assurance (QA) program, which describes the data quality objectives and the process used to obtain these objectives, to support PRC's data requirements.

The subcontractor will be required to attend site briefings and participate in joint inspections of pipe access locations prior to beginning the work. In addition, the subcontractor shall prepare and deliver figures and reports presenting the results of the work, and perform all other tasks incidental to the work unless specifically assumed by PRC under this statement of work (SOW).

TABLE 1
DRAIN LINES TO BE SURVEYED

LINE TYPE	LOCATION	SURVEY TYPE	LINE LENGTH	ACCESS[1]	SURVEY REQUIRED[3]
Subterranean Drain Line	Buildings 5 and 5A, starting in Small Parts Paint Shop and ending at storm sewer manhole 6F-2	pipe interior	560 feet (maximum run between clean-outs no greater than 150 feet)	down comer header and 4 clean-outs	Yes
Non-exposed Drain Lines and Down Comers	Building 400, starting in Rooms 203, 204, and 213 on second floor and ending at industrial waste drain line	pipe interior	200 feet	floor drains	Yes
Exposed Drain Lines and Down Comers	Building 400, first floor ceiling lines associated with Rooms 203, 204, and 213	pipe exterior	500 feet	N/A	Yes
Subterranean Storm Sewer Line	Storm sewer line F, from manhole 6F-2 to water line	pipe interior	800 feet (maximum run between manholes no greater than 250 feet)	manholes	Yes
Subterranean Storm Sewer Line	Storm sewer line F, interior of specified manholes	manhole	15 manholes, from top of manhole to bottom of manhole	manholes	Yes
Subterranean Storm Sewer Line	Storm Sewer Line FF, interior of manhole 1FF and collection sump in Building 400A	manhole	2 manholes, from top of manhole to bottom of manhole	manhole and water collection sump	Yes
Subterranean Storm Sewer Line	Storm Sewer Line R; interior of manhole R3	manhole	1 manhole, from top of manhole to bottom of manhole	manhole	Yes

Notes: 1 - Subcontractor will specify minimum pipe diameter that can be surveyed

The following sections provide a more detailed description of each section of drain line.

3.1 BUILDING 5 DRAIN LINE AND STORM SEWER LINE F

The subcontractor shall survey the interior of the storm sewer line F, starting at the manhole closest to the Seaplane lagoon that is not tidally influenced, and moving upstream through the drain line inside of Building 5. The subcontractor will end the survey within the section of drain line where the level of activity is approximately 5 times the established background.

The affected drain line inside of Building 5 starts above the Small Parts Paint Shop on the east side of the room, runs along the ceiling and travels down the north wall where it enters the concrete floor.

Where the drain line enters the concrete floor in the Small Parts Paint Shop, the pipe is 4 inches in diameter. The drain line travels north in Building 5 for 60 feet under the fire lane into Building 5A, where it turns 90 degrees to the west. At this point, the drain line is shown to be 10 inches in diameter. The drain line travels west under the concrete floor for approximately 460 feet, where it leaves the footprint of the building (along this 460 foot section, access to the drain line is possible through four clean-outs). At this point, the diameter of the line has increased three times to a diameter of 18 inches. The line changes diameter again outside of the building footprint to 21 inches. The drain line travels another 100 feet outside of the building where it connects to the first storm sewer manhole (6F-2) of storm sewer line F. Storm sewer line F travels west approximately 100 feet where it turns south for approximately 1,600 feet to the Seaplane lagoon.

For the manholes in storm sewer line F which are tidally influenced, the subcontractor will survey the interior of the manholes from the top of each manhole to the sediment layer on the bottom of each manhole. In addition, the subcontractor will also be required to survey approximately 10 of the storm sewer manholes in the East/West running sections of storm sewer line F.

3.2 BUILDING 400 DRAIN LINES AND STORM SEWER LINE FF

The subcontractor will be required to survey the interior of the floor drain lines within Rooms 203, 204, and 213 from the location at which the lines enter the floor to the locations where the drain lines connect to the industrial waste lines on the north and south sides of Building 400. All overhead drain lines associated with these rooms which are accessible from first floor will also be surveyed. To gain access to all exposed overhead drain lines in Building 400, a lift device will be provided by the Navy.

For storm sewer line FF, the subcontractor will survey the interior of the two storm sewer manholes located in Taxiway 7 and the collection sump which is located just inside of the hanger door of Building 400A. The subcontractor will survey the interior of the storm sewer manhole from the top of the manhole to the sediment layer on the bottom of the manhole.

3.3 STORM SEWER LINE R

The subcontractor will be required to survey the interior of the storm sewer manhole R3 of storm sewer line R, from the top of the manhole to the sediment layer on the bottom of the manhole.

4.0 TECHNICAL TASKS

The following sections describe the technical tasks to be performed by the subcontractor. Where appropriate, PRC support tasks are also described.

4.1 MOBILIZE/DEMOBILIZE

The subcontractor shall supply and transport all necessary materials, equipment, and personnel to the site from the subcontractor's facility and back again. This task includes all lodging, meals and similar costs for maintaining personnel in Alameda while performing the work. Costs for all materials, equipment, and personnel that must be procured in the field to maintain operability are also included.

4.2 ATTEND PRC ORIENTATION MEETING

The subcontractor's personnel shall attend a joint meeting with PRC management and site personnel to discuss the schedule and logistics for performing the work described in this SOW. In addition, the subcontractor's personnel shall participate in a joint inspection of the drain lines and access locations to ensure a complete understanding of the job logistics and proper planning prior to beginning the work.

4.3 SURVEY DRAIN LINES FOR RADIOLOGICAL CONTAMINATION

The subcontractor shall survey the specified pipes for Radium-226 contamination. The subcontractor shall survey the interior and accessible exterior of the piping identified in Section 3.0 of this SOW. The following sections describe the technical specifications for the surveys.

4.3.1 Interior Pipe Surveys

The subcontractor shall perform interior pipe surveys using a deployment system capable of moving a gamma radiation detector through small and large bore piping, non-destructively, at distances described in Table 1.

The subcontractor shall perform the interior pipe surveys using a detector system that will provide radiation measurement sensitivities as described below:

(1) The detector shall produce a signal which can be correctly identified as a net positive increase in radioactivity, with a confidence level of 95 percent, from a point-source of radium which has an activity of 100 nanocuries (nCi).

(2) For fixed reading measurements which require that a count rate be taken while the detector is stationary, the subcontractor shall determine the maximum distance between the detector and the 100 nCi source necessary to achieve the required detection limit (within a reasonable time frame). The subcontractor will then take static readings at no more than twice this distance, for the given time frame.

(3) For scanning measurements, the scanning rate shall be adjusted to achieve the specified sensitivity described in (1) above. The subcontractor will not exceed this scan rate while taking scanning measurements. This rate will be determined under actual field conditions.

The subcontractor shall propose calculations to demonstrate the required sensitivity and determine actual scan rates based upon actual field conditions and detector response. The subcontractor shall use the detection level (L_D) (not the critical level) in demonstrating the detection capability of the system. The L_D is defined as the 95 percent confidence interval for false negative protection (or Type II error). In the event that significantly elevated activities are identified in a section of piping, the PRC field oversight manager may specify a faster scan rate, lengthen the distance between static measurement locations, or terminate the survey.

4.3.2 Exterior Pipe Surveys

The determination of detection limits for exterior pipe surveys shall include the consideration of any attenuation caused by the piping. The subcontractor shall perform exterior pipe surveys using a detector system that will provide radiation measurement sensitivities as described below:

(1) The detector shall produce a signal which can be correctly identified as a net positive increase in radioactivity, with a confidence level of 95 percent, from a point-source of radium which has an activity of 100 nanocuries (nCi).

(2) For fixed reading measurements which require that a count rate be taken while the detector is stationary, the subcontractor shall determine the maximum distance between the detector and the 100 nCi source necessary to achieve the required detection limit (within a reasonable time frame). The subcontractor will then take static readings at no more than twice this distance, for the given time frame.

(3) For scanning measurements, the scanning rate shall be adjusted to achieve the specified sensitivity described in (1) above. The subcontractor will not exceed this scan rate while taking scanning measurements. This rate will be determined under actual field conditions.

4.3.2A Storm Sewer Manhole Surveys

For the storm sewer manhole surveys, the subcontractor will lower a 2 by 2 inch sodium iodide scintillation detector down the center of the manhole and record the gamma activitiy every 12 inches. At the point where the detector reaches the air/water interface, the subcontractor will move the detector against the wall of the manhole and take measurements every 6 inches to the sediment layer at the bottom of the manhole. This configuration will be repeated in four quadrants of the manhole. The activity on the surface of the sediment will be measured at a minimum of 5 locations.

4.3.3 Quality Assurance

The subcontractor will use background data to determine detection limits for each system surveyed. The subcontractor shall perform background radiation surveys in similar piping, manholes, and drain lines which are known to be free of radioactive contamination. Locations of piping, manholes, and drain lines known not to have been influenced by radium painting operations will be chosen by PRC. The subcontractor shall take into consideration parameters such as pipe diameter, construction material, detector type, detector orientation, and signal cable length when determining radiation background for each system.

To demonstrate detector sensitivities and for calibration purposes of gamma emissions of radium-226 and its decay products, the subcontractor shall use a radium-226 source traceable to National Institute of Standards and Technology (NIST) standards. Calibration of the systems and proper operation must be verified and documented using a check source each day during which surveys are performed and prior to the subcontractor removing the equipment from the site. Surveys performed with equipment improperly calibrated shall be performed again after the deficiencies are corrected. All calibrations and daily checks must be documented in writing.

In addition, the subcontractor shall provide a written QA program which includes, at a minimum, the following:

- Calibration procedures
- Instrument sensitivity and calibration check procedures
- QA check frequency
- Instrument control charts
- Documentation of all calculations, calibration checks and radiation measurements
- Data validation procedures

4.4 DAILY LOG

The subcontractor shall provide the PRC field oversight manager with a log on a daily basis to report the progress made and quantities used for the purposes of billing and payment. The subcontractors log shall show only those items found on the schedule of prices and shall be reported using only those units of measurements found in Section 11, schedule of prices. No other units of measurement shall be presented by the subcontractor. The daily log will be completed and signed by the subcontractor.

4.5 PREPARE REPORTS

The subcontractor shall prepare and deliver to PRC reports detailing the results of the radiological surveys. The reports shall present the results for each section of pipe surveyed. Two types of reports are required: field reports and a final report.

4.5.1 Field Reports

The subcontractor shall provide field reports within one working day of surveying for each pipe segment surveyed. Each report will include the following information:

(1) Survey narrative containing site information (location, piping descriptions, length surveyed), detector information (model number, serial number, calibration information), general information (name and signature of each person, time and date survey was performed), background data used for comparison, and detection limits for survey.

(2) Measurement data consisting of fixed measurement interval or scan rate, converted activity and counting error in microcuries, and reference to the case narrative.

Field reports will consist of pre-printed forms which are filled out with the information described above. The completed forms may be generated by hand or by computer. The subcontractor shall deliver the field reports to the PRC field oversight manager in hard copy form no later than noon the day following each survey.

4.5.2 Final Report

The final report shall be delivered to PRC within 15 working days after the last pipe survey. Data in the final report shall have been reviewed for accuracy by the subcontractor and shall be marked validated and signed and dated by the person who performed the validation. A computer readable copy of the final report shall be delivered to PRC on 3-1/2-inch IBM-PC formatted high-density diskettes at the same time the hard copy report is delivered. A separate set of tables and figures shall be provided in electronic format for each pipe section surveyed. The tables and figures shall be labeled in accordance with the PRC nomenclature for the pipe sections. Data tables shall be in Excel for Windows format, ASCII (dbf) format, or comma delimited text format. Figures shall be in a graphics format which is compatible with Designer for Windows. The following minimum information shall be required in each table for each pipe section: (1) time and date of survey, (2) scan rate or fixed measurement counting time, (3) detection limit, (4) pipe diameter in inches, (5) pipe material if known, (6) background activity, (7) type of radiation measured, (8) activity measured in microcuries, and (9) approximate distance from pipe datum where each measurement was taken (feet along pipe). The figures shall consist of a two-dimensional plot for each section of pipe surveyed. The activity measured along the length of each pipe shall be plotted on the Y-axis as a function of distance on the X-axis. The units for activity will be expressed in microcuries and the distance will be expressed in feet. Each figure and table shall be labeled with the appropriate building- and pipe identifier.

4.6 PRC SUPPORT AND OVERSIGHT

Prior to performing the surveys, PRC will appoint a field oversight manager for the project. The field oversight manager will provide technical support to the subcontractor. Technical support will consist of providing access to all locations to be surveyed; coordinating with NAS Alameda, NADEP, and

EFA West staff; coordinating off-site laboratory services; and managing the investigative derived waste (IDW).

PRC shall manage and dispose of all normally expendable materials resulting from the work described herein, unless the materials are contaminated with hazardous materials that did not originate at the site. The subcontractor will immediately notify PRC of waste contaminated by hazardous or radioactive materials that did not originate at the site and, following PRC approval, remove the waste from the site. All radioactive material generated at the site will remain within the custody of the Navy.

PRC shall provide access to 120-volt electricity for survey equipment. The subcontractor will be responsible for the removal of furniture, covers, and equipment. In addition, the subcontractor shall remove the storm sewer manhole covers to allow the subcontractor to attach piping and fittings to the pipe through which to pass detectors. Any piping, fixtures, and labor required to plumb the subcontractor's equipment to the pipe to be surveyed is considered incidental to performing the work and must be supplied by the subcontractor and removed when the work is completed.

4.7 REVIEW REPORTS AND ELECTRONIC FILES

PRC shall review the field reports for conformity with the specifications. PRC will review field reports within one working day of receiving them. PRC shall review the final report and electronic files and provide comments to the subcontractor within 10 working days of receipt. The subcontractor will make appropriate changes and submit a revision of the final report within 10 working days of receipt of the comments. PRC will review the revised final report within 10 working days of receipt. If the project manager determines that the revised final report is complete and fulfils all specifications and requirements in this SOW, the project manager will transmit approval to the PRC procurement office for payment of all invoices submitted by the subcontractor. If the revised final report does not meet the specifications and requirements of the SOW, the project manager will transmit to the PRC procurement office an order for stop payment until a time in which all discrepancies have been reconciled.

5.0 HEALTH AND SAFETY

The subcontractor is not required to have a radioactive materials licence to perform the work specified in this SOW; however, the subcontractor shall provide PRC with a statement of qualifications which demonstrates the ability of the subcontractor to implement an appropriate radiological safety program.

The subcontractor shall follow **ALL** Federal, State, and local Occupational Safety and Health Administration (OSHA) requirements for general industry, hazardous waste site operations, and construction during all field work, including adherence to Title 29 of the Code of Federal Regulations (29 CFR) 1910.96, "Ionizing Radiation." Subcontractor employees also will comply with U.S. Army Corps of Engineers Safety and Health Requirements Manual, Section 28 (Hazardous, Toxic, Radioactive Waste Activities) and all other regulatory and U.S. Navy environmental health and safety requirements including, but not necessarily limited to, fire protection, hazardous and nonhazardous waste disposal, and traffic safety. All subcontractor personnel engaged in field work involving hazardous and/or radioactive material must meet the training and medical surveillance requirements of Title 29 of the Code of Federal Regulations (29 CFR) 1910.120(f), "Medical Surveillance," and requirements of 29 CFR 1910.120(e), "Training." In addition, at a minimum one of the subcontractor's onsite employees must have a current hazardous waste operations and emergency response training 8 hour Supervisory certification.

PRC will provide a base-wide health and safety plan (HSP) which sets forth minimum requirements for the subcontractor to follow. The subcontractor shall submit a radiological protection and safety plan for work at the site, with any additional supplements to PRC's base-wide HSP deemed necessary. The subcontractor will be required to incorporate both Navy and PRC comments into its health and safety plan before any field work is performed. In addition, the subcontractor shall make available to PRC any and all applicable health and safety standard operating procedures referenced in its HSP.

The subcontractor is solely responsible for health, safety, and radiological protection of its personnel performing field work associated with this SOW and for implementation of any necessary monitoring, dosimetry, or bioassay required by its safety plans or regulations. The subcontractor shall provide a qualified radiation safety officer (RSO) whose principal responsibility will be to implement the subcontractor's health, safety, and radiological protection plans.

Prior to performing field work, the subcontractor shall conduct a health, safety, and radiation protection briefing for its employees, PRC personnel, and any Navy representatives who are expected to perform daily functions during field work. In addition, the subcontractor will perform a weekly safety meeting for all onsite field personnel. The subcontractor will also be required to provide radiation safety controls and site controls throughout the duration of the project. The subcontractor will develop and incorporate into its HSP a contingency plan for the control and clean-up of radioactive contamination in the event that a section of potentially contaminated piping is broken during surveying.

During field operations, PRC may audit the implementation of the subcontractor's safety program. The PRC field oversight manager or the Navy representative may direct the subcontractor to stop work at any time for failure to fully implement any portion of the health and safety program.

PRC will identify locations where a confined space permit is required to perform work. If any location identified by PRC presents a confined space issue, the subcontractor will follow proper training protocol and procedures for confined space entries.

Level D personal protection is expected to be suitable for all activities described in this SOW; however, the subcontractor shall be prepared to increase the level of protection as required by its RSO. The subcontractor shall provide and use protective glasses, ear protection, boots with steel toes and shanks, gloves, and coveralls or dedicated clothing as a minimum for Level D activities.

Decontamination of the subcontractor's equipment and personnel is included as a task incidental to the work. The subcontractor's personnel shall decontaminate themselves and the subcontractor's equipment prior to exiting controlled areas. All decontamination activities shall be performed under the direct supervision of the subcontractor's RSO. Prior to the removal of any equipment from the site, the subcontractor shall provide documentation of surveys of all equipment demonstrating that radioactivity levels on the equipment are below the regulatory release limits. Protective clothing which becomes contaminated during field operations shall remain at the site and become part of the investigative derived waste (IDW). PRC will provide IDW containers for all contaminated materials.

6.0 REPORTS, DATA AND OTHER DELIVERABLES

The subcontractor shall deliver the following reports, data, and deliverables to the PRC project manager as specified:

(1) Field reports (2 copies)
(2) Final Report (10 copies)
(3) Computer readable diskette copies of final report, data tables, and figures (2 copies)
(4) Copies of calibration and daily check records for the survey equipment (10 copies)
(5) Daily log (1 copy)

7.0 SCHEDULE

PRC expects all required radiological surveying (see Table 1) to be performed by September 13, 1996. The proposed schedule of tasks shall be as follows:

Task	Schedule
Mobilization, orientation, passes, setup	August 26, 1996
Building 400 drain line survey	August 26 - 28, 1996
Building 5 drain line survey	August 29 - 30, 1996
Storm sewer line F survey	September 3 - 6, 1996
Storm sewer line FF survey	September 9, 1996
Storm sewer line R survey	September 13, 1996

8.0 PERSONNEL

The successful bidder will be required to provide a list of **ALL** potential personnel to work at the NAS Alameda facilities with appropriate training documentation before beginning work on this SOW. The subcontractor personnel will also be required to obtain a personal badge and vehicle passes the morning the work begins. PRC will coordinate pass requests and will meet subcontractor personnel to lead them through the process.

9.0 MEASUREMENT AND PAYMENT

This section deleted from the original statement of work.

10.0 STANDARDS AND REFERENCES

The following are incorporated by reference:

Federal Register: 29 CFR 1910.96.

Federal Register: 29 CFR 1910.120.

U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1. October 1992.

11.0 SCHEDULE OF PRICES

Description	Unit	Quantity	Unit Price	Total
1. Mobilization/Demobilization				
a. Moving equipment, tools, supplies, and personnel to and from the site area. Includes providing equipment for Level D and Level C personal protection.	lump sum	1	$2,206.00	$ 2,406.00
2. Survey Piping				
a. Survey exterior of piping.	foot	500	$ 32.79	$ 16,395.00
b. Survey interior of piping 2" - 4" in diameter.	foot	100	$ 18.33	$ 1,833.00
c. Survey interior of piping 4" - 8" in diameter.	foot	350	$ 18.33	$ 6,415.00
d. Survey interior of piping 8" - 16" in diameter.	foot	300	$ 18.33	$ 5,499.00
e. Survey interior of piping >16" in diameter	foot	800	$ 18.33	$ 14,664.00
f. Survey interior of manhole	manhole	10	$1,253.00	$ 22,554.00
3. Miscellaneous				
a. Supply lifting devices (Scissor lift rental)	week	2	$2,575.00	$2,575.00
b. Standby Time	½ day	2	$1,303.00	------------
Firm Fixed Price Total:				**$72,341.00**